Building a statistical model that provides skillful winter precipitation forecasts for the Mediterranean and the Middle East.

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AER
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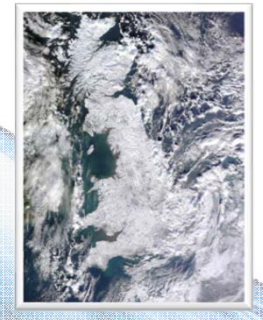
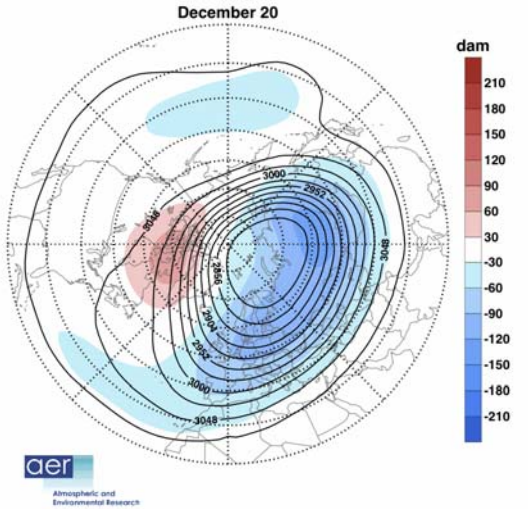


Outline

- Skillful seasonal prediction of precipitation remains a challenge
- Much of the current skill is derived from the prediction of ENSO and its influence on the atmospheric circulation.
- The North Atlantic Oscillation (NAO) is strongly related to jet variability in the North Atlantic.
- By using boundary forcings that skillfully predict the phase of the winter NAO, a skillful statistical can be developed that also predicts precipitation in the Mediterranean and the Middle East.

Arctic Oscillation (AO)/Polar Vortex

- Dominant mode of Northern Hemisphere climate variability. Also known as the North Atlantic Oscillation.
- Can be thought of as a metric of how much mixing of atmospheric masses is occurring in the atmosphere.

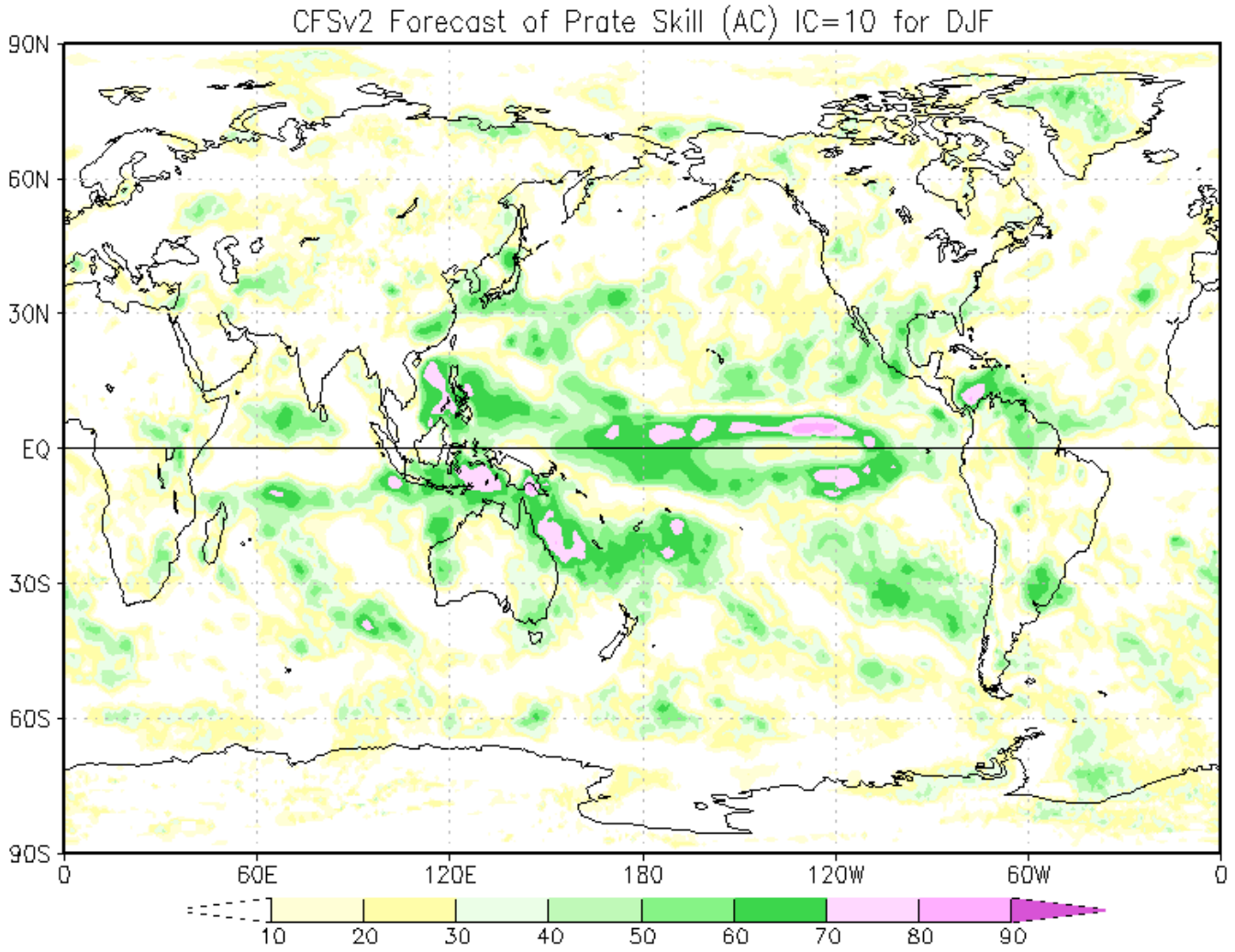


- Positive AO/strong polar vortex – little mixing with strong low pressure/cold air sitting over the pole and higher pressure/warmer air to the south.
- Negative AO/weak polar vortex – strong mixing causes warm air to rush the Pole and Arctic south spills equatorward

Model inputs

- El Niño Southern Oscillation (ENSO)
- North Atlantic sea surface temperatures
- October Eurasian snow cover.
- November Barents-Kara Arctic sea ice concentration
- Mediterranean sea surface temperatures
- Tropospheric precursors (sea level pressure anomalies).

