Teleconnections

Teleconnections Linking Worldwide Climate Anomalies

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Teleconnections are important for climate predictions:

- they can be used as a predictive tool
- they are instrumental for understanding climate variability and for the improvement of predictive skill in sub-seasonal and seasonal forecasts.
- All the mechanism involving the teleconnections are not fully understood.
- They involve different time scales from sub-seasonal to decadal
- Due to climate change they are not stationary

Assessing model teleconnections:

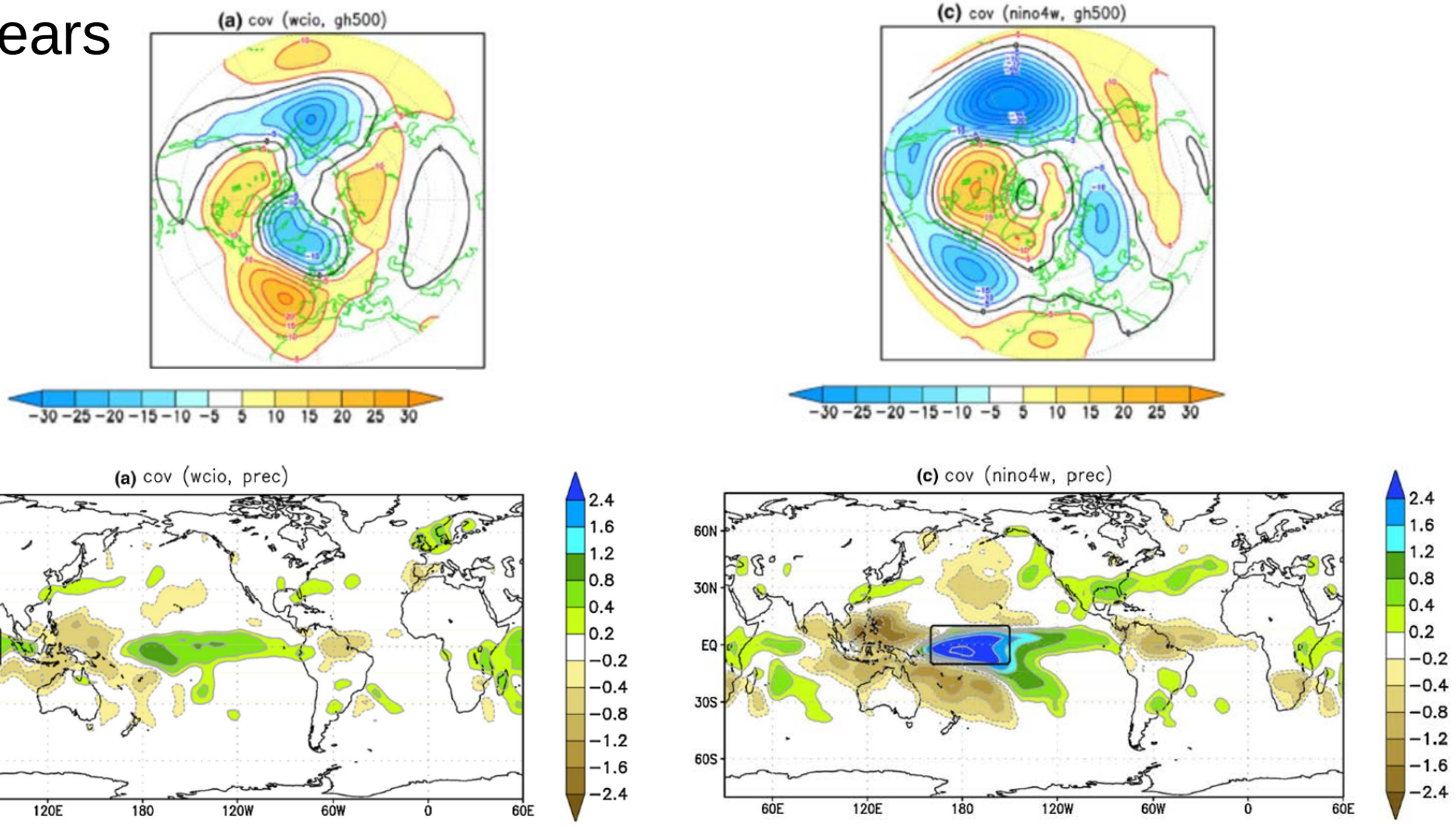
Which teleconnections should be chosen to assess model performance ? (indices vs one-point correlation maps)

How well models reproduce the teleconnection seasonal cycle?

Determining the best diagnostic tools to identify teleconnections, for example, linear versus nonlinear techniques.

