




Performance of JMA's Seasonal Ensemble Prediction Model for Recent Events



Takashi Yamada

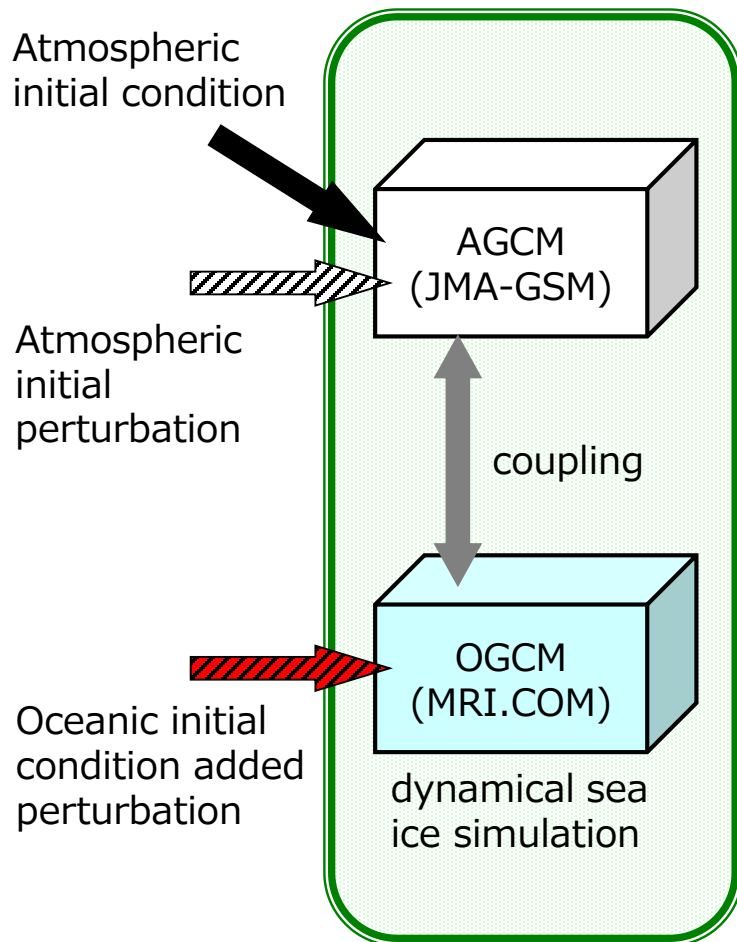
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Japan Meteorological Agency*

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Specification of JMA's Seasonal EPS

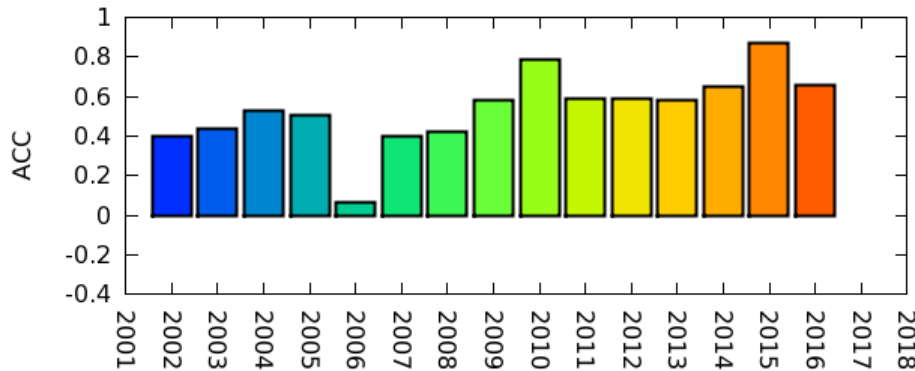
JMA/MRI-CPS2



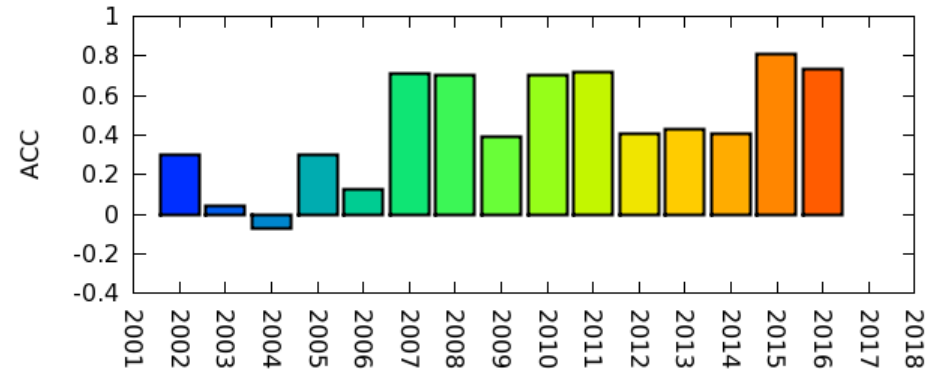
Model	Coupled Ocean-Atmospheric General Circulation Model (CGCM) including interactive dynamical sea ice model
Upgrade	Last: June 2015 Frequently: Every Half Decade
Atmosphere Resolution	Horizontal: 110km (TL159) Vertical: 60 levels up to 0.1hPa
Ocean Resolution	Horizontal: 1.0 Lon x 0.3-0.5 Lat Vertical: 52 Levels + BBL With Tri-polar Grid (Global Ocean Domain)
Forecast range	Up to 4-7 months
Initial Condition	Atmosphere, Land: JRA-55 Ocean: MOVE/MRI.COM-G2
Green House Gases	CO2, CH4, N2O, CHC-11, CHF-12, HCFC-22 (RCP4.5 scenario)
Ensemble method	Breeding of Growing Mode (BGM) Lagged Average Forecasting (LAF) Stochastic Physics Scheme
Ensemble size	51 (13 BGMs × 4 initial days LAF of 5-day interval - 1 member)
Freq. of model product creation	Once a month (Around 20 th of every month)
Hindcast Period	1979 - 2014

