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Characteristics of the Beaufort Sea High

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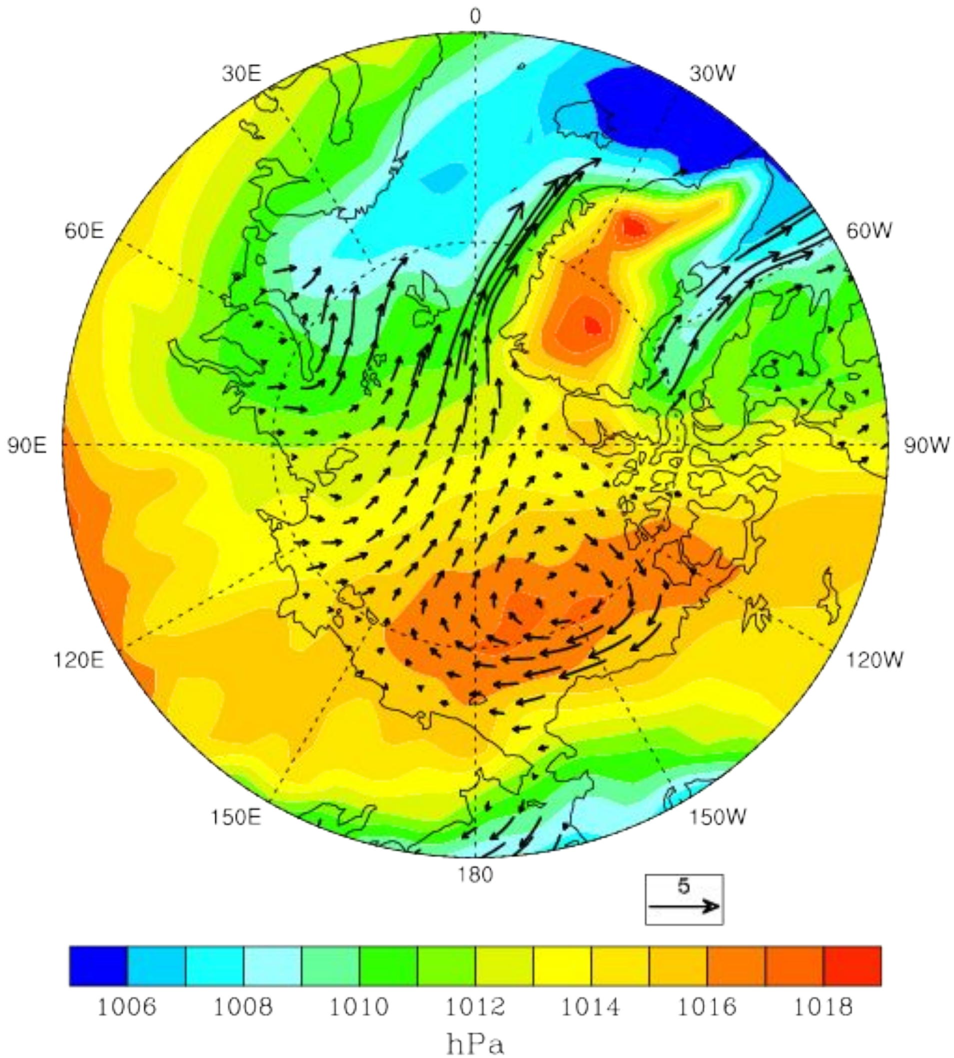
The Beaufort Sea High



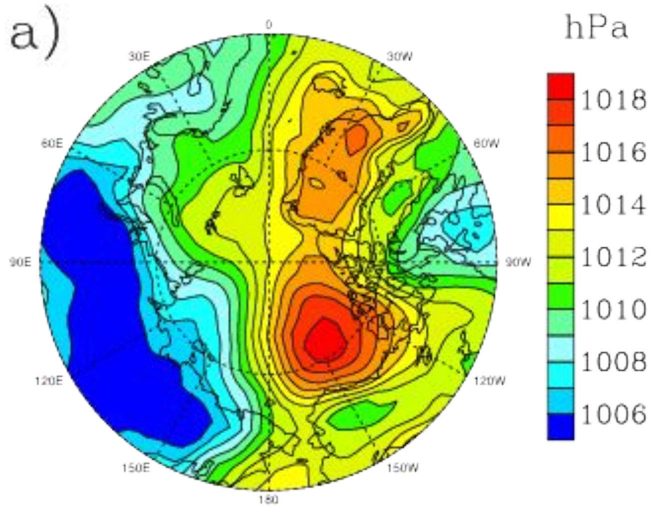
The Beaufort Sea High (BSH) is a prominent feature of the annual mean sea level pressure (SLP) field for the Arctic.

Surface winds associated with the BSH largely control the mean circulation of the sea ice cover.

Variability in the strength and location of the BSH has been tied to the strong downward trend in summer sea ice extent.

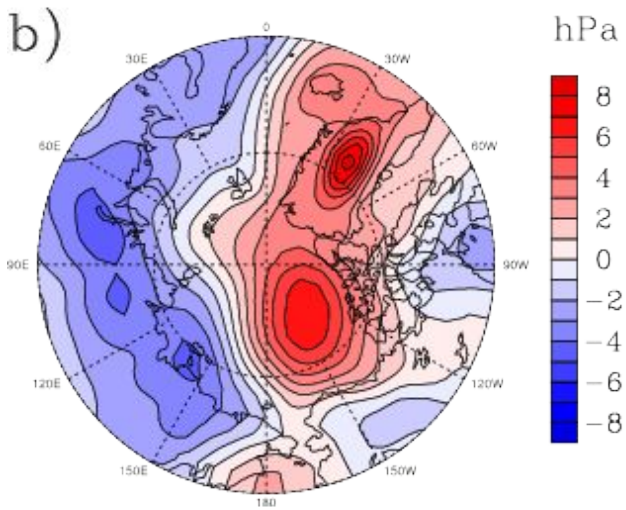
Left: Annual mean SLP (1979-2008) from NCEP/NCAR and mean sea ice velocity vectors (1979-2006)

