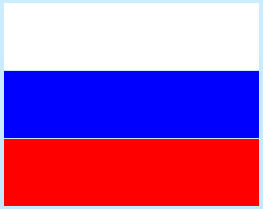
PICES 2012 Meeting
11-20 October 2013, Nanaimo, BC, Canada



CLIMATE VARIABILITY IN THE NORTHWEST PACIFIC: REGIMES, MECHANISMS, TRENDS, IMPACTS ON COMMERCIAL FISH STOCKS

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Data

1951-2013:

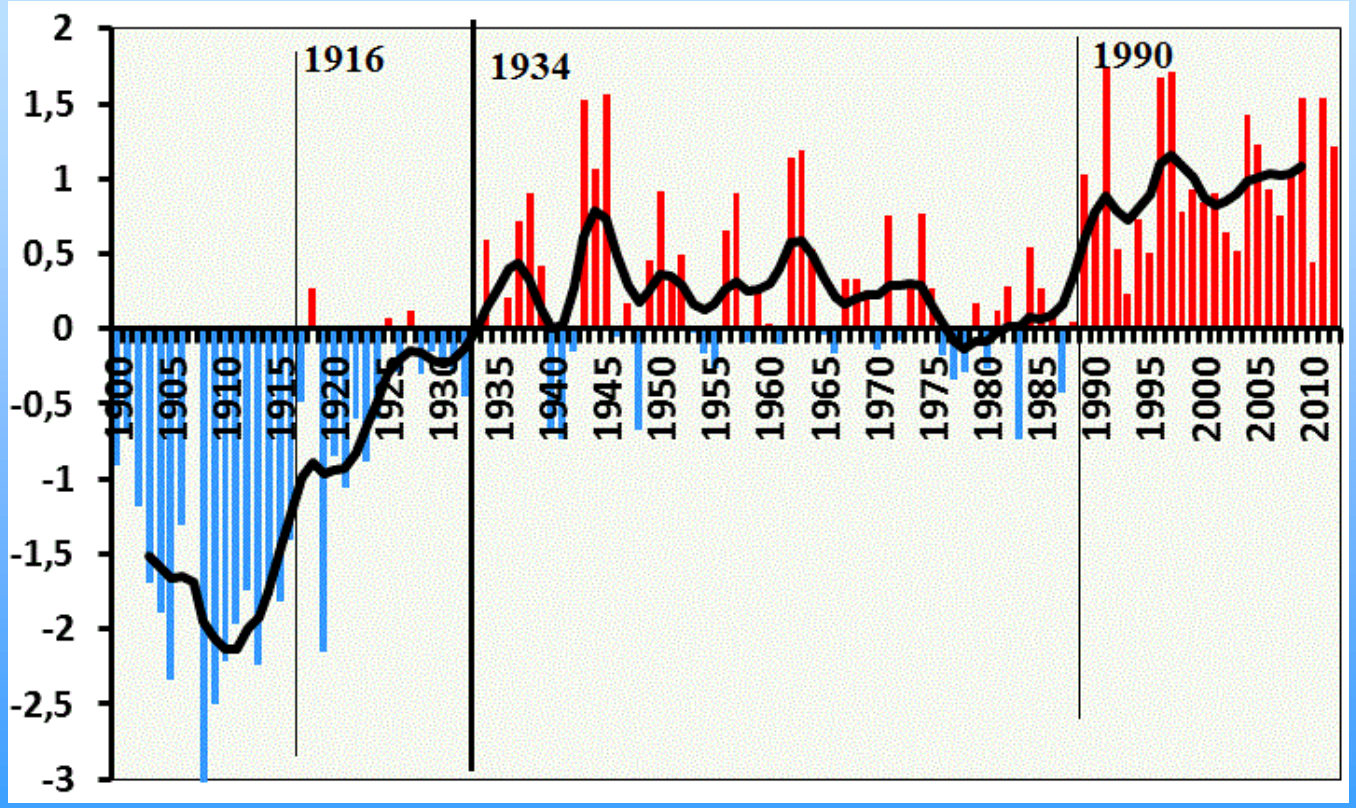
•Commonly used spatiotemporal datasets : ERSST v.3b (www.ncdc.noaa.gov/ersst/), SLP and H_{500} (www.esrl.noaa.gov/psd/data/gridded/ data.ncep.reanalysis.html);

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/;

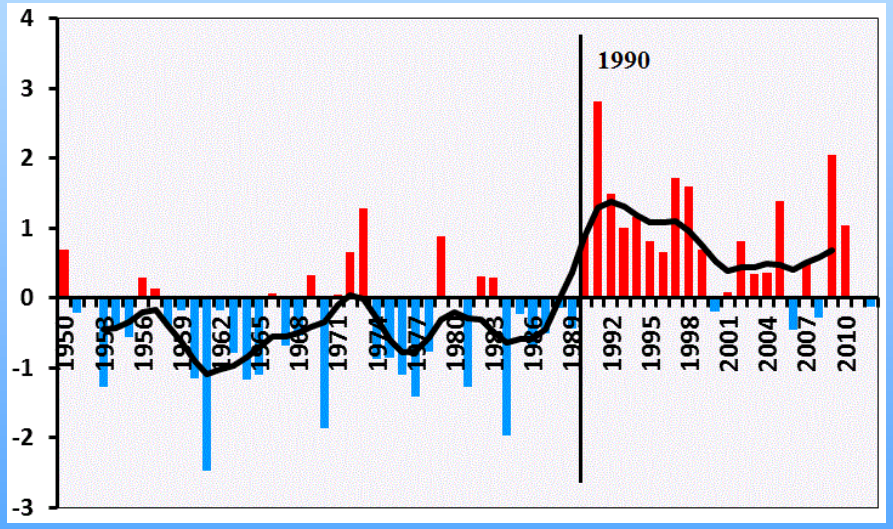
- Data on Russian salmon catches (1911-2012) (VNIRO, 1986, NPAFC), recruitment of EK (1963-2009) and WK (1972-2001) walleye pollock (TINRO-Center)

WARMING TREND IN THE NORTH PACIFIC AS SHOWN BY EOF2 PC (14%) OF SSTA FIELD, 1900-2012

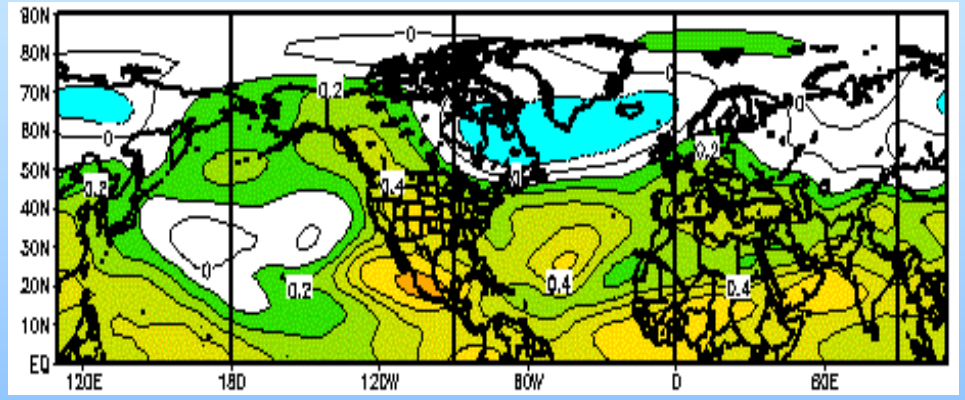


Warming trend in the North Pacific in 1950-2012 as shown by EOF3 PC (10.9%) OF SSTA FIELD, 1950-2012 (a); correlation pattern between PC3 and H500 in the NH (b) and over the globe (c)

(a)



(b)



