Data, Observation & Modelling

Fri. Nov 13, 2026 2:00 PM - 3:30 PM JST | Fri. Nov 13, 2026 5:00 AM - 6:30 AM UTC | Room A (Oshidori) (2F)

Oral A5 Ocean Digital Twins, Data Architectures and AI-Enabled Approaches

Chair: Philipp S. Sommer, Tomoki Tozuka

3:15 PM - 3:30 PM JST | 6:15 AM - 6:30 AM UTC

[7MgO-EqD-06] Developing an Observation-Constrained Ocean Digital Twin: EnOI Data Assimilation for the GEPSv3 Coupled Prediction System

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Accurate ocean state estimation is crucial for developing operational Digital Twins of the Ocean and coupled climate prediction. We've created an Ensemble Optimal Interpolation (EnOI) system for the Taiwan Multi-scale Community Ocean Model (TIMCOM), which is the ocean component of Taiwan's Global Ensemble Prediction System version 3 (GEPSv3). This system operates in a cycling, weakly coupled configuration and provides ocean initial conditions for subsequent coupled forecasts. It assimilates diverse observations, including Argo temperature and salinity profiles, World Ocean Database in situ profiles from moorings, XBTs, CTDs and OSDs, and NOAA OISST sea-surface temperatures. A 100-member NMC-method ensemble is used for surface assimilation, followed by a demeaned 250-member year-to-year ensemble for in situ assimilation.

We evaluated the system using an observing system experiment with four configurations: full assimilation, assimilation without Argo, SST-only assimilation, and a no-assimilation control. An independent 20% subset of Argo profiles from the SynObs ArRef dataset was withheld from all experiments for verification. Full assimilation significantly reduced the temperature RMSE by 7.8% at depths of 100–300 metres and 4.4% at 300–750 metres, with no statistically significant degradation at any depth. This improvement is particularly notable in the upper thermocline. However, below 300 metres, attributing the improvement to individual observing systems remains uncertain due to sparse independent profile coverage.

Following the SynObs Flagship protocol, TIMCOM achieved a 0.710 °C RMSE over the 0–50 metre depth range, comparable to MOVE-G3F, FOAM, GIOPS and ORAS6. These results demonstrate the effectiveness of the observation-assimilation component in a global coupled prediction system and support further development towards an operational, observation-constrained ocean digital twin.

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