David vs. Goliath: David Wins again in Winter 2010

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Preview

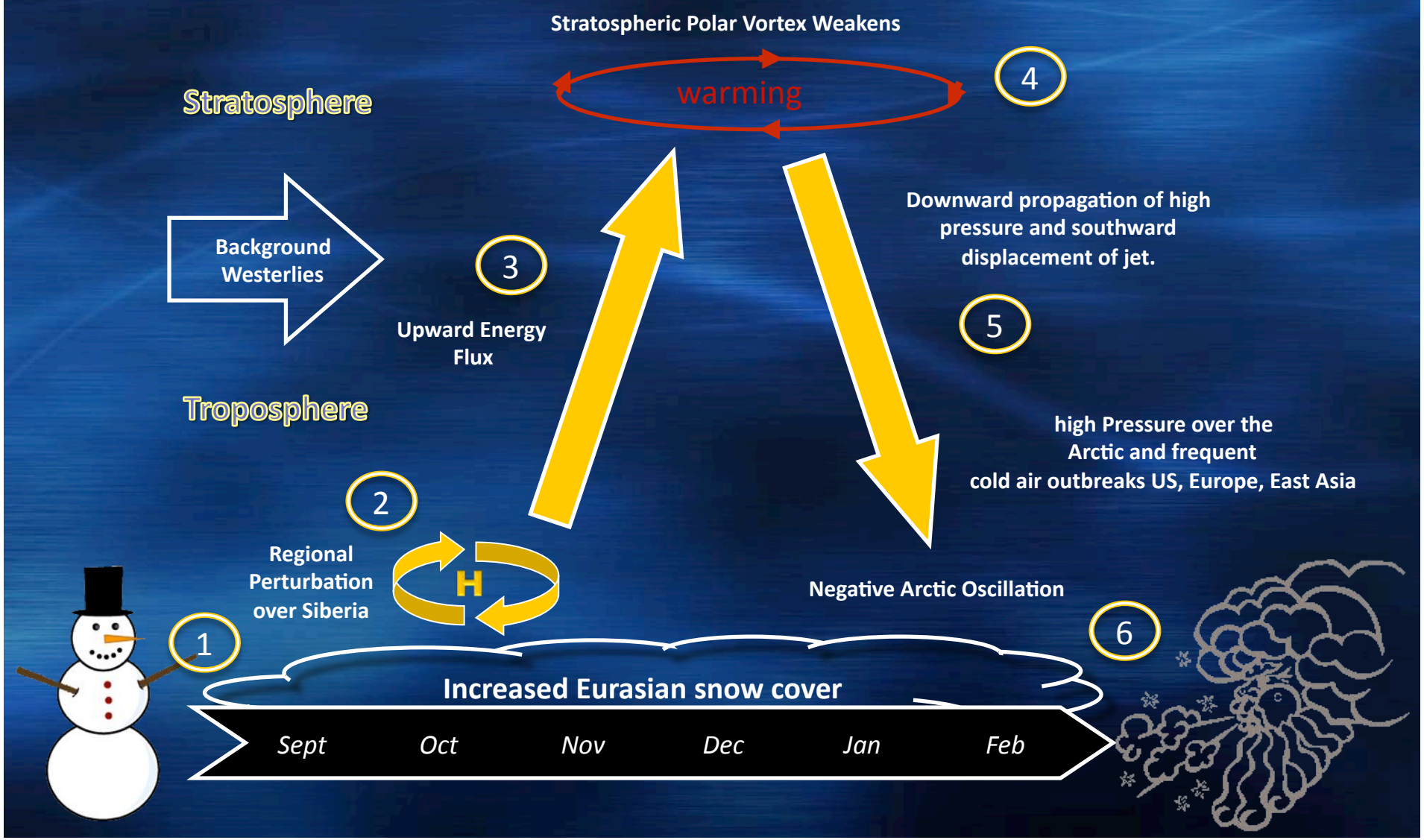
- Strong tropical (ENSO) and Arctic (Siberian snow cover, Siberian high) boundary forcings were present prior to the winter and therefore potentially influencing the winter climate in 2009/10.

- The dominant Northern Hemisphere winter circulation pattern can be shown to have originated with a two-way stratosphere-troposphere interaction forced by high latitude Eurasian land surface and lower tropospheric atmospheric conditions (i.e. high pressure) during autumn.

