The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific and
Cultural Organization

IAEA
International Atomic Energy Agency

1968-10

Conference on Teleconnections in the Atmosphere and Oceans

17 - 20 November 2008

Teleconnection patterns: an overview.

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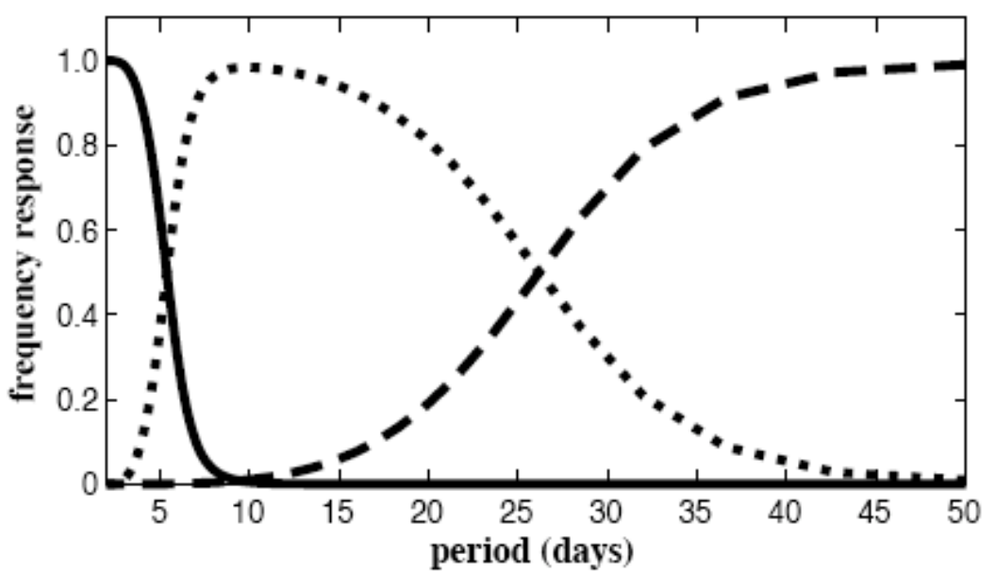
Cross-frequency coupling, Skewness, and Blocking

Teleconnection Patterns: Why do they exist?

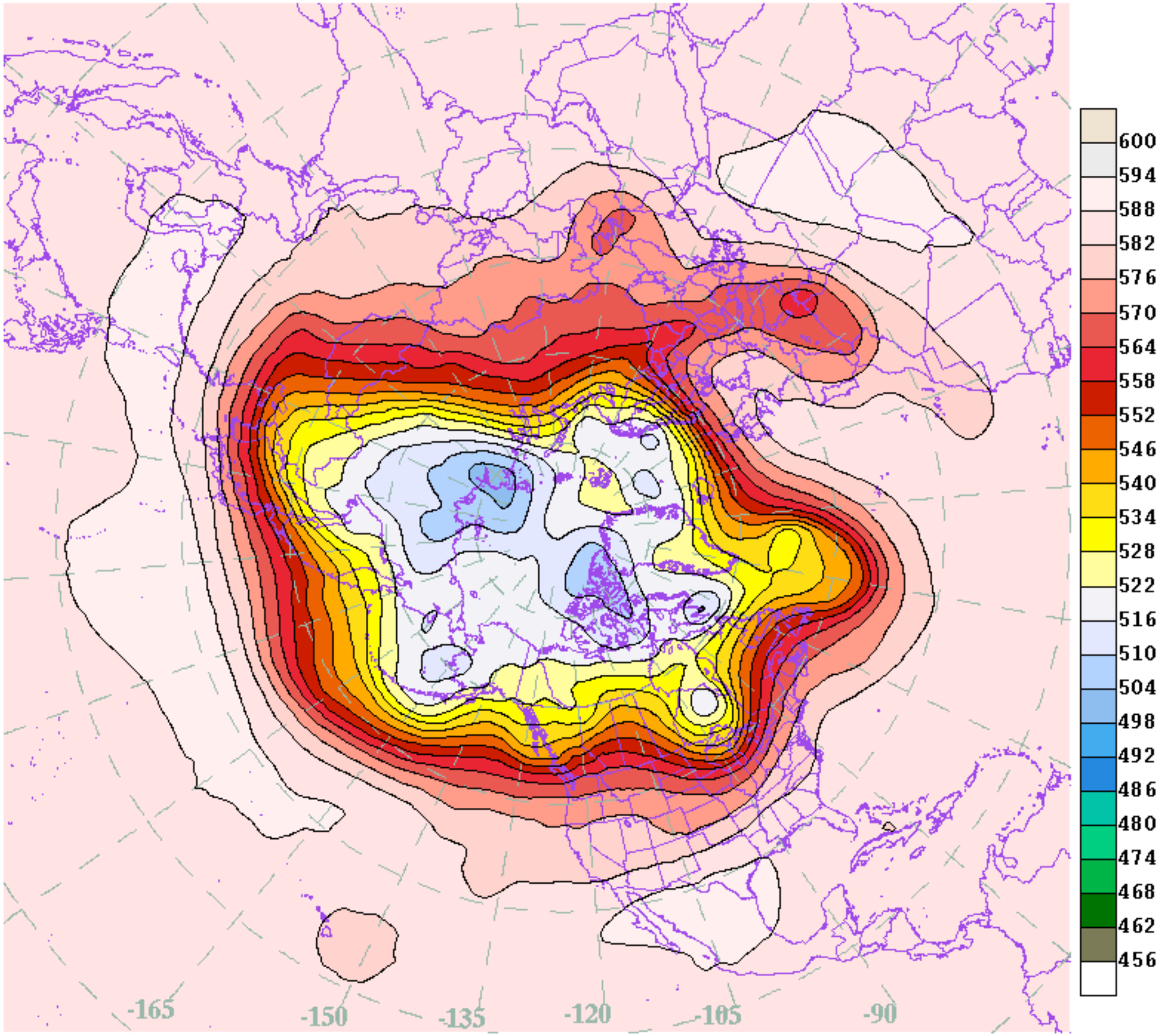
H Baroclinic waves <6 d
L Low frequencies >6 d
Blackmon 1976

H Baroclinic waves <6 d
M Barotropic Rossby waves 6-30 d
L Perturbations in stationary waves >30d

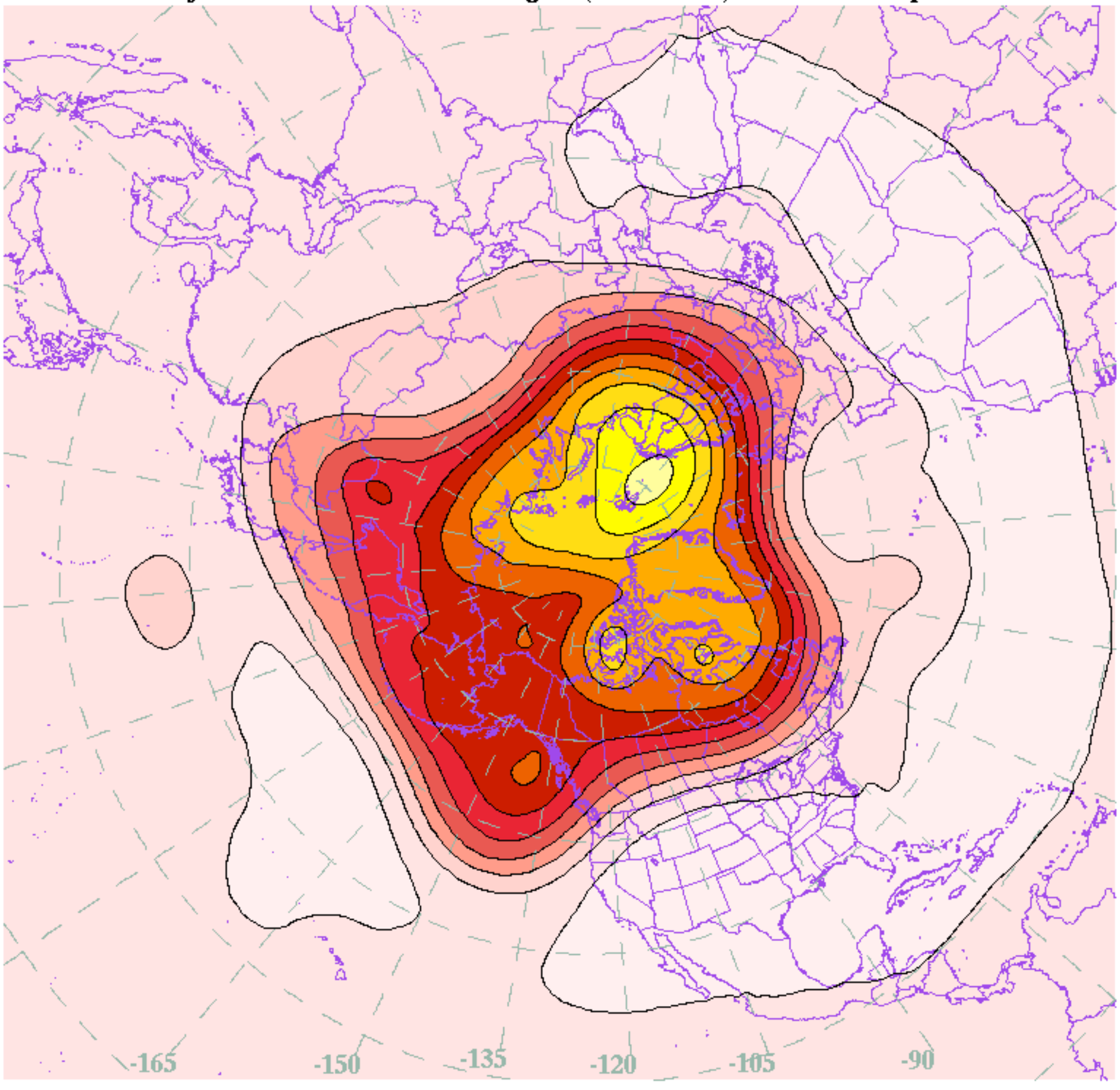


000 Hr Fcst 500 MB Heights (dekameters) valid 00Z Thu 01 Nov 2007

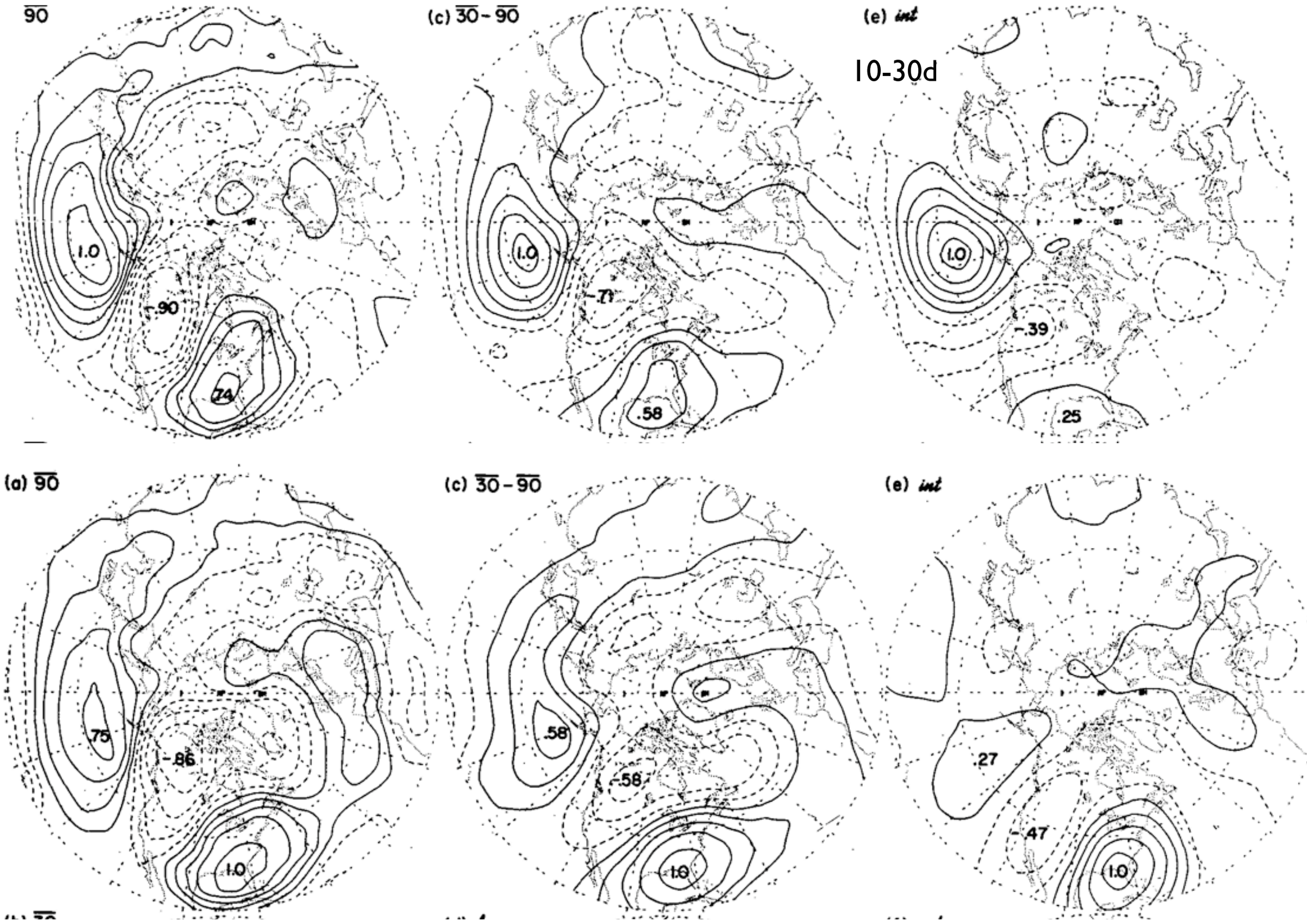
(initialized 00Z Thu 01 Nov 2007)



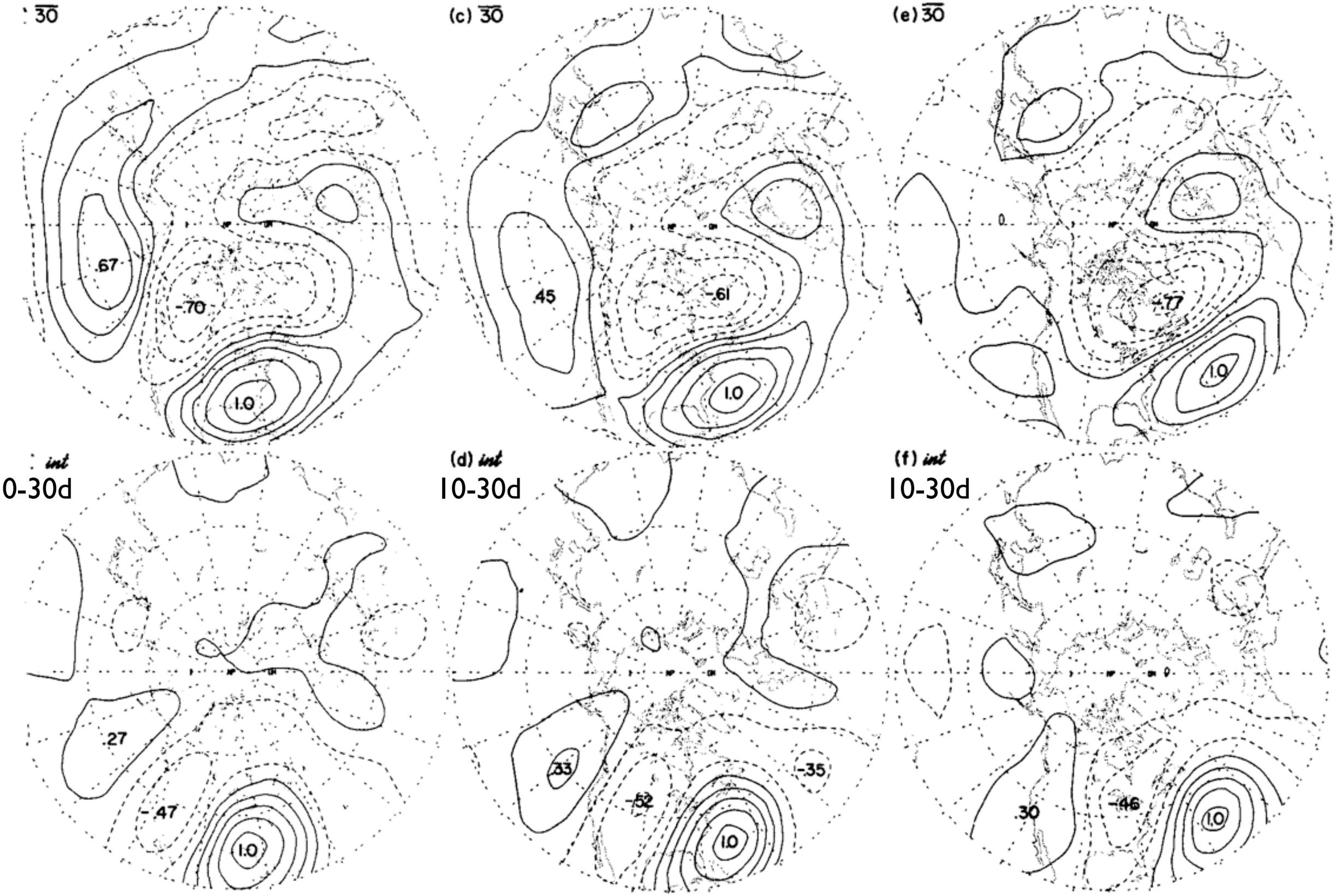
5-day Centered Mean 500 MB Heights (dekameters) valid 00Z 01 Sep 2007



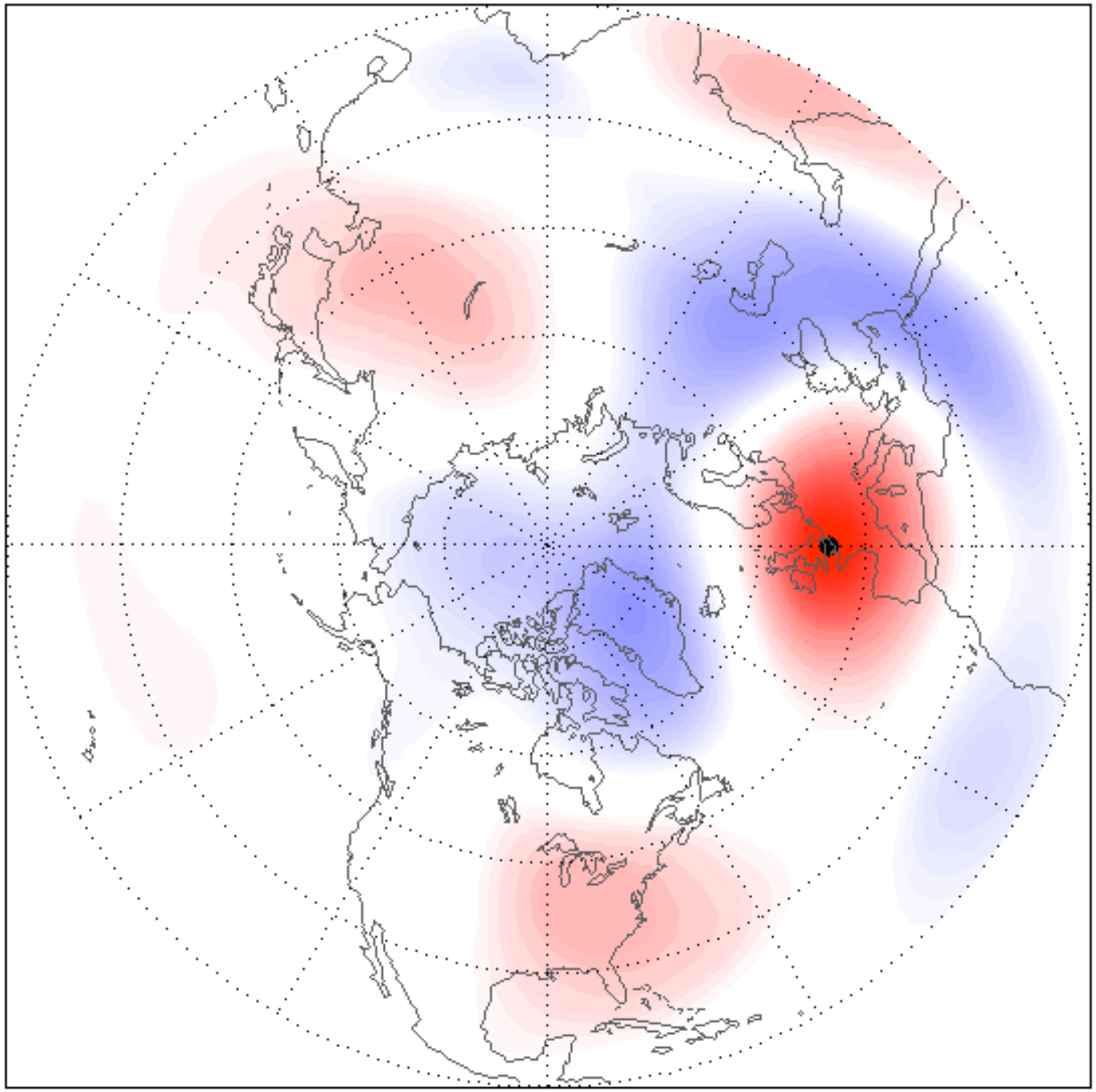
Univ. of Washington Dept. of Atm. Sci.



Blackmon et al. (1984)

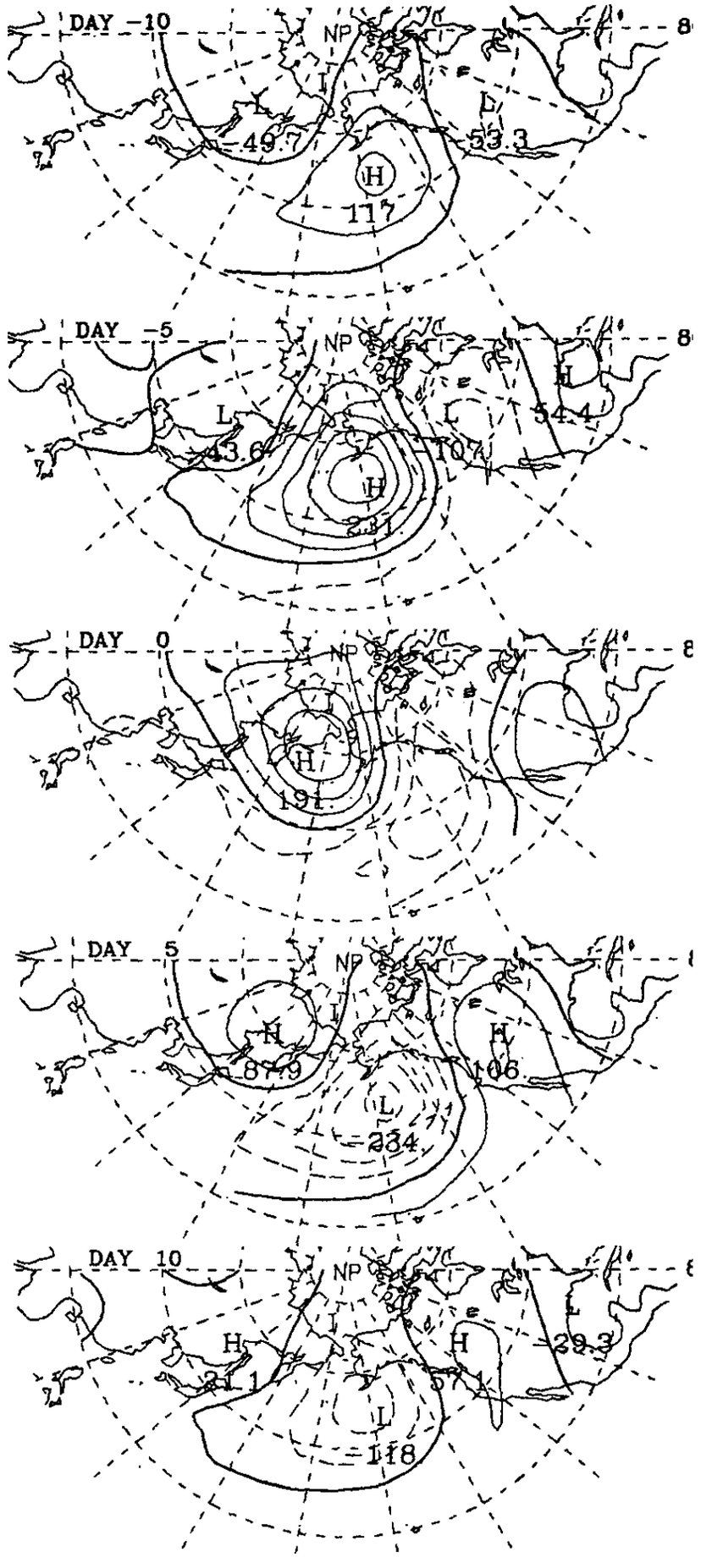


Blackmon et al. (1984)

