

Extratropical response to sub-seasonal tropical forcing during the 2015-16 El Niño

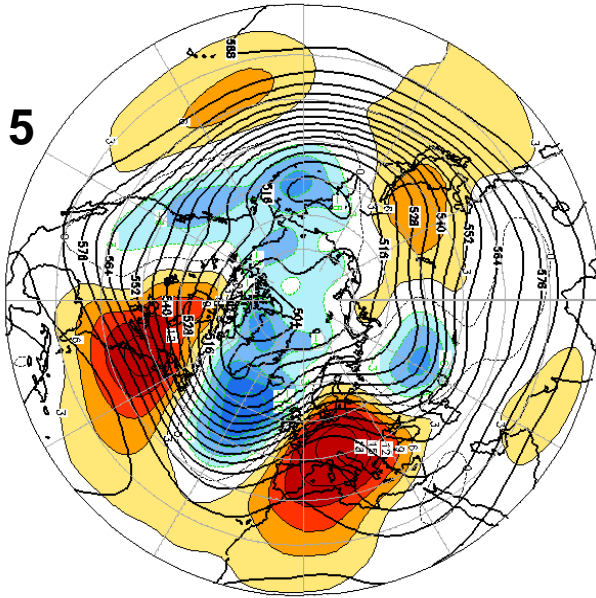
**Laura Ferranti
Franco Molteni**

*With thanks to Roberto Buizza, Linus Magnusson and
Frederic Vitart*

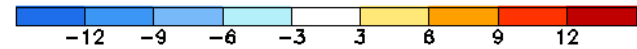
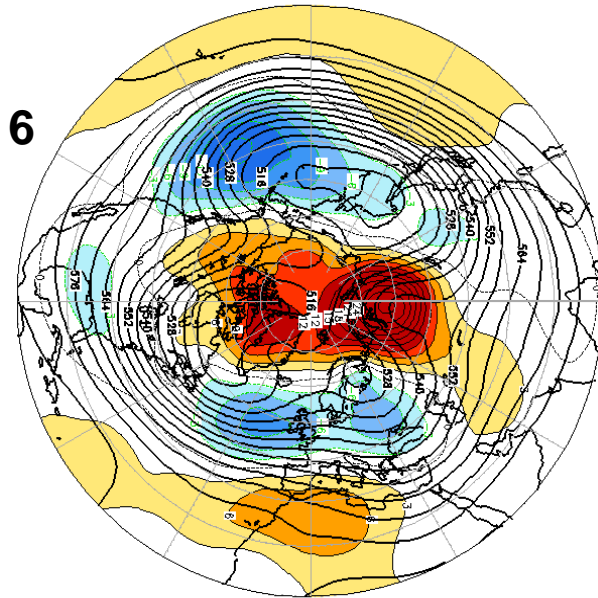
Outline

- Observed sub-seasonal variability in Euro-Atlantic and Indo-Pacific circulation during winter 2015-16
- Teleconnections between Indo-Pacific rainfall and N.Hem. circulation from analysis and ECMWF System-4 seasonal ensembles for DJF
- Sub-seasonal variability in tropical rainfall and teleconnections from selected ensemble members of the operational ECMWF seasonal forecast for winter 2015-16
- Predictability on month 1 and 2 time scale, and the impact of systematic model errors in System 4

Dec 2015

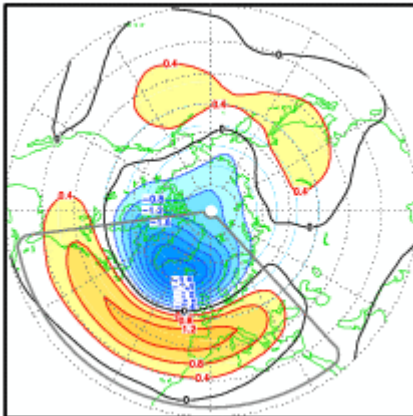


Jan 2016

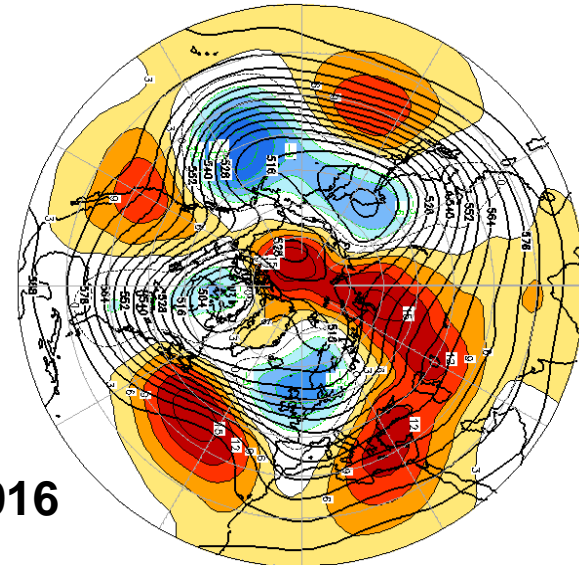


Z 500 hPa height and anomaly
from NOAA Climate Diagnostics Bulletin

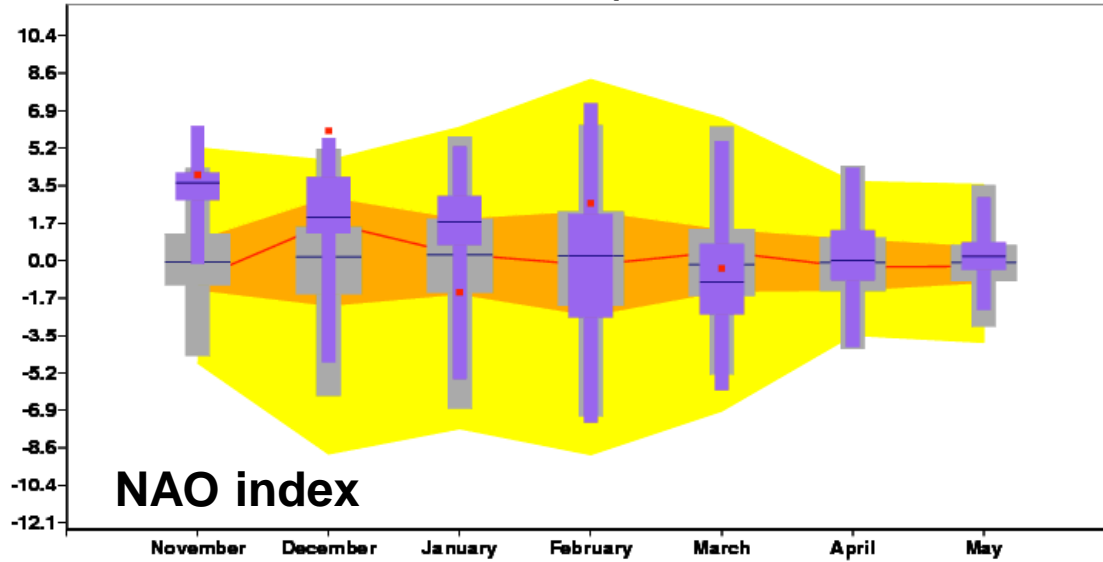
eof 1: North Atlantic Oscillation (NAO)