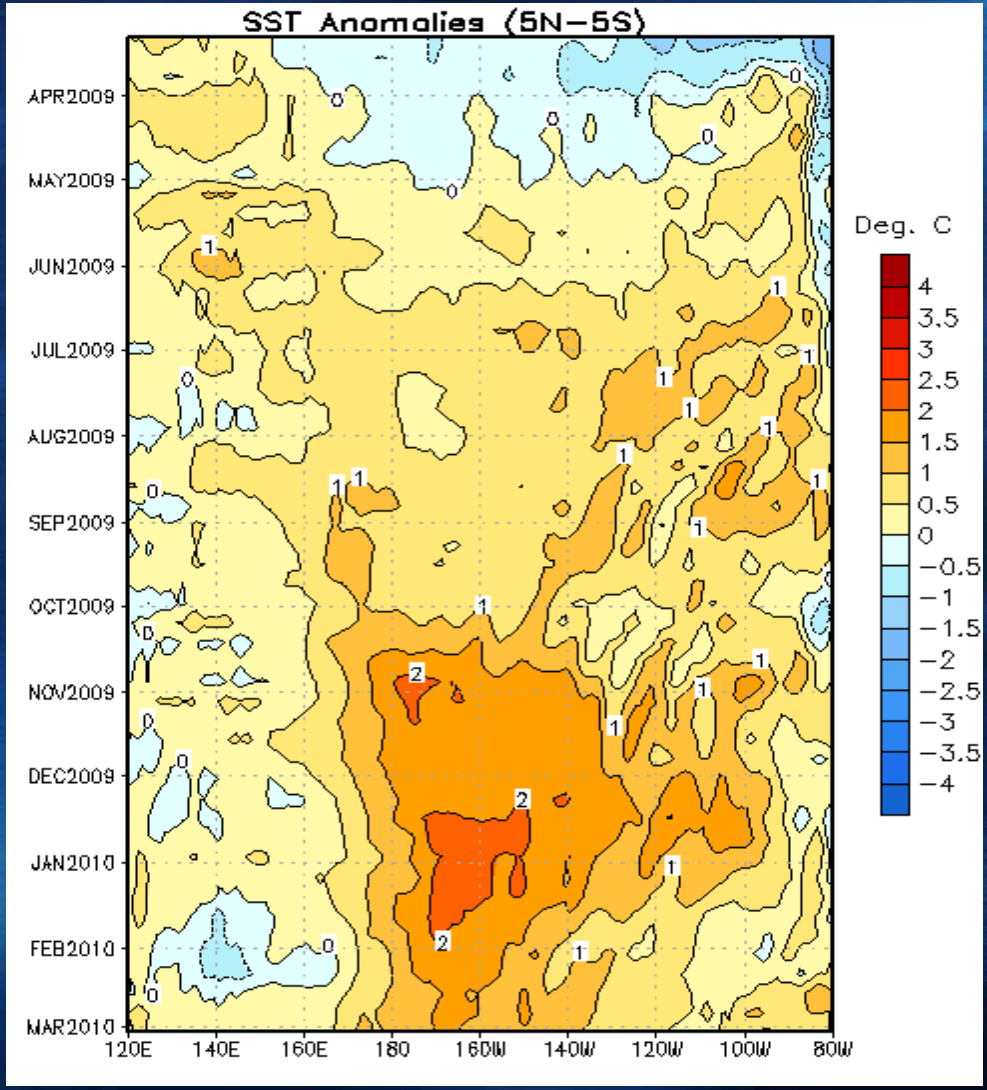
- This cycle occurred twice in relatively quick succession contributing to the record low values of the AO observed in the winter of 2009/10.

- It is shown that the AO explained a greater variance of the observed temperature pattern across the extratropical landmasses of the NH than ENSO.

