

Assessing seasonal predictability over the North Atlantic / Europe arising from stratosphere – troposphere coupling in a seasonal prediction system

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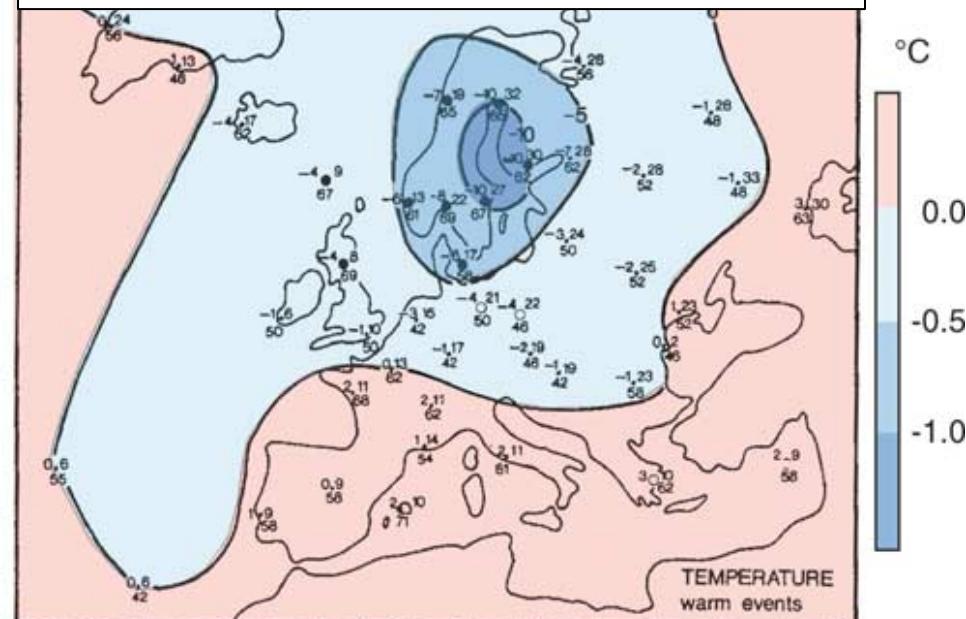
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University of Hamburg / CliSAP Cluster of Excellence



A connection between El Niño and Europe?

El Niño events are suggested to cause anomalies in winter temperature and precipitation patterns over the North Atlantic / Europe region.

Figure: composite anomaly temperature for 26 El Niño events (1880 – 1988)



Fraedrich & Müller (1992),
from: Brönnimann (2007)



1. Prediction skill in the MPI-ESM seasonal prediction system

2. An El Niño teleconnection pathway through the stratosphere

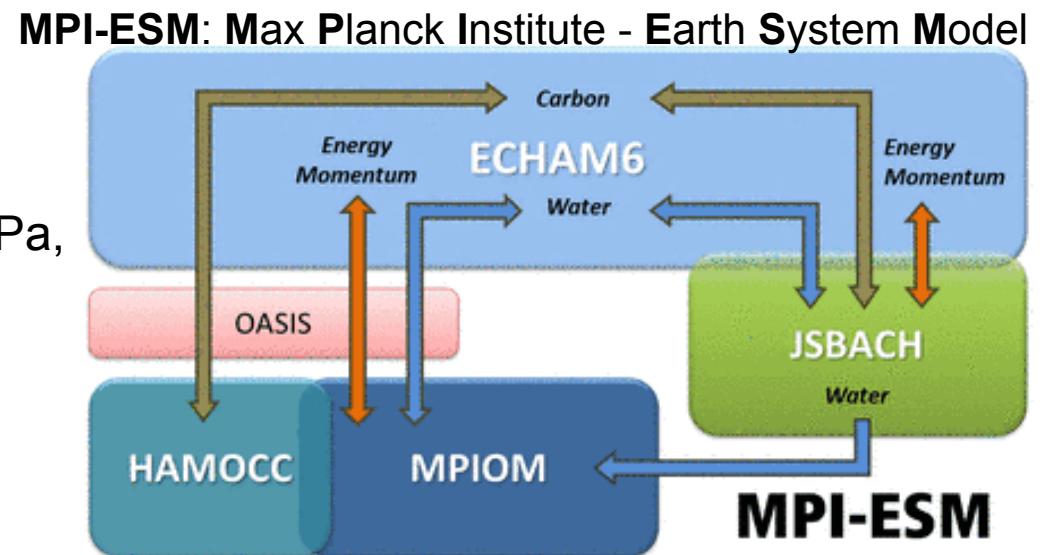
3. Predictability in the North Atlantic / Europe region