Prediction Scores for Boreal Winter in Tropics

chi200, TR, ACC, R90K1, DJF



psi200, TR, ACC, R90K1, DJF

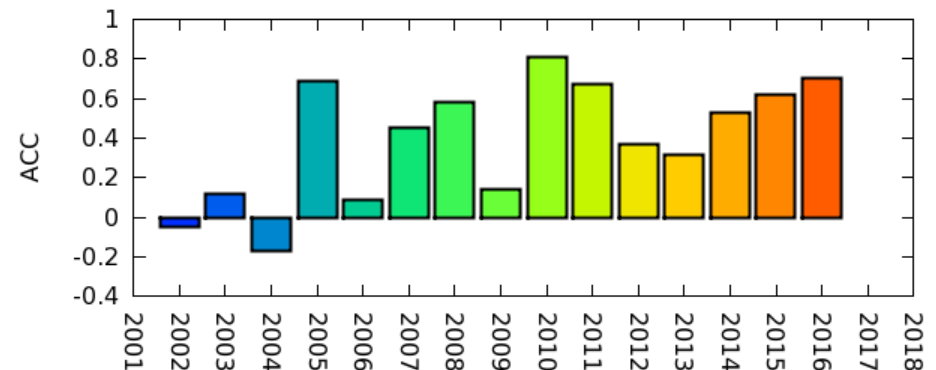


Current model started to be in operation in 2015.

Coupled model started to be in operation in 2010.

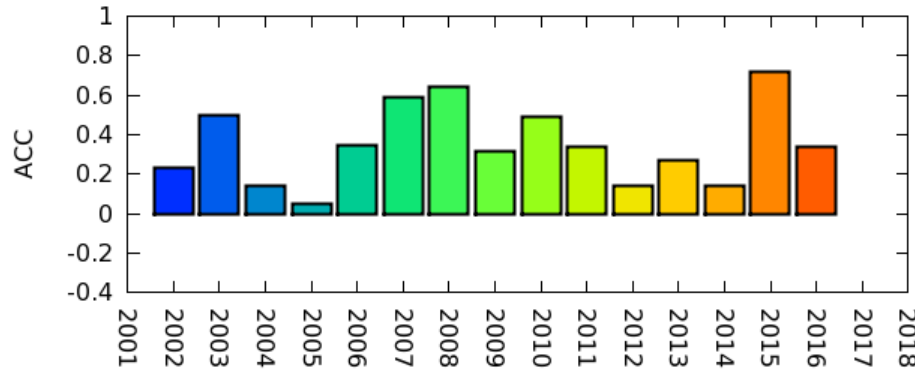
- Stable upward trends can be seen, reflecting the model improvement.
- Two peaks of 2010 and 2015 can be seen, reflecting the temporary increase of predictability in association with major ENSO events.

