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Barcelona Supercomputing Center
Centro Nacional de Supercomputación

EXCELENCIA SEVERO OCHOA

SPECS highlights

Research on teleconnections at BSC

DANAE project

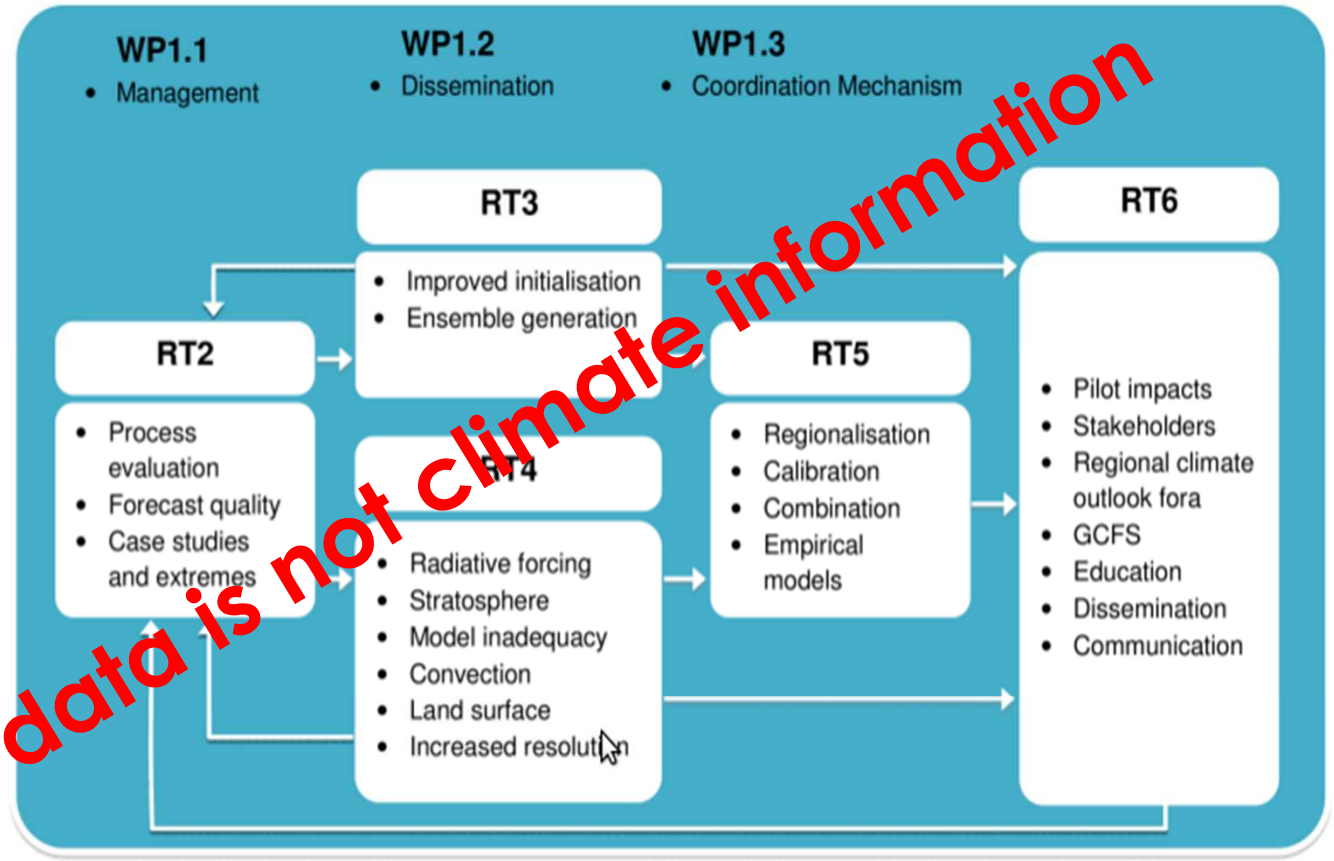
J. García-Serrano (BSC-ES)

with contributions from CPG, ESS,
Rein Haarsma (KNMI), Ileana Bladé (UB)

SPECS overview

Strong links to EUPORIAS, but also NACLIM, IS-ENES2, PREFACE, …

Forecast System	Project Partners
CNRM-CM5	CNRM, CERFACS
EC-Earth	KNMI, SMHI, BSC, ENEA
IFS/NEMO	ECMWF, UOXF
IPSL-CM5	CNRS
MPI-ESM	MPG, Uni[illegible]
UM	UKMET



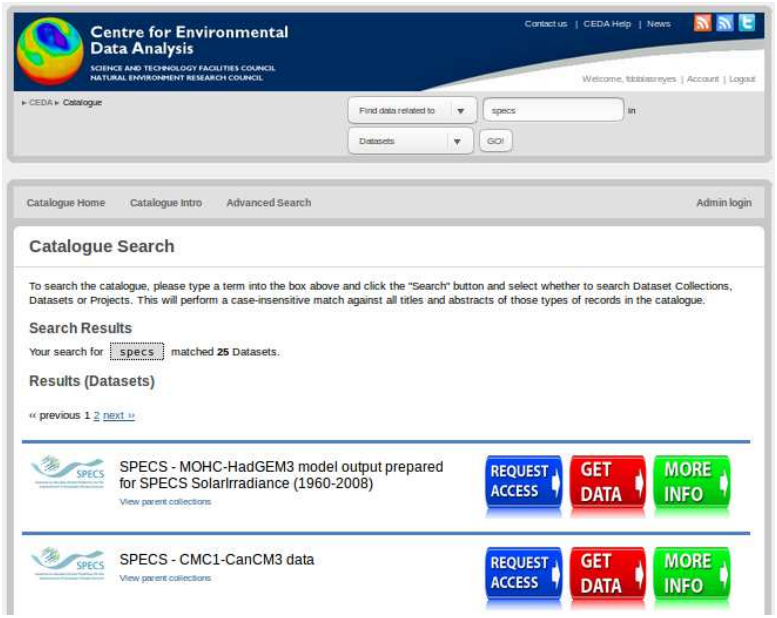
Climate data is not climate information

Coordinated experiments

Tenths of climate prediction experiments, seven models, with different configurations and parameterisations

Focus on both skill improvements and processes (case studies)

130 TB of output (and growing), most of it available from ESGF (a primer in climate prediction), curated in the long term

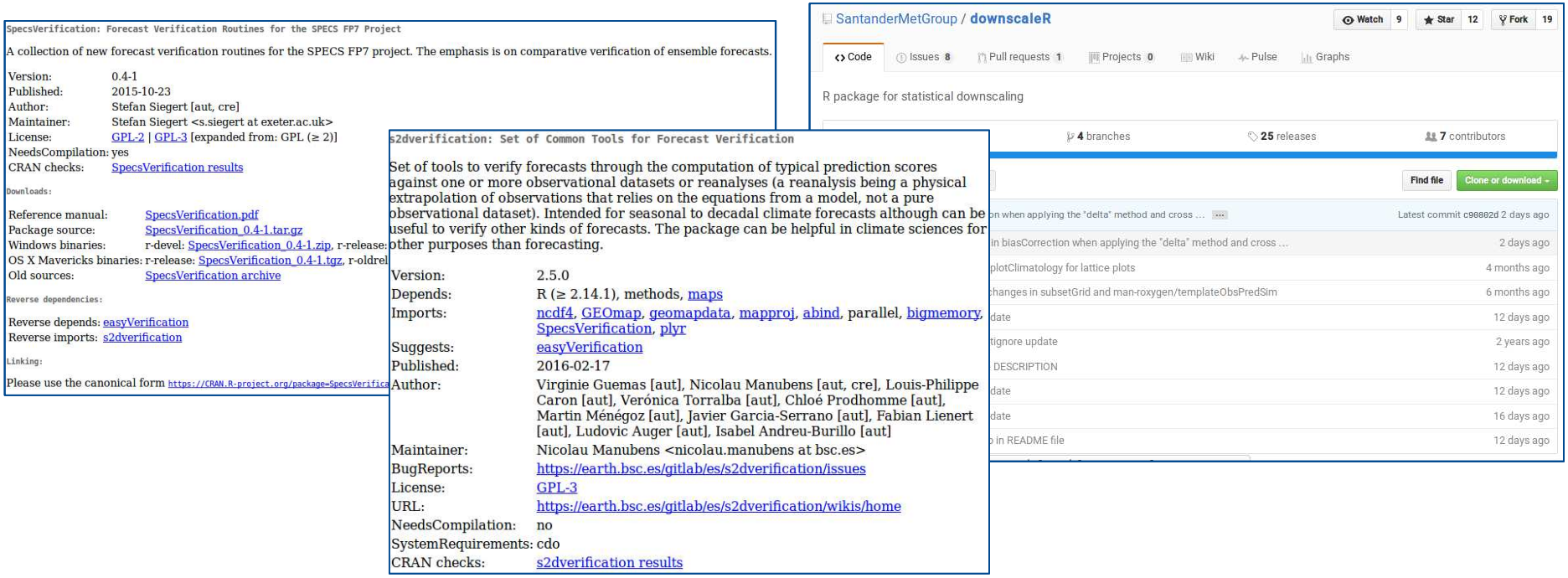


Data management and experiment documentation are fundamental. They shouldn't be underestimated

Open access tools

Portals are useful, but open access tools allow to go beyond what is initially considered by portal developers

The packages created in SPECS can be better adapted to address specific problems in an interaction with the users

