SYMPOSIUM OP'24 ADVANCING OCEAN PREDICTION SCIENCE FOR SOCIETAL BENEFITS

KIAPS KOREA INSTITUTE OF ATMOSPHERIC PREDICTION SYSTEMS

Theme #5.2 Ocean DA

Development of global ocean data assimilation for the KIAPS system (NEMO-CICE)

Eunbyeol Ko, Hyeyeong Jang, Jiyoun Kim, Yonghwan Kwon, Adam Clayton, In-Hyuk Kwon
(ebko@kiaps.org), Korea Institute of Atmospheric Prediction Systems (KIAPS)

Introduction

- We have developed a global ocean DA system based on KMA's GODAPS (Global Ocean Data Assimilation and Prediction System), so that it is can be weakly-coupled to the KIM atmospheric DA system.
- GODAPS consists of the ocean and sea-ice model (NEMO-CICE), the quality control system (NEMOQC), and the ocean DA system (NEMOVAR).
- KIM (Korean Integrated Model): a non-hydrostatic model based on a cubed-sphere grid - was developed for the global atmosphere/land NWP system that was made operational at KMA in 2020.

Development Status

- Develop the global ocean DA system for the KIM system.
  - ✓ Step 1. Change surface forcing system (KMA UM ➔ KIM)
  - ✓ Step 2. Shorten DA cycles and window lengths
    - Cycles more frequently
    - Background time (-3 to 3 hr) to match analysis center time with KIM
    - IAU length 3 hours for full increments at analysis
  - ✓ Step 3 (future plan). Add catch-up cycles, to allow assimilation of late-arriving observations
    - Analyze the impact of catch-up cycles on the number of assimilated observations and resulting DA performance.

Results

Table 1. Experiment configurations and assimilated observations

	OPER (UM)	CTL (24H)	EXP (6H)
Model	NEMOv3.6/CICEv5		
Resolution	extORCA025L75		
Surface forcing	KMA UM (~10km)	KMA KIM (~12 km)	
DA method	3DVAR-FGAT		
DA window	24 hours (2-day hindcast)	24 hours (-24 to 0)	6 hours (-3 to 3)
IAU length	24 hours		3 hours
Forecast	7 days	5 days	6 hours (00Z: 5 days)
Period	2022/05/01 – 2022/08/31 (CTL & EXP spin-up in May)		

	Profile	Surface		Altimeter	Sea-ice
Variables	T, S (in-situ)	SST (in-situ)	SST (satellite)	SLA (satellite)	SIC (satellite)
Platform	Argo moored buoy XBT, CTD, etc	surface drifter moored buoy	AVHRR AMSR2 VIIRS	AltiKa SRAL Poseidon-3B SIRAL	SSMIS

