Verification & Intercomparison of Global Eulerian Ocean Currents

Saima Aijaz[1], Gary B. Brassington[1], Prasanth Divakaran[1], Charly Régnier[2], Marie Drévillon[2], Jan Maksymczuk[3], K. Andrew Peterson[4]

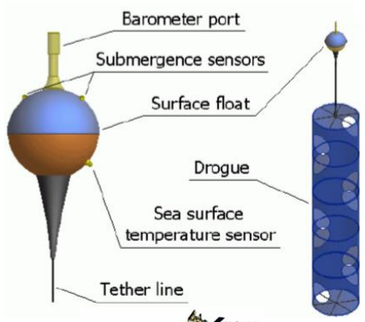
[1]Bureau of Meteorology, Australia; [2]Mercator Océan International, France; [3]Met Office, UK; [4]Environment and Climate Change Canada

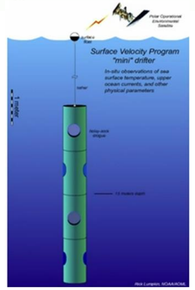
Introduction

The main purpose of the study is verification of ocean currents from the Bureau's operational Ocean Model, Analysis and Prediction System (OMAPS) against the global drifter buoy (GDP) observations, and inter-comparisons with global ocean systems: Mercator Océan International (MOi), France; Forecast Ocean Assimilation (FOAM025 & FOAM-12), coupled atmosphere–land–ocean–ice data assimilation (CPLDA), UK Met Office; Global Ice-Ocean Prediction System (GDPS-GIOPS), and Global Ensemble Prediction System (GEPS), Canada.

Methods

- CLASS4 data standard for verification against reference observing platforms established by the OceanPredict task team for Intercomparison and Validation (IV-TT) has been adopted.
- Corrected stokes drift from global wave model MFWAM and tidal currents from FES2014 have been added to the global model currents.
- Daily, monthly, annual global and regional statistics have been computed.
- Lagrangian diagnostics using particle tracker, OceanPARCELS, were used to track particle trajectories.

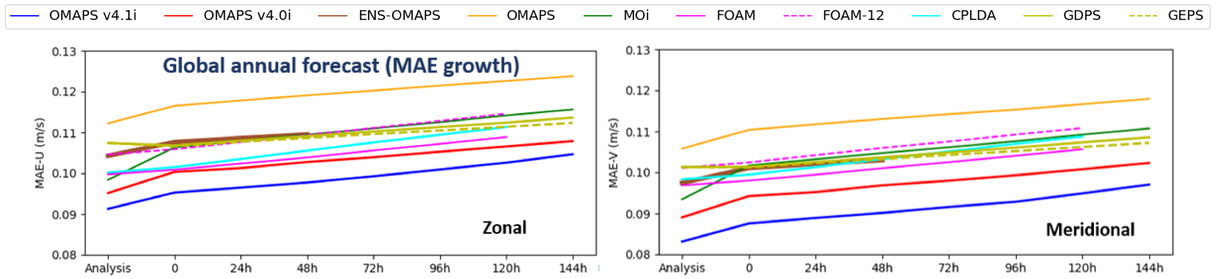




Schematic of the GDP, the buoy and tether (upper left) and the drogue (upper right). Lower: Entire drifter assembly

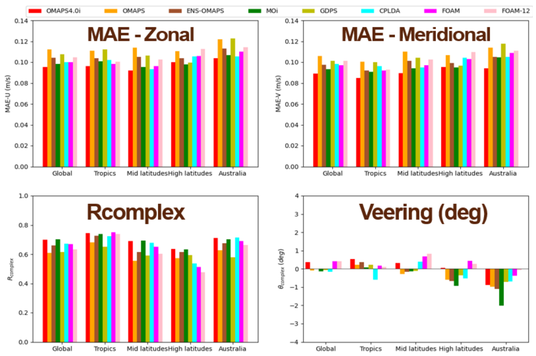
Data

- Currents observations are from GDP drifter buoys consisting of a spherical buoy with a tether line and drogue. GDP track currents at 15 m depth.
- Bureau's OMAPS based on MOM5, 0.1°x0.1° resolution, 51 vertical layers. three model configurations: OMAPS 4.0i (hybrid EnKF-EnOi DA), ENS-OMAPS 3.4, and OMAPS 3.4.
- MOi based on NEMO 3.1, 1/12° resolution at equator, 75 vertical layers.
- FOAM025, CPLDA & FOAM-12 based on NEMO 3.6, 1/4° & 1/12° resolution at equator, 75 layers.
- GDPS-GIOPS & GEPS based on NEMO 3.6, 1/4° resolution at equator, 50 vertical layers.



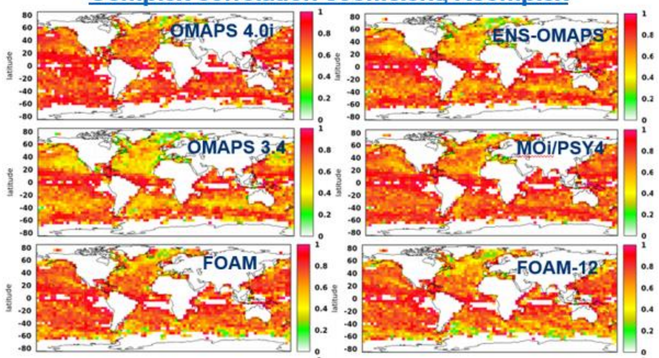
Forecast mean abs. error (MAE) growth for zonal (left) and meridional currents (right) for nine global ocean models.

Regional annual statistics, 2022

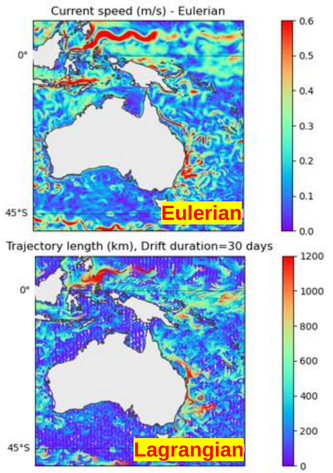


Mean abs error (MAE) (top) and correlation coefficient and veering (bottom) for global, tropics, mid-lats, high-lats, and Aus.

Complex correlation coefficient, Rcomplex



Annual (2022) complex correlation between model analysis currents and observations shown in 4°x4° bins.



Eulerian OMAPS currents speeds (top) and trajectory lengths (km) after 30 days

Summary

- Despite the differences in configuration of the model systems in spatial resolutions; vertical mixing schemes; atmospheric forcing; and DA, all systems produce remarkably similar statistics.
- Bureau's OMAPS 4.0i/4.1i outperforms all other models.
- Current verification is considered independent as currents are not assimilated during the initialisation or DA process.
- Inclusion of Stokes drift leads to higher model skill while including tides has no significant effect.
- Currents from the Eulerian model correspond well with the Lagrangian trajectories.

Aijaz, S., G.B. Brassington, P. Divakaran, C. Régnier, M. Drévillon, J. Maksymczuk, K. A. Peterson, 2023. Verification and intercomparison of global ocean Eulerian near-surface currents, Ocean Modelling, 186, 102241, https://doi.org/10.1016/j.ocemod.2023.102241.

Bureau of Meteorology R&D Workshop 7-10 August 2023, Melbourne, Australia

Contact: saima.aijaz@bom.gov.au