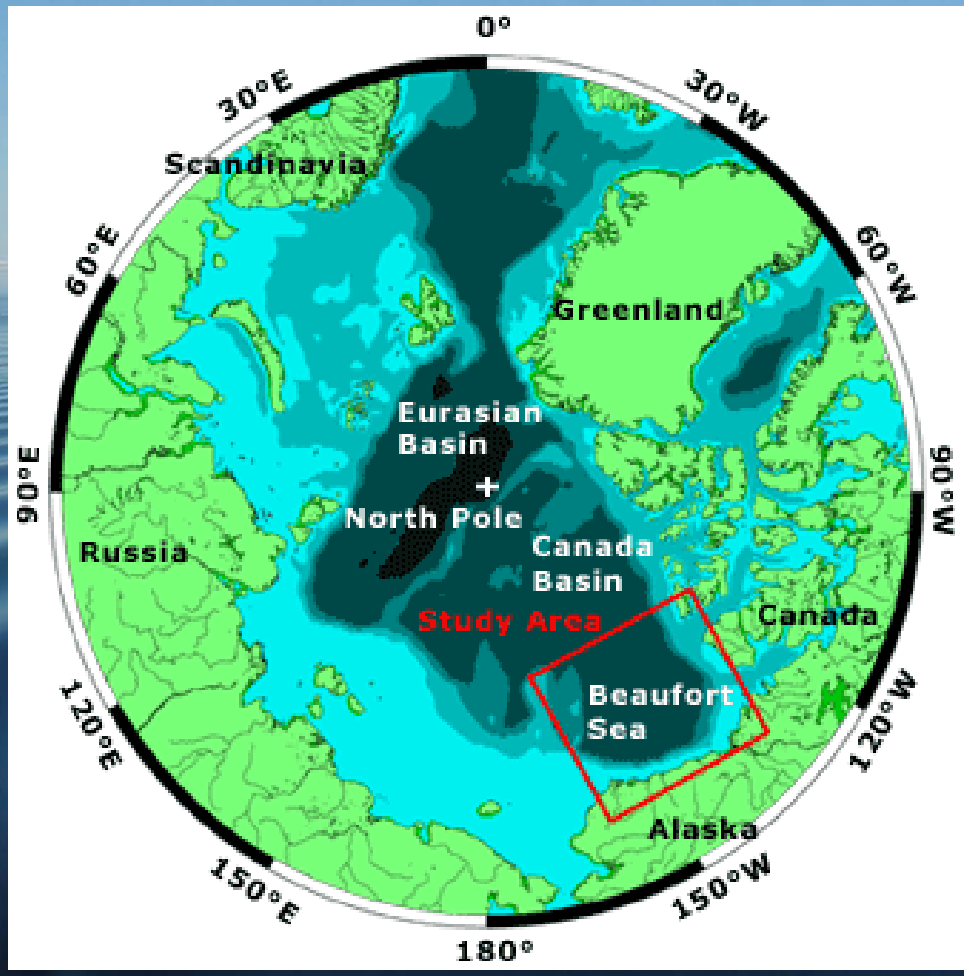
Arctic Ocean freshwater content and preliminary intercomparison results

A. Proshutinsky

NSF project 2003-2005:

"Beaufort Gyre freshwater experiment: Study of freshwater accumulation and release mechanism and a role of fresh water in Arctic climate variability"

(http://www.whoi.edu/beaufortgyre)