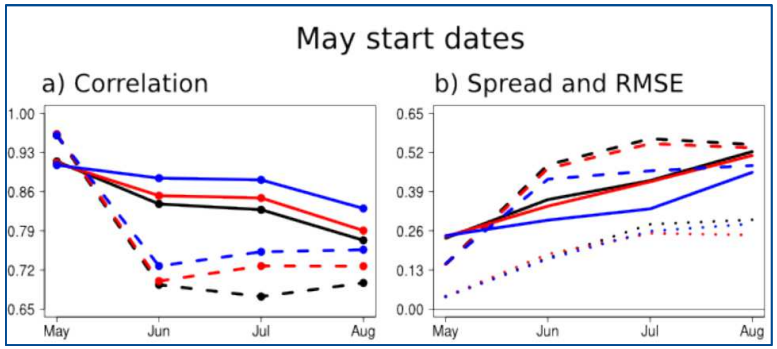


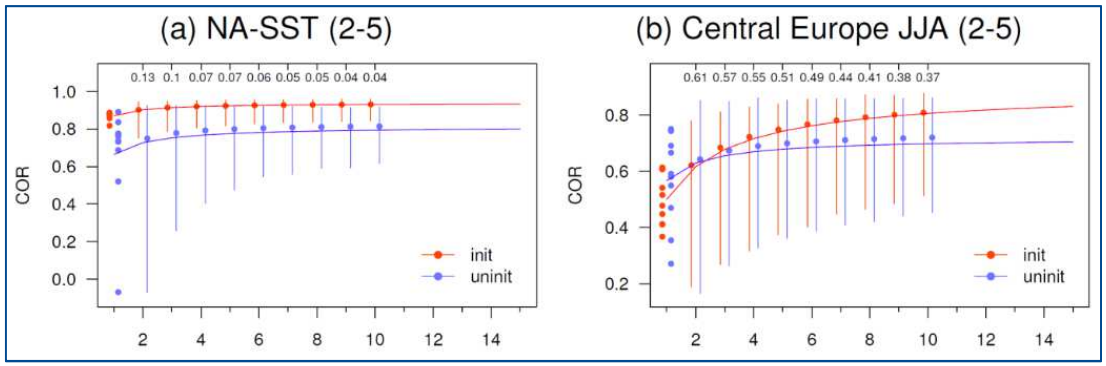
There is no magic recipe, users should be accompanied to make an efficient use of these tools

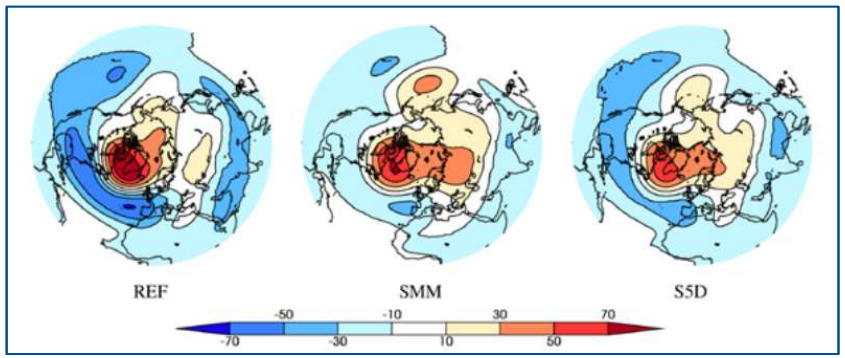
Some results…

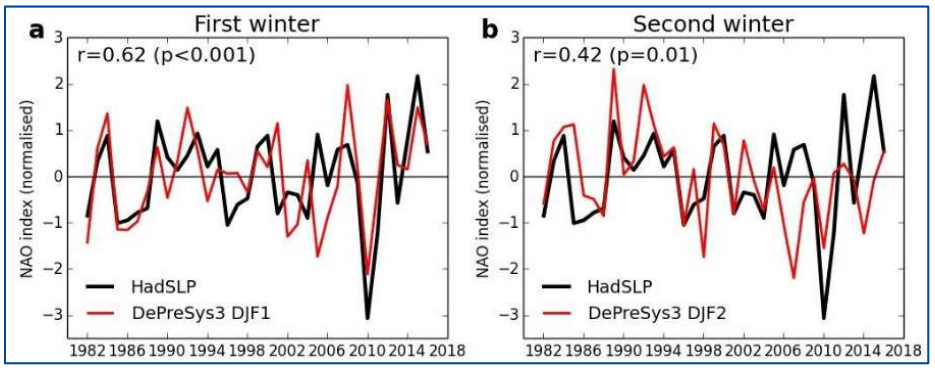
Improvements in the resolution, vegetation treatment, stochastic parameterisations, initialisation, sampling (ensemble and hindcast size), …

Improvements in forecast quality are found, but statistical significance is an issue









Improving the forecast systems takes long time; need to focus on those aspects that have a stronger impact for a wide range of users (e.g. NAO)

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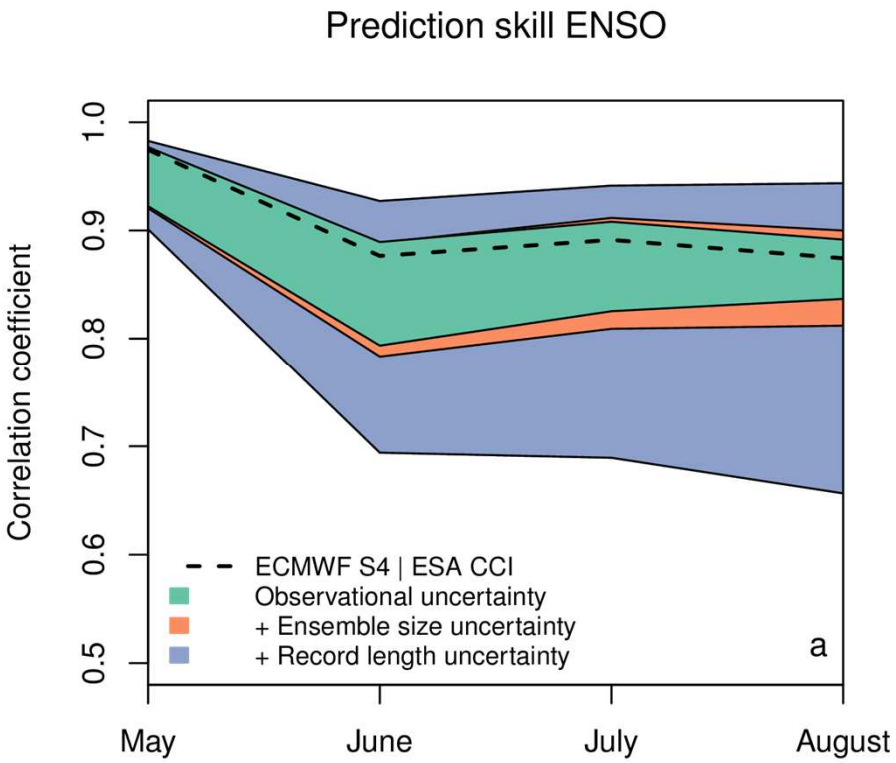
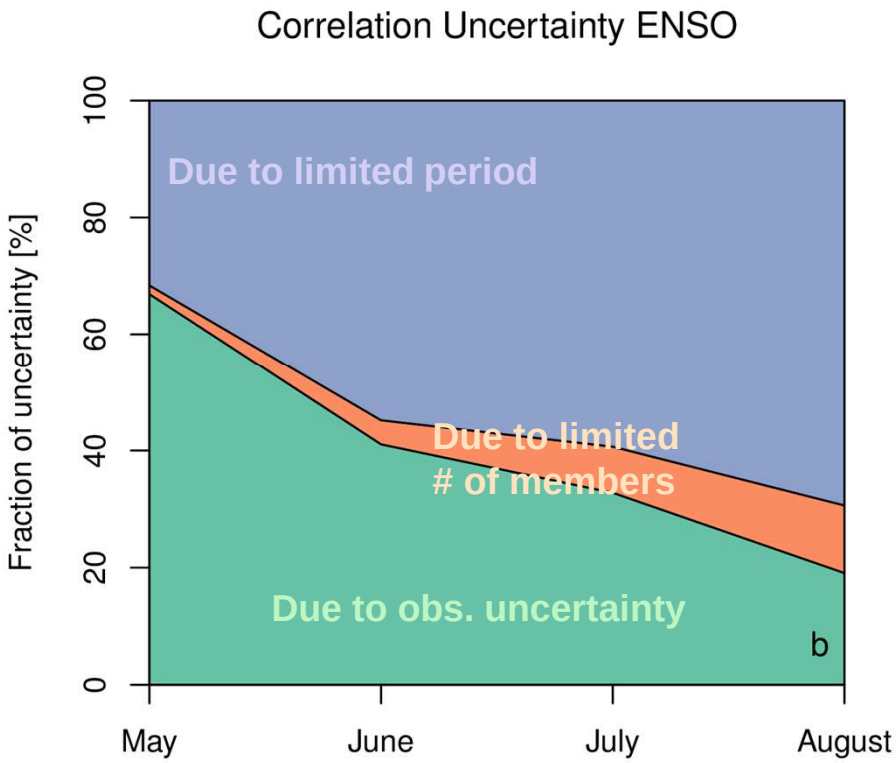
Research at BSC

Uncertainty in (seasonal) forecast verification

- Ensemble forecast: ECMWF's S4
- Verification product: ESA-CCI
- Uncertainty envelopes estimated by bootstrapping

