

Synoptic Climatology

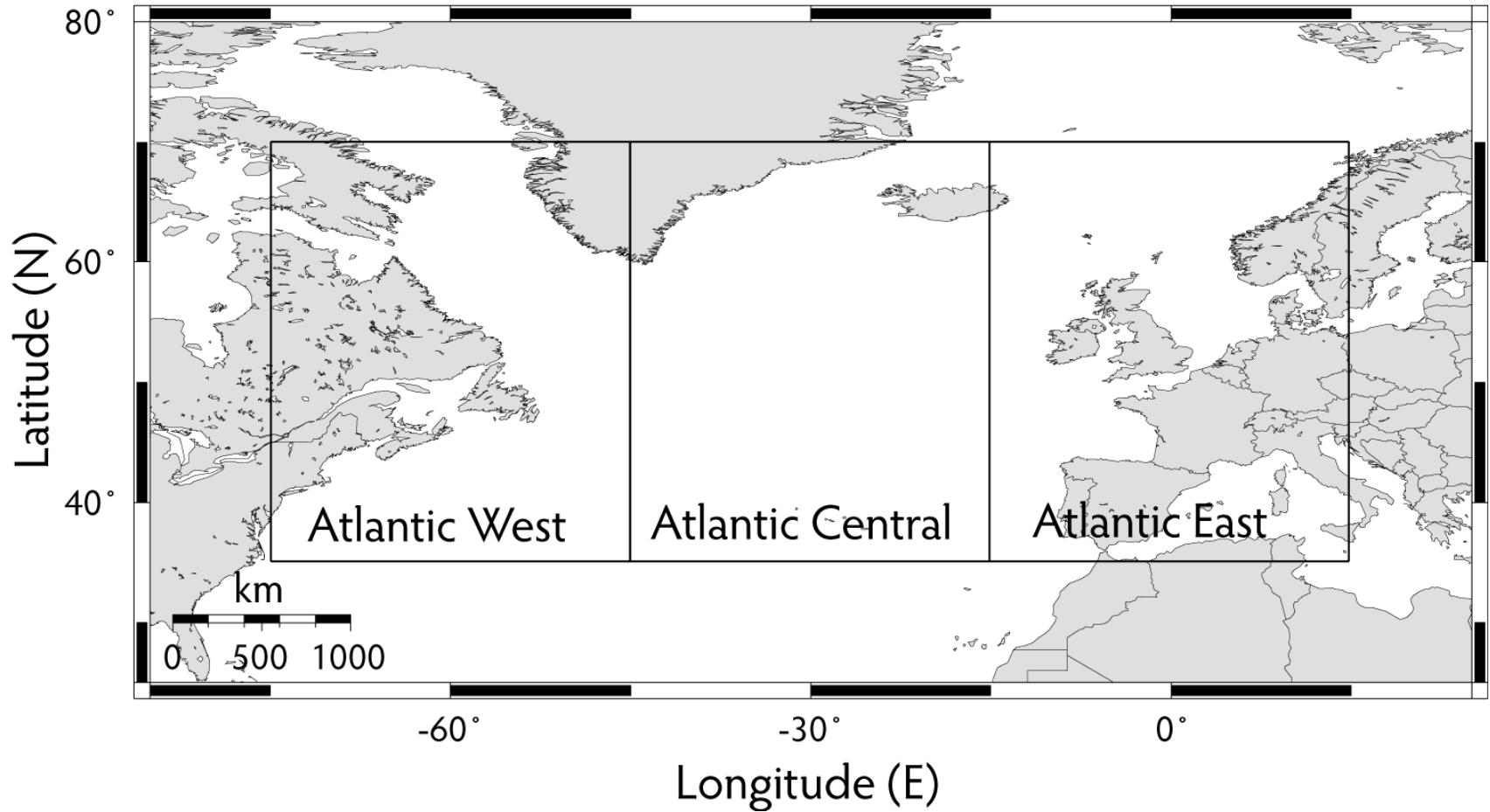
Dave Kimmel

East Carolina University

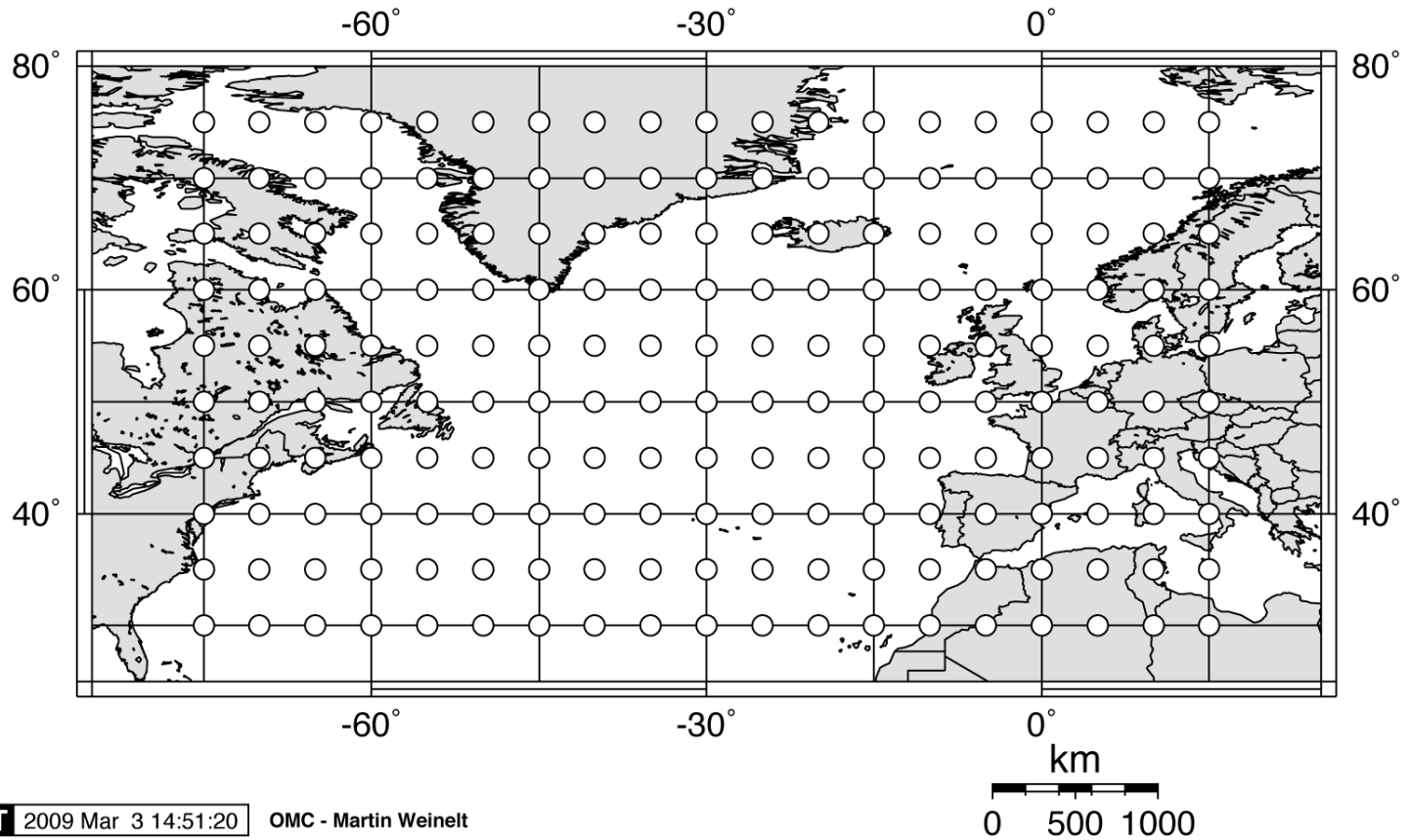
Goals from the PRS Workshop in February

