

LORA: LETKF-based Ocean Research Analysis: Assimilating high-frequency satellite observations

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LORA [LETKF-based Ocean Research Analysis]: Assimilating high-frequency satellite observations

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1 Introduction

- Frequent satellite observations** (ex. Himawari-8)
 - dt = 10 min. & dx = 2km
- Motivation for frequent data assimilation (DA)
- Challenging topic: Frequent DA**
 - Analyses with dynamical imbalance
 - Initial shocks with high-frequency gravity wave
 - Degradation of accuracy

2 Motivation

- Explore an optimal setting for frequent DA in an EnKF-based ocean data assimilation system
- Create EnKF-based ocean research analysis datasets
- Compare validation results with existing reanalysis and observational datasets

3 EnKF-based ocean data assimilation system

- Regional ocean model**
 - Model: sbPOM v1.0 (Jordi and Wang 2012)
 - Domain: Western North Pacific (dx=0.1° or 0.25° + 50 σ-layers)
 - Spin-up period: 2011.01–2015.06
- Assimilation**
 - Method: LETKF (Hunt et al. 2007)
 - Ensemble size: 100, Assimilation interval: **1 day**
 - Assimilation data: Satellite SST/SSS/SSH and in-situ T/S
 - Assimilation period: 2015.07.07 –

4 Covariance inflation & IAU (Ohishi et al. in press)

- Geostrophic balance**
- Accuracy**
- Ensemble spread**

Combination of RTPP ($\alpha=0.8-0.9$) and IAU
→ Better balance and accuracy

5 Adaptive Obs. Error Inflation (AOEI) (Ohishi et al. in review)

NO AOEI run vs AOEI run

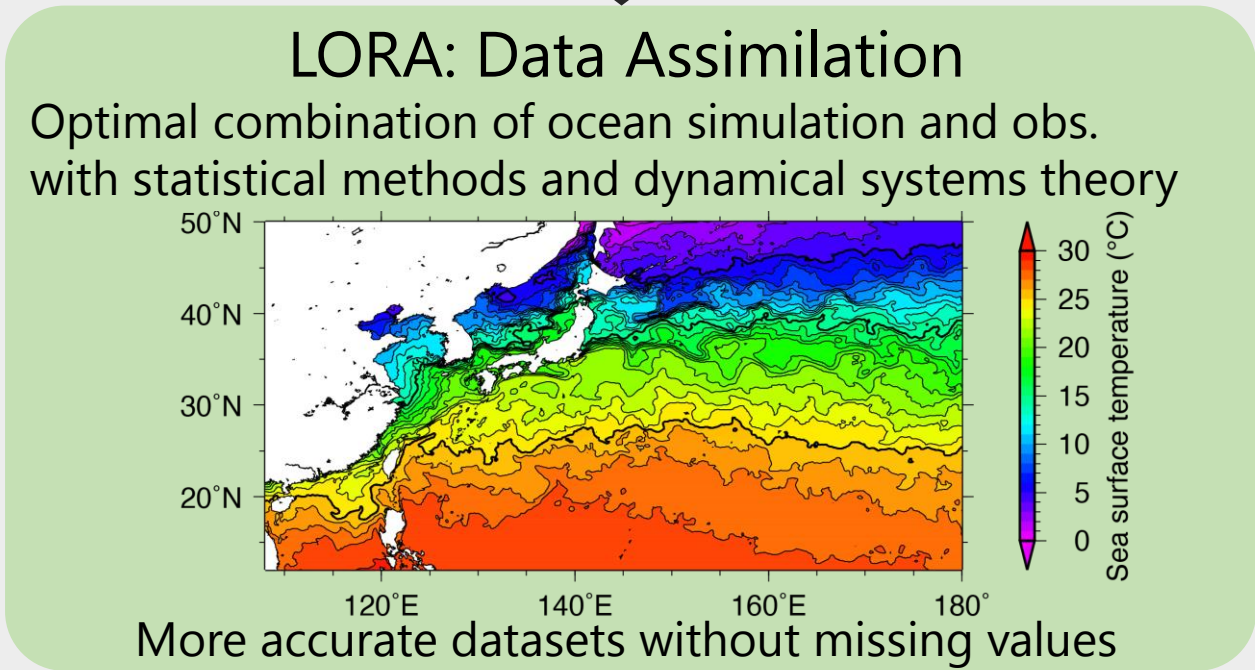
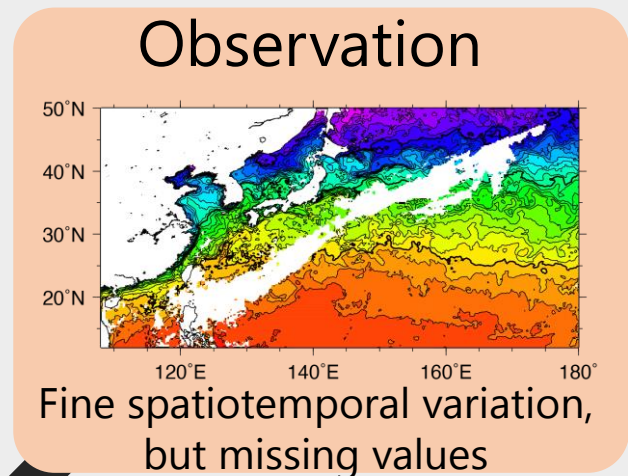
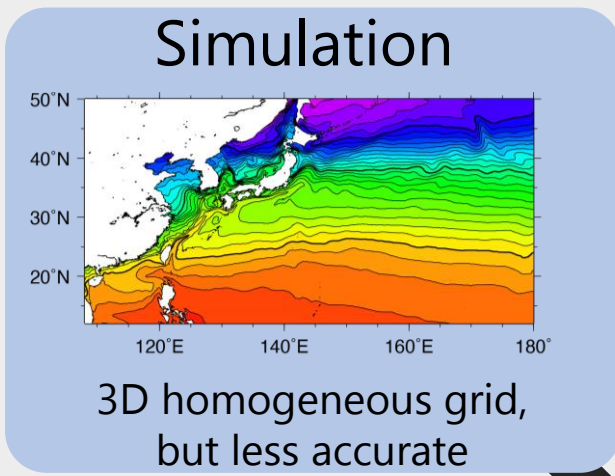
- AOEI is based on innovation statistics
- AOEI improves low-salinity structure

