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(Online Presentation)

Early results of OSEs conducted for the SynObs international multi-system OSE effort using an Japanese operational system

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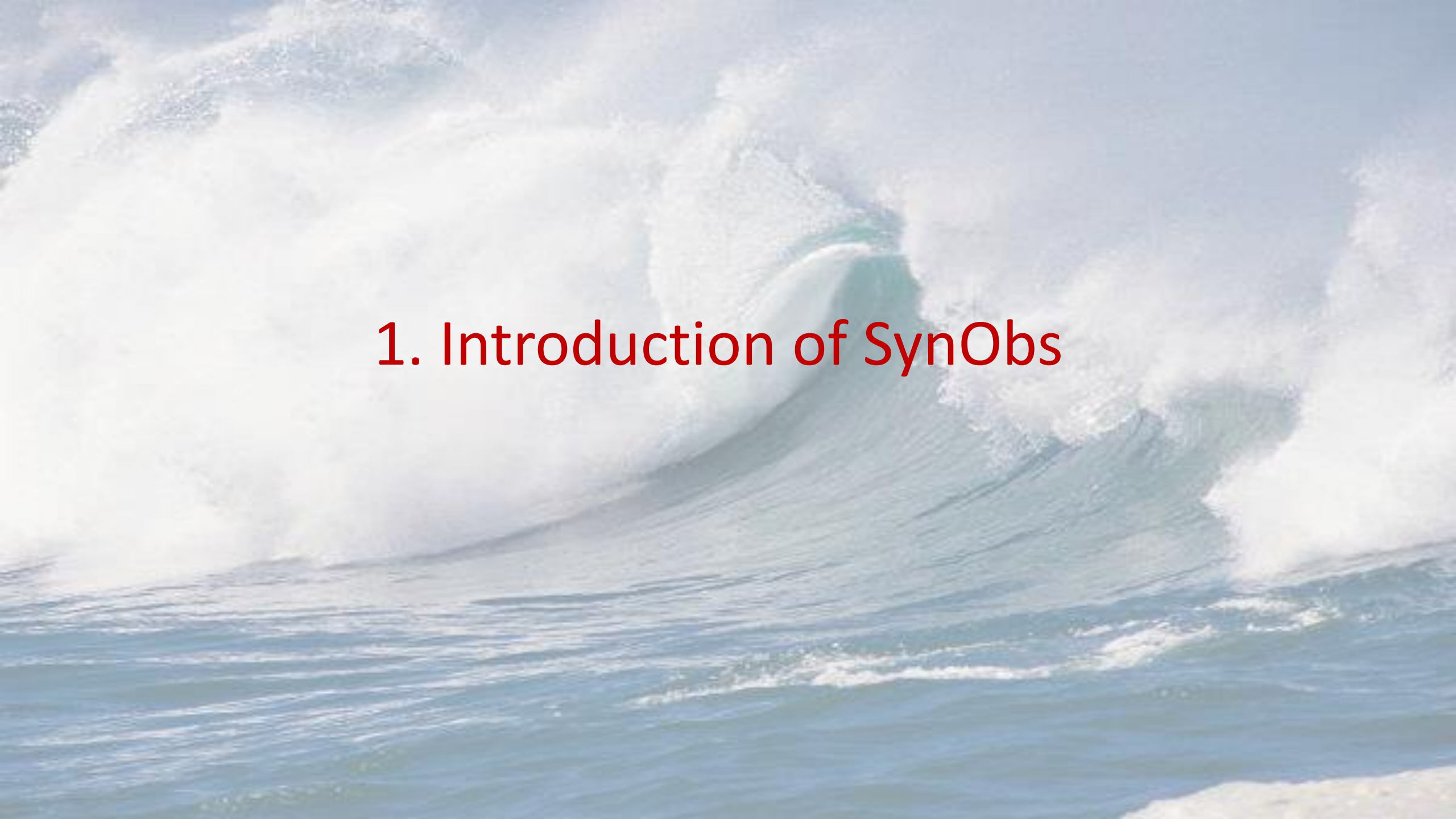

1. Introduction of SynObs

Synergistic Observing Network for Ocean Prediction

Led by OceanPedict OS-Eval TT

- Objective

  SynObs will seek the way to extract maximum benefits from the combination among various observation platforms, typically between satellite and in situ observation data, in ocean predictions.

- Strategy

  SynObs aims to identify the optimal combination of different ocean observation platforms through observing system design/evaluation, and to develop assimilation methods with which we can draw synergistic effects.

SynObs Contact

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https://oceanpredict.org/un-decade-of-ocean-science/synobs-2/

Mailing List

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☆ Outline of SynObs Activity Plan

1. Collaboration for evaluation and design

- Collaboration on a Multi-System OSE and OSSE (SynObs flagship OSEs/OSSEs)
- Establish the best practice based on the collaboration above.

2. Supporting DA scheme development

- Share the information on the development of DA schemes
- Planning of observation campaigns for DA scheme development If necessary

3. Framework to provide information from ocean prediction systems in real time

- Explore the methods to evaluate observing system status in real-time

4. OS-Eval showcase and reporting

- Introduce OS-Eval examples to demonstrate its potential (E.g., Frontiers in Marine Science Special collection is on-going!)
- Contributing to WMO Observation Impact workshop and Rolling Review of Requirement (RRR)

