KS-22-10 Cruise Summary

1. Cruise Information

- 1.1 Cruise ID: KS-22-10
- 1.2 Name of vessel: Shinsei-maru
- 1.3 Title of the cruise: Simultaneous observations with an aircraft on marine aerosols and their effects on cloud microphysics in the Northwestern Pacific
- 1.4 Chief scientist: Yoshimi Kawai

Global Oceanic Environment Research Group Global Ocean Observation Research Center Research Institute for Global Change (RIGC) Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

1.5 Representative of the Science Party: Yoshimi Kawai (JAMSTEC)

1.6 Cruise period: 15 July – 2 August 2022

1.7 Ports of departure / call / arrival: Yokosuka / Kushiro / Hachinohe

1.8 Research area: Southeast off Hokkaido, Northwestern Pacific

1.9 Research map: (Figure 1)

2. Overview of Research Activities

2.1 Purpose and outline

This cruise conducted observations together with an aircraft, aiming to evaluate physical and chemical properties of aerosols and their impacts on clouds in summer in the subarctic Northwestern Pacific Ocean, which is one of the regions where lowlevel cloud amount and its radiative forcing are highest in the globe and plays an important role in the earth's radiation budget. One of the purposes of the cruise was to reveal physical and chemical properties of marine aerosols comprehensively using various state-of-the-art instruments. Another purpose was to quantitatively evaluate flux of aerosols from the ocean. Such a comprehensive observation campaign, which had not been conducted before in this region, reveals the basic features of aerosols in the region of high biological activities. Furthermore, this cruise investigated air-sea interaction related with a marine heat wave. Besides air temperature, humidity, wind speed, and air pressure, the aircraft observed cloud microphysics properties, chemical composition of aerosols, the number of particles, particle radius distribution, and their vertical profiles, which cannot be measured on a vessel or land. These aircraft observations are combined with the near-surface observations on the vessel such as SST, chlorophyll-a concentration, surface fluxes, cloud base height, and aerosol particles, which are difficult to be measured by an aircraft.

2.2 Activities

2.2.1 Atmospheric sounding using GPS radiosonde, and aircraft observations

Vertical profiles of air temperature, relative humidity, and wind velocity were observed 50 times in total at 12 sites with GPS radiosondes (red dots in Fig.1). Simultaneous observations with an aircraft were performed 7 times in total (red circles in Fig.1). Balloons of 150g were used except for two cases, in which 100-g balloons were launched. The aircraft came from/to Memanbetsu airport in Hokkaido.

Instrument: GPS radiosonde (Vaisala, RS41-SG), ASAP sounding station (balloon launcher) (Vaisala, ALS211), ground check device (Vaisala, RI41-B), software (Vaisala, DigiCORA MW41), subsystem (Vaisala, SPS311G), GPS antenna (Vaisala, GA31AL), UHF antenna (Vaisala, RM32AL), balloon (TOTEX Corporation, TA-150, TA-100)

2.2.2 Oceanographic survey using CTD/XCTD

Vertical profiles of water temperature and salinity up to 1100-m depth were observed 30 times in total at 17 sites (black pluses in Fig.1). CTD observations and water sampling were carried out 12 times in total at 8 sites (red and blue circles in Fig.1).

Instrument: XCTD (Tsurumi-Seiki Co., Ltd., XCTD-1N), CTD system (Sea-Bird Electronics, Inc., SBE911plus), carousel water sampler (Sea-Bird Electronics, Inc., SBE32), oxygen sensor (Sea-Bird Electronics, Inc., SBE43), transmissometer (WET Labs, Inc., C-Star), turbidity sensor (Seapoint Sensors, Inc., Seapoint Turbidity Meter), fluorescence sensor (Seapoint Sensors, Inc., Seapoint Chlorophyll Fluorometer), photosynthetically active radiation (PAR) sensor (Li-cor, Inc., Biospherical/Licor)

2.2.3 Continuous atmospheric measurements

Air temperature, relative humidity, wind speed, wind direction, atmospheric pressure, rain rate, and downward radiation were continuously measured with instruments permanently installed on the vessel. Cloud base height, cloud cover, turbulent surface fluxes, and precipitable water were also observed with special instruments brought by the scientists during the cruise.

- Instrument: Microwave radiometer (Furuno ELECTRIC Co., Ltd., KASMI-100), Allsky camera (Furuno ELECTRIC Co., Ltd., MLACMO-100), GNSS receiver (LiGHTHOUSE Technology and Consulting Co.,Ltd., SKR-L9P) and antenna (Hemishphere, A45), Ceilometer (CL31, Vaisala), Turbulent flux measurement system (Climatec, Inc., custom order)
- 2.2.4 Continuous oceanic measurements

Surface temperature, salinity, chlorophyll concentration, dissolved oxygen, turbidity, and current speed were continuously measured with instruments permanently installed on the vessel. Wave height and visible images of the sea surface were also observed with special instruments brought by the scientists during the cruise.

- Instrument: Time lapse camera (Brinno, model TLC200pro), Wave gauge using the marine radar system (Japan Radio Co., Ltd., X-band radar)
- 2.2.5 Sampling and measurement of aerosol and seawater particles

Aerosol and seawater particles were measured with special instruments brought by the scientists during the cruise.

Instrument: Optical particle counter (OPC) (Particle Plus, model 8306) × 2, Aerosol sampler (Arios, AS-24W), Laser disdrometer (Adolf Thies GmbH & Co. KG, 5.4110, provided by Senecom. Inc. in Japan as a disdrometer model SE-LP5411), High volume air sampler (KIMOTO ELECTRIC Co., Ltd., Model 120SL) × 2, Complex Amplitude Sensing version 1 (CAS) (handmade; Moteki 2021 Optics

Express), Low volume aerosol sampler (Tokyo Dylec Corp.), Steam Cyclone -CAS (handmade), Scanning Mobility Particle Sizer (SMPS) (TSI Inc., DMA Model 3080 + CPC Model 3775), Low-volume air sampler (handmade)



Figure 1. Cruise track (solid line) and observation sites. Circles, pluses and red dots represent CTD, XCTD and GPS radiosondes, respectively. Red circles denote the locations of simultaneous observations with an aircraft.