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INTERACTION OF MAJOR TELECONNECTION PATTERNS AS A MECHANISM LINKING THE NORTH PACIFIC AND NORTH ATLANTIC CLIMATE

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THE MAIN OBJECTIVES:

(1) to identify the main spatial modes of common mean winter SSTA variability in the NP and NA and their relation to the atmospheric patterns for the 1957-2012 period and 2 subperiods of 1957-1988 and 1972-2012;

(2) to consider a very simplified qualitative mechanism of their evolution and shift;

(3) to present some evidence of change in character of statistical relationships among various climatic indices after the climate regime shift.

Data

1957-2012:

•Commonly used spatiotemporal datasets : ERSST v.3b (www.ncdc.noaa.gov/ersst/) and H_{500};

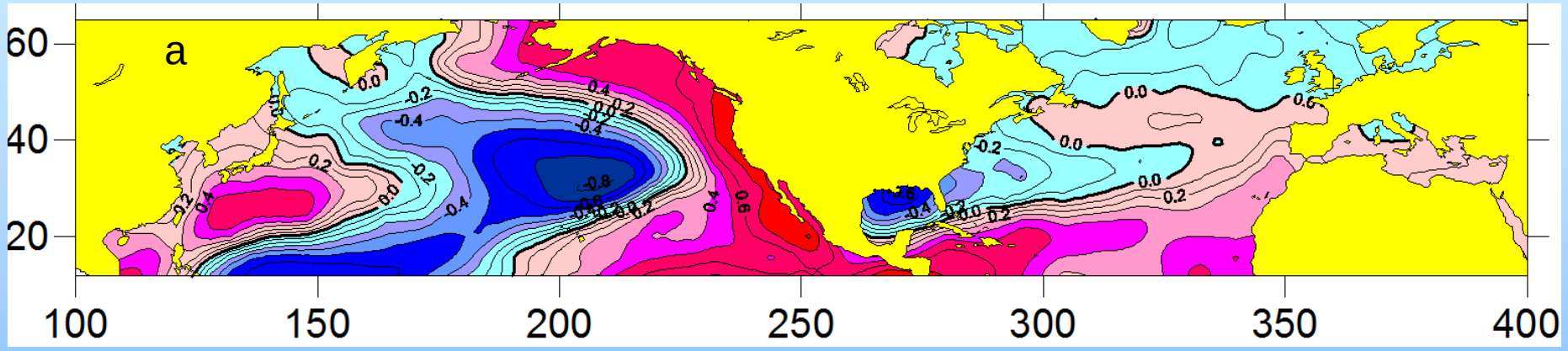
(www.esrl.noaa.gov/psd/data/gridded/ data.ncep.reanalysis.html)

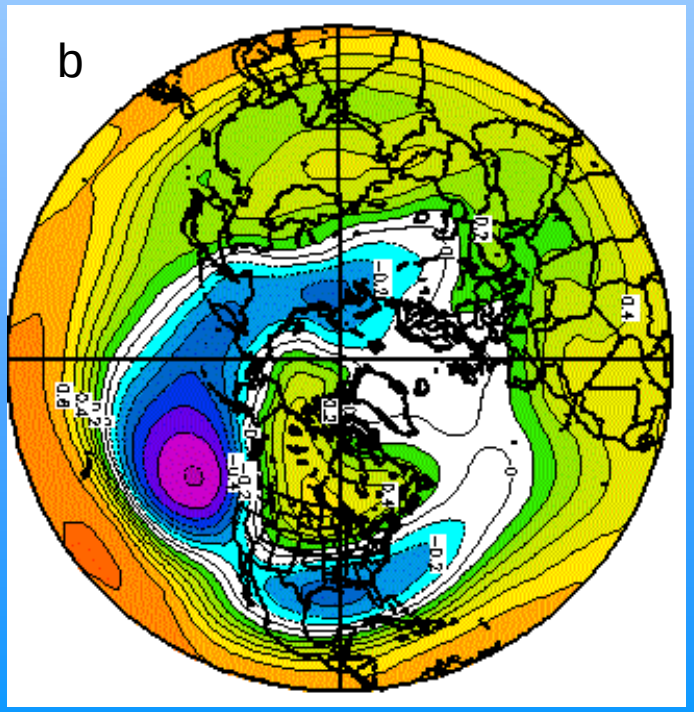
•SST dataset from the Russian Hydrometeorological Centre (used for the cluster analysis);

1950-2012:

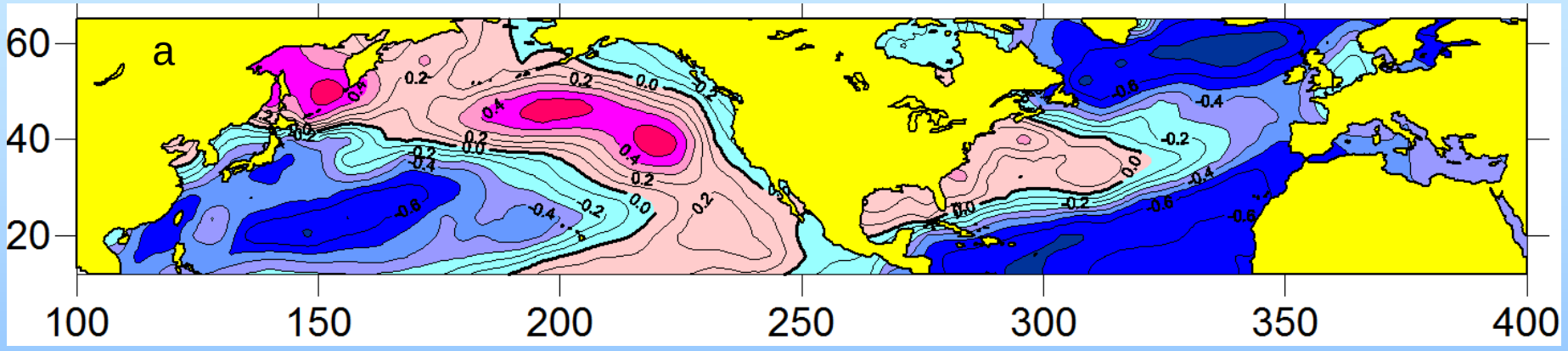
•Time series of various climatic indices available from www.esrl.noaa.gov/psd/data/climateindices/ and the NPGO index, from www.o3d.org/npgo/.

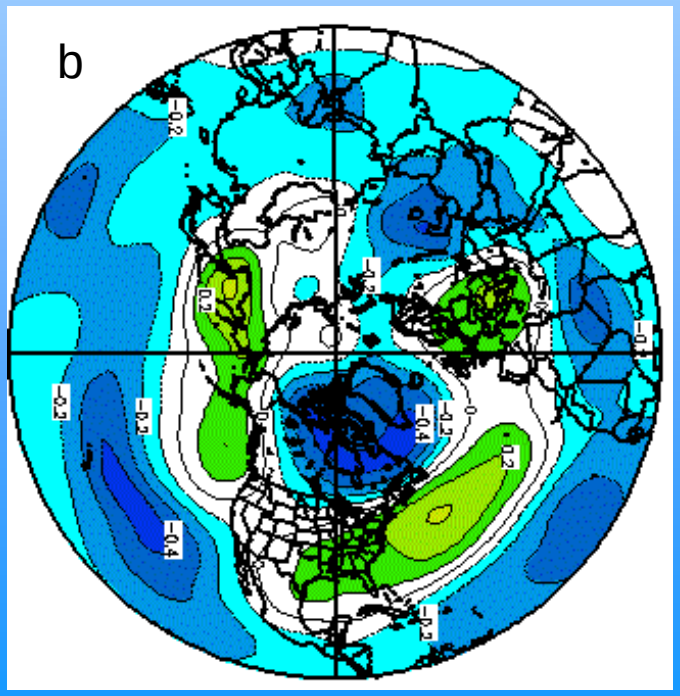
Correlation patterns between EOF1 PC (26.4%) and mean winter: SSTA field in the NA and NP (a), geopotential heights on H500 (b) for the 1957-2012 period (MODE1)