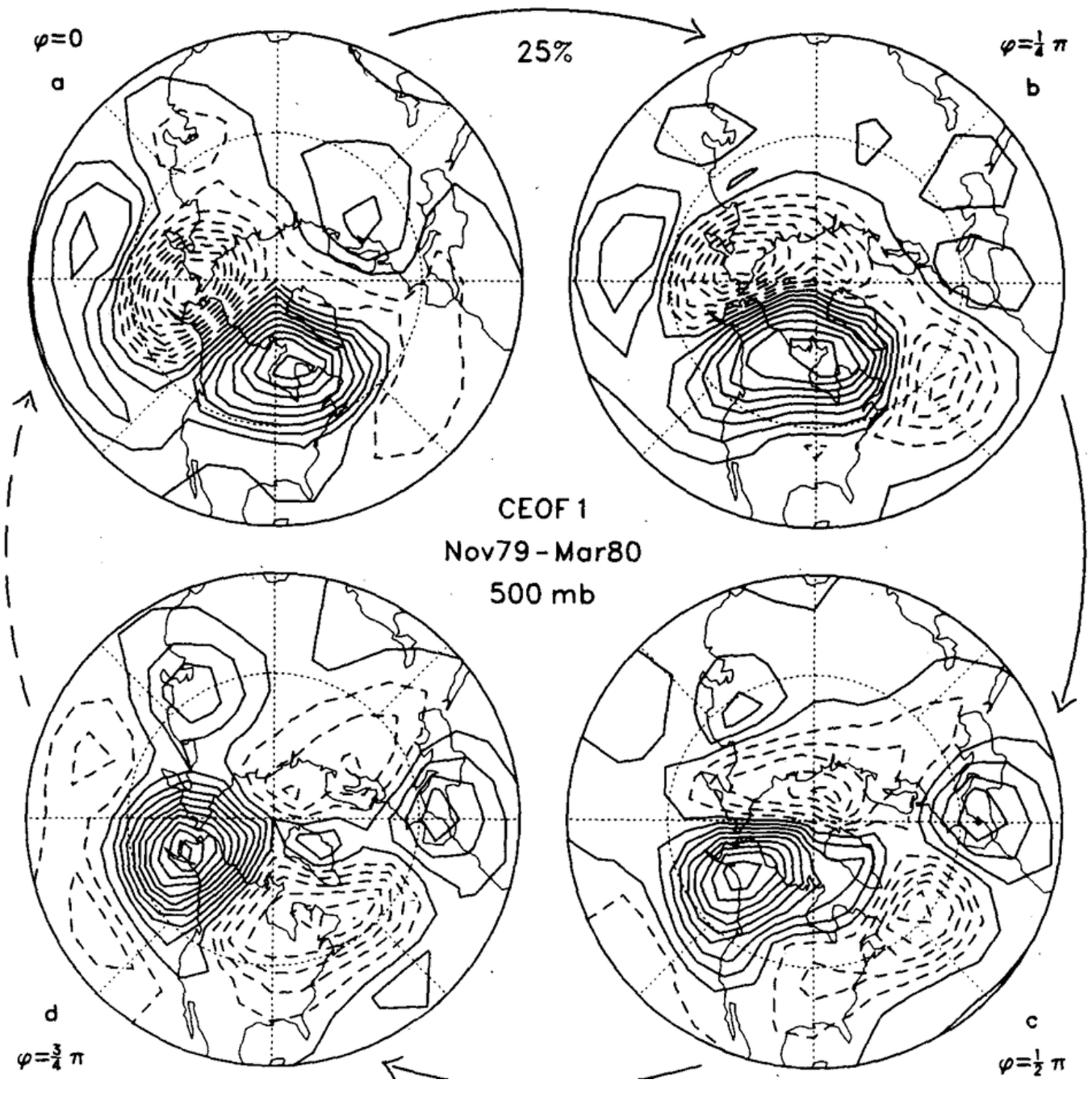


M

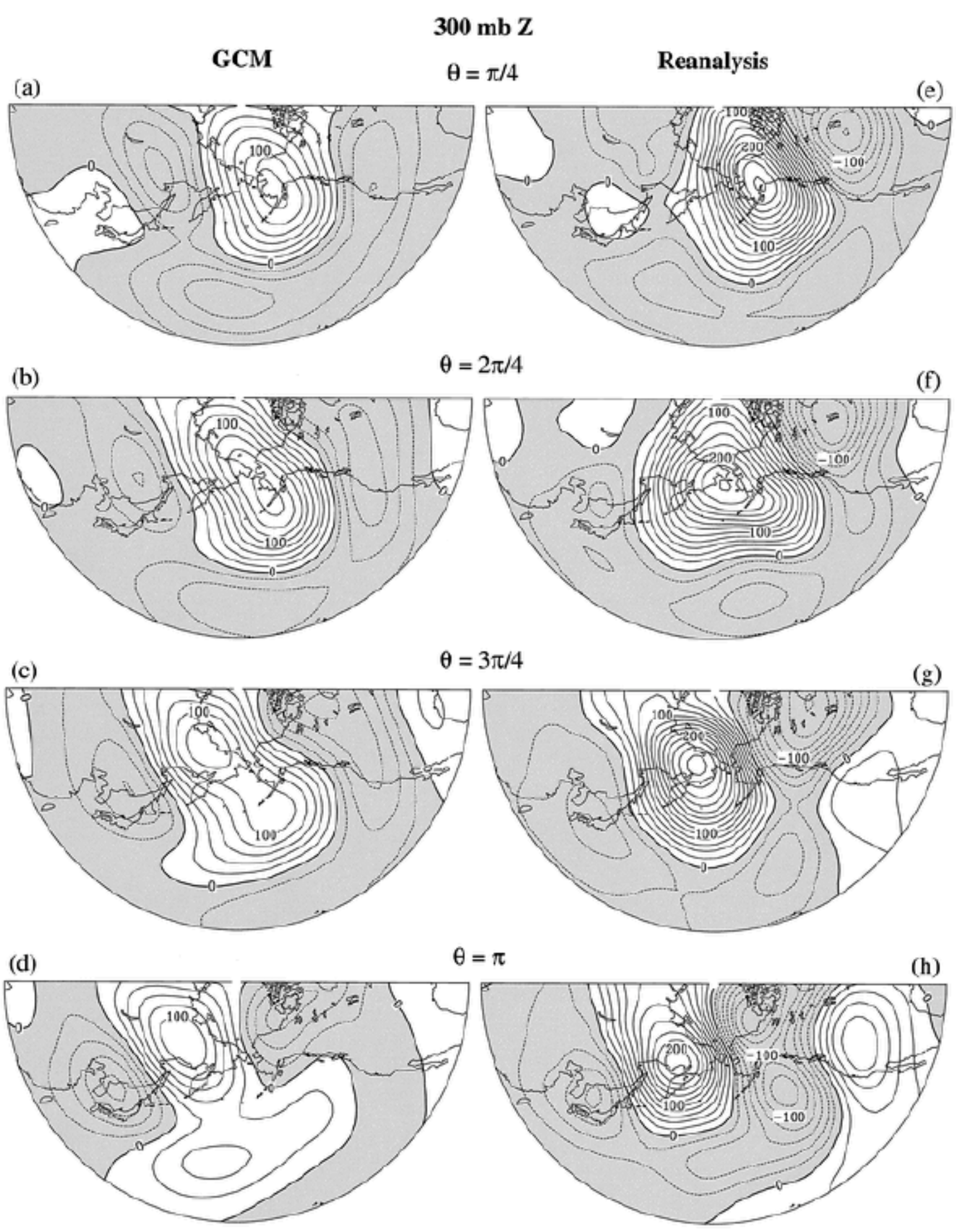
Kushnir (1987)

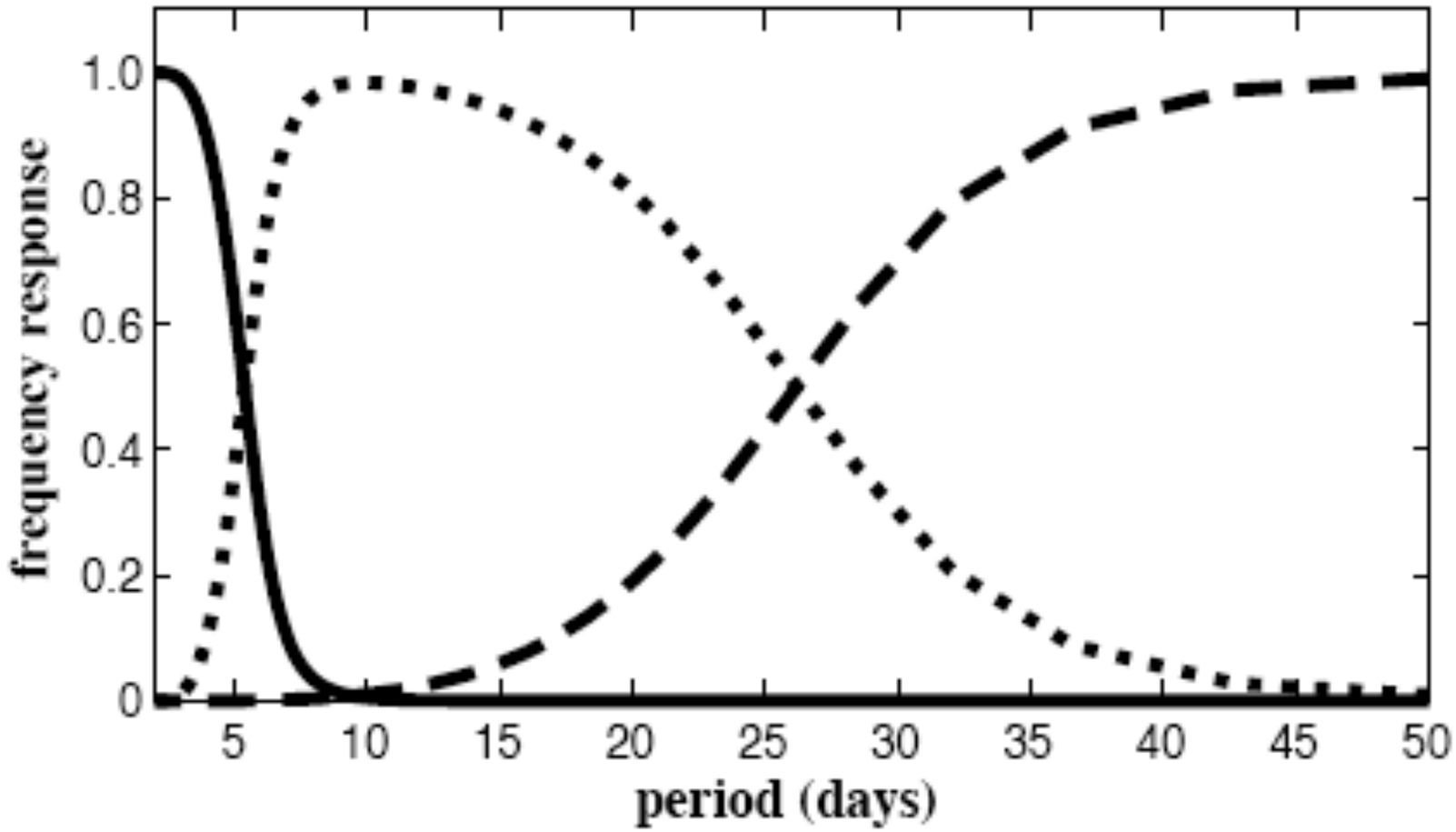


Branstator (1987)



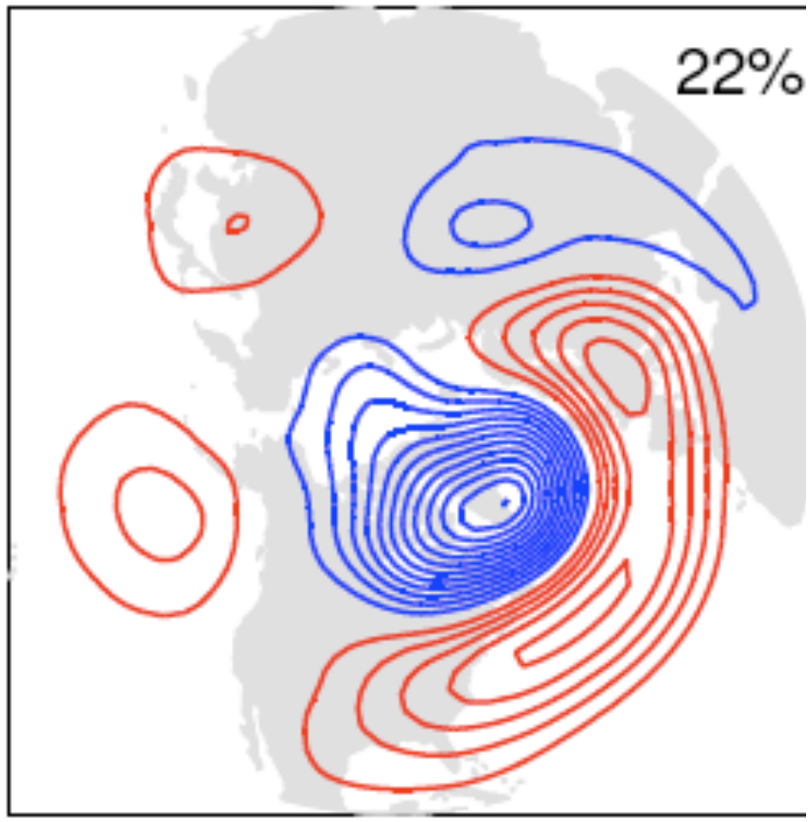
Lau and Nath (1999)

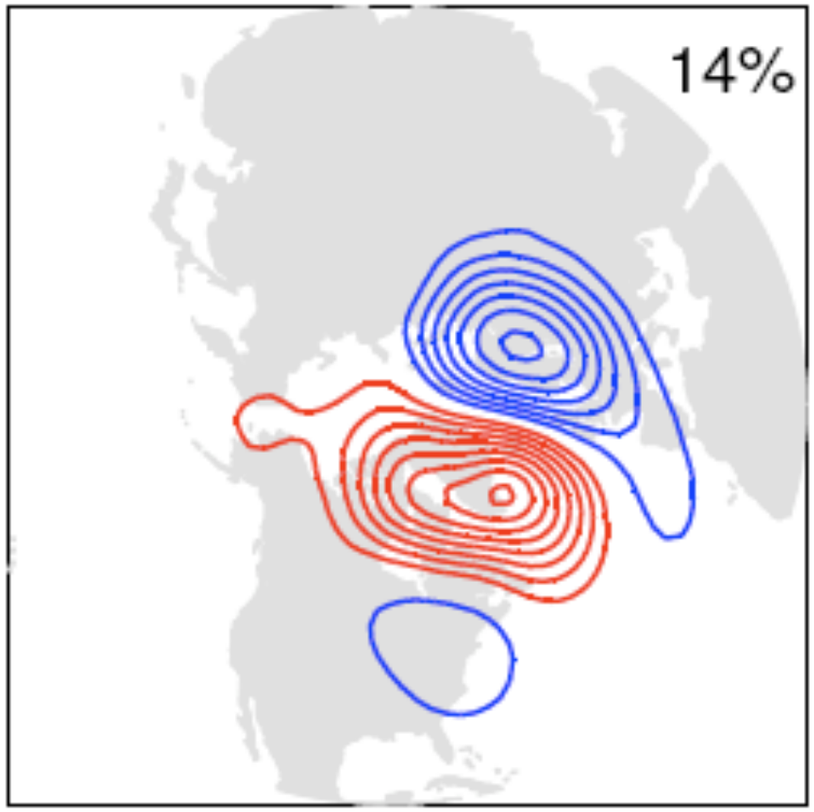


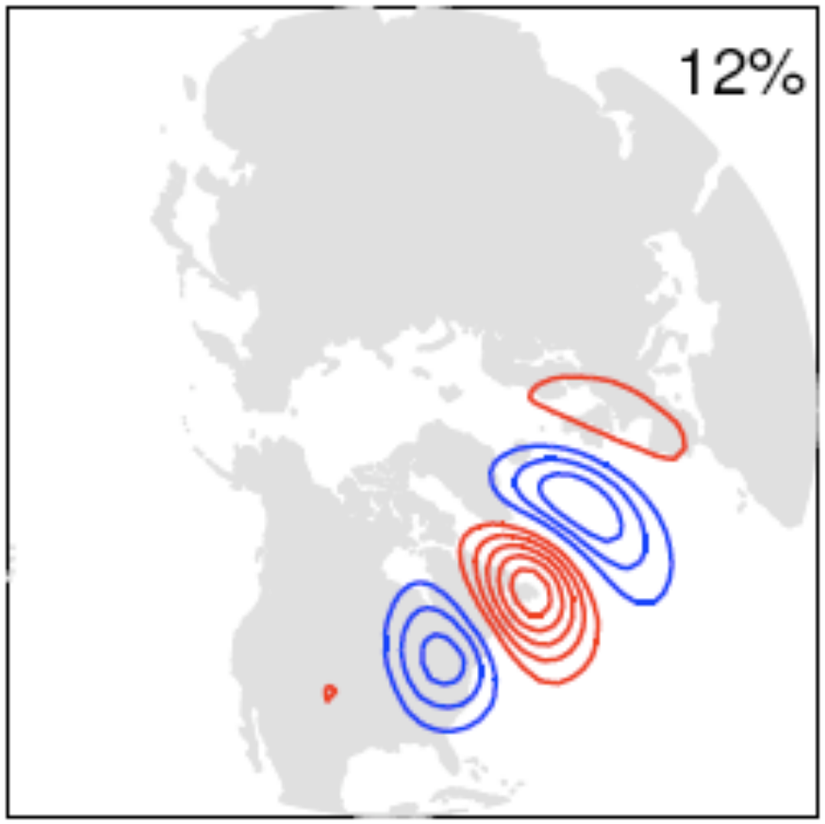

frequency response
1.0
0.8
0.6
0.4
0.2
0
5
10
15
20
25
30
35
40
45
50
period (days)