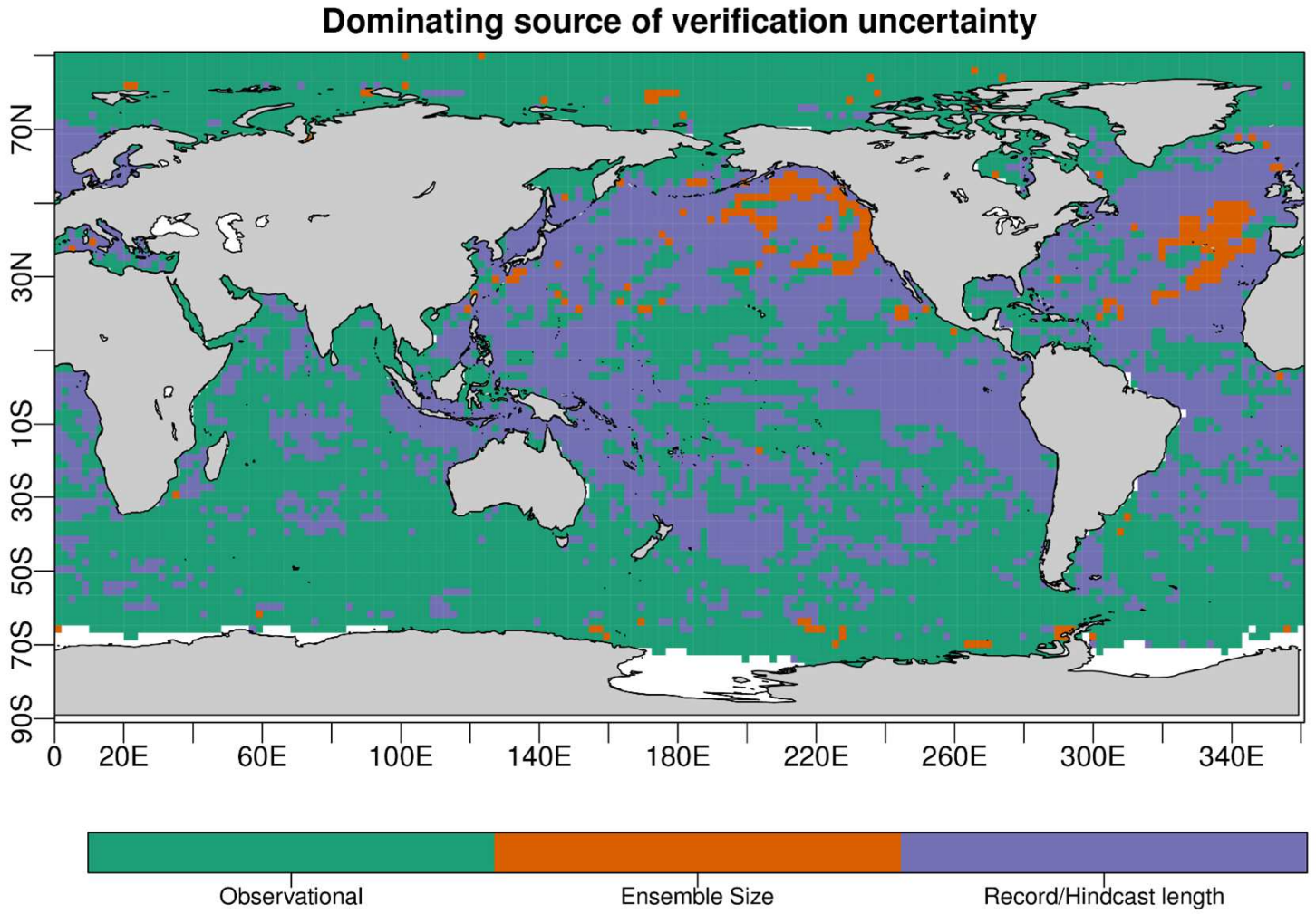




Observational uncertainty accounts for 20-60%
of total uncertainty in skill score!

Bellprat et al. (under review)

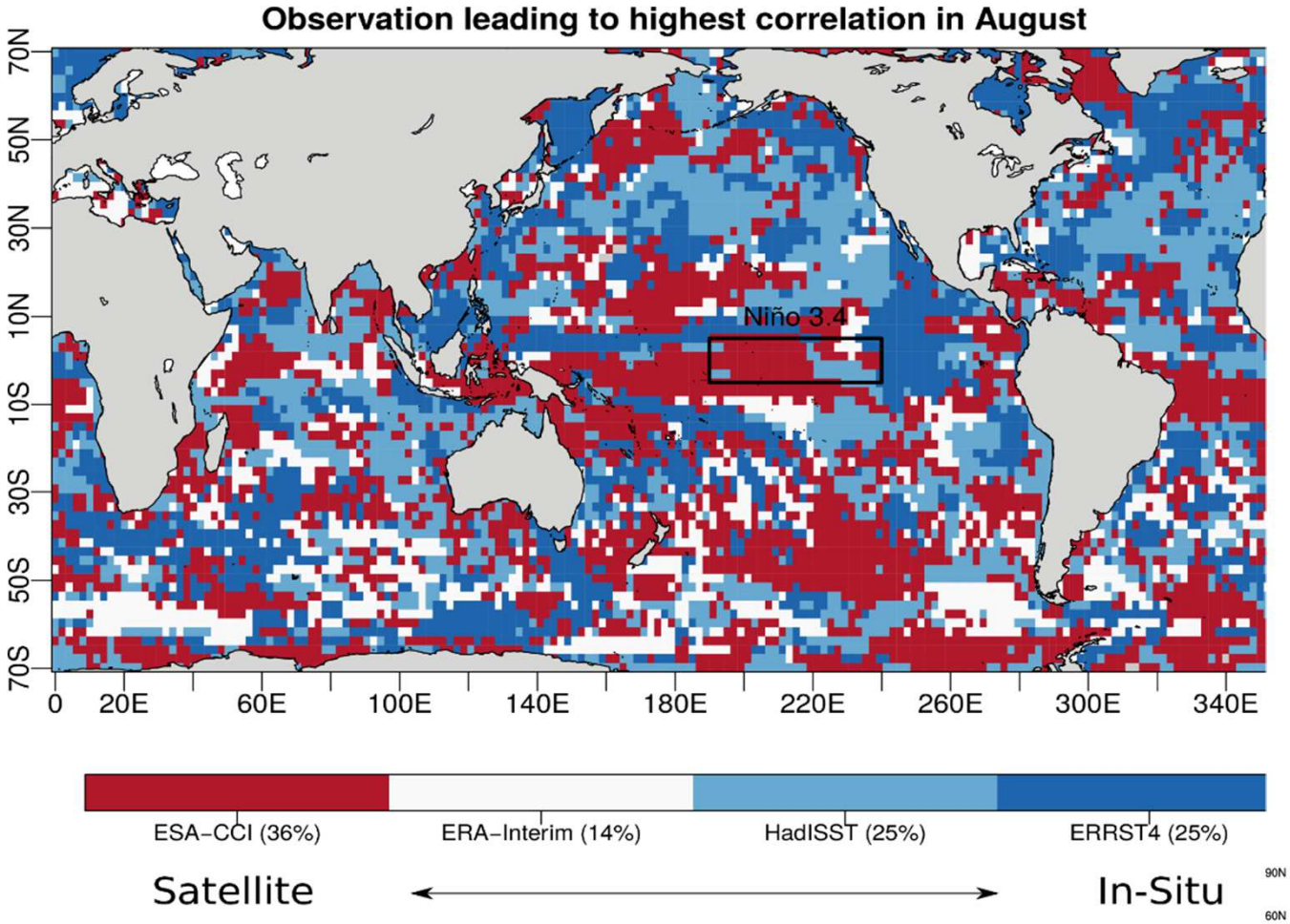
Uncertainty in (seasonal) forecast verification

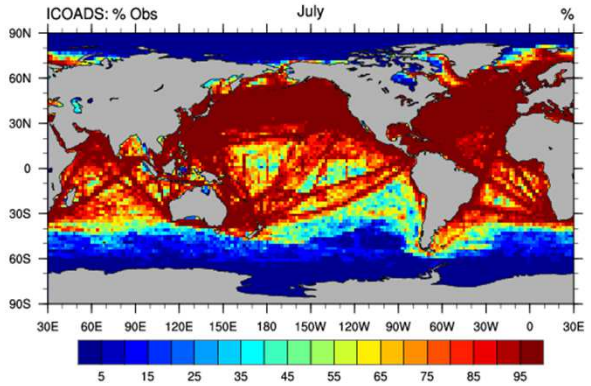


The verification of SST forecasts is limited by observational uncertainty at high latitudes

Bellprat et al. (under review)