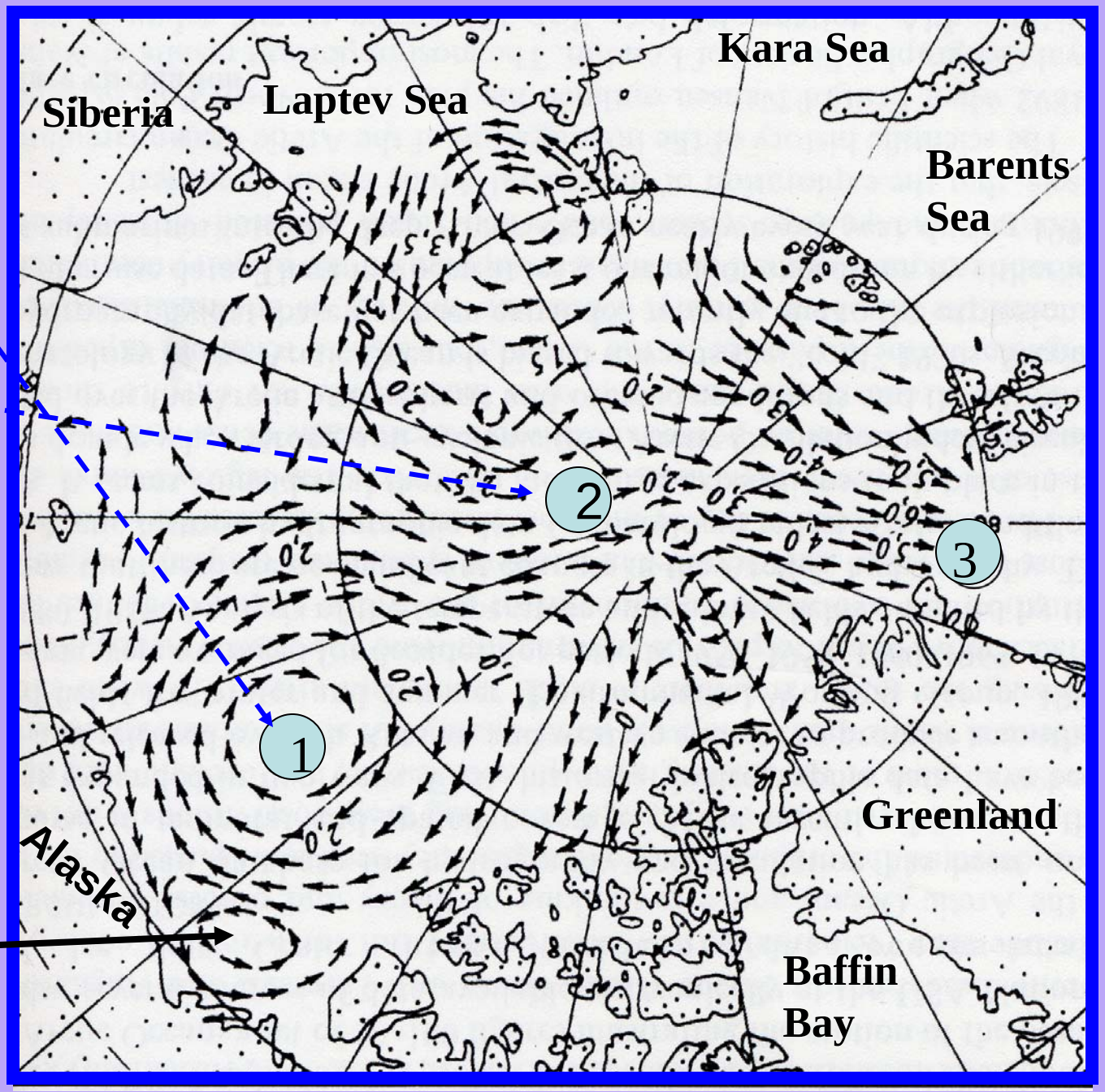


1 – Beaufort Gyre

2 – Transpolar Drift

3 – West Greenland current

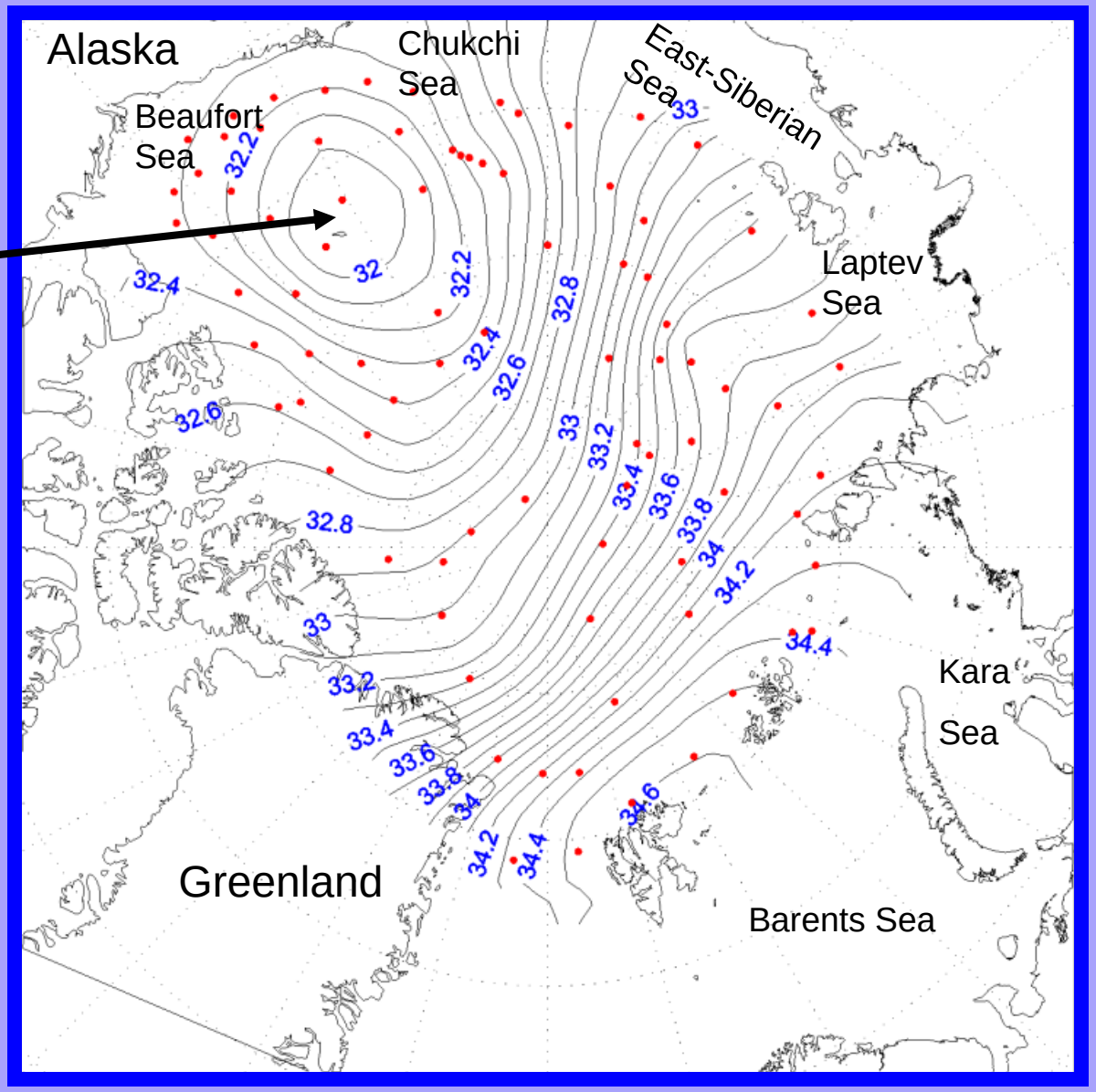
Cyclonic Gyre



Toporkov, 1970.

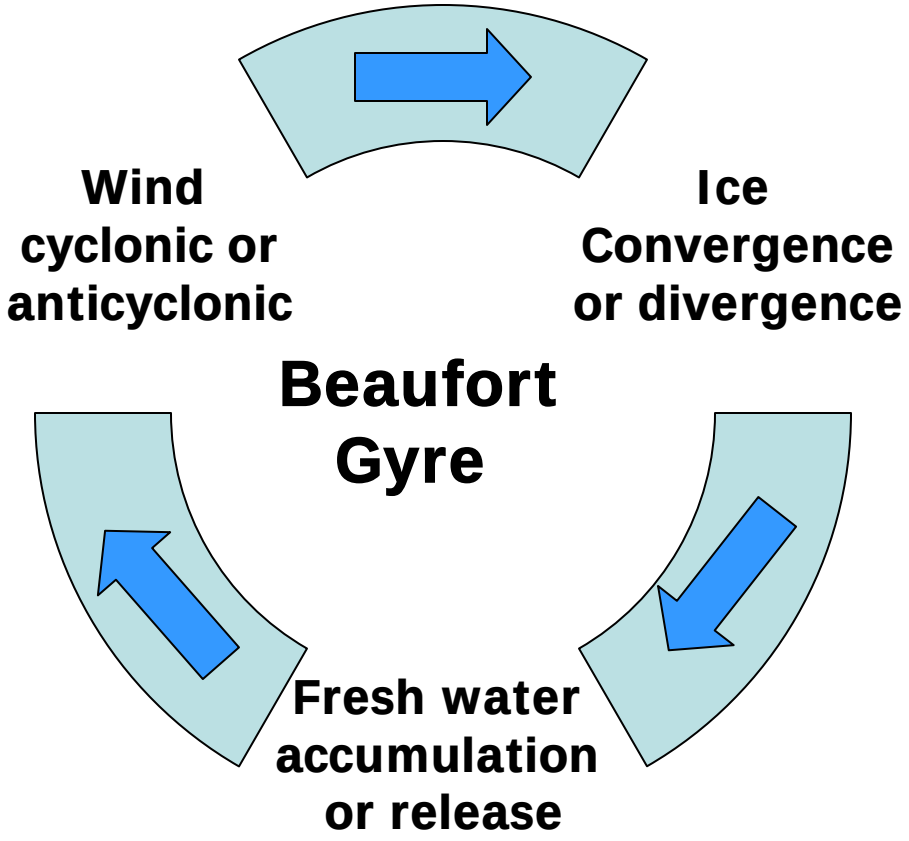
Typical salinity distribution in the upper 200-meter layer