psi850, TR, ACC, R90K1, DJF

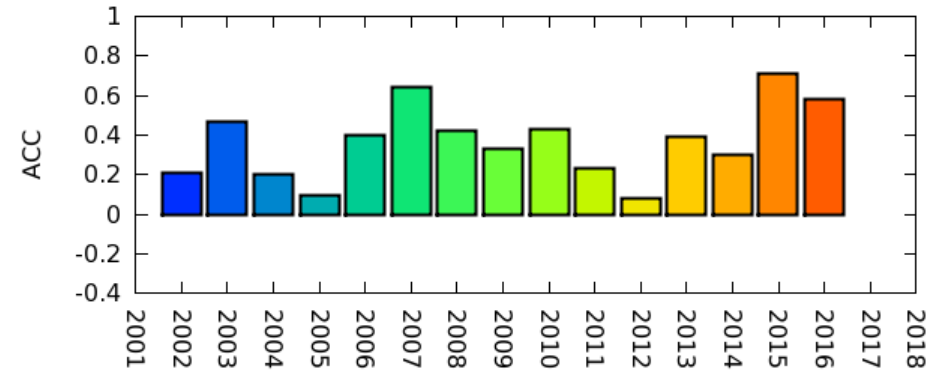


Prediction Scores for Boreal Winter in Northern Hemisphere

Z500, NH, ACC, R90K1, DJF



T850, NH, ACC, R90K1, DJF

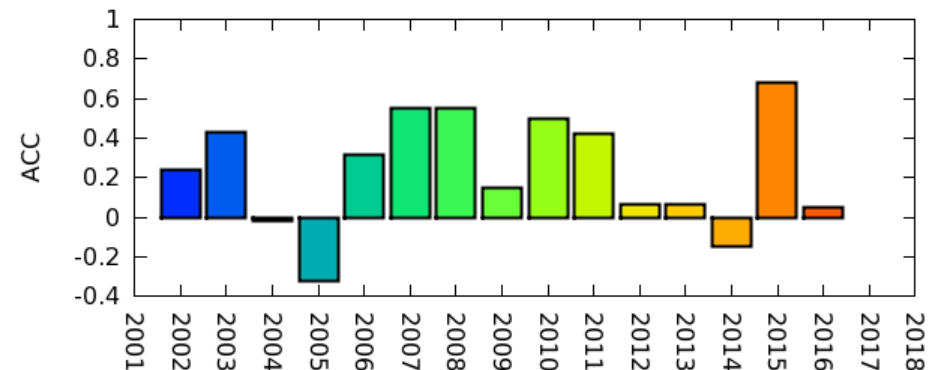


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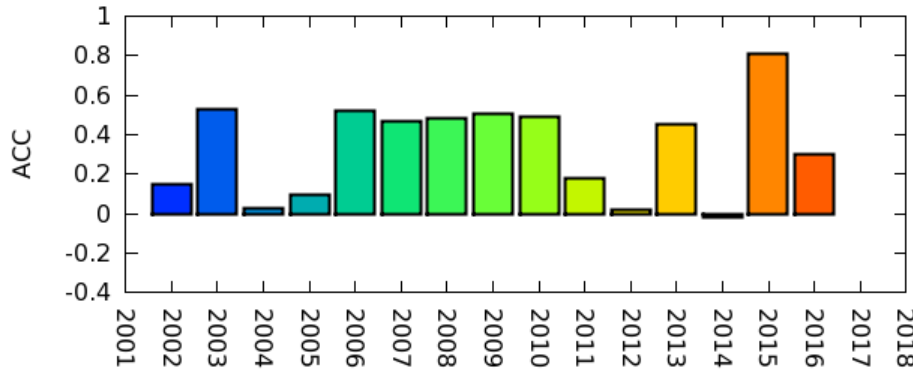
- Unlike tropics, upward trends are unclear, indicating the difficulty of model improvement.
- The Score in 2015 recorded the highest, reflecting both a large amplitude ENSO event and a model improvement.
- The peak in 2010 was not seen, unlike tropics.

PSEA, NH, ACC, R90K1, DJF

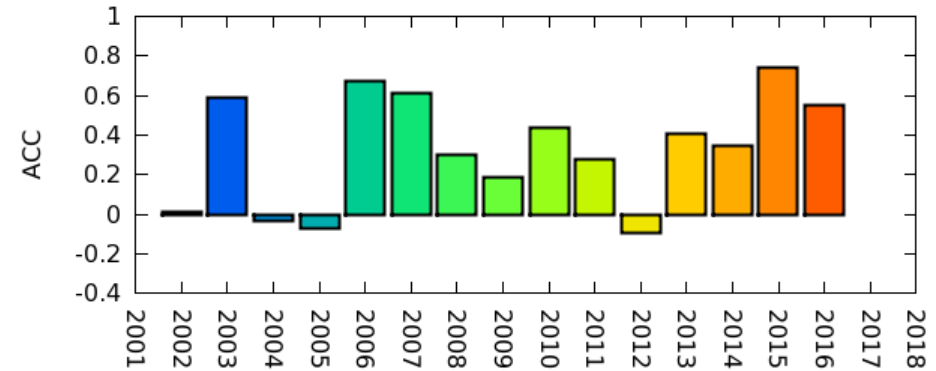


Prediction Scores for Boreal Winter in Eurasia

Z500, EU, ACC, R90K1, DJF



T850, EU, ACC, R90K1, DJF

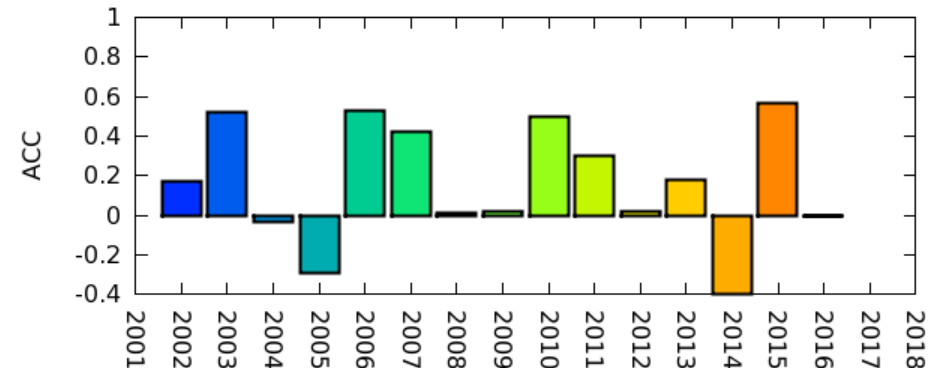


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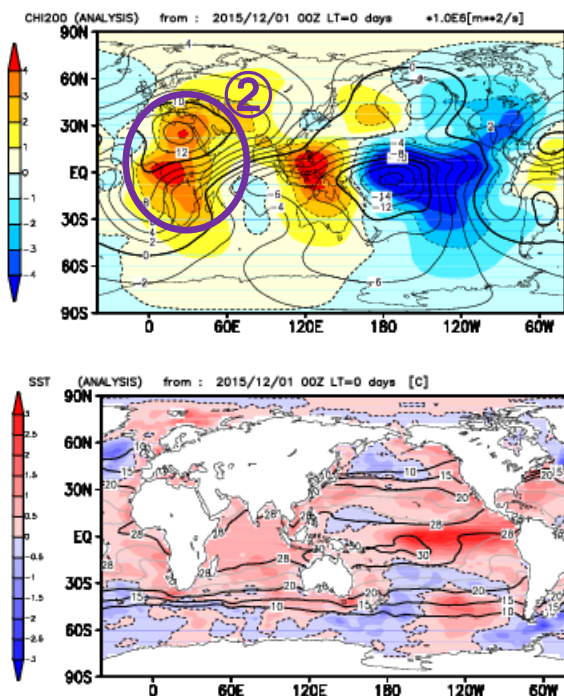
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PSEA, EU, ACC, R90K1, DJF

