Comparison of decadal and interdecadal dynamics of mass pelagic fish stocks in the North Atlantic and North Pacific in relation to climate variations in the Northern Hemisphere

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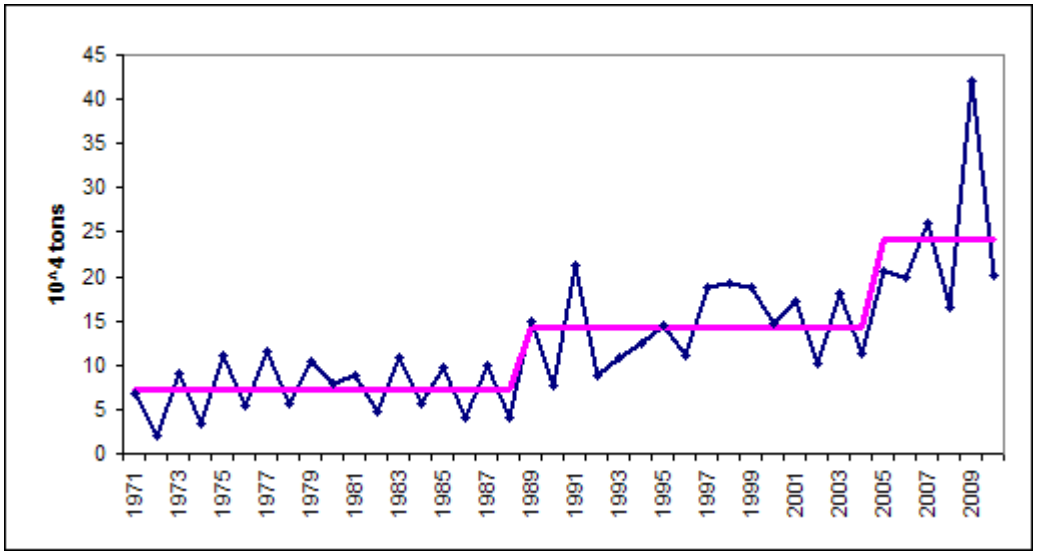
OUTLINES

- **Consider changes in the state of pelagic fish stocks in the Northwest Pacific and Northeast Atlantic during the last 40-50 years**
- **Relationships between changes in fish stocks and climatic variables and SSTA field in the NH**
- **Correspondence between correlation patterns and actual large-scale climatic patterns in the NH**
- **Conclusions**

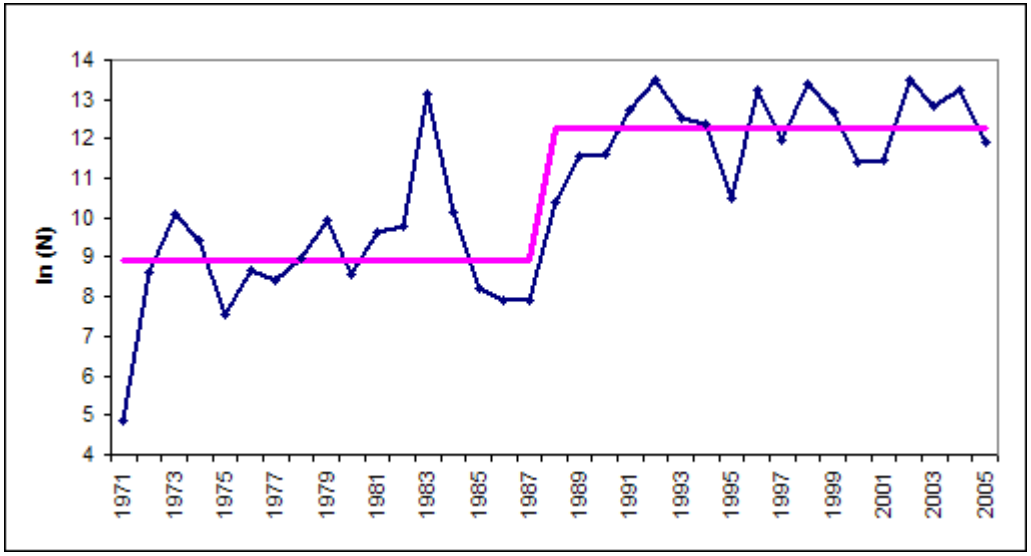
DATA

- **ERSST v. 3b (http://www.cdc.noaa.gov/cdc/data.noaa.ersst.html)**
- **H500 (NCEP/NCAR Reanalysis,*http://www.esrl.noaa.gov/psd/*)**
- **Climatic Indices (NAO, PDO,AMO, etc.)**
- **Far East Salmon Catches (NPAFC Reports, 2007-2010; Dynamics…, 1989)**
- **Biological Parameters of NE Atlantic fish stocks (catch in numbers-at-age, recruitment, SSB) (Reports of ICES WGs, 2002-2010)**

Total Russian catches of pink salmon and total NSS herring catch in numbers – at age 4