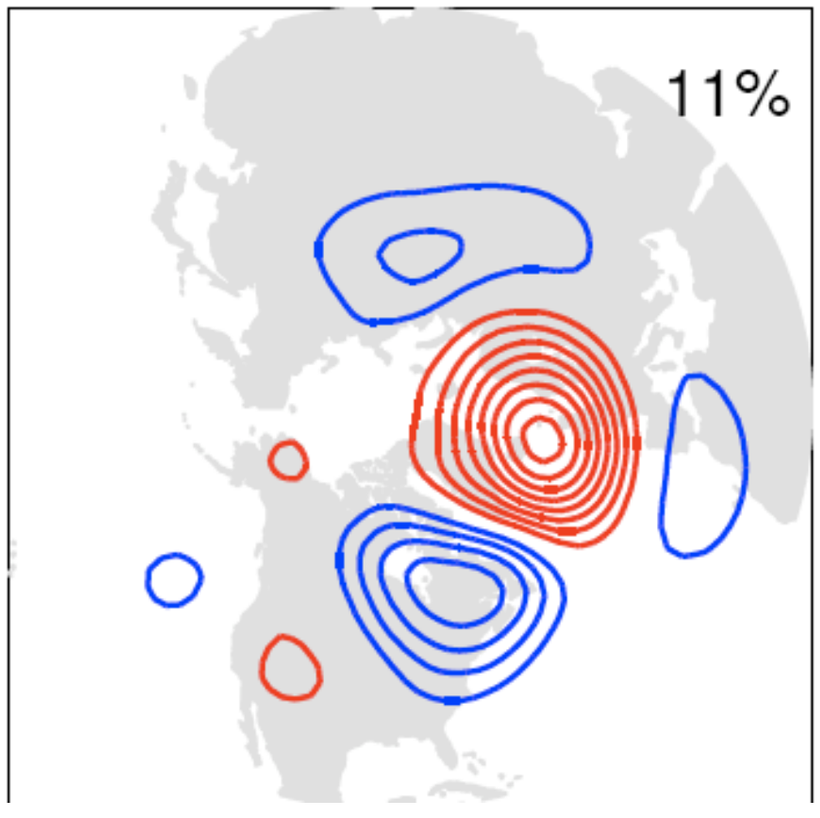
$$Z' = Z_L + Z_M + Z_H$$

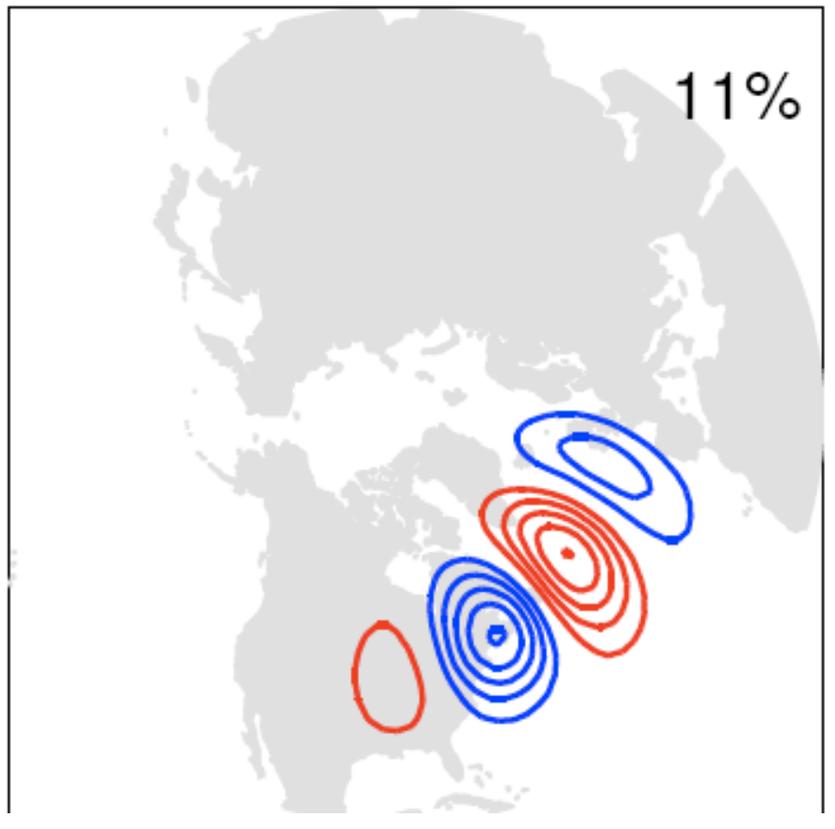
EOFs
Atlantic

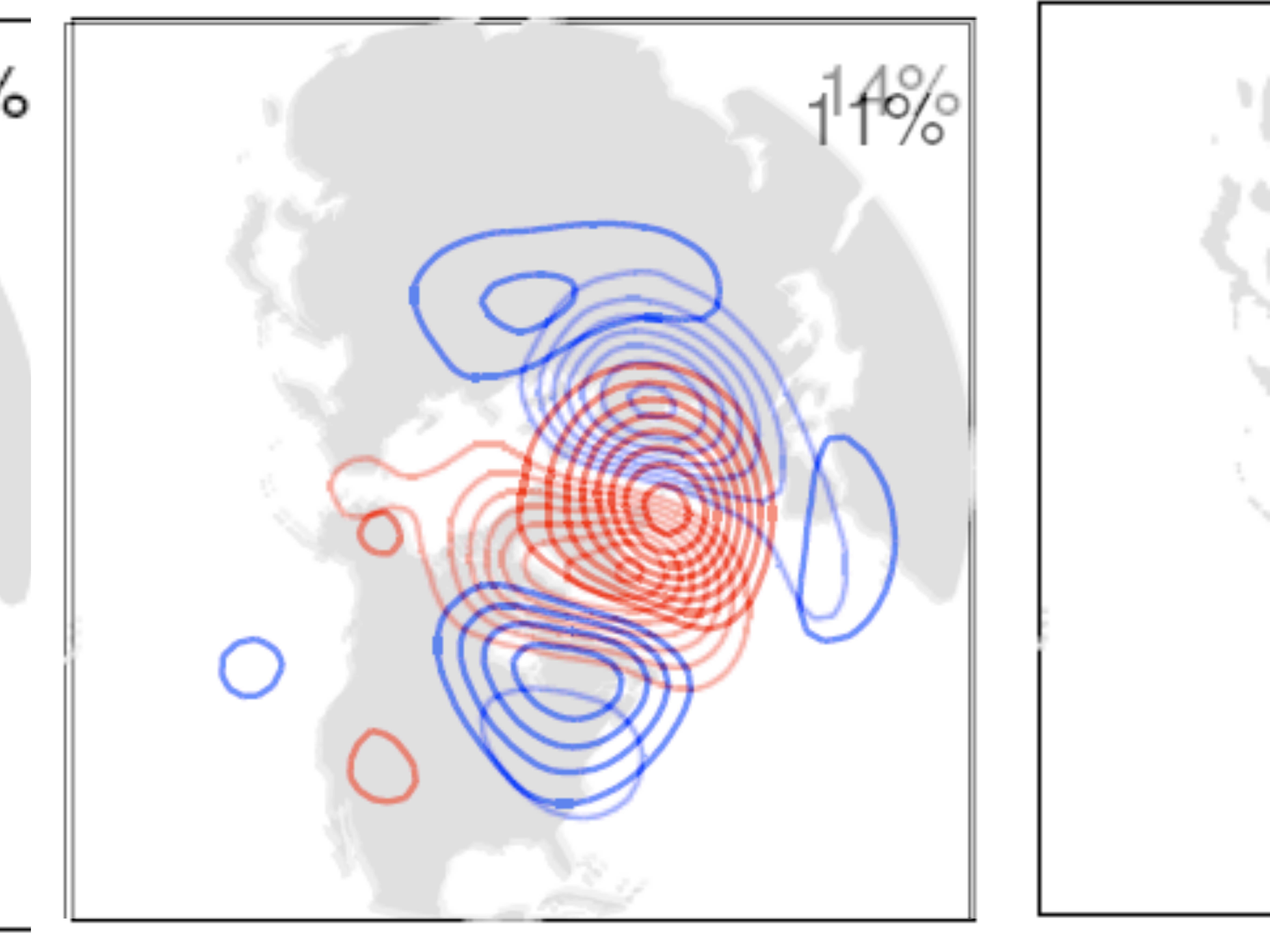


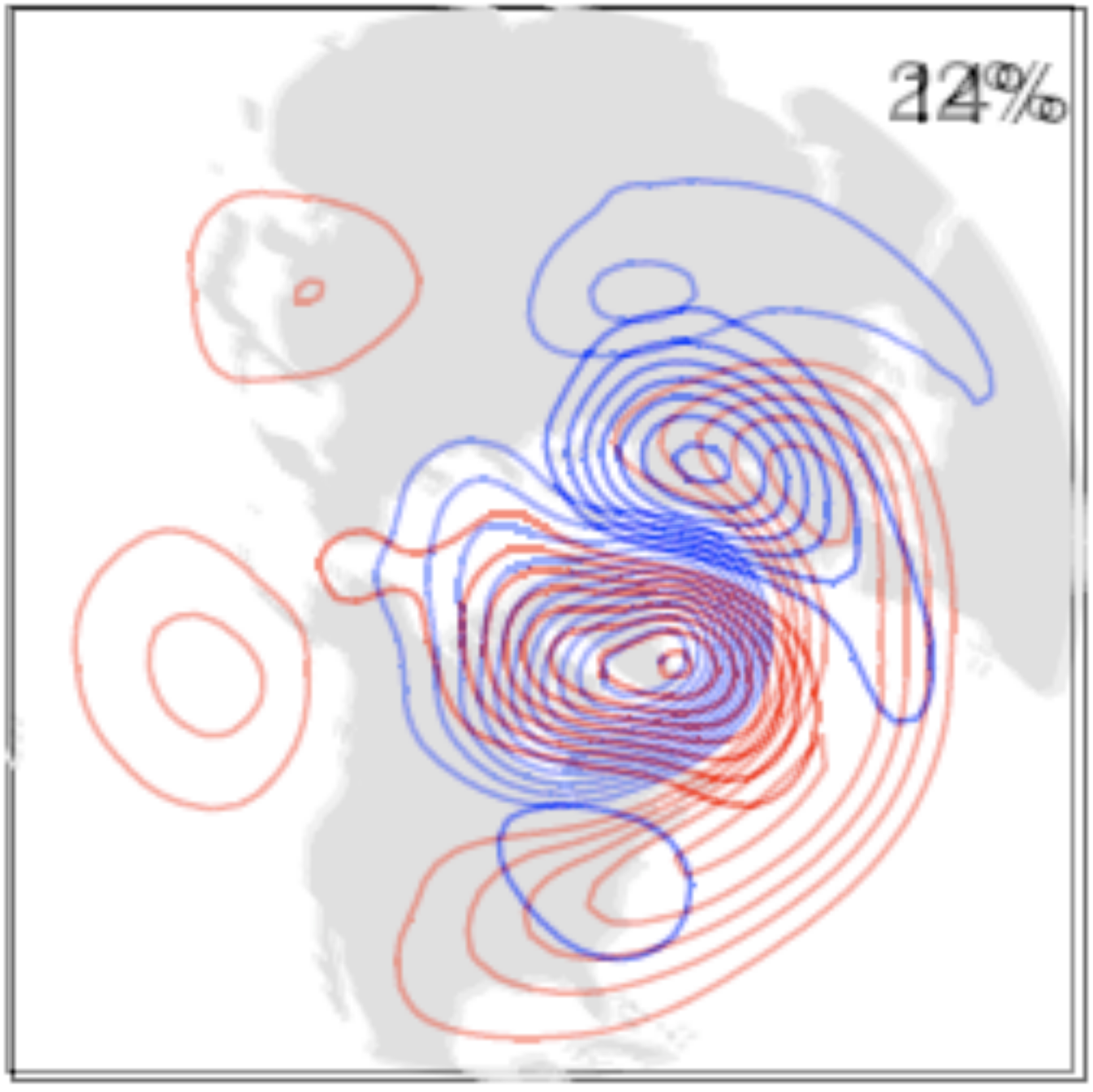




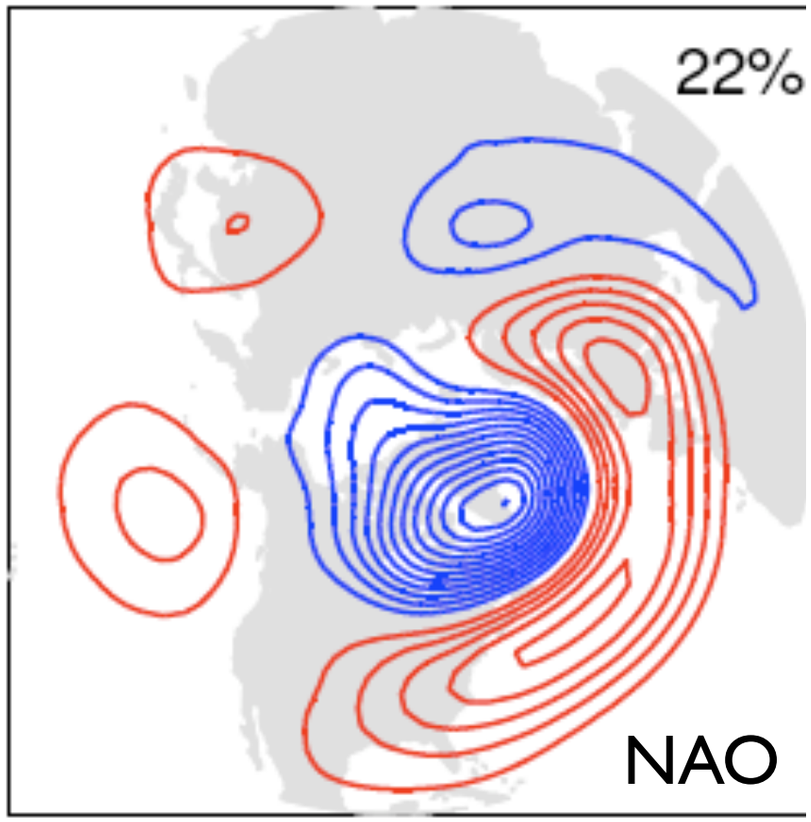


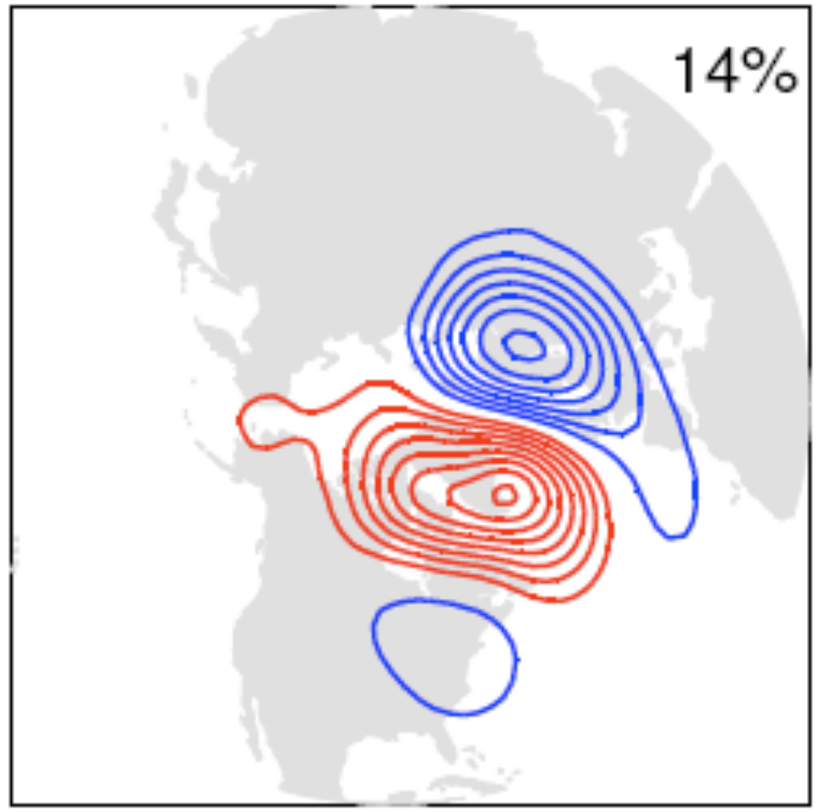


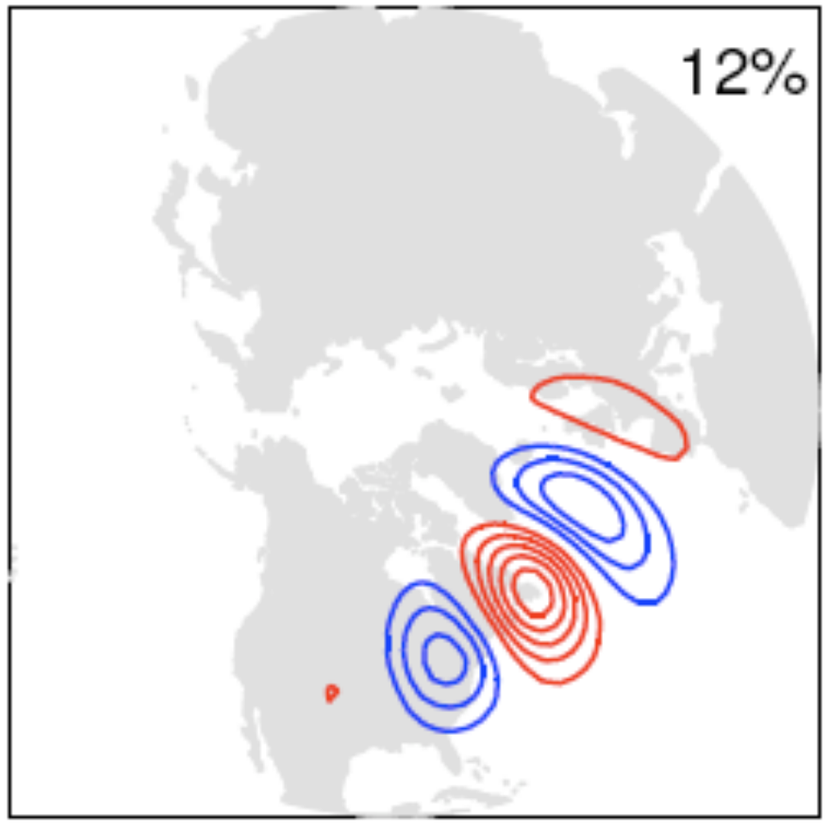

14%
11%

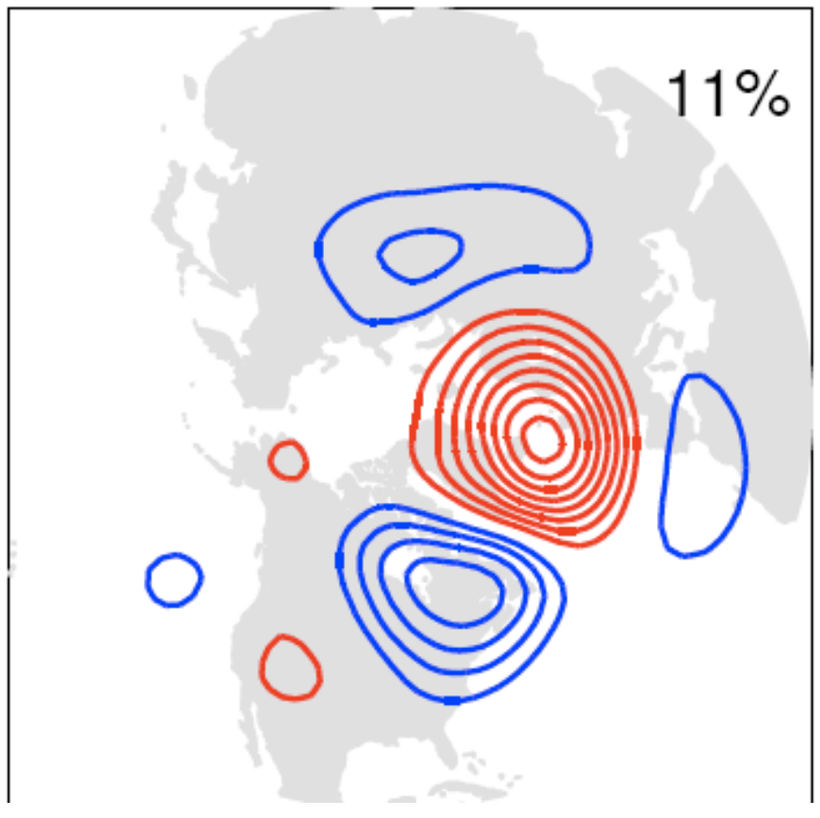

22%

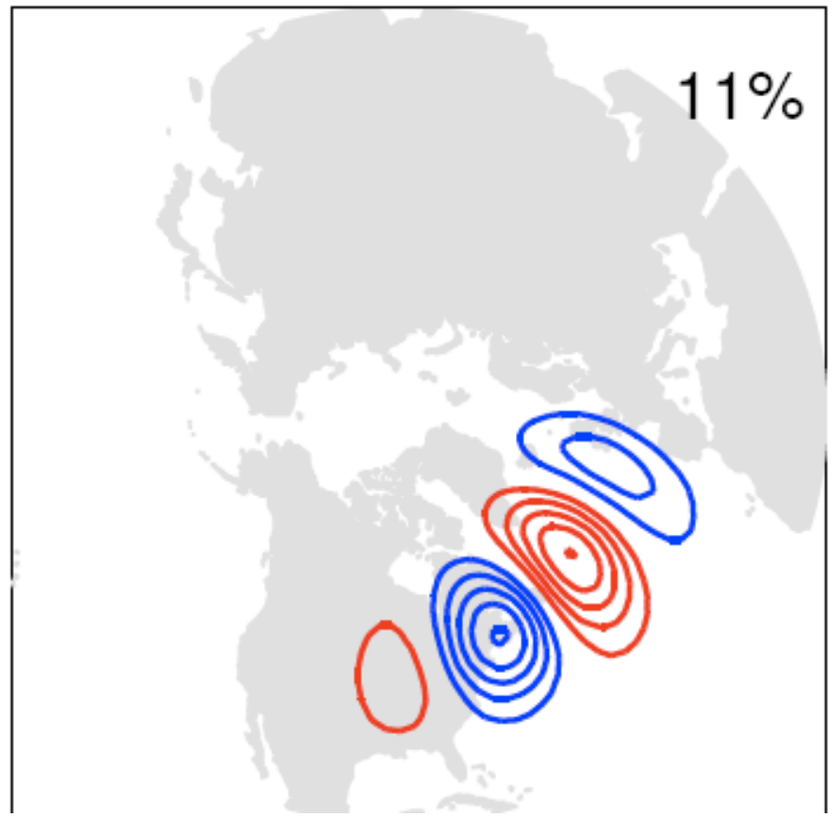
EOFs Atlantic