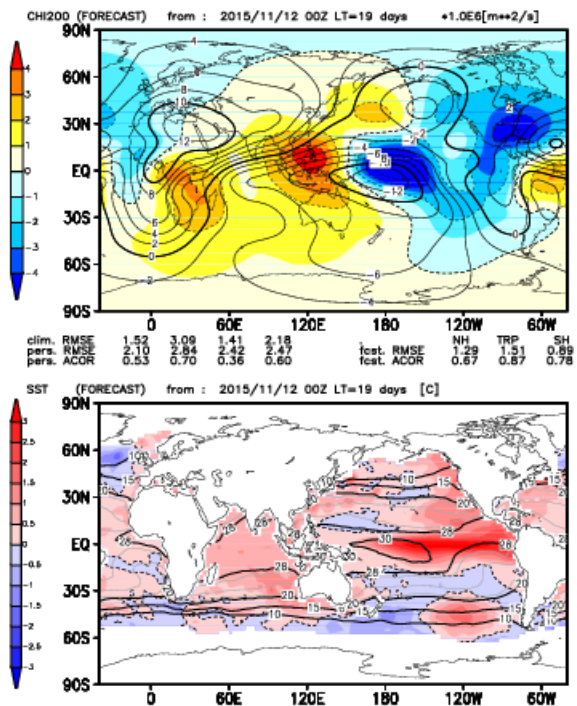


Comparison between Analysis and Forecast for Boreal Winter 2015/2016

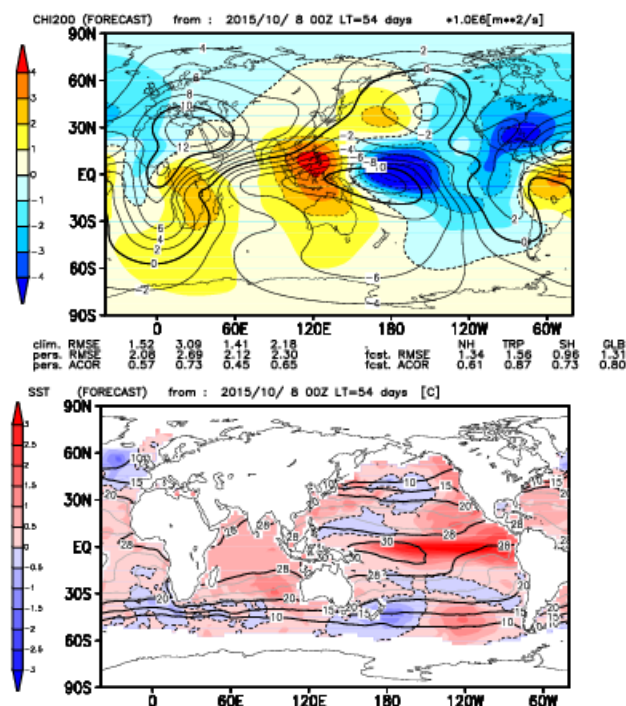
JRA-55 and SST Analysis



November Initial Forecast



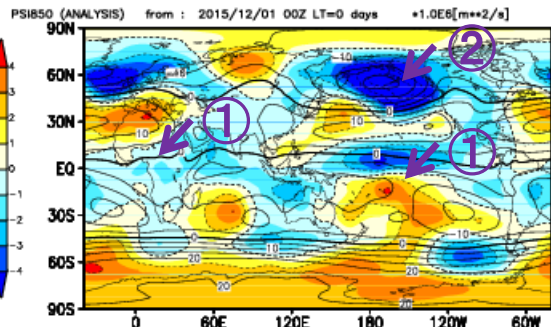
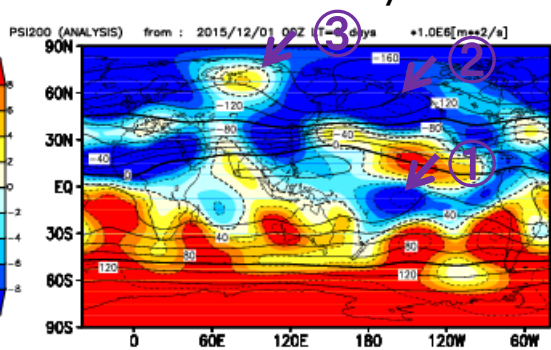
October Initial Forecast



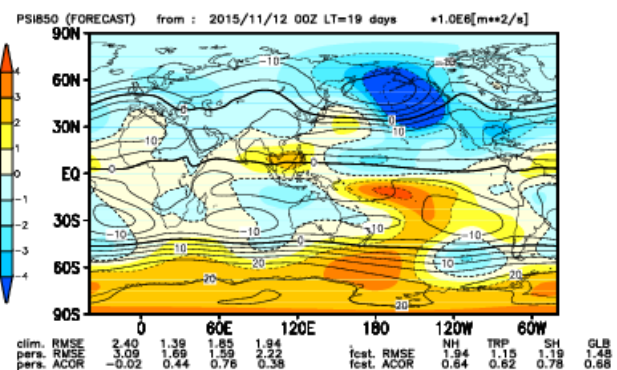
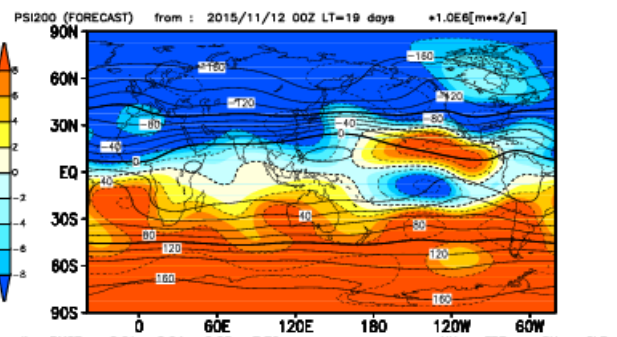
- ① Velocity Potential and SSTs were almost perfectly predicted over tropics.
- ② However, divergent anomalies over Middle East were not predicted and divergent anomalies over the western Indian Ocean were weaker than analysis.