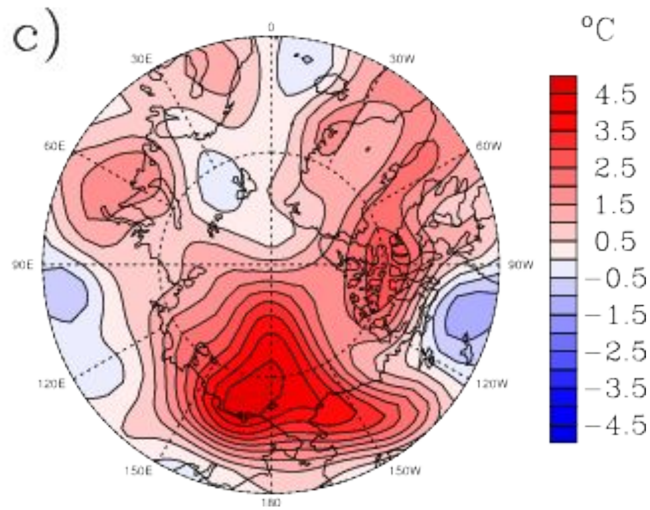
The situation for summer 2007



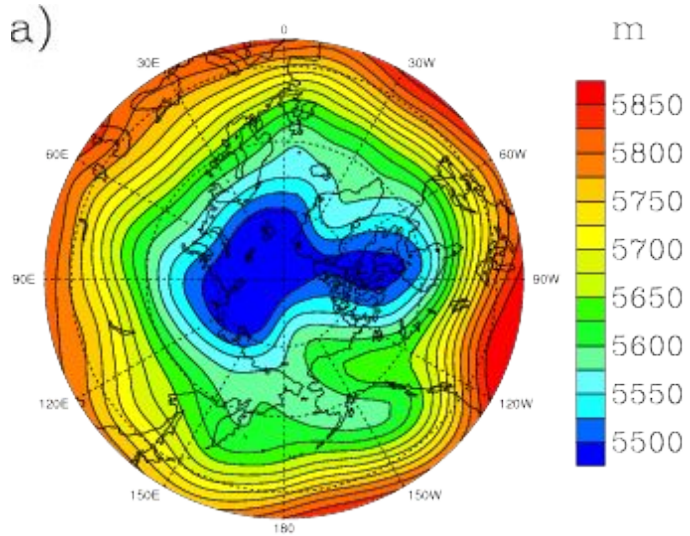
A strong BSH was part of the summer Arctic "Dipole Anomaly" (Wang et al., 2009)

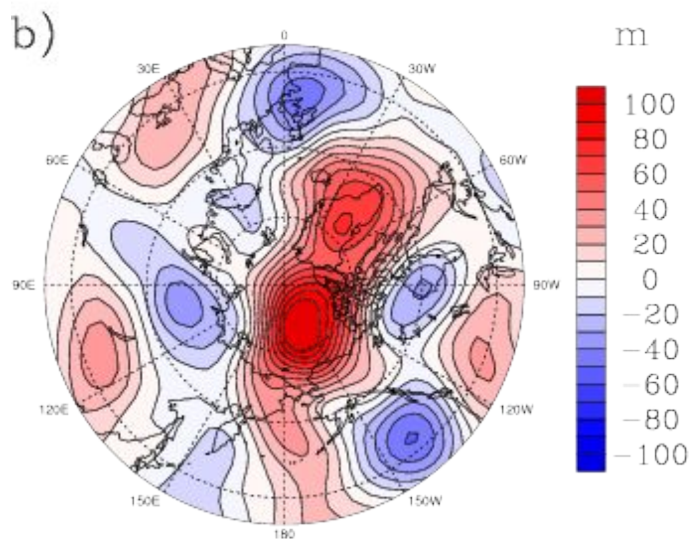
a) Mean SLP
b) SLP anomalies
c) 925 hPa temperature anomalies





The situation for summer 2007





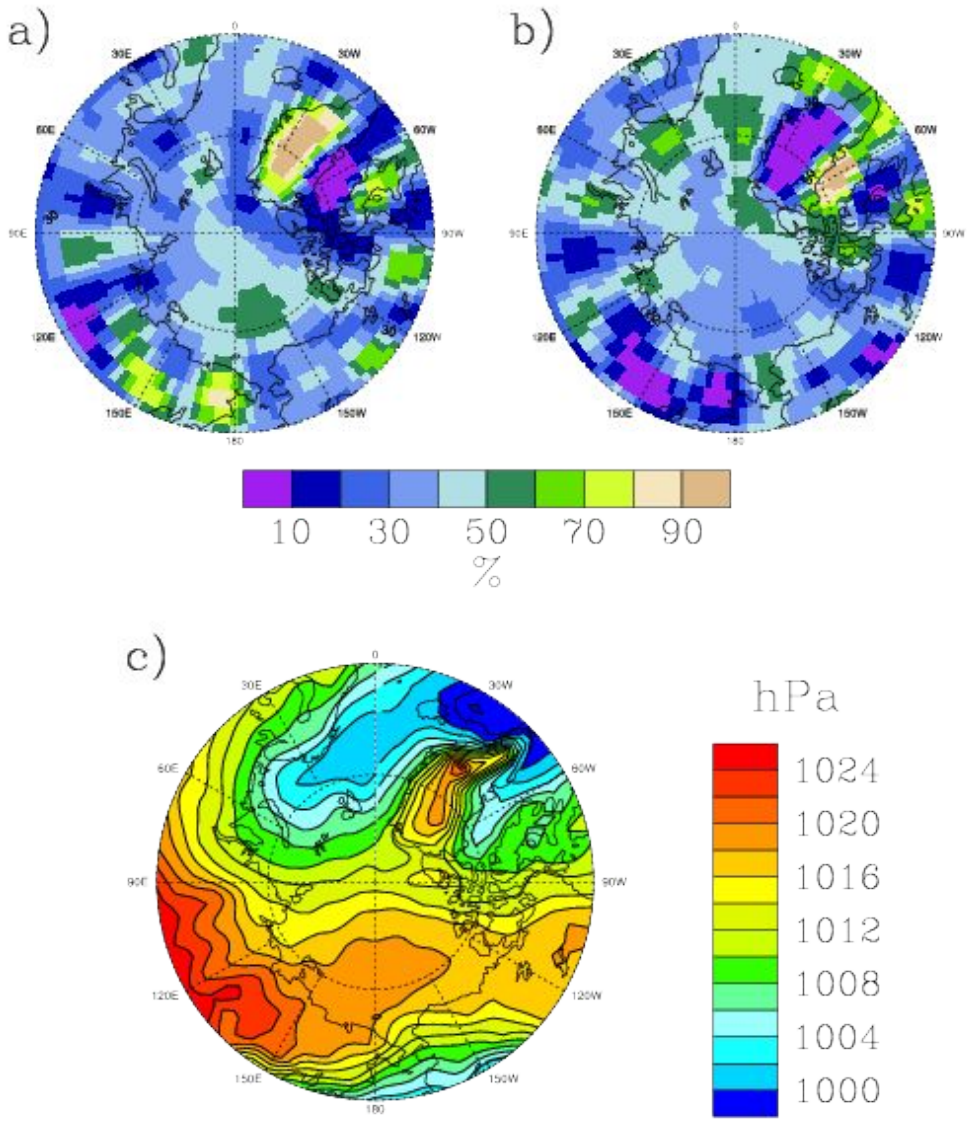
The BSH during summer 2007 was located downstream of an anomalously strong 500 hPa ridge, associated with an extreme positive phase of the Pacific North American (PNA) teleconnection pattern (L'Heureux et al., 2008).