Beaufort Gyre

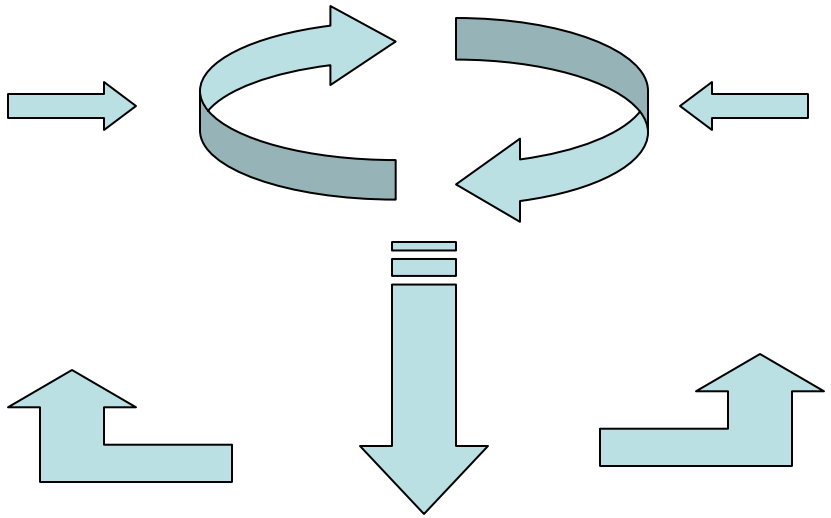


AARI EWG joint USA – Russia data archive 1948-1993

Beaufort Gyre mechanism of fresh water accumulation and release

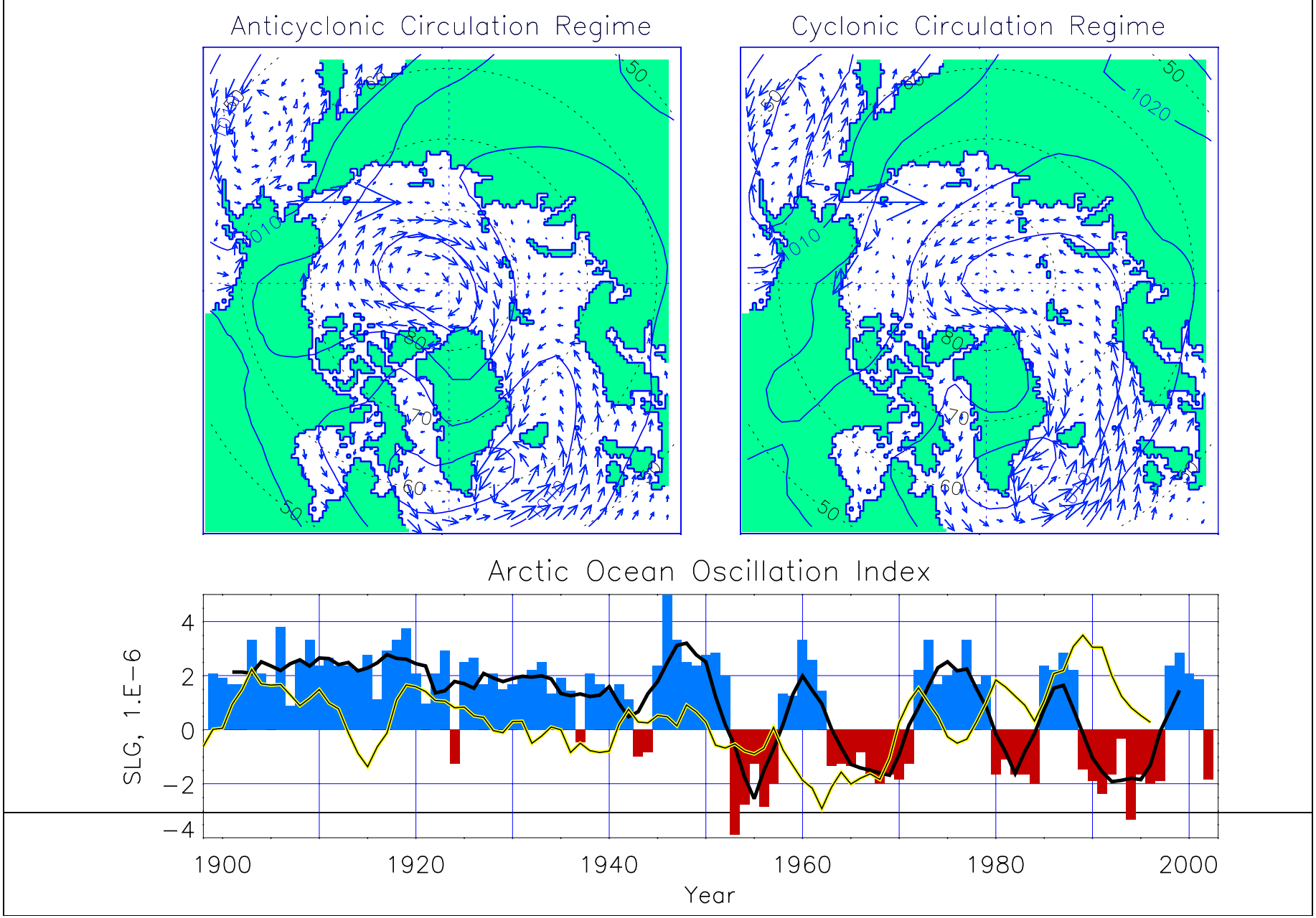


Ice and water convergence, Fresh water accumulation due to Ekman pumping and sea ice accumulation due to ridging and cooling