Uncertainty in (seasonal) forecast verification

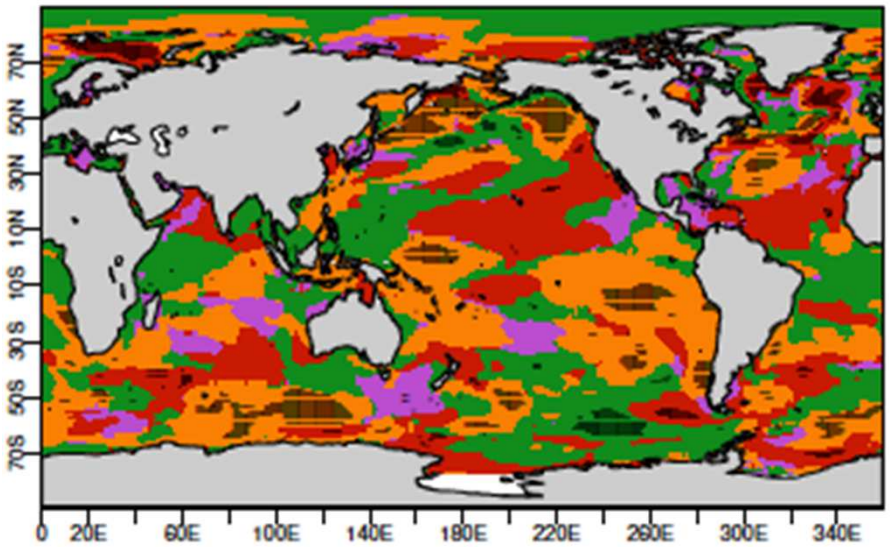




Massonnet et al. (2016, Science)

Climate model

Initialisation



Minimum RMSE of the SST for the forecast yrs 2-5, get with different initialisation

Volpi et al. (2016, ClimDyn)

FFI — **Full Field initialisation**

OSI-AI — **Ocean-Sea-Ice Anomaly initialisation**

ρ-OSI-wAI — **OSI weighted anomalies**

NOINI — **No Initialisation**

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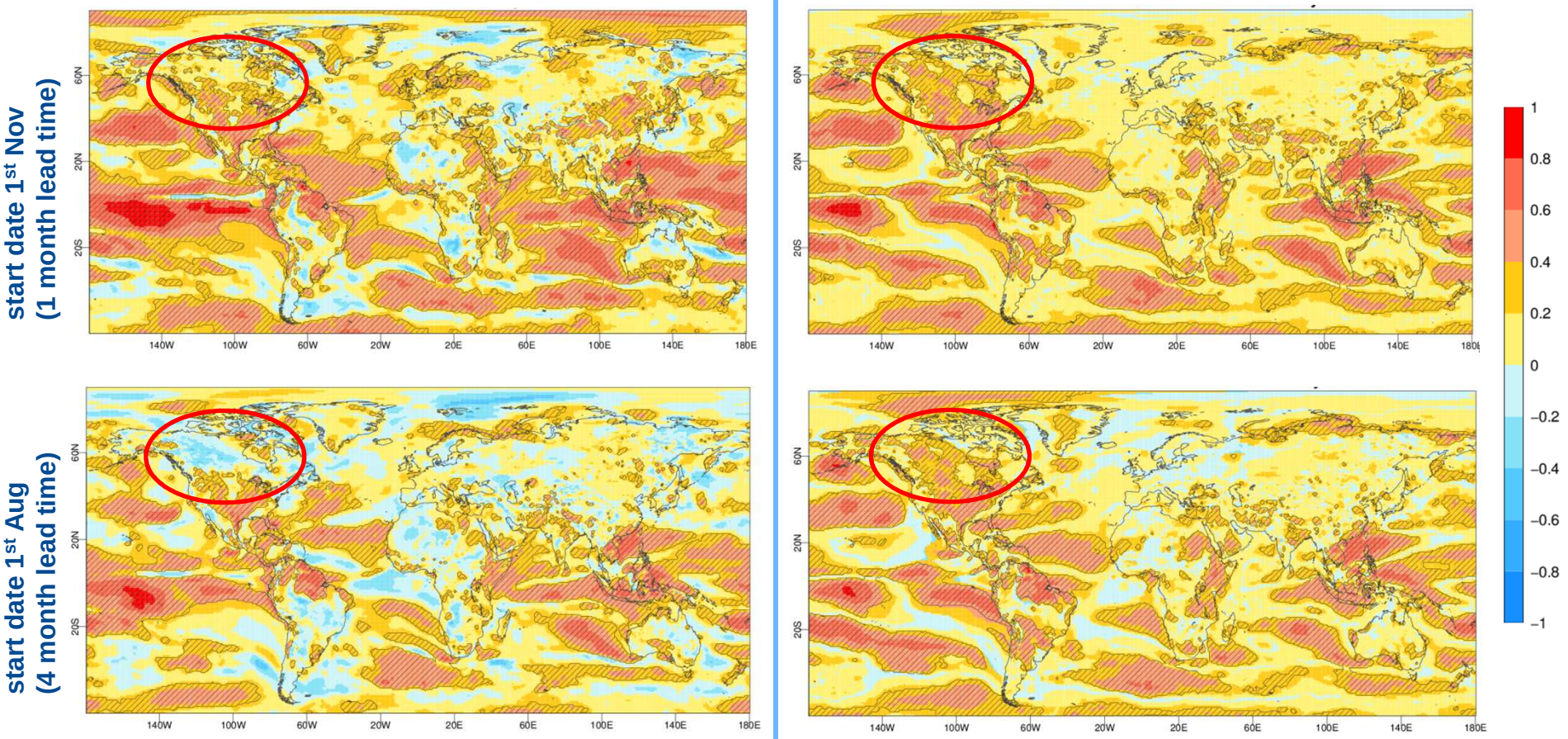
Ensemble mean correlation: ECMWF S4 and ERA-Interim
DJF season (1981-2015)

ECMWF S4 predicted 10m wind speed

10m wind speed from ECMWF S4 predicted Niño3.4 index

start date 1st Nov
(1 month lead time)

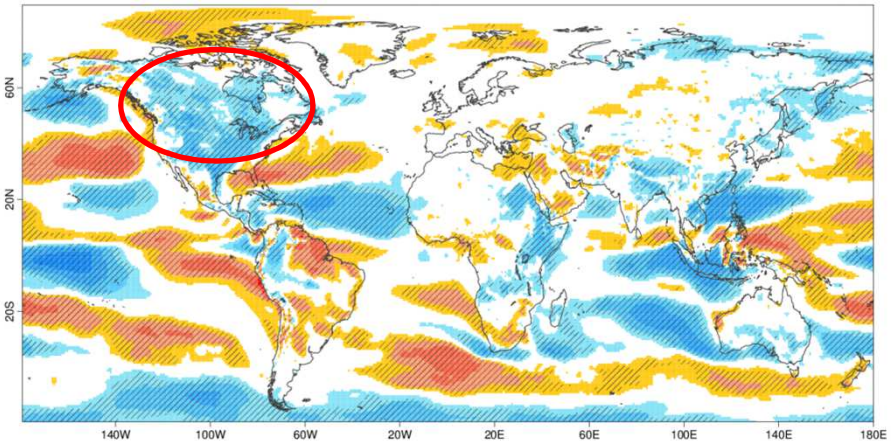
start date 1st Aug
(4 month lead time)



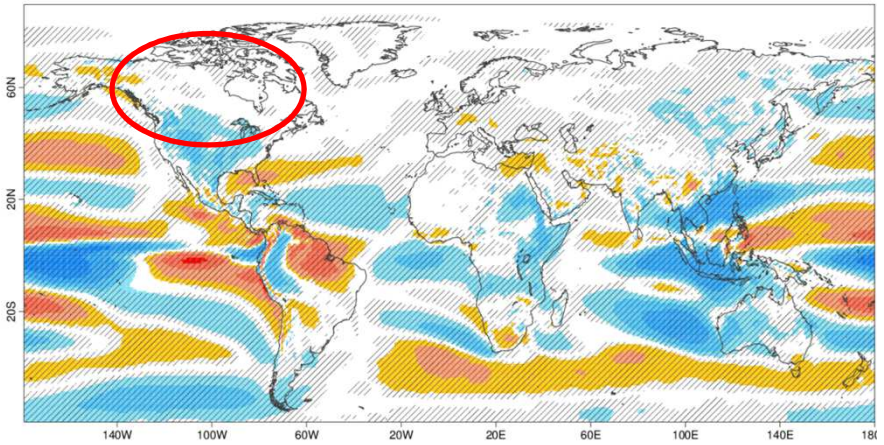
Gonzalez-Reviriego et al. (in preparation)

One-point correlation maps: Niño3.4 index and 10m wind speed DJF season (1981-2015)

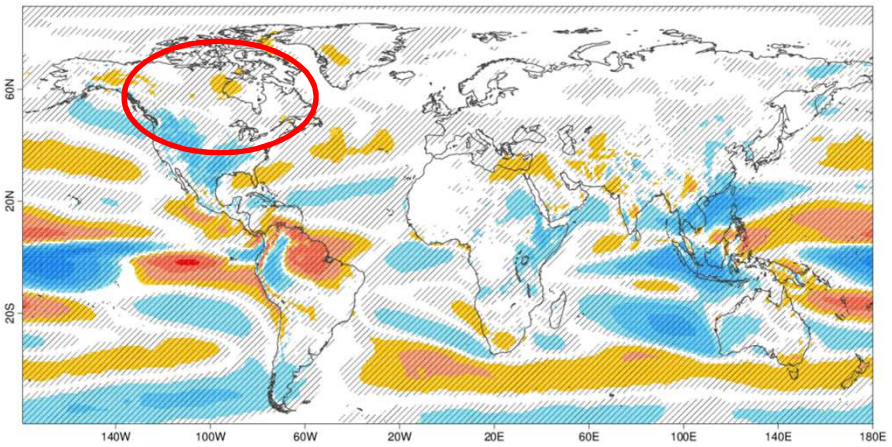
ERA-Interim

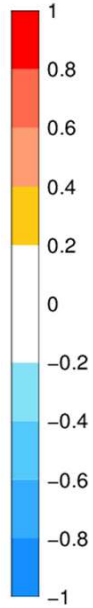


ECMWF S4, start date 1st Nov (1 month lead time)