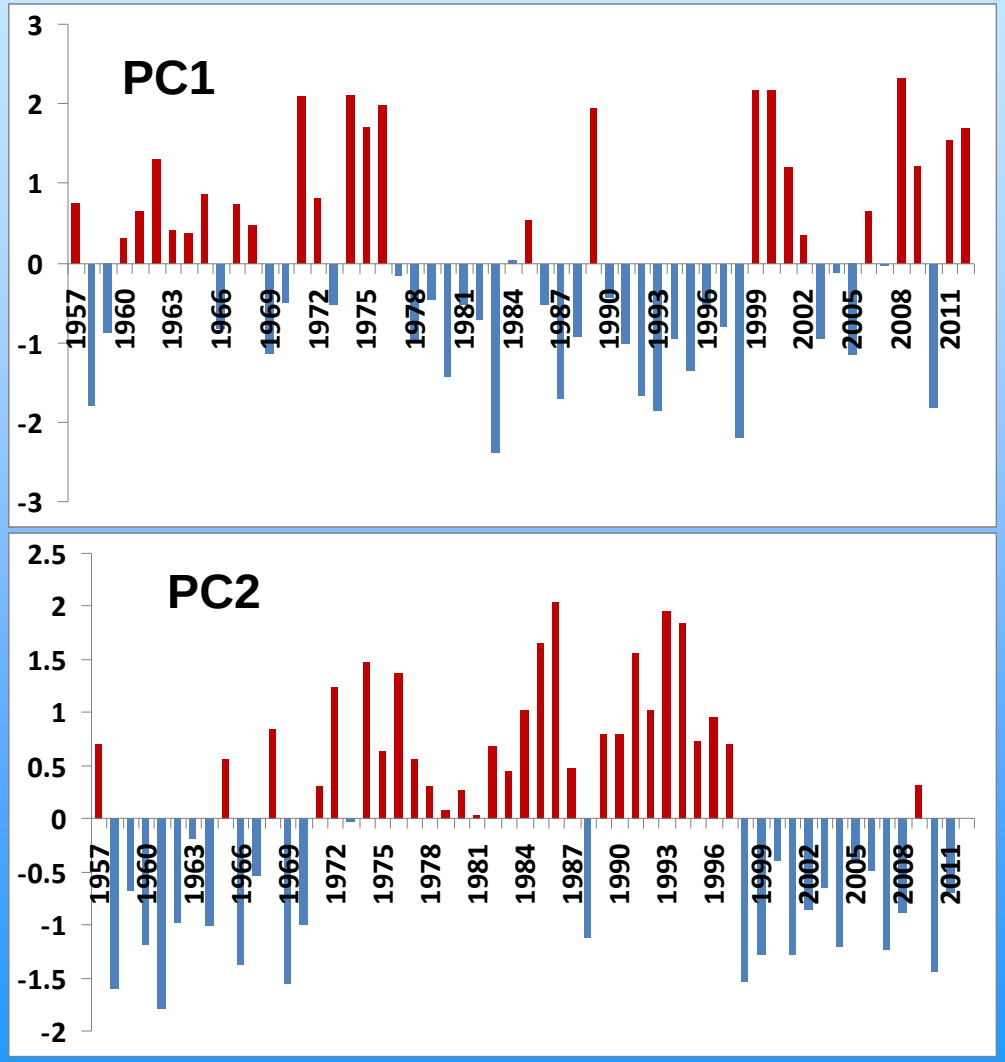


Correlation patterns between EOF2 PC (21.7%) and mean winter: SSTA field in the NA and NP (a), geopotential heights at H500 (b) for the 1957-2012 period (MODE2)

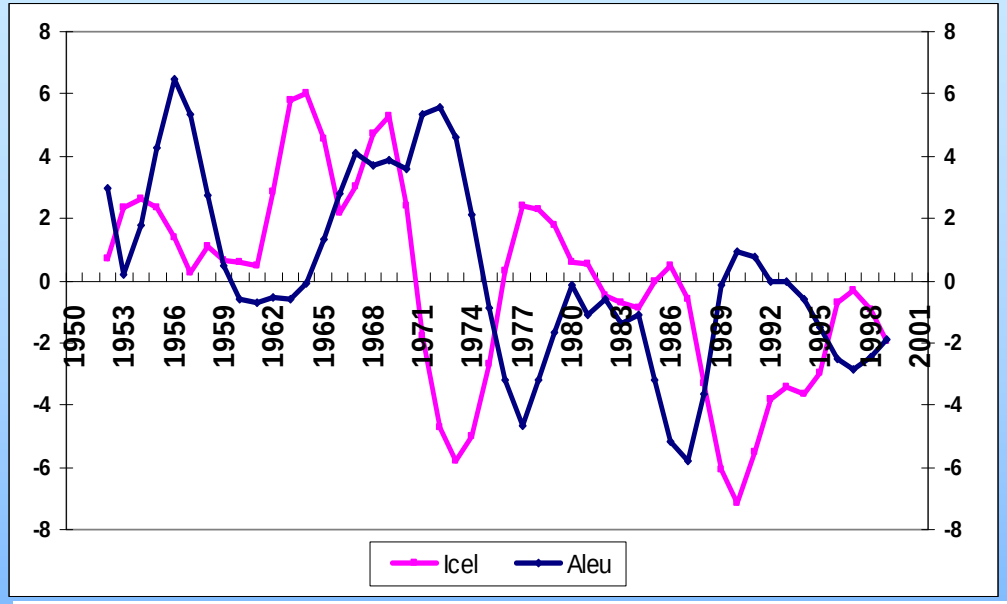




Time series of the first 2 EOF PCs of combined SSTA field for 1957-2012



5-yr running means of central pressure anomalies in the Icelandic and Aleutian Lows



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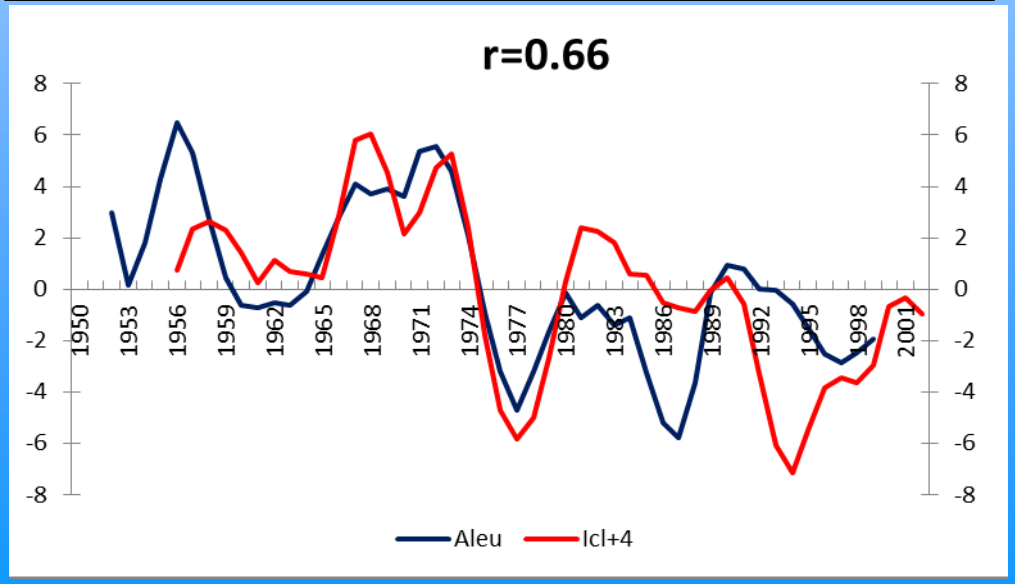
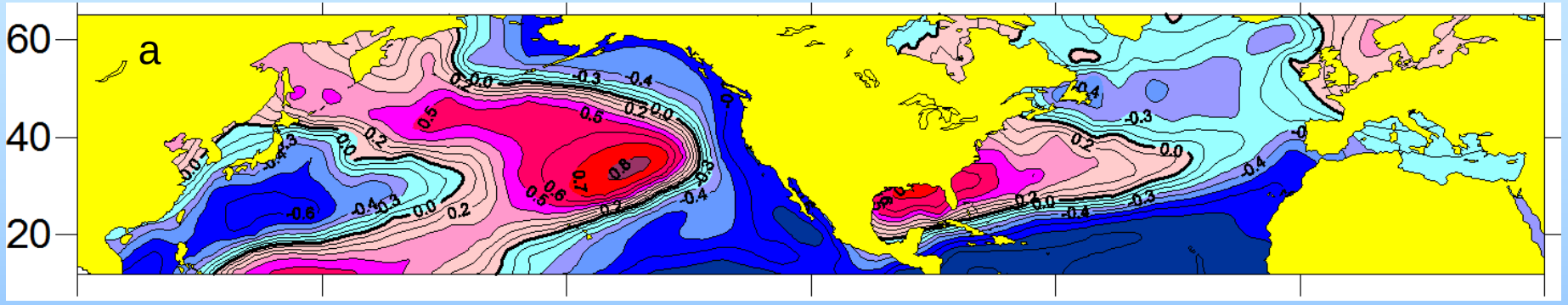
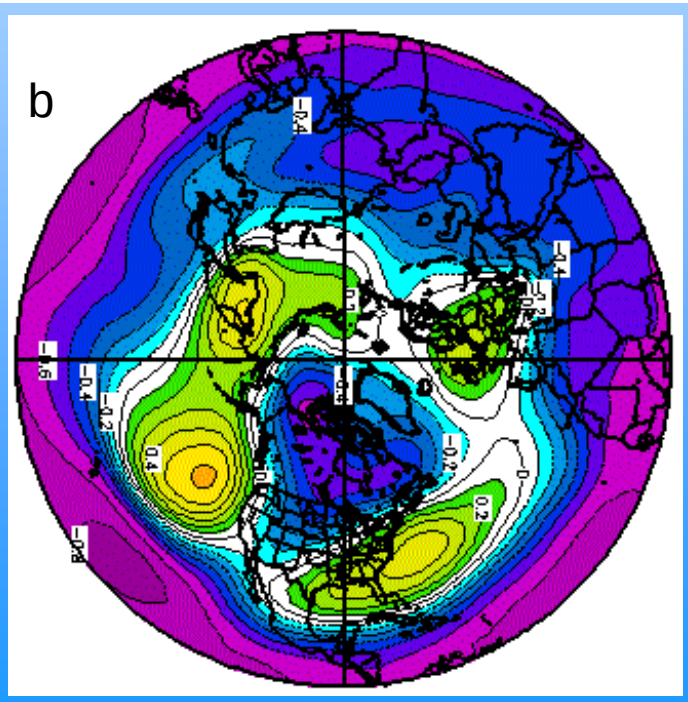
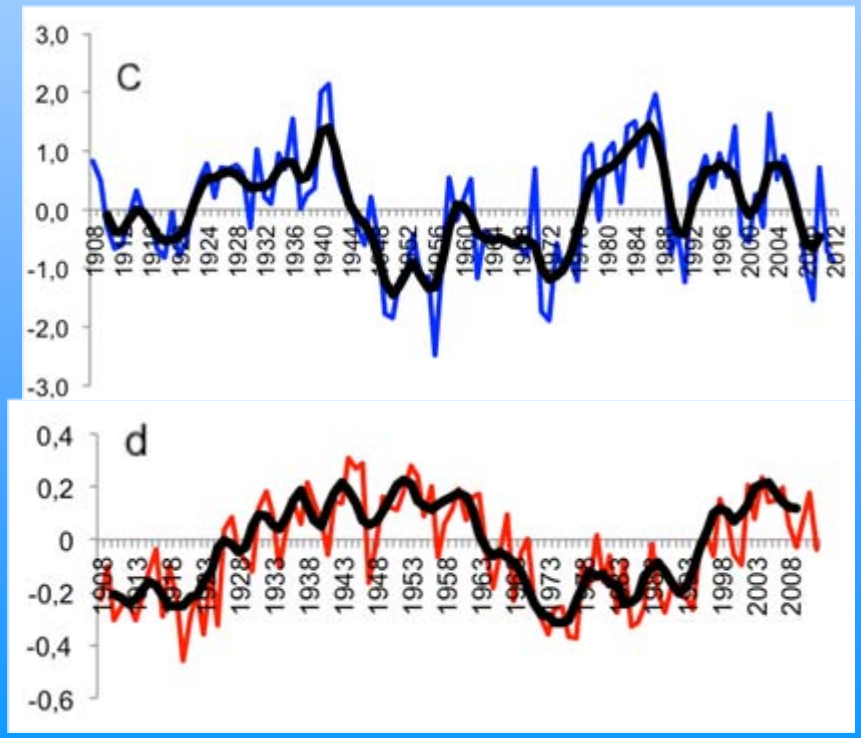