Difficulty to detect due to short observational history

Teleconnections and heat sources over the tropical Indian and Pacific oceans using ECMWF re-analysis (erainterim) 30 years



Convection over Indian Ocean=> +ve NAO

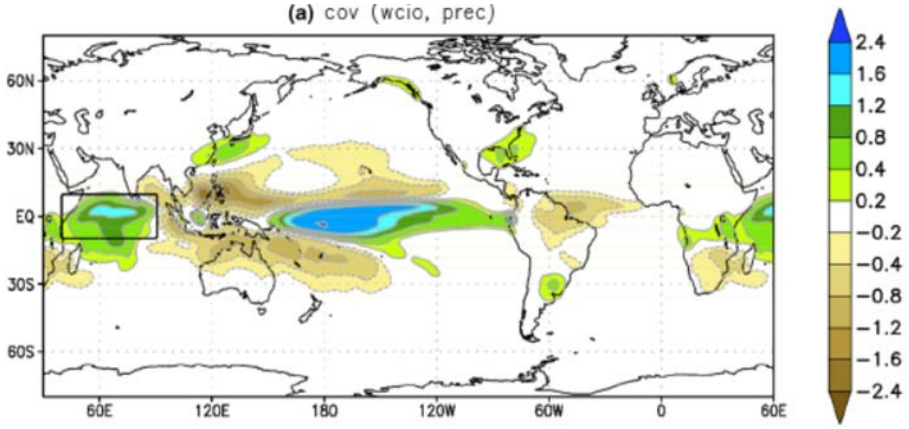
Convection Central Pacific=> PNA-like

From Molteni et al 2015

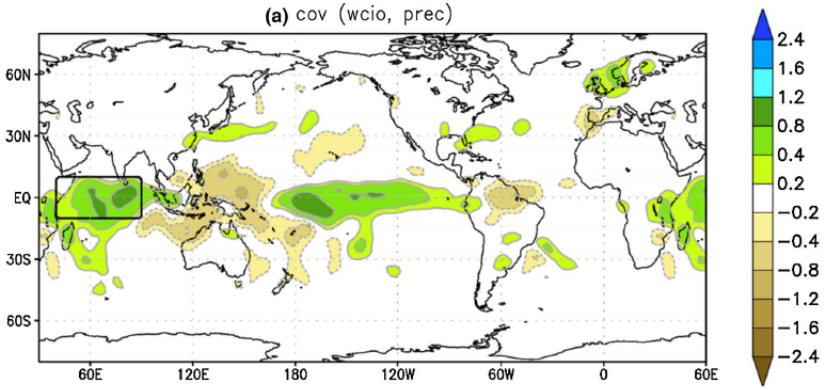
Extra-tropical model teleconnections based on 30 years of reforecast:

From Molteni et al. 2015

System4



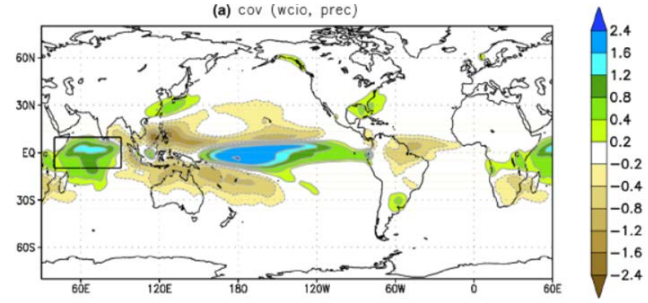
era-interim

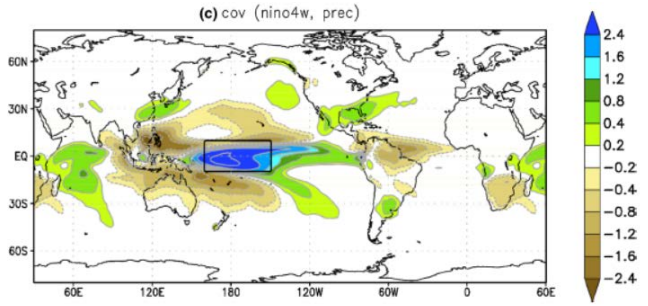


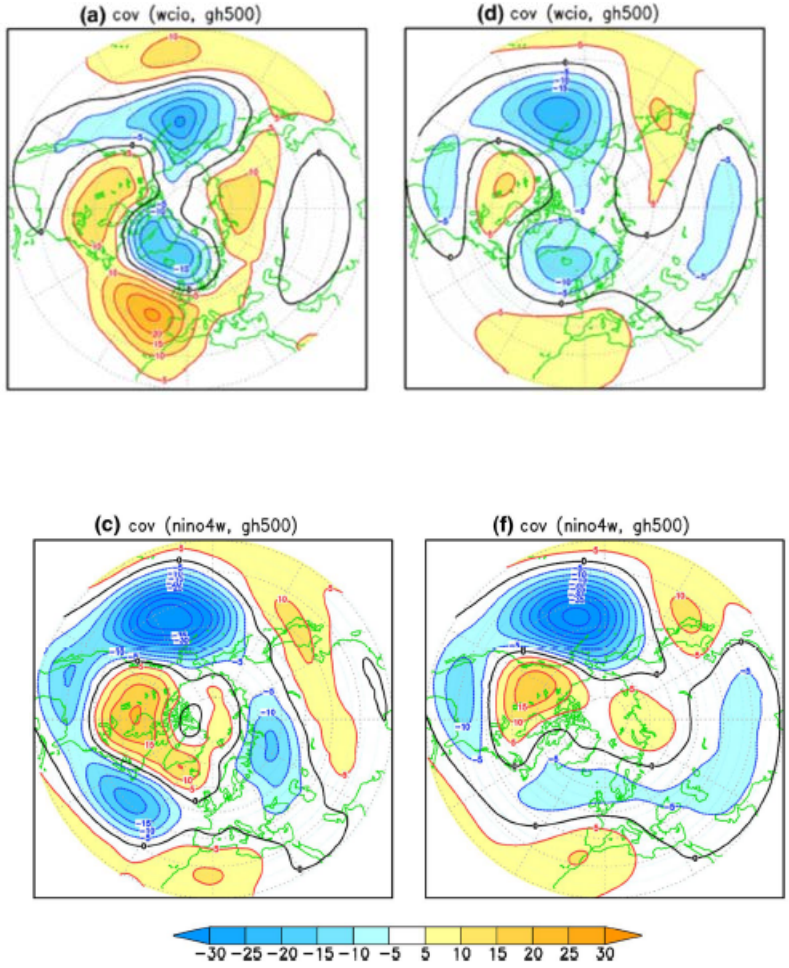
Extra-tropical model teleconnections based on 30 years of reforecast:

From Molteni et al. 2015

Era-interim System4

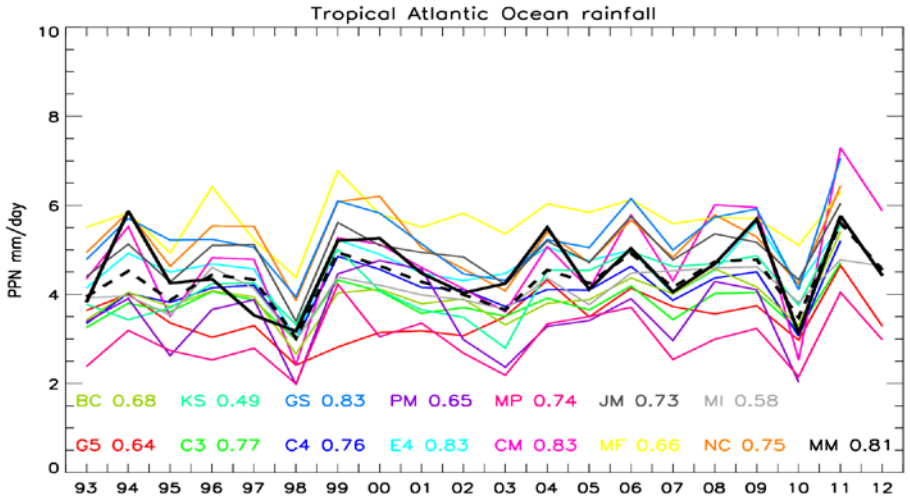


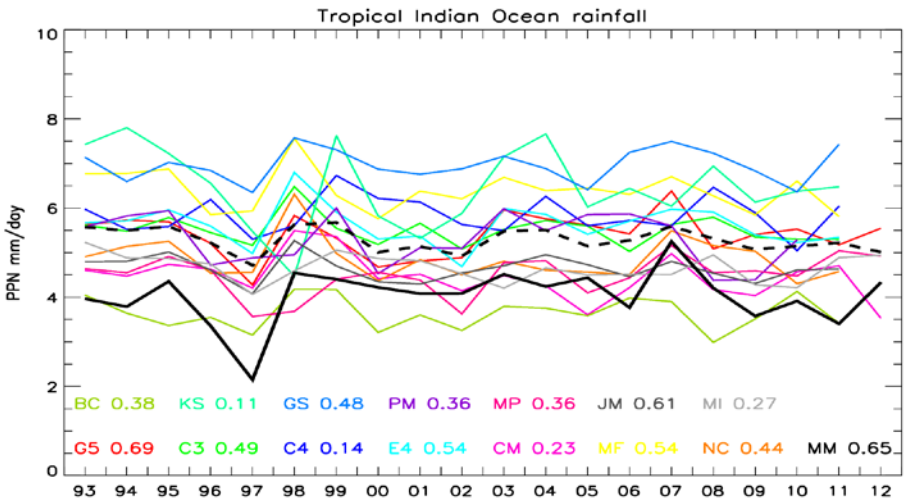


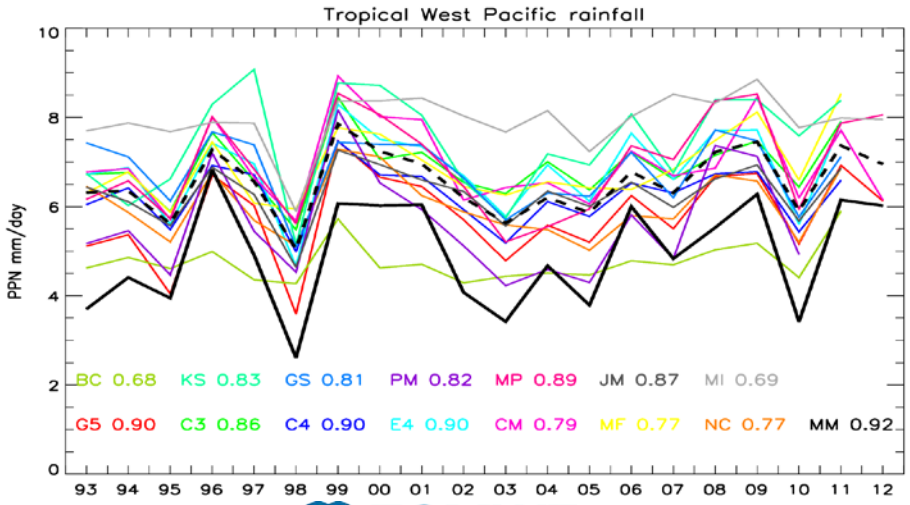


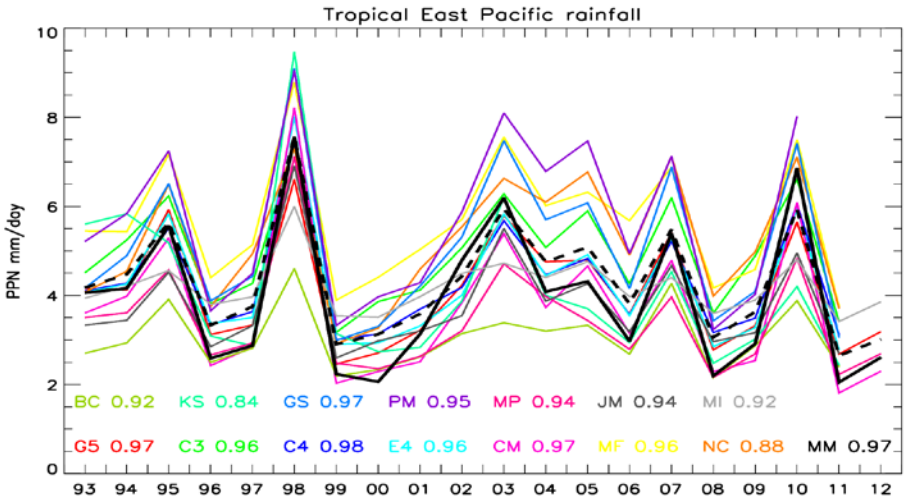
WGSIP teleconnection project

Tropical convective heating is one of the main drivers of teleconnections.





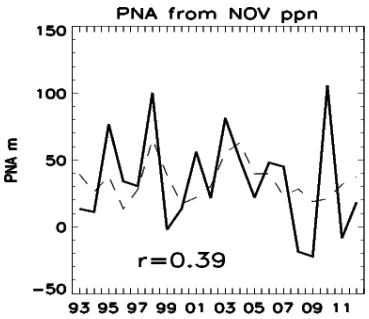
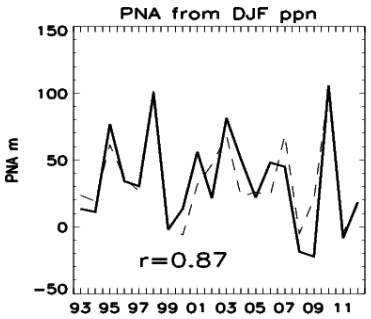
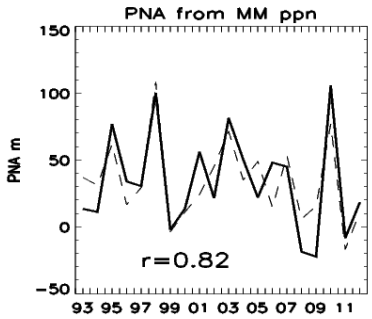
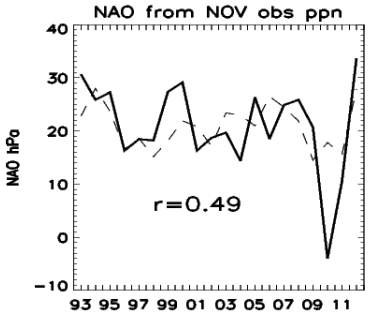
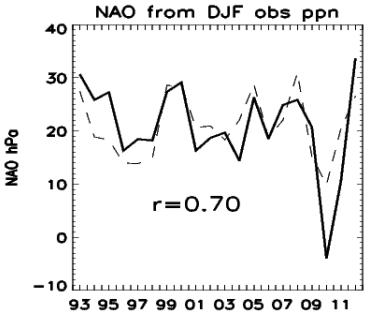
