



The latest updates for the JMA operational systems

Yosuke Fujii, Goro Yamanaka, Nariaki Hirose, Norihisa Usui, Yuhei Takaya,
and Yutaro Kubo*

Meteorological Research Institute

*Japan Meteorological Agency**



Overview of the latest JMA system updates

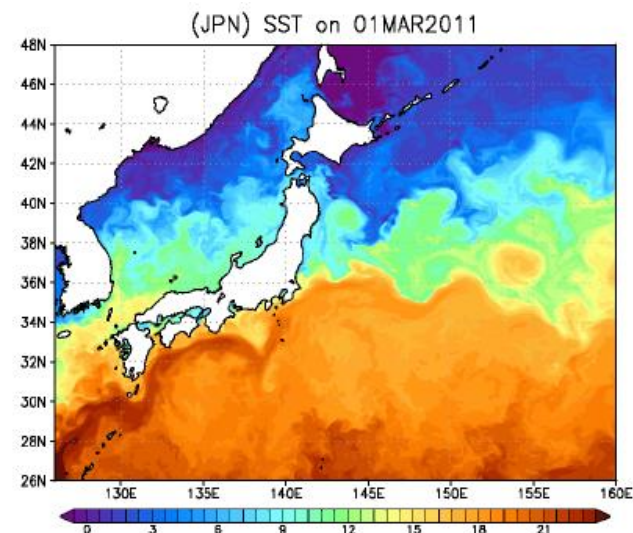
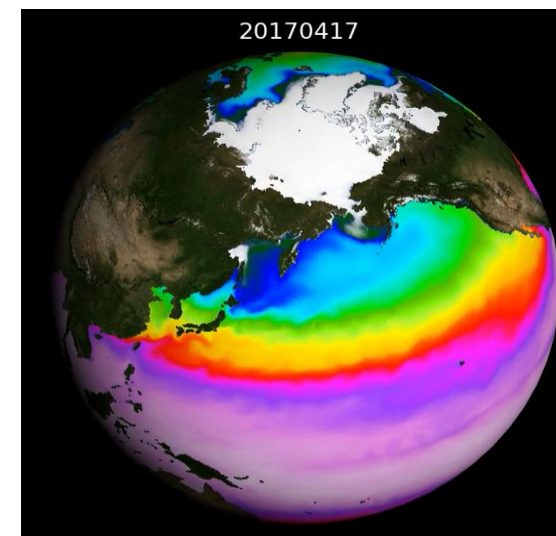


Global System - MOVE/MRI.COM-G3

- The JMA operational seasonal prediction system has been updated from CPS3 to **CPS4** in Jan. 2026.
- Sub-seasonal prediction, such as one-month forecast, has been produced by CPS4 as well.

Regional System – MOVE/MRI.COM-NP/JPN

- High-resolution regional ocean reanalysis around Japan over 60 years (**FORA-JPN60**) is expected to be released soon.



JMA Previous (CPS3) and Latest (CPS4) Seasonal Prediction Systems



		JMA/MRI-CPS3 (February 2022-January 2026)	JMA/MRI-CPS4 (January 2026-)
Horizontal resolution	Atmosphere	TL319 (approx. 55 km)	TL319 (approx. 55 km)
	Ocean	0.25 degree (longitude) × 0.25 degree (latitude)	0.25 degree (longitude) × 0.25 degree (latitude)
Vertical resolution	Atmosphere	100 layers with top at 0.01 hPa	128 layers with top at 0.01 hPa
	Ocean	60 layers	60 layers
Initial conditions	Atmosphere	Global Analysis (GA)	GA and Ozone Analysis
	Land	Offline Land Analysis	Offline Land Analysis (modified)
	Ocean/Sea ice	MOVE/MRI.COM-G3	MOVE/MRI.COM-G3
Initial perturbation	Atmosphere	Breeding of Growing Modes (BGMs)	Singular Vectors (SVs) + Local Ensemble Transform Kalman Filter (LETKF)
	Ocean	Analysis uncertainty pattern	Analysis uncertainty pattern
Model perturbation	Atmosphere	Stochastic Perturbation of Physics Tendency (SPPT)	SPPT and Stochastic Humidity Profile for Convective parametrization (SHPC)
Ensemble size		5 members / day for 6-month prediction	5 members / day for 6-month prediction 50 members / week for 1-month prediction