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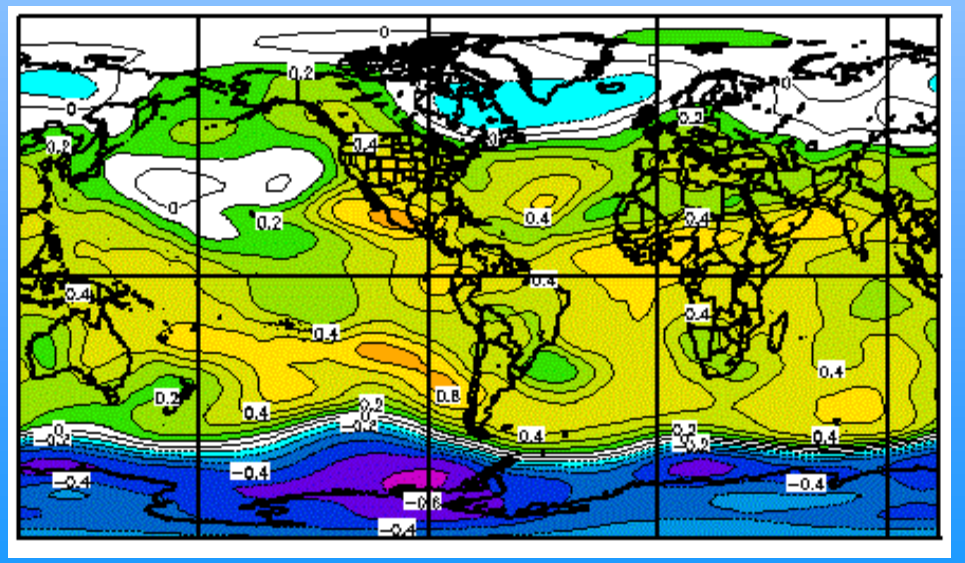
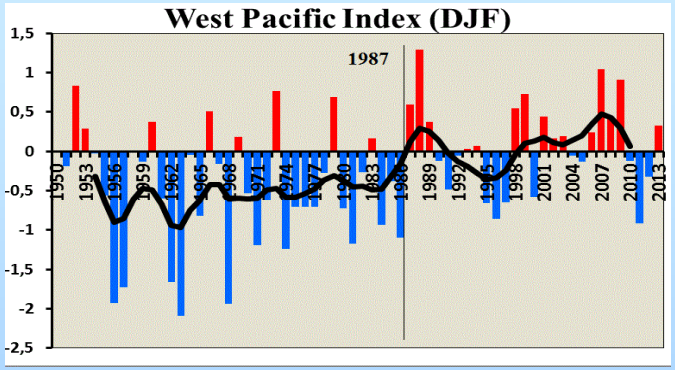
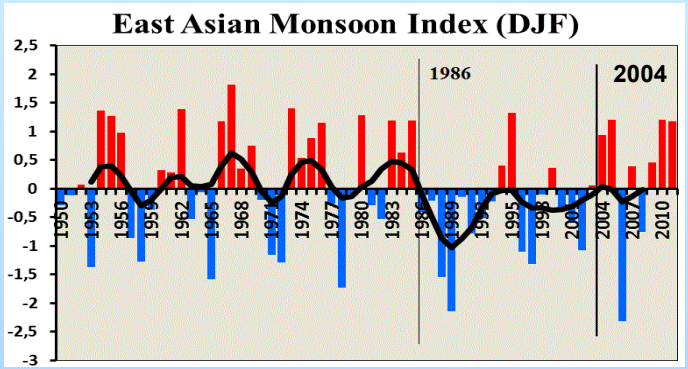
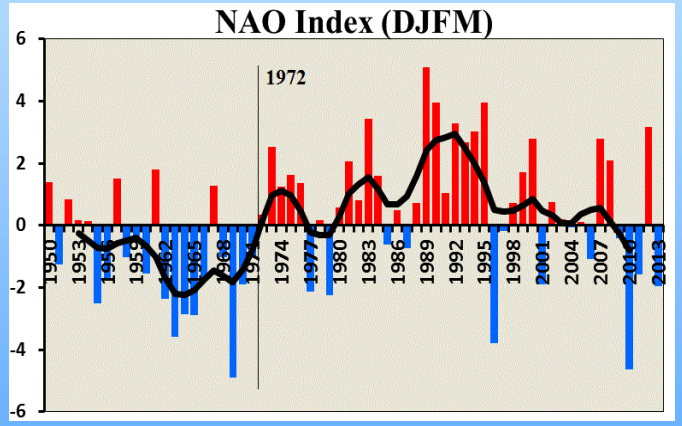


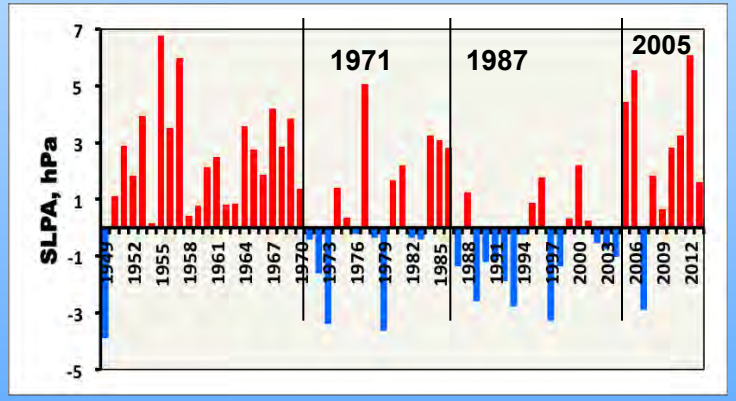
Climatic Indices associated with the NWP area

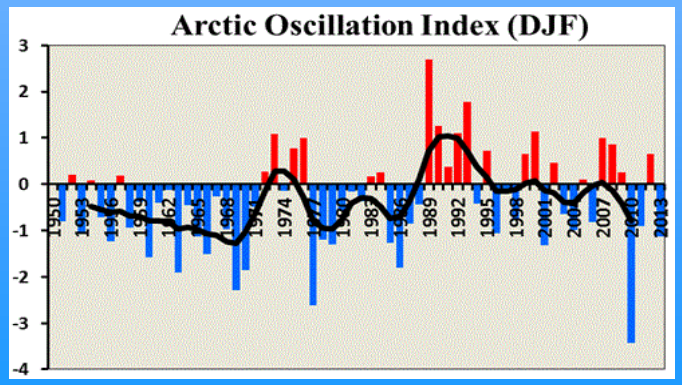






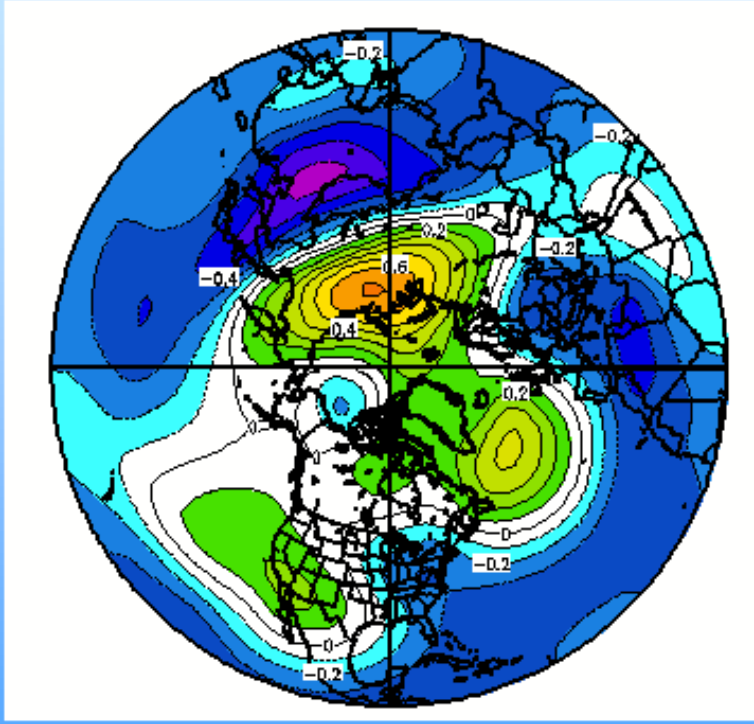
SLPA in Siberian High (Irkutsk)



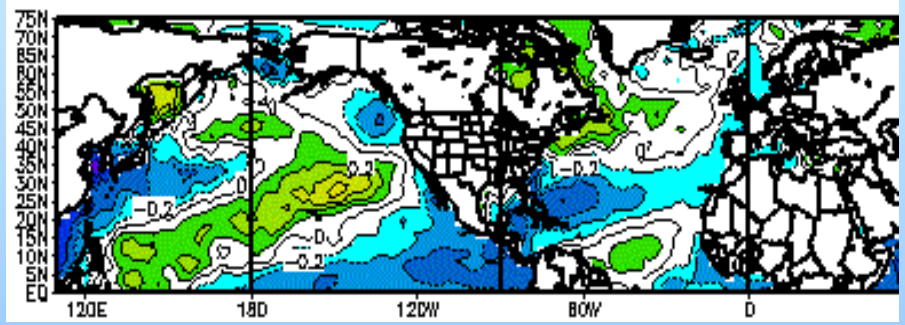


Correlation patterns of SLP (DJF) at Irkutsk station with:

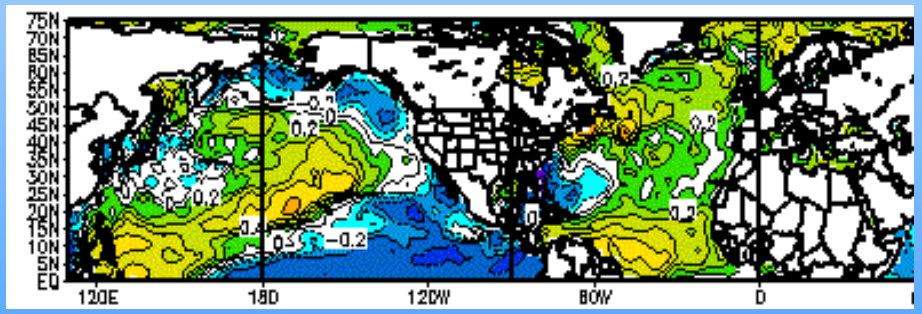
H500, 1951-2012



SST, 1951-2012

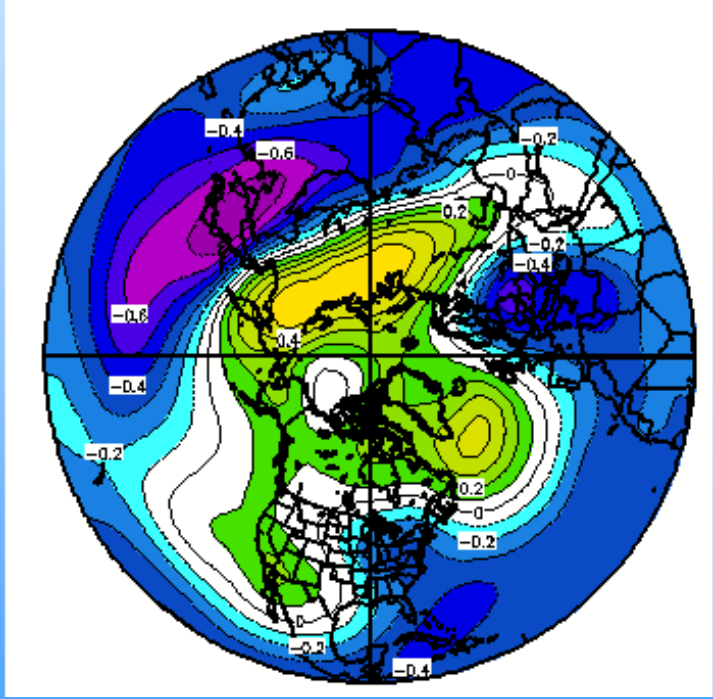


SST, 1987-2012

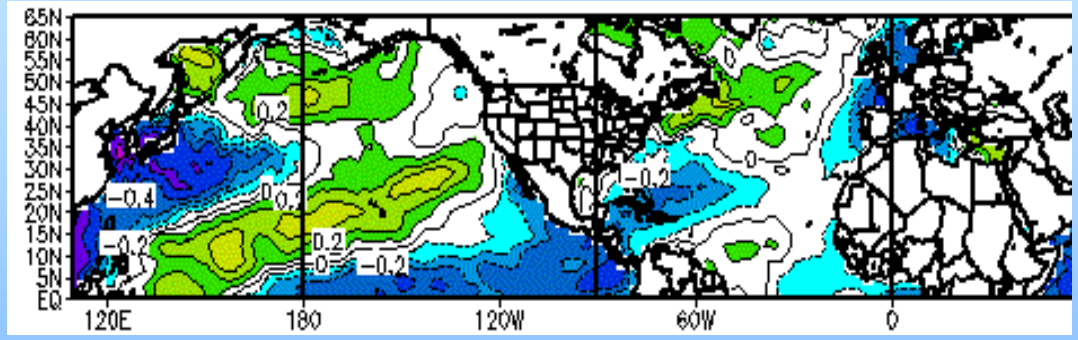


Correlation patterns of East Asian winter (DJF) monsoon index with:

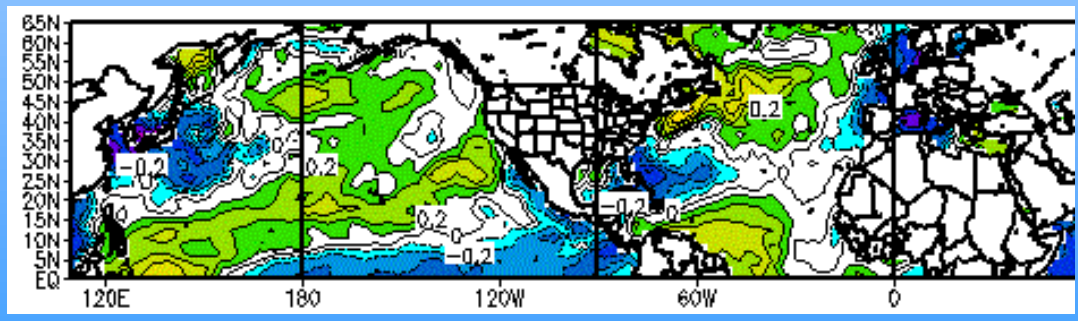
H500, 1951-2012



SST, 1951-2012

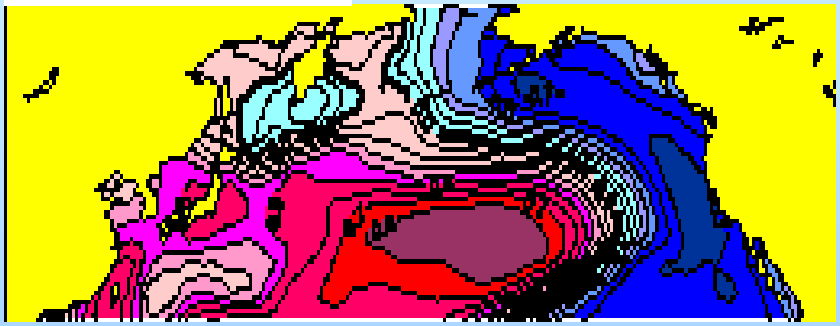


SST, 1987-2012

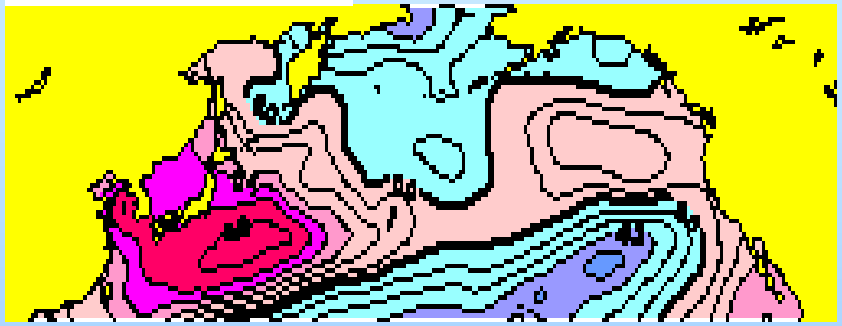


First 5 EOFs (78.2%) of mean winter (I-IV) SSTA field in the NP, 1972-2013

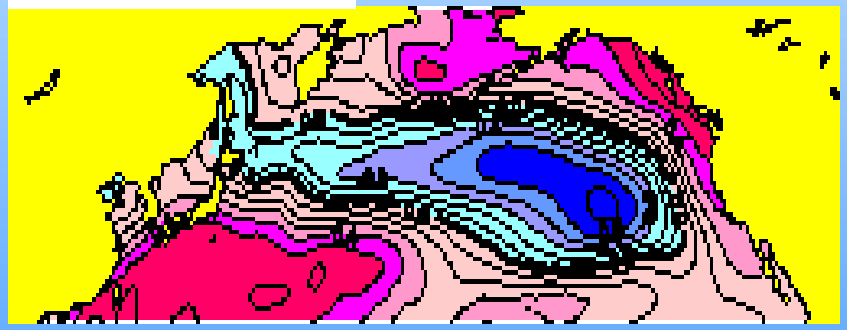
EOF1 (36.8%)