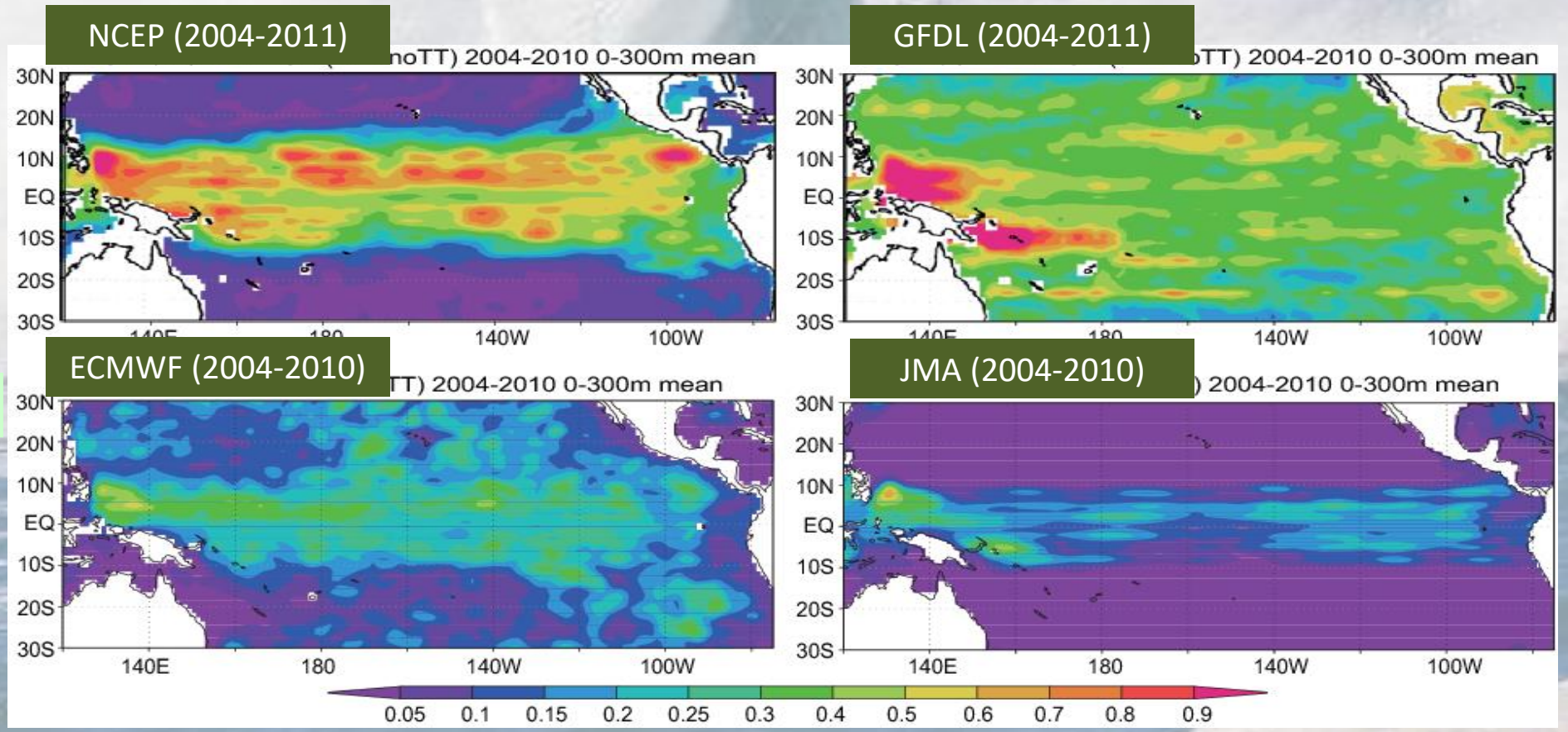
2. SynObs Flagship OSEs

☆ Lesson learnt from past Observing System Evaluation Studies

- ◆ OceanPredict OS-Eval TT have encouraged observing system evaluation studies since 2007.
- ◆ From the experience we learnt the following lessons
  - ✓ Multi-system approach is necessary to mitigate influence of system dependency.
  - ✓ Detailed information from observational community and their needs must be considered.
  - ⇒ Closer collaboration among ocean prediction and observational communities are necessary.

0-300m averaged RMSD of temperature (˚C) between the regular ODA runs and OSE without assimilating tropical mooring buoys

From Fujii et al., 2015 QJRMS



☆ Plan of SynObs Flagship OSEs/OSSEs

- SynObs is currently conducting OSEs/OSSEs using various ocean and S2S prediction systems with a common setting, and named it as SynObs flagship OSE.
  - More than 10 systems are participating in the flagship OSE/OSSE project

◆ OP (Ocean Prediction) OSEs

- Use higher-resolution ocean DA and prediction systems.
- Assimilation run for 2020-2022 (at least for 2020)
- 10-day predictions: Started from every pentad

◆ S2S (Subseasonal-to-seasonal) OSEs

- Use coupled prediction systems including lower-resolution ocean DA for initialization
- Reanalysis run for 2003-2022 (2023?)
- Subseasonal (1-month) predictions: Once a month
- Seasonal (4-month) predictions: from May and Nov.

◆ OP (Ocean Prediction) OSSEs

- Planned for evaluating SWOT, glider observations in coastal and shelf seas, satellite ocean velocity. etc.
- 1-year assimilation run and 10-day predictions from every pentad

Systems participating in the OP OSEs

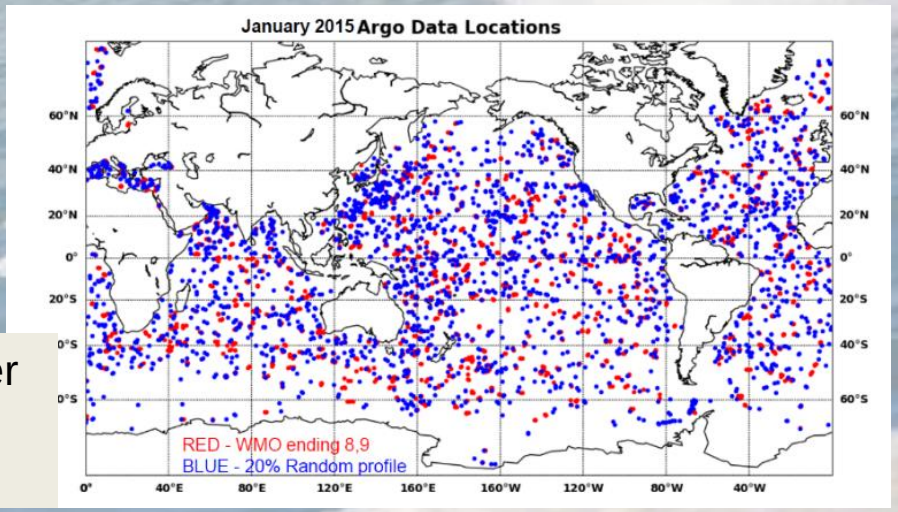
Center	System	Area	Res. (Deg.)
UK MetOffice	FOAM	Global	1/12
NOAA/NCEP	RTOFS-DA	Global	0.08
ECMWF	ORAS5/6	Global	1/4
NASA/GMAO	GEO-S2S V3	Global	1/4
JMA/MRI	MOVE-G3F	Global	1/4
ECCC	GIOPS	Global	1/4
NOAA/NCEP	GLORe	Global	1
NOAA/QUOSAP	MOM6	Global	?
JAMSTEC-APL	JCOPE-FGO	Semi-glob.	0.1
JMA/MRI	MOVE-NP	N Pac.	1/10x1/11
Pukyong Uni.	KOOS-OPEM	N. Pac	1/24
REMO-UFBA	HYCOM-RODAS	S. Atl.	1/12
MetService, NZ	MetService, NZ	S. Pac.	1/24