(a) 500 hPa height

(b) 500 hPa height anomaly

Ogi et al. (2004, 2007): Strong BSH relates to the negative phase of the summer Northern Annular Mode (NAM).

Anticyclonic and cyclonic wind frequencies for winter



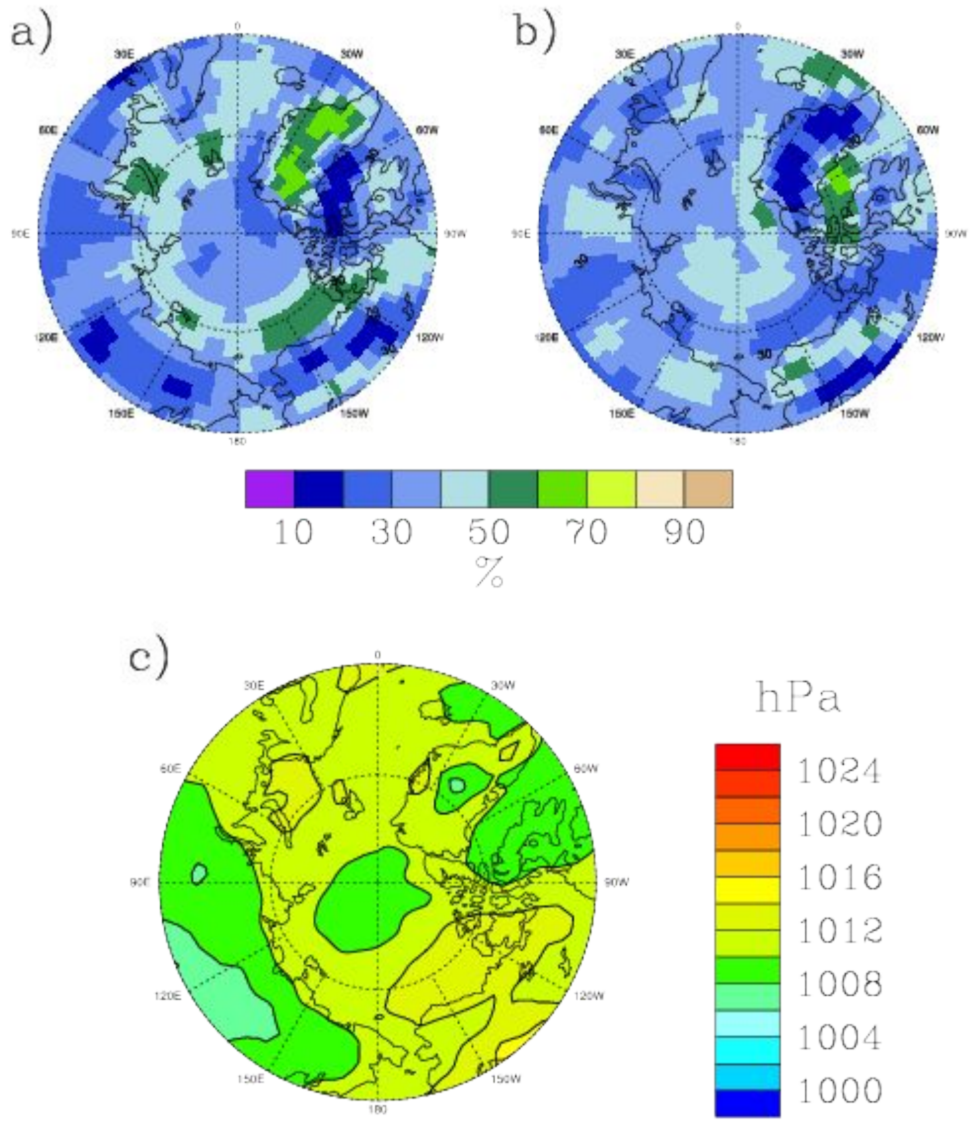
a) % frequency of anticyclonic surface winds

b) % frequency of cyclonic surface winds

c) Mean sea level pressure

Based on % of all six-hour analyses (1979-2008) that positive (negative) relative vorticity exceeds the smallest 25^{th} percentile of all positive (negative) relative vorticity events poleward of 60^{o}N.