6 LORA: LETKF-based Ocean Research Analysis (Ohishi et al. submitted)

- Outputs**
 - Daily-mean 3D-analytical ensemble mean and spread
 - Daily-mean all ensemble analyses at the sea surface
 - Daily-mean analytical mixed layer heat and salinity budget terms
- Accuracy of surface horizontal velocity relative to drifter buoys**
 - U RMSD
 - U RMSD difference
 - LORA better fits
 - JCOPE2M better fits
 - AVISO better fits
- Accuracy relative to the KEO buoy**
- Accuracy relative to Himawari-8 SST**
 - LORA better fits

7 Summary

- An EnKF-based regional ocean data assimilation system was developed.
- For frequent DA, the combination of IAU, RTPP ($\alpha=0.8-0.9$), and AOEI is found to be optimal.
- LORA demonstrates sufficient accuracy for geoscientific researches.
- LORA will be released through a JAXA website in 2022/23.
- *If you would like to use LORA before the release, please contact me.*



What's new in LORA ?

■ Global reanalysis datasets

3D-VAR	4D-VAR	KF	EnKF
5 datasets	2	2	PEODAS

Currently not available
DA interval: 5 day

■ High-resolution regional reanalysis datasets (dx < 1/10° in the Pacific)

3D-VAR	4D-VAR	KF	EnKF
JCOPE2M (JAMSTEC) FRA-ROMS (FRA)	FORA-WNP30 (MRI & JAMSTEC)	DREAMS (Kyushu Univ.)	<u>LORA</u>

Plan to release in 2022/23
DA interval: 1 day

(c.f. Balmaseda et al. 2015; Martin et al. 2015)