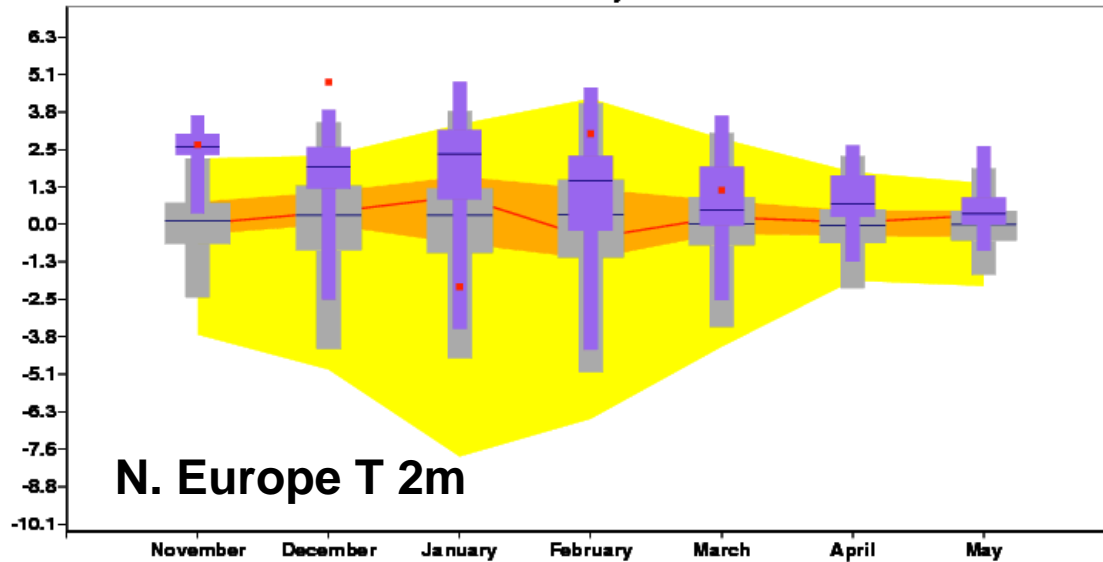
Feb 2016



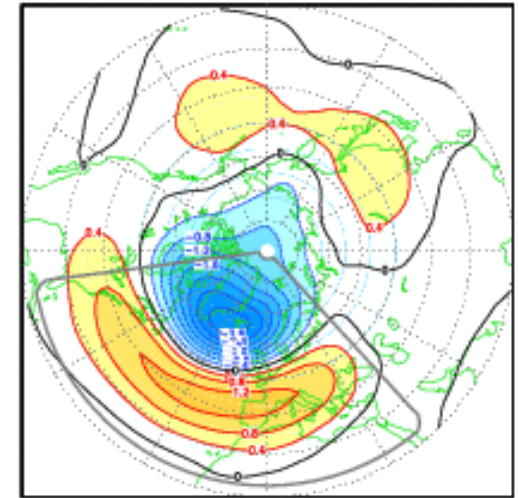
North Atlantic Oscillation
 Forecast initial date: 20151101
 Ensemble size: Forecast=51 Model climate=450 Analysis climate=30



2m temp. anomalies (K) latitude= 65.0 to 50.0 longitude= -10.0 to 30.0
 Forecast initial date: 20151101
 Ensemble size: Forecast=51 Model climate=450 Analysis climate=30

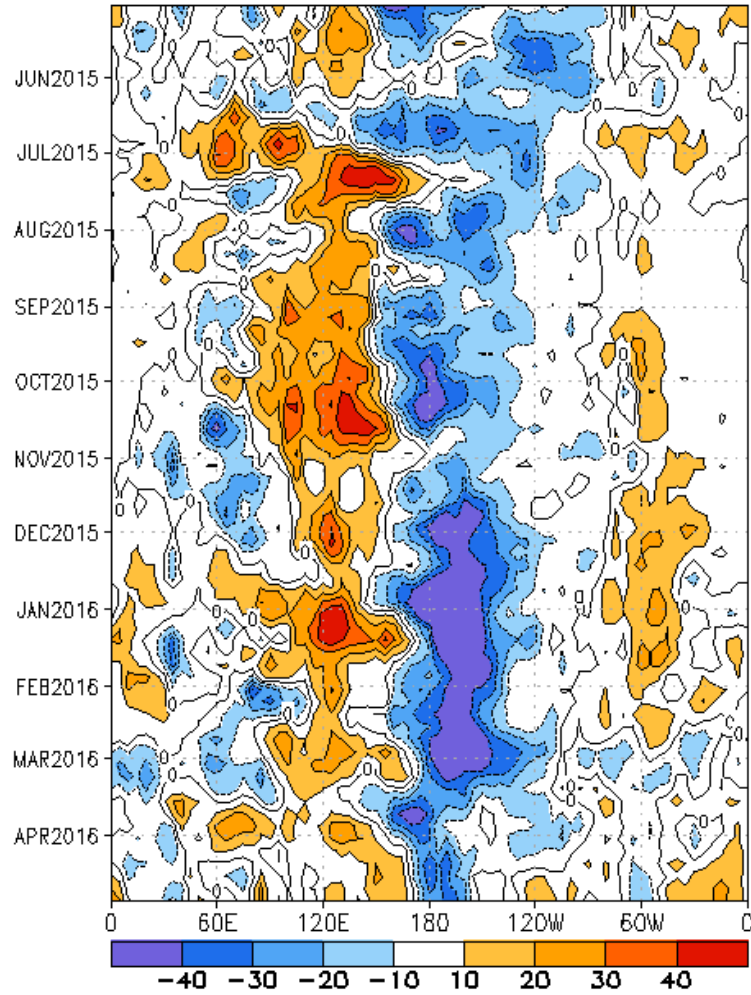


eof 1: North Atlantic Oscillation (NAO)



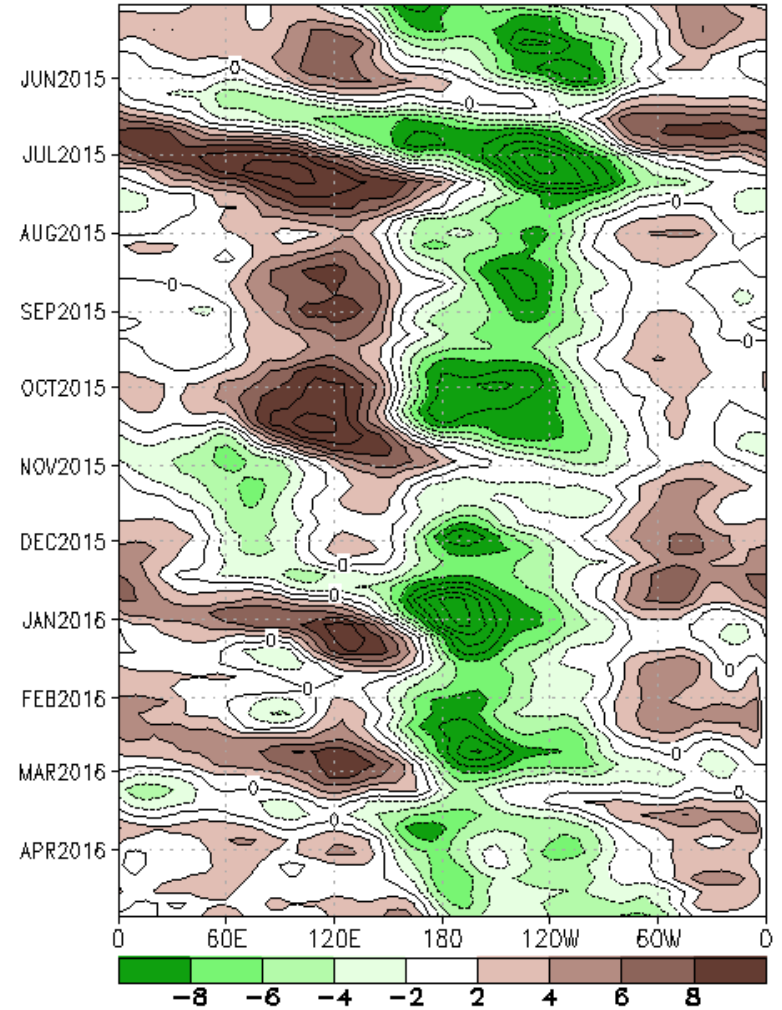
Climagrams
 System-4
 ensemble fc.
 from 1 Nov. 2015