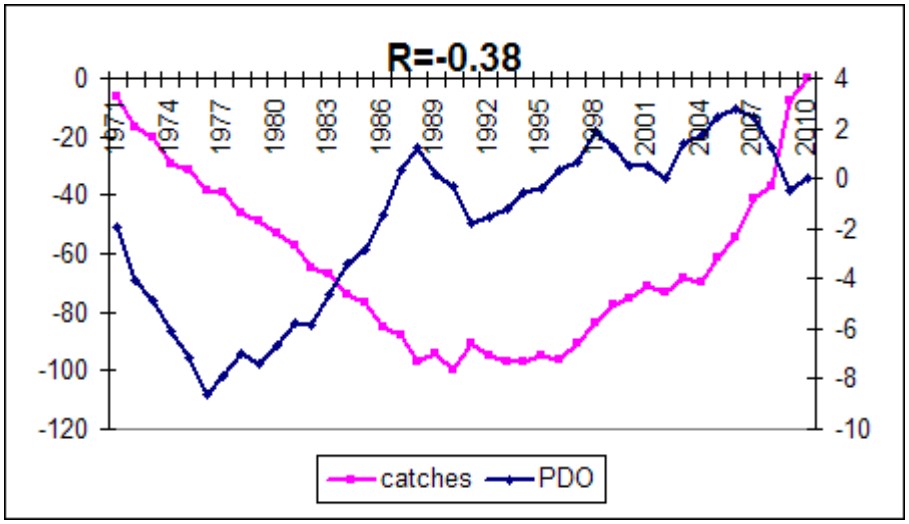


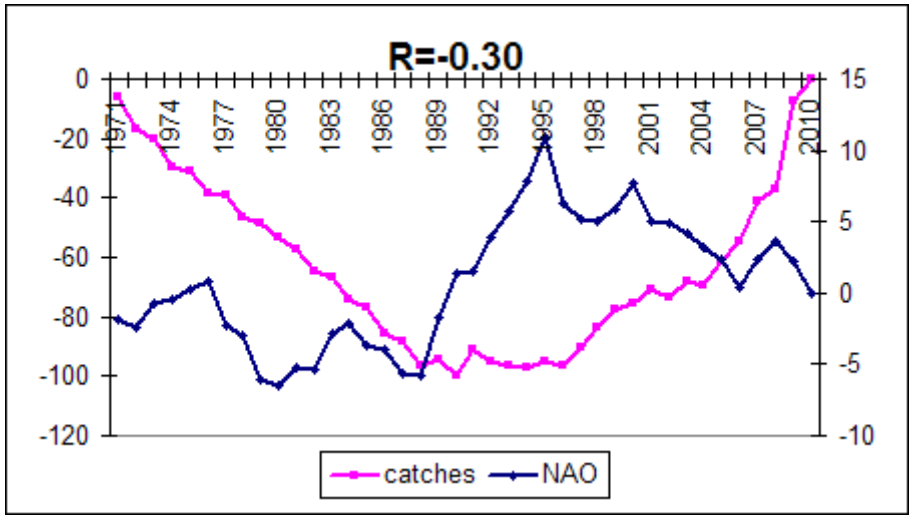
Pink salmon

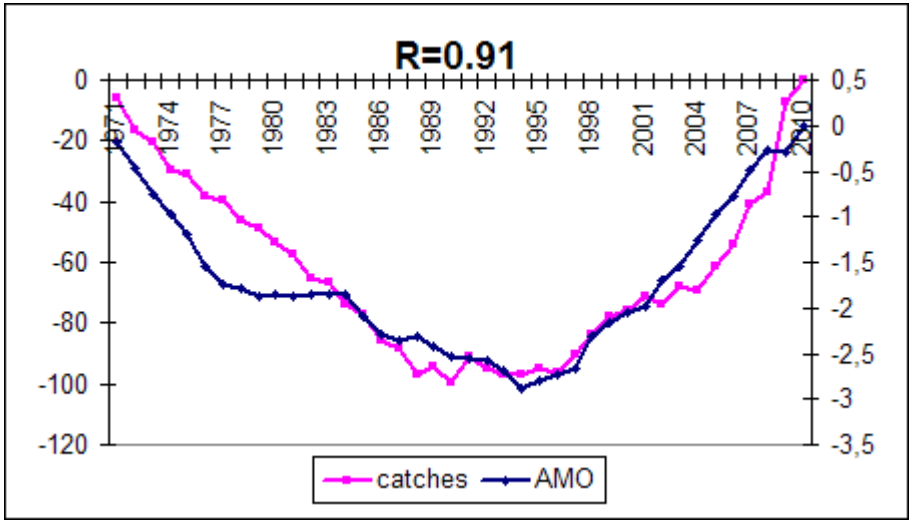


Herring

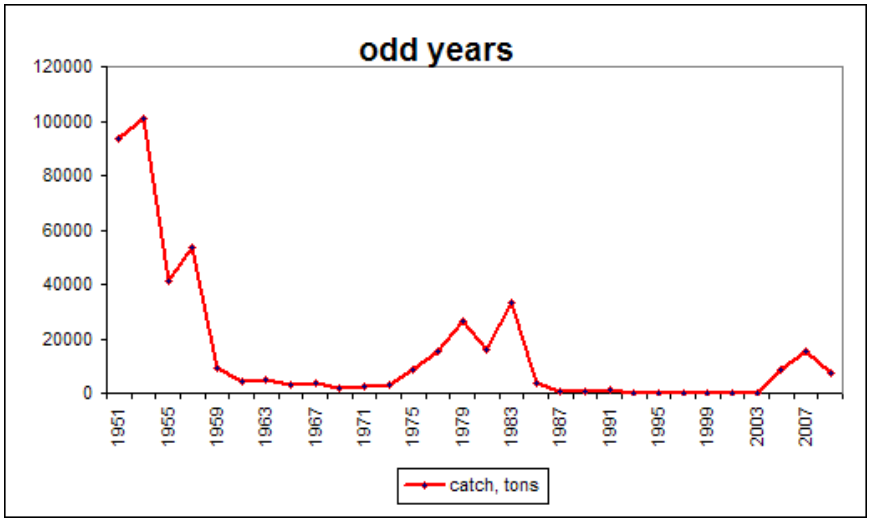
CS of anomalies of total pink salmon catch and climatic indices