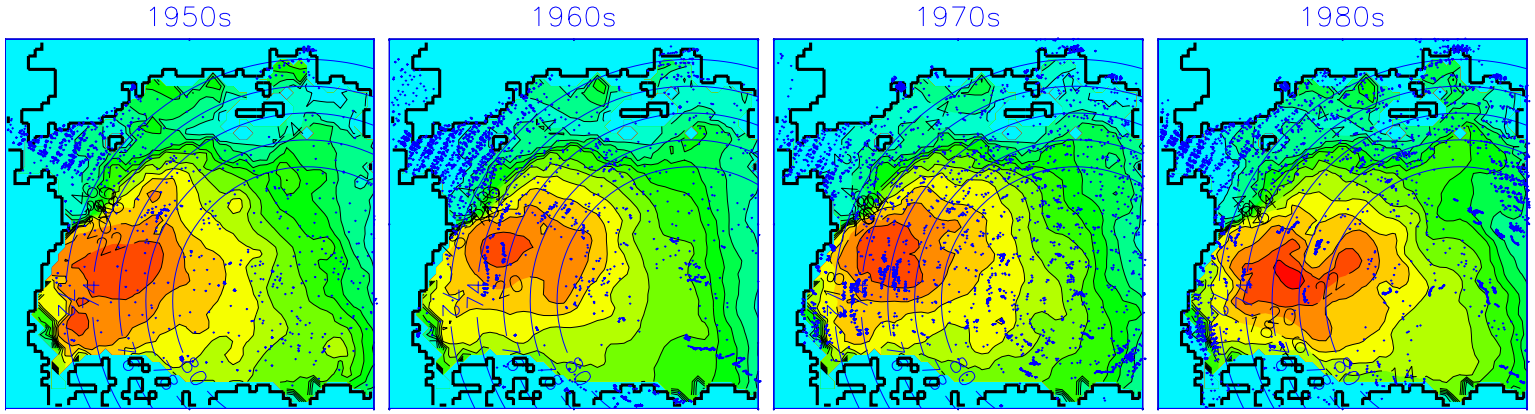


Downwelling in the center and upwelling along continental slope

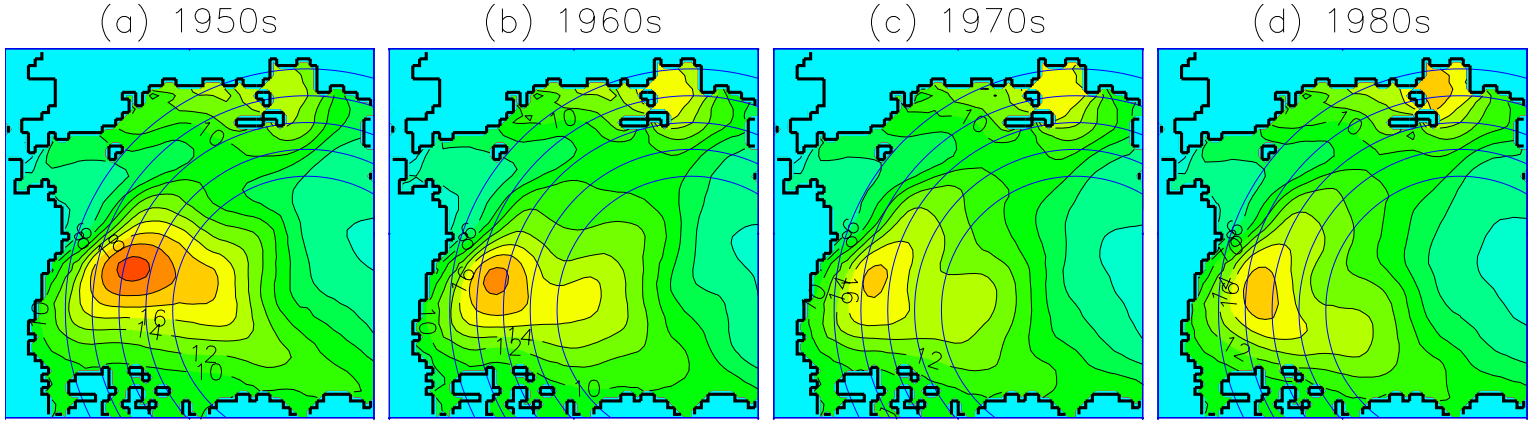
Circulation regimes 1900-2002

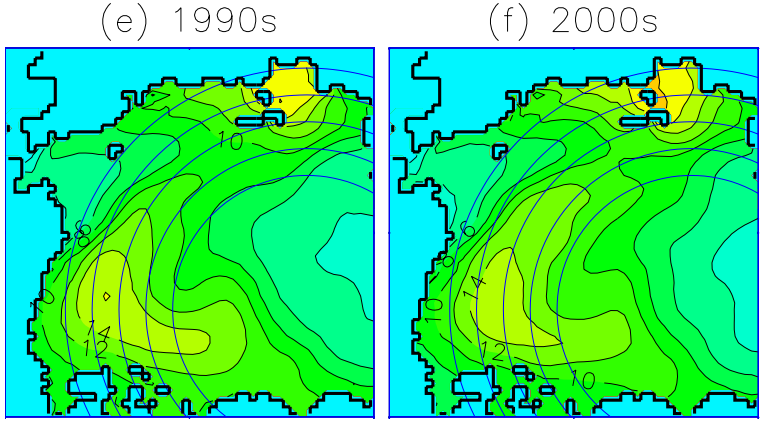


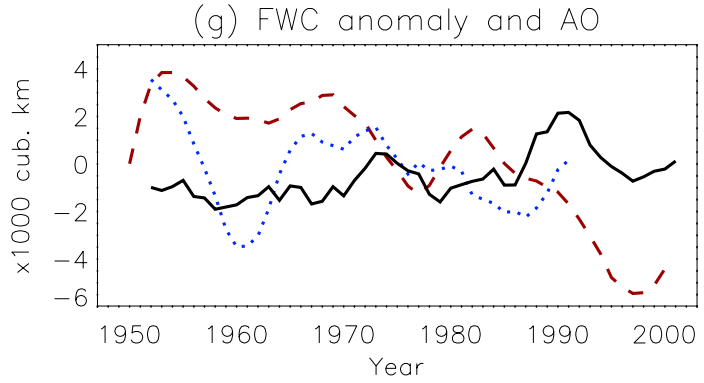
A. From observations (EWG, atlas, 1997)

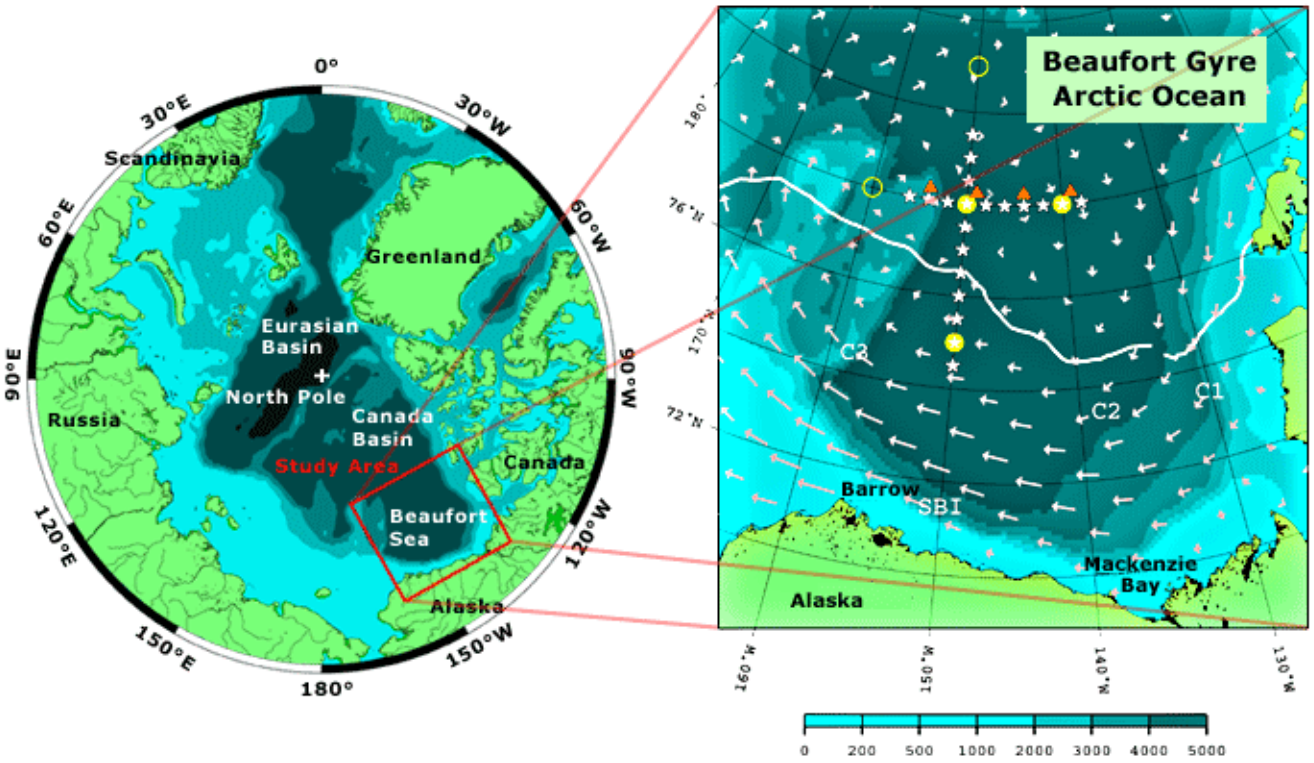


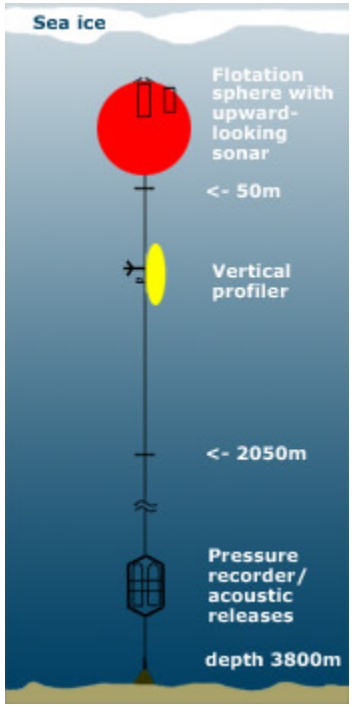
B. From AWI (Germany) coupled ice-ocean model

