Developing the next-generation operational global ocean data assimilation system at JMA

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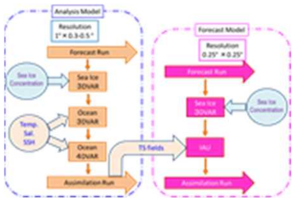
1. Introduction



- Global Ocean 4DVAR System for seasonal forecasting in JMA
  - JMA are currently developing an global ocean 4DVAR system for the next generation of the seasonal forecasting system in JMA. A sea-ice 3DVAR scheme is also applied.
- Evaluation of the impact of the 4DVAR and increased resolution
  - The 4DVAR scheme improves SST fields. It constrains the nonlinear model trajectory to observation data more tightly.
  - Dynamical downscaling is expect to conserve fine structures resolved by higher resolution model.
  - The impact of sea ice assimilation is also evaluated.
- Re-forecast using coupled model
  - Atmospheric model is updated as well.

2. System Configuration

	MOVE-G2 (current system)	MOVE-G3A	MOVE-G3F
Resolution	1.0°(lon) x 0.3-0.5°(lat)	1.0°(lon) x 0.3-0.5°(lat)	0.25°(lon) x 0.25°(lat)
TS Analysis	IAU-3DVAR-FGAT	IAU-4DVAR	insert G3A TS fields with IAU (dynamical downscaling)
Assimilated SST	COBE-SST	MGDSST	
Sea Ice	Not assimilated	3DVAR	3DVAR
Assimilation window	10days	10days	10days

4. Re-forecast using Coupled Prediction System

	CPS2 (current system)	CPS3
Ocean Model	Same as MOVE-G2	Same as MOVE-G3F
Atmos. Model	TL159L60 (~110km, up to 0.1hPa)	TL319L100 (~55km, up to 0.01hPa)

- Target period: Jun.- Jul.- Aug. (Initial date: 11 Apr and 26 Apr)
- Re-forecast period: from 1991 to 2014

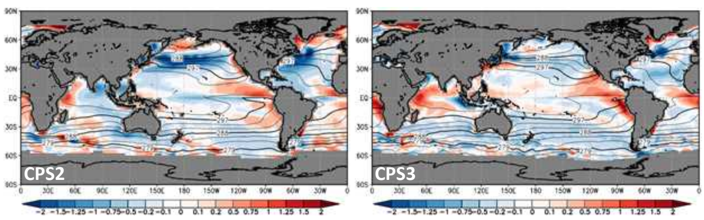


Fig.5 SST biases (color) and model climatology (contour) for boreal summer predictions started from May in CPS2(left) and CPS3(right).

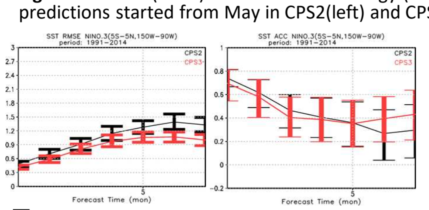


Fig.6 RMSE(left) and ACC (right) of monthly area SSTs in the NINO.3 (5S-5N, 150W-90W) region. The red and black line indicates CPS3 and CPS2 respectively. The bars indicate the 95% confidence intervals.

- ☐ Cold biases seen in the eastern equatorial Pacific are improved.
- ☐ Forecasting skill for NINO3 SST is increased.

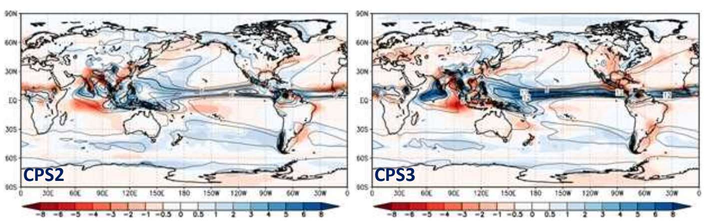


Fig.7 Precipitation biases (color) and model climatology (contour) for boreal summer predictions started from May in CPS2(left) and CPS3(right).

- ☐ Increased positive biases seen in ITCZ and the western equatorial Pacific should be improved.