Dynamical Model Precipitation Forecast Skill



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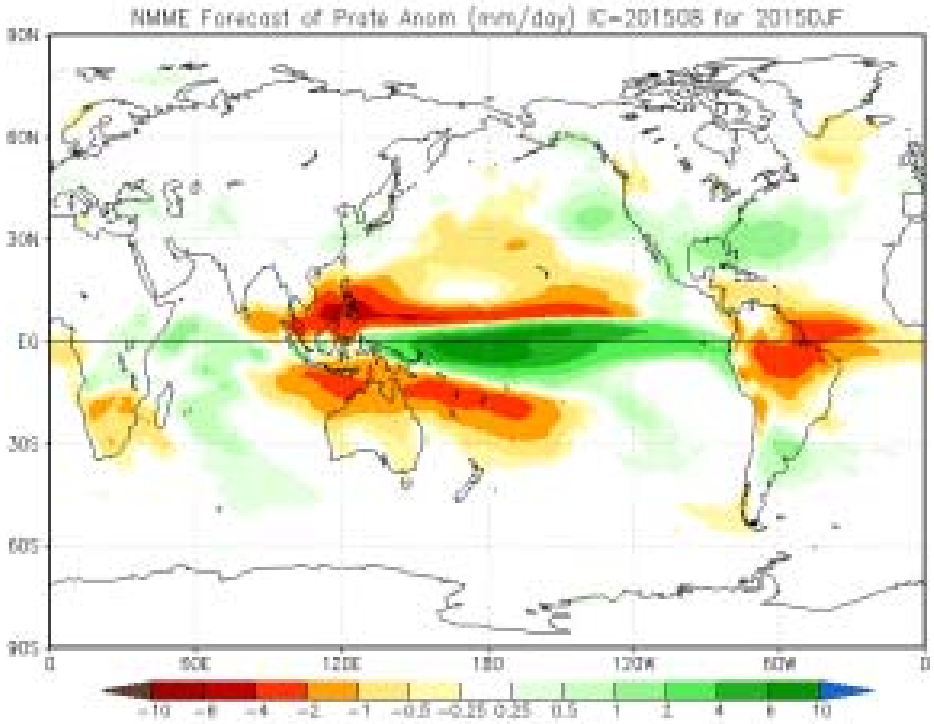
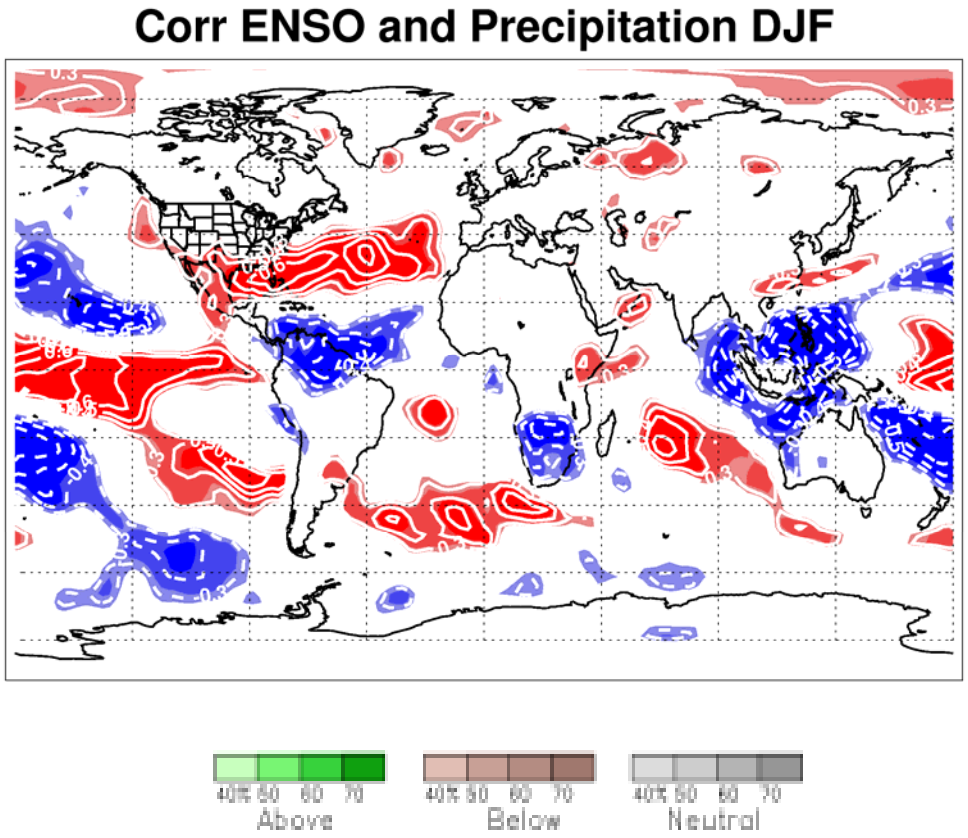
ENSO Dynamical Model Forecast





Models are confident in regions with high skill from ENSO and forecast looks nearly identical as from simple statistics

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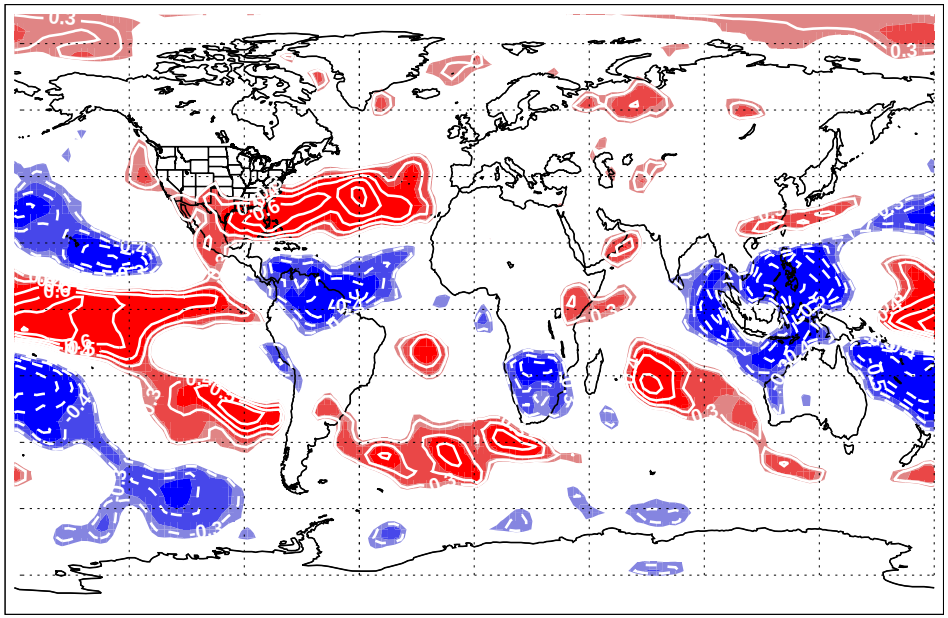
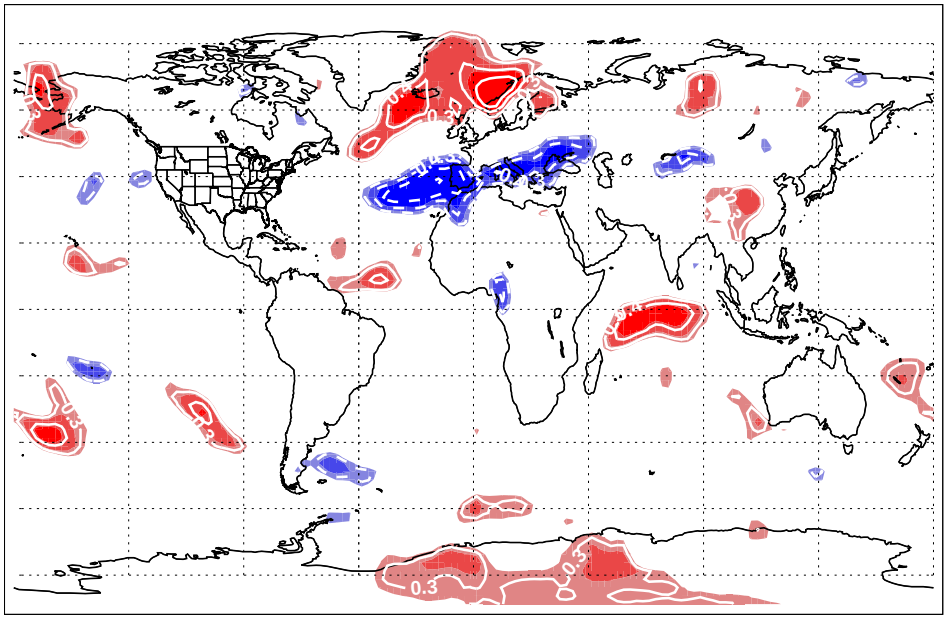
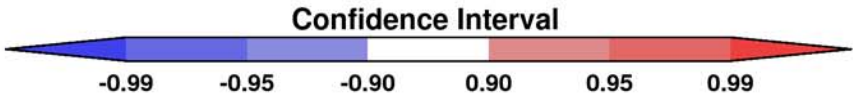
Correlations of ENSO with Global Precipitation