Outgoing Longwave Radiation Anomaly (W/m²)



Data updated through April 2016

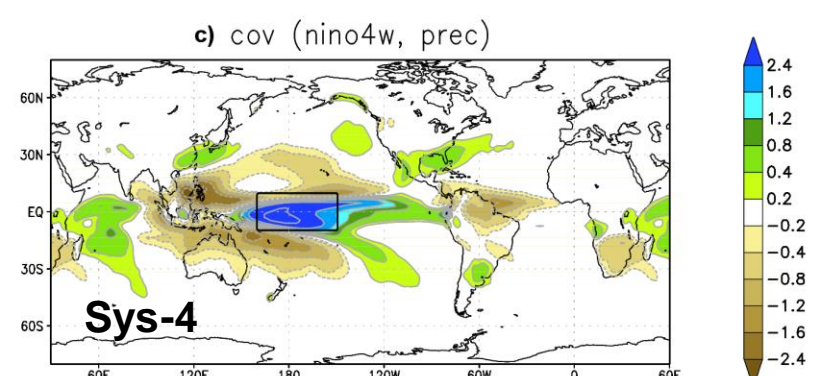
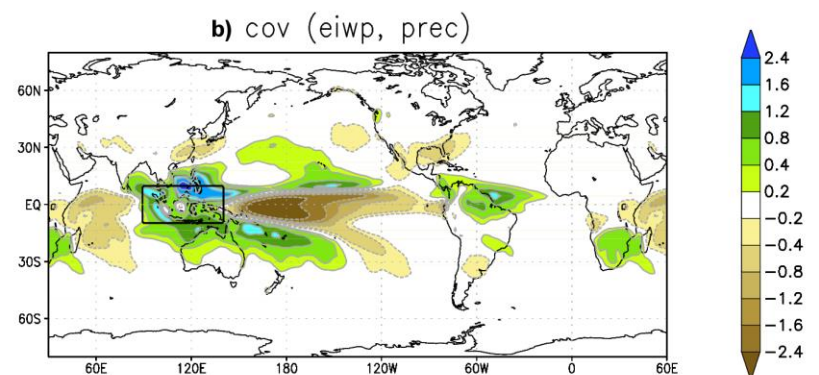
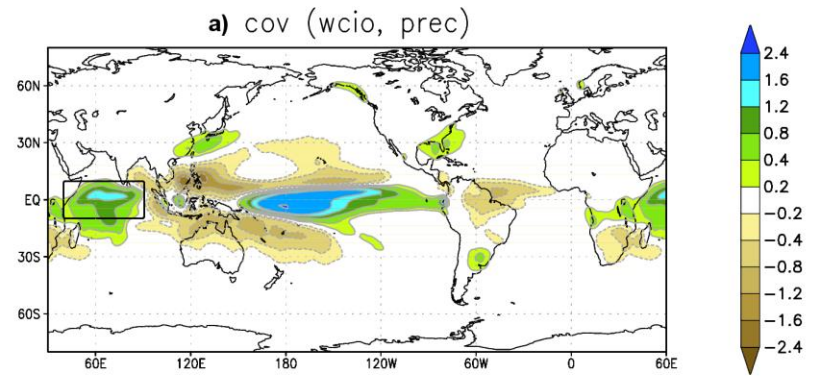
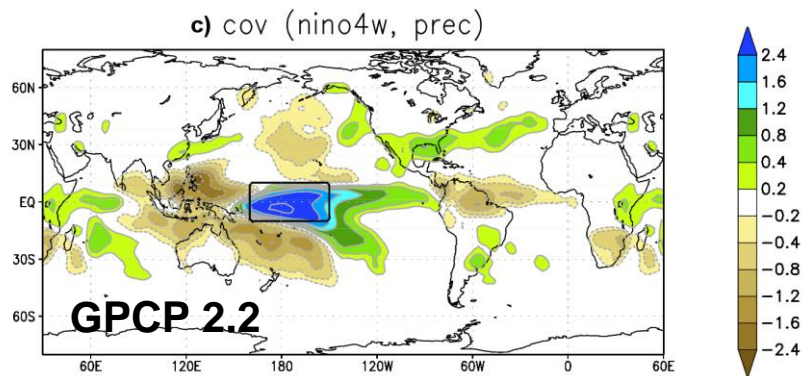
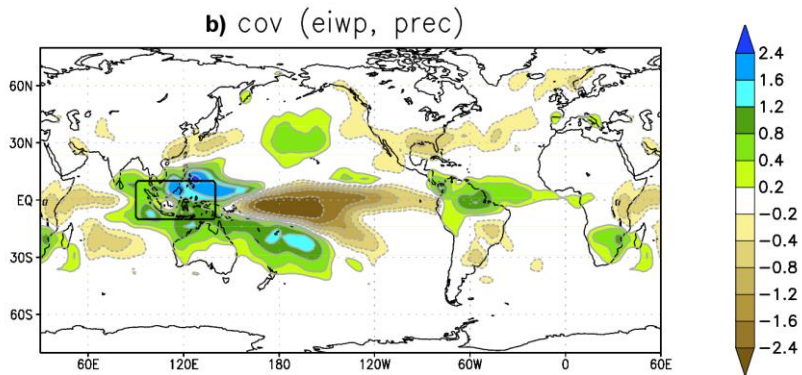
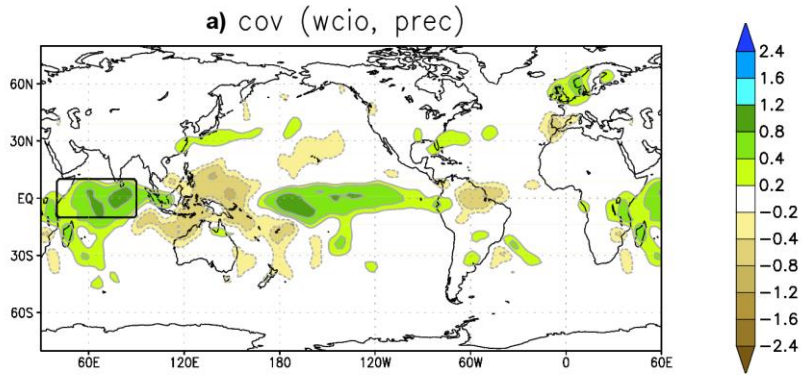
200-hPa Velocity Potential Anomaly