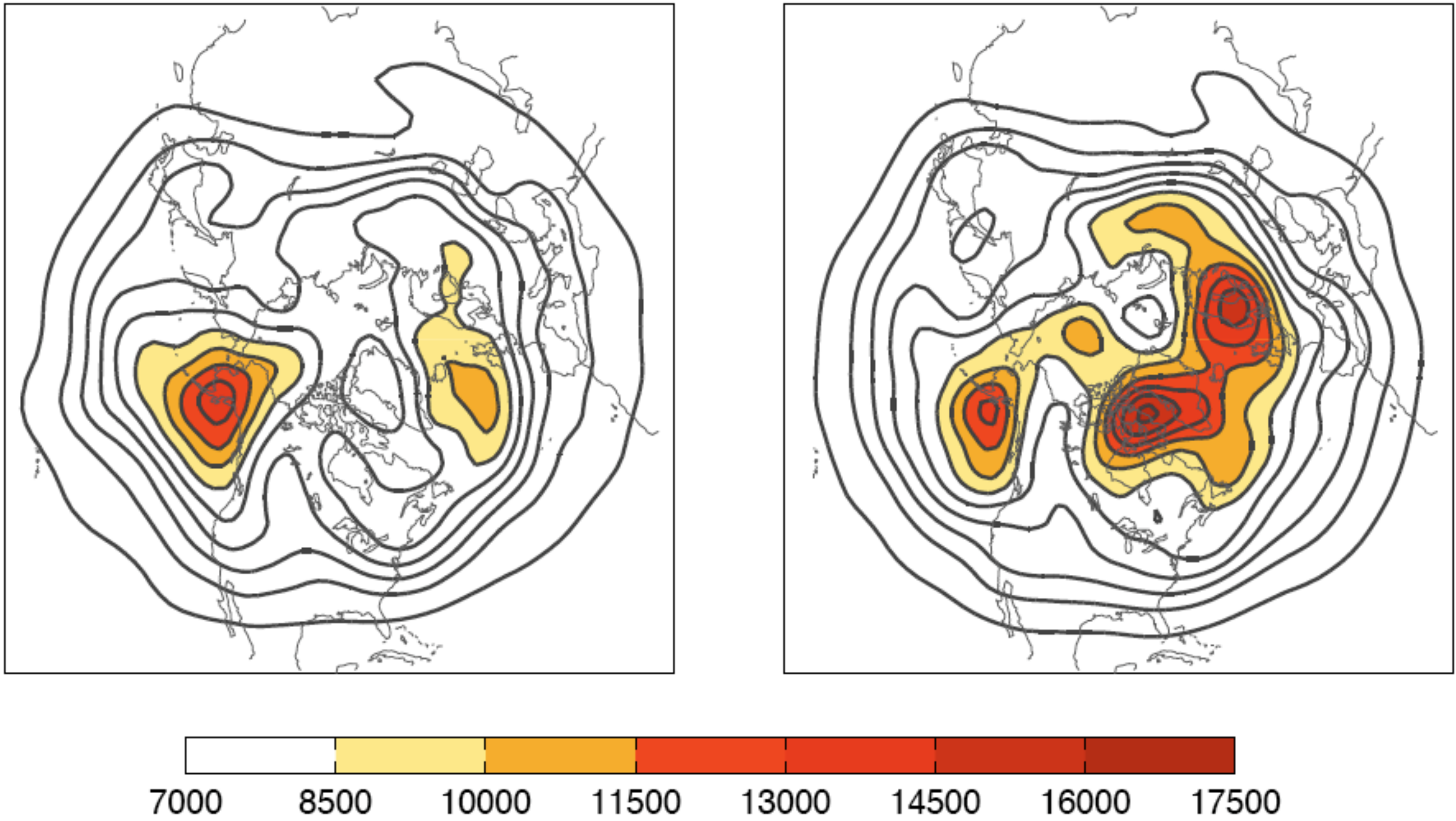


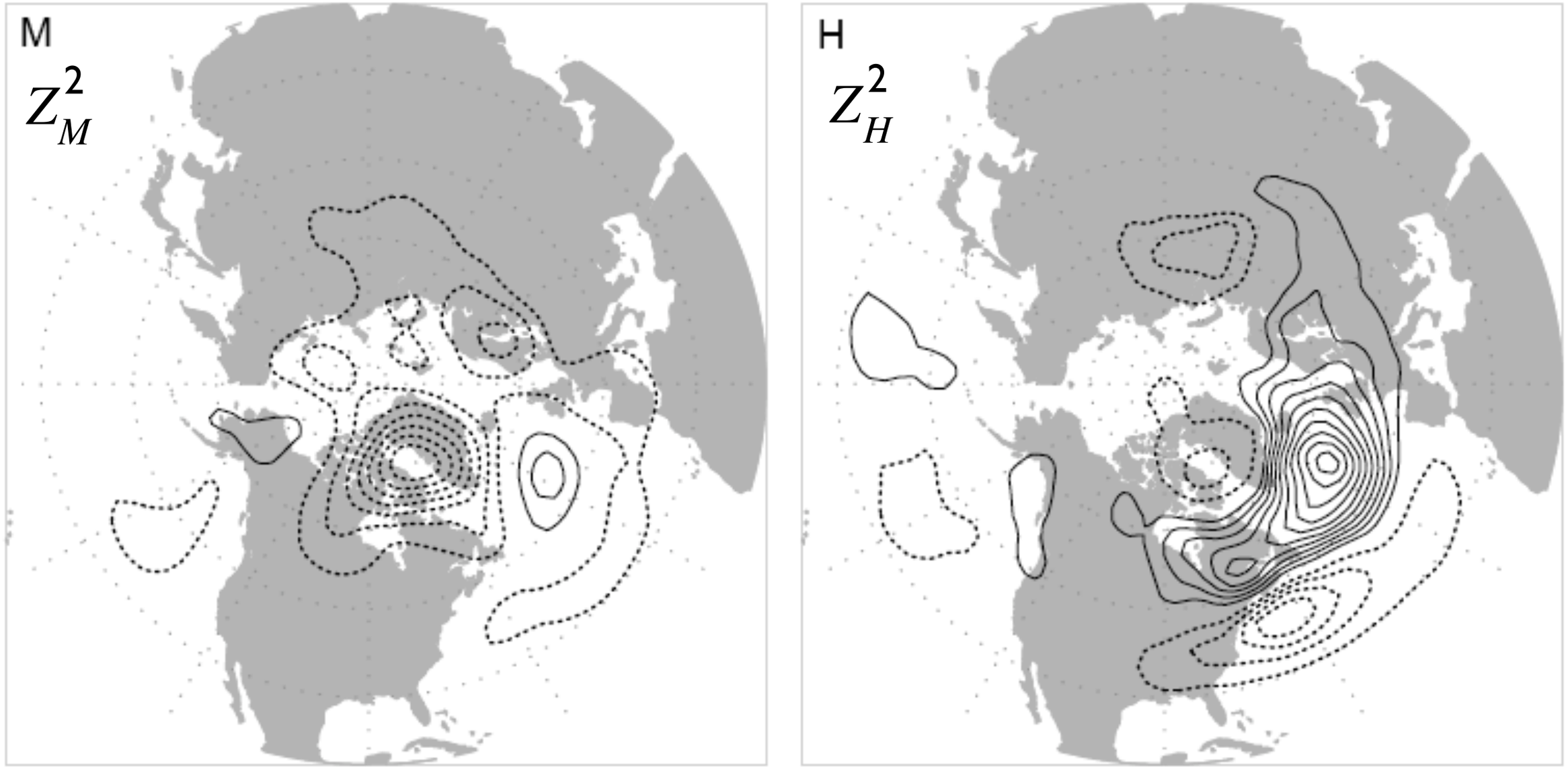
Cross-frequency coupling

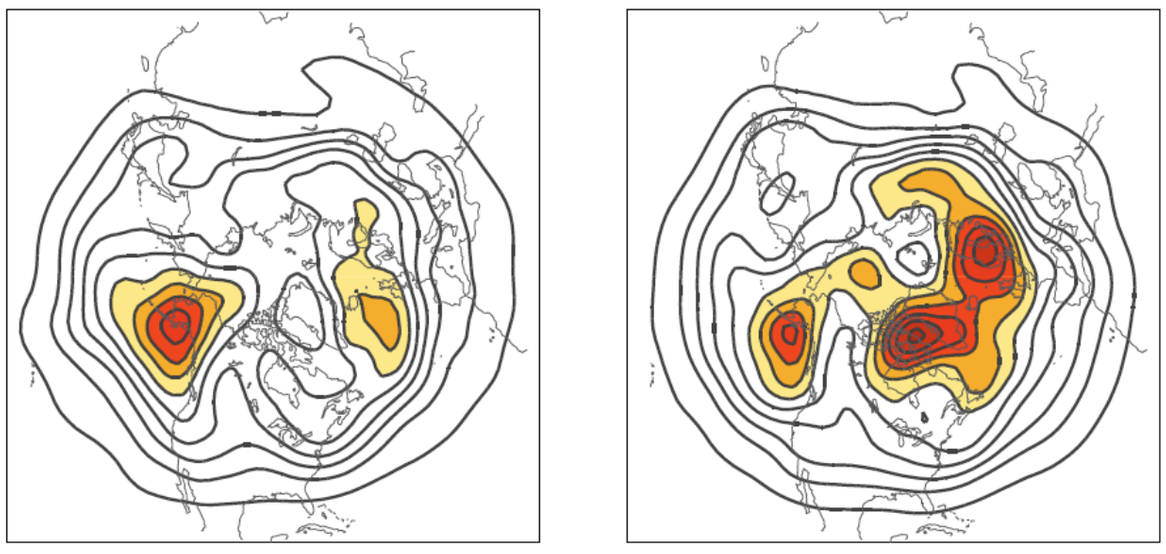
Z_M^2

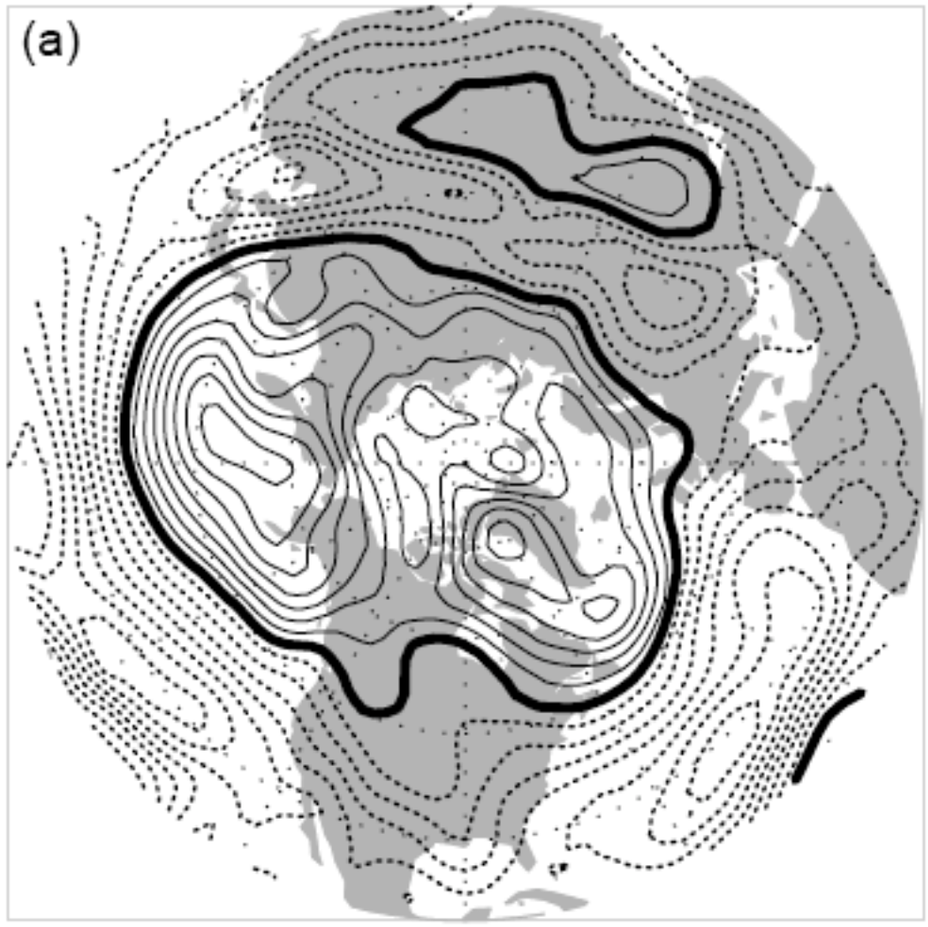
NAO$^+$

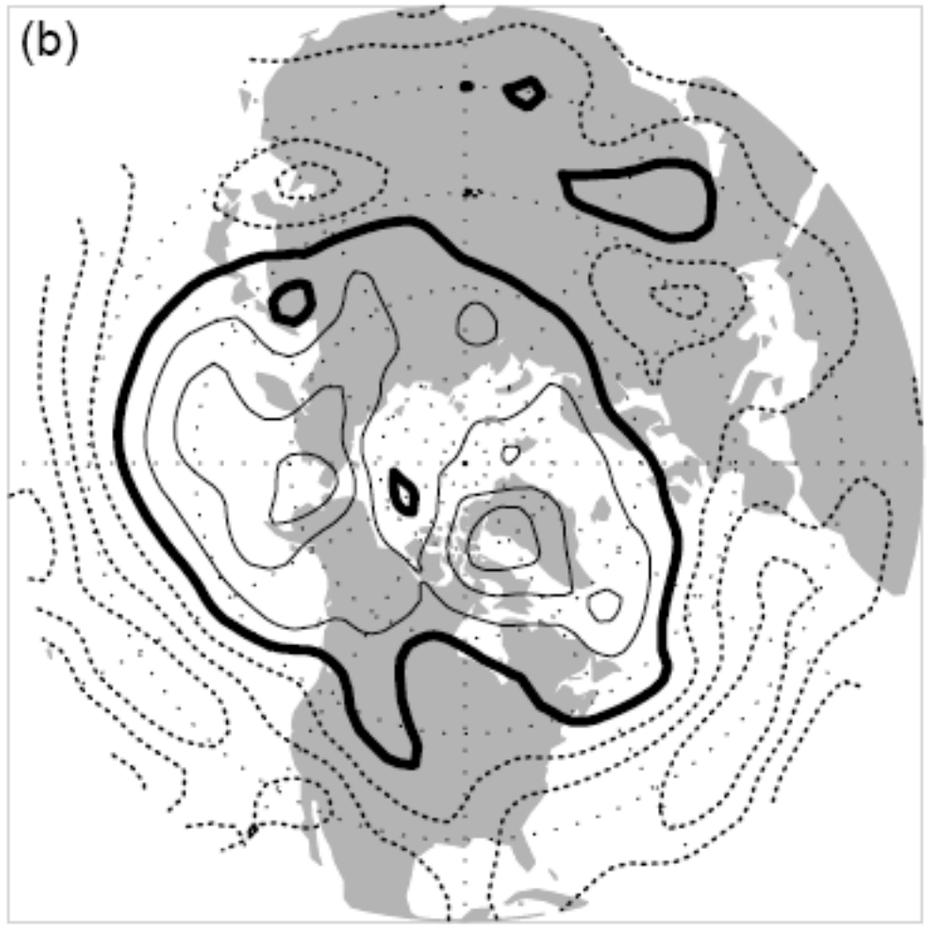
NAO$^-$

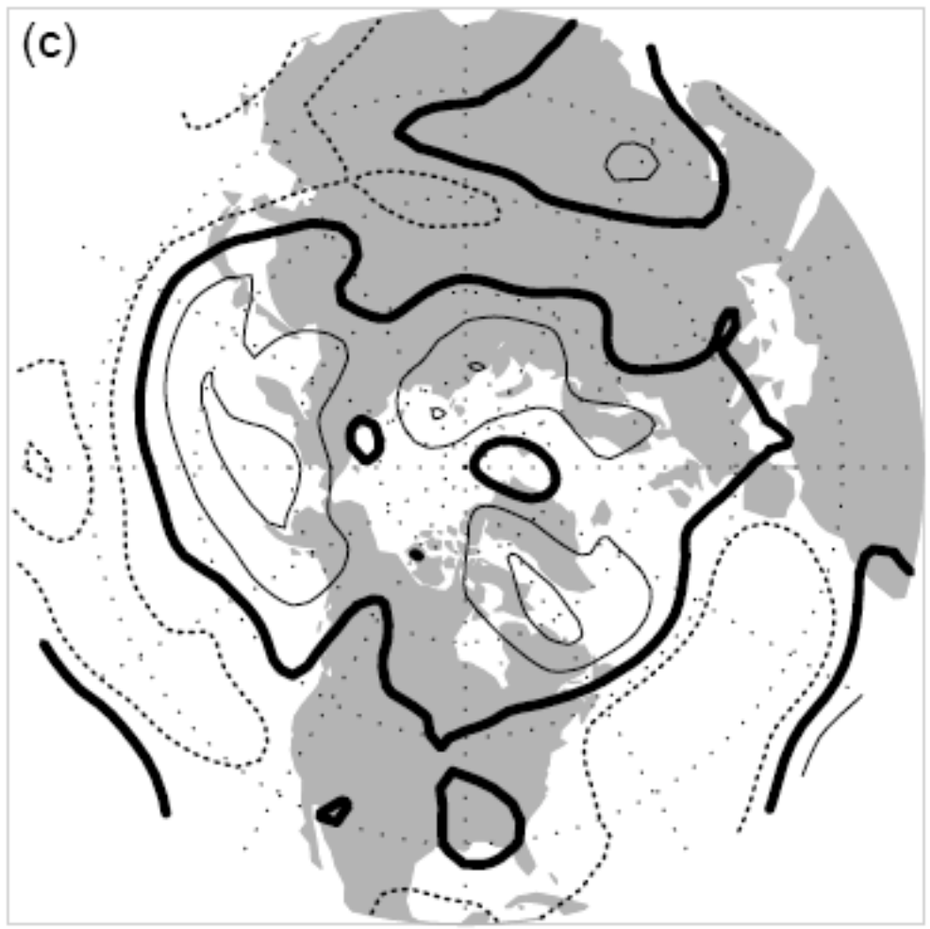


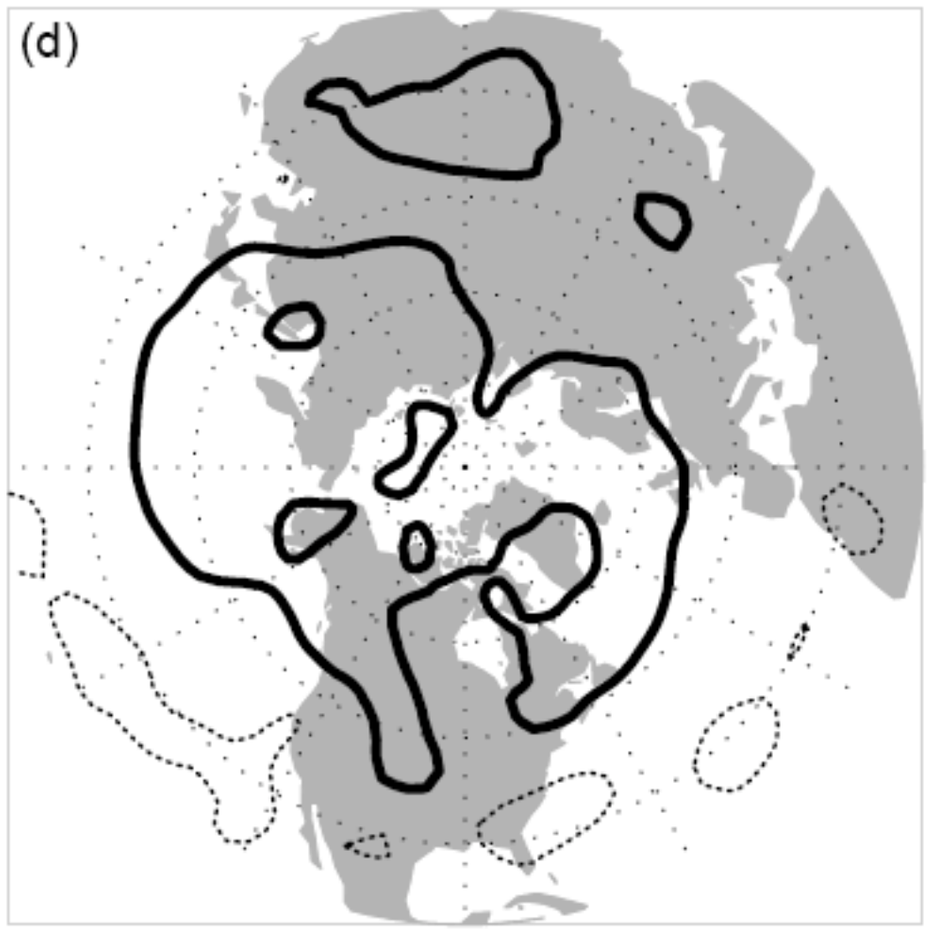

M
Z_M^2
H
Z_H^2



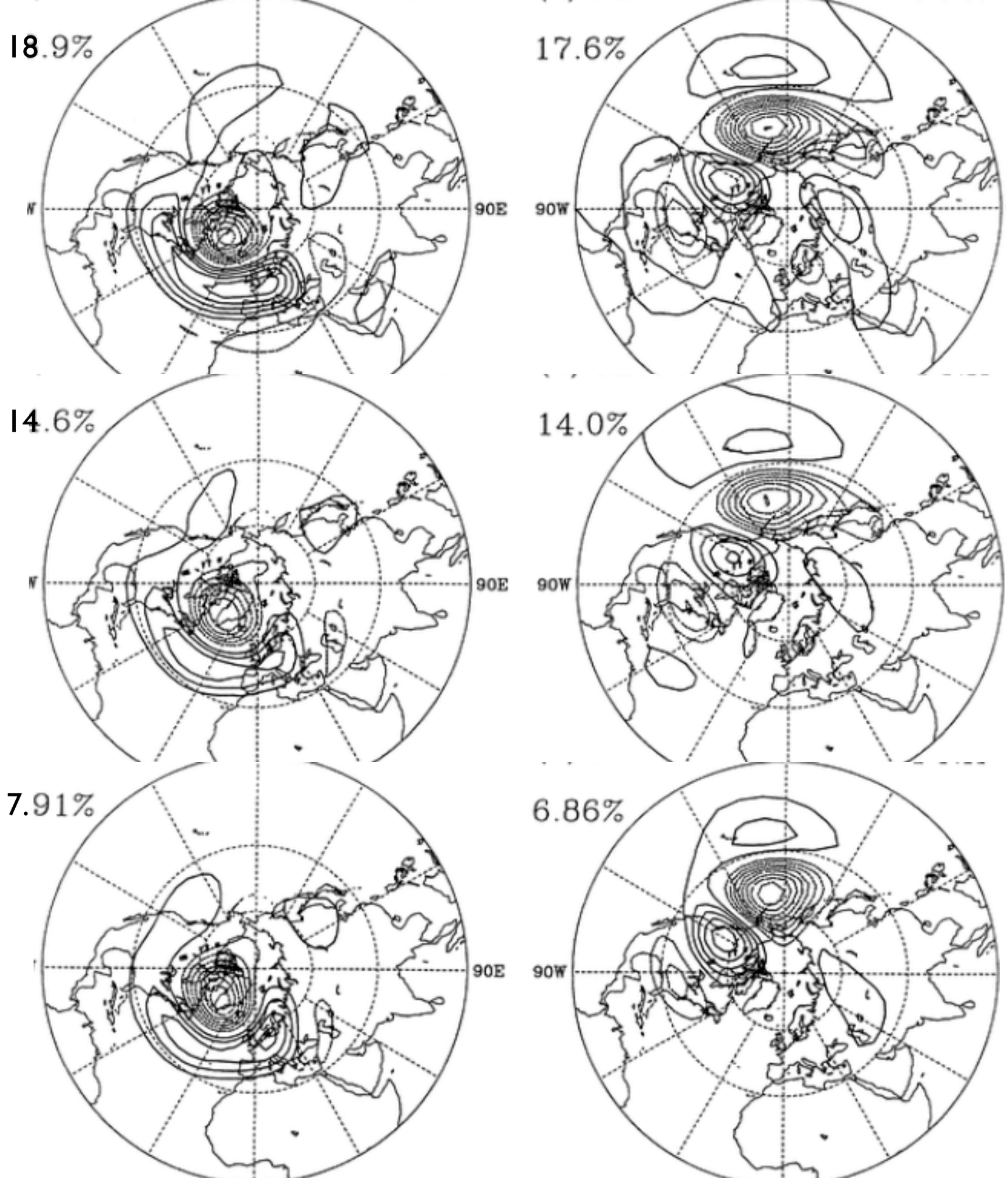

(a)


(b)


(c)

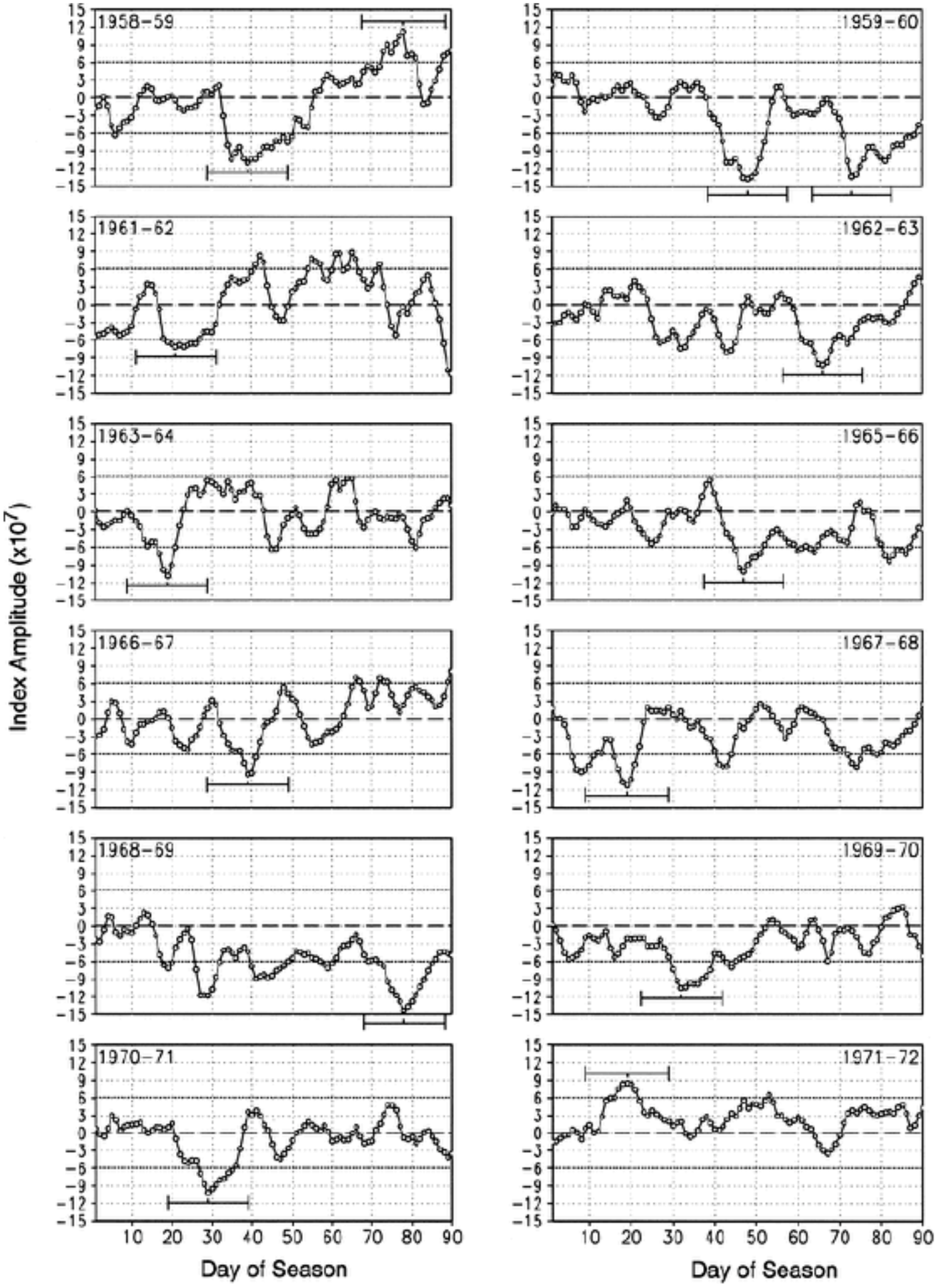

(d)

Feldstein (2000)