IL leads AL by 4 years

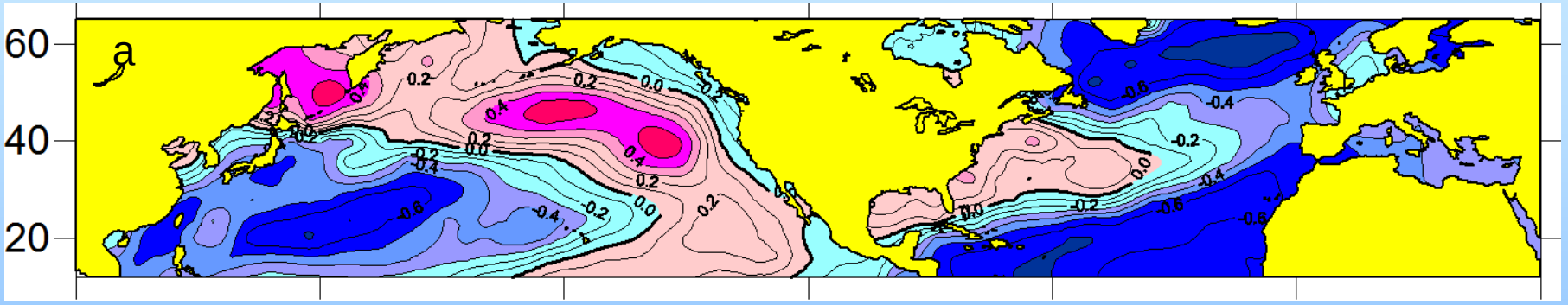
Correlation patterns between EOF1 PC (39.5%) and mean winter: SSTA field in the NA and NP (a), geopotential heights on H500 (b) for 1957-1988; time series of PDO (c) and AMO (d) indices (MODE1)

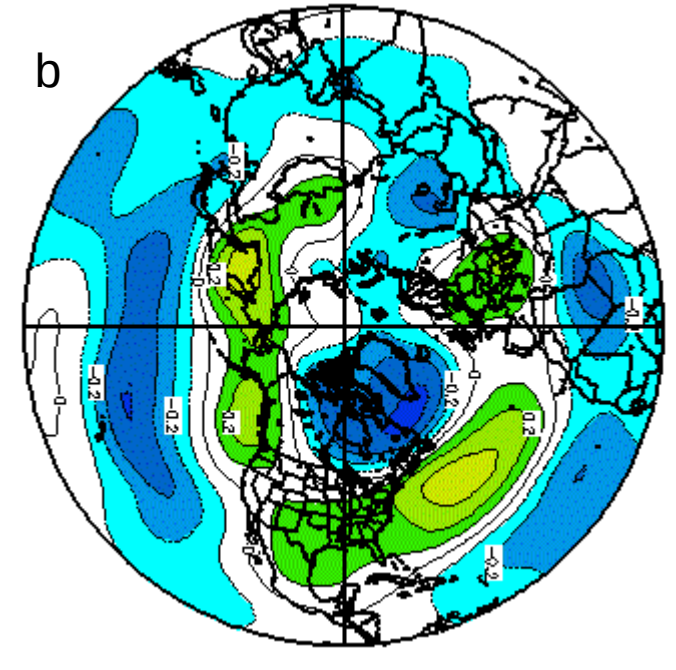


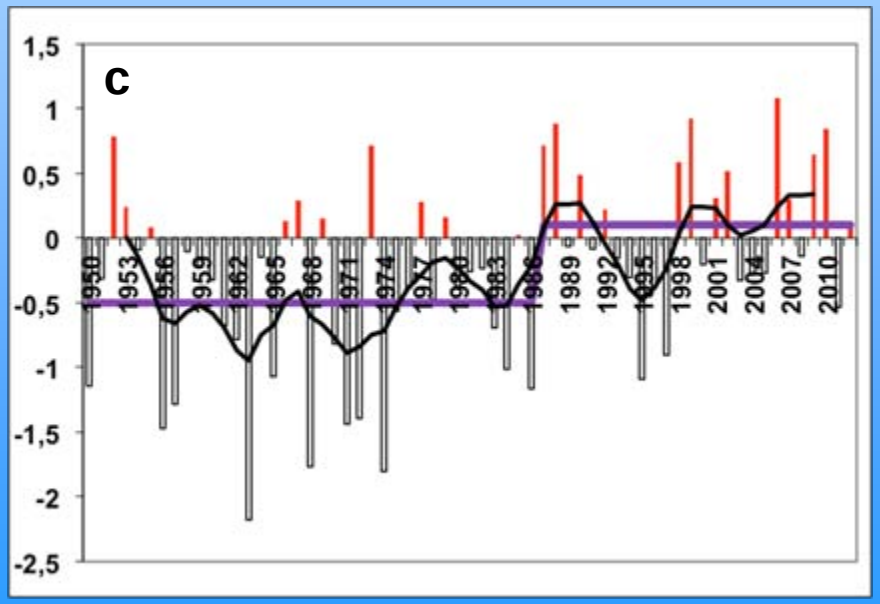




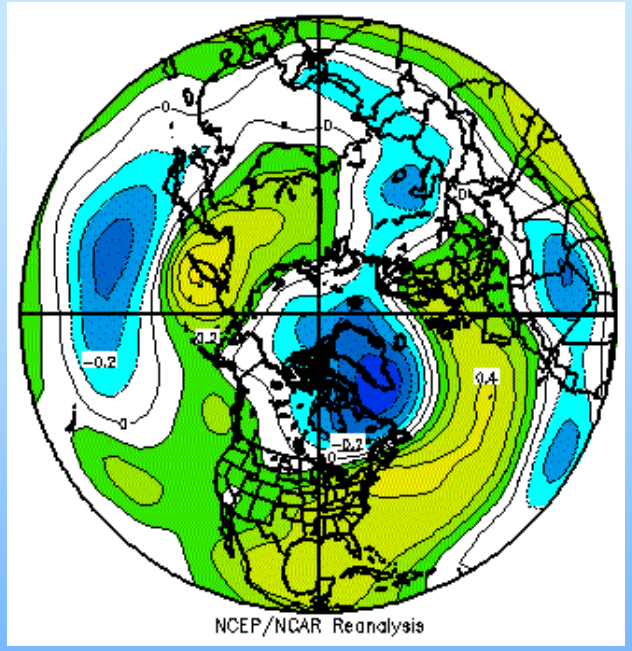
Correlation patterns between EOF2 PC (18.7%) and mean winter: SSTA field in the NA and NP (a), geopotential heights on H500 (b) for 1957-1988 (MODE2); time series of the West Pacific index (c)