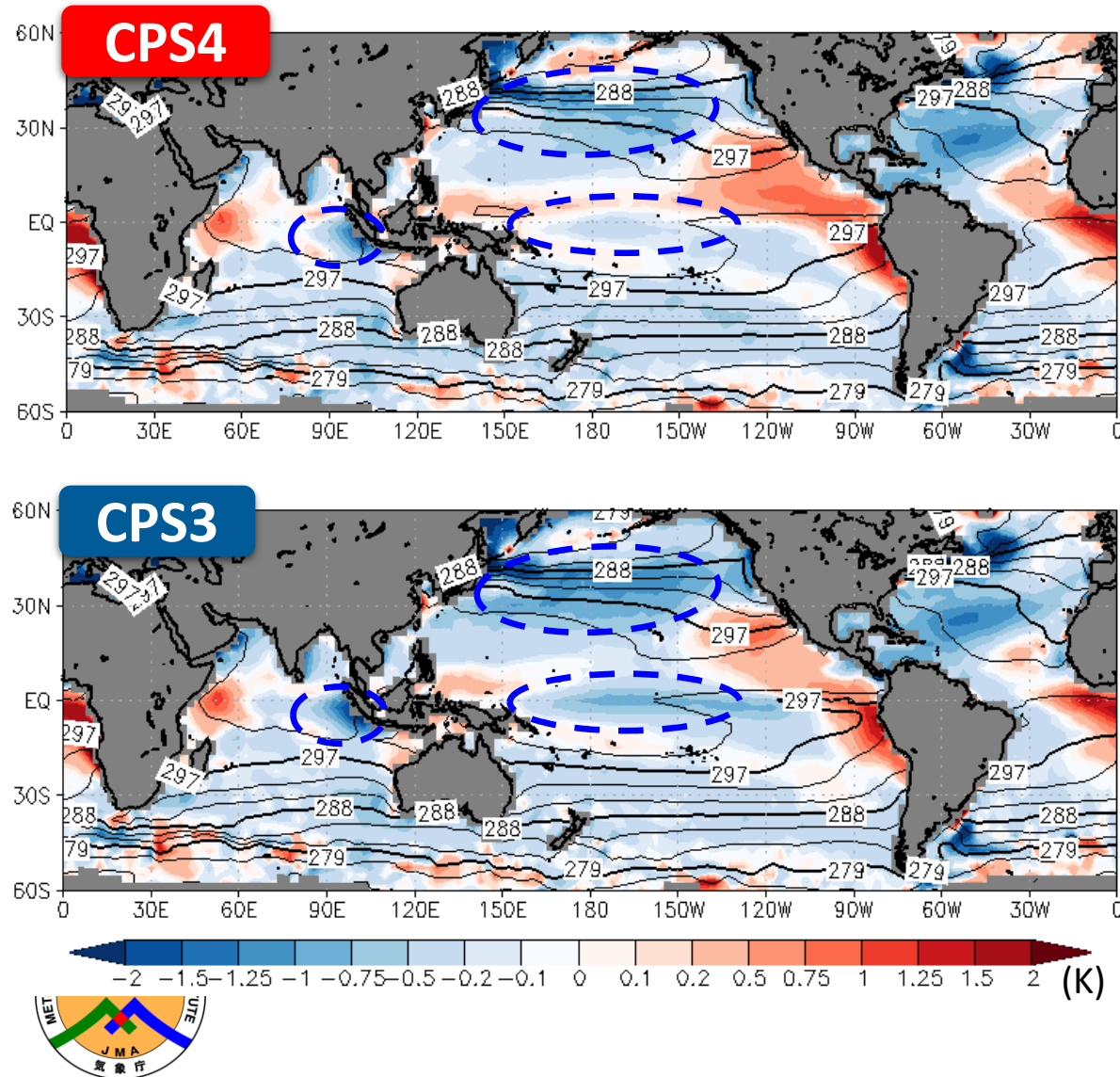


Performance of CPS4 for SST



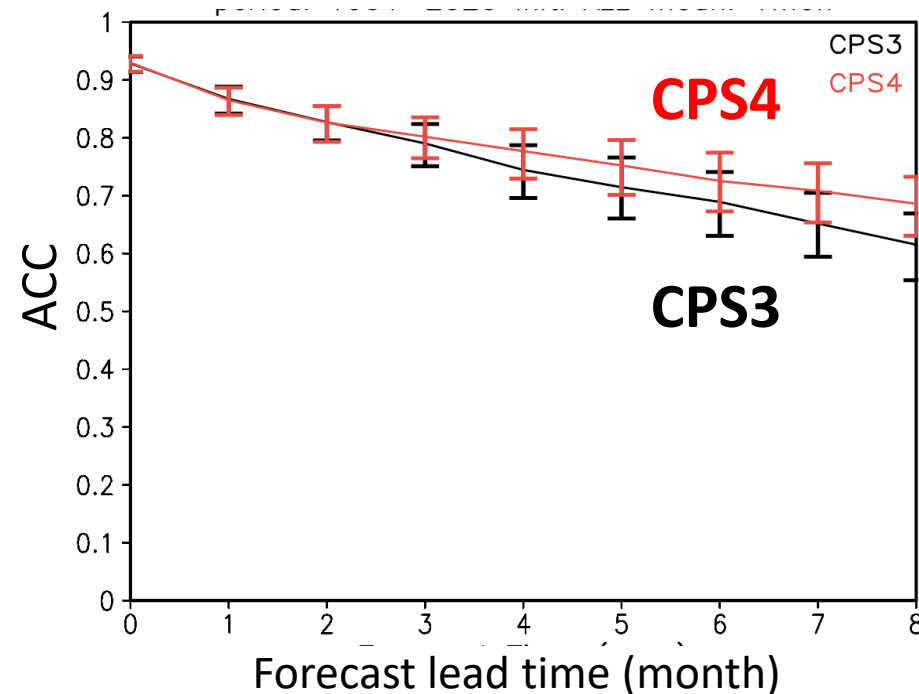
Mean Error

JJA 1991-2020, Initial month: May



ACC (WNP: 130-150E, 15N-EQ)

All months 1991-2020



- Cold tongue (low SST) bias in the equatorial Pacific and low SST biases in the eastern equatorial Indian Ocean and mid-latitude North Pacific are substantially reduced.
- Anomaly correlation coefficients (ACCs) in the western tropical Pacific are improved.