Comparison between Analysis and Forecast for Boreal Winter 2015/2016

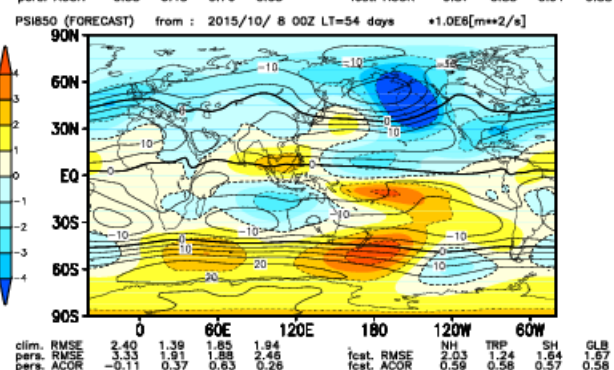
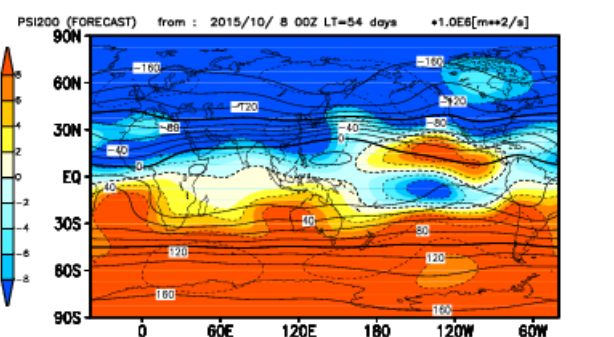
JRA-55 Analysis



November Initial Forecast



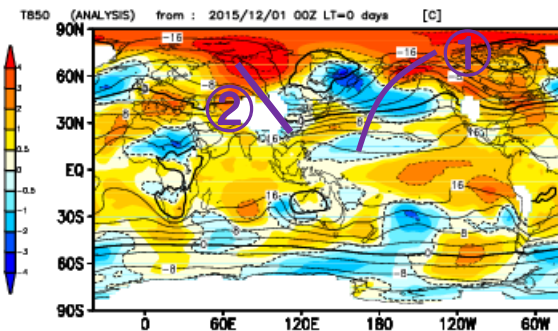
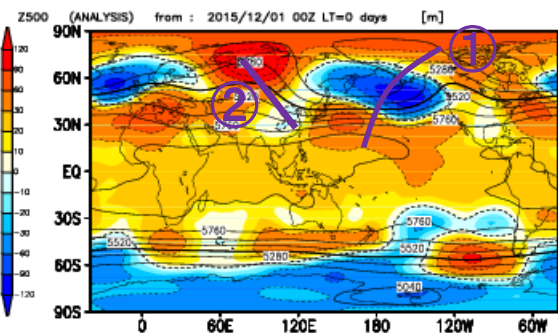
October Initial Forecast



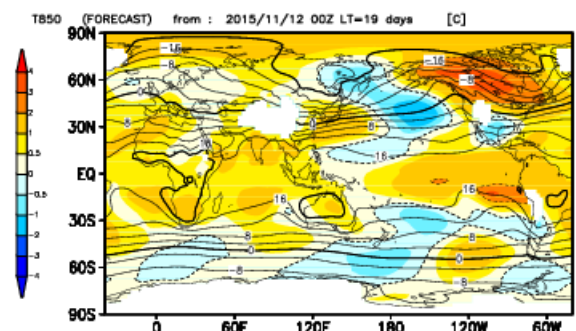
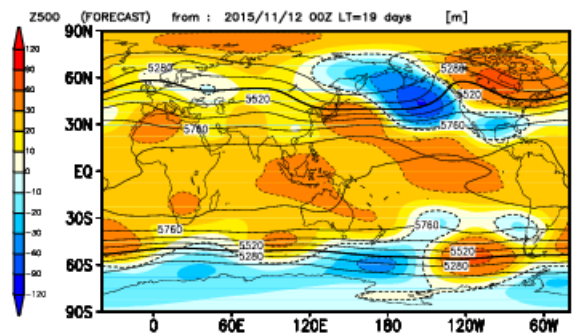
- ① Rossby responses over the Pacific were well predicted, while that over the western Indian Ocean were weaker than analysis in association with the errors of velocity potential.
- ② Aleutian Low anomalies were well predicted in association with PNA teleconnection.
- ③ Anticyclonic anomalies over East Siberia were not predicted.

Comparison between Analysis and Forecast for Boreal Winter 2015/2016

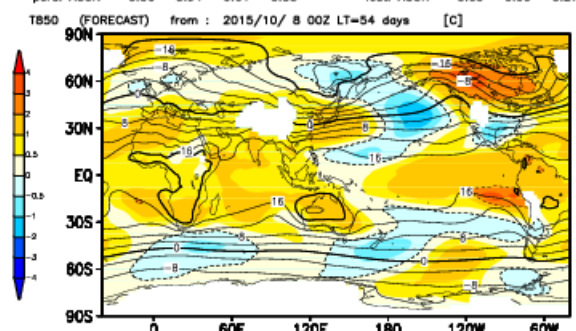
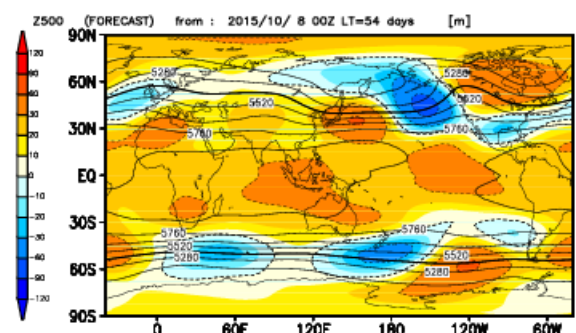
JRA-55 Analysis



November Initial Forecast



October Initial Forecast



- ① Positive PNA and negative TNH teleconnection were well predicted.
- ② However, colder condition over the eastern part of East Asia were not predicted significantly, because a positive EU teleconnection was not predicted.