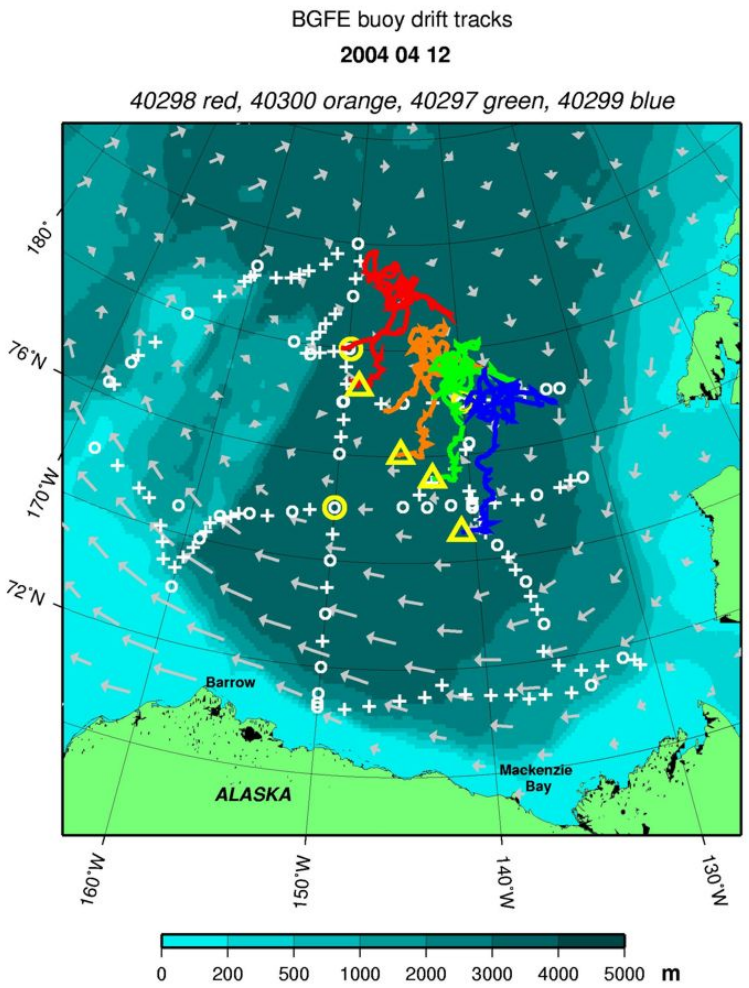




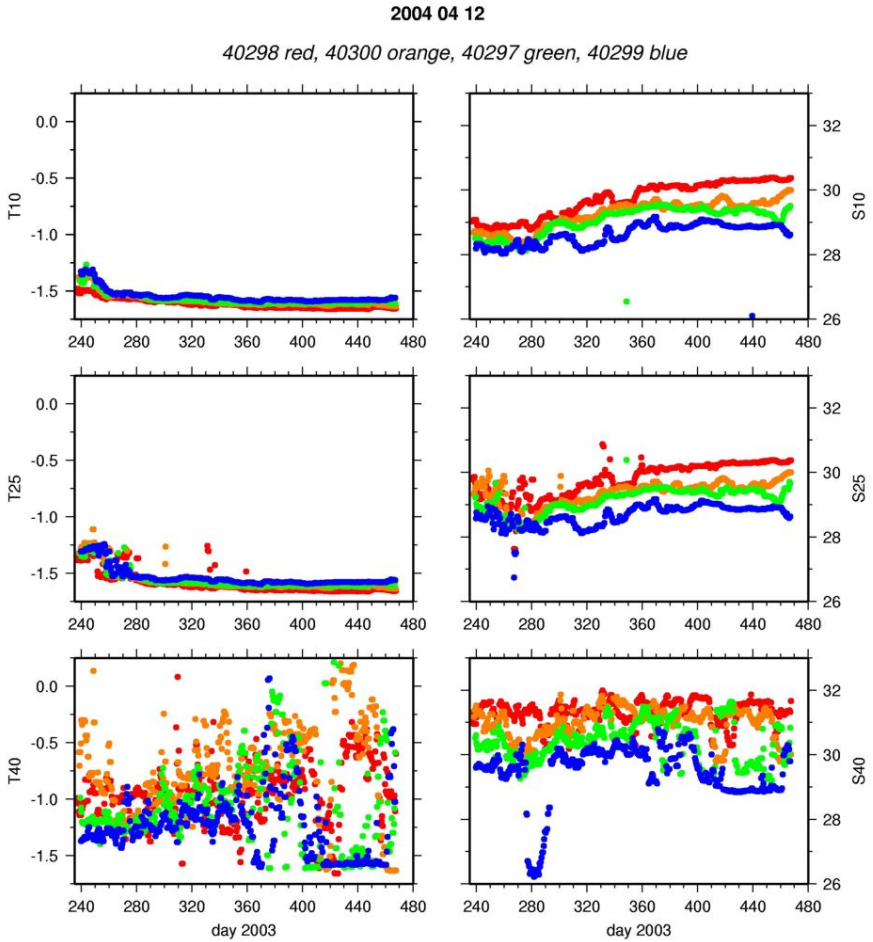


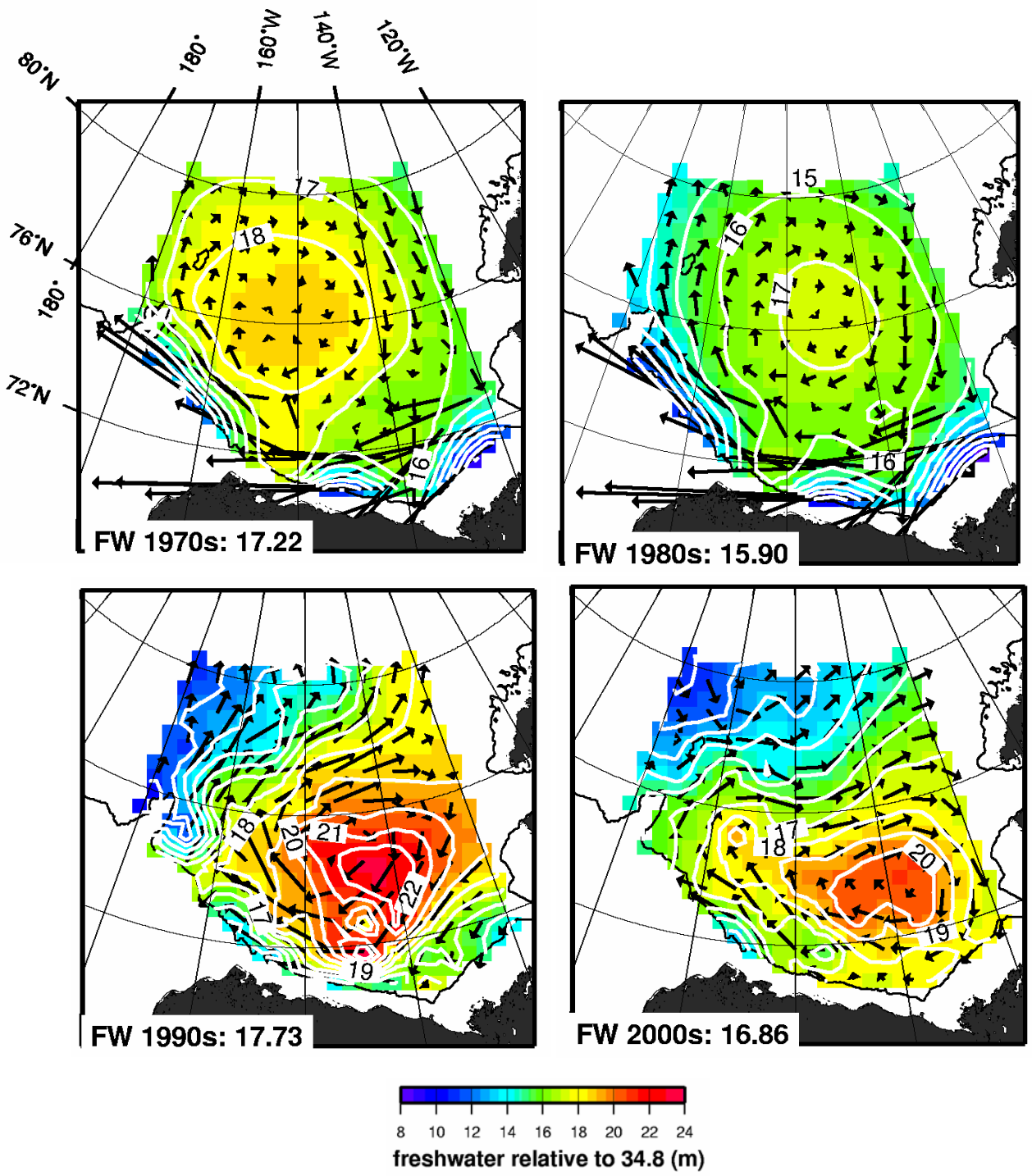

0°
30°E
30°W
60°E
60°W
90°E
90°W
120°E
120°W
150°E
150°W
180°
Scandinavia
Greenland
Eurasian Basin
+
North Pole
Russia
Canada Basin
Study Area
Canada
Beaufort Sea
Alaska
Beaufort Gyre
Arctic Ocean
C2
C2
C1
Barrow
SBI
Mackenzie Bay
Alaska
0
200
500
1000
2000
3000
4000
5000