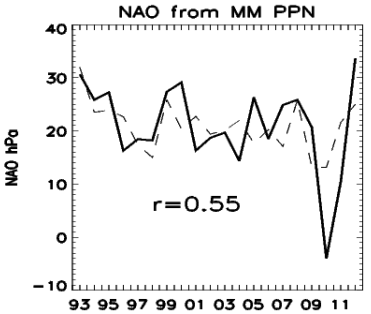




Scaife et al. 2018

WGSIP teleconnections

PNA and NAO predictions using linear regression of four rainfall indices

	November obs. rainfall	DJF obs. rainfall	multi-model rainfall
PNA			
NAO			

Perfect knowledge of tropical rainfall would allow highly skilful predictions of both the PNA, NAO.

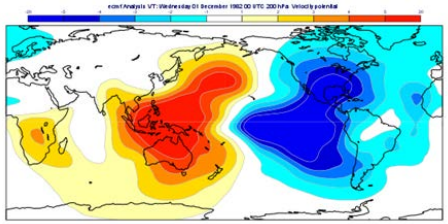
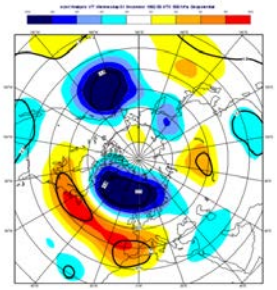
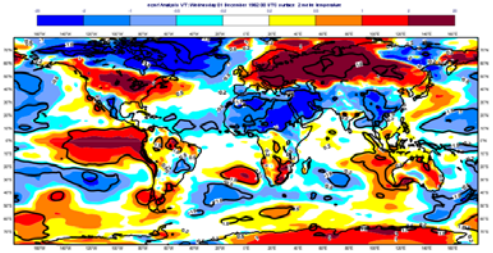
some skill can even be derived from knowledge of November rainfall,