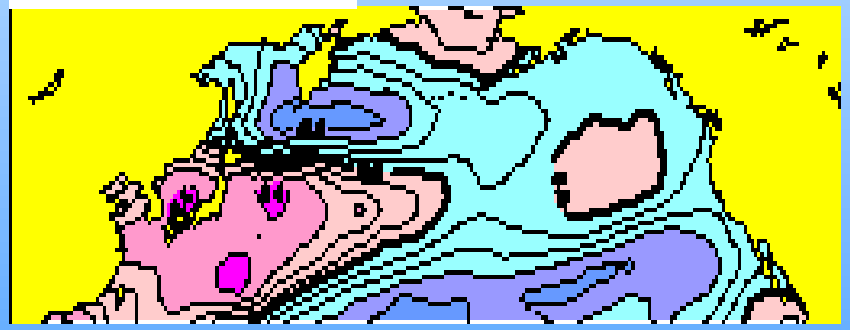
EOF4 (6.6%)



EOF2 (18.1%)

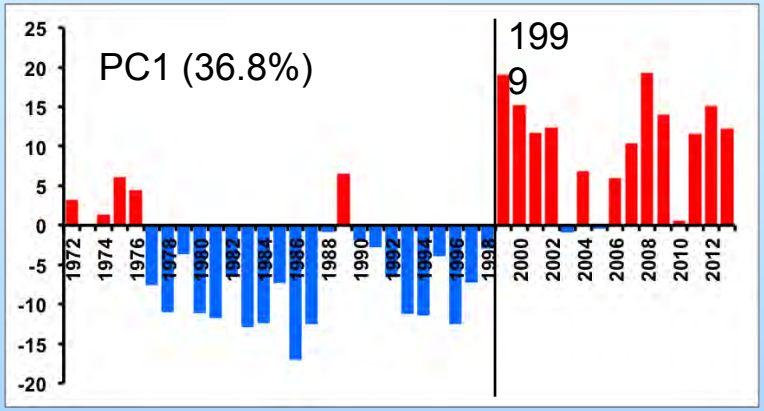


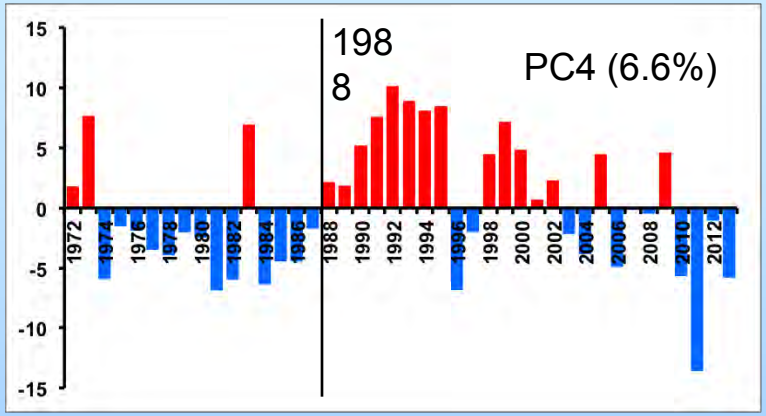
EOF5 (6.0%)

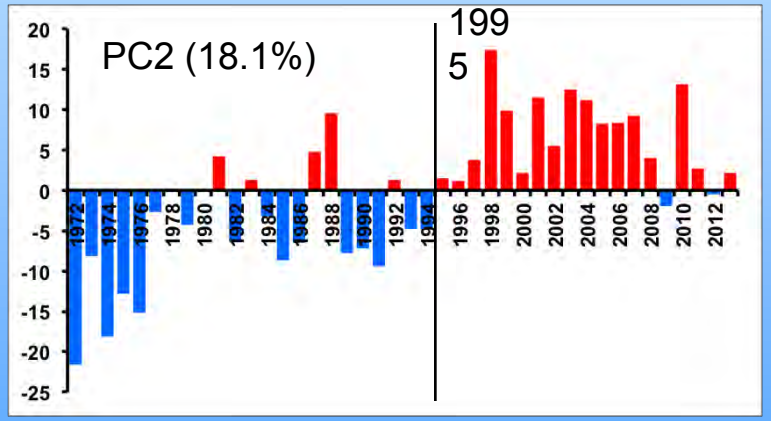


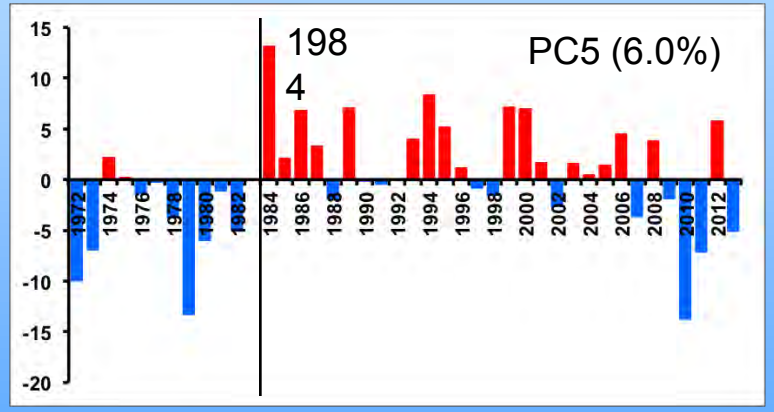
EOF3 (10.7%)

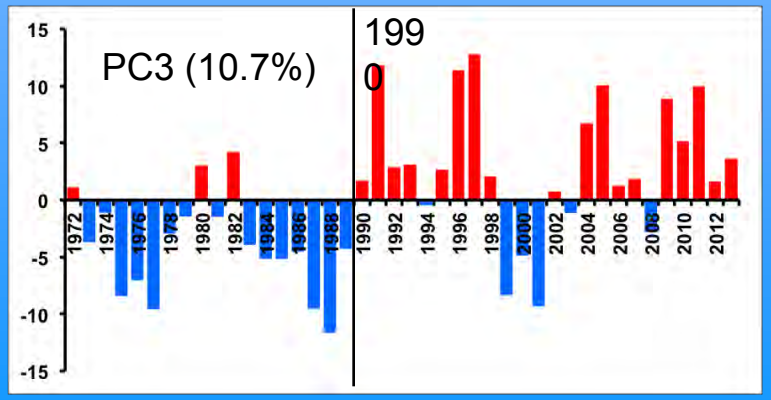
First 5 PCs (78.2%) of mean winter (I-IV) SSTA field in the NP, 1972-2013