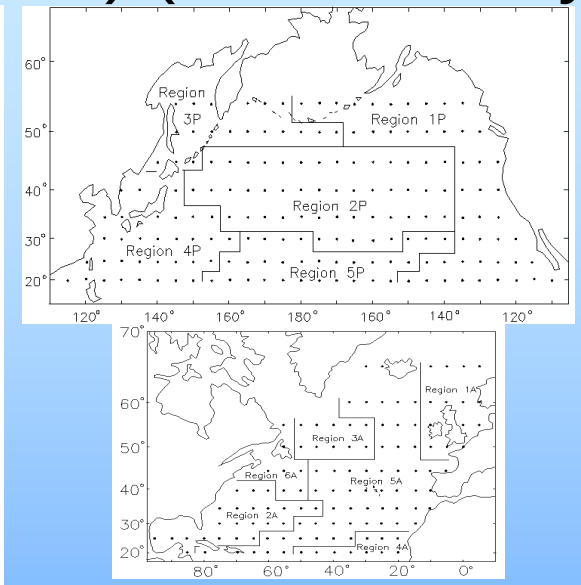




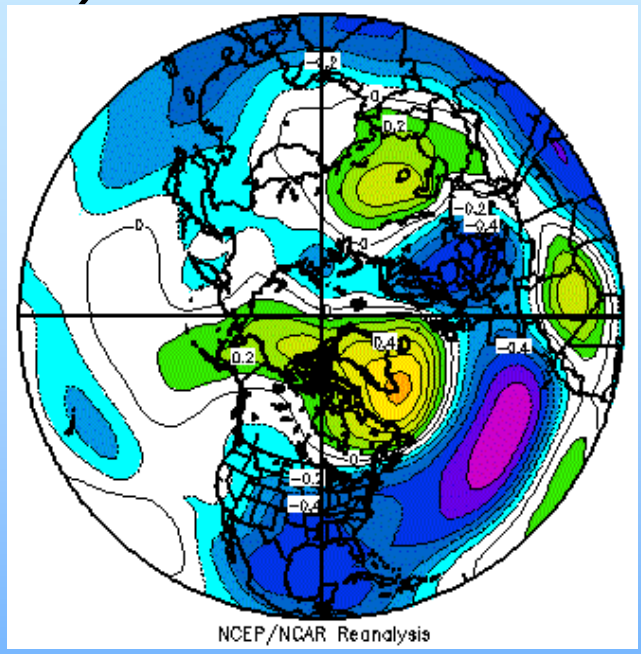


Association between eastern NWP and NWA (1957-1991) (cluster analysis)

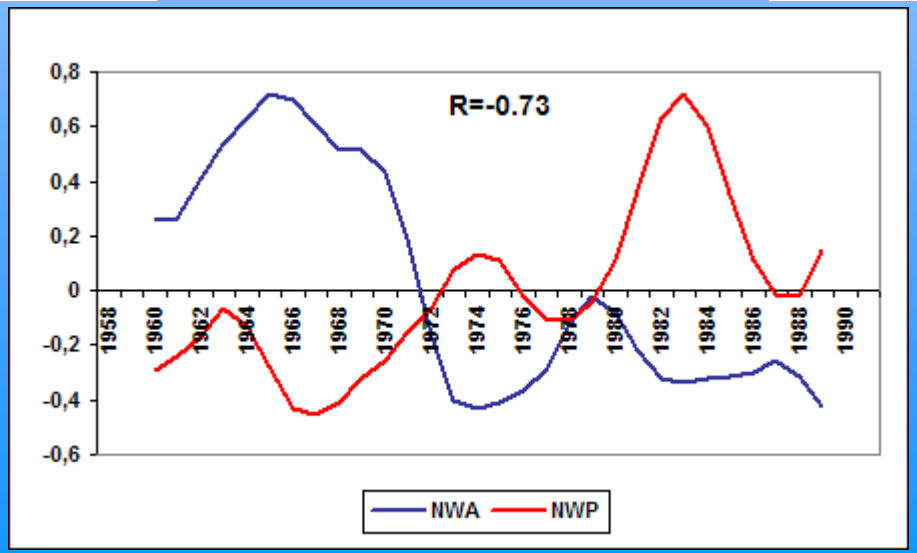




5-yr running SSTA means

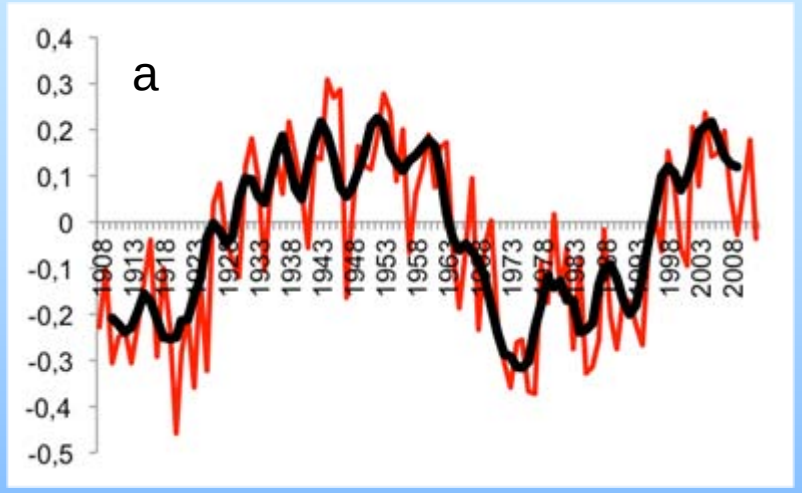


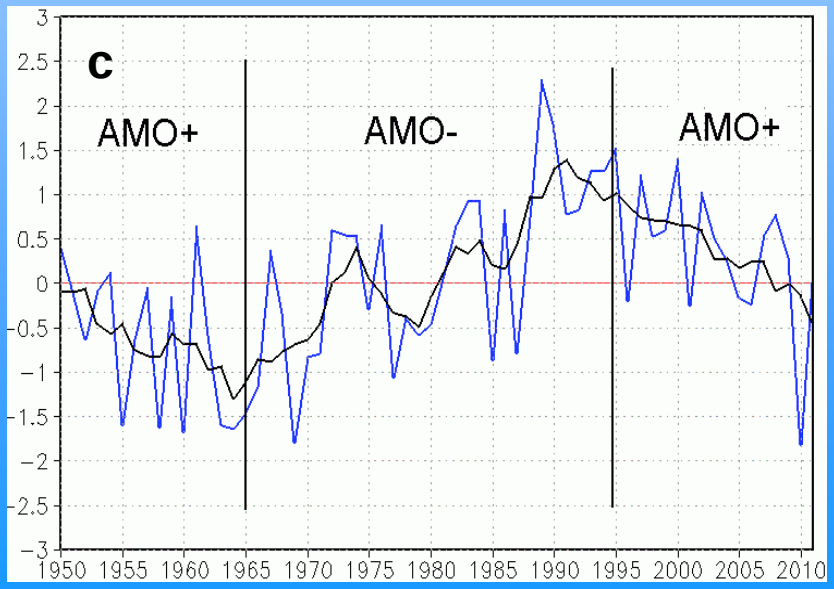
Correlation:
NWP (region 3P)
to H500

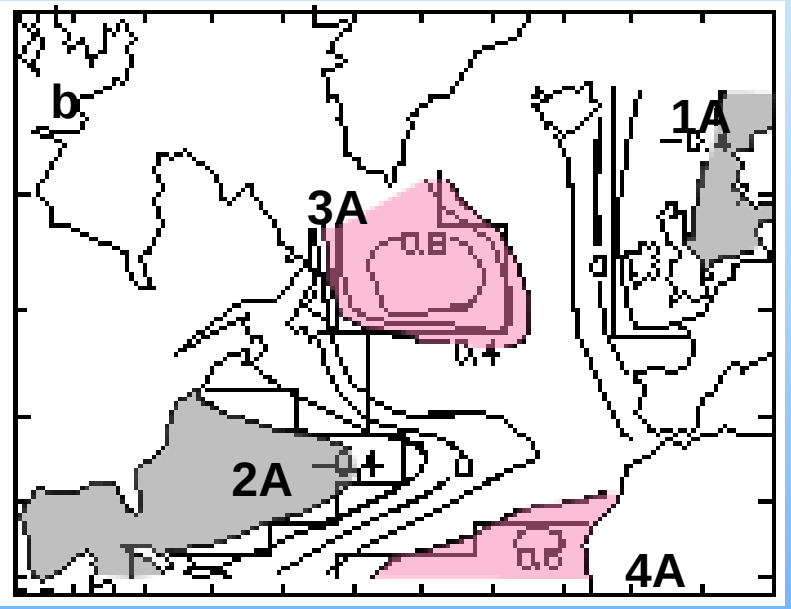


Correlation:
NWA (region 3A)
to H500

AMO time series (a), four-pole structure of SSTA variations in the NA (1957-1991) (b), and NAO index (c)