Anticyclonic and cyclonic wind frequencies for summer



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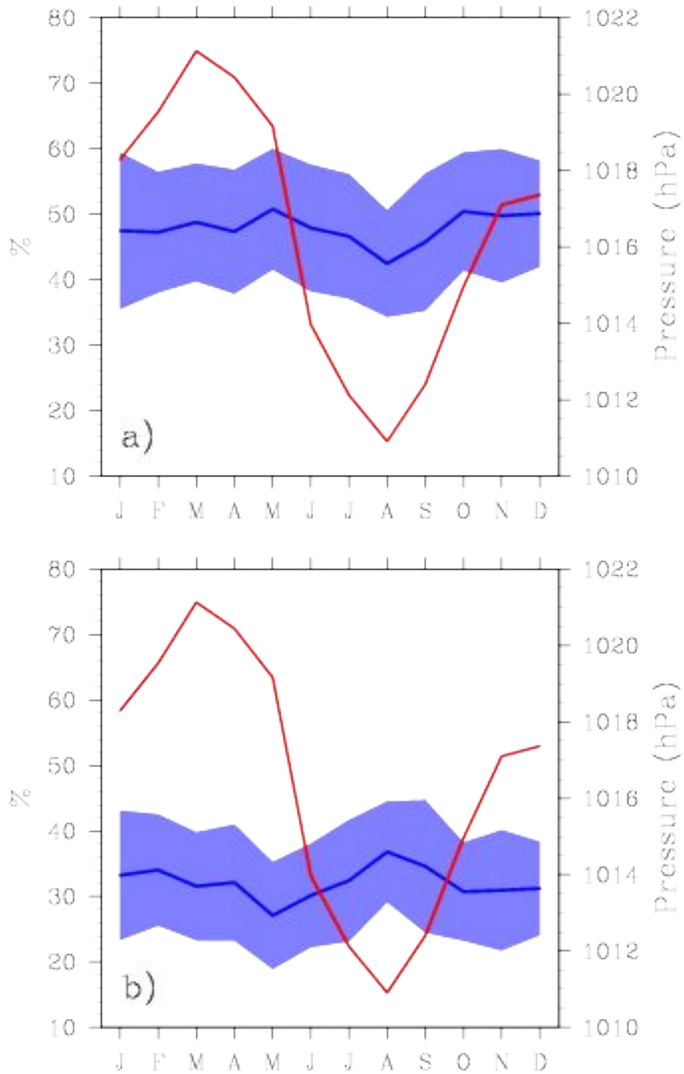
Annual cycles of vorticity and SLP for the BSH region



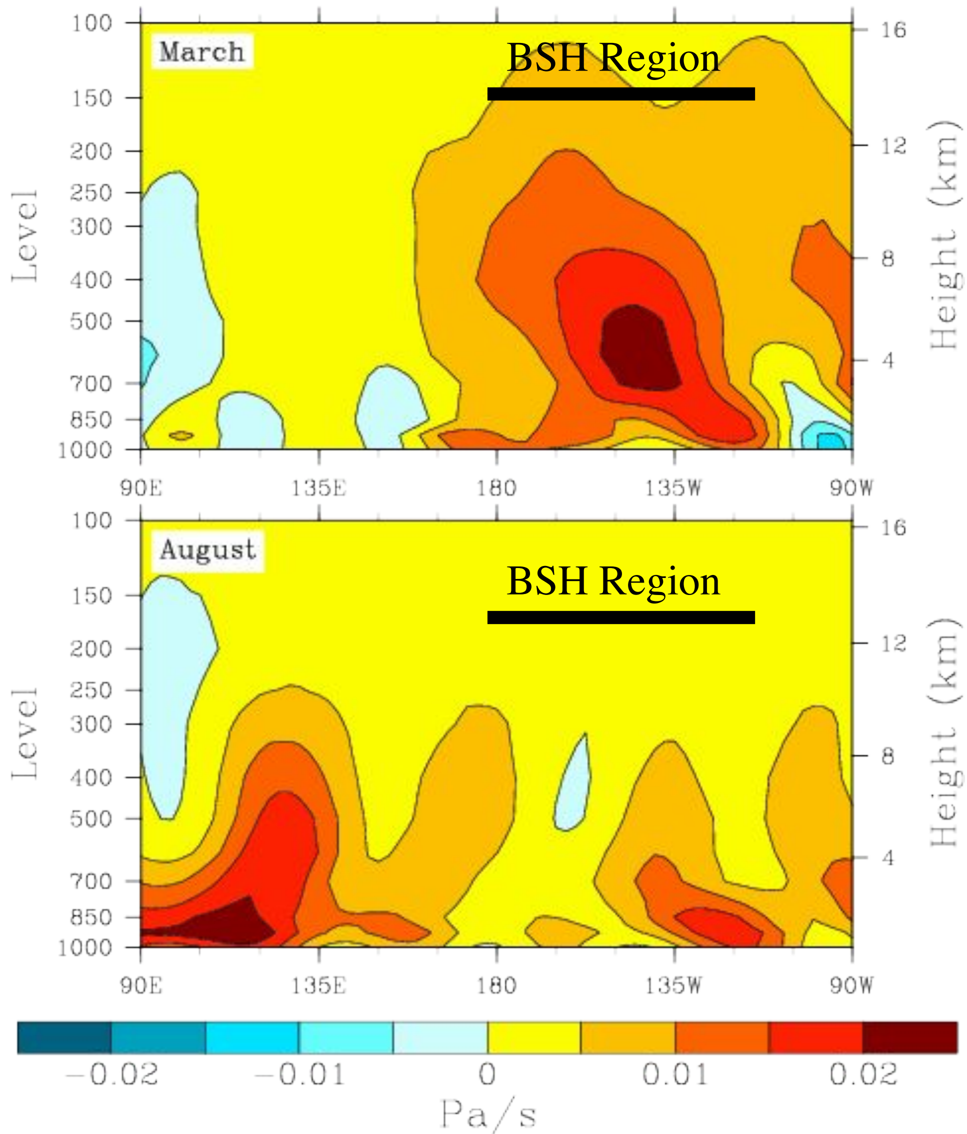
a) Frequency of negative vorticity (anticyclonic surface winds) in percent (blue) with mean SLP (red)

b) Frequency of positive vorticity (cyclonic surface winds) in percent (blue) with SLP (red)

Blue shading represents +/- 1 standard deviation of monthly frequencies.

BSH region: 72.5^{o}N to 80^{o}N, 180^{o}E to 225.0^{o}E (encompasses center of BSH as it appears in the seasonal vorticity frequency maps).