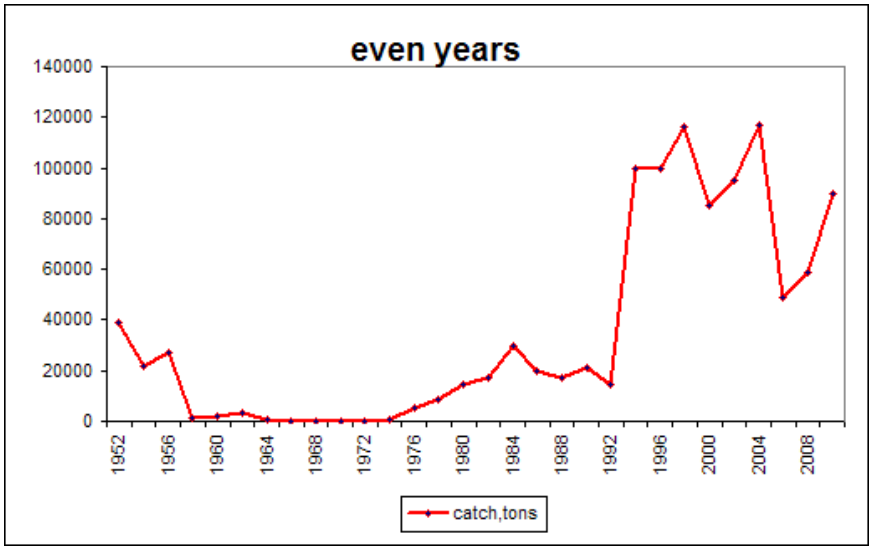




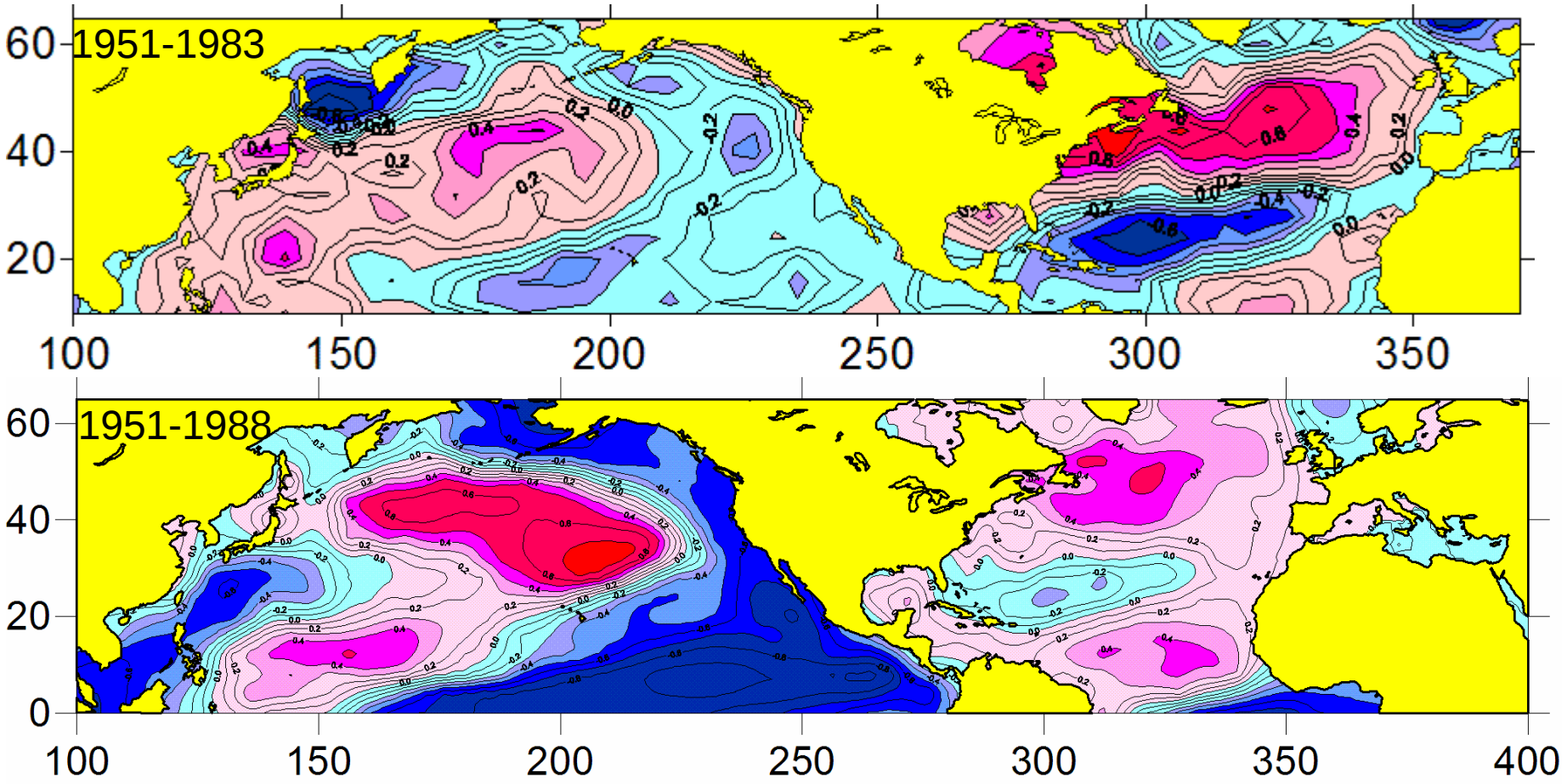


Total Russian catches of West Kamchatka pink salmon

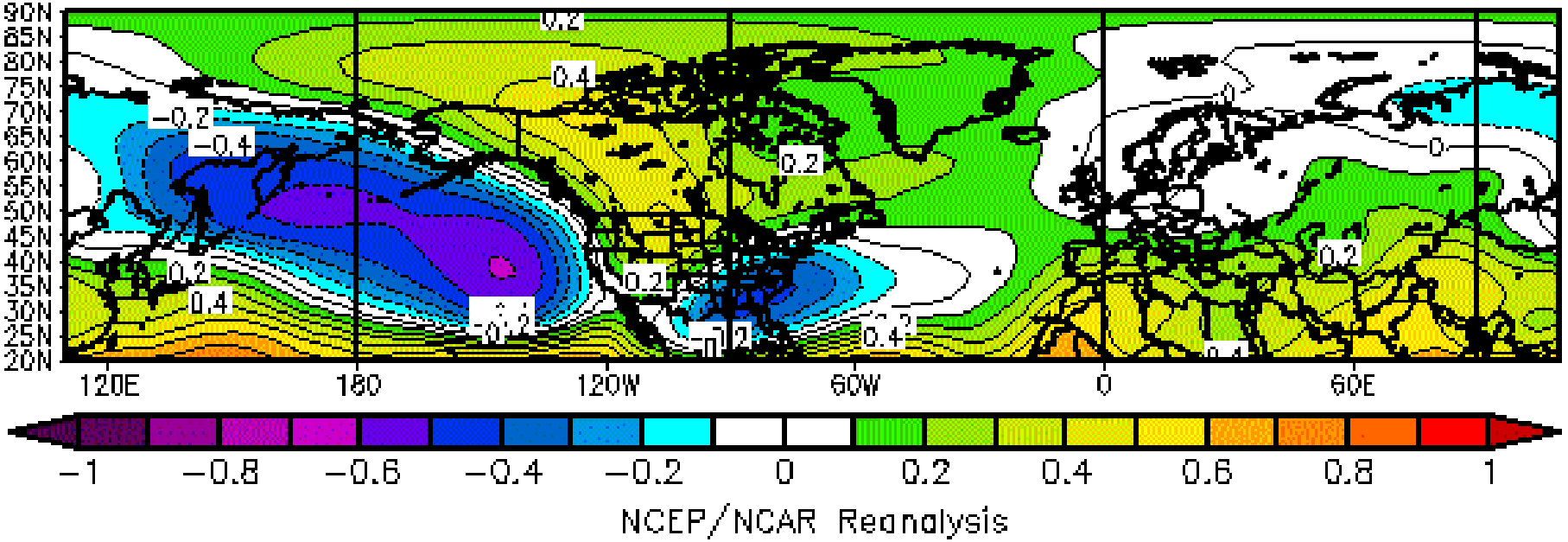




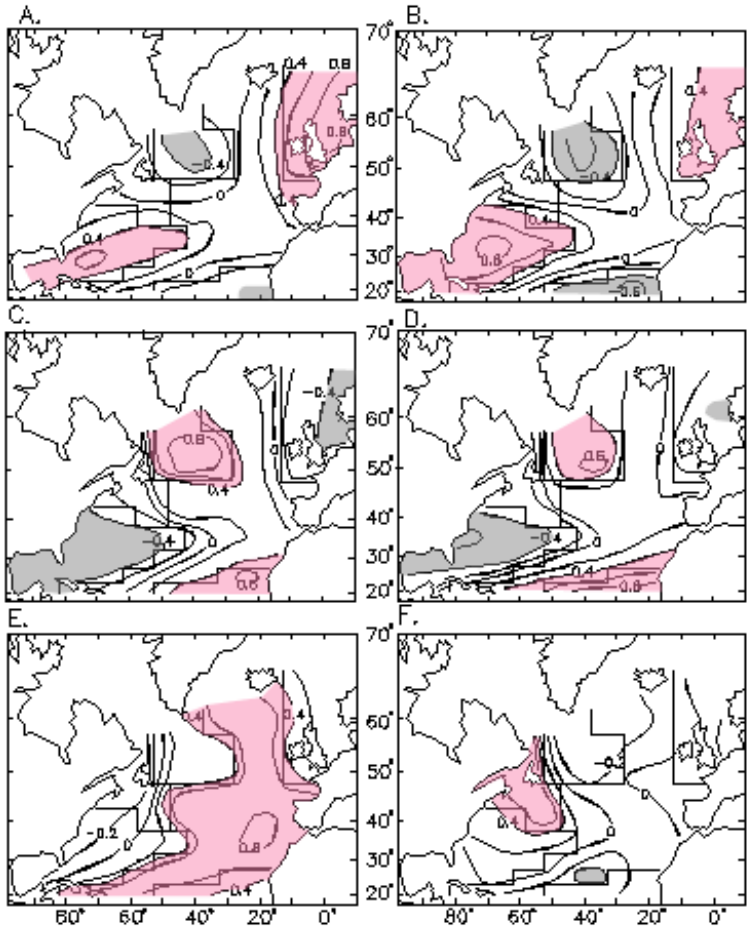
Correlation patterns: 1) between WK pink salmon catch (odd years) and NH SSTA; 2) combined for the 1st SVD mode of SSTA with reversed sign (59.8%)

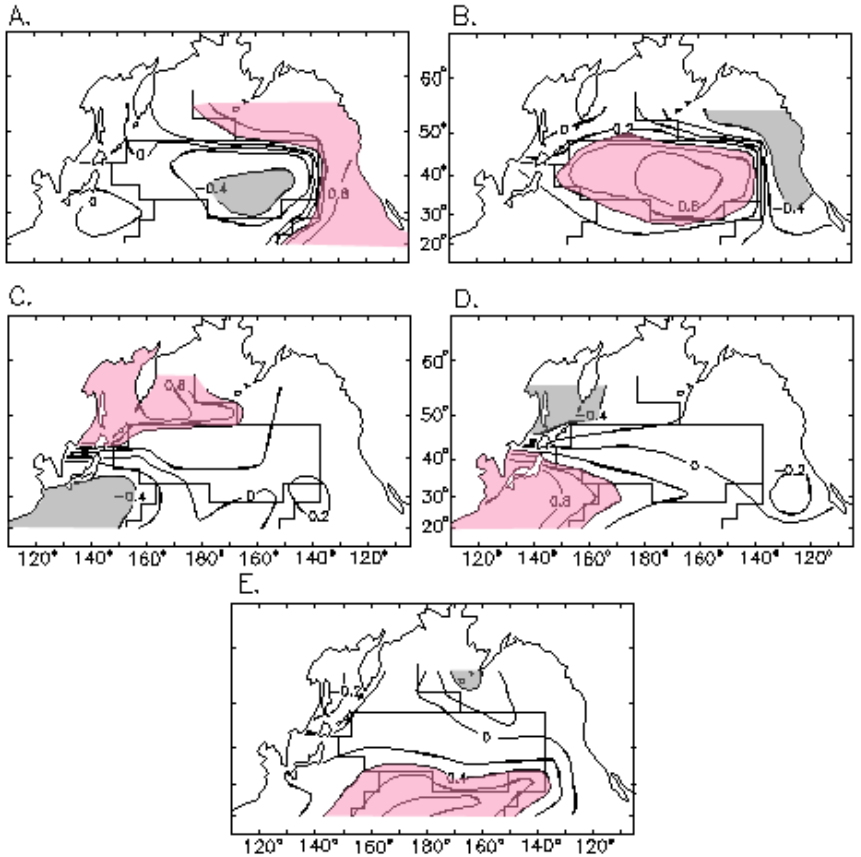


Correlation pattern between the 1st SVD for NP SSTA and mean winter H_{500} anomalies (1951-1988)