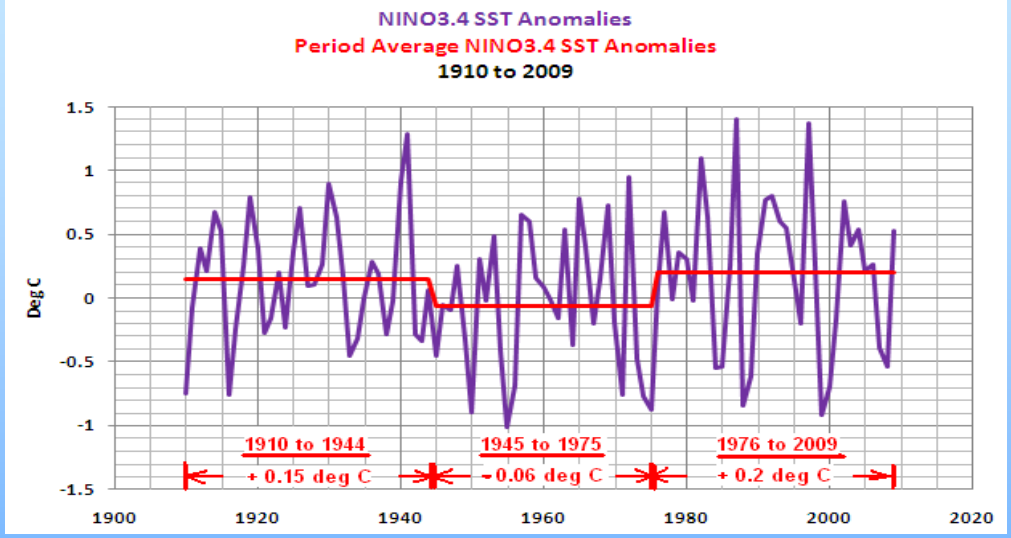




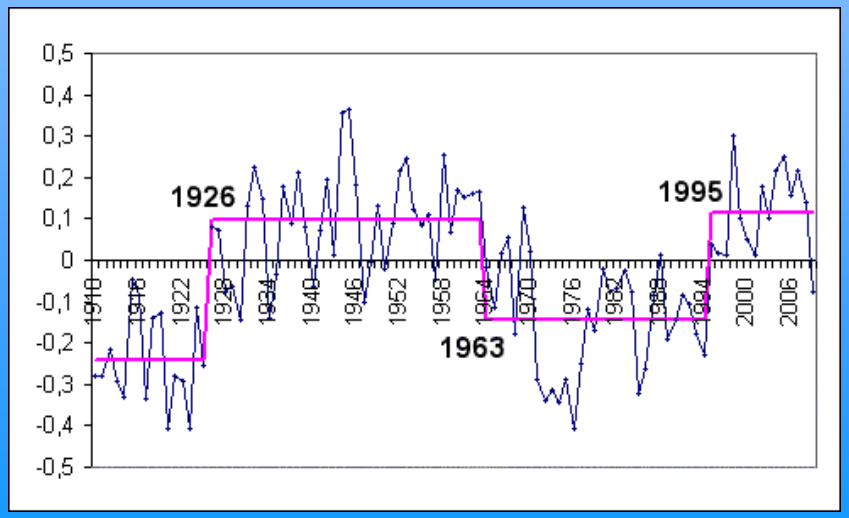


R (PC1(1A÷4A); NA) ≈ -0.90

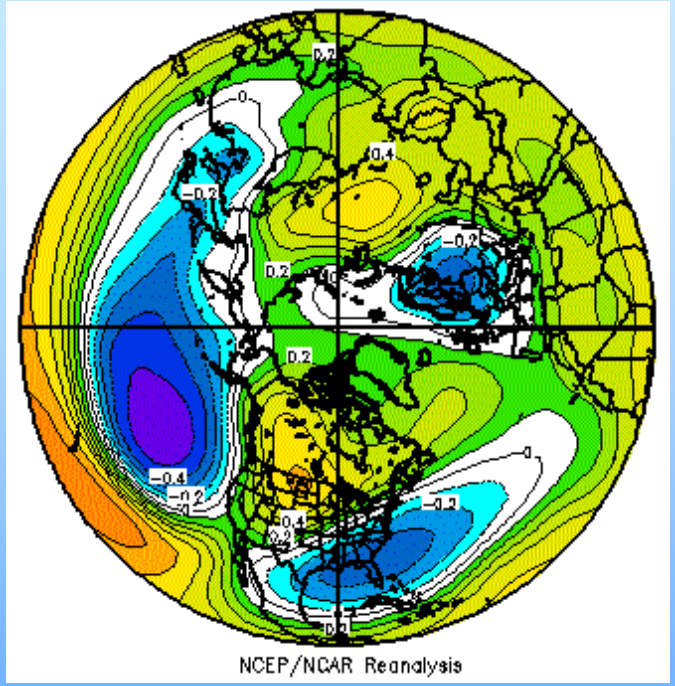
Association between regime shifts of Nino 3.4 and AMO

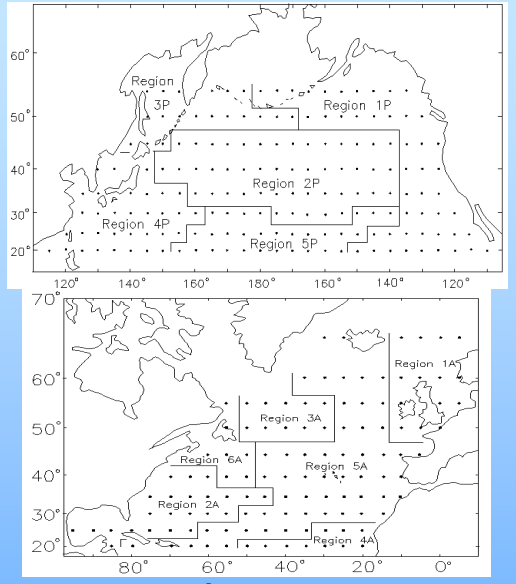


Tisdale, 2010,
http://tinyurl.com/29e3cto

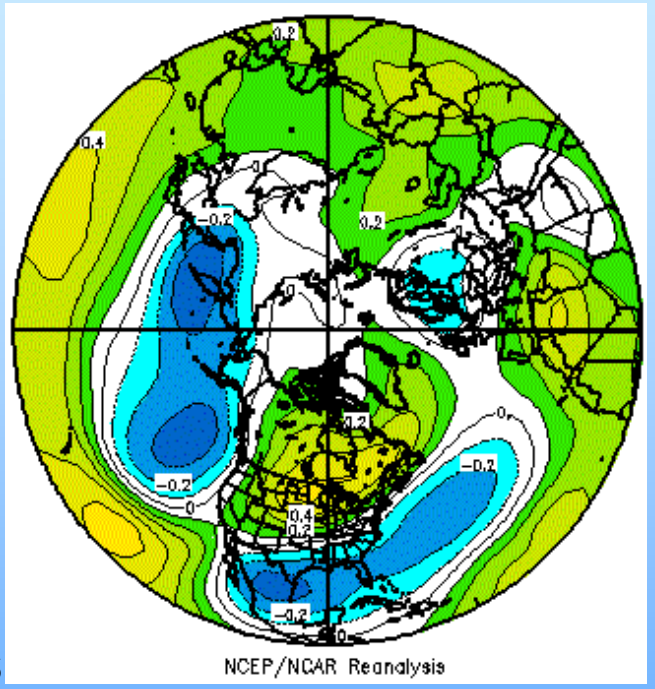


Association between eastern NP and central NA (1958-1991)