Corr ENSO and Precipitation DJF



Corr AO and Precipitation DJF





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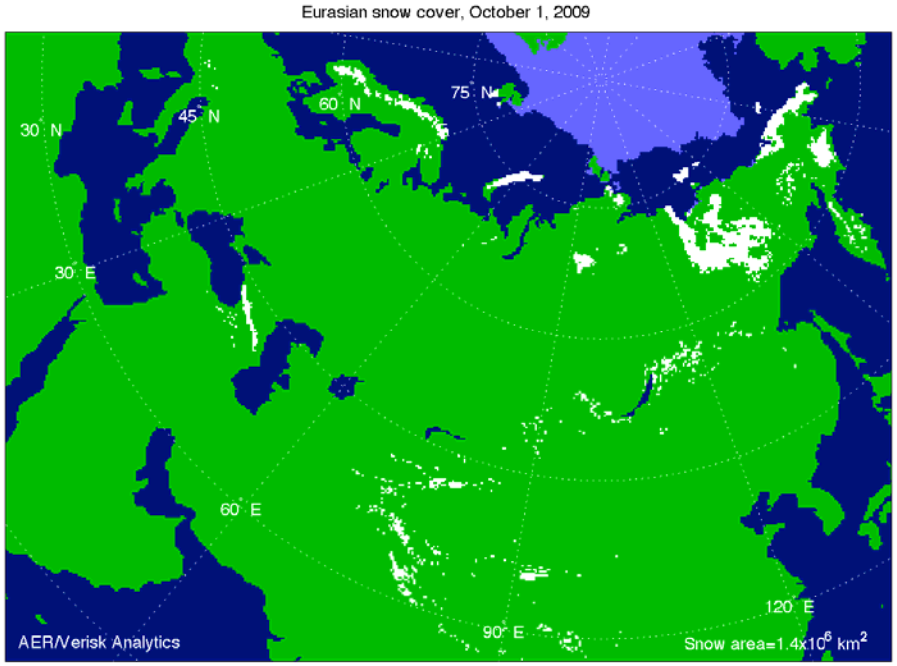
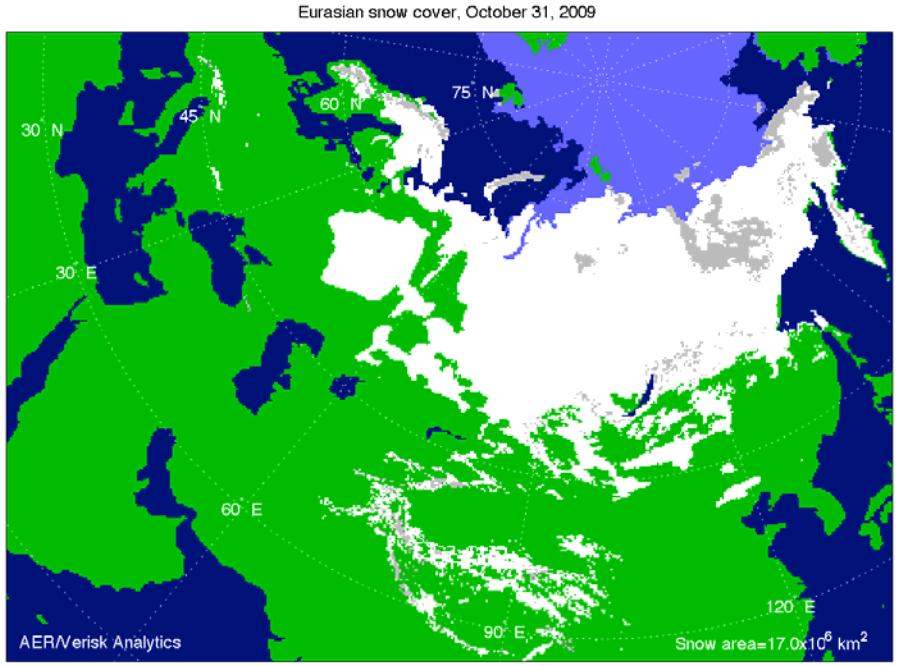
October Eurasian Snow Advance Index





An index that represents the rate of change of snow covered area during the month of October

