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R/V *Mirai* Cruise Report MR24-04

Observation of air-sea interaction over the Tropical Northwestern Pacific

Tropical Northwestern Pacific

June 21 – July 30, 2024

Japan Agency for Marine-Earth Science and Technology
(JAMSTEC)

MR24-04 Cruise Report

Table of contents

1. Introduction

Tropical Northwestern Pacific is located in the northern edge of Indo-Pacific Warm Pool, where sea surface temperatures (SSTs) are significantly higher than the other parts of the ocean. Vigorous cumulus convection induced by high SSTs releases large amount of latent heat of water vapor in the free troposphere, not only driving atmospheric large-scale circulations known as the Hadley and Walker Circulations, but also energizing various types of atmospheric disturbances such as Boreal Summer Intraseasonal Oscillations (BSISOs), tropical depressions and typhoons, and Pacific-Japan pattern. These disturbances sometimes cause serious disasters such as torrential rainfall, thunderstorms, and storm surges, as well as long-lasting drought, making enormous impacts on weather and climate in East and Southeast Asia and Pacific Island countries. Therefore, it is of social importance as well as scientific interest to investigate key processes that develop these disturbances and modulate their behavior. Accumulation of in situ observation data of the atmosphere and ocean is tremendously beneficial for such studies.

Therefore, we conducted shipborne observation activity using Research Vessel (R/V) *Mirai* over the tropical Northwestern Pacific, which is the main purpose of R/V *Mirai* MR24-04 cruise. We performed station observation at (15-00N, 132-00E) for the period from June 26 to July 25, 2024. Observational items include 3-hourly radiosonde sounding, 3-hourly conductivity-temperature-depth (CTD) and lowered acoustic Doppler current profiler (LADCP) observations, and surface drifter observation, in addition to a series of continuous observations. We also deployed three Wave Gliders during the station observation period, which were positioned about 50 km away from R/V *Mirai*. In addition, an ocean wave buoy and an ARGO float were deployed on the way from Japan to the station observation point.

This cruise report summarizes the observational items and preliminary results during the R/V *Mirai* MR24-04 cruise. First several sections describe the basic information such as cruise track and on-board personnel list. Details of the observational items are described in Section 5, followed by additional information and figures in Appendices.

** Remarks **

This cruise report is a preliminary documentation as of the end of the cruise. Contents may be not updated after the end of the cruise, or subject to change without notice. Data on this report may be raw or not processed. Please ask the Chief Scientist and the Principal Investigators for the latest information.

2. Cruise summary

2.1 Ship

Name	Research Vessel MIRAI
L × B × D	128.6m × 19.0m × 13.2m
Gross Tonnage	8,706 tons
Call Sign	JNSR
Home Port	Mutsu, Aomori Prefecture, Japan

2.2 Cruise Code

MR24-04

2.3 Project Name (Main mission)

"Observation of air-sea interaction over the Tropical Northwestern Pacific"

2.4 Undertaking Institute

Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
2-15, Natsushima-cho, Yokosuka, Kanagawa 237-0061, Japan

2.5 Chief Scientist

Satoru YOKOI
Marine and Coastal Meteorology Research Group,
Center for Coupled Ocean-Atmosphere Research (CCOAR),
Research Institute for Global Change (RIGC), JAMSTEC

2.6 Periods and Port Call

June 21, 2024:	departed Shimizu, Japan
July 30, 2024:	arrived at Shimizu, Japan

2.7 Research Themes of Sub Projects and Principal Investigators (PIs)

The following five projects, which were proposed at the MR24-04 cruise symposium, are joined into the main mission.

(1) Observation of aerosol optical properties over the ocean (PI: Kazuma AOKI of Univ. Toyama)
(2) Observation of air-sea fluxes in typhoon's strong surface wind condition by ocean wave buoy (PI: Tomoya SHIMURA of Kyoto Univ.)
(3) Observational study for temperature and salinity profile in the ocean surface layer (PI: Gilles REVERDIN of LOCEAN, Hugo BELLENGER of LMD)
(4) Verification and improvement of air-sea flux calculation in cloud-resolving model SCALE-RM (PI: Hiroaki MIURA of Univ. Tokyo)
(5) Characteristic relationship between sea surface temperature and cumulus convection over the tropical Northwestern Pacific in early summer (PI: Tsubasa KOHYAMA of Ochanomizu Univ.)

2.8 Observation Summary

GPS radiosonde	272 times	June 21 to July 29 (SMT)
Higher-altitude GPS radiosonde	22 times	June 28 to July 24
C-band weather radar	continuous	June 22 to July 29
Ceilometer	continuous	June 21 to July 30
Surface meteorological observations	continuous	June 21 to July 30
Mie/Raman lidar	continuous	June 21 to July 30
Water vapor and wind coherent lidar	continuous	June 21 to July 30
Disdrometers	continuous	June 21 to July 30
Micro rain radar	continuous	June 21 to July 30
Microwave radiometer	continuous	June 21 to July 30
Sky radiometer	continuous	June 21 to July 30
Aerosol and gas observations	continuous	June 21 to July 30
GNSS precipitable water	continuous	June 21 to July 30
Continuous monitoring of surface seawater	continuous	June 21 to July 28
pCO2	continuous	June 21 to July 27
CTD profiling	214 profiles	June 26 to July 25
LADCP	214 profiles	June 26 to July 25
RINKO Profiler	225 profiles	June 26 to July 25
Sea water sampling	28 times	June 26 to July 24
Shipboard ADCP	continuous	June 21 to July 30
XCTD	8 profiles	June 28 to July 19
Deployment of ocean wave buoy	1 buoy	June 24 at (20-00N, 134-00E)
Deployment of ARGO float	1 float	June 26 at (16-00N, 134-00E)
Deployment of Wave Gliders	3 systems	June 27 to July 19
Deployment of surface drifters	4 times	June 30 – July 1, July 6 – July 7, July 12 – July 13, and July 16 – July 18.
Underway geophysics	continuous	June 21 to July 30

2.9 Overview

In order to investigate atmospheric and oceanic variations over the Tropical Northwestern Pacific, intensive observations using R/V *Mirai* were carried out at the station observation point (15-00N, 132-00E) and its surrounding area, which is the main purpose of this cruise.

On the way from Shimizu to the station observation point, we deployed an ocean wave buoy at (20-00N, 134-00E), and an ARGO float at (16-00N, 134-00E).

The station observation was performed from June 26 to July 25, 2024. At the beginning, we deployed three Wave Gliders (WGs) on June 27. These WGs stayed nearby the station observation point for about one day after the deployment, and then moved to their own station observation points, which are about 50 km away from the vessel's station point, to stay there for 20 days from June 29 to July 18, measuring surface meteorological parameters, sea surface temperature and salinity, current velocity, and so forth. Observation items onboard R/V *Mirai* included 3-hourly radiosonde observation, RINKO Profiler casts, and CTD/LADCP casts. Furthermore, higher-altitude GPS radiosonde observation using bigger balloon was performed 22 times, deployment and recovery of surface drifters were performed 4 times.

Continuous observations, such as Doppler radar, surface meteorological observation, ceilometer, and monitoring of surface seawater, were conducted wherever possible during the whole cruise. Furthermore, we brought several observational instruments, such as lidars, disdrometers, microwave radiometer, MAX-DOAS, sky radiometer, and so forth, to perform continuous observations.

2.10 Acknowledgements

We would like to express our sincere thanks to Master Haruhiko INOUE and his crew.

3. Cruise track and log

3.1 Cruise track

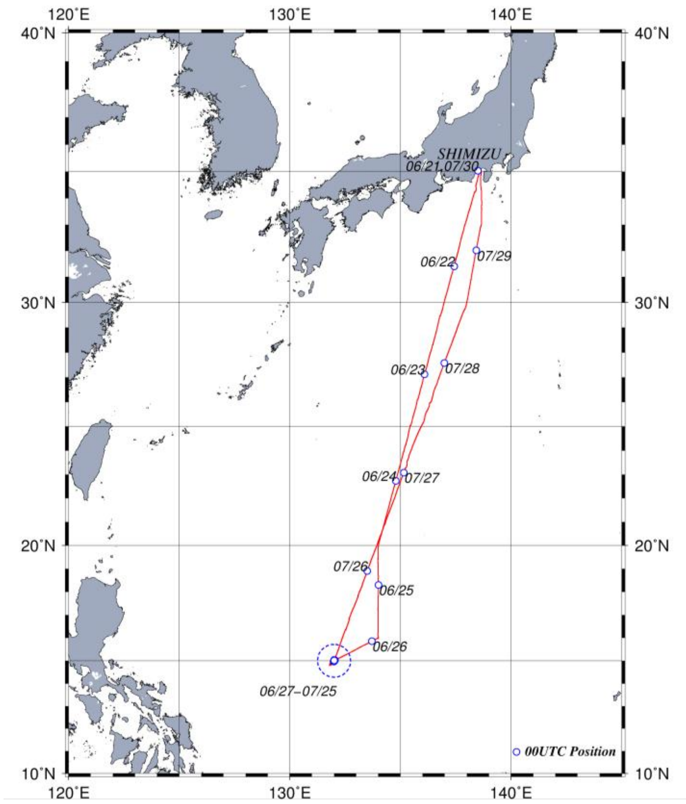


Figure 3.1-1: Cruise track for the entire period. Solid blue circles represent the vessel's positions at 00 UTC.

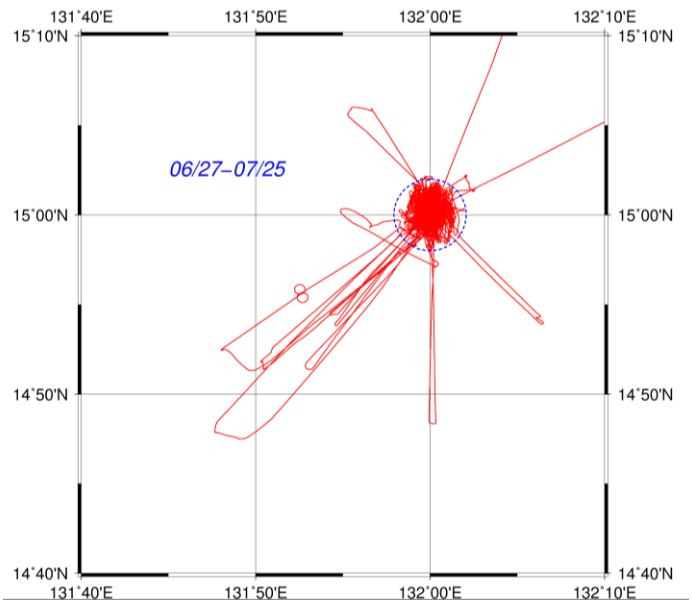


Figure 3.1-2: Cruise track just around the station observation point.

3.2 Cruise log

Date and time				Location	Event
in UTC		in SMT			
June 21	0100	June 21	1000		Departure from Shimizu, Japan
	0700		1600		Start surface seawater monitoring
	1201		2101	(33-06N, 137-57E)	Radiosonde (#001)
	1730	June 22	0230	(32-20N, 137-42E)	Radiosonde (#002)
	1930		0330		Start Doppler radar observation
	2330		0830	(31-29N, 137-27E)	Radiosonde (#003)
June 22	0530		1430	(30-32N, 137-09E)	Radiosonde (#004)
	1130		2030	(29-28N, 136-47E)	Radiosonde (#005)
	1730	June 23	0230	(28-19N, 136-28E)	Radiosonde (#006)
	2330		0830	(27-12N, 136-07E)	Radiosonde (#007)
June 23	0530		1430	(26-07N, 135-47E)	Radiosonde (#008)
	1130		2030	(25-02N, 135-27E)	Radiosonde (#009)
	1730	June 24	0230	(23-57N, 135-09E)	Radiosonde (#010)
	2330		0830	(22-49N, 134-49E)	Radiosonde (#011)
June 24	0530		1430	(21-42N, 134-29E)	Radiosonde (#012)
	1130		2030	(20-33N, 134-10E)	Radiosonde (#013)
	1432		2332	(20-00N, 134-00E)	Deployment of Ocean Wave Buoy
	1730	June 25	0230	(19-28N, 133-59E)	Radiosonde (#014)
	1752		0252	(19-24N, 133-59E)	Radiosonde (#015) (*Relaunch)
	2330		0830	(18-23N, 134-00E)	Radiosonde (#016)
June 25	0530		1430	(17-18N, 133-59E)	Radiosonde (#017)
	1130		2030	(16-13N, 133-59E)	Radiosonde (#018)
	1247		2147		Calibration for magnetometer
	1730	June 26	0230	(16-01N, 134-00E)	Radiosonde (#019)
	2100		0600	(16-00N, 134-00E)	RINKO Profiler (C01001)
	2121		0621	(16-00N, 134-00E)	CTD (C01M001; 1,000m with water sampling)
	2224		0724	(16-00N, 134-00E)	Deployment of ARGO Float
	2330		0830	(15-54N, 133-48E)	Radiosonde (#020)
June 26	0530		1430	(15-22N, 132-45E)	Radiosonde (#021)
	1000		1900		Arrival at the station observation point (15-00N, 132-00E)
	1130		2030	(15-01N, 132-01E)	Radiosonde (#022)
	1430		2330	(14-58N, 132-00E)	Radiosonde (#023)
	1730	June 27	0230	(15-00N, 132-00E)	Radiosonde (#024)
	2030		0530	(15-01N, 132-00E)	Radiosonde (#025)
	2330		0830	(15-02N, 132-02E)	Radiosonde (#026)
	2341		0841	(15-02N, 132-02E)	Deployment of Wave Glider (SV3-248)
	2354		0854	(15-02N, 132-02E)	Deployment of Wave Glider (SV3-196)
June 27	0033		0933	(15-02N, 132-02E)	Deployment of Wave Glider (SV3-252)
	0230		1130	(14-58N, 132-00E)	Radiosonde (#027)
	0300		1200	(14-59N, 132-00E)	RINKO profiler (STN001)
	0455		1355		Deployment of Sea Snake thermistor
	0530		1430	(15-01N, 132-00E)	Radiosonde (#028)

	0600		1500	(15-01N, 132-00E)	RINKO profiler (STN002)
	0618		1518	(15-01N, 132-01E)	CTD (STNM001; 500m)
	0830		1730	(14-59N, 132-01E)	Radiosonde (#029)
	1130		2030	(15-01N, 132-01E)	Radiosonde (#030)
	1430		2330	(15-00N, 132-01E)	Radiosonde (#031)
	1500	June 28	0000	(15-00N, 132-01E)	RINKO profiler (STN003)
	1514		0014	(15-00N, 132-01E)	CTD (STNM002; 500m)
	1730		0230	(15-00N, 132-00E)	Radiosonde (#032)
	1800		0300	(15-00N, 132-00E)	RINKO profiler (STN004)
	1815		0315	(15-00N, 132-01E)	CTD (STNM003; 500m)
	2030		0530	(15-00N, 131-59E)	Radiosonde (#033)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN005)
	2114		0614	(15-00N, 132-00E)	CTD (STNM004; 500m)
	2330		0830	(15-01N, 132-00E)	Radiosonde (#034)
June 28	0000		0900	(14-59N, 132-00E)	RINKO profiler (STN006)
	0015		0915	(14-59N, 132-00E)	CTD (STNM005; 500m)
	0230		1130	(15-01N, 132-00E)	Radiosonde (#035)
	0300		1200	(15-01N, 132-00E)	RINKO profiler (STN007)
	0306		1206	(15-01N, 132-00E)	XCTD (#1)
	0428		1328	(15-01N, 132-00E)	Higher-altitude radiosonde (#01)
	0530		1430	(15-00N, 132-00E)	Radiosonde (#036)
	0600		1500	(15-00N, 132-00E)	RINKO profiler (STN008)
	0622		1522	(15-00N, 132-00E)	CTD (STNM006; 500m)
	0830		1730	(15-01N, 131-59E)	Radiosonde (#037)
	0900		1800	(15-00N, 131-59E)	RINKO profiler (STN009)
	0914		1814	(15-01N, 132-00E)	CTD (STNM007; 500m)
	1130		2030	(15-01N, 132-00E)	Radiosonde (#038)
	1200		2100	(15-01N, 132-00E)	RINKO profiler (STN010)
	1213		2113	(15-01N, 132-01E)	CTD (STNM008; 1000m with water sampling)
	1430		2330	(15-00N, 132-01E)	Radiosonde (#039)
	1500	June 29	0000	(15-00N, 132-01E)	RINKO profiler (STN011)
	1513		0013	(15-00N, 132-01E)	CTD (STNM009; 500m)
	1730		0230	(15-01N, 132-00E)	Radiosonde (#040)
	1800		0300	(15-01N, 132-00E)	RINKO profiler (STN012)
	1812		0312	(15-01N, 132-00E)	CTD (STNM010; 500m)
	2030		0530	(15-01N, 132-00E)	Radiosonde (#041)
	2100		0600	(15-00N, 132-01E)	RINKO profiler (STN013)
	2110		0610	(15-00N, 132-01E)	CTD (STNM011; 500m)
	2327		0827	(14-59N, 132-00E)	Radiosonde (#042)
June 29	0000		0900	(14-59N, 132-00E)	RINKO profiler (STN014)
	0017		0917	(14-59N, 132-00E)	CTD (STNM012; 500m)
	0230		1130	(15-01N, 132-00E)	Radiosonde (#043)
	0300		1200	(15-00N, 132-00E)	RINKO profiler (STN015)
	0312		1212	(15-00N, 132-00E)	CTD (STNM013; 500m)
	0427		1327	(15-01N, 132-00E)	Higher-altitude radiosonde (#02)
	0530		1430	(15-00N, 132-00E)	Radiosonde (#044)
	0600		1500	(15-00N, 132-00E)	RINKO profiler (STN016)
	0614		1514	(15-00N, 132-00E)	CTD (STNM014; 500m)

	0830		1730	(14-59N, 132-00E)	Radiosonde (#045)
	0900		1800	(14-59N, 132-00E)	RINKO profiler (STN017)
	0914		1814	(14-59N, 132-00E)	CTD (STNM015; 500m)
	1130		2030	(15-01N, 132-00E)	Radiosonde (#046)
	1200		2100	(15-01N, 132-00E)	RINKO profiler (STN018)
	1218		2118	(15-01N, 132-00E)	CTD (STNM016; 1000m with water sampling)
	1430		2330	(14-59N, 132-00E)	Radiosonde (#047)
	1500	June 30	0000	(14-59N, 132-00E)	RINKO profiler (STN019)
	1511		0011	(14-59N, 132-01E)	CTD (STNM017; 500m)
	1730		0230	(15-00N, 132-01E)	Radiosonde (#048)
	1800		0300	(15-00N, 132-01E)	RINKO profiler (STN020)
	1810		0310	(15-00N, 132-01E)	CTD (STNM018; 500m)
	2030		0530	(15-00N, 132-01E)	Radiosonde (#049)
	2100		0600	(14-59N, 132-00E)	RINKO profiler (STN021)
	2110		0610	(14-59N, 132-00E)	CTD (STNM019; 500m)
	2150		0650		Recovery of Sea Snake Thermistor
	2242		0742	(14-54N, 131-54E)	Deployment of Surface Drifter (#1-1)
	2248		0748	(14-54N, 131-55E)	Deployment of Surface Drifter (#1-2)
	2330		0830	(14-59N, 131-39E)	Radiosonde (#050)
	2340		0840		Deployment of Sea Snake Thermistor
June 30	0000		0900	(14-59N, 131-59E)	RINKO profiler (STN022)
	0014		0914	(14-59N, 131-59E)	CTD (STNM020; 500m)
	0230		1130	(15-02N, 131-59E)	Radiosonde (#051)
	0300		1200	(15-01N, 131-59E)	RINKO profiler (STN023)
	0315		1215	(15-01N, 131-59E)	CTD (STNM021; 500m)
	0530		1430	(15-00N, 131-59E)	Radiosonde (#052)
	0600		1500	(15-00N, 131-59E)	RINKO profiler (STN024)
	0615		1515	(15-00N, 131-59E)	CTD (STNM022; 500m)
	0830		1730	(15-00N, 131-59E)	Radiosonde (#053)
	0900		1800	(15-00N, 131-59E)	RINKO profiler (STN025)
	0911		1811	(15-00N, 132-00E)	CTD (STNM023; 500m)
	1130		2030	(15-00N, 132-00E)	Radiosonde (#054)
	1200		2100	(15-00N, 132-00E)	RINKO profiler (STN026)
	1213		2113	(15-00N, 132-00E)	CTD (STNM024; 1000m with water sampling)
	1423		2323	(15-00N, 132-01E)	Radiosonde (#055)
	1500	July 1	0000	(15-00N, 132-01E)	RINKO profiler (STN027)
	1510		0010	(15-00N, 132-01E)	CTD (STNM025; 500m)
	1730		0230	(14-59N, 132-01E)	Radiosonde (#056)
	1800		0300	(14-59N, 132-01E)	RINKO profiler (STN028)
	1810		0310	(14-59N, 132-01E)	CTD (STNM026; 500m)
	2030		0530	(14-59N, 132-01E)	Radiosonde (#057)
	2100		0600	(14-59N, 132-01E)	RINKO profiler (STN029)
	2108		0608	(14-59N, 132-01E)	CTD (STNM027; 500m)
	2330		0830	(15-01N, 132-00E)	Radiosonde (#058)
July 1	0000		0900	(15-01N, 132-00E)	RINKO profiler (STN030)
	0013		0913	(15-01N, 132-00E)	CTD (STNM028; 500m)
	0050		0950		Recovery of Sea Snake Thermistor
	0150		1050		Recovery of Surface Drifter (#1-1)

	0200		1100		Recovery of Surface Drifter (#1-2)
	0214		1114	(15-06N, 131-57E)	RINKO profiler (C02001)
	0230		1130	(15-05N, 131-58E)	Radiosonde (#059)
	0300		1200		Deployment of Sea Snake Thermistor
	0300		1200	(15-02N, 131-59E)	RINKO profiler (STN031)
	0313		1213	(15-02N, 131-59E)	CTD (STNM029; 500m)
	0419		1319	(15-01N, 131-59E)	Higher-altitude radiosonde (#03)
	0530		1430	(15-00N, 131-59E)	Radiosonde (#060)
	0600		1500	(15-00N, 131-59E)	RINKO profiler (STN032)
	0611		1511	(15-00N, 131-59E)	CTD (STNM030; 500m)
	0830		1730	(14-59N, 132-00E)	Radiosonde (#061)
	0900		1800	(14-59N, 132-00E)	RINKO profiler (STN033)
	0910		1810	(14-59N, 132-00E)	CTD (STNM031; 500m)
	1130		2030	(14-59N, 132-00E)	Radiosonde (#062)
	1200		2100	(15-00N, 132-00E)	RINKO profiler (STN034)
	1212		2112	(15-00N, 132-00E)	CTD (STNM032; 1000m with water sampling)
	1430		2330	(15-00N, 132-01E)	Radiosonde (#063)
	1500	July 2	0000	(15-00N, 132-01E)	RINKO profiler (STN035)
	1512		0012	(15-00N, 132-01E)	CTD (STNM033; 500m)
	1730		0230	(15-01N, 132-01E)	Radiosonde (#064)
	1800		0300	(15-01N, 132-01E)	RINKO profiler (STN036)
	1812		0312	(15-01N, 132-01E)	CTD (STNM034; 500m)
	2030		0530	(15-00N, 132-01E)	Radiosonde (#065)
	2100		0600	(15-00N, 132-01E)	RINKO profiler (STN037)
	2110		0610	(15-00N, 132-01E)	CTD (STNM035; 500m)
	2330		0830	(15-01N, 132-01E)	Radiosonde (#066)
July 2	0000		0900	(15-00N, 132-00E)	RINKO profiler (STN038)
	0012		0912	(15-00N, 132-00E)	CTD (STNM036; 500m)
	0230		1130	(15-01N, 132-00E)	Radiosonde (#067)
	0300		1200	(15-01N, 132-00E)	RINKO profiler (STN039)
	0311		1211	(15-01N, 132-00E)	CTD (STNM037; 500m)
	0426		1326	(15-01N, 132-00E)	Higher-altitude radiosonde (#04)
	0530		1430	(15-00N, 132-00E)	Radiosonde (#068)
	0600		1500	(15-00N, 132-00E)	RINKO profiler (STN040)
	0613		1513	(15-01N, 132-00E)	CTD (STNM038; 500m)
	0830		1730	(15-00N, 132-00E)	Radiosonde (#069)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN041)
	0909		1809	(15-00N, 132-00E)	CTD (STNM039; 500m)
	1130		2030	(15-00N, 132-00E)	Radiosonde (#070)
	1200		2100	(15-00N, 132-00E)	RINKO profiler (STN042)
	1211		2111	(15-00N, 132-00E)	CTD (STNM040; 1000m with water sampling)
	1430		2330	(15-00N, 131-59E)	Radiosonde (#071)
	1500	July 3	0000	(15-00N, 131-59E)	RINKO profiler (STN043)
	1511		0011	(15-00N, 131-59E)	CTD (STNM041; 500m)
	1730		0230	(15-00N, 131-59E)	Radiosonde (#072)
	1800		0300	(15-00N, 132-00E)	RINKO profiler (STN044)
	1809		0309	(15-00N, 131-59E)	CTD (STNM042; 500m)
	2030		0530	(15-00N, 132-00E)	Radiosonde (#073)

	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN045)
	2109		0609	(15-00N, 132-00E)	CTD (STNM043; 500m)
	2330		0830	(15-00N, 132-00E)	Radiosonde (#074)
July 3	0000		0900	(15-00N, 132-00E)	RINKO profiler (STN046)
	0011		0911	(15-00N, 132-00E)	CTD (STNM044; 500m)
	0230		1130	(15-01N, 132-00E)	Radiosonde (#075)
	0300		1200	(15-01N, 132-00E)	RINKO profiler (STN047)
	0312		1212	(15-01N, 132-00E)	CTD (STNM045; 500m)
	0530		1430	(15-01N, 132-00E)	Radiosonde (#076)
	0600		1500	(15-01N, 132-00E)	RINKO profiler (STN048)
	0610		1510	(15-01N, 132-00E)	CTD (STNM046; 500m)
	0831		1731	(15-00N, 132-00E)	Radiosonde (#077)
	0900		1800	(14-59N, 132-00E)	RINKO profiler (STN049)
	0910		1810	(14-59N, 132-00E)	CTD (STNM047; 500m)
	1130		2030	(15-01N, 131-59E)	Radiosonde (#078)
	1200		2100	(15-01N, 132-00E)	RINKO profiler (STN050)
	1210		2110	(15-01N, 132-00E)	CTD (STNM048; 1000m with water sampling)
	1430		2330	(15-00N, 132-00E)	Radiosonde (#079)
	1500	July 4	0000	(15-00N, 132-00E)	RINKO profiler (STN051)
	1511		0011	(15-00N, 132-00E)	CTD (STNM049; 500m)
	1731		0231	(15-00N, 131-59E)	Radiosonde (#080)
	1800		0300	(15-00N, 132-00E)	RINKO profiler (STN052)
	1809		0309	(15-00N, 132-00E)	CTD (STNM050; 500m)
	2030		0530	(15-00N, 132-00E)	Radiosonde (#081)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN053)
	2109		0609	(15-00N, 132-00E)	CTD (STNM051; 500m)
	2330		0830	(15-01N, 132-01E)	Radiosonde (#082)
July 4	0000		0900	(15-01N, 132-00E)	RINKO profiler (STN054)
	0011		0911	(15-01N, 132-00E)	CTD (STNM052; 500m)
	0230		1130	(15-00N, 132-00E)	Radiosonde (#083)
	0300		1200	(15-00N, 132-00E)	RINKO profiler (STN055)
	0312		1212	(15-00N, 132-00E)	CTD (STNM053; 500m)
	0435		1335	(14-59N, 132-00E)	Higher-altitude radiosonde (#05)
	0530		1430	(14-59N, 132-00E)	Radiosonde (#084)
	0600		1500	(14-59N, 132-00E)	RINKO profiler (STN056)
	0611		1511	(14-59N, 132-00E)	CTD (STNM054; 500m)
	0830		1730	(15-00N, 132-00E)	Radiosonde (#085)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN057)
	0910		1810	(15-00N, 132-00E)	CTD (STNM055; 500m)
	1130		2030	(15-00N, 132-00E)	Radiosonde (#086)
	1200		2100	(15-00N, 132-00E)	RINKO profiler (STN058)
	1209		2109	(15-00N, 132-00E)	CTD (STNM056; 1000m with water sampling)
	1430		2330	(15-01N, 131-59E)	Radiosonde (#087)
	1500	July 5	0000	(15-00N, 131-59E)	RINKO profiler (STN059)
	1511		0011	(15-00N, 131-59E)	CTD (STNM057; 500m)
	1730		0230	(15-01N, 132-01E)	Radiosonde (#088)
	1800		0300	(15-01N, 132-00E)	RINKO profiler (STN060)
	1808		0308	(15-01N, 132-00E)	CTD (STNM058; 500m)

	2030		0530	(14-59N, 132-00E)	Radiosonde (#089)
	2100		0600	(14-59N, 132-00E)	RINKO profiler (STN061)
	2109		0609	(14-59N, 132-00E)	CTD (STNM059; 500m)
	2145		0645		Recovery of Sea Snake Thermistor
	2330		0830	(14-58N, 131-58E)	Radiosonde (#090)
	2350		0850		Deployment of Sea Snake Thermistor
July 5	0000		0900	(14-59N, 131-59E)	RINKO profiler (STN062)
	0010		0910	(14-59N, 131-59E)	CTD (STNM060; 500m)
	0145		1045		Recovery of Sea Snake Thermistor
	0225		1125		Deployment of Sea Snake Thermistor
	0230		1130	(15-00N 132-00E)	Radiosonde (#091)
	0300		1200	(15-00N, 132-00E)	RINKO profiler (STN063)
	0310		1210	(15-00N, 132-00E)	CTD (STNM061; 500m)
	0530		1430	(15-00N, 132-00E)	Radiosonde (#092)
	0600		1500	(15-00N, 132-00E)	RINKO profiler (STN064)
	0610		1510	(15-00N, 132-00E)	CTD (STNM062; 500m)
	0830		1730	(15-00N, 132-00E)	Radiosonde (#093)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN065)
	0911		1811	(15-00N, 132-00E)	CTD (STNM063; 500m)
	1130		2030	(15-01N, 132-00E)	Radiosonde (#094)
	1200		2100	(15-01N, 132-00E)	RINKO profiler (STN066)
	1209		2109	(15-01N, 132-00E)	CTD (STNM064; 1000m with water sampling)
	1430		2330	(15-00N, 132-00E)	Radiosonde (#095)
	1500	July 6	0000	(15-00N, 132-00E)	RINKO profiler (STN067)
	1510		0010	(15-00N, 132-00E)	CTD (STNM065; 500m)
	1730		0230	(15-00N, 132-01E)	Radiosonde (#096)
	1800		0300	(15-00N, 132-01E)	RINKO profiler (STN068)
	1809		0309	(15-00N, 132-01E)	CTD (STNM066; 500m)
	2030		0530	(15-00N, 132-00E)	Radiosonde (#097)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN069)
	2109		0609	(15-00N, 132-00E)	CTD (STNM067; 500m)
	2145		0645		Recovery of Sea Snake Thermistor
	2247		0747	(14-48N, 132-00E)	Deployment of Surface Drifter (#2-1)
	2251		0751	(14-48N, 132-00E)	Deployment of Surface Drifter (#2-2)
	2330		0830	(14-55N, 132-00E)	Radiosonde (#098)
	2353		0853		Deployment of Sea Snake Thermistor
July 6	0000		0900	(14-58N, 132-00E)	RINKO profiler (STN070)
	0011		0911	(14-59N, 132-00E)	CTD (STNM068; 500m)
	0230		1130	(15-00N, 132-00E)	Radiosonde (#099)
	0300		1200	(15-00N, 132-00E)	RINKO profiler (STN071)
	0311		1211	(15-00N, 132-00E)	CTD (STNM069; 500m)
	0426		1326	(15-00N, 132-01E)	Higher-altitude radiosonde (#06)
	0530		1430	(14-59N, 132-01E)	Radiosonde (#100)
	0600		1500	(14-59N, 132-01E)	RINKO profiler (STN072)
	0609		1509	(14-59N, 132-01E)	CTD (STNM070; 500m)
	0830		1730	(15-00N, 132-00E)	Radiosonde (#101)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN073)
	0909		1809	(15-00N, 132-00E)	CTD (STNM071; 500m)

	1130		2030	(15-00N, 132-00E)	Radiosonde (#102)
	1200		2100	(15-00N, 132-00E)	RINKO profiler (STN074)
	1209		2109	(15-00N, 132-00E)	CTD (STNM072; 1000m with water sampling)
	1430		2330	(14-59N, 132-00E)	Radiosonde (#103)
	1500	July 7	0000	(14-59N, 132-01E)	RINKO profiler (STN075)
	1510		0010	(14-59N, 132-01E)	CTD (STNM073; 500m)
	1730		0230	(15-01N, 132-00E)	Radiosonde (#104)
	1800		0300	(15-01N, 132-00E)	RINKO profiler (STN076)
	1809		0309	(15-01N, 132-00E)	CTD (STNM074; 500m)
	2030		0530	(15-00N, 132-00E)	Radiosonde (#105)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN077)
	2109		0609	(15-00N, 132-00E)	CTD (STNM075; 500m)
	2330		0830	(14-59N, 131-59E)	Radiosonde (#106)
July 7	0000		0900	(14-59N, 131-59E)	RINKO profiler (STN078)
	0011		0911	(14-59N, 131-59E)	CTD (STNM076; 500m)
	0044		0944		Recovery of Sea Snake Thermistor
	0212		1112		Recovery of Surface Drifter (#2-1)
	0226		1126		Recovery of Surface Drifter (#2-2)
	0228		1128	(14-48N, 131-48E)	Radiosonde (#107)
	0237		1137	(14-48N, 131-48E)	RINKO profiler (C03001)
	0300		1200	(14-51N, 131-49E)	XCTD (#02)
	0415		1315		Deployment of Sea Snake Thermistor
	0530		1430	(15-00N, 131-59E)	Radiosonde (#108)
	0600		1500	(15-00N, 131-59E)	RINKO profiler (STN079)
	0611		1511	(15-00N, 131-59E)	CTD (STNM077; 500m)
	0828		1728	(15-00N, 131-59E)	Radiosonde (#109)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN080)
	0909		1809	(15-00N, 132-00E)	CTD (STNM078; 500m)
	1130		2030	(15-01N, 132-00E)	Radiosonde (#110)
	1200		2100	(15-00N, 132-00E)	RINKO profiler (STN081)
	1209		2109	(15-00N, 132-00E)	CTD (STNM079; 1000m with water sampling)
	1430		2330	(15-00N, 132-00E)	Radiosonde (#111)
	1500	July 8	0000	(14-59N, 132-00E)	RINKO profiler (STN082)
	1510		0010	(14-59N, 131-59E)	CTD (STNM080; 500m)
	1730		0230	(15-01N, 131-59E)	Radiosonde (#112)
	1800		0300	(15-00N, 131-59E)	RINKO profiler (STN083)
	1809		0309	(15-00N, 131-59E)	CTD (STNM081; 500m)
	2030		0530	(15-00N, 132-00E)	Radiosonde (#113)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN084)
	2109		0609	(15-00N, 132-00E)	CTD (STNM082; 500m)
	2330		0830	(15-00N, 132-00E)	Radiosonde (#114)
July 8	0000		0900	(15-00N, 132-00E)	RINKO profiler (STN085)
	0010		0910	(15-00N, 132-00E)	CTD (STNM083; 500m)
	0230		1130	(15-01N, 131-59E)	Radiosonde (#115)
	0300		1200	(15-01N, 131-59E)	RINKO profiler (STN086)
	0309		1209	(15-01N, 131-59E)	CTD (STNM084; 500m)
	0427		1327	(15-01N, 131-59E)	Higher-altitude radiosonde (#07)
	0530		1430	(15-00N, 132-00E)	Radiosonde (#116)

	0600		1500	(15-00N, 132-00E)	RINKO profiler (STN087)
	0610		1510	(15-00N, 132-00E)	CTD (STNM085; 500m)
	0830		1730	(15-00N, 132-00E)	Radiosonde (#117)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN088)
	0909		1809	(15-00N, 132-00E)	CTD (STNM086; 500m)
	1130		2030	(15-00N, 132-00E)	Radiosonde (#118)
	1200		2100	(15-00N, 132-00E)	RINKO profiler (STN089)
	1209		2109	(15-00N, 132-00E)	CTD (STNM087; 1000m with water sampling)
	1430		2330	(15-00N, 131-59E)	Radiosonde (#119)
	1500	July 9	0000	(14-59N, 131-59E)	RINKO profiler (STN090)
	1509		0009	(14-59N, 131-59E)	CTD (STNM088; 500m)
	1730		0230	(15-00N, 131-59E)	Radiosonde (#120)
	1800		0300	(15-00N, 132-00E)	RINKO profiler (STN091)
	1810		0310	(15-00N, 132-00E)	CTD (STNM089; 500m)
	2030		0530	(15-00N, 132-00E)	Radiosonde (#121)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN092)
	2108		0608	(15-00N, 132-00E)	CTD (STNM090; 500m)
	2330		0830	(15-00N, 132-00E)	Radiosonde (#122)
July 9	0000		0900	(15-00N, 132-00E)	RINKO profiler (STN093)
	0010		0910	(15-00N, 132-00E)	CTD (STNM091; 500m)
	0230		1130	(15-00N, 132-00E)	Radiosonde (#123)
	0300		1200	(14-59N, 132-00E)	RINKO profiler (STN094)
	0309		1209	(14-59N, 132-00E)	CTD (STNM092; 500m)
	0530		1430	(15-00N, 132-00E)	Radiosonde (#124)
	0600		1500	(15-00N, 132-00E)	RINKO profiler (STN095)
	0611		1511	(15-00N, 132-00E)	CTD (STNM093; 500m)
	0830		1730	(15-00N, 132-00E)	Radiosonde (#125)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN096)
	0908		1808	(15-00N, 132-00E)	CTD (STNM094; 500m)
	1130		2030	(15-00N, 132-00E)	Radiosonde (#126)
	1200		2100	(15-00N, 132-00E)	RINKO profiler (STN097)
	1209		2109	(15-00N, 132-00E)	CTD (STNM095; 1000m with water sampling)
	1430		2330	(14-59N, 131-59E)	Radiosonde (#127)
	1500	July 10	0000	(14-59N, 131-59E)	RINKO profiler (STN098)
	1511		0011	(14-59N, 131-59E)	CTD (STNM096; 500m)
	1730		0230	(15-01N, 132-00E)	Radiosonde (#128)
	1800		0300	(15-00N, 132-00E)	RINKO profiler (STN099)
	1809		0309	(15-00N, 132-00E)	CTD (STNM097; 500m)
	2030		0530	(15-00N, 132-00E)	Radiosonde (#129)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN100)
	2109		0609	(15-00N, 132-00E)	CTD (STNM098; 500m)
	2330		0830	(15-00N, 132-00E)	Radiosonde (#130)
July 10	0000		0900	(15-00N, 132-00E)	RINKO profiler (STN101)
	0010		0910	(15-00N, 132-00E)	CTD (STNM099; 500m)
	0230		1130	(15-00N, 132-00E)	Radiosonde (#131)
	0300		1200	(15-00N, 132-00E)	RINKO profiler (STN102)
	0309		1209	(15-00N, 132-00E)	CTD (STNM100; 500m)
	0427		1327	(15-00N, 132-01E)	Higher-altitude radiosonde (#08)

	0530		1430	(15-00N, 132-01E)	Radiosonde (#132)
	0600		1500	(15-00N, 132-01E)	RINKO profiler (STN103)
	0610		1510	(15-00N, 132-01E)	CTD (STNM101; 500m)
	0830		1730	(15-00N, 132-00E)	Radiosonde (#133)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN104)
	0909		1809	(15-00N, 132-00E)	CTD (STNM102; 500m)
	1130		2030	(15-00N, 132-00E)	Radiosonde (#134)
	1200		2100	(15-00N, 132-00E)	RINKO profiler (STN105)
	1209		2109	(15-00N, 132-00E)	CTD (STNM103; 1000m with water sampling)
	1430		2330	(15-00N, 132-01E)	Radiosonde (#135)
	1500	July 11	0000	(15-00N, 132-01E)	RINKO profiler (STN106)
	1511		0011	(15-00N, 132-01E)	CTD (STNM104; 500m)
	1730		0230	(15-00N, 132-00E)	Radiosonde (#136)
	1800		0300	(15-00N, 132-00E)	RINKO profiler (STN107)
	1809		0309	(15-00N, 132-00E)	CTD (STNM105; 500m)
	2030		0530	(15-00N, 132-00E)	Radiosonde (#137)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN108)
	2109		0609	(15-00N, 132-00E)	CTD (STNM106; 500m)
	2330		0830	(15-01N, 132-00E)	Radiosonde (#138)
July 11	0000		0900	(15-00N, 132-00E)	RINKO profiler (STN109)
	0010		0910	(15-01N, 132-00E)	CTD (STNM107; 500m)
	0230		1130	(15-00N, 132-00E)	Radiosonde (#139)
	0300		1200	(15-00N, 132-00E)	RINKO profiler (STN110)
	0309		1209	(15-00N, 132-00E)	CTD (STNM108; 500m)
	0427		1327	(15-00N, 132-00E)	Higher-altitude radiosonde (#09)
	0530		1430	(14-59N, 132-00E)	Radiosonde (#140)
	0600		1500	(14-59N, 132-00E)	RINKO profiler (STN111)
	0611		1511	(14-59N, 132-00E)	CTD (STNM109; 500m)
	0830		1730	(15-00N, 132-00E)	Radiosonde (#141)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN112)
	0909		1809	(15-00N, 132-00E)	CTD (STNM110; 500m)
	1130		2030	(15-00N, 132-00E)	Radiosonde (#142)
	1200		2100	(15-00N, 132-00E)	RINKO profiler (STN113)
	1209		2109	(15-00N, 132-00E)	CTD (STNM111; 1000m with water sampling)
	1430		2330	(15-00N, 132-01E)	Radiosonde (#143)
	1500	July 12	0000	(14-59N, 132-01E)	RINKO profiler (STN114)
	1510		0010	(15-00N, 132-01E)	CTD (STNM112; 500m)
	1730		0230	(15-00N, 132-01E)	Radiosonde (#144)
	1800		0300	(15-00N, 132-01E)	RINKO profiler (STN115)
	1810		0310	(15-00N, 132-01E)	CTD (STNM113; 500m)
	2030		0530	(15-00N, 132-00E)	Radiosonde (#145)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN116)
	2108		0608	(15-00N, 132-00E)	CTD (STNM114; 500m)
	2143		0643		Recovery of Sea Snake Thermistor
	2231		0731	(14-54N, 131-55E)	Deployment of Surface Drifter (#3-1)
	2236		0736	(14-54N, 131-55E)	Deployment of Surface Drifter (#3-2)
	2320		0820		Deployment of Sea Snake Thermistor
	2330		0830	(14-59N, 131-59E)	Radiosonde (#146)

July 12	0000		0900	(14-59N, 131-59E)	RINKO profiler (STN117)
	0010		0910	(14-59N, 131-59E)	CTD (STNM115; 500m)
	0230		1130	(14-59N, 132-00E)	Radiosonde (#147)
	0300		1200	(14-59N, 132-00E)	RINKO profiler (STN118)
	0308		1208	(14-59N, 132-00E)	CTD (STNM116; 500m)
	0427		1327	(14-59N, 132-00E)	Higher-altitude radiosonde (#10)
	0530		1430	(14-59N, 132-00E)	Radiosonde (#148)
	0600		1500	(14-59N, 132-00E)	RINKO profiler (STN119)
	0611		1511	(14-59N, 132-00E)	CTD (STNM117; 500m)
	0830		1730	(15-00N, 132-00E)	Radiosonde (#149)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN120)
	0908		1808	(15-00N, 132-00E)	CTD (STNM118; 500m)
	1130		2030	(15-00N, 132-01E)	Radiosonde (#150)
	1200		2100	(15-00N, 132-01E)	RINKO profiler (STN121)
	1209		2109	(15-00N, 132-01E)	CTD (STNM119; 1000m with water sampling)
	1430		2330	(15-00N, 132-01E)	Radiosonde (#151)
	1500	July 13	0000	(15-00N, 132-00E)	RINKO profiler (STN122)
	1510		0010	(15-00N, 132-00E)	CTD (STNM120; 500m)
	1730		0230	(15-01N, 132-00E)	Radiosonde (#152)
	1800		0300	(15-01N, 132-00E)	RINKO profiler (STN123)
	1808		0308	(15-01N, 132-00E)	CTD (STNM121; 500m)
	2030		0530	(15-00N, 132-00E)	Radiosonde (#153)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN124)
	2108		0608	(15-00N, 132-00E)	CTD (STNM122; 500m)
	2330		0830	(14-59N, 131-59E)	Radiosonde (#154)
July 13	0000		0900	(14-59N, 131-59E)	RINKO profiler (STN125)
	0010		0910	(14-59N, 131-59E)	CTD (STNM123; 500m)
	0045		0945		Recovery of Sea Snake Thermistor
	0156		1056		Recovery of Surface Drifter (#3-1)
	0208		1108		Recovery of Surface Drifter (#3-2)
	0215		1115	(14-52N, 131-50E)	RINKO profiler (C04001)
	0230		1130	(14-52N, 131-51E)	Radiosonde (#155)
	0300		1200	(14-56N, 131-55E)	XCTD (#03)
	0335		1235		Deployment of Sea Snake Thermistor
	0427		1327	(14-59N, 131-59E)	Higher-altitude radiosonde (#11)
	0530		1430	(14-59N, 132-00E)	Radiosonde (#156)
	0600		1500	(14-59N, 132-00E)	RINKO profiler (STN126)
	0611		1511	(14-59N, 132-00E)	CTD (STNM124; 500m)
	0830		1730	(15-00N, 132-00E)	Radiosonde (#157)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN127)
	0908		1808	(15-00N, 132-00E)	CTD (STNM125; 500m)
	1130		2030	(15-00N, 132-00E)	Radiosonde (#158)
	1200		2100	(15-00N, 132-00E)	RINKO profiler (STN128)
	1209		2109	(15-00N, 132-00E)	CTD (STNM126; 1000m with water sampling)
	1430		2330	(15-00N, 132-00E)	Radiosonde (#159)
	1500	July 14	0000	(15-00N, 132-00E)	RINKO profiler (STN129)
	1525		0025	(15-00N, 132-00E)	CTD (STNM127; 500m)
	1730		0230	(14-59N, 132-00E)	Radiosonde (#160)

	1800		0300	(14-59N, 131-59E)	RINKO profiler (STN130)
	1809		0309	(14-59N, 131-59E)	CTD (STNM128; 500m)
	2030		0530	(15-00N, 132-00E)	Radiosonde (#161)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN131)
	2109		0609	(15-00N, 132-00E)	CTD (STNM129; 500m)
	2330		0830	(15-00N, 132-00E)	Radiosonde (#162)
July 14	0000		0900	(15-00N, 132-00E)	RINKO profiler (STN132)
	0009		0909	(15-00N, 132-00E)	CTD (STNM130; 500m)
	0230		1130	(15-00N, 131-59E)	Radiosonde (#163)
	0300		1200	(15-00N, 131-59E)	RINKO profiler (STN133)
	0309		1209	(15-00N, 131-59E)	CTD (STNM131; 500m)
	0429		1329	(15-00N, 131-59E)	Higher-altitude radiosonde (#12)
	0530		1430	(15-00N, 131-59E)	Radiosonde (#164)
	0600		1500	(15-00N, 131-59E)	RINKO profiler (STN134)
	0610		1510	(15-00N, 131-59E)	CTD (STNM132; 500m)
	0830		1730	(15-01N, 132-00E)	Radiosonde (#165)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN135)
	0908		1808	(15-00N, 132-00E)	CTD (STNM133; 500m)
	1130		2030	(15-00N, 132-00E)	Radiosonde (#166)
	1200		2100	(15-00N, 132-00E)	RINKO profiler (STN136)
	1209		2109	(15-00N, 132-00E)	CTD (STNM134; 1000m with water sampling)
	1430		2330	(15-00N, 132-00E)	Radiosonde (#167)
	1500	July 15	0000	(15-00N, 132-00E)	RINKO profiler (STN137)
	1510		0010	(15-00N, 132-00E)	CTD (STNM135; 500m)
	1730		0230	(15-01N, 132-00E)	Radiosonde (#168)
	1800		0300	(15-01N, 132-00E)	RINKO profiler (STN138)
	1809		0309	(15-01N, 132-00E)	CTD (STNM136; 500m)
	2030		0530	(15-00N, 132-00E)	Radiosonde (#169)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN139)
	2109		0609	(15-00N, 132-00E)	CTD (STNM137; 500m)
	2330		0830	(15-00N, 132-00E)	Radiosonde (#170)
July 15	0000		0900	(15-00N, 132-00E)	RINKO profiler (STN140)
	0009		0909	(15-00N, 132-00E)	CTD (STNM138; 500m)
	0230		1130	(15-00N, 132-00E)	Radiosonde (#171)
	0300		1200	(15-00N, 132-00E)	RINKO profiler (STN141)
	0309		1209	(15-00N, 132-01E)	CTD (STNM139; 500m)
	0427		1327	(15-00N, 132-01E)	Higher-altitude radiosonde (#13)
	0530		1430	(15-00N, 132-01E)	Radiosonde (#172)
	0600		1500	(15-00N, 132-00E)	RINKO profiler (STN142)
	0610		1510	(15-00N, 132-01E)	CTD (STNM140; 500m)
	0830		1730	(15-00N, 132-00E)	Radiosonde (#173)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN143)
	0907		1807	(15-00N, 132-00E)	CTD (STNM141; 500m)
	1130		2030	(15-00N, 132-00E)	Radiosonde (#174)
	1200		2100	(15-00N, 132-01E)	RINKO profiler (STN144)
	1208		2108	(15-00N, 132-01E)	CTD (STNM142; 1000m with water sampling)
	1430		2330	(15-00N, 132-00E)	Radiosonde (#175)
	1500	July 16	0000	(15-00N, 132-00E)	RINKO profiler (STN145)

	1509		0009	(15-00N, 132-00E)	CTD (STNM143; 500m)
	1730		0230	(15-01N, 132-00E)	Radiosonde (#176)
	1800		0300	(15-00N, 132-00E)	RINKO profiler (STN146)
	1808		0308	(15-00N, 131-59E)	CTD (STNM144; 500m)
	2030		0530	(15-00N, 132-00E)	Radiosonde (#177)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN147)
	2109		0609	(15-00N, 132-00E)	CTD (STNM145; 500m)
	2140		0640		Recovery of Sea Snake Thermistor
	2246		0746	(14-54N, 132-06E)	Deployment of Surface Drifter (#4-1)
	2251		0751	(14-54N, 132-06E)	Deployment of Surface Drifter (#4-2)
	2330		0830	(14-59N, 132-02E)	Radiosonde (#178)
	2343		0843		Deployment of Sea Snake Thermistor
July 16	0000		0900	(15-00N, 132-01E)	RINKO profiler (STN148)
	0009		0909	(15-00N, 132-01E)	CTD (STNM146; 500m)
	0230		1130	(15-00N, 131-59E)	Radiosonde (#179)
	0300		1200	(15-00N, 131-59E)	RINKO profiler (STN149)
	0308		1208	(15-00N, 131-59E)	CTD (STNM147; 500m)
	0427		1327	(15-00N, 131-59E)	Higher-altitude radiosonde (#14)
	0530		1430	(15-00N, 131-59E)	Radiosonde (#180)
	0600		1500	(15-00N, 131-59E)	RINKO profiler (STN150)
	0610		1510	(15-00N, 131-59E)	CTD (STNM148; 500m)
	0830		1730	(15-00N, 132-00E)	Radiosonde (#181)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN151)
	0908		1808	(15-00N, 132-00E)	CTD (STNM149; 500m)
	1130		2030	(15-00N, 132-00E)	Radiosonde (#182)
	1200		2100	(15-00N, 132-00E)	RINKO profiler (STN152)
	1211		2111	(15-00N, 132-00E)	CTD (STNM150; 1000m with water sampling)
	1430		2330	(15-00N, 131-59E)	Radiosonde (#183)
	1500	July 17	0000	(15-00N, 131-59E)	RINKO profiler (STN153)
	1509		0009	(15-00N, 131-59E)	CTD (STNM151; 500m)
	1730		0230	(15-01N, 131-59E)	Radiosonde (#184)
	1800		0300	(15-00N, 131-59E)	RINKO profiler (STN154)
	1811		0311	(15-00N, 131-59E)	CTD (STNM152; 500m)
	2030		0530	(15-00N, 132-01E)	Radiosonde (#185)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN155)
	2109		0609	(15-00N, 132-00E)	CTD (STNM153; 500m)
	2330		0830	(15-00N, 132-00E)	Radiosonde (#186)
July 17	0000		0900	(15-00N, 132-00E)	RINKO profiler (STN156)
	0010		0910	(15-00N, 132-00E)	CTD (STNM154; 500m)
	0230		1130	(15-00N, 132-00E)	Radiosonde (#187)
	0300		1200	(15-00N, 132-00E)	RINKO profiler (STN157)
	0309		1209	(15-00N, 132-00E)	CTD (STNM155; 500m)
	0427		1327	(15-00N, 132-00E)	Higher-altitude radiosonde (#15)
	0530		1430	(14-59N, 131-59E)	Radiosonde (#188)
	0600		1500	(14-59N, 131-59E)	RINKO profiler (STN158)
	0609		1509	(14-59N, 131-59E)	CTD (STNM156; 500m)
	0830		1730	(15-00N, 132-00E)	Radiosonde (#189)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN159)

	0908		1808	(15-00N, 132-00E)	CTD (STNM157; 500m)
	1130		2030	(15-00N, 132-00E)	Radiosonde (#190)
	1200		2100	(15-00N, 132-00E)	RINKO profiler (STN160)
	1209		2109	(15-00N, 132-00E)	CTD (STNM158; 1000m with water sampling)
	1430		2330	(15-00N, 132-01E)	Radiosonde (#191)
	1500	July 18	0000	(15-00N, 132-00E)	RINKO profiler (STN161)
	1510		0010	(15-00N, 132-00E)	CTD (STNM159; 500m)
	1730		0230	(14-59N, 132-00E)	Radiosonde (#192)
	1800		0300	(14-59N, 132-00E)	RINKO profiler (STN162)
	1809		0309	(14-59N, 132-00E)	CTD (STNM160; 500m)
	2030		0530	(14-59N, 132-00E)	Radiosonde (#193)
	2100		0600	(14-59N, 132-00E)	RINKO profiler (STN163)
	2110		0610	(14-59N, 132-00E)	CTD (STNM161; 500m)
	2330		0830	(14-58N, 131-59E)	Radiosonde (#194)
July 18	0000		0900	(14-58N, 131-59E)	RINKO profiler (STN164)
	0009		0909	(14-58N, 131-59E)	CTD (STNM162; 500m)
	0044		0944		Recovery of Sea Snake Thermistor
	0159		1059		Recovery of Surface Drifter (#4-1)
	0220		1120		Recovery of Surface Drifter (#4-2)
	0230		1130	(14-52N, 131-48E)	Radiosonde (#195)
	0234		1134	(14-52N, 131-48E)	RINKO profiler (C05001)
	0300		1200	(14-55N, 131-51E)	XCTD (#04)
	0310		1210		Calibration for magnetometer
	0416		1316		Deployment of Sea Snake Thermistor
	0426		1326	(14-59N, 131-59E)	Higher-altitude radiosonde (#16)
	0530		1430	(14-59N, 131-59E)	Radiosonde (#196)
	0600		1500	(14-59N, 131-59E)	RINKO profiler (STN165)
	0609		1509	(14-59N, 131-59E)	CTD (STNM163; 500m)
	0814		1714	(15-00N, 132-00E)	Radiosonde (#197)
	0900		1800	(15-01N, 131-59E)	RINKO profiler (STN166)
	0908		1808	(15-01N, 131-59E)	CTD (STNM164; 500m)
	1130		2030	(15-00N, 132-00E)	Radiosonde (#198)
	1200		2100	(15-00N, 132-00E)	RINKO profiler (STN167)
	1209		2109	(15-00N, 132-00E)	CTD (STNM165; 1000m with water sampling)
	1430		2330	(15-00N, 132-00E)	Radiosonde (#199)
	1500	July 19	0000	(15-00N, 132-00E)	RINKO profiler (STN168)
	1511		0011	(15-00N, 132-00E)	CTD (STNM166; 500m)
	1730		0230	(15-00N, 131-59E)	Radiosonde (#200)
	1800		0300	(15-00N, 131-59E)	RINKO profiler (STN160)
	1809		0309	(15-00N, 131-59E)	CTD (STNM167; 500m)
	2028		0528	(15-00N, 132-00E)	Radiosonde (#201)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN170)
	2108		0608	(15-00N, 132-00E)	CTD (STNM168; 500m)
	2140		0640		Recovery of Sea Snake Thermistor
	2330		0830	(15-01N, 132-00E)	Radiosonde (#202)
July 19	0000		0900	(15-02N, 132-00E)	XCTD (#05)
	0025		0925		Recovery of Wave Glider (SV3-196)
	0034		0934	(15-02N, 132-00E)	RINKO profiler (C06001)

	0141		1041		Recovery of Wave Glider (SV3-252)
	0146		1046	(14-57N, 132-00E)	RINKO profiler (C07001)
	0230		1130	(15-00N, 131-55E)	Radiosonde (#203)
	0258		1158	(14-59N, 131-57E)	XCTD (#06)
	0311		1211		Recovery of Wave Glider (SV3-248)
	0319		1219		RINKO profiler (C08001)
	0417		1317		Deployment of Sea Snake Thermistor
	0426		1326	(15-00N, 131-58E)	Higher-altitude radiosonde (#17)
	0530		1430	(14-59N, 131-59E)	Radiosonde (#204)
	0600		1500	(14-59N, 131-59E)	RINKO profiler (STN171)
	0602		1502	(14-59N, 131-59E)	XCTD (#07)
	0830		1730	(15-00N, 132-00E)	Radiosonde (#205)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN172)
	0905		1805	(15-00N, 132-00E)	XCTD (#08)
	1130		2030	(15-00N, 131-59E)	Radiosonde (#206)
	1200		2100	(15-00N, 131-59E)	RINKO profiler (STN173)
	1210		2110	(15-00N, 131-59E)	CTD (STNM169; 1000m with water sampling)
	1430		2330	(15-00N, 132-00E)	Radiosonde (#207)
	1500	July 20	0000	(15-00N, 132-00E)	RINKO profiler (STN174)
	1511		0011	(15-00N, 132-00E)	CTD (STNM170; 500m)
	1730		0230	(15-00N, 131-59E)	Radiosonde (#208)
	1800		0300	(15-00N, 131-59E)	RINKO profiler (STN175)
	1809		0309	(15-00N, 131-59E)	CTD (STNM171; 500m)
	2030		0530	(15-00N, 132-00E)	Radiosonde (#209)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN176)
	2108		0608	(15-00N, 132-00E)	CTD (STNM172; 500m)
	2330		0830	(14-59N, 131-59E)	Radiosonde (#210)
July 20	0000		0900	(14-59N, 131-59E)	RINKO profiler (STN177)
	0009		0909	(14-59N, 131-59E)	CTD (STNM173; 500m)
	0230		1130	(15-00N, 131-59E)	Radiosonde (#211)
	0300		1200	(15-00N, 131-59E)	RINKO profiler (STN178)
	0309		1209	(15-00N, 131-59E)	CTD (STNM174; 500m)
	0427		1327	(14-59N, 131-59E)	Higher-altitude radiosonde (#18)
	0530		1430	(15-00N, 132-00E)	Radiosonde (#212)
	0600		1500	(15-00N, 132-00E)	RINKO profiler (STN179)
	0609		1509	(15-00N, 132-00E)	CTD (STNM175; 500m)
	0830		1730	(15-00N, 132-00E)	Radiosonde (#213)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN180)
	0908		1808	(15-00N, 132-00E)	CTD (STNM176; 500m)
	1130		2030	(15-01N, 132-01E)	Radiosonde (#214)
	1200		2100	(15-01N, 132-01E)	RINKO profiler (STN181)
	1209		2109	(15-01N, 132-01E)	CTD (STNM177; 1000m with water sampling)
	1430		2330	(15-00N, 132-00E)	Radiosonde (#215)
	1500	July 21	0000	(15-01N, 132-00E)	RINKO profiler (STN182)
	1509		0009	(15-01N, 132-00E)	CTD (STNM178; 500m)
	1730		0230	(15-00N, 132-00E)	Radiosonde (#216)
	1800		0300	(15-00N, 132-00E)	RINKO profiler (STN183)
	1808		0308	(15-00N, 132-00E)	CTD (STNM179; 500m)

	2030		0530	(15-00N, 132-00E)	Radiosonde (#217)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN184)
	2108		0608	(15-00N, 132-00E)	CTD (STNM180; 500m)
	2330		0830	(15-00N, 131-59E)	Radiosonde (#218)
July 21	0000		0900	(15-00N, 131-59E)	RINKO profiler (STN185)
	0011		0911	(14-59N, 131-59E)	CTD (STNM181; 500m)
	0230		1130	(15-00N, 132-00E)	Radiosonde (#219)
	0300		1200	(14-59N, 132-00E)	RINKO profiler (STN186)
	0309		1209	(14-59N, 132-00E)	CTD (STNM182; 500m)
	0427		1327	(15-00N, 131-59E)	Higher-altitude radiosonde (#19)
	0530		1430	(14-59N, 132-00E)	Radiosonde (#220)
	0600		1500	(14-59N, 132-00E)	RINKO profiler (STN187)
	0610		1510	(14-59N, 132-00E)	CTD (STNM183; 500m)
	0830		1730	(14-59N, 132-00E)	Radiosonde (#221)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN188)
	0908		1808	(15-00N, 132-00E)	CTD (STNM184; 500m)
	1130		2030	(15-01N, 132-00E)	Radiosonde (#222)
	1200		2100	(15-00N, 132-00E)	RINKO profiler (STN189)
	1211		2111	(15-01N, 132-00E)	CTD (STNM185; 1000m with water sampling)
	1430		2330	(15-00N, 132-01E)	Radiosonde (#223)
	1500	July 22	0000	(15-00N, 132-01E)	RINKO profiler (STN190)
	1510		0010	(15-00N, 132-01E)	CTD (STNM186; 500m)
	1730		0230	(15-01N, 132-01E)	Radiosonde (#224)
	1800		0300	(15-01N, 132-01E)	RINKO profiler (STN191)
	1809		0309	(15-01N, 132-01E)	CTD (STNM187; 500m)
	2030		0530	(15-00N, 132-00E)	Radiosonde (#225)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN192)
	2111		0611	(15-00N, 132-00E)	CTD (STNM188; 500m)
	2333		0833	(15-00N, 132-00E)	Radiosonde (#226)
July 22	0000		0900	(15-00N, 132-00E)	RINKO profiler (STN193)
	0009		0909	(15-00N, 132-00E)	CTD (STNM189; 500m)
	0230		1130	(15-00N, 132-00E)	Radiosonde (#227)
	0300		1200	(15-00N, 132-00E)	RINKO profiler (STN194)
	0308		1208	(15-00N, 131-59E)	CTD (STNM190; 500m)
	0423		1323	(15-00N, 132-00E)	Higher-altitude radiosonde (#20)
	0530		1430	(15-00N, 132-00E)	Radiosonde (#228)
	0600		1500	(15-00N, 132-00E)	RINKO profiler (STN195)
	0610		1510	(15-00N, 132-00E)	CTD (STNM191; 500m)
	0830		1730	(15-00N, 132-01E)	Radiosonde (#229)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN196)
	0908		1808	(15-00N, 132-00E)	CTD (STNM192; 500m)
	1130		2030	(15-00N, 132-00E)	Radiosonde (#230)
	1200		2100	(15-00N, 132-00E)	RINKO profiler (STN197)
	1208		2108	(15-00N, 132-00E)	CTD (STNM193; 1000m with water sampling)
	1430		2330	(15-01N, 132-00E)	Radiosonde (#231)
	1500	July 23	0000	(15-01N, 132-00E)	RINKO profiler (STN198)
	1511		0011	(15-01N, 132-00E)	CTD (STNM194; 500m)
	1730		0230	(15-00N, 131-58E)	Radiosonde (#232)

	1800		0300	(15-00N, 131-59E)	RINKO profiler (STN199)
	1808		0308	(15-00N, 131-59E)	CTD (STNM195; 500m)
	2030		0530	(15-00N, 132-00E)	Radiosonde (#233)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN200)
	2108		0608	(15-00N, 132-00E)	CTD (STNM196; 500m)
	2330		0830	(15-00N, 132-00E)	Radiosonde (#234)
July 23	0000		0900	(15-00N, 132-00E)	RINKO profiler (STN201)
	0008		0908	(15-00N, 132-00E)	CTD (STNM197; 500m)
	0230		1130	(15-00N, 132-00E)	Radiosonde (#235)
	0300		1200	(15-00N, 132-00E)	RINKO profiler (STN202)
	0309		1209	(15-00N, 132-00E)	CTD (STNM198; 500m)
	0427		1327	(15-00N, 132-00E)	Higher-altitude radiosonde (#21)
	0530		1430	(15-00N, 131-59E)	Radiosonde (#236)
	0600		1500	(15-00N, 131-59E)	RINKO profiler (STN203)
	0609		1509	(15-00N, 131-59E)	CTD (STNM199; 500m)
	0830		1730	(15-00N, 132-00E)	Radiosonde (#237)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN204)
	0908		1808	(15-00N, 132-00E)	CTD (STNM200; 500m)
	1130		2030	(15-01N, 132-00E)	Radiosonde (#238)
	1200		2100	(15-01N, 132-00E)	RINKO profiler (STN205)
	1209		2109	(15-01N, 132-00E)	CTD (STNM201; 1000m with water sampling)
	1430		2330	(15-00N, 132-00E)	Radiosonde (#239)
	1500	July 24	0000	(15-00N, 132-00E)	RINKO profiler (STN206)
	1509		0009	(15-00N, 132-00E)	CTD (STNM202; 500m)
	1719		0219	(15-00N, 132-01E)	Radiosonde (#240)
	1800		0300	(15-00N, 132-00E)	RINKO profiler (STN207)
	1809		0309	(15-00N, 132-00E)	CTD (STNM203; 500m)
	2030		0530	(15-00N, 132-00E)	Radiosonde (#241)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN208)
	2108		0608	(15-00N, 132-00E)	CTD (STNM204; 500m)
	2330		0830	(14-59N, 132-00E)	Radiosonde (#242)
July 24	0000		0900	(14-59N, 132-00E)	RINKO profiler (STN209)
	0008		0908	(14-59N, 132-00E)	CTD (STNM205; 500m)
	0230		1130	(15-00N, 132-01E)	Radiosonde (#243)
	0300		1200	(15-00N, 132-01E)	RINKO profiler (STN210)
	0309		1209	(15-00N, 132-01E)	CTD (STNM206; 500m)
	0426		1326	(15-01N, 132-01E)	Higher-altitude radiosonde (#22)
	0530		1430	(15-01N, 131-59E)	Radiosonde (#244)
	0600		1500	(15-00N, 131-59E)	RINKO profiler (STN211)
	0609		1509	(15-00N, 131-59E)	CTD (STNM207; 500m)
	0630		1530		Recovery of Sea Snake Thermistor
	0830		1730	(15-00N, 132-00E)	Radiosonde (#245)
	0900		1800	(15-00N, 132-00E)	RINKO profiler (STN212)
	0908		1808	(15-00N, 132-00E)	CTD (STNM208; 500m)
	1130		2030	(15-00N, 132-00E)	Radiosonde (#246)
	1200		2100	(15-00N, 132-00E)	RINKO profiler (STN213)
	1208		2108	(15-00N, 132-00E)	CTD (STNM209; 1000m with water sampling)
	1430		2330	(15-00N, 132-00E)	Radiosonde (#247)

	1500	July 25	0000	(15-01N, 132-00E)	RINKO profiler (STN214)
	1512		0012	(15-01N, 132-00E)	CTD (STNM210; 500m)
	1730		0230	(15-00N, 132-00E)	Radiosonde (#248)
	1800		0300	(15-00N, 132-00E)	RINKO profiler (STN215)
	1808		0308	(15-00N, 132-00E)	CTD (STNM211; 500m)
	2030		0530	(15-00N, 132-00E)	Radiosonde (#249)
	2100		0600	(15-00N, 132-00E)	RINKO profiler (STN216)
	2108		0608	(15-00N, 132-00E)	CTD (STNM212; 500m)
	2330		0830	(15-00N, 132-00E)	Radiosonde (#250)
July 25	0000		0900	(15-01N, 132-00E)	RINKO profiler (STN217)
	0009		0909	(15-00N, 132-00E)	CTD (STNM213; 500m)
	0048		0948		Departure from the station observation point
	0230		1130	(15-20N, 132-08E)	Radiosonde (#251)
	0530		1430	(15-52N, 132-20E)	Radiosonde (#252)
	0830		1730	(16-21N, 132-31E)	Radiosonde (#253)
	1130		2030	(16-50N, 132-41E)	Radiosonde (#254)
	1430		2330	(17-20N, 132-53E)	Radiosonde (#255)
	1730	July 26	0230	(17-49N, 133-05E)	Radiosonde (#256)
	2030		0530	(18-19N, 133-16E)	Radiosonde (#257)
	2330		0830	(18-50N, 133-28E)	Radiosonde (#258)
July 26	0230		1130	(19-20N, 133-40E)	Radiosonde (#259)
	0530		1430	(19-52N, 133-53E)	Radiosonde (#260)
	0830		1730	(20-24N, 134-05E)	Radiosonde (#261)
	1130		2030	(20-54N, 134-18E)	Radiosonde (#262)
	1730	July 27	0230	(21-58N, 134-43E)	Radiosonde (#263)
	2330		0830	(23-01N, 135-07E)	Radiosonde (#264)
July 27	0530		1430	(24-09N, 135-32E)	Radiosonde (#265)
	1130		2030	(25-12N, 136-04E)	Radiosonde (#266)
	1730	July 28	0230	(26-26N, 136-30E)	Radiosonde (#267)
	2330		0830	(27-30N, 136-57E)	Radiosonde (#268)
July 28	0530		1430	(28-38N, 137-26E)	Radiosonde (#269)
	0622		1522		Stop surface seawater monitoring
	1130		2030	(29-42N, 137-54E)	Radiosonde (#270)
	1730	July 29	0230	(30-52N, 138-11E)	Radiosonde (#271)
	2330		0830	(32-00N, 138-25E)	Radiosonde (#272)
	2333		0833		Calibration for magnetometer
July 29	0200		1100		Stop Doppler radar observation
July 30	0000	July 30	0900		Arrival at Shimizu, Japan

4. List of participants
4.1 Participants (on board)

Name	Affiliation	Theme number*
Satoru YOKOI	JAMSTEC	M, 3
Masaki KATSUMATA	JAMSTEC	M
Ayako SEIKI	JAMSTEC	M
Shinya OGINO	JAMSTEC	M
Takenari KINOSHITA	JAMSTEC	M
Akari WATANABE	JAMSTEC	M
Toru SAKAMOTO	JAMSTEC	M
Kazumasa UENO	The University of Tokyo	M, 4
Keiichi HASHIMOTO	The University of Tokyo	M, 4
Yuri MITA	Ochanomizu University	M, 5
Antonio LOURENCO	LOCEAN	M, 3
Ryo OYAMA	Nippon Marine Enterprise Inc. (NME)	T
Soichiro SUEYOSHI	NME	T
Haruna YAMANAKA	NME	T
Yasuhiro ARII	Marine Works Japan Ltd. (MWJ)	T
Nobuhiro FUJII	MWJ	T
Hiroyuki NAKAJIMA	MWJ	T
Yuki MIYAJIMA	MWJ	T
Aine YODA	MWJ	T
Katsunori SAGISHIMA	MWJ	T
Misato KUWAHARA	MWJ	T
Takuya IZUTSU	MWJ	T
Tomoki NAKAMURA	MWJ	T
Kengo FUJITA	MWJ	T

* "Theme number" corresponds to that of sub projects shown in Section 2.7.
M and T mean main mission and technical staff, respectively.

4.2 Participants (Not on board)

Name	Affiliation	Theme number*
Kunio YONEYAMA	JAMSTEC	M
Mikiko FUJITA	JAMSTEC	M
Yugo KANAYA	JAMSTEC	M
Fumikazu TAKETANI	JAMSTEC	M
Takuma MIYAKAWA	JAMSTEC	M
Hisahiro TAKASHIMA	JAMSTEC / Fukuoka University	M
Tatsuya FUKUDA	JAMSTEC	M
Tomoe NASUNO	JAMSTEC	M
Kazuma AOKI	University of Toyama	M, 1
Tomoya SHIMURA	Kyoto University	M, 2

Gilles REVERDIN	LOCEAN	M, 3
Hugo BELLENGER	LMD	M, 3
Hiroaki MIURA	University of Tokyo	M, 4
Tsubasa KOHYAMA	Ochanomizu University	M, 5

4.3 Ship Crew

Name	Occupation
Haruhiko INOUE	Master
Masato CHIBA	Chief Officer
Hirosada MATSUSHITA	1st Officer
Keiji KANAYAMA	2nd Officer
Yasuhito IIDA	Jr. 2nd Officer
Natsuko SAKURAI	3rd Officer
Kohei NANAO	Jr. 3rd Officer
Kazuhiko KANEDA	Chief Engineer
Jun TAKAHASHI	1st Engineer
Genta TAKEYA	2nd Engineer
Atsushi IDOSAKA	3rd Engineer
Masanori MURAKAMI	Chief Radio Operator
Kazuyoshi KUDO	Boatswain
Tsuyoshi SATO	Boatswain
Shuji KOMATA	Quarter Master
Hideaki TAMOTSU	Quarter Master
Hideyuki OKUBO	Quarter Master
Masaya TANIKAWA	Quarter Master
Shohei UEHARA	Quarter Master
Yuki OISHI	Sailor
Ryota KUME	Sailor
Kazuya SUMOMOZAWA	Sailor
Iori TERASAKI	Sailor
Ryu HARADA	Sailor
Katsuyuki YOSHIDA	No. 1 Oiler
Kazuya ANDO	Oiler
Tsuyoshi UCHIYAMA	Assistant Oiler
Shodai KAYABA	Assistant Oiler
Yuta WAKUGAWA	Assistant Oiler
Kyotaro MARUYAMA	Assistant Oiler
Toru WADA	Chief Steward
Kanjuro MURAKAMI	Steward
Toshiyuki TAKAMA	Steward
Mizuki NAKANO	Steward
Yuta HANGAI	Steward

5. Summary of observations

5.1 GPS radiosonde

(1) Personnel

Satoru YOKOI	(JAMSTEC)	- Principal Investigator
Masaki KATSUMATA	(JAMSTEC)	
Ayako SEIKI	(JAMSTEC)	
Toru SAKAMOTO	(JAMSTEC)	
Keiichi HASHIMOTO	(Univ. Tokyo)	
Kazumasa UENO	(Univ. Tokyo)	
Yuri MITA	(Ochanomizu Univ.)	
Ryo OYAMA	(NME)	- Operation Leader
Soichiro SUEYOSHI	(NME)	
Haruna YAMANAKA	(NME)	
Masanori MURAKAMI	(Ship Crew)	

(2) Objectives

To obtain atmospheric profile of temperature, humidity, and wind speed/direction from the surface up to lower stratosphere.

(3) Methods

The on-board radiosonde system manufactured by Vaisala Oyj was used, which consists of processor (SPS-311), processing and recording software (MW41, ver. 2.19.0), GPS antenna (GA20), UHF antenna (RB21), ground check kit (RI45), pressure sensor for ground check (PTB-330), and balloon launcher (ASAP). GPS radiosonde sensors (RS-41SGP) were launched with balloons (Totex TA-200). In case the relative wind to the ship is not appropriate for the launch using ASAP, handy launch was selected.

The radiosondes were launched every 6 hours from 12 UTC on 21 June to 12 UTC on 26 June, and every 3 hours from 12 UTC on 26 June to 12 UTC on 26 July, and every 6 hours from 12 UTC on 26 July to 00 UTC on 29 July (nominal time). In total 272 soundings were carried out, as listed in Table 5.1-1.

(4) Preliminary Results

Figure 5.1-1 is time-height cross section of temperature, relative humidity, water vapor mixing ratio, zonal wind, and meridional wind. Several basic parameters are derived from the sounding data and plotted in Fig. 5.1-2, such as convectively available potential temperature (CAPE), convective inhibition (CIN), and total precipitable water vapor (TPW). Vertical profiles of temperature and dew point temperature on a thermodynamic chart with wind profiles for individual soundings are attached in Appendix A.

(5) Data archive

Data were sent to the world meteorological community via Global Telecommunication System (GTS) through the Japan Meteorological Agency, immediately after each observation. Raw data is recorded in Vaisala original binary format during ascent. The ASCII data is also available. These raw datasets will be submitted to the Data Management Group of JAMSTEC and will be open to the public via “Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)” website:
https://www.godac.jamstec.go.jp/darwin/en

Table 5.1-1: Radiosonde launch log, with surface values and maximum height.