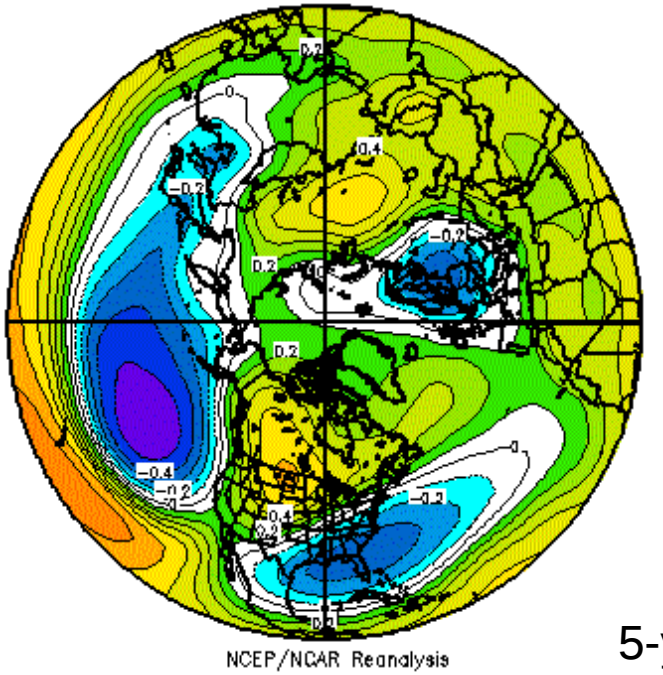
Results of cluster analysis of the NA and NP SSTA (1957-1991)





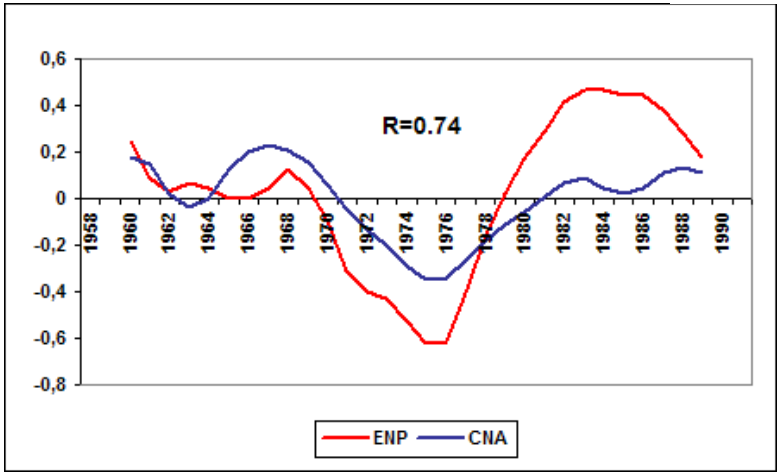
(Krovnin, 1995)

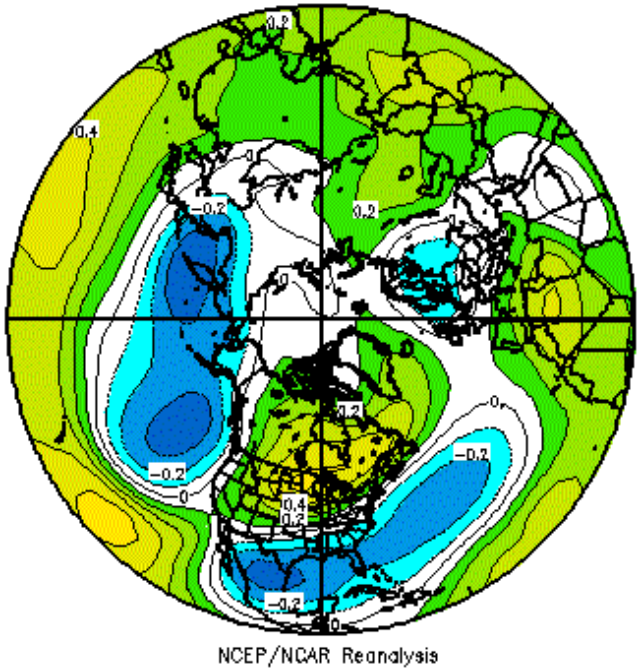
Association between eastern NP and central NA (1958-1991)



Correlation:
Eastern NP (region 1P)
to H500

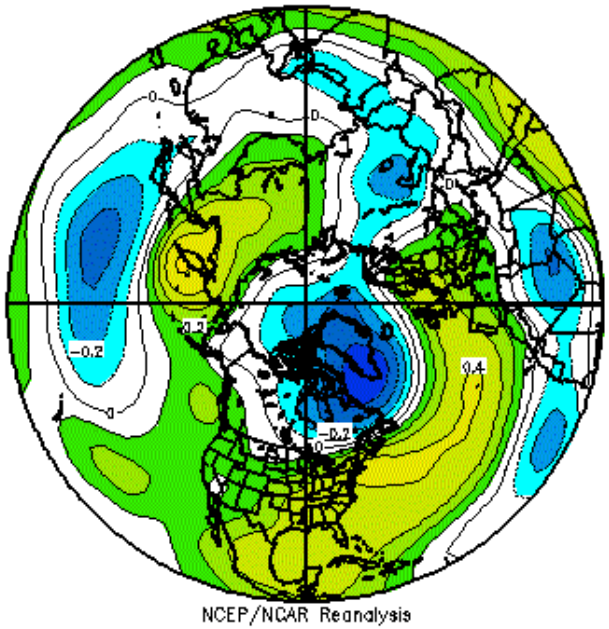
5-yr running SSTA means





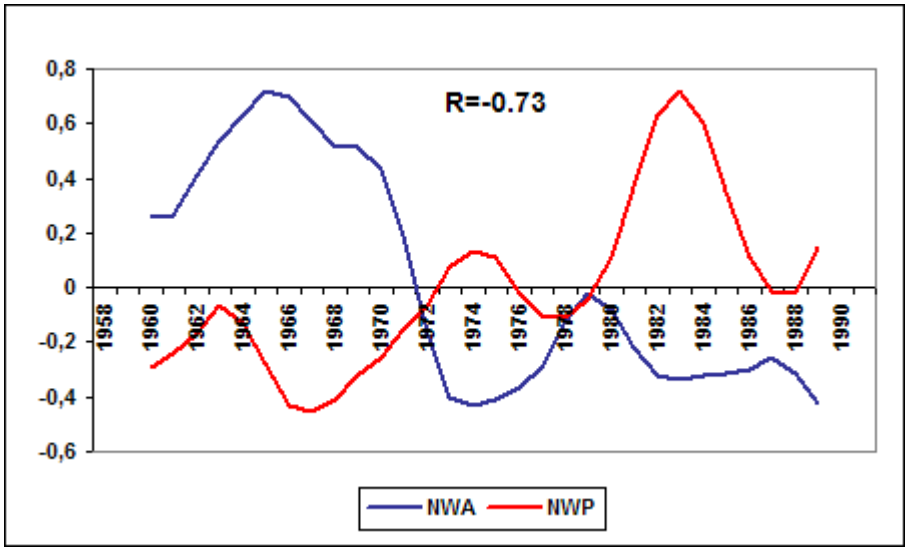
Correlation:
Central NA(region 5A)
to H500