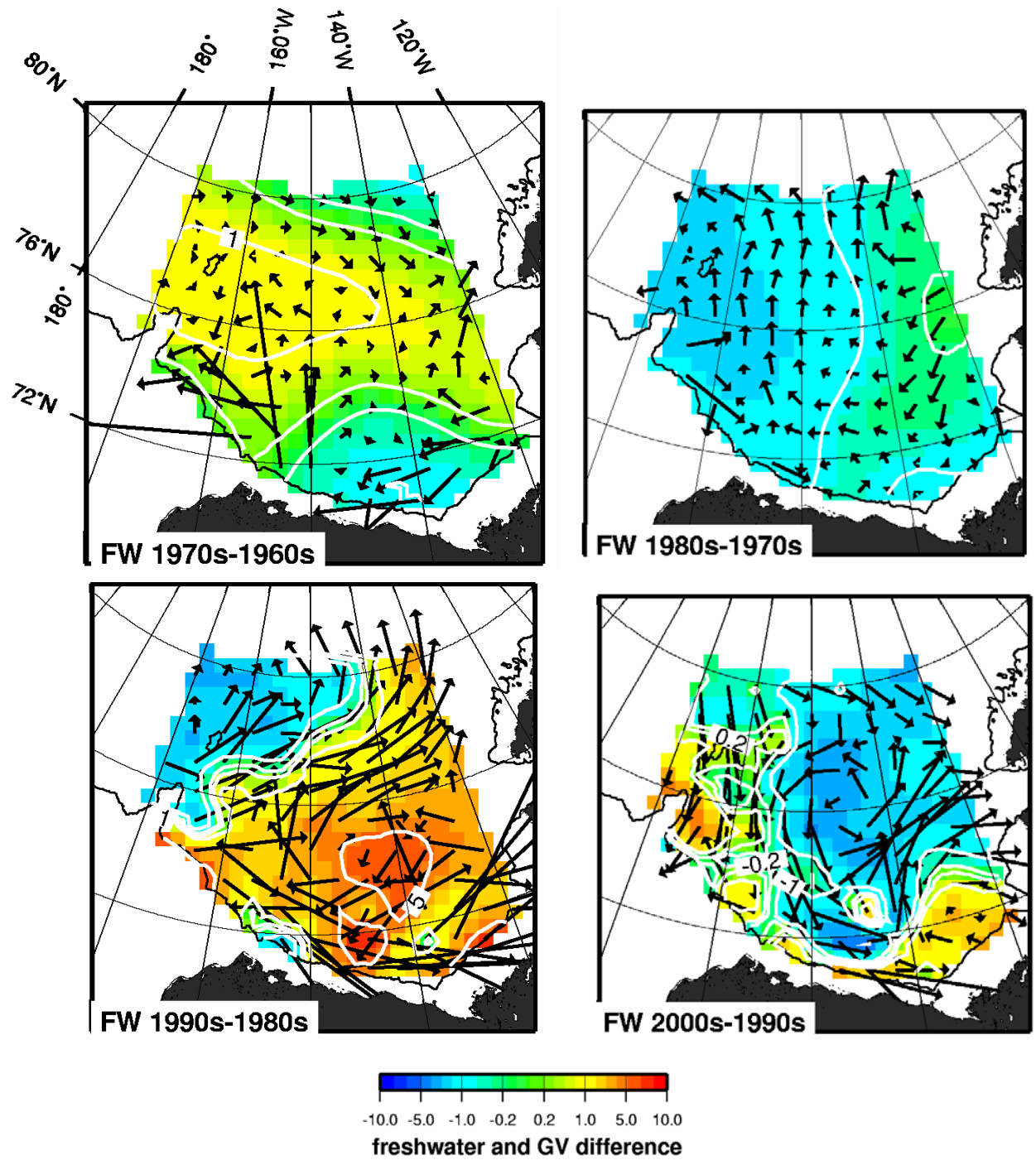

Sea ice
Flotation sphere with upward-looking sonar
<- 50m
Vertical profiler
<- 2050m
Pressure recorder/ acoustic releases
depth 3800m

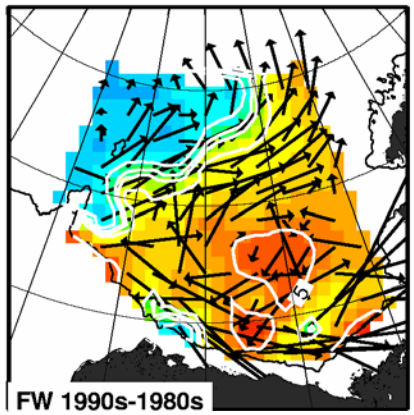


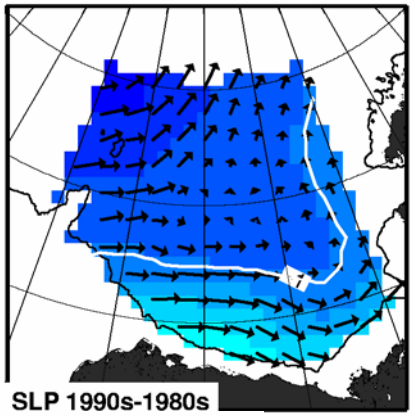
BGFE buoy drift tracks (solid lines) and latest locations (triangles) superimposed on IBCAO bathymetry (shading). Also indicated are BGFE moorings (yellow circles), JWACS 2003 CTD (white circles) and XCTD (white crosses) stations, and mean annual ice drift vectors from IABP climatology (grey vectors).

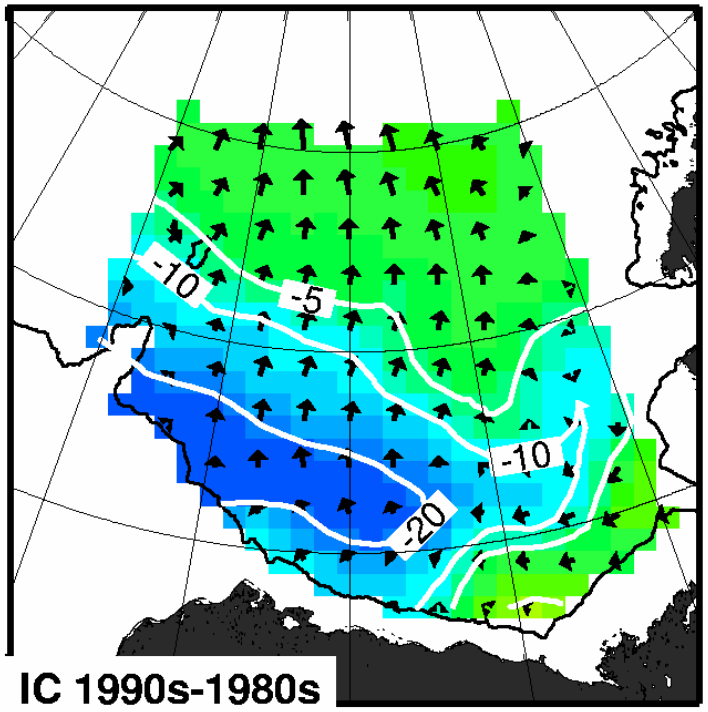



80°N
76°N
72°N
180°
160°W
140°W
120°W
FW 1970s: 17.22
FW 1980s: 15.90
FW 1990s: 17.73
FW 2000s: 16.86
8 10 12 14 16 18 20 22 24
freshwater relative to 34.8 (m)