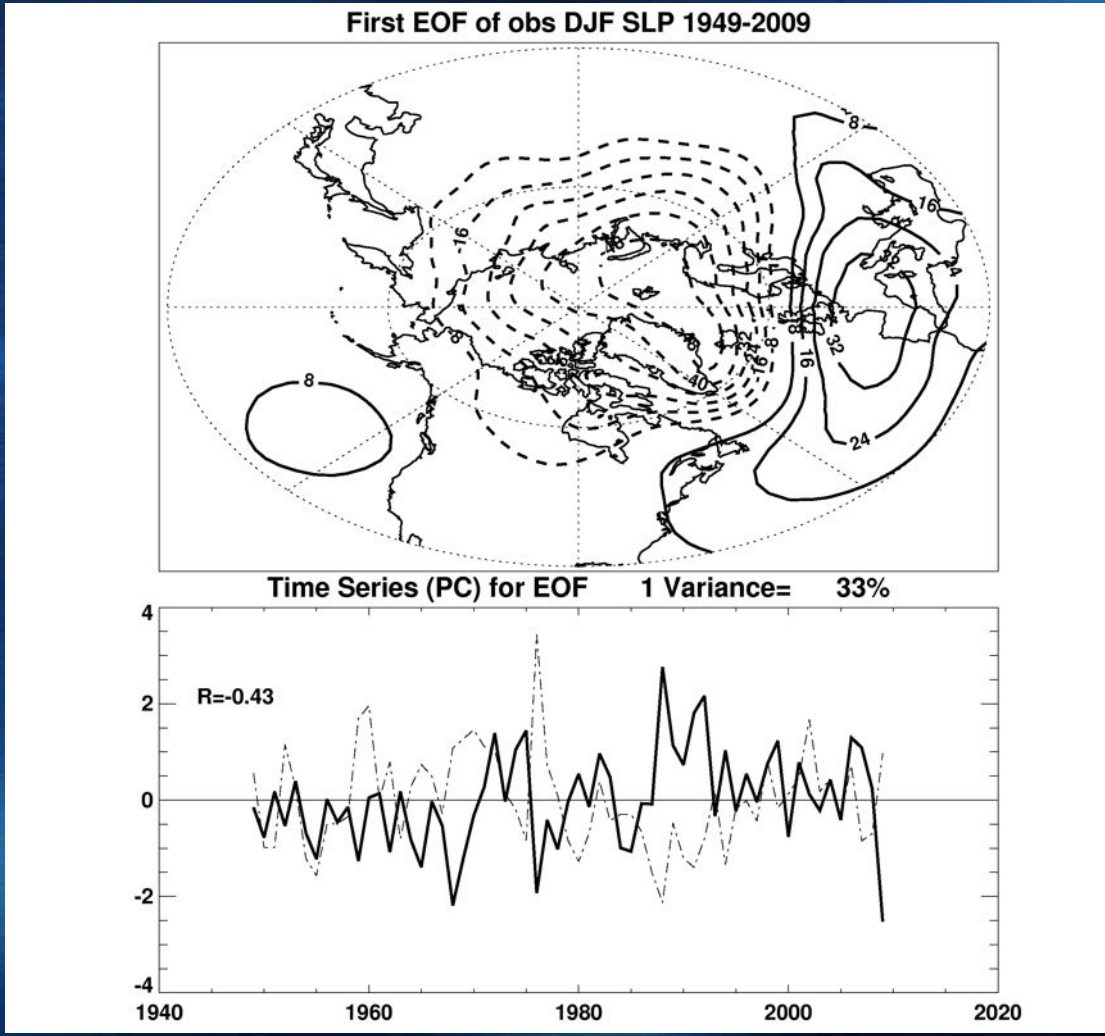
Snow Forced Cold Signal (Cohen et al. 2007)