ID	SN	Date	Lat	Long	Psfc	Tsfc	RHsfc	WD	Wsp	SST	Max height			Cloud	
		YYYYMMDDHH	degN	degE	hPa	degC	%	deg	m/s	degC	hPa	m	Duration	Amount	Type
RS001	V4321114	2024062112	33.179	137.983	1003.8	23.5	78	82	6.0	23.92	23.5	25700	5773	3	Ci, As
RS002	V4321109	2024062118	32.387	137.718	1005.9	24.0	81	102	2.4	23.90	24.0	25552	5339	3	Ci, Sc
RS003	V4321022	2024062200	31.538	137.467	1007.4	24.6	85	102	6.0	24.05	22.9	25837	5097	7	As,Cu,Sc,Ac
RS004	V4321106	2024062206	30.592	137.164	1007.3	26.4	95	232	9.8	26.23	22.6	25949	5896	10	As
RS005	V4321026	2024062212	29.512	136.823	1009.2	26.4	97	231	8.4	25.90	23.6	25650	5634	9	As, Ac
RS006	V4321104	2024062218	28.391	136.485	1009.3	26.8	98	206	9.7	26.49	23.8	25563	5958	1	As, Ci
RS007	V4321103	2024062300	27.262	136.137	1011.0	28.3	88	214	8.1	28.25	21.8	26105	5611	2	Sc, Cs, Ci
RS008	V4321025	2024062306	26.192	135.815	1010.5	29.2	82	224	8.9	29.57	25.7	25042	5865	1	Cu, Ci, Nb
RS009	V4321108	2024062312	25.112	135.493	1011.7	29.2	83	240	3.5	30.10	18.5	27162	6461	1	Cu, Nb
RS010	V4321099	2024062318	24.031	135.172	1011.6	28.8	82	157	2.8	29.78	26.4	24809	5353	3	Cu
RS011	V4321065	2024062400	22.898	134.841	1012.6	29.6	75	123	4.6	29.52	20.3	26507	6175	1	Cu, Sc
RS012	V4321115	2024062406	21.787	134.513	1010.7	30.1	77	118	6.8	30.44	23.3	25604	5986	1	Cu
RS013	V4321063	2024062412	20.650	134.184	1010.9	30.2	76	99	11.6	30.92	22.3	25873	6277	3	Cu
RS014	V4321116	2024062418	19.543	133.998	1010.4	29.8	79	101	10.2	30.83	941.4	647	133	3	Cu
RS015	V4321117	2024062418	19.442	133.989	1010.5	29.7	80	107	10.7	30.72	88.5	17388	3976	3	Cu
RS016	V4321214	2024062500	18.457	134.002	1010.9	30.4	77	81	12.0	30.67	20.3	26435	5749	5	As,Cu, Sc
RS017	V4321102	2024062506	17.382	133.990	1008.6	30.6	74	82	11.3	30.87	18.6	26984	6229	5	Cu, As, Sc
RS018	V4321107	2024062512	16.252	134.000	1010.1	30.0	74	84	11.6	30.60	17.1	27570	6625	6	Cu, Sc
RS019	V4321127	2024062518	16.023	134.000	1009.2	29.3	79	98	10.8	30.52	19.7	26632	6225	4	Cu,As
RS020	V4321169	2024062600	15.935	133.866	1010.3	30.1	73	104	11.1	30.45	16.6	27750	6676	3	Cu, Ci, As, Cs
RS021	V4920050	2024062606	15.412	132.827	1008.8	30.4	78	111	10.7	30.51	23.8	25397	5398	7	Cu, Ci
RS022	V4920061	2024062612	15.015	132.005	1010.8	29.9	78	108	7.9	30.48	19.0	26897	6466	2	unkinown
RS023	V4920065	2024062615	14.980	132.002	1011.0	29.4	81	109	6.7	30.44	21.2	26167	5529	3	Cu
RS024	V4920052	2024062618	15.015	132.008	1010.4	29.7	78	123	6.9	30.44	23.3	25541	5725	7	Cu
RS025	V4920057	2024062621	15.029	132.002	1011.1	28.6	73	128	8.4	30.43	27.1	24545	5430	7	Cu, St, Sc, Ac, Ci, Cs
RS026	V4910405	2024062700	15.036	132.034	1011.8	28.1	80	182	3.4	30.41	18.7	26951	5933	9	Sc, Cu, As
RS027	V4910404	2024062703	14.976	131.999	1010.8	28.7	80	78	5.3	30.39	17.5	27412	5231	9	Sc, As
RS028	V4920063	2024062706	15.014	132.006	1010.1	29.2	79	68	6.3	30.44	15.2	28362	6289	10	Sc, Cu, As
RS029	V4920064	2024062709	14.999	132.016	1009.9	29.3	78	73	8.5	30.39	18.9	26898	6125	10	Sc, Cu, As
RS030	V5010379	2024062712	15.010	132.007	1011.4	29.4	79	75	5.6	30.38	20.6	26341	5701	9	Cu, As
RS031	V4920060	2024062715	14.980	132.019	1010.8	29.6	78	73	7.5	30.38	25.2	25050	6195	8	unknown
RS032	V4920059	2024062718	15.012	132.006	1009.5	29.7	80	68	6.8	30.36	17.7	27295	6280	6	Cu, Sc, As, Ac
RS033	V4920056	2024062721	15.022	131.989	1010.2	29.7	78	82	6.2	30.37	25.2	25008	5714	7	Nb, Cu, Sc, Ac, Cs, Ci
RS034	V4920842	2024062800	15.000	131.995	1011.0	29.5	79	71	9.1	30.35	27.8	24413	5982	7	Nb, Cu, Ac, As, Cc, Ci
RS035	V4920053	2024062803	15.006	131.994	1009.8	29.2	85	42	7.3	30.43	17.3	27472	5709	6	Cu, Sc, Nb, Cc, Ci, Cs
RS036	V4920054	2024062806	15.000	131.999	1008.6	30.1	77	57	7.9	30.53	18.0	27193	5920	5	Cu, As, Ci
RS037	V4920058	2024062809	15.004	131.990	1008.3	30.1	77	56	8.1	30.51	23.3	25544	5806	4	Cu, Sc, As, Ci
RS038	V4850427	2024062812	15.017	131.994	1009.4	30.0	81	56	9.5	30.45	35.0	22970	5460	2	unknown
RS039	V4850377	2024062815	15.029	132.003	1009.4	29.6	81	58	7.7	30.41	23.6	25502	6164	1	Cu
RS040	V4850367	2024062818	15.022	131.998	1008.4	28.3	85	35	8.9	30.38	21.9	25934	5616	5	Cu, As, St
RS041	V4850375	2024062821	15.011	132.003	1007.8	29.2	80	62	6.3	30.36	44.0	21529	4573	2	Cu, Sc, Cs, Ci
RS042	V4850432	2024062900	14.996	131.994	1008.8	29.5	82	48	4.9	30.36	22.0	25911	6269	8	Cu, Sc, Cs
RS043	V4850430	2024062903	15.004	131.996	1008.4	29.6	80	83	4.6	30.48	25.5	24954	5726	2	Cu, Sc, Nb, Cs, Ci, As
RS044	V4920828	2024062906	15.002	131.999	1007.2	29.9	77	90	5.7	30.72	22.9	25635	5824	2	Cu, Nb, Ci, Cs, Sc
RS045	V4920829	2024062909	14.998	132.000	1007.0	29.4	82	96	6.4	30.65	22.2	25853	5724	1	Cc, Ci, Sc

RS046	V4850368	2024062912	15.016	132.000	1008.8	29.7	78	113	6.4	30.49	21.7	26060	6094	1 unknown
RS047	V4920066	2024062915	14.984	131.996	1009.3	29.8	75	90	6.2	30.44	29.8	24015	5614	7 Cu
RS048	V4850378	2024062918	14.991	132.013	1008.3	29.5	72	93	6.8	30.41	19.4	26746	5949	1 Cu
RS049	V4850216	2024062921	14.998	132.005	1007.8	29.3	78	90	5.9	30.38	23.7	25419	5963	2 Cu, Sc, Ci
RS050	V4850429	2024063000	14.954	131.954	1008.6	29.7	72	94	6.8	30.39	21.1	26187	5908	1 Cu, Cs
RS051	V4840676	2024063003	15.023	131.985	1008.1	29.8	79	103	7.3	30.50	22.9	25683	5603	2 Cu, Sc, As
RS052	V4840677	2024063006	15.005	131.989	1006.8	29.7	76	96	7.8	30.61	18.3	27093	6356	3 Cu, Ci, Ac, As, Sc
RS053	V4850390	2024063009	15.010	131.988	1006.6	29.7	77	97	6.3	30.62	20.3	26467	6095	1 Cu, Sc, Ci
RS054	V4840693	2024063012	15.008	132.000	1008.2	29.9	78	121	5.8	30.50	37.9	22646	5338	3 Cu
RS055	V4840669	2024063015	15.004	132.012	1008.4	29.6	78	110	6.5	30.46	25.9	24897	5398	7 Cu, unknown
RS056	V4840672	2024063018	14.976	132.018	1007.2	29.3	80	98	3.1	30.47	20.2	26480	5972	8 Cu, Sc
RS057	V4850304	2024063021	14.997	132.020	1007.4	29.2	79	88	4.9	30.43	21.1	26179	5763	3 Cu, Sc, Ac, Ci, Cs
RS058	V4850370	2024070100	15.019	132.003	1008.6	29.8	77	73	5.7	30.43	21.3	26129	5602	6 Cu, Sc, Cs, Ci, Cc, Ac, As
RS059	V4840667	2024070103	15.098	131.944	1008.2	30.0	77	94	6.9	30.56	20.2	26488	5492	8 Cu, Sc, As, Ac, Ci
RS060	V4840674	2024070106	15.014	131.982	1007.2	28.8	81	75	7.7	30.53	22.8	25675	5503	10 Cu, Sc, As
RS061	V4840678	2024070109	15.003	132.009	1006.4	28.8	82	140	3.2	30.50	23.6	25477	5643	10 Sc, As, Cu, Ac, St, Ns
RS062	V4840691	2024070112	14.998	132.010	1007.8	29.0	79	53	2.0	30.47	22.6	25760	5500	10 Nb
RS063	V4850376	2024070115	14.998	132.015	1007.7	29.1	80	52	4.3	30.46	22.2	25886	5674	6 unknown
RS064	V4850386	2024070118	15.010	132.018	1006.8	29.0	83	60	5.1	30.43	22.4	25805	5729	4 Cu, Sc
RS065	V4840670	2024070121	15.005	132.012	1007.6	28.9	85	86	6.7	30.43	22.1	25880	5897	7 Cu, Sc, Ci
RS066	V4840695	2024070200	15.008	132.007	1009.2	29.6	79	110	6.7	30.44	21.9	25966	6175	3 Cu, Sc, Ci, Cs
RS067	V4840696	2024070203	15.028	132.005	1008.9	29.8	79	112	5.5	30.56	20.0	26560	5859	6 Cu, Sc, Ci
RS068	V4850270	2024070206	15.011	131.997	1007.7	29.9	76	84	5.6	30.72	22.1	25913	6116	8 Cu, Ci, Sc
RS069	V4850373	2024070209	15.012	131.999	1007.4	29.8	79	83	6.7	30.72	28.5	24270	5781	5 Sc, Cu, Ac, Ci, Cc, Ns, As
RS070	V4850431	2024070212	15.015	132.003	1009.4	29.7	79	104	8.3	30.59	19.8	26679	6030	1 Sc, Cu
RS071	V4850152	2024070215	14.996	131.991	1010.3	29.8	77	85	7.2	30.50	24.3	25328	5779	1 St, Cu
RS072	V4850388	2024070218	15.001	131.987	1009.1	29.4	80	69	6.8	30.48	19.4	26748	6088	3 Cu
RS073	V4850387	2024070221	15.006	131.995	1008.9	29.5	78	86	5.7	30.46	20.9	26239	6289	2 Cu,Sc, As, Cs, Ci
RS074	V4850389	2024070300	15.006	132.001	1010.5	29.8	77	47	6.7	30.47	26.6	24733	5885	6 Cu, Nb, Sc, Ci, As, Cs
RS075	V4840859	2024070303	15.011	131.997	1009.9	28.9	83	48	3.8	30.61	29.1	24137	5259	3 Cu, Sc, Ci, Cc, Nb
RS076	V4821049	2024070306	15.024	132.007	1008.5	29.5	81	68	9.1	30.69	17.8	27326	6188	4 Cu, Sc, Nb, Ci, Cc
RS077	V4850096	2024070309	15.013	132.001	1008.4	28.2	89	117.0	9.8	30.65	26.9	24650	7022	9 Nb, St, Sc
RS078	V4850153	2024070312	15.020	131.989	1009.9	29.6	78	97	9.0	30.54	23.6	25498	5520	1 Nb
RS079	V4850154	2024070315	15.008	131.996	1010.0	29.9	78	93	9.9	30.54	21.4	26149	5957	2 Cu, Sc
RS080	V4850307	2024070318	14.992	131.984	1008.6	28.2	83	102	5.9	30.48	29.2	24114	5479	6 Ns
RS081	V4840036	2024070321	15.017	131.997	1008.5	28.0	88	104	5.9	30.47	25.6	24945	5317	4 Cu, Sc, Ac, Ci
RS082	V4840267	2024070400	15.026	132.009	1009.6	29.5	77	119	6.4	30.47	23.4	25535	5270	7 Cu, Sc, Ac, Ci
RS083	V4840033	2024070403	15.009	132.008	1009.3	29.7	76	113	6.3	30.58	20.9	26274	5649	8 Cu, Sc, As, Ci
RS084	V4840034	2024070406	14.984	131.999	1007.4	29.7	76	89	6.5	30.64	24.2	25315	5646	5 Cu, Sc, Ci, Cc, Cs
RS085	V4840058	2024070409	15.004	131.998	1007.1	29.8	78	72	6.5	30.71	20.4	26408	5833	9 Nb, Sc, Cu
RS086	V4840297	2024070412	15.004	131.995	1008.9	27.5	84	91	4.4	30.54	22.8	25728	5320	6 Nb
RS087	V4840251	2024070415	15.003	131.991	1009.2	29.1	84	122	6.8	30.49	19.7	26650	6199	3 Cu, Sc, Nb
RS088	V4840268	2024070418	15.012	132.008	1007.3	29.4	77	120	4.8	30.48	36.6	22683	5277	3 Cu, Sc
RS089	V4840298	2024070421	14.993	132.004	1007.0	29.2	76	118	6.1	30.46	19.8	26579	5887	4 Cu, Sc, Ci, Cs
RS090	V4840218	2024070500	14.927	131.940	1007.9	29.4	78	119	6.5	30.47	22.1	25874	5685	2 Cu, Sc, Ci
RS091	V4840031	2024070503	15.005	132.000	1007.9	29.5	76	129	5.5	30.62	20.9	26243	5814	3 Cu, Sc, Ci
RS092	V4840219	2024070506	15.005	132.006	1006.8	29.3	81	101	7.2	30.81	20.8	26279	5640	6 Cu, Sc, Cc, Cs, Ci
RS093	V4840295	2024070509	15.009	132.012	1006.8	29.6	78	105	3.5	30.77	20.5	26369	5896	2 Cu, Sc, As
RS094	V4840221	2024070512	15.022	132.002	1008.1	29.3	80	81	4.7	30.68	20.1	26518	6049	3 unknown

RS095	V4840300	2024070515	15.011	132.005	1008.4	29.5	77	78	4.5	30.59	22.4	25805	6078	2 Cu, Sc, As
RS096	V4840968	2024070518	15.001	132.015	1007.1	29.3	79	81	6.0	30.57	36.7	22675	5302	3 Cu, Sc, Nb
RS097	V4840964	2024070521	15.000	132.008	1007.1	28.9	83	118	4.8	30.54	31.4	23617	5176	8 Cu, Sc, Ac, As, Cc
RS098	V4840967	2024070600	14.851	132.004	1008.4	29.8	78	90	5.1	30.57	20.2	26434	6861	7 Cu, Sc, Ac, Cc, Ci
RS099	V4840961	2024070603	15.004	132.003	1008.2	30.0	78	70	6.2	30.81	20.3	26410	5802	6 Cu, Sc, Ci, Cc, Ac
RS100	V4840965	2024070606	14.989	132.011	1007.7	30.0	78	81	4.8	30.99	21.1	26170	5453	8 Cu, Sc, Ci, Cc
RS101	V4841012	2024070609	15.010	131.999	1007.2	30.0	73	58	7.7	30.81	20.1	26500	6196	2 Sc, Ac, Ci, Cu, As
RS102	V4840969	2024070612	15.012	132.003	1008.7	29.9	77	47	7.6	30.73	20.2	26488	5838	1 Cu, Sc
RS103	V4850371	2024070615	14.999	132.007	1008.5	29.8	77	59	9.8	30.63	23.3	25540	5895	2 Cu, Sc, As
RS104	V4840217	2024070618	15.010	132.001	1006.8	29.8	75	69	9.0	30.59	20.5	26348	5846	1 Cu, As
RS105	V4841010	2024070621	15.006	132.001	1006.6	29.6	75	74	8.4	30.52	21.1	26129	6380	2 Cu, Sc, Ci, Cs
RS106	V4841101	2024070700	14.992	131.992	1007.6	30.0	77	91	10.1	30.52	22.0	25894	5598	2 Nb, Cu, Sc, Ac, Ci
RS107	V4840779	2024070703	14.792	131.816	1007.5	29.7	78	128	6.3	30.61	20.7	26279	5629	1 Cu, Sc, Ci, Nb
RS108	V4840220	2024070706	14.995	131.988	1006.5	30.2	77	69	7.7	30.78	25.2	25041	5668	9 Cu, Sc, Nb, Ci, Cc
RS109	V4840987	2024070709	15.004	131.983	1006.3	30.2	77	80	5.7	30.72	21.4	26082	5728	9 Nb, Sc, Cu, As
RS110	V4840972	2024070712	15.014	132.006	1008.2	29.8	79	79	7.2	30.65	25.9	24869	5580	8 unknown
RS111	V4840971	2024070715	14.998	131.996	1008.1	29.6	84	77	6.7	30.56	20.2	26468	5925	3 Cu, Sc, As, St
RS112	V4840032	2024070718	15.008	131.989	1006.7	28.7	79	100	9.2	30.54	21.8	25932	5852	2 Cu, Nb, Sc, St
RS113	V4850666	2024070721	15.012	131.993	1006.4	29.5	81	95	9.6	30.52	22.1	25832	5592	3 Cu, Sc, Ci
RS114	V4910064	2024070800	15.011	131.999	1006.5	30.2	78	87	10.7	30.52	18.3	27041	5941	3 Cu, Sc, Ci, Cc, Cs
RS115	V4840966	2024070803	15.022	131.993	1006.4	30.5	72	113	10.0	30.60	40.3	22085	5125	2 Cu, Sc, Ci, Cs, As
RS116	V4840296	2024070806	15.001	131.999	1005.5	30.4	76	105	8.7	30.69	18.5	27010	5780	7 Nb, Cu, Sc, Ci, Cs
RS117	V4850604	2024070809	15.010	131.994	1005.7	28.9	87	78	4.7	30.68	21.4	26105	6163	5 Cu, Ac, Sc, Cc, Ci, As
RS118	V4920096	2024070812	15.018	132.001	1007.6	30.1	77	107	7.9	30.62	21.0	26231	5855	1 Cu, Sc
RS119	V4920101	2024070815	14.996	131.995	1008.6	29.3	83	87	6.4	30.58	20.1	26546	5872	3 Cu, Sc, St, As
RS120	V4850601	2024070818	14.989	131.984	1007.4	29.4	80	93	8.6	30.53	20.7	26324	5731	3 Cu, Sc, As, St
RS121	V4841009	2024070821	15.009	132.002	1007.5	29.7	77	115	6.6	30.51	25.4	24996	5819	3 Cu, Sc, Ci, Cs
RS122	V4840963	2024070900	15.008	132.004	1008.6	29.6	80	141	4.0	30.53	38.6	22343	5386	5 Cu, Sc, Ci
RS123	V4840299	2024070903	14.993	132.008	1008.1	30.1	78	88	5.7	30.68	19.7	26620	5995	2 Cu, Sc, Ci, Nb
RS124	V4848249	2024070906	15.002	132.004	1007.3	29.9	78	81	5.7	30.88	19.3	26770	5752	6 Cu, Sc, Nb, Cs, Ci, As
RS125	V4840970	2024070909	15.013	132.001	1007.1	29.8	80	77	8.6	30.81	31.1	23718	5505	2 Sc, As, Ac, Ci
RS126	V4910061	2024070912	15.013	132.000	1008.7	29.8	77	100	7.0	30.68	26.1	24833	5405	3 As, ?
RS127	V4841011	2024070915	14.993	131.996	1009.3	29.8	79	108	7.2	30.60	29.4	24087	5424	3 Cu, Sc, St, Cs, As
RS128	V4850665	2024070918	15.007	131.999	1008.5	29.5	80	104	6.1	30.59	22.1	25872	5555	4 Cu, Sc, St, Nb, Cs
RS129	V5010664	2024070921	15.010	131.998	1007.9	29.7	77	107	5.9	30.54	19.3	26735	6212	1 Cu, Sc, Cs, Ci, Cc
RS130	V5010352	2024071000	15.010	132.005	1009.1	29.8	75	112	3.4	30.56	20.7	26280	5901	6 Cu, Sc, Ci
RS131	V4850662	2024071003	15.014	132.008	1008.9	29.9	77	96	2.6	30.94	20.0	26526	5997	2 Cu. Sc, Ci
RS132	V4910062	2024071006	15.001	132.015	1007.5	30.2	71	73	2.3	31.29	19.5	26679	5717	4 Cu, Sc, Ci, Cs
RS133	V5010661	2024071009	15.013	132.003	1007.1	29.9	77	63	4.2	31.09	20.6	26333	5716	1 Sc, Cu, As, Ac
RS134	V5010383	2024071012	15.012	131.999	1008.3	29.1	83	116	4.6	30.95	23.5	25502	5725	7 Sc, Cu
RS135	V4910063	2024071015	15.002	132.003	1008.7	29.8	77	50	4.0	30.83	18.9	26926	6002	4 Cu, Sc, Cs, Ci, As
RS136	V4920093	2024071018	15.004	132.004	1007.4	29.6	81	55	3.5	30.77	20.2	26453	5970	5 Cu, Sc, Ci, As
RS137	V5010654	2024071021	15.007	132.005	1007.2	29.0	81	61	4.1	30.68	20.3	26396	6102	8 Cu, Sc, As, Ci, Cs
RS138	V4850661	2024071100	15.020	131.995	1008.0	29.7	78	98	5.9	30.68	20.7	26282	5403	7 Cu, Sc, As, Ci, Cs
RS139	V4850663	2024071103	15.006	132.000	1006.8	29.9	76	117	5.2	30.87	20.7	26287	5521	9 Cu, Sc, As, Ci, Cs
RS140	V4910066	2024071106	14.991	131.994	1005.5	29.9	75	133	5.8	31.08	21.1	26149	5648	9 Cu, Sc, As, Ci, Cs
RS141	V4910425	2024071109	15.010	132.003	1005.1	30.0	77	137	4.8	31.05	17.9	27237	6596	7 Sc, Cu, Ci, Cs
RS142	V5010655	2024071112	15.008	132.010	1006.2	29.9	75	133	5.7	30.84	19.9	26572	6096	2 As, Cs, Cu, Sc
RS143	V4920099	2024071115	14.992	132.009	1006.6	29.8	75	106	3.6	30.80	27.9	24429	6059	2 Cu, Sc, St, Ci

RS144	V5010351	2024071118	15.002	132.022	1005.4	29.4	80	68	4.7	30.70	19.1	26789	6279	4	Cu, Sc, Ci, Cs
RS145	V5010651	2024071121	15.012	132.005	1005.1	29.0	80	122	2.4	30.72	30.2	23869	5490	3	Cu,Sc,Ci,Cs
RS146	V5010650	2024071200	14.968	131.971	1005.8	29.7	79	68	4.9	30.69	18.3	27076	6160	2	Cu, Sc, Ci, Cs, Cc
RS147	V4910423	2024071203	14.990	131.996	1004.8	29.8	78	88	4.5	30.96	23.2	25534	5509	3	Cu, Sc, Ci, Cs
RS148	V4920094	2024071206	14.983	131.998	1003.9	30.0	77	97	5.7	31.12	21.2	26113	5812	2	Cu, Sc, Ci, Cs
RS149	V5010560	2024071209	15.010	132.003	1003.8	30.1	76	85	5.0	31.12	20.9	26237	5913	5	Sc, Ci, Cu, As
RS150	V5010649	2024071212	15.015	132.009	1005.3	29.6	81	104	5.5	30.95	19.6	26681	6062	1	Sc
RS151	V4850603	2024071215	15.006	132.013	1005.4	30.0	80	100	8.5	30.86	20.2	26470	6041	4	Cu, Sc, Ci, Cs
RS152	V4920097	2024071218	15.011	132.003	1003.9	29.4	81	119	5.6	30.83	20.1	26449	5999	6	Cu, Sc, As, Cs
RS153	V5010652	2024071221	15.009	132.000	1004.2	28.2	86	110	9.2	30.75	21.2	26099	5521	8	Cu, Sc, Ac, Cs, Ci, Cc
RS154	V4920794	2024071300	14.988	131.994	1005.7	29.6	80	103	6.8	30.75	21.6	26009	5590	9	Cu, Sc, As, Ci, Cs
RS155	V4850664	2024071303	14.863	131.839	1005.5	29.8	79	128	4.2	30.82	16.2	27876	5784	10	Cu, Sc, As, Ac, Ci, Cs
RS156	V4911270	2024071306	14.988	131.993	1004.7	29.5	80	152	2.2	30.97	16.9	27575	6017	10	Cu, Sc, As, Ac, Ns
RS157	V5010663	2024071309	15.002	131.984	1004.8	28.9	84	54	1.8	30.85	21.6	25997	5973	10	Nb, Sc, Ac, As, Cu
RS158	V4911390	2024071312	15.002	131.984	1004.8	28.9	84	54	1.8	30.85	20.9	26252	6048	10	Nb, Sc, Cu, As
RS159	V4911388	2024071315	15.003	132.006	1006.9	29.1	84	103	5.9	30.73	29.0	24157	5428	10	Nb, Sc, Cu, As, St
RS160	V4911398	2024071318	14.993	132.006	1006.3	28.6	86	172	3.0	30.72	19.4	26671	6000	10	Nb, Sc, Cu, As, St, Cs
RS161	V4920006	2024071321	15.003	131.998	1005.7	29.7	79	76	6.3	30.69	20.6	26319	5826	9	Cu, Sc, As, Cs, Cc
RS162	V4911397	2024071400	15.009	131.996	1007.1	29.9	79	86	11.1	30.67	18.4	27005	6217	9	Cu, Sc, Ci, Cs
RS163	V4911391	2024071403	15.001	131.993	1006.6	29.7	79	91	8.8	30.72	21.3	26088	5538	8	Cu, Sc, Ci, Cs, Cc, Nb, As
RS164	V4920002	2024071406	14.995	131.986	1005.4	29.8	78	102	11.0	30.75	27.2	24509	5314	9	Cu,Sc, As, Ci, Cs
RS165	V4920004	2024071409	15.007	131.995	1006.3	29.7	79	97	10.4	30.72	26.3	24740	5803	10	Sc, Ac, As
RS166	V4920833	2024071412	15.011	132.005	1008.0	29.9	76	96	8.8	30.69	24.4	25208	5677	10	Sc, As
RS167	V4911389	2024071415	15.010	132.003	1007.5	30.1	76	97	8.4	30.67	22.3	25815	5706	10	Sc, Cu, Cs, Nb
RS168	V4911238	2024071418	15.019	131.999	1006.2	28.8	78	124	9.5	30.66	29.5	24017	5366	8	Cu, Sc, As, Cs, Nb
RS169	V4911392	2024071421	15.008	132.001	1007.0	28.5	80	117	5.3	30.62	20.3	26389	5592	10	Cs, As, Cu, Sc, Ci
RS170	V4911267	2024071500	15.008	132.002	1008.6	29.8	76	94	5.7	30.63	21.4	26058	5789	10	As, Cu, Sc, Ci, Ac
RS171	V4920055	2024071503	15.001	132.009	1007.6	29.7	79	47	6.3	30.67	18.3	27096	5673	10	As, Cu, Sc
RS172	V4911271	2024071506	14.999	132.008	1006.2	29.9	77	71	7.5	30.70	19.7	26583	5218	10	As, Cu, Sc, Cc, Ci, Ac
RS173	V5010653	2024071509	15.012	132.001	1006.2	30.0	78	63	8.6	30.68	19.1	26777	6074	8	Sc, As, Cs, Cu
RS174	V4920830	2024071512	15.011	132.001	1006.9	29.5	80	75	7.6	30.65	19.5	26665	6007	8	Sc, Ac
RS175	V4920007	2024071515	15.010	132.004	1007.6	30.2	79	77	8.5	30.63	20.5	26362	5943	9	Sc, Ac, Cu, As
RS176	V4911396	2024071518	15.015	131.993	1006.1	29.9	80	87	11.2	30.62	35.2	22900	5498	3	Cu, Sc, St, Ac
RS177	V4911272	2024071521	15.005	131.993	1006.7	29.7	81	93	9.5	30.60	26.0	24808	5904	7	Cs, Cu, Sc
RS178	V4920012	2024071600	14.938	132.072	1008.2	29.5	72	103	8.8	30.60	19.8	26569	5423	9	As, Nb, Cu, Cs, Sc, Ci, Cc
RS179	V4911241	2024071603	15.009	131.998	1007.5	30.3	78	87	10.8	30.65	33.0	23309	4984	8	As, Cs, Cu, Sc, Ci, Cc
RS180	V4911393	2024071606	15.009	131.978	1006.4	30.5	75	89	10.0	30.75	24.2	25264	5308	8	As, Cu, Sc, Cs, Ci, Ac
RS181	V4920005	2024071609	15.011	132.000	1006.7	30.5	73	97	11.4	30.76	27.4	24481	5425	7	Sc, Cu, Ci, Cc, As, Ac
RS182	V4920008	2024071612	15.016	131.995	1007.8	30.1	78	92	8.1	30.70	19.9	26519	6222	8	As, Cs, Cu, Sc
RS183	V4911387	2024071615	14.997	131.985	1008.0	29.5	83	87	8.2	30.67	20.4	26375	5927	10	Cu, As, Sc, Ci
RS184	V4911395	2024071618	15.019	131.984	1006.3	28.6	89	91	11.9	30.63	23.1	25547	5411	9	As, Cu, Sc
RS185	V4911242	2024071621	15.016	132.013	1006.7	29.7	79	110	12.2	30.62	25.2	24956	5441	8	As, Sc, Cu, Ci, Cs
RS186	V4920009	2024071700	15.009	132.003	1008.0	30.0	76	121	8.0	30.61	29.5	23984	5600	9	Cs, Cu, Sc, Ci, As, Cc
RS187	V4920003	2024071703	15.004	132.003	1007.8	29.9	78	103	8.3	30.68	23.4	25485	5586	7	Cs, Cu, Sc, Ci, As, Cc, Ac
RS188	V4920011	2024071706	14.992	131.990	1006.6	29.9	74	93	7.2	30.84	22.0	25854	5617	7	Cs, As, Ci, Cu, Sc
RS189	V4920826	2024070709	15.009	132.002	1006.9	29.7	79	95	4.5	30.86	21.8	25927	5808	1	Sc, Ci, As
RS190	V4920832	2024071712	15.007	131.998	1008.4	29.7	78	125	5.6	30.75	20.7	26298	6148	1	Sc, Nb, Ac
RS191	V4910408	2024071715	15.006	132.012	1008.5	29.4	79	98	5.0	30.72	21.6	26023	6112	2	Sc, Cu, Ci, Cs
RS192	V4850092	2024071718	14.973	131.998	1006.9	29.3	83	123	3.6	30.70	20.4	26359	6177	4	Cu, Sc, St

RS193	V4910421	2024071721	14.991	132.005	1006.9	29.1	84	112	4.4	30.66	22.1	25871	6575	7	Cu, Sc, As, Cs
RS194	V4911240	2024071800	14.983	131.994	1008.3	29.8	76	81	8.1	30.66	20.6	26310	5670	2	Nb, Cu, Sc, Cs, As, Ci, Cc
RS195	V4850093	2024071803	14.868	131.813	1007.5	30.3	77	115	5.1	30.74	19.5	26691	5774	8	Cs, Cu, Ci, Sc, Cc
RS196	V4840730	2024071806	14.987	131.980	1006.2	29.8	76	49	4.2	30.98	22.0	25877	5653	8	Cs, Cu, Sc, As, Ci, Cc
RS197	V4910422	2024071809	15.007	131.992	1005.9	29.0	84	39	6.6	31.07	284.6	10133	2172	8	Nb, Sc, As
RS198	V4910397	2024071812	15.003	131.992	1007.3	29.0	82	61	5.5	30.91	23.3	25544	5954	3	Nb, Sc, Cs, Ci
RS199	V4840771	2024071815	15.010	132.008	1007.8	29.6	78	82	9.1	30.81	21.3	26113	6090	8	Ac, Nb, Cu, Sc, Cs
RS200	V4850215	2024071818	14.996	131.982	1006.1	29.8	79	91	7.6	30.73	21.2	26142	5989	10	As, Sc, Cu, St
RS201	V4840769	2024071821	15.005	131.998	1005.6	29.3	82	44	6.3	30.76	21.7	25964	6366	10	Cu, As
RS202	V4850197	2024071900	15.026	131.997	1006.8	28.6	80	96	8.4	30.72	24.2	25284	5126	10	Cu, As, Sc
RS203	V4840732	2024071903	14.980	131.950	1006.2	28.3	85	110	7.0	30.70	27.1	24578	4638	10	As, Cu, Sc
RS204	V4840814	2024071906	14.989	131.983	1004.4	29.2	78	83	4.9	30.77	19.1	26776	5537	9	As, Cu, Sc, Ac
RS205	V4911268	2024071909	15.016	131.985	1003.5	29.3	83	53	7.5	30.77	26.2	24795	5854	8	Nb, Sc, Cu, Ci, As, Cc
RS206	V4840815	2024071912	15.008	131.989	1004.6	29.3	85	84	11.2	30.68	35.3	22936	4920	10	Ns
RS207	V4840999	2024071915	15.009	132.009	1005.1	27.9	94	118	8.7	30.64	38.5	22414	4411	10	St, Cu, Sc, Nb
RS208	V4840774	2024071918	15.010	131.988	1003.1	28.5	84	142	12.2	30.68	43.3	21636	4836	10	St, Sc, Ns, Cu
RS209	V4850195	2024071921	15.019	132.008	1003.3	28.7	85	138	7.2	30.67	18.7	26936	6292	10	Sc, Cu, Cs, Cc, Ci, As
RS210	V4910424	2024072000	14.987	131.993	1005.4	28.1	90	152	8.6	30.66	18.8	26927	5894	10	As, Cu, Sc, Cs, Ci
RS211	V4631208	2024072003	14.994	131.994	1005.9	29.4	76	161	7.6	30.70	21.0	26225	5427	10	As. Cu, Cs
RS212	V4821040	2024072006	14.994	132.000	1004.9	29.4	81	150	6.3	30.69	26.0	24860	5377	10	Cu, Cs, As, Sc, Ci
RS213	V4840694	2024072009	15.002	132.015	1004.3	29.3	77	184	6.5	30.70	32.8	23388	5159	7	Sc, Ac, As, Ci, Cs, Cc, Cu
RS214	V4821041	2024072012	15.007	132.016	1006.1	29.1	82	169	6.5	30.61	23.1	25618	5862	10	Nb, As, Ac
RS215	V4910407	2024072015	14.998	132.006	1005.8	28.0	86	249	6.3	30.55	36.9	22677	5324	10	St, As, Cu
RS216	V4840729	2024072018	15.000	132.009	1004.5	28.8	81	211	5.6	30.54	25.6	24946	5412	10	St, Cu, Sc, As, Ac
RS217	V4850071	2024072021	14.997	132.016	1004.6	28.3	82	216	5.9	30.58	25.9	24845	5387	10	As, Cs, Ac, Cu, Sc
RS218	V4910406	2024072100	14.995	131.991	1005.2	29.3	78	210	5.7	30.61	32.9	23368	5127	10	As, Cu, Ac, Sc, Cs
RS219	V4840772	2024072103	14.993	131.992	1005.3	29.9	78	200	6.4	30.66	19.9	26594	5673	10	As, Cu, Sc
RS220	V4840773	2024072106	14.989	131.994	1004.2	29.5	80	210	11.7	30.63	24.8	25158	5012	10	Cu, As, Sc
RS221	V4911269	2024072109	14.981	132.006	1004.8	29.4	84	190	11.7	30.58	21.4	26117	5676	10	As, Sc, Ac
RS222	V4850290	2024072112	15.007	132.014	1006.1	29.3	82	182	13.7	30.51	37.5	22574	4017	10	As, Ns, Cu
RS223	V4840692	2024072115	15.003	132.017	1008.3	27.9	99	177	2.8	30.42	559.1	5009	1457	10	Ns, Cu
RS224	V4840762	2024072118	15.008	132.020	1005.9	29.7	78	175	6.8	30.40	31.1	23695	4893	10	As, Cu, Sc, St
RS225	V4840780	2024072121	15.009	132.007	1005.9	29.7	81	162	8.7	30.40	25.0	25113	5020	10	Cu, Sc
RS226	V4910403	2024072200	15.003	132.021	1007.5	27.1	84	160	11.9	30.39	25.6	24991	5917	10	As, Cu, Sc
RS227	V4840759	2024072203	15.003	132.012	1007.9	27.8	85	190	6.9	30.37	38.1	22475	4787	10	Cu, As, Sc
RS228	V4840761	2024072206	15.005	132.005	1005.8	27.1	80	195	5.9	30.32	27.2	24573	5242	10	As, Cu
RS229	V4920010	2024072209	15.005	132.019	1006.0	28.5	81	161	7.9	30.31	28.5	24273	5365	10	As, Ac, Nb
RS230	V4840816	2024072212	15.008	132.007	1007.1	29.2	82	147	8.8	30.32	26.4	24783	5702	10	As, Sc, Cu
RS231	V4840812	2024072215	15.013	132.012	1007.6	29.3	82	155	10.8	30.33	23.6	25523	5577	9	Ci, Cc, Nb, Sc, St
RS232	V4840813	2024072218	15.002	131.984	1006.3	28.4	89	136	13.1	30.27	36.0	22815	5082	10	As, Sc, Ci, Cu
RS233	V5010564	2024072221	15.001	132.012	1006.6	28.3	75	165	11.7	30.31	26.5	24727	5321	10	As, Cu, Sc
RS234	V5010354	2024072300	14.999	132.009	1007.2	29.0	83	154	9.9	30.33	19.8	26597	5525	10	Cs, Cu, Ac, Sc, As
RS235	V4910391	2024072303	14.998	132.015	1006.8	29.7	75	155	7.9	30.38	18.0	27233	5797	10	As, Cu, Cs, Sc, Ci, Cc
RS236	V4840770	2024072306	14.998	131.994	1006.0	29.9	74	165	10.7	30.50	25.1	25078	5462	5	Cu, Sc, Ci, Cs, As, Ac
RS237	V4920843	2024072309	15.003	132.009	1004.9	27.3	87	161	7.0	30.38	31.0	23731	6124	10	As, Cs, Sc, Cu
RS238	V4910398	2024072312	15.011	132.010	1006.8	28.9	82	191	6.8	30.35	23.4	25577	5629	10	As, Cu
RS239	V4920831	2024072315	15.005	132.007	1007.4	28.9	82	177	5.1	30.38	24.7	25190	5695	9	Cs, As, Cc
RS240	V5010563	2024072318	14.999	132.009	1006.5	26.7	91	217	12.2	30.35	32.5	23431	4869	10	As, Ns, Sc, Cu
RS241	V4850714	2024072321	14.999	132.016	1005.7	28.1	78	192	7.7	30.36	22.0	25904	5970	10	Cs, As, Ac, Sc

RS242	V4911315	2024072400	14.990	132.010	1006.4	29.3	71	193	6.7	30.36	18.0	27197	5825	10	Cs, Ac, As, Cu
RS243	V4850709	2024072403	15.003	132.017	1006.6	29.3	76	143	8.8	30.39	23.5	25470	5192	10	Cs, As, Ac, Cc, Cu
RS244	V4631211	2024072406	15.013	131.995	1004.4	29.1	82	153	13.0	30.38	22.2	25807	5464	10	Cu, Cs, As, Ci, Sc, Cc
RS245	V4911318	2024072409	15.012	132.002	1005.1	29.3	82	163	8.0	30.38	26.6	24683	5483	9	Cs, Ci, Cc, As, Cu
RS246	V4910401	2024072412	15.004	132.014	1006.5	29.4	81	159	8.7	30.37	21.3	26123	6045	5	unknown
RS247	V4910399	2024072415	15.001	131.997	1007.1	26.6	89	296	8.2	30.35	28.3	24295	4928	10	Ns, St, Cu, Sc
RS248	V4911317	2024072418	15.009	131.996	1005.8	26.9	80	138	3.1	30.33	38.0	22441	7835	10	Cu, unknown
RS249	V5010559	2024072421	15.000	131.997	1004.8	28.5	79	134	6.9	30.33	17.9	27202	6070	10	Cs, Ac, As, Cu, Sc
RS250	V4911319	2024072500	15.008	132.010	1006.2	29.5	81	142	6.8	30.31	24.5	25179	5951	10	Ac, Sc, Cu, As, Cs
RS251	V4850713	2024072503	15.276	132.110	1005.9	30.0	81	143	8.5	30.41	12.7	29512	7623	10	As, Ac, Cs, Cu, Sc
RS252	V4850724	2024072506	15.807	132.305	1005.4	29.7	81	129	10.4	30.35	21.5	26037	5630	10	As, Cu, Sc
RS253	V4920834	2024072509	16.301	132.491	1005.7	28.7	82	110	10.0	30.36	23.9	25348	5525	10	As, Sc, Ac, Cu
RS254	V5010353	2024072512	16.778	132.683	1008.1	28.8	76	117	9.7	30.18	37.6	22575	4159	10	unknown
RS255	V4920825	2024072515	17.269	132.858	1008.5	28.7	84	110	8.0	30.13	25.2	25068	5329	10	As, Cu, Ac, Cs
RS256	V4910400	2024072518	17.764	133.071	1007.9	28.8	80	113	5.8	30.19	22.1	25893	5457	10	As, Sc
RS257	V4910392	2024072521	18.253	133.260	1008.2	29.1	79	121	7.4	30.11	24.8	25140	5931	10	Cs, As, Sc, Cu, Ac, Ci
RS258	V5010349	2024072600	18.766	133.450	1009.7	29.8	79	102	10.0	29.98	19.5	26701	6278	8	Cu, Ci, Cc, Cs, As
RS259	V4910426	2024072603	19.295	133.653	1008.6	29.7	74	73	2.5	30.24	30.1	23946	5306	9	As, Cs, Ac, Sc, Cu, Ci
RS260	V4840811	2024072606	19.814	133.859	1009.8	29.6	82	99	8.7	30.30	15.8	28062	6480	10	Cs, Cu, Sc, As, Ac, Ci
RS261	V4920051	2024072609	20.335	134.058	1010.1	29.5	81	94	8.7	29.99	21.1	26212	5637	7	Ac, As, Cu, Sc, Cc, Cs
RS262	V5010561	2024072612	20.858	134.268	1011.8	29.6	82	79	9.6	29.84	22.3	25923	6314	5	Cu, Sc, As, Cs
RS263	V4910402	2024072618	21.890	134.683	1011.9	29.6	83	88	7.1	30.25	30.6	23873	5104	10	Nb, Ac, Cu
RS264	V5010382	2024072700	22.955	135.098	1014.4	30.2	77	89	10.4	30.37	20.6	26432	6089	4	Ci, Cu, As, Sc
RS265	V4631207	2024072706	24.100	135.517	1013.2	27.5	82	105	7.4	30.60	35.1	23072	4925	10	As, Ac, Nb, Sc, Ci
RS266	V4920793	2024072712	25.133	136.022	1015.2	29.5	81	77	11.1	30.48	21.3	26255	5928	1	As, Cu
RS267	V5010350	2024072718	26.364	136.488	1014.8	29.5	80	108	7.5	30.30	21.0	26334	5721	2	Cu, Sc, Cs
RS268	V5010381	2024072800	27.439	136.922	1015.0	29.3	80	79	1.9	30.56	20.6	26500	5780	2	Cs, Ci, Cu, Sc
RS269	V4850710	2024072806	28.578	137.401	1012.4	29.8	77	52	2.8	31.24	20.6	26497	5599	6	Cs, Ci, Cu, Sc
RS270	V4911316	2024072812	29.645	137.857	1012.0	29.8	75	294	6.8	−	22.1	26114	5734	1	unknown
RS271	V4850712	2024072818	30.787	138.165	1008.5	29.2	89	298	11.1	−	24.3	25452	5741	5	Cs, Cu, Cb
RS272	V5010662	2024072900	31.985	138.341	1007.0	30.0	82	307	11.3	−	33.9	23371	4959	8	Cs, Ci

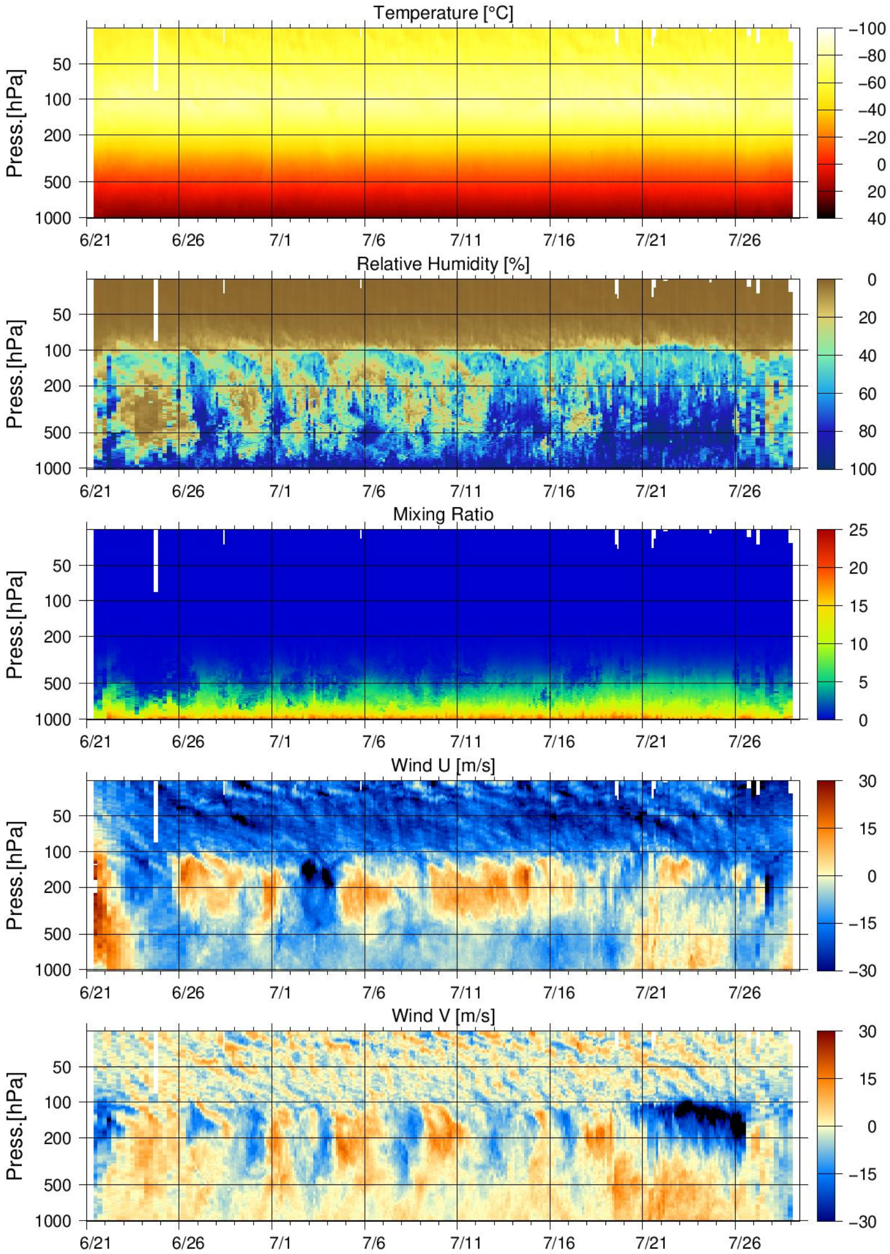


Fig. 5.1-1: Time-height cross sections of temperature, relative humidity, water vapor mixing ratio, zonal wind, and meridional wind.

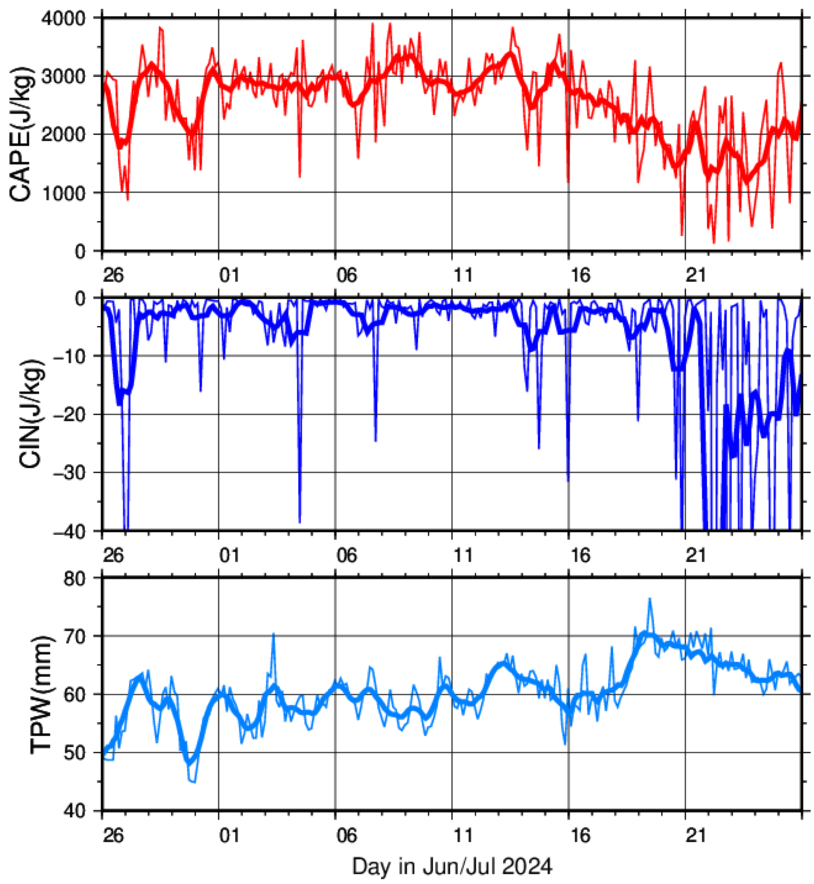


Fig. 5.1-2: Time series of convective available potential energy (CAPE), convective inhibition (CIN), and total precipitable water (TPW). Thin lines show the 3-hourly time series, while thick lines represent diurnal running averages.

5.2 Higher-altitude GPS radiosonde

(1) Personnel

Takenari KINOSHITA	(JAMSTEC)	- Principal Investigator
Shin-Ya OGINO	(JAMSTEC)	
Akari WATANABE	(JAMSTEC)	
Ryo OYAMA	(NME)	
Souichiro SUEYOSHI	(NME)	
Haruna YAMANAKA	(NME)	

(2) Objectives

To obtain atmospheric profile of temperature, humidity, and wind speed/direction from the surface up to upper stratosphere (around 40 km altitude) where the normal meteorological balloons cannot reach.

(3) Methods

The higher-altitude GPS radiosonde observations were carried out by launching Meisei iMS-100 radiosondes with TOTEX TX2000 balloons. We launched the balloons with the balloon launcher made by NME. The data transmitted from radiosondes were received by Meisei RD08AC system, which consists of a receiver, an antenna, a pre-amplifier, a laptop computer, and cables.

We carried out 22 observations from 28 June to 24 July, when the Mirai was at the station (15N, 132E). The observation point, date, launch time, and maximum altitude of each launch are shown in Table 5.2-1.

(4) Preliminary Results

Figure 5.2-1 shows time-altitude cross sections of zonal and meridional wind velocities, and temperature. We could obtain the sounding data more than 35 km altitude except four sounding data. Some wavy structures, which include gravity waves, can be seen from 20 km to 40 km. We will analyze the structures of gravity waves to understand the material transport driven by gravity waves.

(5) Data archive

The data will be submitted to the Data Management Group (DMG) of JAMSTEC, and will be opened to the public via “Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)” in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e).

Table 5.2-1: The observation point, date, launch time and maximum altitude of each launch of higher altitude observations.

Date	Obs. Point number	Time (JST)	Lat	Lon	Maximum altitude (km)	Remarks
June 28	HA-001	13:28	15N	132E	38.1 km	
June 29	HA-002	13:28	15N	132E	37.2 km	
July 1	HA-003	13:20	15N	132E	40.6 km	
July 2	HA-004	13:26	15N	132E	35.6 km	
July 4	HA-005	13:35	15N	132E	39.7 km	
July 6	HA-006	13:27	15N	132E	35.7 km	
July 8	HA-007	13:27	15N	132E	37.9 km	
July 10	HA-008	13:27	15N	132E	38.4 km	
July 11	HA-009	13:27	15N	132E	36.9 km	
July 12	HA-010	13:27	15N	132E	27.1 km	
July 13	HA-011	13:27	15N	132E	18.2 km	
July 14	HA-012	13:29	15N	132E	27.4 km	
July 15	HA-013	13:28	15N	132E	41.2 km	
July 16	HA-014	13:27	15N	132E	40.0 km	
July 17	HA-015	13:28	15N	132E	39.8 km	
July 18	HA-016	13:27	15N	132E	38.6 km	
July 19	HA-017	13:27	15N	132E	39.3 km	
July 20	HA-018	13:28	15N	132E	39.7 km	
July 21	HA-019	13:28	15N	132E	38.1 km	Level flight
July 22	HA-020	13:23	15N	132E	27.5 km	
July 23	HA-021	13:28	15N	132E	37.3 km	Level flight
July 24	HA-022	13:27	15N	132E	40.0 km	

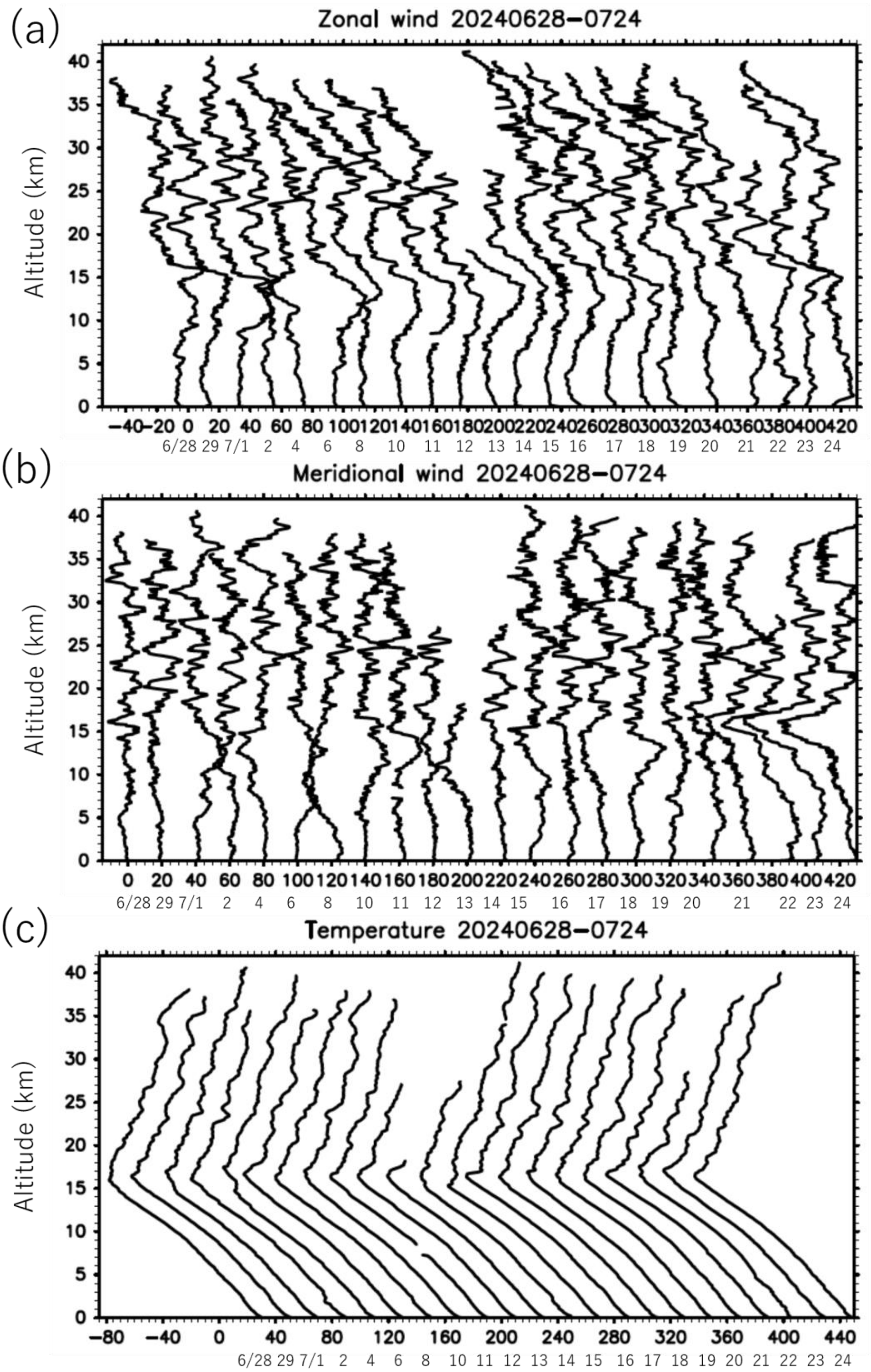


Fig. 5.2-1: Time series of vertical profiles of observed (a) zonal and (b) meridional wind velocities and (c) temperature. The intervals are 20 m/s or ℃.

5.3 C-band weather radar

(1) Personnel

Satoru YOKOI	(JAMSTEC)	Principal Investigator
Masaki KATSUMATA	(JAMSTEC)	
Ayako SEIKI	(JAMSTEC)	
Akari WATANABE	(JAMSTEC / Univ. of Ryukyus)	
Toru SAKAMOTO	(JAMSTEC / Niigata Univ.)	
Kazumasa UENO	(Univ. of Tokyo)	
Keiichi HASHIMOTO	(Univ. of Tokyo)	
Yuri MITA	(Ochanomizu Univ.)	
Ryo OYAMA	(NME)	Operation Leader
Soichiro SUEYOSHI	(NME)	
Haruna YAMANAKA	(NME)	

(2) Objective

Weather radar observations in this cruise aim to investigate the structure and evolution of precipitating systems over the tropical ocean.

(3) Radar specifications

The C-band weather radar on board the R/V Mirai is used. The basic specifications of the radar are as follows:

Frequency:	5370 MHz (C-band)
Polarimetry:	Horizontal and vertical (simultaneously transmitted and received)
Transmitter:	Solid-state transmitter
Pulse Configuration:	Using pulse-compression
Output Power:	6 kW (H) + 6 kW (V)
Antenna Diameter:	4 meter
Beam Width:	1.0 degrees
Inertial Navigation Unit:	PHINS (IXBLUE SAS France)

(4) Available radar variables

Radar variables, which are converted from the power and phase of the backscattered signal at vertically- and horizontally-polarized channels, are as follows:

Radar reflectivity:	Z
Doppler velocity:	Vr
Spectrum width of Doppler velocity:	SW
Differential reflectivity:	ZDR
Differential propagation phase:	ΦDP
Specific differential phase:	KDP
Co-polar correlation coefficients:	ρHV

(5) Operational methodology

The antenna is controlled to point the commanded ground-relative direction, by controlling the azimuth and elevation to cancel the ship attitude (roll, pitch, and yaw) detected by the navigation unit. The Doppler velocity is also corrected by subtracting the ship movement in the beam direction.

For maintenance, internal signals of the radar are checked and calibrated at the beginning and the end of the cruise. Meanwhile, the peak output power and the radar's pulse width are checked daily.

During the cruise, the radar is operated in modes shown in Table 5.3-1. A dual PRF mode is used for volume scans. For RHI and surveillance PPI scans, a single PRF mode is used.

(6) Data

The C-band weather radar observations were conducted continuously during the cruise, except nearby the main islands of Japan. The observation periods were as follows:

1830UTC on June 21 – 0200UTC on July 29

An example of the obtained snapshots is shown in Fig. 5.3-1, when the tropical depression was formed to the south of the vessel. The surveillance PPI (in the upper panel) shows that the precipitation is organized in a meso-alpha-scale band oriented in ENE-WSW direction, which consists of several meso-beta-scale lines oriented in NE-SW direction. The Doppler velocity (in the lower panel) shows that the approaching component in the eastern half and vice verca, which means easterly prevailed. The slight shift of the wind direction in the lowermost layer (i.e. east-southeasterly) can be found by the close inspection.

Figure 5.3-2 shows the time series of the areal coverage of the echo, which was calculated from the surveillance scan. For the stationary observation period. The small areal coverage implying scattered convections are found in the three-quarters of the period, while the widespread echo (like in the upper panel of Fig. 5.3-1) prevailed in the last quarter.

Further detailed analyses of the obtained data, as well as the quality controls, will be performed after the cruise.

(7) Data archive

The obtained data will be submitted to the Data Management Group of JAMSTEC.

Table 5.3-1 Scan modes of C-band weather radar

<table>
<tr><td></td><td>Surveillance PPI Scan</td><td colspan="6">Volume Scan</td><td>RHI Scan</td></tr>
<tr><td>Repeated Cycle (min.)</td><td>30</td><td colspan="6">6</td><td>6</td></tr>
<tr><td>Times in One Cycle</td><td>1</td><td colspan="6">1</td><td>3</td></tr>
<tr><td rowspan="2">PRF(s) (Hz)</td><td rowspan="2">400</td><td colspan="6">dual PRF (ray alternative)</td><td rowspan="2">1250</td></tr>
<tr><td>667</td><td>833</td><td>938</td><td>1250</td><td>1333</td><td>2000</td></tr>
<tr><td>Azimuth (deg)</td><td colspan="7">Full Circle</td><td>Option</td></tr>
<tr><td>Bin Spacing (m)</td><td colspan="8">150</td></tr>
<tr><td>Max. Range (km)</td><td>300</td><td colspan="2">150</td><td colspan="2">100</td><td colspan="2">60</td><td>100</td></tr>
<tr><td>Elevation Angle(s) (deg.)</td><td>0.5</td><td colspan="2">0.5</td><td colspan="2">1.0, 1.8, 2.6, 3.4, 4.2, 5.1,</td><td colspan="2">18.7, 23.0, 27.9, 33.5, 40.0</td><td>0.0~ 60.0</td></tr>
</table>

			6.2, 7.6, 9.7, 12.2, 15.2		

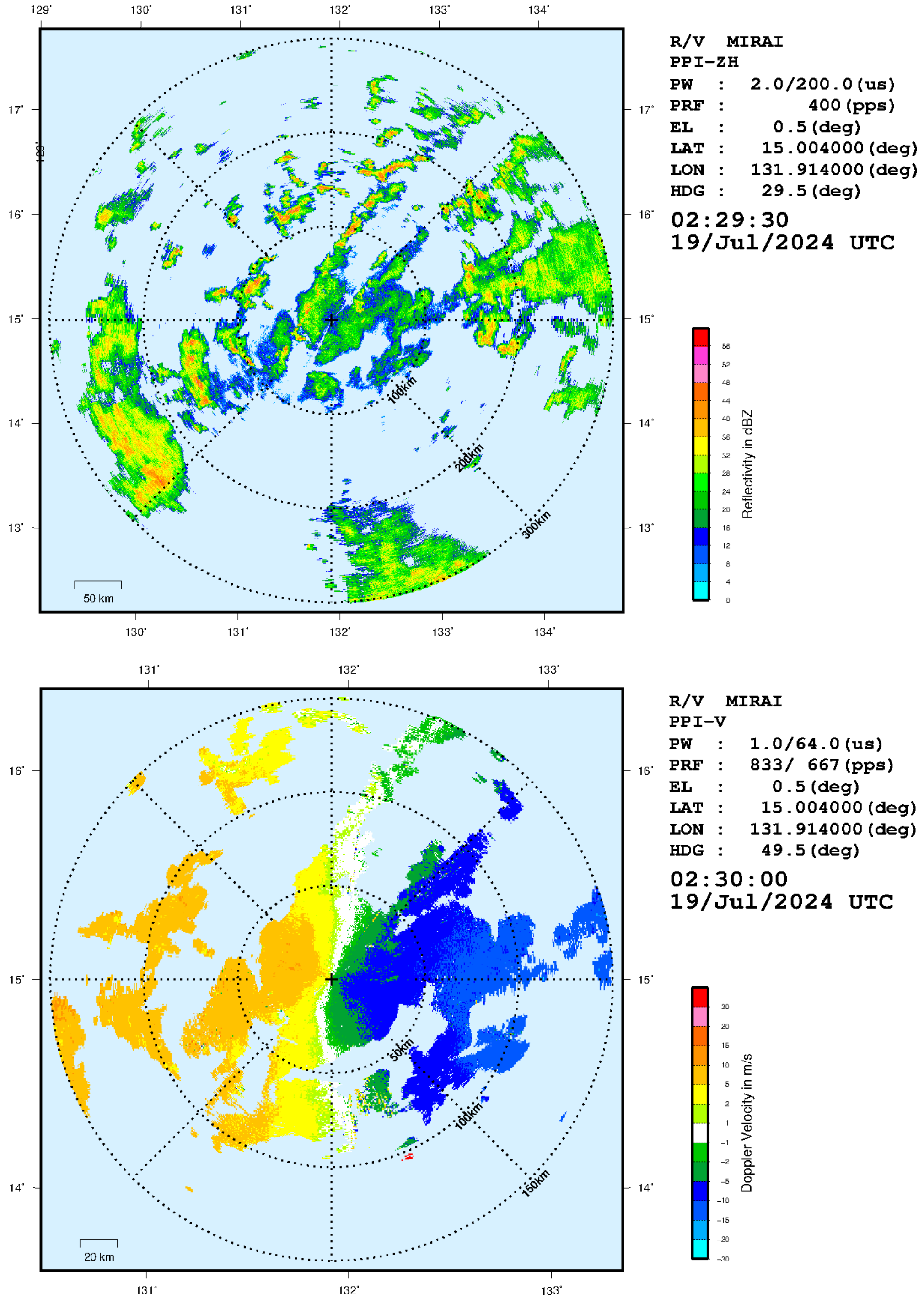


Fig. 5.3-1: Example of the obtained data by the PPI scans at (around) 0230UTC on Jul.19, 2024. The upper panel is for the radar reflectivity by the surveillance PPI scan (at the elevation of 0.5º within a 300-km range distance), whereas the lower panel is for the Doppler velocity by the

volume scan (at the elevation of 1.0º within a 100-km range distance).

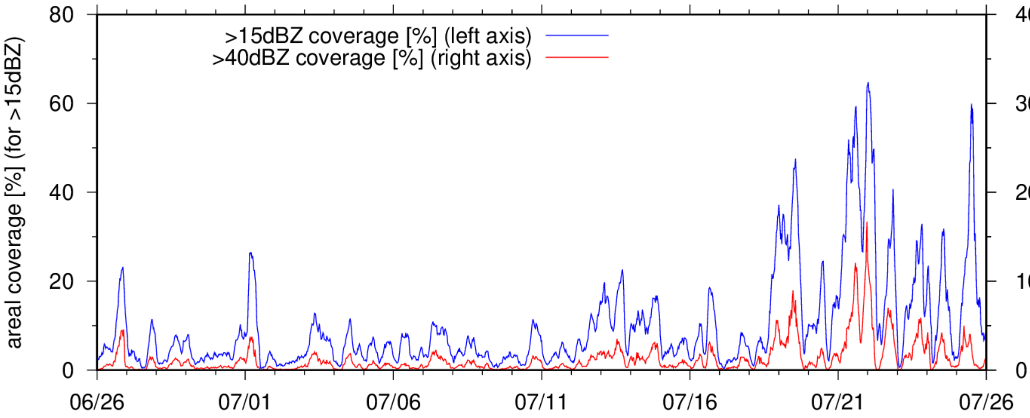


Fig. 5.3-2: Time series of the radar echo areal coverage during the stationary observation period (Jun. 26 – Jul. 25), obtained by the surveillance scans (at the elevation of 0.5º) every 30 minutes. The calculated area is limited within the 200-km in range distance to exclude data with coarse spatial resolution. Blue line is for > 15 dBZ (scale in left axis), while red for > 40 dBZ (scale in right axis), respectively.

5.4 Ceilometer

(1) Personnel

Satoru YOKOI	(JAMSTEC)	- Principal Investigator
Ryo OYAMA	(NME)	- Operation Leader
Souichiro SUEYOSHI	(NME)	
Haruna YAMANAKA	(NME)	
Masanori MURAKAMI	(MIRAI Crew)	

(2) Objectives

The information of cloud base height and the liquid water amount around cloud base is important to understand the process on formation of the cloud. As one of the methods to measure them, the ceilometer observation was carried out.

(3) Methods

We measured cloud base height and backscatter profile using ceilometer (CL51, VAISALA, Finland) throughout the MR24-04 cruise.

Major parameters for the measurement configuration are as follows;

Laser source: Indium Gallium Arsenide (InGaAs) Diode Laser
Transmitting center wavelength: 910±10 nm at 25 degC
Transmitting average power: 19.5 mW
Repetition rate: 6.5 kHz
Detector: Silicon avalanche photodiode (APD)
Measurement range: 0 ~ 15 km
0 ~ 13 km (Cloud detection)
Resolution: 10 meter in full range
Sampling rate: 36 sec
Sky Condition 0, 1, 3, 5, 7, 8 oktas (9: Vertical Visibility)
(0: Sky Clear, 1:Few, 3:Scattered, 5-7: Broken, 8: Overcast)

On the archive dataset, cloud base height and backscatter profile are recorded with the resolution of 10 m (33 ft).

(4) Parameters

1. Cloud base height [m].
2. Backscatter profile, sensitivity and range normalized at 10 m resolution.
3. Estimated cloud amount [oktas] and height [m]; Sky Condition Algorithm.

(5) Preliminary results

Figure 5.4-1 shows the time series plot of the lowest, second and third cloud base height during the cruise.

(6) Data archive

Ceilometer data obtained in this cruise will be submitted to the Data Management Group of JAMSTEC, and will be opened to the public via "Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)" in JAMSTEC web site.

<https://www.godac.jamstec.go.jp/darwin/en>

(7) Remarks

1) Window Cleaning

02:09UTC 24 Jun. 2024
00:38UTC 29 Jun. 2024
06:03UTC 04 Jul. 2024
04:50UTC 09 Jul. 2024
04:41UTC 14 Jul. 2024
07:56UTC 19 Jul. 2024
23:45UTC 24 Jul. 2024

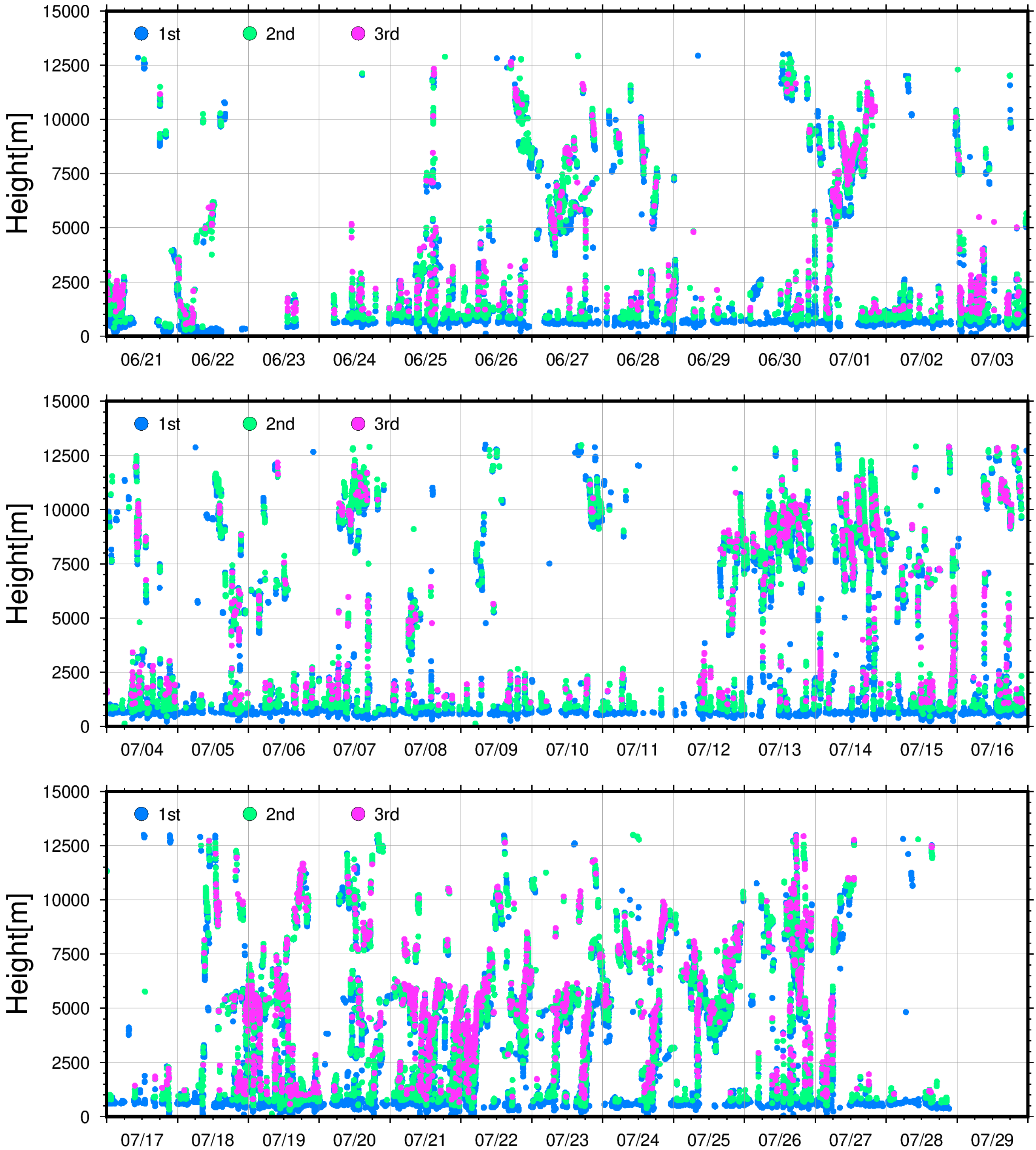


Fig. 5.4-1: 1st (Blue), 2nd (Green) and 3rd (Red) lowest cloud base height during the cruise.

5.5 Surface meteorological observations

(1) Personnel

Satoru YOKOI	(JAMSTEC)	- Principal Investigator
Masaki KATSUMATA	(JAMSTEC)	
Ryo OYAMA	(NME)	- Operation Leader
Souichiro SUEYOSHI	(NME)	
Haruna YAMANAKA	(NME)	
Masanori MURAKAMI	(NME)	- MIRAI Crew

(2) Objectives

Surface meteorological parameters are observed as a basic dataset of the meteorology. These parameters provide the temporal variation of the meteorological condition surrounding the ship.

(3) Methods

Surface meteorological parameters were observed throughout the MR21-03 cruise. During this cruise, we used two systems for the observation.

i. *MIRAI Surface Meteorological observation (SMet) system*

Instruments of SMet system are listed in Table 5.5-1 and measured parameters are listed in Table 5.5-2 Data were collected and processed by KOAC-7800 weather data processor made by Koshin-Denki, Japan. The data set consists of 6-second averaged data.

ii. *Shipboard Oceanographic and Atmospheric Radiation (SOAR) measurement system*

SOAR system designed by BNL (Brookhaven National Laboratory, USA) consists of major six parts.

a) Analog meteorological data sampling with CR1000 logger manufactured by Campbell Inc., Canada – wind, pressure, and rainfall (by a capacitive rain gauge (CRG)) measurement.
b) Digital meteorological data sampling from individual sensors —air temperature, relative humidity and rainfall (by optical rain gauge (ORG)) measurement.
c) Radiation data sampling with CR1000X logger manufactured by Campbell Inc., Radiometers designed by Hukseflux Thermal Sensors B.V. Netherlands. – short and long wave downward radiation measurement.
d) "SeaSnake" the floating thermistor designed by BNL – skin sea surface temperature (SSST) measurement.
e) Photosynthetically Available Radiation (PAR) and Ultraviolet Irradiance (UV) sensor manufactured by Biospherical Instruments Inc., USA. – PAR and UV measurement
f) Scientific Computer System (SCS) developed by NOAA (National Oceanic and Atmospheric Administration, USA) – centralized data acquisition and logging of all data sets.

SCS recorded Radiation, air temperature, relative humidity, CR1000, ORG and PAR data. SCS composed Event data (JamMet) from these data and ship's navigation data every 6 seconds. Instruments and their locations are listed in Table 5.5-3 and measured parameters are listed in Table 5.5-4.

SeaSnake has two thermistor probes (5cm and 100cm from the cable end respectively) and output voltage was converted to SSST by Steinhart-Hart equation with the following coefficients "a", "b" and "c", which were led from the calibration data.

No.2 Sensor	Period of use : 04:17UTC 27 Jun. 2024 - 01:45UTC 05 Jul. 2024		
	A	B	c
SSST-005	7.009582E-4	-2.249353E-4	-4.160601E-8
SSST-100	7.060118E-4	-2.245964E-4	-4.134756E-8

No.4 Sensor	Period of use : 02:25UTC 05 Jul. 2024 - **:**UTC ** Jul. 2024		
	A	B	c
SSST-005	7.369776E-4	-2.207104E-4	-5.060254E-8
SSST-100	7.407358E-4	-2.204912E-4	-4.971901E-8

$y = a + b * x + c * x^3$
$x = \log (1 / ((V_{ref} / V - 1) * R_2 - R_1))$
$T = 1 / y - 273.15$

V_{ref} = 2500 [mV]
R_1 = 249000 [Ω]
R_2 = 1000 [Ω]
T: Temperature [degC]
V: Sensor output voltage [mV]

For the quality control as post processing, we checked the following sensors, before and after the cruise.

i. Young Rain gauge (SMet and SOAR)
Inspect of the linearity of output value from the rain gauge sensor to change Input value by adding fixed quantity of test water.

ii. Barometer (SMet and SOAR)
Comparison with the portable barometer value, PTB330, VAISALA

iii. Thermometer (air temperature and relative humidity) (SMet and SOAR)
Comparison with the portable thermometer value, HM70, VAISALA

iv. SeaSnake SSST (SOAR)
SeaSnake thermistor probes were calibrated by 7008 Calibration bath, FLUKE Inc. USA, equipped with NSR-160 / NS-07115 Standard Platinum Resistance Thermometer (SPRT), Netsusin Inc,., Japan.

(4) Preliminary Results

Figure 5.5-1 shows the time series of the following parameters;

Wind (SMet)
Air temperature (SMet)
Relative humidity (SMet)
Precipitation (SOAR, CRG)
Short/long wave radiation (SOAR)
Barometric Pressure (SMet)
Sea surface temperature (SMet)
Significant wave height (SMet)

Figure 5.5-2 shows the time series of SSST compared to intake sea surface temperature (TSG).

(5) Data archive

These data obtained in this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via "Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)" in JAMSTEC web site.

<https://www.godac.jamstec.go.jp/darwin/en>

(6) Remarks

1. The following periods, SST data of SMET was available.
    07:02UTC 21 Jun. 2024 - 06:33UTC 28 Jul. 2024

2. The following time, increasing of SMet capacitive rain gauge data were invalid due to transmitting for MF/HF radio.
    21:51UTC 22 Jun. 2024
    01:43UTC 23 Jun. 2024
    02:37UTC 23 Jun. 2024
    00:55UTC 07 Jul. 2024
    21:35UTC 14 Jul. 2024
    00:48UTC 21 Jul. 2024
    00:56UTC 21 Jul. 2024
    00:37UTC 28 Jul. 2024

3. The followin time, SMet data acquisition was suspended due to the system trouble.
    01:24:13UTC 04 Jul. 2024

4. The following period, anemometer of SOAR data was invalid due to the sensor failure.
    00:00UTC 21 Jun. 2024 - 06:25UTC 29 Jun. 2024

5. During this cruise, VU-01 Ventilation units (for SR20 and IR20) were not attached.

6. SeaSnake (SSST) observation
    (i) The following period, SSST observation was carried out.
    04:55UTC 27 Jun. 2024 - 06:30UTC 24 Jul. 2024

    (ii) The following periods, SSST observation data were invalid.
    21:50UTC 29 Jun. 2024 - 23:40UTC 29 Jun. 2024
    00:50UTC 01 Jul. 2024 - 03:00UTC 01 Jul. 2024
    21:45UTC 04 Jul. 2024 - 23:50UTC 04 Jul. 2024
    01:45UTC 05 Jul. 2024 - 02:25UTC 05 Jul. 2024
    21:45UTC 05 Jul. 2024 - 23:53UTC 05 Jul. 2024
    00:44UTC 07 Jul. 2024 - 04:15UTC 07 Jul. 2024
    21:43UTC 11 Jul. 2024 - 23:20UTC 11 Jul. 2024
    00:45UTC 13 Jul. 2024 - 03:35UTC 13 Jul. 2024
    21:40UTC 15 Jul. 2024 - 23:43UTC 15 Jul. 2024
    00:44UTC 18 Jul. 2024 - 04:16UTC 18 Jul. 2024
    21:40UTC 18 Jul. 2024 - 04:17UTC 19 Jul. 2024
    00:50UTC 09 Jul. 2024 - 01:10UTC 09 Jul. 2024
    00:45UTC 22 Jul. 2024 - 00:58UTC 22 Jul. 2024

Table 5.5-1: Instruments and installation locations of MIRAI Surface Meteorological observation system

Sensors	Type	Manufacturer	Location (altitude from surface)
Anemometer	KS-5900	Koshin Denki, Japan	Foremast (25 m)
Tair/RH	HMP155	Vaisala, Finland	Compass deck (21 m)
with aspirated radiation shield	43408 Gill	R.M. Young, U.S.A.	starboard and port side
Thermometer: SST	RFN2-0	Koshin Denki, Japan	4th deck (-1m, inlet -5m)
Barometer	Model-370	Setra System, U.S.A.	Captain deck (13 m) Weather observation room
Capacitive rain gauge	50202	R. M. Young, U.S.A.	Compass deck (19 m)
Optical rain gauge	ORG-815DS	Osi, USA	Compass deck (19 m)
Radiometer (short wave)	MS-802	Eko Seiki, Japan	Radar mast (28 m)
Radiometer (long wave)	MS-202	Eko Seiki, Japan	Radar mast (28 m)
Wave height meter	WM-2	Tsurumi-seiki, Japan	Bow (10 m) Stern (8m)

Table 5.5-2: Parameters of MIRAI Surface Meteorological observation system

Parameter	Units	Remarks
1 Latitude	degree	
2 Longitude	degree	
3 Ship's speed	knot	MIRAI log
4 Ship's heading	degree	MIRAI gyro
5 Relative wind speed	m/s	6sec./10min. averaged
6 Relative wind direction	degree	6sec./10min. averaged
7 True wind speed	m/s	6sec./10min. averaged
8 True wind direction	degree	6sec./10min. averaged
9 Barometric pressure	hPa	adjusted to sea surface level 6sec. averaged
10 Air temperature (starboard)	degC	6sec. averaged
11 Air temperature (port)	degC	6sec. averaged
12 Dewpoint temperature (starboard)	degC	6sec. averaged
13 Dewpoint temperature (port)	degC	6sec. averaged
14 Relative humidity (starboard)	%	6sec. averaged
15 Relative humidity (port)	%	6sec. averaged
16 Sea surface temperature	degC	6sec. averaged
17 Precipitation intensity (optical rain gauge)	mm/hr	hourly accumulation
18 Precipitation (capacitive rain gauge)	mm/hr	hourly accumulation
19 Downwelling shortwave radiation	W/m^2	6sec. averaged
20 Downwelling infra-red radiation	W/m^2	6sec. averaged
21 Significant wave height (bow)	m	hourly
22 Significant wave height (stern)	m	hourly
23 Significant wave period (bow)	second	hourly
24 Significant wave period (stern)	second	hourly

Table 5.5-3: Instruments and installation locations of SOAR system

Sensors (Meteorological)	Type	Manufacturer	Location *
Anemometer	05106	R.M. Young, USA	Foremast (25 m)
Barometer	PTB210	VAISALA, Finland	Foremast (23 m)
with pressure port	61002 Gill	R.M. Young, USA	
Rain gauge	50202	R.M. Young, USA	Foremast (24 m)
Tair/RH	HMP155	VAISALA, Finland	Foremast (23 m)
with aspirated radiation shield	43408 Gill	R.M. Young, USA	
Optical rain gauge	ORG-815DR	Osi, USA	Foremast (24 m)

Sensors (Radiation)	Type	Manufacturer	Location *
Radiometer (short wave)	SR20	Hukseflux Thermal Sensors B.V., Netherlands	Foremast (25 m)
Radiometer (long wave)	IR20	Hukseflux Thermal Sensors B.V., Netherlands	Foremast (25 m)

Sensor (PAR&UV)	Type	Manufacturer	Location *
PAR&UV sensor	PUV-510	Biospherical Instruments Inc., USA	Navigation deck (18m)

Sensor (SeaSnake)	Type	Manufacturer	Location *
Thermistor	107	Campbell Scientific, USA	Bow, 5m extension (0 m)

*Location : Altitude from surface

Table 5.5-4: Parameters of SOAR system

Parameter	Units	Remarks
1 Latitude	degree	
2 Longitude	degree	
3 SOG	knot	
4 COG	degree	
5 Relative wind speed	m/s	
6 Relative wind direction	degree	
7 Barometric pressure	hPa	
8 Air temperature	degC	
9 Relative humidity	%	
10 Precipitation intensity (optical rain gauge)	mm/hr	
11 Precipitation (capacitive rain gauge)	mm/hr	reset at 50 mm
12 Down welling shortwave radiation	W/m^2	
13 Down welling infrared radiation	W/m^2	
14 “SeaSnake” raw data	mV	
15 SSST (SeaSnake)	degC	
16 PAR	$microE/cm^2/sec$	
17 UV 305 nm	$microW/cm^2/nm$	
18 UV 320 nm	$microW/cm^2/nm$	
19 UV 340 nm	$microW/cm^2/nm$	
20 UV 380 nm	$microW/cm^2/nm$	

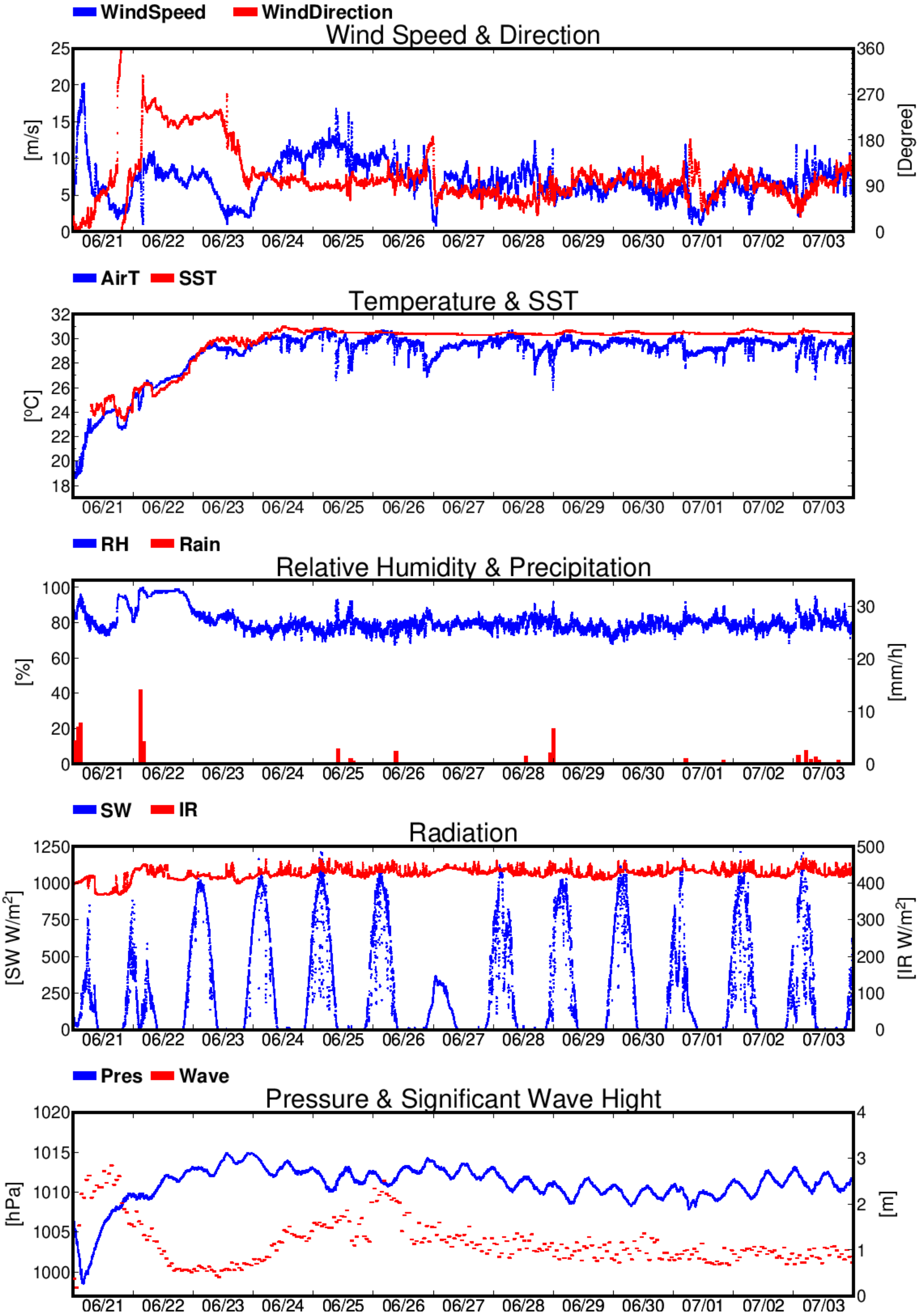


Fig. 5.5-1: Time-height cross sections of potential temperature anomaly from the period average.

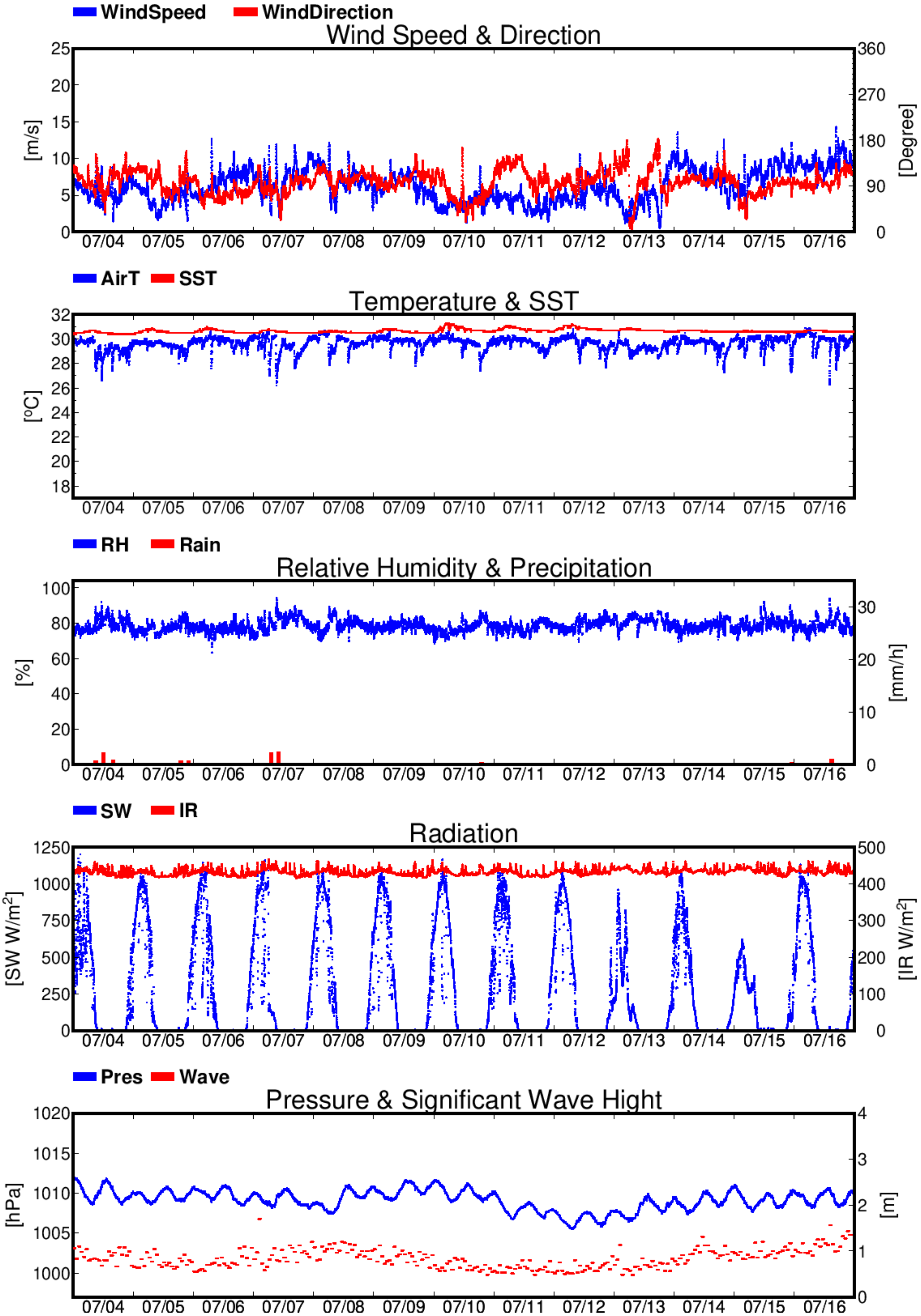


Fig. 5.5-1 (Continued)

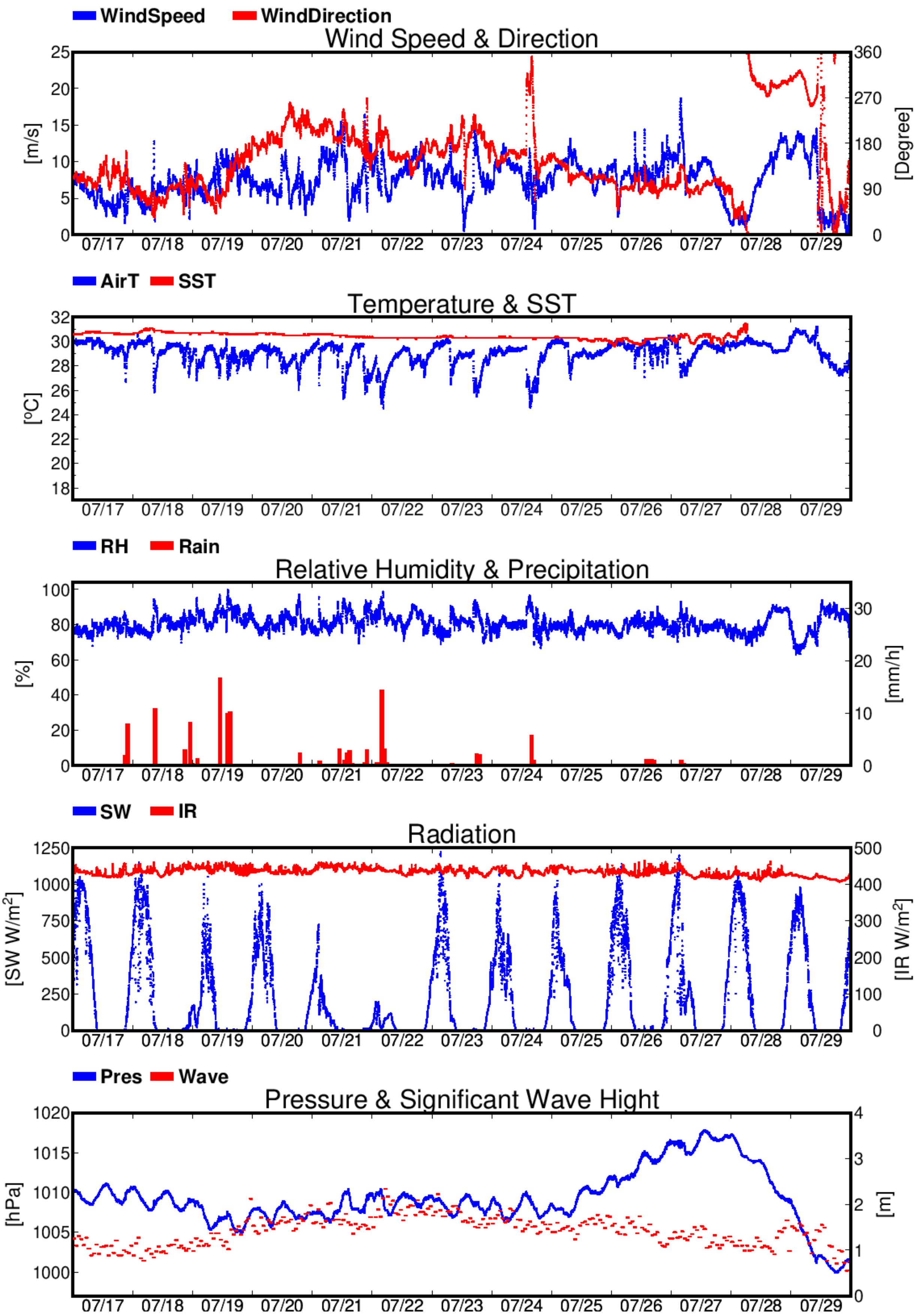


Fig. 5.5-1 (Continued)

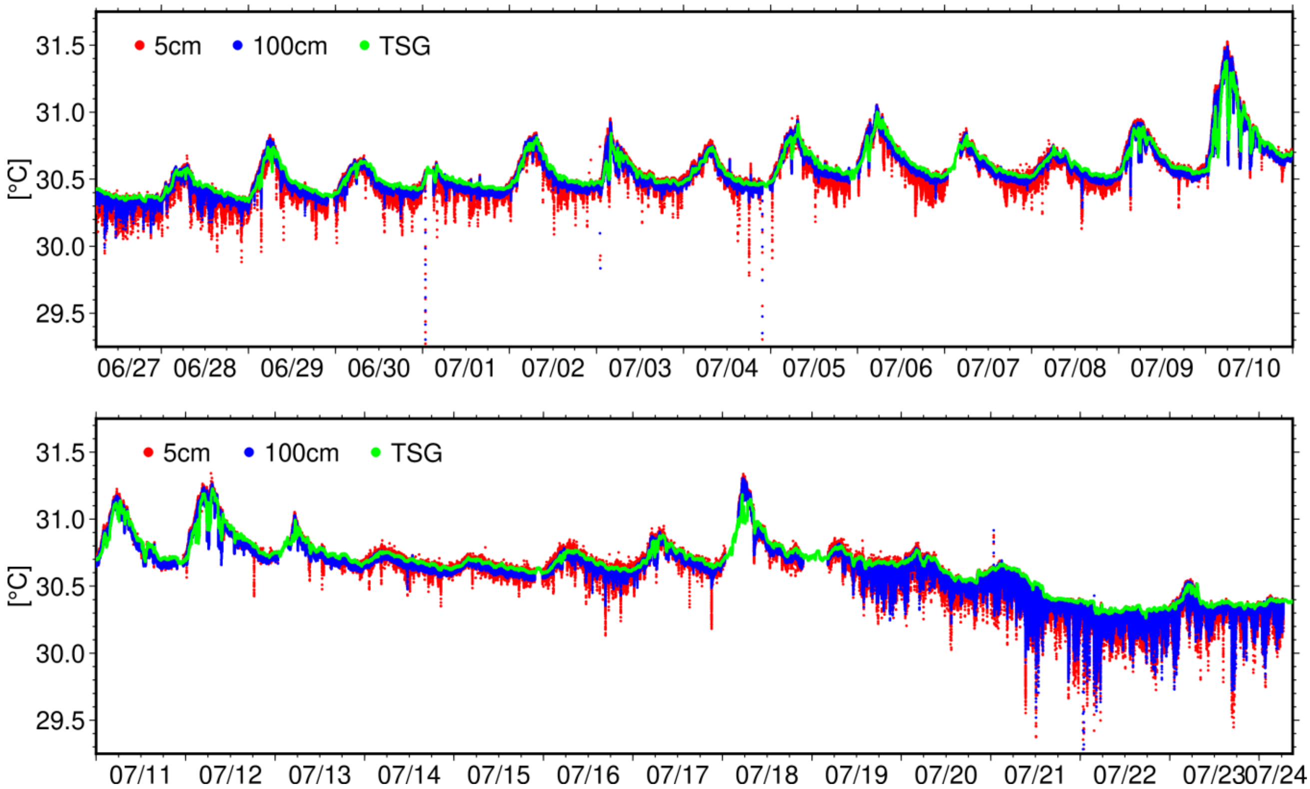


Fig. 5.5-2: Time series of Skin Sea Surface Temperature (SSST;5cm:Red 100cm:Blue) and Intake Sea Surface Temperature (TSG:Green).