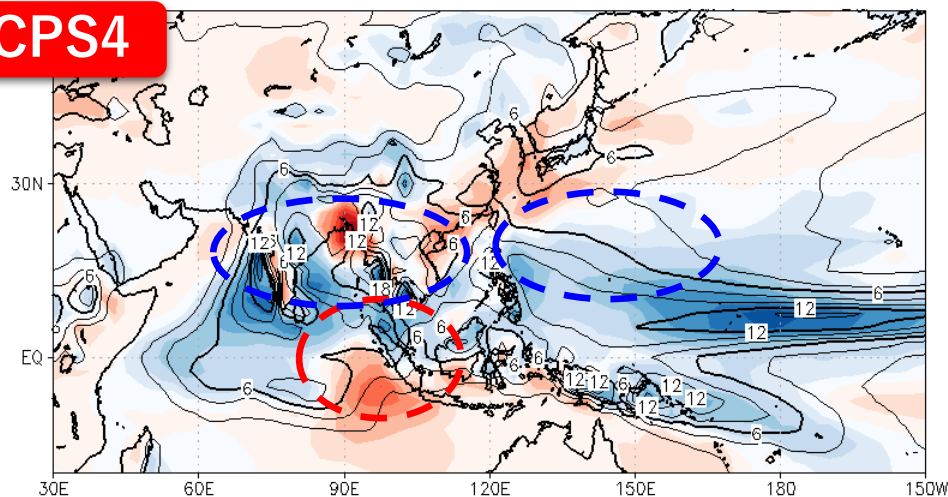
Performance of CPS4 for Precipitation



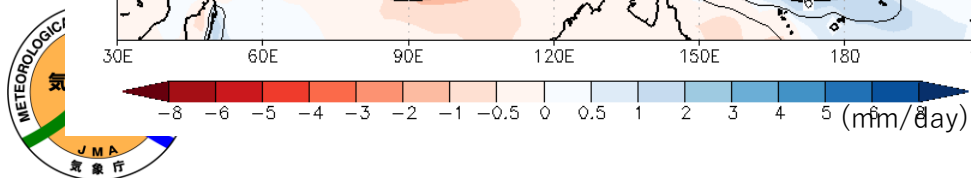
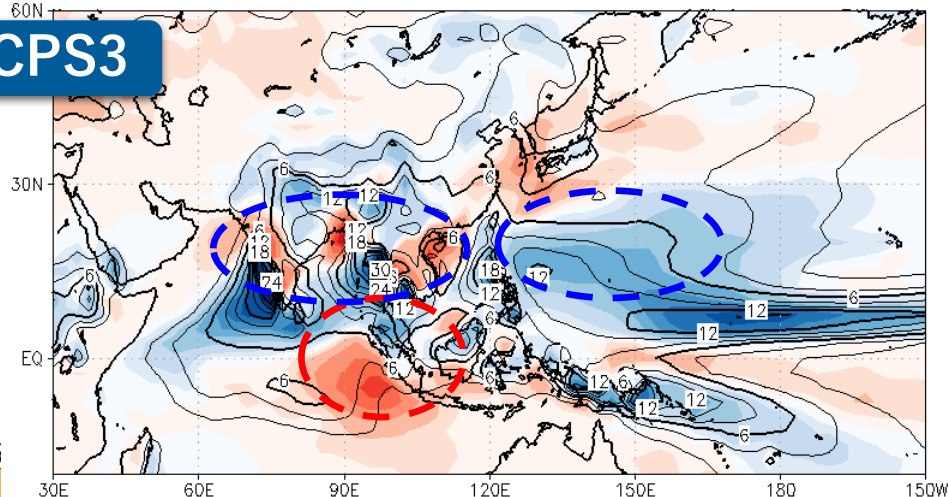