Multi-model predictions of tropical rainfall improve on these empirical forecast scores

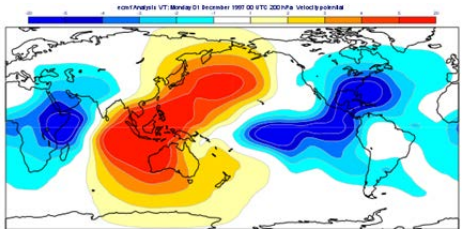
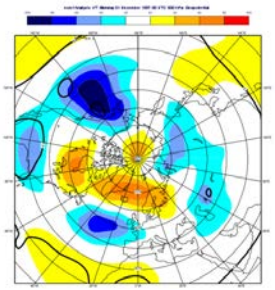
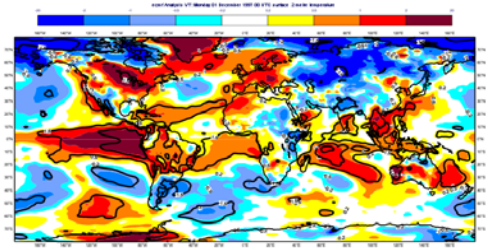
Scaife et al. 2018

The 3 recent strong ENSO events

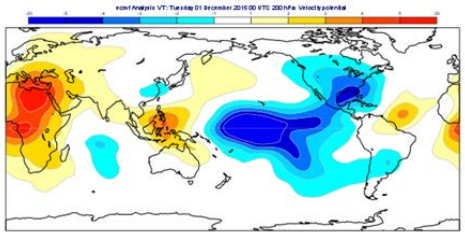
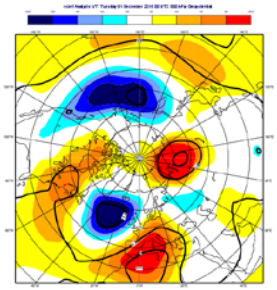
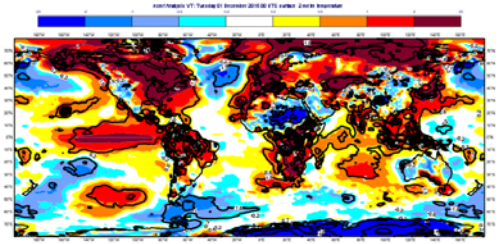
Dec-Jan 1982/83

Dec-Jan 1997/98

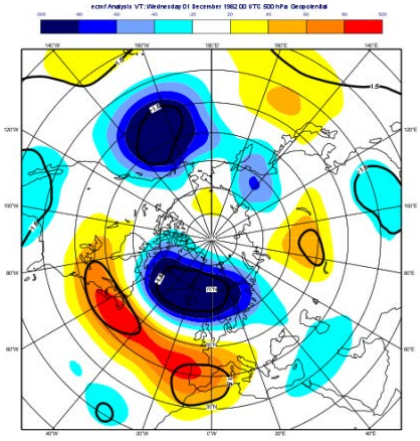
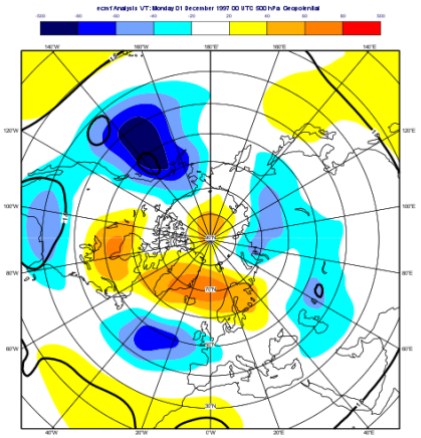
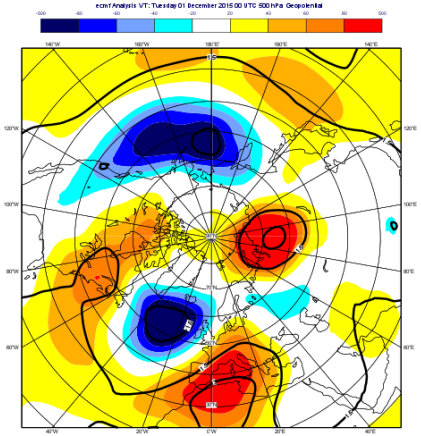
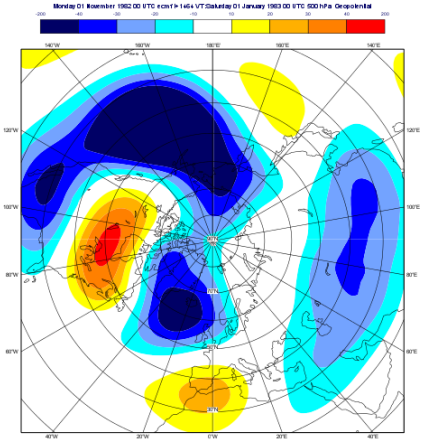
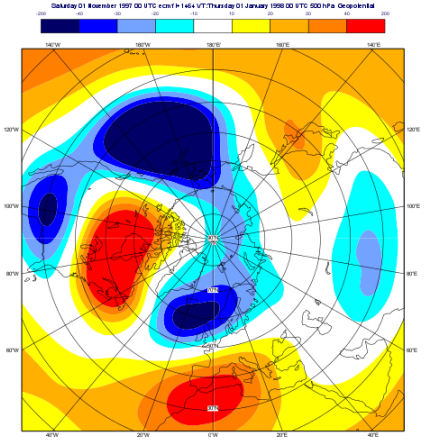
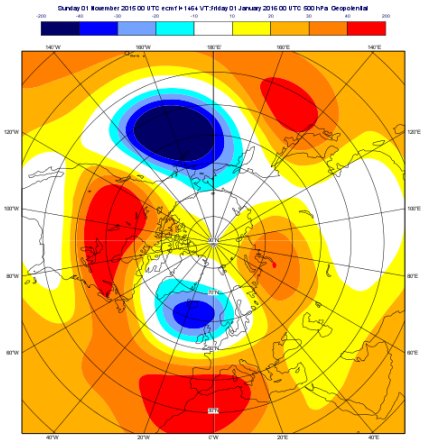