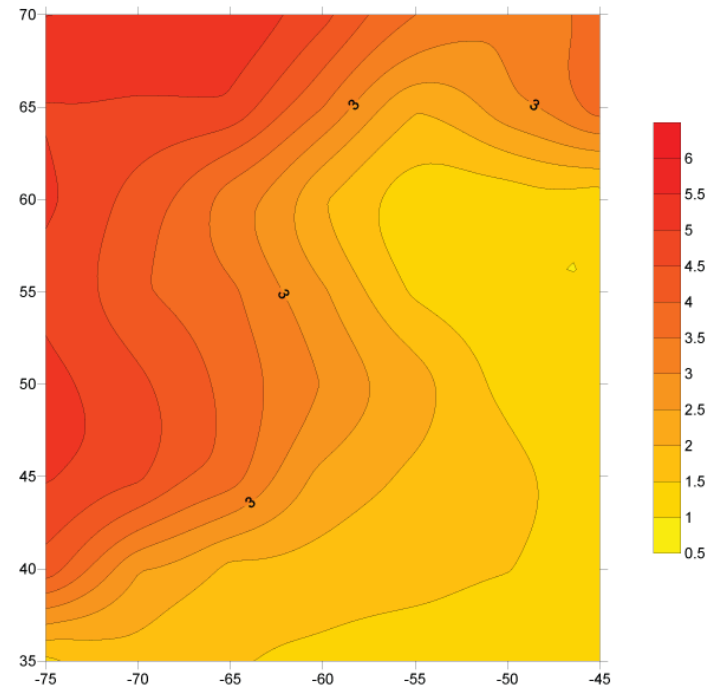
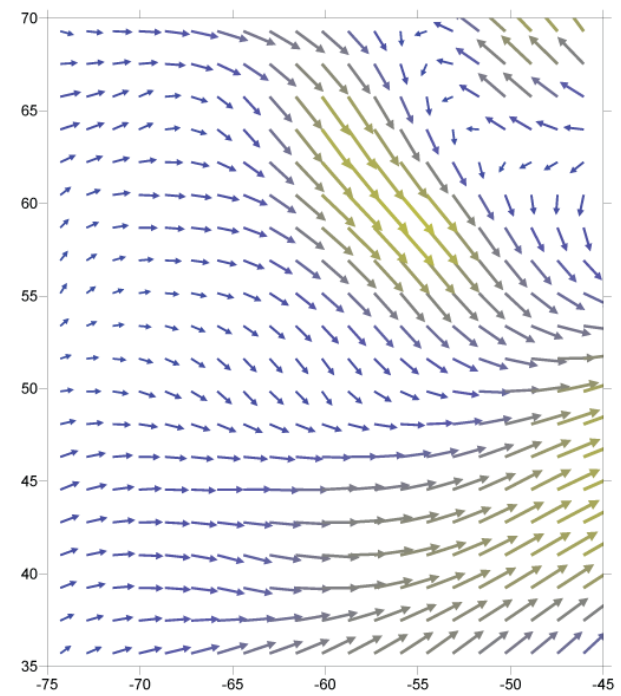
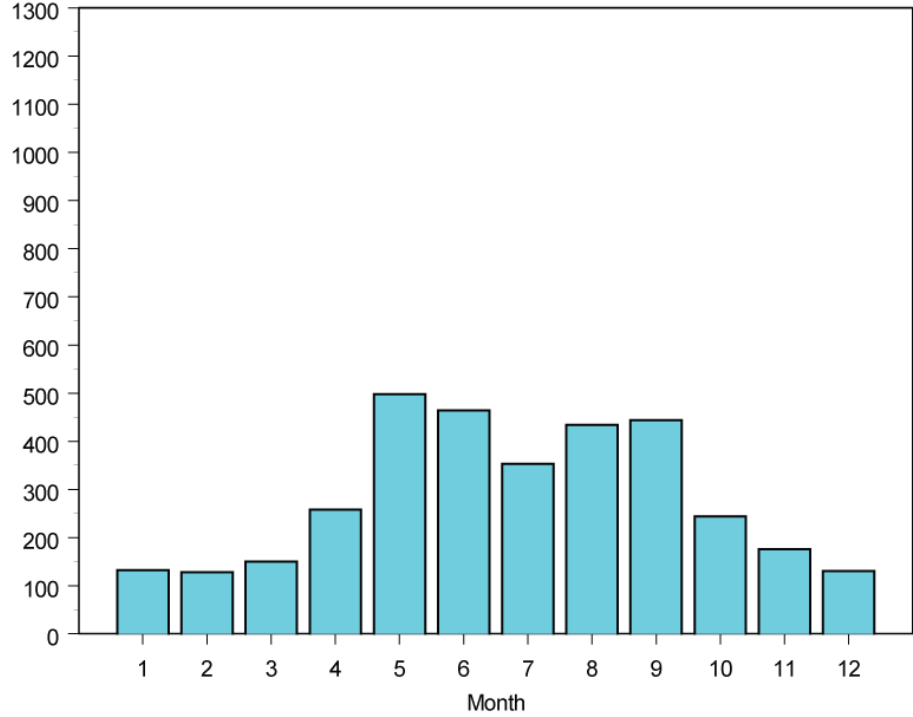
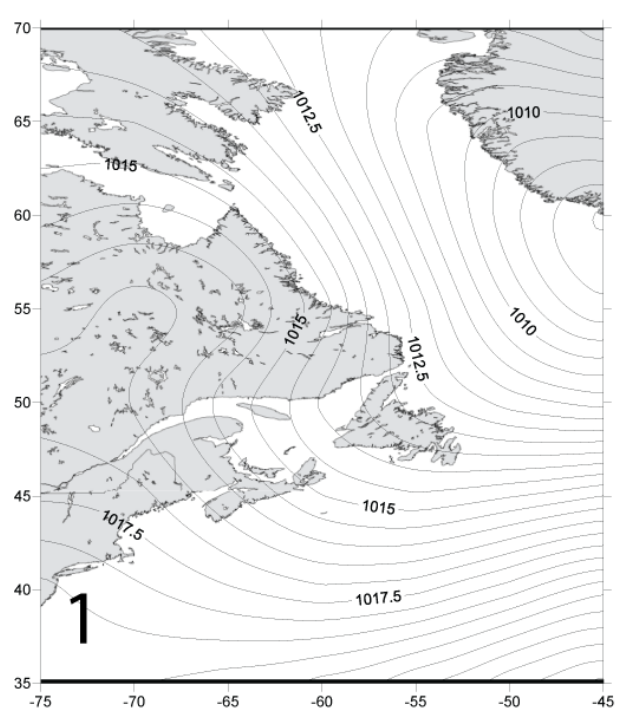
- Paper published