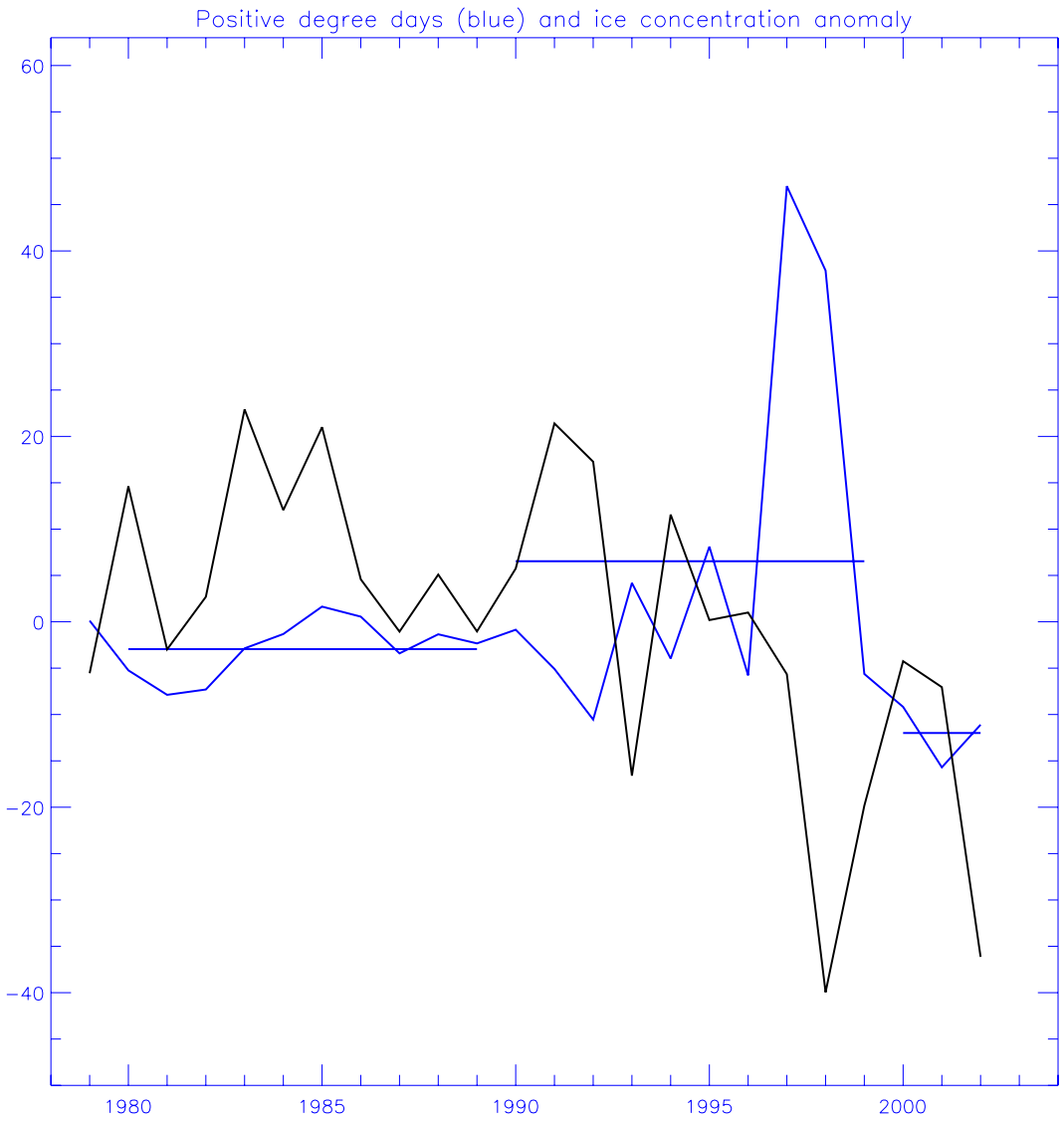

80°N
180°
160°W
140°W
120°W
76°N
180°
72°N
1
FW 1970s-1960s
FW 1980s-1970s
5
FW 1990s-1980s
0.2
-0.2
-1
FW 2000s-1990s
-10.0 -5.0 -1.0 -0.2 0.2 1.0 5.0 10.0
freshwater and GV difference