☆ SynObs flagship OSEs (OSE settings and the schedule)

- OSE Settings for OP and S2S OSEs
  - Control Run (CNTL)
    - Basically, regular observation data are assimilated
    - 20% of Argo data are withhold and used as reference.
    - Other observation data regularly assimilated in each system will be assimilated.
  - OSEs
    - Data of a targeted observation type are excluded (e.g., NoArgo, NoMoor, NoAlt etc.)
- OP OSSE setting is now being discussed.
- Analysis
  - **SynObs asked some volunteer groups to analyze the OSE/OSSE results generally in their own way.**
  - Results are planned to be **stored as netCDF files in a public database on a JAMSTEC-APL server** and shared with the analysis groups.

Suggested OSE Settings

1	CNTL	Ocean Model		SST	Argo 80%	Mooring	Other TS	Alt. (optional)
2	NoAlt	Ocean Model		SST	Argo 80%	Mooring	Other TS	
3	NoArgo	Ocean Model		SST		Mooring	Other TS	Alt. (optional)
4	NoMoor	Ocean Model		SST	Argo 80%		Other TS	Alt. (optional)
5	NoSST	Ocean Model			Argo 80%	Mooring	Other TS	Alt. (optional)
6	NoInsitu	Ocean Model		SST				Alt. (optional)
7	SSTonly	Ocean Model		SST				
8	Free	Ocean Model						
9	HalfArgo	Ocean Model		SST	Argo 40%	Mooring	Other TS	Alt. (optional)
10	Oper	Ocean Model	Oper. Setting	SST	Argo 100%	Mooring	Other TS	Nadir Altimeter



Distributions of Argo floats whose last digits of WMO number is 8 or 9 (red) and 20% random profiles (blue). Example for January 2015 (Thanks to Li Ren, NASA/GMAO.)

3. OSEs conducted in JMA/MRI for the SynObs flagship OSE activity

★ Setting of the S2S Analysis OSEs for the flagship OSEs in JMA/MRI

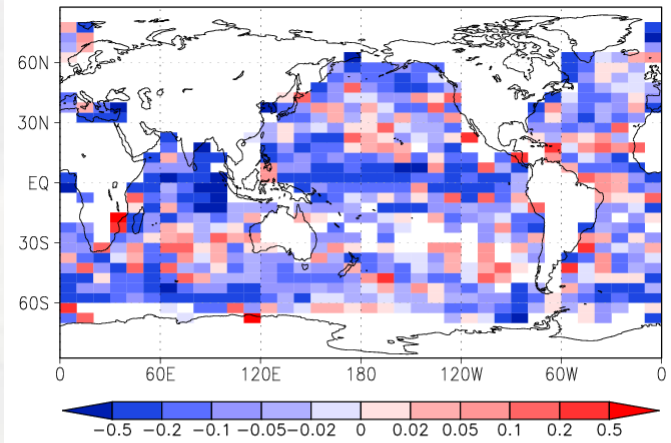
MOVE-G3 Ocean RA for the calibration of operational Seasonal Forecasts

- ✓ RA runs of major S2S OSEs are completed.
- ✓ Forecast runs have not started yet.
- ✓ RA runs for OP OSEs using higher resolution model (1/4° resolution) are also on-going.
- ✓ Only RA runs of the 3 S2S OSEs are shown today.

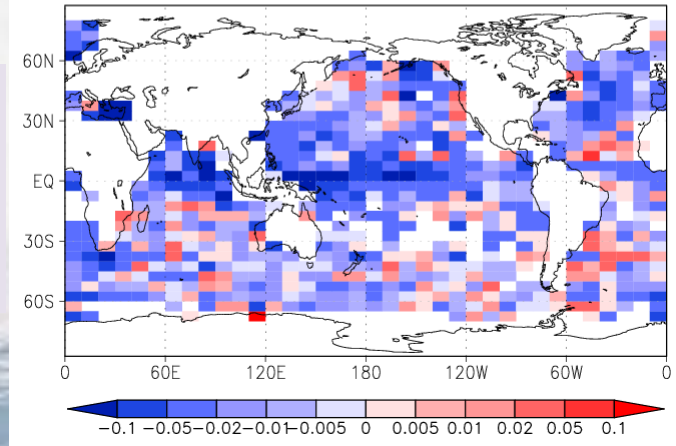
☆ Differences of RMSE wrt. Independent Argo between OSEs (2003-2010)

RMSE(CNTL) – RMSE(NoInSitu)