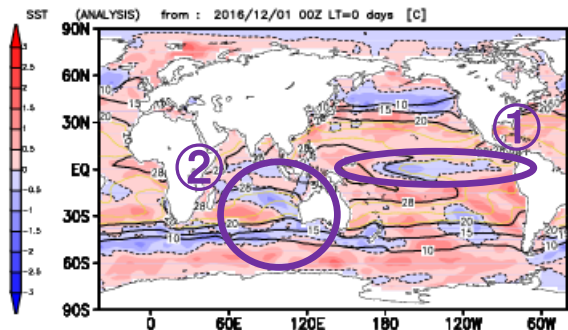
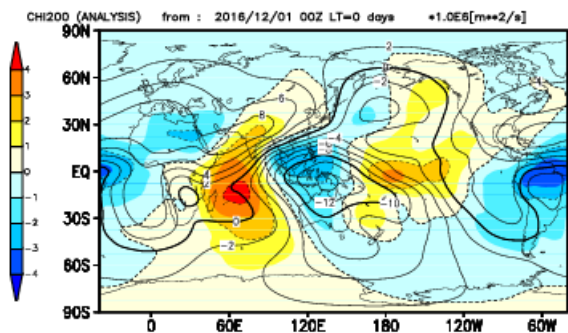
Summary for Boreal Winter 2015/2016

- Most of scores in 2015 recorded the highest reflecting both a large amplitude ENSO event and a model improvement.
- Velocity Potential and SSTs were almost perfectly predicted over tropics. However, divergent anomalies over Middle East were not predicted and divergent anomalies over the western Indian Ocean were weaker than analysis.
- Rossby responses over the Pacific were well predicted, while that over the western Indian Ocean were weaker than analysis in association with the errors of velocity potential.
- Positive PNA and negative TNH teleconnection were well predicted. Aleutian Low anomalies were also well predicted in association with PNA teleconnection.
- However, colder condition over the eastern part of East Asia were not predicted significantly, because a positive EU teleconnection was not predicted.

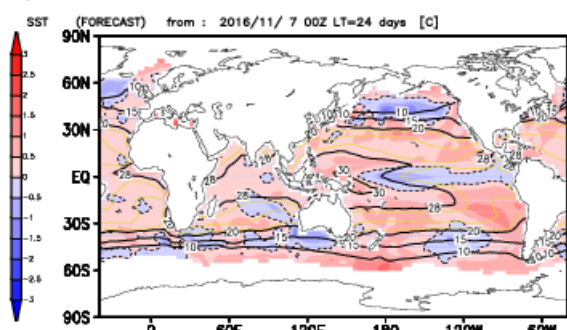
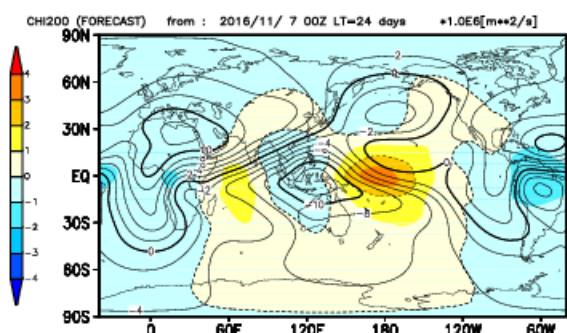
Although most of scores recorded the highest, colder conditions over the eastern part of East Asia were not predicted significantly due to failure to predict EU teleconnection and domination of influence from high latitudes.
How to improve the forecast skill of teleconnection over Eurasia is a future subject.

Comparison between Analysis and Forecast for Boreal Winter 2016/2017

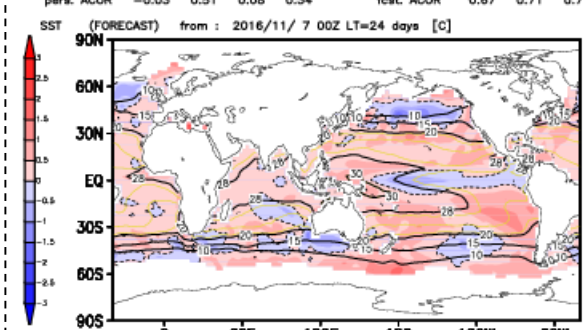
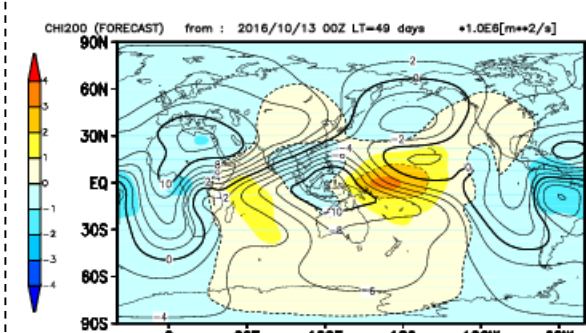
JRA-55 Analysis



November Initial Forecast



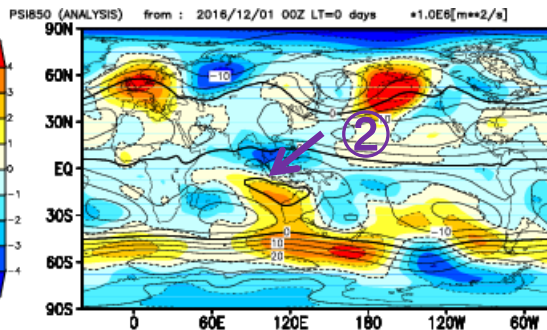
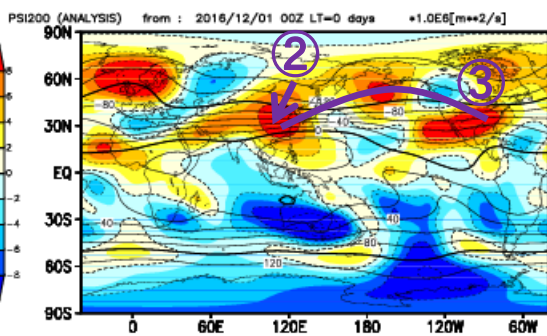
October Initial Forecast