ECMWF S4, start date 1st Aug (4 month lead time)



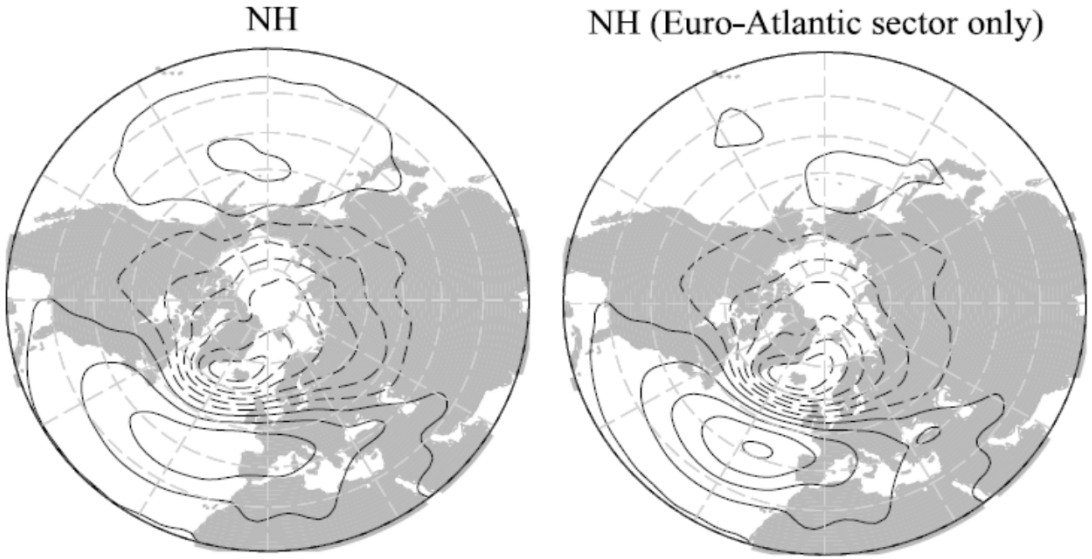


Gonzalez-Reviriego et al. (in preparation)

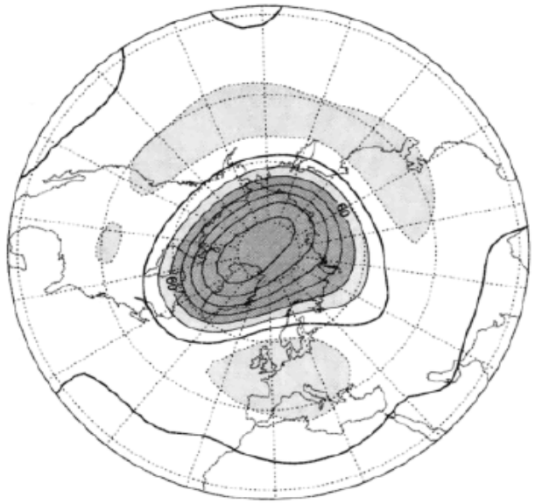
On the hemispheric scale of the winter NAO

AO

NAO

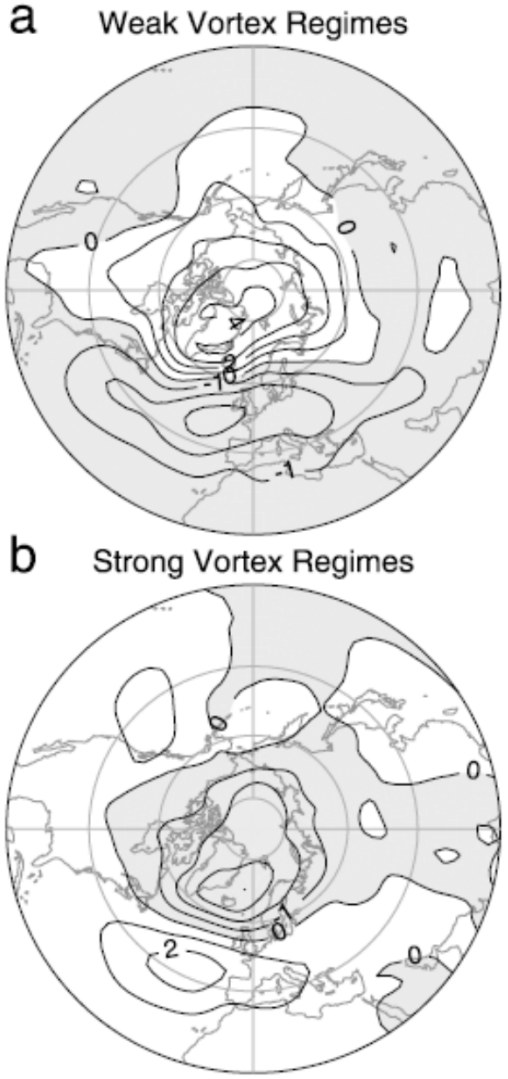


(JFM, 1958-1999; Thompson et al. 2003)



NAM at 50hPa

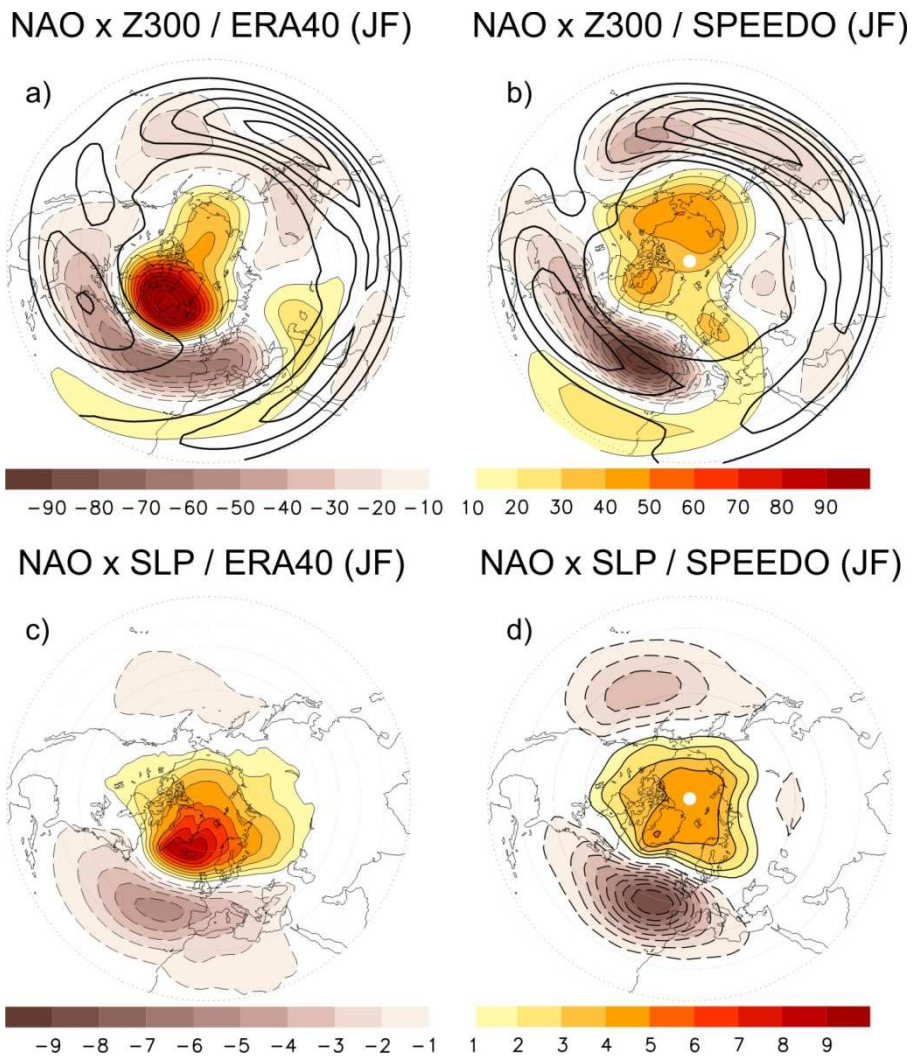
(Z50; Baldwin et al. 1994)



(SLP; Baldwin and Dunkerton 2001)

On the hemispheric scale of the winter NAO

NAO/CWP paradigm



winter NAO has a distinct global signature at upper-tropospheric levels

(Branstator 2002)

On the hemispheric scale of the winter NAO

NAO/CWP paradigm

SPEEDY (e.g. Haarsma and Hazeleger 2007)

intermediate complexity AGCM

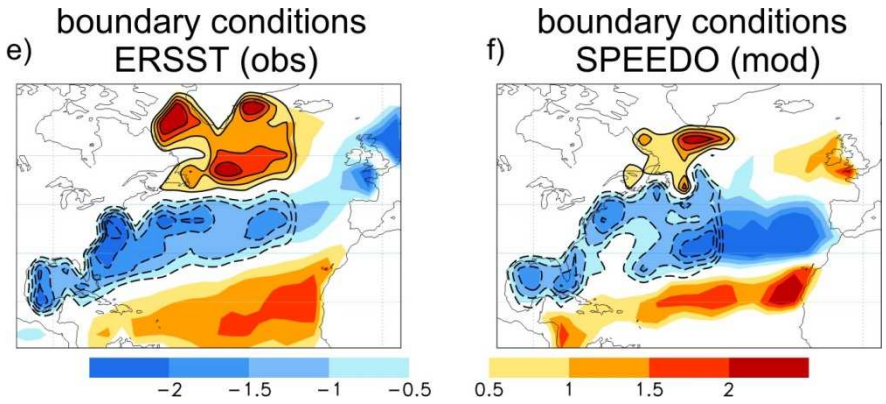
no stratosphere

T30 (96 lon x 48 lat)