5.6 Mie / Raman Lidar

(1) Personnel

Masaki KATSUMATA (JAMSTEC)

Kyoko TANIGUCHI (JAMSTEC) (not on board)

(2) Objective

The objective of this observation is to capture the vertical distribution of clouds, aerosols, and water vapor in high spatio-temporal resolution.

(3) Parameters

355nm Mie scattering signal

532nm Mie scattering signal

1064nm Mie scattering signal

387nm Raman nitrogen scattering signal (nighttime only)

408nm Raman water vapor scattering signal (nighttime only)

607nm Raman nitrogen scattering signal (nighttime only)

660nm Raman water vapor scattering signal (nighttime only)

(4) Instruments and methods

The Mirai Lidar system transmits a 10-Hz pulse laser in three wavelengths: 1064nm, 532nm, 355nm. For cloud and aerosol observation, the system detects Mie scattering at these wavelengths. The separate detections of polarization components at 532 nm and 355 nm obtain additional characteristics of the targets. The system also detects Raman water vapor signals at 660 nm and 408nm, Raman nitrogen signals at 607 nm and 387nm at nighttime. Based on the signal ratio of Raman water vapor to Raman nitrogen, the system offers water vapor mixing ratio profiles.

(5) Preliminary Results

The lidar system observed the lower atmosphere throughout the cruise (21 June to 29 July, 2024). All data will be reviewed after the cruise to maintain data quality.

(6) Data Archive

The obtained data will be submitted to the Data Management Group of JAMSTEC.

5.7 Water Vapor and Wind Coherent Lidar

(1) Personnel

Masaki KATSUMATA	(JAMSTEC)	
Tetsu SAKAI	(Meteorological Research Institute, Japan Meteorological Agency) (not on board)	
Satoru YOSHIDA	(MRI - JMA)	(not on board)
Tomohiro NAGAI	(MRI - JMA)	(not on board)
Takuya KAWABATA	(MRI - JMA)	(not on board)
Kenya YANO	(Mitsubishi Electric Co.)	(not on board)
Eisuke HARAGUCHI	(Mitsubishi Electric Co.)	(not on board)
Masaharu IMAKI	(Mitsubishi Electric Co.)	(not on board)

(2) Objective

To retrieve the vertical profile of the water vapor amount and horizontal / vertical wind for the lower troposphere.

(3) Method

The "ship-based water vapor and wind coherent lidar" used in this study is capable of retrieving the vertical profile of the water vapor amount by differential absorption between two wavelengths on and off the water vapor absorption band (which is generally called as the DIAL [DIfferential Absorption Lidar]), as well as the vertical profile of the wind by Doppler shift of the backscattered signal simultaneously.

The lidar was developed particularly for the ship-based observation, by referring to the original system as in Imaki et al. (2020) utilizing an eye-safe laser at 1.53 μm. The lidar for this study was installed inside the 10-feet sea container, which was settled at the stern of the upper deck. See Fig. 5.7-1 for the installation.

The system sequentially observes four directions with 90 degrees separations in azimuth (i.e. 0, 90, 180, 270 from a particular horizontal direction). A zenith angle of 11.5 degrees is set for all four directions. Combining wind speed along these four directions enables to retrieve the three-dimensional wind vector including horizontal and vertical wind. Note that all the angles are relative to the lidar system, to be required to correct ship motions in post-processing. The data of ship motions / attitudes were monitored and recorded separately for post-processing. The vertical profile of the water vapor is retrieved to integrate the data (from all four directions, or from particular direction(s)) for certain period.

During the cruise, observations at each direction were usually performed for 2 seconds followed by an interval of 0.5 seconds. The range resolution along each direction is set to 76.7 meters to set the vertical resolution of 75 meters with zenith angle of the four observation directions Observations were made continuously through the cruise, with some intermittent pauses by the experimental and technical reasons. Through the observation period, the window at the roof of the container to transmit the laser beam and receive the backscatter signal was cleaned by the blower beside to continuously blow / dry the water drops on the window, and by cleaning by hand once per day for the dirt by the sea salt etc.

The obtained data will be converted to the vertical profile of the horizontal wind vector and vertical wind speed, as well as to the vertical profile of the water vapor amount. The temporal resolutions of these parameters will be examined after the cruise to achieve the best combination of data quality and temporal resolution.

(4) Results

All datasets will be analyzed and examined after the cruise.

(5) Data archive

The data will be submitted to the JAMSTEC Data Management Group (DMG).

(6) Acknowledgment

Nippon Marine Enterprise Ltd. kindly supported the installation and operation. The observation was supported by the JSPS KAKENHI Grant 22H00250

Fig. 5.7-1: Photographs of the ship-based water vapor and wind coherent lidar system. (Left) The lidar system inside the sea container. (Right) Sea container with the lidar system (circled in red) at the stern of the R/V Mirai.

5.8 Disdrometers

(1) Personnel

Masaki KATSUMATA	(JAMSTEC)	- Principle Investigator
Shin-ichiro SHIMA	(Kobe Prefectural Univ.)	(not on board)
Akari WATANABE	(JAMSTEC / Univ. of Ryukyus)	
Keiichi HASHIMOTO	(Univ. of Tokyo)	

(2) Objectives

A disdrometer observes size and number of raindrops. The objective of this observation is (a) to reveal microphysical characteristics of the rainfall, depends on the type, temporal stage, etc. of the precipitating clouds, and (b) to verify the cloud microphysical information retrieved by radar-observed parameters (especially from the C-band weather radar in Section 5.3)

(3) Instrumentations and Methods

Principal instrument is the two-dimensional video disdrometer (2DVD) (manufactured by Joanneum Research). The 2DVD continuously make line-scan in the direction parallel to the ground from two orthogonal directions to obtain form of the precipitation particles and its falling velocity. The sampling area is 100 mm x 100 mm in the center of the 2DVD body.

The 2DVD was installed on the top (roof) of the anti-rolling system, as shown in Fig. 5.8-1. The windbreak net fence with 2.8 m x 2.8 m x 1.0 m was installed at the bow-starboard corner to surround the 2DVD, to reduce the effect of wind. The horizontal wind nearby the sampling area was continuously observed by the supersonic anemometer (CCP-ULP, Climatec). To ensure drop size distribution obtained by the 2DVD, two optical disdrometers (LPM, Adolf Thes GmbH & Co.; RainScope, Meisei Electric Co., Ltd.) were installed beside the 2DVD.

(4) Preliminary Results

The data have been obtained all through the cruise. An example is shown in Figs. 5.8-2 to 5.8-4. Each raindrop fall into the sampling area of the 2DVD was imaged, as in Fig. 5.8-2. The data can be integrated, for example, to obtain drop size distribution as in Fig. 5.8-3. The LPM also obtain the drop size distribution as in Fig. 5.8-4. Further analyses using the obtained data will be performed after the cruise.

(5) Data Archive

All data obtained during this cruise will be submitted to the JAMSTEC Data Management Group (DMG).

(6) Acknowledgment

The 2DVD was kindly provided by the Snow and Ice Research Center of the National Institute for Earth Science and Disaster Prevention (NIED). The installation, calibration and operation of the instruments were greatly supported by Hydrotech Co. Ltd. The observation was partly supported by JSPS KAKENHI 23H00149. The RainScope was kindly provided by Dr. Kenji Suzuki of Yamaguchi Univ. Installation and operation of the instruments were helped by Nippon Marine Enterprise Ltd.

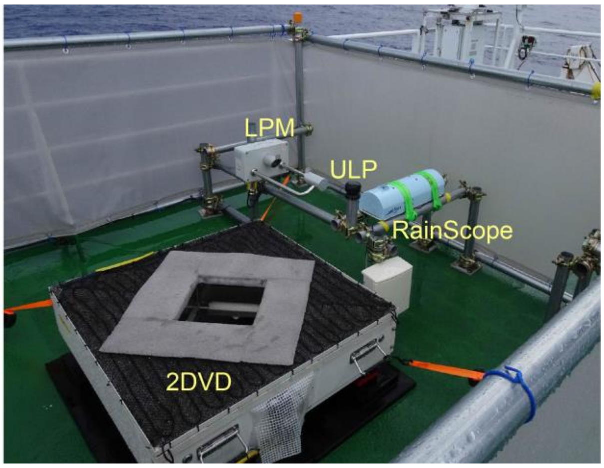


Fig. 5.8-1: Instruments used in this study.

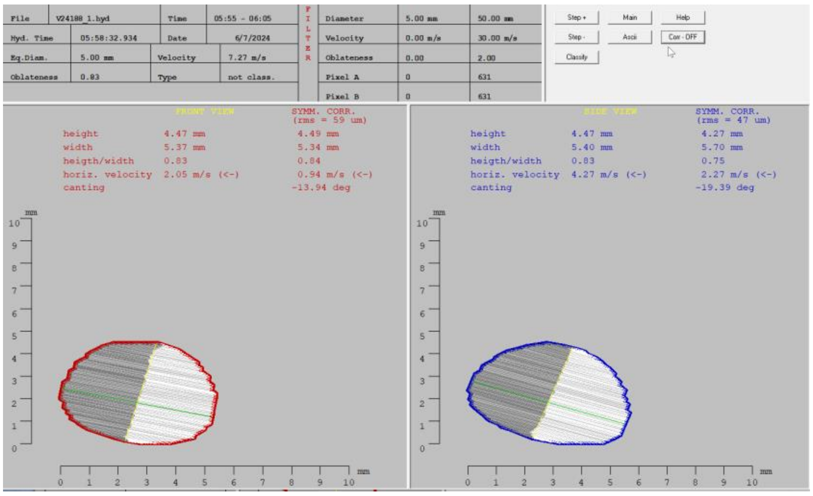


Fig. 5.8-2: A sample of the raindrop observed by the 2DVD. Form of the raindrop, captured by two cameras, are shown in the bottom, with the parameters obtained from the images.

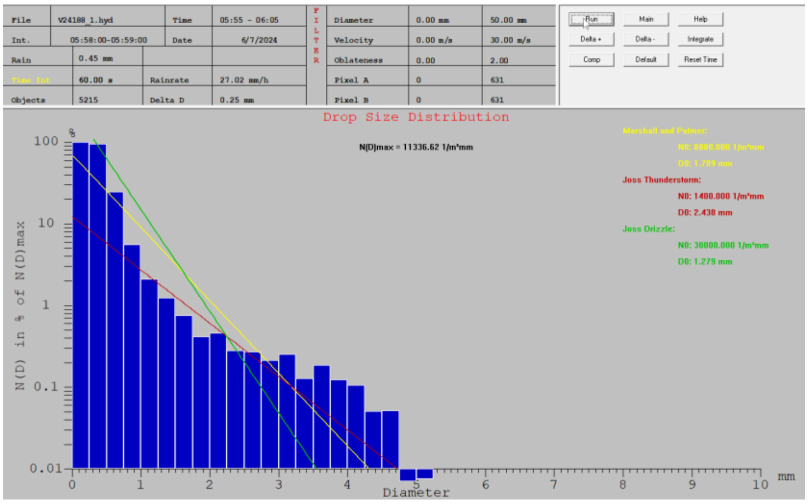


Fig. 5.8-3: A sample of the drop size distribution for a 1-minute period, retrieved by the 2DVD, by showing number of drops (ordinate) for each equivalent diameter bins (abscissa).

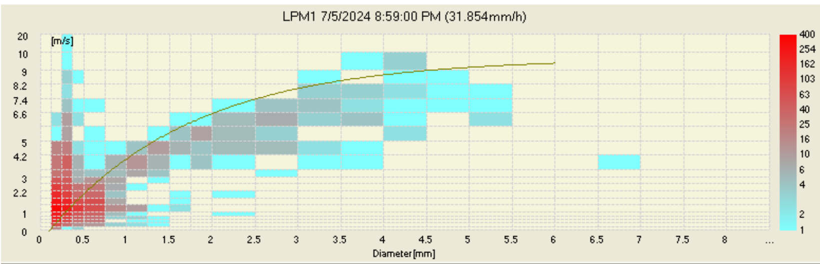


Fig. 5.8-4: A sample of the drop size distribution captured by the LPM, by showing frequency distribution of number of drops for each bin of diameter (abscissa) and fall speed (ordinate).

5.9 Micro Rain Radar

(1) Personnel

Masaki KATSUMATA (JAMSTEC) - Principle Investigator

(2) Objectives

The micro rain radar (MRR) is a compact vertically-pointing Doppler radar, to detect vertical profiles of rain drop size distribution. The objective of this observation is to understand detailed vertical structure of the precipitating systems.

(3) Instruments and Methods

The MRR-2 (METEK GmbH) was utilized. The specifications are in Table 5.9-1. The antenna unit was installed at the starboard side of the anti-rolling systems (see Fig. 5.9-1), and wired to the junction box and laptop PC inside the vessel.

The data was averaged and stored every one minute. The vertical profile of each parameter was obtained every 100 meters in range distance (i.e. height) up to 3100 meters. The recorded parameters were; Drop size distribution, radar reflectivity, path-integrated attenuation, rain rate, liquid water content and fall velocity..

Fig. 5.9-1: Photo of the antenna unit of MRR

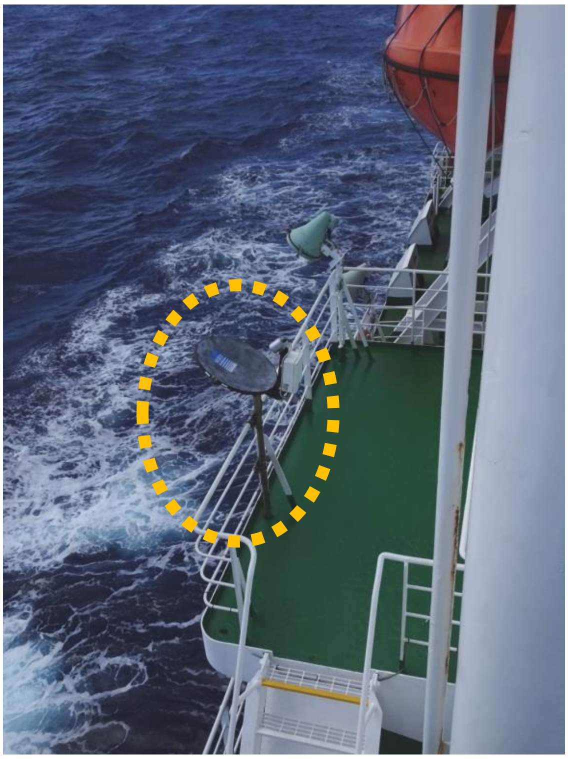


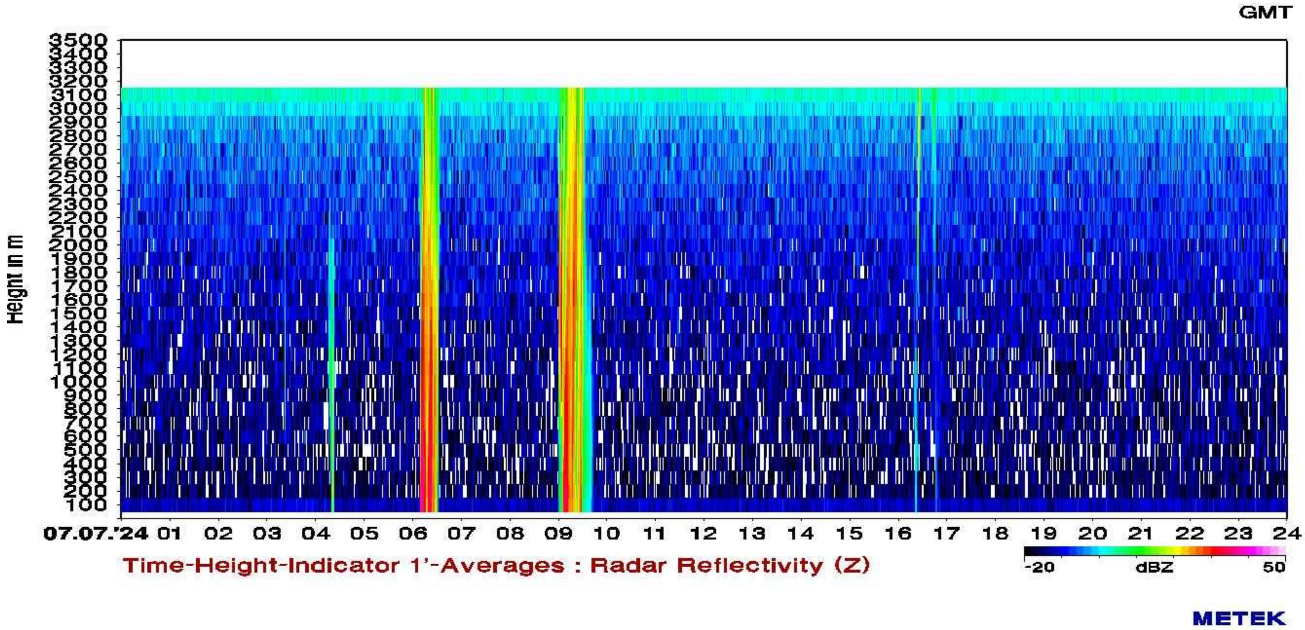
Table 5.9-1: Specifications of the MRR-2.

Transmitter power	50 mW
Operating mode	FM-CW
Frequency	24.230 GHz (modulation 1.5 to 15 MHz)
3dB beam width	1.5 degrees
Spurious emission	< -80 dBm / MHz
Antenna Diameter	600 mm
Gain	40.1 dBi

(4) Preliminary Results

The data have been obtained all through the cruise. A sample of the obtained data is Fig. 5.9-2, showing the time-height cross section of the radar reflectivity for a day (24 hours). An event of weak short rain (04Z), followed by two event of the strong tall rains (06Z and 09Z) and one event of weal tall rain (16Z) can be found in the example.

The further analyses will be after the cruise.



(5) Data Archive

All data obtained during this cruise will be submitted to the JAMSTEC Data Management Group (DMG).

5.10 Microwave Radiometer

(1) Personnel

Masaki KATSUMATA	(JAMSTEC)	
Akira KUWANO-YOSHIDA	(Kyoto Univ.)	(not on board)
Masahiro MINOWA	(Furuno Electric Co., Ltd.)	(not on board)

(2) Objective

To retrieve the total column integrated water vapor, and the vertical profiles of water vapor and temperature, in the atmosphere

(3) Method

Two microwave radiometers (hereafter MWR; manufactured by Furuno Electric Co., Ltd.) are used. The MWRs received natural microwave within the angle of 20 deg. from zenith. One of the MWRs for the water vapor observes at the frequencies around 22 GHz, to retrieve the column integrated water vapor (or precipitable water), and the vertical profile of the water vapor. The other MWR measures at the frequencies around 55 GHz to retrieve vertical profile of the air temperature. The observation was made approximately every 20 seconds except when periodic auto-calibration was on-going (once in several minutes). The rain sensor is equipped to identify the period of rainfall.

In addition to the MWRs, the whole sky camera was installed beside the MWR. This is to monitor cloud cover, which also affects the microwave signals. The camera obtained the whole-sky image every 2 minutes.

All instruments were installed at the top of the roof of aft wheelhouse, as in Fig. 5.10-1. The data were continuously obtained all through the cruise period.

(4) Results

The data have been obtained all through the cruise. The further analyses for the water vapor (column-integrated amount and vertical profile), the air temperature (vertical profile), etc., will be carried out after the cruise.

(5) Data archive

The data will be submitted to the JAMSTEC Data Management Group (DMG).

(6) Acknowledgment

The observation was supported by the JSPS KAKENHI Grant 23H00519.

Fig. 5.10-1: Outlook of the instruments installed at the roof of the aft wheelhouse; the microwave radiometer for the air temperature (right), microwave radiometer for the water vapor (middle), and the whole-sky camera (left).

5.11 Aerosol optical characteristics measured by ship-borne sky radiometer

(1) Personnel

Kazuma Aoki (University of Toyama) not onboard

Sky radiometer operation was supported by Nippon Marine Enterprises, Ltd.

(2) Objective

Objective of this observation is to study distribution and optical characteristics of marine aerosols by using a ship-borne sky radiometer (POM-01 MK-III: PREDE Co. Ltd., Japan). Furthermore, collections of the data for calibration and validation to the remote sensing data were performed simultaneously.

(3) Parameters

- Aerosol optical thickness at five wavelengths (400, 500, 675, 870 and 1020 nm)
- Ångström exponent
- Single scattering albedo at five wavelengths
- Size distribution of volume (0.01 μm – 20 μm)
- # GPS provides the position with longitude and latitude and heading direction of the vessel, and azimuth and elevation angle of the sun. Horizon sensor provides rolling and pitching angles.

(4) Instruments and Methods

The sky radiometer measures the direct solar irradiance and the solar aureole radiance distribution with seven interference filters (0.315, 0.4, 0.5, 0.675, 0.87, 0.94, and 1.02 μm). Analysis of these data was performed by SKYRAD.pack version 4.2 developed by Nakajima et al. 1996 and 2020.

(5) Data archives

Aerosol optical data are to be archived at University of Toyama (K.Aoki, SKYNET/SKY: http://skyrad.sci.u-toyama.ac.jp/) after the quality check and will be submitted to JAMSTEC.

References

Nakajima,T., G.Tonna, R.Rao, P.Boi, Y.Kaufman and B.Holben (1996) Use of sky brightness measurements from ground for remote sensing of particulate polydispersions, Appl. Opt., 35, 2672–2686, https://doi.org/10.1364/AO.35.002672.

Aoki. K., T.Takemura, K.Kawamoto, and T.Hayasaka (2013), Aerosol climatology over Japan site measured by ground-based sky radiometer, AIP Conf. Proc. 1531, 284-287 (2013); doi: 10.1063/1.4804762.

Nakajima,T., Campanelli,M., Che,H., Estellés,V., Irie,H., Kim,S.-W., Kim,J., Liu,D., Nishizawa,T., Pandithurai,G., Soni,V.K., Thana,B., Tugjsurn,N.-U., Aoki,K., Hashimoto,M., Higurashi,A., Kazadzis,S., Khatri,P., Kouremeti,N., Kudo,R., Marenco,F., Momoi,M., Ningombam,S. S., Ryder,C.L., and Uchiyama,A.(2020) An overview and issues of the sky radiometer technology and SKYNET, Atmos. Meas. Tech., 13, 4195–4218, 2020, https://doi.org/10.5194/amt-13-4195-2020.

5.12 Aerosol and gas observations

(1) Personnel

Fumikazu TAKETANI	(JAMSTEC)	- Principal Investigator	- not on board
Yugo KANAYA	(JAMSTEC)		- not on board
Hisahiro TAKASHIMA	(JAMSTEC/Fukuoka Univ.)		- not on board

Operation for all instruments was supported by Nippon Marine Enterprises, Ltd

(2) Objectives

To investigate roles of aerosols in the marine atmosphere in relation to climate change

To investigate processes of biogeochemical cycles between the atmosphere and the ocean.

(3) Methods

(3-1) CO and O_3 observations

Ambient air was continuously sampled on the compass deck and drawn through ~20-m-long Teflon tubes connected to a gas filter correlation CO analyzer (Model 48i-TLE, Thermo Fisher Scientific) and a UV photometric ozone analyzer (Model 205, 2B Tech), located in the Research Information Center. The data will be used for characterizing air mass origins.

(3-2) Aerosol extinction coefficient (AEC) and trace gases

Multi-Axis Differential Optical Absorption Spectroscopy (MAX-DOAS), a passive remote sensing technique measuring spectra of scattered visible and ultraviolet (UV) solar radiation, was used for atmospheric aerosol and gas profile measurements. MAXDOAS were installed at the deck above stabilizer of ship. Our MAX-DOAS instrument consists of two main parts: an outdoor telescope unit and an indoor spectrometer (Acton SP-2358 with Princeton Instruments PIXIS-400B), connected to each other by a 14-m bundle optical fiber cable. The line of sight was in the directions of the portside of the vessel and the scanned elevation angles were 1.5, 3, 5, 10, 20, 30, 90 degrees in the 30-min cycle. The roll motion of the ship was measured to autonomously compensate additional motion of the prism, employed for scanning the elevation angle. For the selected spectra recorded with elevation angles with good accuracy, DOAS spectral fitting was performed to quantify the slant column density (SCD) of NO_2 (and other gases) and O_4 (O_2-O_2, collision complex of oxygen) for each elevation angle. Then, the O_4 SCDs were converted to the aerosol optical depth (AOD) and the vertical profile of aerosol extinction coefficient (AEC) using an optimal estimation inversion method with a radiative transfer model. Using derived aerosol information, retrievals of the tropospheric vertical column/profile of NO_2, IO, and other gases were made.

(4) Data archive

These data obtained in this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via "Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)" in JAMSTEC web site. <http://www.godac.jamstec.go.jp/darwin/e>

(5) Acknowledgments

We thank the crew of the R/V Mirai, staff of Nippon Marine Enterprises, Ltd., and Dr. Satoru YOKOI for their support with observations throughout the cruise.

5.13 GNSS precipitable water

(1) Personnel

Mikiko FUJITA (JAMSTEC) (not on board)

(2) Objectives

Getting the GNSS satellite data to estimate the total column integrated water vapor content of the atmosphere.

(3) Instruments and Methods

The GNSS satellite data was archived to the receiver (Ublox F9P) with 5 sec intervals. The GNSS antenna (Hemisphere HEMA45) was set on the starboard near the meteorological observation room. The observations were carried out all through the cruise.

(4) Preliminary Results

We will calculate the total column integrated water vapor from observed GNSS satellite data after the cruise.

(5) Data Archive

Raw data is recorded as UBX format and stream data every 5 seconds. These raw datasets are available from Mikiko Fujita of JAMSTEC. Corrected data will be submitted to JAMSTEC Marine-Earth Data and Information Department and will be archived there.

5.14 Continuous monitoring of surface seawater

(1) Personnel

Satoru YOKOI	(JAMSTEC)	- Principal Investigator
Misato KUWAHARA	(MWJ)	-Operation Leader
Takuya IZUTSU	(MWJ)	

(2) Objective

Our purpose is to obtain temperature, salinity, dissolved oxygen, and fluorescence data continuously in near-sea surface water.

(3) Parameters

Temperature
Salinity
Dissolved oxygen
Fluorescence
Turbidity

(4) Instruments and Methods

The Continuous Sea Surface Water Monitoring System (Marine Works Japan Co. Ltd.) has four sensors and automatically measures temperature, salinity, dissolved oxygen, fluorescence, and turbidity in near-sea surface water every one minute. This system is located in the “sea surface monitoring laboratory” and connected to shipboard LAN-system. Measured data, time, and location of the ship were stored in a data management PC. Sea water was continuously pumped up to the laboratory from an intake placed at the approximately 4.5 m below the sea surface and flowed into the system through a vinyl-chloride pipe. The flow rate of the surface seawater was adjusted to 10 dm^3 min^{-1}.

a. Instruments

Software

SeaMoni Ver.1.2.0.0

Sensors

Specifications of the each sensor in this system are listed below.

Temperature and Conductivity sensor

Model:	SBE-45, SEA-BIRD ELECTRONICS, INC.
Serial number:	4557820-0319
Measurement range:	Temperature -5 ºC - +35 ºC
	Conductivity 0 S m^{-1} - 7 S m^{-1}
Initial accuracy:	Temperature 0.002 ºC
	Conductivity 0.0003 S m^{-1}
Typical stability (per month):	Temperature 0.0002 ºC
	Conductivity 0.0003 S m^{-1}
Resolution:	Temperature 0.0001 ºC
	Conductivity 0.00001 S m^{-1}

Bottom of ship thermometer

Model:	SBE 38, SEA-BIRD ELECTRONICS, INC.
Serial number:	38-1299
Measurement range:	-5 ºC - +35 ºC
Initial accuracy:	±0.001 ºC
Typical stability (per 6 month):	0.001 ºC
Resolution:	0.00025 ºC

Dissolved oxygen sensor

Model:	RINKO II, JFE ADVANTECH CO. LTD.
Serial number:	0035
Measuring range:	0 mg L^{-1} - 20 mg L^{-1}
Resolution:	0.001 mg L^{-1} - 0.004 mg L^{-1} (25 ºC)
Accuracy:	Saturation ± 2 % F.S. (non-linear) (1 atm, 25 ºC)

Fluorescence & Turbidity sensor

Model:	C3, TURNER DESIGNS
Serial number:	2300707
Measuring range:	Chlorophyll in vivo 0 μg L^{-1} – 500 μg L^{-1}
Minimum Detection Limit:	Chlorophyll in vivo 0.03 μg L^{-1}
Measuring range:	Turbidity 0 NTU - 1500 NTU

Minimum Detection Limit: Turbidity 0.05 NTU

(5) Observation log

Periods of measurement, maintenance, and problems during this cruise are listed in Table 5.14-1.

Table 5.14-1: Events list of the Sea surface water monitoring during MR24-04

System Date [UTC]	System Time [UTC]	Events	Remarks
2024/06/21	08:08	All the measurements started and data was available.	Start
2024/06/30	09:25 - 09:35	Filter Cleaning	
2024/07/11	09:24 - 09:41	Filter Cleaning	
2024/07/23	12:40 - 13:02	Filter Cleaning.	
2024/07/28	06:22	All the measurements stopped.	End

We took the surface water samples from this system once a day to compare sensor data with bottle data of salinity, dissolved oxygen, and chlorophyll a. The results are shown in fig. 5.14-2. All the salinity samples were analyzed by the Model 8400B "AUTOSAL" manufactured by Guildline Instruments Ltd. (see 5.19), and dissolve oxygen samples were analyzed by Winkler method (see 5.20), chlorophyll a were analyzed by 10-AU manufactured by Turner Designs. (see 5.21).

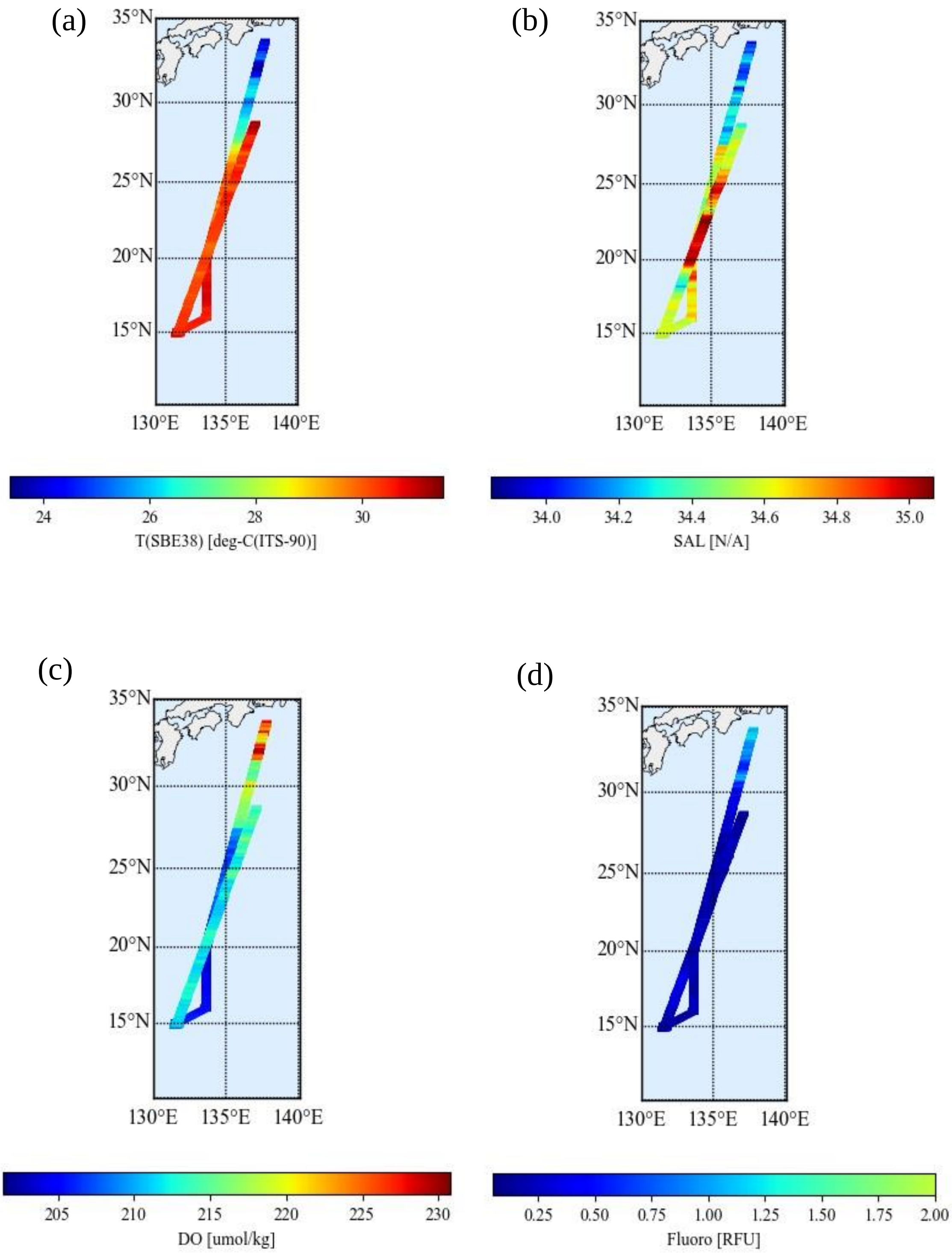


Figure 5.14-1: Spatial and temporal distribution of (a) temperature, (b) salinity, (c) dissolved oxygen, and (d) fluorescence in MR24-04 cruise.

(a)

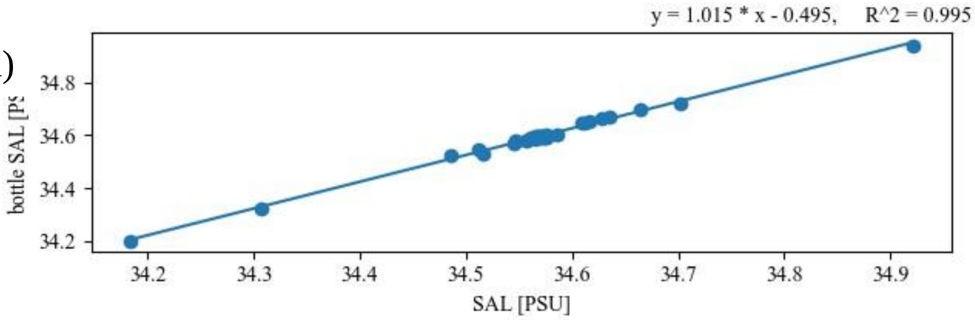


Figure 5.14-2-1: Correlation of salinity between sensor data and bottle data.

(b)

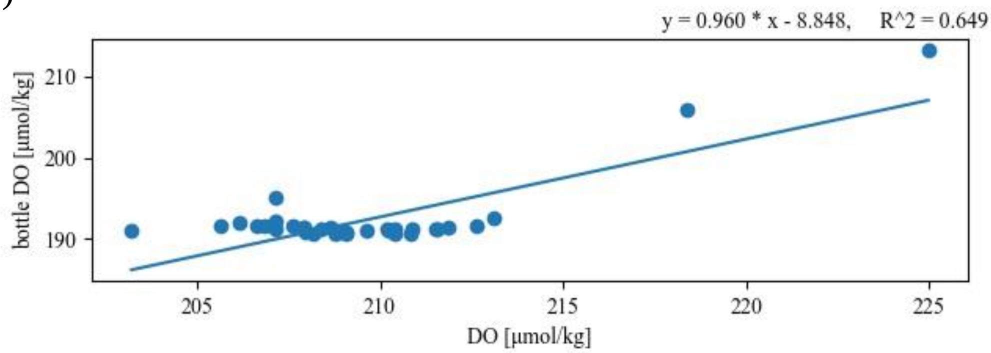


Figure 5.14-2-2: Correlation of dissolved oxygen between sensor data and bottle data.

(c)

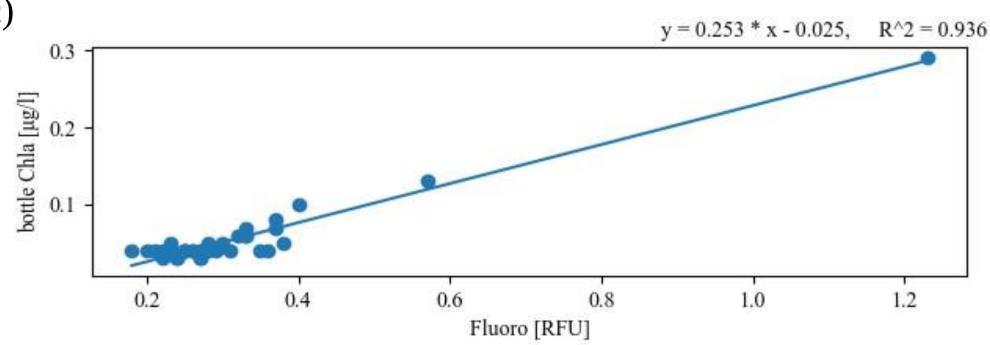


Figure 5.14-2-3: Correlation of fluorescence between sensor data and bottle data.

(6) Data archives

These data obtained in this cruise will be submitted to the Data Management

Group (DMG) of JAMSTEC, and will opened to the public via “Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)” in JAMSTEC web site.

<http://www.godac.jamstec.go.jp/darwin/e>

5.15 pCO_2

(1) Personnel

Satoru YOKOI	(JAMSTEC)	- Principal Investigator
Yasuhiro ARII	(MWJ)	- Operation Leader
Katsunori SAGISHIMA	(MWJ)	

(2) Objectives

In this cruise, we measured pCO_2 (partial pressure of CO_2) in the atmosphere and surface seawater continuously along cruise tracks in the Pacific in order to quantify how much CO_2 is absorbed in the region.

(3) Methods, Apparatus and Performance

Atmospheric and surface seawater pCO_2 were measured with a system having the off-axis integrated-cavity output spectroscopy gas analyzer (Off-Axis ICOS; 911-0011, Los Gatos Research). Standard gases were measured every about 6 hours, and atmospheric air taken from the bow of the ship (approx.13 m above the sea level) were measured every about 3 hours. Seawater was taken from an intake placed at the approximately 4.5 m below the sea surface and introduced into the equilibrator at the flow rate of (4 - 5) L min^{-1} by a pump. The equilibrated air was circulated in a closed loop by a pump at flowrate of (0.2 - 0.4) L min^{-1} through two electric cooling units, a stirring cooler, and the Off-Axis ICOS.

(4) Preliminary result

Cruise track during pCO_2 observation is shown in figure 5.15-1. Distributions of atmospheric and surface seawater CO_2 were shown in Figure 5.15-2, along with those of sea surface temperature (SST).

(5) Problems

During the observation, we were unable to maintain a constant pressure within the Off-Axis ICOS cell. Therefore, there may be an issue with the CO_2 concentration.

(5) Data archive

These data obtained in this cruise will be submitted to the Data Management Group of JAMSTEC, and will be opened to the public via “Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)” in JAMSTEC web site.

<http://www.godac.jamstec.go.jp/darwin/e>

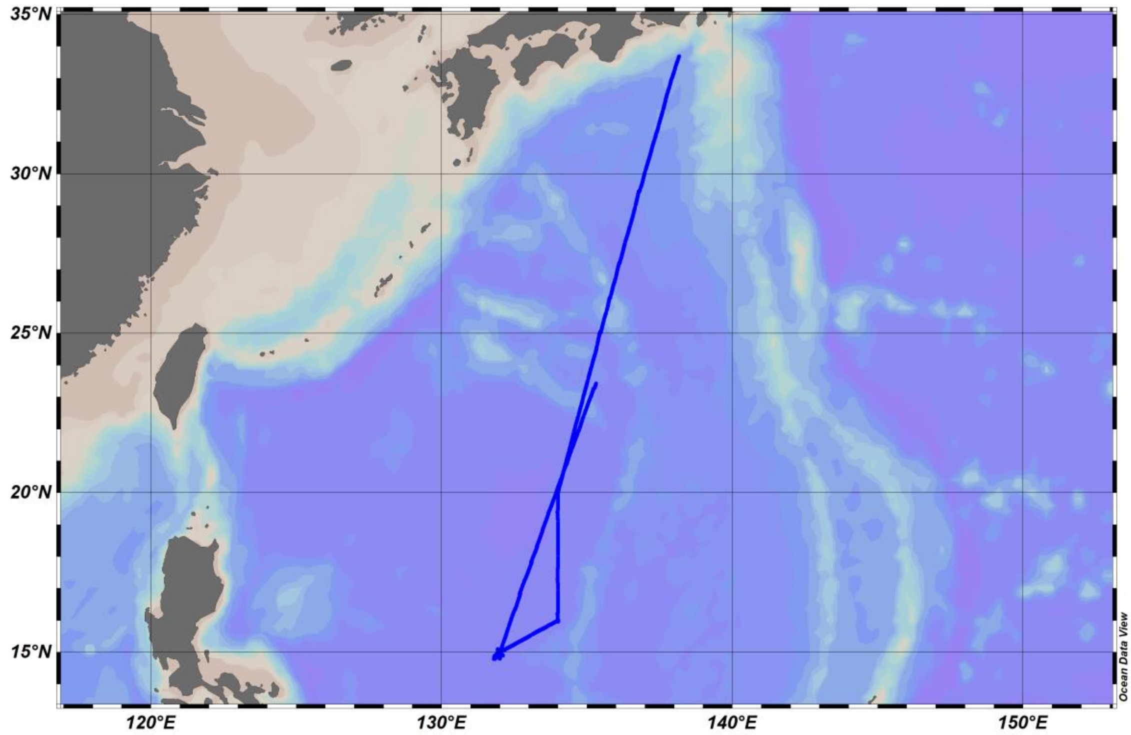


Figure 5.15-1: Observation map

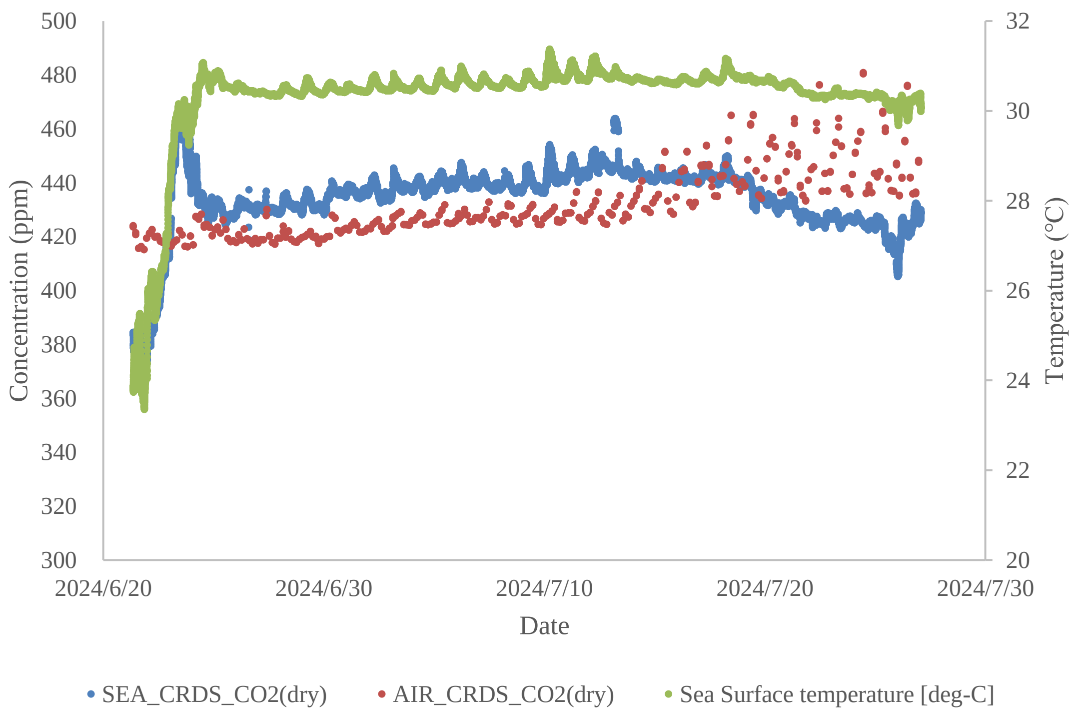


Figure 5.15-2: Distributions of atmospheric and surface seawater CO_2 along the observation line as a function of time.

5.16 CTD profiling

(1) Personnel

Satoru YOKOI (JAMSTEC) (Principal Investigator)

Aine YODA (MWJ) (Operation Leader)

Hiroyuki NAKAJIMA (MWJ)

Nobuhiro FUJII (MWJ)

Yuki MIYAJIMA (MWJ)

Tomoki NAKAMURA (MWJ)

Kengo FUJITA (MWJ)

(2) Objective

The CTD/water sampling measurements were conducted to obtain vertical profiles of seawater properties by sensors and water sampling.

(3) Instruments and method

Instruments used in this cruise are as follows:

Winch and cable

Traction winch system (3.0 ton) (Dynacon, Inc., Bryan, Texas, USA)

Armored cable (φ = 9.53 mm)

Compact underwater slip ring swivel

Frame

592 kg stainless steel frame for 36-position 12-L water sample bottles

Aluminum rectangular fin (54 × 90 cm) to resist frame's rotation

Water sampler and sampling bottle

36-position carousel water sampler, SBE 32 (Sea-Bird Scientific, Washington, USA)

Serial no. 3254451-0826

12-L sample bottle, model OTE 110 (OceanTest Equipment, Inc., Fort Lauderdale, Florida, USA)

(No TEFLON coating, with Nitoril O-rings)

Deck unit

SBE11plus (Sea-Bird Scientific, Washington, USA)

Serial no. 11P54451-0872

Underwater unit

Pressure sensor, SBE 9plus (Sea-Bird Scientific, Washington, USA)

Serial no. 09P21746-0575 (79492) (calibration date: June 7, 2022)

Temperature sensor, SBE 03Plus (Sea-Bird Scientific, Washington, USA)

Primary, Serial no. 031524 (calibration date: February 14, 2024)

Secondary, Serial no. 03P2453 (calibration date: September 16, 2023)

Conductivity sensor, SBE 04C (Sea-Bird Scientific, Washington, USA)

Primary, Serial no. 042435 (calibration date: February 1, 2024)

Secondary, Serial no. 043063 (calibration date: September 13, 2023)

Dissolved oxygen sensor, RINKO III (JFE Advantech Co., Ltd., Hyogo, Japan)

Serial no. 0278 (calibration date: May 22, 2024)

Dissolved oxygen sensor, SBE 43 (Sea-Bird Scientific, Washington, USA)

Primary, Serial no. 432036 (calibration date: November 16, 2023)

Secondary, Serial no. 430205 (calibration date: September 2, 2023)

(Casts Used: C01M001, STNM001~STNM125)

Secondary, Serial no. 430949 (calibration date: December 16, 2023)

(Casts Used: STNM001~STNM126)

Chlorophyll fluorometer (Seapoint Sensors Inc., New Hampshire, USA)

Serial no. 3701, Gain: 30X (0-15 ug/L)

PAR sensor, PAR-Log ICSW (Sea-Bird Scientific, Washington, USA)

Serial no. 2180 (calibration date: September 14, 2021)

Pump, SBE 5T (Sea-Bird Scientific, Washington, USA)

Primary, Serial no. 054595

Secondary, Serial no. 053293

Software

Data acquisition software, SEASAVE-Win32, version 7.26.7.121

Data processing software, SBEDataProcessing-Win32, version 7.26.7.129 and some original modules

(4) Data Collection and processing

(4.1) Data collection

The CTD system was powered on at least 15 minutes in advance of the data acquisition to stabilize the pressure sensor. The data was acquired at least two minutes before and after the CTD cast to collect atmospheric pressure data on the ship's deck.

The CTD package was lowered into the water from the starboard side and held 10 m beneath the surface to activate the pump. After the pump was activated, the package was lifted to the surface and lowered at a rate of 1.0 m/s to 200 m (or 300m when significant wave height was high) then the package was stopped to operate the heave compensator of the crane. The package was lowered again and at 1.0m/s to the bottom. The bottle was fired after waiting from the stop for 60 seconds to enhance changing the water between inside and outside of the bottle. At 200m (or 300m) from the surface, the package was stopped to stop the heave compensator of the crane.

Date, time and locations of the CTD casts are listed in Table 5.16-1. The time series contours of secondary temperature, salinity, dissolved oxygen, fluorescence and photosynthetically active radiation with pressure are shown in Figure. 5.16-1. Vertical profile (down cast) of secondary temperature, salinity and dissolved oxygen with pressure are shown in the appendix.

(4.2) Data collection problems

At cast STNM005, just after CTD package was brought back on deck, data acquisition was lost. On the same time, deck unit's fuse was found to be melted. After CTD package was stored, seacable was re-terminated.

At cast STNM015, during upcast at 475m, CTD data acquisition was lost. This time, deck unit's fuse was not melted. The cast was aborted and CTD package was brought back to deck. After CTD package was stored, seacable was re-terminated.

Just after the observation started, there was a slight difference between primary(S/N: 042435) and secondary(S/N: 043063) conductivity sensor. By comparing the data with the bottle analysis salinity measured by using AUTOSAL, the secondary conductivity sensor was found to be closer to the bottle data.

Just after the observation started, there was a slight difference between primary(S/N: 432036) and secondary(S/N: 430205) dissolved oxygen sensor. By comparing the data with the bottle data from the dissolved oxygen analyzer, secondary sensor had a difference of 20 μmol/L.

Just after the observation started, primary dissolved oxygen sensor (S/N 432036) seemed to have bigger amplitude when compared to secondary dissolved oxygen sensor (S/N 430205). Before cast STNM126, secondary sensor (S/N 430205) was changed to another sensor (S/N 430949). When comparing primary sensor with changed secondary sensor, primary sensor's amplitude of the voltage value was not as big to determine as a malfunction of the sensor. However, from after cast STNM150, the primary sensor's amplitude of the voltage value increased, and primary sensor was determined as malfunction.

More detailed information about the irregularities in data (noise, spike or shift, etc.) is recorded in remarks sheet included in data submission.

The definitions of these irregularities are as follows:

(1) noise: not singly but continuously detected outliers.

(2) spike: one-off outlier which is detected after data processing and is oceanographically impossible.

(3) shift: continuous data trend which is deviated from accurate ones.

(4.3) Data Processing

The following are the data processing software (SBEDataProcessing-Win32) and original software data processing module sequence and specifications used in reduction of CTD data in this cruise.
(The process in order)

DATCNV converted the raw data to engineering unit data. DATCNV also extracts bottle information where scans were marked with the bottle confirm bit during acquisition. The scan duration to be included in bottle file was set to 3.0 seconds, and the offset was set to 0.0 seconds. The hysteresis correction for the SBE 43 data (voltage) was applied for both profile and bottle information data.

TCORP (original module, version 1.1) corrected the pressure sensitivity of the temperature (SBE3) sensor for both profile and bottle information data.

RINKOCOR (original module, 1.0) corrected the time-dependent, pressure-induced effect (hysteresis) of the RINKOIII profile data.

RINKOCORROS (original module) corrected the time-dependent, pressure-induced effect (hysteresis) of the RINKOIII bottle information data by using the hysteresis-corrected profile data.

BOTTLESUM created a summary of the bottle data. The data were averaged over 4.4 seconds.

ALIGNCTD converted the time-sequence of sensor outputs into the pressure sequence to ensure that all calculations were made using measurements from the same parcel of water. For a SBE 9plus CTD with the ducted temperature and conductivity sensors and a 3000-rpm pump, the typical net advance of the conductivity relative to the temperature is 0.073 seconds. So, the SBE 11plus deck unit was set to advance the primary and the secondary conductivity for 1.73 scans (1.75/24 = 0.073 seconds). Oxygen data are also systematically delayed with respect to depth mainly because of the long time constant of the oxygen sensor and of an additional delay from the transit time of water in the pumped plumbing line. For primary sensor of SBE43, there was no delay so it was not compensated. Secondary sensor of SBE43 was changed during the observation, so the first sensor was compensated by 2 seconds and the second sensor was compensated by 4 seconds advancing the SBE 43 oxygen sensor output (voltage) relative to the temperature data. Delay of the RINKOIII data was also compensated by 1 second advancing sensor output (voltage) relative to the temperature data.

WILDEDIT marked extreme outliers in the data files. The first pass of WILDEDIT obtained the accurate estimate of the true standard deviation of the data. The data were read in blocks of 1000 scans. Data greater than 10 standard deviations were flagged. The second pass computed a standard deviation over the same 1000 scans excluding the flagged values. Values greater than 20 standard deviations were marked bad. This process was applied to pressure, depth, temperature, conductivity, and SBE 43 output.

CELLTM used a recursive filter to remove conductivity cell thermal mass effects from the measured conductivity. Typical values for SBE 9plus with TC duct and 3000 rpm pump which were 0.03 for thermal anomaly amplitude alpha and 7.0 for the time constant 1/beta were used.

FILTER performed a low-pass filter on pressure and depth with a time constant of 0.15 second. In order to produce zero phase lag (no time shift) the filter runs forward first then backward.

WFILTER performed as a median filter to remove spikes in fluorometer data. A median value was determined by 49 scans of the window.

SECTIONU (original module, version 1.1) selected a time span of data based on scan number in order to reduce a file size. The minimum number was set to be the starting time when the CTD package was beneath the sea-surface after activation of the pump. The maximum number was set to be the end time when the depth of the package was 1 dbar below the surface. The minimum and maximum numbers were automatically calculated in the module.

LOOPEDIT marked scans where the CTD was moving less than the minimum velocity of 0.0 m/s (traveling backwards due to ship roll).

DESPIKE (original module, version 1.0) removed spikes of the data. A median and mean absolute deviation was calculated in 1-dbar pressure bins for both down and up cast, excluding the flagged values. Values greater than 4 mean absolute deviations from the median were marked bad for each bin. This process was performed twice for temperature, conductivity and RINKOIII output.

DERIVE was used to compute dissolved oxygen (SBE43), salinity, potential temperature, and sigma-theta.

BINAVG averaged the data into 1-decibar pressure bins and 1-sec time bins. The center value of the first bin was set equal to the bin size. The bin minimum and maximum values are the center values plus and minus half the bin size. Scans with pressures greater than the minimum and less than or equal to the maximum were averaged. Scans were interpolated so that a data recorded exist every dbar.

BOTTOMCUT (original module, version 0.1) deleted the deepest pressure bin when the averaged scan number of the deepest bin was smaller than the average scan number of the bin just above.

SPLIT was used to split data into down cast and up cast.

(5) Data archive

These data obtained in this cruise will be submitted to the Data Management Group of JAMSTEC, and will be opened to the public via "Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)" in JAMSTEC web site.

Table 5.16-1 MR24-04 CTD cast table

Stnnbr	Castno	Date(UTC)	Time(UTC)		BottomPosition		Depth	Wire	HT Above	Max	Max	CTD	Remark
		(mmddyy)	Start	End	Latitude	Longitude	(m)	Out (m)	Bottom (m)	Depth	Pressure	Filename	
C01	001	062524	21:28	22:13	16-00.16N	133-59.87E	5229.0	1000.2	-	1001.6	1010.0	C01M001	
STN	001	062724	06:24	06:47	15-01.01N	132-00.52E	6122.0	497.2	-	501.4	505.0	STNM001	
STN	002	062724	15:20	15:43	14-59.60N	132-01.41E	5419.0	498.7	-	500.4	504.0	STNM002	
STN	003	062724	18:21	18:43	15-00.14N	132-00.53E	6080.0	501.1	-	503.4	507.0	STNM003	
STN	004	062724	21:20	21:43	15-00.46N	131-59.82E	6122.0	497.8	-	500.4	504.0	STNM004	
STN	005	062824	00:20	00:43	14-59.14N	131-59.87E	5597.0	499.8	-	500.4	504.0	STNM005	
STN	006	062824	06:28	06:50	15-00.32N	131-59.83E	6113.0	496.9	-	500.4	504.0	STNM006	
STN	007	062824	09:19	09:43	15-00.69N	132-00.03E	6124.0	498.9	-	502.4	506.0	STNM007	
STN	008	062824	12:18	13:21	15-00.51N	132-00.69E	6113.0	1004.4	-	1000.7	1009.0	STNM008	
STN	009	062824	15:19	15:42	15-00.09N	132-01.04E	5783.0	499.8	-	501.4	505.0	STNM009	
STN	010	062824	18:18	18:41	15-00.96N	131-59.90E	6127.0	498.0	-	500.4	504.0	STNM010	
STN	011	062824	21:17	21:39	14-59.97N	132-00.66E	5916.0	499.4	-	502.4	506.0	STNM011	
STN	012	062924	00:22	00:44	14-58.92N	131-59.92E	5763.0	497.8	-	501.4	505.0	STNM012	
STN	013	062924	03:18	03:40	15-00.36N	131-59.99E	6115.0	499.8	-	502.4	506.0	STNM013	
STN	014	062924	06:19	07:45	14-59.89N	131-59.91E	6049.0	500.2	-	502.4	506.0	STNM014	
STN	015	062924	09:20	09:30	14-59.27N	131-59.80E	5550.0	497.4	-	500.4	504.0	STNM015	
STN	016	062924	12:23	13:19	15-01.00N	132-00.44E	6121.0	1000.0	-	1000.7	1009.0	STNM016	
STN	017	062924	15:17	15:39	14-58.60N	132-00.51E	5807.0	501.3	-	503.4	507.0	STNM017	
STN	018	062924	18:16	18:38	14-59.51N	132-00.59E	5492.0	501.5	-	503.4	507.0	STNM018	
STN	019	062924	21:15	21:37	14-59.34N	132-00.22E	5492.0	498.7	-	500.4	504.0	STNM019	
STN	020	063024	00:19	00:40	14-59.45N	131-59.17E	5576.0	498.3	-	501.4	505.0	STNM020	
STN	021	063024	03:20	03:42	15-01.37N	131-59.29E	6120.0	498.9	-	500.4	504.0	STNM021	
STN	022	063024	06:20	06:42	15-00.22N	131-59.29E	6116.0	497.2	-	500.4	504.0	STNM022	
STN	023	063024	09:17	09:39	14-59.73N	131-59.64E	5908.0	499.1	-	501.4	505.0	STNM023	
STN	024	063024	12:18	13:16	14-59.75N	132-00.12E	5850.0	1000.0	-	1000.7	1009.0	STNM024	
STN	025	063024	15:16	15:38	14-59.81N	132-01.25E	5484.0	500.4	-	500.4	504.0	STNM025	
STN	026	063024	18:15	18:37	14-59.09N	132-01.21E	5684.0	499.3	-	501.4	505.0	STNM026	
STN	027	063024	21:14	21:36	14-59.36N	132-01.21E	5513.0	500.4	-	503.4	507.0	STNM027	
STN	028	070124	00:18	00:39	15-00.72N	132-00.18E	6124.0	501.3	-	502.4	506.0	STNM028	
STN	029	070124	03:18	03:40	15-01.71N	131-59.35E	6108.0	499.6	-	500.4	504.0	STNM029	
STN	030	070124	06:16	06:37	15-00.34N	131-58.95E	6113.0	498.5	-	501.4	505.0	STNM030	
STN	031	070124	09:17	09:39	14-59.18N	132-00.37E	5635.0	499.1	-	501.4	505.0	STNM031	
STN	032	070124	12:17	13:20	14-59.91N	132-00.38E	5988.0	1000.6	-	1000.7	1009.0	STNM032	
STN	033	070124	15:18	15:39	14-59.85N	132-01.45E	5528.0	501.7	-	500.4	504.0	STNM033	
STN	034	070124	18:17	18:39	15-00.57N	132-01.08E	6106.0	497.4	-	500.4	504.0	STNM034	
STN	035	070124	21:16	21:38	14-59.60N	132-00.76E	5446.0	499.3	-	502.4	506.0	STNM035	

STN	036	070224	00:17	00:39	15-00.36N	132-00.38E	6115.0	497.4	-	500.4	504.0	STNM036	
STN	037	070224	03:16	03:38	15-01.37N	132-00.19E	6138.0	498.5	-	500.4	504.0	STNM037	
STN	038	070224	06:18	06:39	15-00.50N	131-59.94E	6123.0	498.5	-	500.4	504.0	STNM038	
STN	039	070224	09:16	09:38	14-59.99N	132-00.22E	6078.0	497.1	-	500.4	504.0	STNM039	
STN	040	070224	12:16	13:14	14-59.94N	131-59.79E	6088.0	999.6	-	1000.7	1009.0	STNM040	
STN	041	070224	15:16	15:37	14-59.62N	131-59.27E	5675.0	500.2	-	503.4	507.0	STNM041	
STN	042	070224	18:14	18:35	15-00.12N	131-59.48E	6115.0	499.6	-	501.4	505.0	STNM042	
STN	043	070224	21:14	21:37	14-59.85N	131-59.85E	6019.0	498.3	-	500.4	504.0	STNM043	
STN	044	070324	00:16	00:37	15-00.16N	132-00.14E	6118.0	498.9	-	501.4	505.0	STNM044	
STN	045	070324	03:17	03:39	15-00.76N	132-00.28E	6122.0	500.7	-	503.4	507.0	STNM045	
STN	046	070324	06:15	06:36	15-00.78N	132-00.11E	6128.0	499.6	-	500.4	504.0	STNM046	
STN	047	070324	09:15	09:37	14-59.44N	131-59.90E	5538.0	497.6	-	500.4	504.0	STNM047	
STN	048	070324	12:15	13:15	15-00.69N	131-59.44E	6134.0	1001.1	-	1000.7	1009.0	STNM048	
STN	049	070324	15:16	15:37	14-59.92N	131-59.72E	6037.0	498.9	-	501.4	505.0	STNM049	
STN	050	070324	18:14	18:34	14-59.63N	131-59.51E	5768.0	498.3	-	500.4	504.0	STNM050	
STN	051	070324	21:14	21:36	14-59.87N	131-59.90E	6015.0	498.0	-	501.4	505.0	STNM051	
STN	052	070424	00:16	00:38	15-00.97N	132-00.49E	6120.0	499.6	-	500.4	504.0	STNM052	
STN	053	070424	03:16	03:37	14-59.81N	132-00.11E	5913.0	498.7	-	500.4	504.0	STNM053	
STN	054	070424	06:16	06:37	14-59.16N	132-00.11E	5587.0	497.4	-	500.4	504.0	STNM054	
STN	055	070424	09:15	09:36	14-59.89N	131-59.83E	6039.0	496.1	-	500.4	504.0	STNM055	
STN	056	070424	12:15	13:13	15-00.25N	131-59.65E	6113.0	1000.0	-	1000.7	1009.0	STNM056	
STN	057	070424	15:16	15:37	15-00.10N	131-59.42E	6119.0	499.1	-	500.4	504.0	STNM057	
STN	058	070424	18:13	18:34	15-00.59N	132-00.34E	6120.0	500.9	-	501.4	505.0	STNM058	
STN	059	070424	21:14	21:36	14-58.85N	131-59.64E	5897.0	499.4	-	501.4	505.0	STNM059	
STN	060	070524	00:15	00:37	14-58.77N	131-59.29E	5966.0	498.2	-	502.4	506.0	STNM060	
STN	061	070524	03:15	03:36	15-00.41N	132-00.04E	6121.0	498.2	-	500.4	504.0	STNM061	
STN	062	070524	06:14	06:35	15-00.13N	132-00.33E	6107.0	498.5	-	500.4	504.0	STNM062	
STN	063	070524	09:16	09:38	14-59.71N	132-00.02E	5848.0	497.8	-	500.4	504.0	STNM063	
STN	064	070524	12:14	13:12	15-01.11N	132-00.18E	6135.0	1001.8	-	1001.7	1010.0	STNM064	
STN	065	070524	15:17	15:38	15-00.21N	132-00.34E	6110.0	499.8	-	500.4	504.0	STNM065	
STN	066	070524	18:14	18:36	14-59.81N	132-00.60E	5773.0	501.8	-	501.4	505.0	STNM066	
STN	067	070524	21:15	21:37	14-59.58N	132-00.38E	5600.0	500.2	-	500.4	504.0	STNM067	
STN	068	070624	00:16	00:37	14-58.57N	132-00.02E	5892.0	500.4	-	500.4	504.0	STNM068	
STN	069	070624	03:16	03:37	14-59.76N	132-00.23E	5875.0	499.4	-	502.4	506.0	STNM069	
STN	070	070624	06:14	06:35	14-58.82N	132-00.62E	5784.0	498.9	-	503.4	507.0	STNM070	
STN	071	070624	09:14	09:36	15-00.24N	132-00.24E	6117.0	502.9	-	500.4	504.0	STNM071	
STN	072	070624	12:15	13:12	14-59.86N	132-00.25E	5981.0	999.8	-	1000.7	1009.0	STNM072	
STN	073	070624	15:14	15:36	14-59.25N	132-00.51E	5614.0	499.6	-	502.4	506.0	STNM073	
STN	074	070624	18:13	18:34	15-00.58N	131-59.94E	6126.0	498.2	-	500.4	504.0	STNM074	
STN	075	070624	21:15	21:36	14-59.85N	132-00.09E	5968.0	498.9	-	502.4	506.0	STNM075	
STN	076	070724	00:17	00:38	14-58.75N	131-59.26E	5957.0	499.3	-	500.4	504.0	STNM076	
STN	077	070724	06:16	06:37	14-59.79N	131-59.18E	5894.0	500.9	-	502.4	506.0	STNM077	
STN	078	070724	09:14	09:35	14-59.89N	131-59.78E	6046.0	498.9	-	500.4	504.0	STNM078	
STN	079	070724	12:15	13:14	15-00.33N	132-00.09E	6119.0	1000.2	-	1000.7	1009.0	STNM079	
STN	080	070724	15:16	15:37	14-59.43N	131-59.44E	5588.0	499.4	-	500.4	504.0	STNM080	
STN	081	070724	18:14	18:35	15-00.17N	131-59.41E	6123.0	499.3	-	501.4	505.0	STNM081	
STN	082	070724	21:15	21:37	15-00.06N	132-00.04E	6103.0	499.8	-	500.4	504.0	STNM082	
STN	083	070824	00:16	00:38	14-59.99N	131-59.77E	6110.0	496.9	-	500.4	504.0	STNM083	
STN	084	070824	03:14	03:34	15-00.81N	131-58.97E	6125.0	498.7	-	502.4	506.0	STNM084	
STN	085	070824	06:14	06:35	14-59.75N	131-59.67E	5878.0	500.0	-	503.4	507.0	STNM085	
STN	086	070824	09:14	09:35	15-00.00N	132-00.00E	6097.0	499.4	-	501.4	505.0	STNM086	
STN	087	070824	12:15	13:13	15-00.32N	131-59.90E	6112.0	1000.4	-	1000.7	1009.0	STNM087	
STN	088	070824	15:14	15:35	14-59.47N	131-59.28E	5608.0	499.8	-	503.4	507.0	STNM088	
STN	089	070824	18:14	18:35	14-59.80N	131-59.82E	5926.0	500.6	-	502.4	506.0	STNM089	
STN	090	070824	21:13	21:35	15-00.03N	132-00.04E	6107.0	499.4	-	501.4	505.0	STNM090	
STN	091	070924	00:16	00:37	15-00.14N	132-00.04E	6113.0	499.1	-	500.4	504.0	STNM091	
STN	092	070924	03:14	03:34	14-59.37N	132-00.38E	5506.0	498.2	-	502.4	506.0	STNM092	
STN	093	070924	06:16	06:37	15-00.18N	132-00.07E	6118.0	500.9	-	503.4	507.0	STNM093	
STN	094	070924	09:14	09:35	15-00.00N	131-59.99E	6090.0	499.3	-	500.4	504.0	STNM094	
STN	095	070924	12:14	13:12	15-00.08N	132-00.14E	6111.0	1000.9	-	1001.7	1010.0	STNM095	
STN	096	070924	15:16	15:37	14-59.28N	131-59.27E	5755.0	500.0	-	503.4	507.0	STNM096	
STN	097	070924	18:14	18:34	15-00.32N	131-59.85E	6121.0	498.3	-	501.4	505.0	STNM097	
STN	098	070924	21:14	21:36	15-00.02N	131-59.99E	6102.0	499.4	-	501.4	505.0	STNM098	
STN	099	071024	00:16	00:39	15-00.05N	132-00.27E	6095.0	502.2	-	504.4	508.0	STNM099	
STN	100	071024	03:13	03:34	15-00.36N	132-00.29E	6116.0	499.1	-	502.4	506.0	STNM100	
STN	101	071024	06:15	06:36	15-00.01N	132-00.66E	5993.0	501.7	-	503.4	507.0	STNM101	
STN	102	071024	09:14	09:36	15-00.04N	132-00.46E	6065.0	499.1	-	501.4	505.0	STNM102	
STN	103	071024	12:14	13:12	14-59.97N	132-00.01E	6077.0	1000.7	-	1000.7	1009.0	STNM103	
STN	104	071024	15:16	15:37	14-59.72N	132-00.70E	5626.0	500.6	-	502.4	506.0	STNM104	
STN	105	071024	18:14	18:35	15-00.48N	132-00.18E	6119.0	501.5	-	502.4	506.0	STNM105	
STN	106	071024	21:14	21:36	14-59.89N	132-00.26E	6012.0	500.0	-	500.4	504.0	STNM106	
STN	107	071124	00:16	00:38	15-00.54N	131-59.99E	6125.0	499.4	-	500.4	504.0	STNM107	
STN	108	071124	03:13	03:34	14-59.97N	131-59.85E	6097.0	500.4	-	502.4	506.0	STNM108	
STN	109	071124	06:15	06:35	14-59.43N	131-59.67E	5536.0	497.2	-	500.4	504.0	STNM109	
STN	110	071124	09:14	09:35	14-59.95N	132-00.02E	6079.0	497.4	-	500.4	504.0	STNM110	
STN	111	071124	12:15	13:13	14-59.74N	132-00.48E	5666.0	1001.3	-	1000.7	1009.0	STNM111	
STN	112	071124	15:15	15:36	14-59.56N	132-00.77E	5447.0	500.0	-	500.4	504.0	STNM112	
STN	113	071124	18:14	18:35	15-00.43N	132-01.16E	6113.0	500.2	-	501.4	505.0	STNM113	
STN	114	071124	21:14	21:35	15-00.22N	132-00.17E	6114.0	500.0	-	502.4	506.0	STNM114	
STN	115	071224	00:15	00:37	14-58.98N	131-59.41E	5898.0	500.9	-	500.4	504.0	STNM115	

STN	116	071224	03:13	03:33	14-58.84N	131-59.64E	5904.0	500.6	-	503.4	507.0	STNM116	
STN	117	071224	06:15	06:35	14-59.20N	132-00.02E	5568.0	500.0	-	502.4	506.0	STNM117	
STN	118	071224	09:14	09:34	15-00.02N	132-00.06E	6108.0	498.0	-	500.4	504.0	STNM118	
STN	119	071224	12:14	13:12	15-00.36N	132-00.77E	6096.0	1002.0	-	1000.7	1009.0	STNM119	
STN	120	071224	15:14	15:35	14-59.72N	132-00.37E	5777.0	500.4	-	500.4	504.0	STNM120	
STN	121	071224	18:13	18:34	15-00.73N	131-59.96E	6125.0	498.9	-	501.4	505.0	STNM121	
STN	122	071224	21:13	21:34	14-59.53N	131-59.99E	5598.0	498.9	-	501.4	505.0	STNM122	
STN	123	071324	00:15	00:37	14-58.74N	131-59.29E	5966.0	498.3	-	501.4	505.0	STNM123	
STN	124	071324	06:18	06:40	14-59.29N	131-59.61E	5575.0	500.2	-	501.4	505.0	STNM124	
STN	125	071324	09:13	09:34	15-00.05N	132-00.03E	6110.0	499.8	-	501.4	505.0	STNM125	
STN	126	071324	12:15	13:11	15-00.14N	132-00.13E	6120.0	1000.2	-	1000.7	1009.0	STNM126	
STN	127	071324	15:31	15:53	14-59.71N	132-00.21E	5791.0	500.7	-	501.4	505.0	STNM127	
STN	128	071324	18:15	18:40	14-58.90N	131-59.07E	5895.0	499.6	-	500.4	504.0	STNM128	
STN	129	071324	21:14	21:34	14-59.59N	131-59.94E	5643.0	500.0	-	502.4	506.0	STNM129	
STN	130	071424	00:15	00:37	15-00.16N	131-59.50E	6120.0	498.2	-	499.5	503.0	STNM130	
STN	131	071424	03:14	03:36	14-59.68N	131-58.88E	5767.0	498.7	-	500.4	504.0	STNM131	
STN	132	071424	06:16	06:38	14-59.63N	131-59.32E	5736.0	500.2	-	500.4	504.0	STNM132	
STN	133	071424	09:13	09:33	15-00.00N	131-59.92E	6105.0	499.8	-	501.4	505.0	STNM133	
STN	134	071424	12:15	13:12	15-00.11N	132-00.10E	6114.0	999.3	-	1000.7	1009.0	STNM134	
STN	135	071424	15:16	15:38	15-00.05N	132-00.03E	6111.0	499.8	-	502.4	506.0	STNM135	
STN	136	071424	18:16	18:38	15-00.91N	131-59.91E	6133.0	498.7	-	500.4	504.0	STNM136	
STN	137	071424	21:14	21:34	15-00.07N	132-00.04E	6106.0	500.0	-	500.4	504.0	STNM137	
STN	138	071524	00:15	00:36	15-00.00N	132-00.01E	6097.0	500.2	-	502.4	506.0	STNM138	
STN	139	071524	03:14	03:36	14-59.83N	132-00.52E	5830.0	499.4	-	500.4	504.0	STNM139	
STN	140	071524	06:15	06:37	14-59.94N	132-00.50E	5957.0	499.6	-	501.4	505.0	STNM140	
STN	141	071524	09:13	09:33	15-00.08N	132-00.05E	6118.0	499.8	-	503.4	507.0	STNM141	
STN	142	071524	12:14	13:10	15-00.04N	132-00.51E	6055.0	1000.4	-	1000.7	1009.0	STNM142	
STN	143	071524	15:16	15:37	15-00.01N	132-00.10E	6091.0	499.6	-	500.4	504.0	STNM143	
STN	144	071524	18:15	18:36	15-00.37N	131-59.42E	6123.0	501.3	-	502.4	506.0	STNM144	
STN	145	071524	21:14	21:35	15-00.02N	132-00.03E	6092.0	500.2	-	502.4	506.0	STNM145	
STN	146	071624	00:15	00:36	14-59.84N	132-01.19E	5524.0	499.1	-	500.4	504.0	STNM146	
STN	147	071624	03:14	03:36	14-59.78N	131-59.33E	5919.0	497.4	-	500.4	504.0	STNM147	
STN	148	071624	06:16	06:37	15-00.10N	131-58.65E	6107.0	499.1	-	500.4	504.0	STNM148	
STN	149	071624	09:13	09:34	15-00.02N	131-59.66E	6113.0	500.2	-	500.4	504.0	STNM149	
STN	150	071624	12:17	13:13	15-00.33N	131-59.56E	6121.0	1000.4	-	1000.7	1009.0	STNM150	
STN	151	071624	15:16	15:37	14-59.71N	131-59.30E	5822.0	499.6	-	501.4	505.0	STNM151	
STN	152	071624	18:17	18:39	15-00.31N	131-59.20E	6114.0	498.2	-	500.4	504.0	STNM152	
STN	153	071624	21:14	21:36	15-00.48N	132-00.35E	6118.0	499.4	-	501.4	505.0	STNM153	
STN	154	071724	00:15	00:37	14-59.99N	131-59.88E	6093.0	499.4	-	500.4	504.0	STNM154	
STN	155	071724	03:14	03:36	14-59.91N	131-59.76E	6053.0	498.5	-	500.4	504.0	STNM155	
STN	156	071724	06:15	06:36	14-59.26N	131-59.19E	5745.0	500.0	-	502.4	506.0	STNM156	
STN	157	071724	09:13	09:33	15-00.05N	131-59.94E	6113.0	498.9	-	500.4	504.0	STNM157	
STN	158	071724	12:15	13:11	14-59.84N	131-59.87E	5997.0	999.6	-	1000.7	1009.0	STNM158	
STN	159	071724	15:17	15:39	14-59.68N	132-00.42E	5685.0	498.5	-	500.4	504.0	STNM159	
STN	160	071724	18:15	18:37	14-58.88N	131-59.80E	5839.0	498.3	-	500.4	504.0	STNM160	
STN	161	071724	21:15	21:36	14-58.88N	131-59.86E	5808.0	497.8	-	500.4	504.0	STNM161	
STN	162	071824	00:15	00:37	14-58.38N	131-59.17E	5981.0	500.0	-	501.4	505.0	STNM162	
STN	163	071824	06:17	06:36	14-59.52N	131-59.02E	5596.0	500.0	-	502.4	506.0	STNM163	
STN	164	071824	09:13	09:34	15-00.64N	131-59.20E	6128.0	500.0	-	499.5	503.0	STNM164	
STN	165	071824	12:14	13:10	14-59.91N	131-59.97E	6045.0	998.2	-	1000.7	1009.0	STNM165	
STN	166	071824	15:16	15:38	15-00.43N	131-59.95E	6119.0	500.2	-	503.4	507.0	STNM166	
STN	167	071824	18:14	18:36	14-59.63N	131-58.72E	5699.0	499.3	-	500.4	504.0	STNM167	
STN	168	071824	21:13	21:34	15-00.00N	132-00.25E	6079.0	499.8	-	500.4	504.0	STNM168	
STN	169	071924	12:16	13:12	14-59.86N	131-59.14E	5981.0	1000.6	-	1000.7	1009.0	STNM169	
STN	170	071924	15:16	15:38	15-00.05N	131-59.69E	6116.0	499.3	-	501.4	505.0	STNM170	
STN	171	071924	18:14	18:36	15-00.38N	131-59.02E	6117.0	499.4	-	501.4	505.0	STNM171	
STN	172	071924	21:13	21:35	14-59.94N	131-59.95E	6057.0	498.2	-	500.4	504.0	STNM172	
STN	173	072024	00:14	00:36	14-58.78N	131-59.01E	5903.0	499.6	-	500.4	504.0	STNM173	
STN	174	072024	03:14	03:36	14-59.63N	131-58.87E	5712.0	498.0	-	500.4	504.0	STNM174	
STN	175	072024	06:15	06:36	14-59.80N	132-00.21E	5902.0	497.4	-	500.4	504.0	STNM175	
STN	176	072024	09:13	09:34	15-00.14N	132-00.09E	6119.0	499.6	-	500.4	504.0	STNM176	
STN	177	072024	12:14	13:11	15-00.65N	132-00.63E	6126.0	1002.2	-	1001.7	1010.0	STNM177	
STN	178	072024	15:15	15:37	15-00.56N	132-00.29E	6125.0	499.4	-	501.4	505.0	STNM178	
STN	179	072024	18:14	18:36	15-00.11N	132-00.08E	6119.0	498.5	-	500.4	504.0	STNM179	
STN	180	072024	21:13	21:34	14-59.89N	131-59.81E	6060.0	498.7	-	500.4	504.0	STNM180	
STN	181	072124	00:16	00:38	14-59.27N	131-59.19E	5699.0	503.1	-	502.4	506.0	STNM181	
STN	182	072124	03:14	03:36	14-59.38N	131-59.84E	5521.0	497.2	-	500.4	504.0	STNM182	
STN	183	072124	06:15	06:37	14-59.04N	131-59.75E	5718.0	498.3	-	501.4	505.0	STNM183	
STN	184	072124	09:13	09:34	14-59.59N	131-59.92E	5690.0	499.4	-	501.4	505.0	STNM184	
STN	185	072124	12:16	13:12	15-00.51N	132-00.13E	6121.0	1001.8	-	1001.7	1010.0	STNM185	
STN	186	072124	15:15	15:38	15-00.36N	132-00.77E	6098.0	500.0	-	501.4	505.0	STNM186	
STN	187	072124	18:14	18:36	15-00.60N	132-00.52E	6131.0	498.3	-	500.4	504.0	STNM187	
STN	188	072124	21:15	21:36	14-59.76N	131-59.85E	5884.0	499.4	-	501.4	505.0	STNM188	
STN	189	072224	00:14	00:36	14-59.95N	132-00.46E	6021.0	499.8	-	500.4	504.0	STNM189	
STN	190	072224	03:14	03:36	15-00.08N	131-59.48E	6120.0	497.2	-	500.4	504.0	STNM190	
STN	191	072224	06:15	06:37	15-00.34N	132-00.45E	6111.0	499.3	-	501.4	505.0	STNM191	
STN	192	072224	09:13	09:35	15-00.10N	132-00.21E	6111.0	496.5	-	500.4	504.0	STNM192	
STN	193	072224	12:14	13:10	15-00.43N	132-00.02E	6120.0	1001.1	-	1001.7	1010.0	STNM193	
STN	194	072224	15:16	15:38	15-00.73N	132-00.23E	6129.0	498.7	-	501.4	505.0	STNM194	
STN	195	072224	18:13	18:35	14-59.69N	131-59.25E	5882.0	498.2	-	501.4	505.0	STNM195	

STN	196	072224	21:13	21:35	14-59.91N	132-00.11E	6055.0	498.7	-	502.4	506.0	STNM196	
STN	197	072324	00:14	00:35	14-59.67N	131-59.96E	5842.0	500.7	-	500.4	504.0	STNM197	
STN	198	072324	03:14	03:36	14-59.69N	132-00.18E	5773.0	497.6	-	500.4	504.0	STNM198	
STN	199	072324	06:14	06:37	15-00.25N	131-59.21E	6118.0	498.9	-	501.4	505.0	STNM199	
STN	200	072324	09:13	09:34	15-00.01N	132-00.05E	6107.0	498.0	-	502.4	506.0	STNM200	
STN	201	072324	12:15	13:11	15-00.80N	132-00.26E	6123.0	1000.9	-	1002.6	1011.0	STNM201	
STN	202	072324	15:15	15:37	15-00.33N	131-59.86E	6117.0	498.0	-	500.4	504.0	STNM202	
STN	203	072324	18:14	18:36	15-00.22N	132-00.36E	6113.0	496.9	-	500.4	504.0	STNM203	
STN	204	072324	21:13	21:34	14-59.85N	132-00.00E	6028.0	499.4	-	501.4	505.0	STNM204	
STN	205	072424	00:14	00:35	14-59.32N	132-00.13E	5498.0	498.3	-	500.4	504.0	STNM205	
STN	206	072424	03:13	03:35	15-00.07N	132-00.60E	6050.0	496.7	-	501.4	505.0	STNM206	
STN	207	072424	06:14	06:36	15-00.47N	131-59.20E	6122.0	496.9	-	500.4	504.0	STNM207	
STN	208	072424	09:13	09:33	15-00.14N	132-00.04E	6121.0	496.3	-	500.4	504.0	STNM208	
STN	209	072424	12:14	13:09	14-59.97N	132-00.24E	6064.0	1000.6	-	1001.7	1010.0	STNM209	
STN	210	072424	15:17	15:40	15-00.68N	131-59.74E	6129.0	497.8	-	501.4	505.0	STNM210	
STN	211	072424	18:14	18:37	14-59.70N	131-59.91E	5847.0	497.1	-	500.4	504.0	STNM211	
STN	212	072424	21:13	21:34	15-00.02N	132-00.02E	6108.0	499.3	-	500.4	504.0	STNM212	
STN	213	072524	00:14	00:35	15-00.49N	132-00.38E	6123.0	500.2	-	501.4	505.0	STNM213	

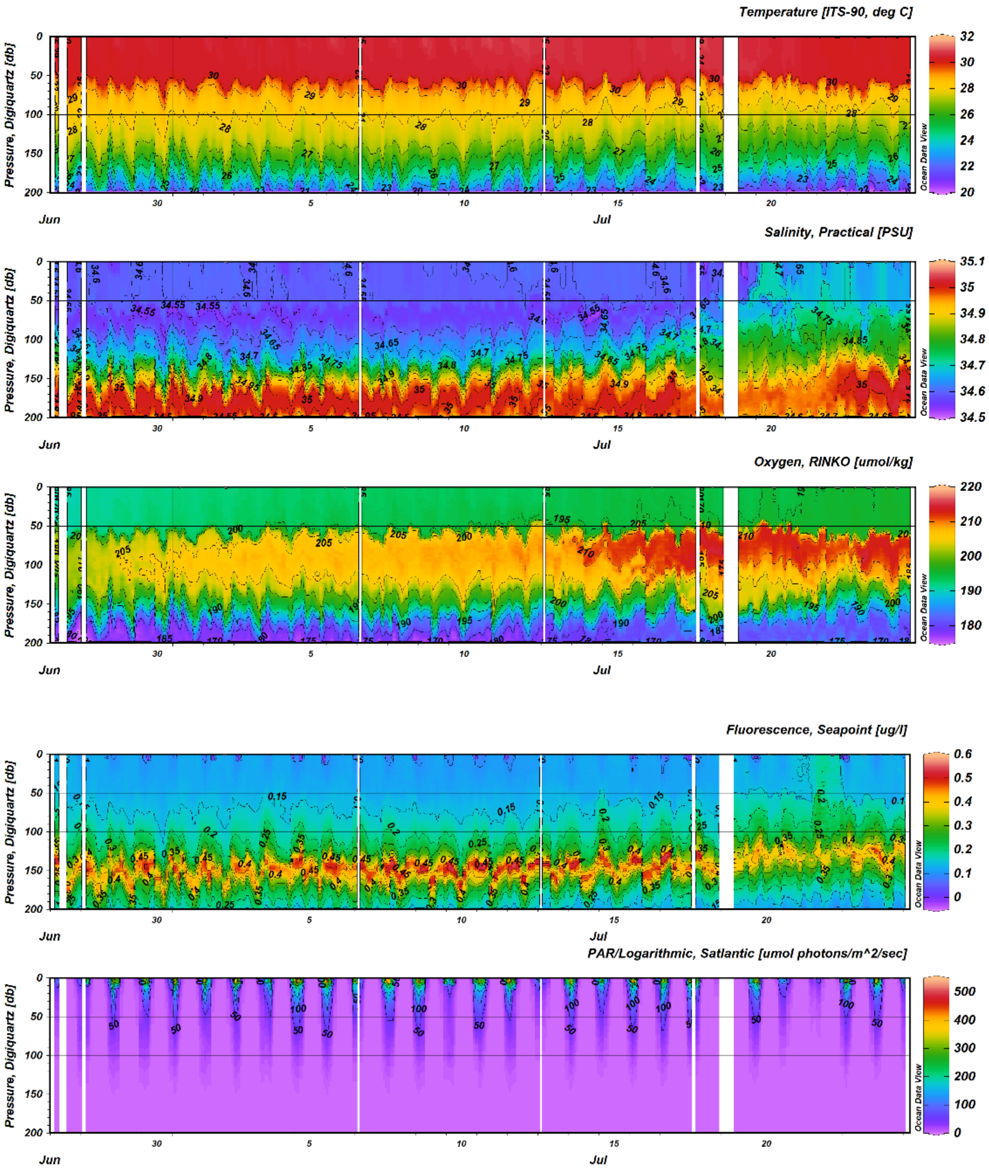


Figure 5.16-1 the time series contours (temperature, salinity, oxygen and fluorescence and photosynthetically active radiation) in fixed point measurement (STNM001 ~ STNM213).