Mean Error

JJA 1991-2020 (Initial month: May)

CPS4

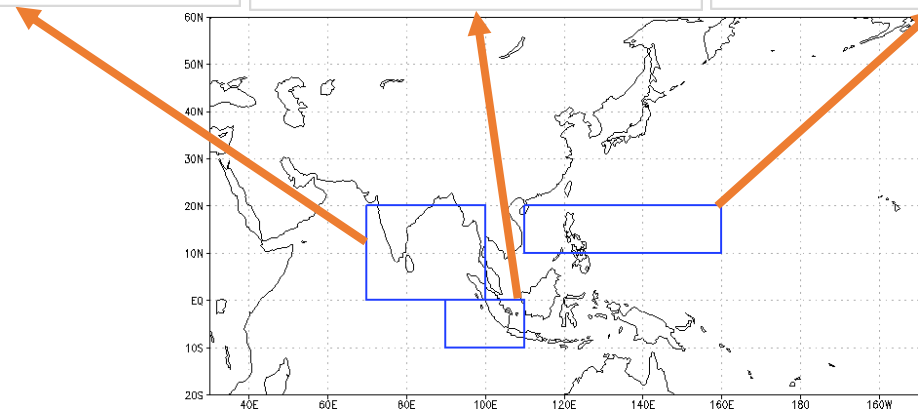
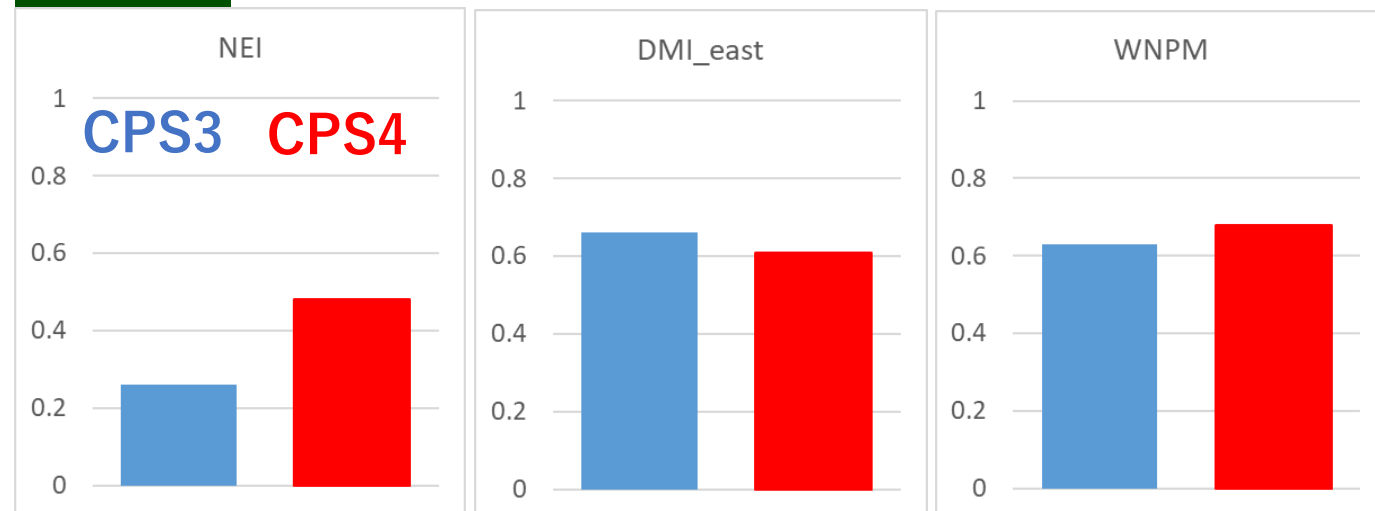