Data updated through April 2016

From NOAA Climate Diagnostics Bulletin

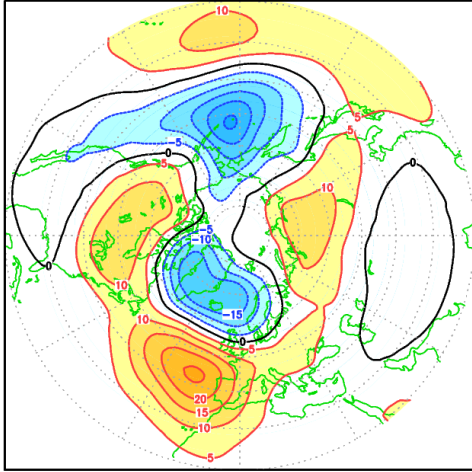
Rainfall teleconnections in GPCP and System 4: DJF anomalies



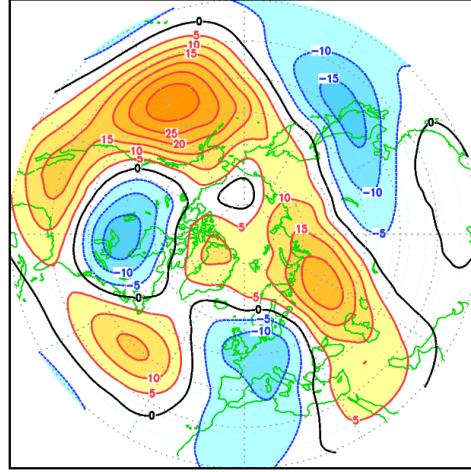
Z 500 hPa cov. with tropical rainfall: ERA-Int. vs. System-4

ERA

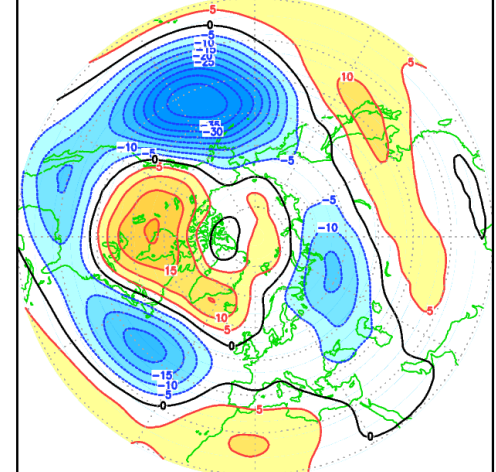
cov (wtind, gh500)



cov (eiwp, gh500)

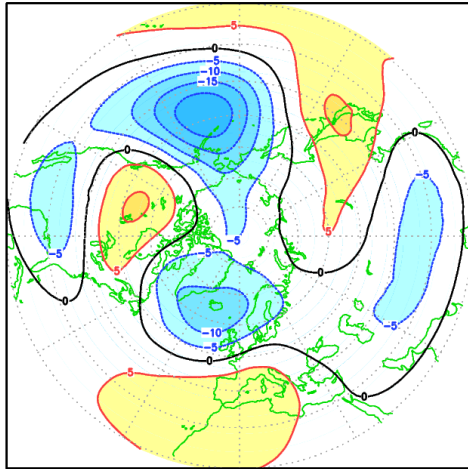


cov (nino4w, gh500)

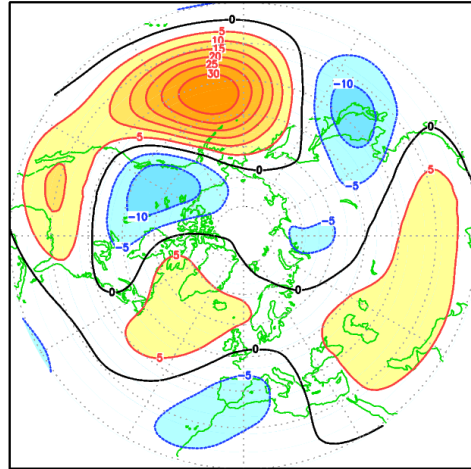


Sys4

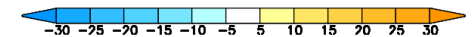
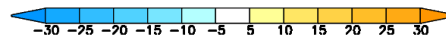
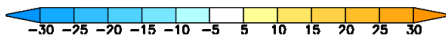
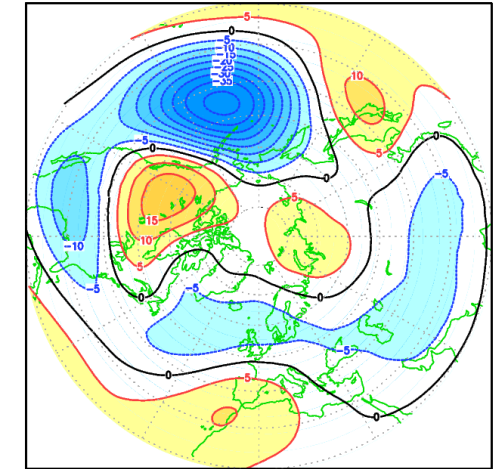
cov (wtind, gh500)



cov (eiwp, gh500)

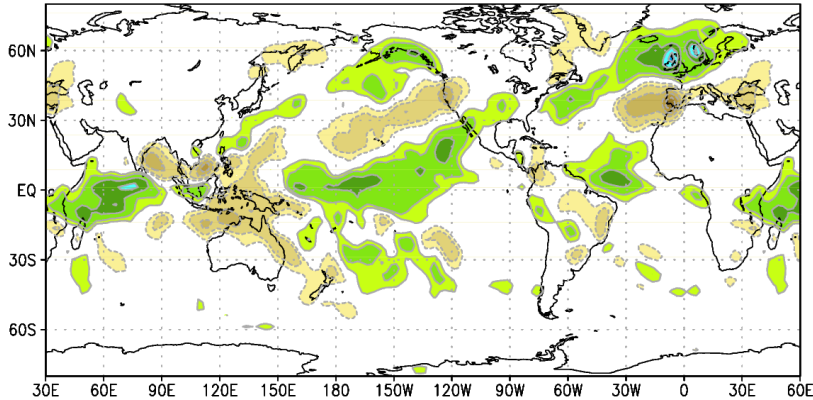


cov (nino4w, gh500)

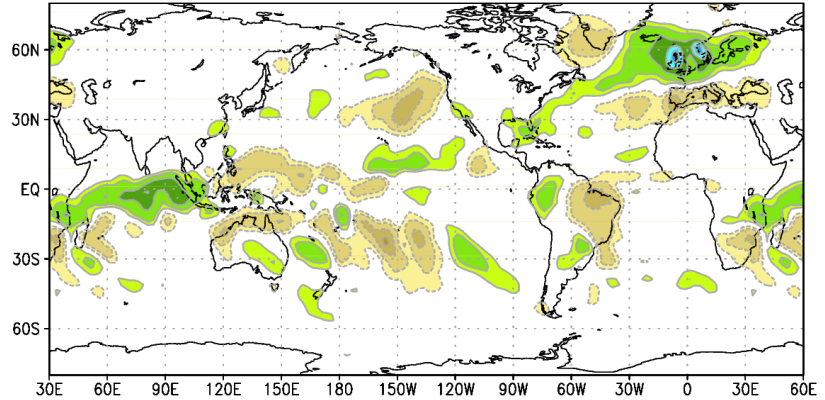


Monthly rainfall covariance with NAO index (GPCP-2.2, ERA-Int.)