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Setup of the MPI-ESM seasonal prediction system

- ECHAM6 (atmosphere)
 - horizontal T63 ($1.9^\circ \times 1.9^\circ$)
 - vertical L47 (47 levels up to 0.01hPa, ~24 levels above 200hPa)
- MPIOM (ocean) plus sea ice
 - horizontal: 1.5°
 - vertical: 40 levels



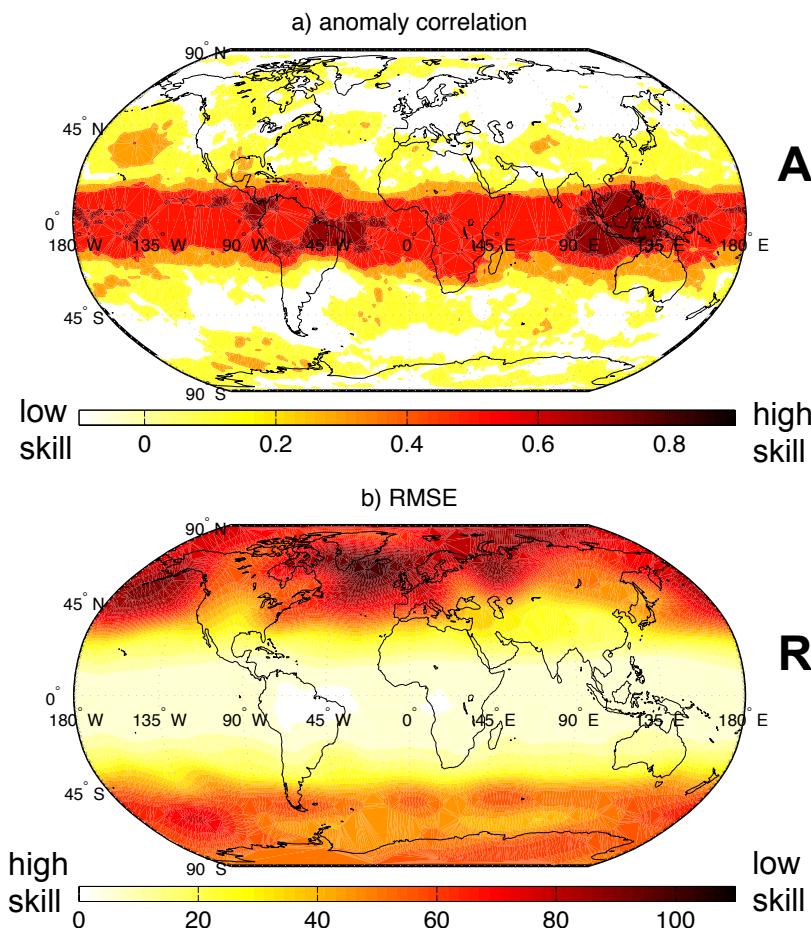
Data assimilation: Nudging (Newtonian relaxation) towards reanalysis data

Hindcasts: November and May start dates for 1980 - 2011

- initialize every November 1 and May 1 with a runtime of 1 year
- 9 ensemble members for each start date

Literature on MPI-ESM: Giorgetta et al (2012), Stevens et al (2013), Jungclaus et al (2013), Schmidt et al (2013)

Model prediction skill



Anomaly Correlation Coefficient (ACC)

500hPa geopotential height prediction skill
for Dec/Jan/Feb, 1982 – 2010 average:
MPI-ESM-LR model vs ERAinterim reanalysis

Root Mean Square Error (RMSE)