- 1. Compile, monthly, seasonal and annual time series of climate pattern frequency
 - Done for West, Central and Eastern Atlantic
 - Time series are available

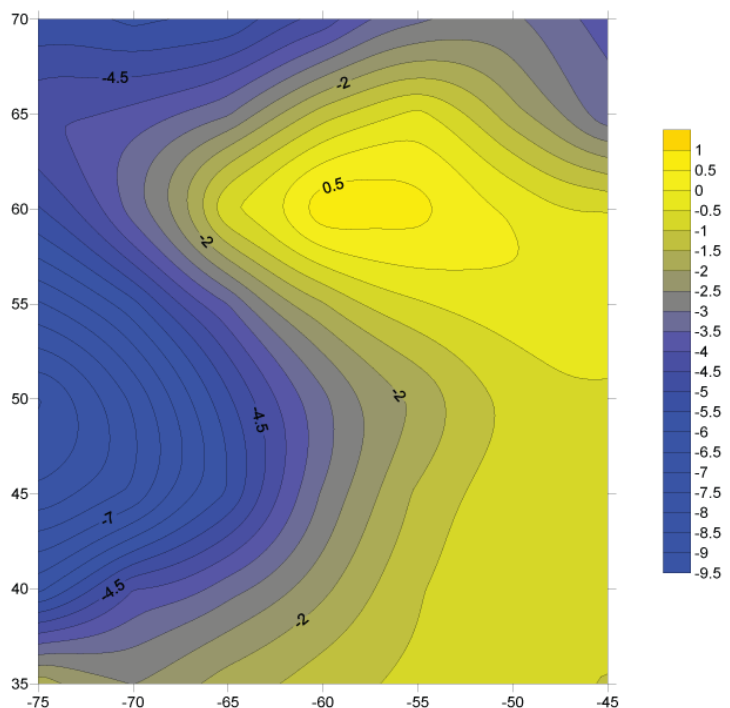