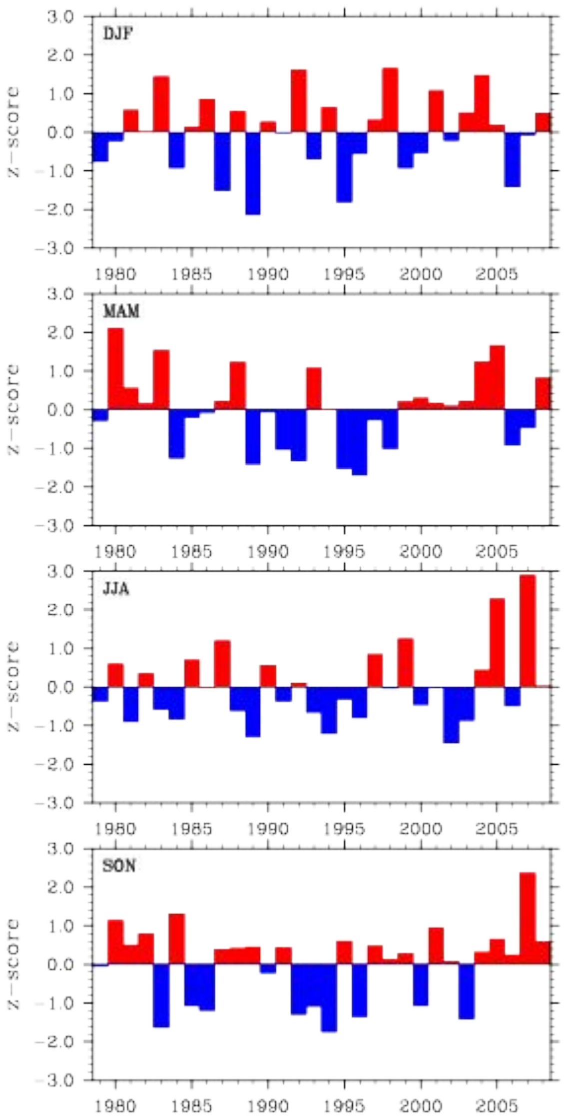
Mean vertical motion (omega)



Omega in Pa s^{-1} along 75º N between 90º E eastward to 90º W for March (top) and August (bottom)

Note the stronger pattern of downward motion (positive omega) in the BSH region in March, when the surface pressure is at its seasonal maximum.