5.17 LADCP

(1) Personnel

Satoru YOKOI (JAMSTEC) (Principal Investigator)
Aine YODA (MWJ) (Operation Leader)
Hiroyuki NAKAJIMA (MWJ)
Nobuhiro FUJII (MWJ)
Yuki MIYAJIMA (MWJ)
Tomoki NAKAMURA (MWJ)
Kengo FUJITA (MWJ)

(2) Objectives

To obtain horizontal current velocity in high vertical resolution.

(3) Methods

The instrument was a Teledyne RDI Workhorse II monitor 300kHz ADCP (WHM300, S/N 22899).

The instrument uses an external battery, which was changed after every 12 hours of used.

The instrument was controlled at deploy and recover stages by the RDI software (BBTalk) installed on the Windows PC. The commands sent to the instrument at setup were contained in ladcp_mr2404_m.txt. The full list of commands sent to the instrument were:

```
CR1                # Retrieve parameter (default)
TC2                # Ensemble per burst
WP1                # Pings per ensemble
TE 00:00:00.00     # Time per ensemble (time between data collection cycles)
TP 00:00.25        # Time between pings in mm:ss
WN25               # Number of Depth cells
WS0400             # Depth cell size (in cm) (recommended setting for 300kHz)
WF0225             # Blank after transit (recommended setting for 300kHz)
WB0                # Mode 1 bandwidth control (default - wide)
WV250              # Ambiguity velocity (in cm/s)
EZ0111101          # Sensor source (speed of sound excluded)
EX00000            # Beam coordinates
CF11111            # Data flow control parameters
```

(See the RDI Workhorse "Commands and Data Output Format" document for details.)

(4) Preliminary results

During the cruise, 214 profiles were obtained in total. All the data has to be converted and quality-controlled before the analyses. The further analyses will be in near future.

(5) Data archive

These data obtained in this cruise will be submitted to the Data Management Group of JAMSTEC, and will be opened to the public via “Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)” in JAMSTEC web site.

5.18 RINKO Profiler

(1) Personnel

Satoru YOKOI	(JAMSTEC)	- Principal Investigator
Aine YODA	(MWJ)	- Operation Leader
Hiroyuki NAKAJIMA	(MWJ)	
Nobuhiro FUJII	(MWJ)	
Yuki MIYAJIMA	(MWJ)	
Tomoki NAKAMURA	(MWJ)	
Kengo FUJITA	(MWJ)	

(2) Objectives

To measure vertical profiles of temperature, salinity, etc., in the ocean near-surface layer, the layer from the surface down to typically 10 m depth.

(3) Methods

We used the RINKO Profiler manufactured by JFE Advantech, which weighs 1 kg in the water. The instrument is equipped with sensors for depth, temperature, conductivity, chlorophyll-a, turbidity, and dissolved oxygen. The specification of the sensors is shown in Table 5.18-1. It is pressure-resistant down to 600 meters.

We tied the instrument to the rope of approximately 25 meters in length, and slowly lowered it by hand from the middle of the starboard side of upper deck of the vessel (so-called "muster pad") down to 15 meters in depth. We performed the measurement just after deployment of an ARGO float (16-00N, 134-00E) (C01001), just after the recovery of the surface drifters (C02001 – C05001), just after the recovery of Wave Gliders (C06001 – C08001), and at the station observation point (STN001 – STN217). In total, there are 226 casts. The data interval was set as every 0.2 second.

(4) Preliminary Results

Figure 5.18-1 is a preliminary result of the measurement, showing time-depth cross section of temperature at the station observation point (STN001 – STN217).

(5) Data archive

All data obtained during this cruise will be submitted to the JAMSTEC Data Management Group (DMG).

Table 5.18-1: The specification of the sensors in RINKO Profiler, as described in the instruction manual.

Parameter	Range	Resolution	Precision	Response
Depth	0 to 600 m	0.01 m	± 0.3 %	0.2 s
Temperature	-3 to 45 ℃	0.001 ℃	± 0.01 ℃	0.2 s
Conductivity	0.5 to 70 mS/cm	0.001 mS/cm	± 0.01 mS/cm	0.2 s
(Salinity)	2 to 42 PSU	0.001 PSU	(not described)	0.2 s
Turbidity	0 to 1000 FTU	0.03 FTU	± 0.3 FTU	0.2 s
Chlorophyll	0 to 400 ppb	0.01 ppb	± 1 % FS	0.2 s
Dissolved oxygen	0 to 20 mg/l	0.001 mg/l	± 2 % FS	0.4 s

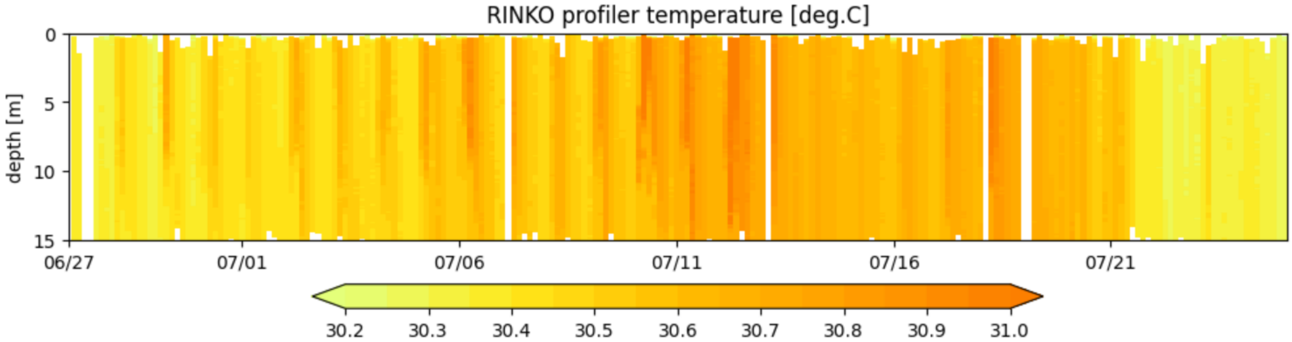


Fig. 5.18-1: Time-depth cross section of observed temperature at the station observation point.

5.19 Salinity of sampled water

(1) Personnel

Satoru Yokoi (JAMSTEC) - Principal Investigator
Katsunori Sagishima (MWJ) - Operation leader

(2) Objective

To provide calibrations for the measurements of salinity collected from CTD casts, bucket sampling and underway surface water monitoring system.

(3) Parameters

Salinity

(4) Instruments and methods

a. Sampling

Seawater samples were collected with 12 Liter water sampling bottles and underway surface water monitoring system. The salinity sample bottle of the 250 ml brown glass bottle with screw cap was used for collecting the sample water. Each bottle was rinsed 3 times with the sample water, and was filled with sample water to the bottle shoulder. The salinity sample bottles for underway surface water monitoring system samples were sealed with a plastic septum and screw cap because we took into consideration the possibility of storage for about one month. The caps were rinsed 3 times with the sample seawater before its use. Each bottle was stored for more than 24 hours in the laboratory before the salinity measurement.

The kind and number of samples taken are shown as follows;

Table 5.19-1. Kind and number of samples

Kind of Samples	Number of Samples
Samples for CTD (C01M001, STNM008, M016, M024, M032, M040, M048, M056, M064, M072, M079, M087, M095, M103, M111, M119, M126, M134, M142, M150, M158, M165, M169, M177, M185, M193, M201, M209)	352
Samples for underway surface water monitoring system	36
Total	388

b. Instruments and Method

The salinity analysis was carried out on R/V MIRAI during the cruise of MR24-04 using the salinometer (Model 8400B "AUTOSAL"; Guildline Instruments Ltd.: S/N 62556) with an additional peristaltic-type intake pump (Ocean Scientific International, Ltd.). A pair of precision digital thermometers (1502A; FLUKE: S/N B78466 and B81550) were used for monitoring the ambient temperature and the bath temperature of the salinometer.

The specifications of the AUTOSAL salinometer and thermometer are shown as follows;

Salinometer (Model 8400B "AUTOSAL"; Guildline Instruments Ltd.)

Measurement Range	: 0.005 to 42 (PSU)
Accuracy	: Better than ± 0.002 (PSU) over 24 hours
Maximum Resolution	: Better than ± 0.0002 (PSU) at 35 (PSU)

Thermometer (1502A: FLUKE)

Measurement Range	: 16 to 30 deg. C (Full accuracy)
Resolution	: 0.001 deg. C
Accuracy	: 0.006 deg. C (@ 0 deg. C)

The measurement system was almost the same as Aoyama *et al.* (2002). The salinometer was operated in the air-conditioned ship's laboratory at a bath temperature of 24 deg. C. The ambient temperature varied from approximately 22 deg. C to 24 deg. C, while the bath temperature was very stable and varied within +/- 0.002 deg. C on rare occasion. The measurement for each sample was done with a double conductivity ratio and defined as the median of 34 readings of the salinometer. (Acquisition of the 34 readings took about 11 seconds when the function dial was turned to the 'read' setting) Data were taken after rinsed 5 times with the sample water. The double conductivity ratio of sample was calculated from average value of two measurements. And it was used to calculate the bottle salinity with the algorithm for the practical salinity scale, 1978 (UNESCO, 1981). In the case of the difference between the double conductivity ratio of these two measurements being greater than or equal to 0.00003, continue to be measured up to 3 times. The difference between the double conductivity ratio of these two measurements being smaller than 0.00002 were selected. The measurement was conducted in about 8 hours per day and the cell was cleaned with neutral detergent after the measurement of the day.

(5) Preliminary results

a. Standard Seawater

Standardization control of the salinometer was set to 601 (20th June). The value of STANDBY was 24+5128 to 24+5129 and that of ZERO was 0.0±0000. The IAPSO Standard Seawater (SSW) batch P168 was used as the standard for salinity. 10 bottles of P168 were measured.

Figure 5.19-1 shows the time series of the double conductivity ratio of the Standard Seawater batch P168. The average of the double conductivity ratio was 1.99985 and the standard deviation was 0.00001 which is equivalent to 0.0001 in salinity.

The specifications of SSW batch P168 used in this cruise are shown as follows;

Batch	: P168
Conductivity ratio	: 0.99993
Salinity	: 34.997
Use by	: 1st December 2026

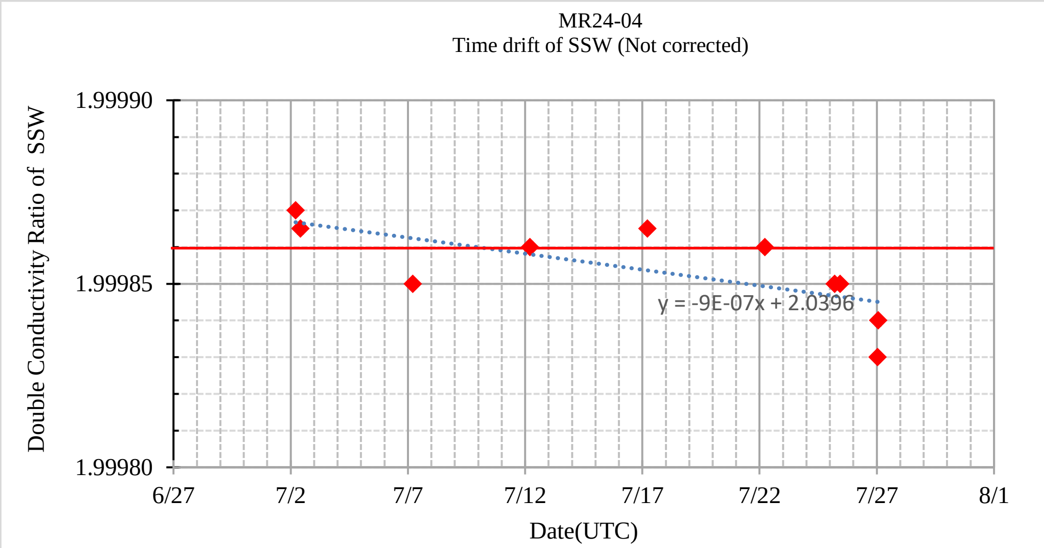


Figure 5.19-1: Time series of double conductivity ratio for the Standard Seawater (before correction)

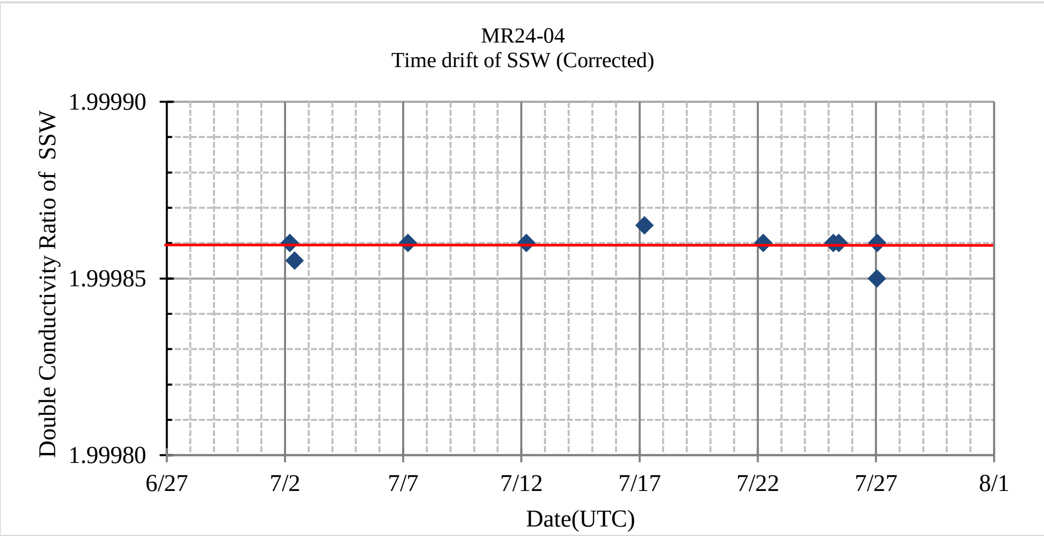


Figure 5.19-2: Time series of double conductivity ratio for the Standard Seawater (after correction)

b. Sub-Standard Seawater

Sub-standard seawater was made from surface sea water filtered by a pore size of 0.45 micrometer and stored in a 20 Liter container made of polyethylene and stirred for at least 24 hours before measuring. It was measured about every about 1hour in order to check for the possible sudden drifts of the salinometer.

c. Replicate Samples

We estimated the precision of this method using 54 pairs of replicate samples taken from the same water sampling bottle. Figure 5.19-3 shows the histogram of the absolute difference between each pair of the replicate samples. The average and the standard deviation of absolute difference among 54 pairs of replicate samples were 0.0004 and 0.0008 in salinity, respectively.

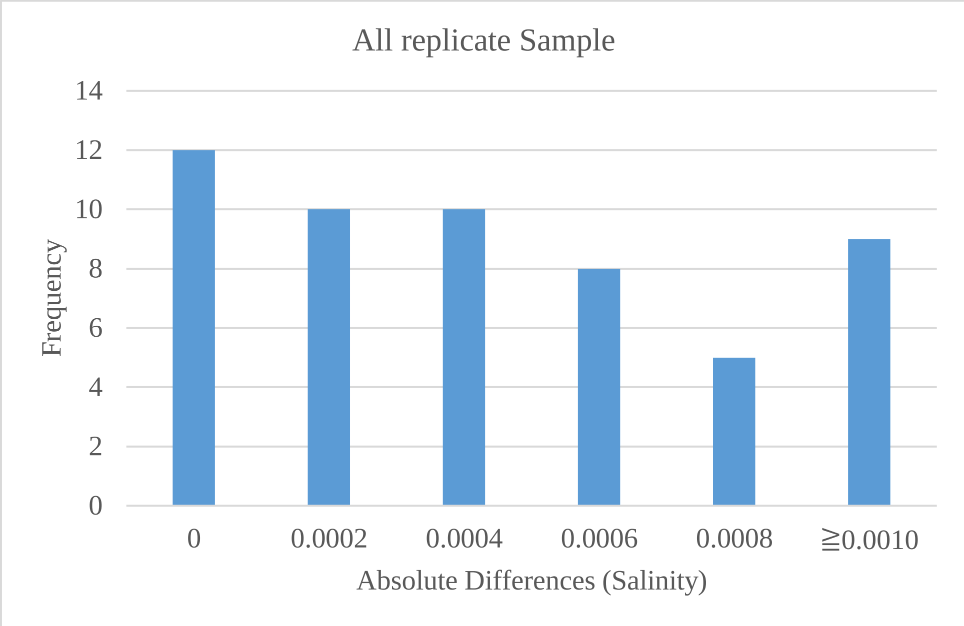


Figure 5.19-3: The histogram of the salinity for the absolute difference of all replicate samples

(6) Data archive

These data obtained in this cruise will be submitted to the Data Management Group of JAMSTEC, and will be opened to the public via “Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)” in JAMSTEC web site.

<http://www.godac.jamstec.go.jp/darwin/e>

(7) Reference

Aoyama, M., T. Joyce, T. Kawano and Y. Takatsuki: Standard seawater comparison up to P129. Deep-Sea Research, I, Vol. 49, 1103-1114, 2002

UNESCO: Tenth report of the Joint Panel on Oceanographic Tables and Standards. UNESCO Tech. Papers in Mar. Sci., 36, 25 pp., 1981

5.20 Dissolved oxygen of sampled water

(1) Personnel

Satoru YOKOI	(JAMSTEC)	- Principal Investigator
Misato KUWAHARA	(MWJ)	- Operation Leader
Takuya IZUTSU	(MWJ)	

(2) Objectives

Determination of dissolved oxygen in seawater by Winkler titration.

(3) Parameters

Dissolved Oxygen

(4) Instruments and Methods

Following procedure is based on winkler method (Dickson, 1996; Culberson, 1991).

a. Instruments

Burette for sodium thiosulfate and potassium iodate;

Automatic piston burette (APB-510 / APB-620) manufactured by Kyoto Electronics Manufacturing Co., Ltd. / 10 cm^3 of titration vessel

Detector;

Automatic photometric titrator (DOT-15X) manufactured by Kimoto Electric Co., Ltd.

Software;

DOT_Terminal Ver. 1.3.1

b. Reagents

Pickling Reagent I:

Manganese (II) chloride solution (3 mol dm^{-3})

Pickling Reagent II:

Sodium hydroxide (8 mol dm^{-3}) / Sodium iodide solution (4 mol dm^{-3})

Sulfuric acid solution (5 mol dm^{-3})

Sodium thiosulfate (0.025 mol dm^{-3})

Potassium iodate (0.001667 mol dm^{-3})

c. Sampling

Seawater samples were collected with 12 Liter water sampling bottles attached to the CTD/Carousel Water Sampling System (CTD system). Seawater for oxygen measurement was transferred from the bottle to a volume calibrated flask (ca. 100 cm^3), and three times volume of the flask was overflowed. Temperature was simultaneously measured by digital thermometer during the overflowing. After transferring the sample, two reagent solutions (Reagent I and II) of 1 cm^3 each were added immediately and the stopper was inserted carefully into the flask. The sample flask was then shaken vigorously to mix the contents and to disperse the precipitate finely throughout. After the precipitate has settled at least halfway down the flask, the flask was shaken again vigorously to disperse the precipitate. The sample flasks containing pickled samples were stored in a laboratory until they were titrated.

d. Sample measurement

For over two hours after the re-shaking, the pickled samples were measured on board. Sulfuric acid solution with its volume of 1 cm^3 and a magnetic stirrer bar were put into the sample flask and the sample was stirred. The samples were titrated by sodium thiosulfate solution whose morality was determined by potassium iodate solution. Temperature of sodium thiosulfate during titration was recorded by a digital thermometer. Dissolved oxygen concentration (μmol kg^{-1}) was calculated by sample temperature during seawater sampling, salinity of the sensor on CTD system, flask volume, and titrated volume of sodium thiosulfate solution without the blank. During this cruise, 2 sets of the titration apparatus were used.

e. Standardization and determination of the blank

Concentration of sodium thiosulfate titrant was determined by potassium iodate solution. Pure potassium iodate was dried in an oven at 130 ºC, and 1.7835 g of it was dissolved in deionized water and diluted to final weight of 5 kg in a flask. After 10 cm^3 of the standard potassium iodate solution was added to another flask using a volume-calibrated dispenser, 90 cm^3 of deionized water, 1 cm^3 of sulfuric acid solution, and 1 cm^3 of pickling reagent solution II and I were added in order. Amount of titrated volume of sodium thiosulfate for this diluted standard potassium iodate solution (usually 5 times measurements average) gave the morality of sodium thiosulfate titrant.

The oxygen in the pickling reagents I (1 cm^3) and II (1 cm^3) was assumed to be 7.6×10^{-8} mol (Murray et al., 1968). The blank due to other than oxygen was determined as follows. First, 1 and 2 cm^3 of the standard potassium iodate solution were added to each flask using a calibrated dispenser. Then 100 cm^3 of deionized water, 1 cm^3 of sulfuric acid solution, 1 cm^3 of pickling II reagent solution, and same volume of pickling I reagent solution were added into the flask in order. The blank was determined by difference between the first (1 cm^3 of potassium iodate) titrated volume of the sodium thiosulfate and the second (2 cm^3 of potassium iodate) one. The titrations were conducted for 3 times and their average was used as the blank value.

(5) Observation log

a. Standardization and determination of the blank

Table 5.20-1: shows results of the standardization and the blank determination during this cruise.

Table 5.20-1: Results of the standardization and the blank determinations during cruise

Date (yyyy/mm/dd)	Potassium iodate ID	Sodium thiosulfate ID	DOT-15X (No.9)		DOT-15X (No.10)		Stations
			E.P. (cm^3)	Blank (cm^3)	E.P. (cm^3)	Blank (cm^3)	
2024/06/22	K23C01	T-22H	3.970	0.001	3.967	0.000	
2024/06/28	K23B09	T-22H	3.972	0.000	3.969	0.001	STNM008, M016, M024
2024/07/02	K23C09	T-22H	3.972	0.000	3.969	0.000	STNM032, M040, M048, M056
2024/07/06	K23C08	T-22H	3.974	0.001	3.969	0.000	STNM064, M072, M079, M087
2024/07/10	K23C07	T-22H	3.973	0.001	3.971	0.000	STNM095, M103, M111, M119
2024/07/14	K23C06	T-22H	3.974	0.001	3.971	0.001	STNM126, M134, M142, M150
2024/07/17	K23C05	T-22H	3.975	0.001	3.971	-0.001	STNM158, M165, M169, M177
2024/07/21	K23D02	T-22H	3.975	0.001	3.970	0.000	
2024/07/21	K23D02	T-22F	3.942	0.002	3.937	-0.001	STNM185, M193, M201, M209
2024/07/26	K23D01	T-22F	3.942	0.000	3.937	0.000	

b. Repeatability of sample measurement

Replicate samples were taken at every CTD casts. The standard deviation of the replicate measurement (Dickson et al., 2007) was 0.09 μmol kg^{-1} (n = 55).

(6) Data archives

These data obtained in this cruise will be submitted to the Data Management Group (DMG) of JAMSTEC, and will open to the public via "Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)" in JAMSTEC web site.

<http://www.godac.jamstec.go.jp/darwin/e>

(7) References

Culberson, C. H. (1991). *Dissolved Oxygen.* WHPO Publication 91-1.

Dickson, A. G. (1996). Determination of dissolved oxygen in sea water by Winkler titration. In *WOCE Operations Manual*, Part 3.1.3 Operations & Methods, WHP Office Report WHPO 91-1.

Dickson, A. G., Sabine, C. L., & Christian, J. R.(Eds.), (2007). *Guide to best practices for ocean CO_2 measurements*, *PICES Special Publication 3*: North Pacific Marine Science Organization.

Murray, C. N., Riley, J. P., & Wilson, T. R. S. (1968). The solubility of oxygen in Winklerreagents used for the determination of dissolved oxygen. *Deep Sea Res.*, 15, 237-238.

5.21 Chlorophyll *a* of sampled water

(1) Personnel

Satoru YOKOI	(JAMSTEC)	- Principal Investigator
Misato KUWAHARA	(MWJ)	- Operation Leader
Takuya IZUTSU	(MWJ)	

(2) Objective

We measured total chlorophyll *a* in seawater by using the fluorometric method.

(3) Parameters

Total chlorophyll *a*

(4) Instruments and methods

We collected samples for total chlorophyll *a* from 9 depths between the surface and 300 m depth including a chlorophyll *a* maximum layer. The chlorophyll *a* maximum layer was determined by a Chlorophyll Fluorometer (Seapoint Sensors, Inc) attached to the CTD system.

Seawater samples for total chlorophyll *a* were vacuum-filtrated (< 0.02 MPa) through glass microfiber filter (Whatman GF/F filter, 25mm-in diameter). Phytoplankton pigments were immediately extracted in a polypropylene tube with 7 ml of *N,N*-dimethylformamide (FUJIFILM Wako Pure Chemical Corporation Ltd.) from phytoplankton retained on the filters (Suzuki and Ishimaru, 1990). The tubes were stored at -20 °C under the dark condition to extract chlorophyll *a* at least for 24 hours.

Chlorophyll *a* concentrations were measured by the fluorometer (10-AU, TURNER DESIGNS), which was previously calibrated against a pure chlorophyll *a* (Sigma-Aldrich Co., LLC). To estimate the chlorophyll *a* concentrations, we applied to the fluorometric "Non-acidification method" (Welschmeyer, 1994).

(5) Preliminary results

270 samples were collected at the 27 casts conducted at the station STN. At each cast, replicate samples were collected from water of chlorophyll *a* maximum layer. Results of replicate sample measurements were shown in Table 5.21-1.

(6) Data archives

These data obtained in this cruise will be submitted to the Data Management Group of JAMSTEC, and will be opened to the public via "Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)" in JAMSTEC web site.

<http://www.godac.jamstec.go.jp/darwin/e>

(7) Reference

Suzuki, R., & Ishimaru T. (1990). An improved method for the determination of phytoplankton chlorophyll using N, N-dimethylformamide. *J. Oceanogr. Soc. Japan*, 46, 190-194.

Welschmeyer, N. A. (1994). Fluorometric analysis of chlorophyll *a* in the presence of chlorophyll *b* and pheopigments. *Limnol. Oceanogr.* 39(8), 1985-1992.

Table 5.21-1: Results of the replicate sample measurements.

Number of replicate sample pairs	27
Standard deviation (μg L^{-1})	0.01

5.22 Iodine of sampled water

(1) Personnel

Fumikazu TAKETANI	(JAMSTEC)	- Principal Investigator	- not on board
Yugo KANAYA	(JAMSTEC)		- not on board
Hisahiro TAKASHIMA	(JAMSTEC/Fukuoka Univ.)		- not on board
Yoko IWAMOTO	(Hiroshima Univ.)		- not on board
Kazuhiko TAKEDA	(Hiroshima Univ.)		- not on board

Sampling for seawater was supported by Marine Works Japan, Ltd

(2) Objectives

To investigate iodate ion (IO_3^-) and iodide ion (I^-) concentrations in the surface seawater and vertical profile at the western North Pacific.

(3) Methods

(3-1) Seawater sampling

Seawater sampling for the vertical profiles (0-1000m) of iodine was performed by Niskin-X bottles on a CTD-rosette system (Table 5.22-1). Surface seawater samples from the faucet on board were also collected (Table 5.22-2). All of the seawater samples were collected in 125-mL HDPE bottles. The bottles were stored at ~4 ºC on board. Then analysis at laboratory after the cruise.

(3-2) Analysis of sampled seawater

An ion chromatography combing a high ion exchange capacity column and a UV detector which was originally developed (Yamane et al., 2015; Takeda et al., 2017; Ito et al., 2018) will be used for determination of iodine. Iodate (IO_3^-), iodide (I^-), nitrite (NO_2^-), nitrate (NO_3^-) and bromide (Br^-) in seawater can be separated and analyzed using a dodecylammonium-coated octadecylsilyl column (TSKgel ODS-120H; Tosoh) with a mobile phase containing 0.3 M NaCl, 0.5 mM n-dodecylamine hydrochloride, and 5 mM phosphate buffer (pH=4.5). Organic iodine will be measured after decomposition of organic iodine to inorganic iodine by UV-light irradiation (500-W Xe lamp).

(4) Observation log

Table 5.22-1: Logs of surface seawater sampling

Table 5.22-2: Logs of seawater sampling by Niskin-X bottles on a CTD-rosette system

(5) Data archive

These data obtained in this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via “Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)” in JAMSTEC web site. <http://www.godac.jamstec.go.jp/darwin/e>

(6) Acknowledgments

We thank the crew of the R/V Mirai, and staff of Marine Works Japan, Ltd, Dr. Ayako SEIKI, and Dr. Satoru YOKOI for their support with observations throughout the cruise.

Table 5.22-1

On board ID	Date Collected					Latitude			Longitude		
	YYYY	MM	DD	hh:mm:ss	UTC/JST	Deg.	Min.	N/S	Deg.	Min.	E/W
Cast-016	2024	06	29	12:13	UTC	15	0.00	N	132	0.00	E
Cast-072	2024	07	06	12:10	UTC	15	0.00	N	132	0.00	E
Cast-126	2024	07	13	12:10	UTC	15	0.00	N	132	0.00	E
Cast-177	2024	07	20	12:09	UTC	15	0.00	N	132	0.00	E
Cast-209	2024	07	24	12:09	UTC	15	0.00	N	132	0.00	E

Table 5.22-2

On board ID	Date Collected					Latitude			Longitude		
	YYYY	MM	DD	hh:mm:ss	UTC/JST	Deg.	Min.	N/S	Deg.	Min.	E/W
TSG-001	2024	06	21	12:35:11	UTC	33	1.14	N	137	55.36	E
TSG-002	2024	06	22	11:10:11	UTC	29	29.95	N	136	49.10	E
TSG-003	2024	06	23	10:59:49	UTC	25	6.23	N	135	29.41	E
TSG-004	2024	06	24	11:06:46	UTC	20	37.97	N	134	10.76	E
TSG-005	2024	06	25	11:24:48	UTC	16	14.03	N	133	59.99	E
TSG-006	2024	06	26	10:34:53	UTC	15	0.26	N	132	0.33	E
TSG-007	2024	06	27	12:33:33	UTC	14	59.27	N	132	1.59	E
TSG-008	2024	06	28	12:37:45	UTC	15	0.52	N	132	0.69	E
TSG-009	2024	06	29	12:46:29	UTC	15	0.98	N	132	0.46	E
TSG-010	2024	06	30	12:37:10	UTC	14	59.75	N	132	0.13	E
TSG-011	2024	07	01	12:36:26	UTC	14	59.91	N	132	0.39	E
TSG-012	2024	07	02	12:44:26	UTC	14	59.94	N	131	59.78	E
TSG-013	2024	07	03	12:39:19	UTC	15	0.68	N	131	59.40	E
TSG-014	2024	07	04	12:33:53	UTC	15	0.25	N	131	59.65	E
TSG-015	2024	07	05	12:34:17	UTC	15	1.11	N	132	0.19	E
TSG-016	2024	07	06	12:37:40	UTC	14	59.86	N	132	0.26	E
TSG-017	2024	07	07	12:37:51	UTC	15	0.34	N	132	0.08	E
TSG-018	2024	07	08	12:36:58	UTC	15	0.32	N	131	59.92	E
TSG-019	2024	07	09	12:35:34	UTC	15	0.09	N	132	0.15	E
TSG-020	2024	07	10	12:37:18	UTC	14	59.97	N	132	0.02	E
TSG-021	2024	07	11	12:36:53	UTC	14	59.74	N	132	0.49	E
TSG-022	2024	07	12	12:38:14	UTC	15	0.36	N	132	0.79	E
TSG-023	2024	07	13	12:36:03	UTC	15	0.15	N	132	0.12	E
TSG-024	2024	07	14	12:35:13	UTC	15	0.11	N	132	0.12	E
TSG-025	2024	07	15	12:40:16	UTC	15	0.04	N	132	0.53	E
TSG-026	2024	07	16	12:38:33	UTC	15	0.34	N	131	59.57	E
TSG-027	2024	07	17	12:37:01	UTC	14	59.84	N	131	59.89	E
TSG-028	2024	07	18	12:34:39	UTC	14	59.91	N	131	59.97	E
TSG-029	2024	07	19	12:36:26	UTC	14	59.86	N	131	59.14	E
TSG-030	2024	07	20	12:36:28	UTC	15	0.65	N	132	0.64	E
TSG-031	2024	07	21	12:36:27	UTC	15	0.51	N	132	0.14	E
TSG-032	2024	07	22	12:33:09	UTC	15	0.43	N	132	0.03	E
TSG-033	2024	07	23	12:33:29	UTC	15	0.80	N	132	0.27	E
TSG-035	2024	07	24	12:35:41	UTC	14	59.96	N	132	0.25	E
TSG-036	2024	07	25	10:57:19	UTC	16	45.71	N	132	40.61	E
TSG-037	2024	07	26	0:53:25	UTC	19	4.16	N	133	33.57	E

5.23 Shipboard ADCP

(1) Personnel

Satoru YOKOI	(JAMSTEC)	- Principal Investigator
Ryo OYAMA	(NME)	- Operation Leader
Souichiro SUEYOSHI	(NME)	
Haruna YAMANAKA	(NME)	
Masanori MURAKAMI	(MIRAI Crew)	

(2) Objectives

To obtain continuous measurement data of the current profile along the ship's track.

(3) Methods

Upper ocean current measurements were made in this cruise, using the hull-mounted Acoustic Doppler Current Profiler (ADCP) system. For most of its operation, the instrument was configured for water-tracking mode. Bottom-tracking mode, interleaved bottom-ping with water-ping, was made to get the calibration data for evaluating transducer misalignment angle in the shallow water. The system consists of following components;

1. R/V MIRAI has installed the Ocean Surveyor for vessel-mount ADCP (frequency 76.8 kHz; Teledyne RD Instruments, USA). It has a phased-array transducer with single ceramic assembly and creates 4 acoustic beams electronically. We mounted the transducer head rotated to a ship-relative angle of 45 degrees azimuth from the keel.
2. For heading source, we use ship's gyro compass (Tokyo Keiki, Japan), continuously providing heading to the ADCP system directory. Additionally, we have Inertial Navigation System (Phins, Ixblue, France) which provide high-precision heading, attitude information, pitch and roll. They are stored in ".N2R" data files with a time stamp.
3. Differential GNSS system (StarPack-D, Fugro, Netherlands) providing precise ship's position.
4. We used VmDas software version 1.50.19 (TRDI) for data acquisition.
5. To synchronize time stamp of ping with Computer time, the clock of the logging computer is adjusted to GNSS time server continuously by the application software.
6. Fresh water is charged in the sea chest to prevent bio fouling at transducer face.
7. The sound speed at the transducer does affect the vertical bin mapping and vertical velocity measurement, and that is calculated from temperature, salinity (constant value; 35.0 PSU) and depth (6.5 m; transducer depth) by equation in Medwin (1975).

Data was configured for "8 m" layer intervals starting about 23 m below sea surface, and recorded every ping as raw ensemble data (.ENR). Additionally, 15 seconds averaged data were recorded as short-term average (.STA). 300 seconds averaged data were long-term average (.LTA), respectively.

(4) Parameters

Major parameters for the measurement, Direct Command, are shown in Table 5.24-1.

Table 5.24-1: Major parameters

Bottom-Track Commands

BP = 001 Pings per Ensemble (almost less than 1,300m depth)

Environmental Sensor Commands

EA = 04500 Heading Alignment (1/100 deg)

ED = 00065 Transducer Depth (0 - 65535 dm)

EF = +001 Pitch/Roll Divisor/Multiplier (pos/neg) [1/99 - 99]

EH = 00000 Heading (1/100 deg)

ES = 35 Salinity (0-40 pp thousand)

EX = 00000 Coordinate Transform (Xform:Type; Tilts; 3Bm; Map)

EZ = 10200010 Sensor Source (C; D; H; P; R; S; T; U)

C (1): Sound velocity calculates using ED, ES, ET (temp.)

D (0): Manual ED

H (2): External synchro

P (0), R (0): Manual EP, ER (0 degree)

S (0): Manual ES

T (1): Internal transducer sensor

U (0): Manual EU

EV = 0 Heading Bias(1/100 deg)

Water-Track Commands

WA = 255 False Target Threshold (Max) (0-255 count)

WC = 120 Low Correlation Threshold (0-255)

WD = 111 100 000 Data Out (V; C; A; PG; St; Vsum; Vsum^2; #G; P0)

WE = 1000 Error Velocity Threshold (0-5000 mm/s)

WF = 0800 Blank After Transmit (cm)

WN = 100 Number of depth cells (1-128)

WP = 00001 Pings per Ensemble (0-16384)

WS = 800 Depth Cell Size (cm)

WV = 0390 Mode 1 Ambiguity Velocity (cm/s radial)

(5) Preliminary results

Figure.5.23-1 shows the time series plot of the current velocity duration of stay in the station observation point.

(6) Data Archive

These data obtained in this cruise will be submitted to the Data Management Group of JAMSTEC and will be opened to the public via "Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)" in JAMSTEC web site.

< https://www.godac.jamstec.go.jp/darwin/en >

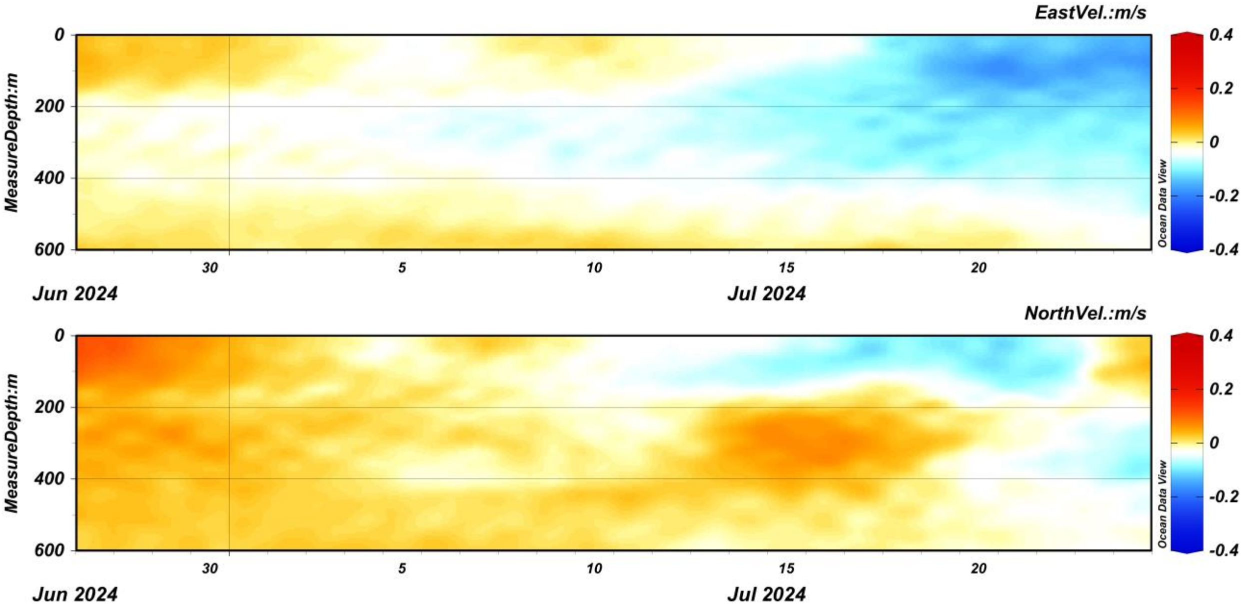


Fig. 5.23-1: The time series plot of the current velocity during the station observation period.

5.24 XCTD

(1) Personnel

Satoru YOKOI	(JAMSTEC)	- Principal Investigator
Ryo OYAMA	(NME)	- Operation Leader
Souichiro SUEYOSHI	(NME)	
Haruna YAMANAKA	(NME)	
Masanori MURAKAMI	(MIRAI Crew)	

(2) Objectives

Investigation of oceanic structure.

(3) Methods

We observed vertical profiles of sea water temperature and salinity measured by XCTD-1N probes manufactured by Tsurumi-Seiki Co. (TSK). The electric signal from the probe was converted by MK-150N (TSK), and was recorded by AL-12B software (Ver.1.6.4, TSK). The specifications of the measured parameters are as in Table 5.24-1.

Table 5.24-1: The range and accuracy of parameters measured by XCTD-1N.

Parameter	Range	Accuracy
Conductivity	0 ~ 60 [mS/cm]	+/- 0.03 [mS/cm]
Temperature	-2 ~ 35 [deg-C]	+/- 0.02 [deg-C]
Depth	0 ~ 1000 [m]	5 [m] or 2 [%] (either of them is major)

(4) Launch log

We launched probes by using automatic launcher during this cruise as listed in Table 5.24-2.

Table 5.24-2: List of XCTD observations. SST (sea surface temperature) and SSS (sea surface salinity).

No.	Date [YYYY/MM/DD]	Time [hh:mm]	Latitude [deg]	Longitude [deg]	Depth [m]	SST [deg-C]	SSS [PSU]	Probe S/N
1	2024/06/28	03:06	15-01.2437N	131-59.8358E	6131	30.481	34.576	23118278
2	2024/07/07	02:59	14-50.1609N	131-49.4353E	5882	30.665	34.565	23118279
3	2024/07/13	03:00	14-56.1708N	131-55.2064E	5087	30.810	34.545	23118280
4	2024/07/18	03:00	14-54.6318N	131-51.1994E	5765	30.854	34.561	23118281
5	2024/07/19	00:00	15-02.1324N	132-00.0372E	5927	30.712	34.520	23118283
6	2024/07/19	02:58	14-59.4191N	131-56.6291E	5755	30.697	34.509	23118282
7	2024/07/19	06:02	14-59.3896N	131-59.2920E	5663	30.779	34.551	23118285
8	2024/07/19	09:05	15-00.2385N	132-00.0127E	6118	30.746	34.550	23118284

(5) Data archive

XCTD data obtained in this cruise will be submitted to the Data Management Group of JAMSTEC, and will be opened to the public via "Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)" in JAMSTEC web site.
<https://www.godac.jamstec.go.jp/darwin/en>

5.25 Ocean wave buoy

(1) Personnel

Tomoya Shimura	(Kyoto University)	(not on board)
Nobuhito Mori	(Kyoto University)	(not on board)

(2) Objectives

The objective of the observation is to measure ocean wave statistics (wave heights, period, direction, spectral shape, etc), sea surface temperature, and sea surface pressure for investigating typhoon-generated extreme ocean wave dynamics.

(3) Methods

The small GNSS-tracked ocean wave buoy manufactured by SOFAR OCEAN TECHNOLOGIES were deployed on the way from Shimizu to the station observation point. Information of the deployment is summarized in Table 5.25-1. The buoy measures locations, bulk wave statistics, wave spectral moments, sea surface temperature, sea surface pressure, and sea surface wind speed every hour. The data are transmitted through the Iridium short burst data every hour.

(4) Preliminary Results

Figure 5.25-1 shows track of the buoy with colored by sea surface temperature, while Fig. 5.25-2 shows time-series of significant wave heights, sea surface temperature, and sea level pressure.

Table 5.25-1: Information of the deployment of the floats.

S/N	WMO number	Date and time (UTC)	Latitude	Longitude
31688C	2102627	2024/06/24 14:32 UTC	20.00N	134.00E

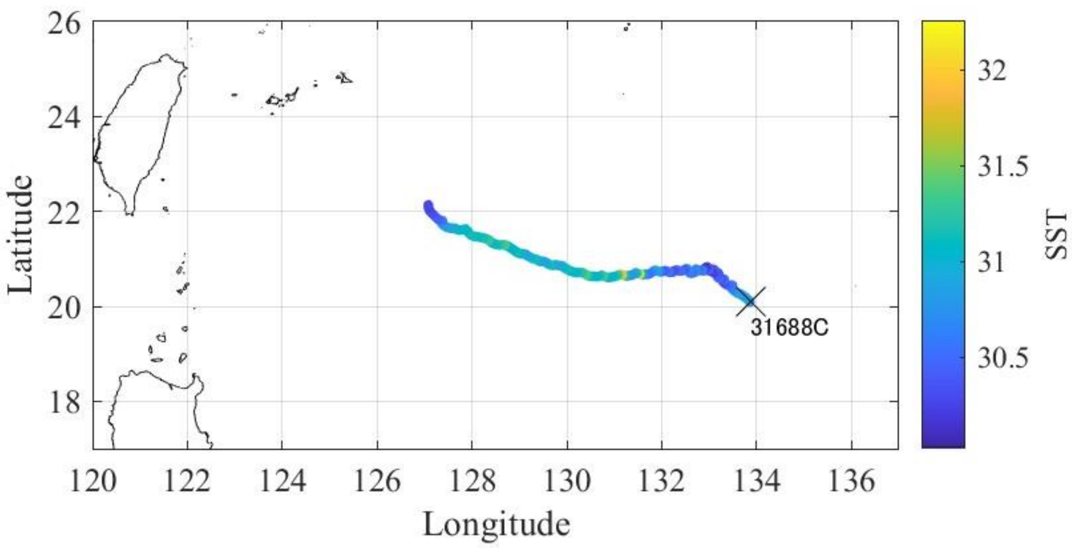
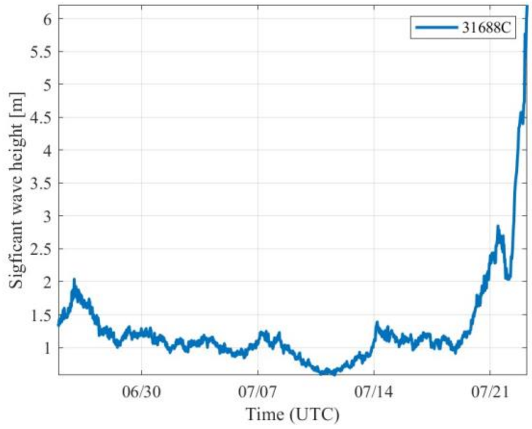
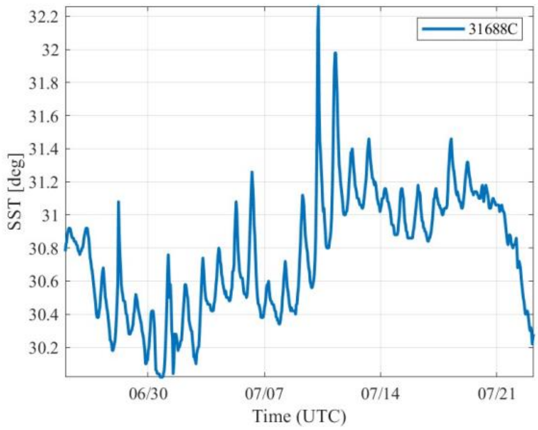


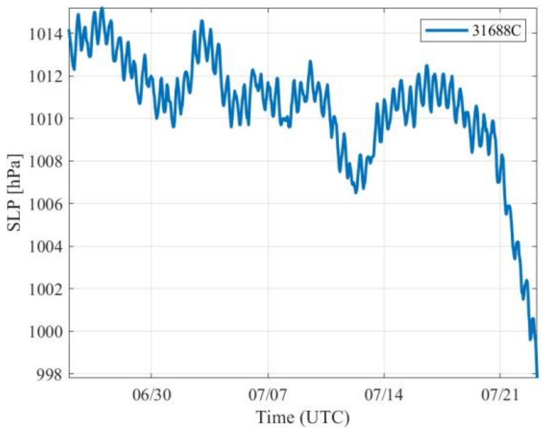
Figure 5.25-1: Track of the buoy with colored by sea surface temperature (SST) from June 25th to July 23th.



(a) Significant wave height



(b) Sea surface temperature



(c) Sea surface pressure

Fig. 5.25-2: Time-series of significant wave heights, sea surface temperature, and sea level pressure from June 25th to July 23th.

5.26 ARGO float

(1) Personnel

Satoru YOKOI (JAMSTEC) - Principal Investigator
Ayako SEIKI (JAMSTEC)

(2) Objectives

The objective of the observation is to measure vertical profiles of sea-water temperature and salinity for investigating oceanic mixed layer structure and air-sea interaction.

(3) Methods

An APEX profiling float manufactured by Teledyne Webb Research was deployed on the way from Shimizu to the station observation point. Information of the deployment is summarized in Table 5.26-1. It has been measuring vertical profile of sea-water temperature and salinity above 500 dbar at about 1000 UTC (1900 Local Time) every day. Note that the float is equipped with RBRargo CTD sensor.

(4) Preliminary Results

Figure 5.26-1 shows the track of the float up to July 26, 2024, while Fig. 5.26-2 shows time-depth cross section of temperature and salinity.

(5) Data archive

The ARGO float data with real-time quality control are provided to Global Data Assembly Center (https://www.euro-argo.eu/ , https://www.coriolis.eu.org/). Delayed mode quality control is conducted for the float data within 6 months ~ 1 year, to satisfy their data accuracy for the use of research.

Table 5.26-1: Information of the deployment of the floats.

S/N	WMO number	Date and time (UTC)	Latitude	Longitude
10462	1902344	22:24 UTC, 25 June 2024	16-00N	134-00E

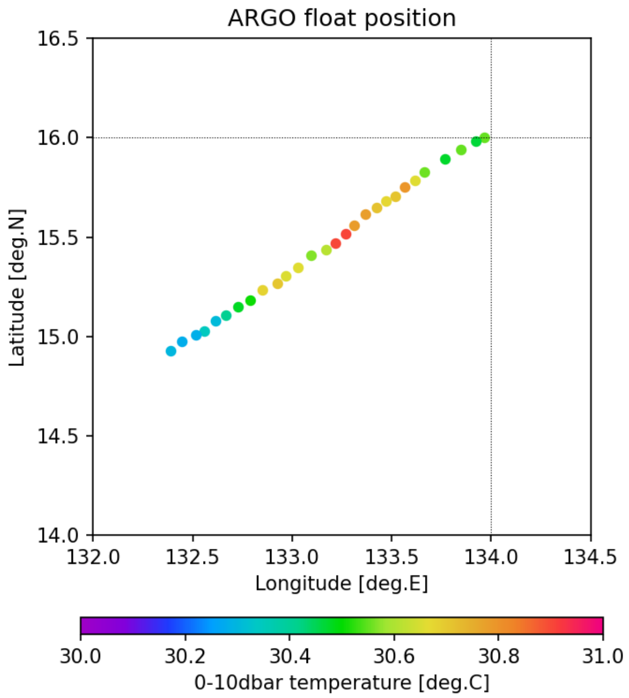


Figure 5.26-1: Track of the float from June 26 to July 26, 2024. Colors indicate temperature averaged from the surface to 10-dbar depth. Dashed lines indicate longitude and latitude of the deployment position. Since the deployment, the float moved southwestward.

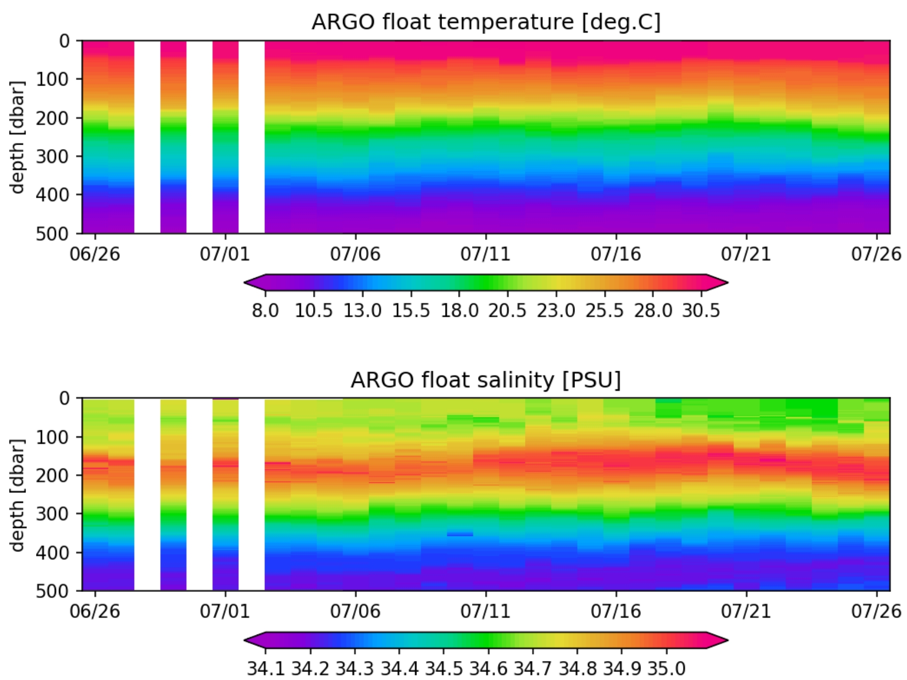


Fig. 5.26-2: Time-depth cross section of (top) temperature and (bottom) salinity observed by the float from June 26 to July 26, 2024.

5.27 Wave Glider

(1) Personnel

Satoru YOKOI	(JAMSTEC)	:Principal Investigator
Masaki KATSUMATA	(JAMSTEC)	
Ayako SEIKI	(JAMSTEC)	
Nobuhiro FUJII	(MWJ)	:Operation leader
Yuki MIYAJIMA	(MWJ)	
Yasuhiro ARII	(MWJ)	
Tomoki NAKAMURA	(MWJ)	
Kengo FUJITA	(MWJ)	
Iwao UEKI	(JAMSTEC)	Not Onboard
Tatsuya Fukuda	(JAMSTEC)	Not Onboard
Yasuhisa Ishihara	(JAMSTEC)	Not Onboard
Makito Yokota	(MWJ)	Not Onboard
Ichiro TAKAHASHI	(MWJ)	Not Onboard
Takayuki Hashimukai	(MWJ)	Not Onboard
Shino Sakabe	(MWJ)	Not Onboard
Tetsuya Nagahama	(MWJ)	Not Onboard
Noriko KAWAKAMI	(MWJ)	Not Onboard

(2) Objectives

The processes at the ocean surface are the key factors in the weather and climate system, through the surface flux (heat, fresh-water, momentum). As a latest successor of the ocean surface platform to observe in-situ surface fluxes, the unmanned ocean-surface vehicle named Wave Glider has been utilized in recent years. In the present cruise, we deployed three Wave Gliders around R/V Mirai to obtain meso-scale spatiotemporal distribution of the surface fluxes and related near-surface status of the ocean and atmosphere.

(3) Instrumentation

(3-1)Wave Glider (as a platform)

The Wave Glider is an autonomous ocean surface vehicle, which utilize both wave energy for propulsion and solar power for supporting on-board computing, communications and sensor payloads. It can travel tens of thousands of miles, collecting data in the most demanding conditions, and deliver this data in real time. The Wave Glider is consisted by two-part architecture; surface float and underwater glider with umbilical cable (Fig. 5.27.-1).

In the present cruise, we utilized 3 Wave Gliders, as listed in Table 5.27-1. The configurations are common for SV3-248 and SV3-252, while SV3-198 differ from other two.

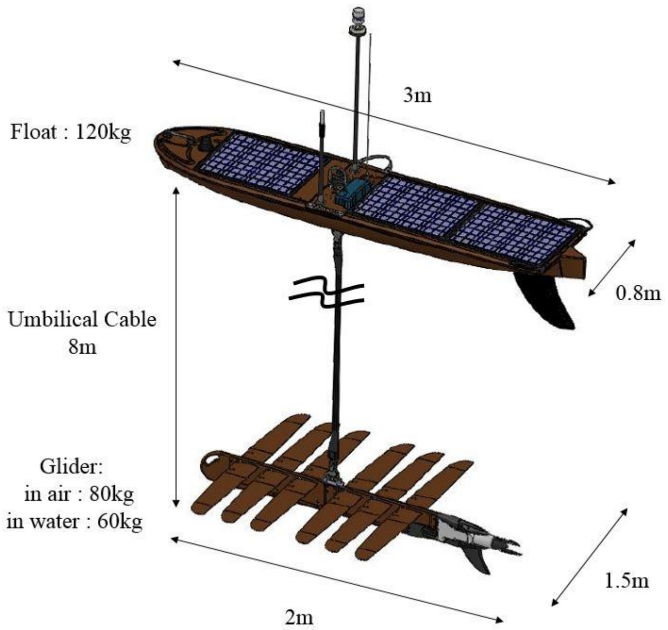


Fig. 5.27-1: Wave Glider SV3 configuration (from Liquid Robotics Inc.)

Table 5.27-1: List of Wave Glider vehicles used in the present cruise.

Name of Vehicle	Dimension of the float	Length of Umbilical Cable	Paint of the float / glider parts
SV3-196	213 x 142 x 21 (cm)	8 meters	Biofauling–resistant coating (color: yellow)
SV3-248	220 x 145 x 33 (cm)	8 meters	Copper anti-biofouling coating
SV3-252			

(3-2) Onboard sensors for oceanic parameters

The Wave Glider in the present study equipped sensors for underwater part as listed in Table 5.27-2. Some sensors were connected to the onboard logger system to store the data and transmit a part of the data in real-time, while other sensors stored its data inside the sensor unit itself. All of the stored data will be recovered after the cruise.

(3-3) Onboard sensors for atmospheric parameters

The Wave Glider in the present study equipped sensors for atmospheric part as listed in Table 5.27-3. As in the table, several types of the meteorological sensor packages were installed; Weather Station (manufactured by Airmar), Weather Transmitter (manufactured by Vaisala Oyj), and Easy JAMMET (developed and assembled by JAMSTEC). The location of the sensors are shown in Fig. 5.27-2. The data were stored in the onboard logger system, and a part of the data were transmitted in real-time. In addition, the receivers of GNSS signals to estimate the column water vapor were also equipped to store the data. All of the stored data will be recovered after the cruise

(3-4) Other equipments

To monitor the status of the vehicle, Front-View camera were attached on SV3-196 and SV3-252. SV3-248 was installed Around-View camera which can capture 360 degree.

Table 5.27-2: List of sensors for the underwater measurements.

Attached Part	Name (type) of Sensor	Recorded Parameter	Notes
Float	Aanderaa 5860B	Temperature Conductivity	Nominal depth of the sensor: 0.2m
	RBR duet TD	Temperature Pressure	
	WH-ADCP (300 kHz)	Vertical profile of current direction and Speed	
Glider	SBE 37	Temperature Conductivity Pressure	
	RBR duet TD	Temperature Pressure	

Table 5.27-3: List of sensor for the atmospheric measurements.

Package	Sensor	Recorded Parameter	# in Fig. 5-27.2	Nominal height ASL [m]	Notes
Wind sensor	R.M. Young 86000	Wind direction and speed	a	1.2	
GNSS receiver	Advanced Navigation, Spatial Dual	GNSS signals (for precipitable water)	b	(N/A)	2 antennas
Weather Station	Airmar PB200	Wind direction and speed Temperature Pressure	c	1.2	
Weather Transmitter	Vaisala WXT533	Rain rate Wind direction and speed	d	1.2	
Easy JAMMET	GE Druck RPS8100	Air Pressure	1	0.8	
	Rotronic MP102H	Temperature Relative humidity	2	0.9	
	Eppley SPP	Downward shortwave radiation	3	1.2	
	Eppley PIR	Downward longwave radiation	4	1.2	SV3-196 not installed
3DWND	WindMaster2 Spatail	3 dimensional wind speed Sound speed Sonic temperature	b	0.9	Only SV3-252 installed

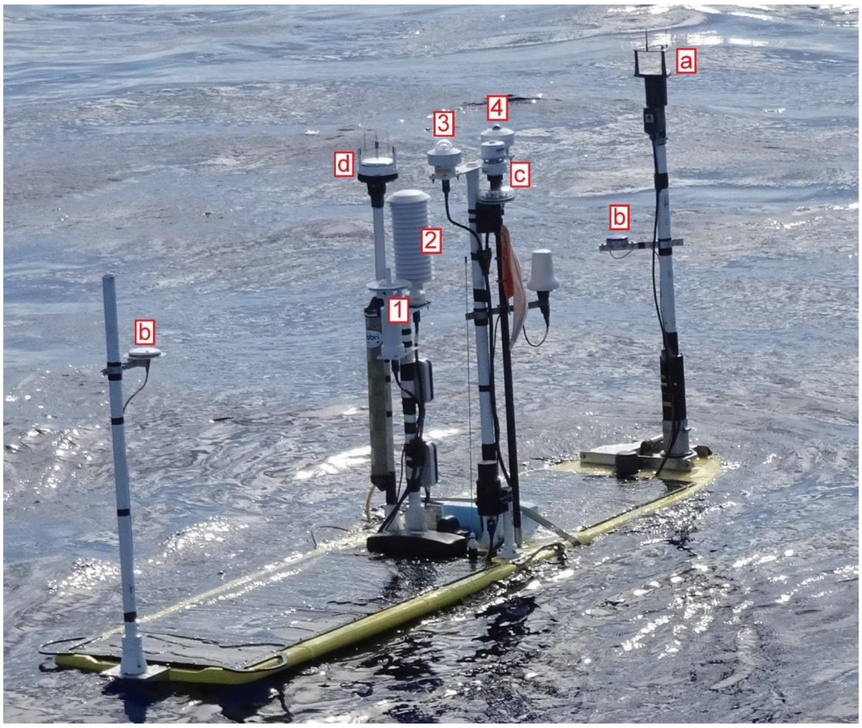


Fig. 5.27-2: Location of the sensors for the atmospheric measurements listed in Table 5.27-3.

(4) Methods

We deployed 3 Wave Gliders in total. The Wave Gliders were deployed (left it on the water to start observation) from and recovered (to pick it up from the water to end the observation) by the R/V Mirai. The operation of the vehicle and the monitoring of the vehicle status and observed data were handled by the member onshore.

The deployment from R/V Mirai was on Jun. 27 nearby the Station (15N, 132E). The recovery by R/V Mirai was on Jul. 19 nearby the Station (15N, 132E). The period was consisted from four stages as follows.

(a) Intercomparison [Jun. 27 (in SMT=UTC+9) to Jun. 28]

The stage was set to compare the data from all Wave Gliders and R/V Mirai each other. This was to evaluate possible bias between data from all platforms. The all Wave Gliders were deployed nearby R/V Mirai before 0100 UTC on Jun. 27. After the deployment, the all Wave Glider and R/V Mirai stayed until 0500 UTC on Jun. 28 (> 24 hours in total) at the designated stations near R/V Mirai. The stations for Wave Gliders located ~ 6 km apart to the north-east to south-east from R/V Mirai which stayed half of the circle within ~ 4 km from the Station (15N, 132E). On R/V Mirai, radiosonde launched at every 3 hours (Section 5.1) and profiling by

RINKO profiler and CTDO profiling (Section 5.17) were also carried out at every 3 hours, as well as other continuous observations during the period.

(b) Transition to the stations [Jun. 28 to Jun. 29]

The stage was to transfer the Wave Gliders from the stations (a) to the stations (c). The Wave Glider traveled by themselves.

(c) Networked observation at stations [Jun. 29 to Jul. 18]

During the stage, each Wave Glider kept each designated station, to form the observation network. The location of each Wave Glider is set 50 km apart to the north-east, south-east and west from R/V Mirai Station (12N, 135E), as shown in Fig. 5.27-3. Actually, each Wave Glider kept on shuttling along the designated line, to ensure the quality of ADCP data by cruising the vehicle with minimal direction shift.

The Wave Gliders arrived the designated stations at or before 0000 UTC on Jun. 29. After the networked observation, all the vehicle departed these stations after 0900 UTC on Jul. 18. The period for the networked observation can be regarded between these two timestamps.

(d) Transition for recovery [Jul. 18 to Jul. 19]

After 0900 UTC on Jul. 18, all the Wave Gliders traveled east of R/V Mirai to wait for the recovery. All the vehicles were recovered until 04UTC of Jul. 19. After each recovery, RINKO profiler was carried out to compare the sensor-observed value.

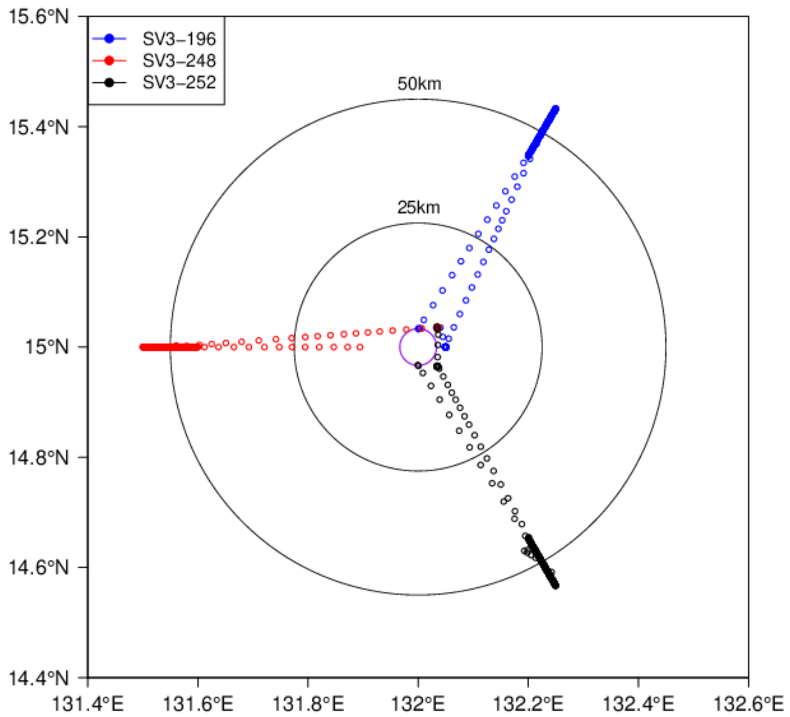


Fig. 5.25-3: Cruise tracks of the Wave Gliders. Red, Blue and Black circles are the hourly position of SV3-248 (for Station-WEST), SV3-196 (occupied Station-NORTH-EAST), and SV3-252 (occupied Station-SOUTH-EAST), respectively. Purple circle indicates the area of the Station (15N, 132E) for R/V Mirai (2-miles radius from the exact (15N, 132E). Black rings indicate the distance from (15N, 132E).

(5) Preliminary Results

We successfully deployed and recovered all three Wave Gliders. A part of the obtained dataset from each vehicle, which was transmitted in real-time, is shown in Figs. 5.27-4, 5.27-5 and 5.27-6 for SV3-196, SV3-248, SV3-252, respectively. The data was well captured, at least qualitatively, with characteristics of the atmospheric and oceanic variations, such as diurnal warming of SST (panel e), immediate air temperature drop and sea surface salinity drop associated with precipitation (panels a, b, and e), and so forth.

The full dataset will be retrieved from the data loggers after the cruise. Data evaluation, quality control, and further analyses will be after the cruise.

(6) Data Archive

All data obtained during this cruise will be submitted to the JAMSTEC Data Management Group (DMG) after quality control is made. In addition, all data will be archived and available from JAMSTEC Wave Glider site at https://www.jamstec.go.jp/ipobs/waveglider/index.html

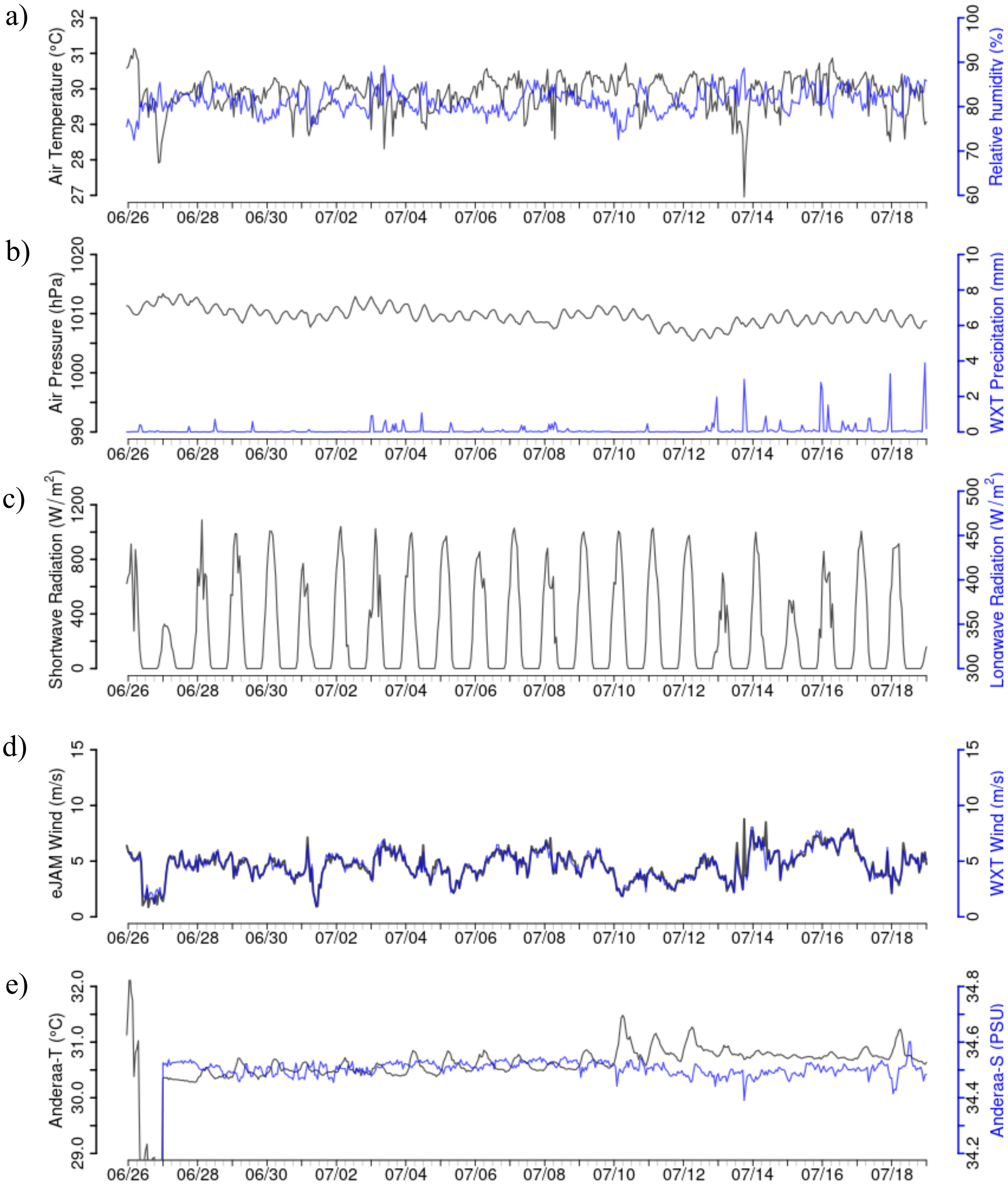


Fig. 5.27-4: Results of observation by the the Wave Glider SV3-196, which occupied “Station-NORTH-EAST”. a) air temparature, relative humidity, b) barometric pressure, precipitation, c) Shortwave radiation, Longwave radiation, d) wind speed , e) sea surface temperature, sea surface salinity.

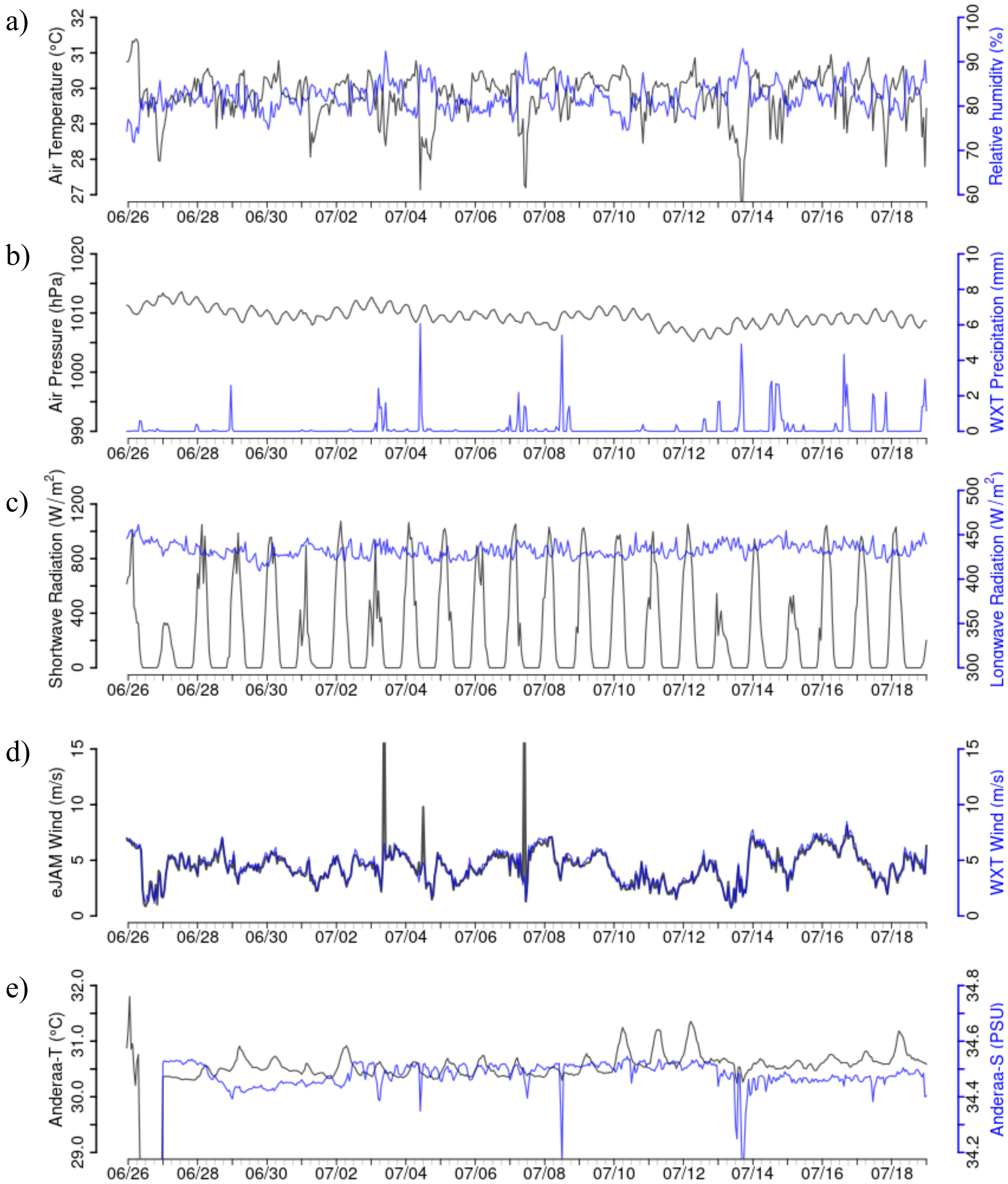


Fig. 5.27-5: Same as Fig. 5.27-4, except by Wave Glider SV3-248, which occupied “Station-WEST”.

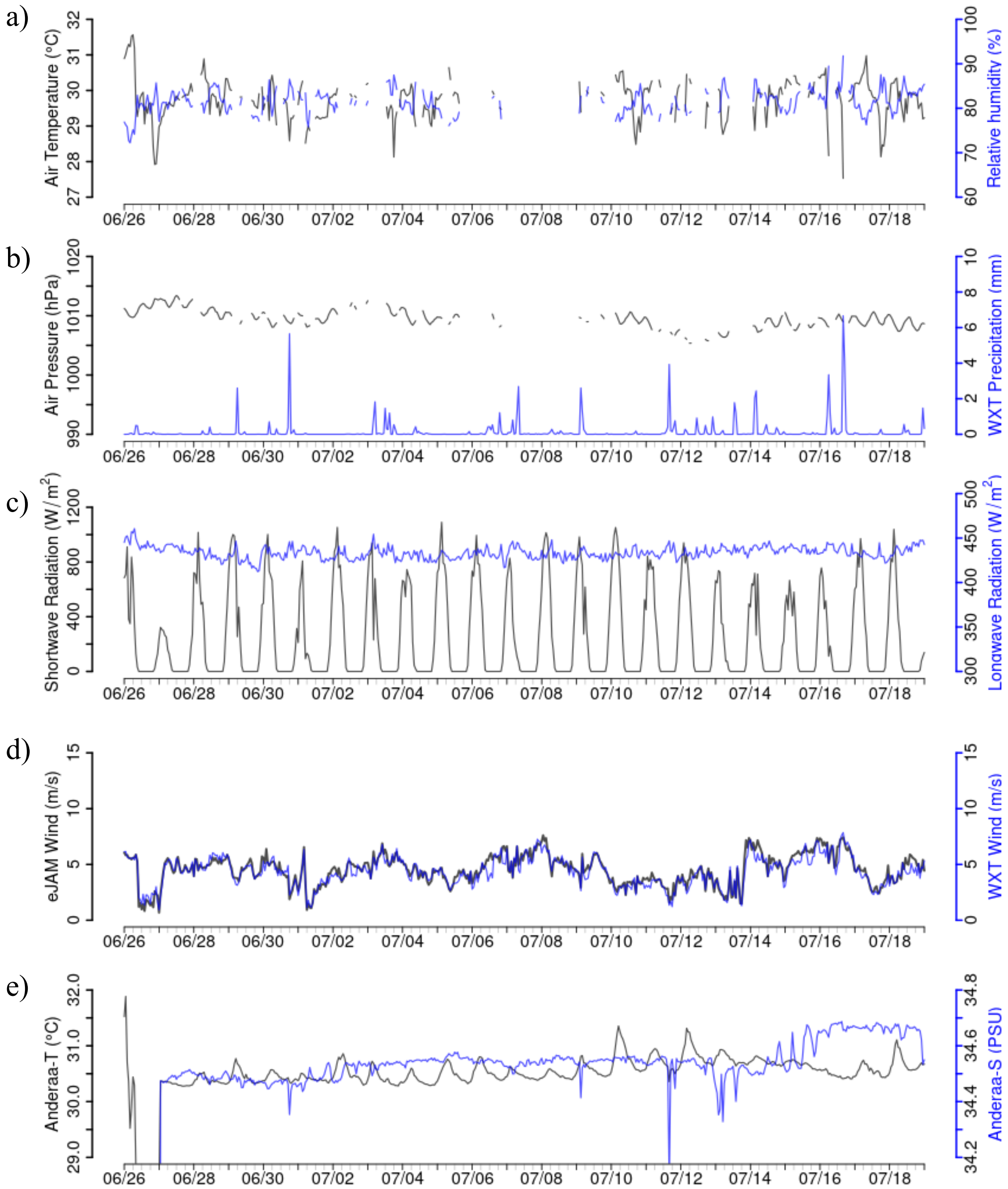


Fig. 5.27-6: Same as Fig. 5.27-4, except by Wave Glider SV3-248, which occupied "Station-SOUTH-EAST". Note that Air temperature, relative humidity and air pressure were occasionally missed due to unknown reasons.

5.28 Surface drifters for near-surface stratification

(1) Personnel

Gilles REVERDIN	(LOCEAN)	(not on board)
Christophe NOISEL	(LOCEAN)	(not on board)
Hugo BELLENGER	(LMD)	(not on board)
Antonio LOURENÇO	(LOCEAN)	
Masaki KATSUMATA	(JAMSTEC)	
Satoru YOKOY	(JAMSTEC)	

(2) Objective

The oceanic near-surface layer is critical to dominate the (latent and sensible) heat flux to the atmosphere, while the layer is severely affected by the atmospheric processes. To investigate the very detailed spatiotemporal structure of the near-surface layer and its relationship to the ocean-atmosphere processes, we deployed two sets of the drifter buoys, which are capable to retrieve the stratification within the first meter layer with very high temporal resolutions (0.1 to 30secondes).

(3) Instrumentation

(3-1) SURPACT

The SURPACT (manufactured by SMRU [Sea Mammal Research Unit, University of St. Andrews, UK]), is a small drifter buoy. It is designed to have the sensor for water temperature and conductivity at 5-cm depth. The vertical acceleration is also measured to estimate the wave height. In addition, a multi-frequency microphone placed under a small cupola records sounds that can be spectrally analyzed to estimate rainfall. Obtained data can be stored within the buoy, or be sent by Argos satellite communications. For further detail, see Reverdin et al. (2013).

(3-2) IST micro chain

The IST micro chain (assembled by LOCEAN, using sensors manufactured by IST [Innovative Sensor Technology Co., Switzerland]) is a small drifter buoy, which quipped tiny (10 x 6 x 1 mm) 5 sensors for water temperature and conductivity along a nadir-oriented cable (with weight at the bottom) to observe vertical profile down to 1 m depth with the interval of 20 cm.

(3-3) HEREON

The HEREON (manufactured by Helmholtz-Zentrum hereon GmbH, Germany) is a small drifter buoy, to provide the GNSS-based location via GlobalStar telecommunication satellite system, and a Spot Trace GPS. It consists of surface buoy diameter 15cm, heigh 15cm and drogue. The vertical length of the drogue panel is 35 cm, while the top of the drogue is at 105 cm depth.

(3-4) CTD48M

The CTD48M (manufactured by SST [Sea&Sun Technology, Germany]) is an autonomous CTD set to measure conductivity, temperature, depth and chlorophyl at 10Hz. One CTD48M is attached at 50cm below the each HEREON drifters and take the measurements at 90cm depth.

(4) Methods

We deployed the drifters for four times during the stationary observation period at (15N, 132E) for "short deployment" experiments. The deployed drifters are grouped in two sets, and the drifters in each set are connected by floating polypropylene line.

Set 1 included one HEREON, one CTD48M, one SURPACT, and one IST micro chain. HEREON and SURPACT, was tied by a 8m long floating line where SURPACT and IST micro chain, was tied by a 5m long floating line. The SURPACT was set to obtain data every 3 seconds that were stored inside the drifter. The CTD48M is attached to Hereon drifter.

Set 2 was identical to Set 1, except not attaching IST micro chain (i.e. Set 2 consisted of one SURPACT and one HEREON with one CTD48M). Each group are shown in Fig. 5.28-1 and Fig. 5.28-2 as photo. Table 5.28-1 is name and serial numbers of the instruments.

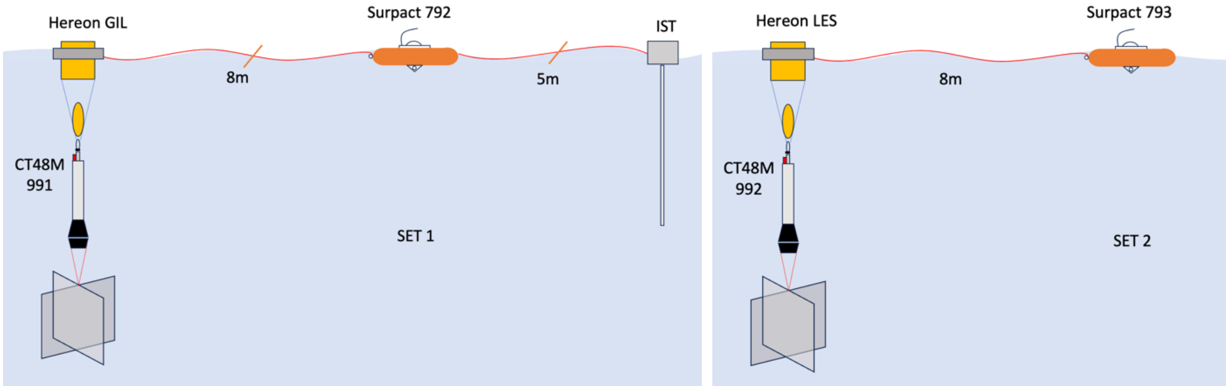


Fig. 5.28-1: Set 1 and 2 are respectively on left and right panels. These two sets were deployed 300m one from each other for all deployments.