1. Prediction skill in the MPI-ESM seasonal prediction model

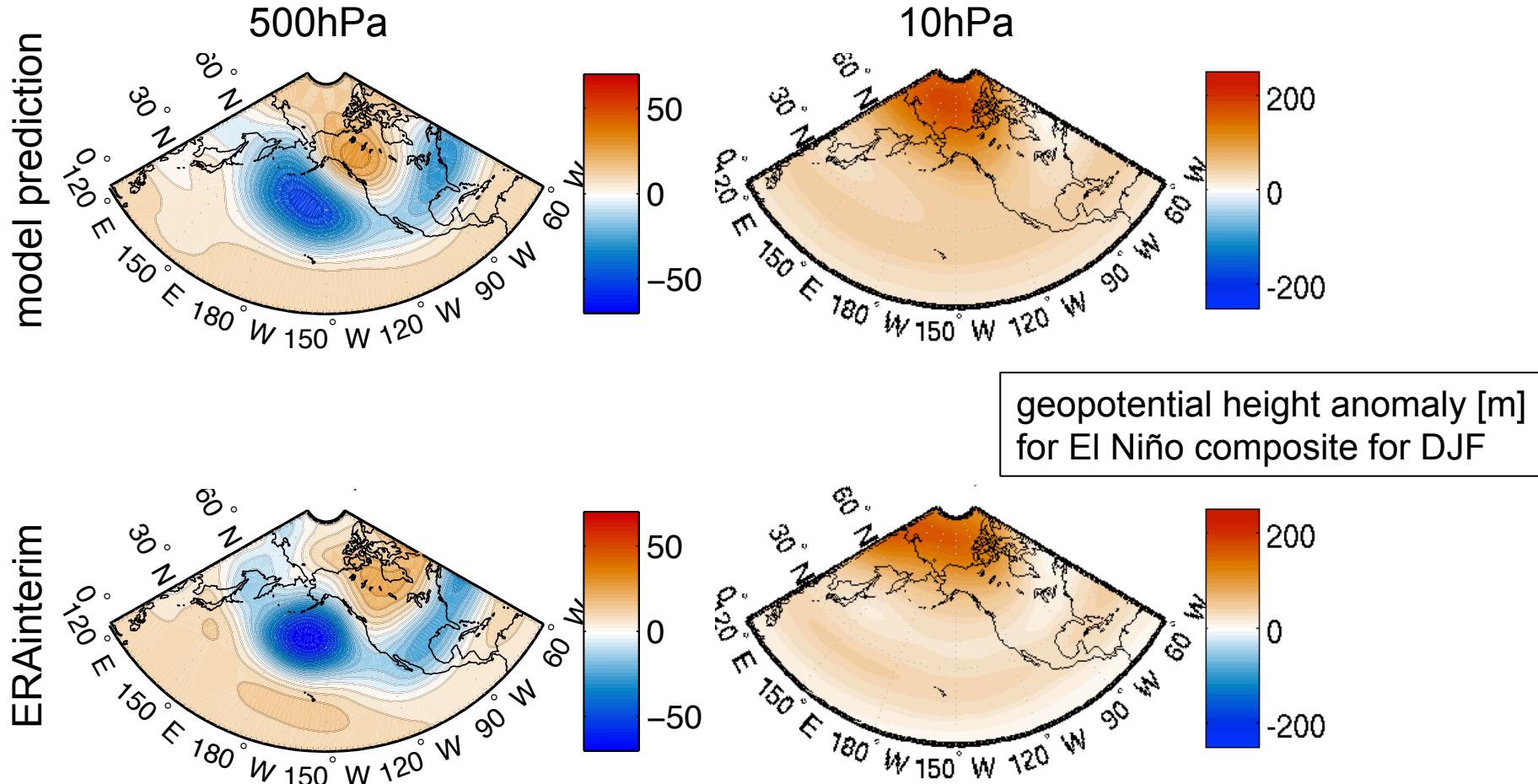
2. An El Niño teleconnection pathway through the stratosphere