CPS3



ACC

JJA 1991-2020 (Initial month: May)



- The excess precipitation biases over the tropical western North Pacific and north Indian Ocean, and under-biases over the southeastern tropical Indian Ocean are reduced.
- ACCs over India and the western Pacific are improved or the same.

JMA Previous (GEPS) and Latest (CPS4) Sub-Seasonal Prediction Systems



		JMA Global Ensemble Prediction System (GEPS) (March 2025-)	JMA/MRI-CPS4 (January 2026-)
Horizontal resolution	Atmosphere	TQ479 (approx. 27 km) 0-18day prediction TQ319 (approx. 40 km) 18-34day prediction	TL319 (approx. 55 km)
	Ocean	-As	0.25 degree (longitude) × 0.25 degree (latitude)
Vertical resolution	Atmosphere	128 layers with top at 0.01 hPa	128 layers with top at 0.01 hPa
	Ocean	-	60 layers
Initial conditions	Atmosphere	Global Analysis (GA)	GA and Ozone Analysis
	Land	GA (real-time) and Offline Land Analysis (re-forecast)	Offline Land Analysis (modified)
	Ocean/Sea ice	-	MOVE/MRI.COM-G3
Initial perturbation	Atmosphere	SVs + LETKF	SVs + LETKF
	Ocean	-	Analysis uncertainty pattern
Model perturbation	Atmosphere	SPPT and SHPC	SPPT and SHPC
Ensemble size		50 members / week for 1-month prediction	5 members / day for 6-month prediction 50 members / week for 1-month prediction