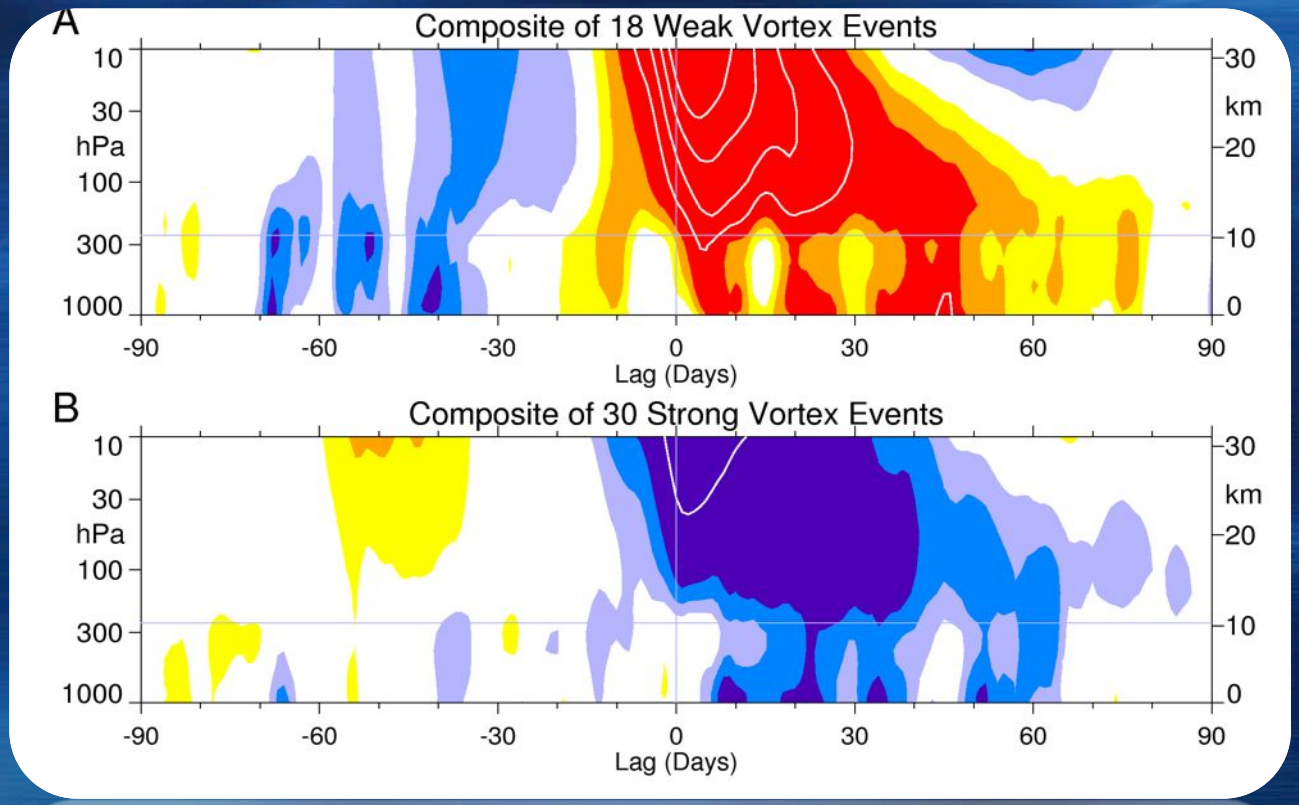
Equatorial Pacific SSTs



DJF Arctic Oscillation

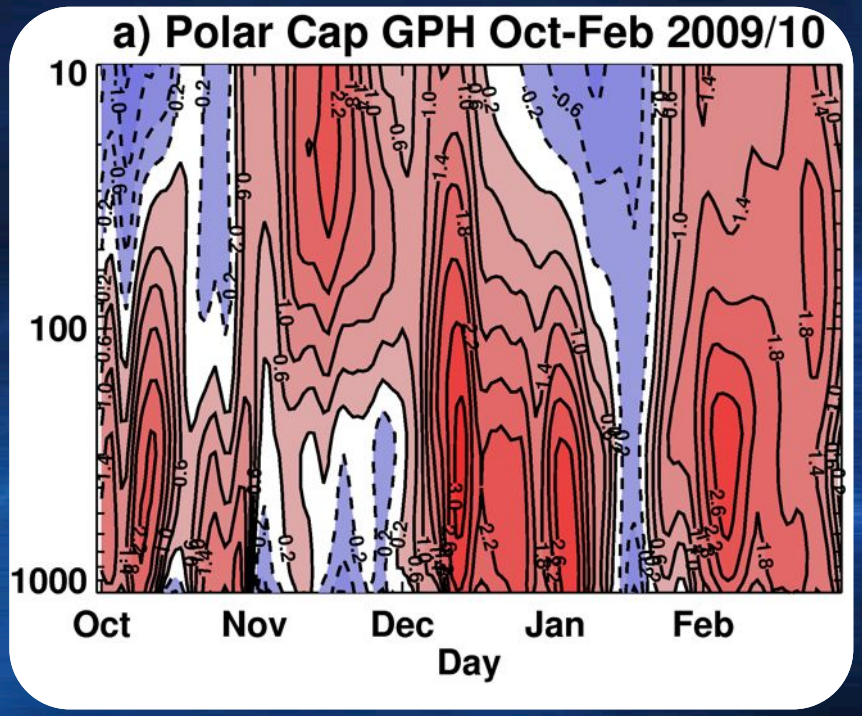


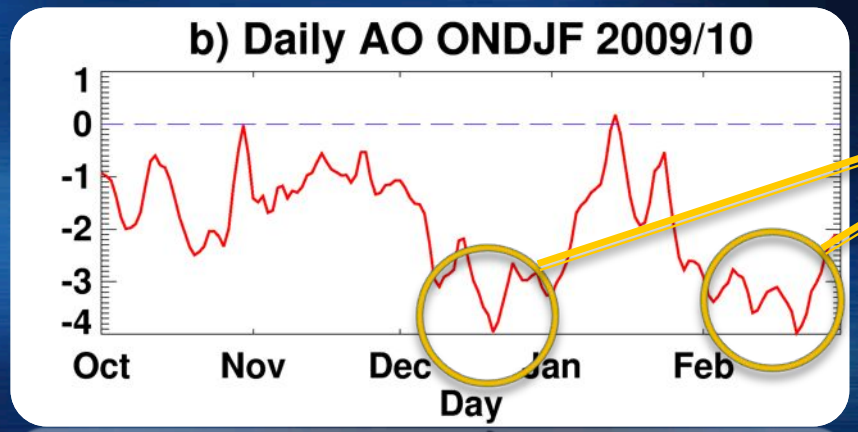
Downward Propagation of NAM Index



Baldwin and Dunkerton 2001

Polar Cap Geopotential Height