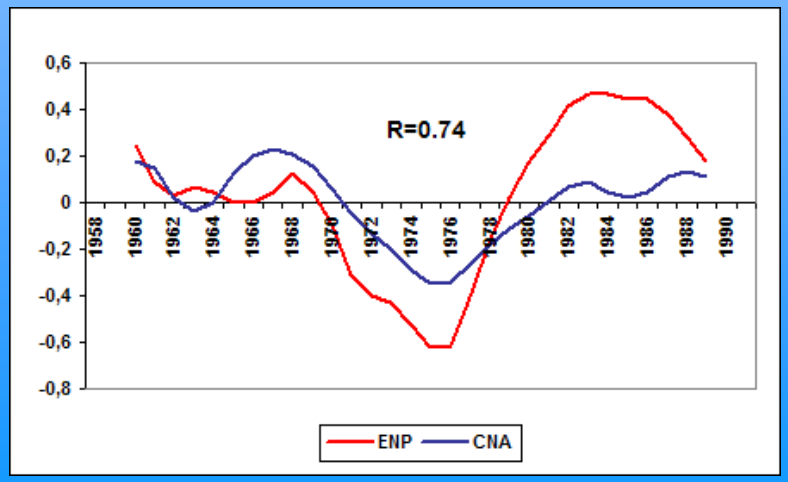




5-yr running SSTA means

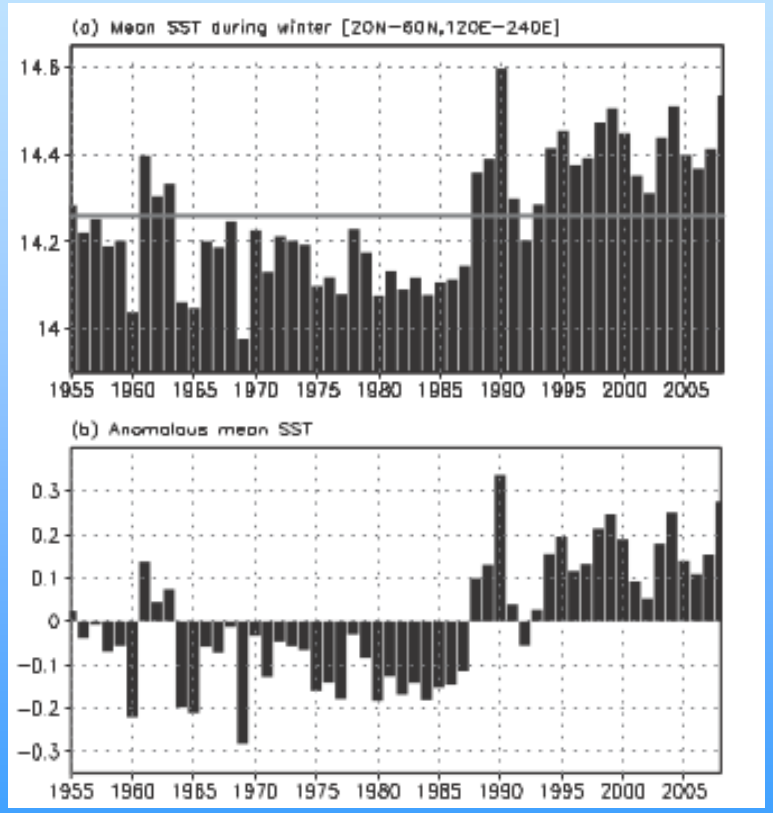


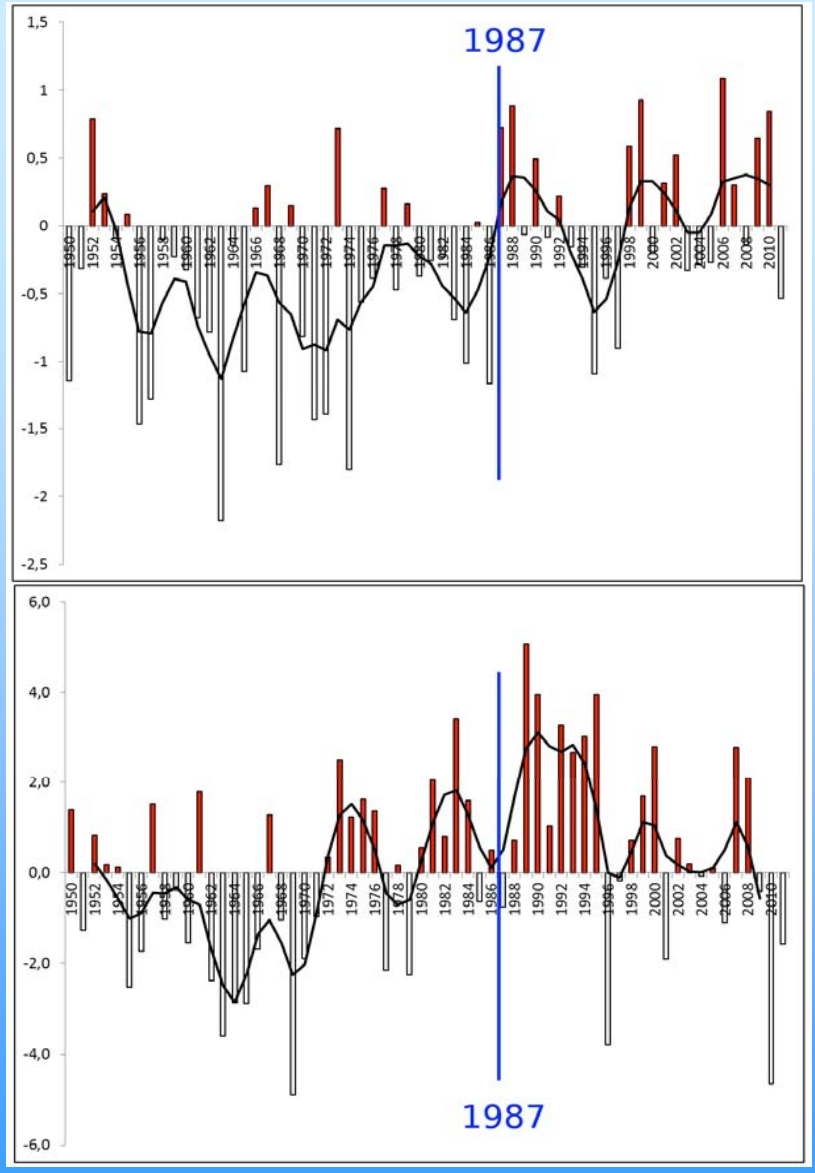
Correlation:
Eastern NP (region 1P)
to H500



Correlation:
Central NA(region 5A)
to H500

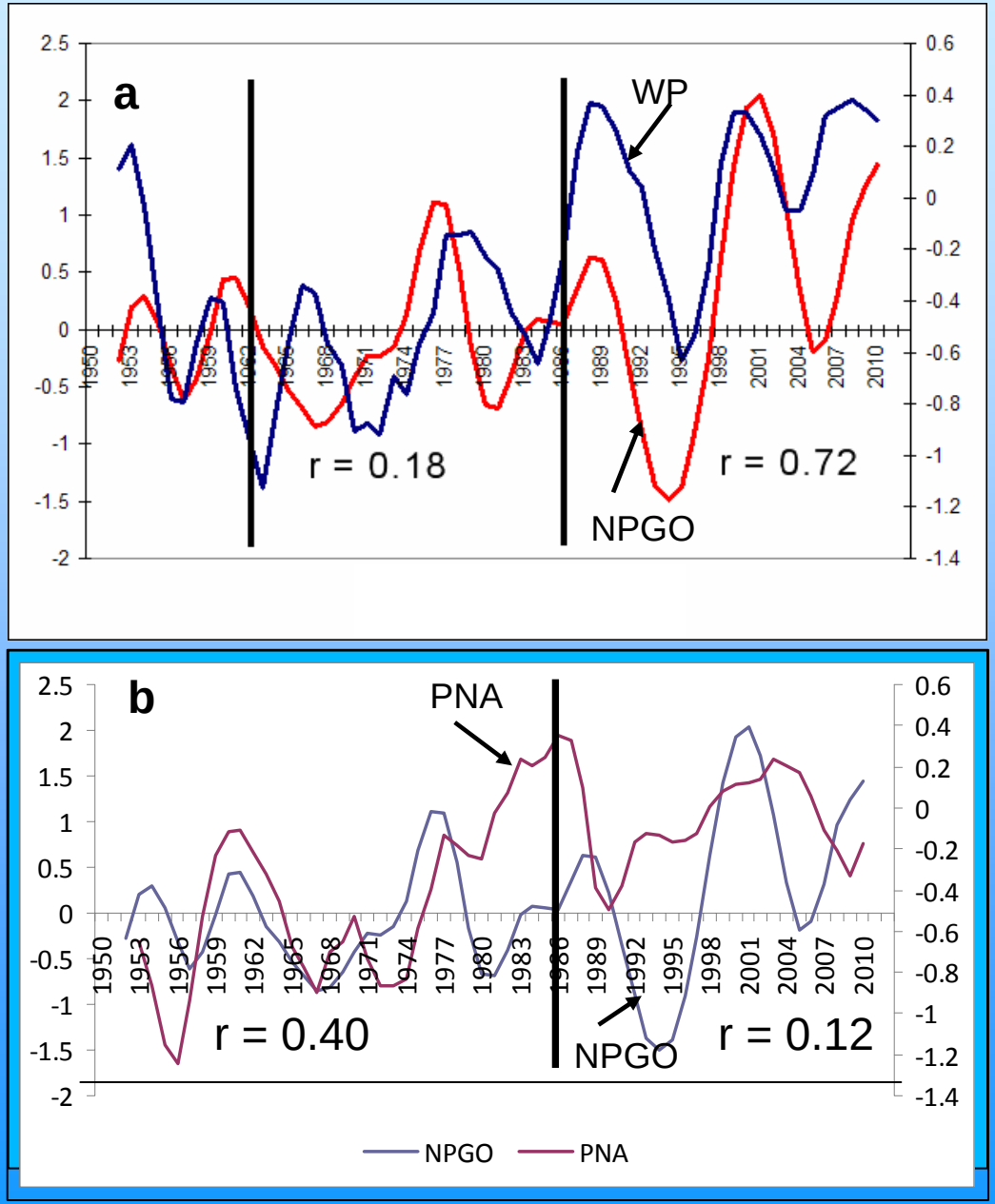
1987 regime shift in the WP (a) and NAO (b) indices (left panel)