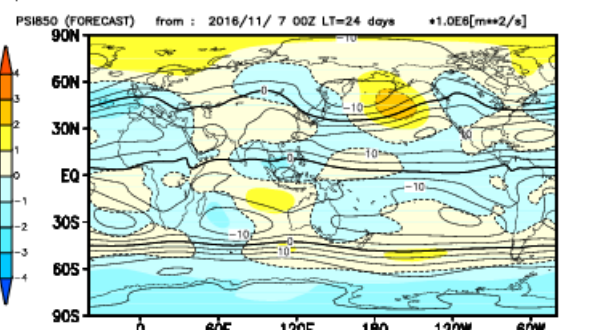
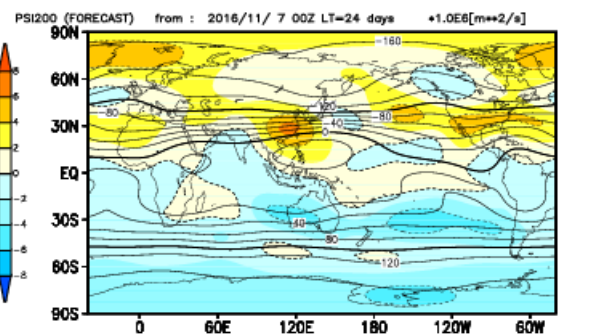
- ① SST anomalies over the equatorial Pacific were colder than analysis indicating an overestimation of La niña conditions.
- ② SSTs in the Indian Ocean were warmer than analysis.
- ③ The wave number 2 pattern of velocity potential was well predicted, but the amplitudes were weaker than analysis except in the equatorial Pacific.

Comparison between Analysis and Forecast for Boreal Winter 2016/2017

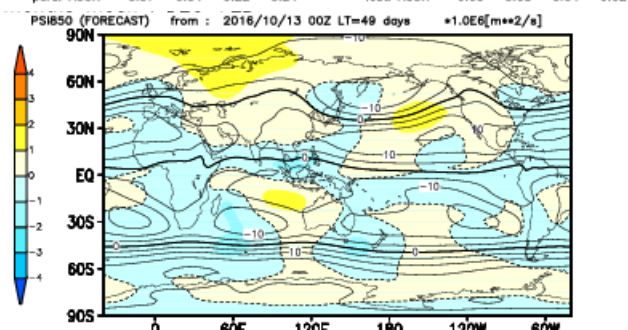
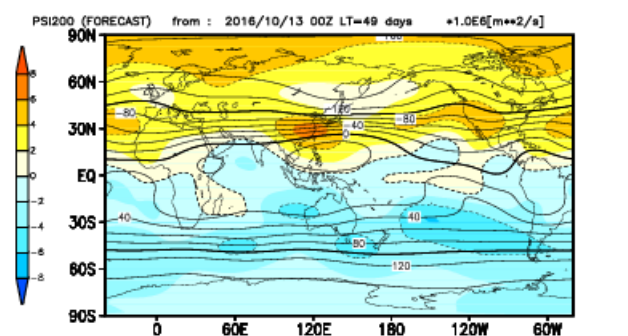
JRA-55 Analysis



November Initial Forecast



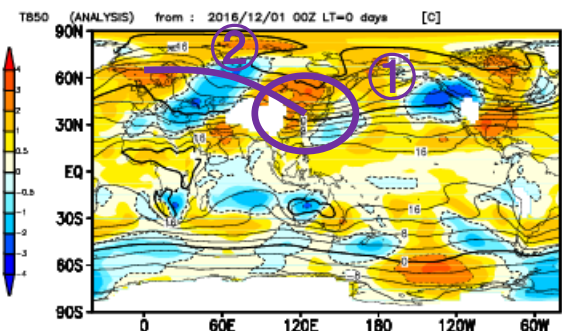
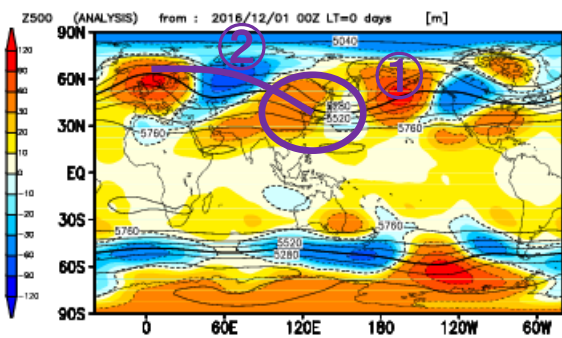
October Initial Forecast



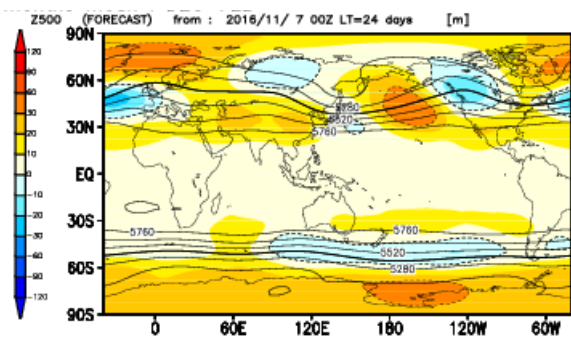
- ① Stream function anomalies were globally weak in association with weak signals in tropics.
- ② However, anticyclonic anomalies at 200hPa over East Asia and equatorial symmetric cyclonic anomalies at 850hPa over the Indochina Peninsula were well predicted in association with active convection over the Maritime Continent.
- ③ A wave train along a subtropical jet stream over the North Pacific was also well predicted.