100m T

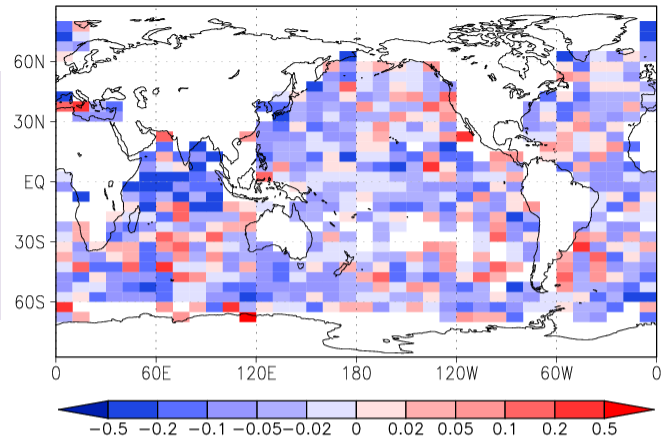


100m S

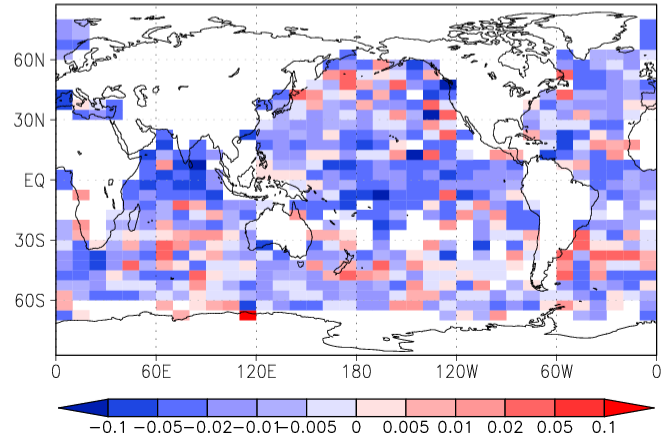


RMSE(CNTL) – RMSE(NoArgo)

100m T

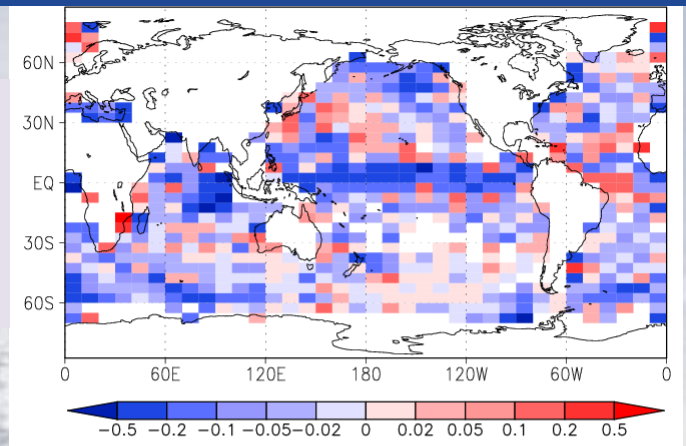


100m S

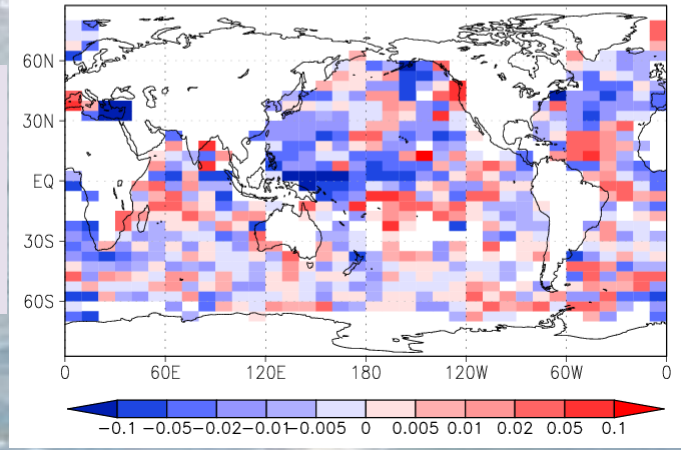


RMSE(NoArgo) – RMSE(NoInSitu)

100m T



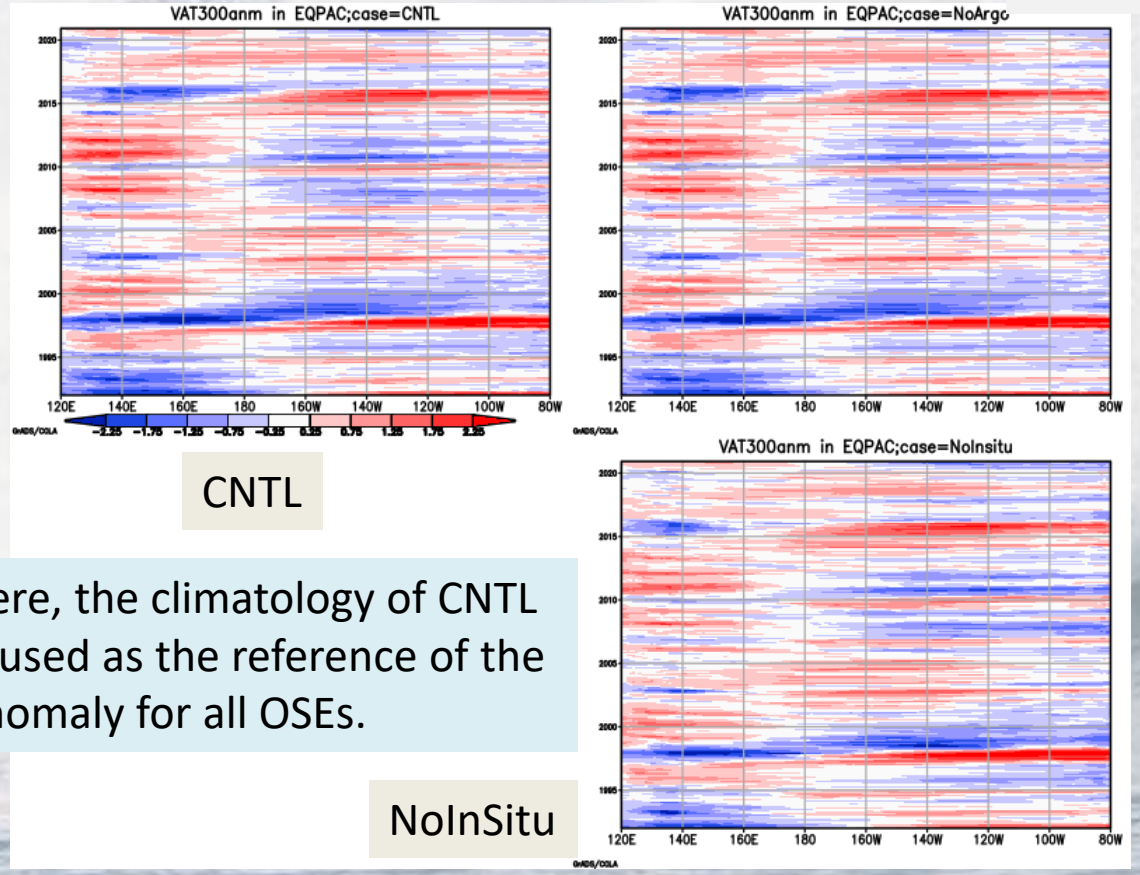
100m S



- In situ observation impact is significant in a large part of the global ocean.
- Argo impact is spread over the entire global ocean.
- The large negative values in the tropical Pacific and Tropical Indian Ocean implies substantial impacts of the tropical moorings.