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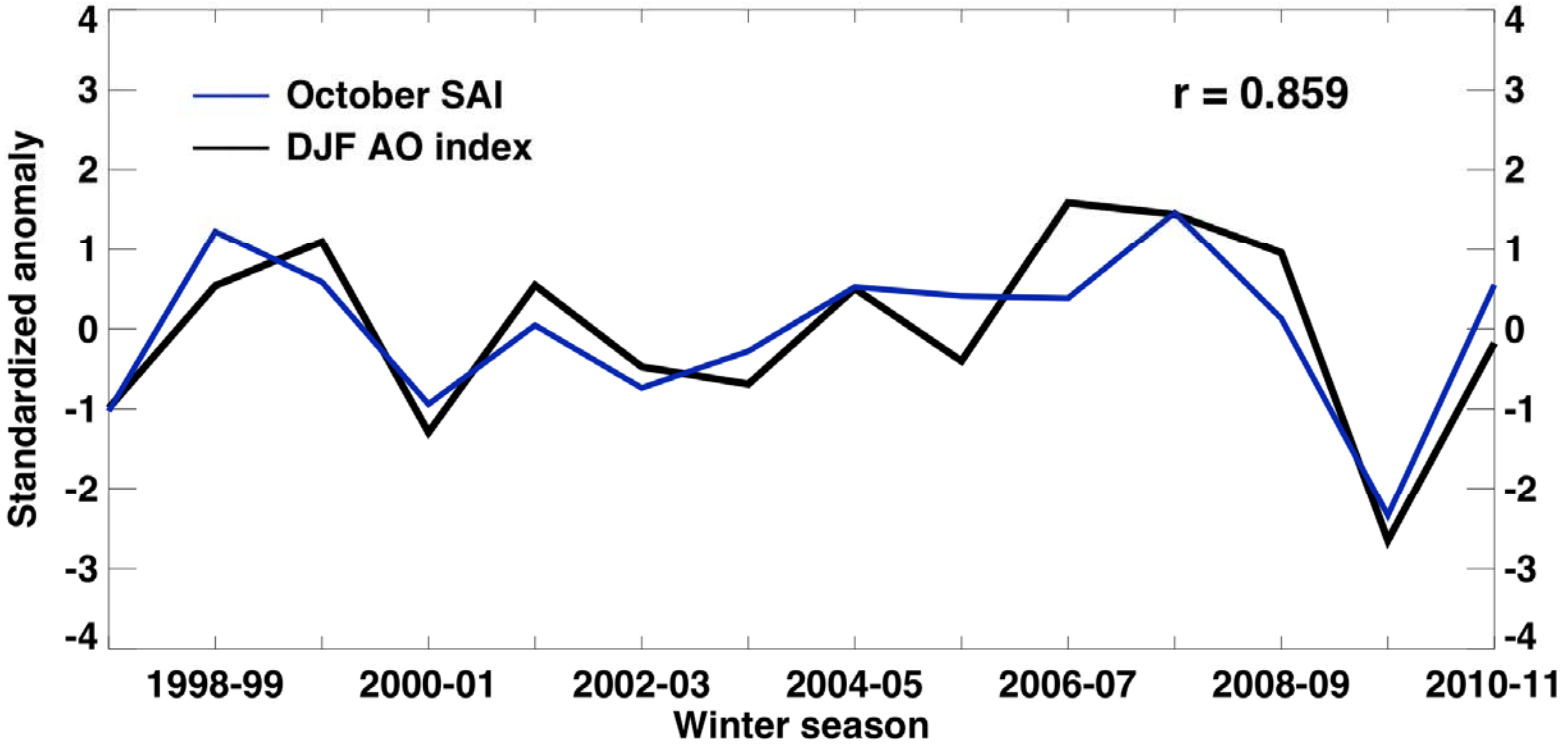
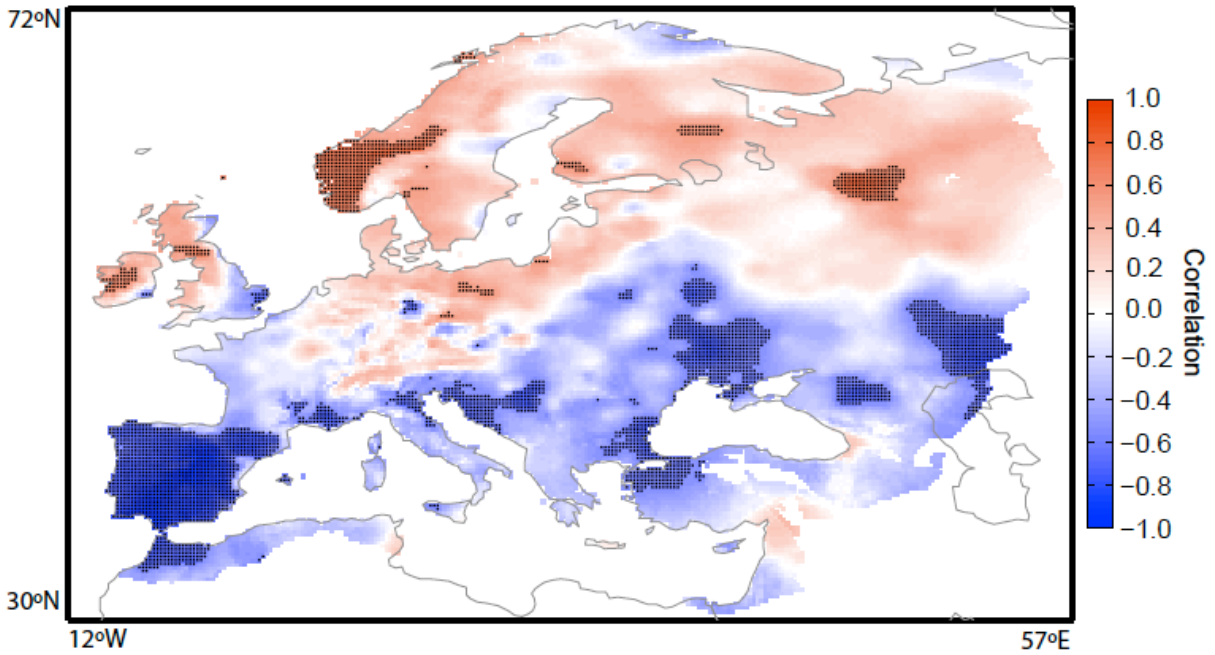
Snow Advance Index (SAI)



- Uses daily values
- Limited to equatorward of 60°N
- Measures rate of change of snow cover

Cohen and Jones (2011)

Correlations of Snow Cover with European/Mediterranean Precipitation



Stippling shows regions of statistical significance

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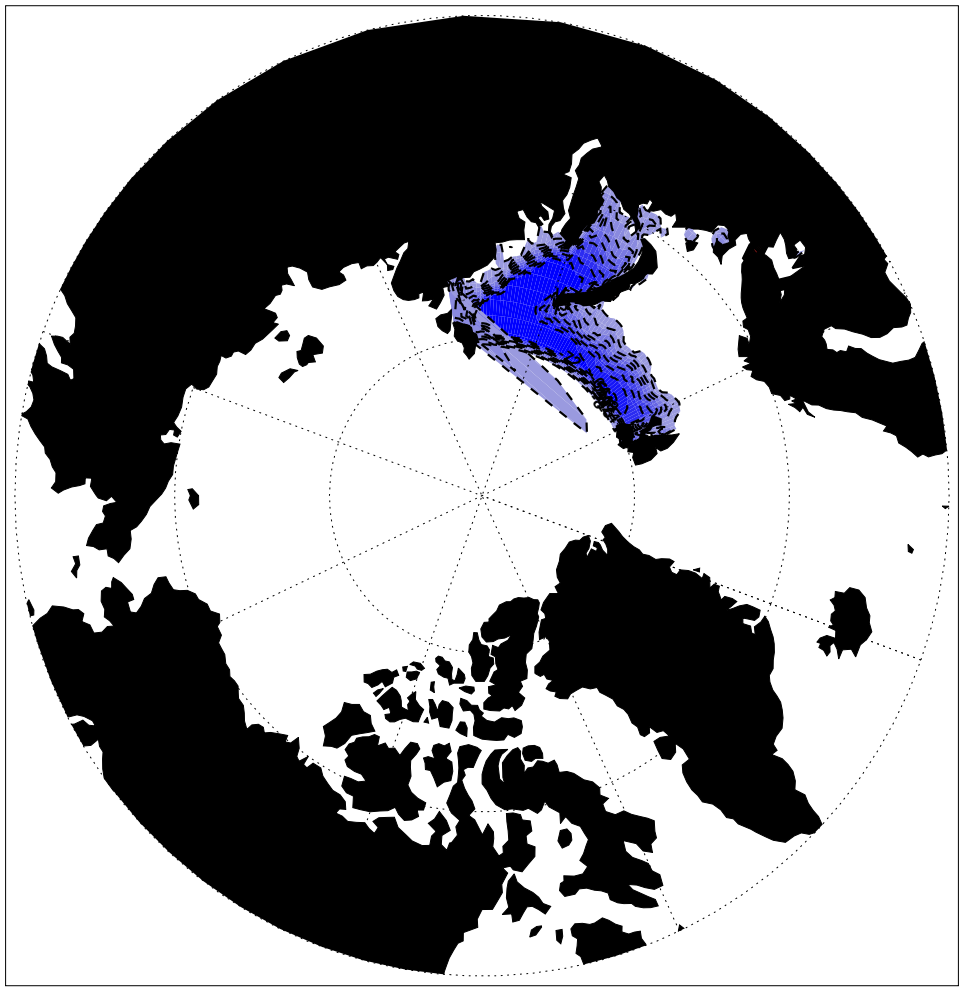
Brands et al. 2012