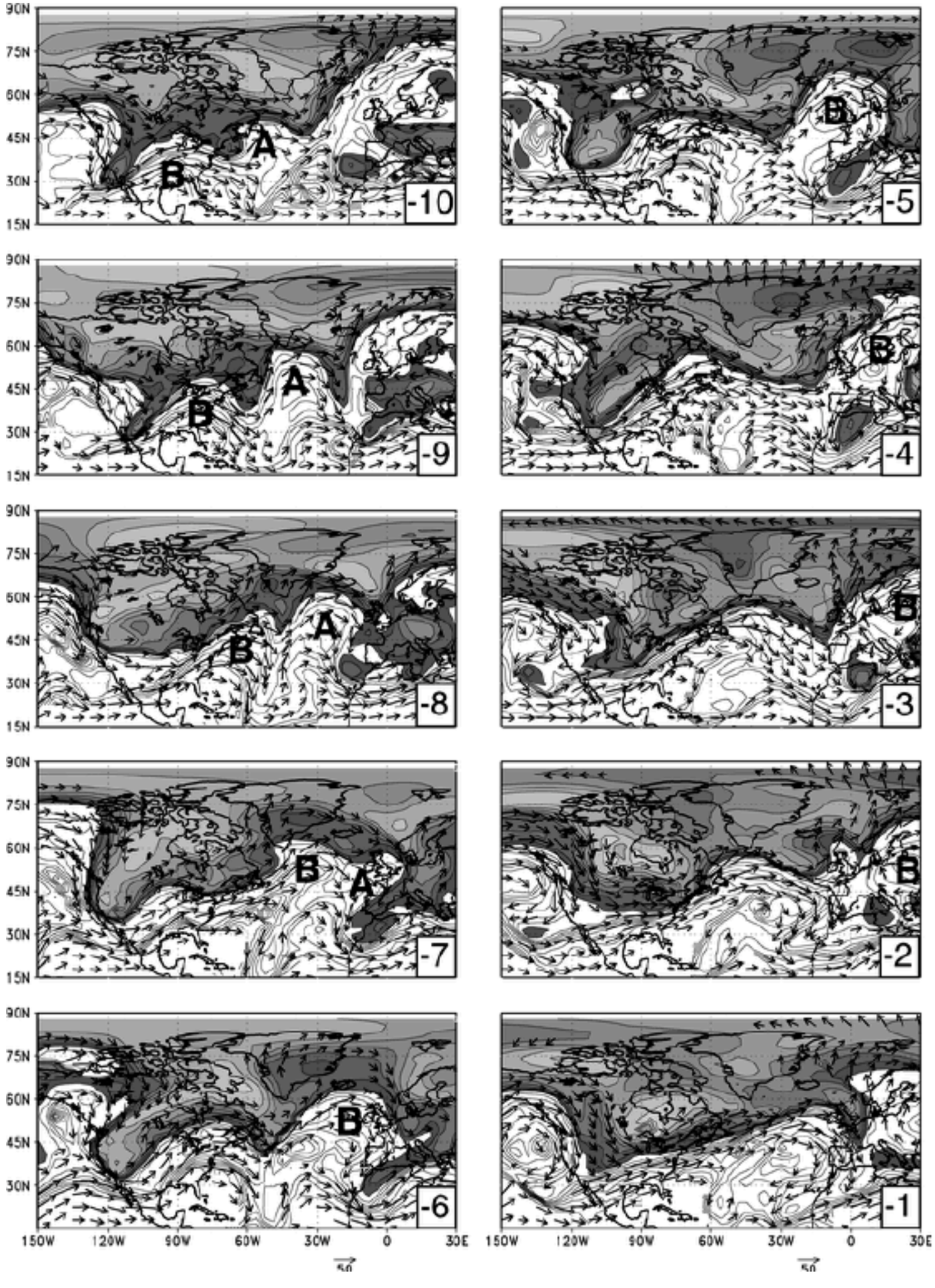


8-10 d decorrelation time of daily indices

The synoptic paradigm

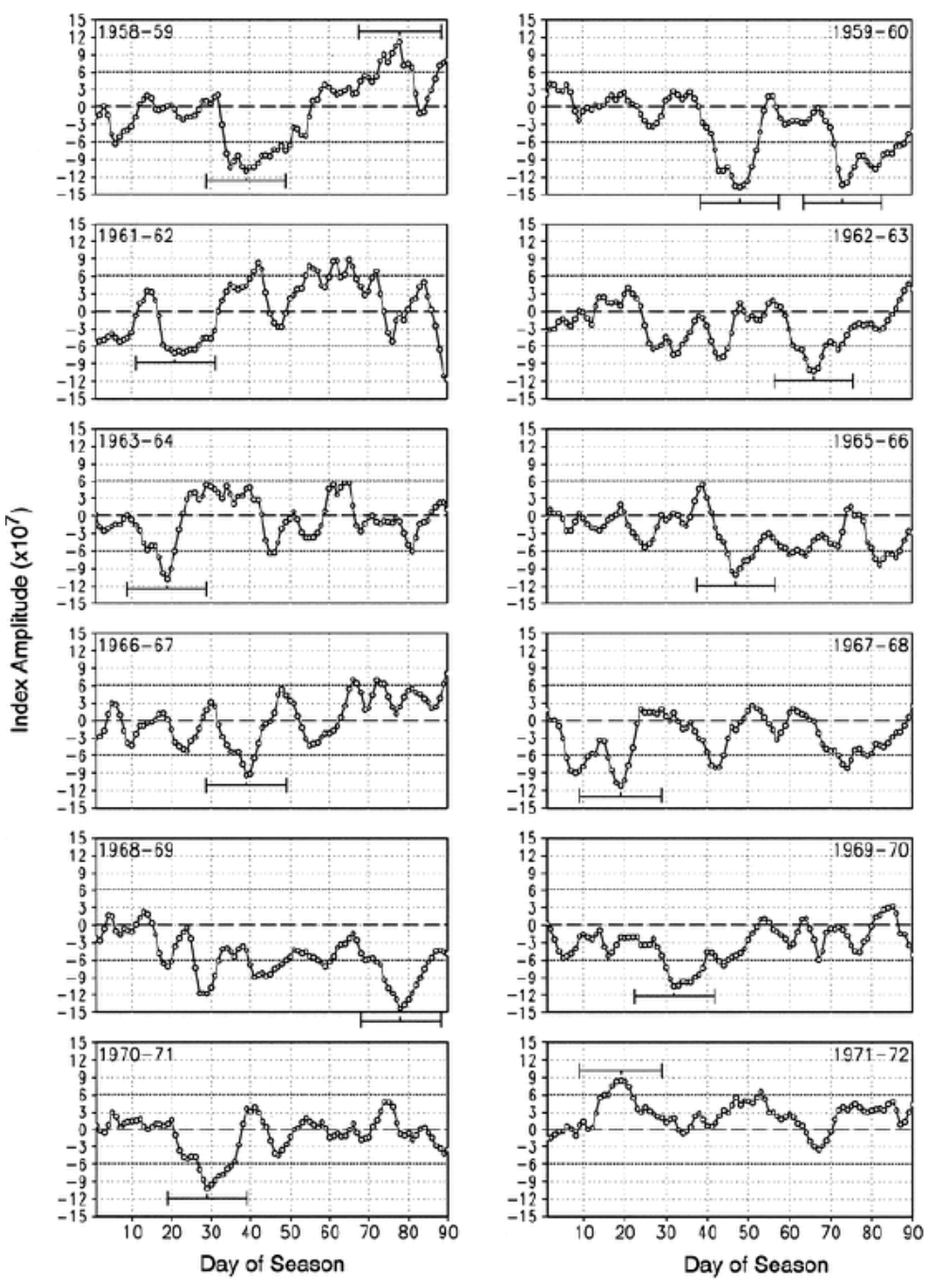


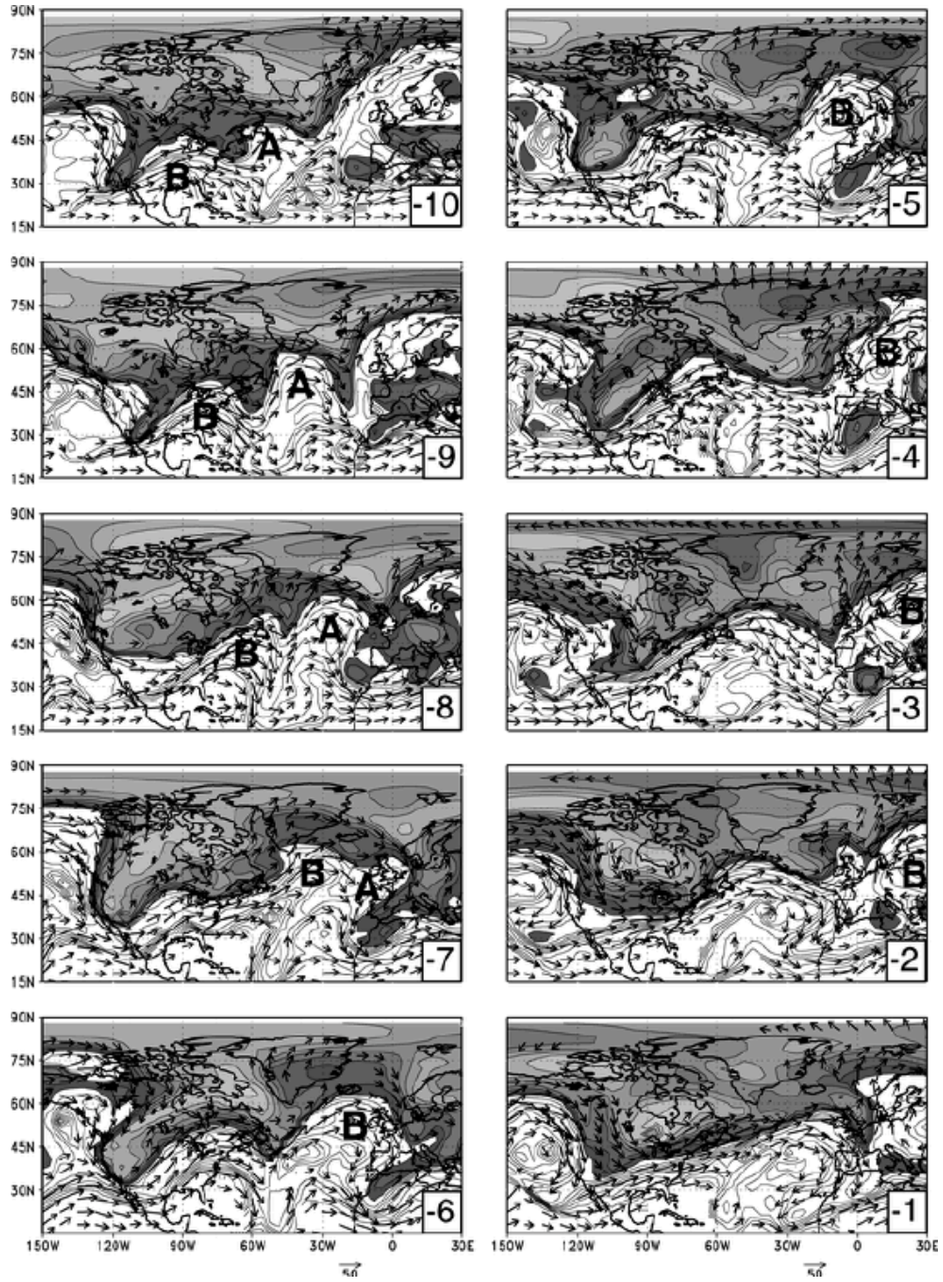
The synoptic paradigm



The synoptic paradigm

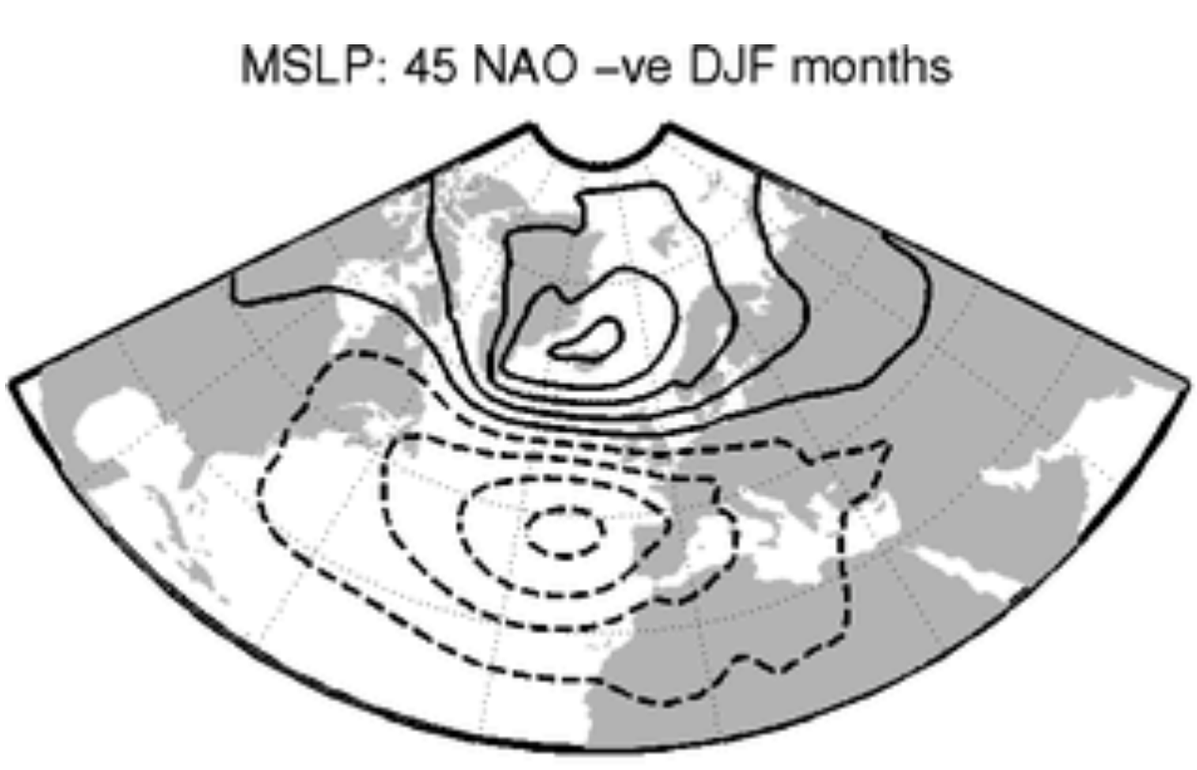
Both polarities of the NAO originate from and are maintained by breaking synoptic-scale waves and that it is the remnants of these breaking waves that form the physical entity of the NAO. *Benedict et al.* (2004)

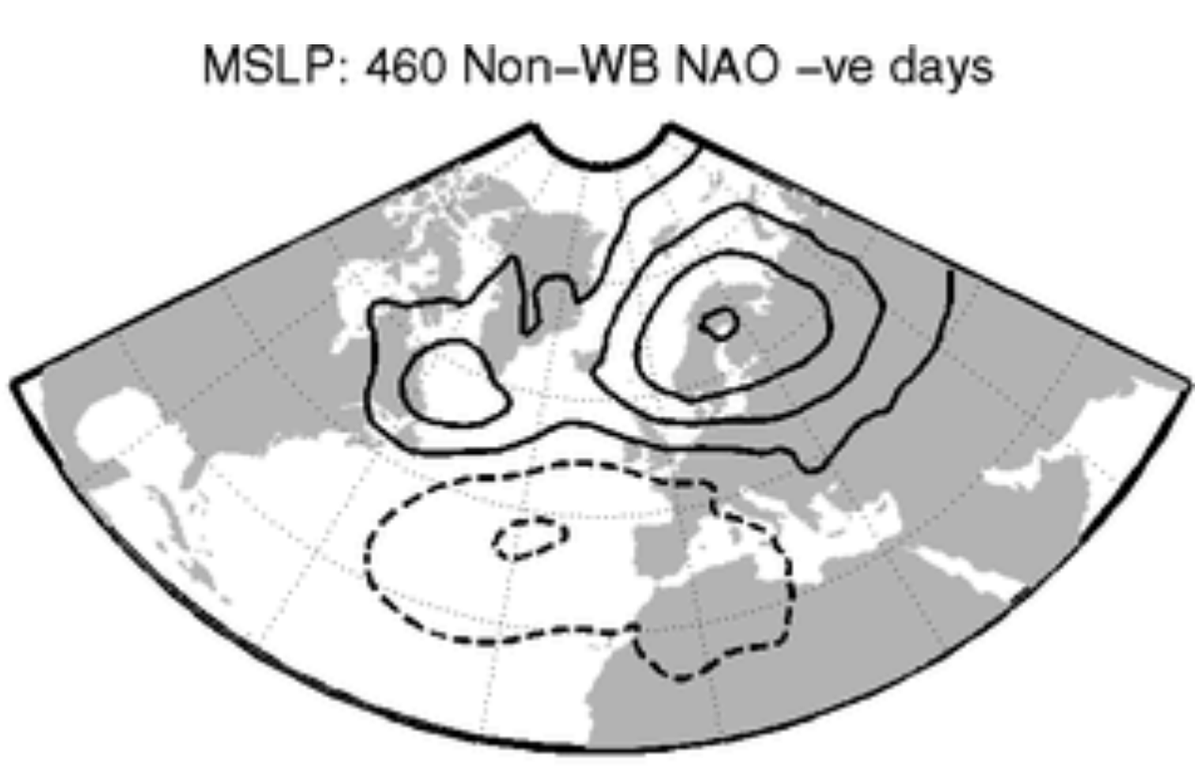


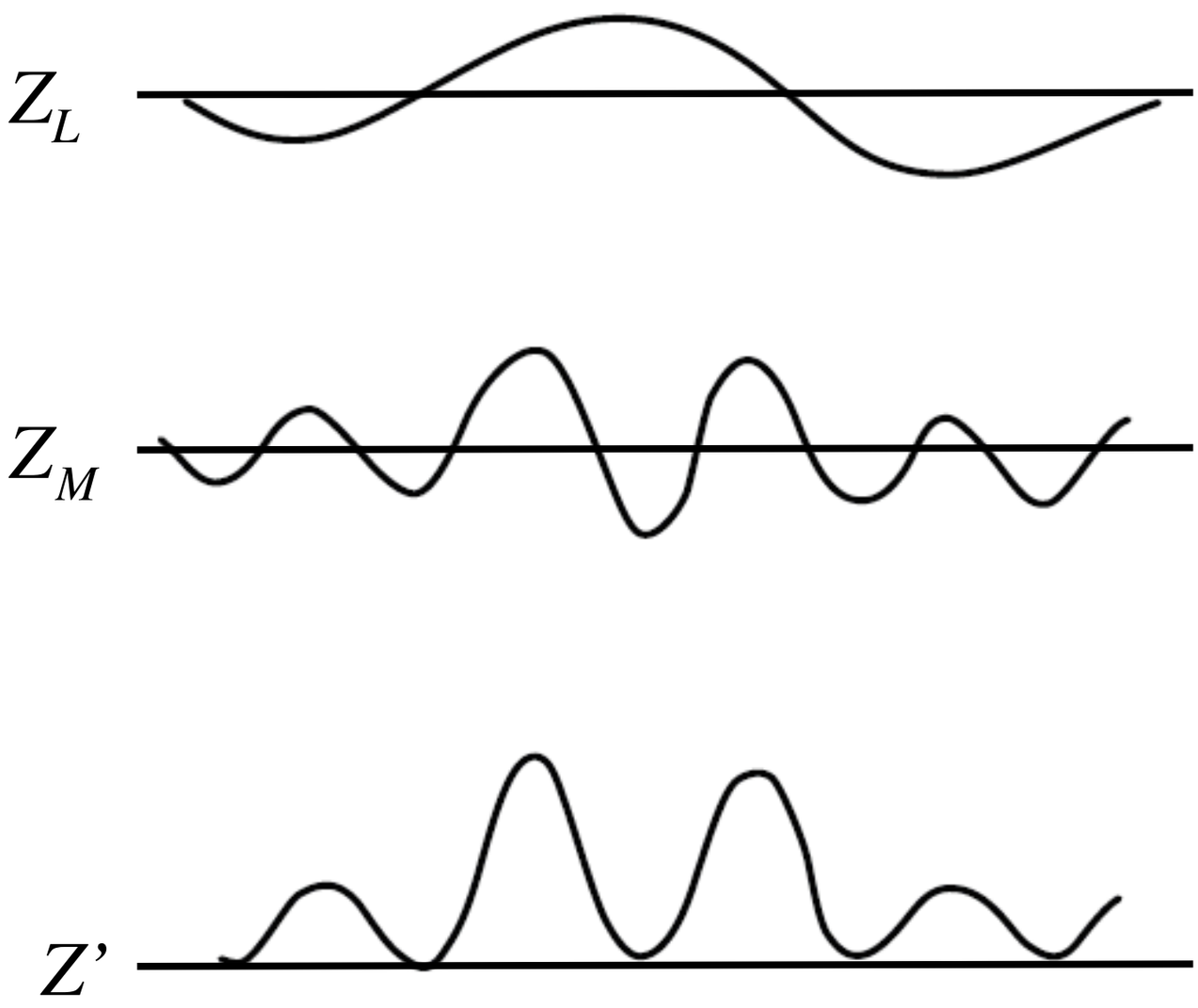


Woollings et al. (2008)

"A positive NAO is envisaged as being a description of periods in which these episodes are infrequent and can be considered as a basic, unblocked situation. A negative NAO is a description of periods in which episodes occur frequently."






Z_L
Z_M
Z'

BB+

(a)

Z

(b)

Z'

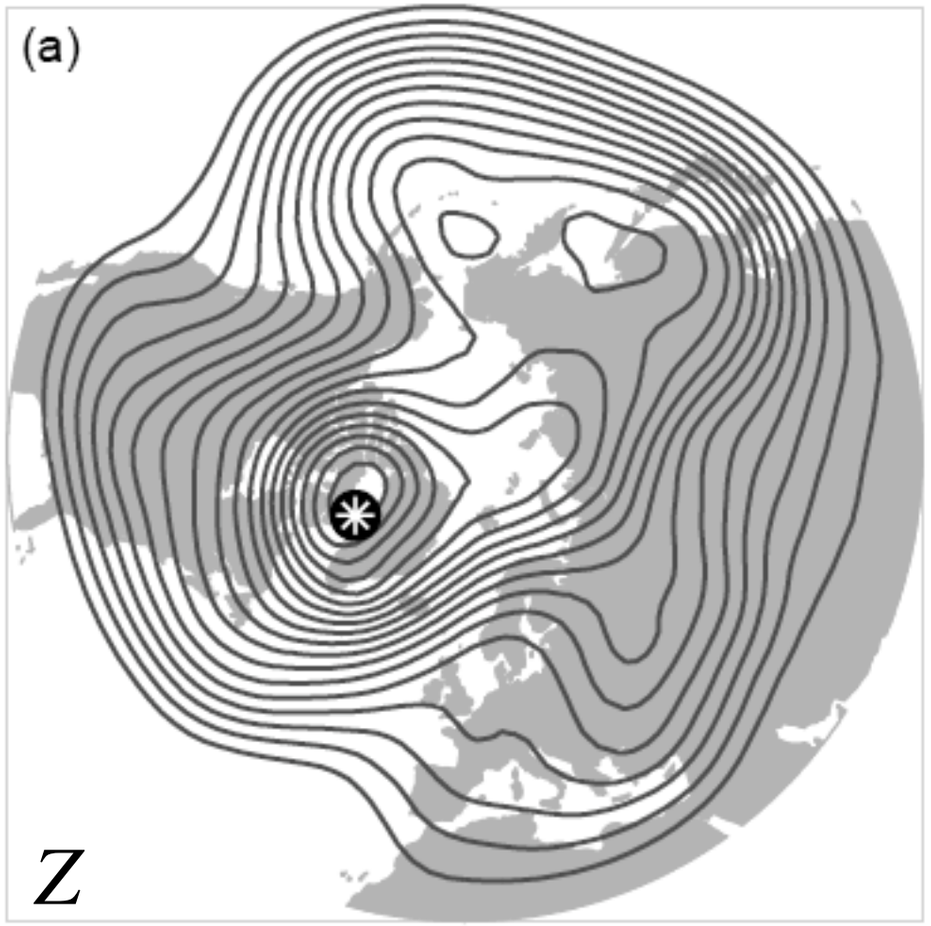
(c)

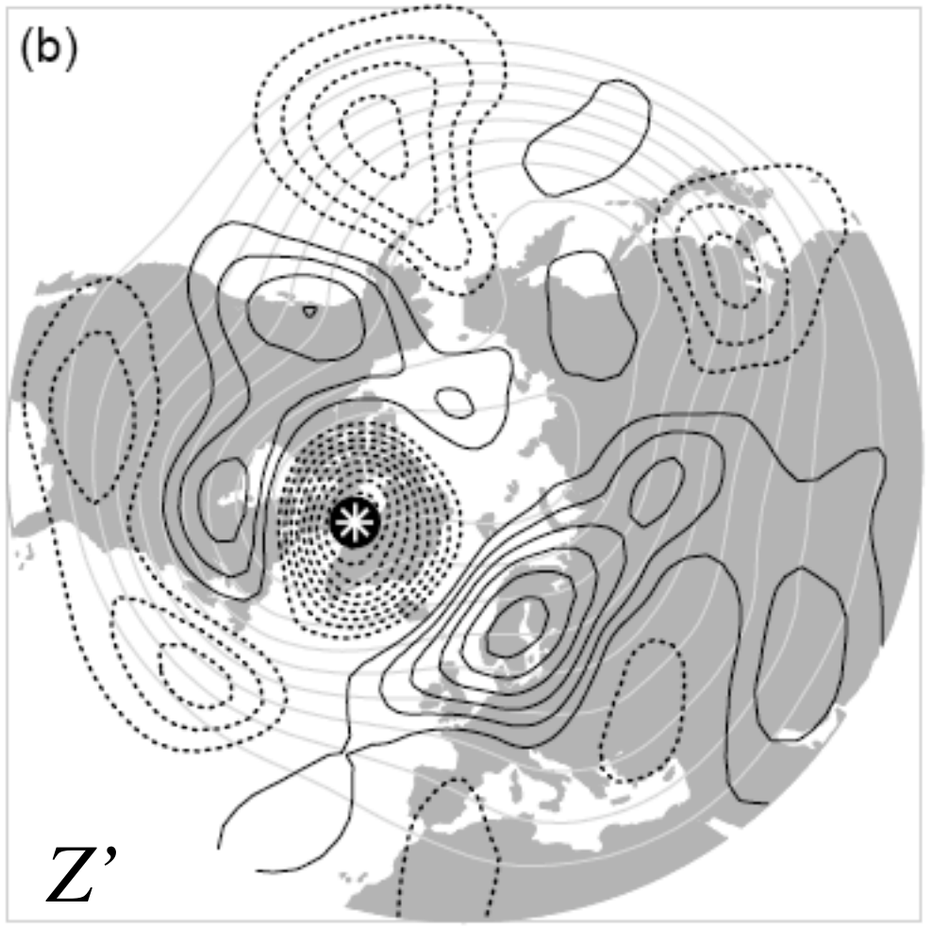
Z_L

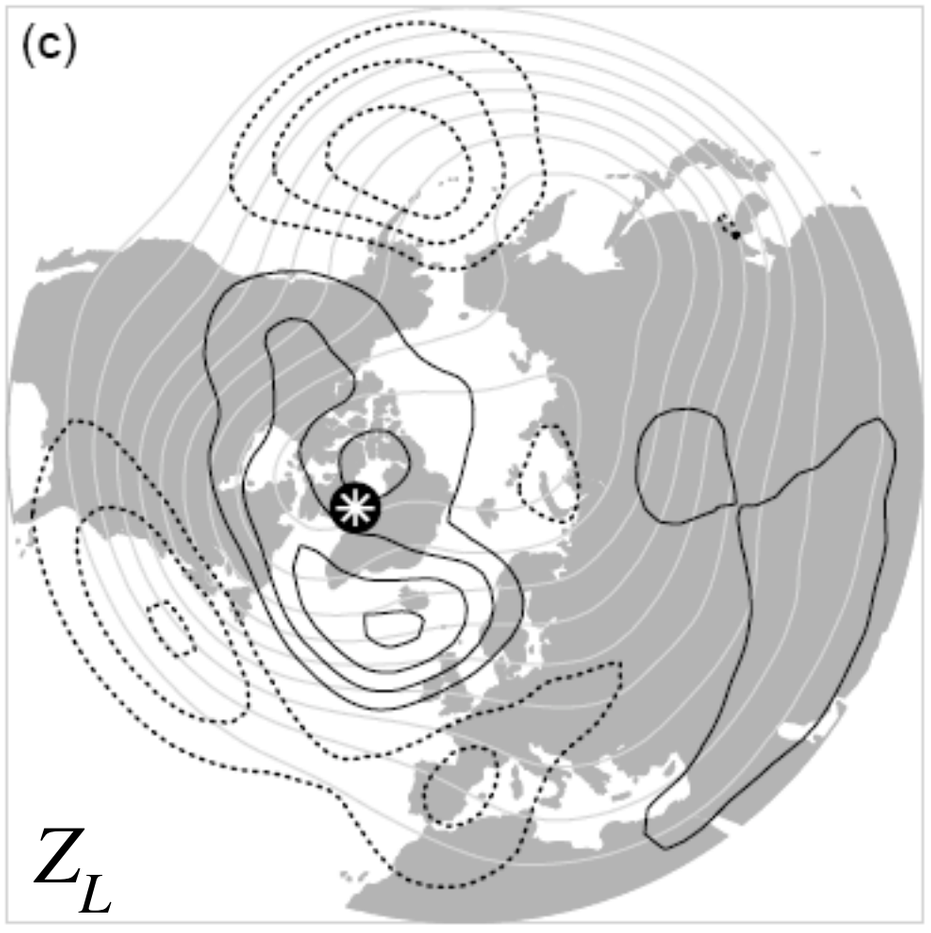
(d)