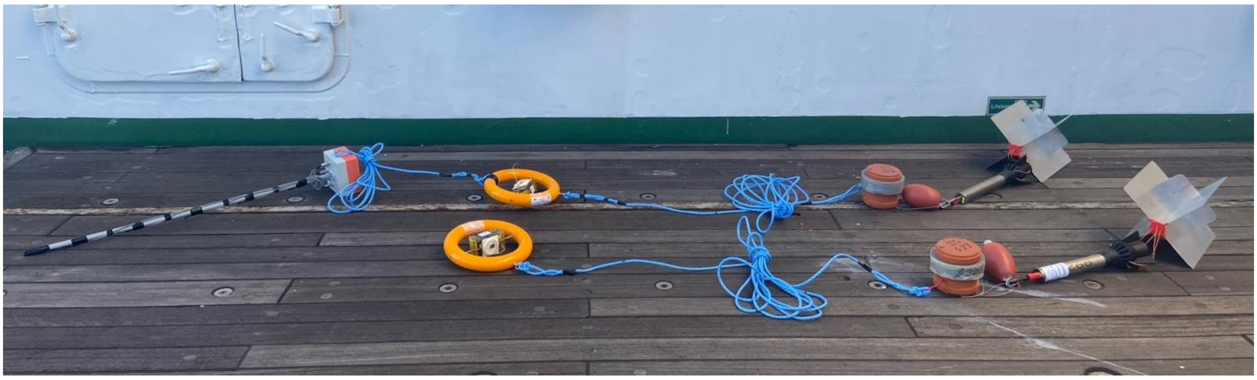


Fig. 5.28-2: The instruments used in the deployments. Front ones are for Set 2, consisted of HEREON drogue and CTD48M (right), HEREON (center), and SURPACT (left). Behind ones are for Set 1, consisted of HEREON drogue and CTD48M (right), HEREON (center-right), SURPACT (center-left) and IST micro chain (left).

Set	Set-1					Set-2				
Deployment	D1	D2	D3	D4		D1	D2	D3	D4	
SURPACT	15792					15793				
HEREON	GIL (340-341)					LES (308-338)				
CTD48M - SST	991	Lost				992				
IST	003					None				

Table 5.28-1: Instruments and its serial numbers used in each deployment.

Deployment information is listed in Table 5.28-2. We released drifters away from the station (15N, 132E), to (1) avoid collision to *Mirai*, which is cruising around the station, and (2) avoid the short-range distance from the vessel where the data from C-band radar (see Section 5.3) degrades. The distance was approximately 8nm for deployments 1, 3 and 4, while 10 nm for 2nd deployment. After the release, the location information was tracked by the reports from HEREON every 5 minutes. Based on the location information, the vessel recovered the drifters in the next day. After each recovery, the observation by RINKO profiler (Section 5.19) was carried out.

Just for notice, the SSST measurement by "Sea Snake" thermistor (see Section 5.5) was paused during the release and recovery ("Sea Snake" can be observable when the ship speed is ≤ 5kt, while we need to steam between the station (15N, 132E) and the point of release / recovery.

Deployment No.	Set	Deployment		Recovery	
		Time	Location	Time	Location
D1	1	29/06/2024 22h48UTC	14°54.43’N 131°54.35’E	01/07/2024 01h41UTC	15°05.91’N 131°55.48’E
	2	29/06/2024 22h42UTC	14°54.47’N 131°54.61’E	01/07/2024 02h03UTC	15°05.83’N 131°56.64’E
D2	1	05/07/2024 22h52UTC	14°48.35’N 132°00.21’E	07/07/2024 02h24UTC	14°47.78’N 131°47.80E
	2	05/07/2024 22h47UTC	14°48.35’N 132°00.02’E	07/07/2024 02h15UTC	14°47.57’N 131°48.89E
D3	1	11/07/2024 22h36UTC	14°53.86’E 131°54.49’N	13/07/2024 02h11UTC	14°51.80’E 131°50.29’N
	2	11/07/2024 22h31UTC	14°53.76’E 131°54.61’N	13/07/2024 01h44UTC	14°51.46’E 131°50.50’N
D4	1	15/07/2024 22h52UTC	14°54.29’E 132°06.24’N	18/07/2024 02h19UTC	14°52.43’E 131°48.25’N
	2	15/07/2024 22h47UTC	14°54.22’E 132°06.07’N	18/07/2024 01h59UTC	14°51.23’E 131°59.58’N

Table 5.28-2: List of the observations. Locations of the drifters when deployed / recovered.

(5) Preliminary Results

We **successfully** deployed and recovered the drifters for four deployments shown in Fig. 5.28-3.

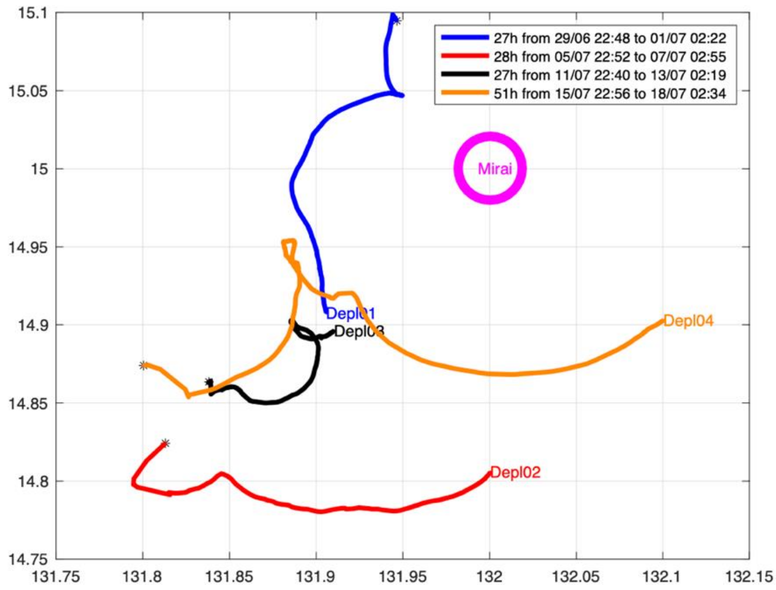


Figure 5.28-3: Trajectory of the four deployments (the 2 sets stays less than 1NM one from each other).

An example of the data obtained is shown in Fig. 5.28-4. The time series well shows 3 drops of salinity recorded by SURPACT at 08 UTC, 14UTC and to 16.30 UTC on July 16th. The C-band radar (see Section 5.3) captured the rain signals in the vicinity of the drifters at the time.

Better understanding and testing of the signals recorded by the IST micro chain prototype, and further analyses will be done after the cruise.

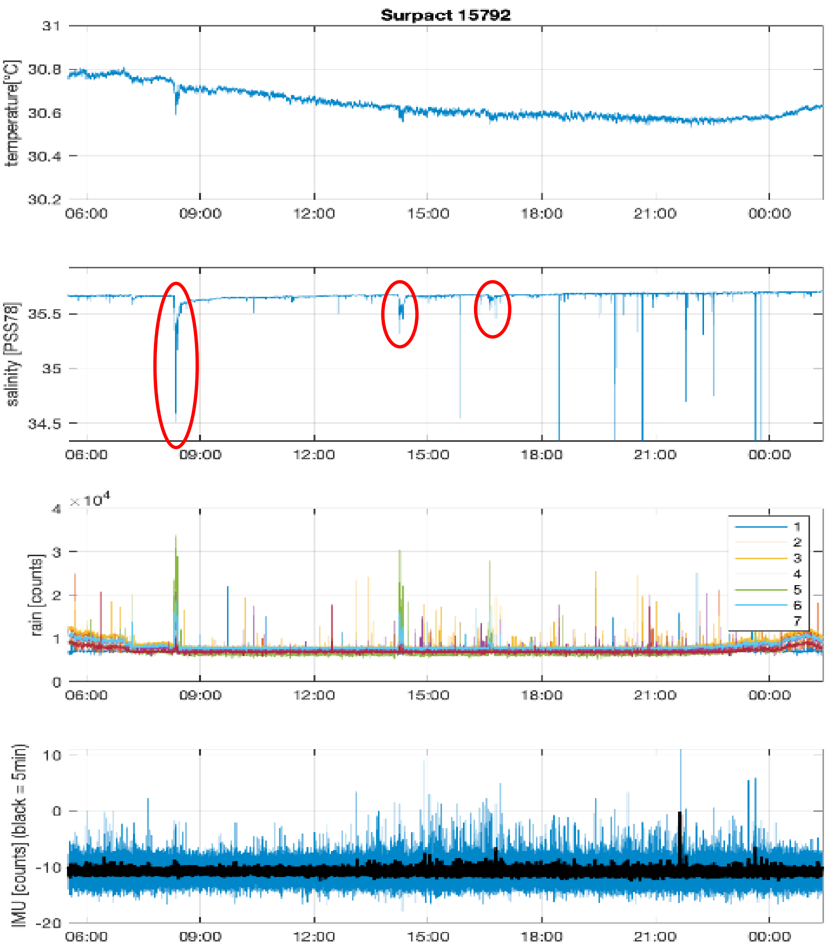


Figure 5.28-4: Time series of the temperature (panel 1) and salinity (panel 2) obtained by SURPACT during the deployment 4. Panel 3 and 4 show respectively the rain and the sea state. The 3 red circles are the 3 rain events recorded. Note that the data are uncorrected.

(6) Data Archive

All data obtained during this cruise will be submitted to the JAMSTEC Data Management Group (DMG), as well as will be archived at LOCEAN, France.

5.29 Underway Geophysics
5.29.1 Sea surface gravity

(1) Personnel

Satoru YOKOI	(JAMSTEC)	- Principal Investigator
Ryo OYAMA	(NME)	- Operation Leader
Souichiro SUEYOSHI	(NME)	
Haruna YAMANAKA	(NME)	
Masanori MURAKAMI	(MIRAI Crew)	

(2) Objectives

The local gravity is an important parameter in geophysics and geodesy. We collected gravity data at the sea surface.

(3) Methods

We measured relative gravity using LaCoste and Romberg air-sea gravity meter S-116 (Micro-G LaCoste, LLC) during this cruise. Parameters of gravity meter are as follows:

Relative Gravity [CU: Counter Unit]
[mGal] = (coef1: 0.9946) * [CU]

(4) Preliminary result

Absolute gravity table was shown in Table.5.29.1-1.

Table 5.29.1-1 Absolute gravity table

No.	Date m/d	UTC hh:mm	Port	Absolute Gravity [mGal]	Sea Level [cm]	Ship Draft [cm]	Gravity at Sensor *1 [mGal]	S-116 Gravity [mGal]
#1	6/20	09:05	Shimizu	979728.98	142	644	979729.67	12000.00
#2	7/31	00:58	Shimizu	979728.94	242	646	979729.95	12005.22

*1: Gravity at Sensor = Absolute Gravity + Sea Level*0.3086/100 + (Draft-530)/100*0.2222

(5) Data Archive

These data obtained in this cruise will be submitted to the Data Management Group of JAMSTEC, and will be opened to the public via “Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)” in JAMSTEC web site.

https://www.godac.jamstec.go.jp/darwin/en

5.29.2 Sea surface three-component magnetic field

(1) Personnel

Satoru YOKOI	(JAMSTEC)	- Principal Investigator
Ryo OYAMA	(NME)	- Operation Leader
Souichiro SUEYOSHI	(NME)	
Haruna YAMANAKA	(NME)	
Masanori MURAKAMI	(MIRAI Crew)	

(2) Objectives

Measurement of magnetic force on the sea is required for the geophysical investigations of marine magnetic anomaly caused by magnetization in upper crustal structure. We measured geomagnetic field using a three-component magnetometer during this cruise.

(3) Methods

A shipboard three-component magnetometer system (Tierra Tecnica SFG2018) is equipped on-board R/V MIRAI. Three-axes flux-gate sensors with ring-cored coils are fixed on the fore mast. Outputs from the sensors are digitized by a 20-bit A/D converter (1 nT/LSB), and sampled at 8 times per second. Ship's heading, pitch, and roll are measured by the Inertial Navigation System (INS) for controlling attitude of a Doppler radar. Ship's position and speed data are taken from LAN every second.

i. Principle of ship-board geomagnetic vector measurement

The relation between a magnetic-field vector observed on-board, ***Hob***, (in the ship's fixed coordinate system) and the geomagnetic field vector, ***F***, (in the Earth's fixed coordinate system) is expressed as:

$$\boldsymbol{Hob} = \boldsymbol{A} * \boldsymbol{R} * \boldsymbol{P} * \boldsymbol{Y} * \boldsymbol{F} + \boldsymbol{Hp} \qquad \text{(a)}$$

where, ***R***, ***P*** and ***Y*** are the matrices of rotation due to roll, pitch and heading of a ship, respectively. ***A*** is a 3 x 3 matrix which represents magnetic susceptibility of the ship, and ***Hp*** is a magnetic field vector produced by a permanent magnetic moment of the ship's body. Rearrangement of Eq. (a) makes

$$\boldsymbol{R} * \boldsymbol{Hob} + \boldsymbol{Hbp} = \boldsymbol{R} * \boldsymbol{P} * \boldsymbol{Y} * \boldsymbol{F} \qquad \text{(b)}$$

where $\boldsymbol{R} = \boldsymbol{A}^{-1}$, and $\boldsymbol{Hbp} = -\boldsymbol{R} * \boldsymbol{Hp}$. The magnetic field, ***F***, can be obtained by measuring ***R***, ***P***, ***Y*** and ***Hob***, if ***R*** and ***Hbp*** are known. Twelve constants in ***R*** and ***Hbp*** can be determined by measuring variation of Hob with ***R***, ***P*** and ***Y*** at a place where the geomagnetic field, ***F***, is known.

(4) Preliminary result

The results will be published after primary processing.

(5) Data Archive

These data obtained in this cruise will be submitted to the Data Management Group of JAMSTEC, and will be opened to the public via “Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)” in JAMSTEC web site.

https://www.godac.jamstec.go.jp/darwin/en

(6) Remarks

1. For calibration of the ship’s magnetic effect, we made a “figure-eight” turn (a pair of clockwise and counter-clockwise rotation). These calibrations were carried out as below.

12:47UTC - 13:12UTC, 25 Jun. 2024 around 16-00N, 134-00E.
03:10UTC - 03:35UTC, 18 Jul. 2024 around 14-56N, 131-53E.
23:02UTC - 23:25UTC, 28 Jul. 2024 around 32-12N, 137-07E.

5.29.3 Swath Bathymetry

(1) Personnel

Satoru YOKOI	(JAMSTEC)	- Principal Investigator
Ryo OYAMA	(NME)	- Operation Leader
Souichiro SUEYOSHI	(NME)	
Haruna YAMANAKA	(NME)	
Masanori MURAKAMI	(MIRAI Crew)	

(2) Objectives

R/V MIRAI is equipped with a Multi narrow Beam Echo Sounding system (MBES), SEABEAM 3012 Model (L3 Communications ELAC Nautik). The objective of MBES is collecting continuous bathymetric data along ship's track to make a contribution to geological and geophysical investigations and global datasets.

(3) Methods

The "SEABEAM 3012 Model" on R/V MIRAI was used for bathymetry mapping during this cruise.

To get accurate sound velocity of water column for ray-path correction of acoustic multibeam, we used Surface Sound Velocimeter (SSV) data to get the sea surface (6.62m) sound velocity, and the deeper depth sound velocity profiles were calculated by temperature and salinity profiles from CTD, XCTD and Argo float data by the equation in Del Grosso (1974) during the cruise. Table 5.29.3-1 shows system configuration and performance of SEABEAM 3012 system.

Table 5.29.3-1 SEABEAM 3012 System configuration and performance

Frequency:	12 kHz
Transmit beam width:	2.0 degree
Transmit power:	4 kW
Transmit pulse length:	2 to 20 msec
Receive beam width:	1.6 degree
Depth range:	50 to 11,000 m
Beam spacing:	Equi-Angle
Number of beams:	301 beams
Swath width:	60 to 150 degree (max)
Depth accuracy:	< 1 % of water depth (average across the swath)

(4) Preliminary Result

The results will be published after primary processing.

(5) Data Archive

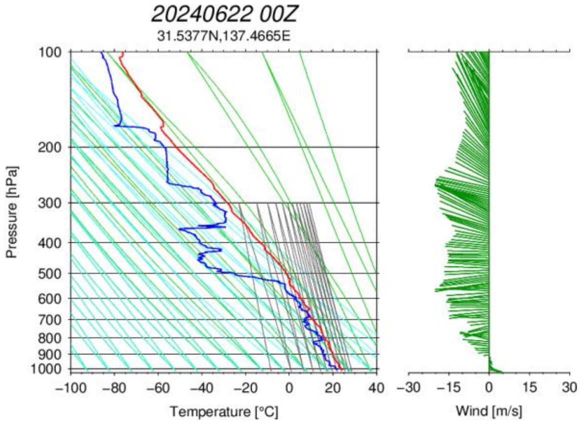
These data obtained in this cruise will be submitted to the Data Management Group of JAMSTEC, and will be opened to the public via "Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)" in JAMSTEC web site.

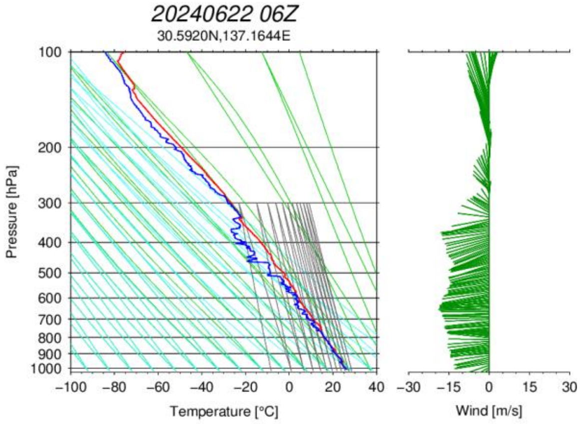
https://www.godac.jamstec.go.jp/darwin/en

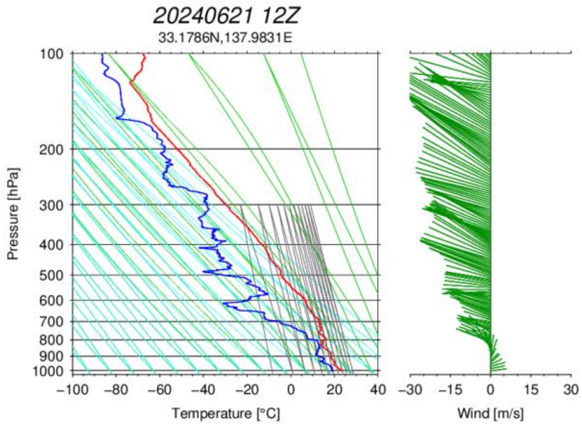
(6) Remarks

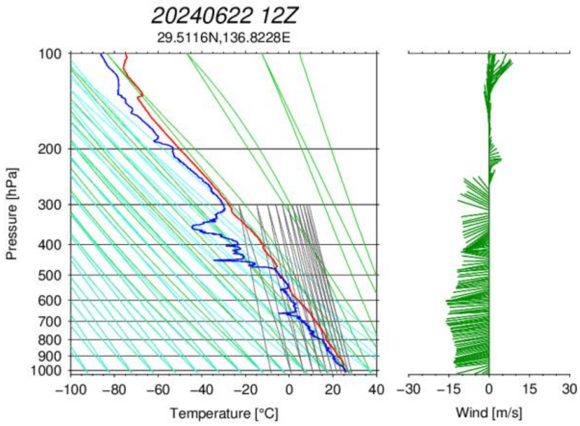
1. Data acquisitions were suspended while stay at the station observation point.
   21:00UTC 27 Jun. 2024 - 00:00UTC 25 Jul. 2024

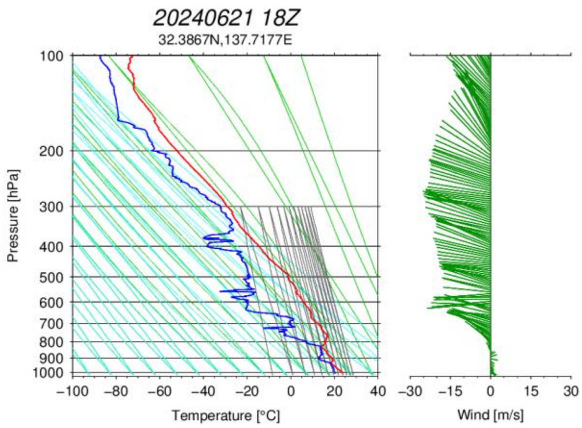
Appendix A: Atmospheric profiles by the radiosonde observations

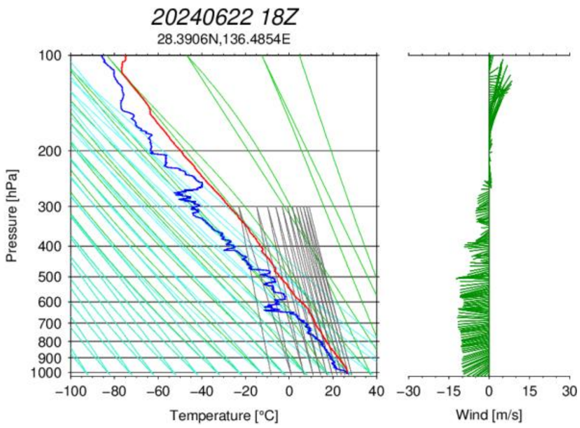












20240623 00Z
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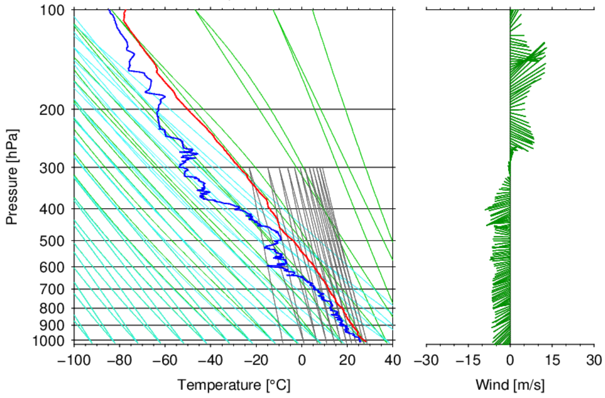

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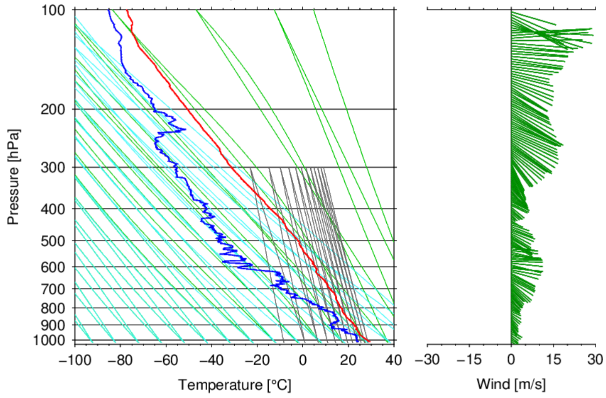

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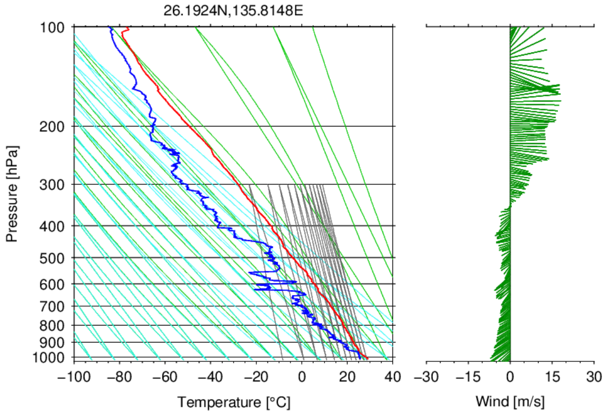

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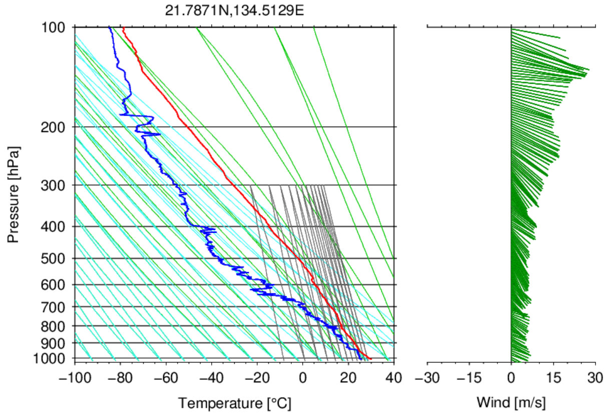

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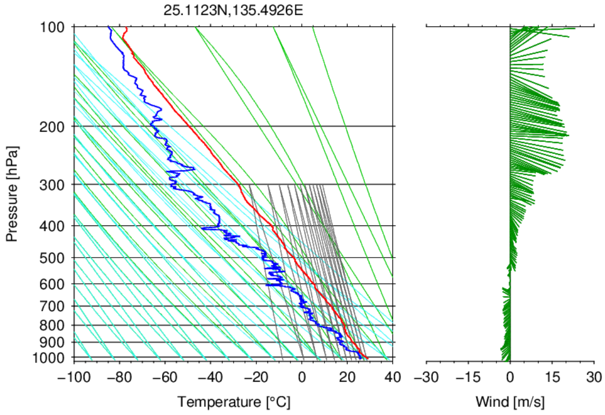

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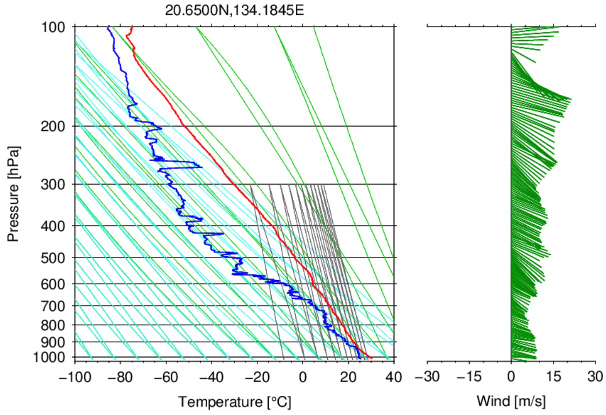

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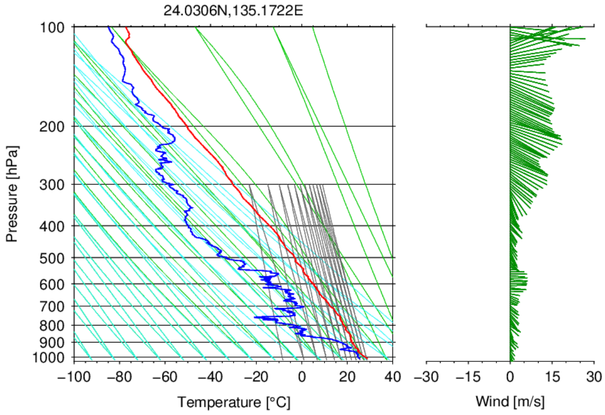

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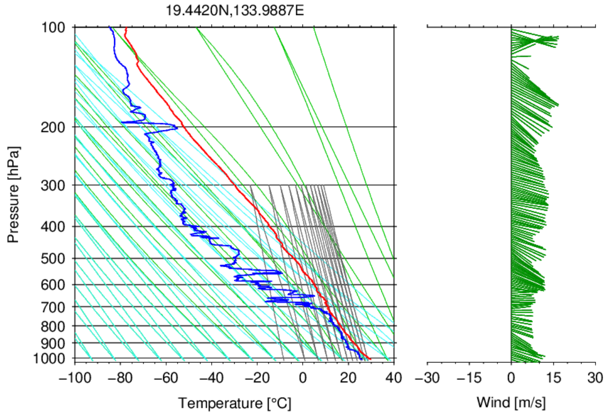

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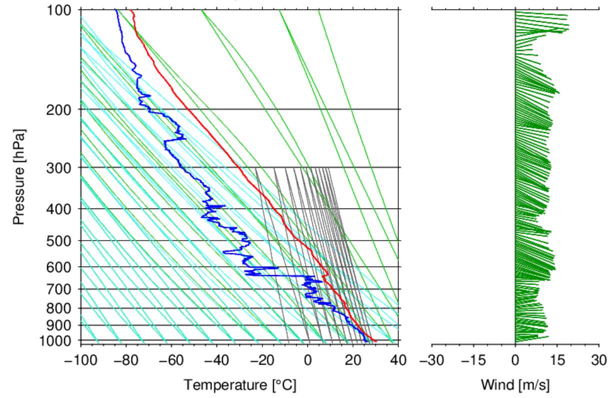

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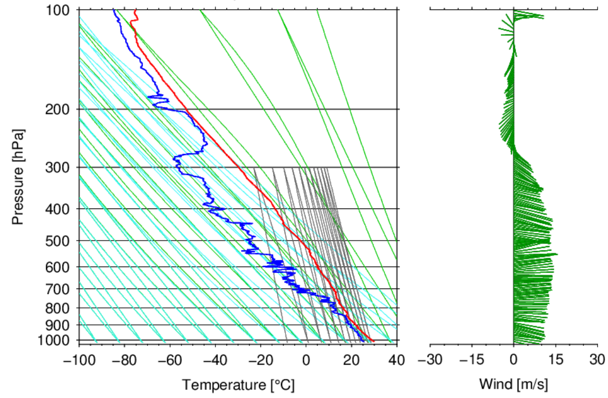

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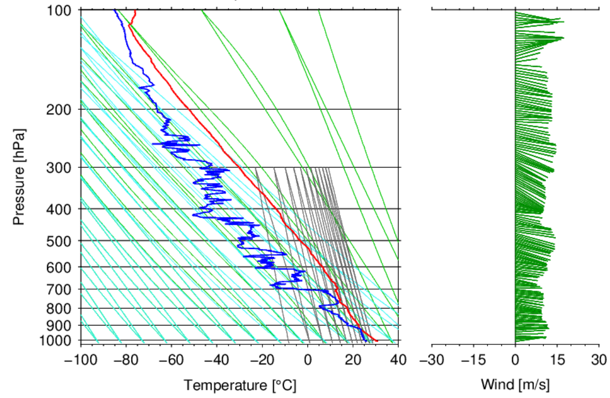

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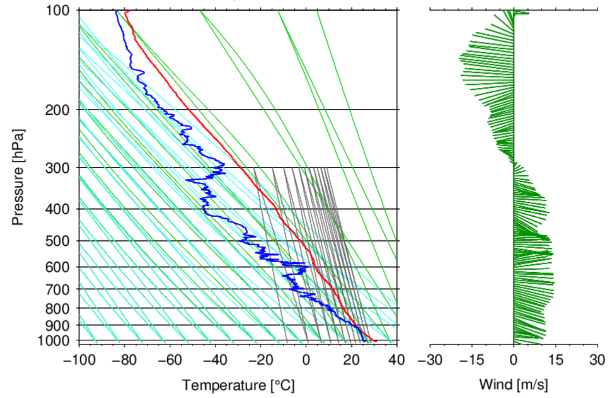

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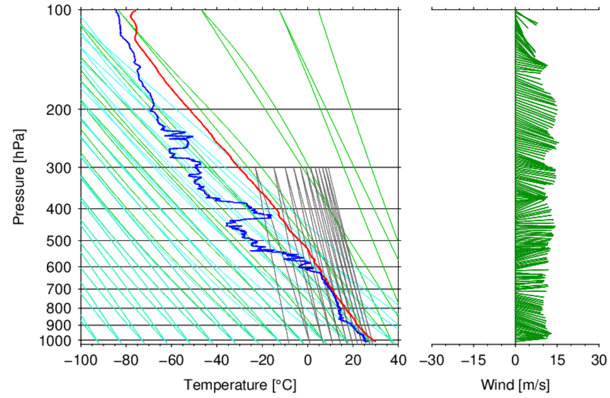

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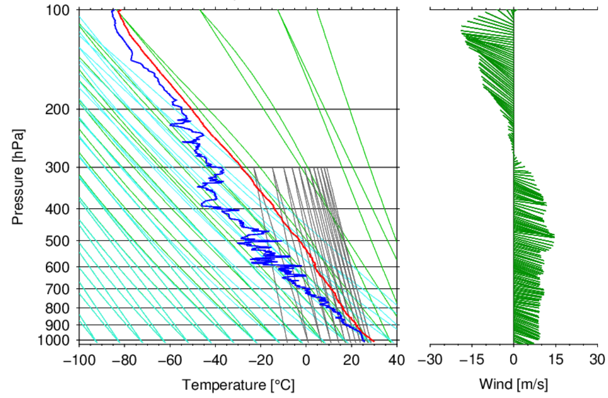

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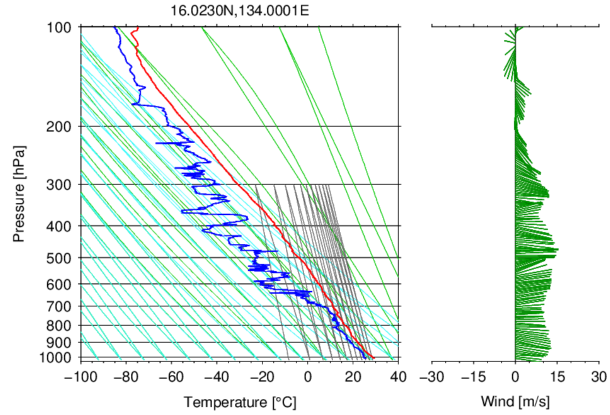

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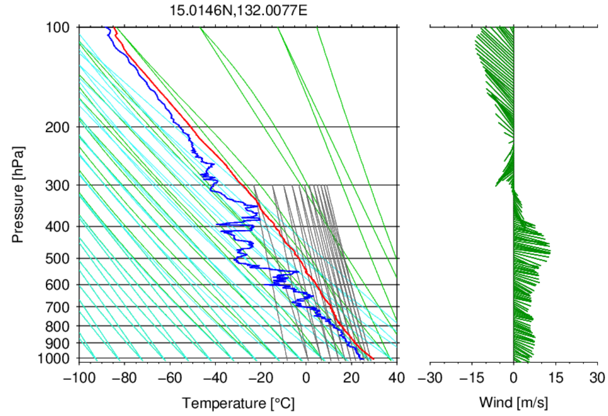

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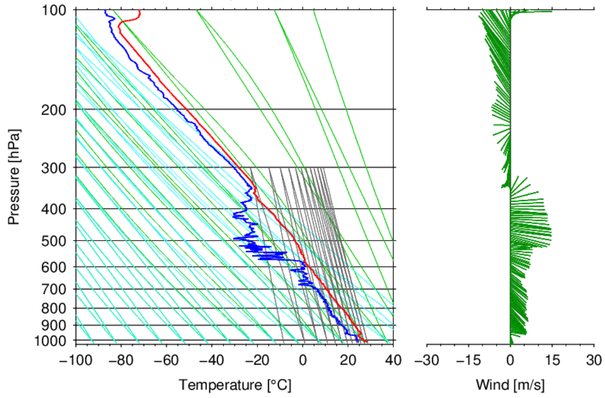

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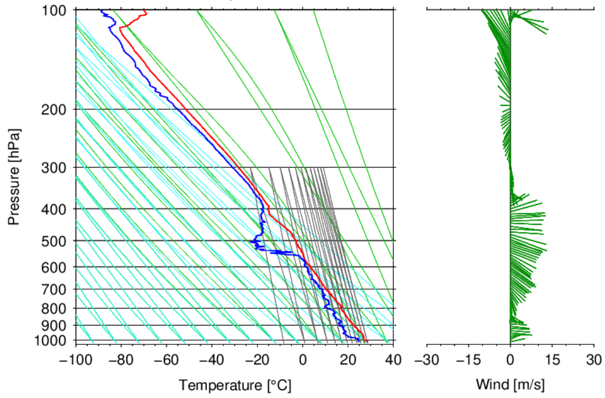

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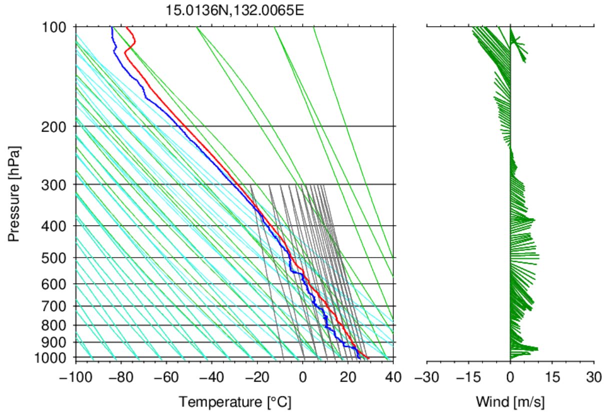

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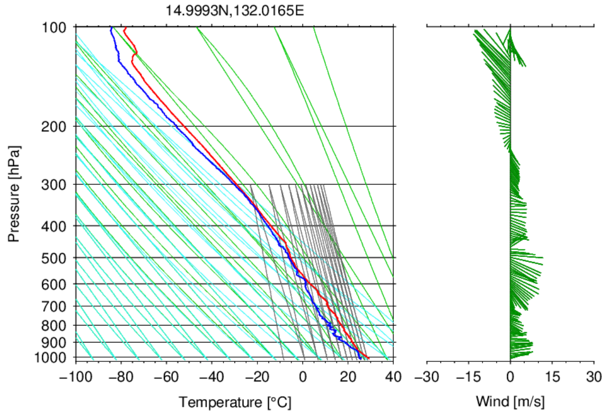

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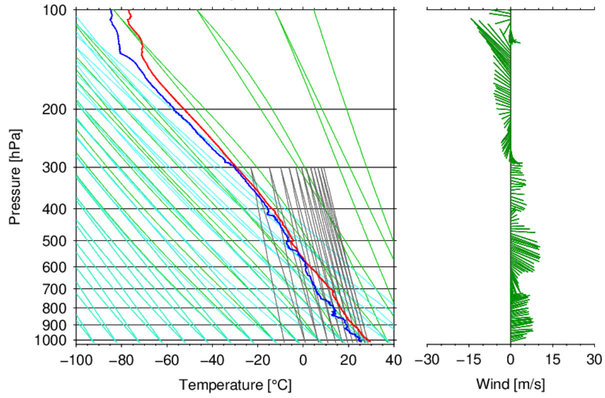

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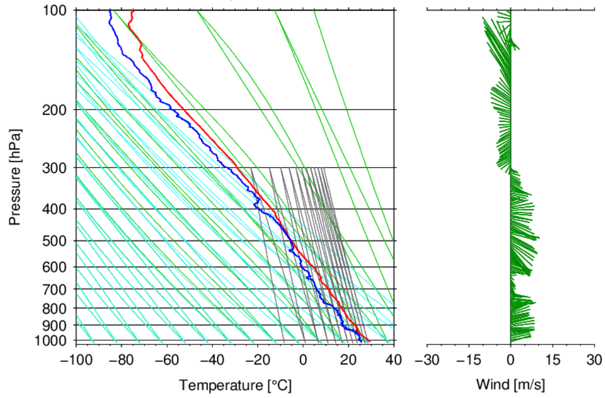

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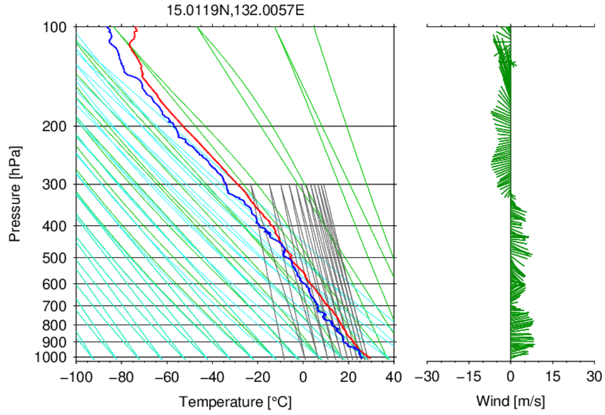

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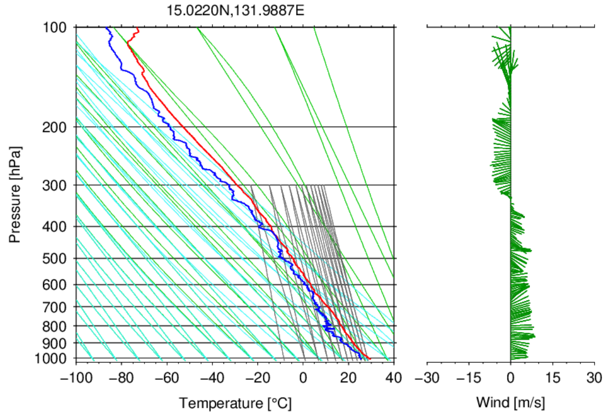

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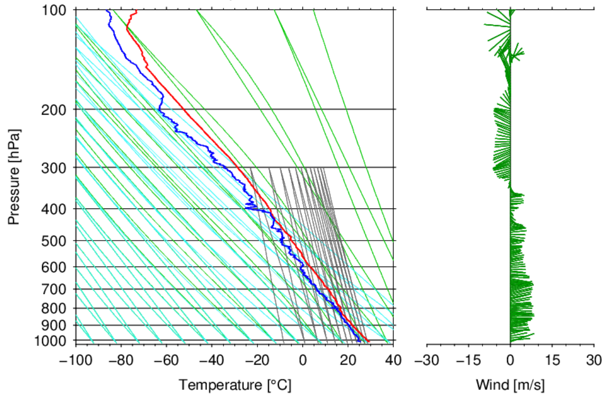

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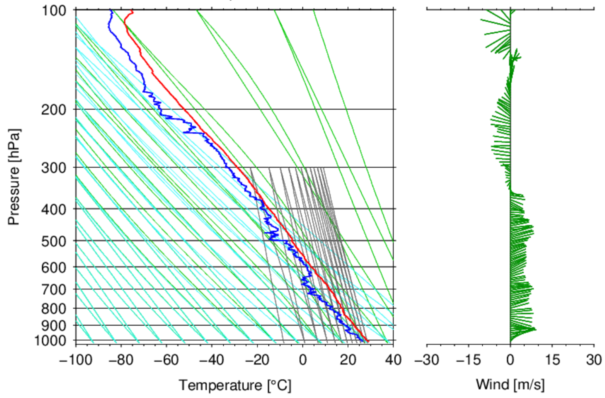

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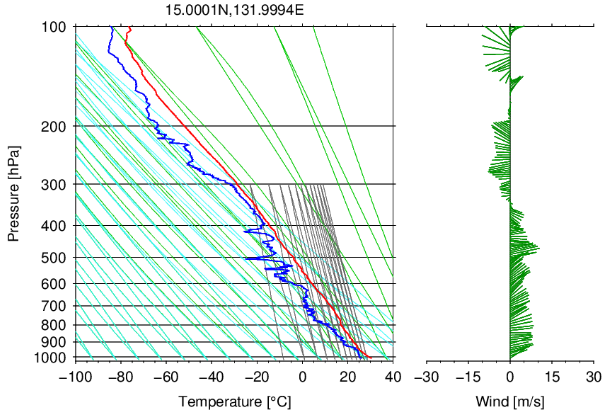

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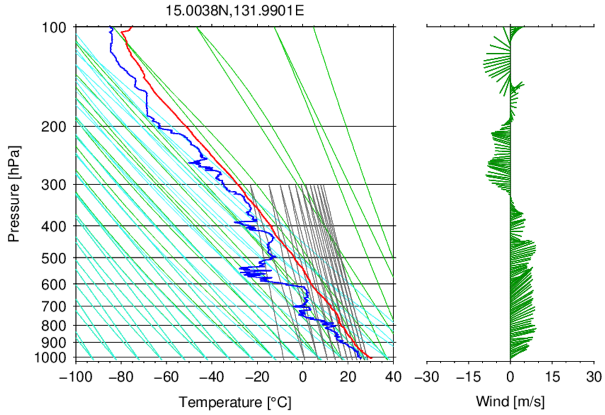

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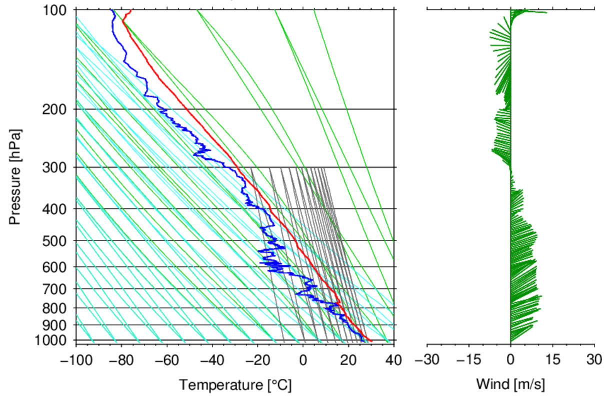

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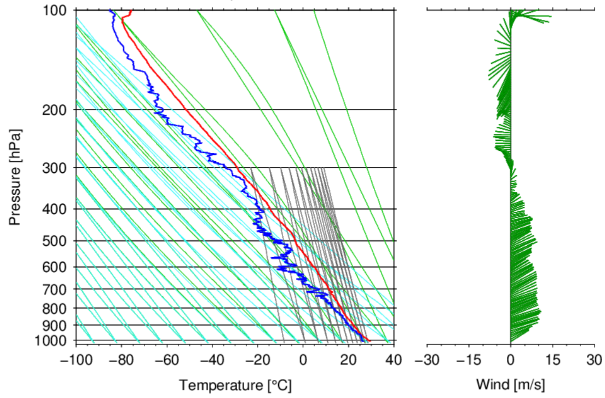

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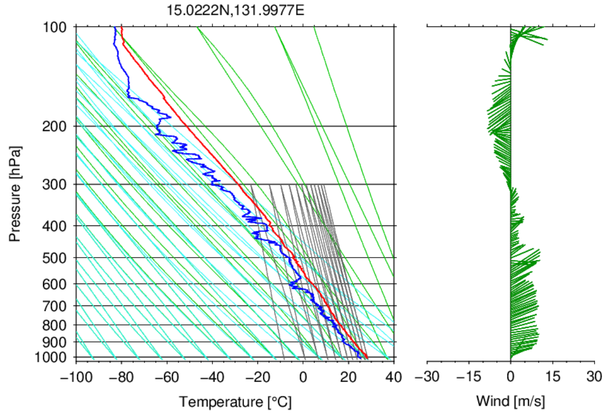

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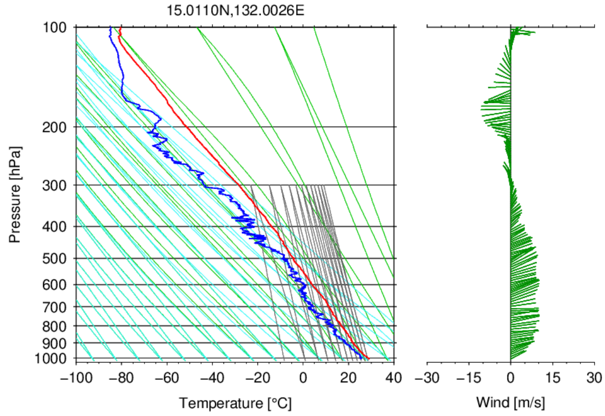

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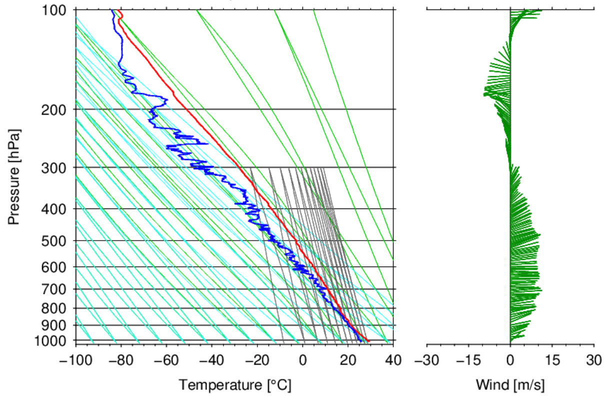

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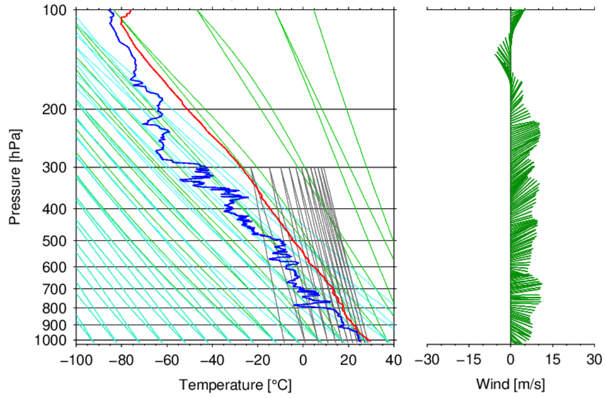

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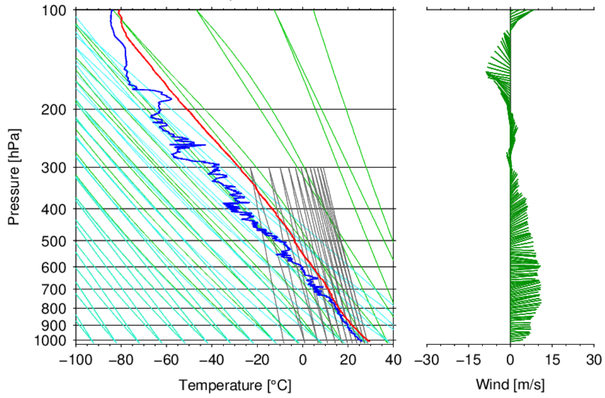

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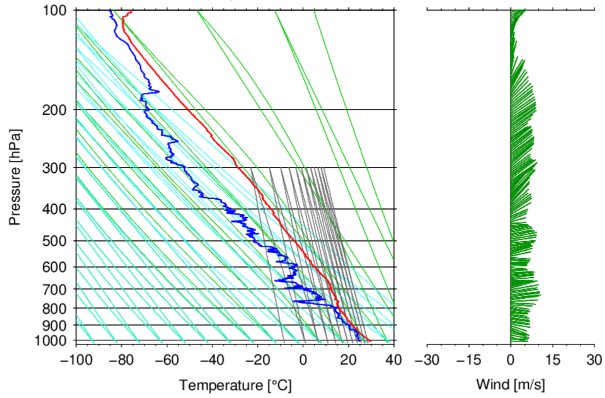

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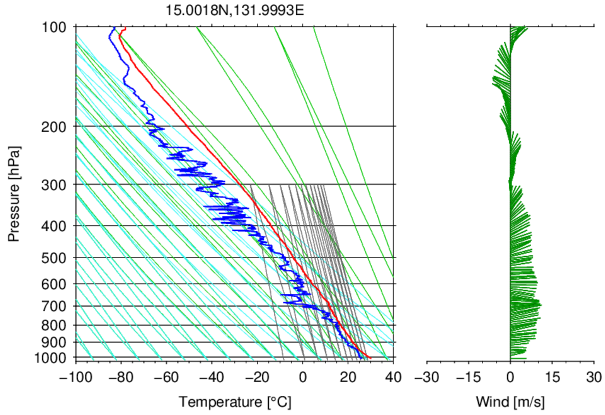

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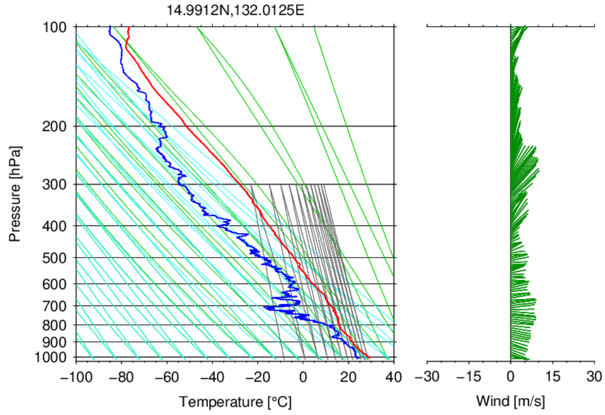

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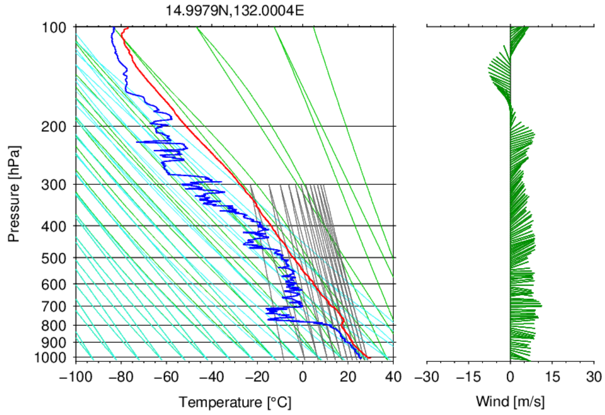

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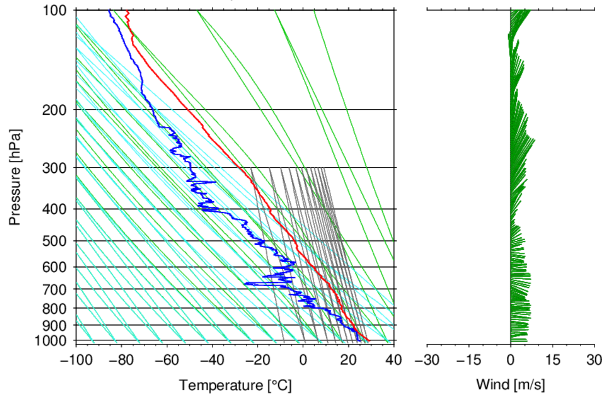

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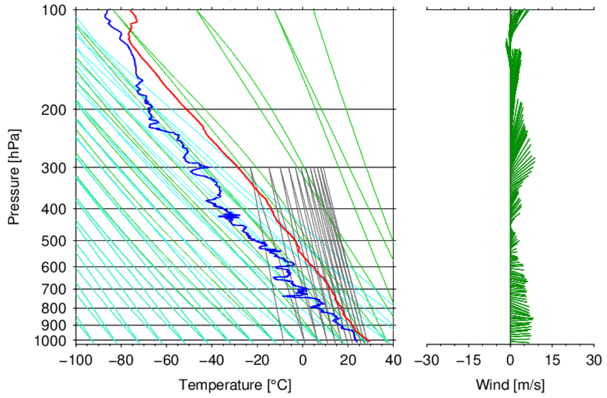

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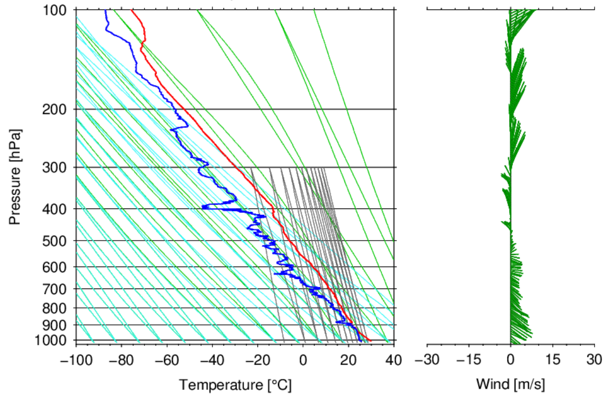

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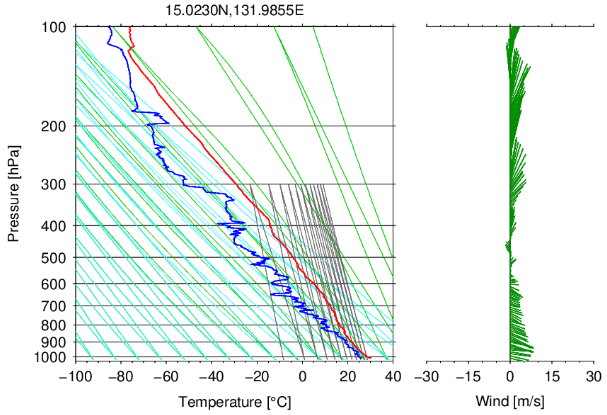

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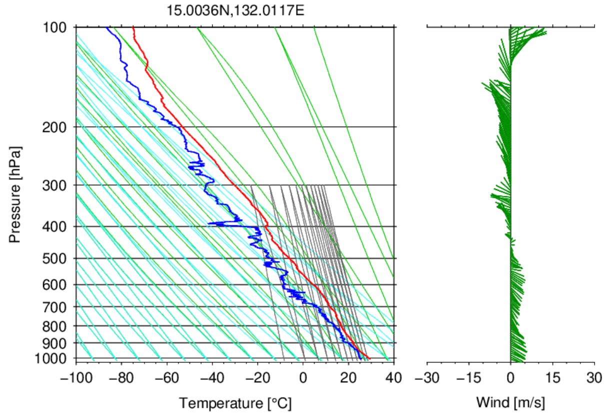

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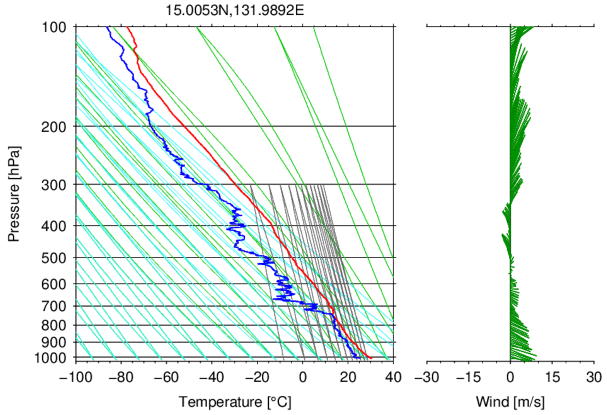

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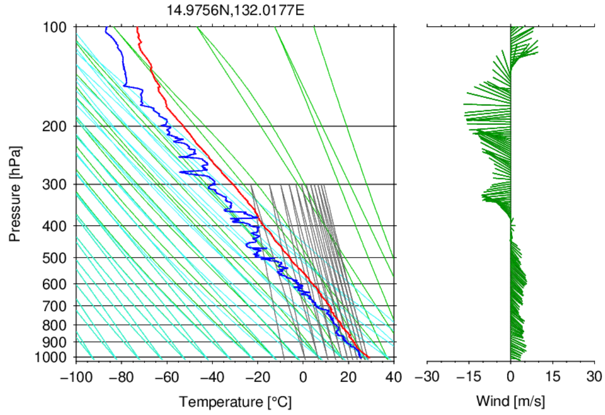

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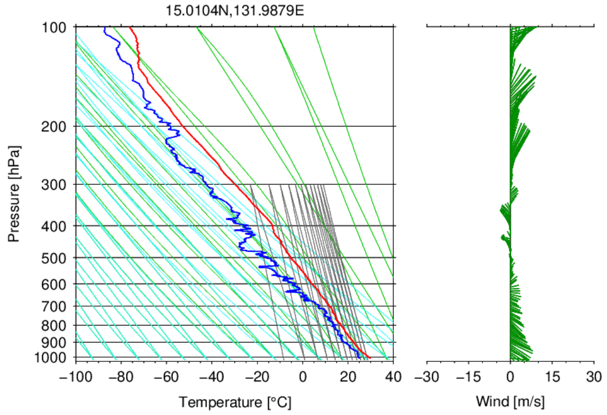

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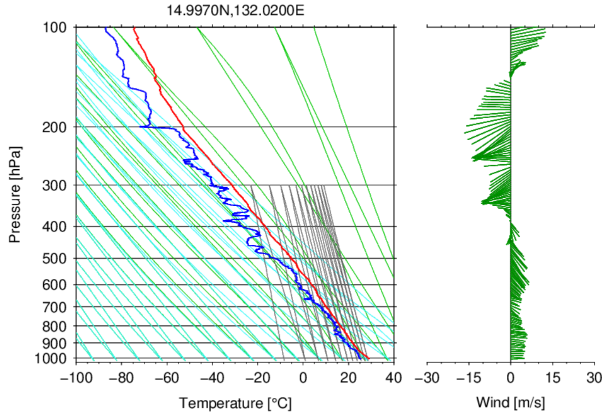

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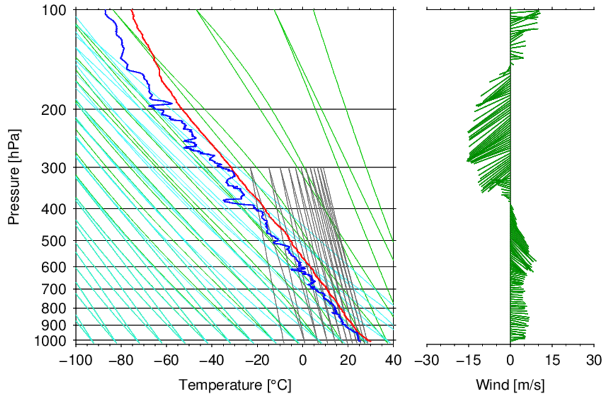

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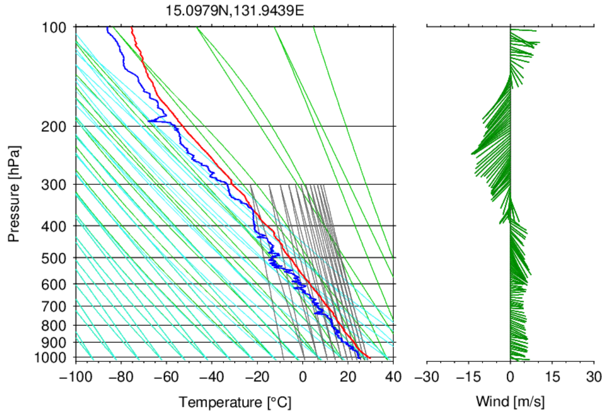

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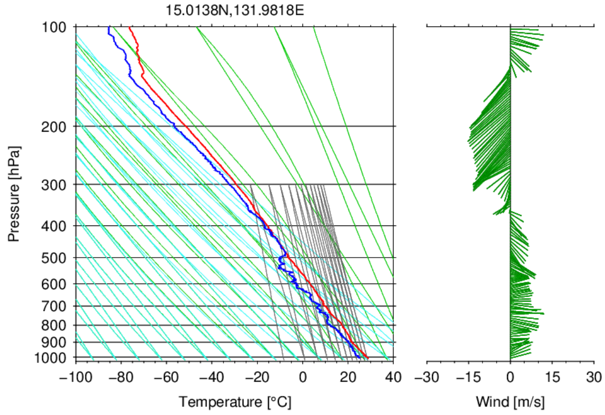

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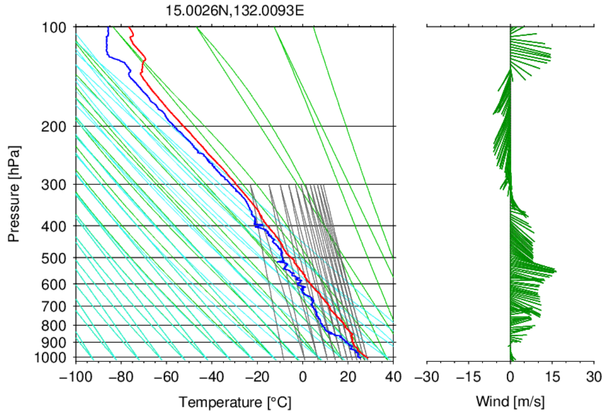

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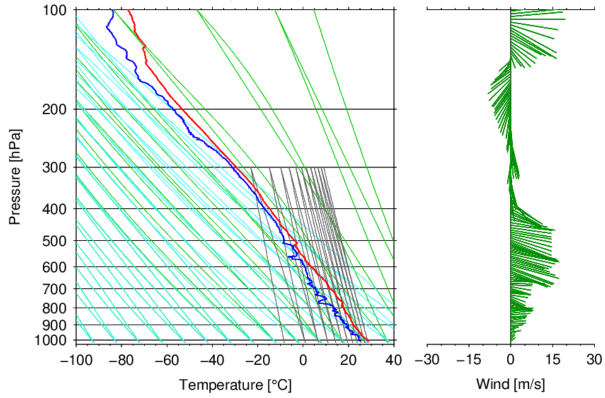

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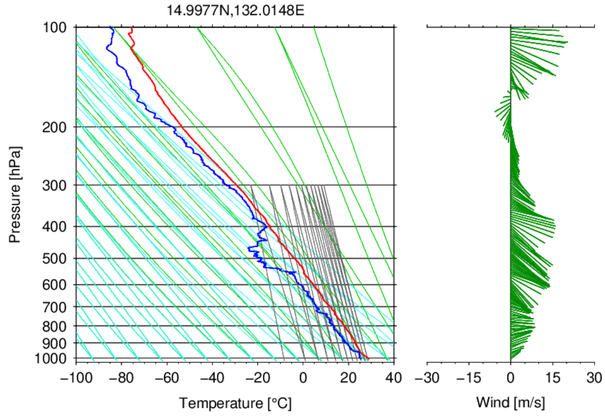

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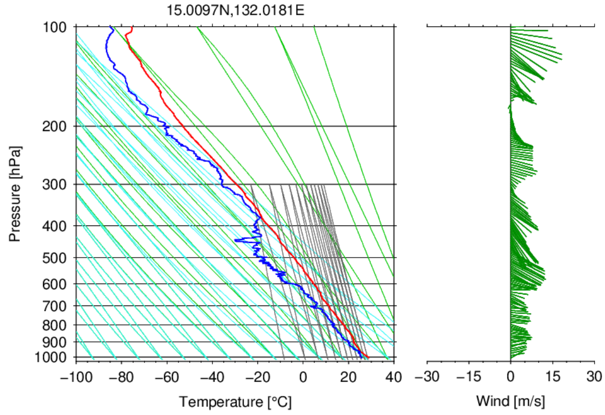

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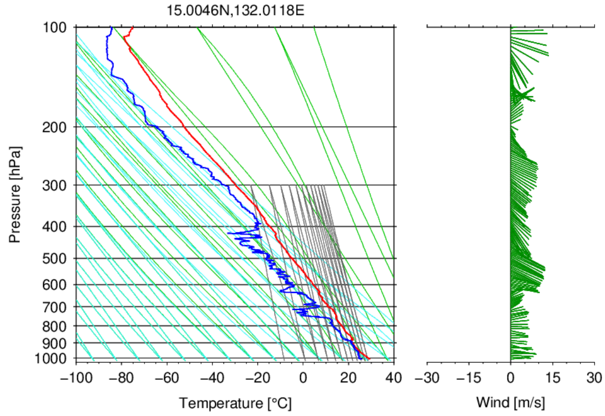

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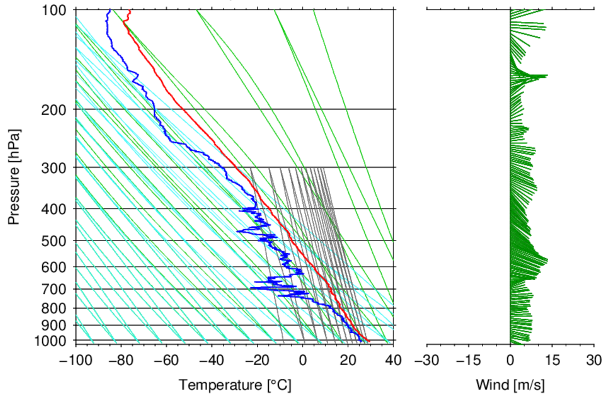

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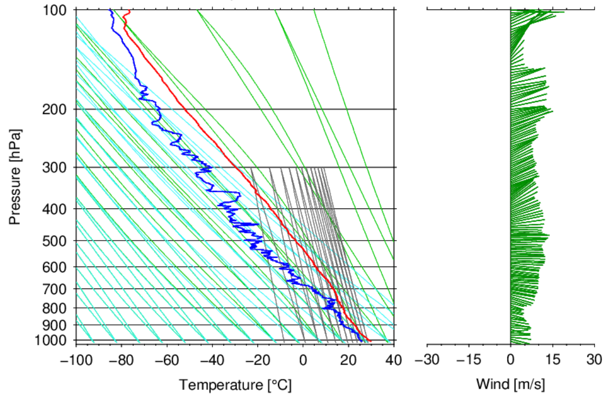

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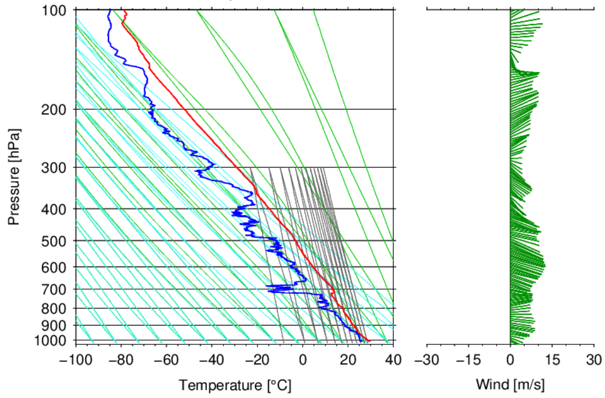

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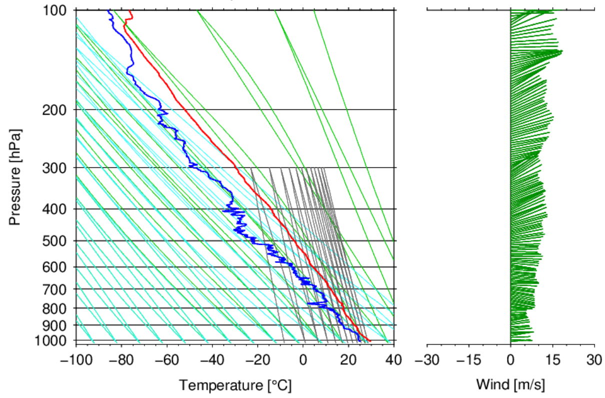

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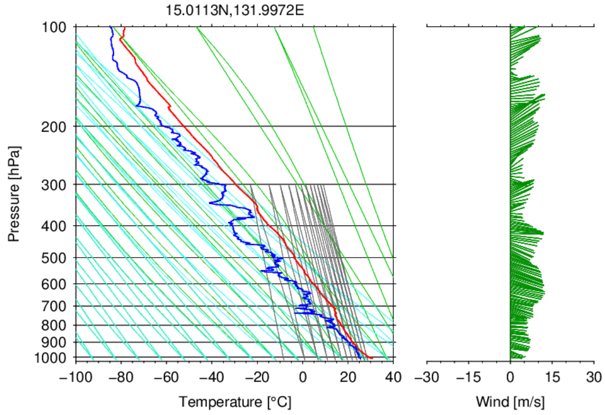

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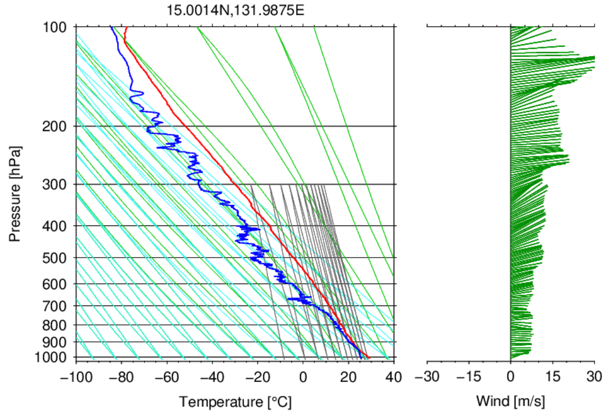

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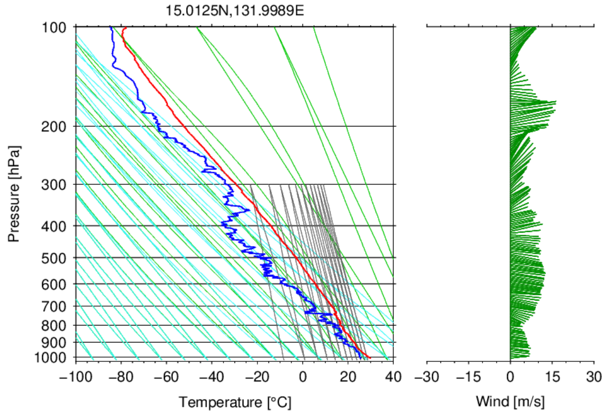

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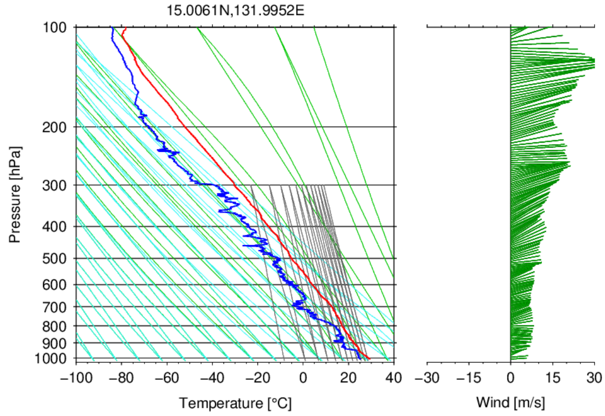

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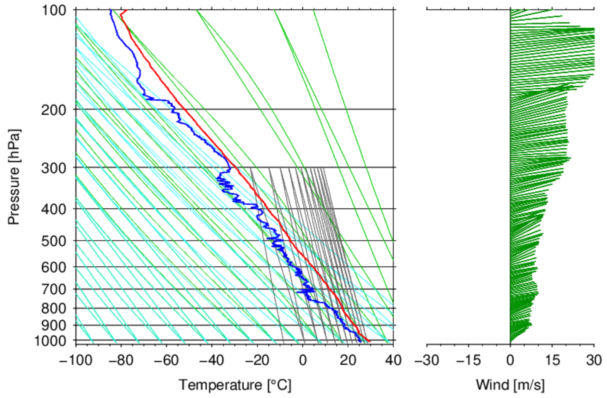

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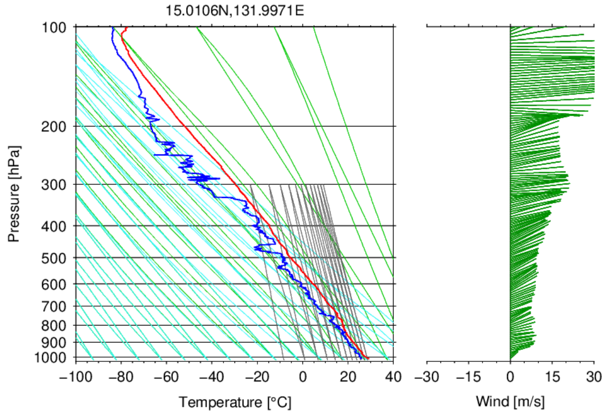

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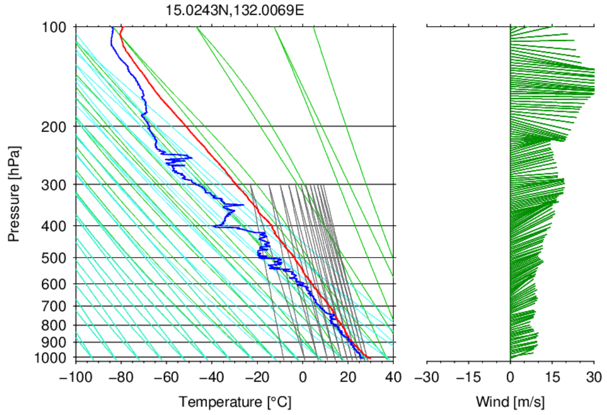

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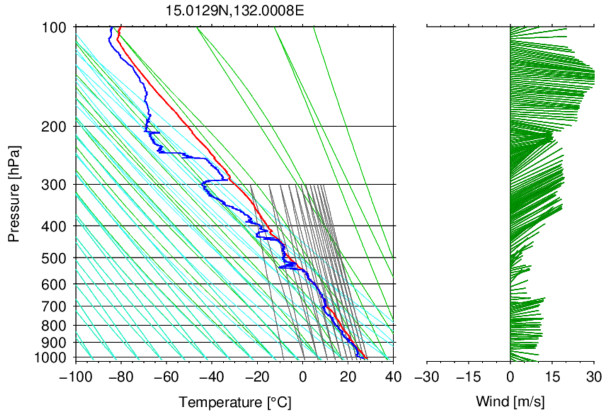

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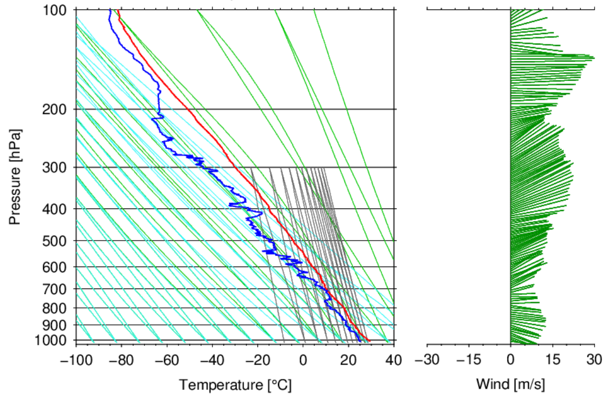

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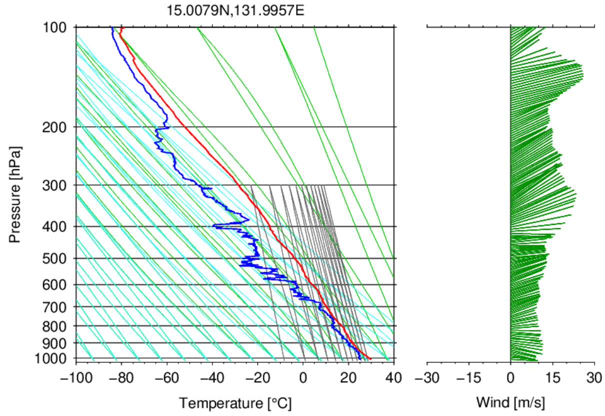

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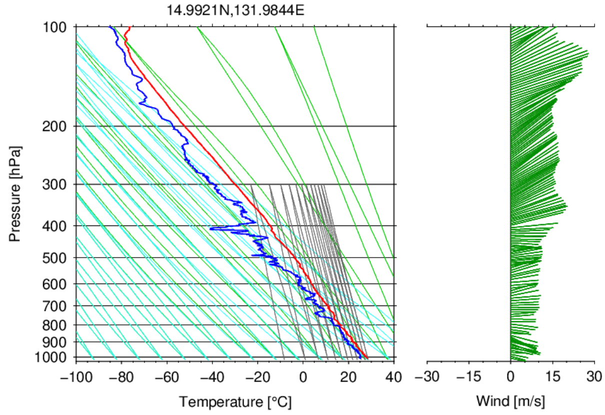

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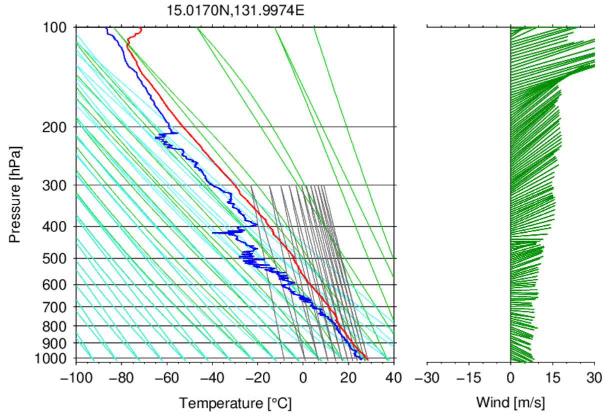

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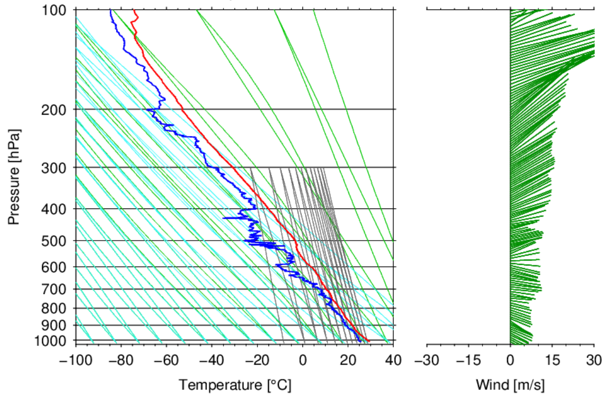

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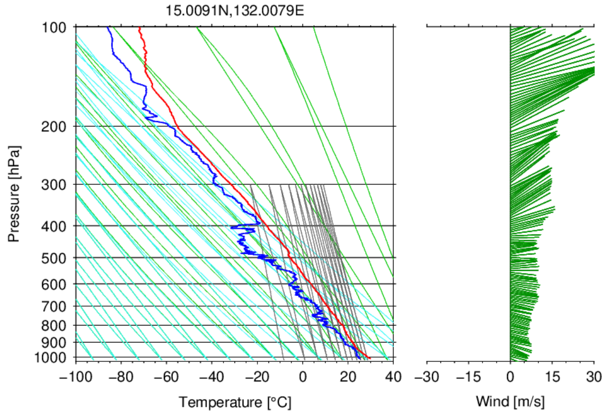

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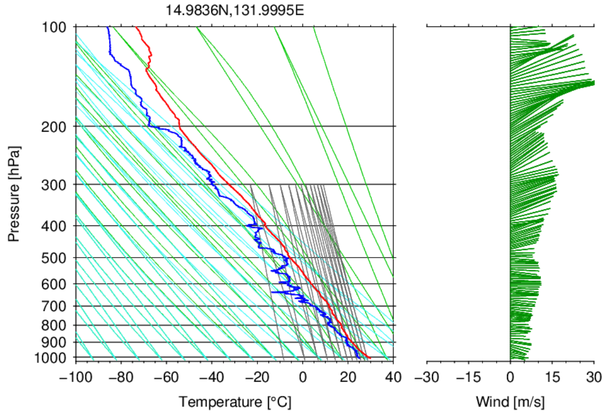

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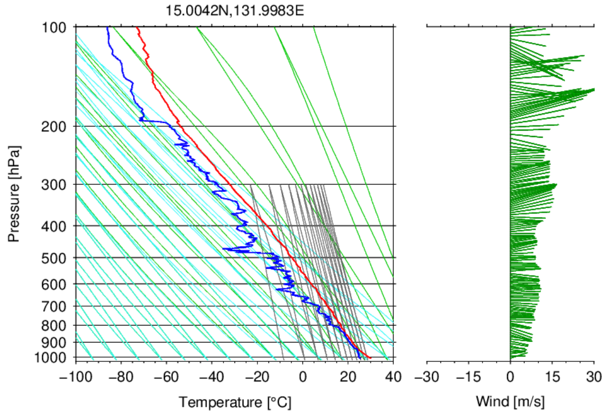

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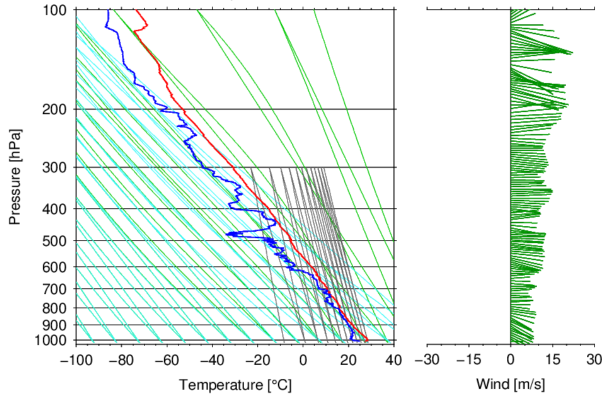

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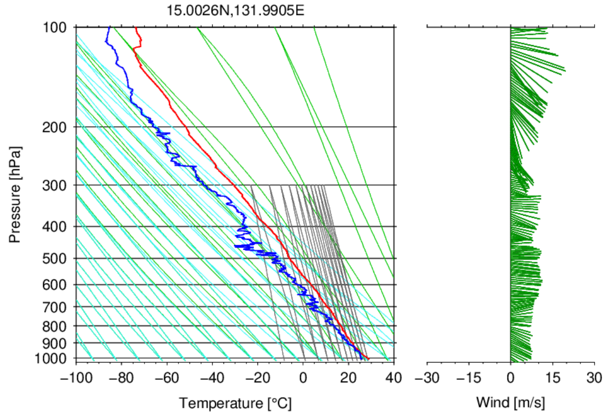

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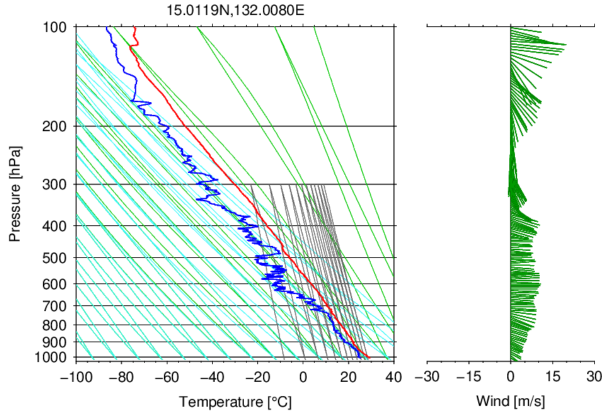

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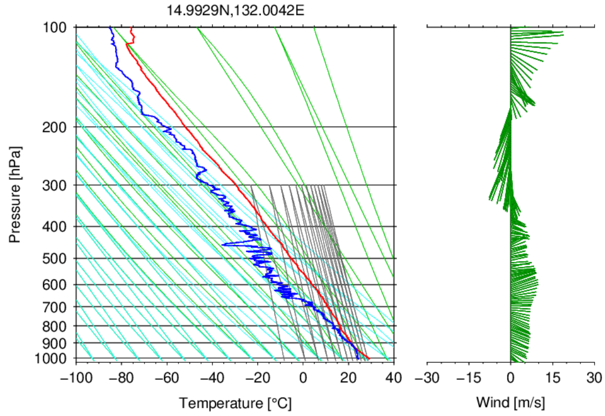

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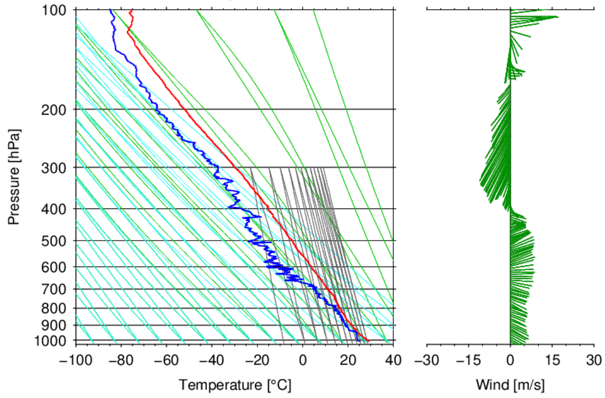

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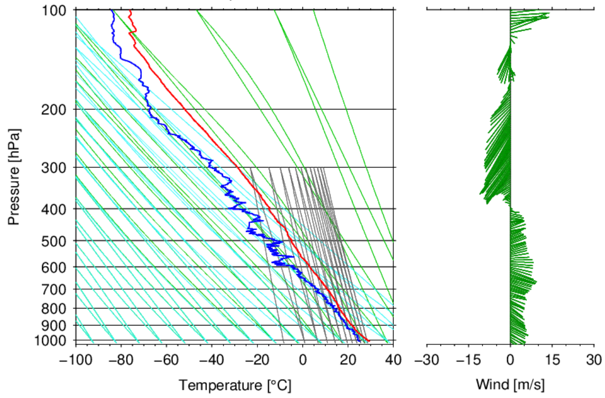