November Barents-Kara sea ice concentration

November 2012 sea ice concentration



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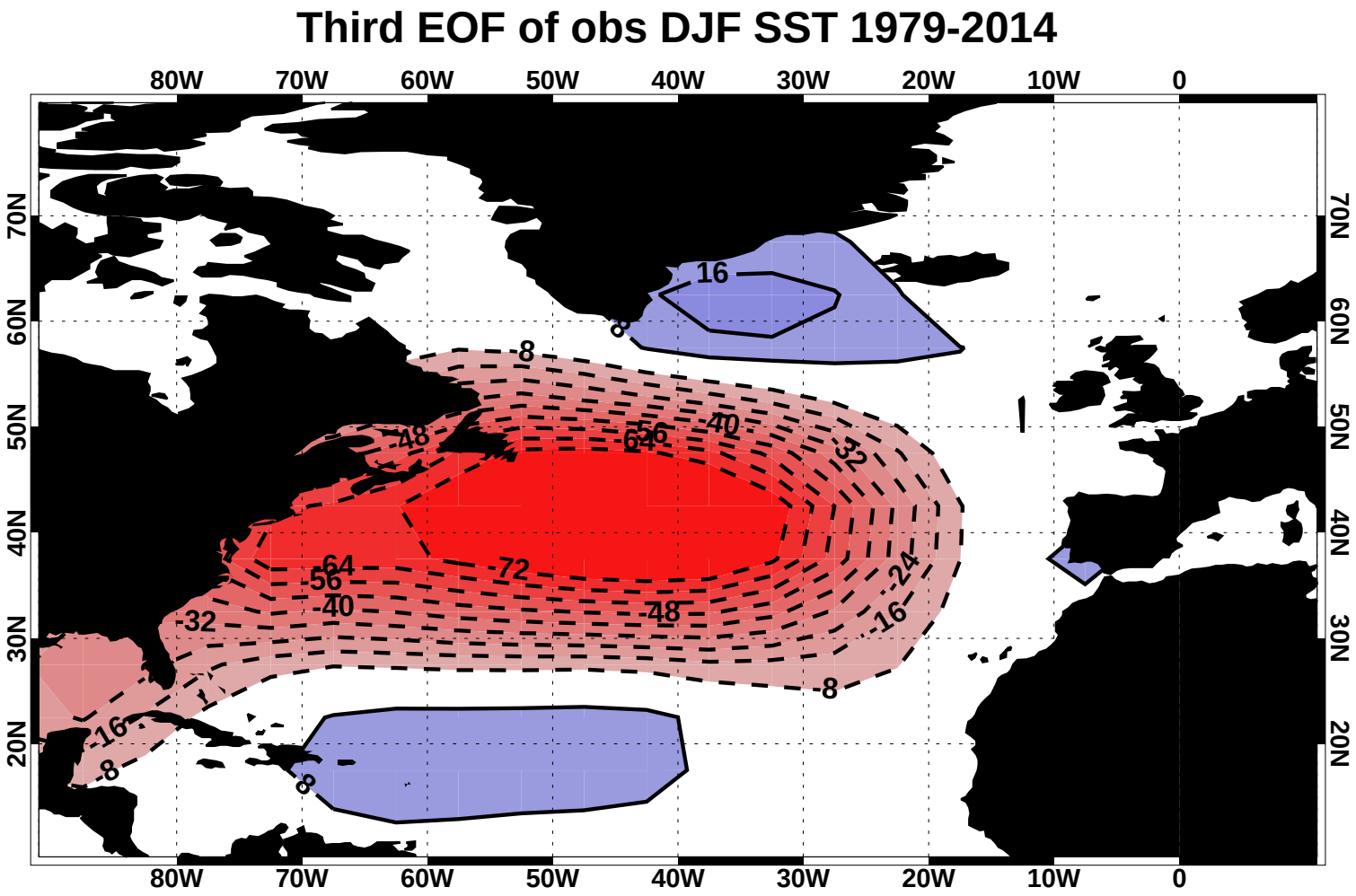
North Atlantic Tripole SST Pattern



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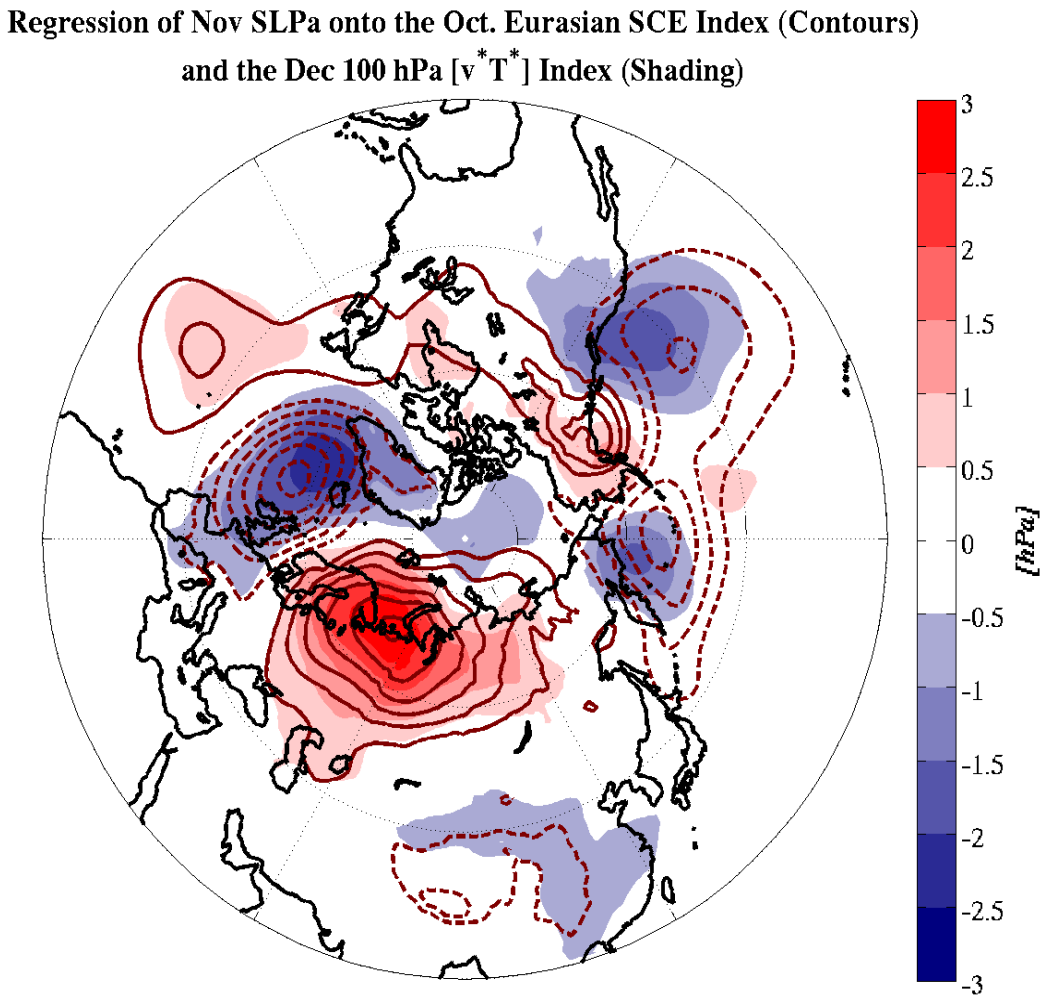
SCE and Polar Vortex strength