L7 (925, 850, 700, 500, 300, 200, 100)

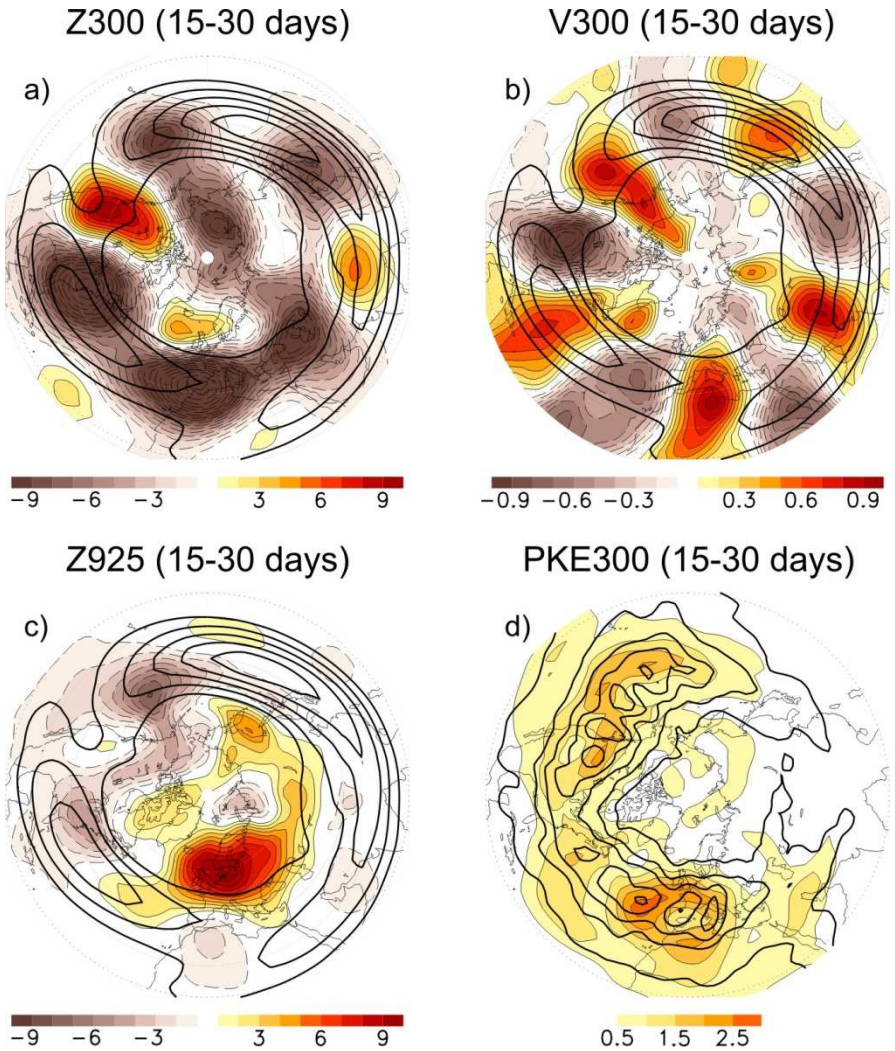
200-member, 30-day long CTL + EXP (NAO+, NAO-)

[vs. EC-EARTH3.2 T255L91]



On the hemispheric scale of the winter NAO

quasi-equilibrium, non-linear stage



García-Serrano and Haarsma (2016, ClimDyn)

MINISTERIO DE ECONOMIA Y COMPETITIVIDAD

Barcelona Supercomputing Center
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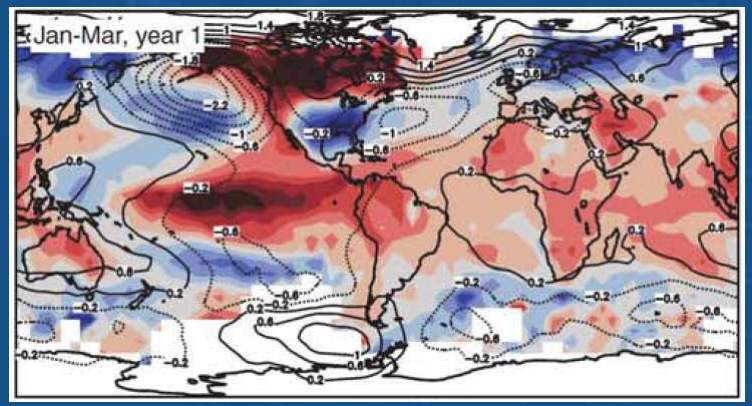
DANAE

"**D**ynamics **A**nd predictability of the ENSO teleconnection in the **NAE** region"

ref. CGL2015-68342-R / 146.400€

I. Bladé (UB), R. Haarsma (KNMI), T. Ambrizzi (USP), D. Matei (MPI),
A. de la Cámara (NCAR), M. Ábalos (NCAR)
+ 1 Postdoc / + 1 PhD



(Brönnimann 2007)

ENSO teleconnection to NAE mid/late-winter

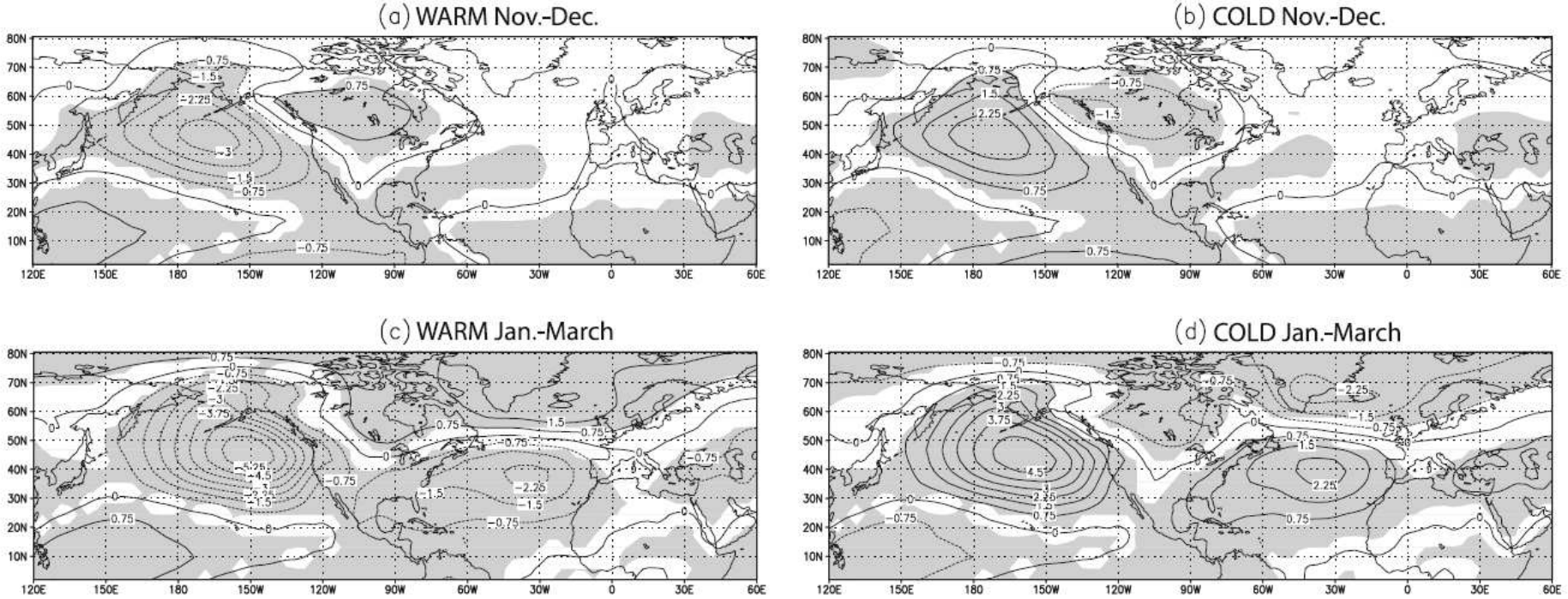
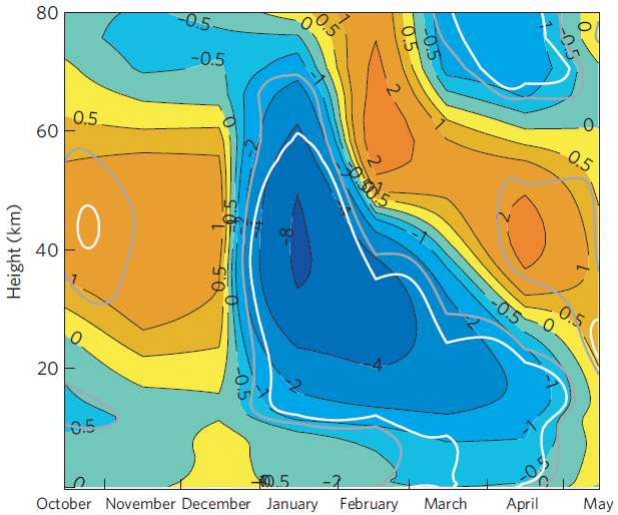
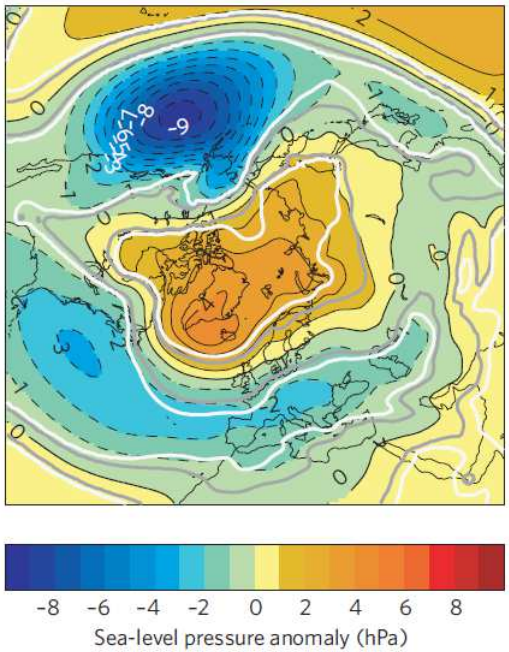


