

## 4D-VAR Ocean State Estimation

March 16, 2018

### ■ Name of data set and the abbreviated name

**Name:** Estimated state of ocean for climate research

**Abbreviation:** ESTOC

### ■ Data Overview

This version of dataset is an updated version of dataset shown by Osafune et al. (2015) (see them for more details). Our four-dimensional variational (4D-VAR) data synthesis system, which consists of an ocean circulation model, its adjoint and an optimization system, is based on a system developed as a part of the Japan Agency for Marine-Earth Science and Technology (JAMSTEC)-Kyoto University collaborative program (known as "the K7 consortium"). The Ocean General Circulation Model (OGCM) is version 3 of the GFDL Modular Ocean Model (MOM3), which is equipped with several sophisticated schemes; e.g., Noh scheme for mixed layer physics, the Gent and McWilliams (GM) scheme for isopycnal mixing, and quicker advection scheme. The horizontal resolution is  $1^\circ$  in both latitude and longitude, with 46 vertical levels spaced from 10 m near the sea surface to 400 m at the bottom. This model is better able to reproduce ocean circulation processes and is expected to form a platform suitable for the use of the 4D-VAR adjoint model.

4D-VAR adjoint data assimilation approach is applied. The adjoint codes of the OGCM were obtained using the Tangent linear and Adjoint Model Compiler (TAMC) and the Transformation of Algorithms in Fortran (TAF). In the 4D-VAR approach, optimized 4-dimensional datasets are sought by minimizing a cost function.

Physical parameters:

The assimilated elements in this study are subsurface temperature and salinity, Sea-surface Temperature (SST), Sea-surface height anomaly (SSHA) and Global Mean Sea Level (GMSL). The subsurface data is from EN4 dataset which was quality controlled using a comprehensive set of objective checks developed at the Hadley Centre of the UK Meteorological Office. This dataset is largely composed of observations from the World Ocean Database 2009 and supplemented by data from the GTSP (Global Temperature and Salinity Profile Program) and Argo autonomous profiling floats. The SST data is from Reynolds and OISST, and SSHA data is derived from high-precision multi-satellite altimetry products distributed by Copernicus Marine Service. The GMSL data, which is incorporated from this version, is monthly data until 2013, which is reconstructed based on Church and White (2011) and published by Ocean and Atmosphere unit in the Commonwealth Scientific and Industrial Research Organisation (CSIRO) ([http://www.cmar.csiro.au/sealevel/sl\\_data\\_cmar.html](http://www.cmar.csiro.au/sealevel/sl_data_cmar.html)). All observational data except for GMSL were averaged onto  $1^\circ$  by  $1^\circ$  bins and then compiled as series of 10-day means for the SST and SSHA data and monthly means for the subsurface and GMSL data. The control variables are surface fluxes (for net-heat, fresh water, and momentum) and oceanic initial conditions. The assimilation window is 58 years during 1957-2014.

## ■ Dataset release date

March 30, 2018

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## ■ References to be cited

Please cite as follows:

Osafune, S., S. Masuda, N. Sugiura, T. Doi (2015) Evaluation of the applicability of the Estimated State of the Global Ocean for Climate Research (ESTOC) data set, *Geophys. Res. Lett.*, 42, 12, 4903–4911.

## ■ Available Products

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Variables, abbreviations	Potential temperature [°C],	tmp
	Salinity [PSU],	sal