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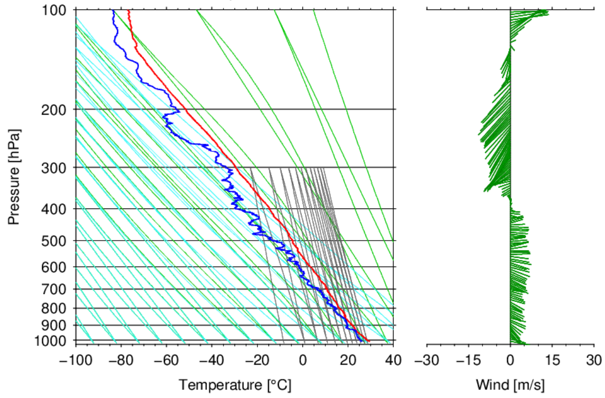

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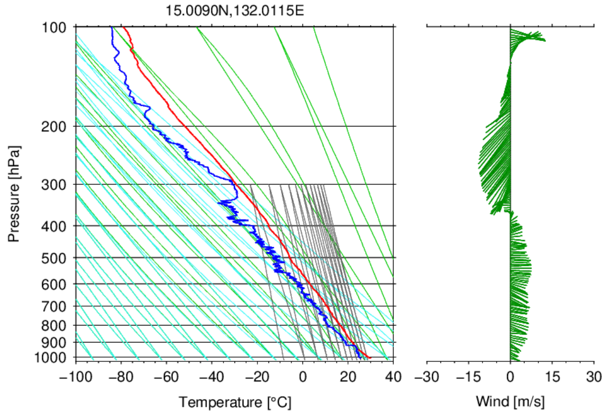

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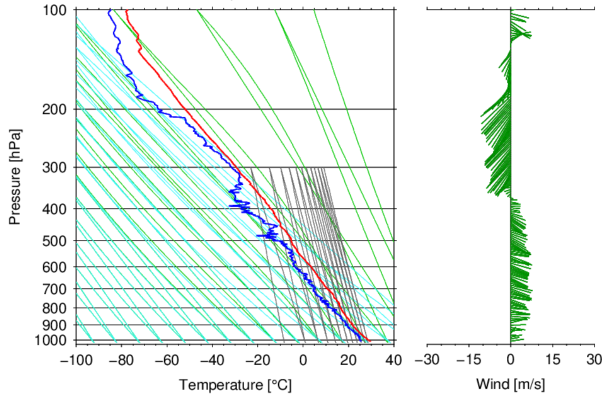

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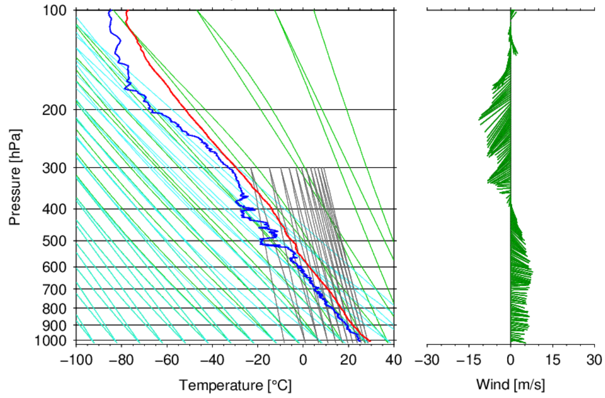

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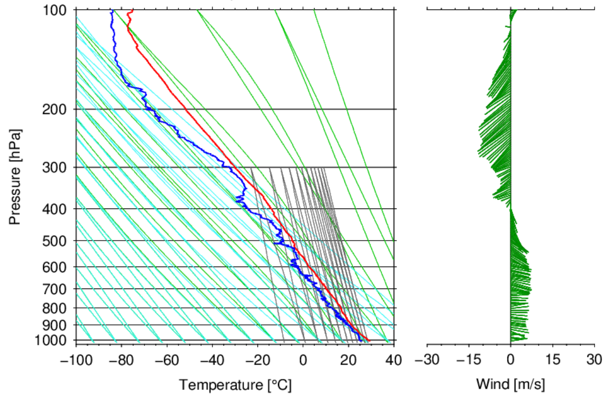

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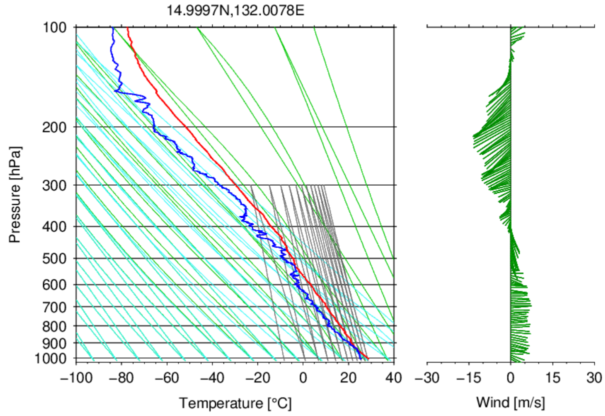

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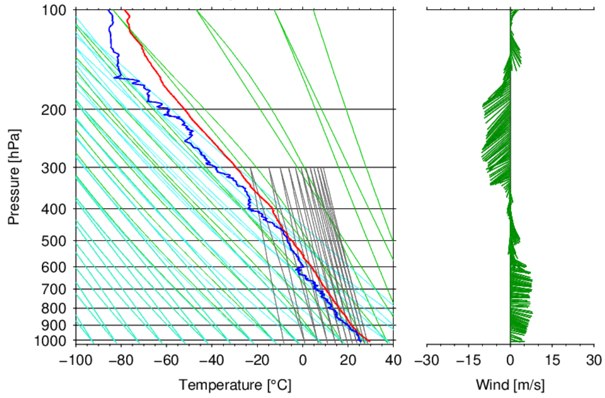

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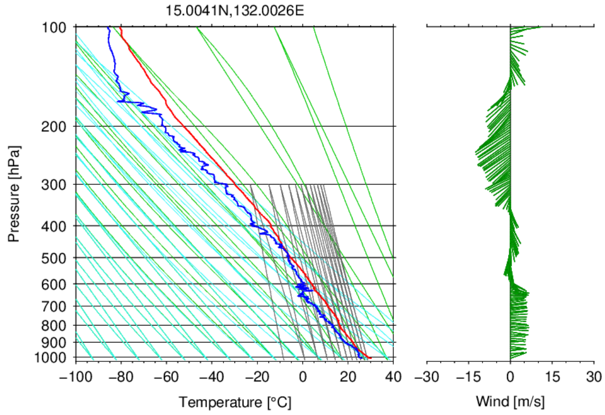

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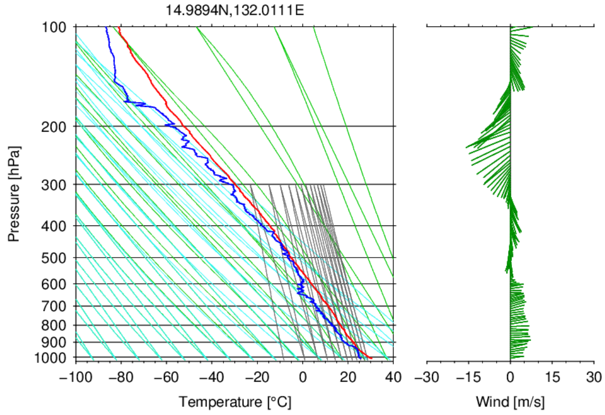

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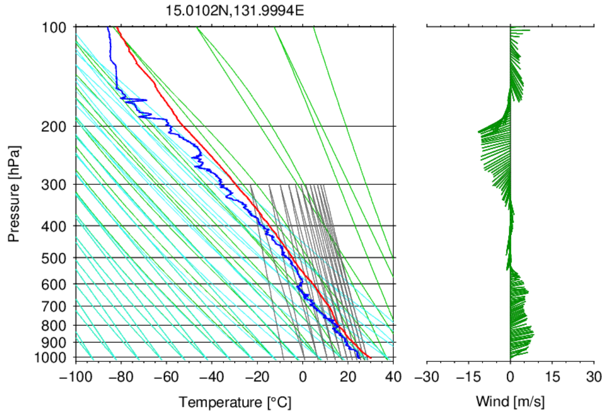

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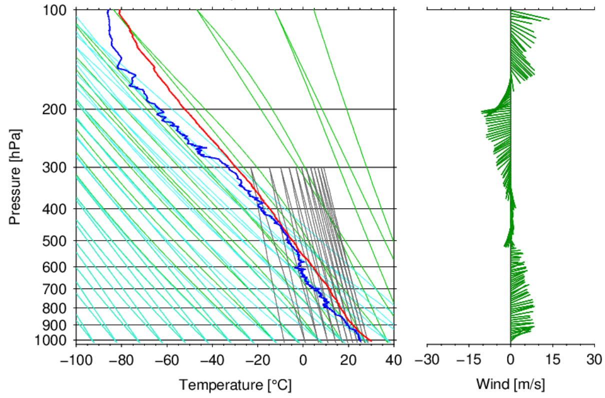

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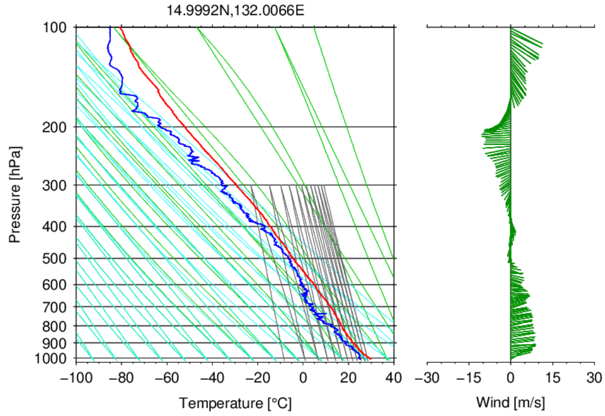

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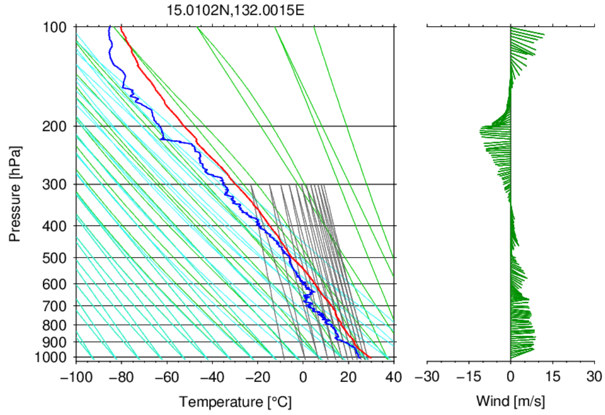

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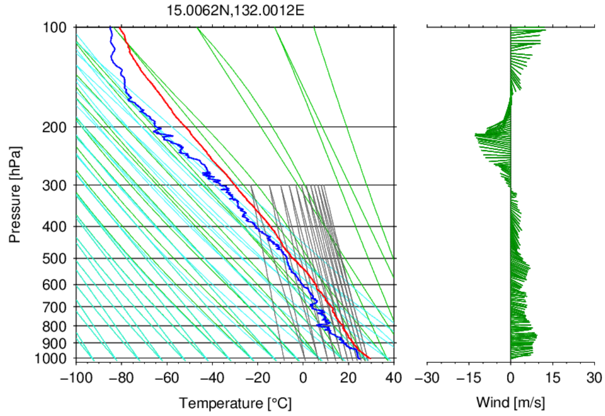

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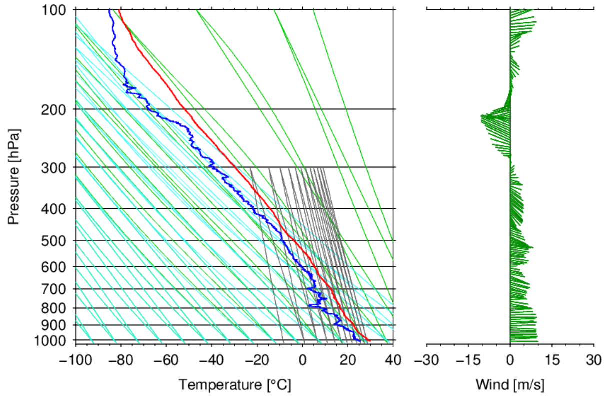

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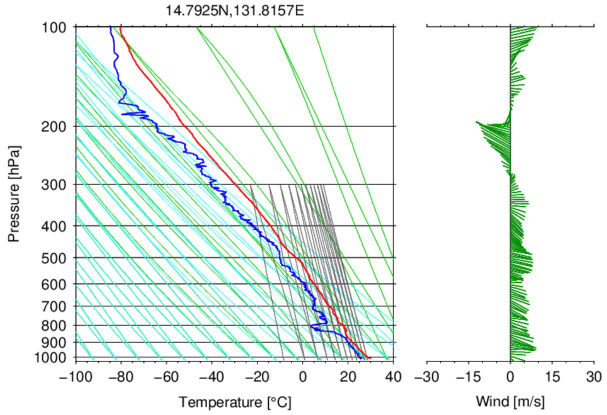

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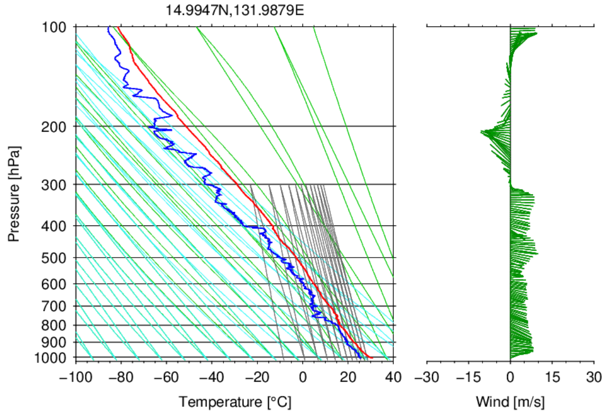

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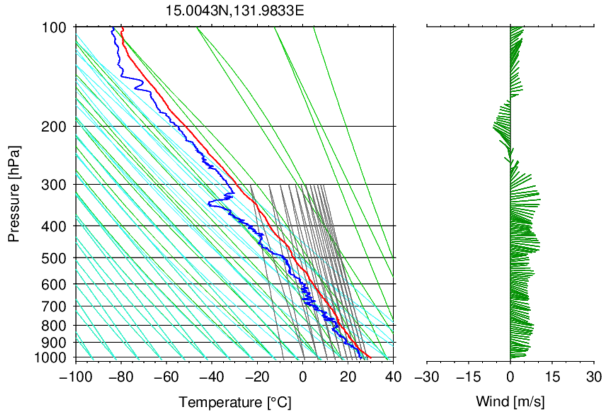

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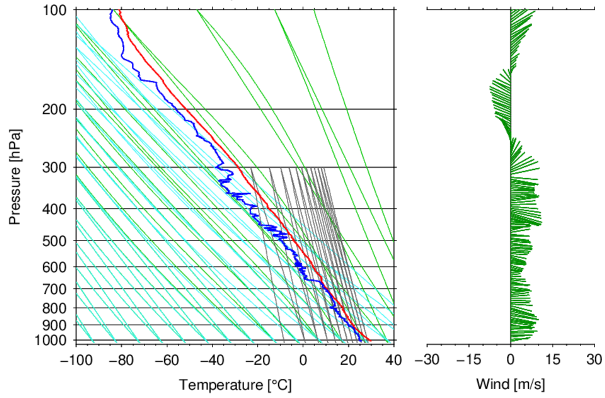

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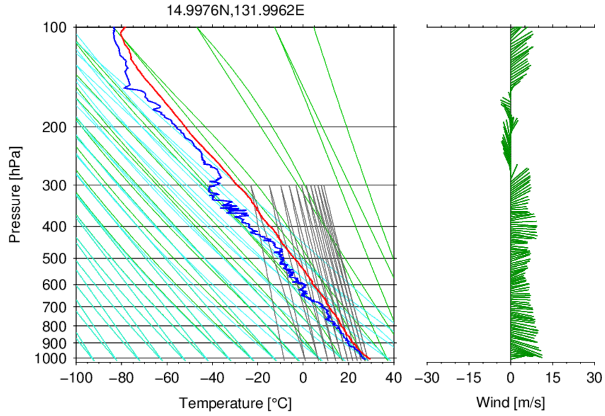

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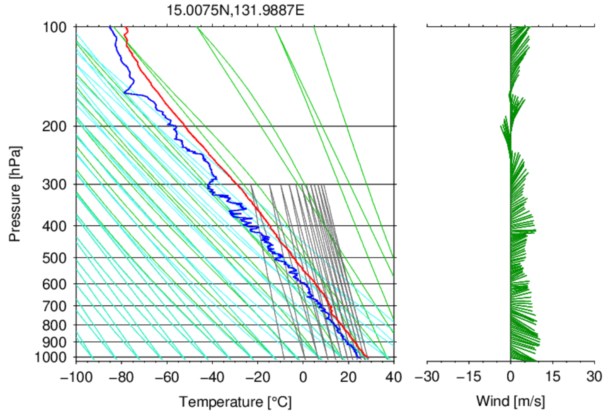

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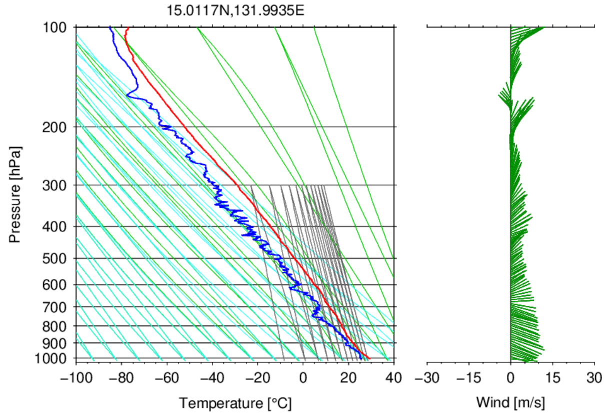

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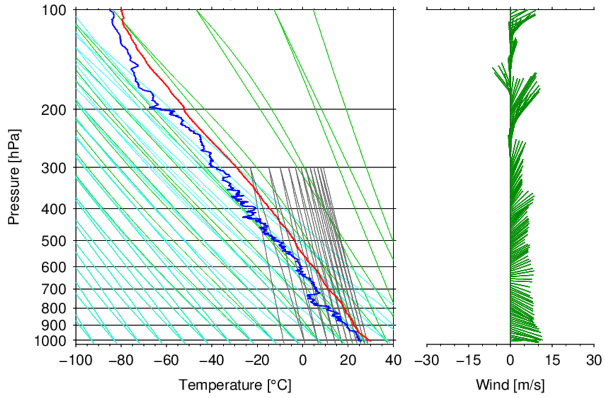

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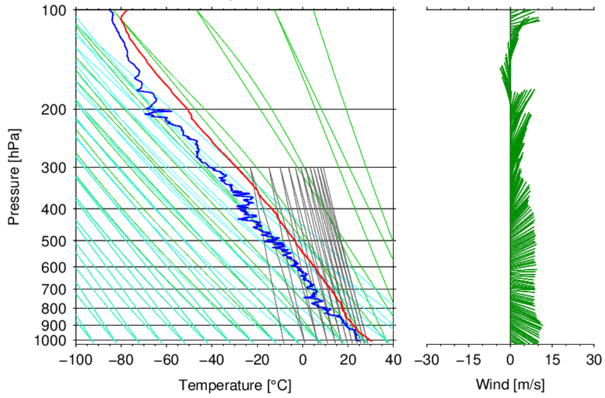

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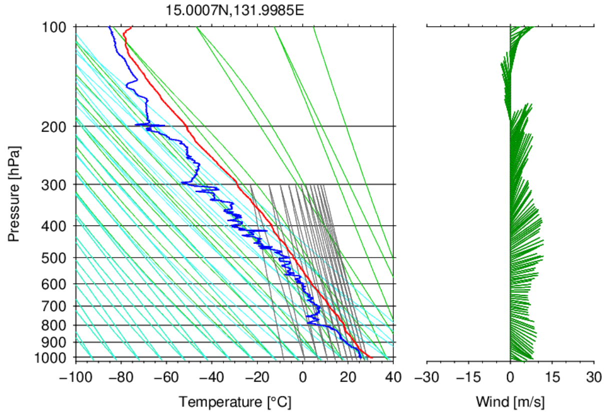

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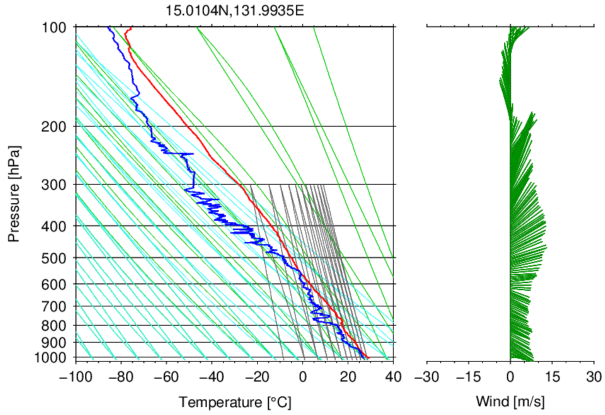

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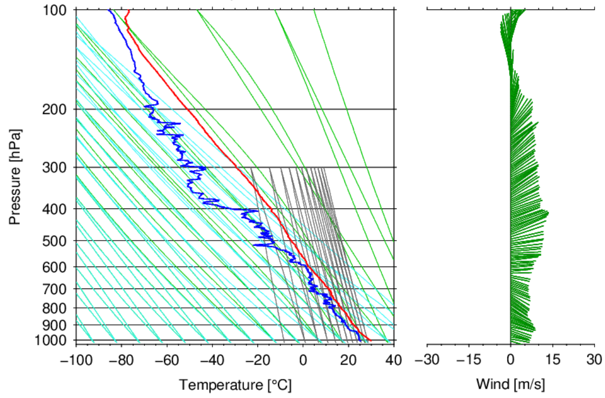

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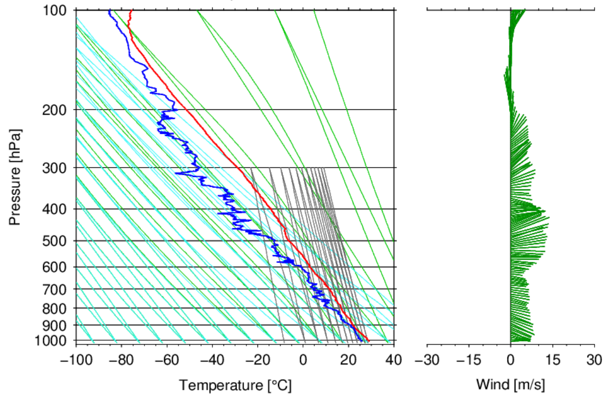

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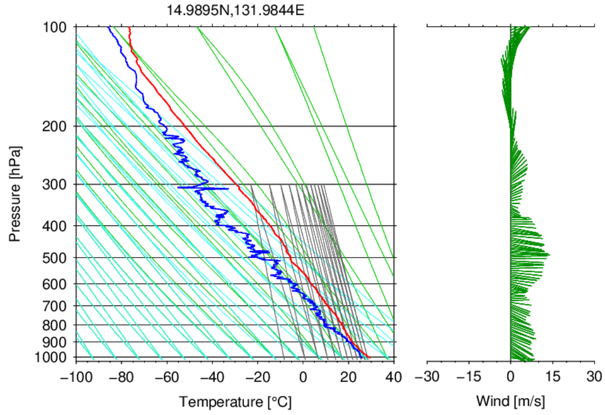

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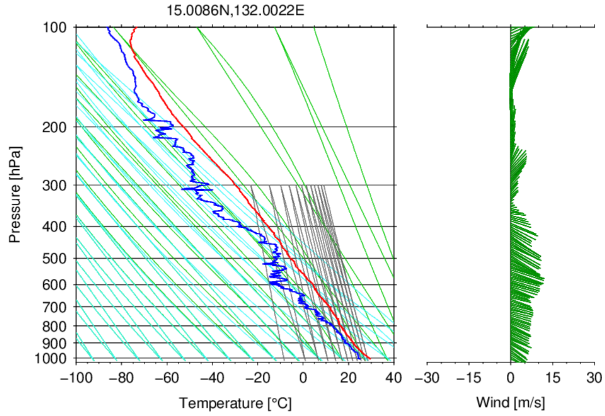

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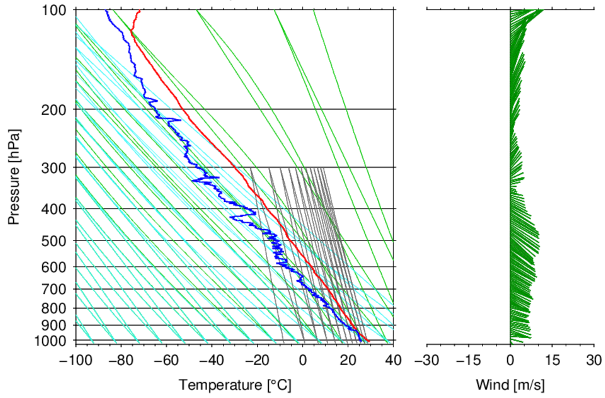

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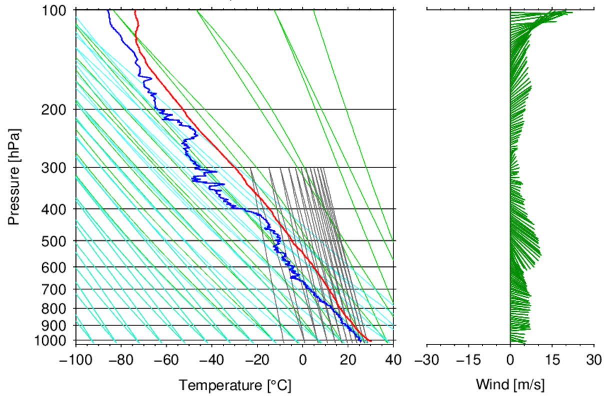

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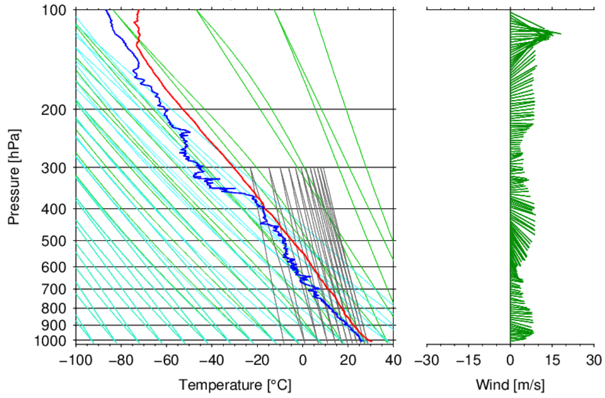

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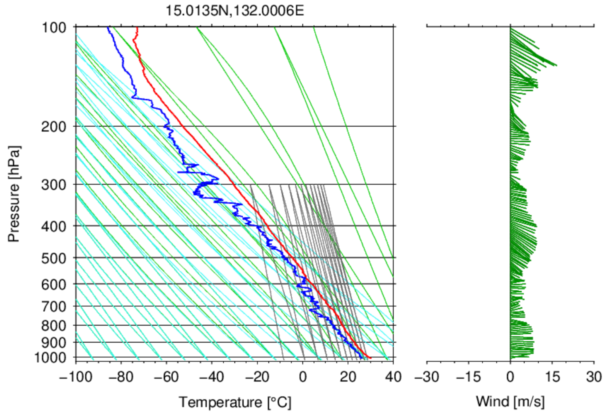

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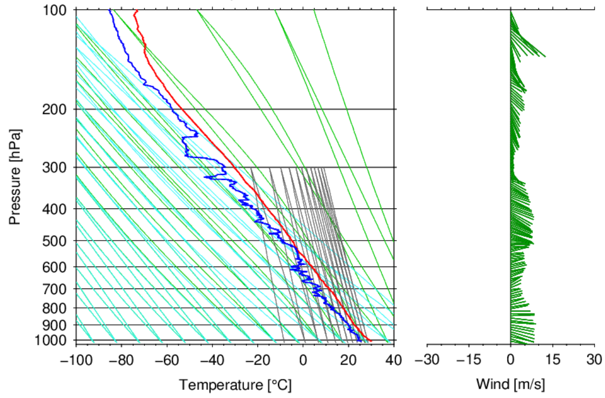

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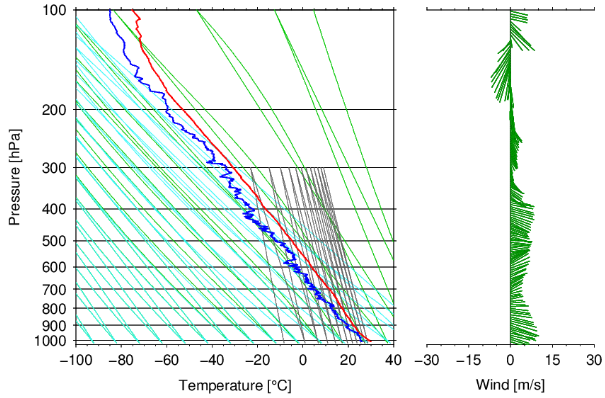

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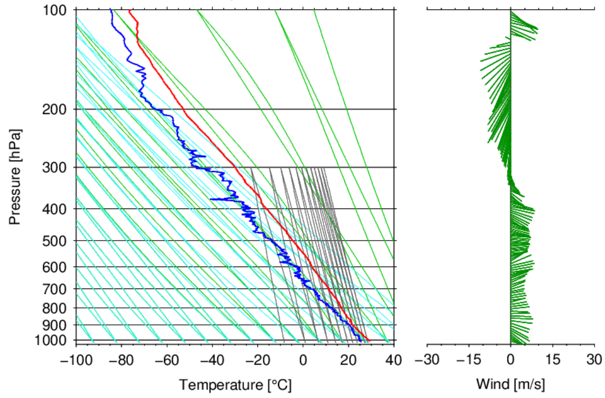

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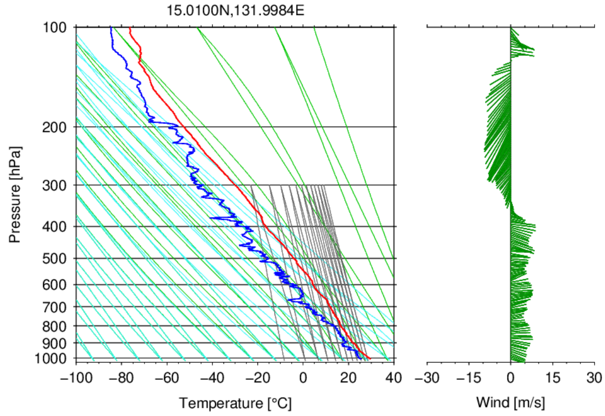

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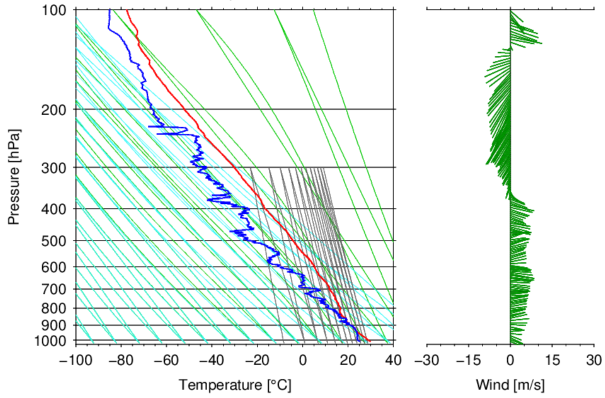

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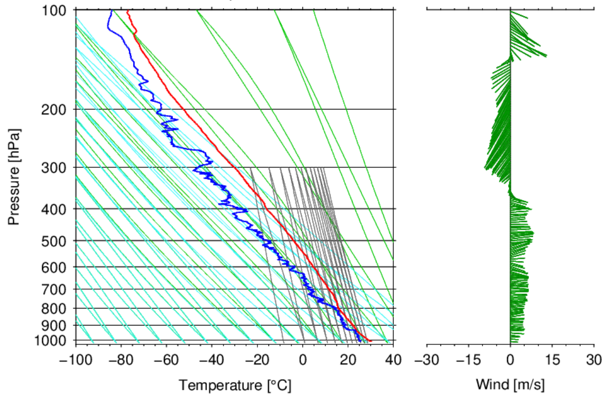

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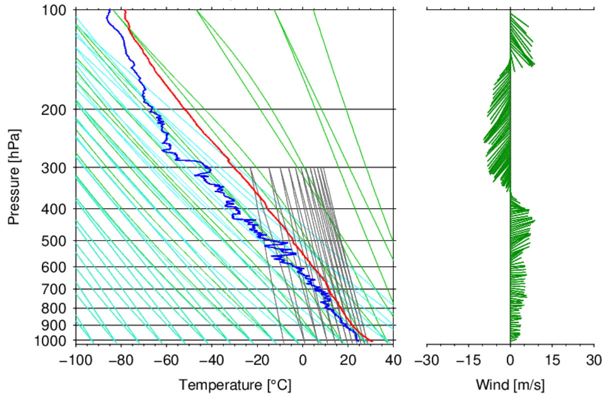

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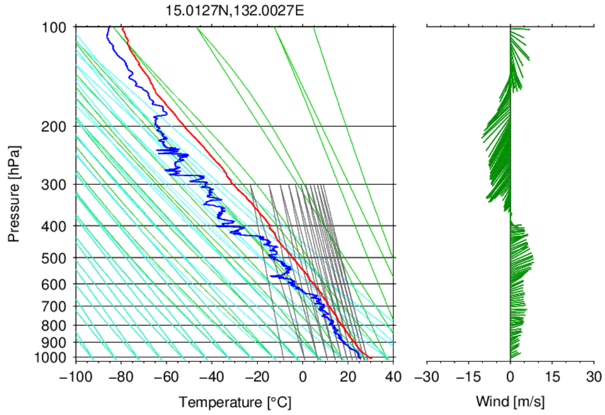

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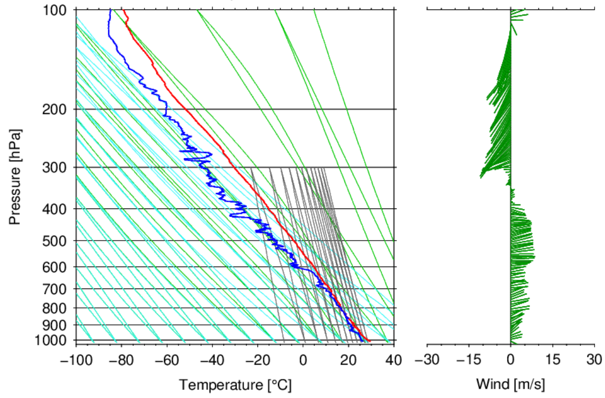

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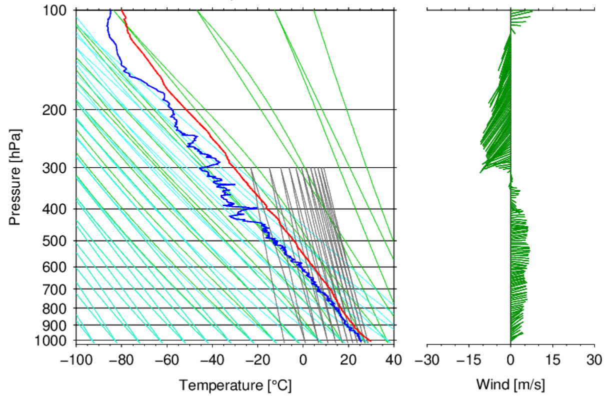

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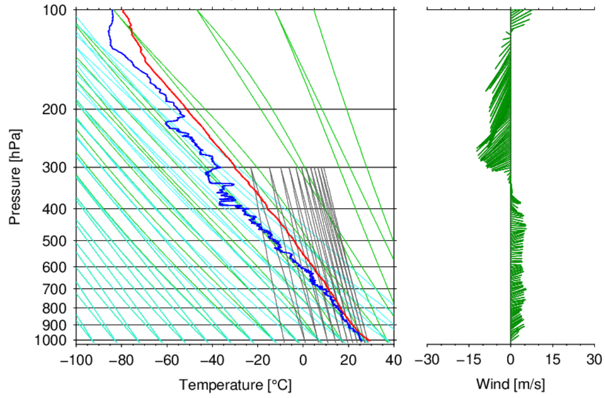

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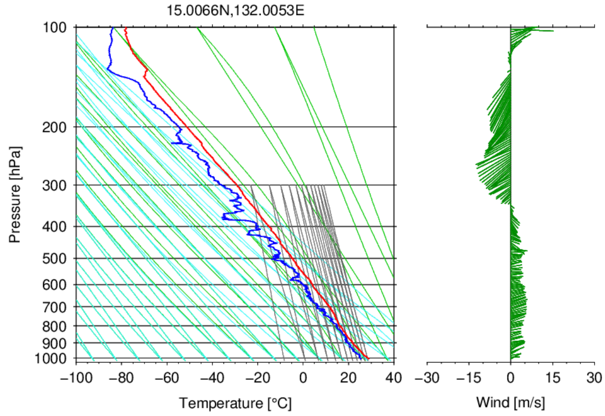

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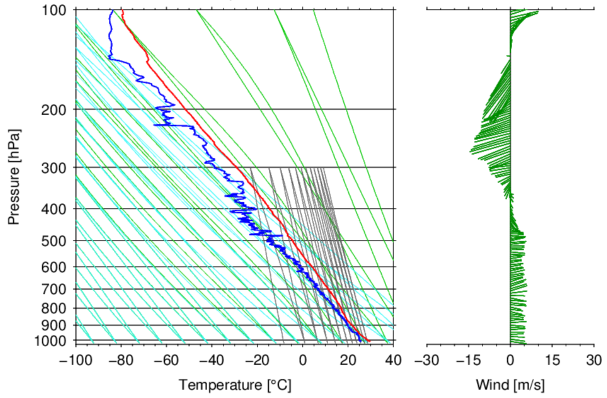

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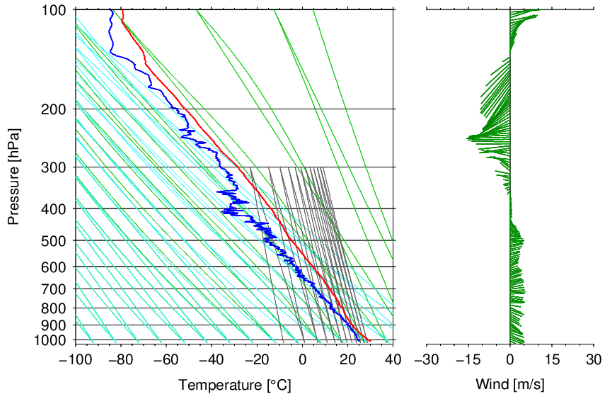

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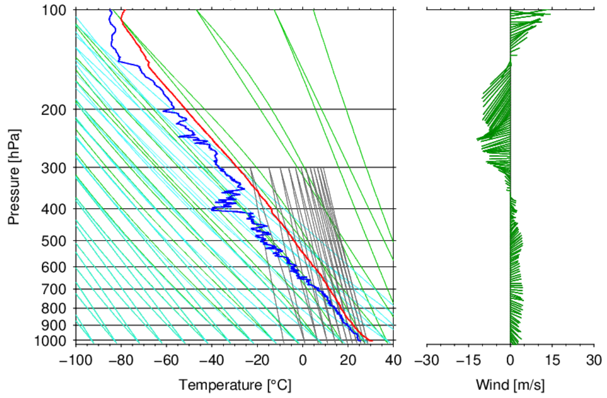

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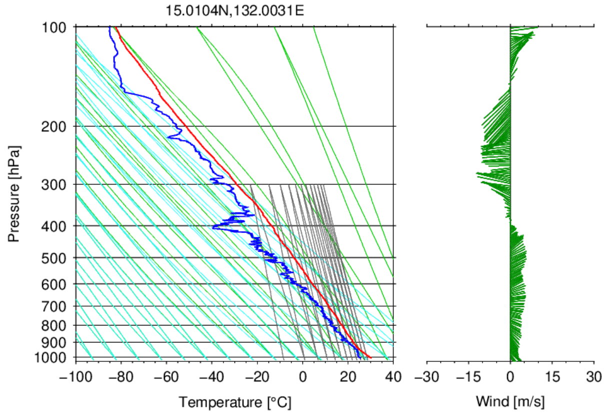

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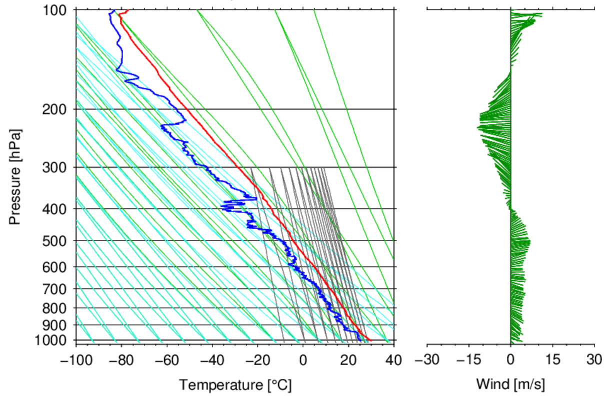

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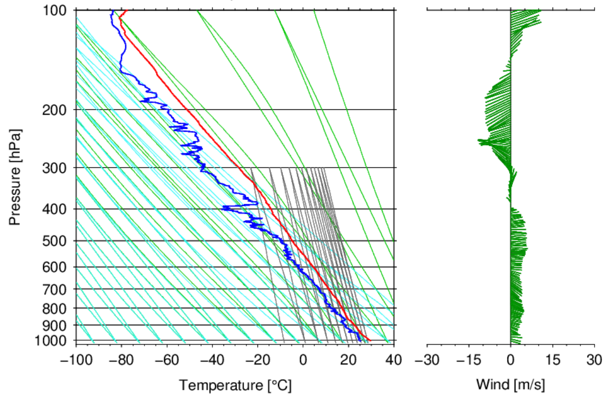

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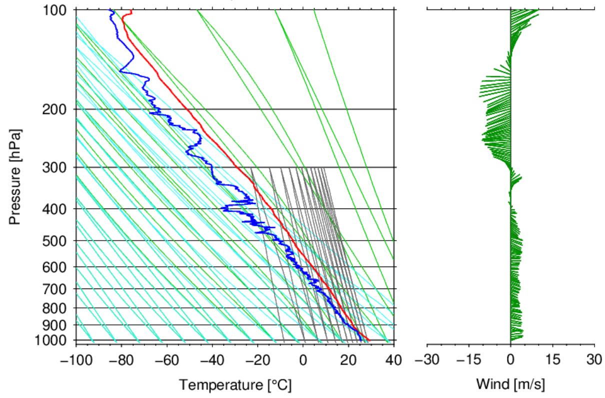

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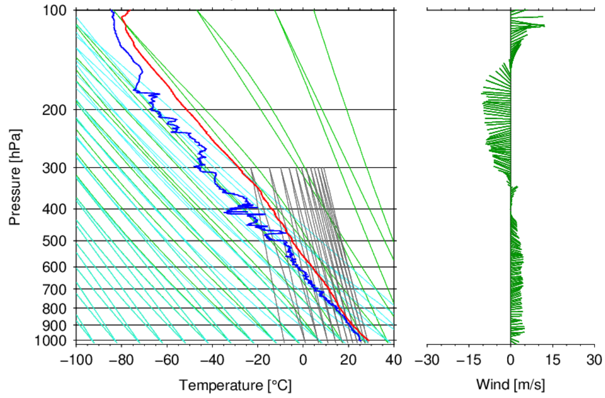

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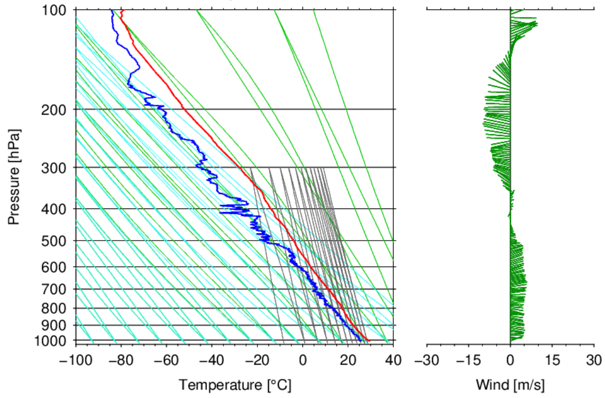

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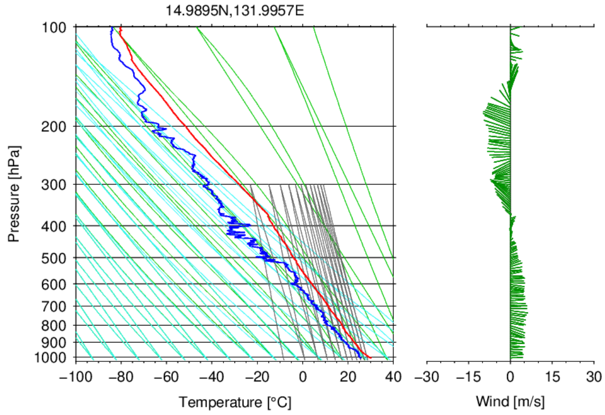

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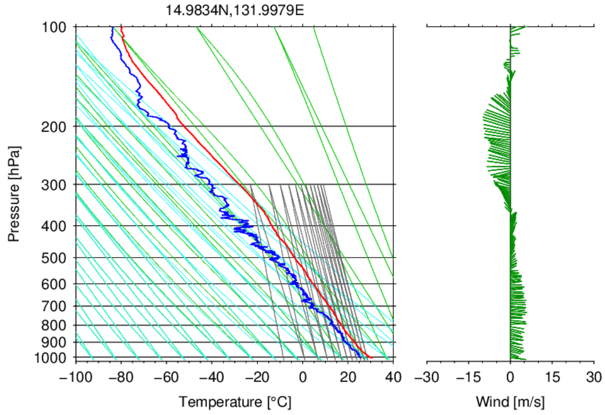

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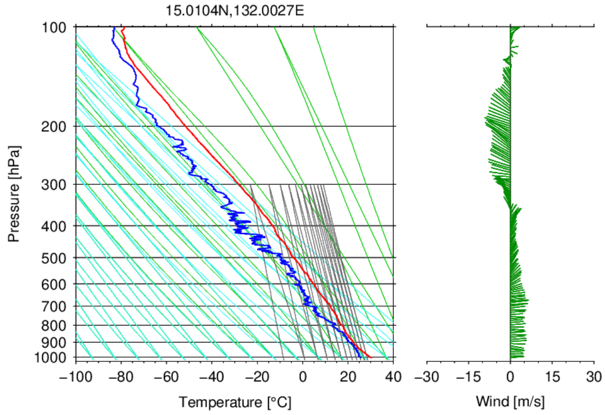

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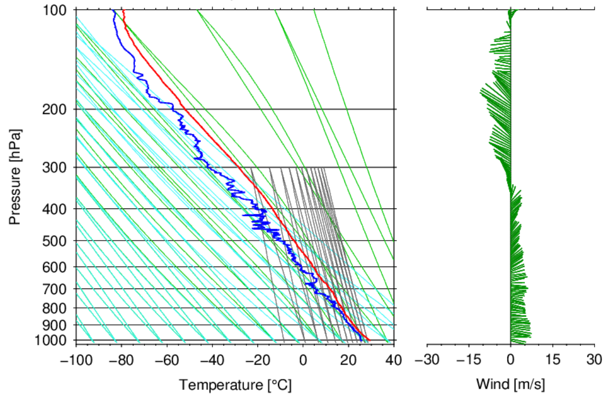

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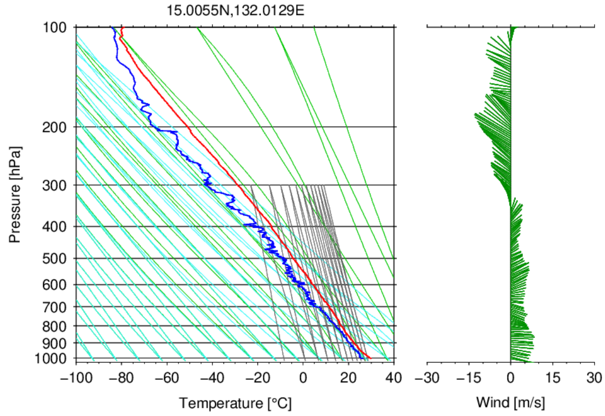

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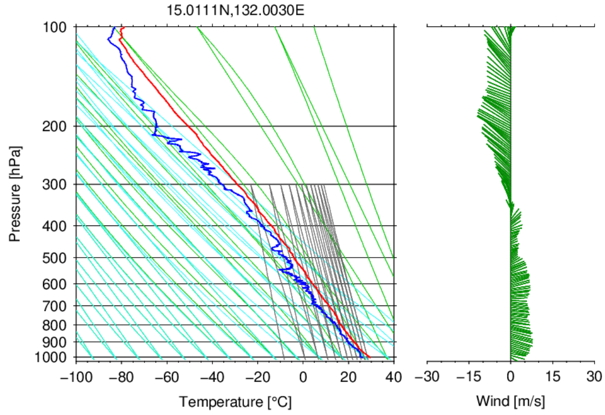

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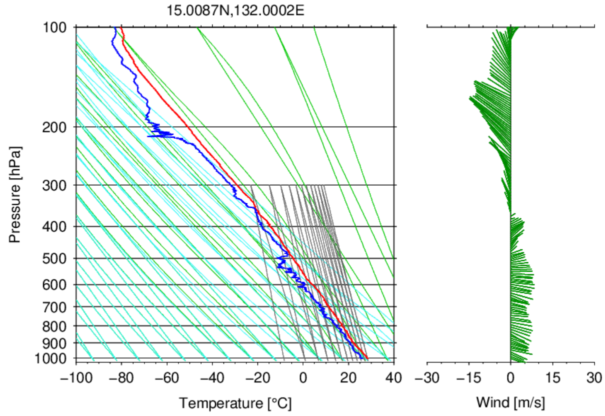

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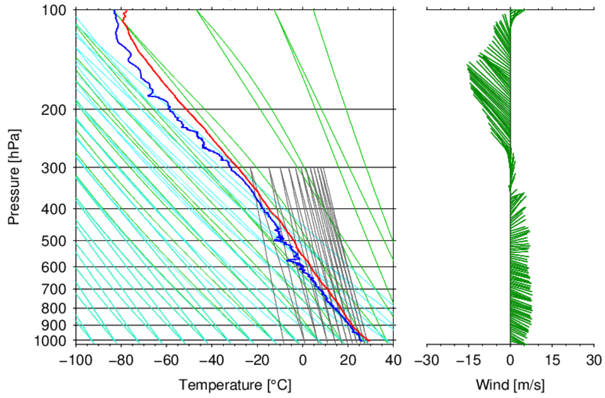

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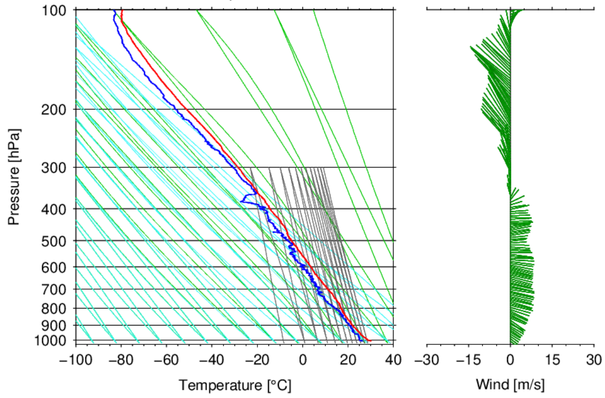

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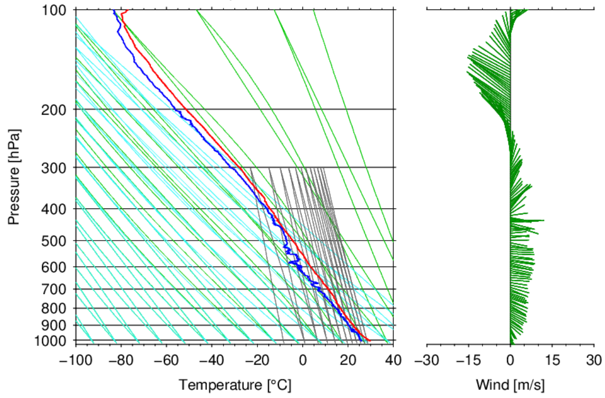

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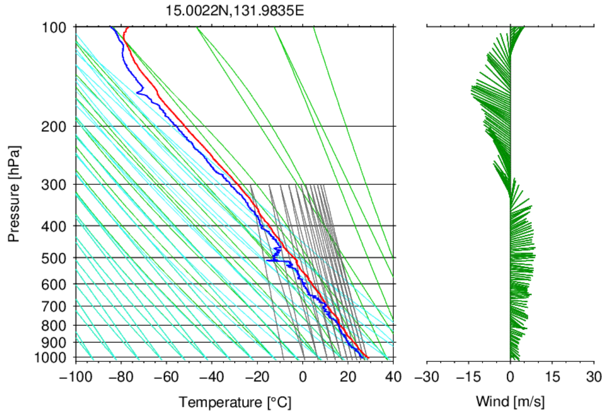

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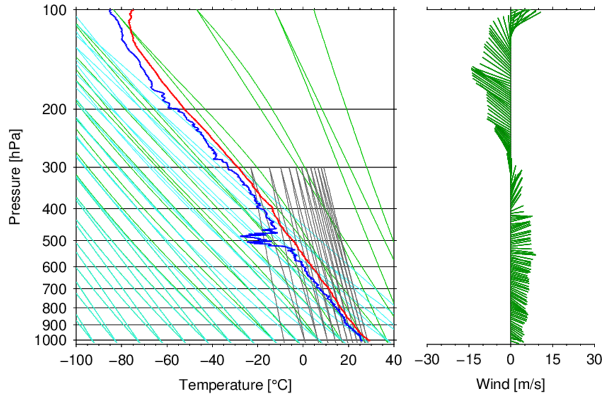

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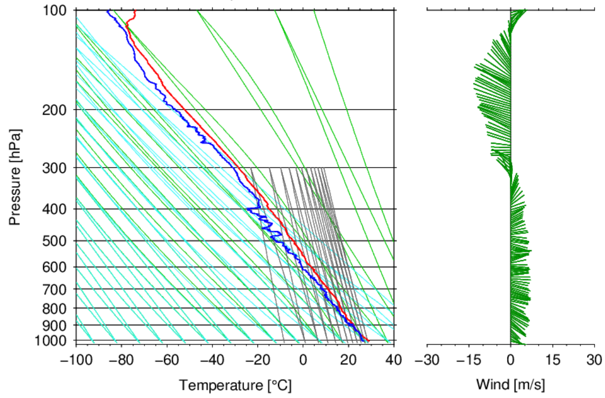

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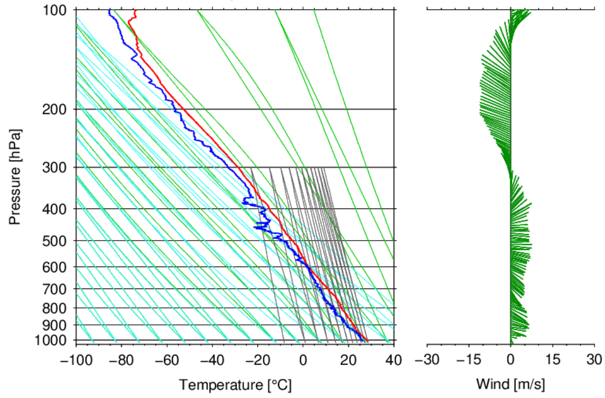

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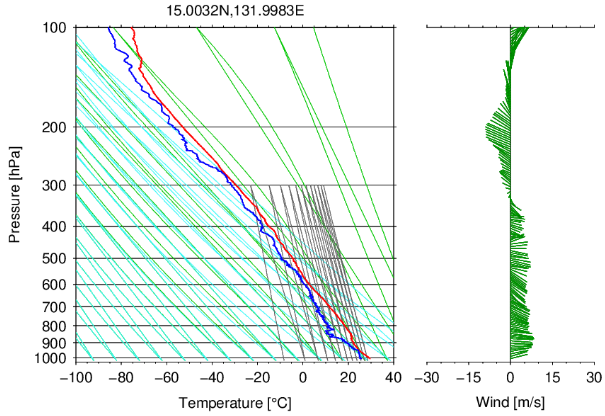

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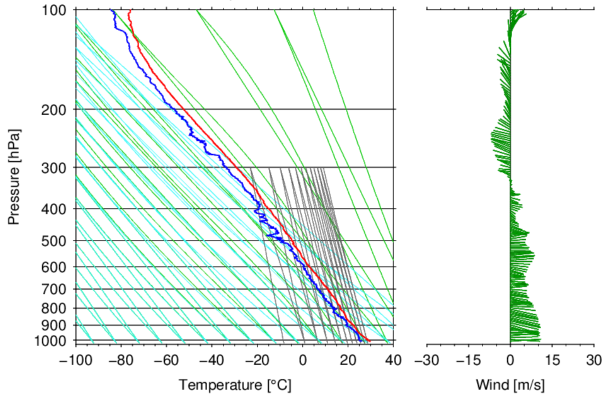

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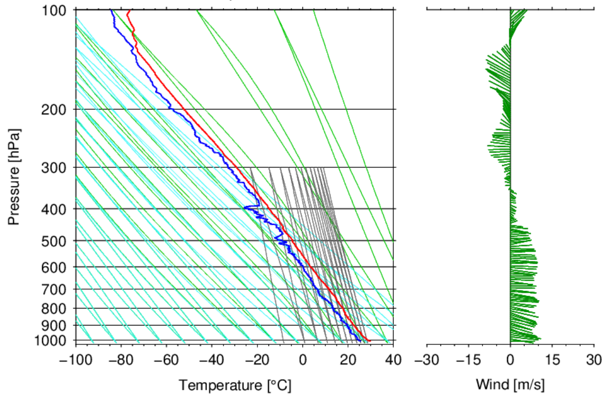

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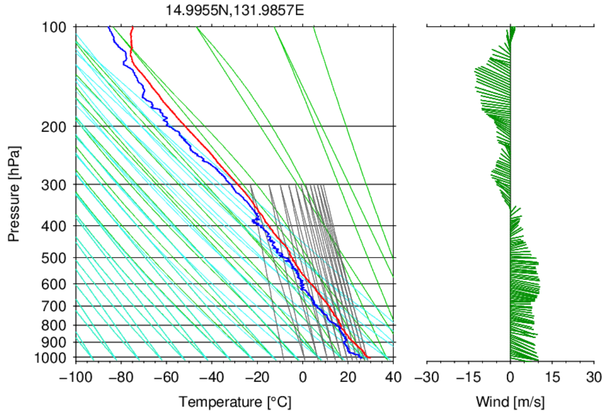

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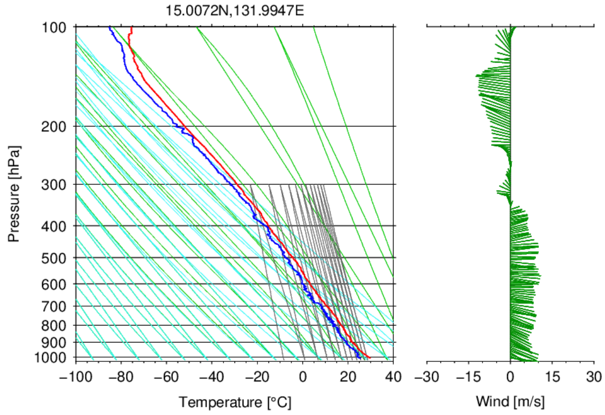

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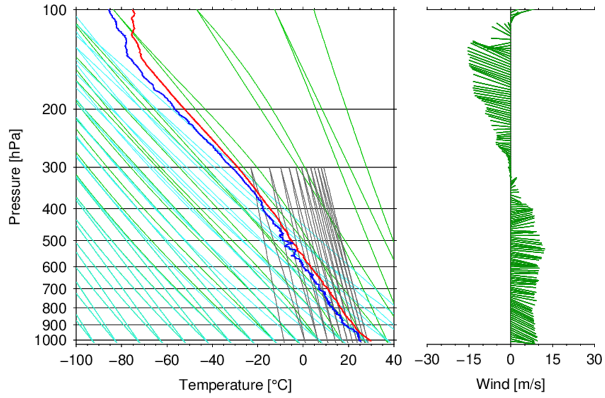

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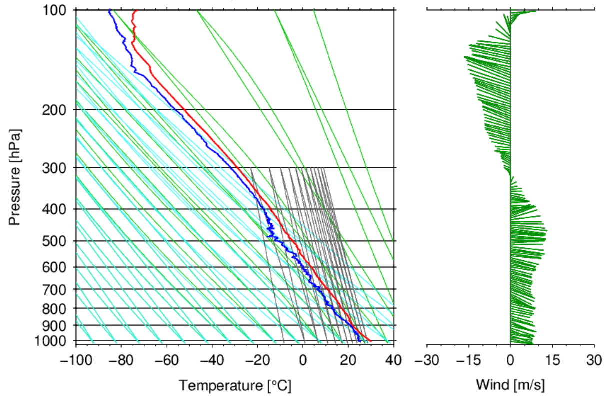

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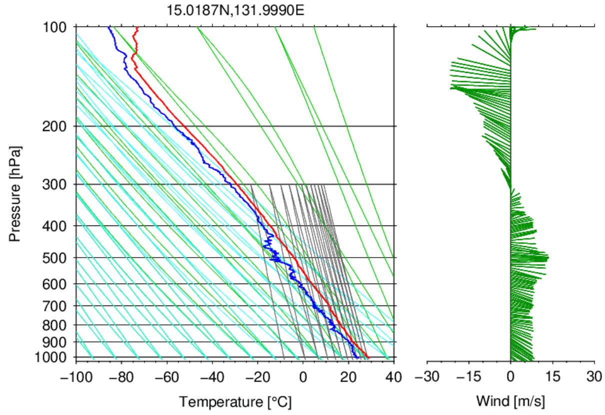

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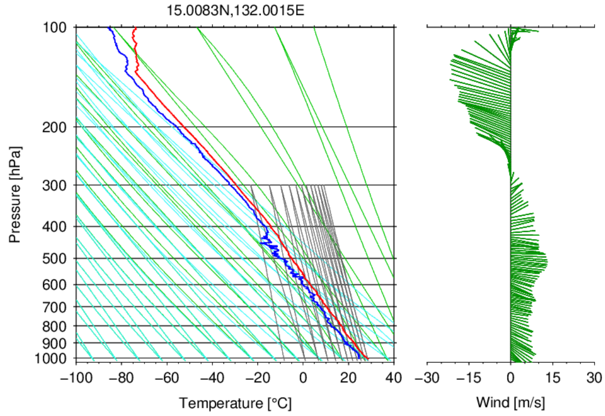

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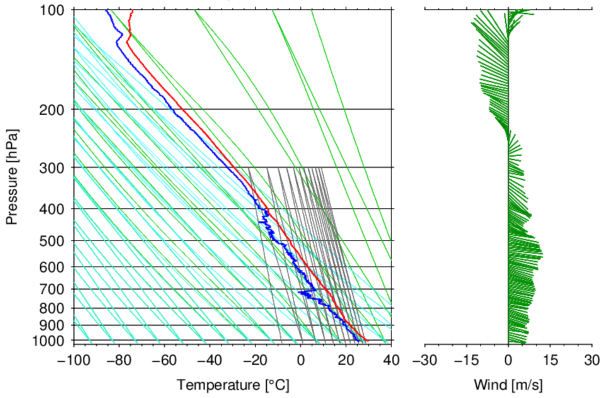

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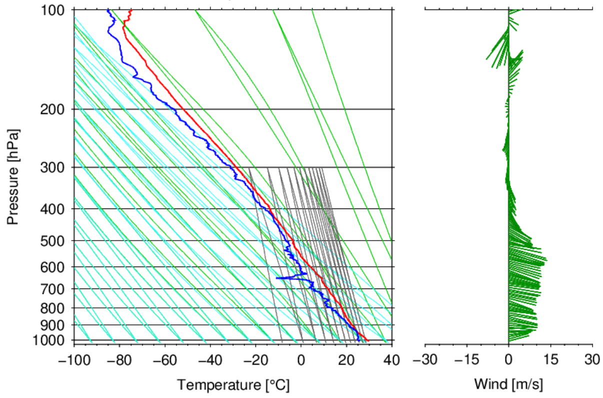

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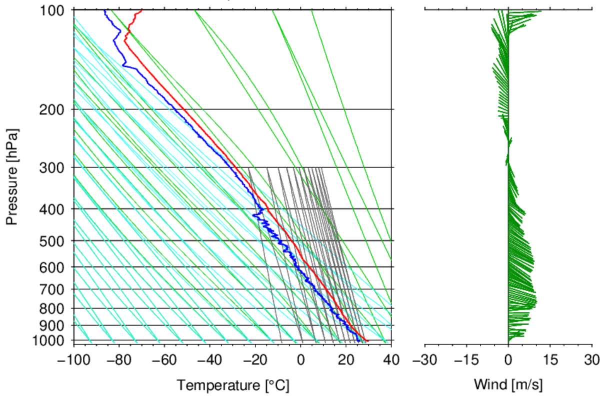

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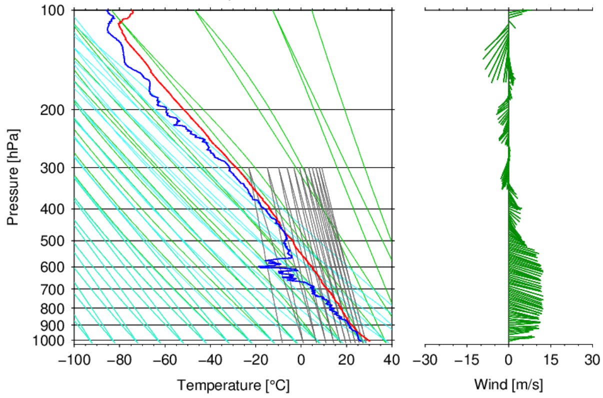

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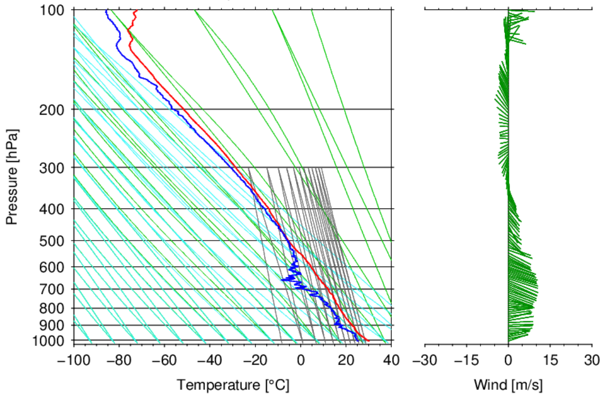

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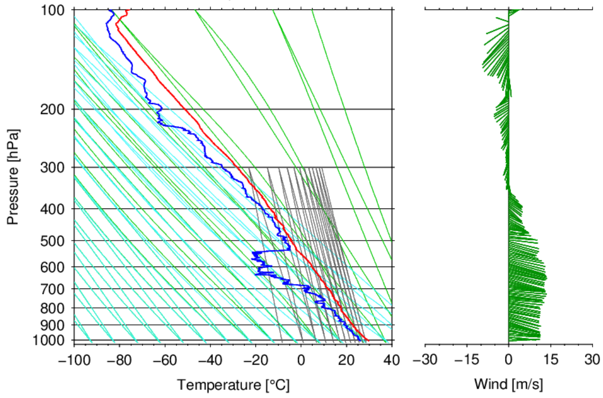

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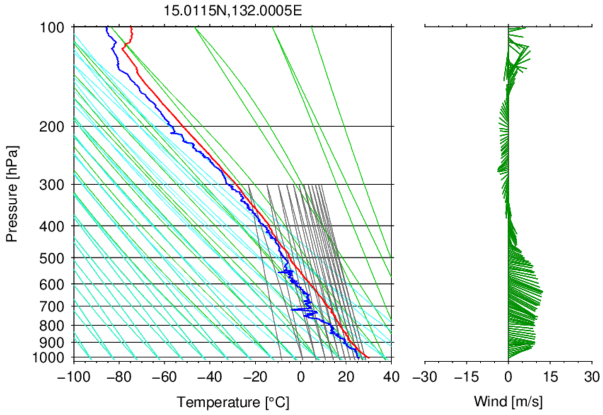

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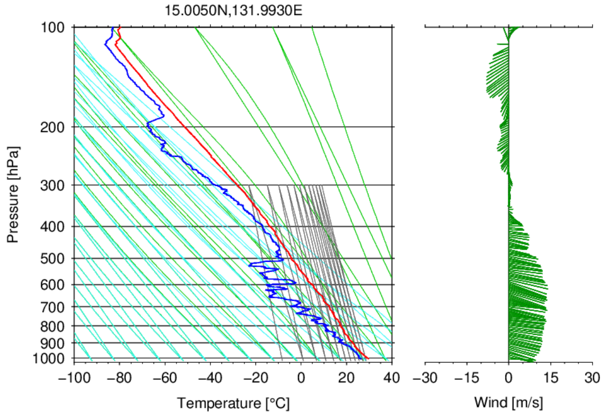

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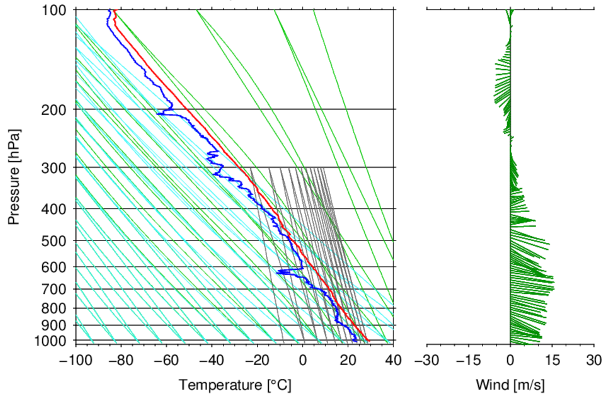

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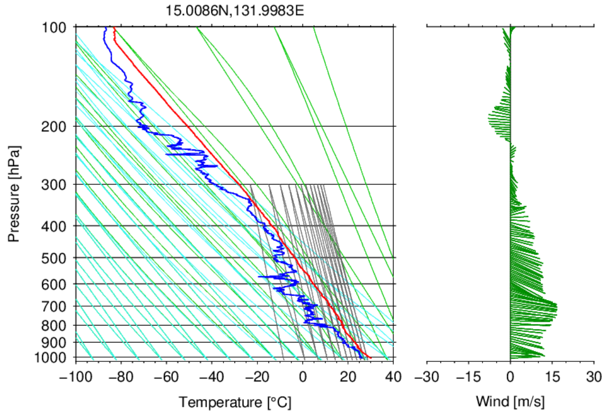

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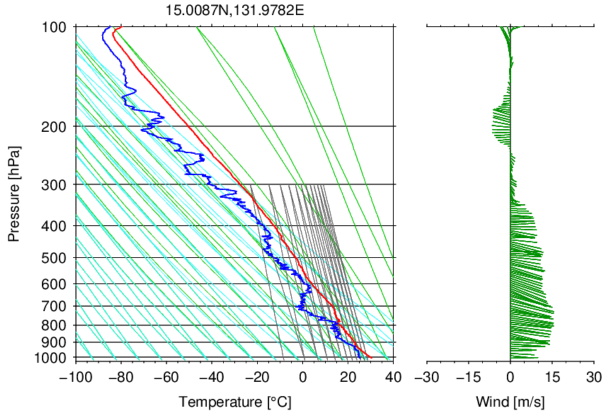

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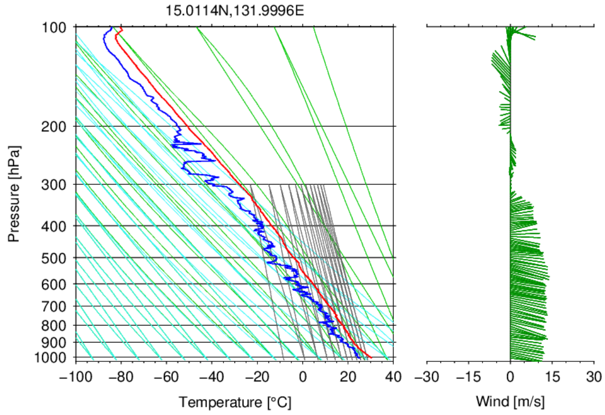

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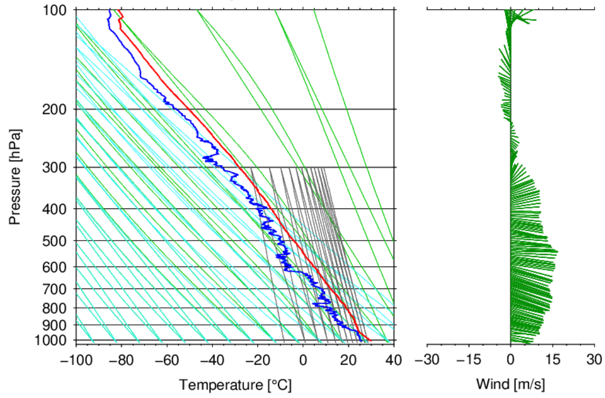

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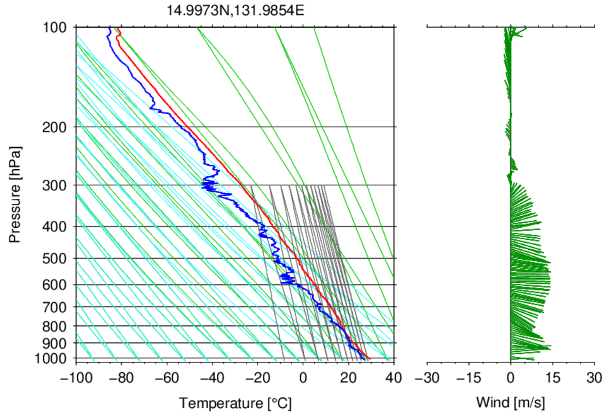

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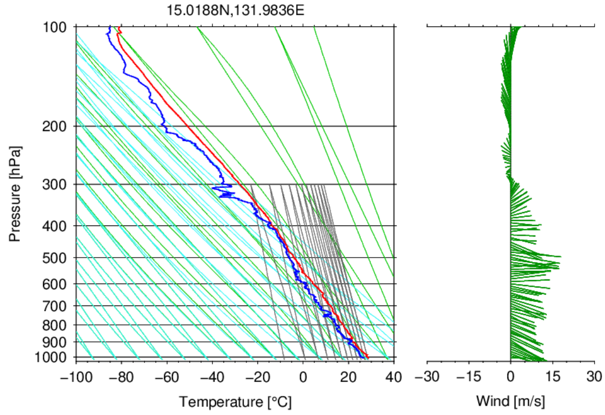

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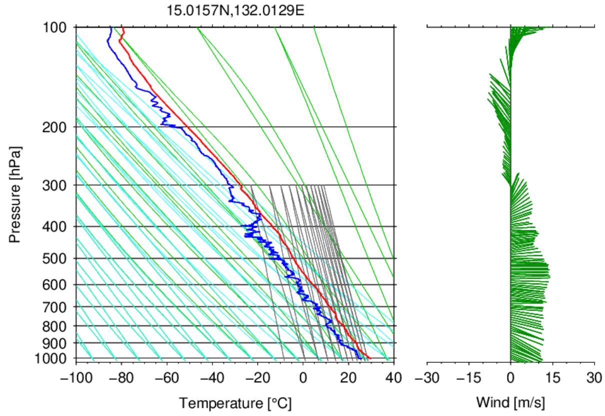

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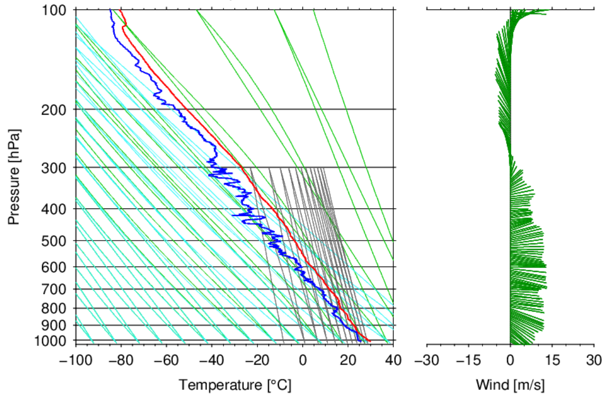

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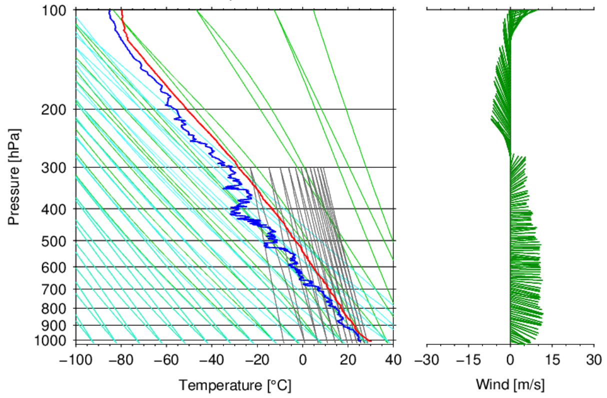

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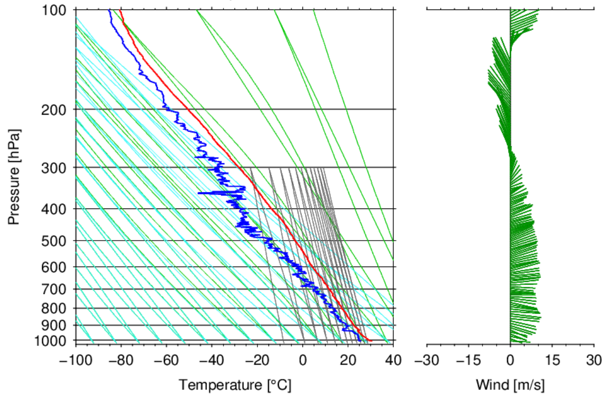

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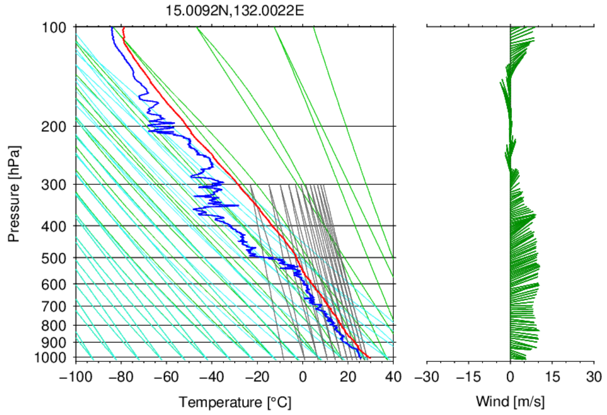

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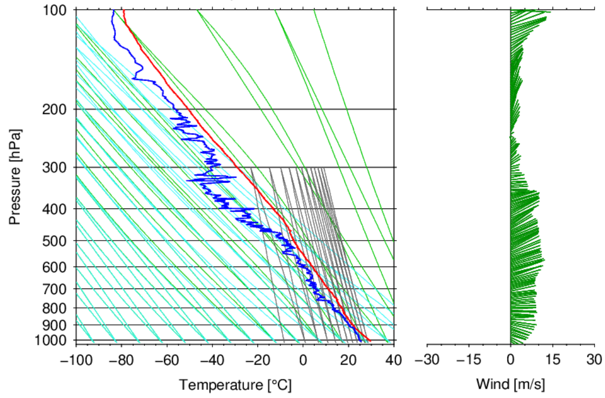

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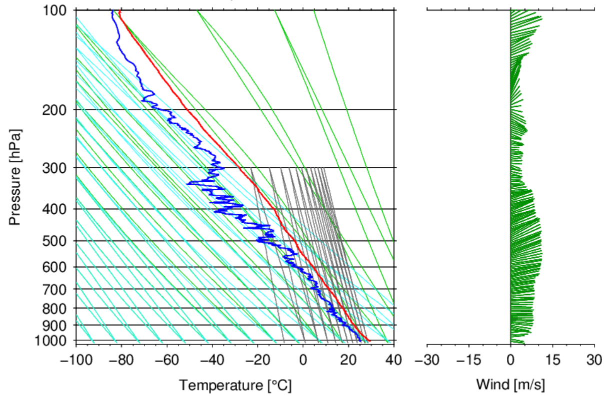

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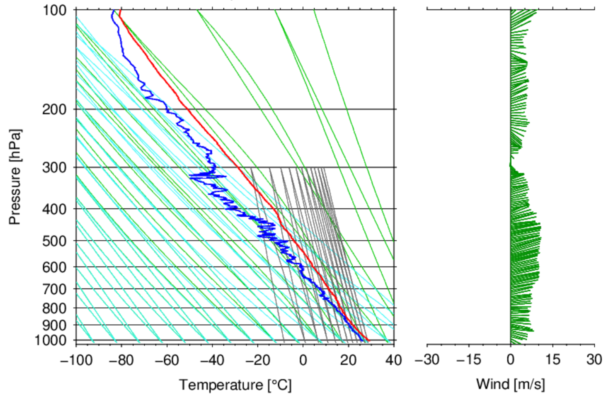

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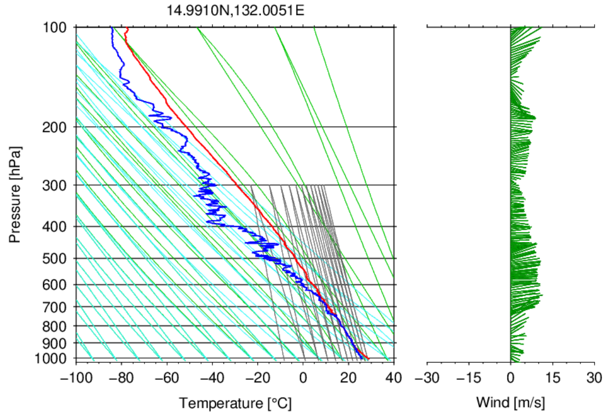

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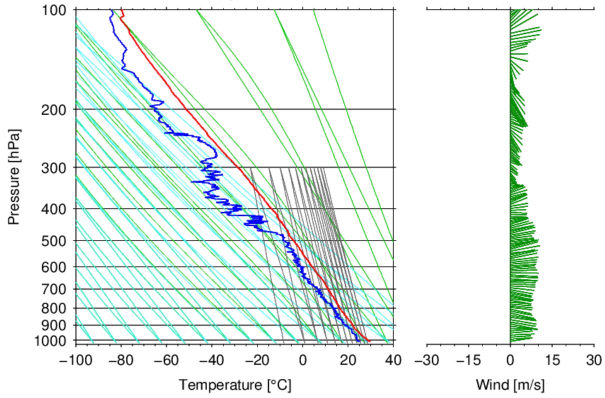

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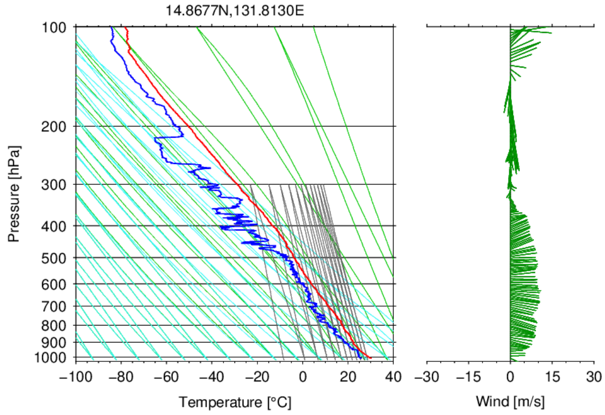

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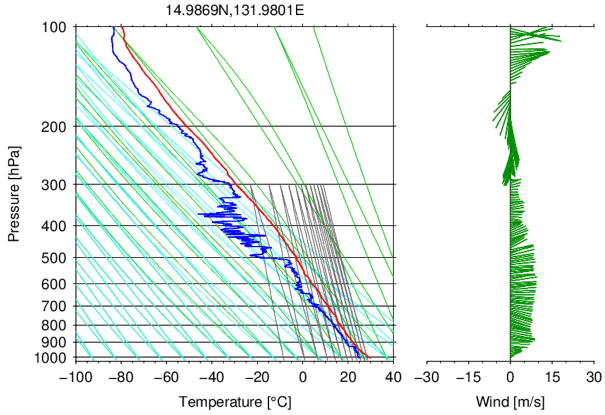

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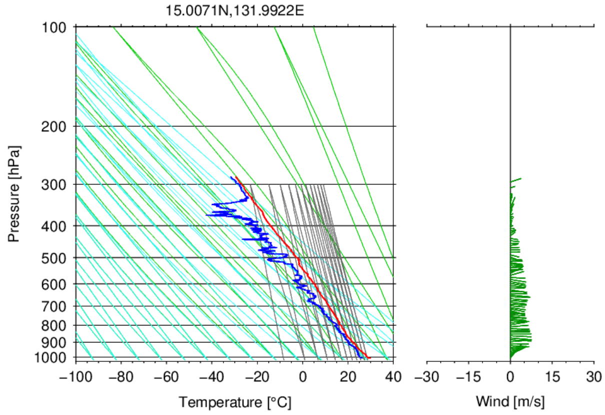

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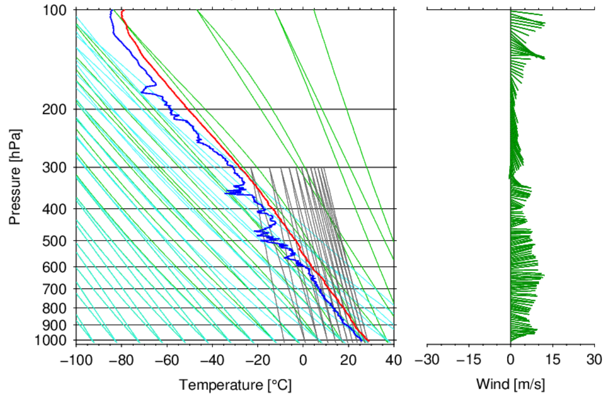

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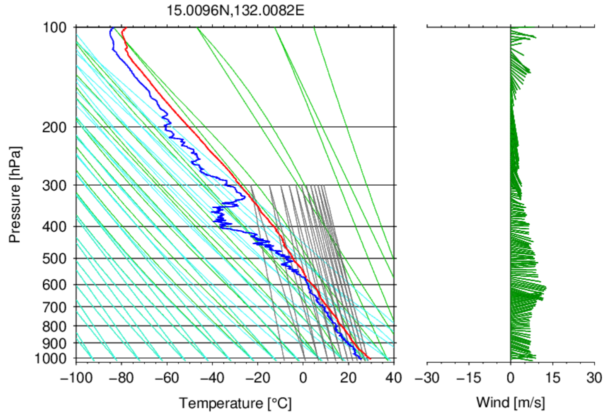