Area weighted geopotential height anomaly poleward of 60°N.

Advantage: excellent proxy for NAM index and better resolves important high latitude regional perturbations.

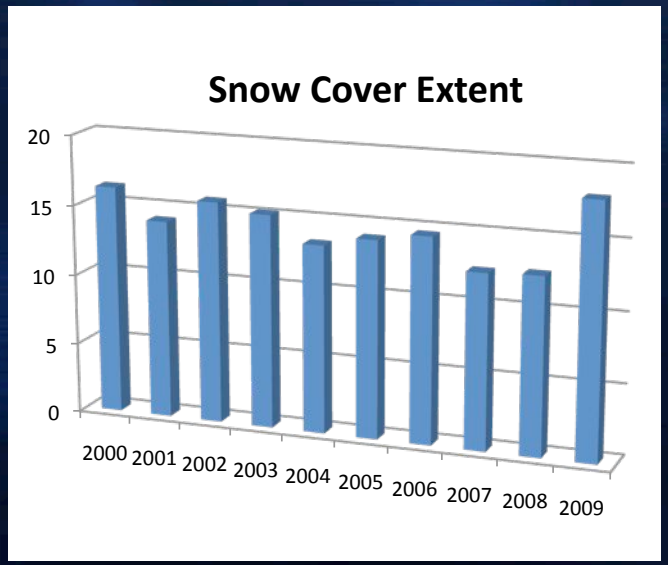
Surface AO of much stronger amplitude after the downward propagation than before.