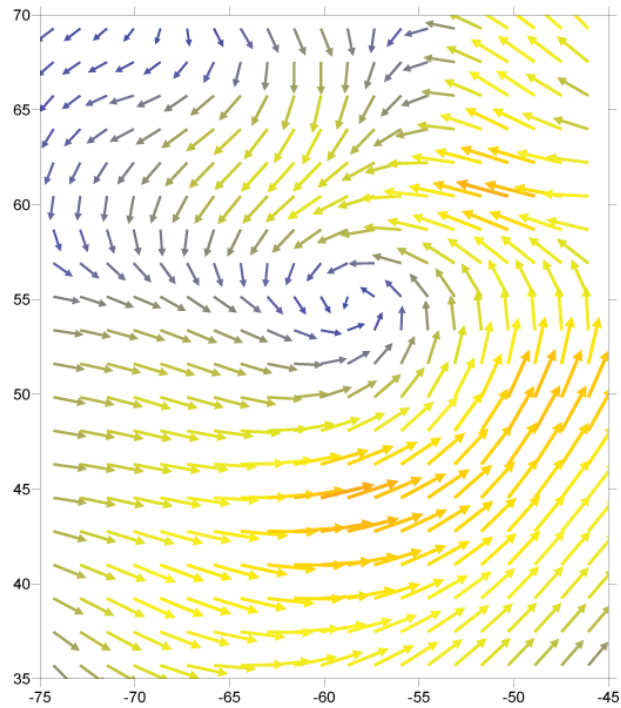
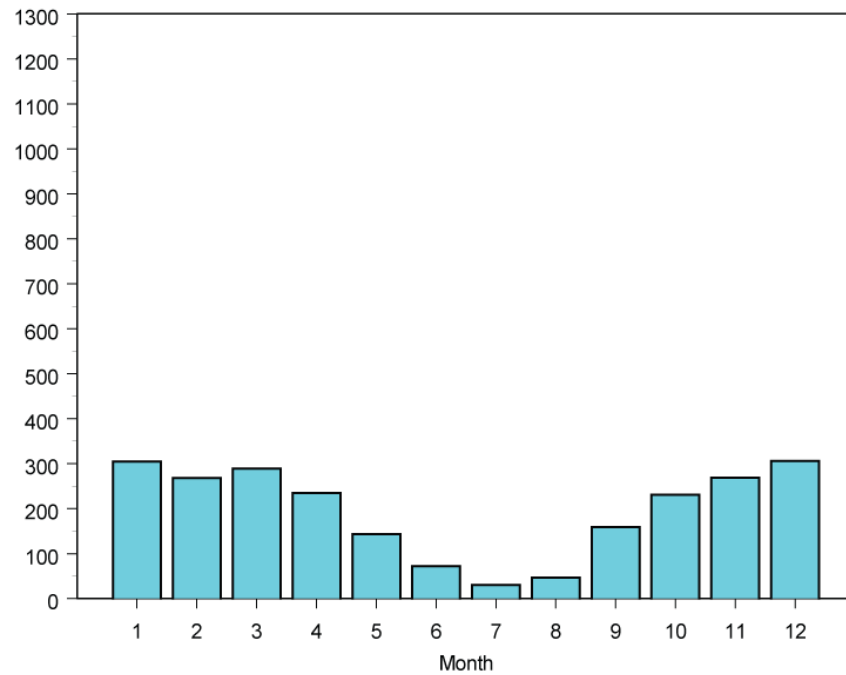
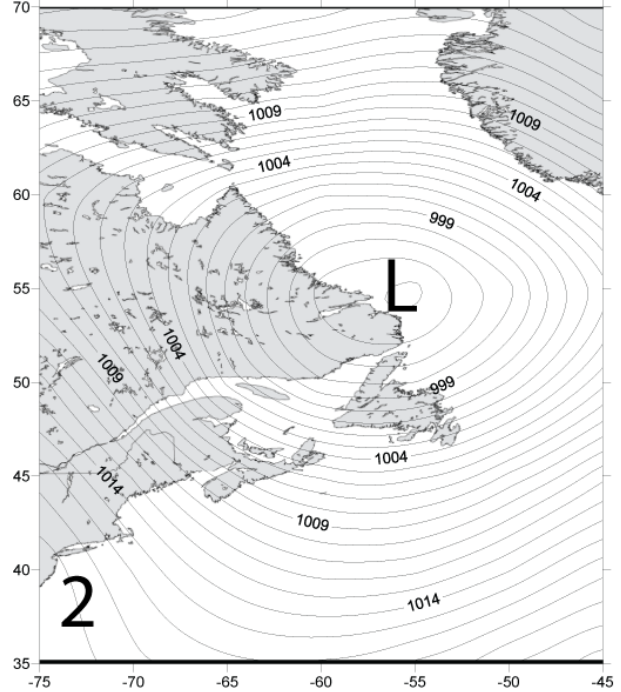
Synoptic Regions

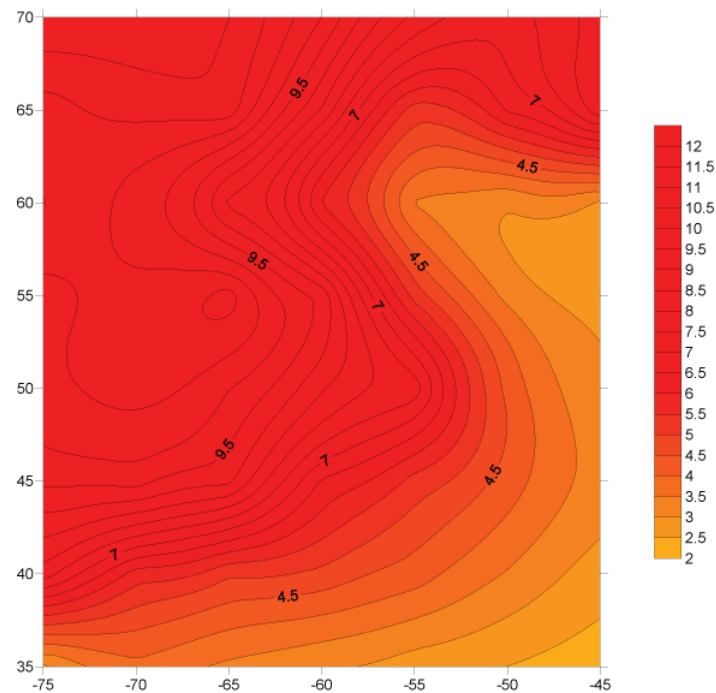
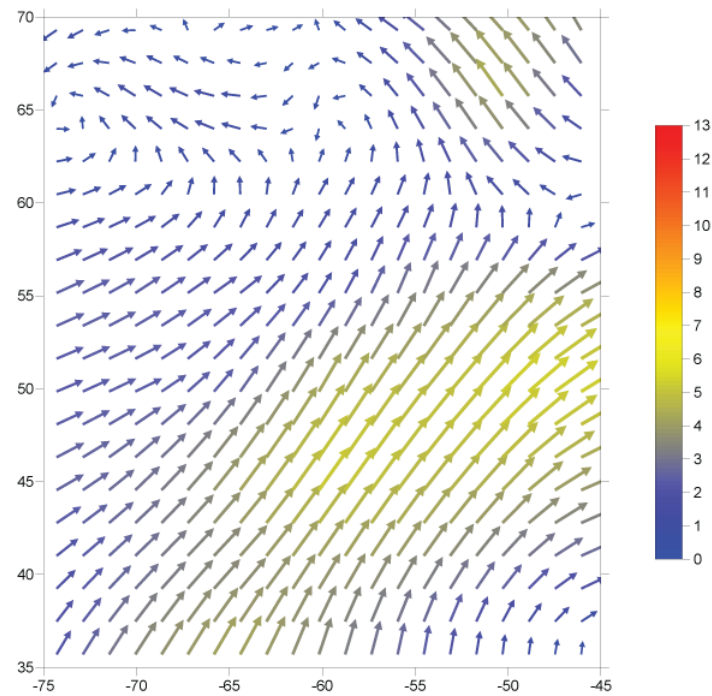