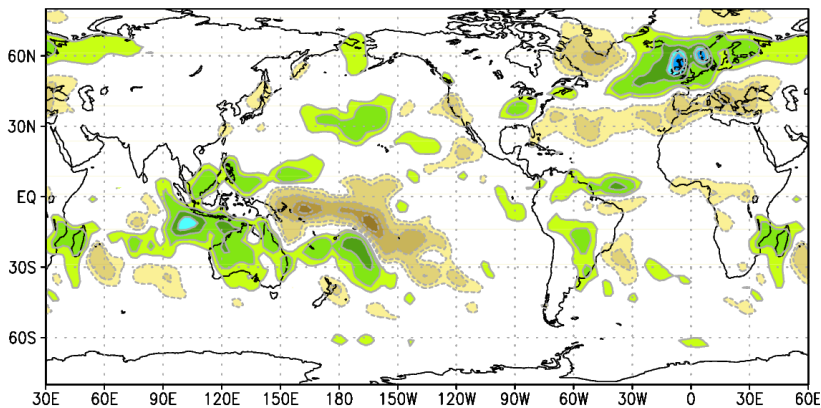
cov (nao, prec) Dec



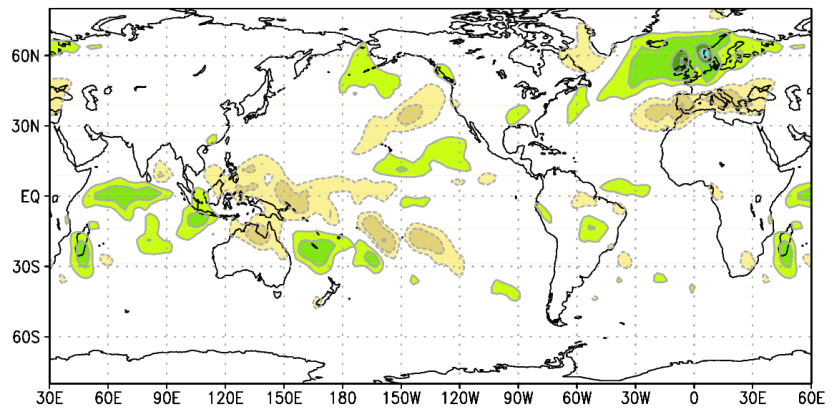
cov (nao, prec) Jan



cov (nao, prec) Feb



cov (nao, prec) DJF

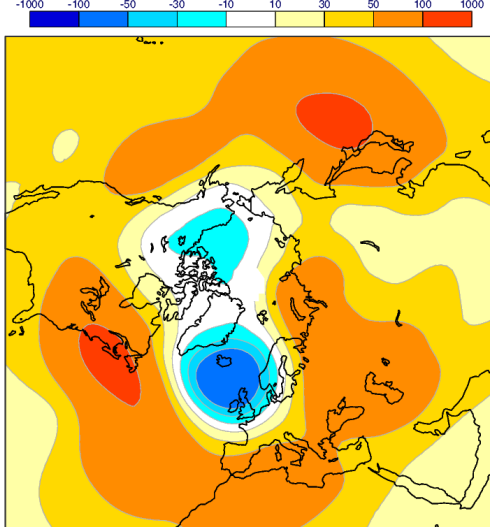


“Best” 5 members in Sys-4: largest NAO-index difference Dec - Jan

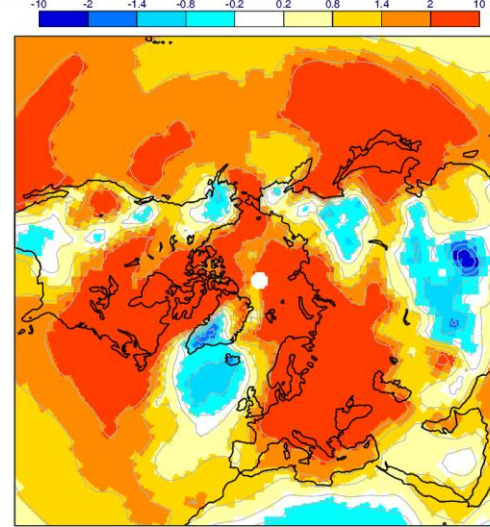
Z 500 hPa

T 2m

01 November 2015 00 UTC ecmf t+1464 VT:Friday 01 January 2016 00 UTC 500 hPa

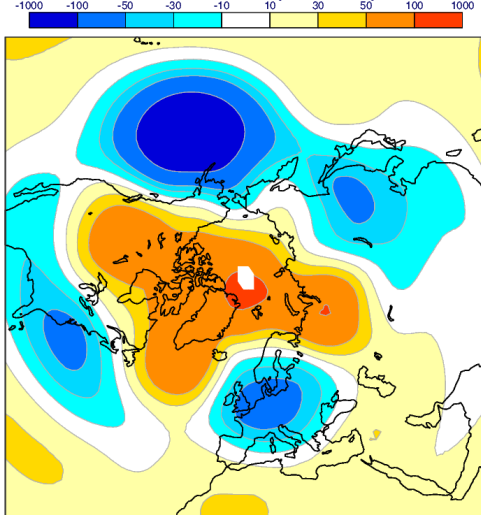


01 November 2015 00 UTC ecmf t+1464 VT:Friday 01 January 2016 00 UTC surface 2 metre

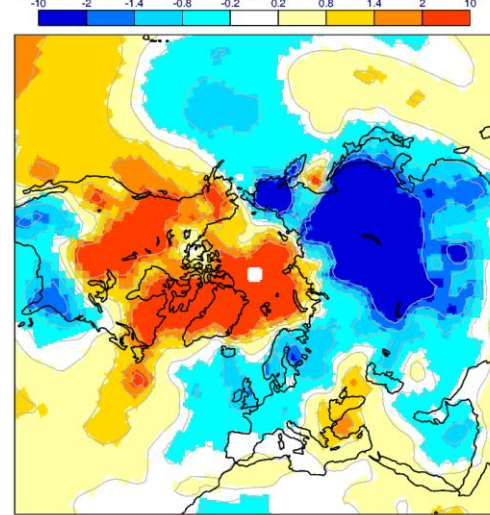


Dec 2015

01 November 2015 00 UTC ecmf t+2208 VT:Monday 01 February 2016 00 UTC 500 hPa



01 November 2015 00 UTC ecmf t+2208 VT:Monday 01 February 2016 00 UTC surface 2 metre

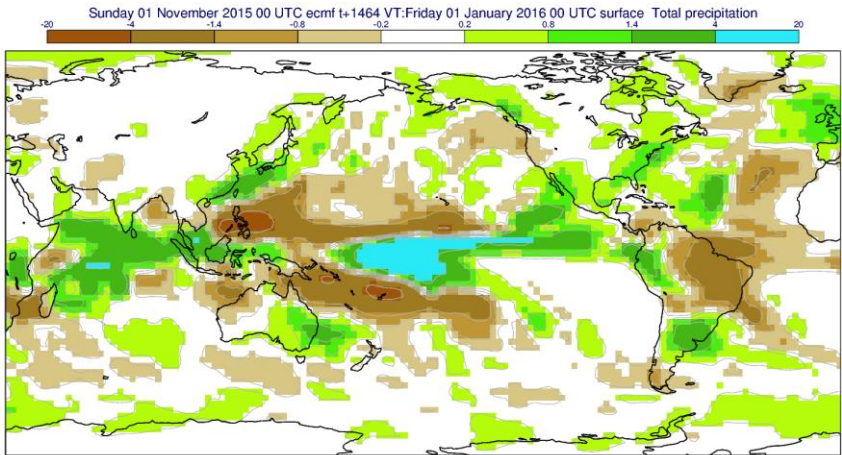


Jan 2016

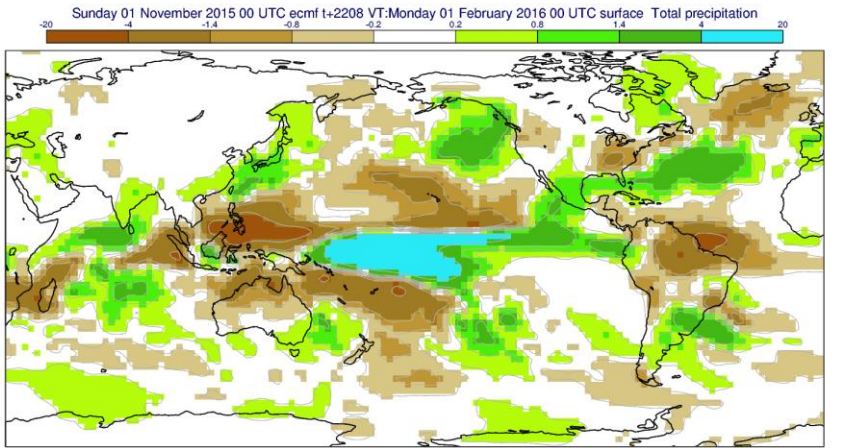
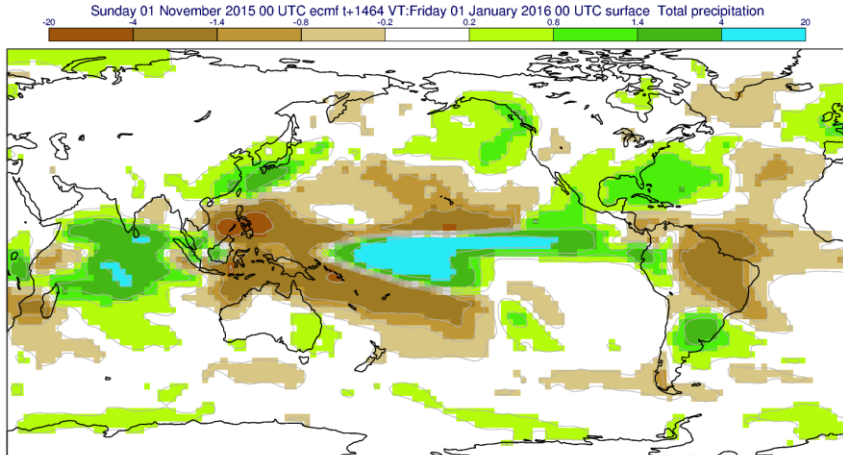
Rainfall anomaly

Best 5 m.