Interannual variability of anticylonic vorticity



Winter

Spring

Summer

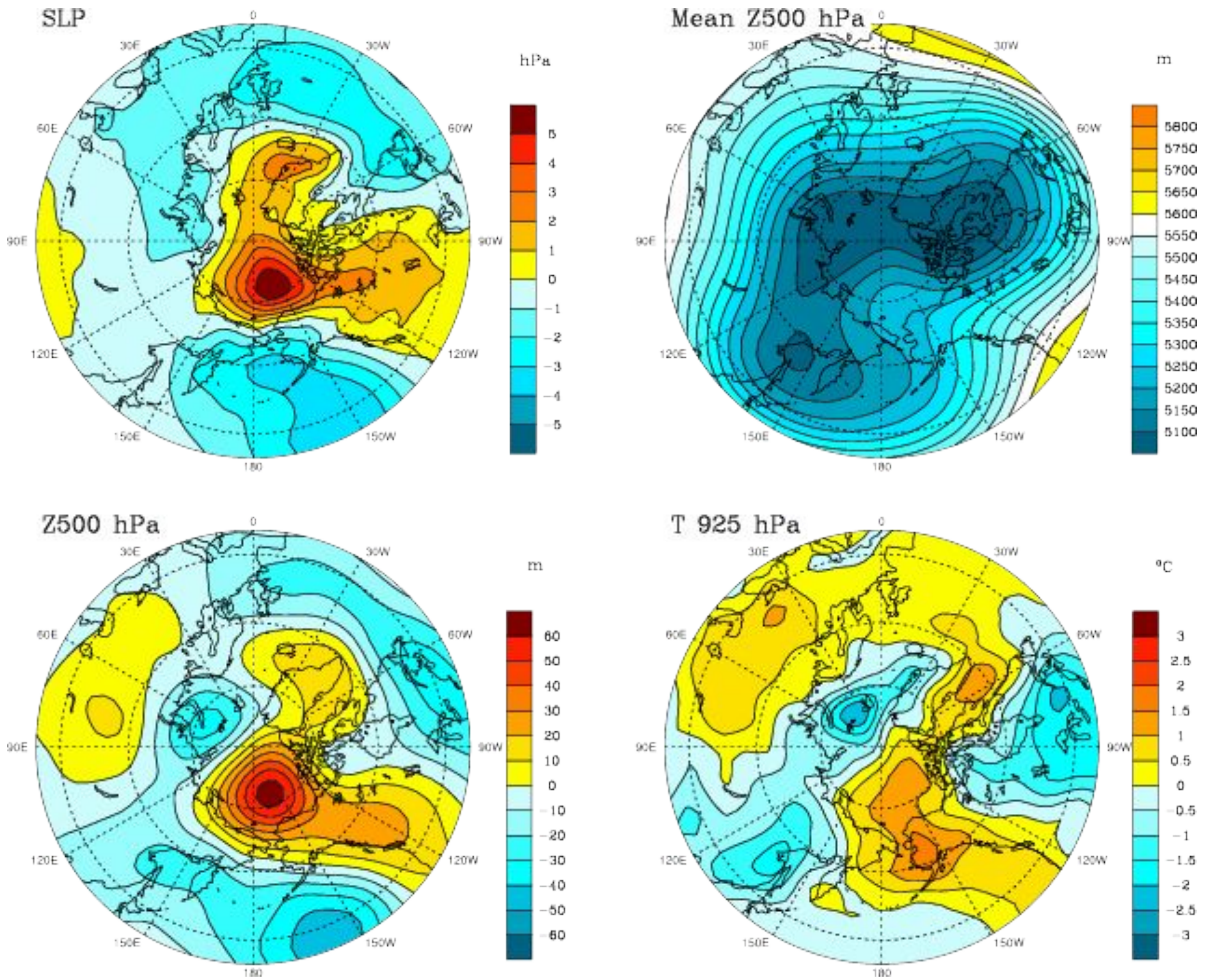
Autumn

Standardized anomalies of anticyclonic vorticity at the surface

No obvious trends in any season

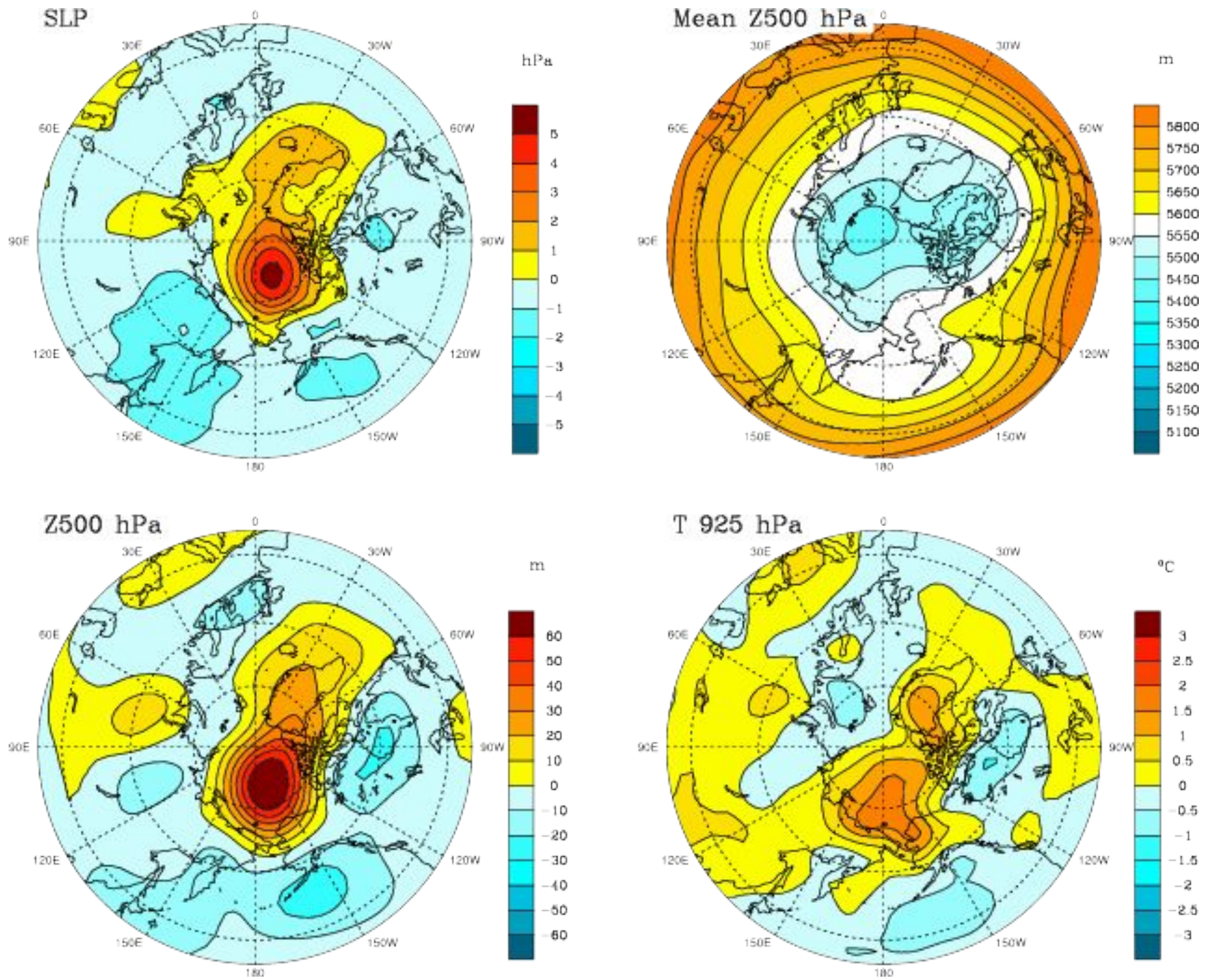
Anomalies are positive in autumn for the past five years and in summer for four of the past five years.

Winter signature of a strong BSH (top 20%)



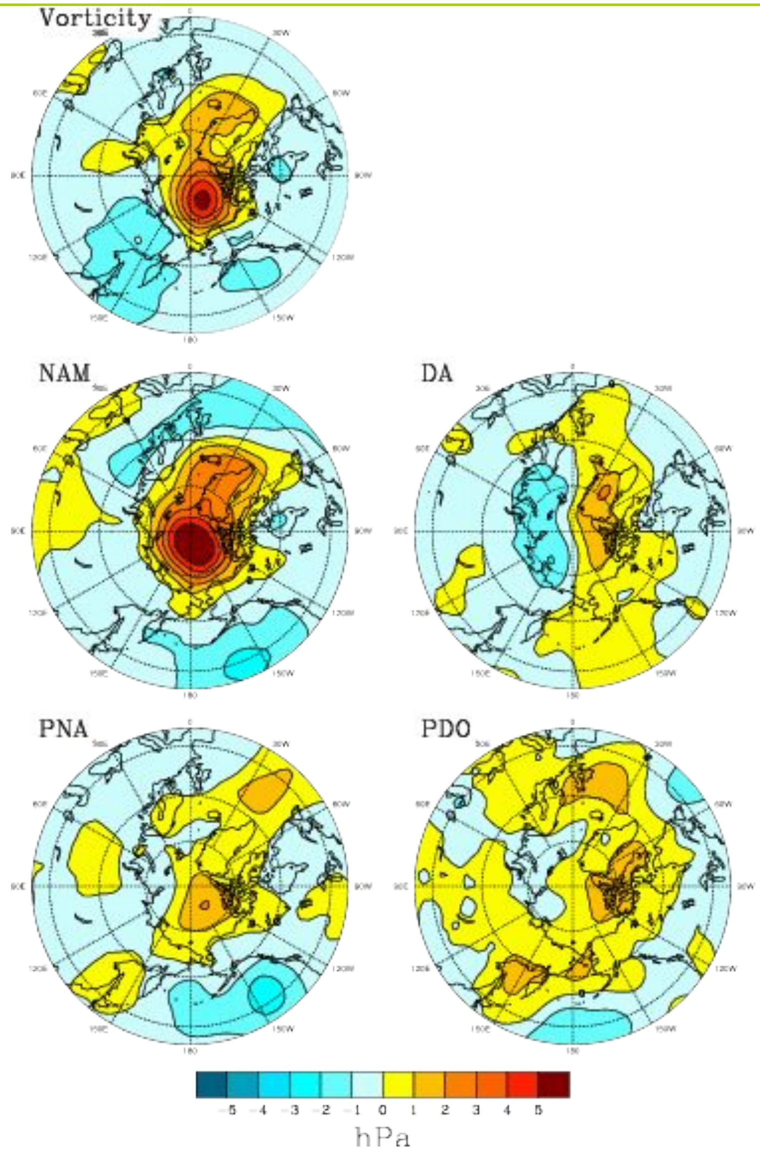
Note the regional split flow at 500 hPa

Summer signature of a strong BSH (top 20%)