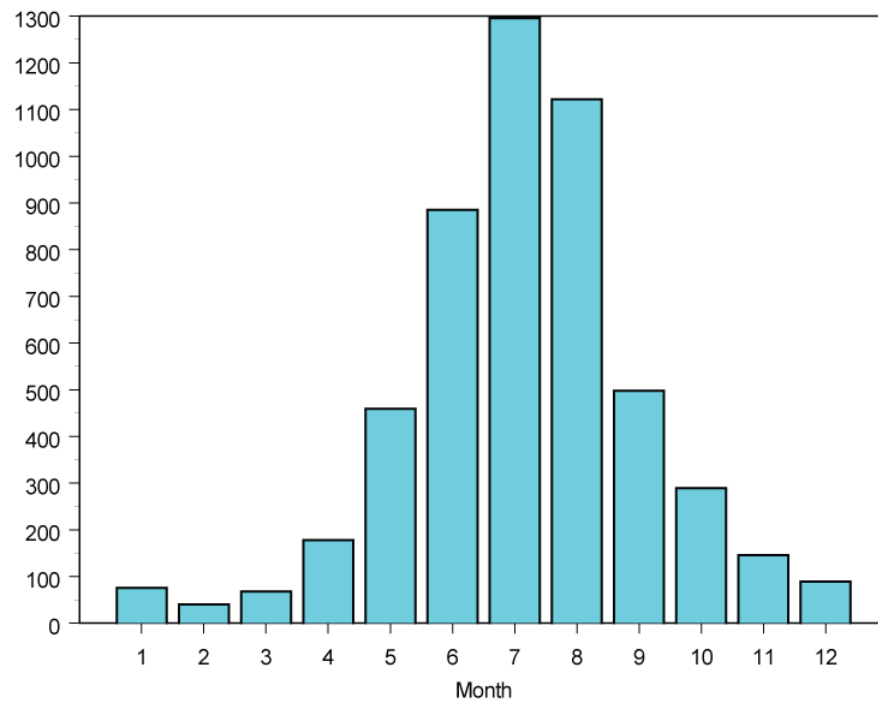
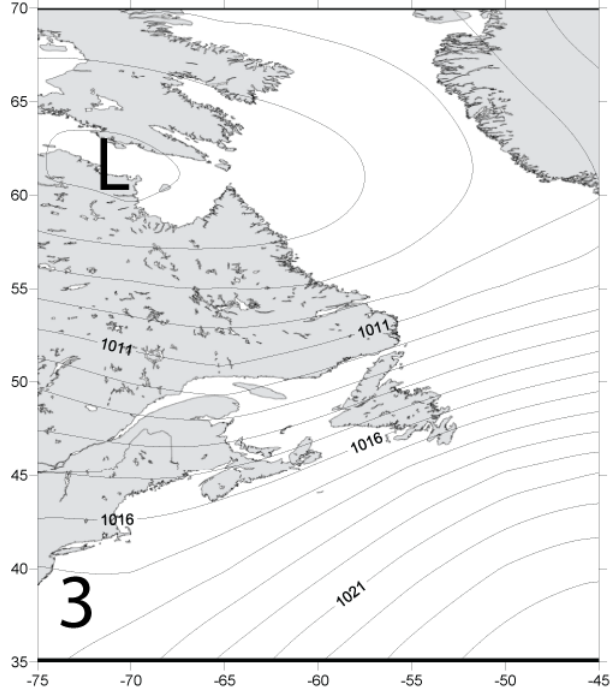


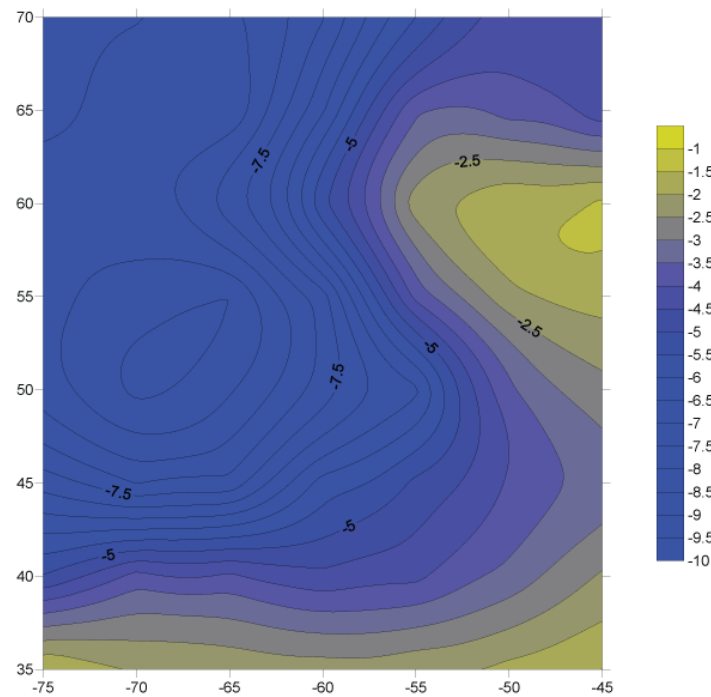
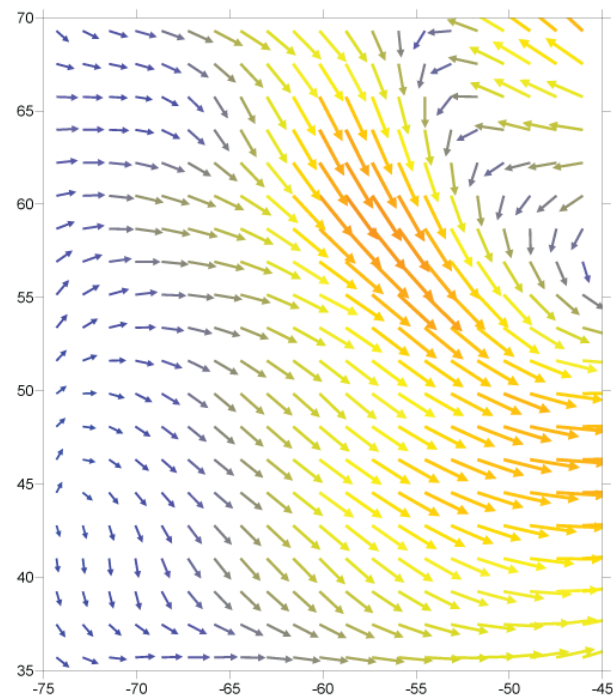