Figure 1. Mean sea level pressure anomaly (SLPA) (in hPa) in (a, b) November–December and (c, d) January–March during warm (Figures 1a and 1c) and cold (Figures 1b and 1d) ENSO events, respectively defined as Niño3 sea surface temperature anomalies (SSTA) > 1C and <–1C. Positive (negative) SLPA are displayed as full (dashed) lines and shading indicates significant values at two-sided 10% significance level according to a Student's t-test (the null hypothesis is that the difference between the cold and warm ENSO samples and the long-term mean is zero). SLPA and SSTA are high-pass filtered by removing all frequencies <0.1 cycle-per-year before the analysis.

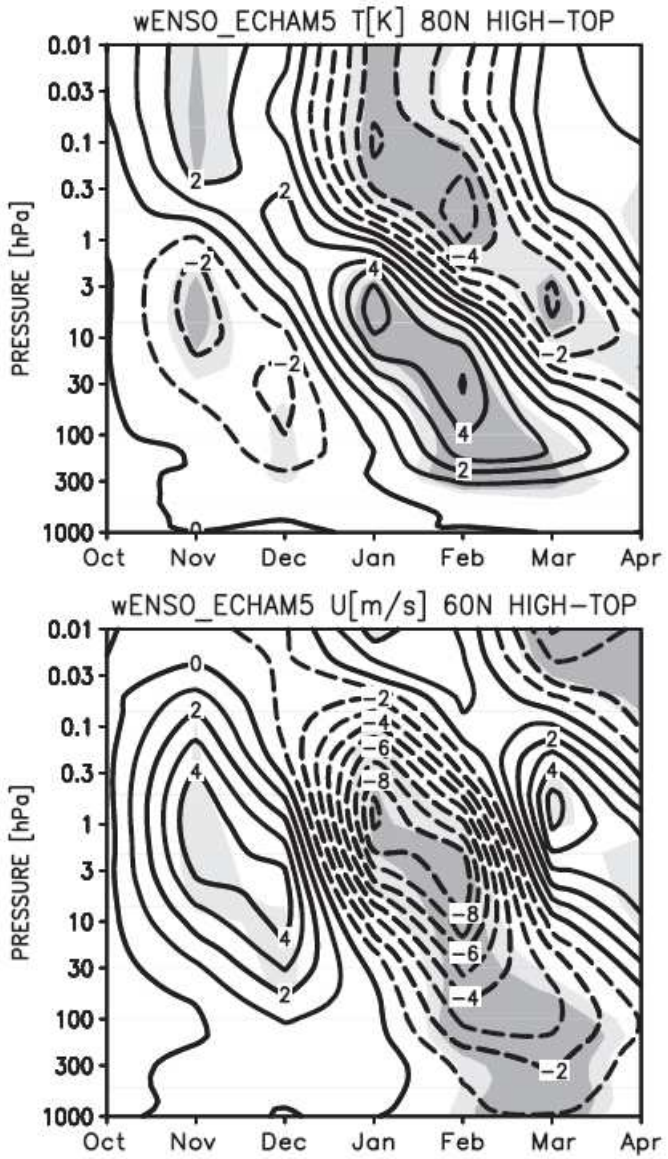
Gouirand et al. (2007, GRL)

ENSO teleconnection to NAE mid/late-winter



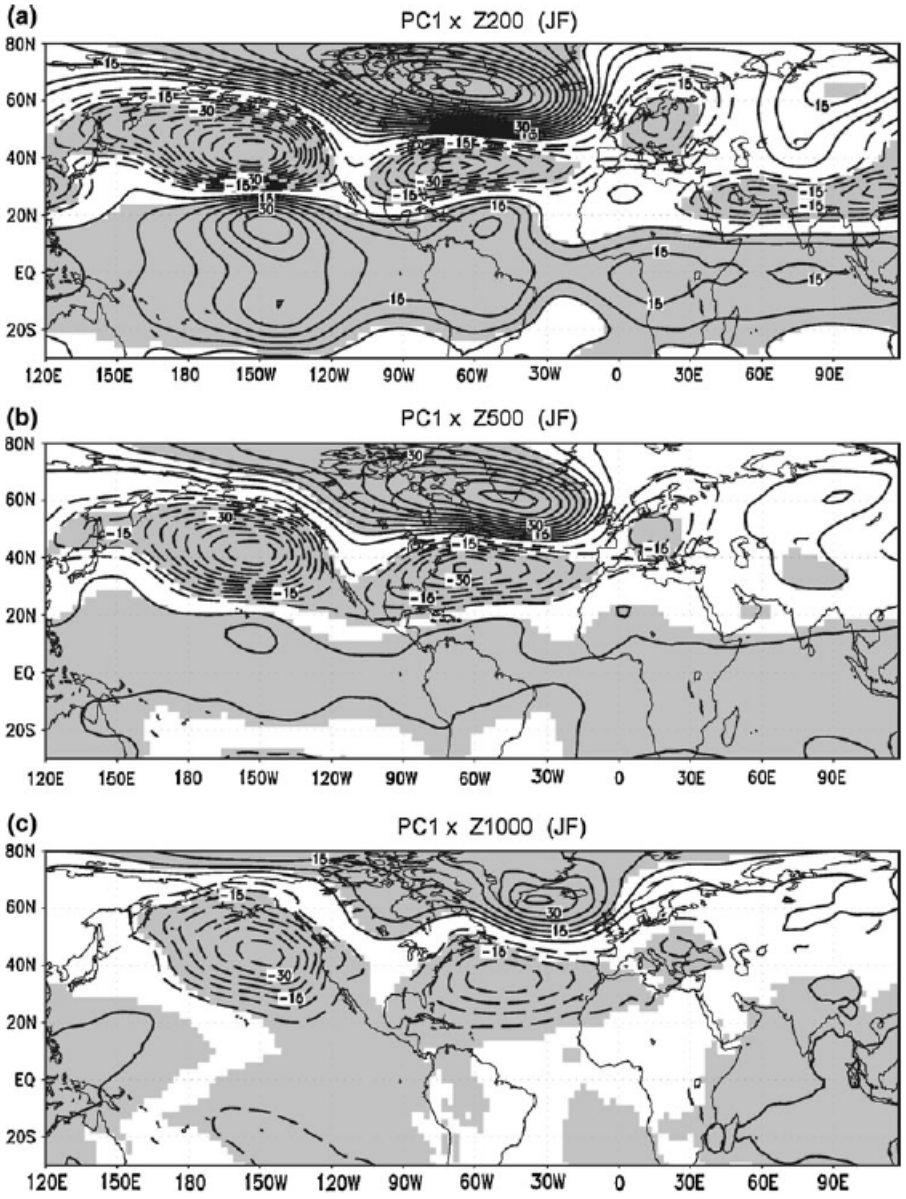


Ineson and Scaife (2009, Nat.Geo)

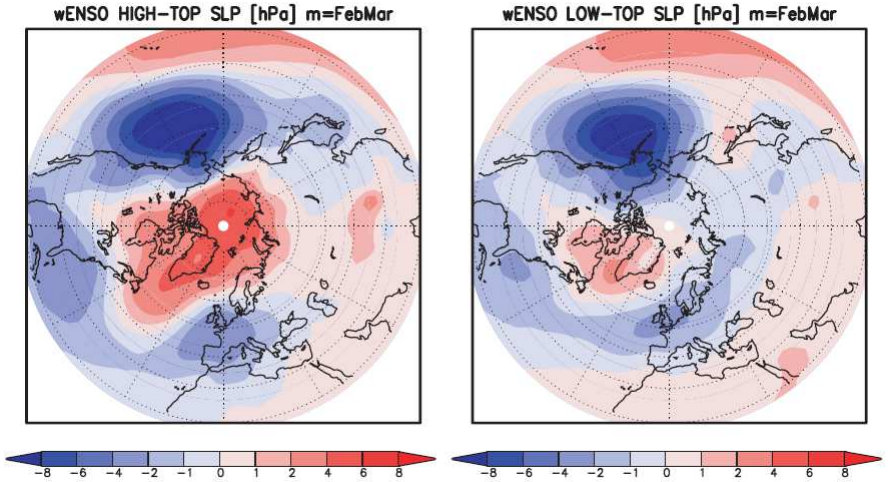


Cagnazzo and Manzini (2009, JCLIM)

ENSO teleconnection to NAE mid/late-winter



García-Serrano et al. (2011, ClimDyn)