Pattern correlation = 0.93 between 40-80°N

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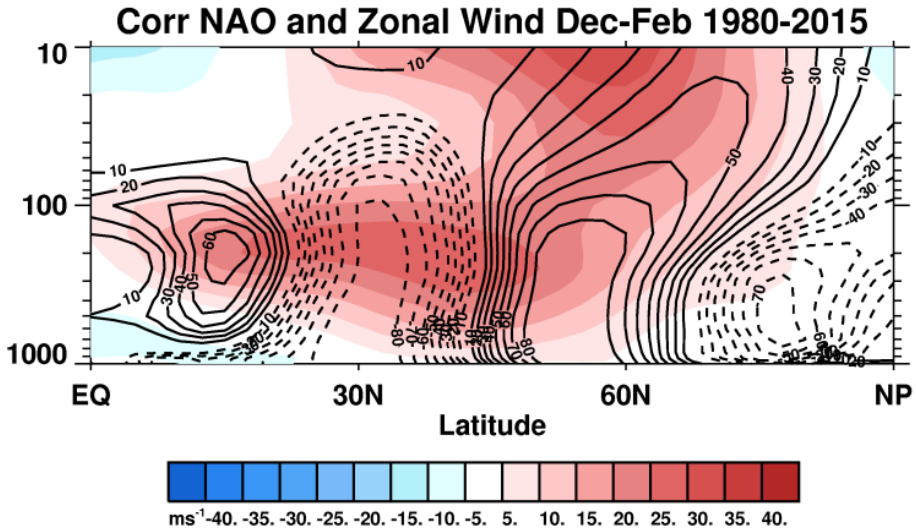
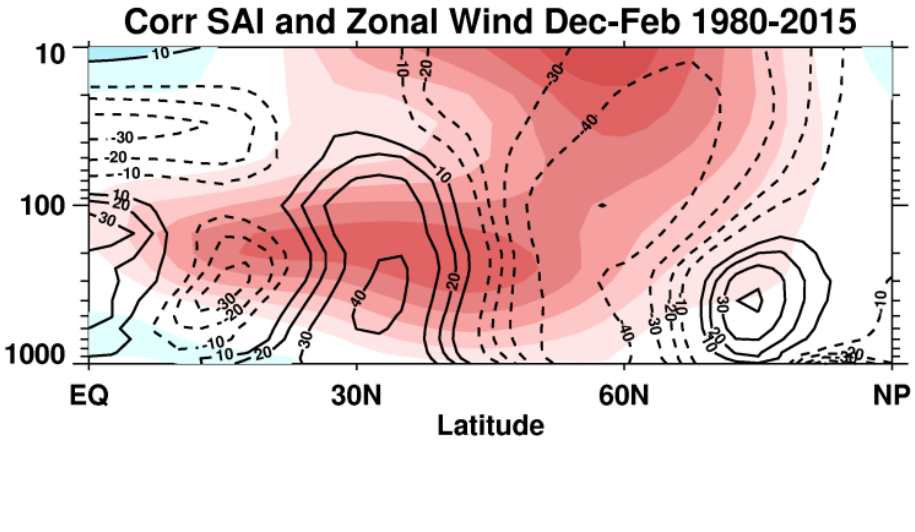
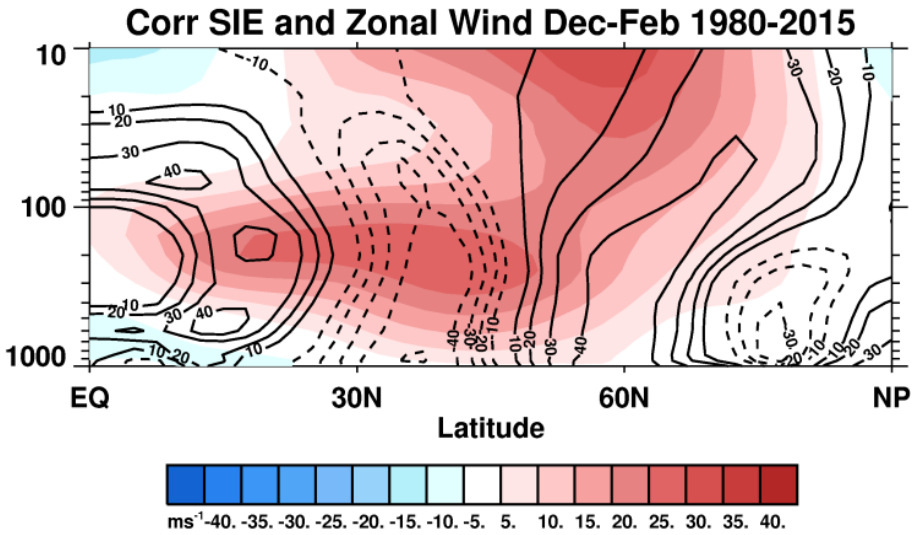
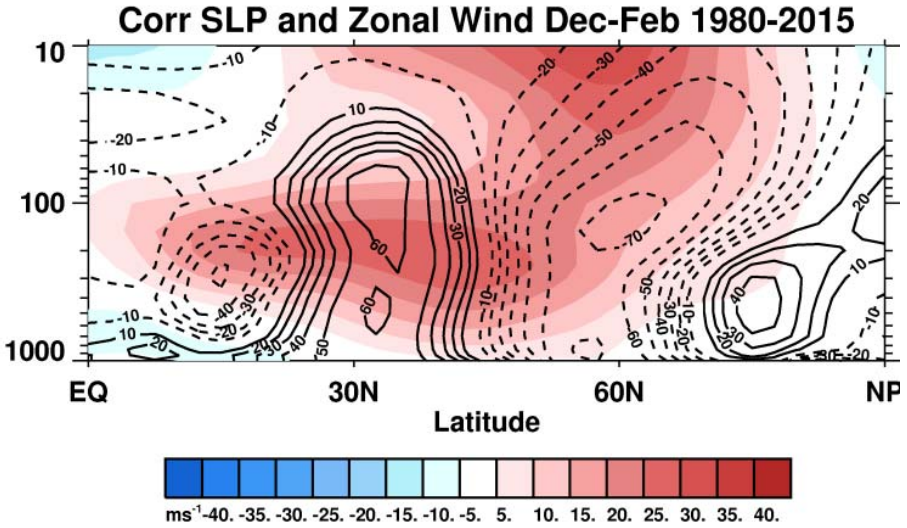
North Atlantic Jet Stream Mean and Variability