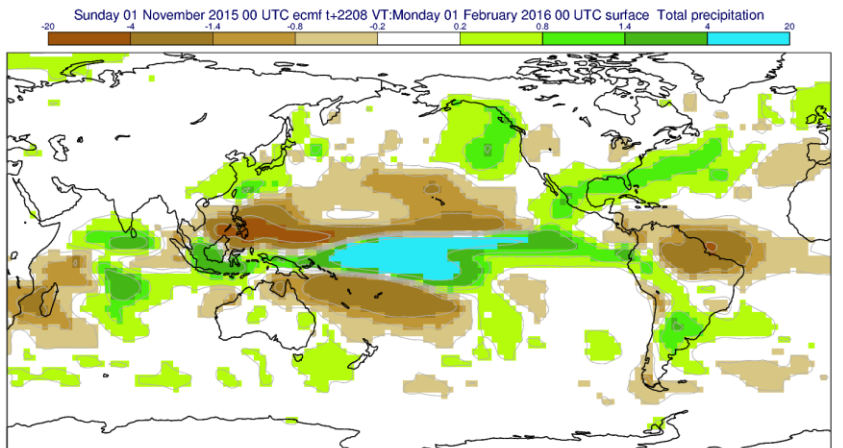
Ensemble mean



Dec
2015



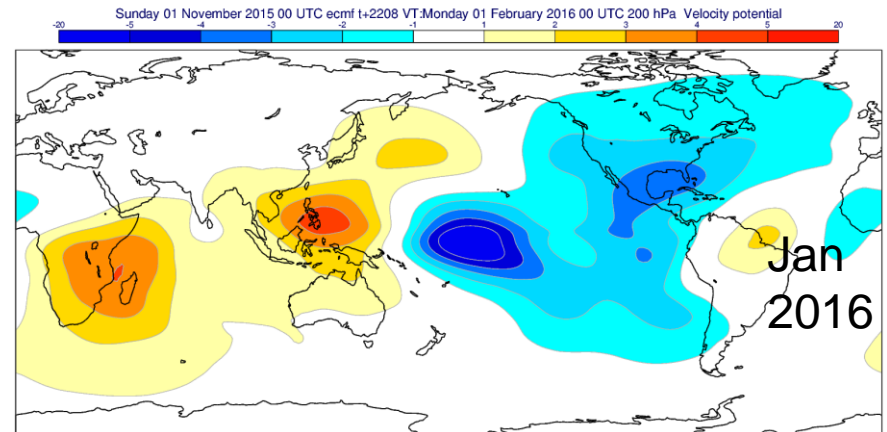
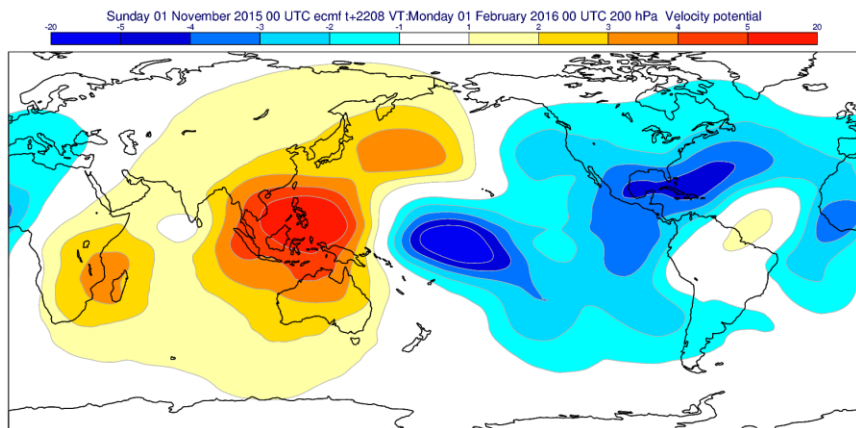
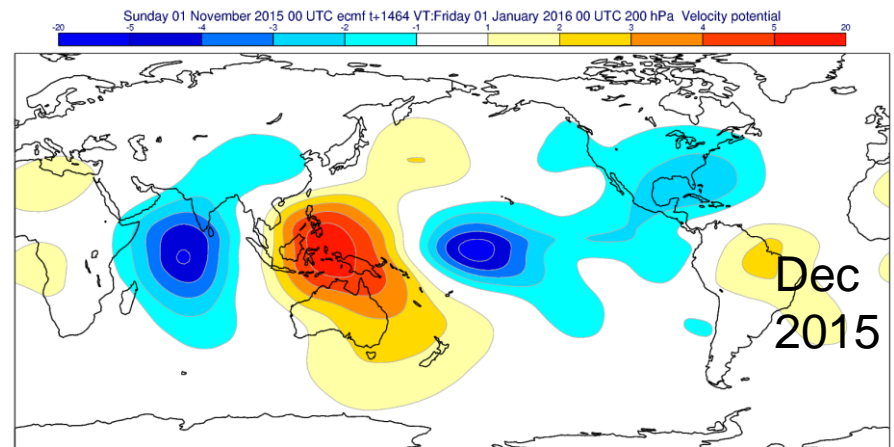
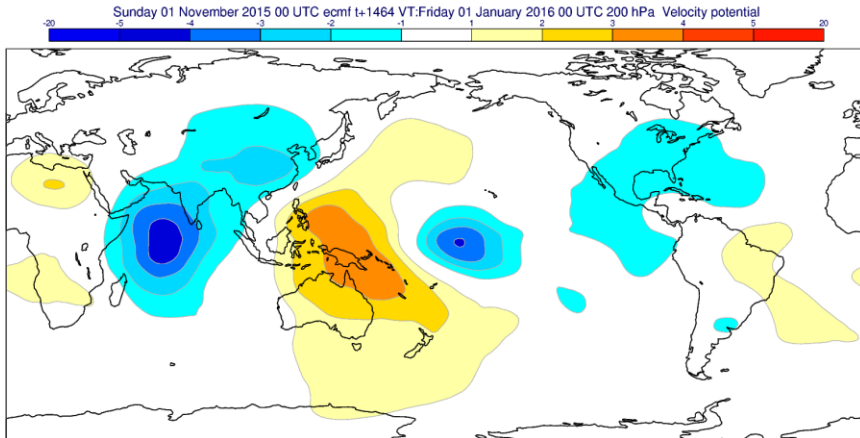
Jan
2016



200 hPa velocity potential anomaly

Best 5 m.

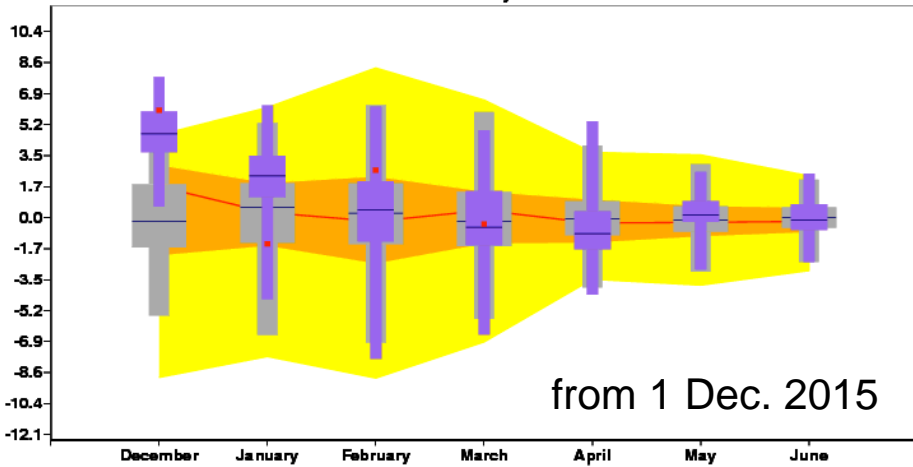
Ensemble mean



North Atlantic Oscillation