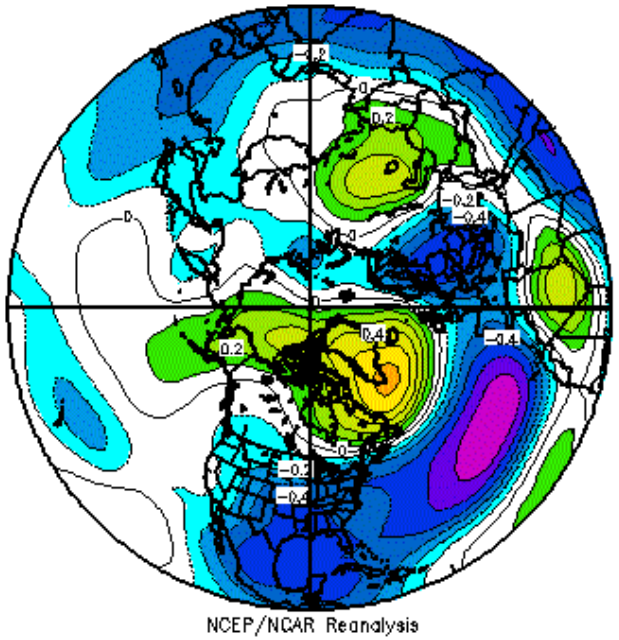
Association between eastern NWP and NWA (1958-1991)



Correlation:
NWP (region 3P)
to H500

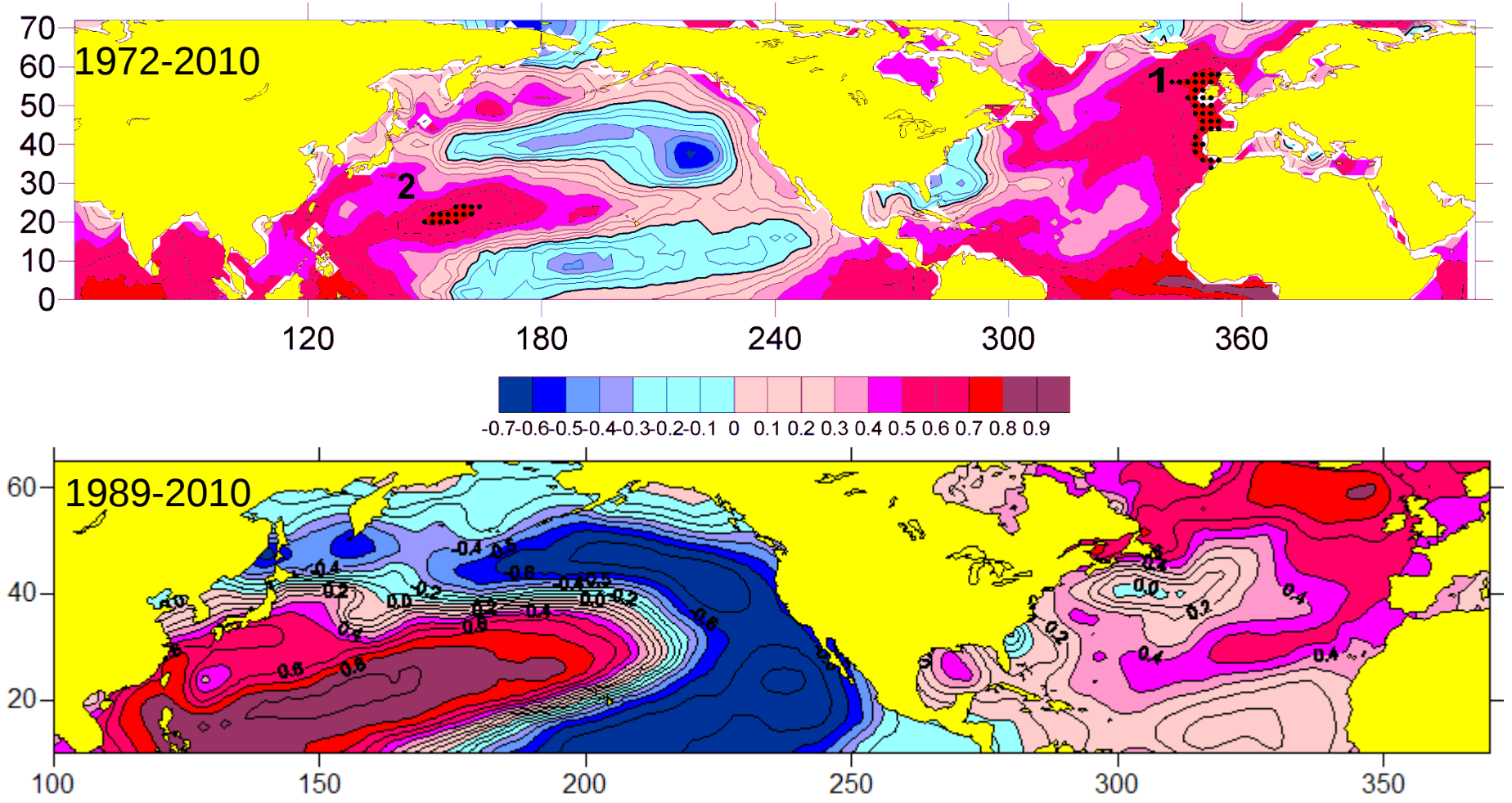
5-yr running SSTA means



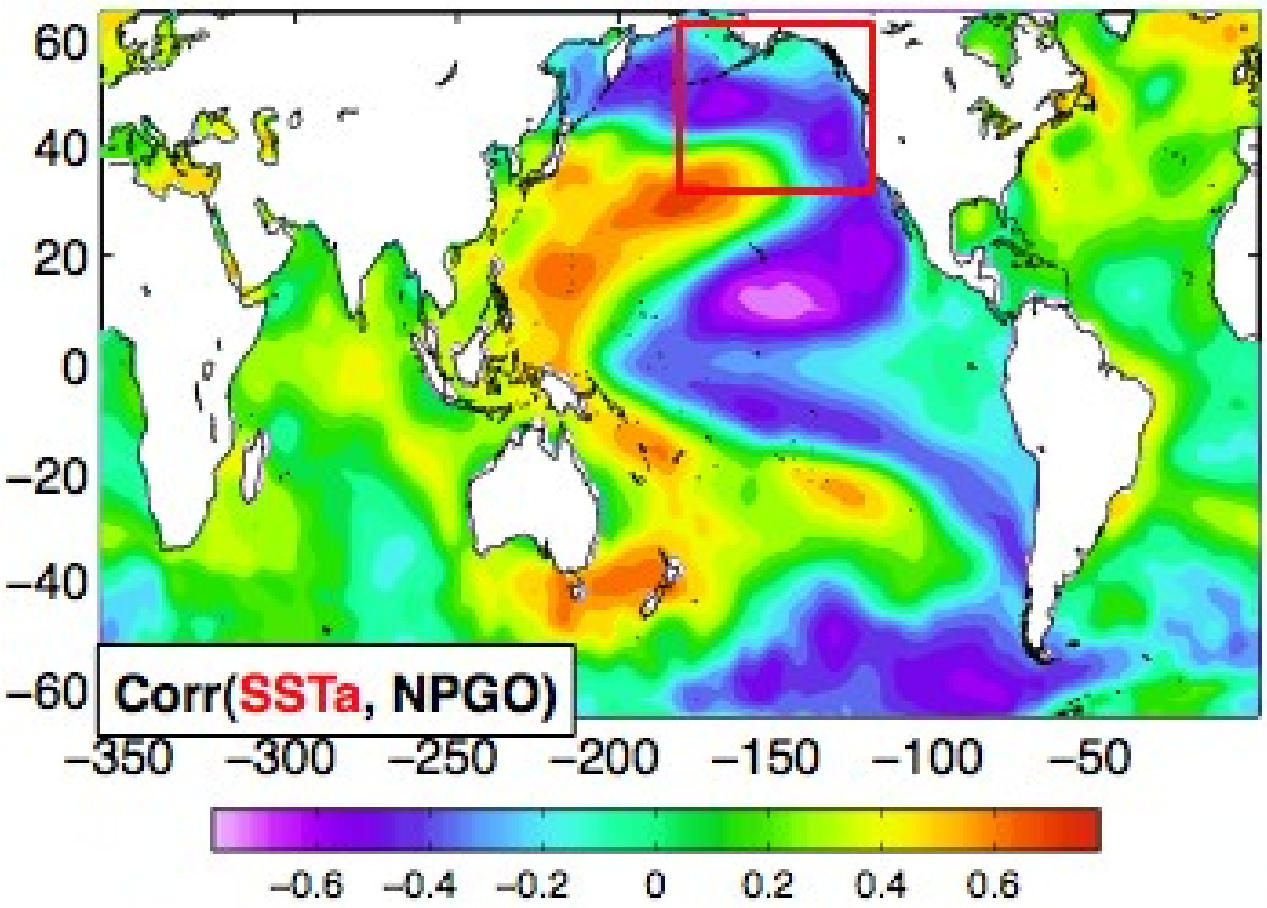


Correlation:
NWA (region 3A)
to H500

Correlation patterns: 1) between WK pink salmon catch (even years) and NH SSTA; 2) combined for the 1st SVD mode of SSTA (53.2%)