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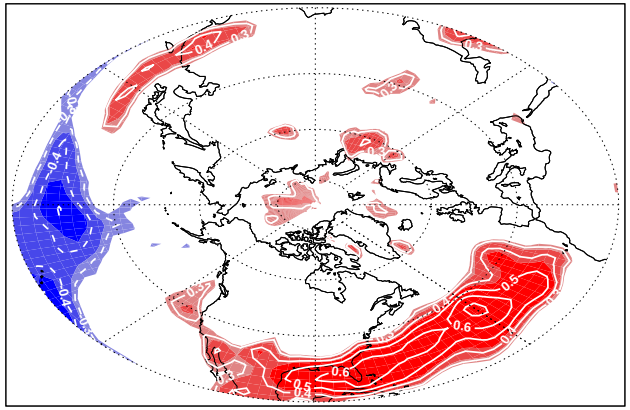
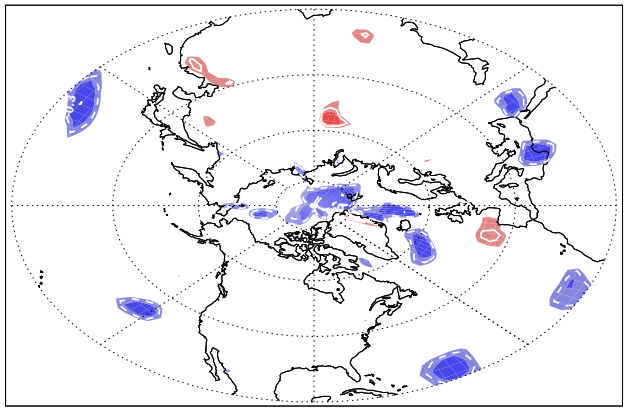
Correlation of six predictors with Northern Hemisphere winter precipitation anomalies.

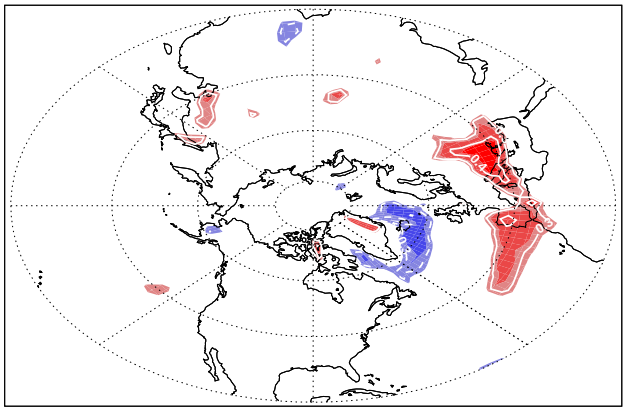
Correlation ENSO and Precipitation DJF



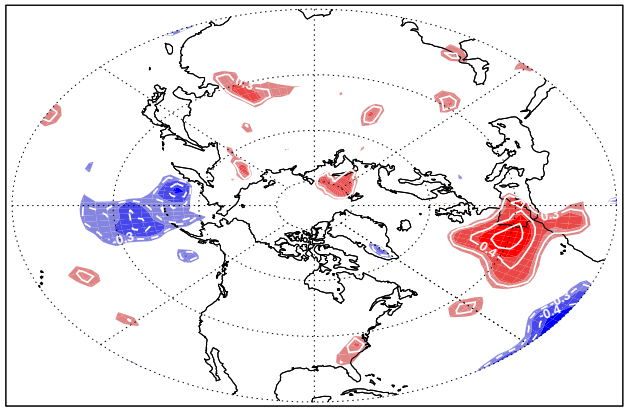
Corr Med box avg SST and Precipitation DJF



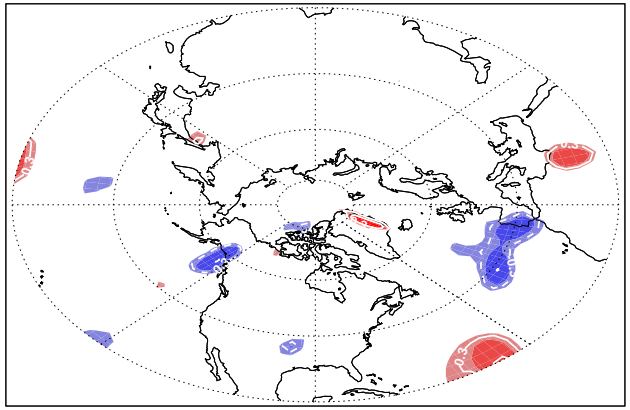
Correlation SAI and Precipitation DJF



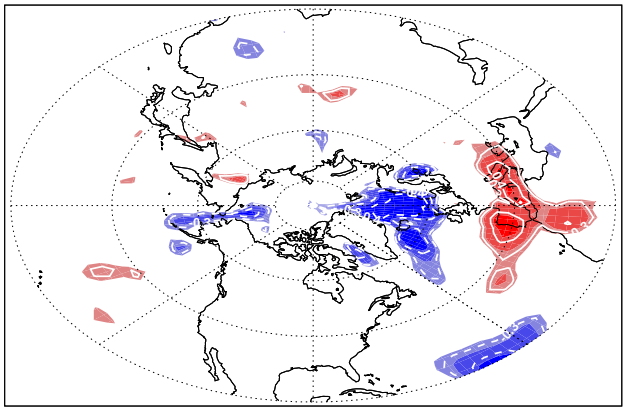
Correlation EOF3 NA SST and Precipitation DJF