3. Predictability in the North Atlantic / Europe region



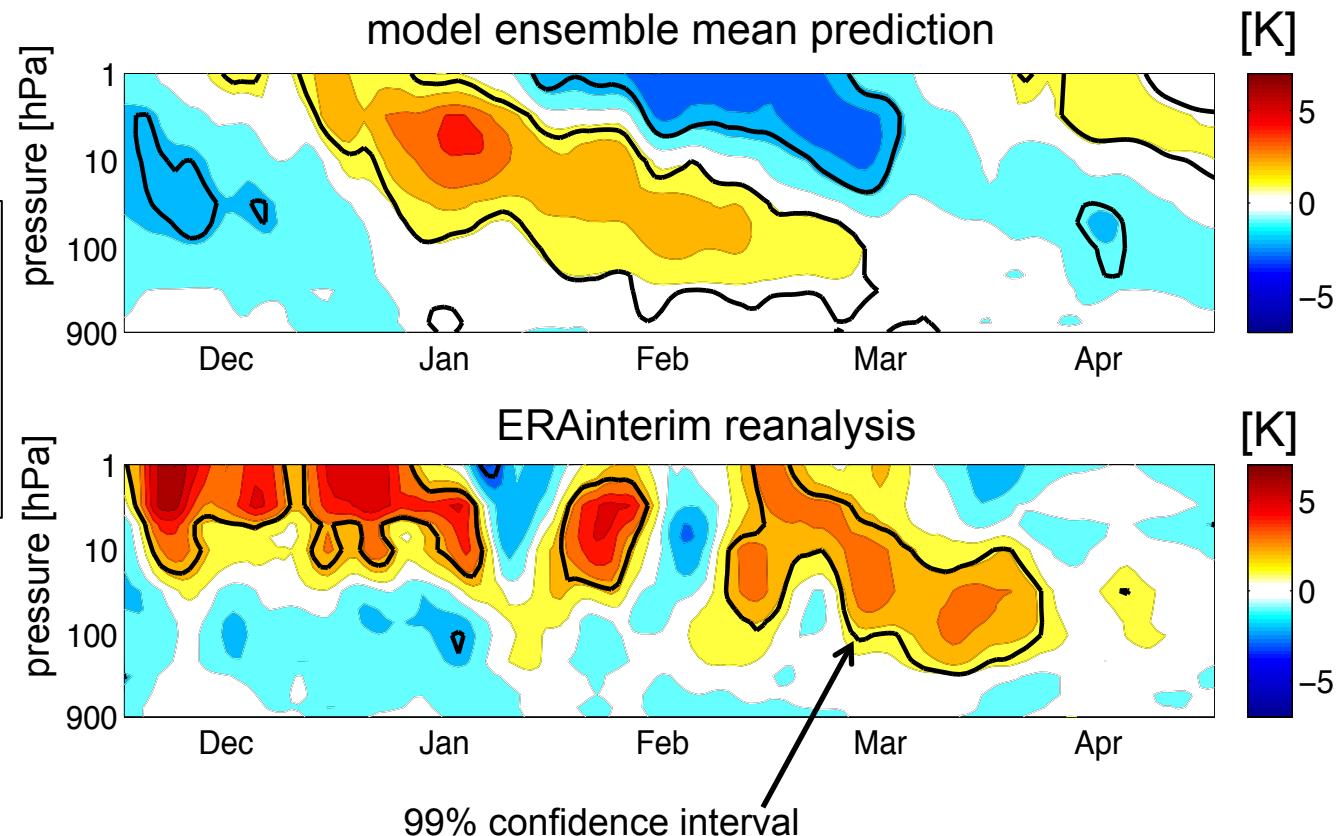
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El Niño teleconnection to the stratosphere