Note the regional split flow at 500 hPa

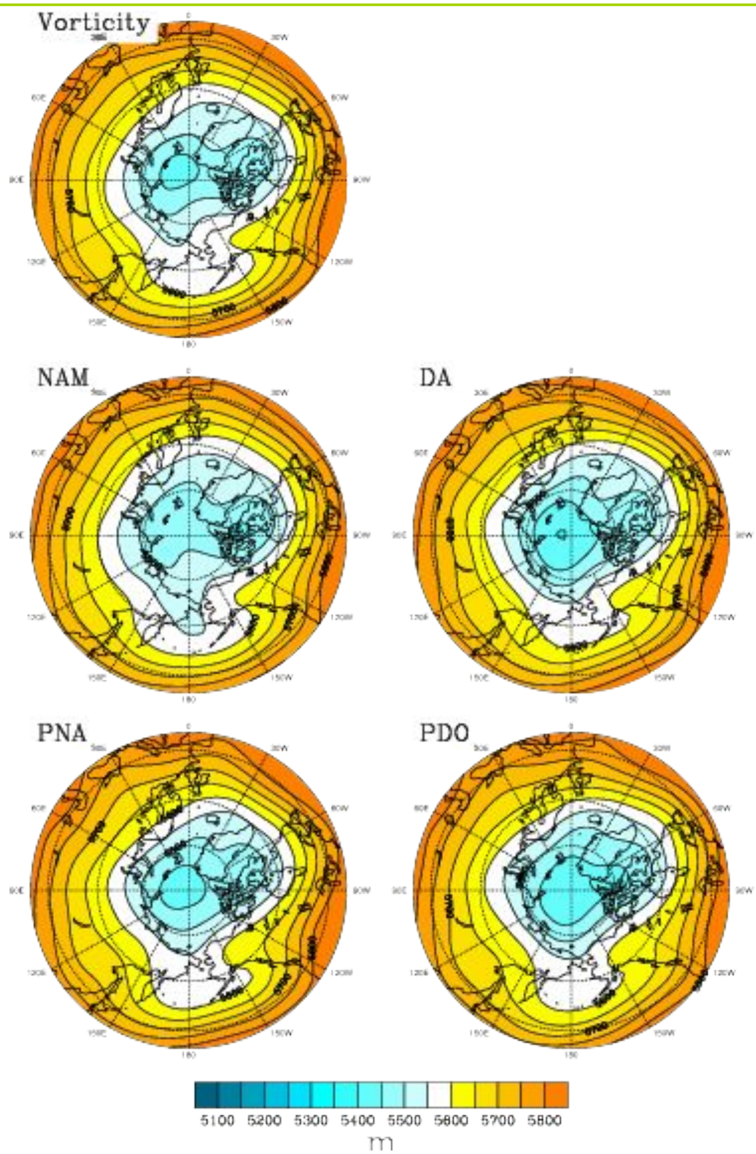
BSH and teleconnection patterns - summer



Mean SLP anomalies for summer months with a strong BSH (as defined by months in the top 20% of the negative vorticity index distribution for the BSH region), with composites corresponding to the negative NAM, positive DA, positive PNA and positive PDO (top 20% of their index distributions)

The strong summer BSH pattern is highly similar to the pattern for the negative NAM and to a lesser extent to the PNA.

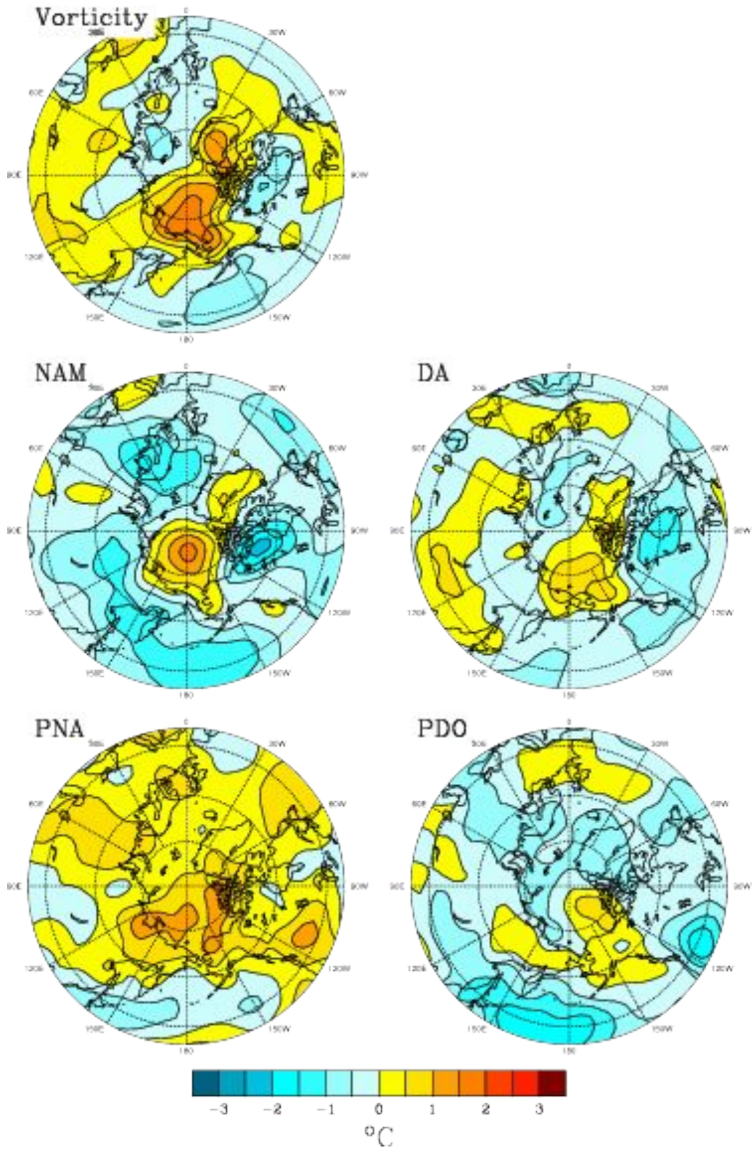
BSH and teleconnection patterns - summer



Mean 500 hPa height for summer months with a strong BSH (as defined by months in the top 20% of the negative vorticity index distribution for the BSH region), with composites corresponding to the negative NAM, positive DA, positive PNA and positive PDO (top 20% of their index distributions)

A key feature of the NAM is the strong curvature of the flow in the BSH region. This is not seen in composites for the DA, PNA or PDO.