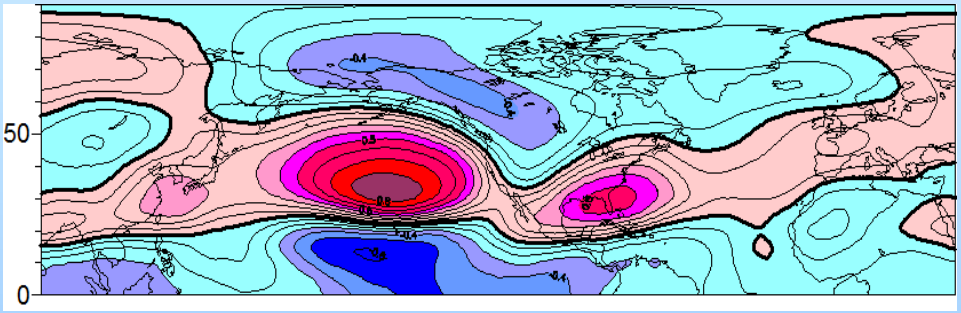




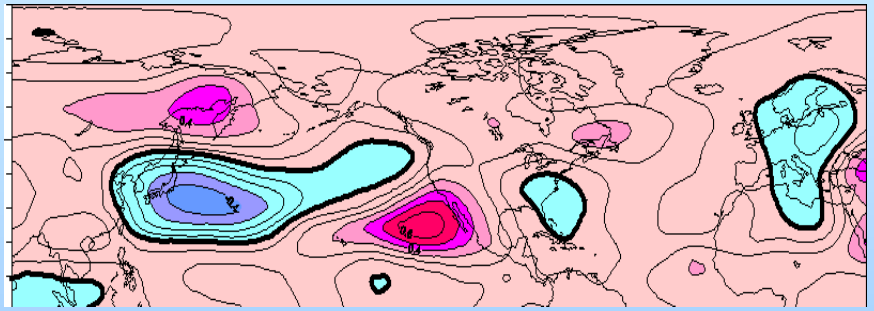


Correlation patterns of the first 5 PCs with H500, 1972-2013

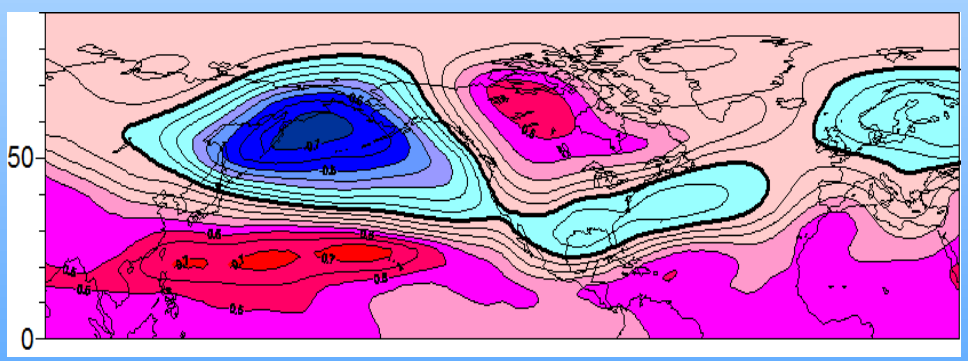
PC1



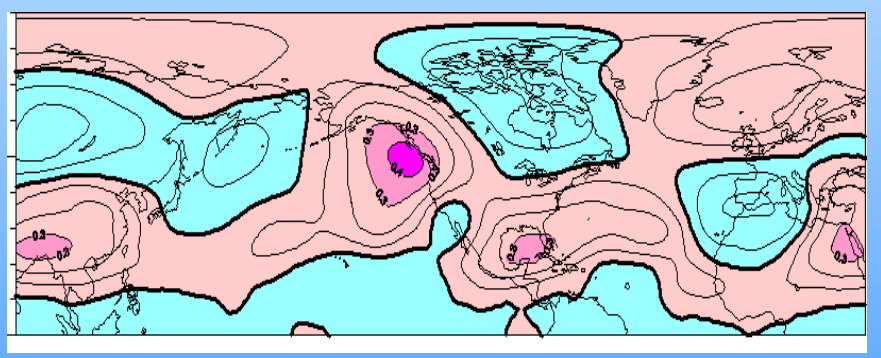
PC4



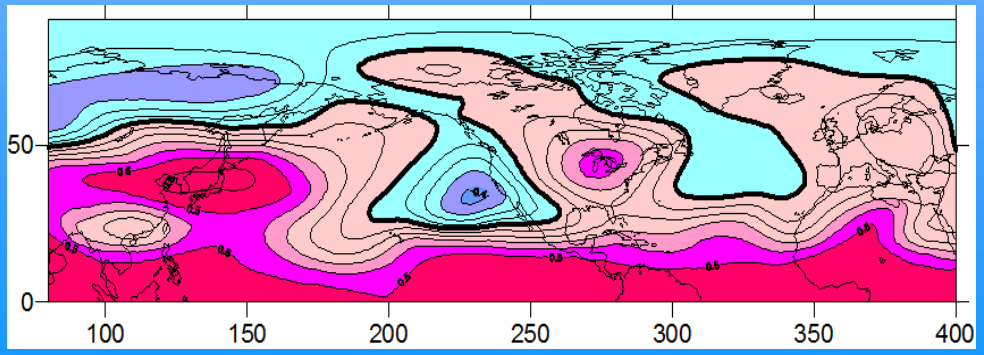
PC2



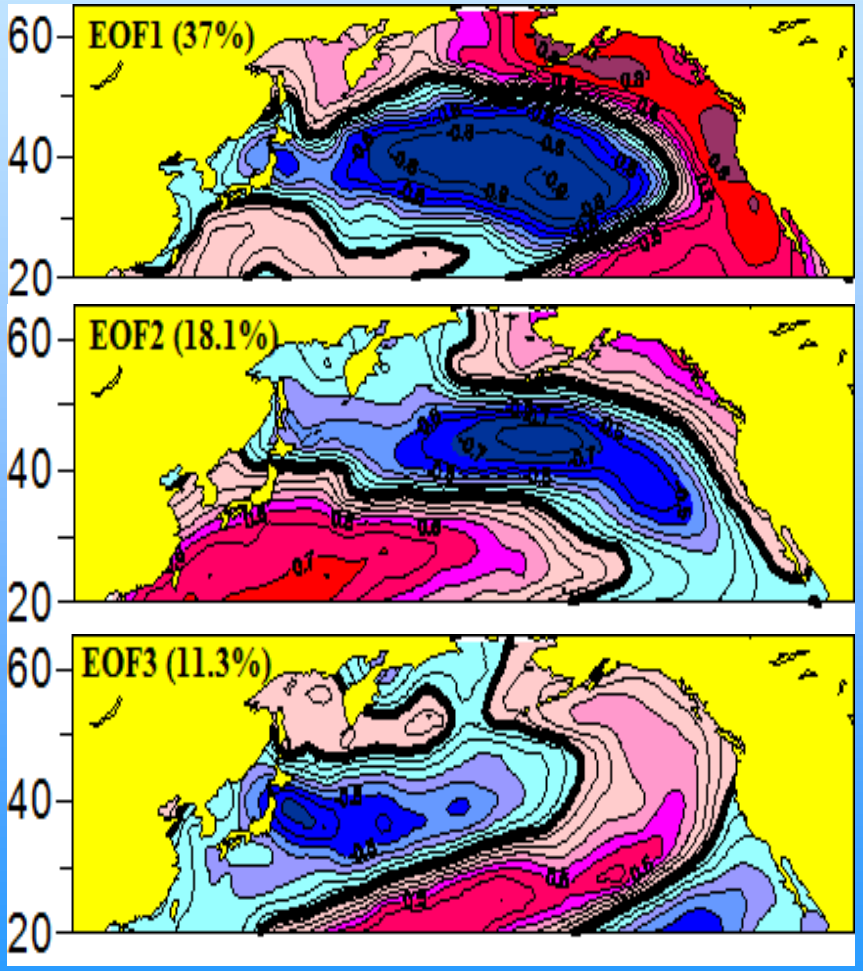
PC5

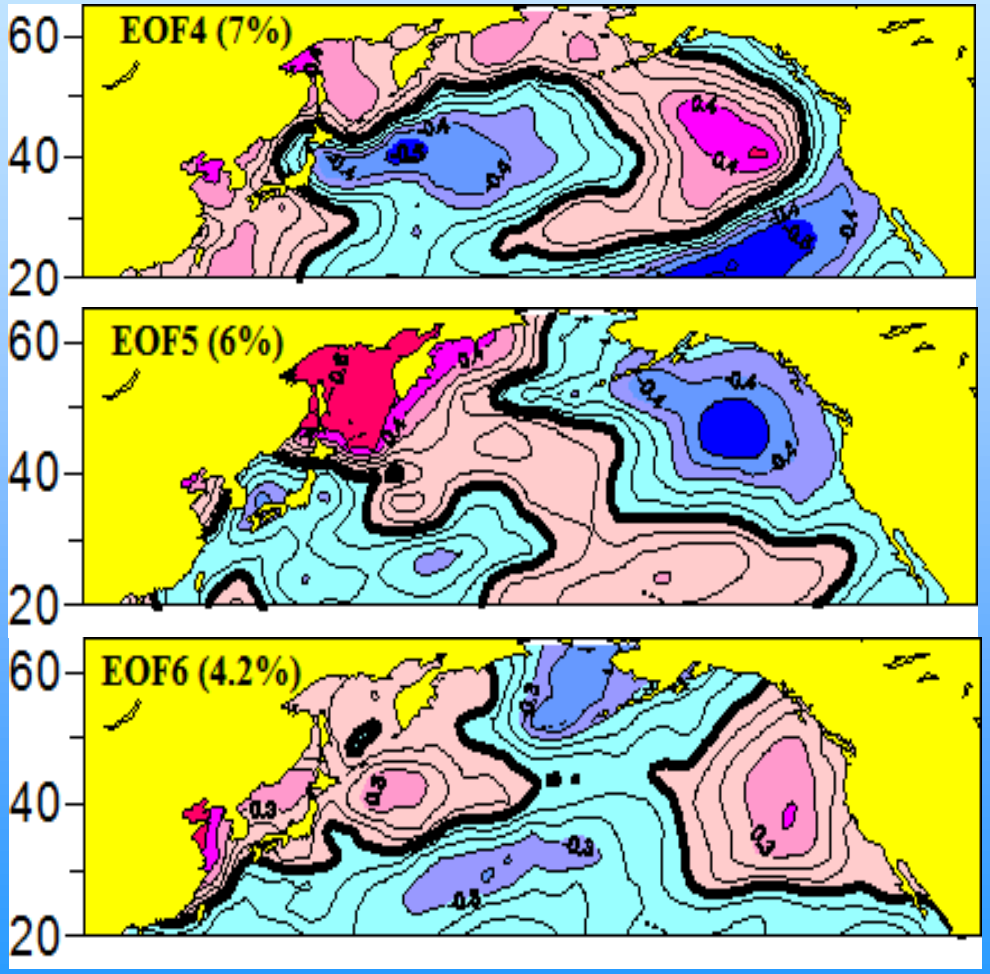


PC3



EOF's of SSTA field (1951-1988)