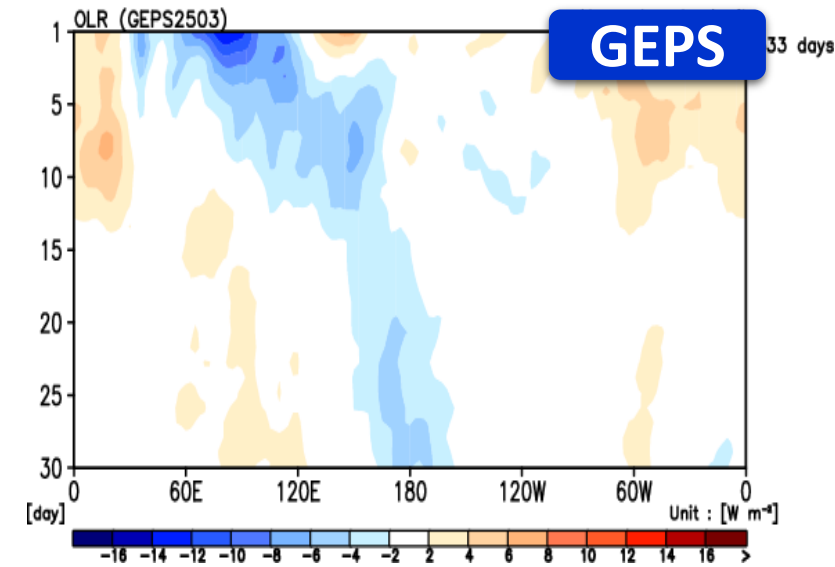
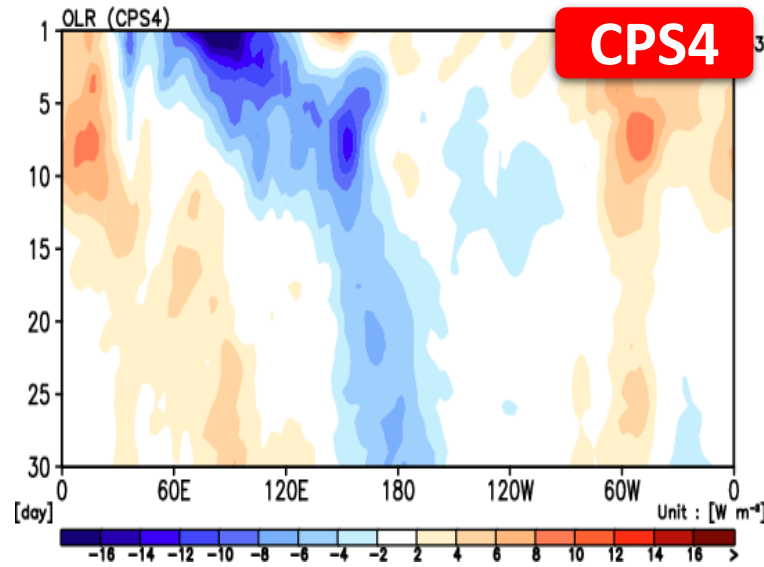
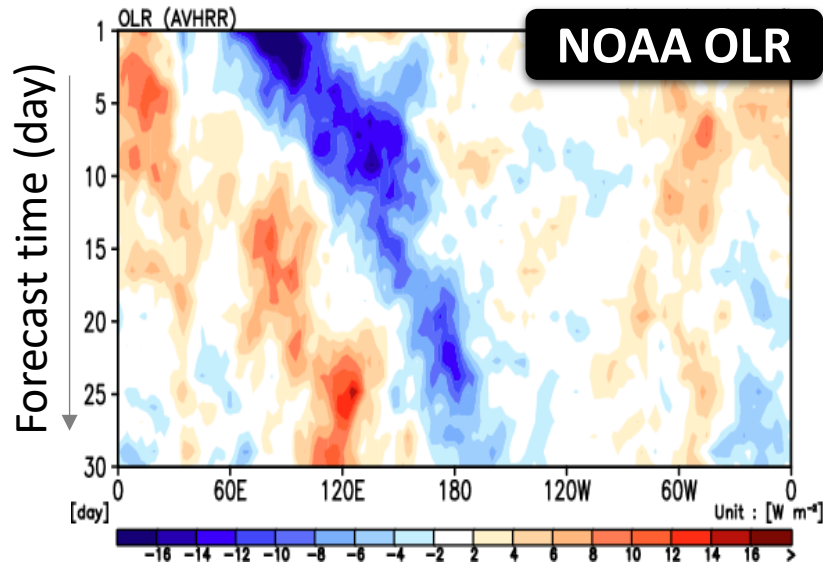