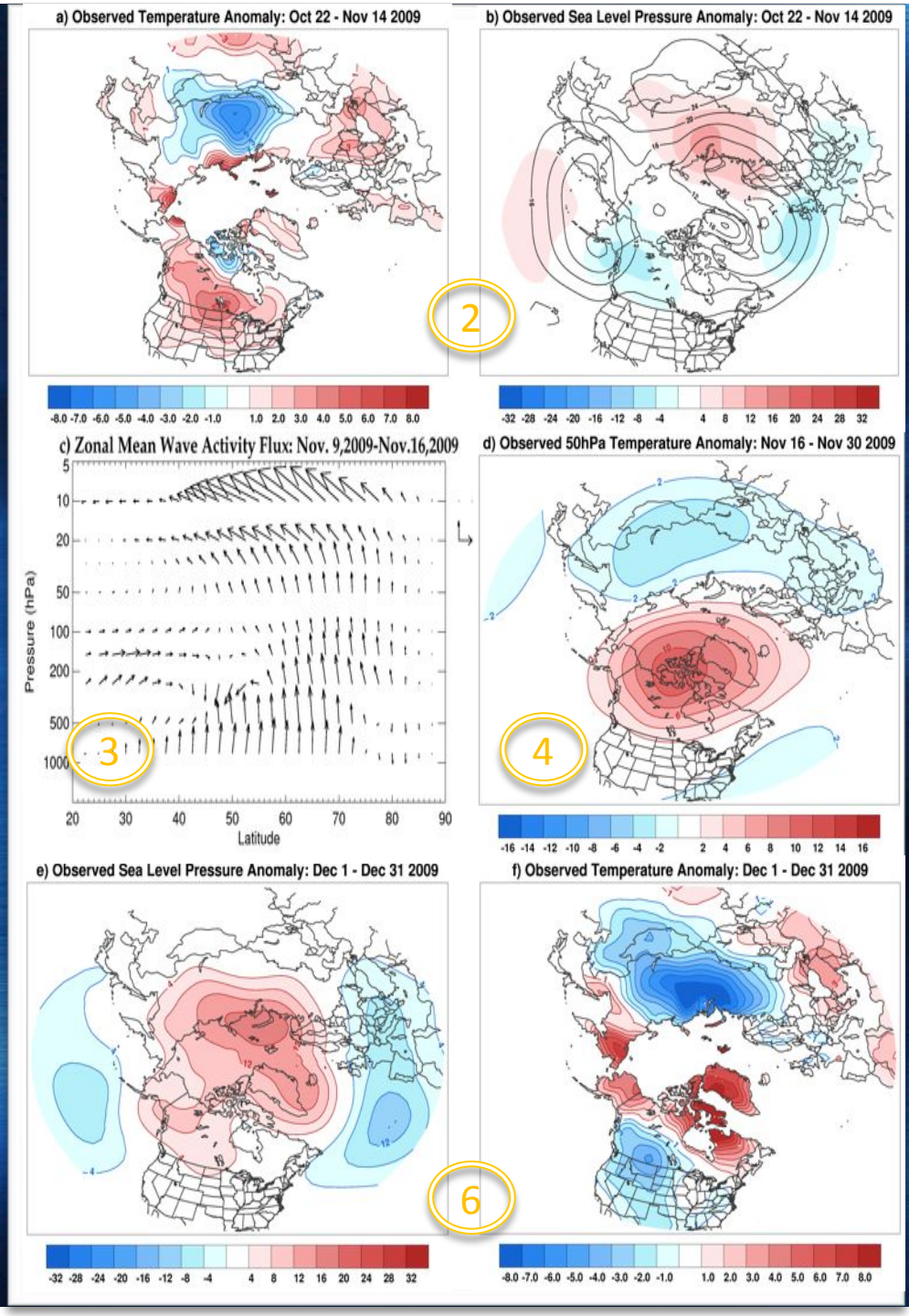
Cohen et al. 2002

October Siberian Snow Cover

A rapid advance occurred in the last three weeks

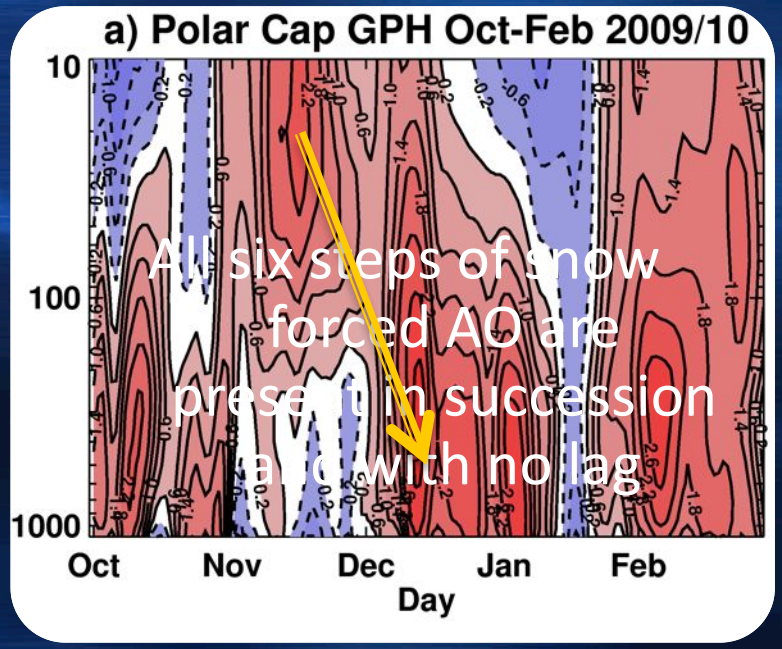
Equivalent to the SCE advance across North America from September through January