Step 1. Change surface forcing

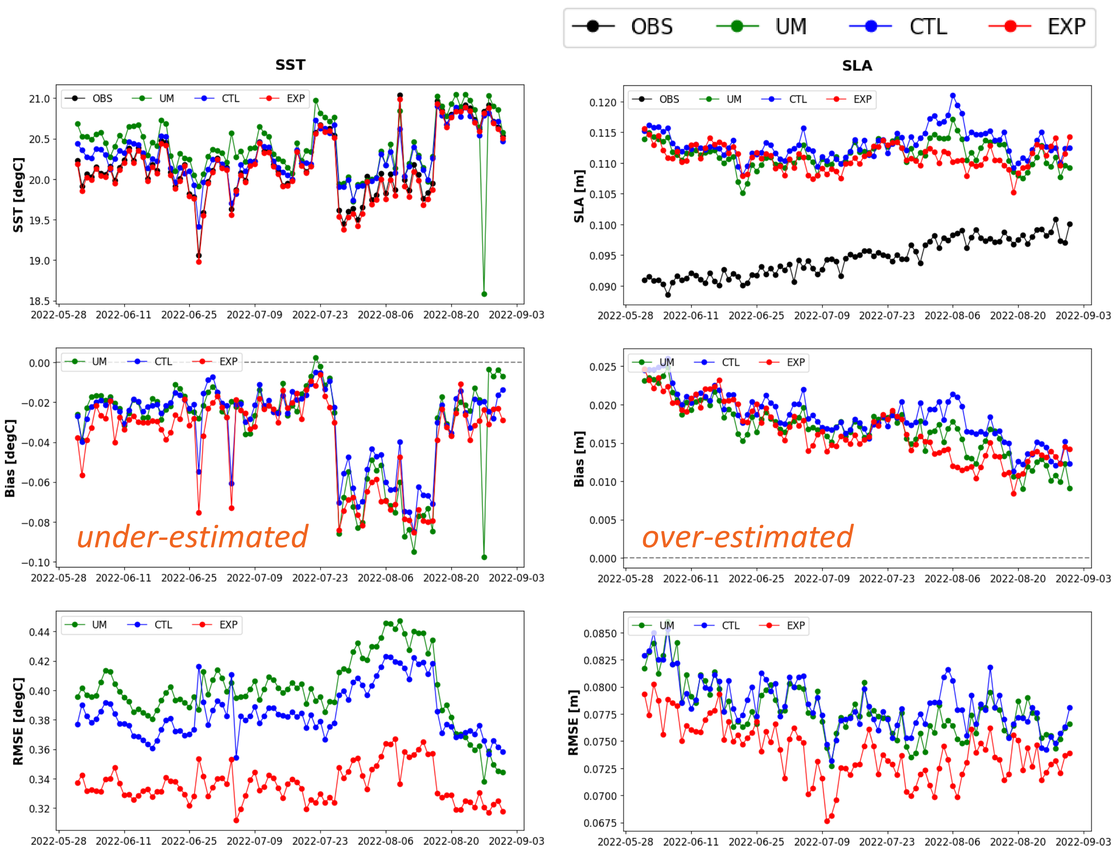

Fig. 1. Time-series of mean value (upper), bias (middle), and RMSE (lower) for SST (left) and SLA (right). The black, green, blue and red lines denote observations, OPER (UM), CTL (KIM 24H) and EXP (KIM 6H) experiment, respectively.

- The impact of surface forcing on the ocean DA performance was neutral (UM vs CTL in Fig. 1).
- SLA was overesatimated in all experiments.
- It is necessary to check the SLA bias -correction proceeses and the updated MDT.

RMSE	OPER	CTL	EXP
SST	0.40	0.38	0.33
SLA	0.077	0.078	0.074

Step 2. Shorten DA cycles and windows

- We adapted the use of satellite SST data to the shorter DA windows by changing the SuperObbing method.
  Thus, more observations were used in the EXP(6H) (Fig. 2. top-left)
- No VIIRS data from late July to mid August, error metrics fluctuated significantly.