Loadings of the first six PCs of the 22 climatic time series for 1972-2013

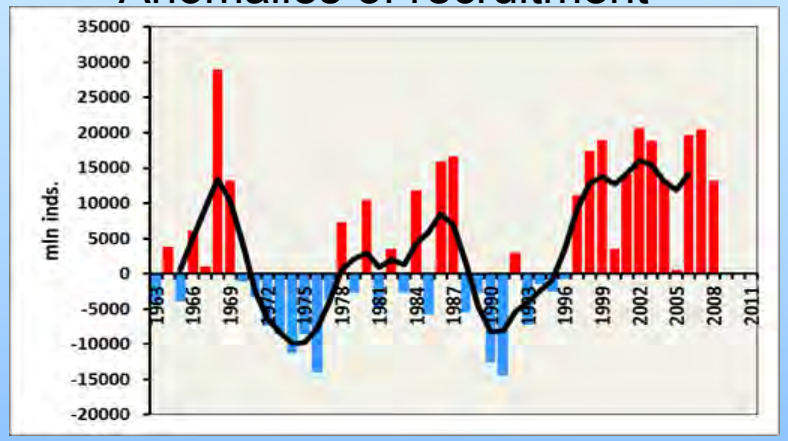
VARIABLE NAME	PC1 31.4%	PC2 20.3%	PC3 11.1%	PC4 10.2%	PC5 7.2%
Scandinavian pattern	0,34	0,04	0,03	**-0,62**	-0,26
Polar/Eurasia pattern	-0,23	-0,05	-0,17	0,31	-0,41
East Atlantic pattern	-0,27	-0,48	0,21	-0,29	0,27
Tropical/NH pattern	-0,30	**0,55**	0,08	-0,15	0,02
North Atlantic Oscillation	-0,50	0,05	-0,34	**0,77**	0,13
Pacific Decadal Oscillation	**0,53**	**-0,76**	0,02	-0,12	-0,18
North Pacific Index	**-0,65**	**0,75**	0,01	-0,01	0,08
Arctic Oscillation	**-0,71**	0,26	-0,14	**0,71**	0,07
West Pacific pattern	-0,40	-0,31	0,24	-0,44	0,48
Winter Monsoon Index	**0,84**	0,39	-0,03	-0,03	-0,05
SLP (Irkutsk)	**0,87**	0,42	-0,05	-0,07	0,02
PC5 (SSTA)	0,09	0,02	**0,67**	-0,29	-0,11
PC3 (SSTA)	**-0,54**	-0,33	0,37	-0,10	0,07
PC4 (SSTA)	0,35	0,16	**0,67**	0,27	0,14
PC2 (SSTA)	0,04	-0,51	0,05	-0,25	**0,79**
PC1 (SSTA)	-0,42	**0,63**	0,04	-0,06	**0,63**
PC1 (SLPA)	**-0,58**	**0,79**	0,02	-0,04	0,08
PC2 (SLPA)	**0,56**	0,11	0,02	0,18	**-0,56**
PC3 (SLPA)	0,35	0,45	0,10	-0,12	0,14
PC4 (SLPA)	0,13	0,23	-0,07	0,27	0,21
PC5 (SLPA)	0,19	0,46	0,27	0,20	0,30
PC6(SLPA)	**0,82**	0,03	0,22	-0,11	-0,04

Loadings of the first six PCs of the 21 climatic time series for 1951-1988

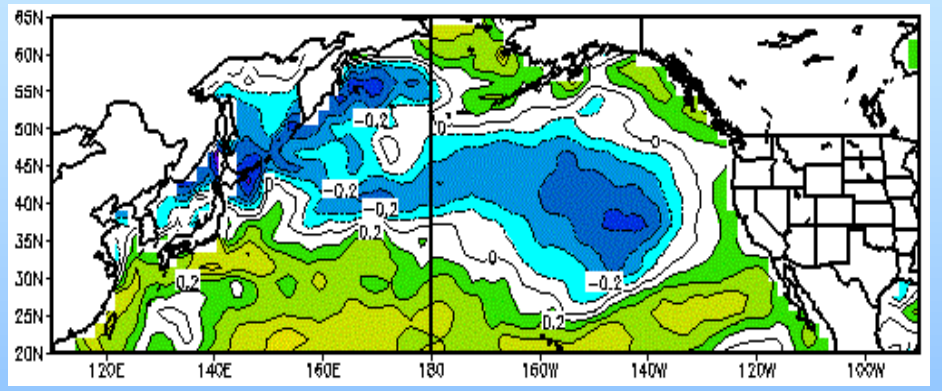
VARIABLE NAME	PC1 33.7%	PC2 23.9%	PC3 10.2%	PC4 9.3%	PC5 8.4%	PC6 4.9%
East Atlantic pattern	-0,05	**-0,55**	0,07	-0,07	-0,36	-0,31
Tropical/NH pattern	0,02	0,01	-0,26	**-0,67**	-0,42	0,27
North Atlantic Oscillation	0,26	-0,18	**-0,81**	0,13	-0,21	0,37
Pacific Decadal Oscillation	**0,71**	**-0,66**	0,10	0,10	-0,39	-0,10
North Pacific Index	**-0,89**	0,45	-0,03	-0,03	0,05	0,05
Arctic Oscillation	-0,14	0,08	**-0,86**	-0,10	-0,07	0,41
West Pacific pattern	-0,27	**-0,64**	0,07	0,18	**-0,55**	-0,25
Winter Monsoon Index	**0,62**	**0,68**	0,04	-0,01	0,09	0,05
SLP (Irkutsk)	**0,68**	**0,70**	0,08	0,03	0,09	0,11
PC6 (SSTA)	0,09	-0,07	-0,30	-0,39	**0,70**	0,01
PC5 (SSTA)	0,25	0,40	-0,46	0,42	0,12	**-0,52**
PC3 (SSTA)	-0,07	-0,21	-0,41	**-0,74**	-0,48	-0,17
PC4 (SSTA)	0,10	0,16	-0,30	**-0,81**	**-0,50**	-0,23
PC2 (SSTA)	-0,11	**-0,57**	0,05	0,14	-0,35	-0,33
PC1 (SSTA)	**0,70**	**-0,69**	0,15	0,14	-0,24	-0,10
PC1 (SLPA)	**-0,85**	**0,51**	-0,03	-0,11	0,06	0,08
PC2 (SLPA)	0,38	0,48	0,01	0,08	**0,58**	0,21
PC3 (SLPA)	0,33	0,31	0,10	**-0,59**	-0,21	0,25
PC4 (SLPA)	-0,16	0,35	0,08	-0,02	0,10	0,38
PC5 (SLPA)	0,29	0,45	-0,40	-0,13	0,12	-0,25
PC6(SLPA)	0,33	0,44	0,38	0,21	0,17	-0,09

Association of East Kamchatka pollock recruitment (2+) with winter SSTA field in the NP and Arctic Oscillation Index