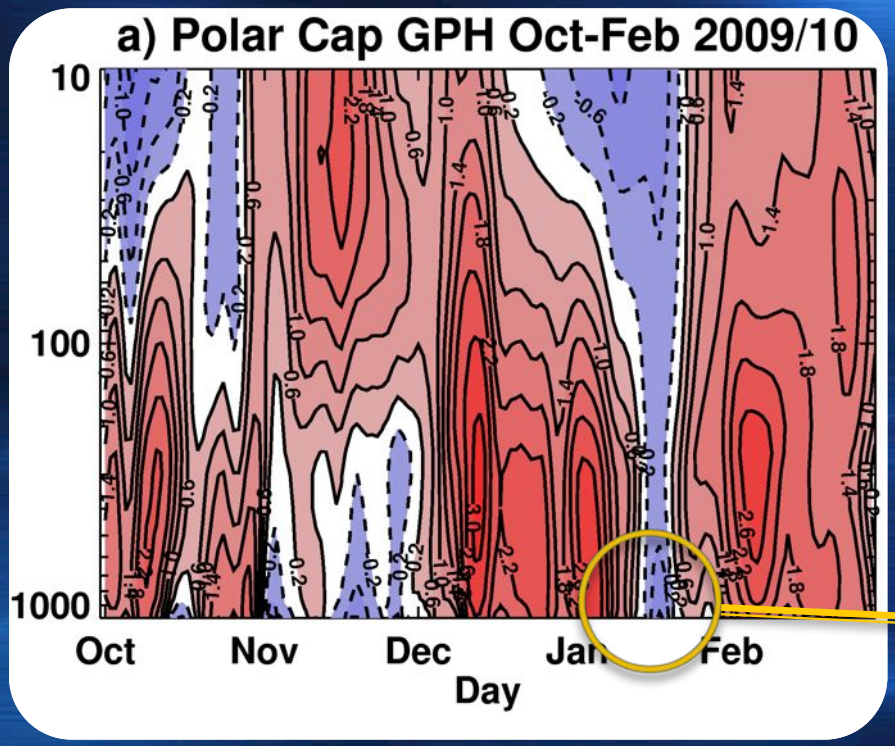


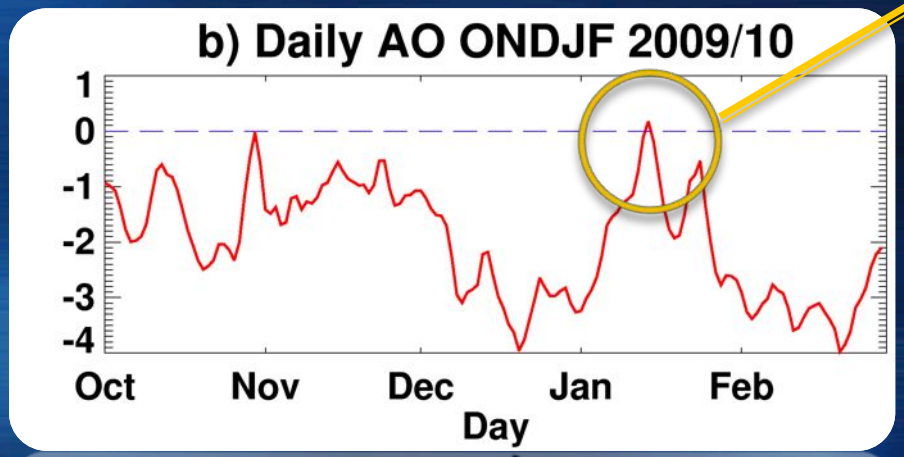


1 Rapid snow cover advance after October 7

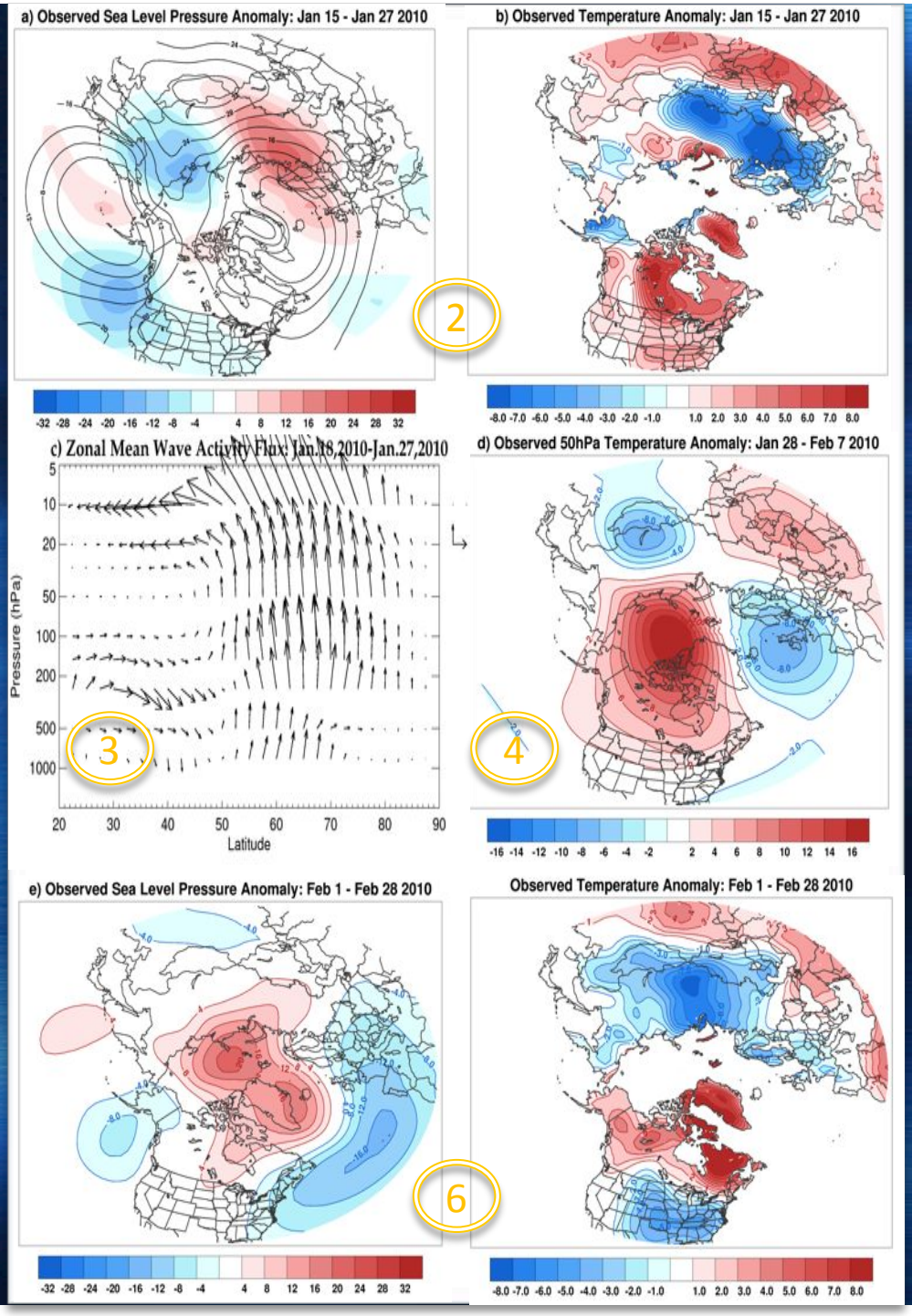
5 Downward propagation mid Nov-Dec 1 as seen on polar cap plot