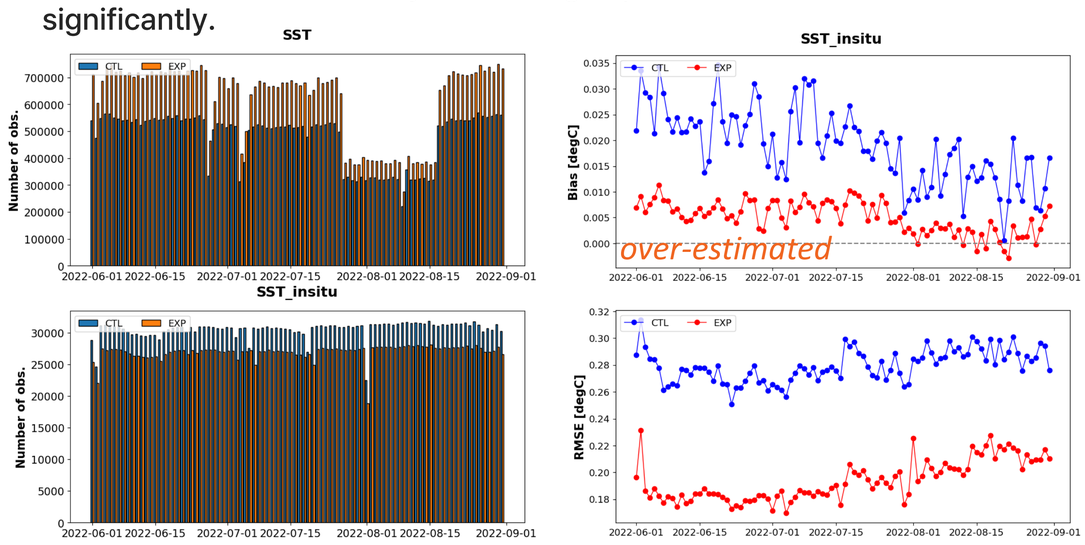

Fig. 2. Time-series of the number of the assimilated observations (left), and bias and RMSE of CTL and EXP using in-situ SST (right). The blue and red lines denote CTL (24H) and EXP (6H) experiment, respectively.

- Overall improvement in SST is achieved by EXP(6H) in the NH, whereas the SSS performance degradation is observed in the run-off area when the results are compared against ECMWF ORAS5 (provided CMEMS, Fig.3).
- In particular, there are large errors in the TP, and depth-error time-series also confirmed that EXP was degraded below the MLD.

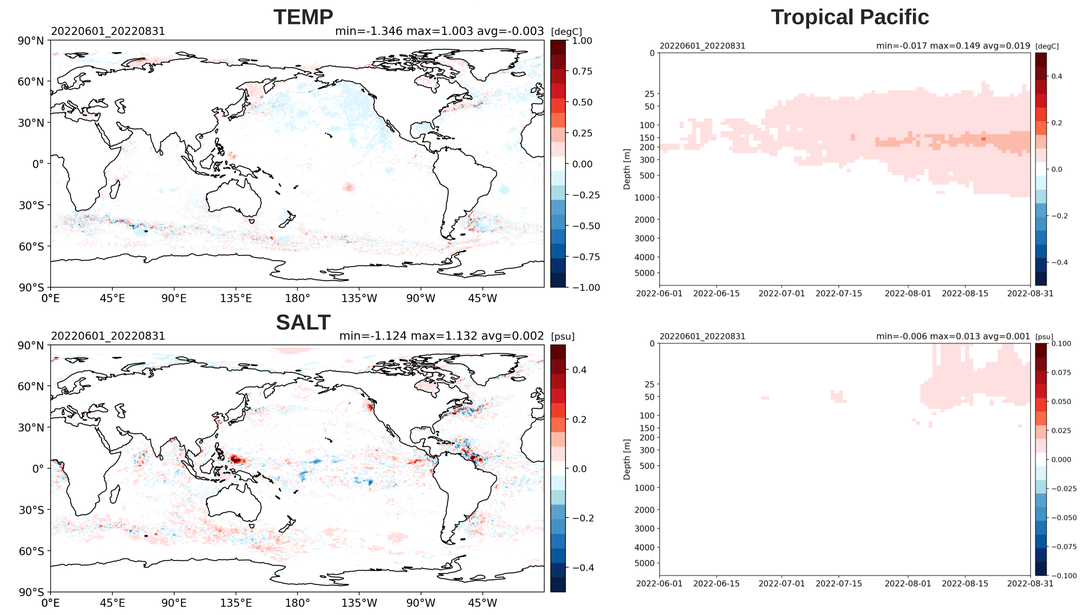

Fig. 3. RMSE difference (EXP-CTL) of the global mean (left) temperature (upper) and salinity (lower), and vertical time-series for the tropical Pacific (right) (reference data: ECMWF ORAS5).

Discussion

- EXP(6H) shows conflicting responses to sea surface and upper/deep ocean.
- Optimal observations usage method for 6 hourly ocean DA.
  - Profile, no significant difference in the number of obs (result not shown)
  - Satellite SST, resolution/range of SuperObbing (6H system: 6 hours, 25km)
- Methods for resolving observation gaps in the operational system.

Ocean Predict In partnership with unesco Intergovernmental Oceanographic Commission

2021 2030 United Nations Decade of Ocean Science for Sustainable Development