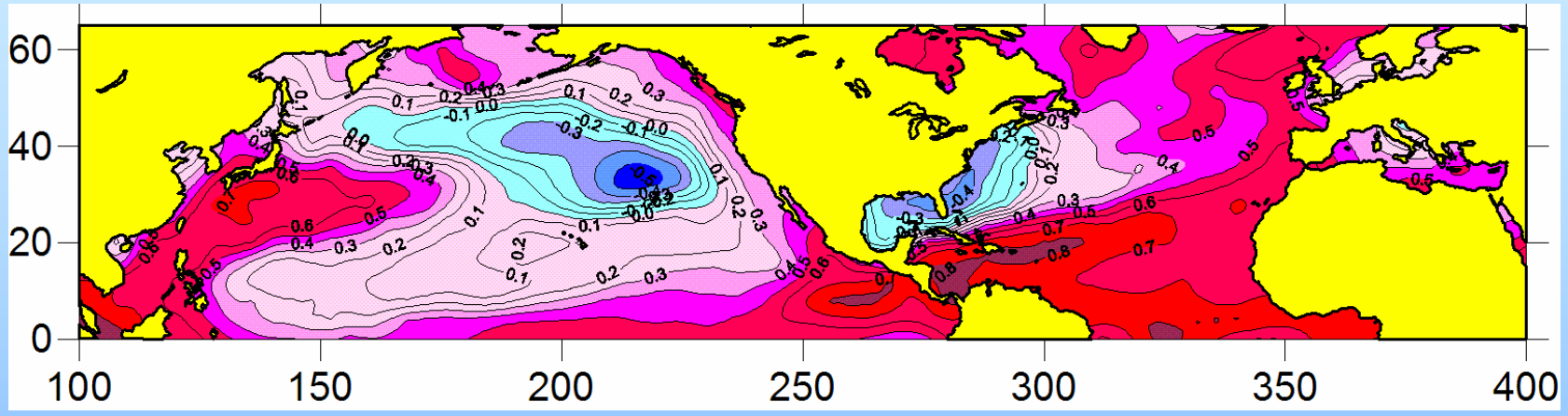


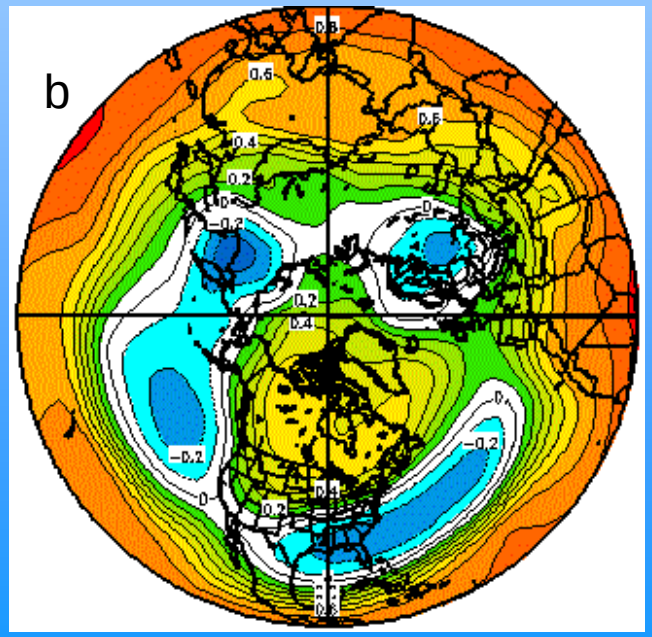
Mean SST in the NP (a) and its anomalies (b) in winter for 1955-2009 (Yeh et al., 2011)

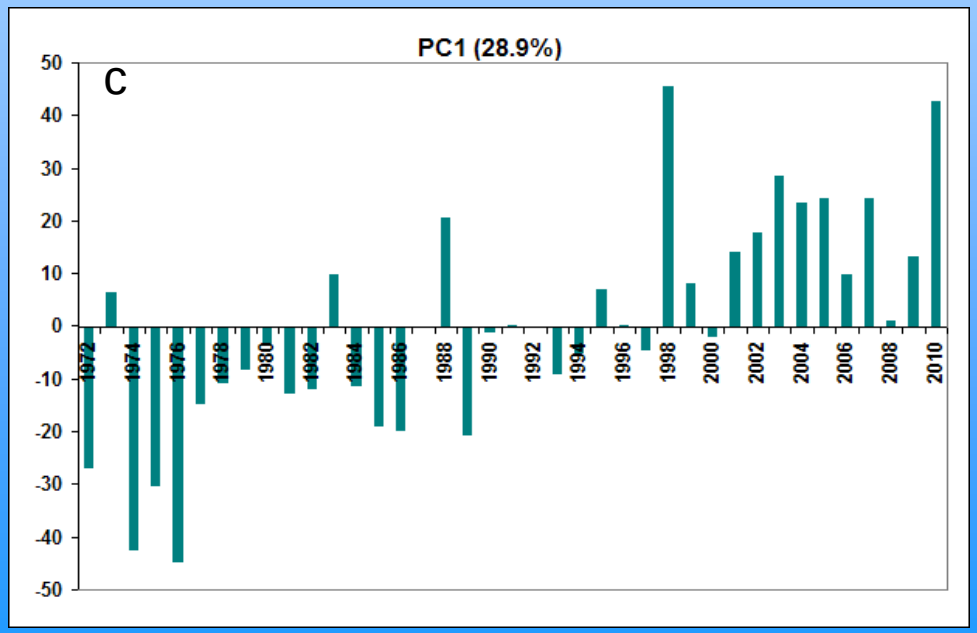
Changes in character of association of NPGO index with the WP (a) and PNA (b) indices during 1950-2012



Correlation patterns between EOF1 PC (28.9%) and mean winter: SSTA field in the NA and NP (a), geopotential heights on H500 (b); PC1 scores (c) for 1972-2012

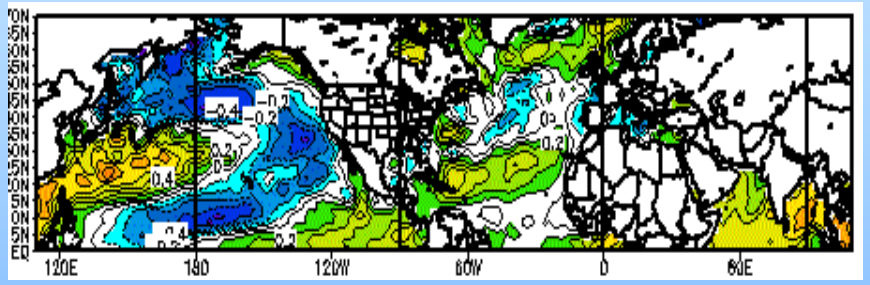




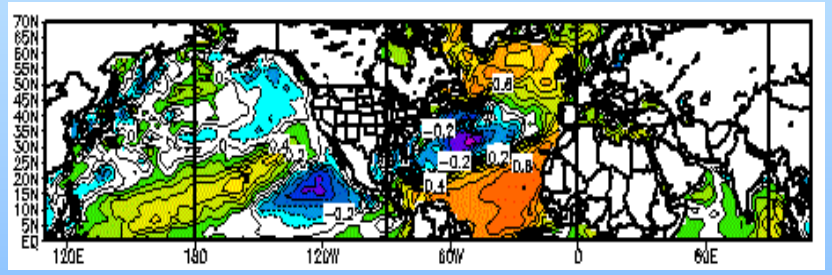


Winter correlation patterns of various climatic indices with SST field for 1987-2012