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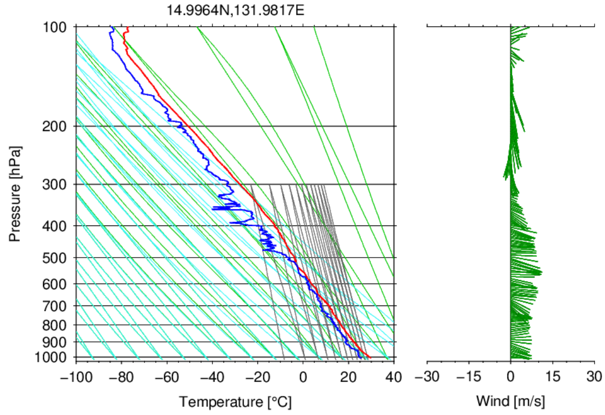

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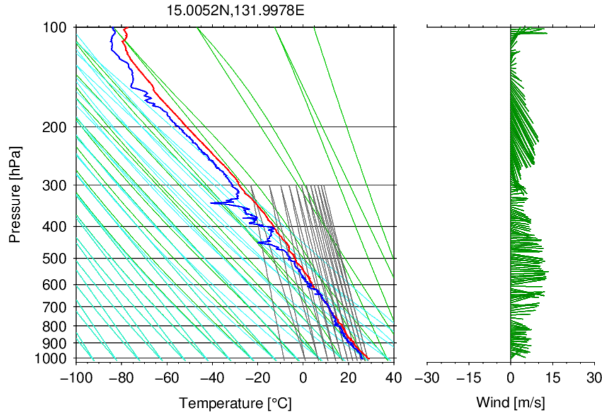

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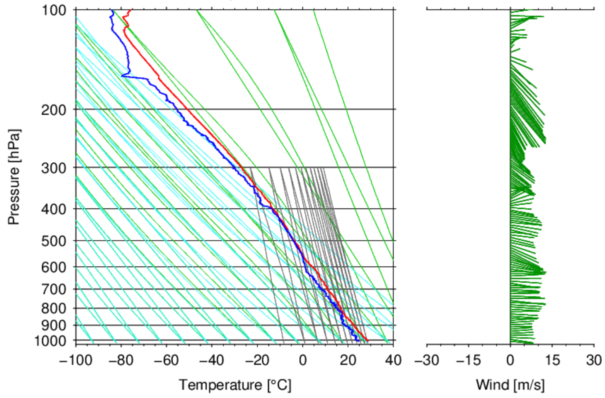

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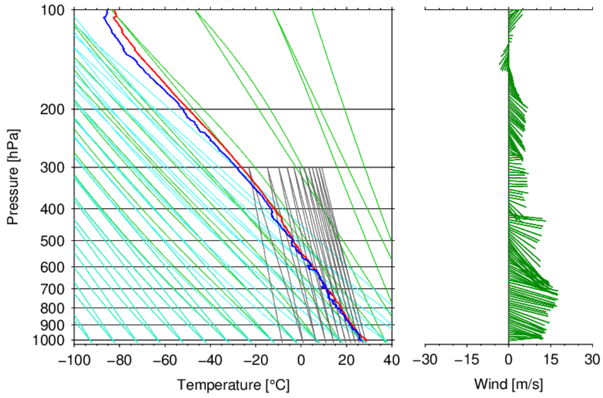

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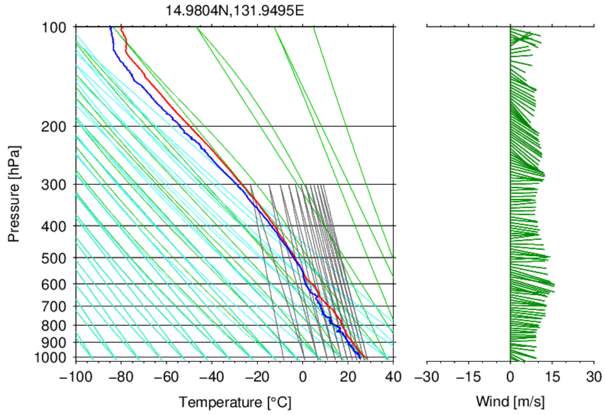

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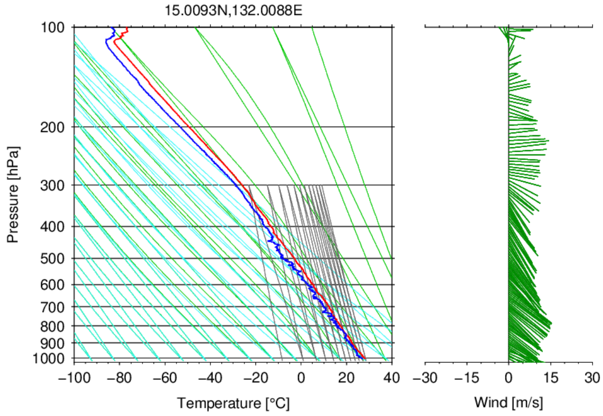

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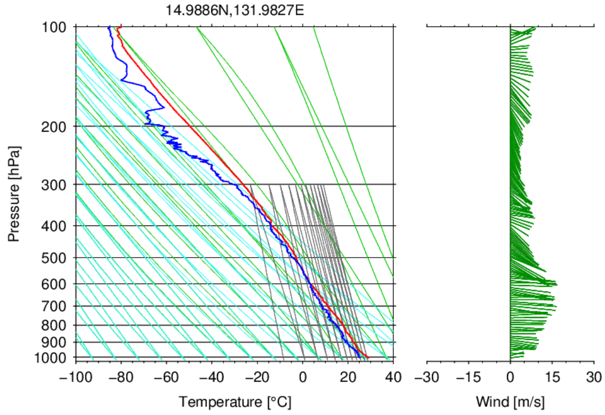

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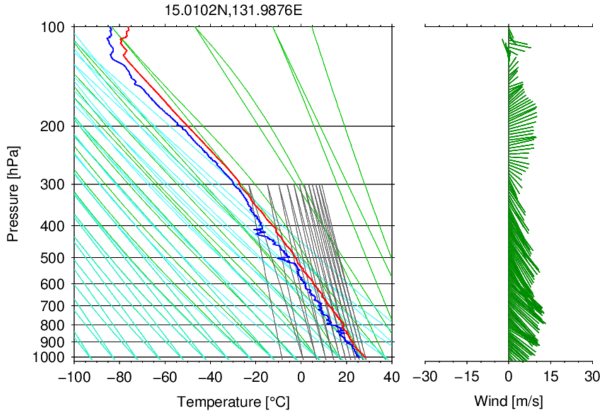

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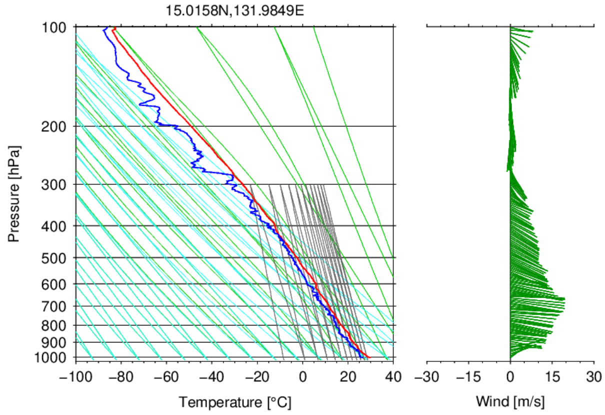

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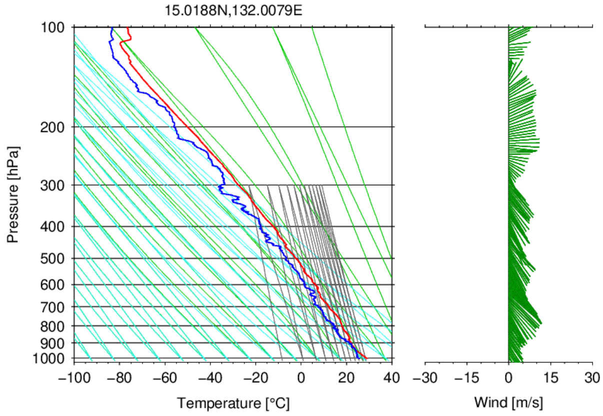

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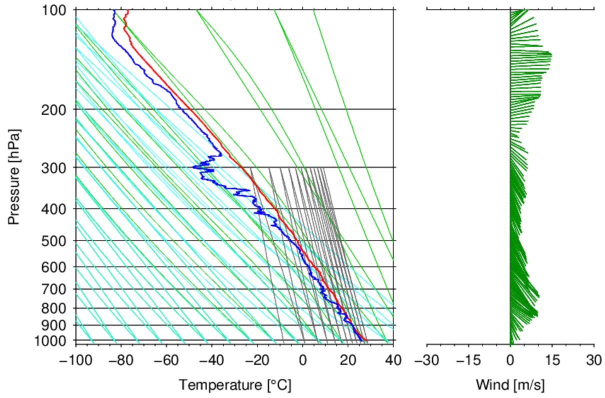

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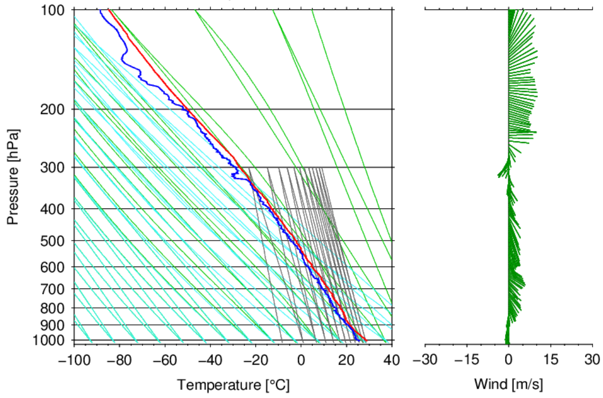

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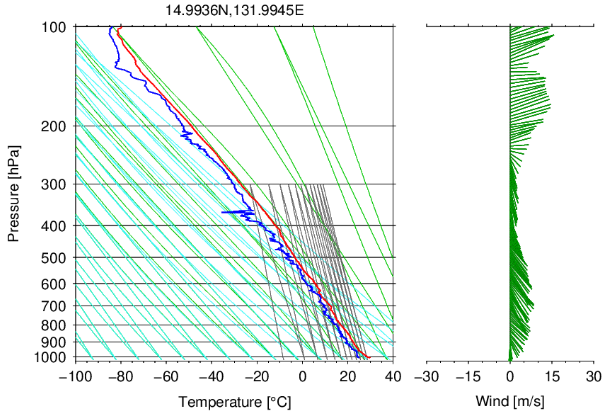

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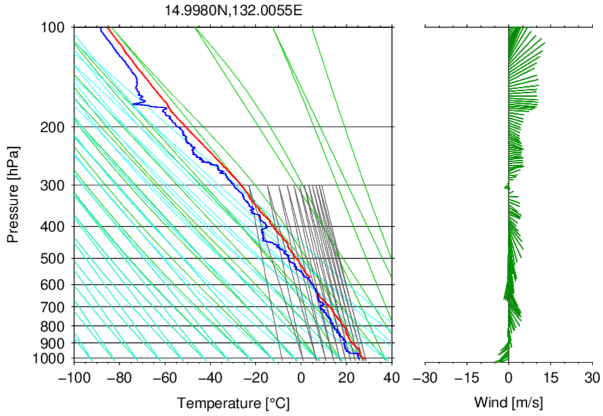

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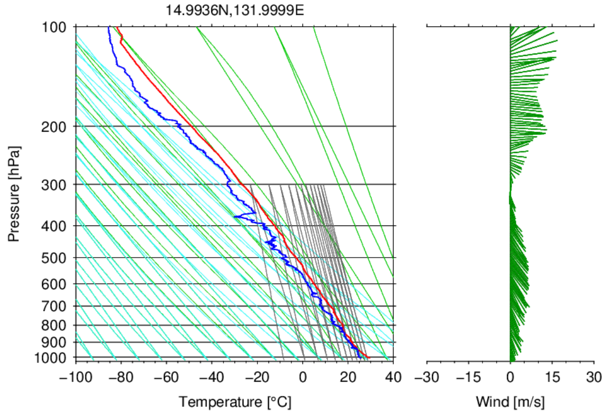

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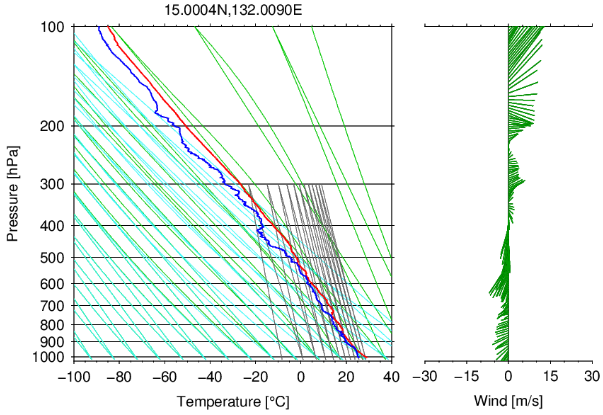

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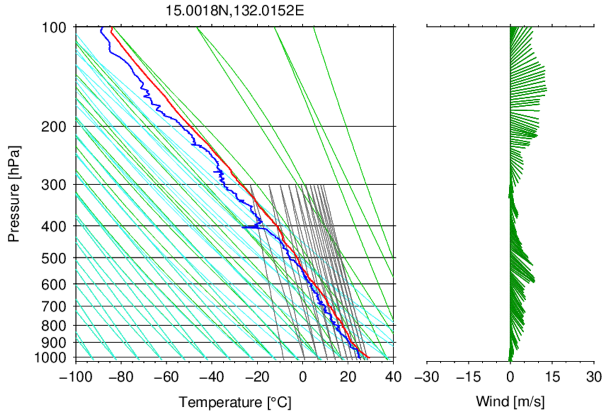

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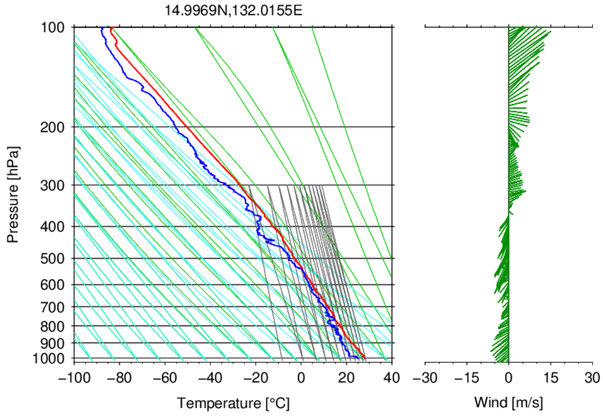

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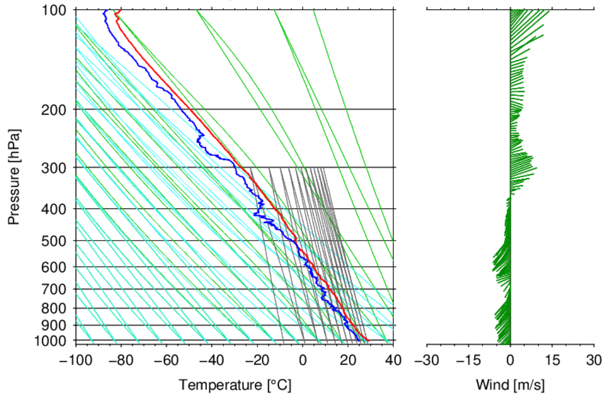

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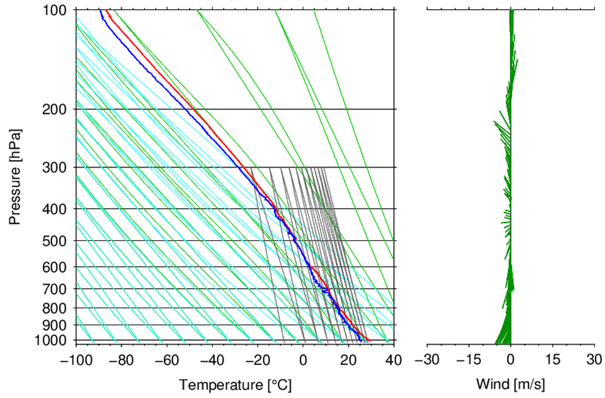

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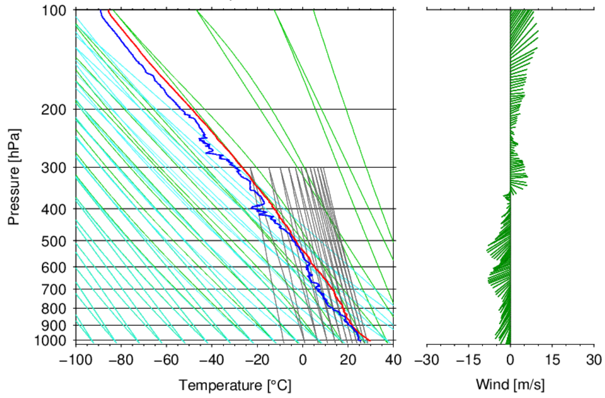

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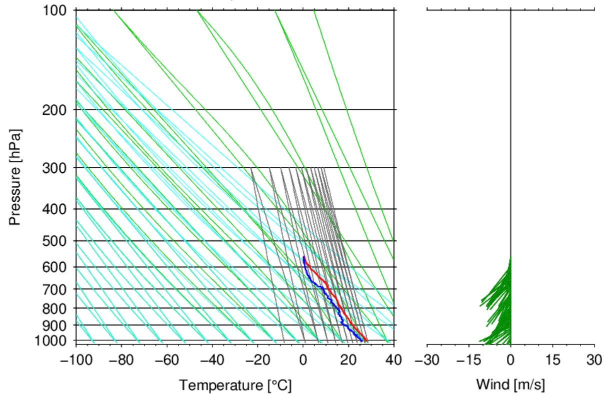

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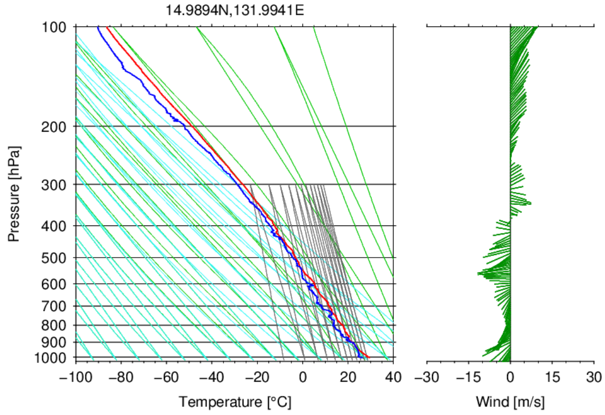

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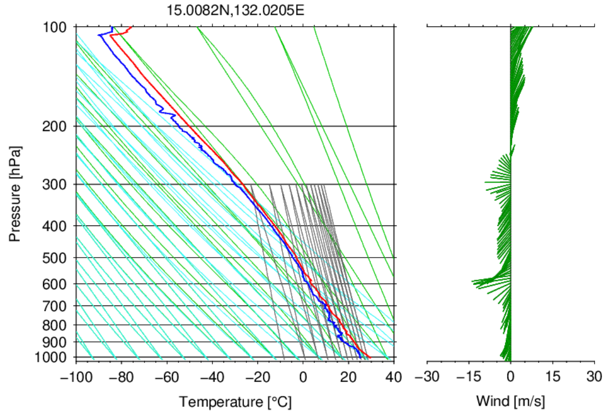

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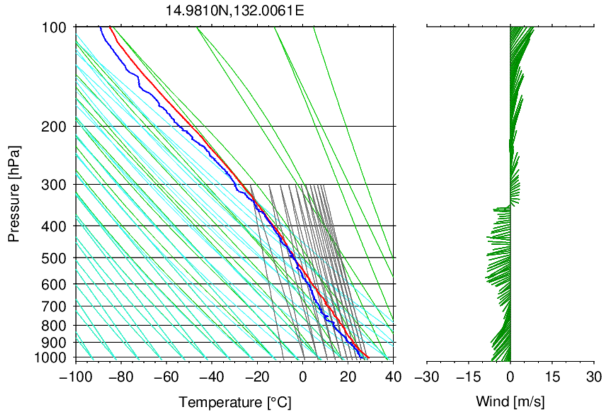

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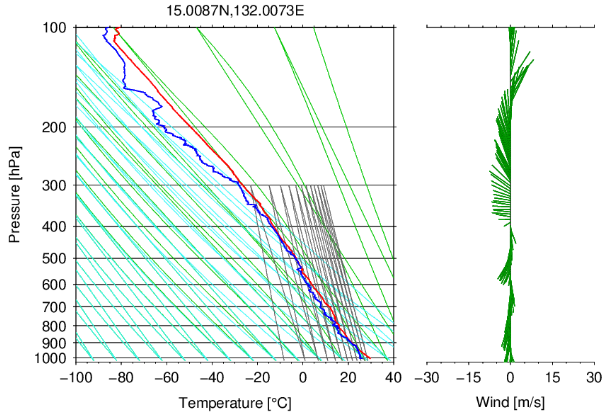

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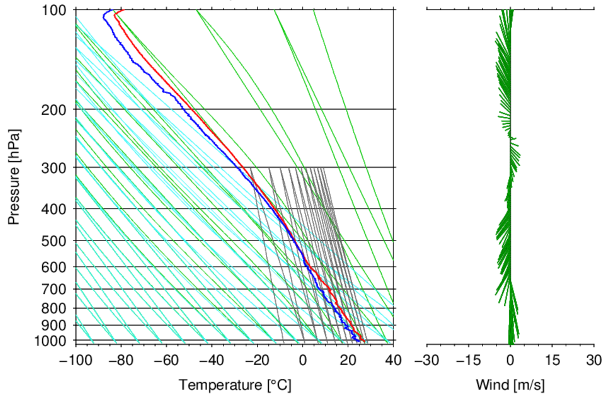

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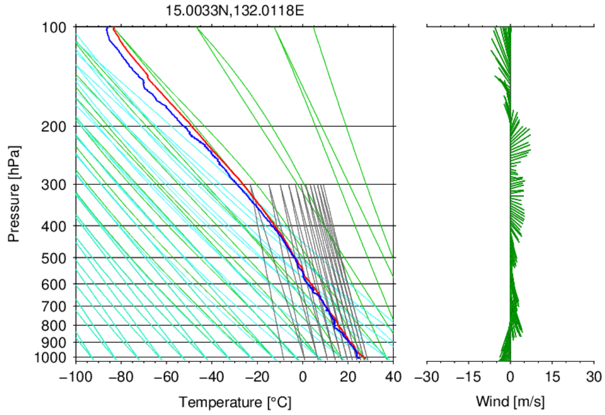

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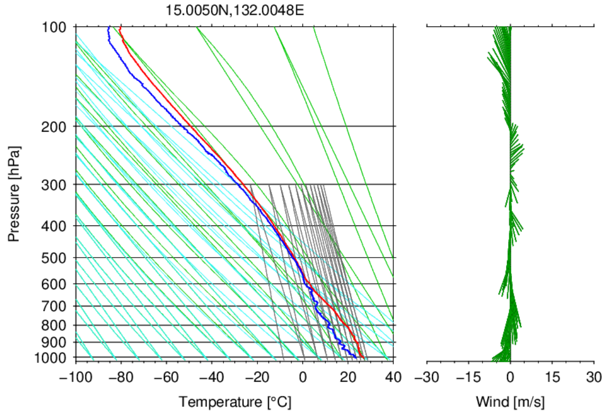

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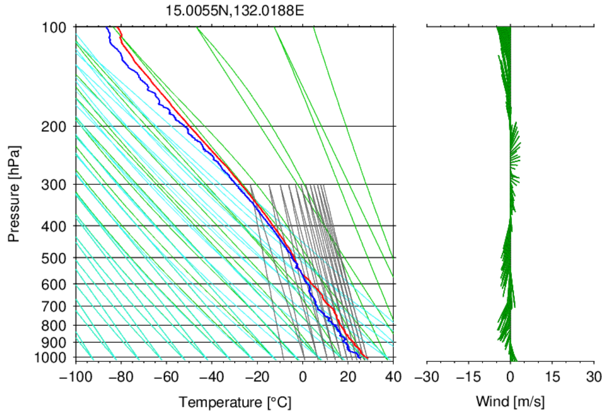

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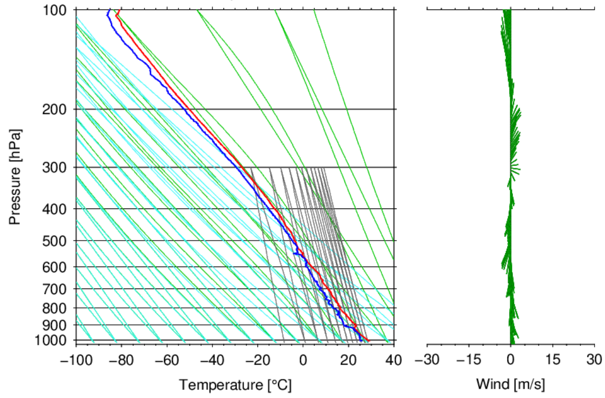

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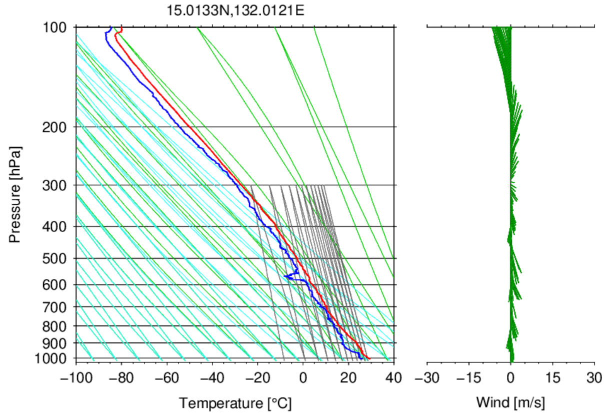

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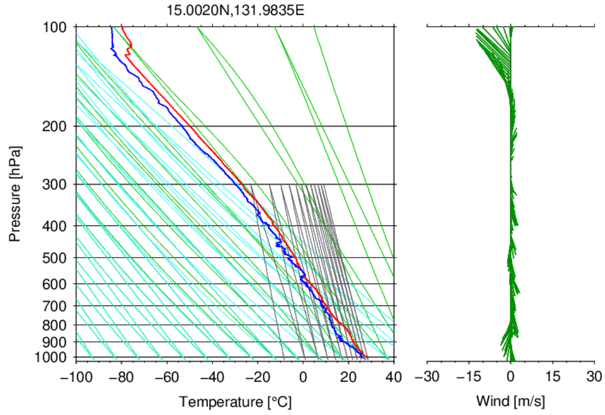

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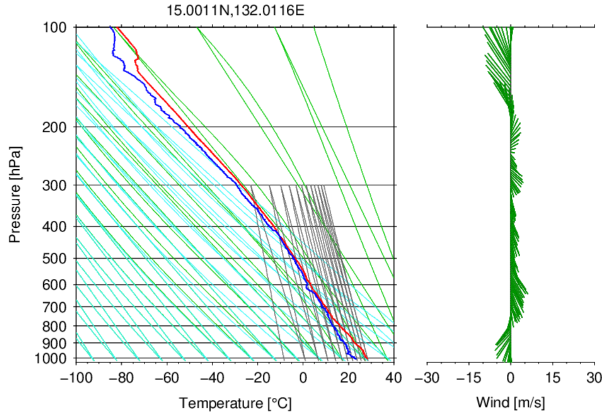

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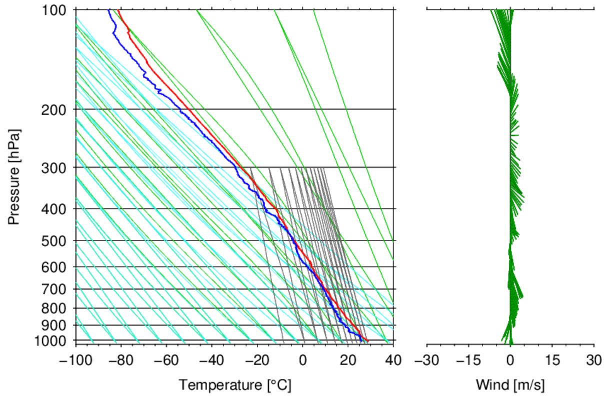

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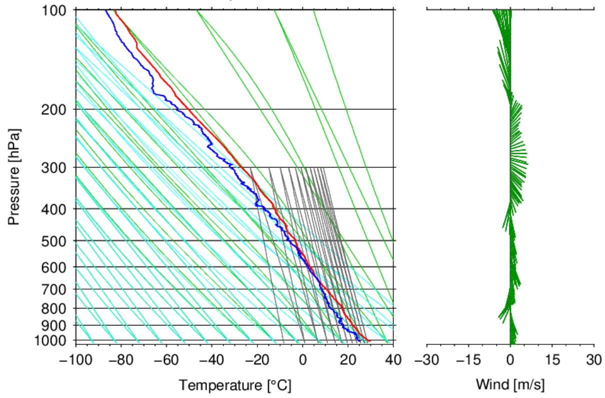

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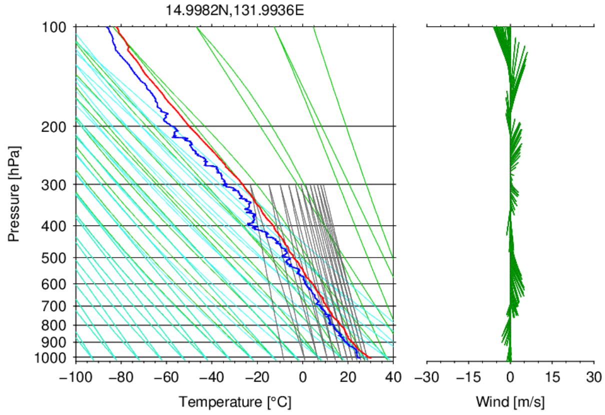

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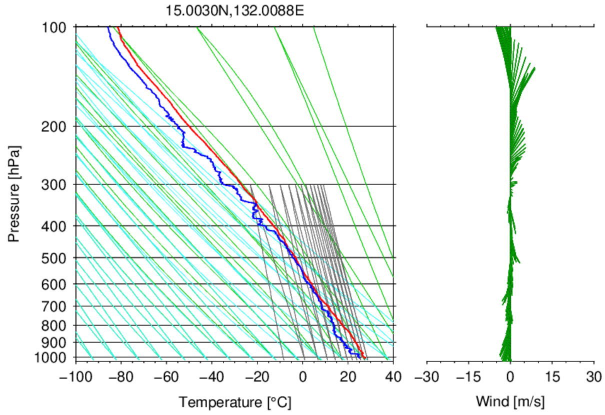

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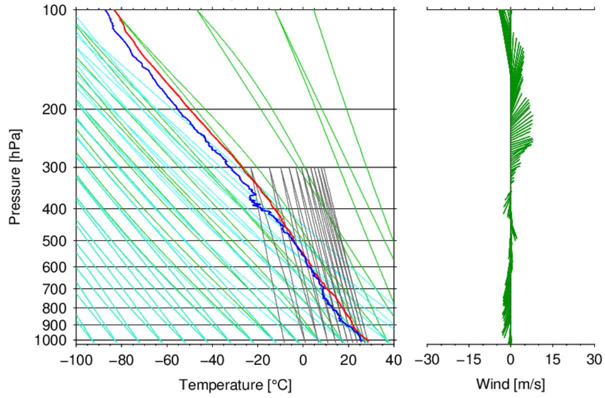

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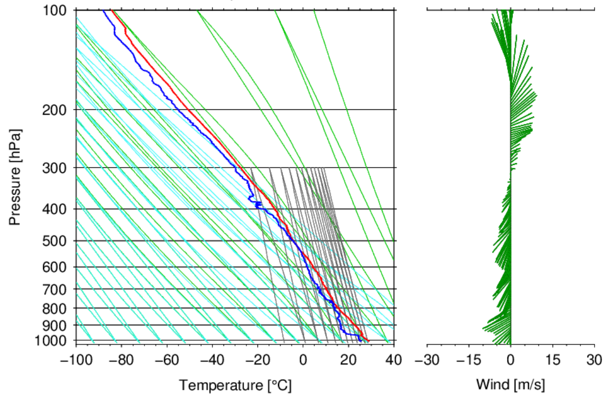

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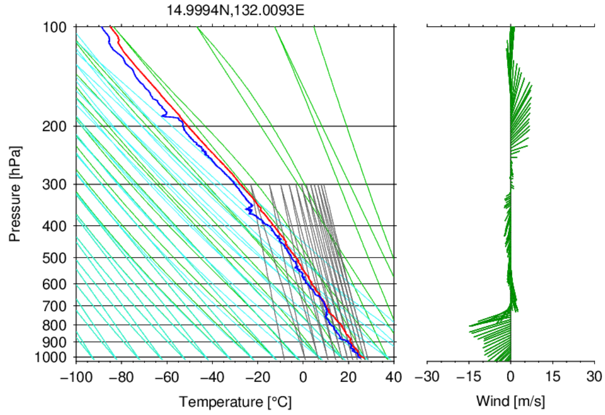

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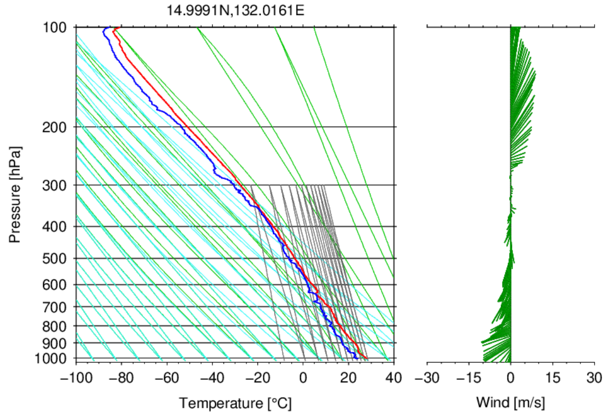

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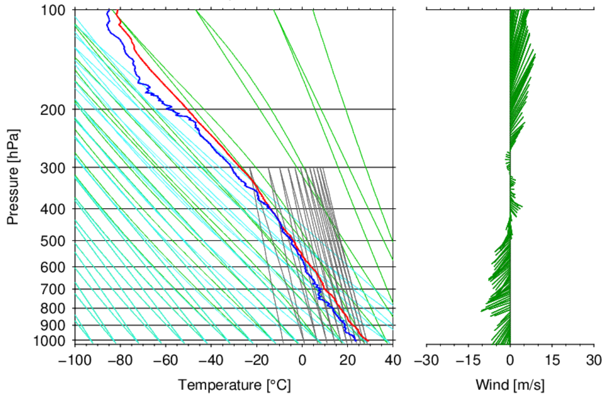

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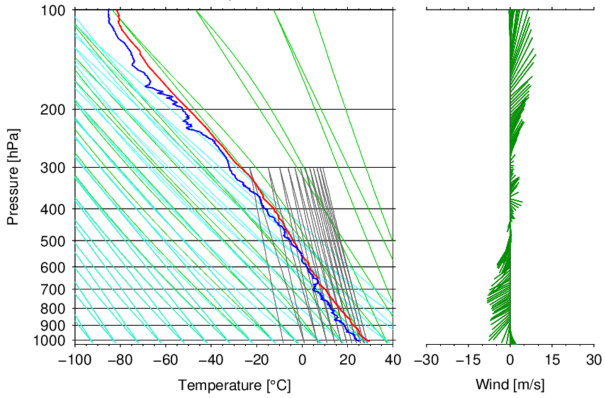

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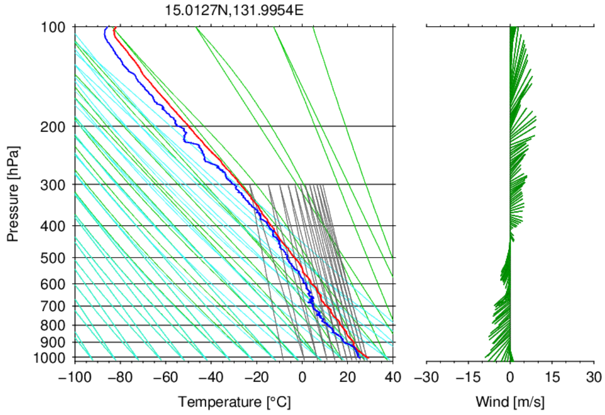

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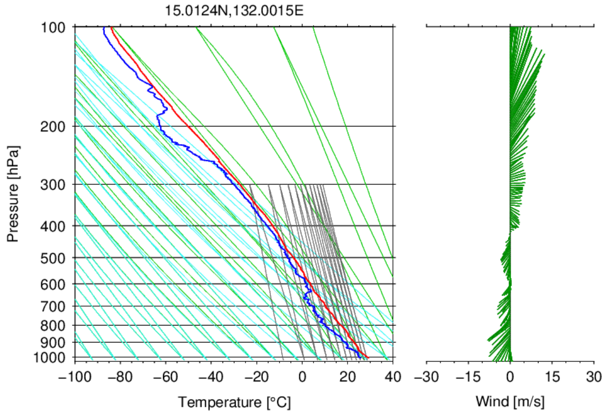

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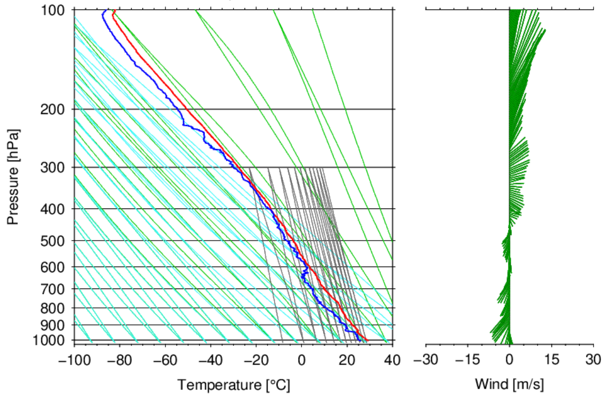

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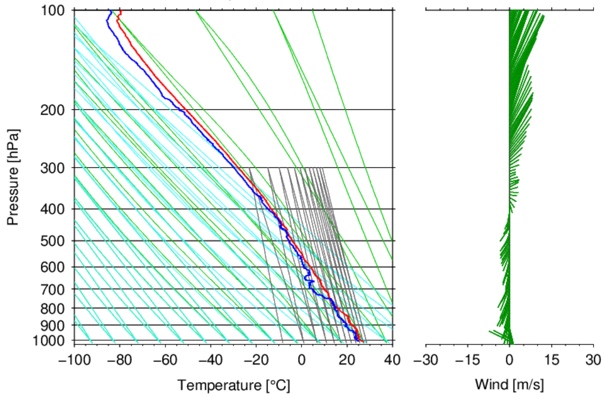

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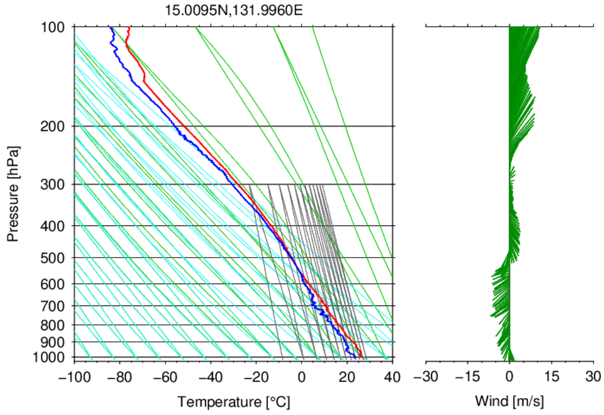

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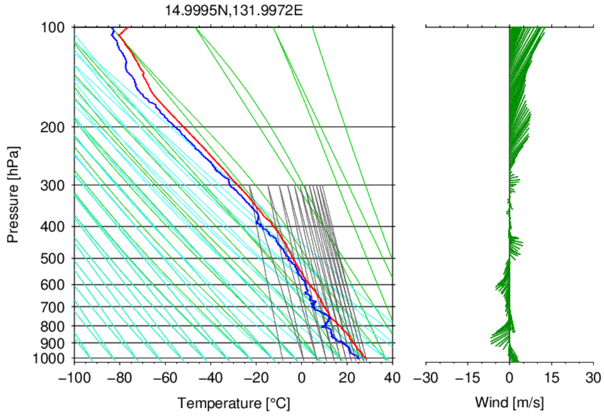

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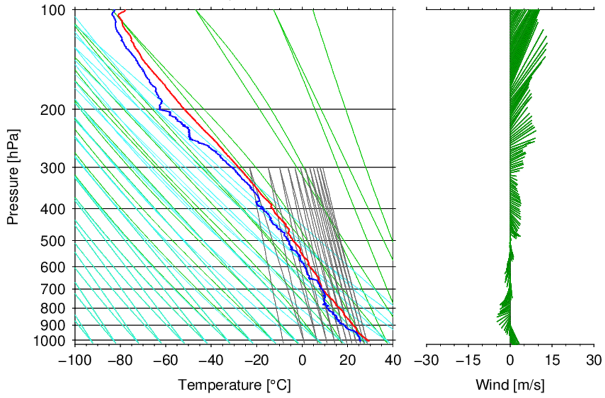

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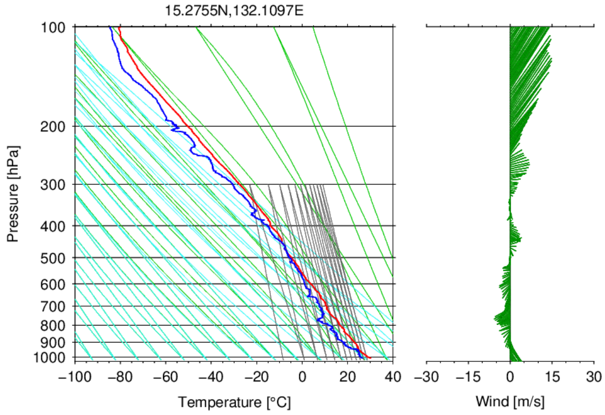

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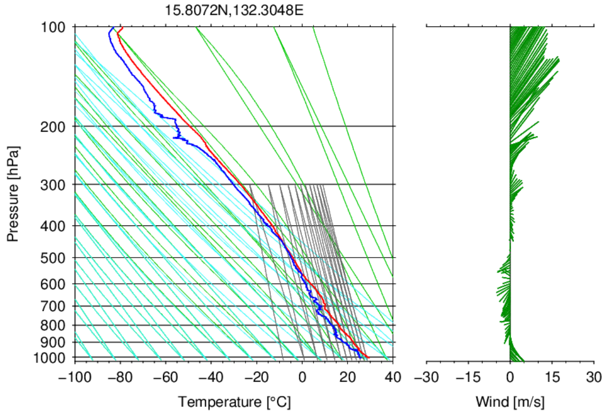

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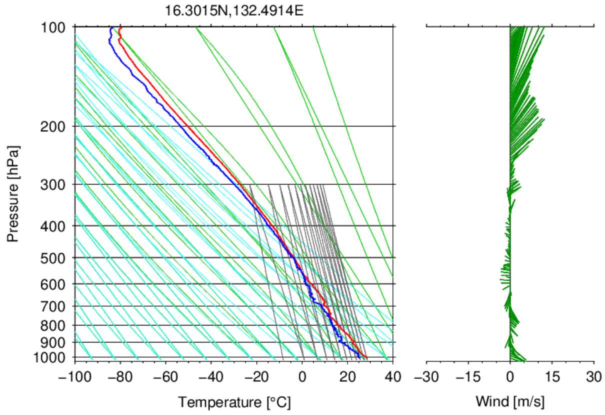

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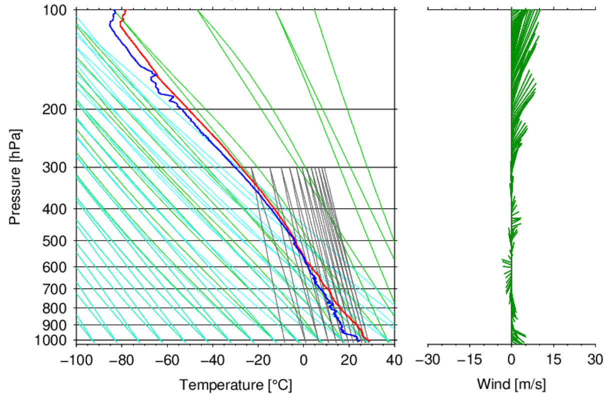

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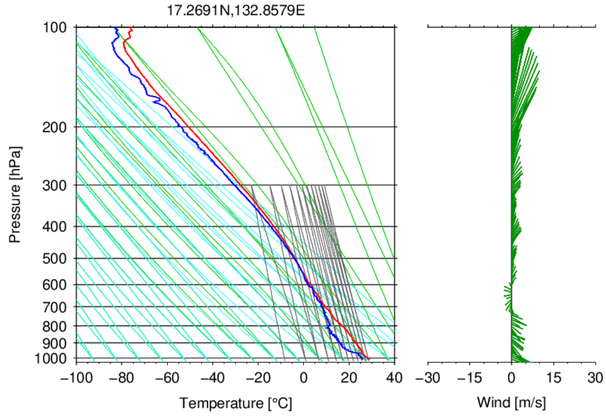

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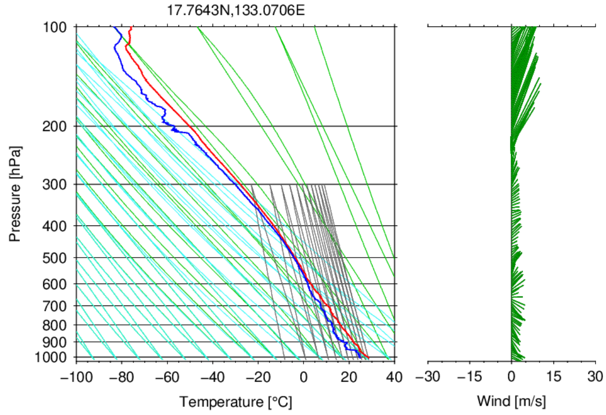

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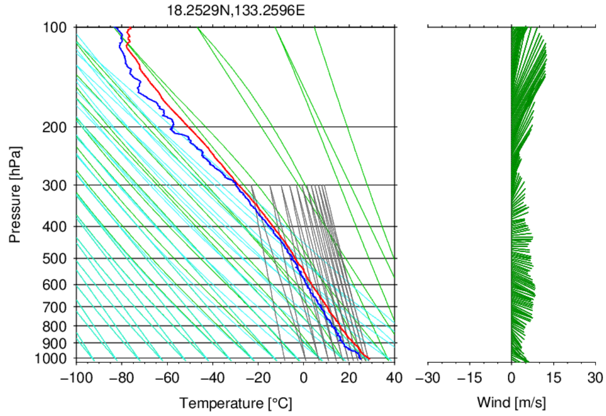

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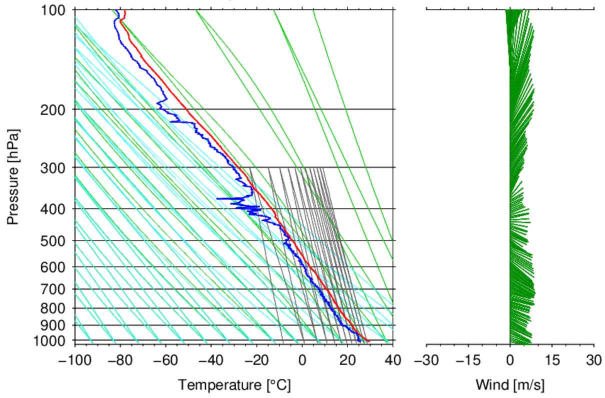

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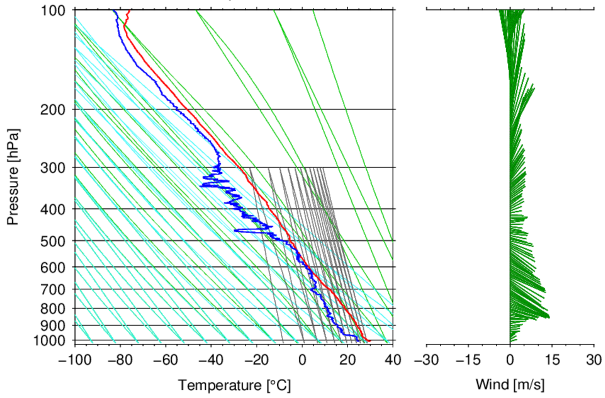

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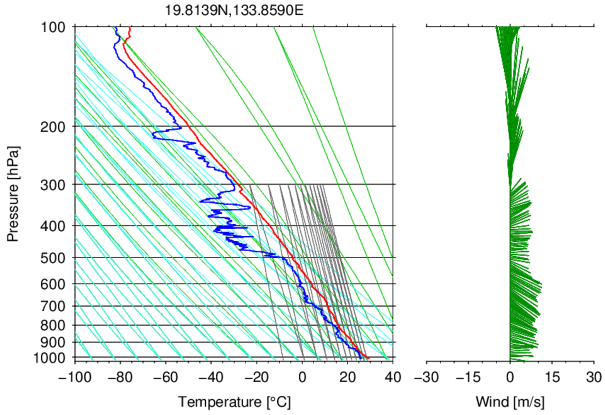

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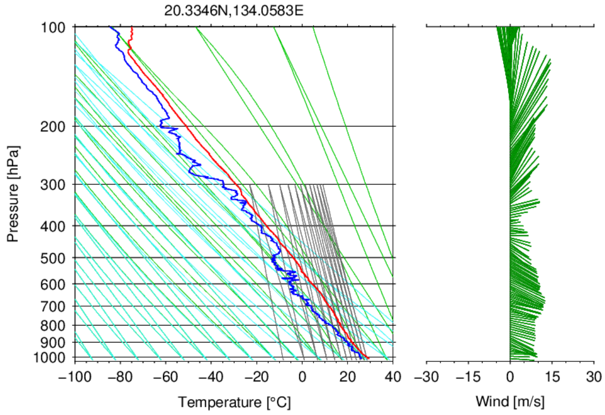

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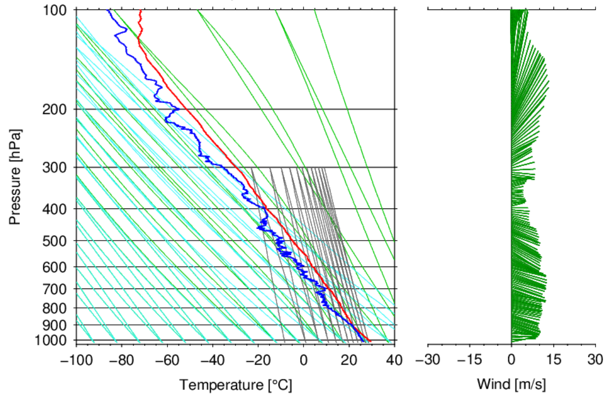

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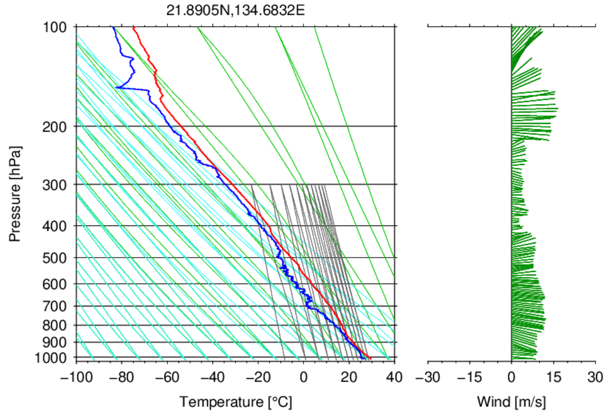

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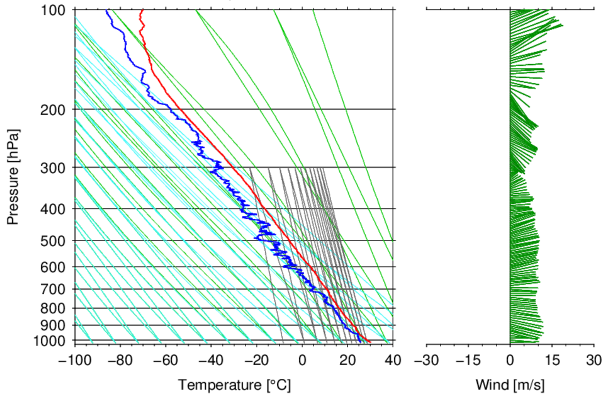

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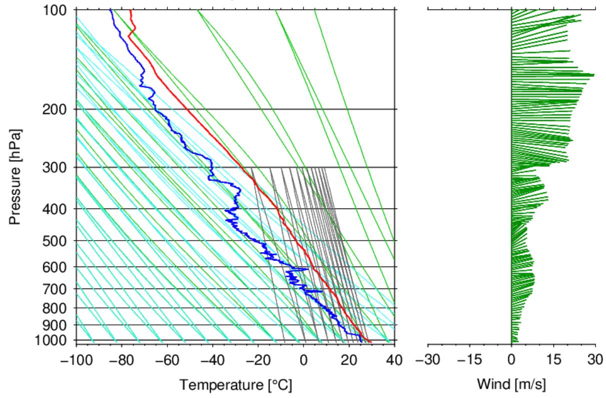

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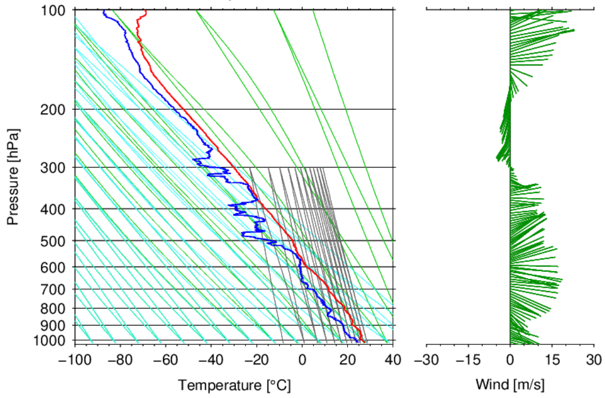

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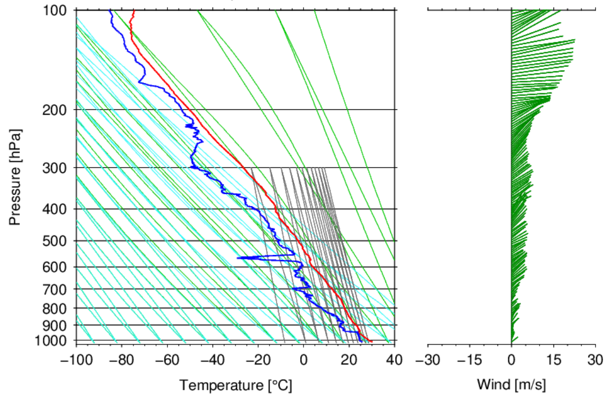

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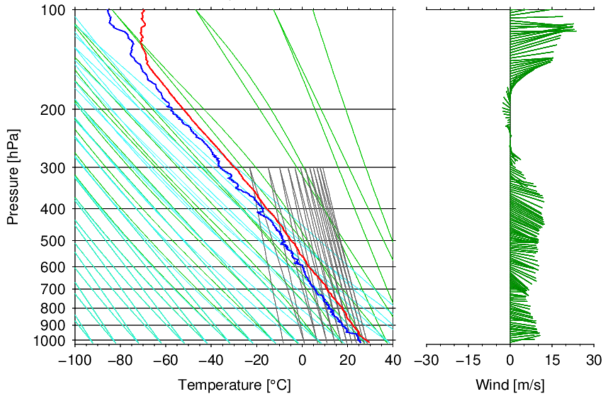

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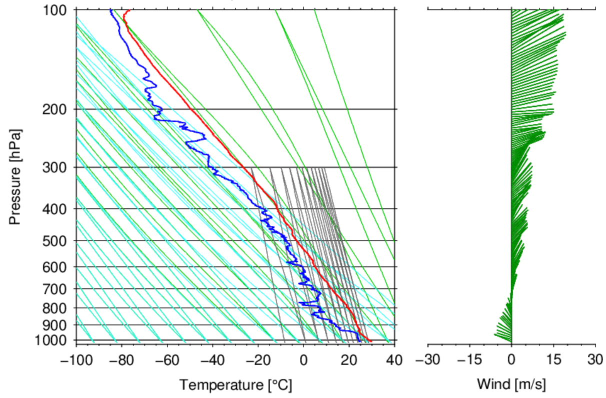
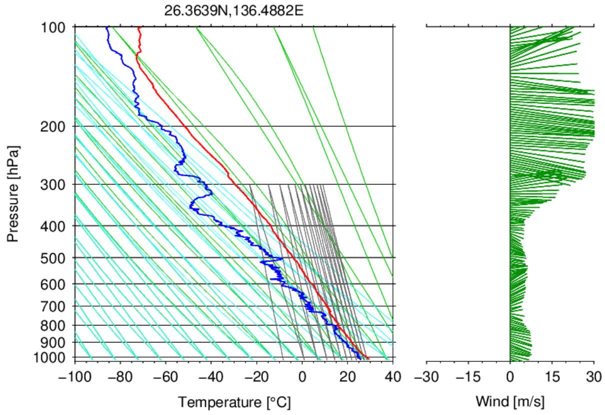
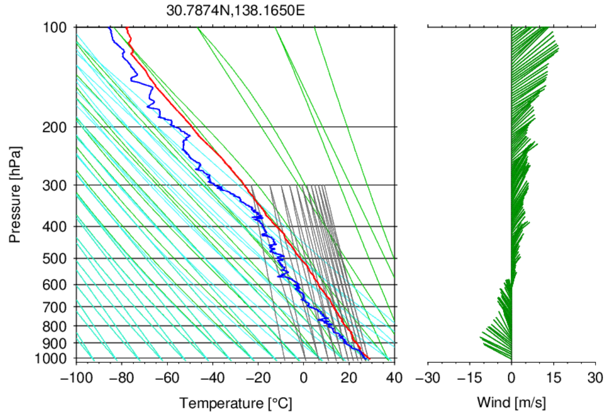
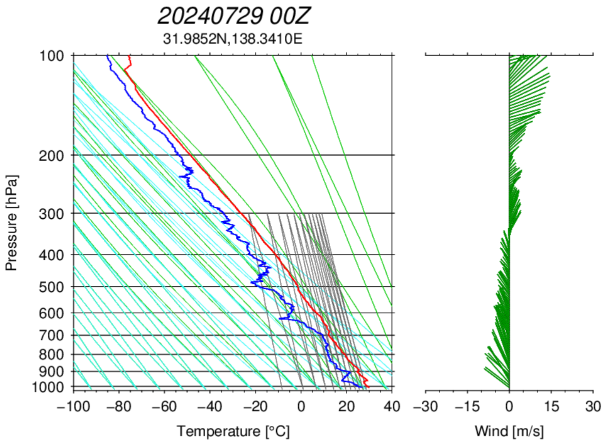


20240727 18Z
26.3639N,136.4882E

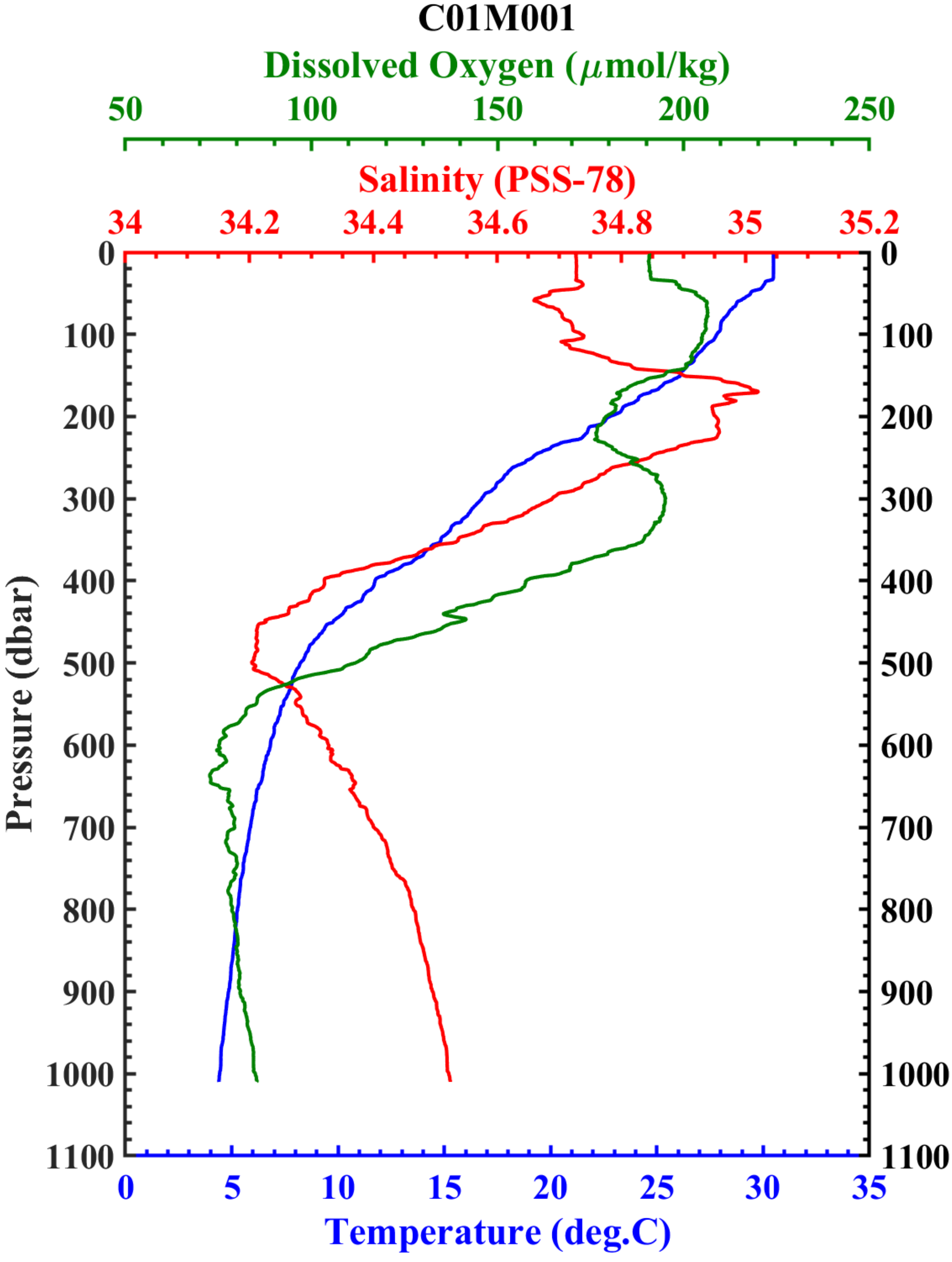


20240728 18Z
30.7874N,138.1650E



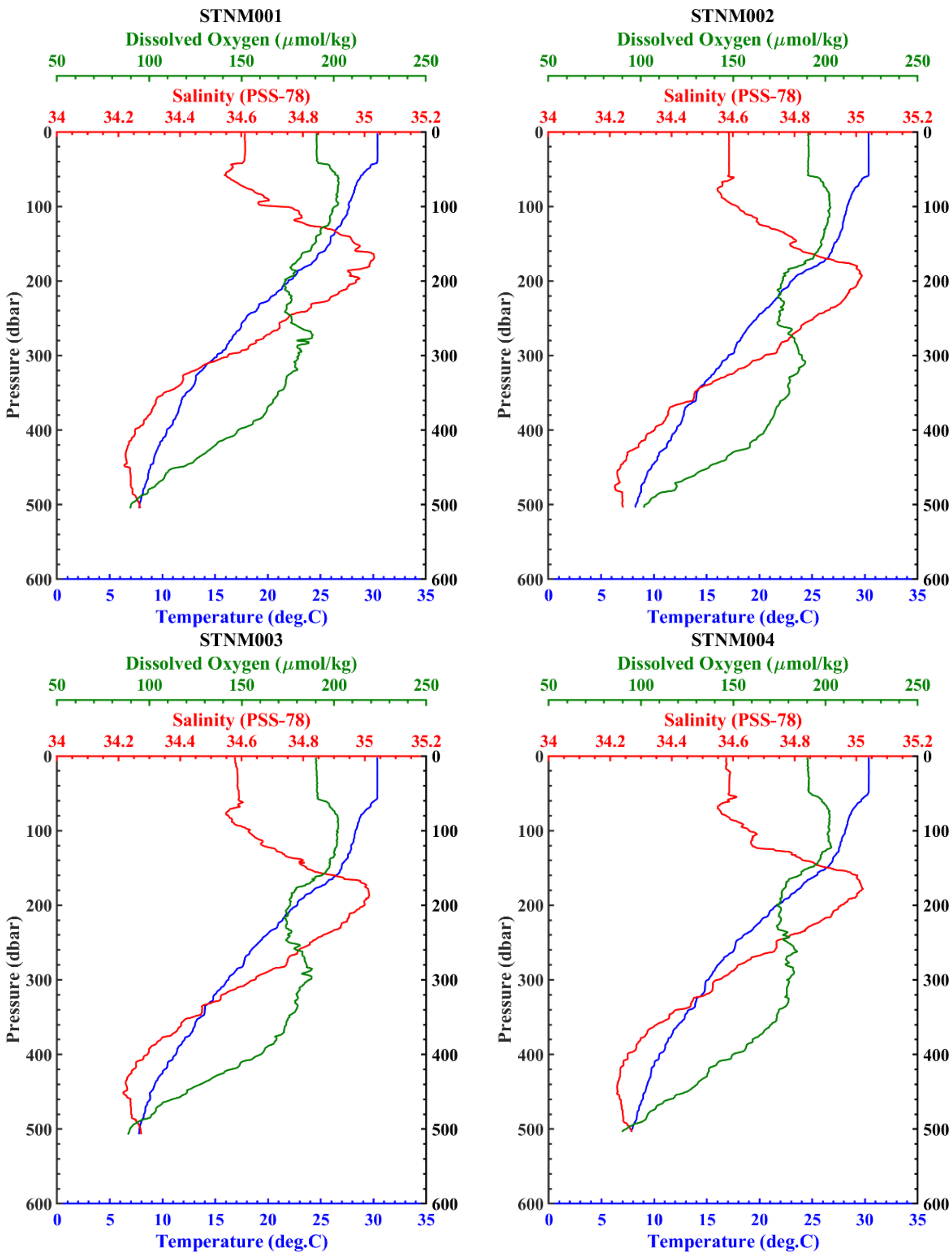

20240729 00Z
31.9852N,138.3410E
Pressure [hPa]
100
200
300
400
500
600
700
800
900
1000
−100 −80 −60 −40 −20 0 20 40
Temperature [°C]
−30 −15 0 15 30
Wind [m/s]

Appendix B: Oceanic profiles by the CTD observations



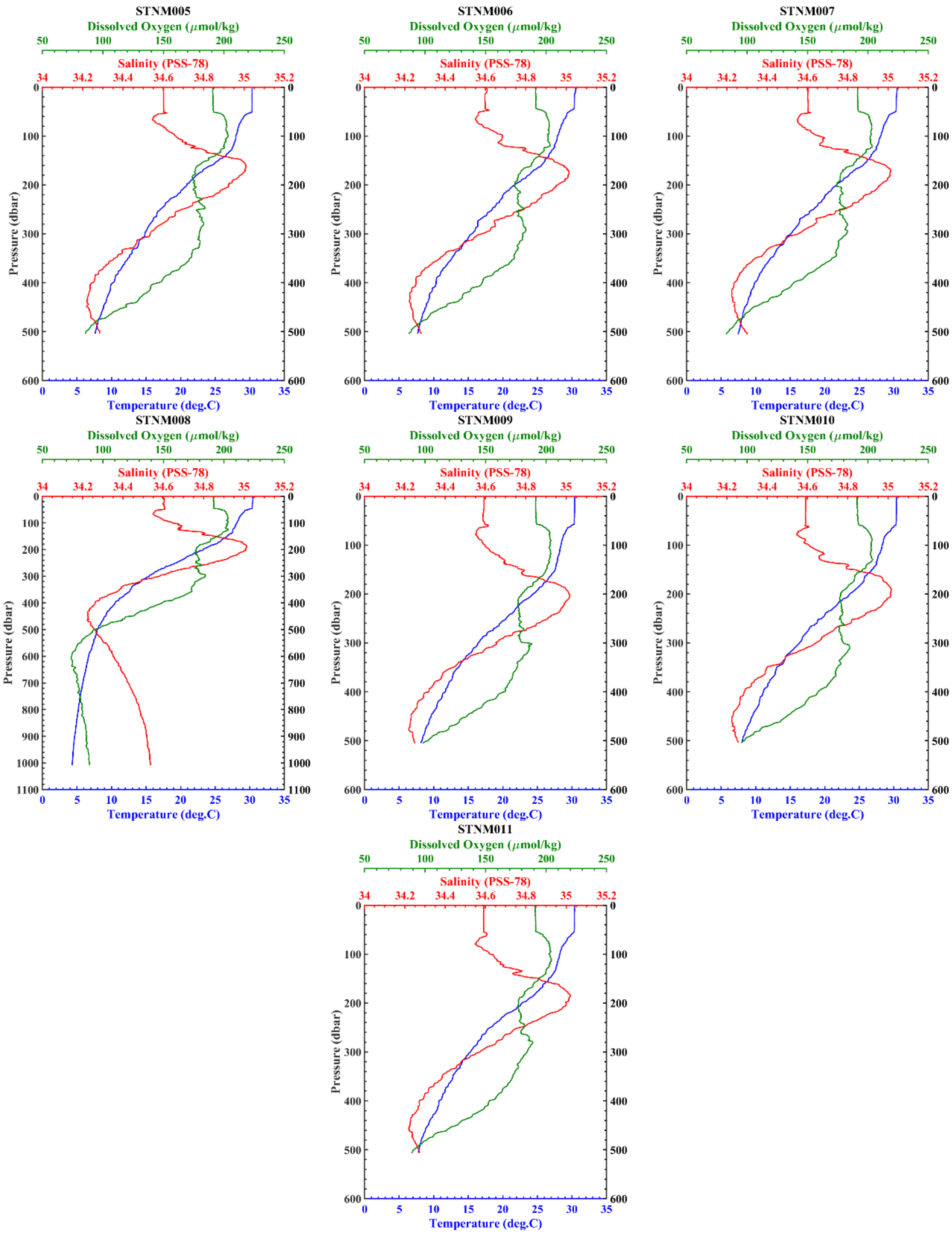
CTD profile : Argo Deployment : Jun. 25, 2024

C01M001



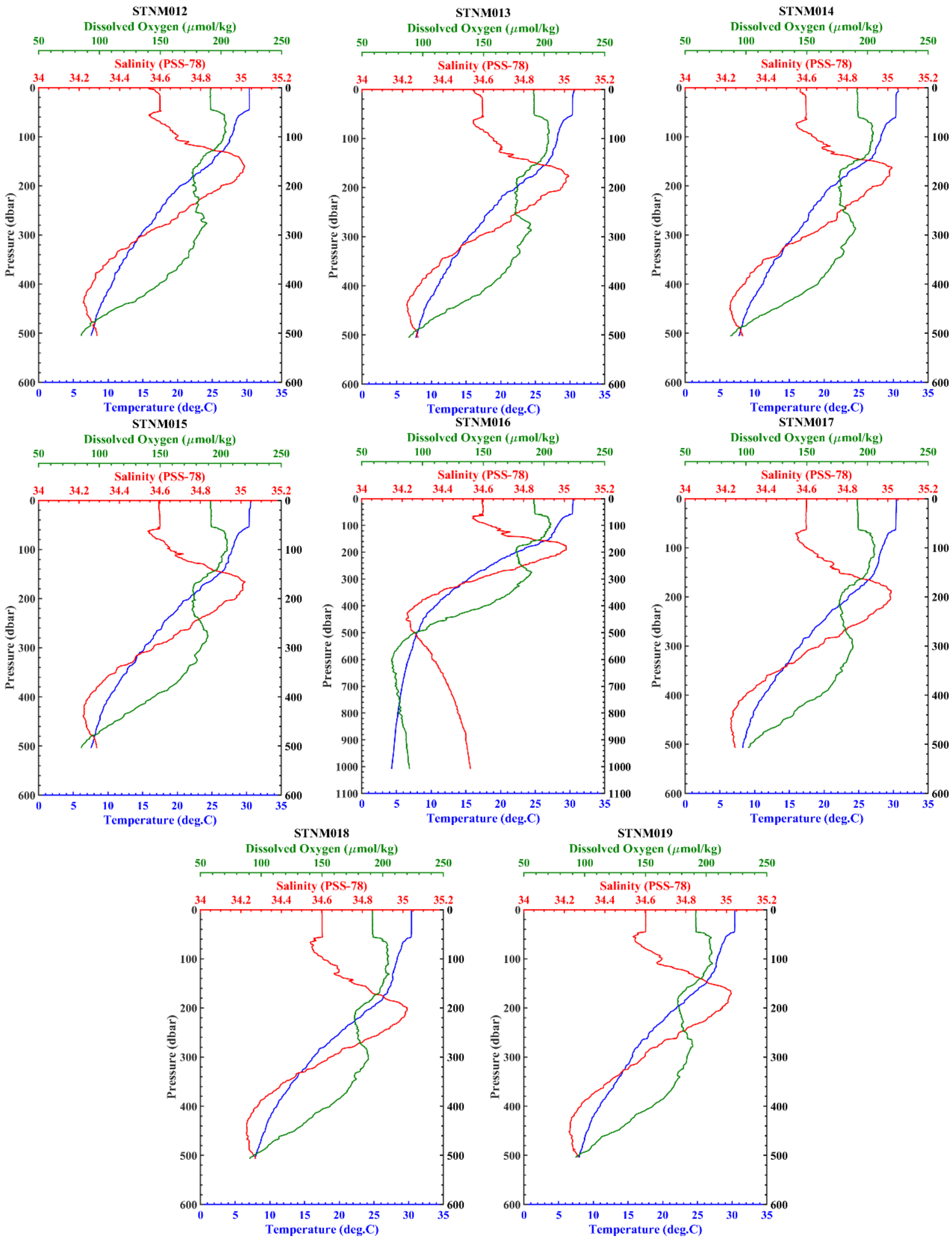
CTD profile : Fixed Station Observation : Jun. 27, 2024

STNM001, STNM002, STNM003, STNM004



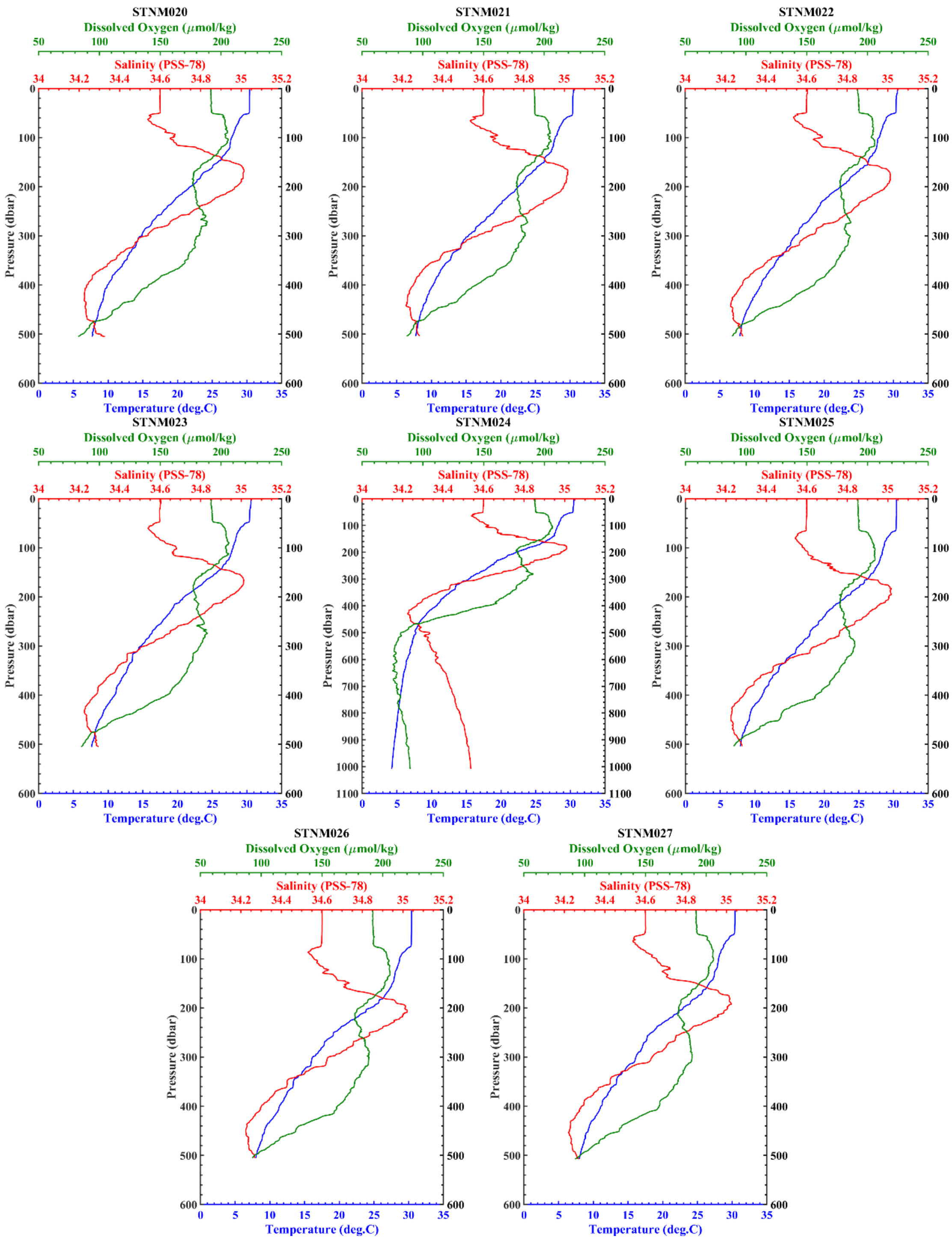
CTD profile : Fixed Station Observation : Jun. 28, 2024

STNM005, STNM006, STNM007, STNM008, STNM009, STNM010, STNM011



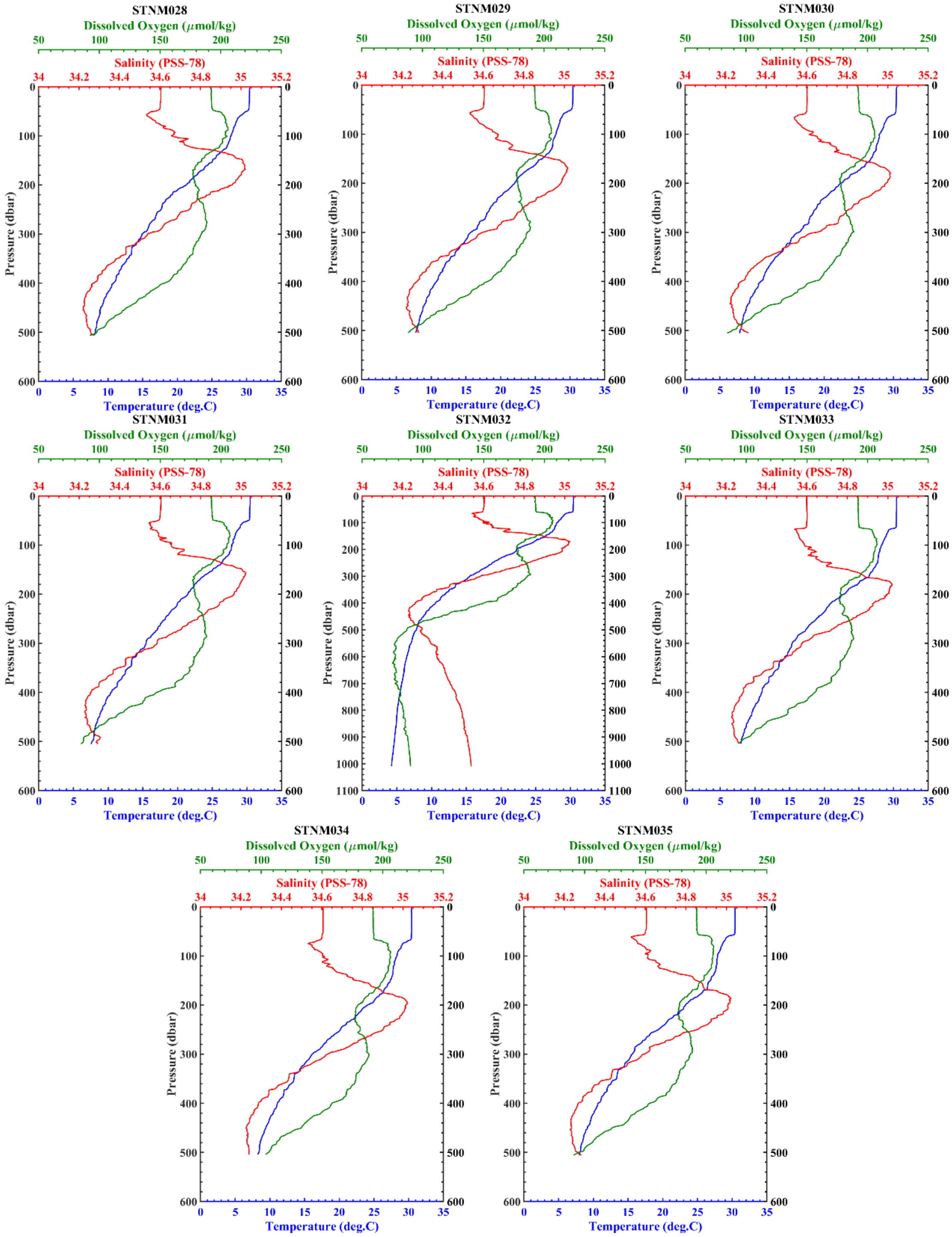
CTD profile : Fixed Station Observation : Jun. 29, 2024

STNM0012, STNM0013, STNM014, STNM015, STNM016, STNM017, STNM018, STNM019



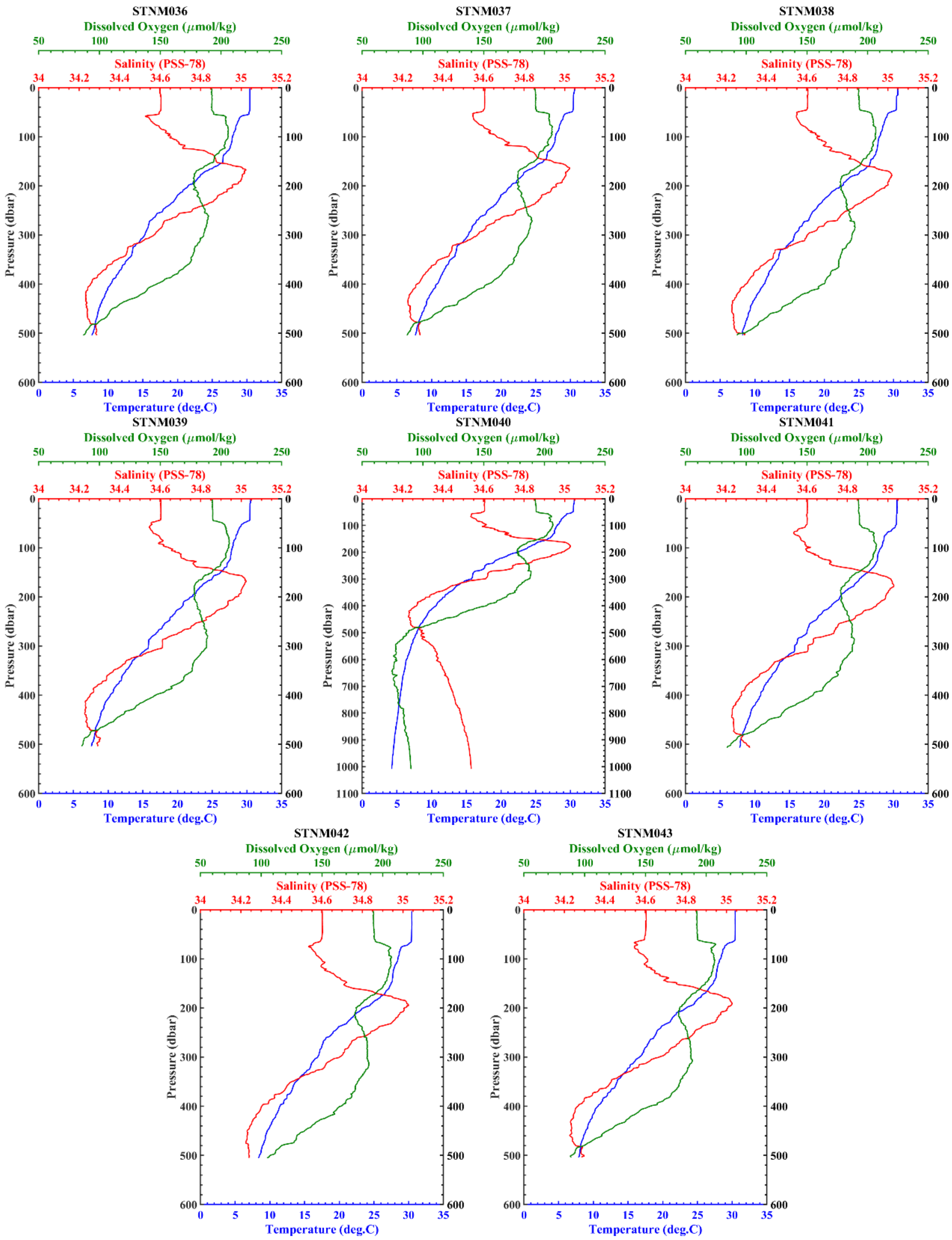
CTD profile : Fixed Station Observation : Jun. 30, 2024