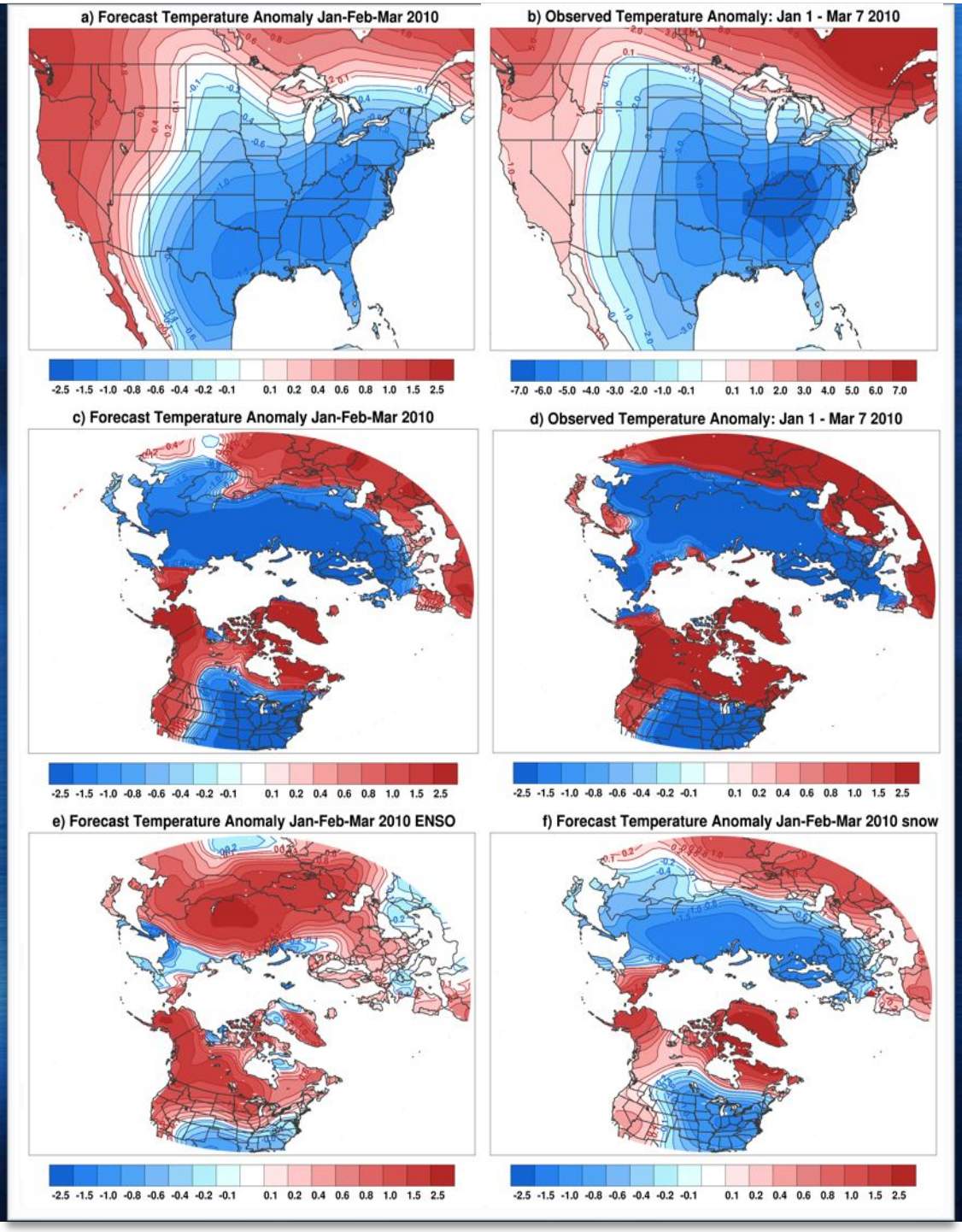
The AO event which peaks in mi-December clearly comes to an end by mid-January



1 Rapid snow cover advance in October and persistently high Eurasian SCE

5 Downward propagation late Jan-Feb 1 as seen on polar cap plot

All six steps of snow forced AO are present in succession with no lag and is identical of what occurred in the fall



Forecast posted to the NSF website in real-time:

http://www.nsf.gov/news/special_reports/autumnwinter/predictions.jsp

Based on the skillful forecast of the model, much of the large-scale temperature variability is due to the snow and positive SLP forcing which is a proxy for the AO. ENSO only seems to have influenced North American temperatures.

A model result after the event is not the same as a model result prior to the event!

Summary

- Both tropical forcing (El Niño) and Arctic forcing (Siberian snow cover and Arctic high pressure) were strong boundary forcings going into the winter of 2009/10.
- A record low Arctic Oscillation was observed in winter 09/10 and it can be shown to have at least partially resulted from an unusual occurrence of two consecutive and rapid cycles of stratosphere-troposphere coupling events forced by surface/lower troposphere anomalies over Northern Eurasia.
- A skillful forecast model of Northern Hemisphere temperature anomalies shows that much of the temperature pattern observed in both Eurasia and North America can be attributed to the AO, El Niño's influence appears to be limited to North America.

Potential Benefit

- A more careful understanding of the link between stratosphere-troposphere coupling, snow cover and the AO/NAM could help in making interannual to decadal predictions (Cohen et al. 2009).

- Increasing our ability to understand and explain natural variability will improve our predictions and message of climate change.

Data

- NCEP/NCAR Reanalysis 1948-2010
- Eurasian snow cover 2009-
  - Remotely sensed snow cover from NOAA