☆ Lon-Time plots of 0-300m TS anomaly at the equator in the Pacific

0-300m averaged Temperature



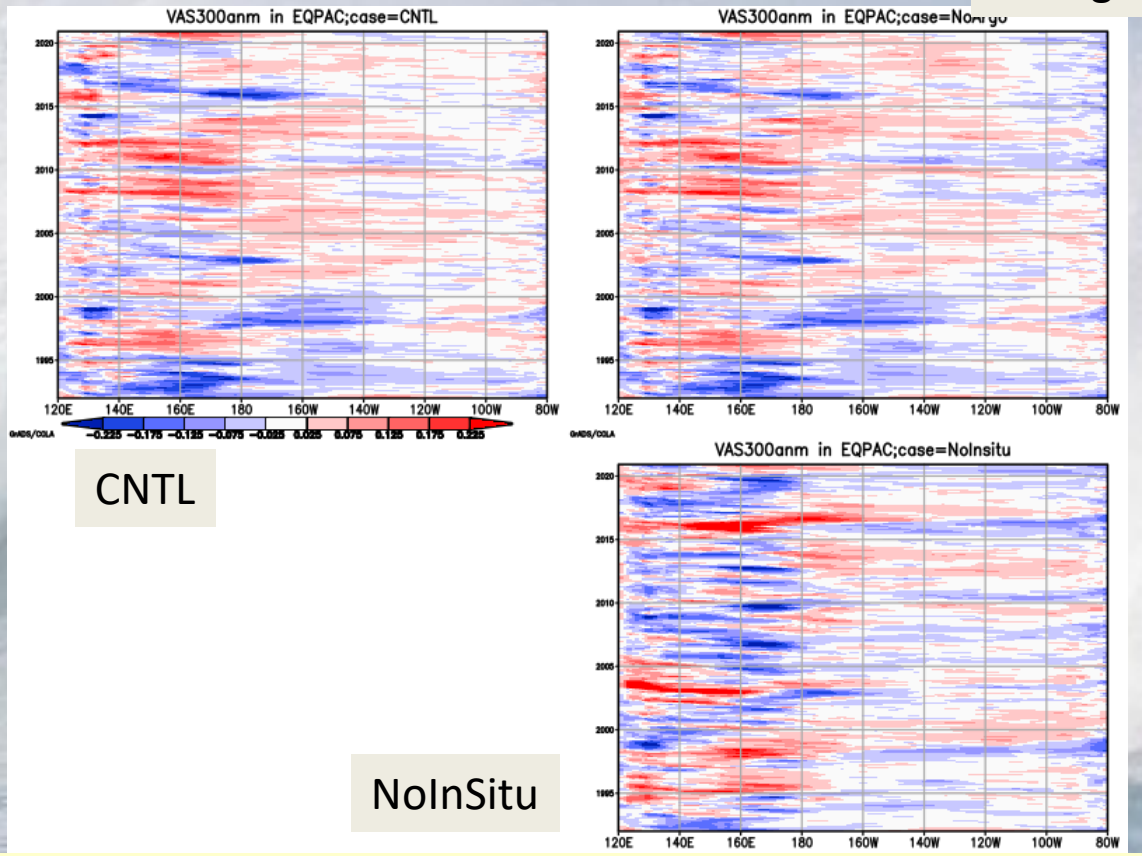
NoArgo

CNTL

Here, the climatology of CNTL is used as the reference of the anomaly for all OSEs.