STNM0020, STNM021, STNM022, STNM023, STNM024, STNM025, STNM026, STNM027



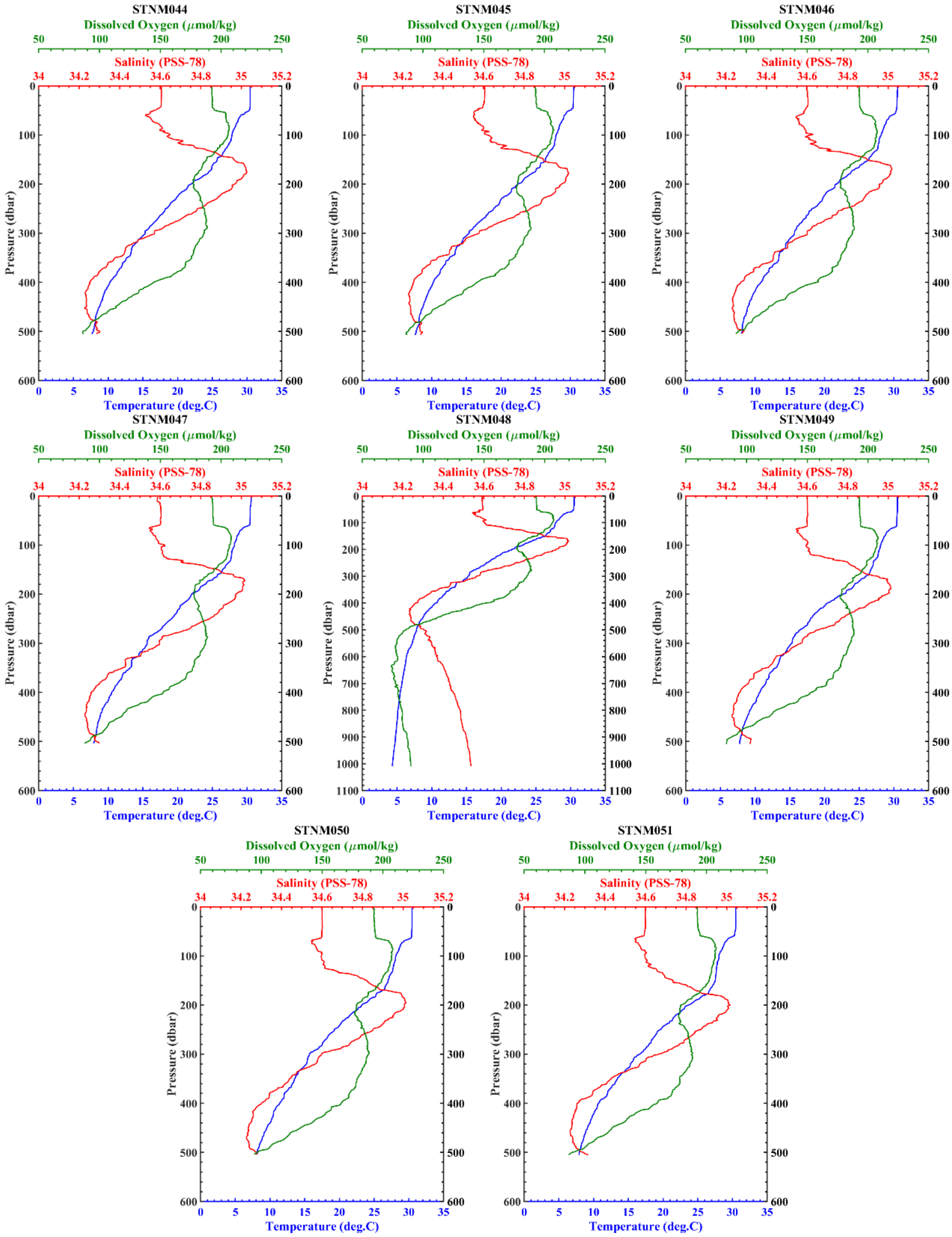
CTD profile : Fixed Station Observation : Jul. 1, 2024

STNM028, STNM029, STNM030, STNM031, STNM032, STNM033, STNM034, STNM035



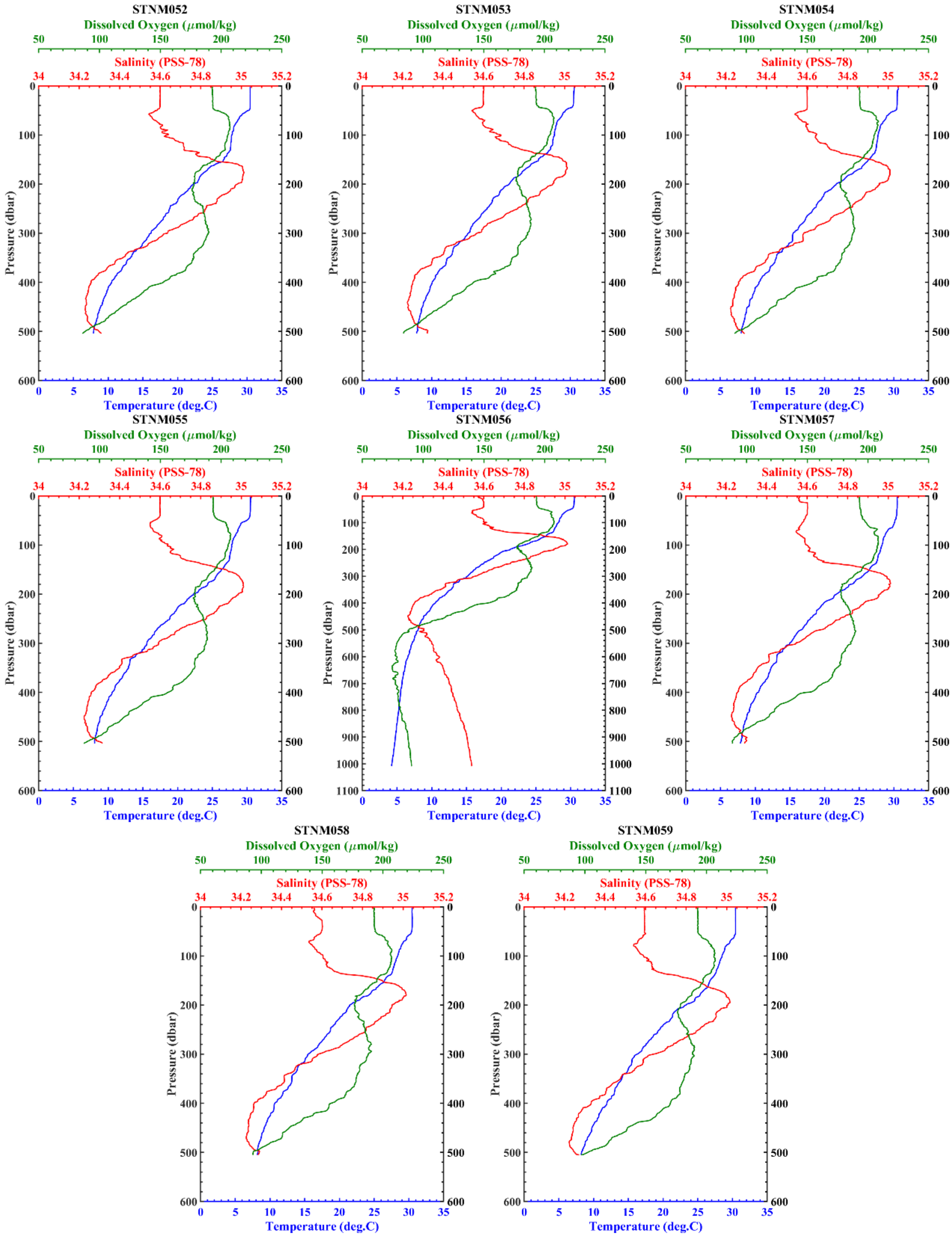
CTD profile : Fixed Station Observation : Jul. 2, 2024

STNM036, STNM037, STNM038, STNM039, STNM040, STNM041, STNM042, STNM043,



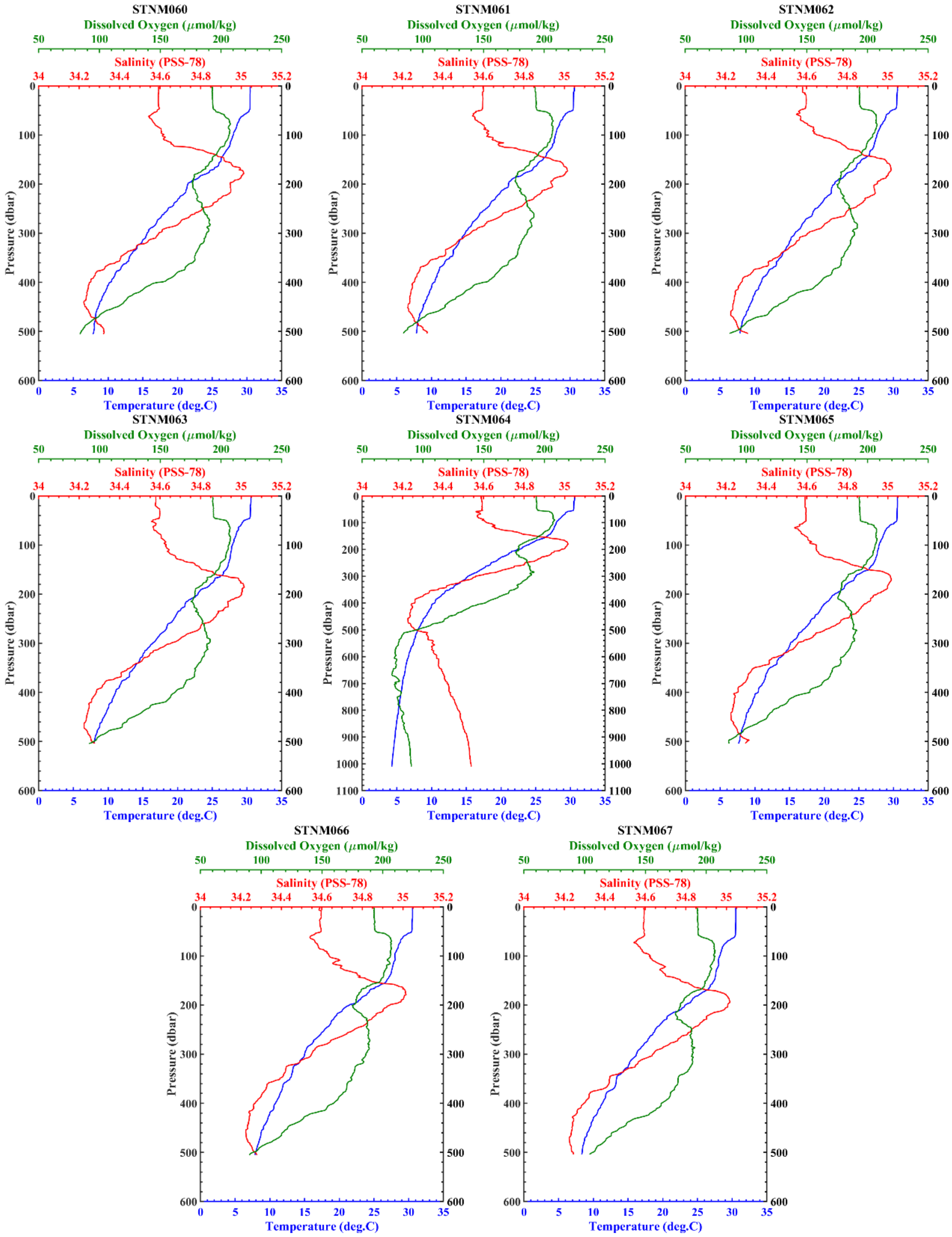
CTD profile : Fixed Station Observation : Jul. 3, 2024

STNM044, STNM045, STNM046, STNM047, STNM048, STNM049, STNM050, STNM051



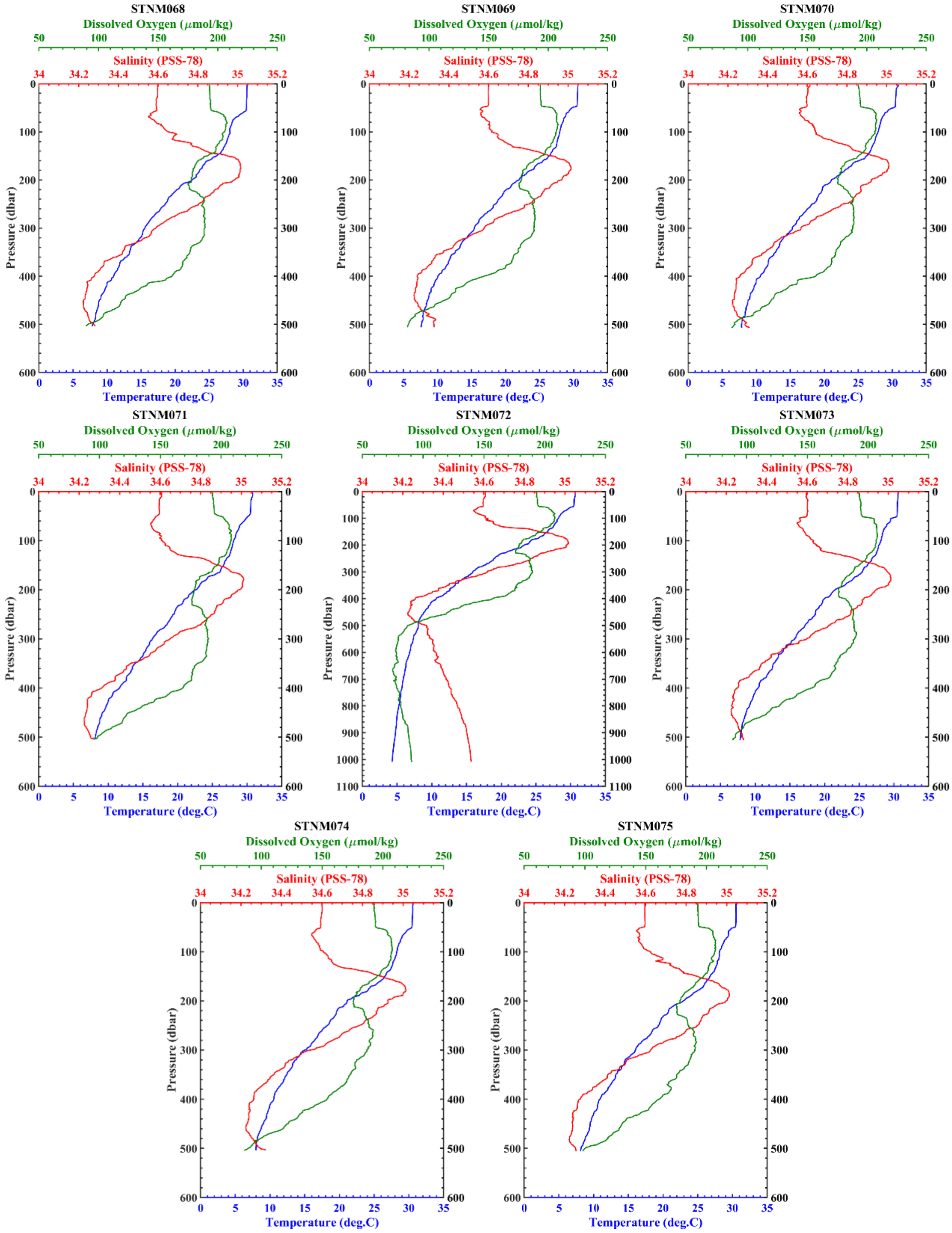
CTD profile : Fixed Station Observation : Jul. 4, 2024

STNM052, STNM053, STNM054, STNM055, STNM056, STNM057, STNM058, STNM059



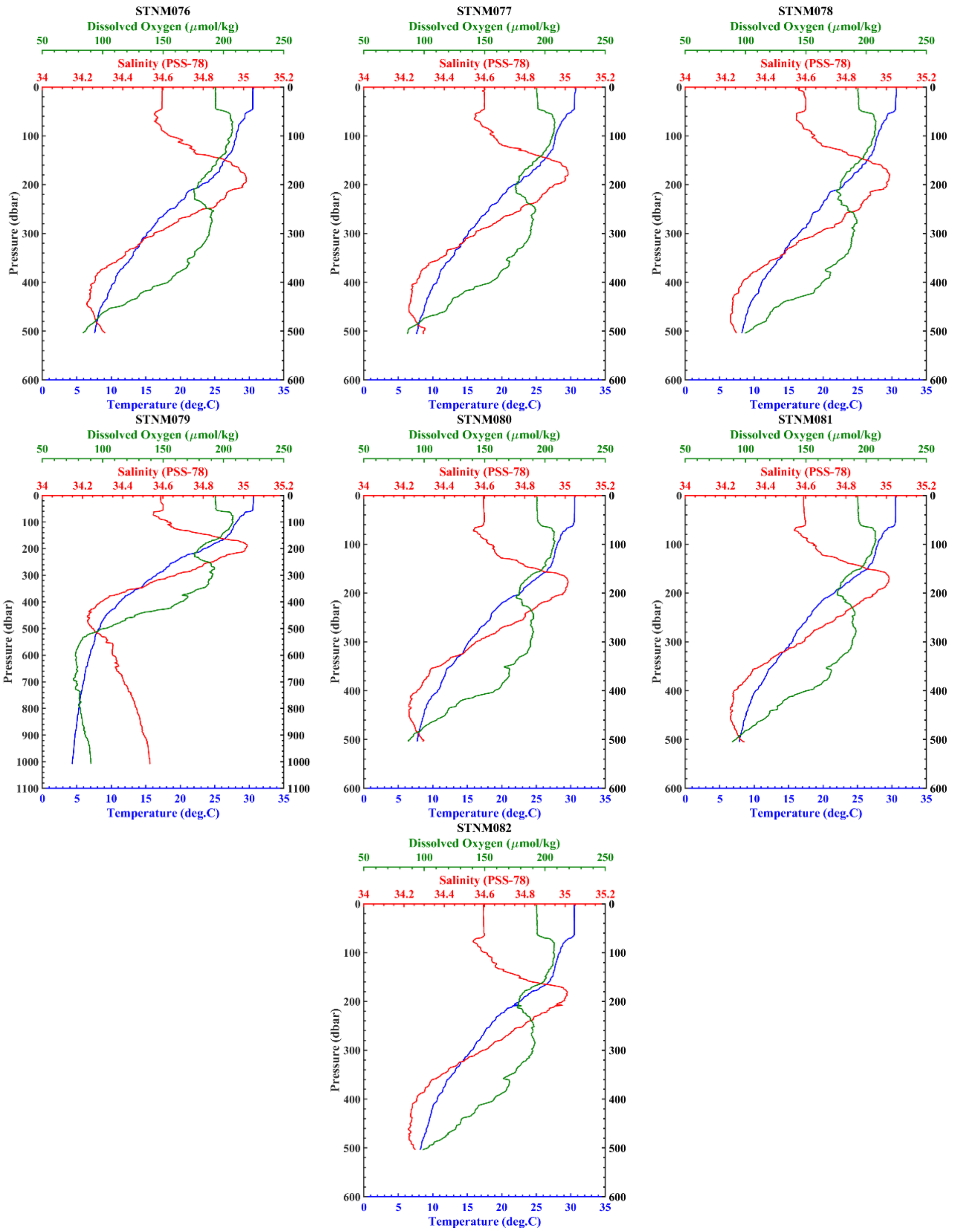
CTD profile : Fixed Station Observation : Jul. 5, 2024

STNM060, STNM061, STNM062, STNM063, STNM064, STNM065, STNM066, STNM067



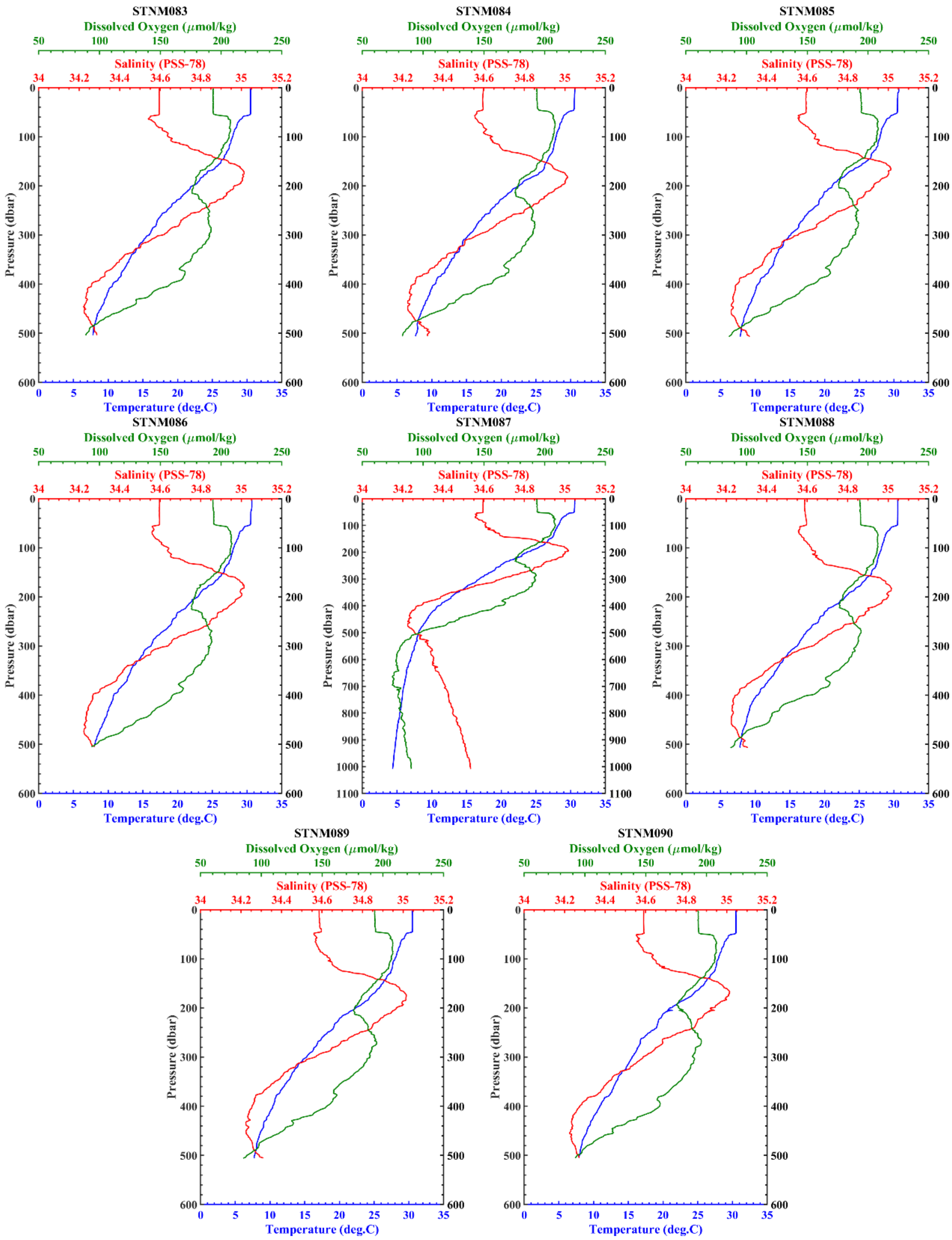
CTD profile : Fixed Station Observation : Jul. 6, 2024

STNM068, STNM069, STNM070, STNM071, STNM072, STNM073, STNM074, STNM075



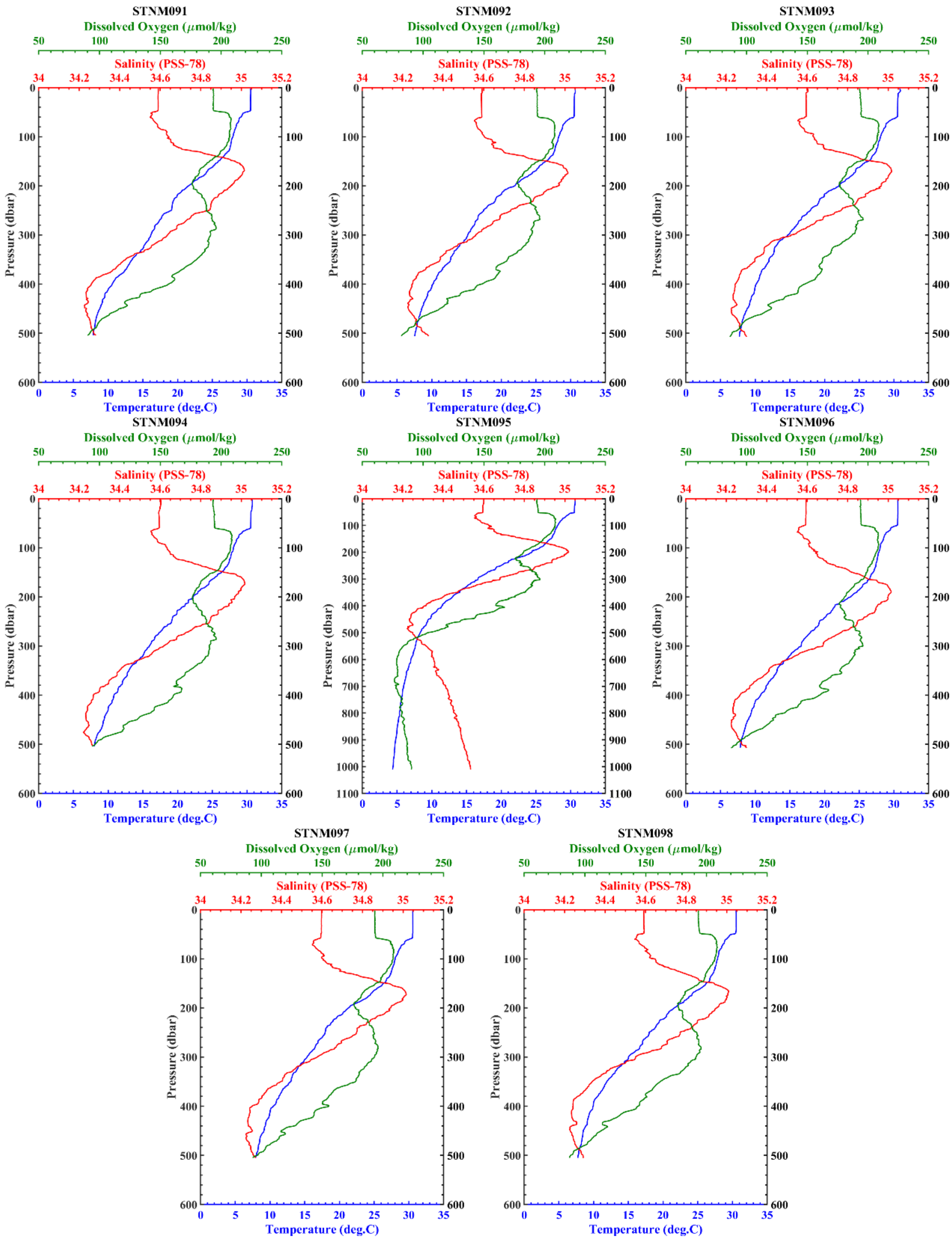
CTD profile : Fixed Station Observation : Jul. 7, 2024

STNM076, STNM077, STNM078, STNM079, STNM080, STNM081, STNM082



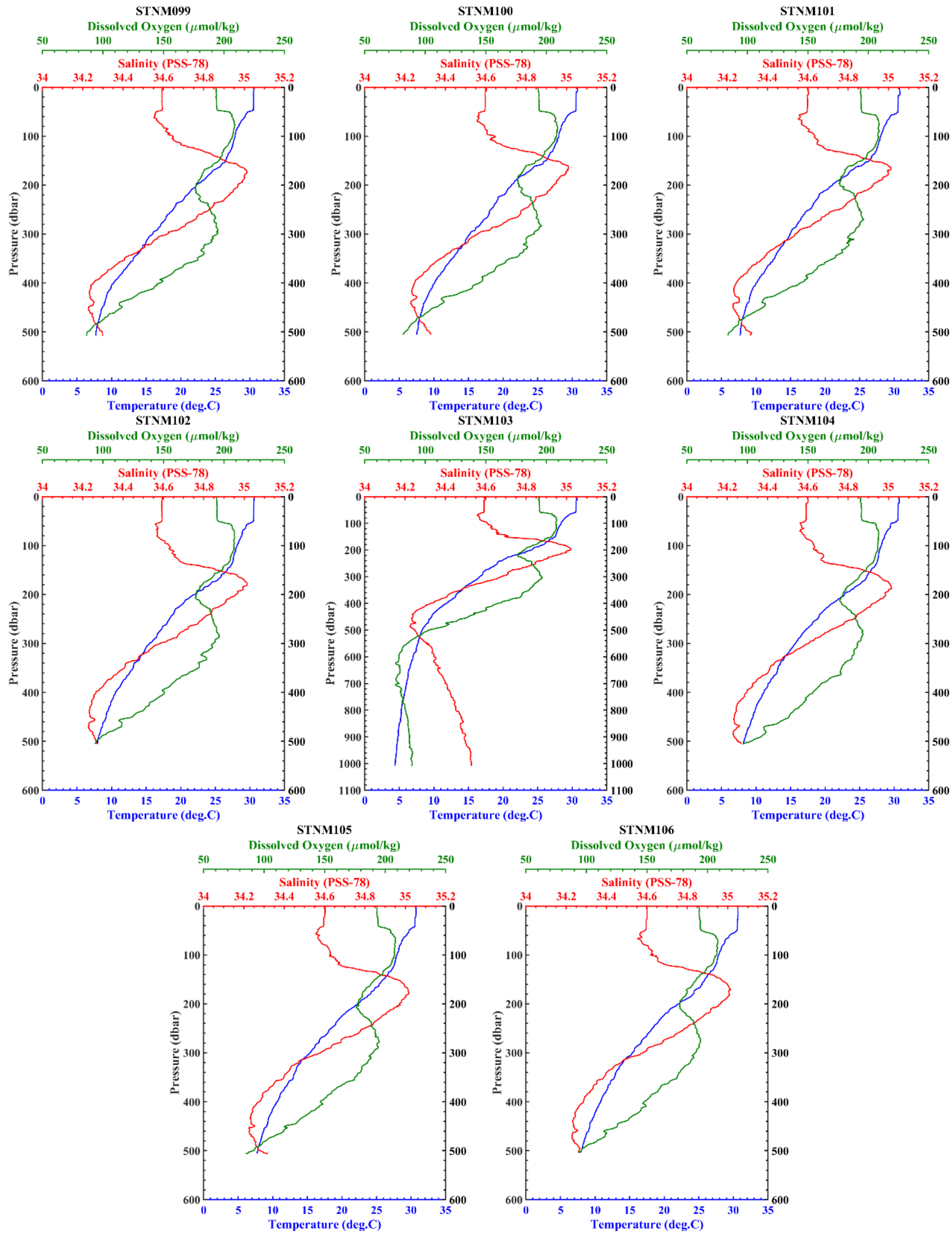
CTD profile : Fixed Station Observation : Jul. 8, 2024

STNM083, STNM084, STNM085, STNM086, STNM087, STNM088, STNM089, STNM090



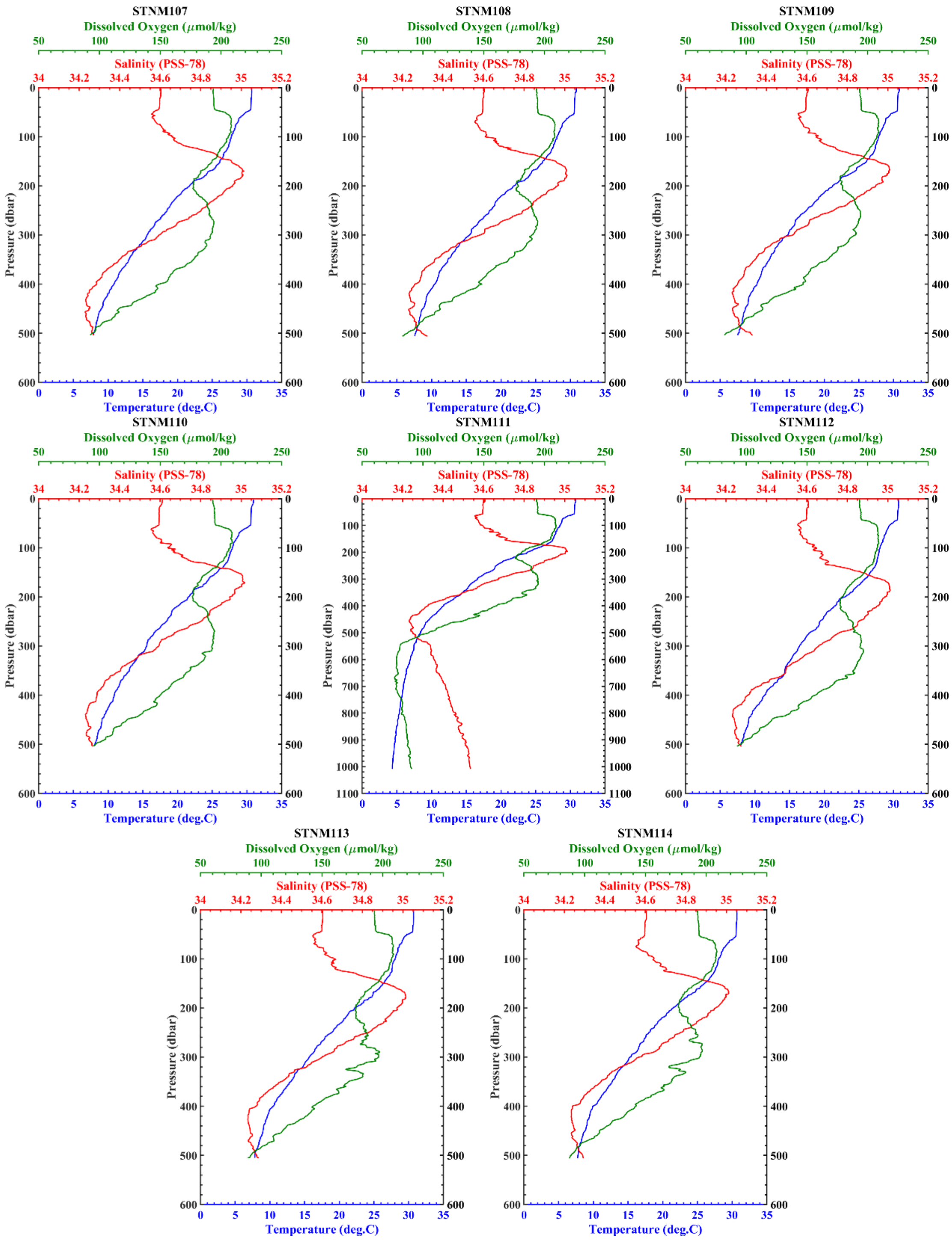
CTD profile : Fixed Station Observation : Jul. 9, 2024

STNM091, STNM092, STNM093, STNM094, STNM095, STNM096, STNM097, STNM098



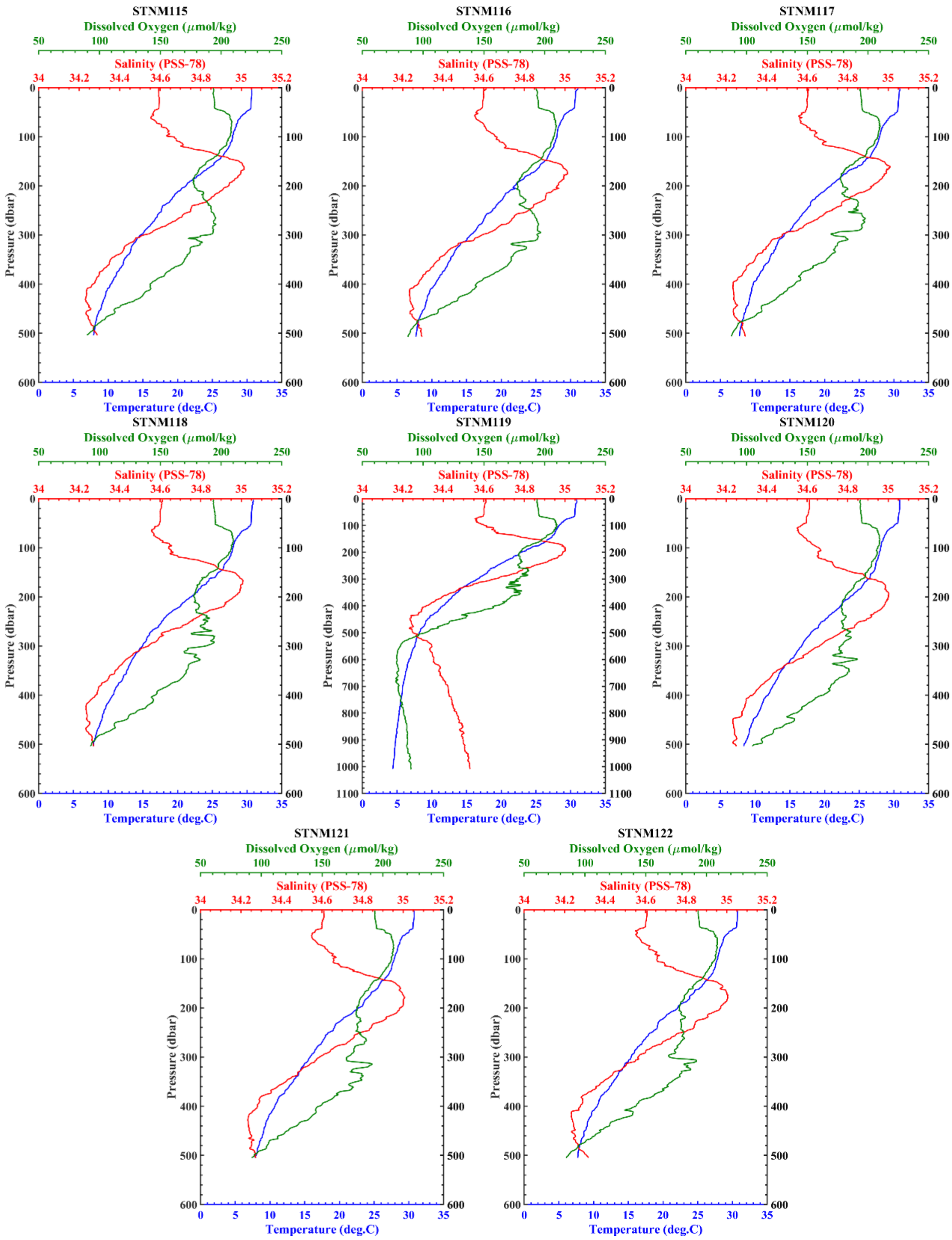
CTD profile : Fixed Station Observation : Jul. 10, 2024

STNM099, STNM100, STNM101, STNM102, STNM103, STNM104, STNM105, STNM106



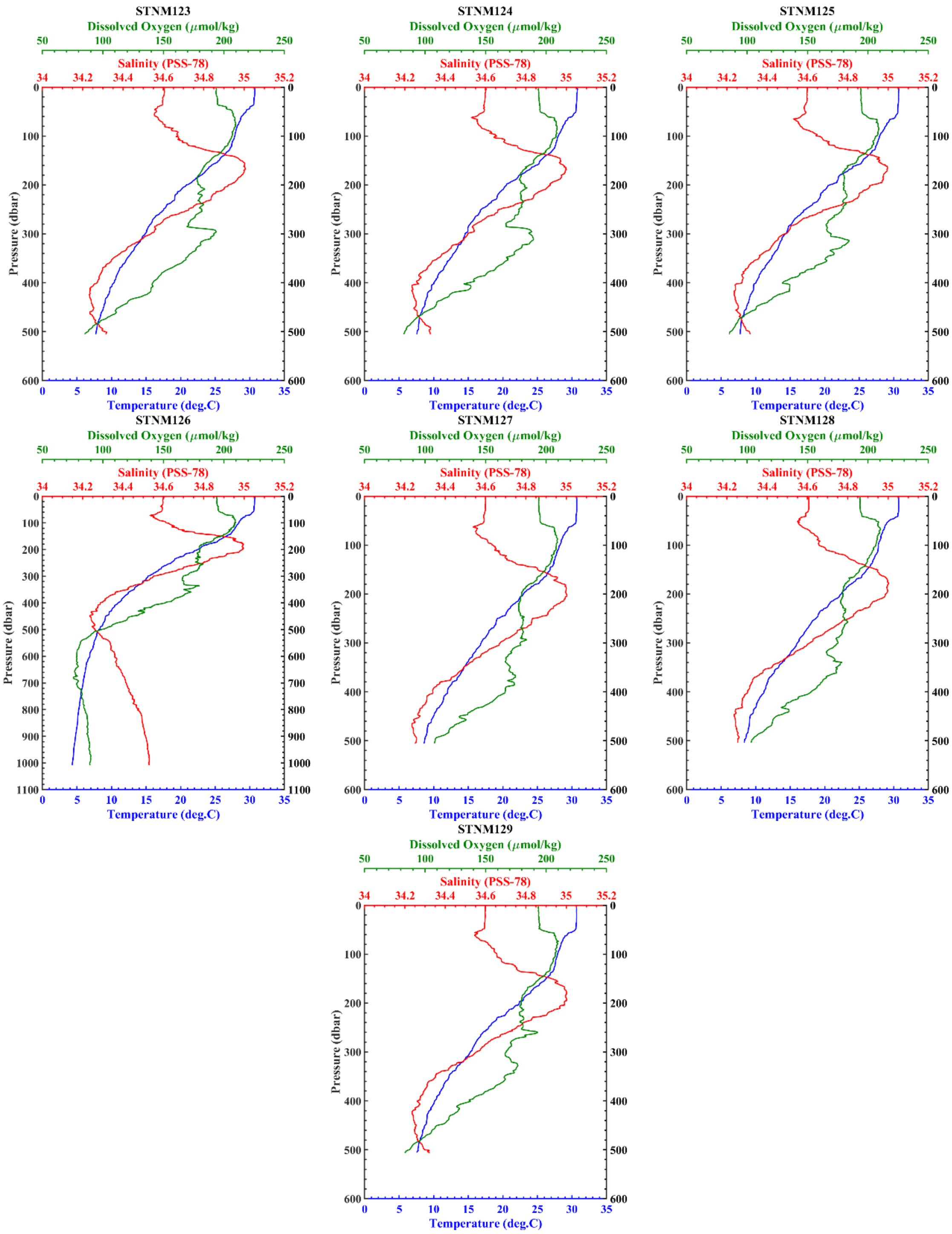
CTD profile : Fixed Station Observation : Jul. 11, 2024

STNM107, STNM108, STNM109, STNM110, STNM111, STNM112, STNM113, STNM114



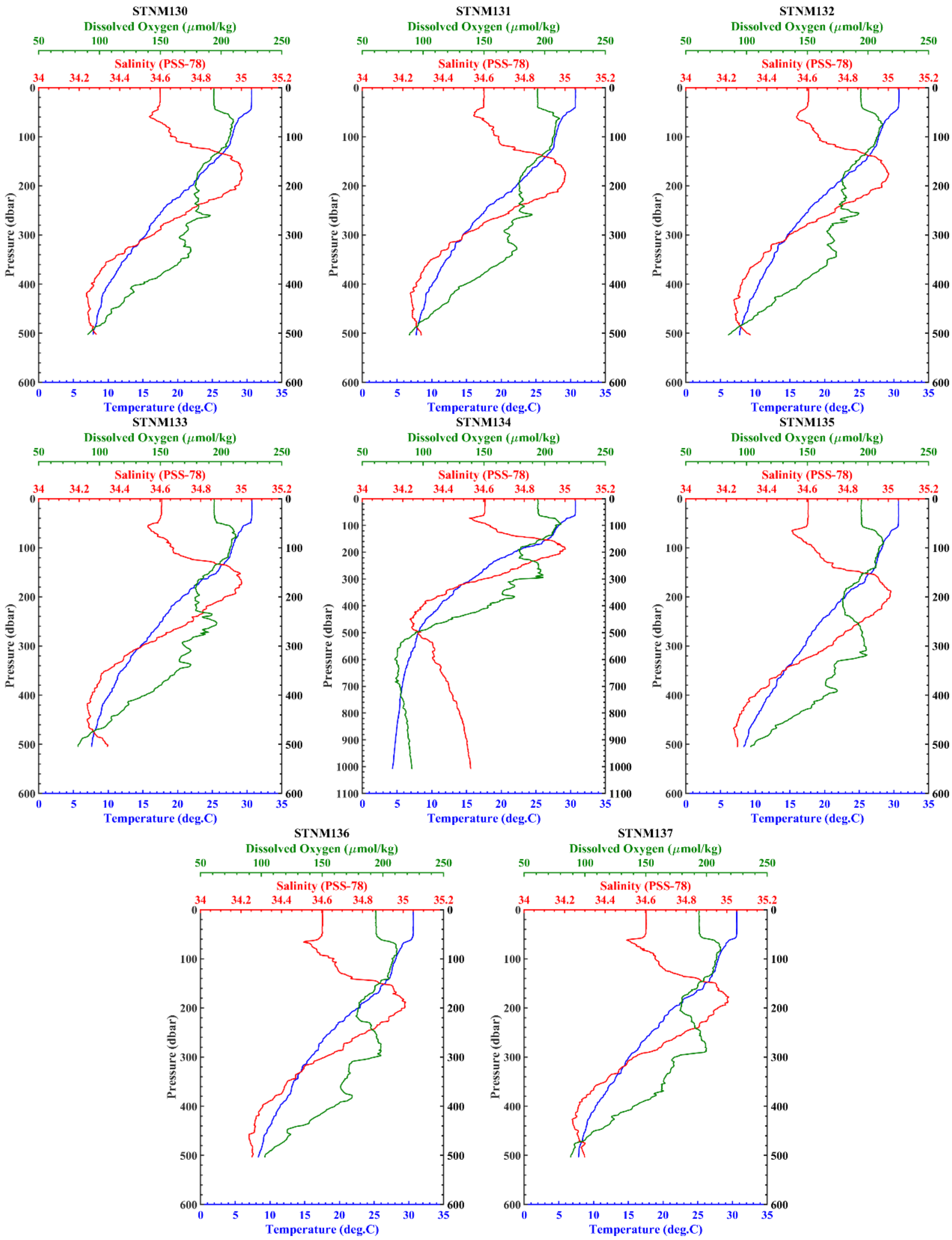
CTD profile : Fixed Station Observation : Jul. 12, 2024

STNM115, STNM116, STNM117, STNM118, STNM119, STNM120, STNM121, STNM122



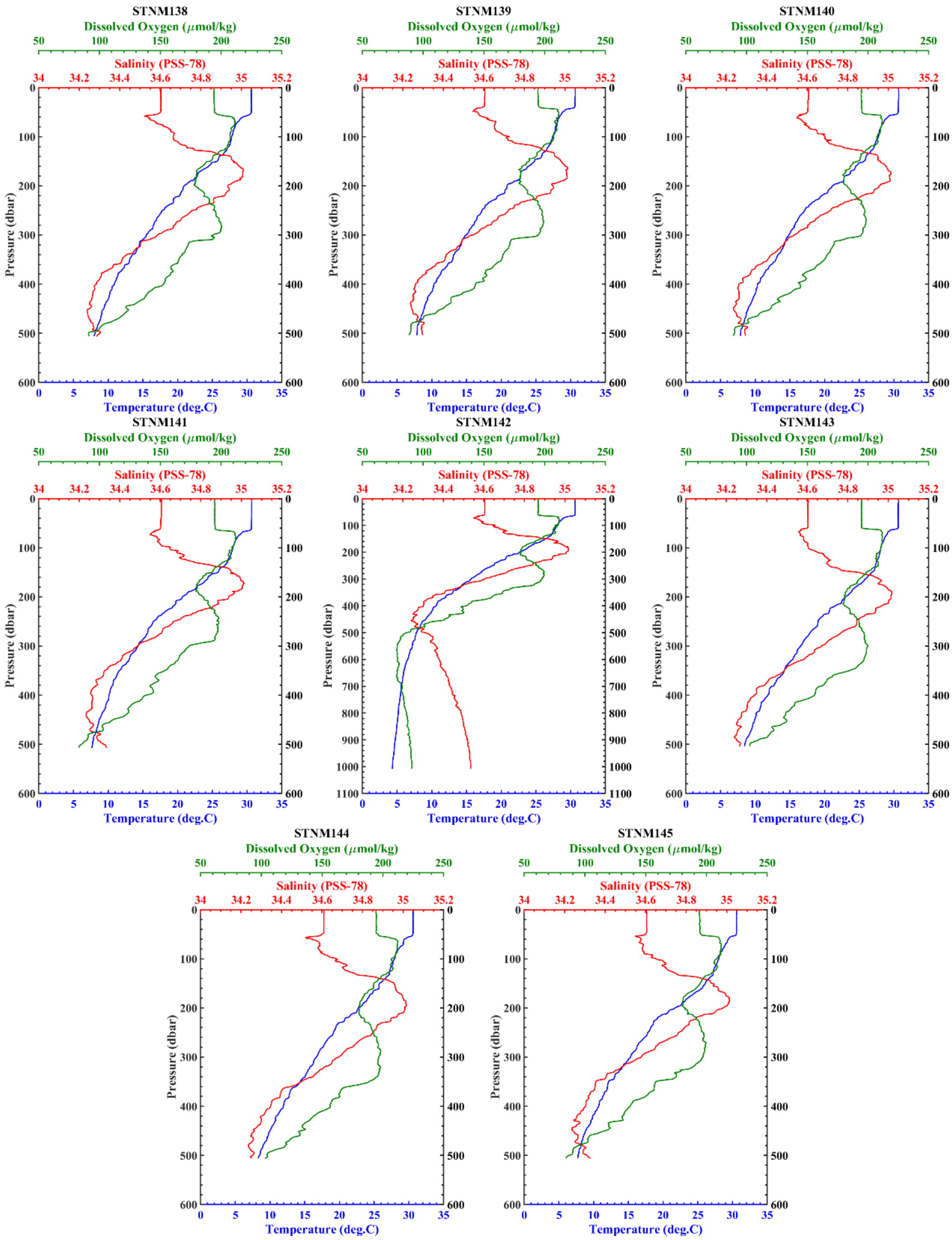
CTD profile : Fixed Station Observation : Jul. 13, 2024

STNM123, STNM124, STNM125, STNM126, STNM127, STNM128, STNM129



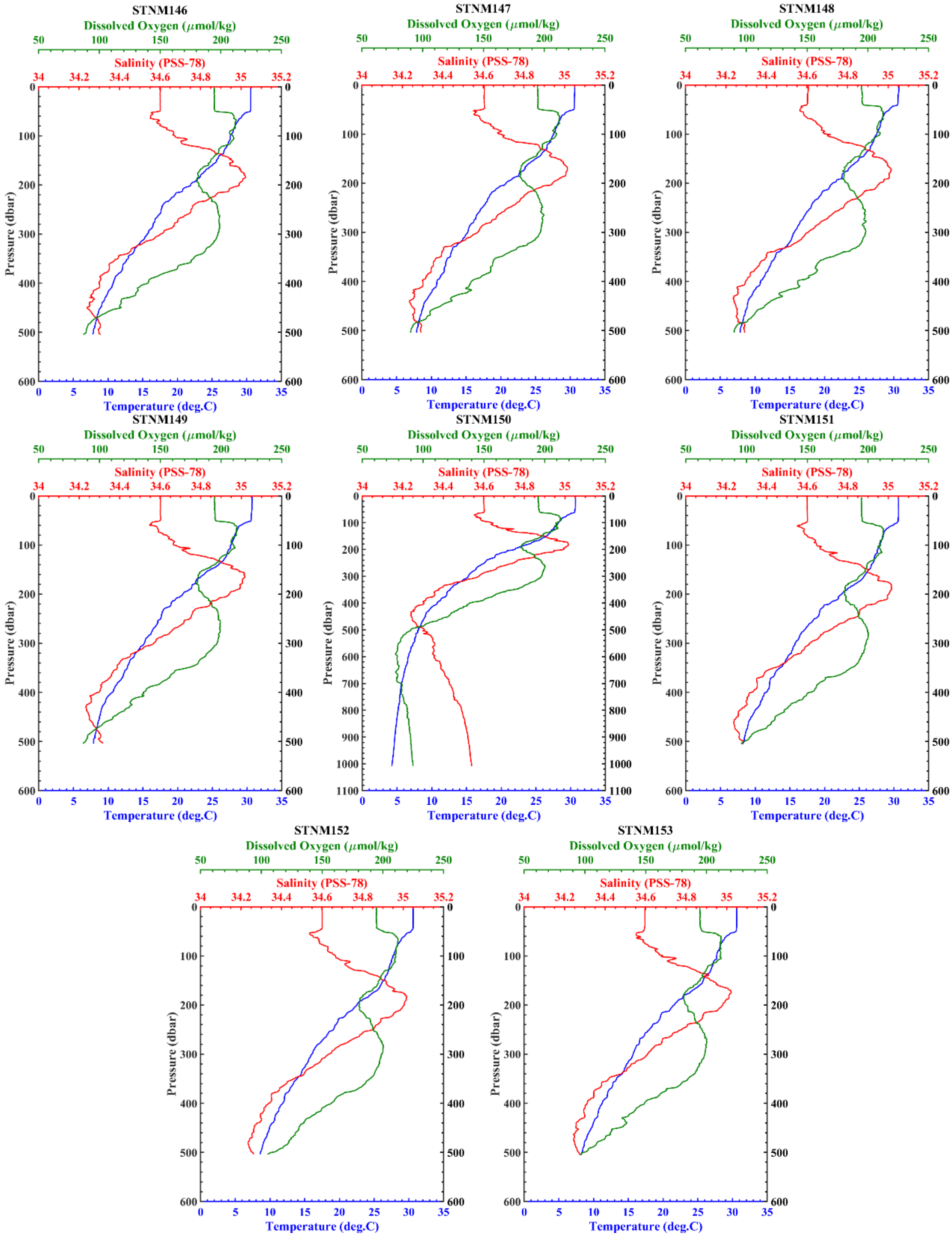
CTD profile : Fixed Station Observation : Jul. 14, 2024

STNM130, STNM131, STNM132, STNM133, STNM134, STNM135, STNM136, STNM137



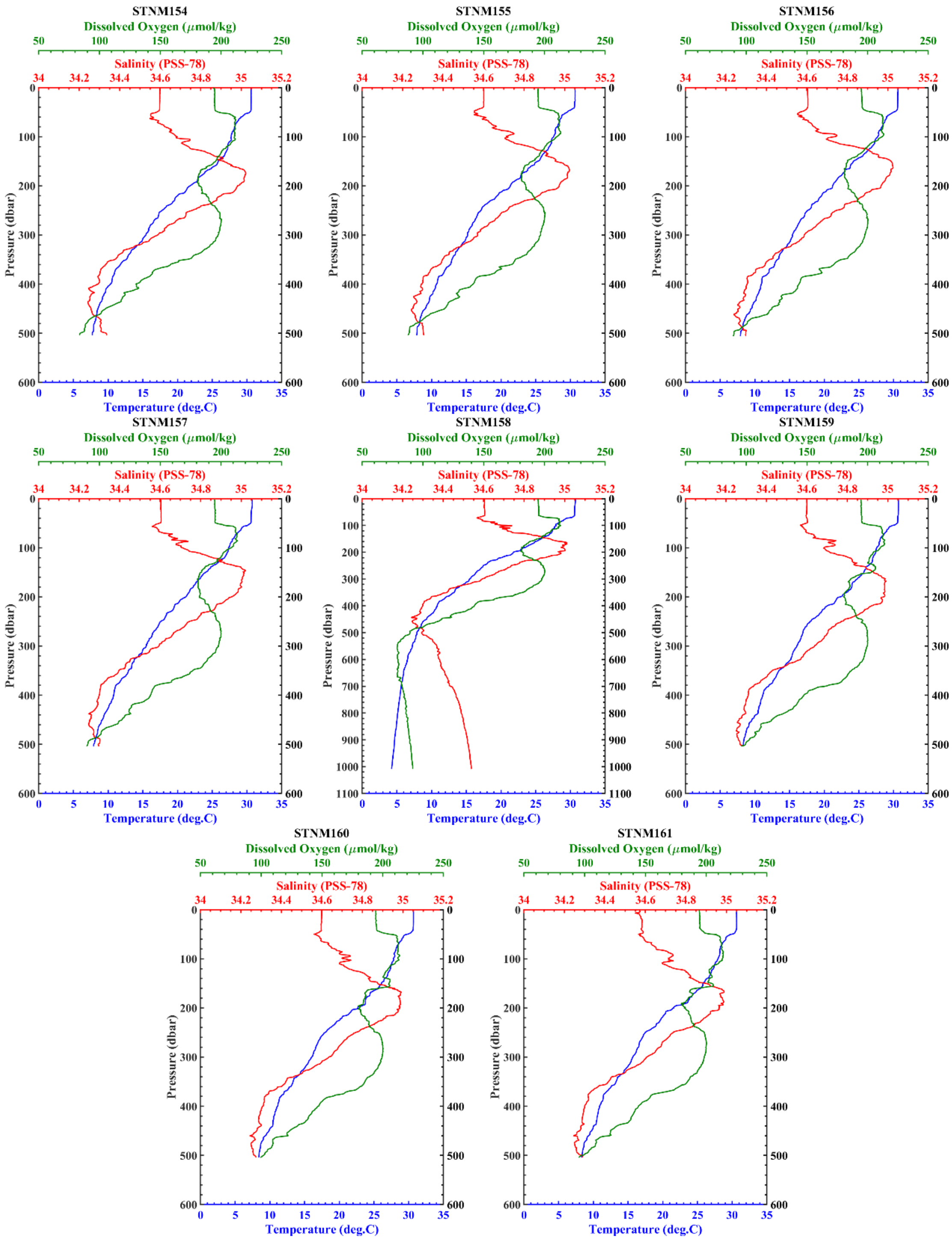
CTD profile : Fixed Station Observation : Jul. 15, 2024

STNM138, STNM139, STNM140, STNM141, STNM142, STNM143, STNM144, STNM145



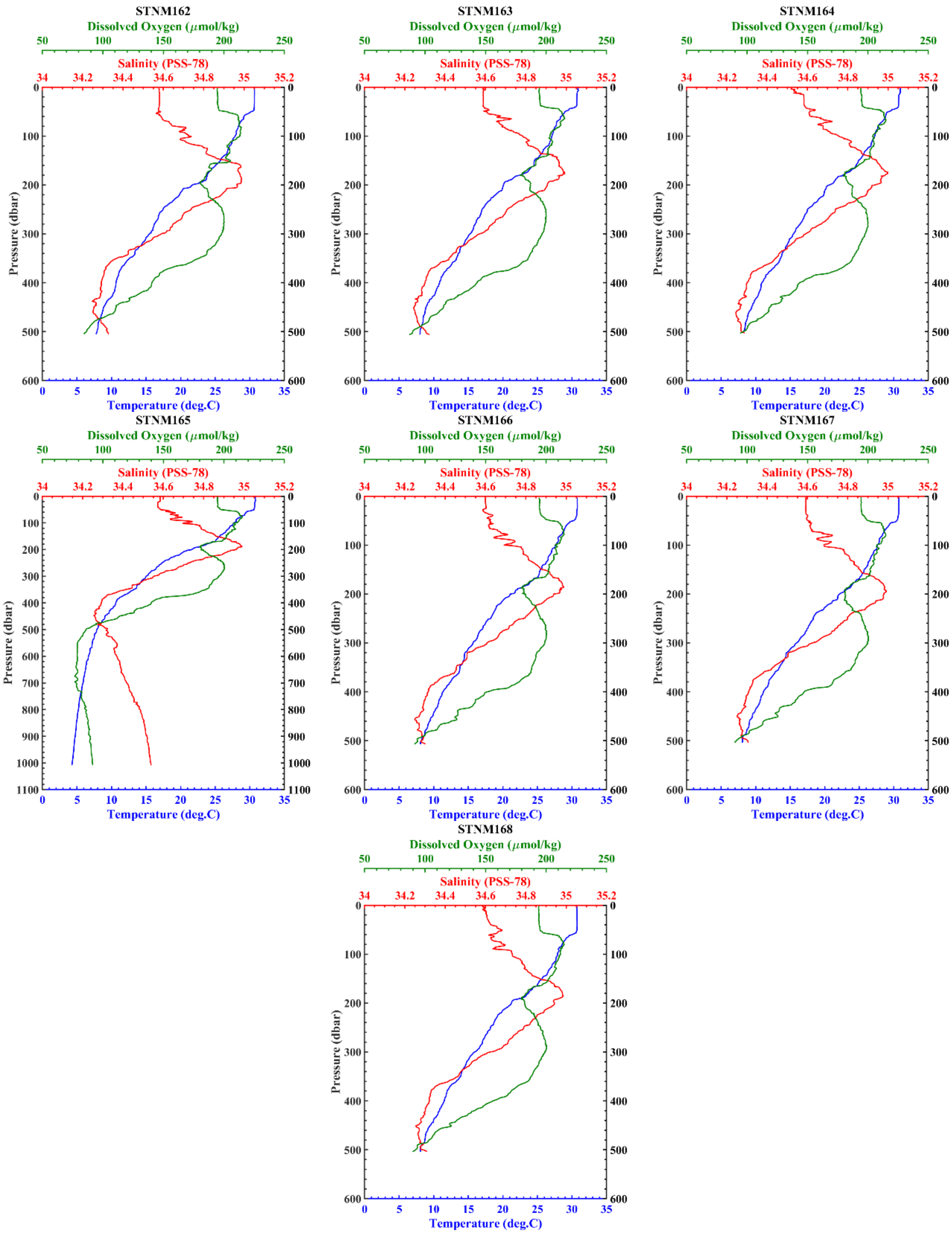
CTD profile : Fixed Station Observation : Jul. 16, 2024

STNM146, STNM147, STNM148, STNM149, STNM150, STNM151, STNM152, STNM153



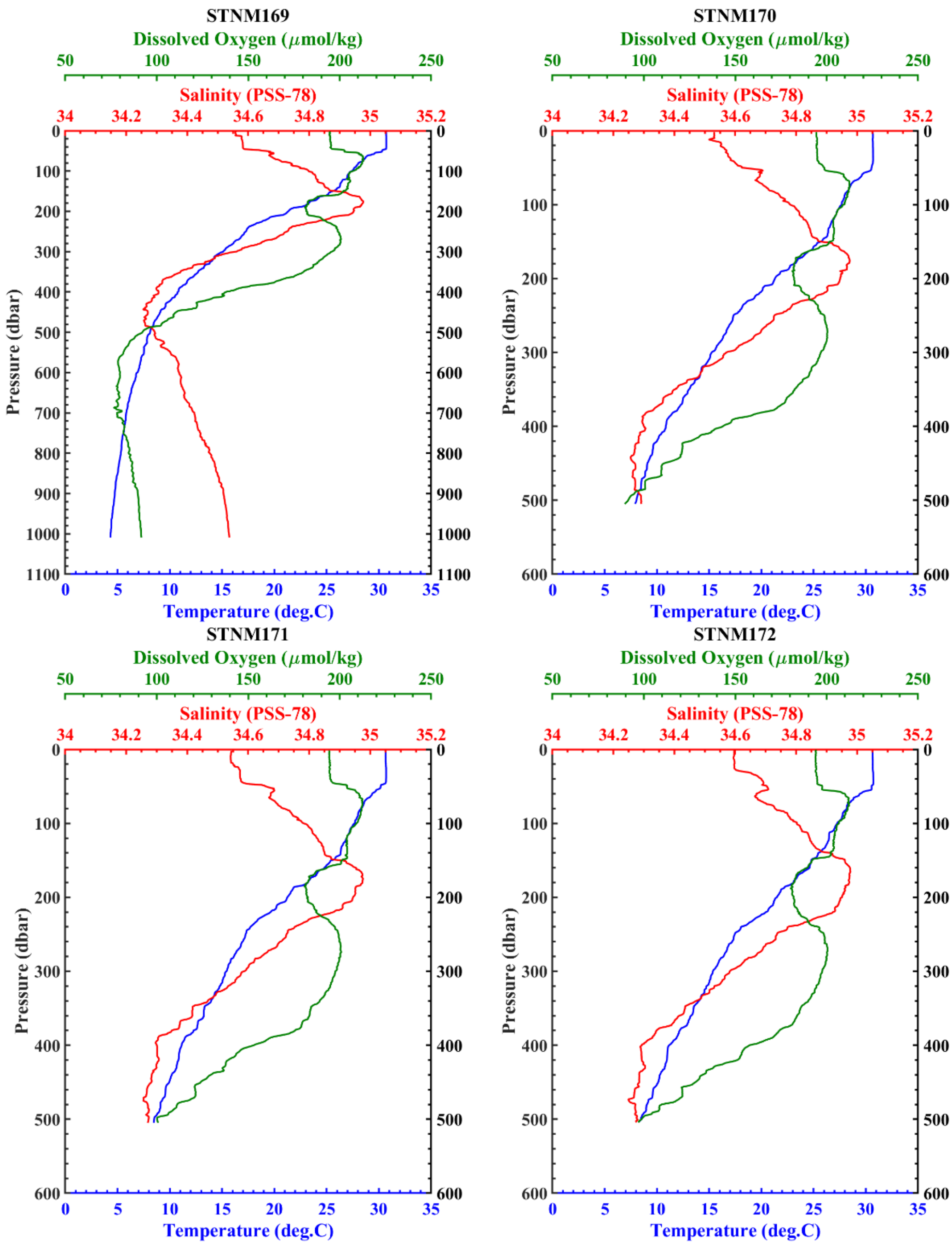
CTD profile : Fixed Station Observation : Jul. 17, 2024

STNM154, STNM155, STNM156, STNM157, STNM158, STNM159, STNM160



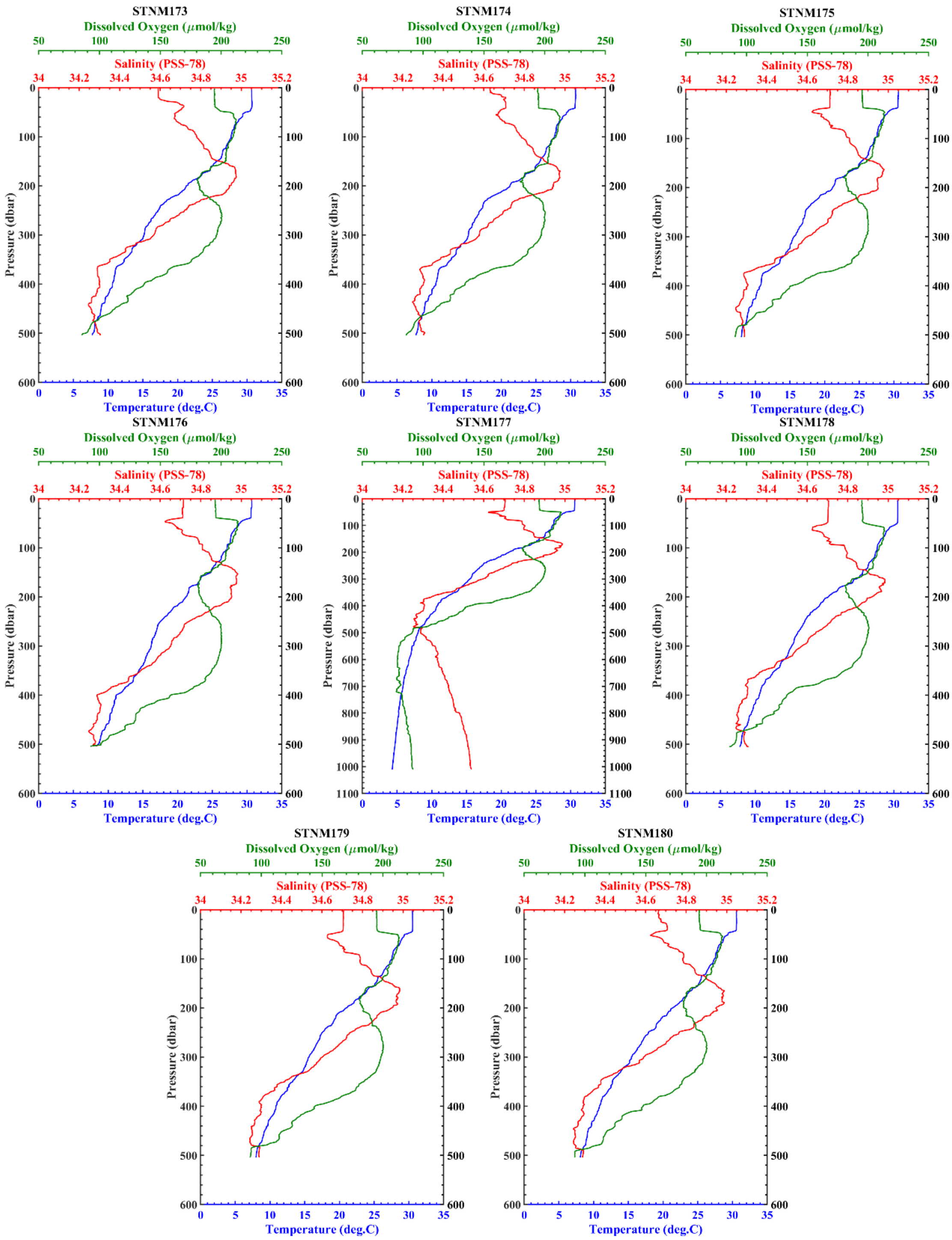
CTD profile : Fixed Station Observation : Jul. 18, 2024

STNM162, STNM163, STNM164, STNM165, STNM166, STNM167, STNM168



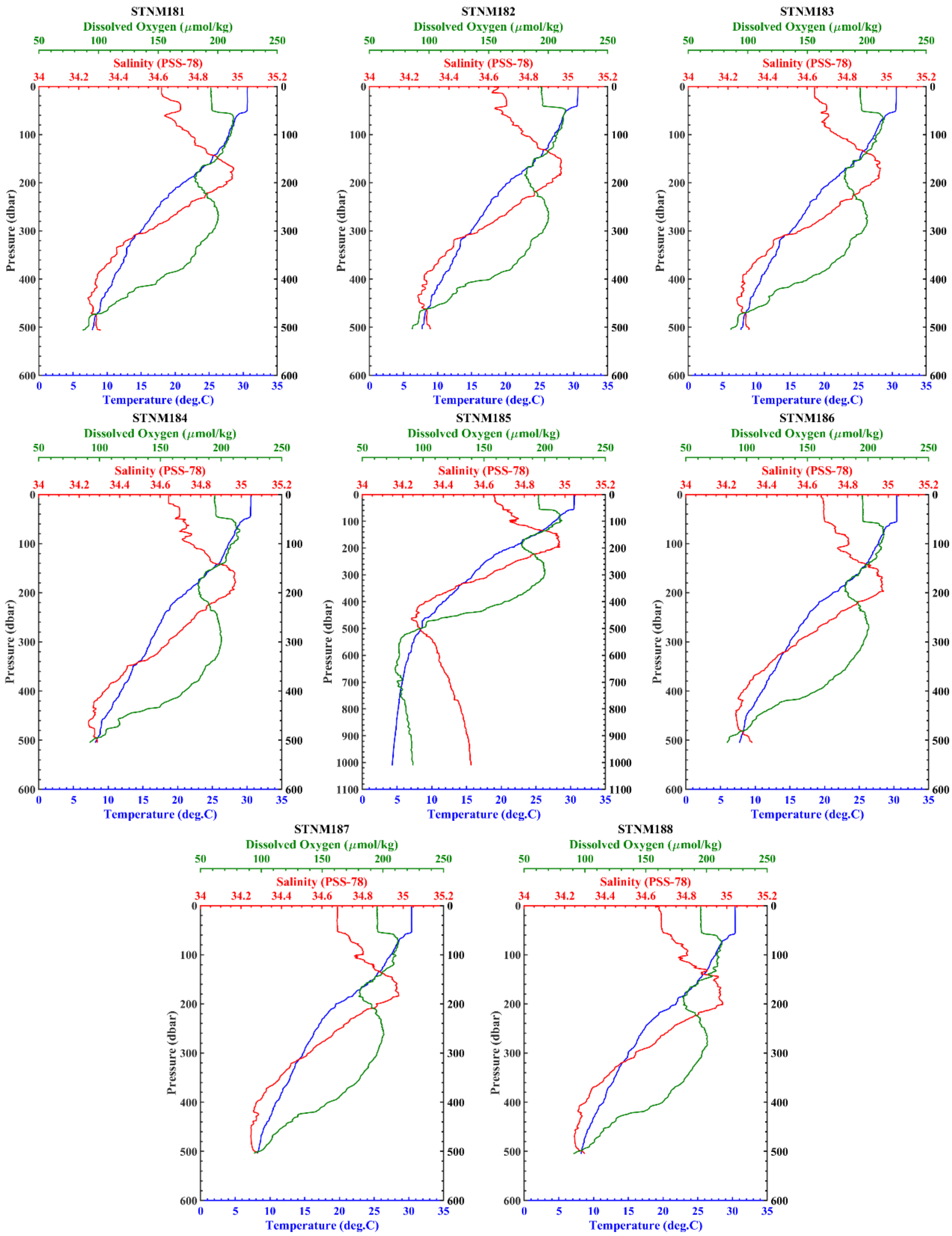
CTD profile : Fixed Station Observation : Jul. 19, 2024

STNM169, STNM170, STNM171, STNM172



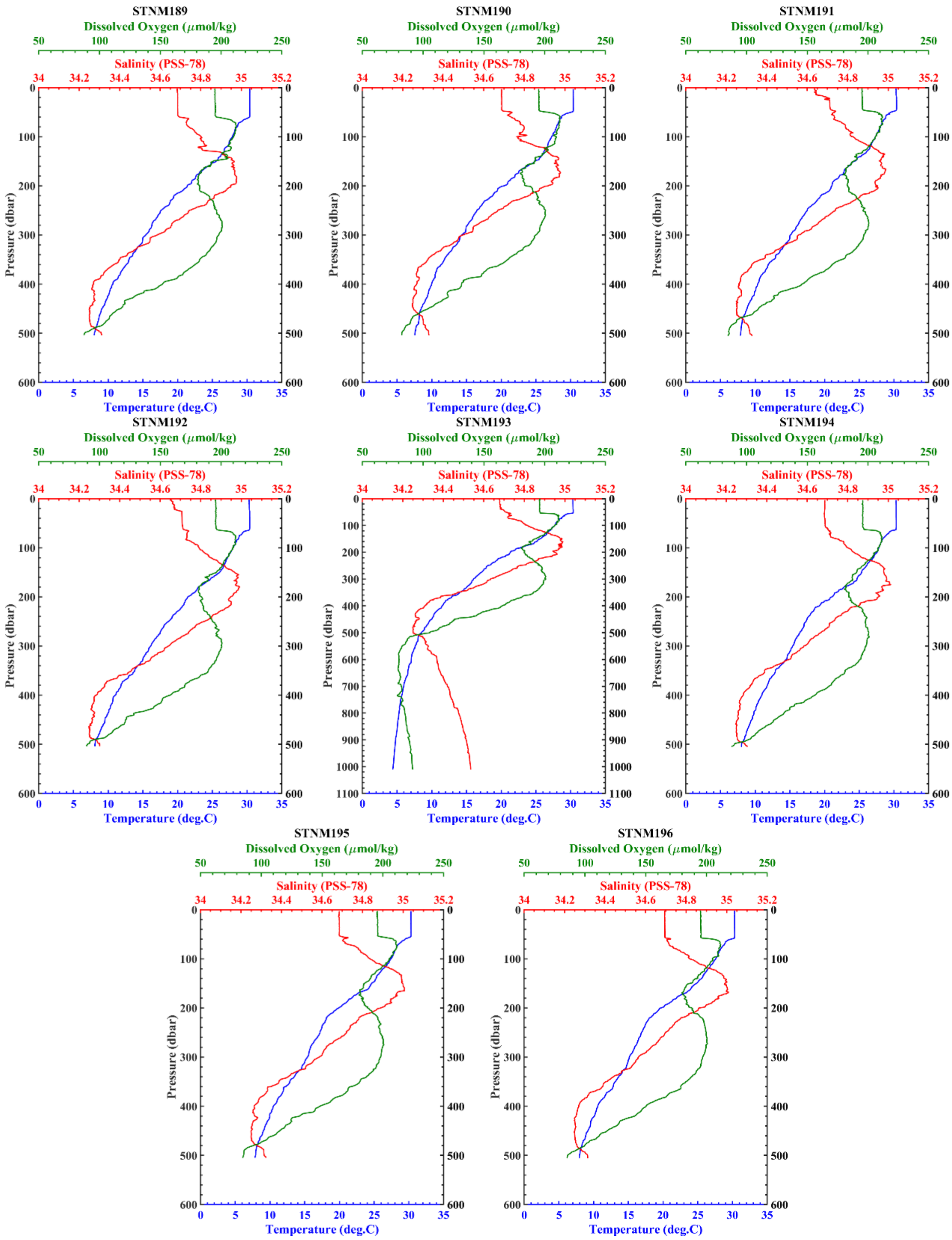
CTD profile : Fixed Station Observation : Jul. 20, 2024

STNM173, STNM174, STNM175, STNM176, STNM177, STNM178, STNM179, STNM180



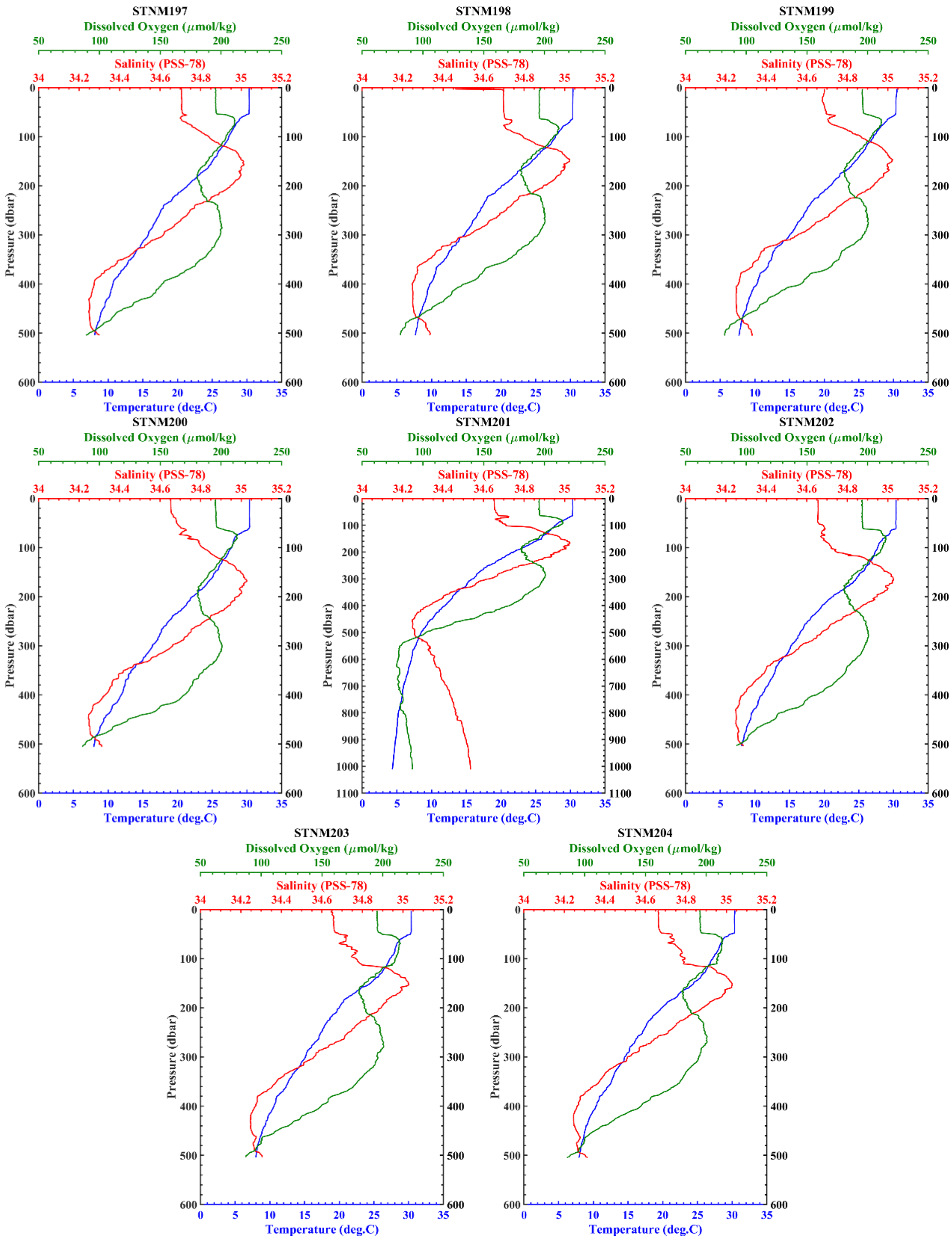
CTD profile : Fixed Station Observation : Jul. 21, 2024

STNM181, STNM182, STNM183, STNM184, STNM185, STNM186, STNM187, STNM188



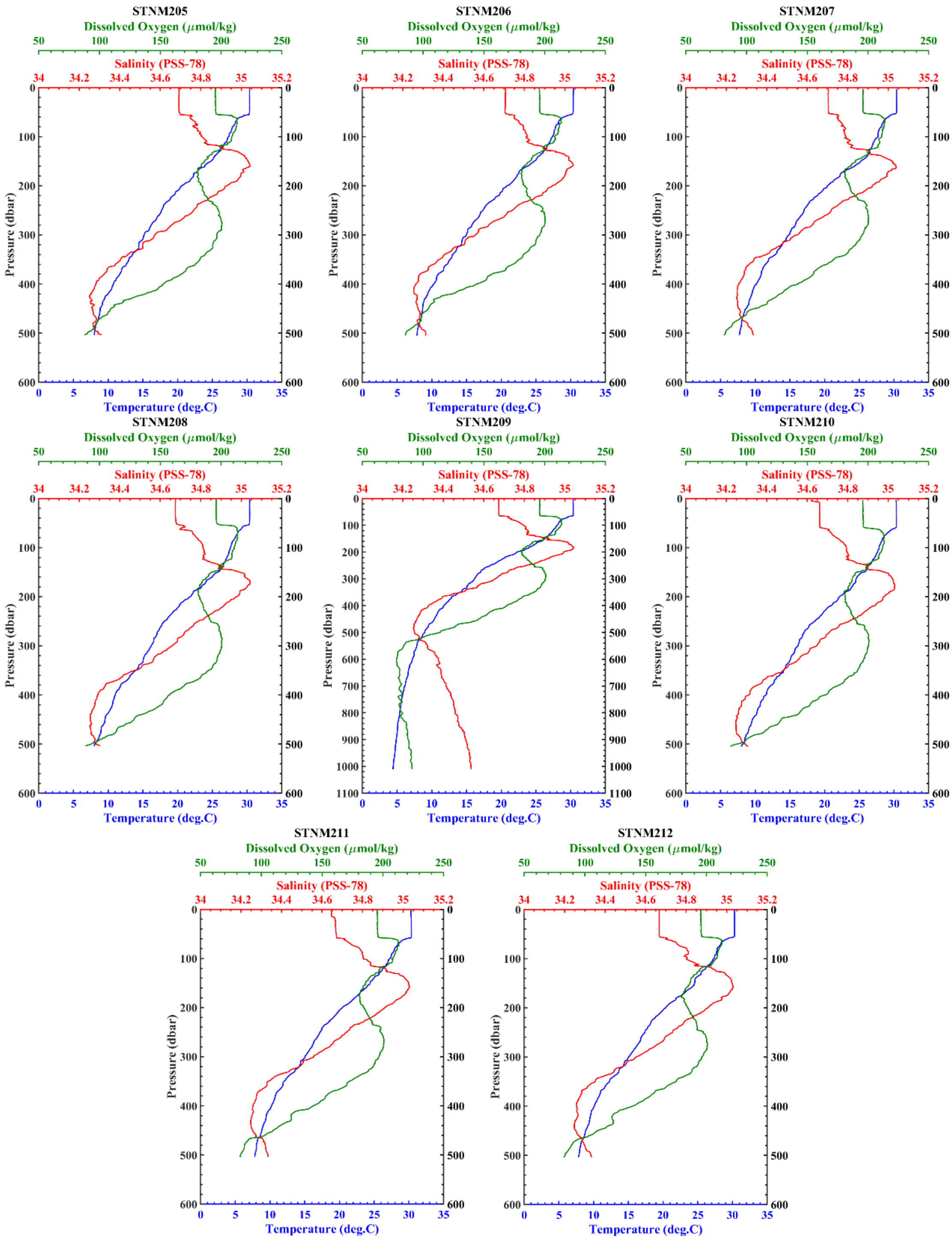
CTD profile : Fixed Station Observation : Jul. 22, 2024

STNM189, STNM190, STNM191, STNM192, STNM193, STNM194, STNM195, STNM196



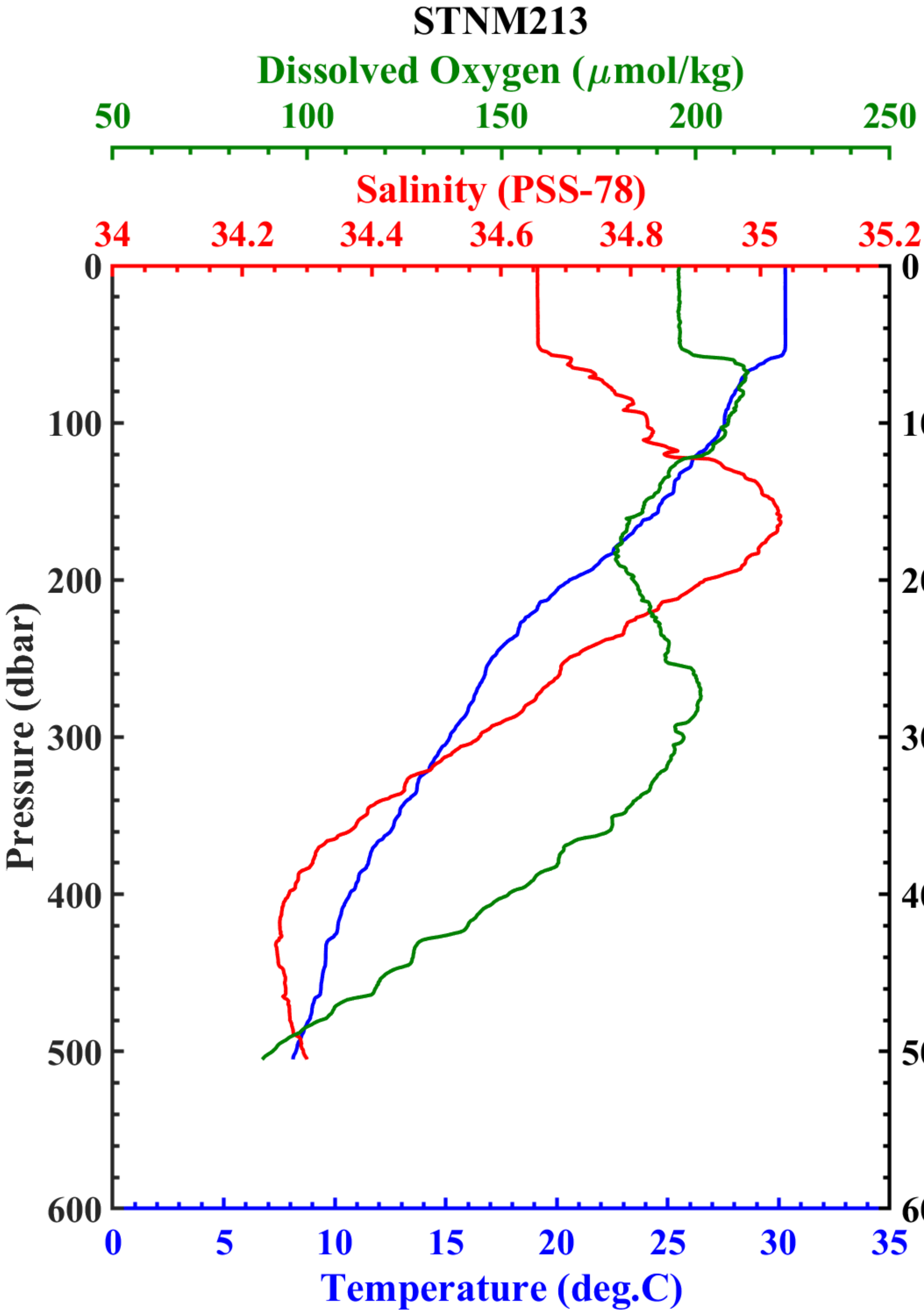
CTD profile : Fixed Station Observation : Jul. 23, 2024

STNM197, STNM198, STNM199, STNM200, STNM201, STNM202, STNM203, STNM204



CTD profile : Fixed Station Observation : Jul. 24, 2024

STNM205, STNM206, STNM207, STNM208, STNM209, STNM210, STNM211, STNM212



CTD profile : Fixed Station Observation : Jul. 25, 2024

STNM213

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