Forecast initial date: 20151201

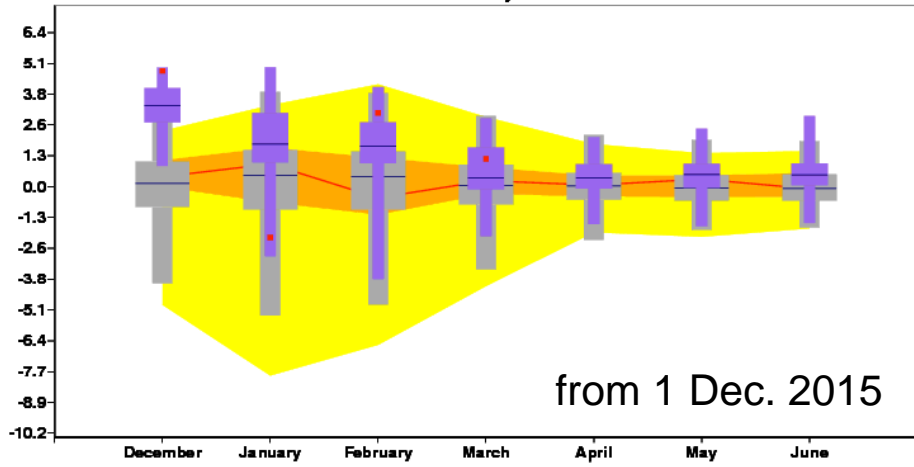
Ensemble size: Forecast=51 Model climate=450 Analysis climate=30



2m temp. anomalies (K) latitude= 65.0 to 50.0 longitude= -10.0 to 30.0

Forecast initial date: 20151201

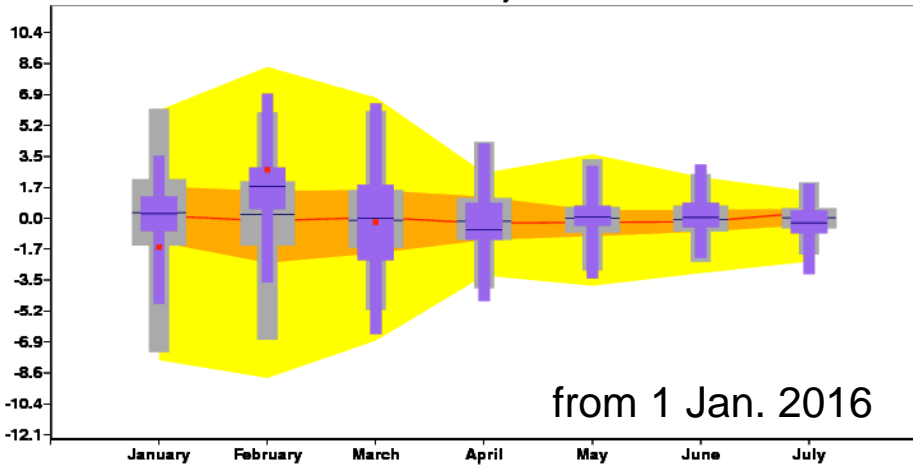
Ensemble size: Forecast=51 Model climate=450 Analysis climate=30