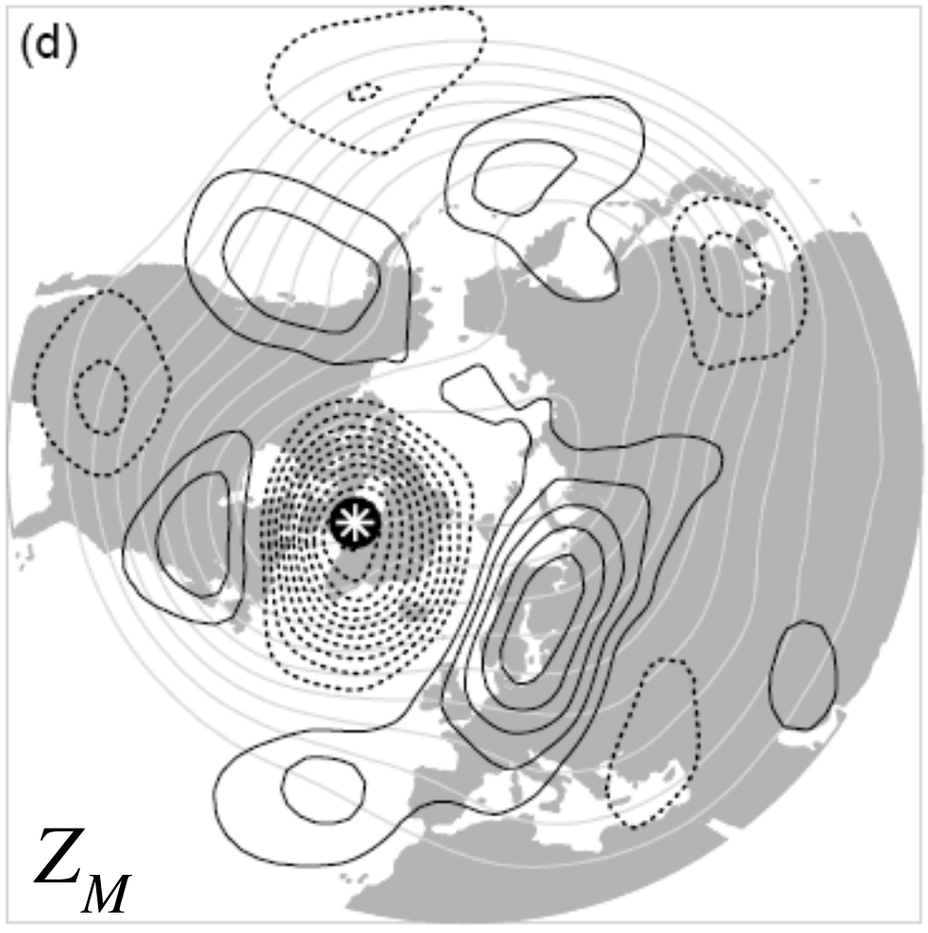
Z_M

BB-

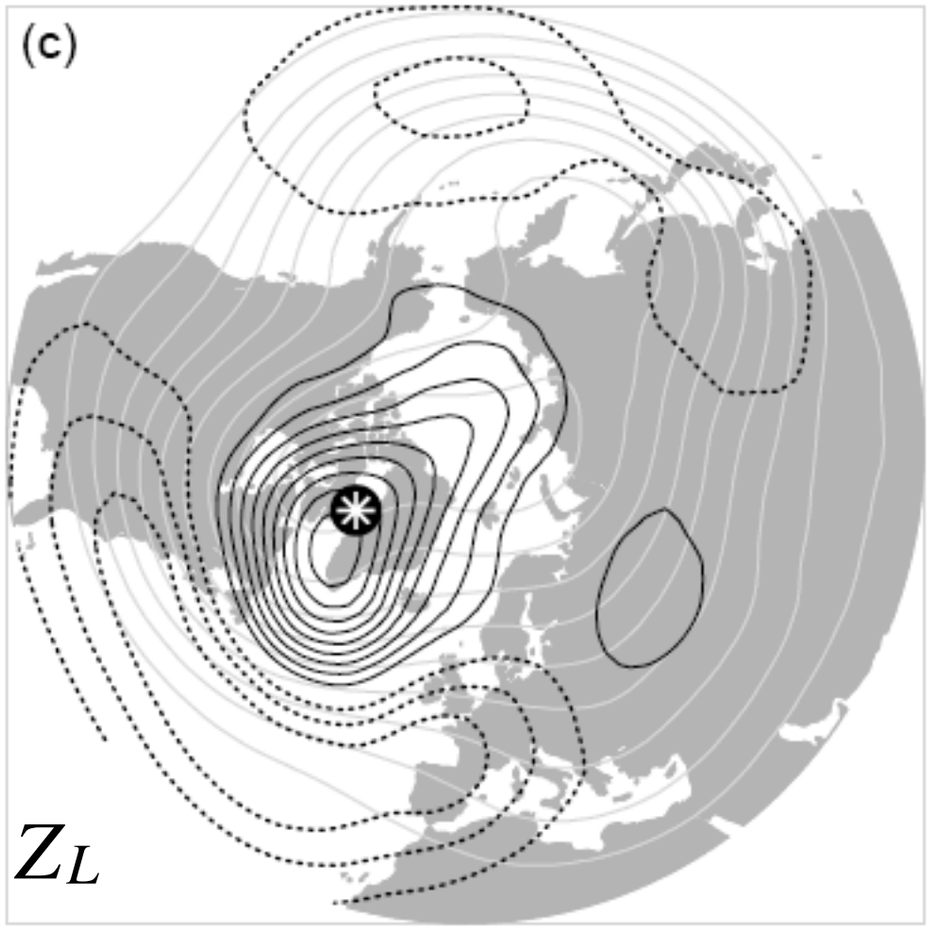


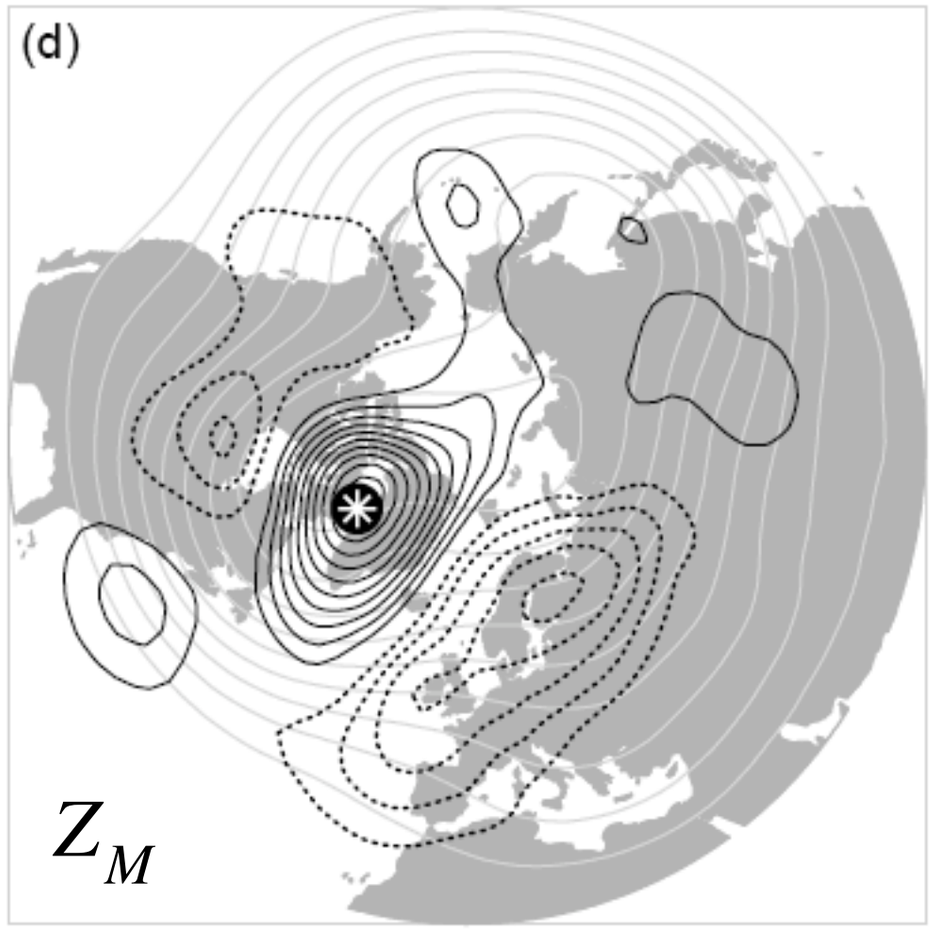


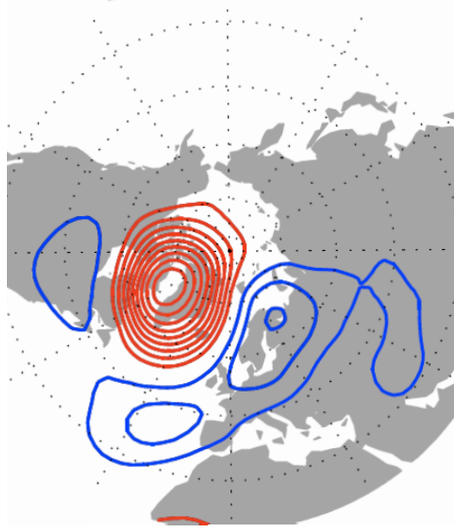




BB+







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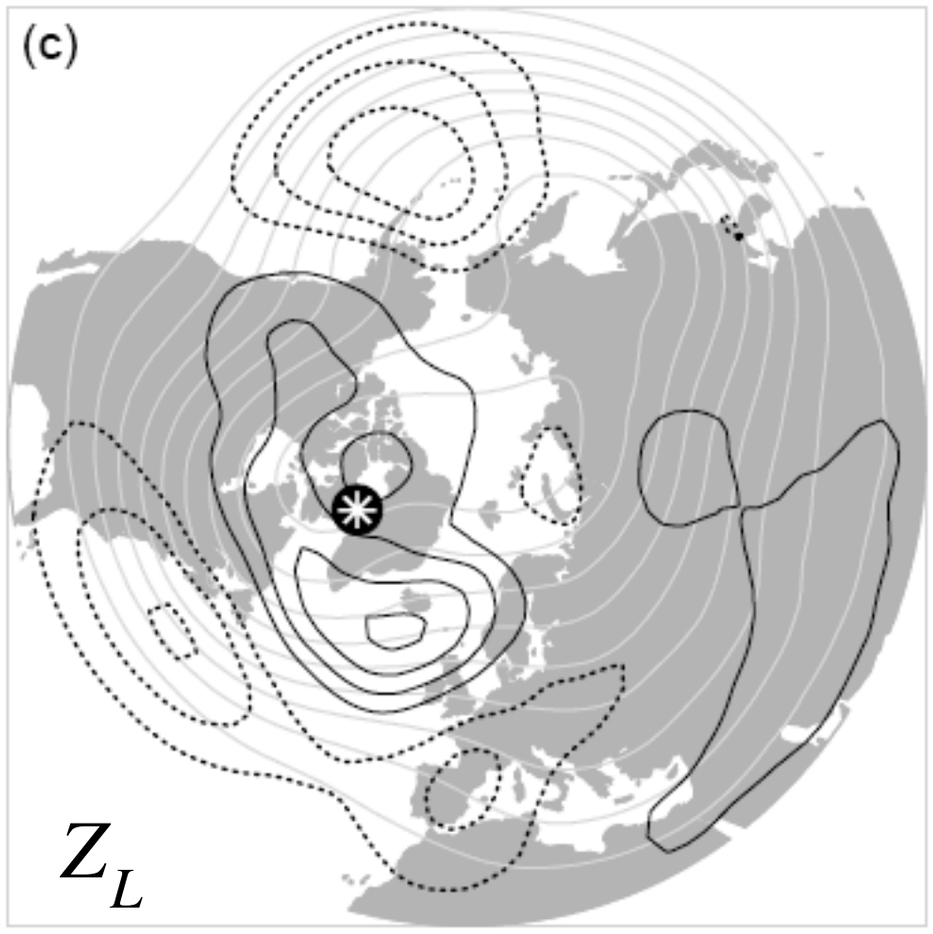
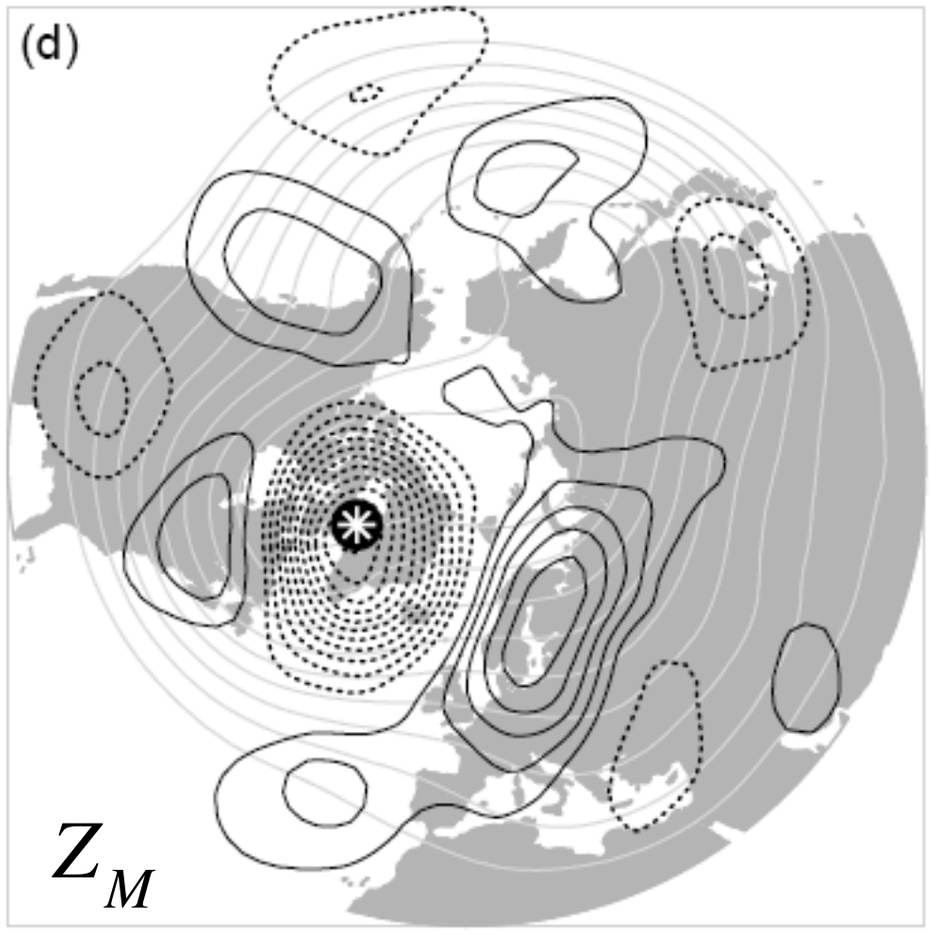
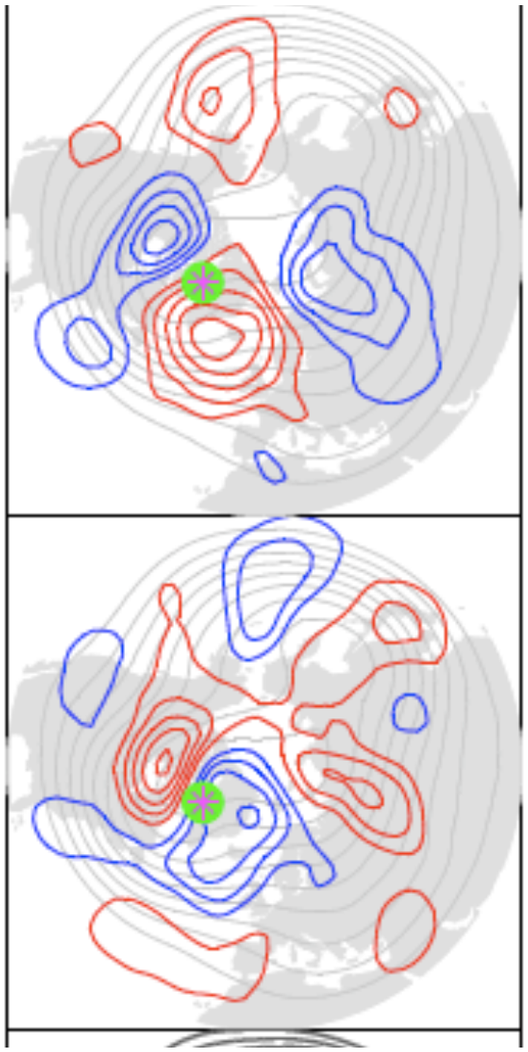
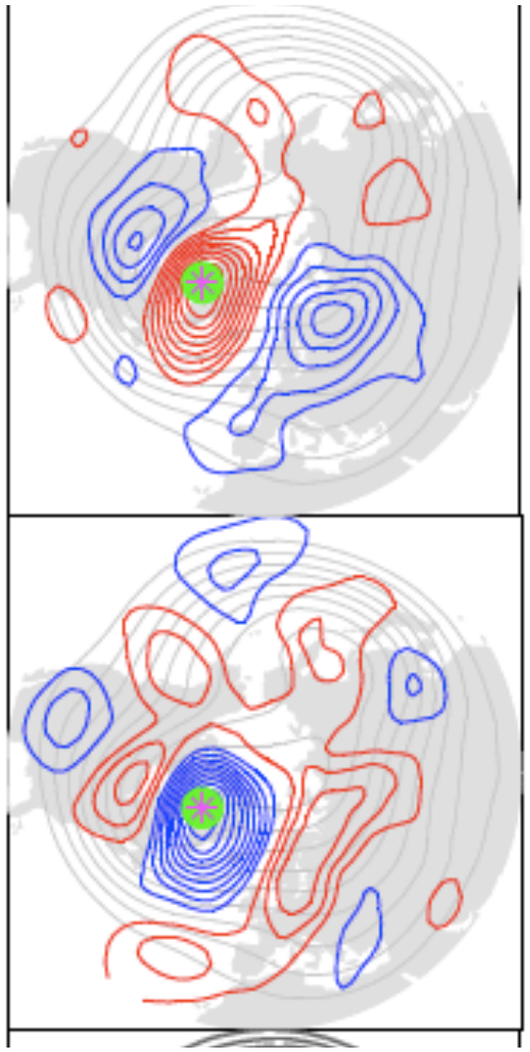
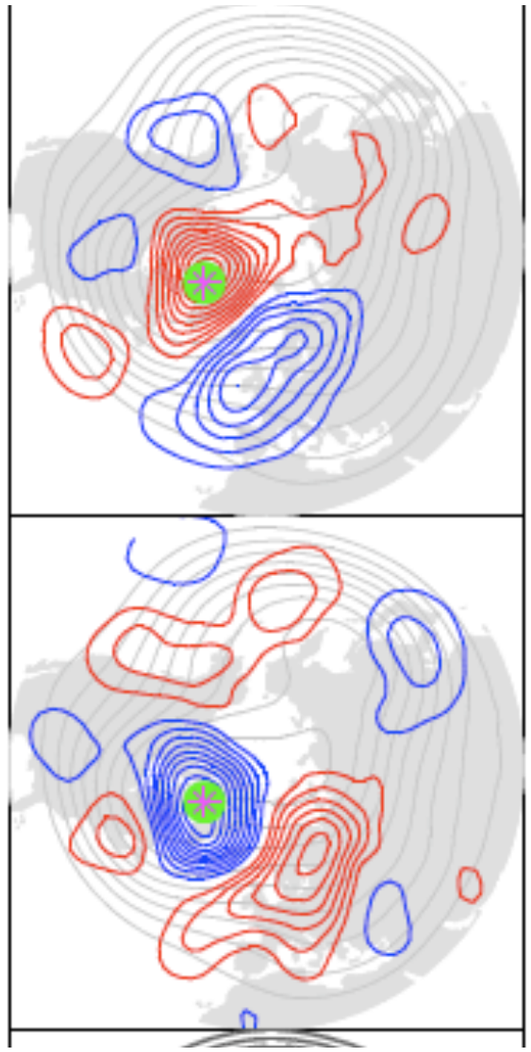
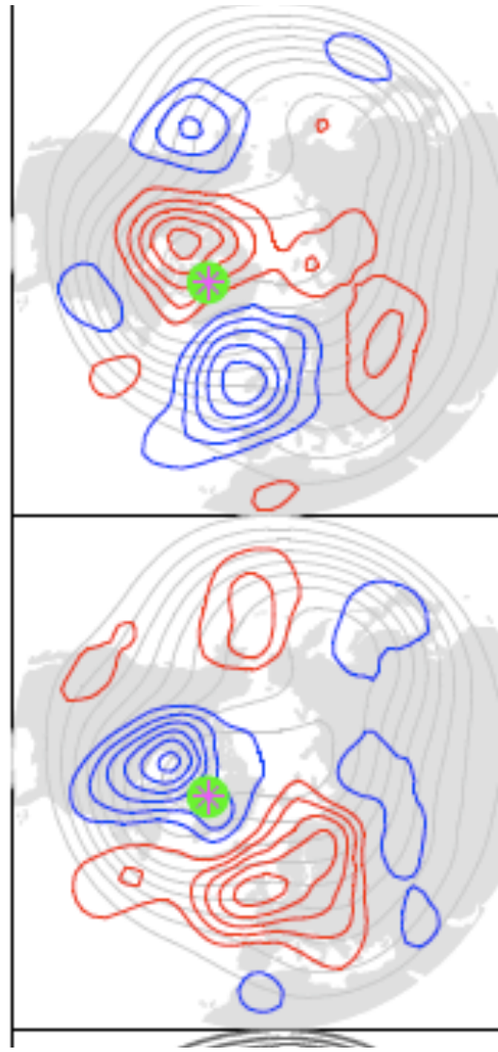
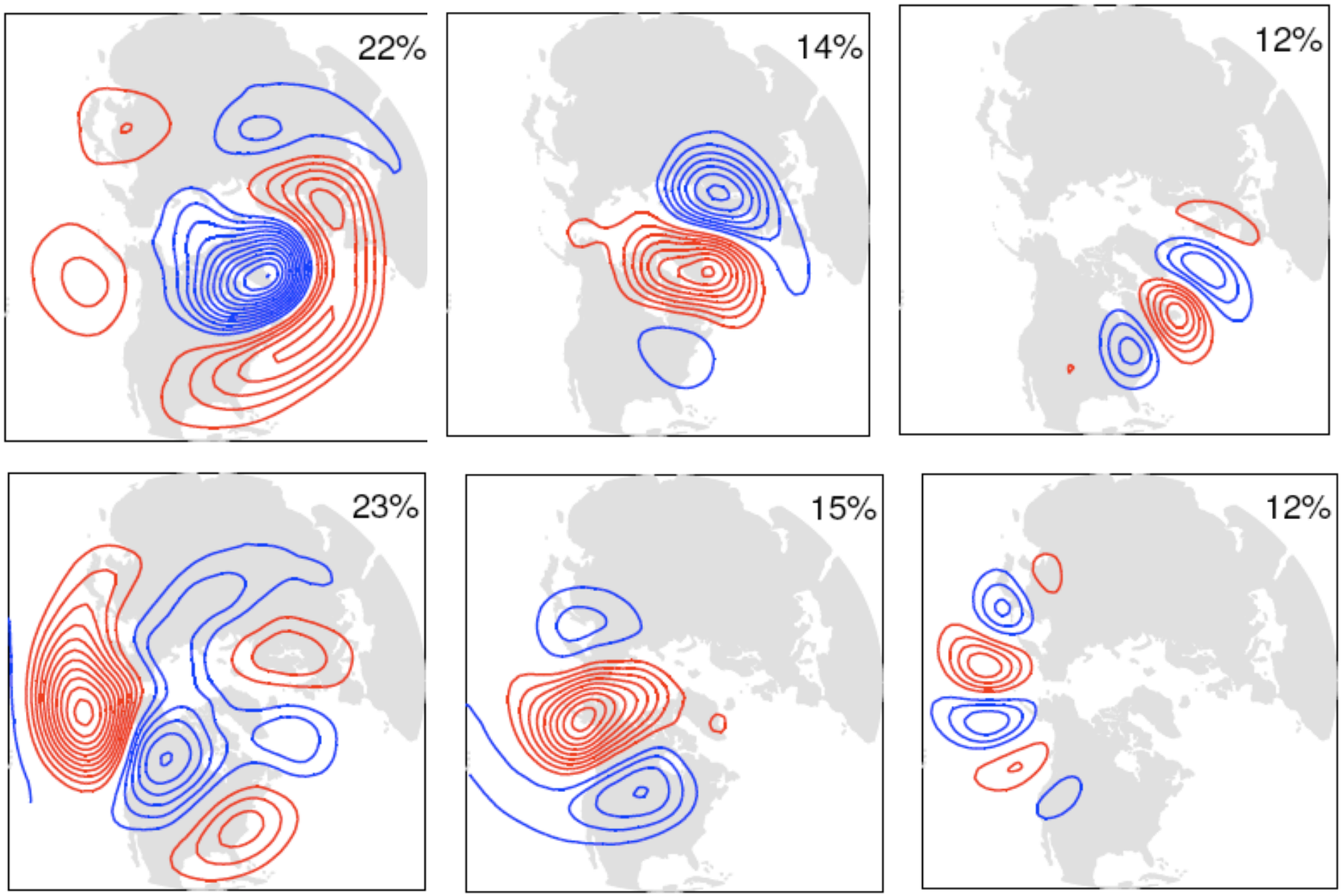