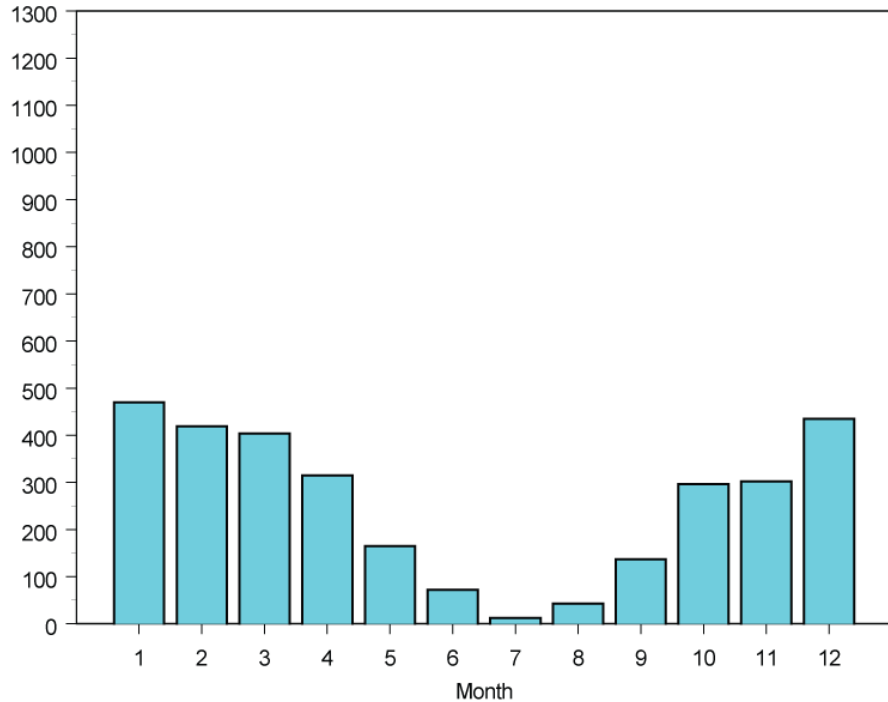
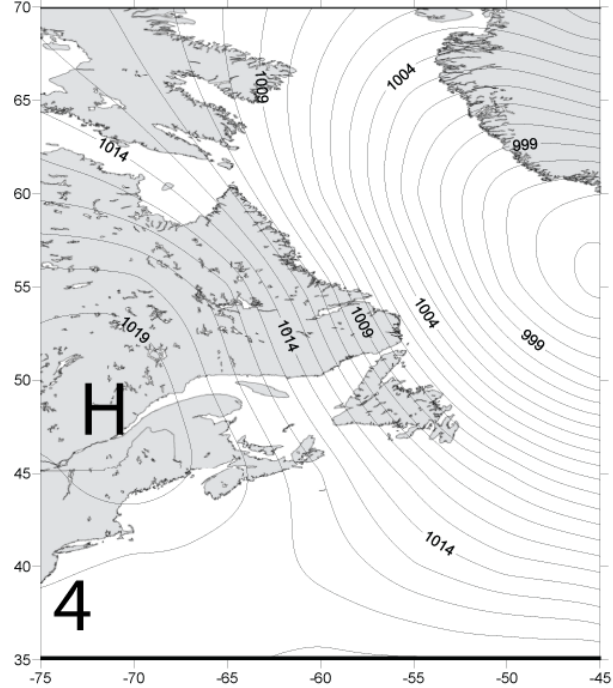
Synoptic grid

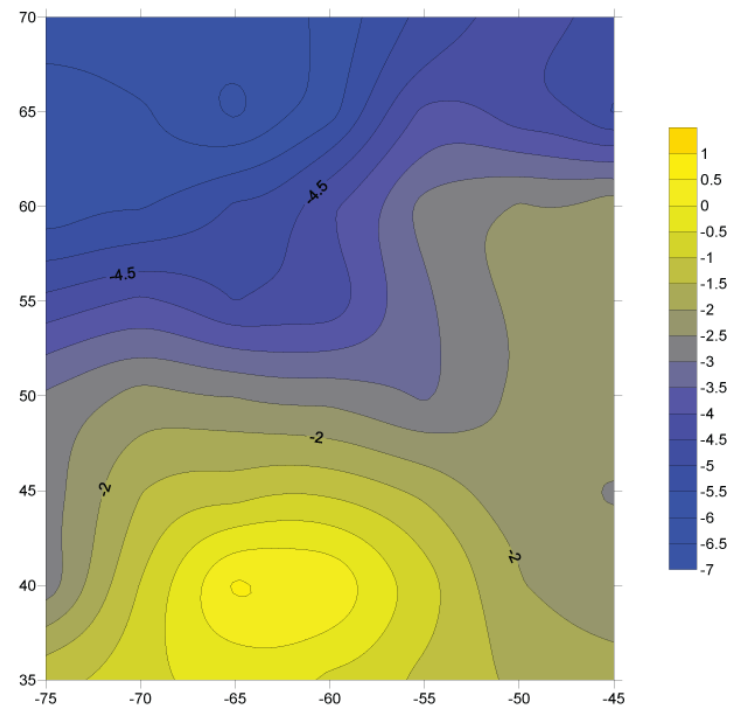
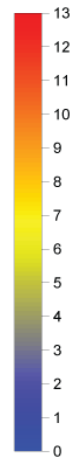
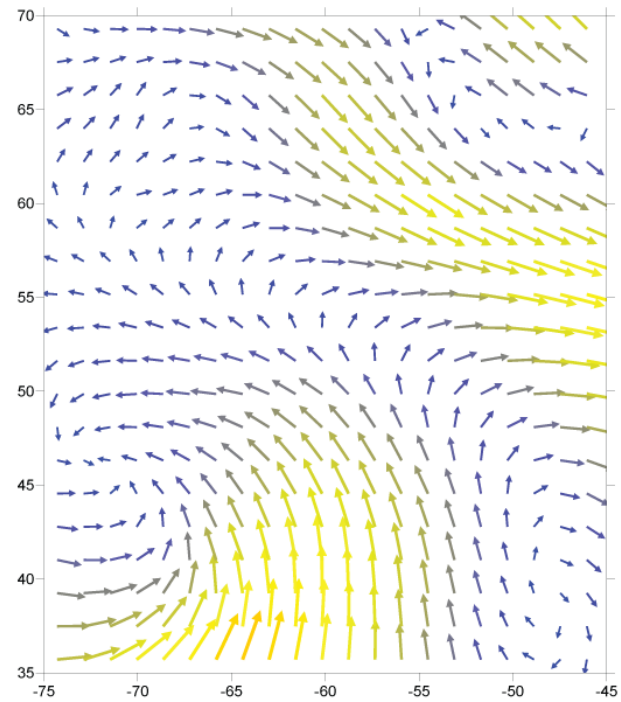