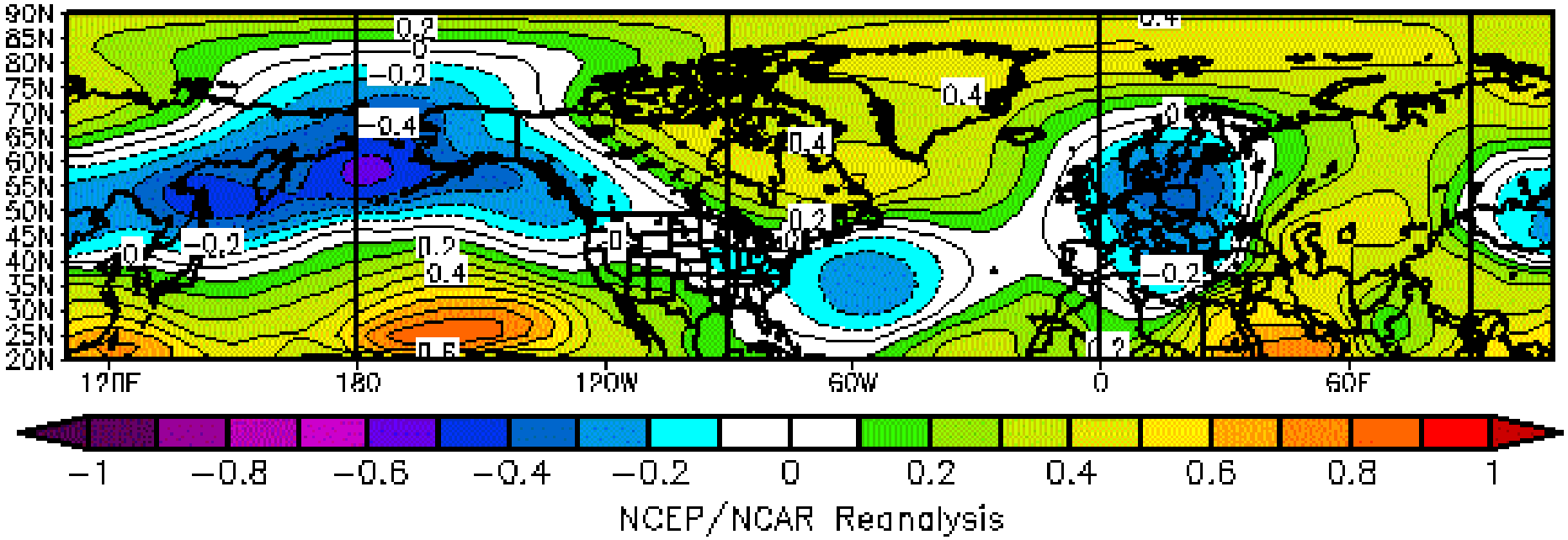


NPGO pattern in Global SSTa

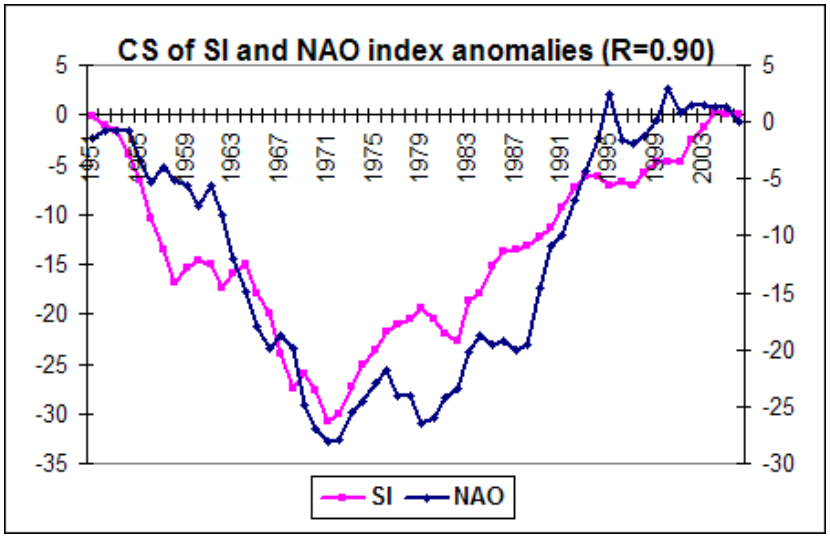


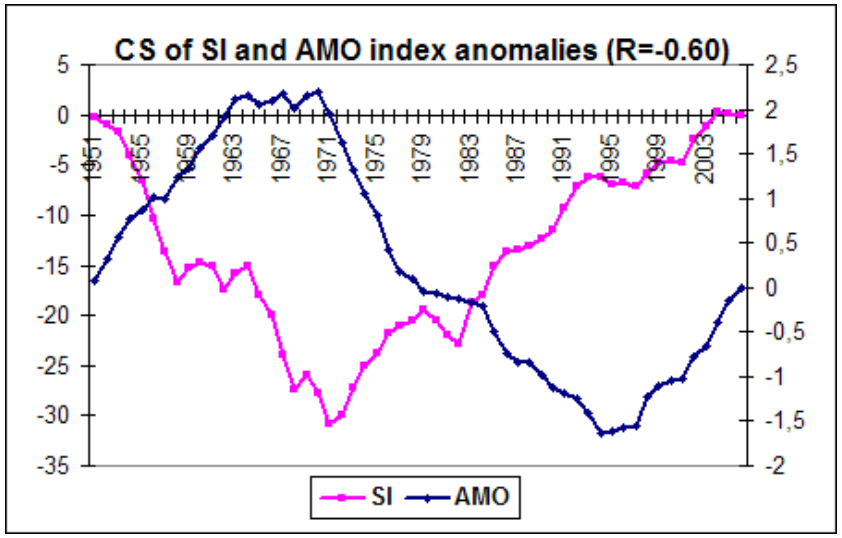
Di Lorenzo et al, 2008

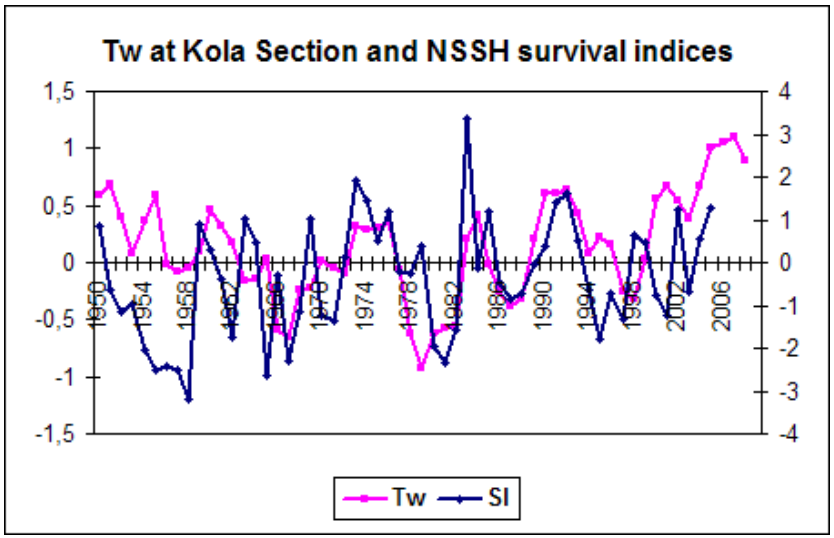
Correlation pattern between the 1st SVD for NP SSTA and mean winter H_{500} anomalies (1989-2010)