Conclusions

L, M, H all exhibit their own distinctive patterns



Conclusions

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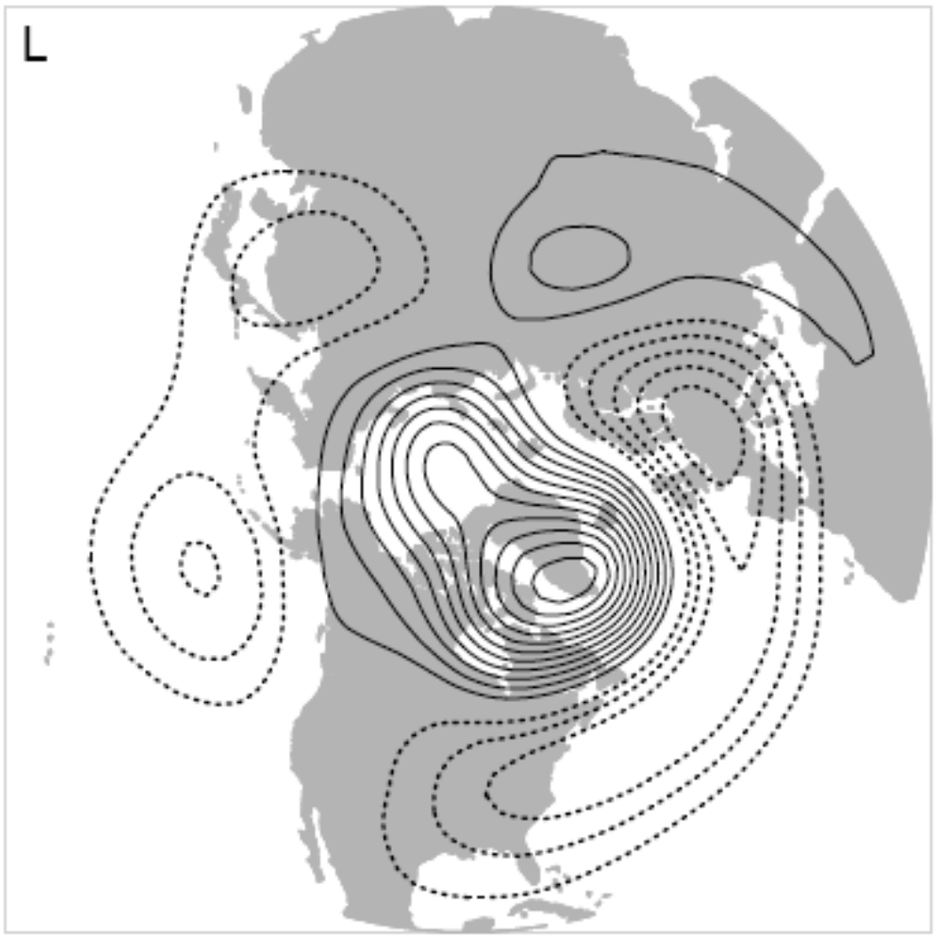
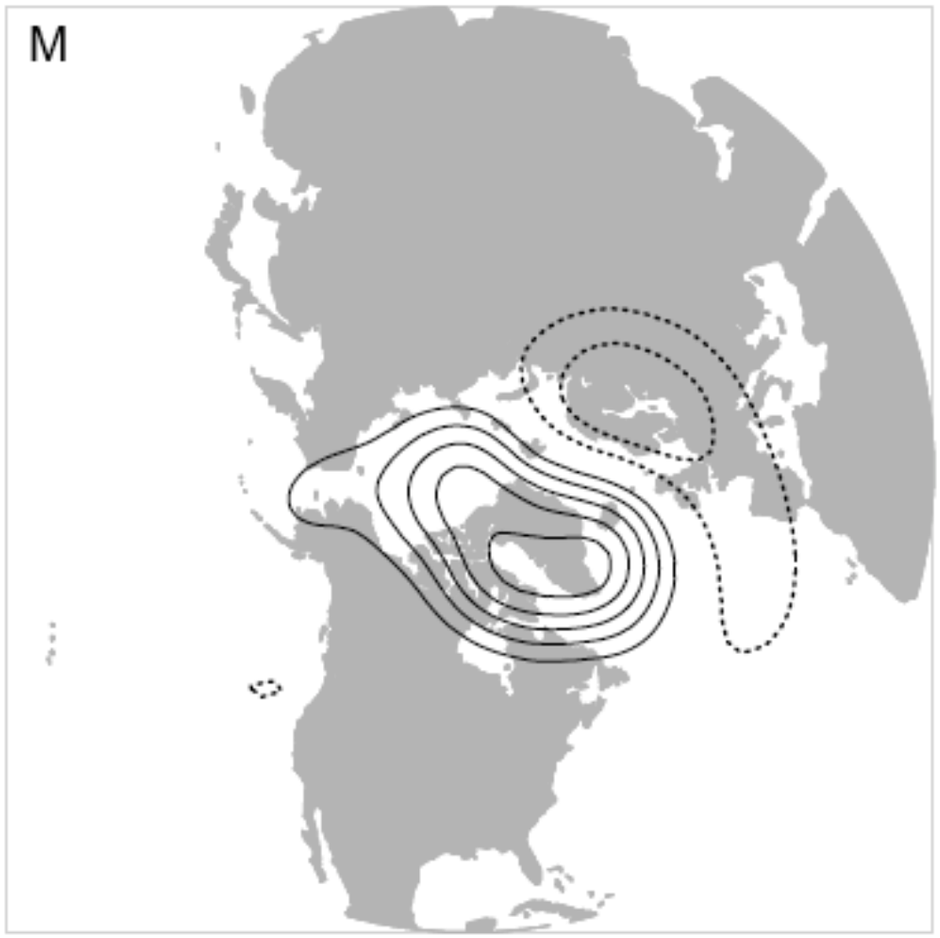
Teleconnection patterns are unique to L





Conclusions

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Teleconnection patterns are unique to L

Variations in daily NAO and other indices is difficult to interpret

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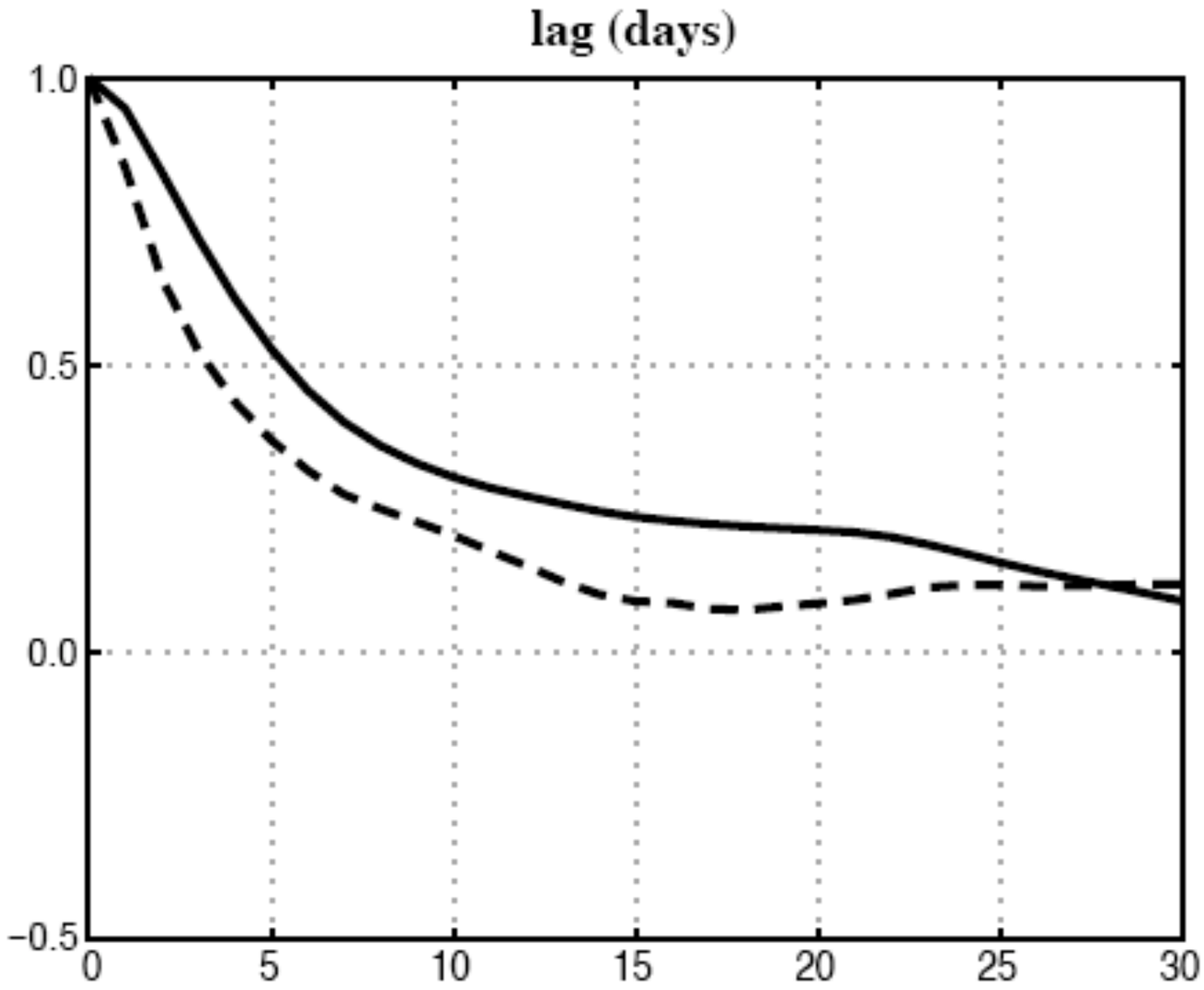

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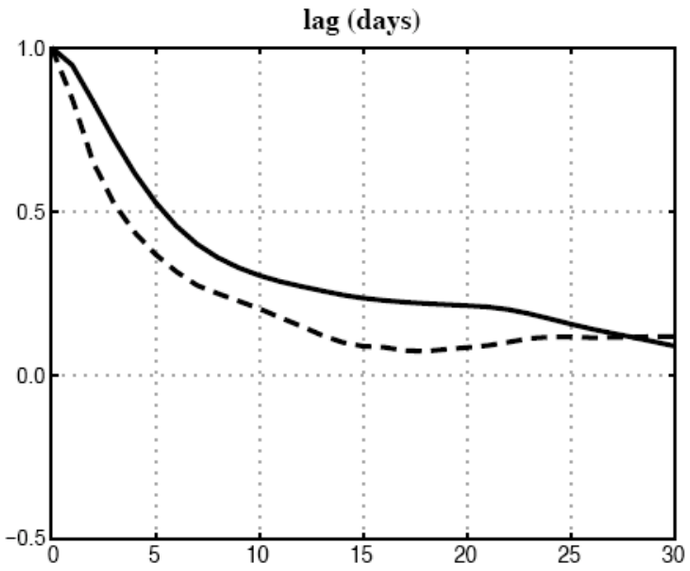

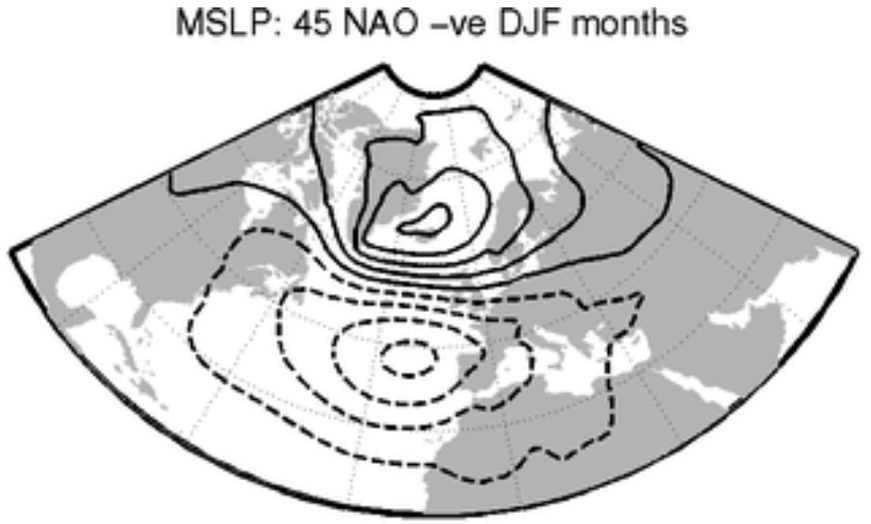

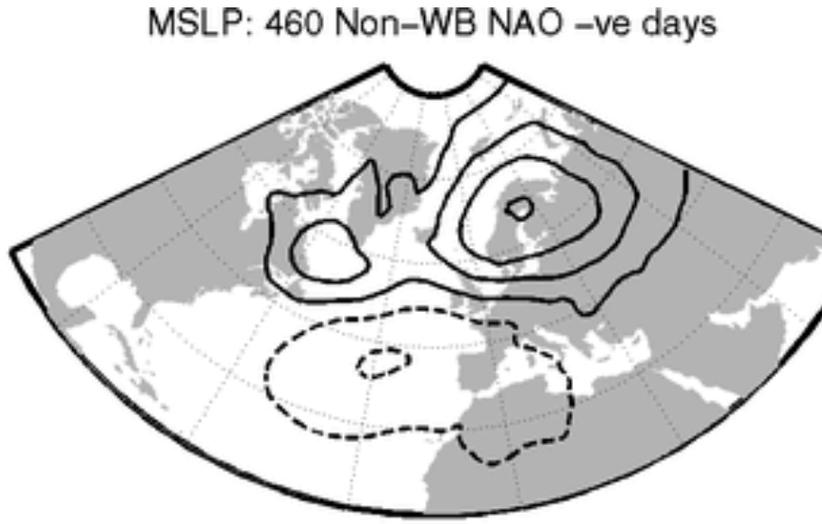

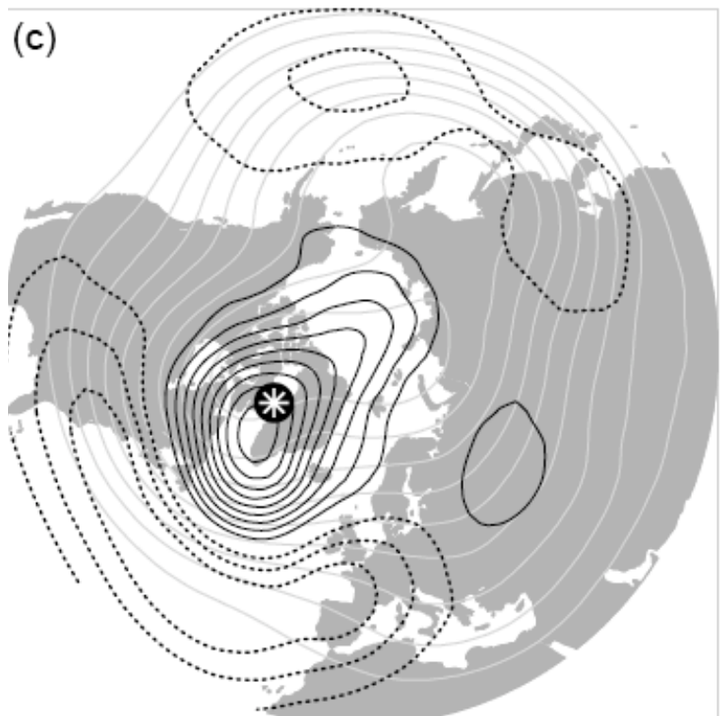

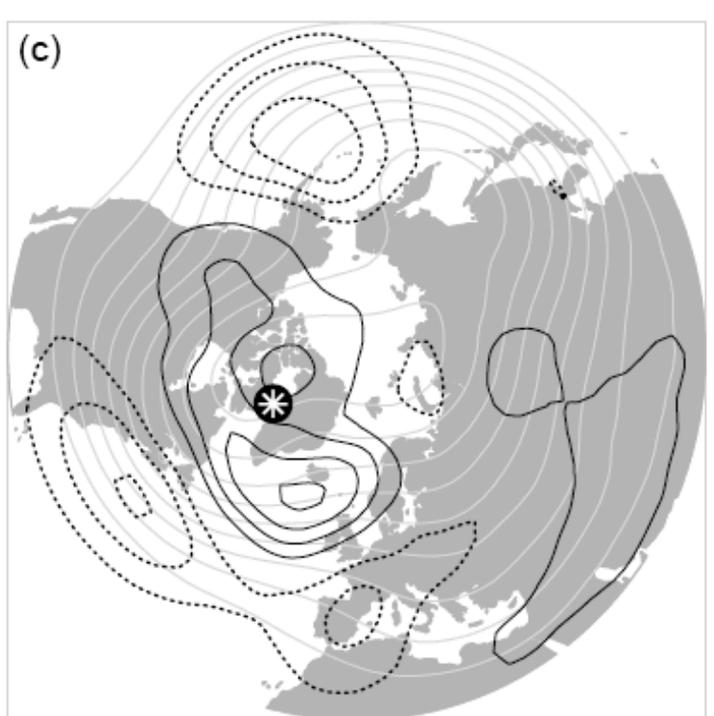

Conclusions

L, M, H all exhibit their own distinctive patterns

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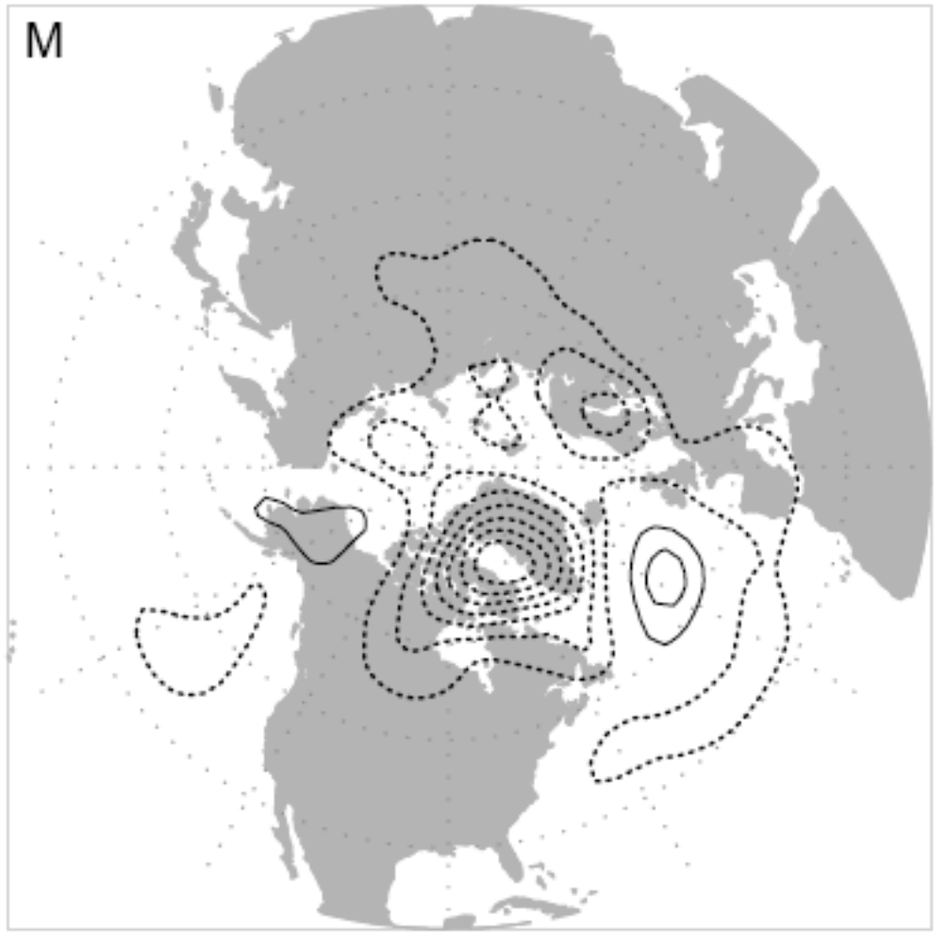

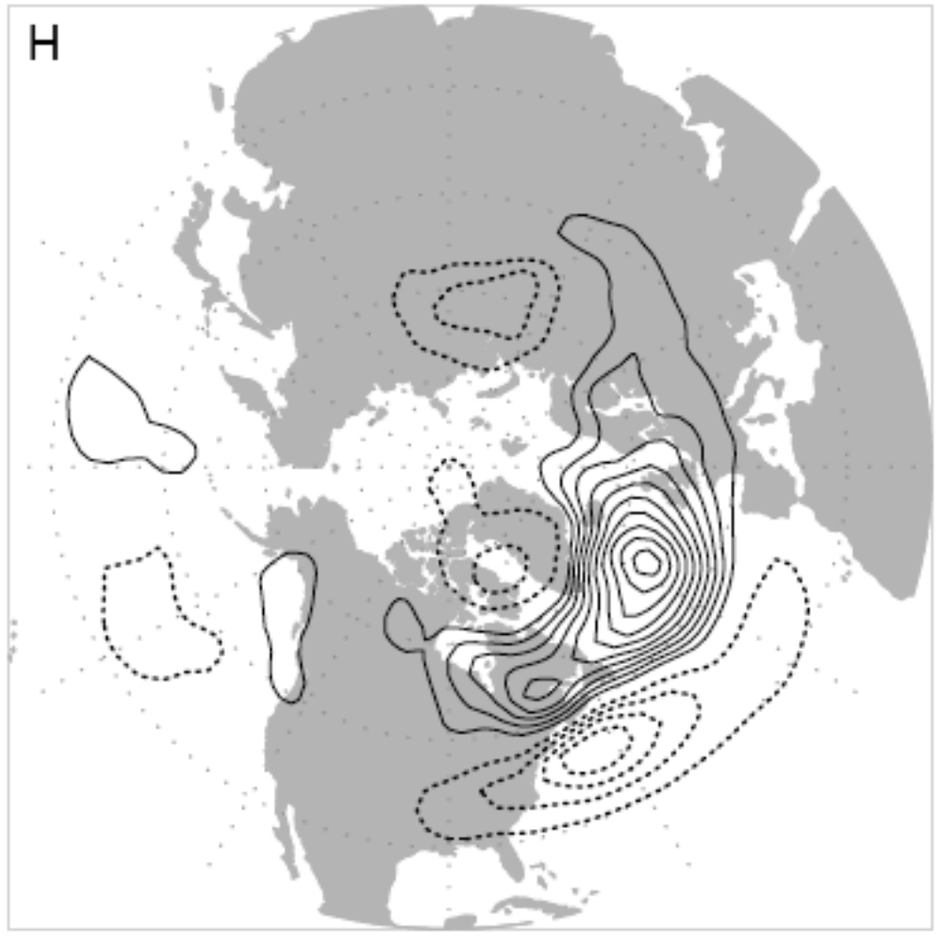

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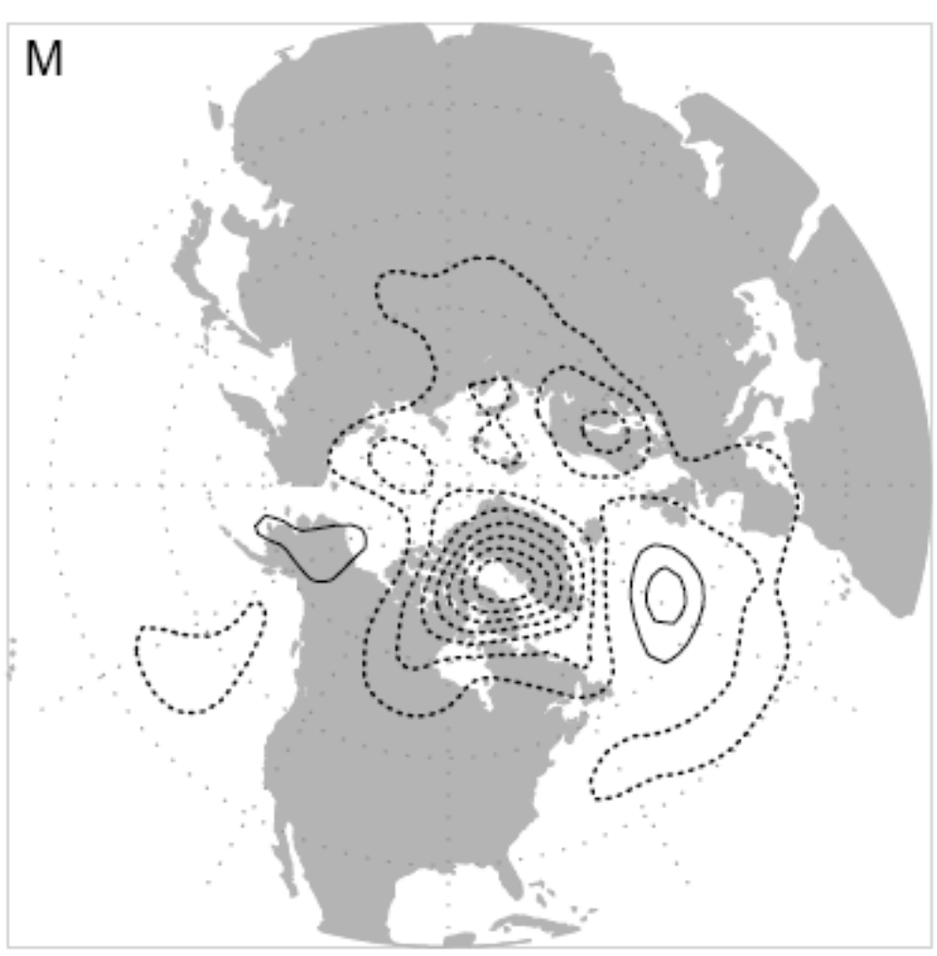