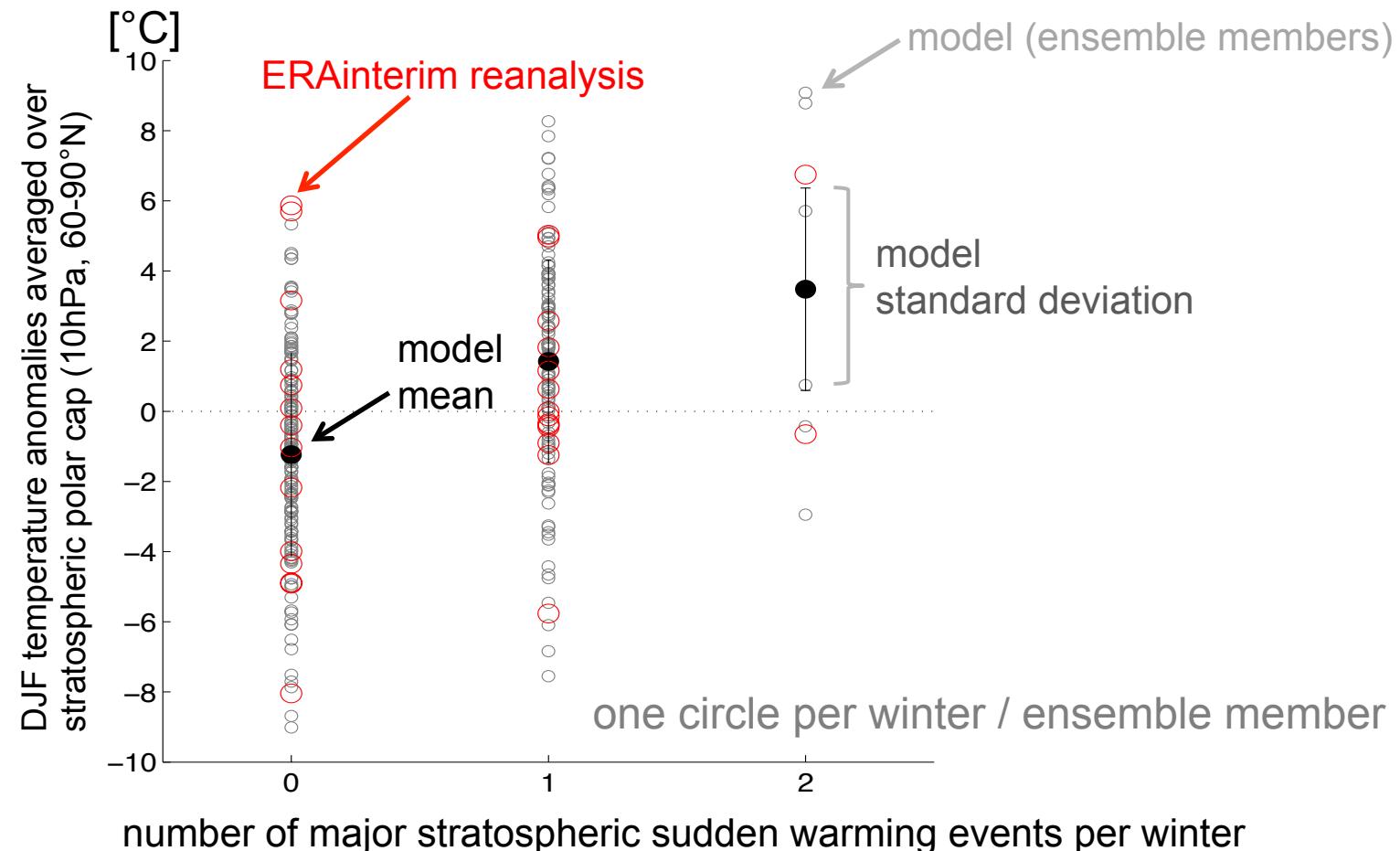
Downward propagation of warm anomaly to the lower stratosphere

80°N temperature anomalies averaged over all El Niño winters
[cp. Fig 4, Manzini et al (2006)]



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Sudden warmings (SSWs) are more frequent for a warm polar stratosphere, as observed for El Niño events