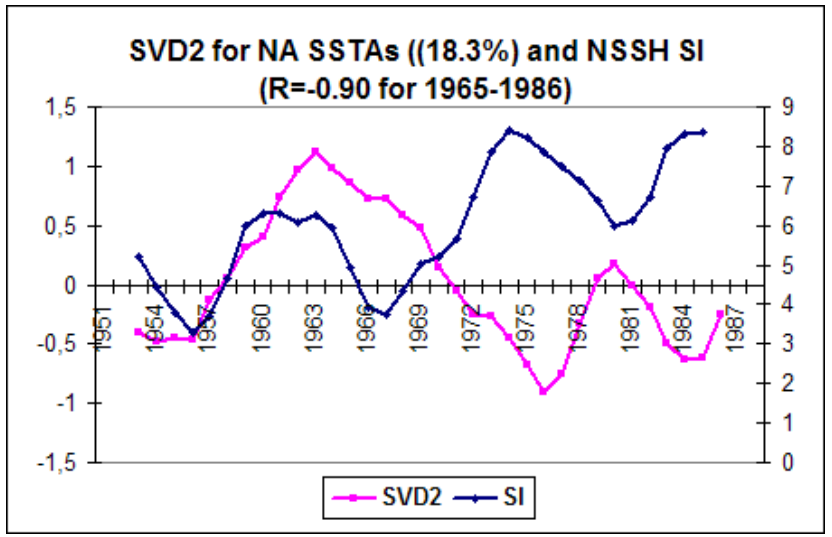


Associations between NSSH survival indices and some climatic variables

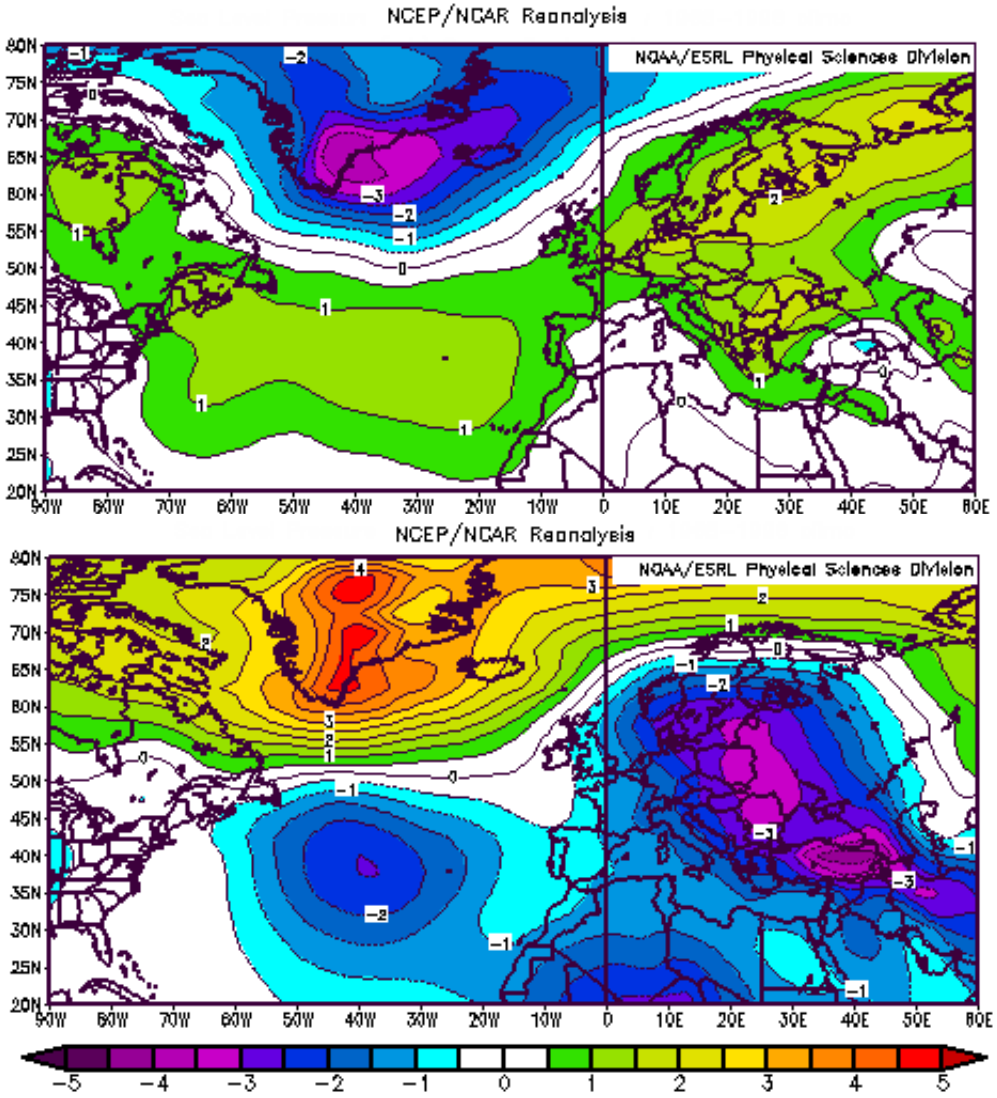








Composite maps of mean winter SLP anomalies in years with extreme survival conditions of NSSH