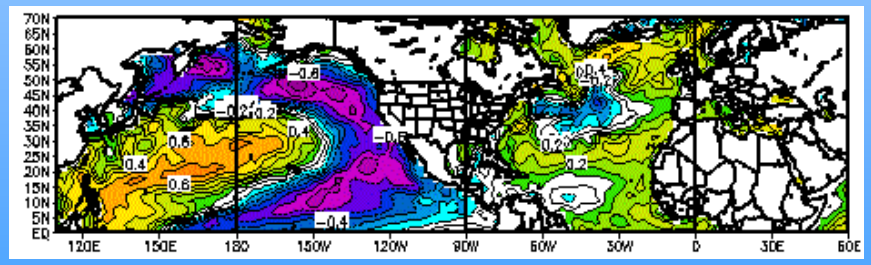
WP



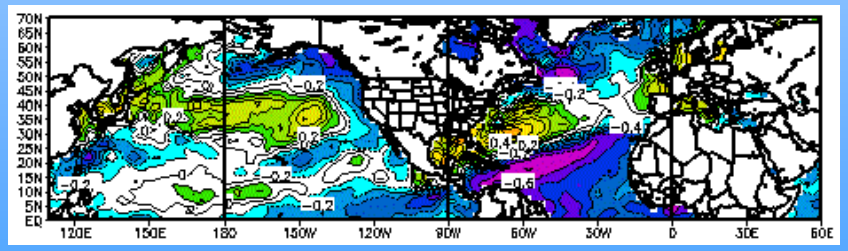
AMM



NPGO



AO



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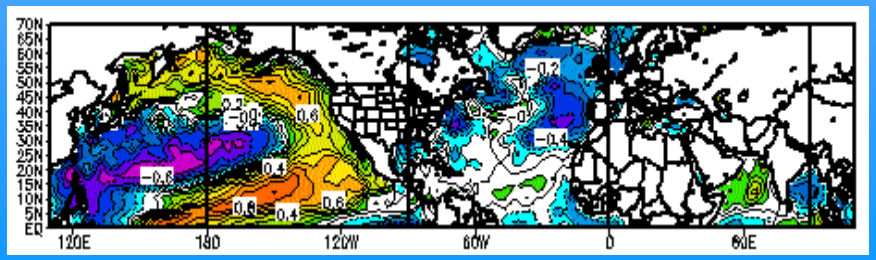
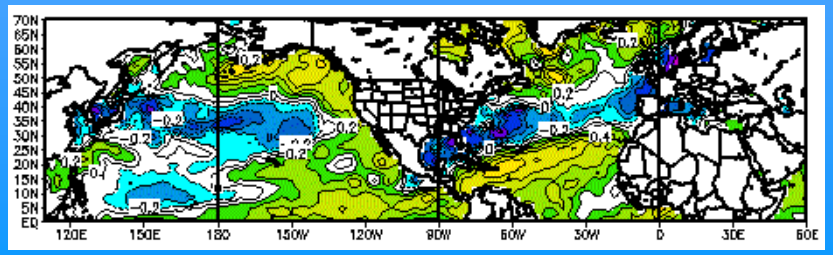


SCA



Loadings of the first four PCs of the 33 climatic time series for 1957-1988

TIME SERIES	PC1 25.4%	PC2 15.4%	PC3 11.3%	PC4 8.9%
NAO (XII-III)	**0,71**	−0,43	−0,12	−0,15
NAO (AZORES)	**0,65**	−0,40	0,00	−0,35
NAO (ICELAND)	**−0,64**	0,21	0,34	0,18
NAO (GIBRALTAR)	0,41	−0,47	−0,32	**−0,56**
ARCTIC OSCILLATION (I-III)	**0,70**	0,10	−0,04	−0,31
WEST ATLANTIC TP (WG, 1981)	**−0,75**	0,03	−0,12	−0,09
SCANDINAVIA TP	0,08	0,23	−0,21	**0,61**
TROPICAL/NORTHERN HEMISPHERE TP	0,50	0,21	0,30	0,10
PNA	0,02	**−0,82**	0,27	0,15
NORTH PACIFIC INDEX	−0,01	**0,85**	−0,21	−0,08
WEST PACIFIC PATTERN	−0,07	−0,16	**−0,68**	**0,45**
SOI (XII-II)	0,27	**0,58**	0,35	−0,07
AMO	**−0,67**	−0,31	−0,22	−0,39
ATLANTIC TRIPOLE	**−0,84**	−0,14	−0,11	−0,38
TROPICAL NORTH ATLANTIC	**−0,86**	−0,20	−0,20	−0,14
REGION 1A (NE Atlantic)	**0,46**	0,02	**−0,72**	−0,29
REGION 2A (SE North Atlantic)	**0,74**	−0,31	−0,09	−0,10
REGION 3A (NW Atlantic)	**−0,77**	0,29	−0,08	−0,24
REGION 4A (SW North Atlantic)	**−0,88**	−0,09	−0,23	0,09
REGION 5A (central NA)	**−0,45**	−0,33	−0,46	−0,37
REGION 6A (Newfoundland)	0,07	−0,07	−0,17	**−0,49**
REGION 1P (eastern North Pacific)	−0,35	**−0,73**	0,18	−0,25
REGION 2P (central North Pacific)	0,14	**0,74**	−0,20	−0,40
REGION 3P (NW Pacific)	0,42	−0,13	0,32	−0,31
REGION 4P (SW North Pacific)	−0,15	0,11	**−0,84**	0,13
REGION 5P (S North Pacific)	0,08	0,01	**−0,43**	−0,23
PC1 (1A-4A)	**−0,93**	0,22	0,02	−0,06
PC1	**0,65**	**0,54**	0,34	−0,08
PC2	−0,26	−0,34	**0,62**	−0,27
PC3	0,11	−0,17	0,40	−0,29
PC4	−0,46	**0,54**	0,13	−0,19
PDO	−0,16	**−0,87**	0,20	0,32
PACIFIC MERIDIONAL MODE (SST)	**−0,51**	−0,13	0,41	−0,13

Loadings of the first four PCs of the 32 climatic time series for 1972-2012

TIME SERIES	PC1 22.6%	PC2 20.7%	PC3 13.2%	PC4 8.6%
NAO (XII-III)	0,15	**−0,58**	**0,63**	0,13
ARCTIC OSCILLATION (I-III)	0,31	**−0,69**	0,39	−0,19
WEST ATLANTIC TP (WG, 1981)	−0,12	**0,78**	−0,11	−0,30
EAST ATLANTIC/WEST RUSSIA TP	0,15	0,07	**0,59**	0,00
SCANDINAVIA TP	**−0,45**	0,36	−0,46	0,17
TROPICAL/NORTHERN HEMISPHERE TP	0,11	**−0,71**	−0,45	0,10
POLAR/EURASIA TP	**−0,48**	−0,17	0,23	−0,14
PNA	−0,18	**0,73**	0,19	0,28
NORTH PACIFIC INDEX	0,29	**−0,61**	−0,38	−0,43
WEST PACIFIC PATTERN	**0,46**	0,19	−0,28	0,26
SOI (XII-II)	0,32	−0,41	−0,67	−0,26
AMO	**0,60**	**0,60**	0,12	−0,37
Tw At KOLA SECTION (0-200 m)	**0,61**	−0,05	0,19	−0,12
TROPICAL NORTH ATLANTIC	0,19	**0,81**	−0,01	−0,47
REGION 1A (NE Atlantic)	**0,74**	0,04	0,45	0,08
REGION 2A (SE North Atlantic)	**0,62**	−0,19	0,31	0,11
REGION 3A (NW Atlantic)	**0,57**	**0,51**	−0,27	−0,28
REGION 4A (SW North Atlantic)	0,22	**0,67**	−0,05	−0,44
REGION 5A (central NA)	**0,78**	0,29	0,28	−0,13
REGION 6A (Newfoundland)	0,05	−0,24	**0,55**	−0,16
REGION 1P (eastern North Pacific)	**−0,55**	0,13	**0,63**	−0,10
REGION 2P (central North Pacific)	**0,45**	**−0,57**	0,09	−0,48
REGION 3P (NW Pacific)	**−0,42**	−0,18	0,29	−0,42
REGION 4P (SW North Pacific)	**0,81**	0,16	0,23	0,12
REGION 5P (S North Pacific)	**0,88**	−0,04	0,06	0,01
PC1	−0,39	0,42	**0,55**	−0,25
PC2	**−0,41**	**−0,66**	−0,04	−0,38
PC3	−0,16	0,43	−0,45	**−0,52**
PC4	−0,08	0,11	0,28	−0,34
PDO	**−0,53**	0,53	0,30	0,37
NPGO	**0,63**	0,25	−0,35	0,40
PACIFIC MERIDIONAL MODE (SST)	**−0,62**	−0,16	−0,08	−0,36

Evolution of common modes of climatic variability in the North Pacific and North Atlantic

Period	Characteristic Pattern
1945-1956	*Strong -PDO ÷ weakening of + AMO (Mode 1)*
1957-1964	*Strengthening of - WP ÷ further prominent weakening of + AMO (Mode 2)*
1965-1976	*Strong -WP ÷ strong -AMO (Mode 2)*
1977-1987	*Strong + PDO ÷ weakening of - AMO (Mode 1)*
1988-1994	*Strengthening of + WP ÷ further prominent weakening of - AMO (Mode 2)*
1995-2006	*Strong + WP ÷ strong + AMO (Mode 2)*
2007 - ?	*Strengthening of -PDO ÷ weakening of +AMO (Mode 1)*


Thank you for attention