NoInSitu

0-300m averaged Salinity



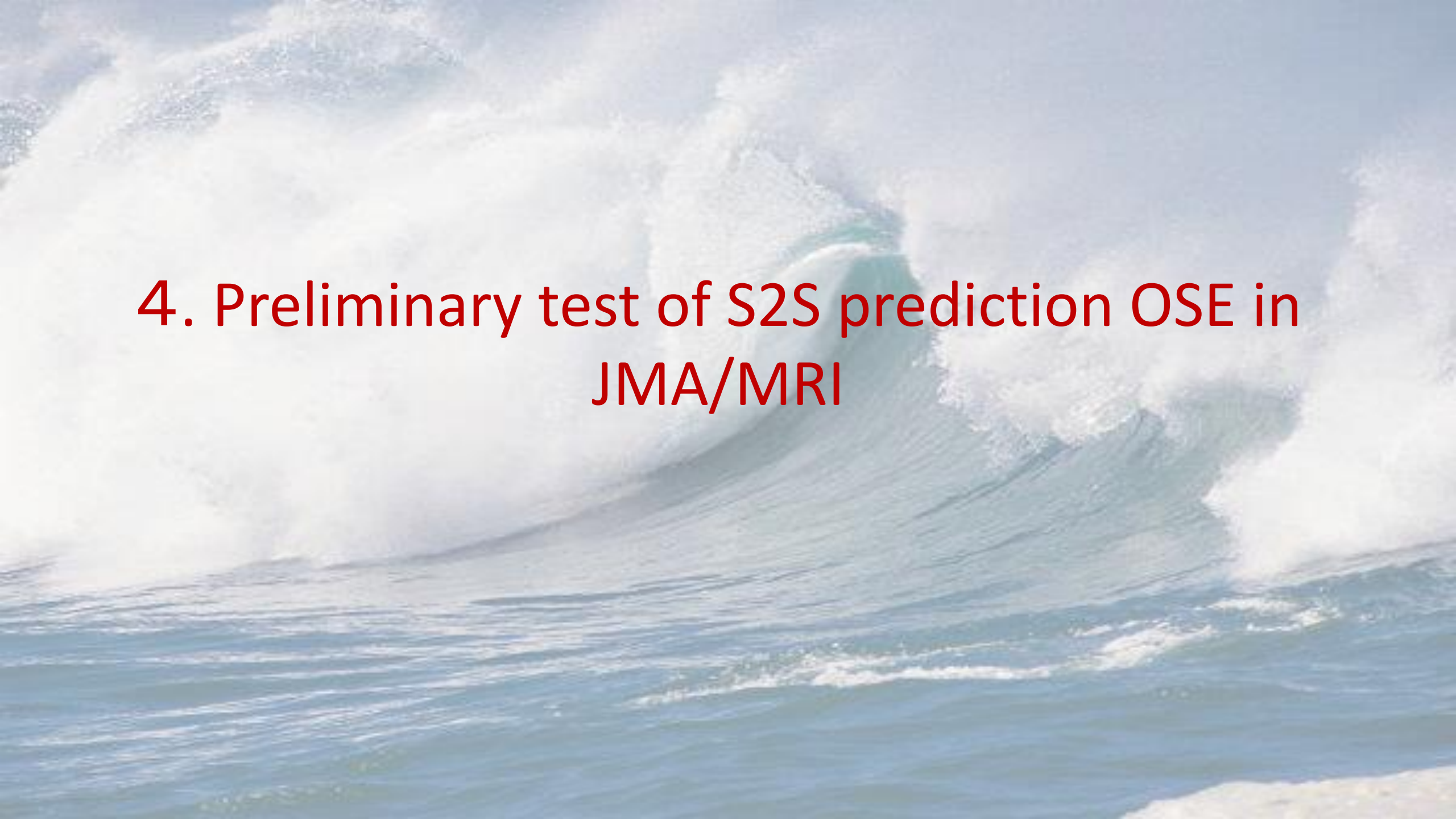
NoArgo

CNTL

NoInSitu

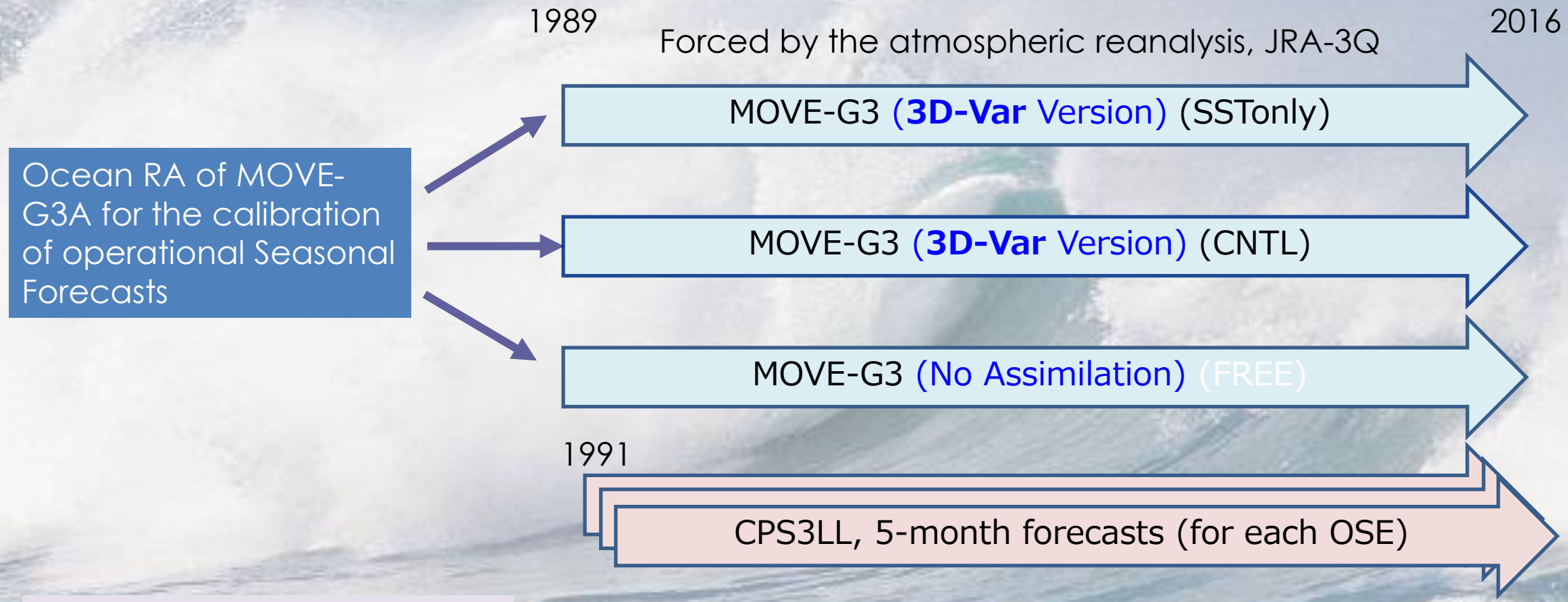
- The T plots of NoArgo and NoInSitu are very similar to the plot for CNTL. Satellite altimetry data, together with wind stress information are effective enough to capture the temperature variation in the equatorial Pacific.

- S plot of NoInsitu significantly differs from the plots of other OSEs. It indicates the necessity of the tropical mooring for reproducing the salinity variation.
- Similarity of the plot between CNTL and NoArgo shows the effectiveness of tropical moorings for reproducing salinity variations.