FW 1990s-1980s

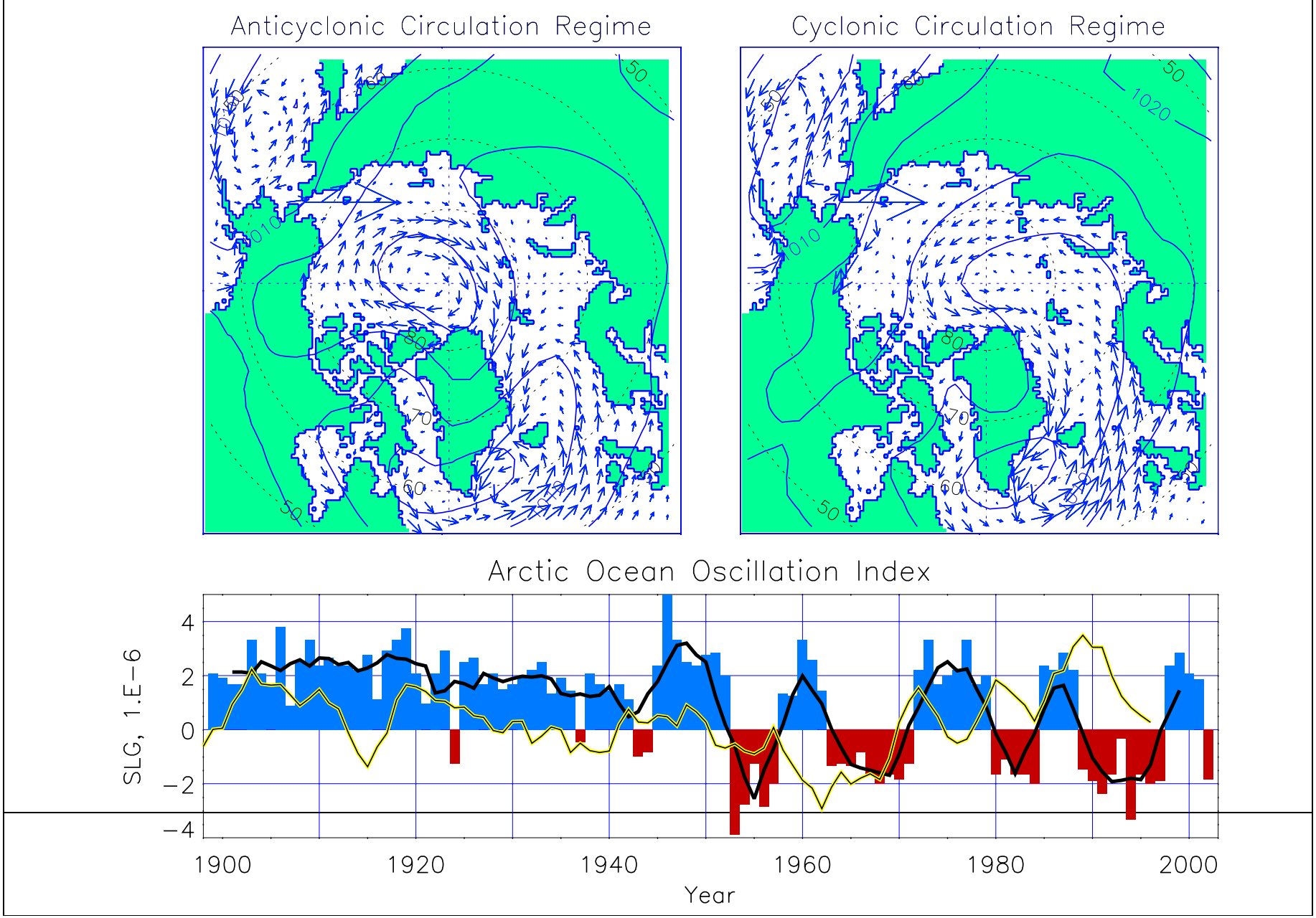

SLP 1990s-1980s

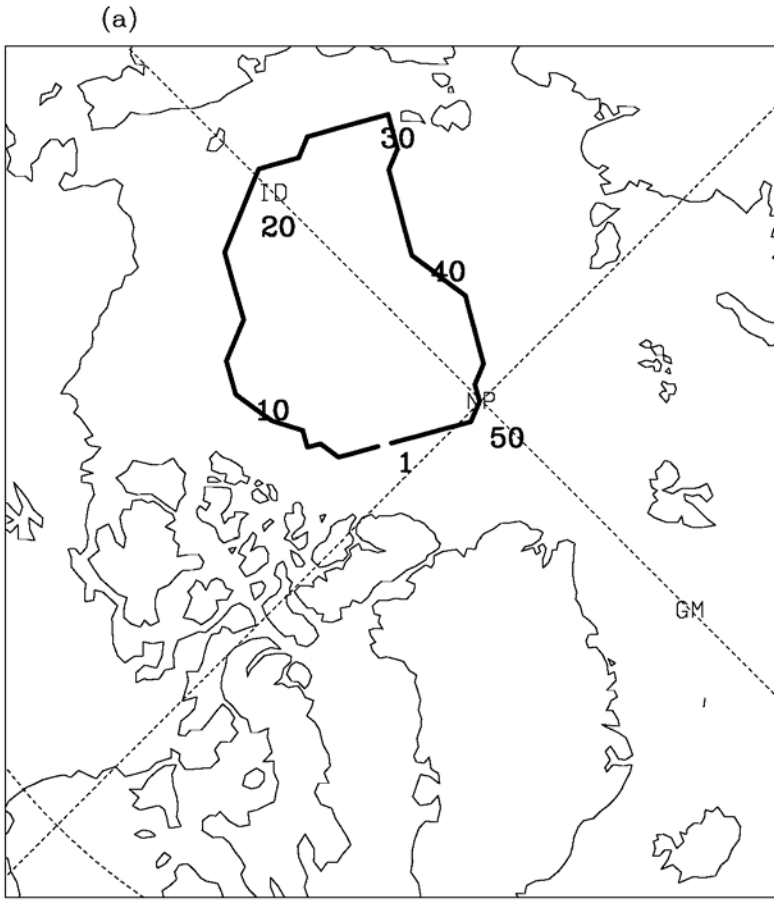

-10
-5
-10
-20
IC 1990s-1980s

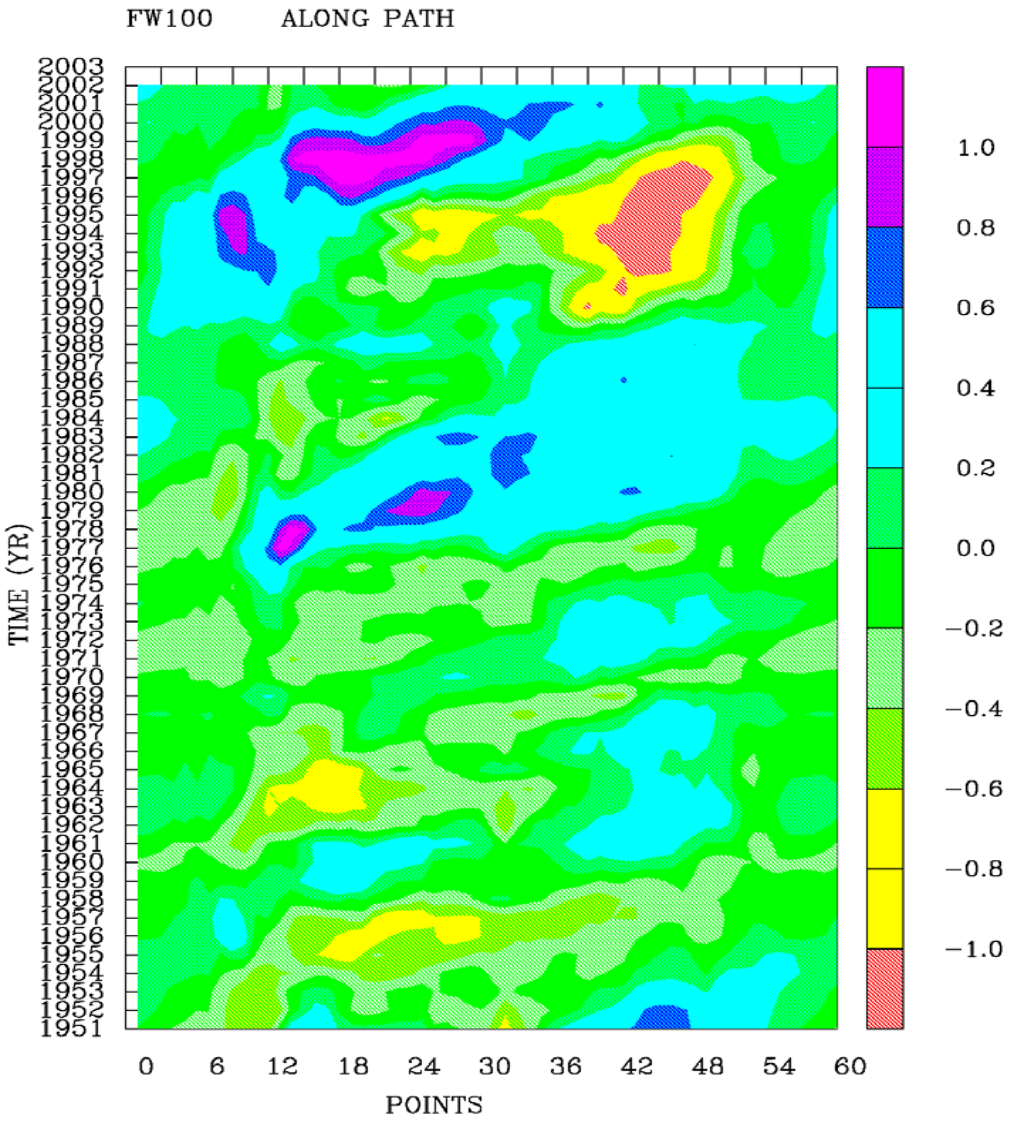
Black – sea ice concentration anomaly
Blue – positive air temperature “degree days”



Circulation regimes 1900-2002




(a)
30
20
40
10
50
1
ND
NP
GM


FW100 ALONG PATH
TIME (YR)
2003
2002
2001
2000
1999
1998
1997
1996
1995
1994
1993
1992
1991
1990
1989
1988
1987
1986
1985
1984
1983
1982
1981
1980
1979
1978
1977
1976
1975
1974
1973
1972
1971
1970
1969
1968
1967
1966
1965
1964
1963
1962
1961
1960
1959
1958
1957
1956
1955
1954
1953
1952
1951
0 6 12 18 24 30 36 42 48 54 60
POINTS
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
−1.0
CI= 0.200