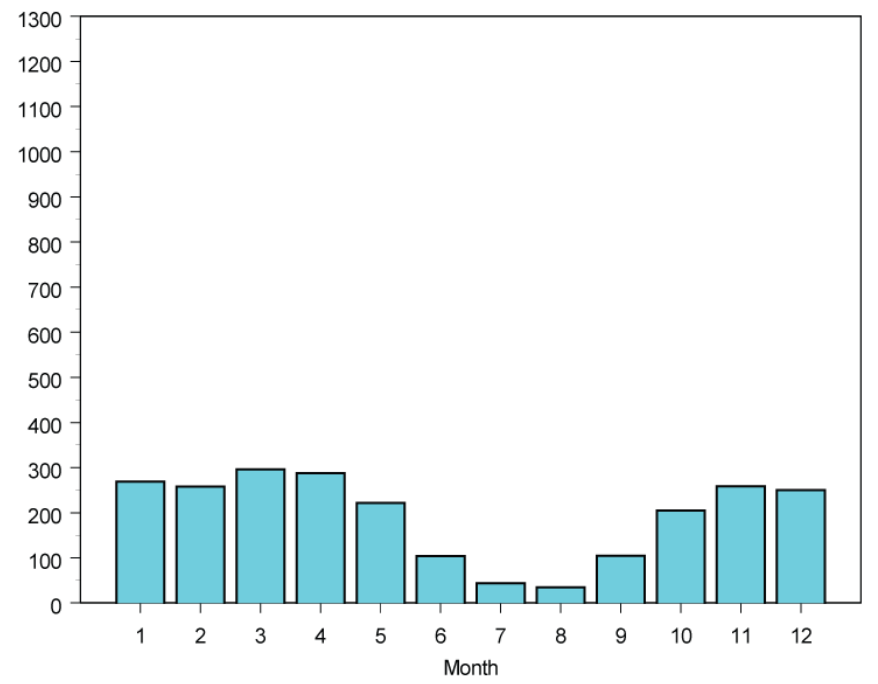
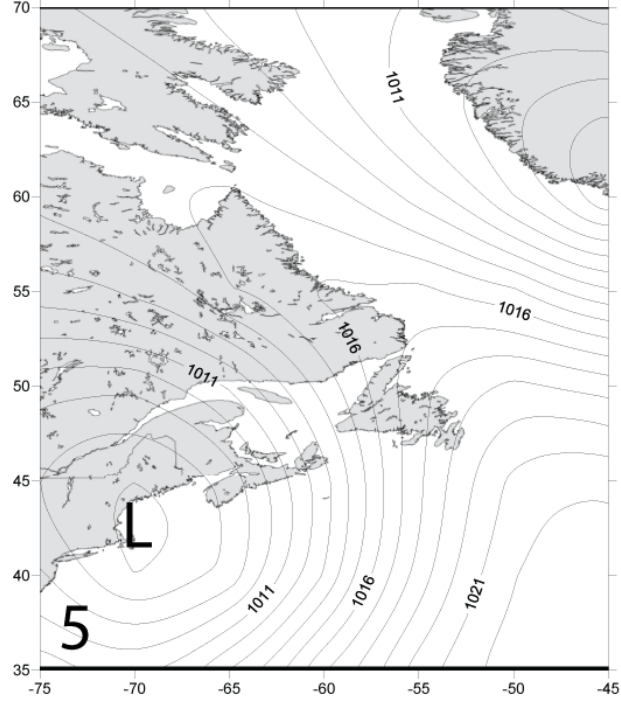


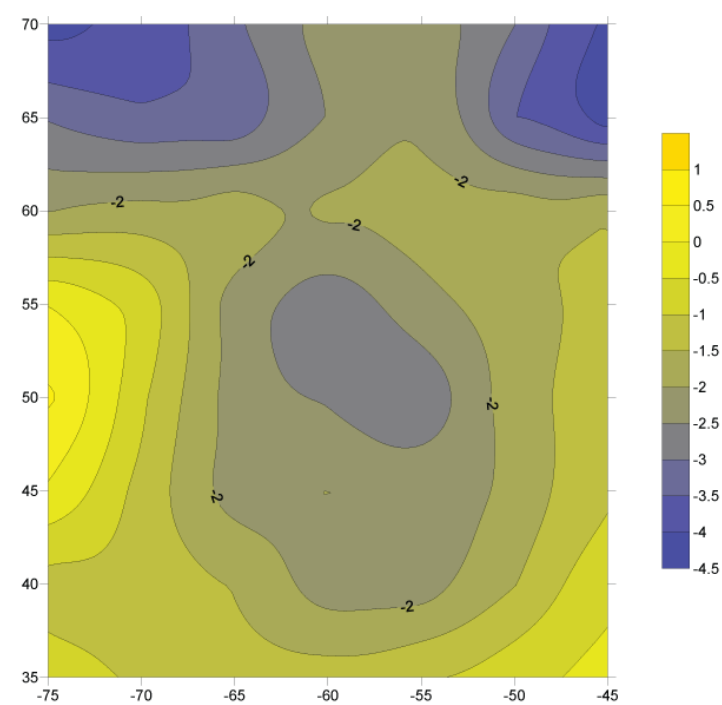
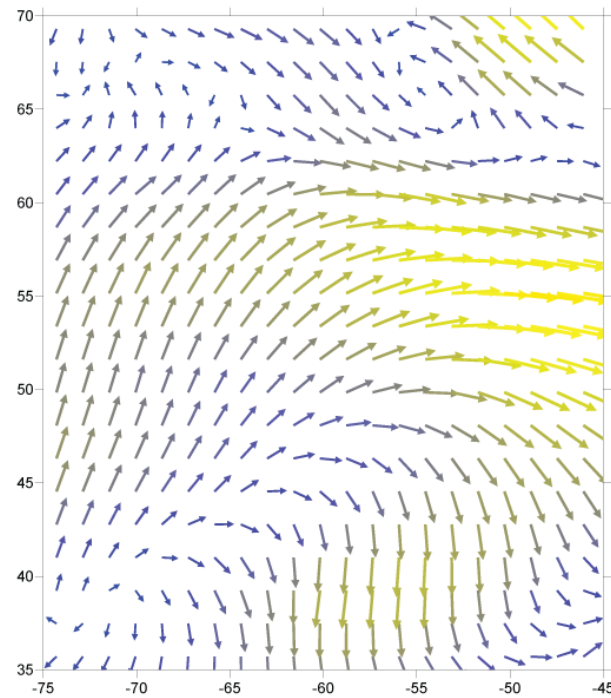