4. Preliminary test of S2S prediction OSE in JMA/MRI

☆ Setting of the preliminary test

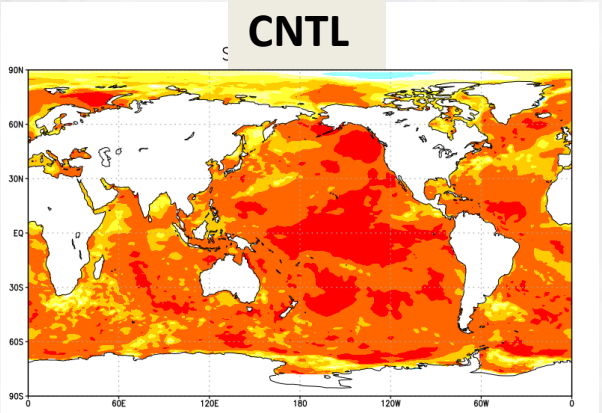
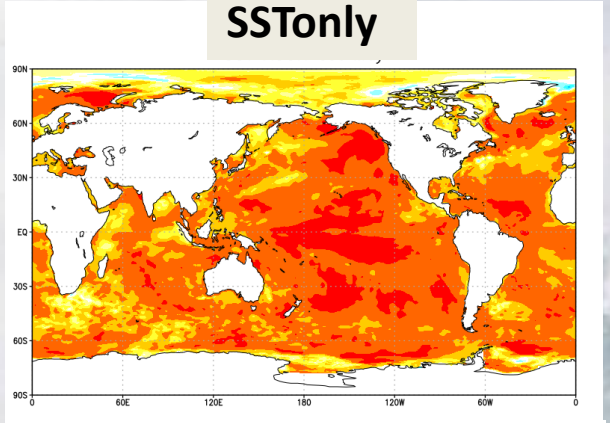
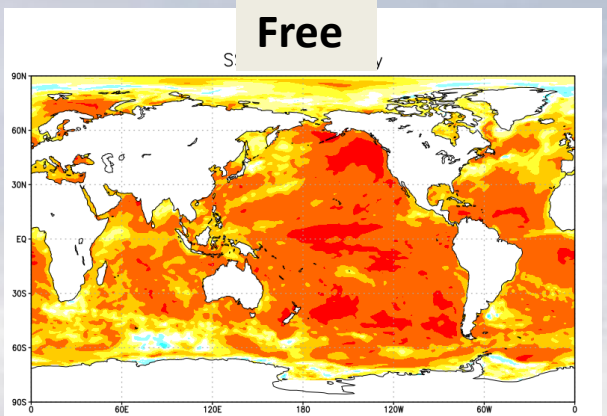
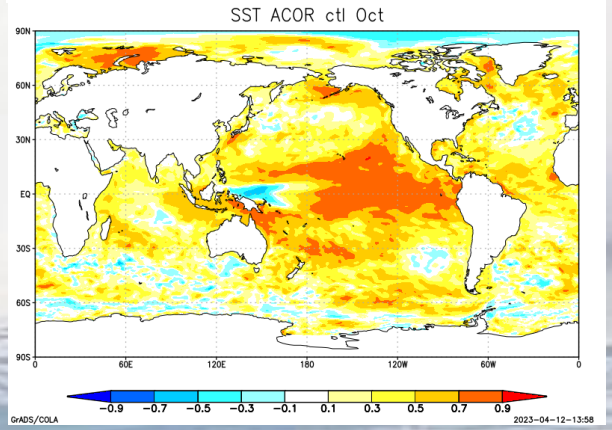
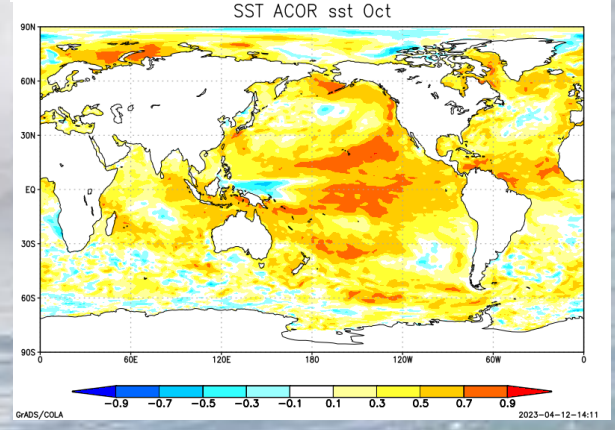
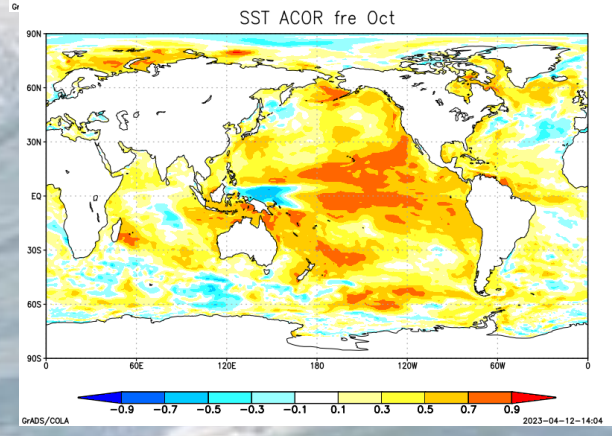


CPS3LL:**Lower-resolution version of CPS3** (Atmos: TL159, Ocean: 0.3-0.5˚x1˚)

◆ Forecasts are started from Apr. 26th of every year
◆ Atmospheric Initial Condition: JRA-3Q