1. Prediction skill in the MPI-ESM seasonal prediction model

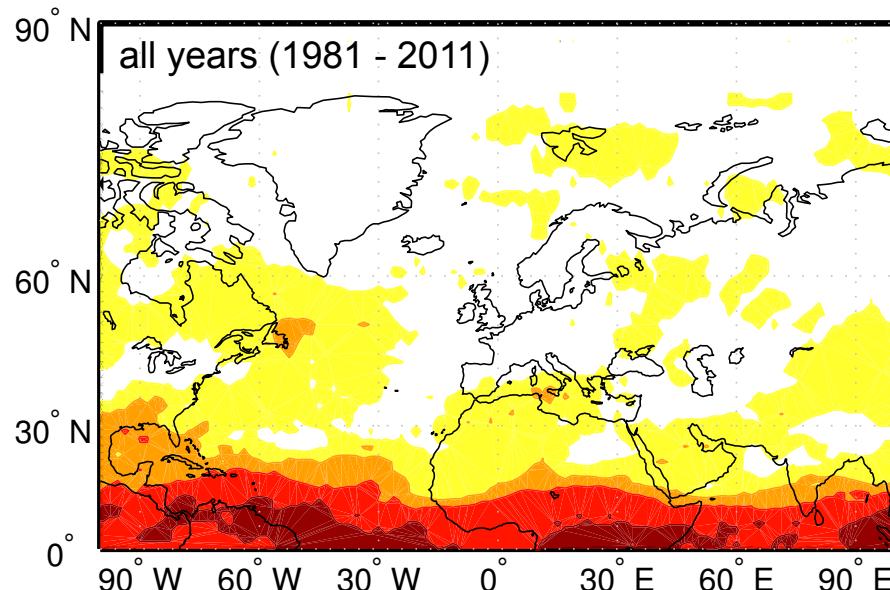
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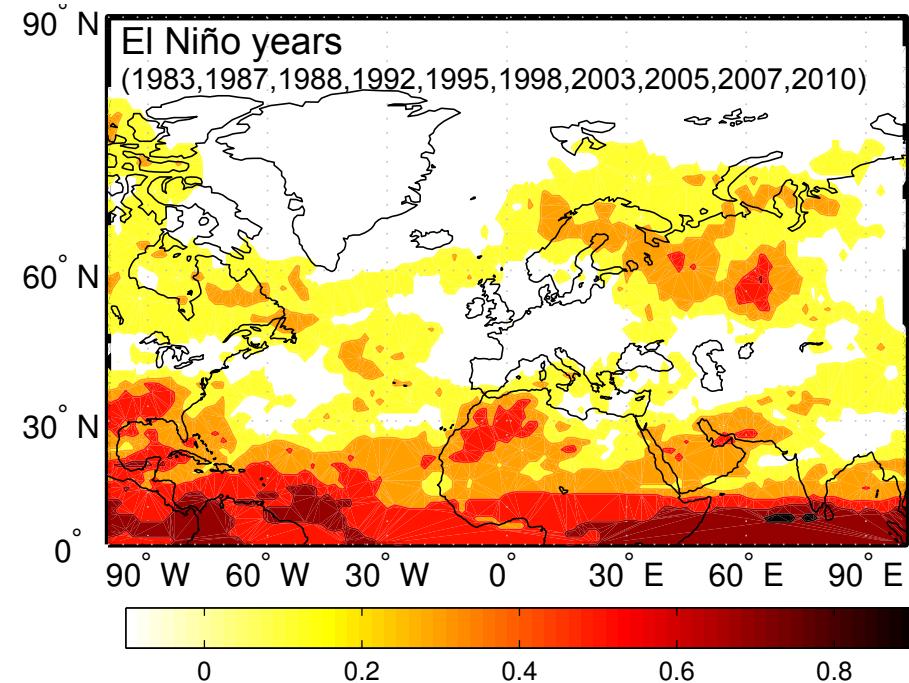


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Improved Spring predictability over Europe during El Niño years