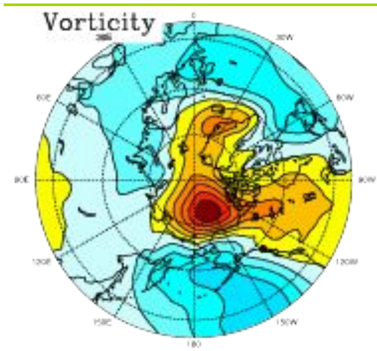
BSH and teleconnection patterns - summer



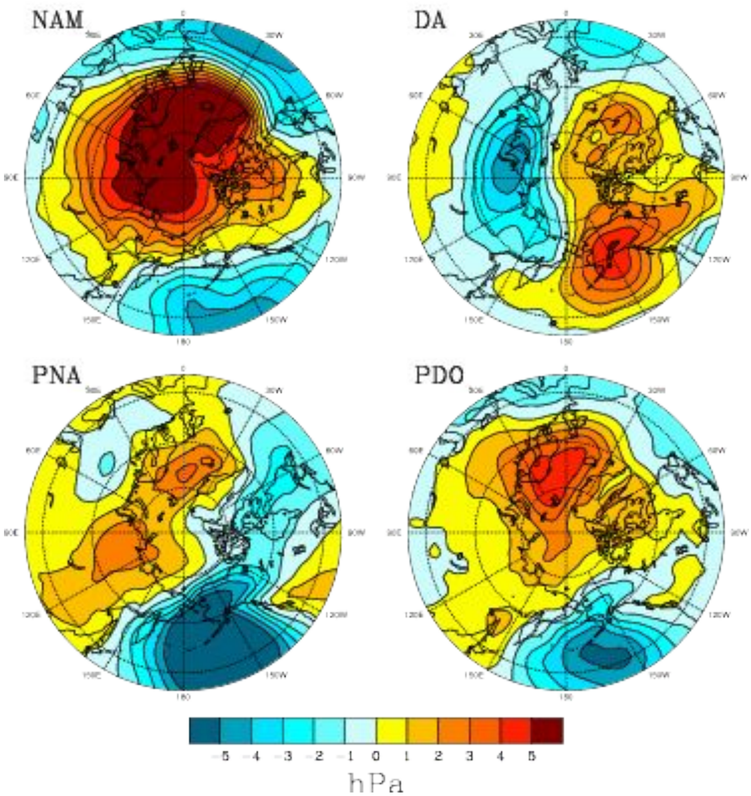
Mean 925 hPa temperature anomalies for summer months with a strong BSH (as defined by months in the top 20% of the negative vorticity index distribution for the BSH region), with composites corresponding to the negative NAM, positive DA, positive PNA and positive PDO (top 20% of their index distributions)

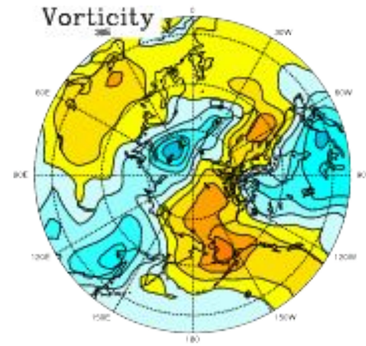
The negative NAM is associated with positive temperature anomalies centered over the BSH region while the strong BSH is associated with positive anomalies over a larger area. The PNA is linked to widespread positive anomalies.

BSH and teleconnection patterns - winter

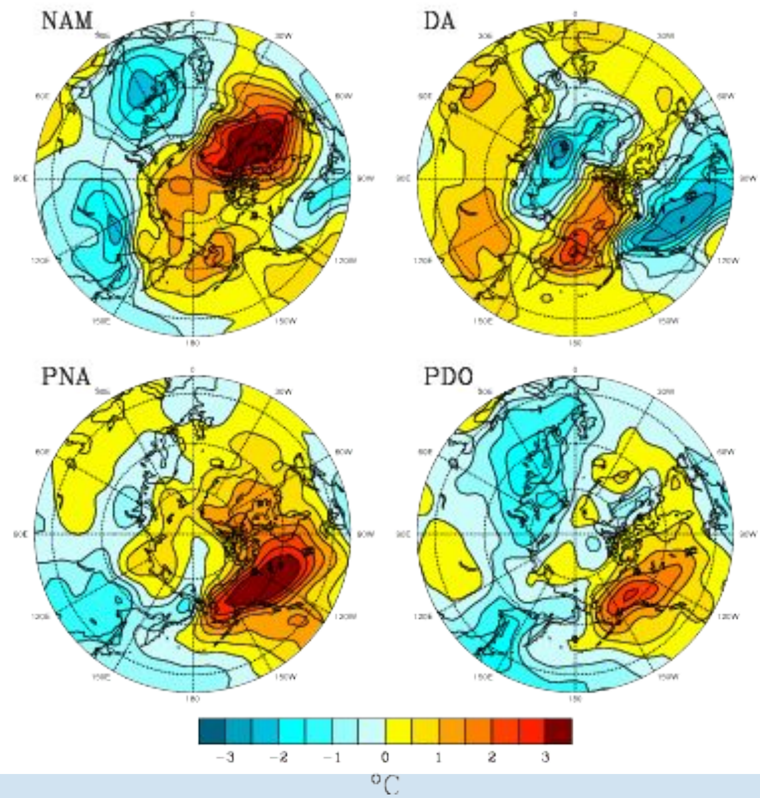


Mean SLP anomalies for a strong BSH and for teleconnection patterns





Mean 925 hPa temperature anomalies for a strong BSH and for teleconnection patterns



Serreze and Barrett, State of the Arctic, Miami 2010

Conclusions

• For all seasons a strong BSH is linked to a regional split flow at 500 hPa, in which a ridge linked to the strong BSH is separate from the western North American ridge to the south

• For all seasons except autumn, a strong BSH is linked to positive lower tropospheric temperature anomalies covering much of the Arctic Ocean, anomalies are especially pronounced during spring.

• There are no obvious temporal trends in the strength of the BSH

• Variations in the strength of the BSH in summer are most clearly allied with the phase of the summer NAM, and to a lesser extent, the PNA, the summer DA and the PDO.

Thank You

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