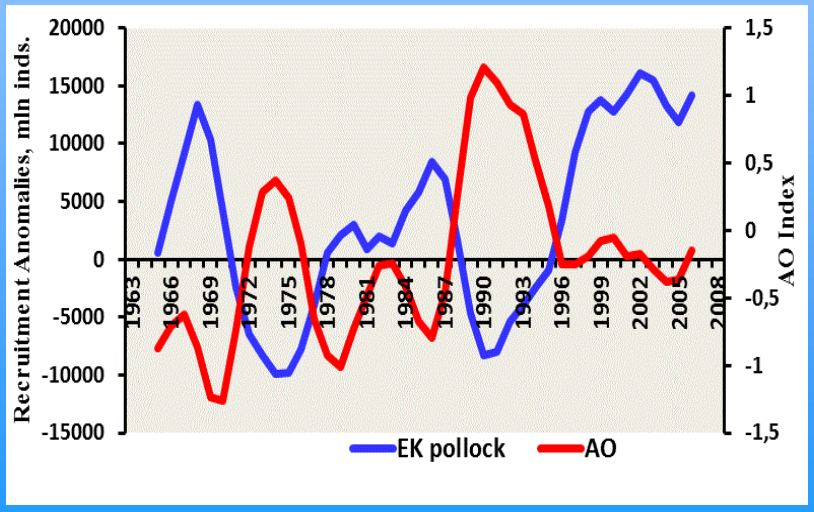
Anomalies of recruitment



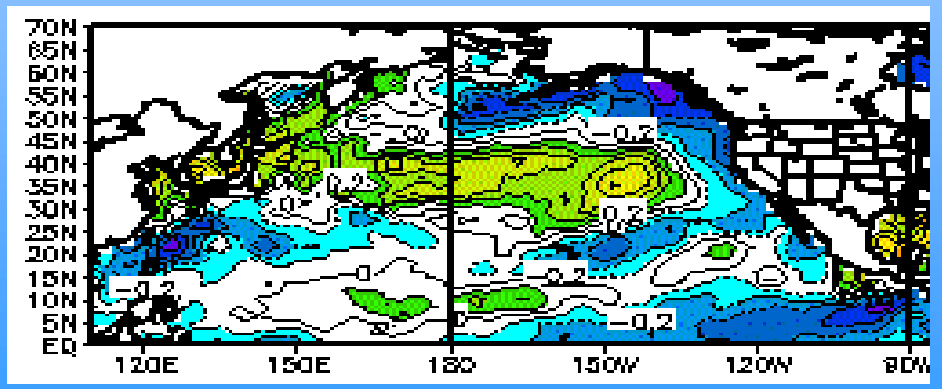
Recruitment and SST



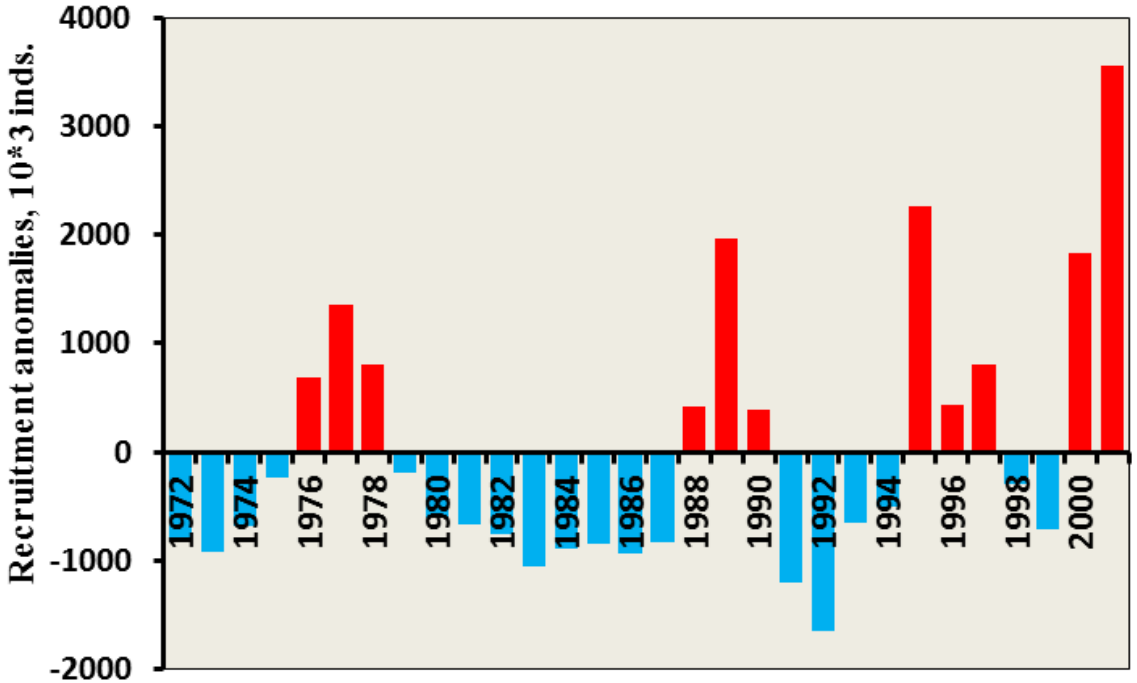
Recruitment and AO index

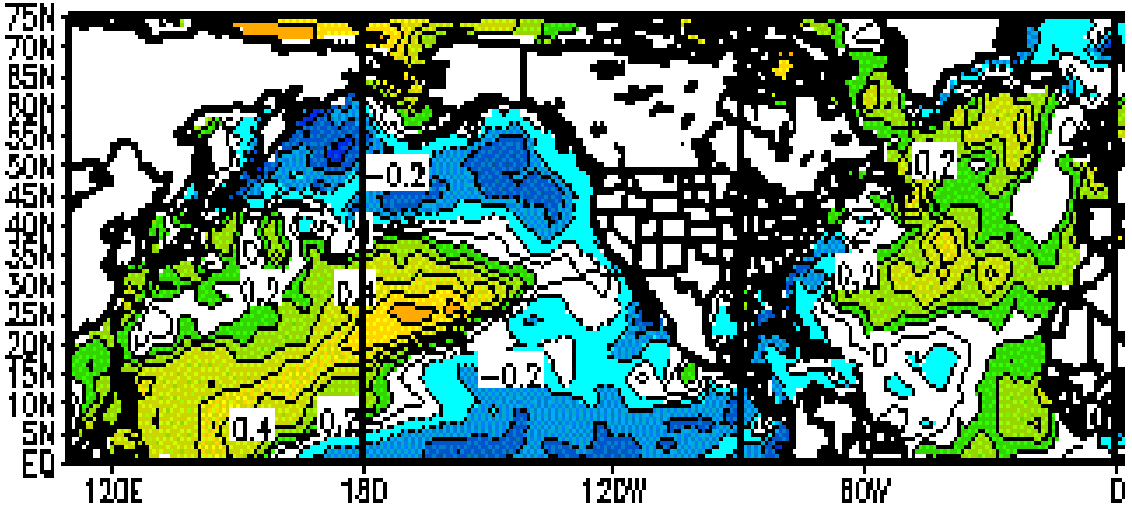


Association of AO index with SST

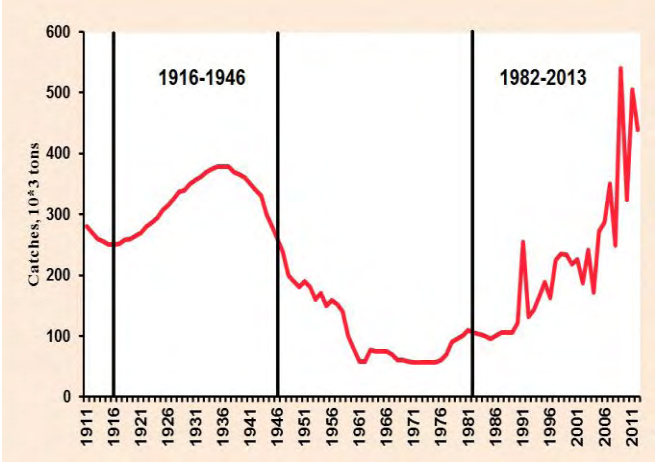


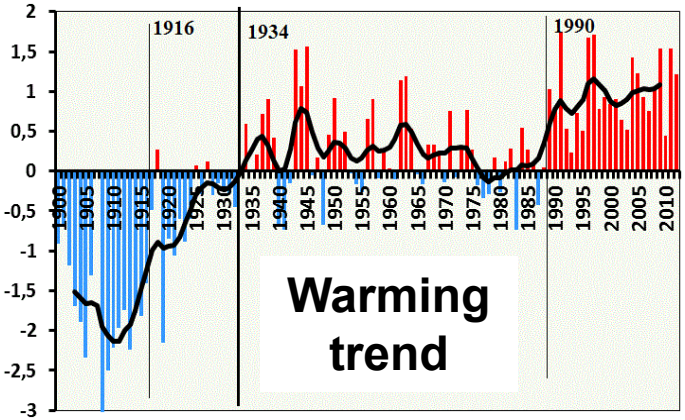
Association of West Kamchatka pollock recruitment (3+) with winter SSTA field in the NH