Correlation B-K SIE and Precipitation DJF



Corr Oct SLP and Precipitation DJF



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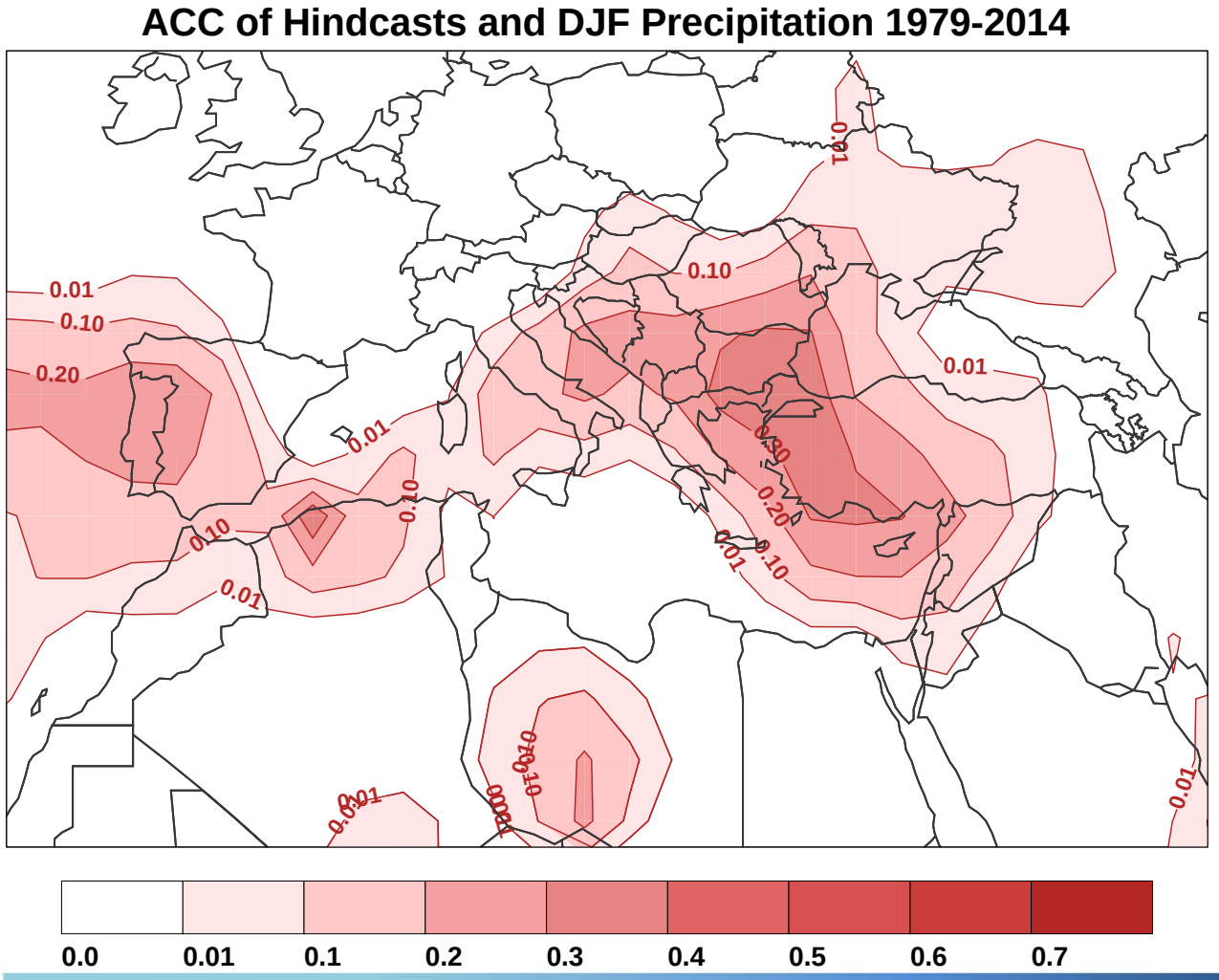
Hindcast skill for statistical model for Mediterranean region



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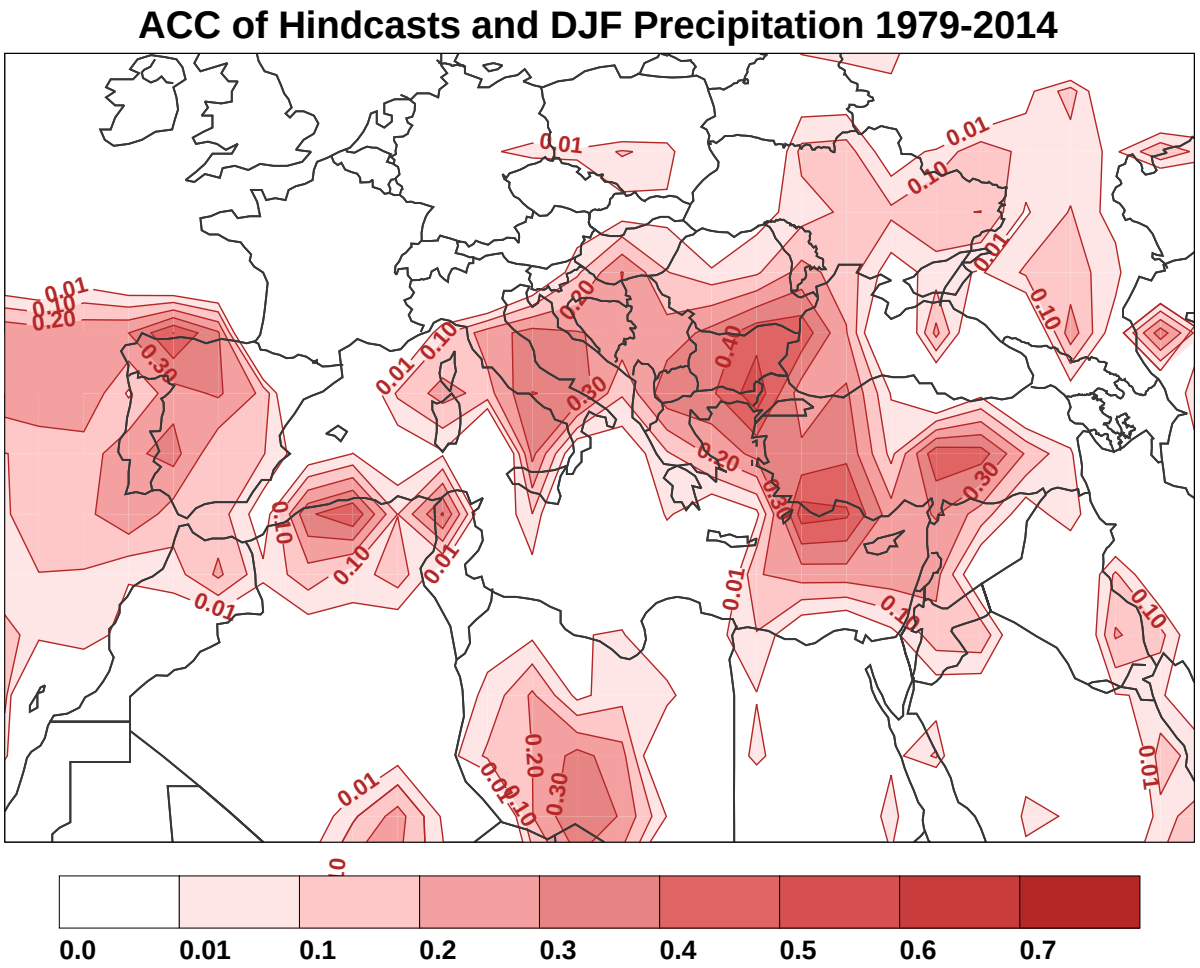

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Summary

- Exploiting relationships between teleconnection indices and precipitation. Affords the best possibility of skillful seasonal forecasts.
- ENSO is highly correlated with precipitation in the tropics but nto in the extratopics with the exception of the Southern United States.
- The NAO is highly correlated with precipitation in the North Atlantic sector, including the Mediterranean.
- Boundary conditions that are leading indicators of the winter NAO can be used in a statistical model to skillfully predict winter precipitation in the Mediterranean and the Middle East.