North Atlantic Oscillation

Forecast initial date: 2016 101

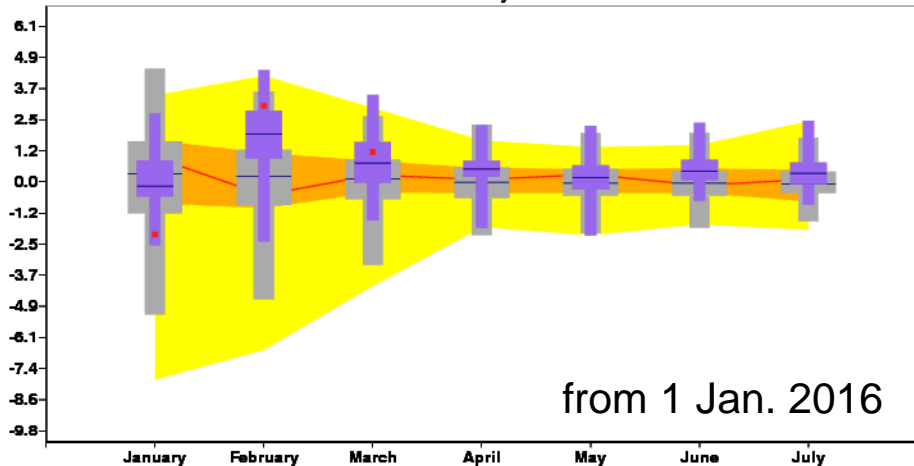
Ensemble size: Forecast=51 Model climate=450 Analysis climate=30



2m temp. anomalies (K) latitude= 65.0 to 50.0 longitude= -10.0 to 30.0

Forecast initial date: 2016 101

Ensemble size: Forecast=51 Model climate=450 Analysis climate=30



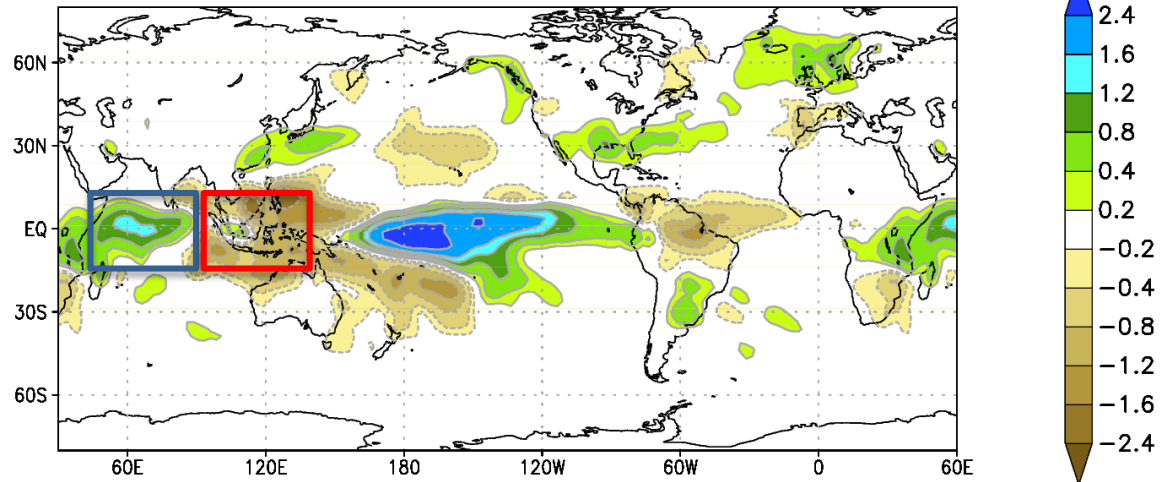
NAO index

N. Europe T 2m

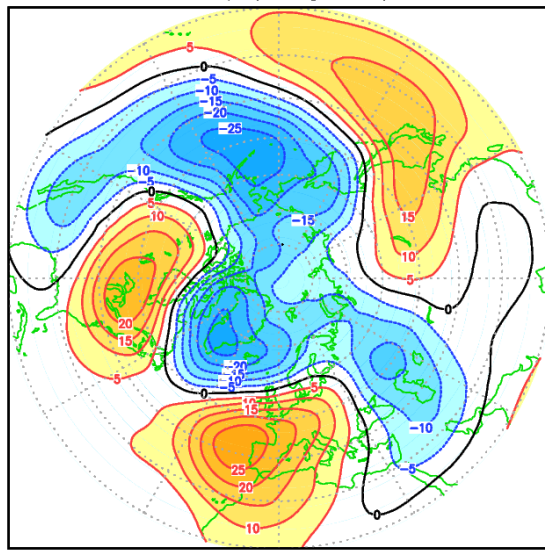
Conclusions

- Intraseasonal variability during the 2015-16 winter was characterized by a strong intensification of the seasonal dry anomaly over the maritime continents in January 2016, extending to the eastern Indian Ocean. In the North Atlantic, the NAO changed from strongly positive in December to negative in January.
- The ECMWF seasonal fc. System 4 captured well the seasonal mean anomalies in both the tropics and the northern extra-tropics, but (on average) failed to reproduce the intraseasonal NAO variations.
- Selected ensemble members, which reproduce the correct NAO change, also show the correct intensification of the drying/subsidence area over Indonesia and the eastern Indian Ocean in January.
- Predictability on sub-seasonal scales seems to be dependent on whether the observed transitions are in the direction of the tri-polar Indo-Pacific anomaly pattern which dominates the ECMWF model's tropical variability. The transition from $-NAO$ in Jan to $+NAO$ in Feb was better predicted than the opposite transition between Dec and Jan.

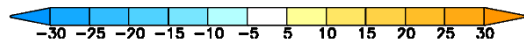
cov (iwpd, prec) Dec-Jan



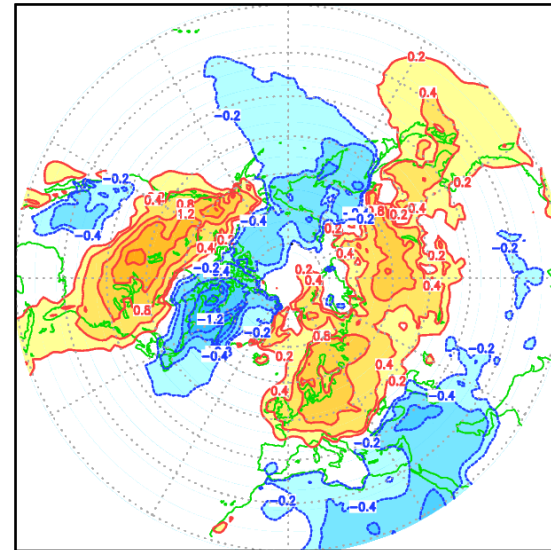
cov (iwpd, gh500)



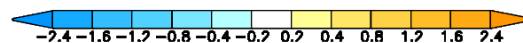
Z 500



cov (iwpd, t2m)



T 2m



MJO Rainfall composites

From NOAA CPC