Performance of CPS4 for MJO



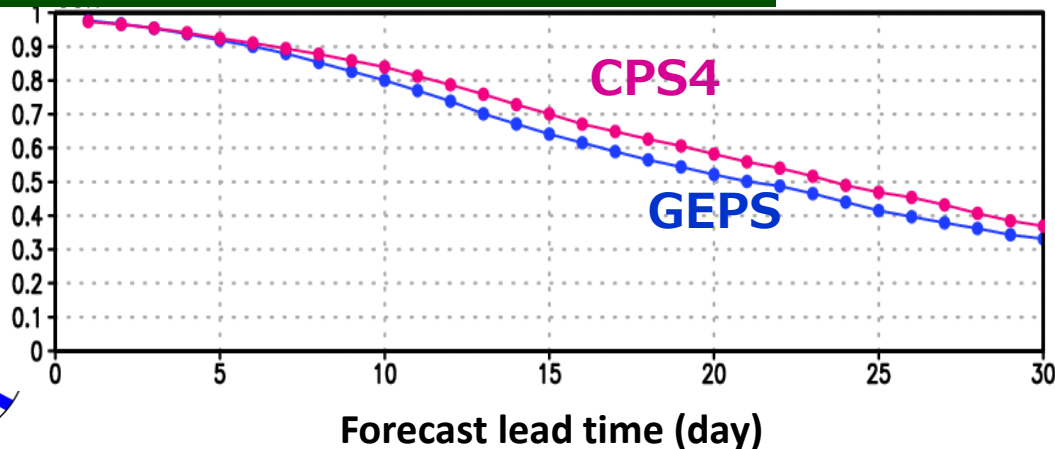
Longitude-time composite for OLR anomalies

Initial phase: convectively active phase of MJO I
n the Indian Ocean | Period: Nov.-Apr. 1991-2020



Bivariate Correlation Coefficient

Initial: all months, 1991-2020



- Higher MJO prediction skill in CPS4 than in GEPS, especially at longer lead times.
- Clearer eastward propagation of large-amplitude MJO in CPS4.



New regional ocean reanalysis over 60 years (FORA-JPN60)



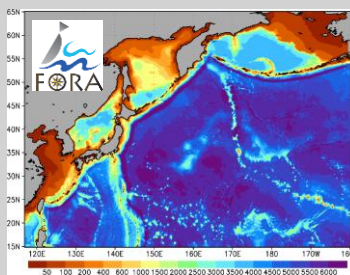
- Variability in the Western North Pacific
 - **Western boundary currents** (Kuroshio/Oyashio/etc)
 - **Mesoscale eddies**
 - Require the resolution smaller than 0.1 degree (**eddy-resolving**)



- **FORA-WNP30** (Usui et al., 2017)

- Resolution: 0.1x0.1deg ~ **10km**
- Region: western North Pacific
- Period: **1982-2016**
- Assimilation: **4D-Var**

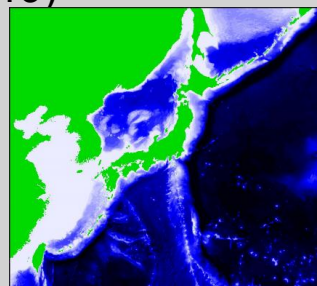
Low resolution & long-term period



- **MOVE/MRI.COM-JPN** (Hirose et al., 2019)

- Resolution: 1/33x1/50deg ~ **2km**
- Region: around Japan
- Period: **2008-2019**
- Assimilation: **4D-Var + IAU**

High resolution & short-term period



New regional ocean reanalysis (FORA-JPN60) will be an update version of the previous ocean reanalysis in the WNP based on MRI/JMA system.

- **FORA-JPN60** (Usui et al., 2026, in revision)