Dec-Jan 2015/16

There is diversity in response over Europe. Large differences are seen between the 3 events in the Walker circulation over Africa and Indian Ocean

Extra-tropical response analysis and model for December-January:

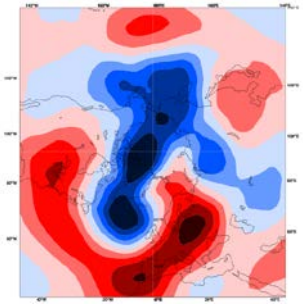
	1982/83	1997/98	2015/16
Analysis			
Sys4 ens. mean Nov. Start 51 members			

S2S teleconnection project - Stan et al. 2017

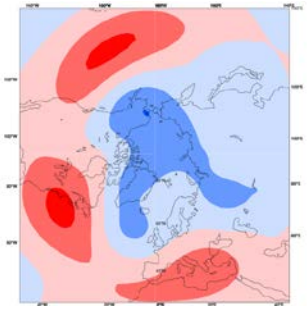
From Vitart 2017

Composites of Z500 3 pentads after an MJO in Phase 3 NDJFM

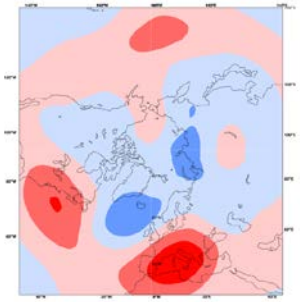
EI 0.48



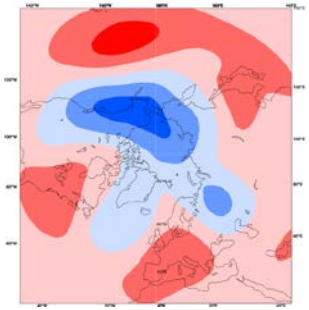
BoM 0.15



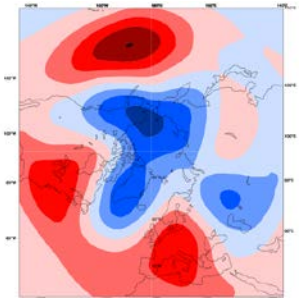
CMA 0.14



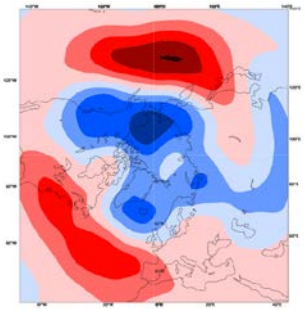