3. Long-term Analysis

- Atmospheric forcing: JRA-55 for MOVE-G2, JRA-55do for MOVE-G3A/F
- Assimilation period: 1991-2014

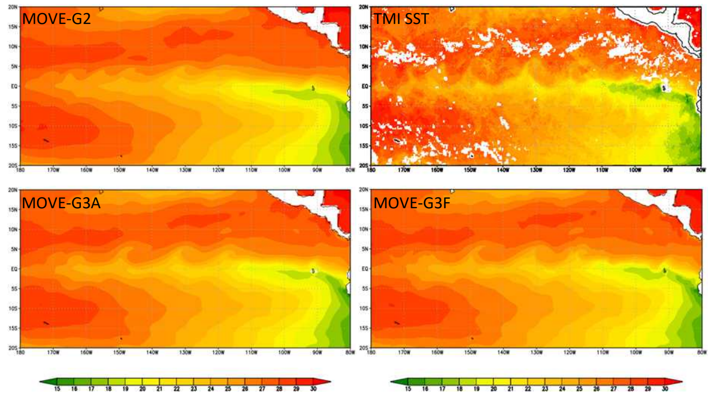


Fig.1 Snapshot of SST fields at 07 Sep. 2010 from MOVE-G2 (top left), TRMM/TMI (top right: 3-days composite), MOVE-G3A (bottom left) and MOVE-G3F (bottom right).

- ☐ Compared to MOVE-G2, MOVE-G3A captures SST variation associated with TIWs. In MOVE-G3F, it is reasonably represented as well.

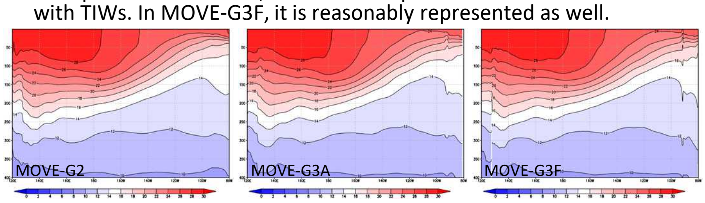


Fig.2 Monthly mean temperature cross section along the Equator in January from the result of MOVE-G2 (left), MOVE-G3A (middle) and MOVE-G3F (right).

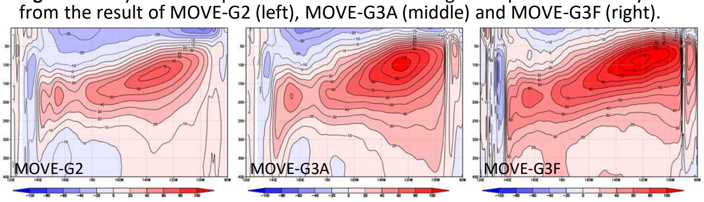


Fig.3 Monthly mean cross section of zonal velocity along the Equator in January from the result of MOVE-G2 (left), MOVE-G3A (middle) and MOVE-G3F (right).

- ☐ While the strength of EUC is improved in MOVE-G3A, EUC reaches to sea surface in MOVE-G3F.

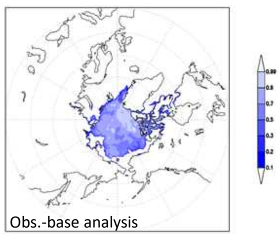


Fig.4 Monthly mean field of Sea ice concentration in August 2010 from the result of MOVE-G2 (top left), MOVE-G3A (top middle), MOVE-G3F (top right) and observation (SSM/I(S)) based analysis (bottom) .

- ☐ Assimilating sea ice concentration has a positive impact for analyzed sea ice field.

5. Summary

- Evaluation of the impact of the 4DVAR and increased resolution
  - The 4DVAR scheme captures SST variation associated with TIWs. Fine resolution model also represents the variation.
  - While the 4DVAR scheme also improves velocity field in the equatorial Pacific, EUC reaches to sea surface in the fine resolution model due to weak SEC.
- Re-forecast using coupled model
  - Although SST cold bias in the equatorial Pacific is improved, positive bias in precipitation should be improved.

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