Comparison between Analysis and Forecast for Boreal Winter 2016/2017

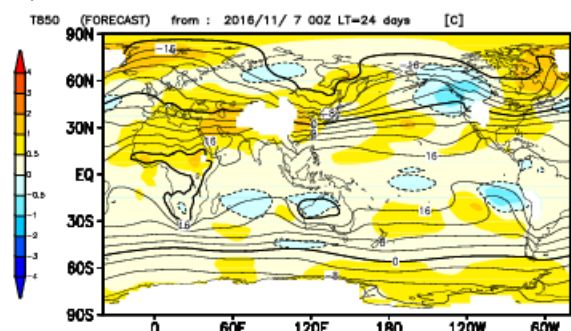
JRA-55 Analysis



November Initial Forecast

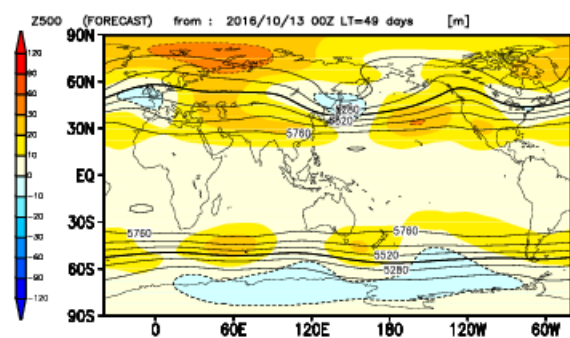


clim. RMSE	32.88	10.50	27.32	25.51	fcst. RMSE	NH	TRP	SH	GLB
pers. RMSE	43.97	5.02	34.08	32.49	fcst. ACOR	0.52	0.94	0.55	0.56
pers. ACOR	0.18	0.90	0.15	0.21					

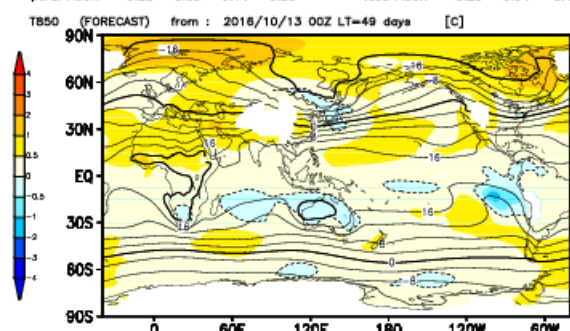


clim. RMSE	1.31	0.64	0.89	0.97	fcst. RMSE	NH	TRP	SH	GLB
pers. RMSE	1.45	0.52	1.19	1.13	fcst. ACOR	0.60	0.79	0.49	0.60
pers. ACOR	0.41	0.55	0.22	0.38					

October Initial Forecast



clim. RMSE	32.88	10.50	27.32	25.51	fcst. RMSE	NH	TRP	SH	GLB
pers. RMSE	38.59	3.05	35.30	30.56	fcst. ACOR	0.25	0.94	-0.12	0.18
pers. ACOR	0.28	0.89	0.14	0.26					



clim. RMSE	1.31	0.64	0.89	0.97	fcst. RMSE	NH	TRP	SH	GLB
pers. RMSE	1.40	0.64	1.14	1.10	fcst. ACOR	0.43	0.78	0.28	0.44
pers. ACOR	0.39	0.50	0.24	0.36					

- ① Although signals were weak, warmer condition over the eastern part of East Asia and colder condition over the sea south of Japan were well predicted on November initial. But, those were not predicted on October initial.
- ② However, the negative EU teleconnection was not predicted.

Summary for Boreal Winter 2016/2017

- SST anomalies over the equatorial Pacific were colder than analysis indicating an overestimation of La niña conditions. SSTs in the Indian Ocean were warmer than analysis.
- The wave number 2 pattern of velocity potential was well predicted, but the amplitudes were weaker than analysis except in the equatorial Pacific.
- Stream function anomalies were globally weak in association with weak signals in tropics. However, anticyclonic anomalies at 200hPa over East Asia and equatorial symmetric cyclonic anomalies at 850hPa over the Indochina Peninsula were well predicted in association with active convection over the Maritime Continent.
- A wave train along a subtropical jet stream over the North Pacific was also well predicted.
- Although signals were weak, warmer condition over the eastern part of East Asia and colder condition over the sea south of Japan were well predicted on November initial. But, those were not predicted on October initial.
- Negative EU teleconnection was not predicted.

Although forecasted signals were weak, warmer condition over the eastern part of East Asia and colder condition over the sea south of Japan were well predicted, because the influence from high latitudes was little and that from tropics was dominant. However, how to improve the forecast skill of teleconnection over Eurasia is a future subject.

Summary

- Regarding scores in tropics, upward trends can be seen reflecting improvement of the model.
- Regarding scores in mid and high latitude, upward trends is unclear reflecting the difficulty of the model improvement.
- Although scores in winter 2015/2016 and 2016/2017 was historically high and velocity potential and stream functions in tropics are well predicted, EU teleconnection in mid and high latitude were not predicted in both cases.
- Especially, it is a problem that colder condition over the eastern part of East Asia was not predicted in 2015/2016 because influence from high latitude is more dominant than that from tropics.
- Therefore, we consider how to improve the forecast skill of teleconnection over Eurasia is a future subject.