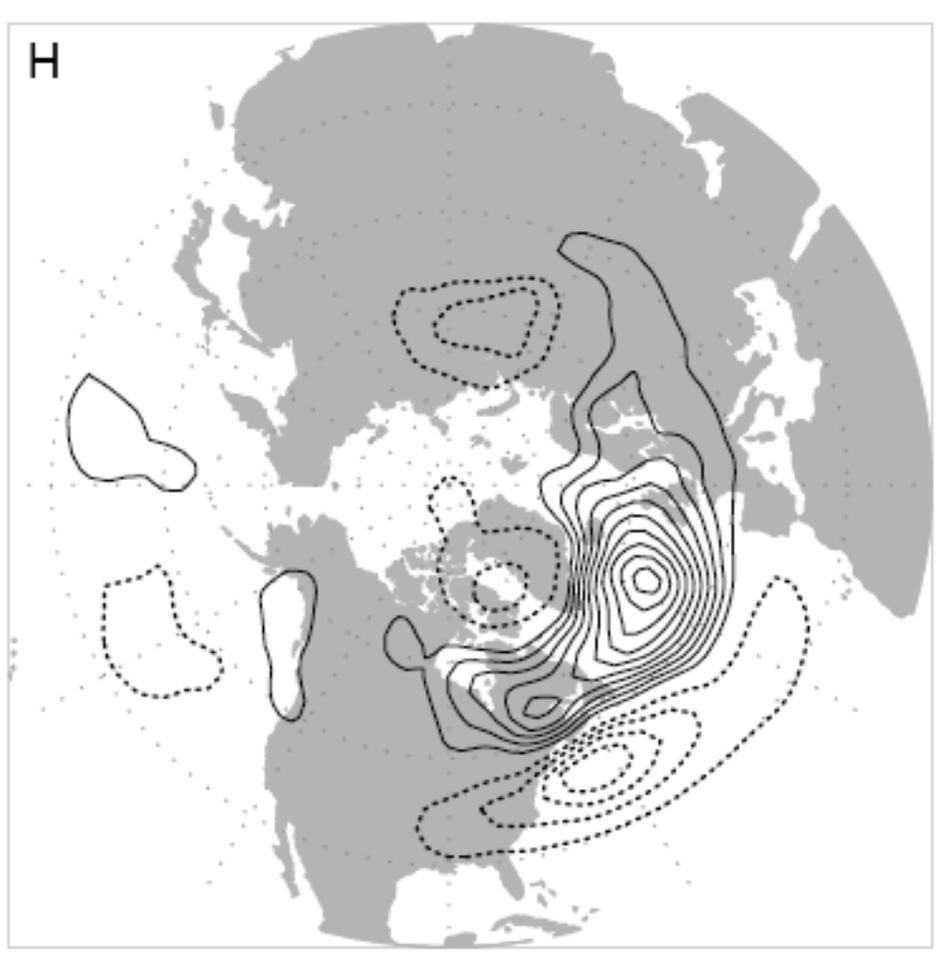

$E = mc^2$

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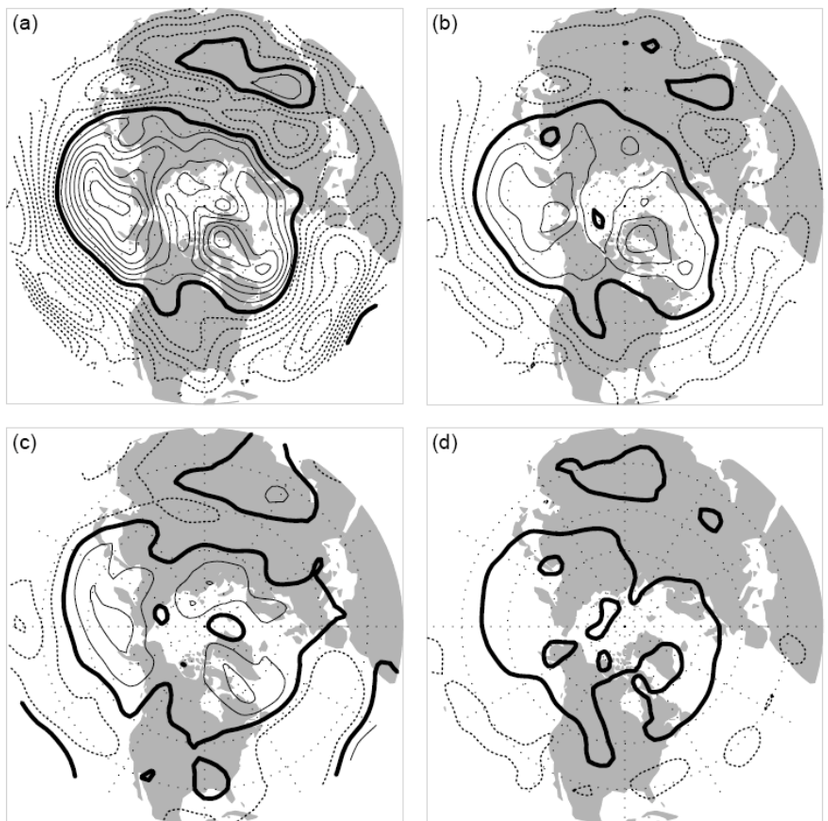

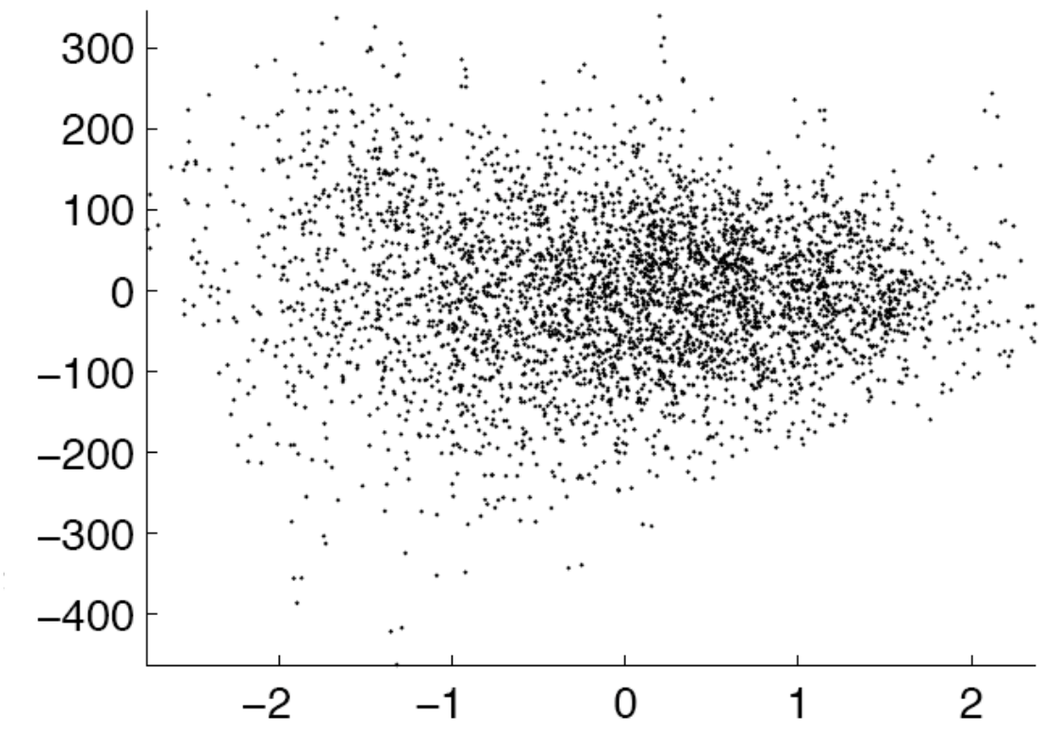

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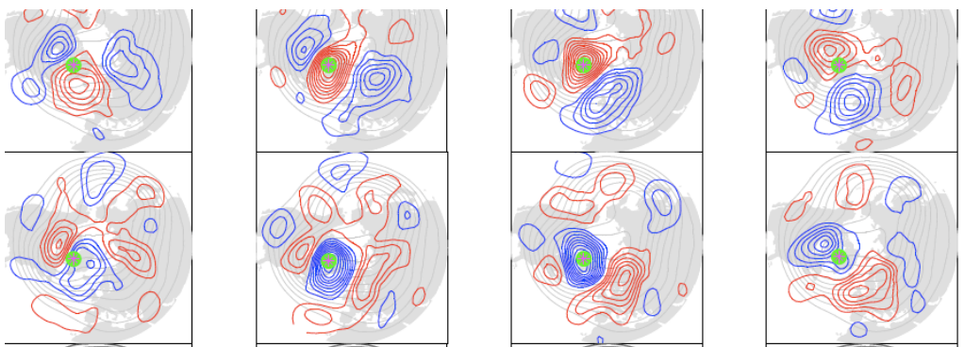
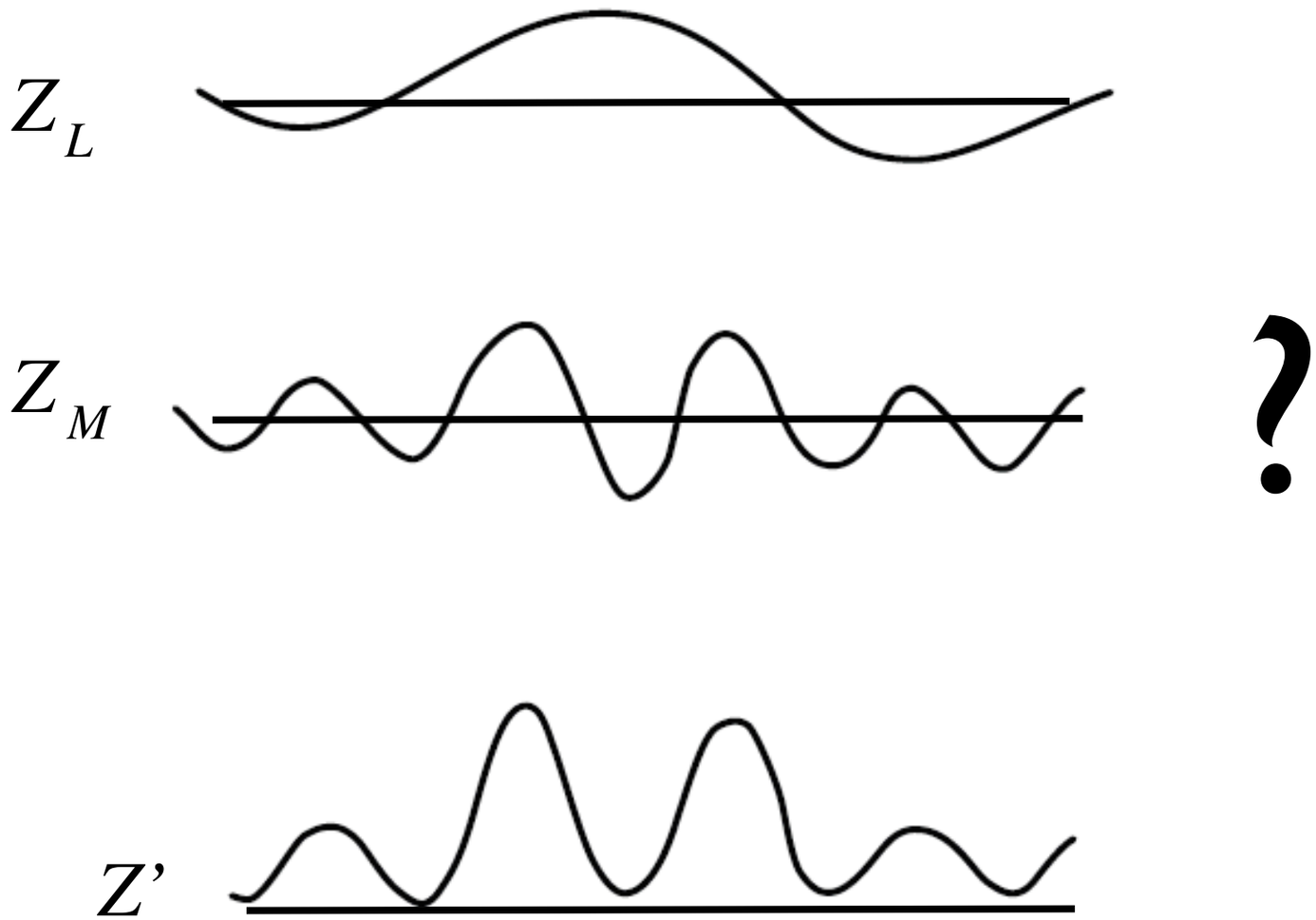
Strong feedback of H upon L

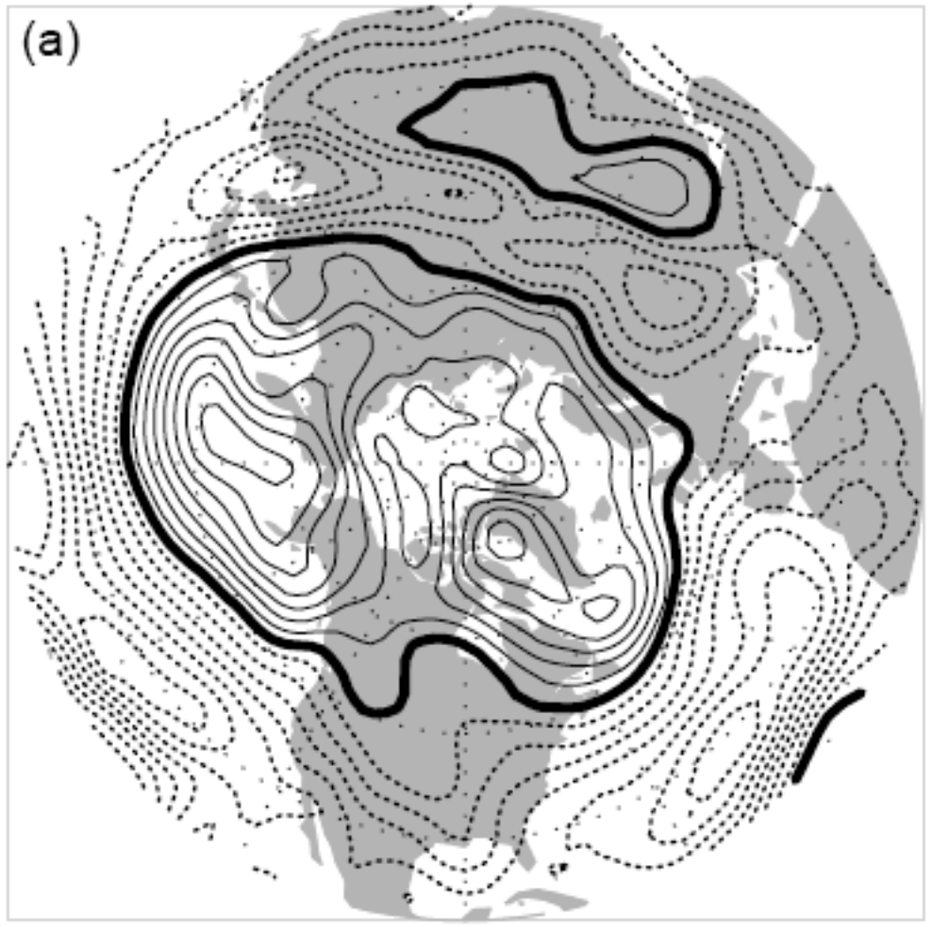
Feedback of M upon L might not be as strong; coupling might be one-way

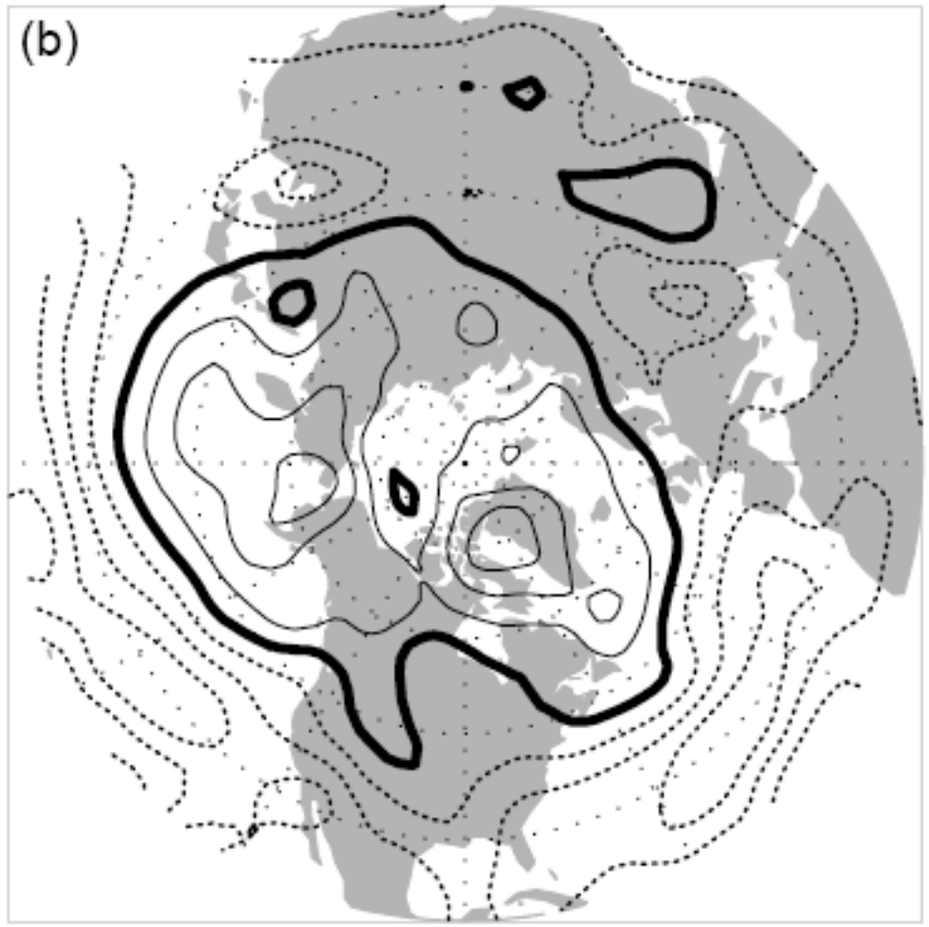
Linear dynamics are important in M, even in high amplitude events

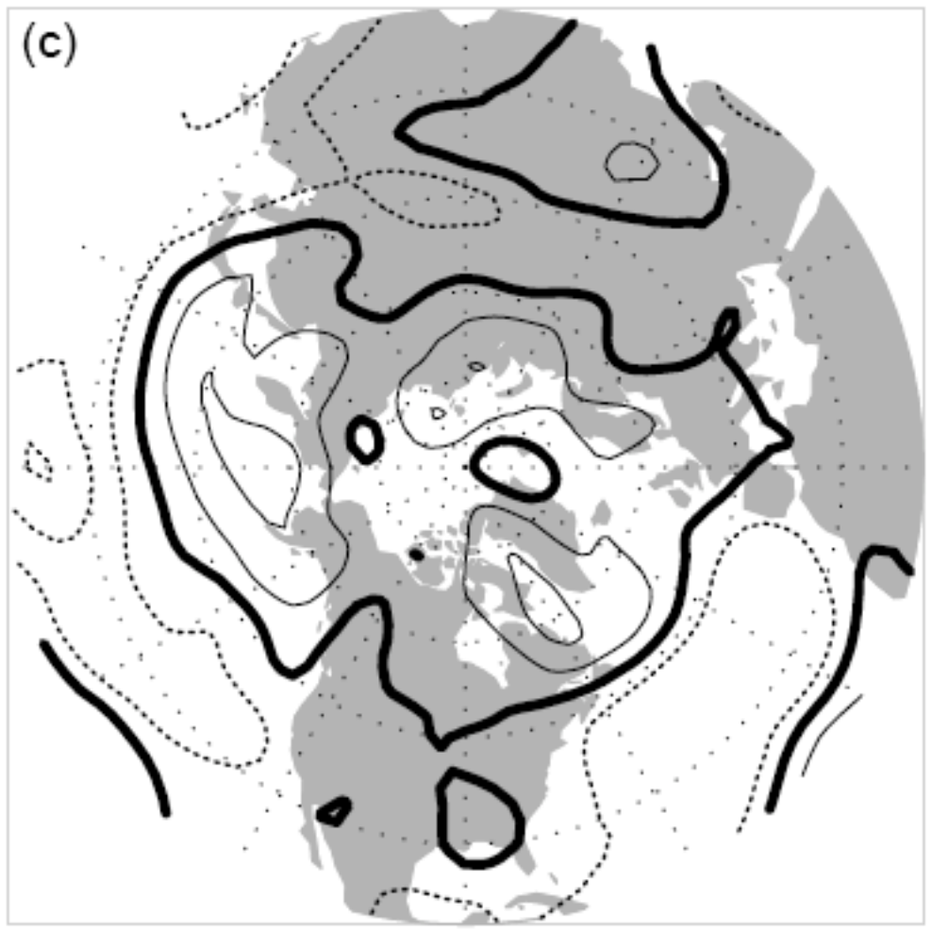
A suitable "null hypothesis" for studies of non-linearity

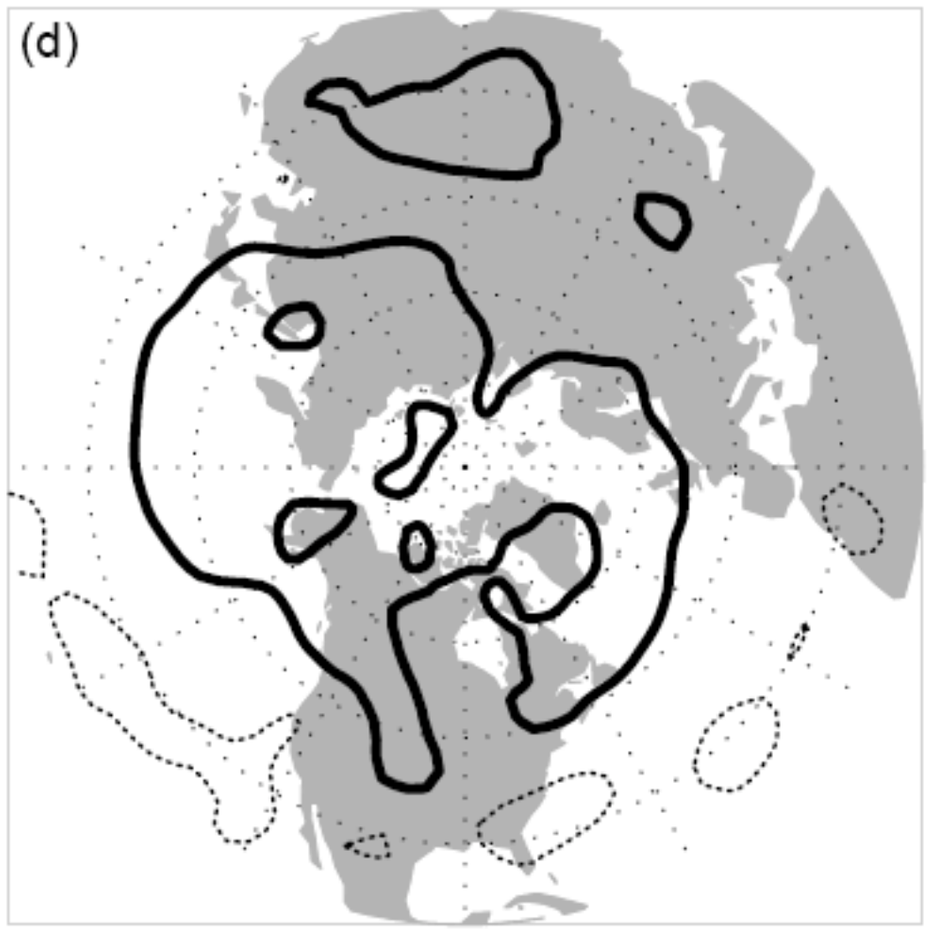



Z_L
Z_M
?
Z’

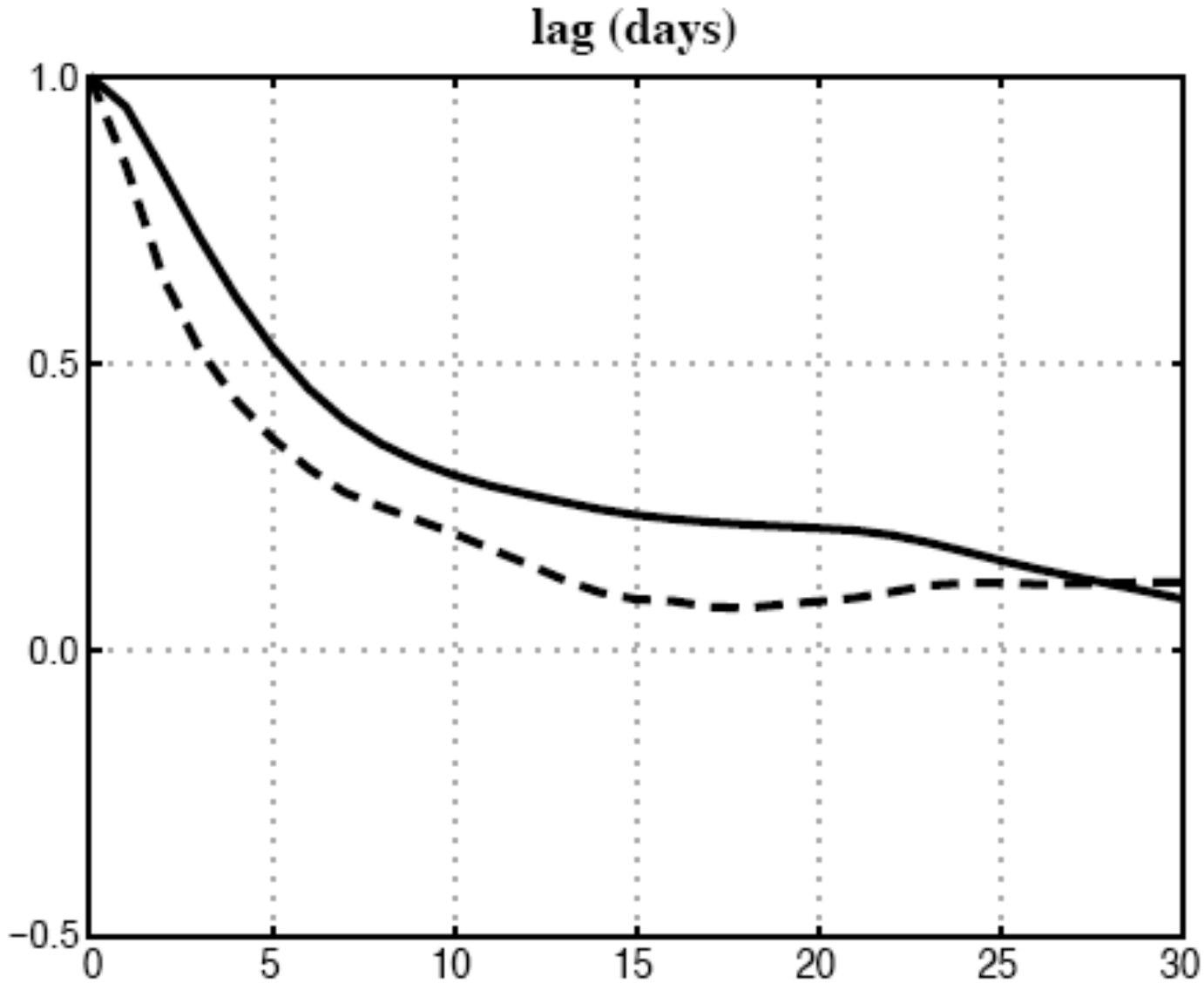

(a)


(b)


(c)


(d)

Role of boundary forcing



Thank you