SYMPOSIUM OP'24 ADVANCING OCEAN PREDICTION SCIENCE FOR SOCIETAL BENEFITS

Theme 5.7

Effects of ocean observations on medium-range weather forecasting for the ECMWF coupled system

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Introduction

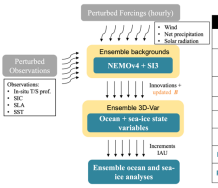
- ECMWF has been using a coupled atmosphere/ocean-waves/ocean/sea-ice modelling system to produce operational weather forecasts for all systems since June 2018.
- Weather forecasting is an initial value problem, so good initial conditions for all components are essential to produce good weather forecasts.
- On the poster we present some results of impacts on coupled forecast quality from an extensive ocean observation experiment where several ocean observation systems have been withheld.

Experimental setup

Ocean data assimilation setup

- Prototype system with NEMO V4 and upgraded NEMOVAR ocean DA
- Better background error formulation
- Better use of observations
- SST is still from a gridded product, but assimilated rather than nudged
- Will form the basis for the next upgrade of the ocean (re)analysis system in 2025
- SynObs OSE protocol with removal of SST, ARGO, moorings, all insitu data, altimeter and no data assimilation

Schematics of the ocean DA system



	ORAS5	ORAS6
Forcing	ERA-interim: 24 h radiation	ERA5: hourly
Model	NEMOv3.4 + LIM2 0.25-deg	NEMOv4 + SI3 (multi-cat.) 0.25-deg
DA algorithm	Deterministic 3DVar-FGAT	Hybrid Ens 3DVar-FGAT
SST DA	Nudging	Ens 3DVar
Ensemble	4 + 1 control	10 + 1 control
Output	Netcdf	GRIB2
Data cover	1981 onwards	1950 onwards
Production	Sequential	Parallel streams

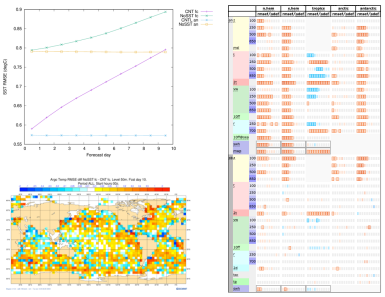
Coupled model setup

- Start day: 20210601
- End day: 20220601
- 00z starts only
- One 10 day forecast per day
- TCo1279 (9-km atmosphere, operational)
- eORCA025 (0.25-degree ocean, operational)
- Prototype modelling system based on NEMO V4 and ECMWF IFS model

Selected results from withholding SST, ARGO and altimeter observations

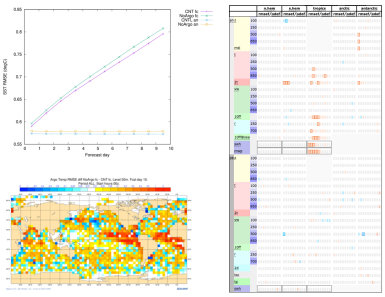
- Validation of ocean forecasts against SST from all globally available drifters.
- ARGO observations at 50m for the last day of the forecast (red colours means increased RMSE).
- Validation of atmospheric forecasts via "scorecards" against operational ECMWF analysis and observations (same convention).

No SST



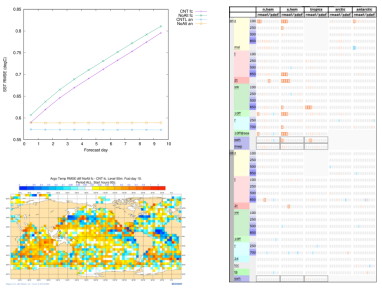
- Removing SST data from the ocean DA system strongly degrades the fit to the SST from point observations from drifters
- ARGO for the temperature at 50m at day 10 is generally degraded
- Large negative impact on the quality of forecasted atmospheric fields
- Removing SST data from the ocean DA system has the largest impact of all the OSE's performed

No ARGO



- Removing ARGO data degrades the SST performance
- ARGO fit is degraded but that is expected
- Small but significant degradation of forecasted atmospheric fields
- Impact of removing Argo data is comparable to other atmospheric model changes in a typical ECMWF IFS Cycle upgrade

No altimeter



- Removing the altimeter data degrades the SST and subsurface temperature performance
- Small but significant degradation of forecasted atmospheric fields
- Impact of removing altimeter is comparable with other atmospheric model changes in magnitude in a typical ECMWF IFS Cycle upgrade

Take home messages

- Ocean initial conditions matter not only for predicting the SST with a coupled system, but also the atmospheric performance.
- Better ocean initial conditions can be obtained by improvements in the observation networks, but also by improving the usage of existing observations in operational ocean data assimilation systems.
- The later can be obtained by better data assimilation algorithms and tuning of parameters (e.g. observation errors) of existing data assimilation systems.
- For some processes, like tropical cyclones, we need good subsurface ocean initial conditions and not just the SST.

Ocean Predict In partnership with unesco Intergovernmental Oceanographic Commission
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