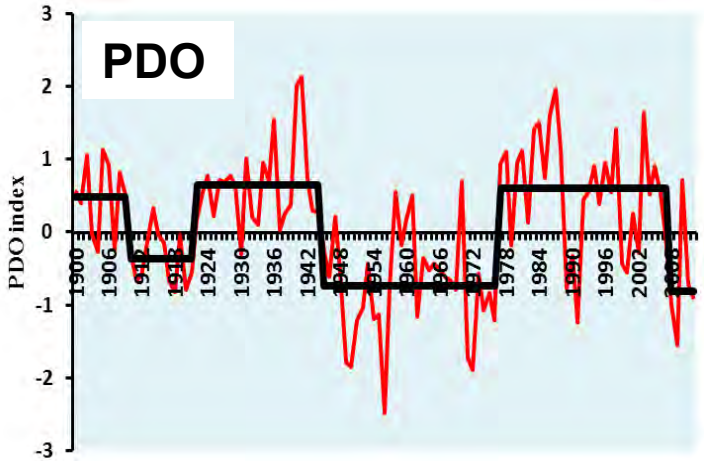




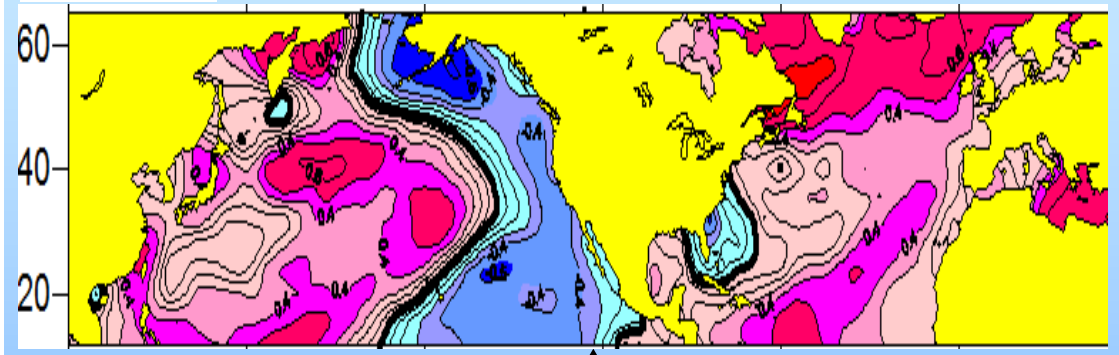
Two periods of high salmon production in Russia and their association with winter SSTA in the NP





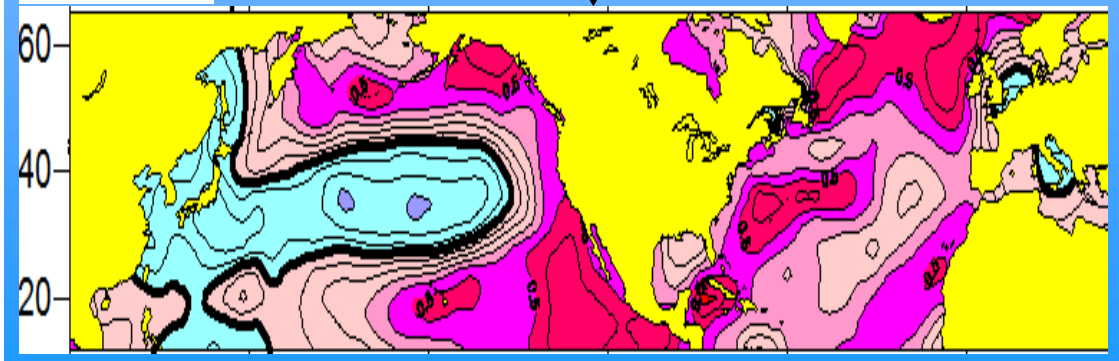


1982-2012

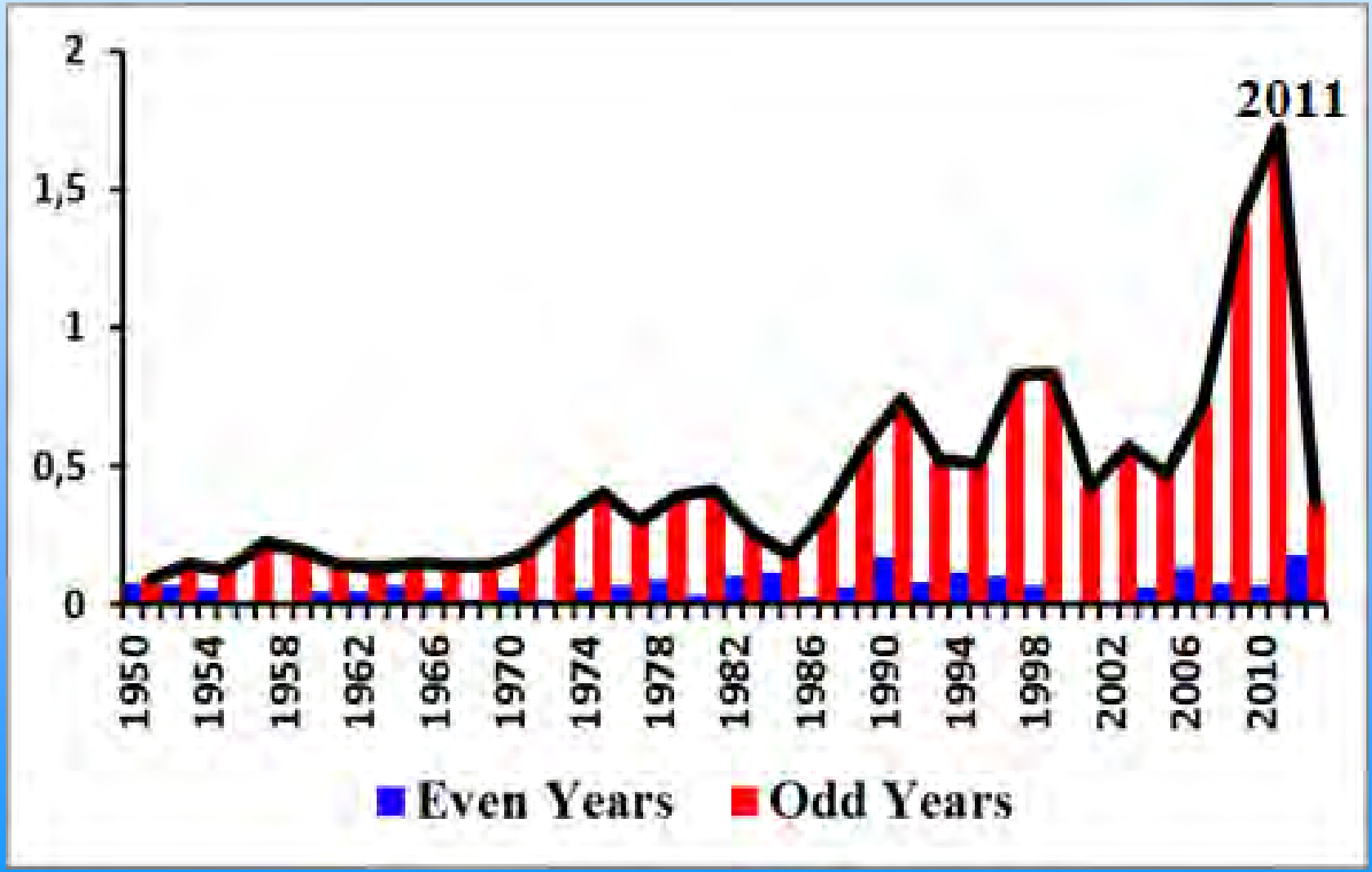


Correlation patterns between salmon catches and mean winter SSTA field for two high salmon periods

1916-1946



Pink salmon catches (10*5 tons) in the western Bering Sea



Conclusion

- **Warming trend in the North Pacific may be associated with the inter-hemispheric climatic processes;**
- **The recent period of prominent warming in the ocean resulted from strengthening of positive phases of the AO and NAO, accompanied by essential weakening of the Siberian High and winter East Asian monsoon. This weakening may be the main contributor to the warming process, first of all, in the western half of the ocean.**


Thank you for attention