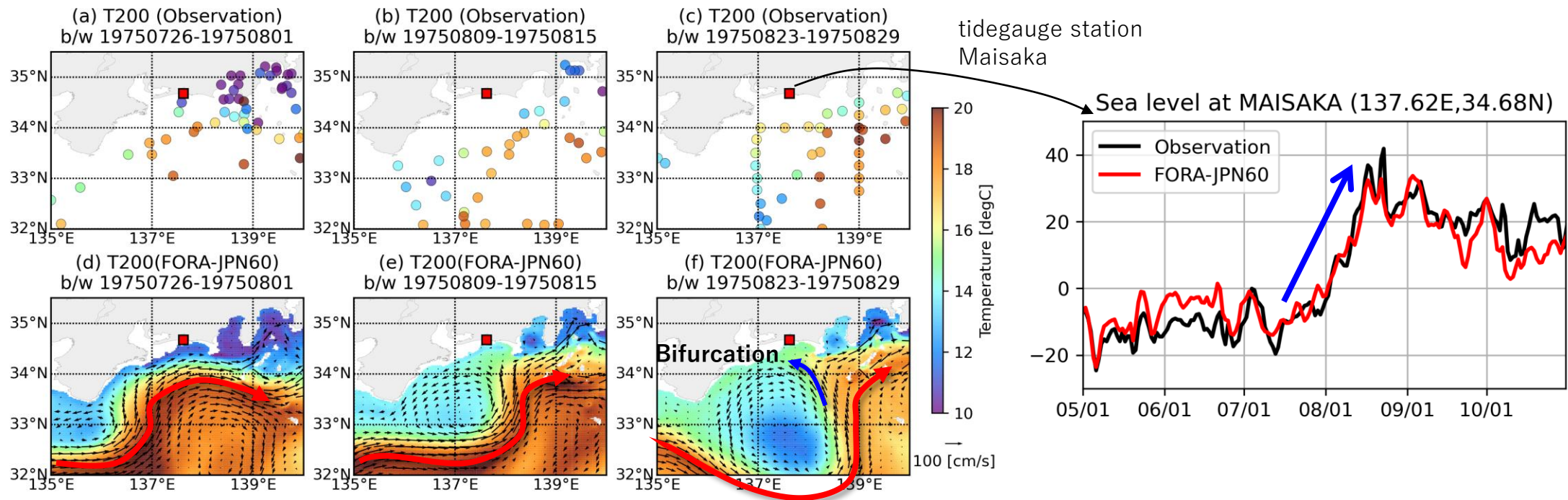
- Resolution: 1/33x1/50deg ~ **2km**
 - Region: Around Japan
 - Period: **1960-2020**
 - Assimilation: **4D-Var + IAU**
- High resolution & long-term period**



Increase in coastal sea level associated with Kuroshio meander



- Kuroshio Large Meander (KLM) started Aug 1975
- In-situ observations are sparse to depict the Kuroshio axis in detail
- FORA-JPN60 could reproduce the KLM and represent the coastal sea level increase that occurs when the current with warm water bifurcates westward from its main axis.



- **Global System**

- JMA/MRI-CPS4 (**CPS4**) was introduced into operation on 22 January 2026. CPS4 outperforms CPS3, including exhibiting reduced biases over the Asia–Pacific region.
- Sub-seasonal prediction, such as one-month forecast, has been produced by CPS4 as well.

- **Regional System**

- High-resolution regional ocean reanalysis around Japan over 60 years (**FORA-JPN60**) is expected to be released soon.
- FORA-JPN60 was able to reproduce the Kuroshio Large Meander started August 1975 and the associated increase in coastal sea levels.



Thank you!



- **Four-dimensional Ocean ReAnalysis for the seas around Japan over 60 years**

- ❑ Ocean system: MOVE-JPN
 - Current operational ocean system in JMA
- ❑ Ocean model: MRI.COMv5.0 (Sakamoto et al., 2023)
 - Model domain: 117-160E, 20-52N
 - Resolution: 2km (1/33 x 1/50)
- ❑ Assimilation: 4D-Var + IAU
 - MOVE-4DVAR (Usui et al., 2015)
 - IAU: Incremental Analysis Updates (Bloom et al., 1996)
- ❑ Forcing
 - Atmospheric: JRA-3Q (Kosaka et al., 2024)
 - River discharge: JMA River index (Urakawa et al., 2016) + CaMaFlood + JRA-55 (Suzuki et al., 2018)
- ❑ Observation
 - In-situ profiles: XBT, CTD, PFL, etc from 1960 to 2020
 - SST: MGDSST from 1982 to 2020 (Kurihara et al., 2006)
 - SSH: along-track SLA from 1993 to 2020
 - Sea ice: JMA's manual analysis from 1982 to 2020 (Nudging)
- ❑ Period: 1960-2020