HMCR 0.13



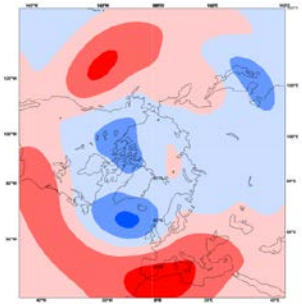
NCEP 0.32



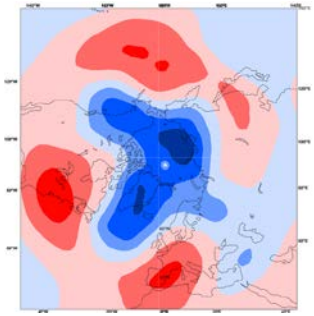
ISAC 0.25



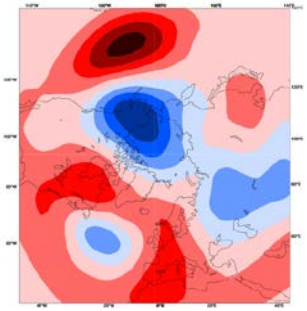
CNRM 0.15



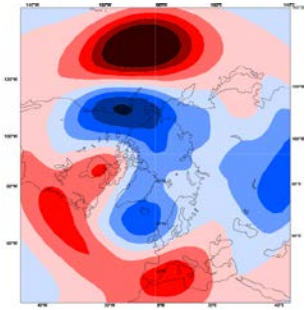
UKMO 0.28



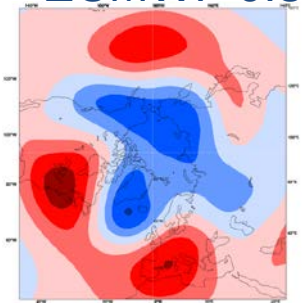
JMA 0.22



ECCC 0.21

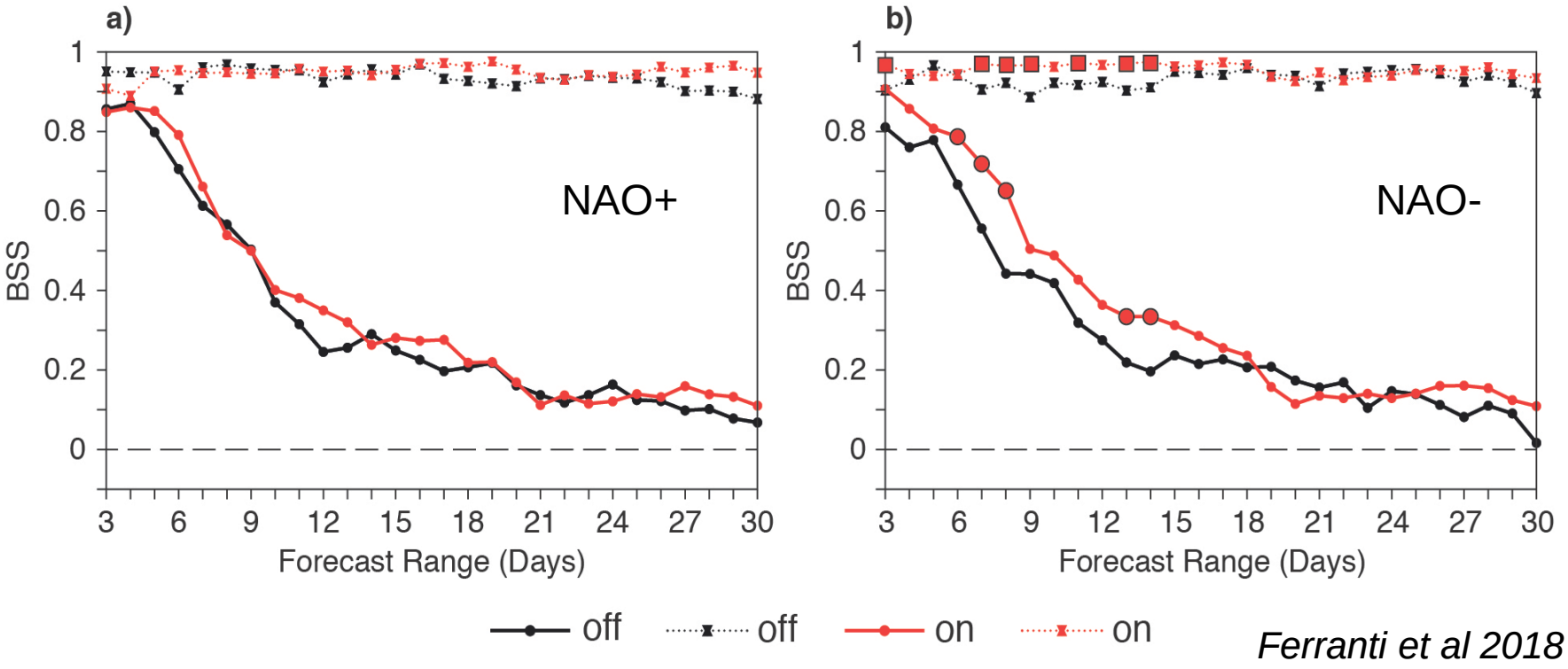


ECMWF 0.31



Pure linear methods, such as EOF analysis/covariances, may not reveal the important effects of nonlinearities.

The extra-tropical response to MJO is not linear, the lagged NAO- response to MJO phase 6-7 is generally larger than the lagged NAO+ response to MJO phase 2-3 (Lin & Brunet 2017, Yadav and Straus 2017). This has an effect on the forecast skill:



Ferranti et al 2018

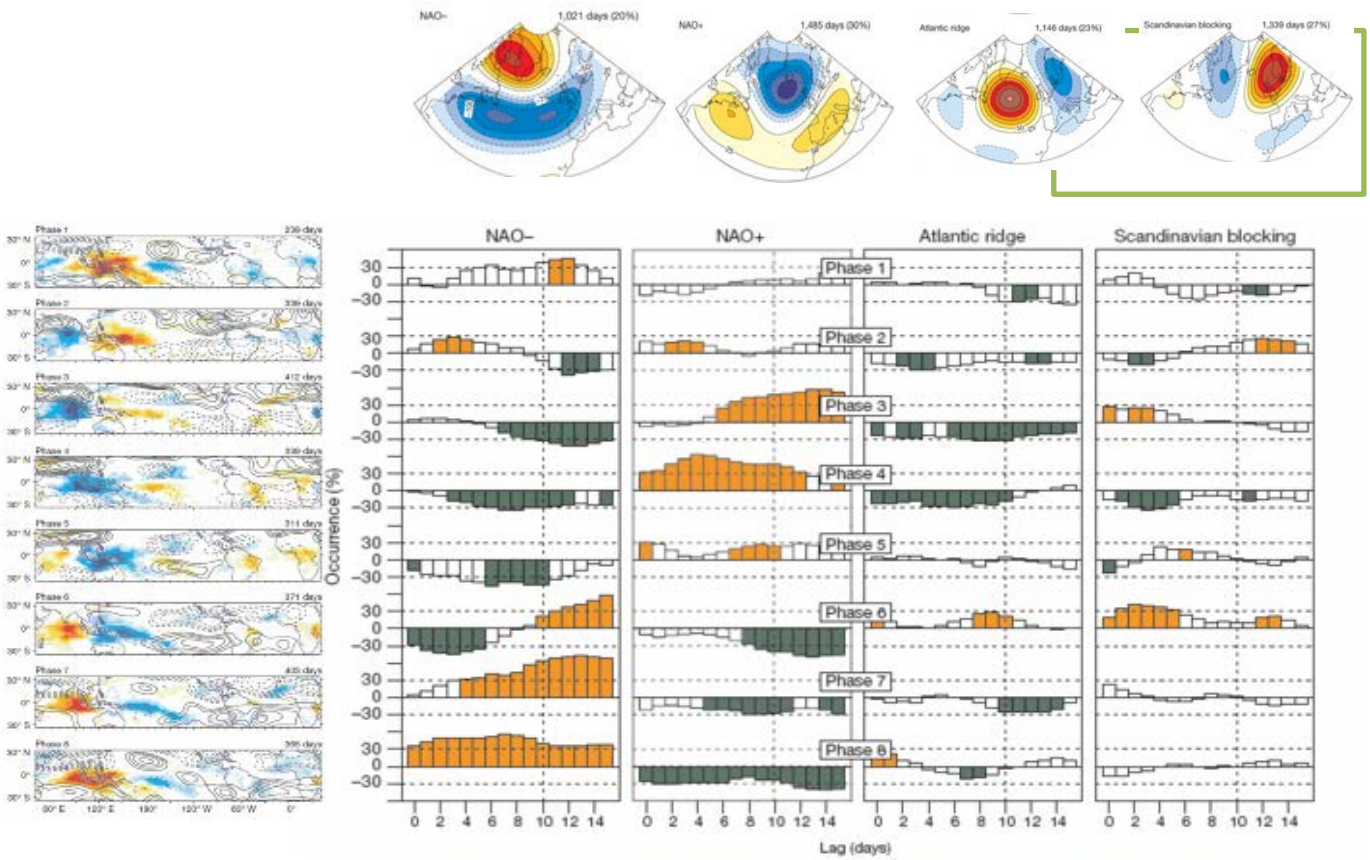
Summary

- Assessing observed and model teleconnections is challenging but crucial for improving climate predictions

- Knowing how models represent teleconnection patterns helps users to understand the climate predictions

- WGSIP and S2S promote the analysis of teleconnections

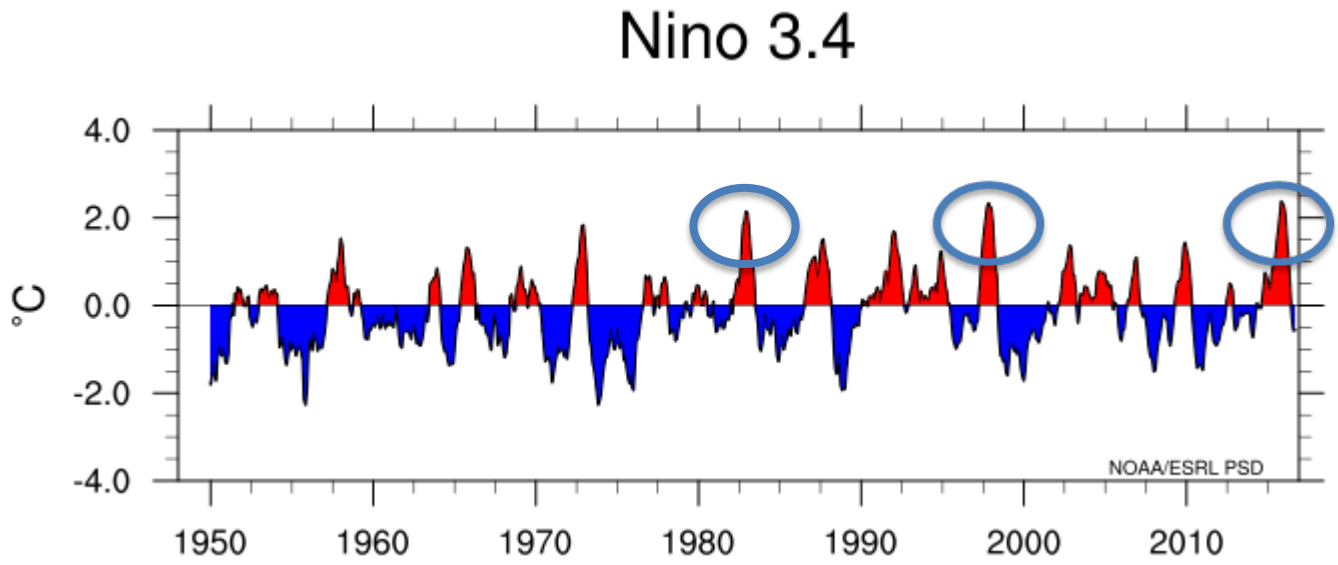
Impact of the MJO on weather regimes



Cassou C,2008: Intraseasonal interaction between the Madden-Julian Oscillation and the North Atlantic Oscillation. *Nature*, **455**, 523-527.

Cassou (2008)

[5N-5S, 150W-90W]



Toniazzo and Scaife 2006 showed that the ENSO response over the Atlantic sector is not linear.

From NOAA/CPC