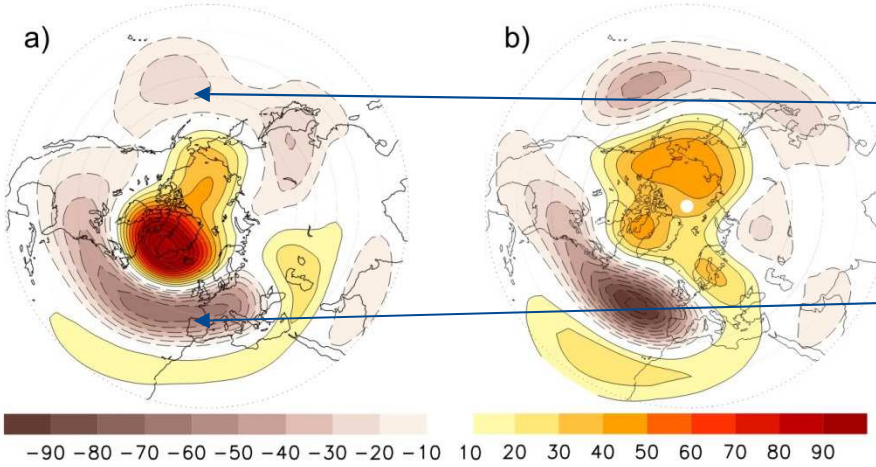
Cagnazzo and Manzini (2009, JCLIM)

- tropospheric pathway in JF?, which can explain the intraseasonal timing of the ENSO teleconnection (Bladé et al. 2008) at surface and in the polar vortex

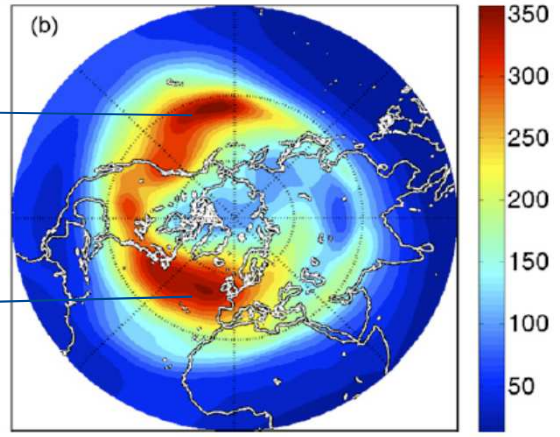
- stratospheric pathway in FM?, acting as a positive feedback, helping the SLP anomaly to persist into early-spring

EXTRA SLIDES

NAO x Z300 / ERA40 (JF)

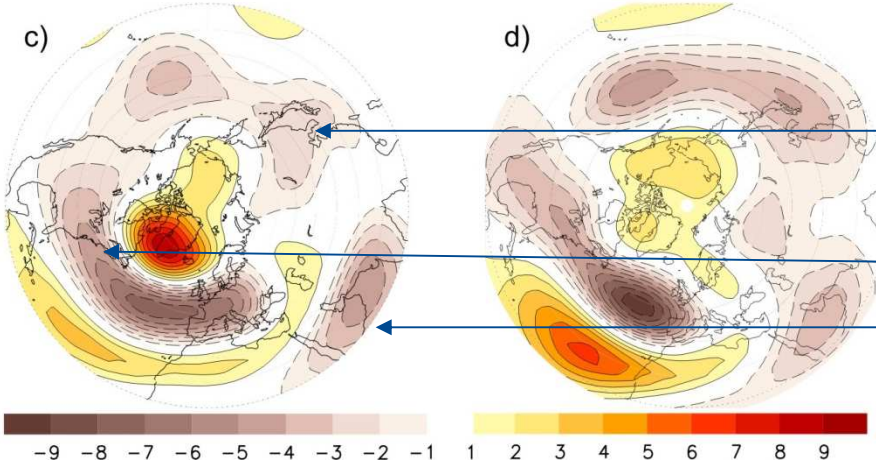


NAO x Z300 / SPEEDO (JF)

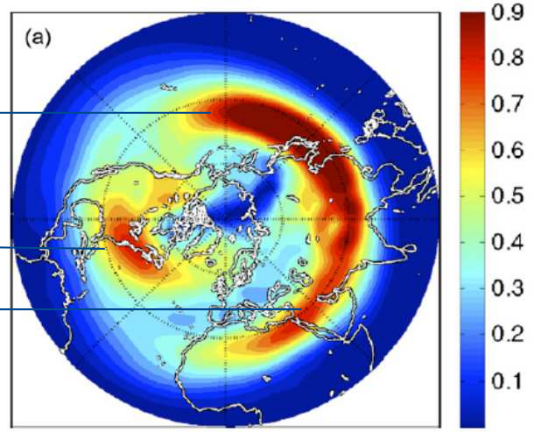


(pke_250hPa; Vallis and Gerber 2008)

NAO x PSI300 / ERA40 (JF)

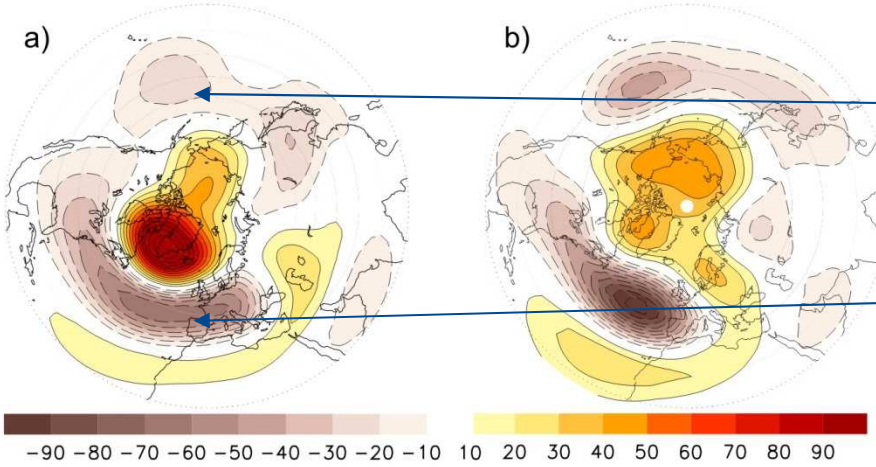


NAO x PSI300 / SPEEDO (JF)

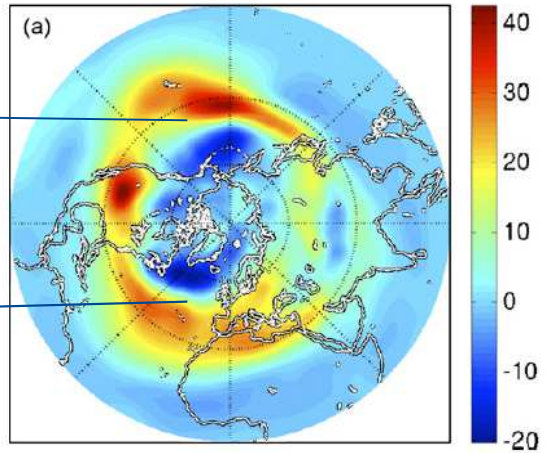


(σ_500hPa; Vallis and Gerber 2008)

NAO x Z300 / ERA40 (JF)

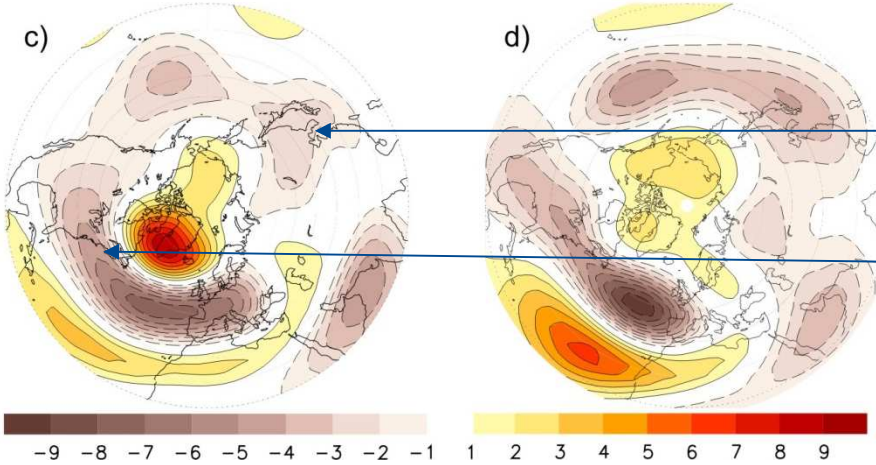


NAO x Z300 / SPEEDO (JF)

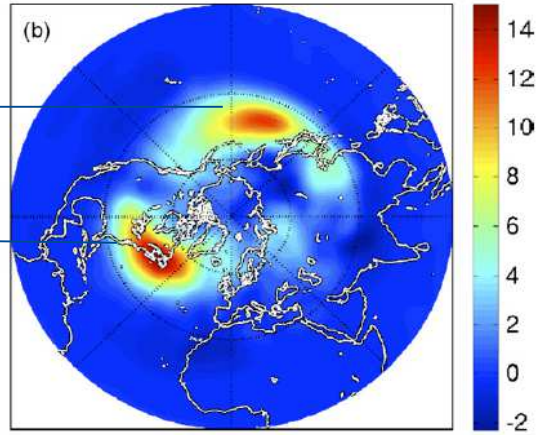


(u'v'_250hPa; Vallis and Gerber 2008)

NAO x PSI300 / ERA40 (JF)



NAO x PSI300 / SPEEDO (JF)



(v'T'_500hPa; Vallis and Gerber 2008)