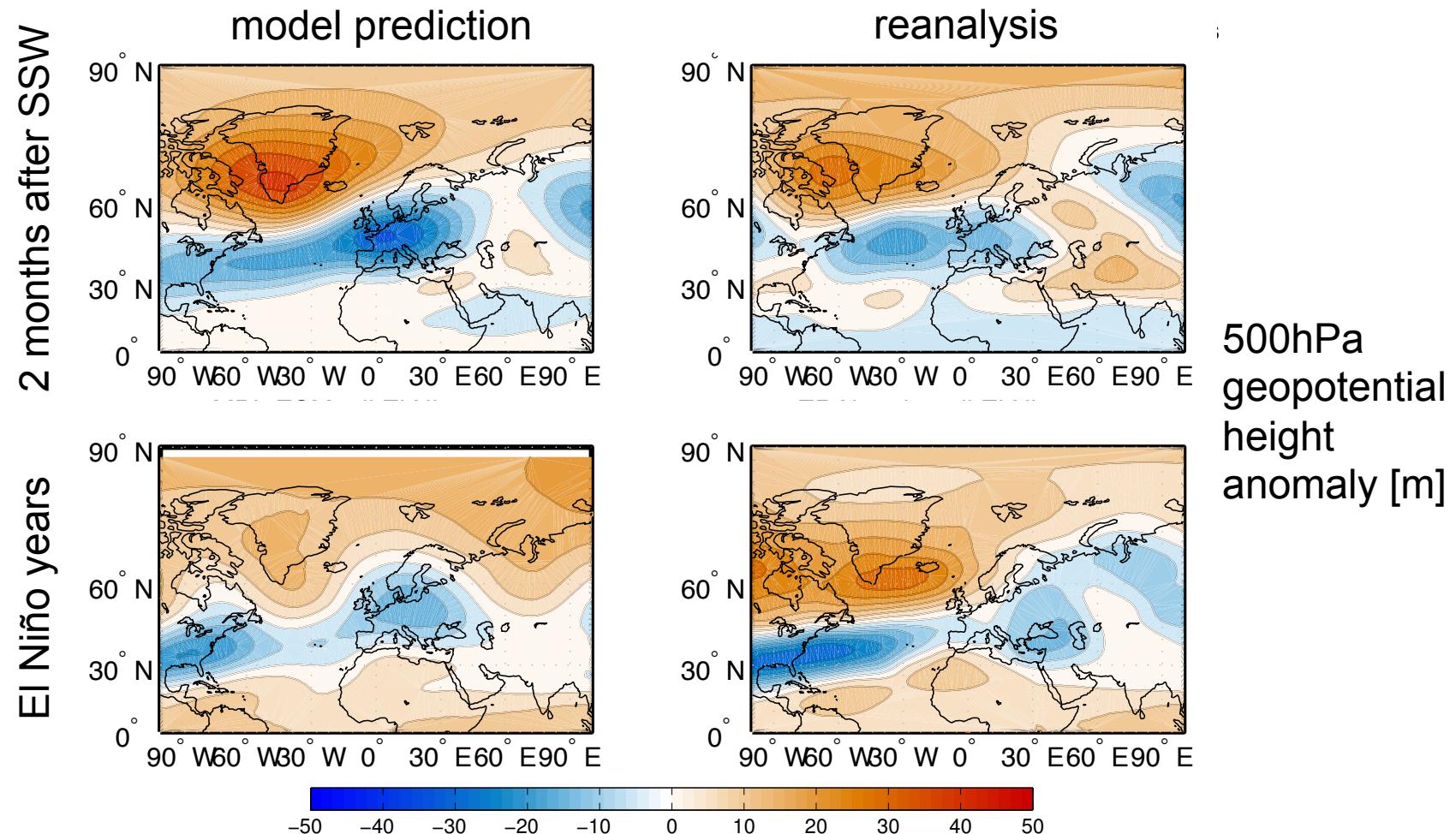


Anomaly Correlation Coefficient (ACC)
for 500hPa geopotential height for JFM

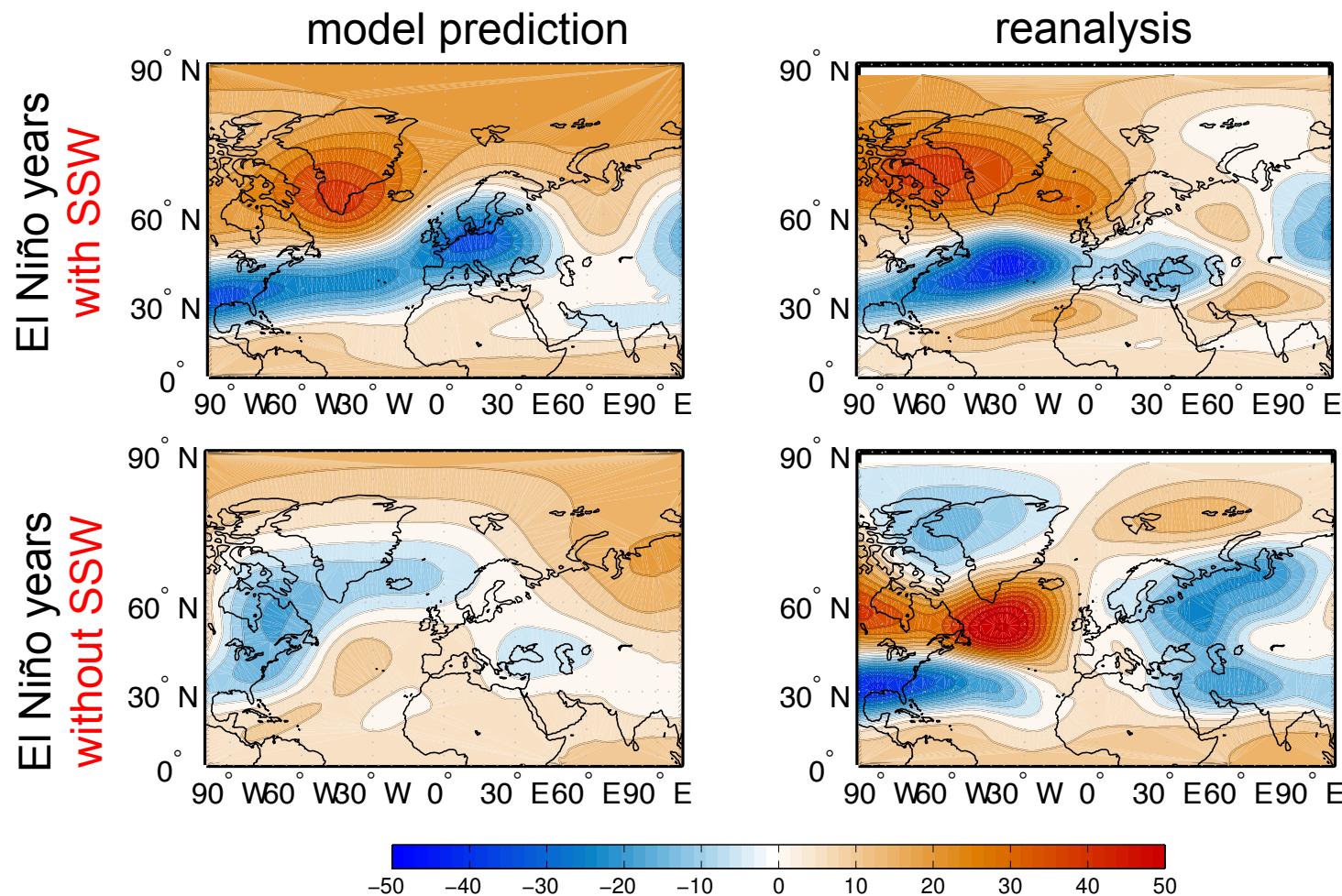


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Variability over Europe for El Niño vs. SSW events



El Niño variability over Europe only reproduced for winters with SSW events





The seasonal forecasting efforts with the MPI-ESM prediction system show the first successful results in terms of a representation of the El Niño teleconnection pattern through the stratosphere.

Stratospheric sudden warming events contribute to the observed seasonal evolution in the stratosphere, as well as to predictability over the North Atlantic / Europe region.

While specific stratospheric sudden warming events cannot be predicted beyond about a month, the phase of ENSO gives an indication of the stratospheric seasonal mean temperature and the tendency of occurrence of sudden warming events.

Predictability over Europe can be increased by using both the stratosphere and El Niño as predictors.

Domeisen, D.I.V., A. H. Butler, K. Fröhlich, M. Bittner, W. Müller, J. Baehr, 2014: Seasonal Predictability over Europe arising from El Niño and Stratospheric Variability in the MPI-ESM Seasonal Prediction System, in review with J. Clim.

Thank you for your attention!



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[Poster EGU2014-12679](#)

Stratospheric Pathway of El Niño-Southern Oscillation in CMIP5 Models

Maddalen Iza, Natalia Calvo, Margaret Hurwitz, Chiara Cagnazzo, Cristina Peña-Ortiz, Amy Butler, Sarah Ineson, Elisa Manzini, and Chaim Garfinkel

[Poster EGU2014-8613](#)

On the relationship between ENSO, Stratospheric Sudden Warmings and Blocking

David Barriopedro and Natalia Calvo



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