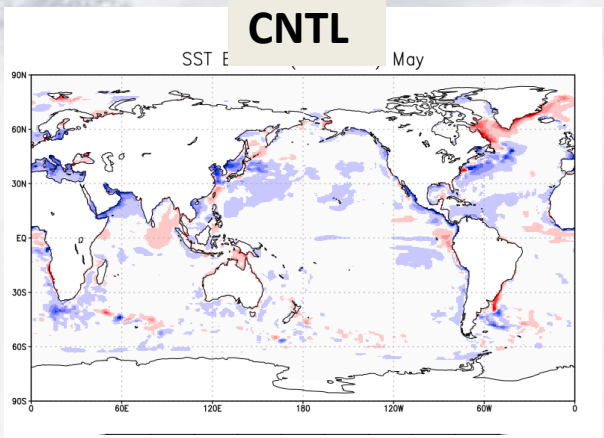
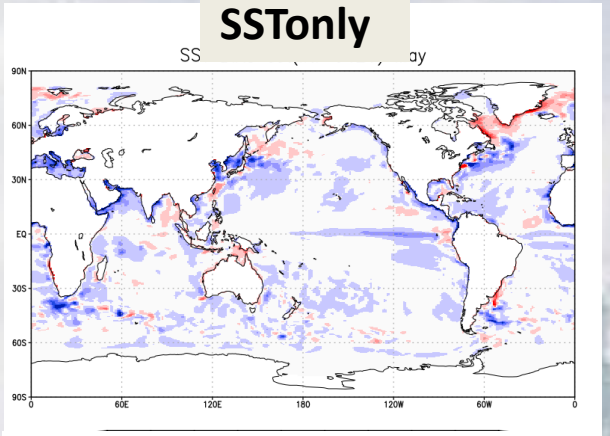
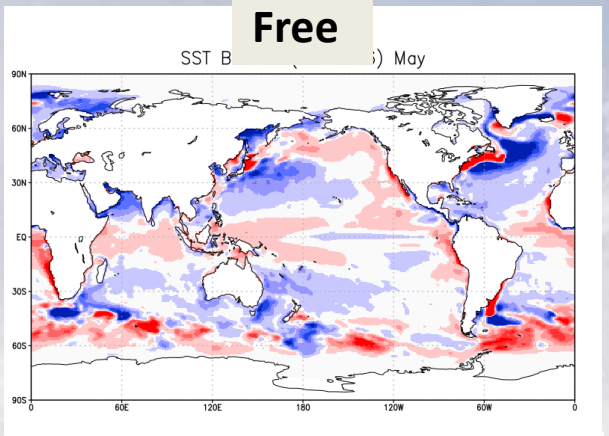
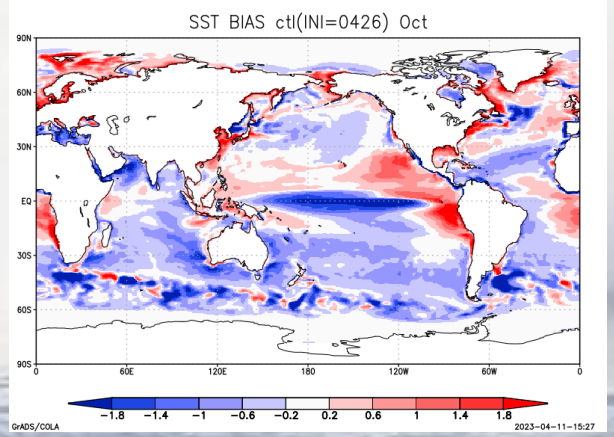
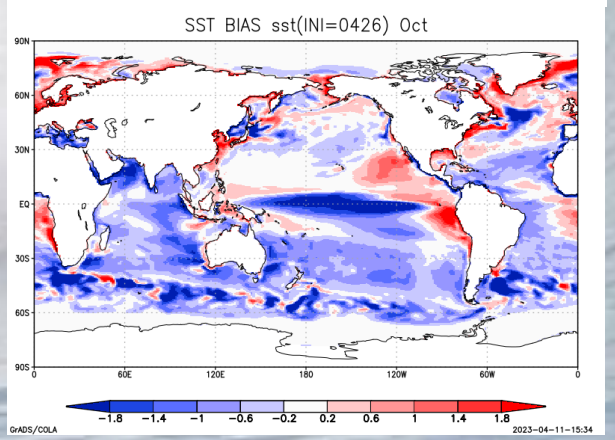
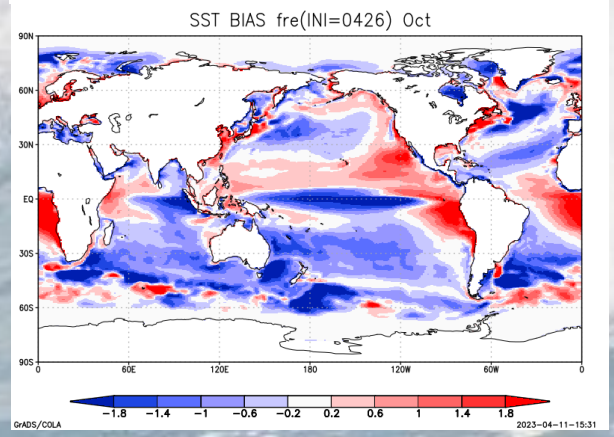
☆ ACC of forecasted SST for the 1st and 6th Month

ACC: Anomaly Correlation Coefficient

	CNTL	SSTonly	Free
May (1st Mon)			
October (6th Mon)			

- In the 1st month, the difference is clear for the areas in which ACC is more than 0.8 in the tropical Pacific.
- In the 6th month, the improved ACC score in CNTL is significant. But, the difference between SSTonly and Free is not clear.

☆ Bias of forecasted SST for the 1st and 6th Month

	CNTL	SSTonly	Free
May (1st Mon)			
October (6th Mon)			

- The cold bias in the equatorial Pacific and the south hemisphere in SSTonly in the 1st month is reduced by assimilating in-situ and satellite altimetry data in CNTL.
- Although the ACC difference is small between SSTonly and Free in the 6th month, the SST bias is clearly reduced in the North Pacific in the range in SSTonly.

5. Summary

☆ Summary and Concluding Remarks

- UN Ocean Decade Project SynObs is now implementing a multi-system OSE/OSSE collaborations, named the flagship OSEs/OSSEs.
- In the flagship OSEs/OSSEs, we try to remove system dependency by averaging OSE results of various systems and try to make fair evaluation and design.
- SynObs will share the OSE/OSSE results through a public web database prepared by JAMSTEC-APL.
- The flagship OSE/OSSE results will be analyzed several analysis groups.
- The results of OSEs in JMA/MRI demonstrate impacts of Argo floats, tropical moorings, other in situ observations, and satellite altimetry data on the ocean reanalysis.
- **Please mail to SynObs (synobs@mri-jma.go.jp) to join the SynObs activities.** (We share the information on the activity through the SynObs mailing list and the SynObs web meetings.)

SynObs Webpage:
https://oceanpredict.org/un-decade-of-ocean-science/synobs-2/

Thank you!!