*3 (4)D-VAR: 3 (4) Dimensional VARIational data assimilation

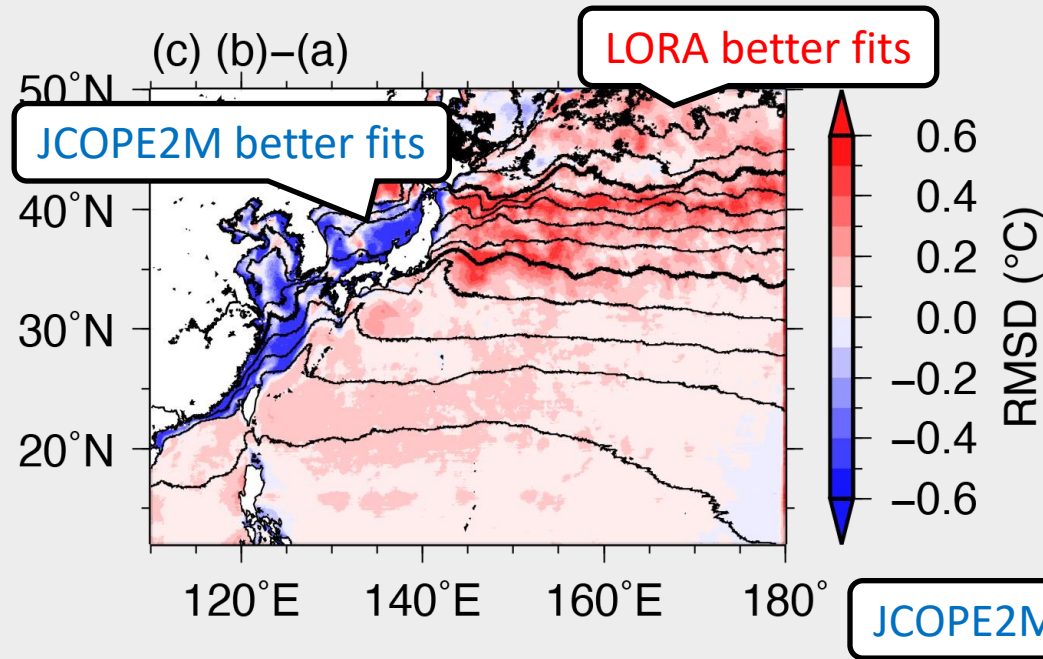
*KF: Kalman Filter *EnKF: Ensemble Kalman Filter

New high-resolution ensemble analysis product
with frequent assimilation in the Pacific region

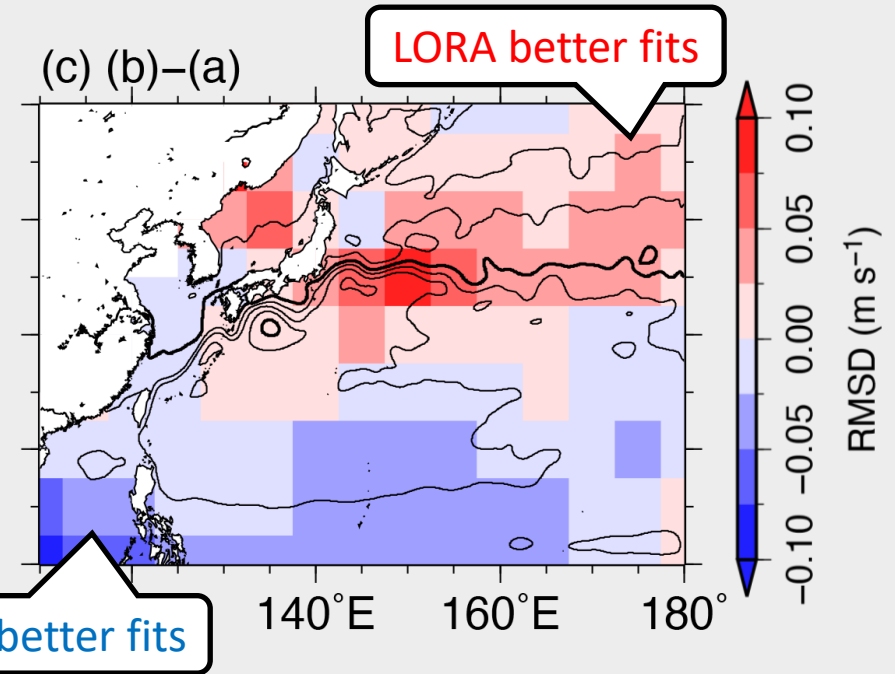
Validation

- RMSD differences between JCOPE2M (3D-VAR) and LORA (LETKF)

Sea surface temperature



Surface zonal velocity



LORA has sufficient accuracy for geoscience researches etc.