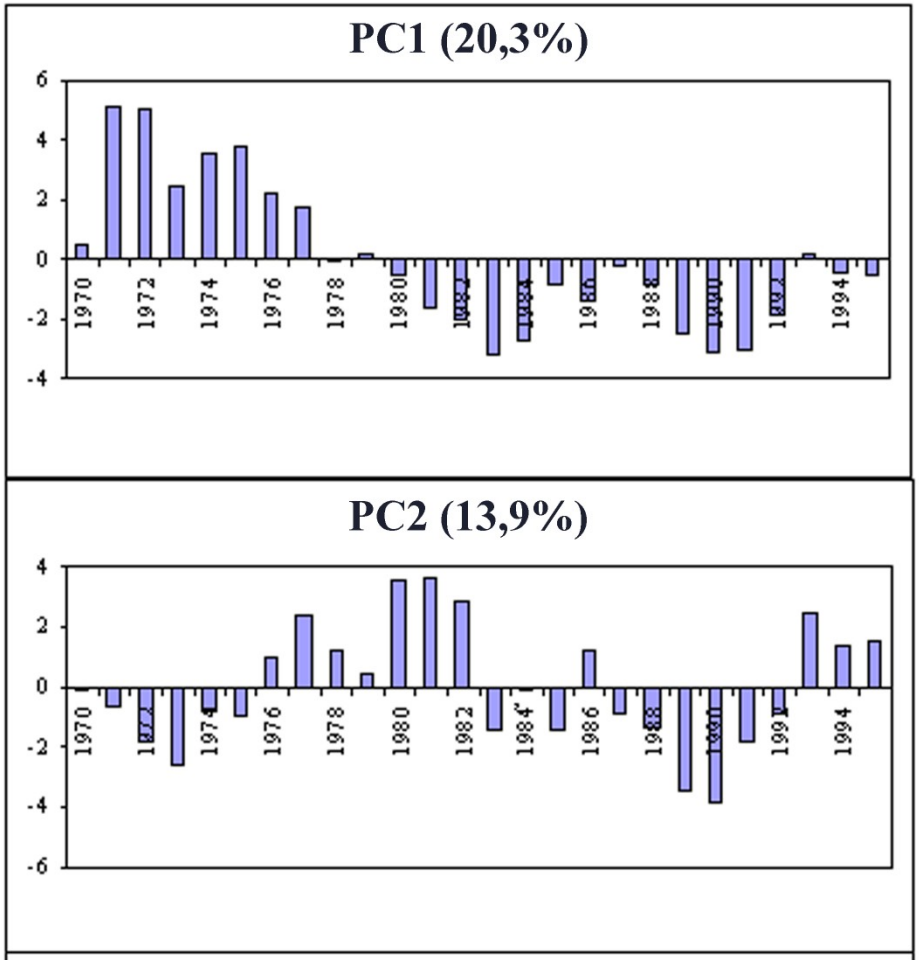


Most favorable

Most unfavorable

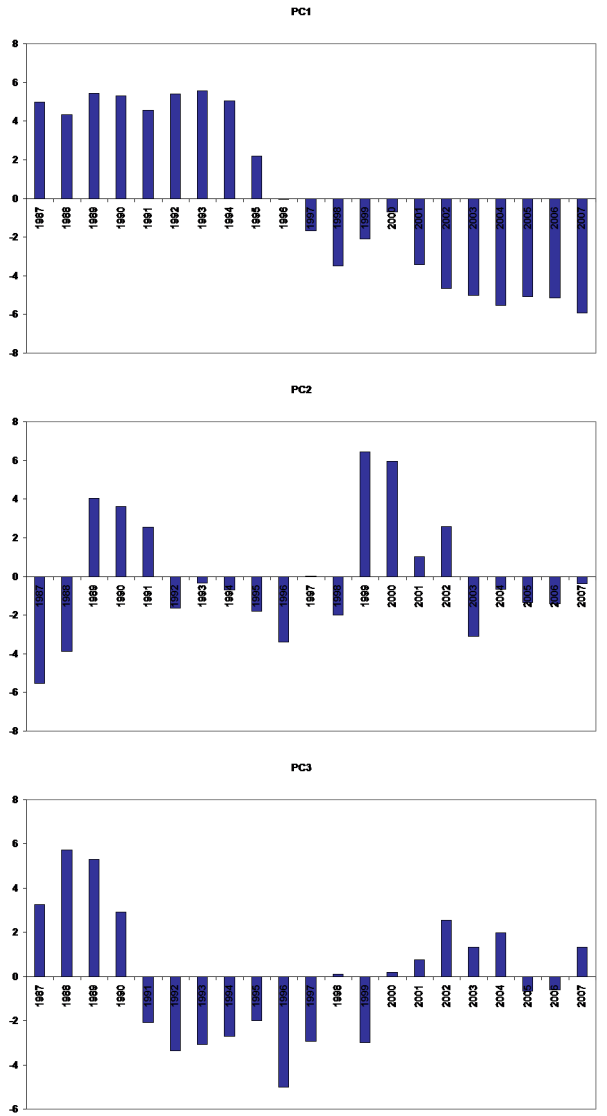
Selected loadings on the first three principal components (PC) from a principal component analysis of the 75 physical and biological variables for the 1970-1995 period

Time series	PC1	PC2
	20.3%	13.9%
Western Atlantic pattern (WA)	0,44	-0,59
Pacific/North American pattern (PNA)	-0,29	-0,62
Winter NAO Index	-0,74	0,45
Winter NP pattern	0,19	0,69
Pacific Decadal Oscillation (PDO)	-0,37	-0,80
Southern Oscillation (SOI)	0,54	0,34
Arctic Oscillation (ARCTIC)	-0,55	0,63
SST in Region a5 (Central North Atlantic)	-0,76	-0,24
SST in Region p1 (Eastern North Pacific)	-0,75	-0,51
SST in Region p2 (Central North Pacific)	-0,10	0,79
Tw (0-200 m) at Kola Section	-0,43	0,50
Haddock in Region 4VW (NAFO)	0,48	-0,07
Haddock NE (ICES)	-0,56	0,37
Halibut NE (ICES)	-0,64	-0,32
Herring Celtic (ICES)	-0,28	-0,59
Herring in Region 6aS+7bc (ICES)	0,19	-0,48
Herring Ireland (ICES)	0,58	-0,24
Herring North Sea (ICES)	0,08	-0,59
Saithe in Region 4+3a (ICES)	-0,73	-0,25
Saithe NE (ICES)	-0,70	-0,08
Saithe Faroe (ICES)	-0,62	-0,53
Sole in Region 7fg (ICES)	-0,65	-0,10
Sockeye (East Kamchatka)	-0,68	-0,07
Sockeye (West Kamchatka)	-0,71	-0,19
Chum (Anadyr)	0,13	-0,38
Chum (East Kamchatka)	-0,08	-0,52
Chum (West Kamchatka)	-0,45	-0,29
Pink (East Kamchatka)	-0,66	-0,05
Pink (West Kamchatka)	-0,59	0,02
Pollock (West Bering Sea)	0,71	0,02
Pollock (East Kamchatka)	0,75	-0,08



Selected loadings on the first three principal components (PC) from a principal component analysis of the 82 physical and biological variables for the 1987-2007 period

Variable	PC1 (25.0%)	PC2 (12.3%)	PC3 (10.6%)
North Atlantic Oscillation	0,39	0,48	0,06
Western Pacific TP	-0,14	-0,12	0,56
Pacific/North American TP	-0,41	-0,62	0,22
Scandinavia TP	-0,17	-0,59	-0,27
Southern Oscillation Index	-0,16	0,61	0,02
Arctic Oscillation	0,43	0,57	0,08
North Pacific Pattern	0,38	0,72	0,13
Northern Oscillation Index	-0,11	0,59	0,34
Multivariate ENSO Index	0,10	-0,66	0,04
Atlantic Multidecadal Oscillation	-0,88	0,06	0,06
Atlantic Tripole	-0,90	0,01	-0,02
Tropical North Atlantic	-0,74	-0,14	0,00
Pacific Decadal Oscillation	-0,16	-0,79	0,15
Northeast Arctic cod	0,45	0,38	0,50
Northeast Arctic haddock	0,07	0,66	0,34
Icelandic haddock	-0,44	0,44	0,10
West of Scotland haddock	0,11	0,74	-0,56
Haddock in ICES Divisions IV+IIIa	0,52	0,41	-0,48
Northeast Arctic saithe	0,80	0,10	0,16
Icelandic saithe	-0,66	0,34	-0,07
Faroe saithe	-0,58	0,10	-0,48
Saithe in ICES Divisions IV+IIIa	0,74	0,08	-0,15
Celtic plaice	-0,53	-0,10	-0,29
Sole in Western Channel	-0,50	0,19	0,01
Herring in the Irish Sea	-0,55	-0,19	-0,17
Herring in ICES Divisions VIaS, VIIbc	-0,81	0,08	-0,33
North Sea herring	0,62	-0,02	-0,46
East Kamchatka pink salmon (odd years)	-0,16	0,40	-0,42
West Kamchatka pink salmon (even years)	-0,66	0,29	-0,22
Kuril pink salmon (even years)	-0,78	0,21	-0,31
Sakhalin pink salmon (odd years)	-0,82	0,33	0,05
East Kamchatka chum salmon	-0,78	-0,24	-0,11
West Kamchatka chum salmon	-0,78	-0,24	-0,11
Kuril chum salmon	-0,91	0,20	-0,03
Sakhalin chum salmon	-0,88	0,01	0,18
East Kamchatka sockeye salmon	-0,17	-0,15	-0,56
West Kamchatka sockeye salmon	-0,84	-0,12	0,33



Conclusions

- **Two different multi-decadal large-scale atmosphere-ocean patterns responsible for relationships between the North Pacific and North Atlantic:**

  1951-1988: PNA-WA TP (PDO (NP) – three – (four-) pole structure in SSTA variations, negative AMO in the NA)

  1989-2010: NPO – NA (?) (Victoria mode (NPGO) in the NP – positive AMO in the NA)

- **Decadal variations were pronounced better in 1951-1988**

- **Predominance of generations of either odd or even years in WK pink salmon stock is clearly associated with the above patterns. Recent rise of abundance and biomass of Far East salmon stocks and WK pink salmon, in particular, are explained by better survival conditions during marine wintering**

- **Long-term variations in the survival indices of NSS herring are determined mainly by NAO, though AMO impacts them also**