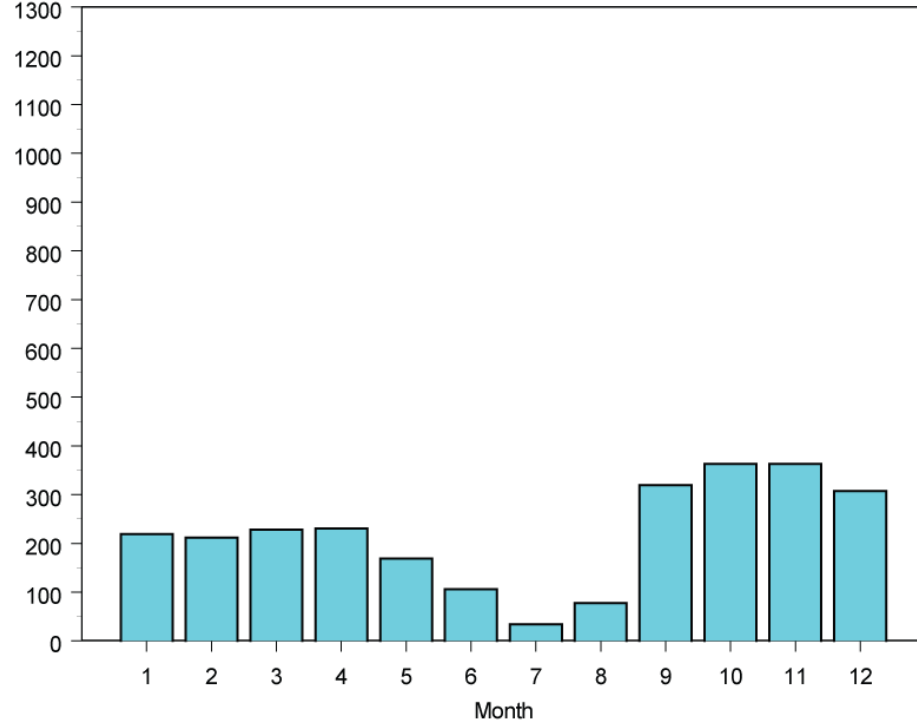
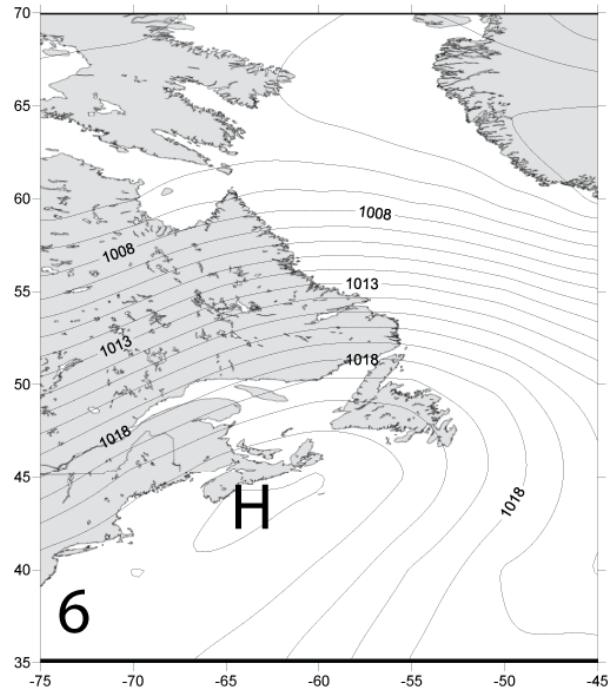


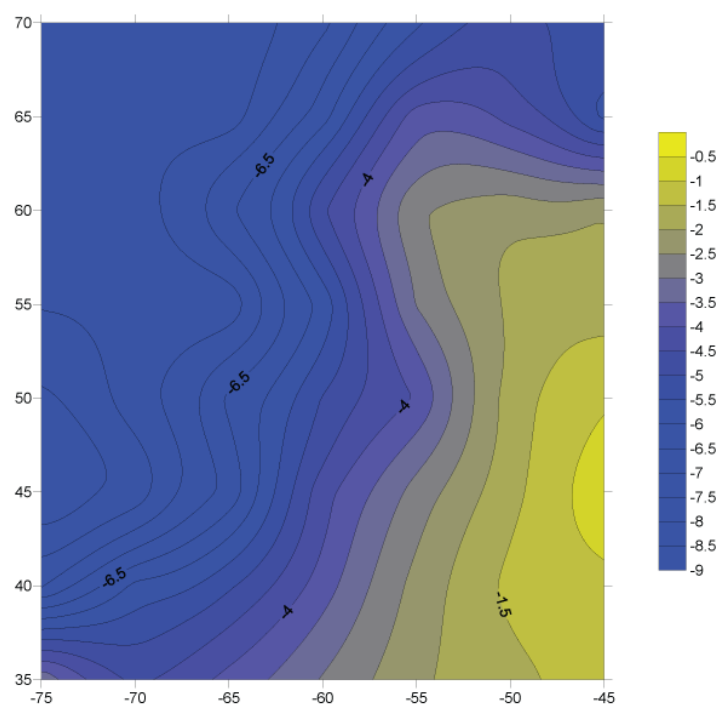
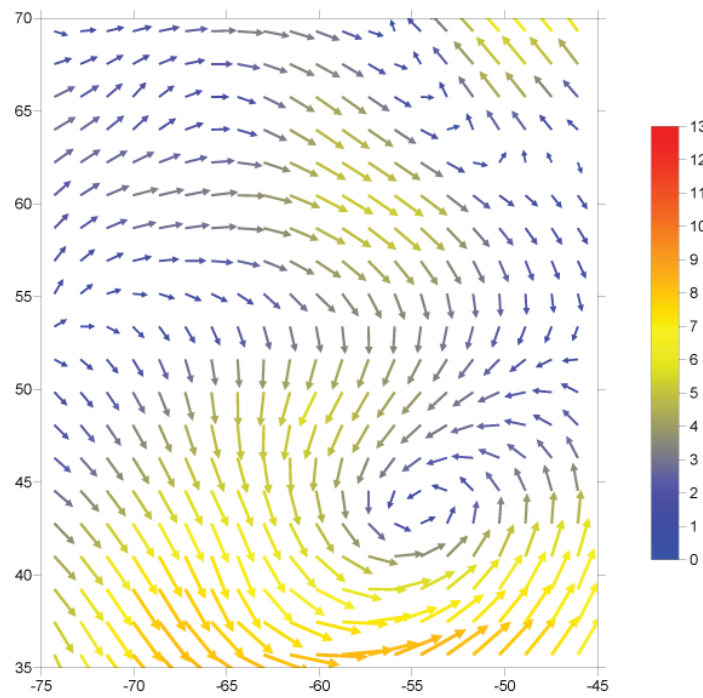
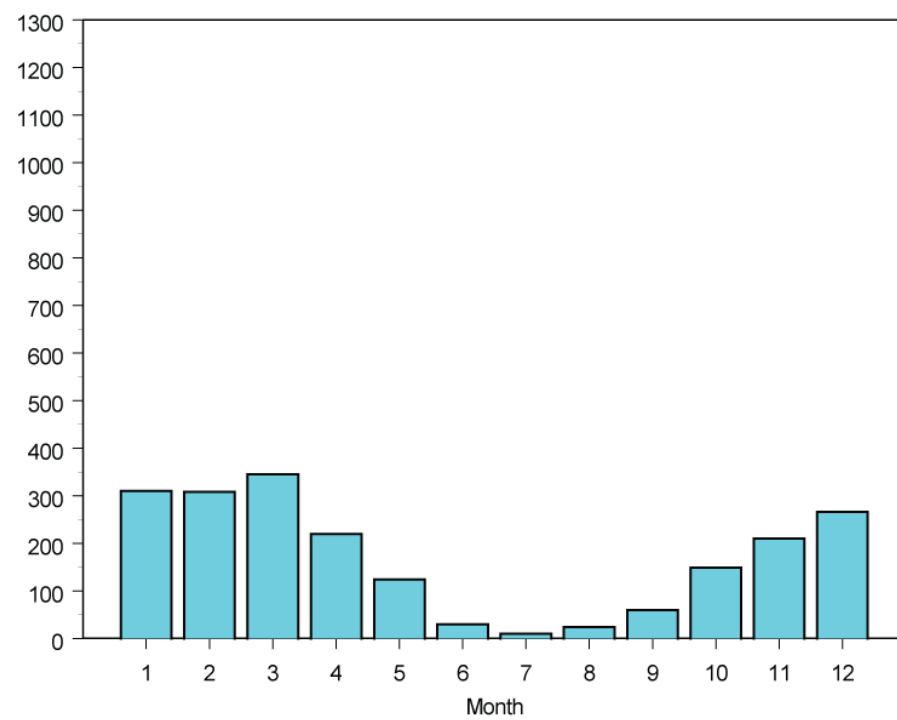
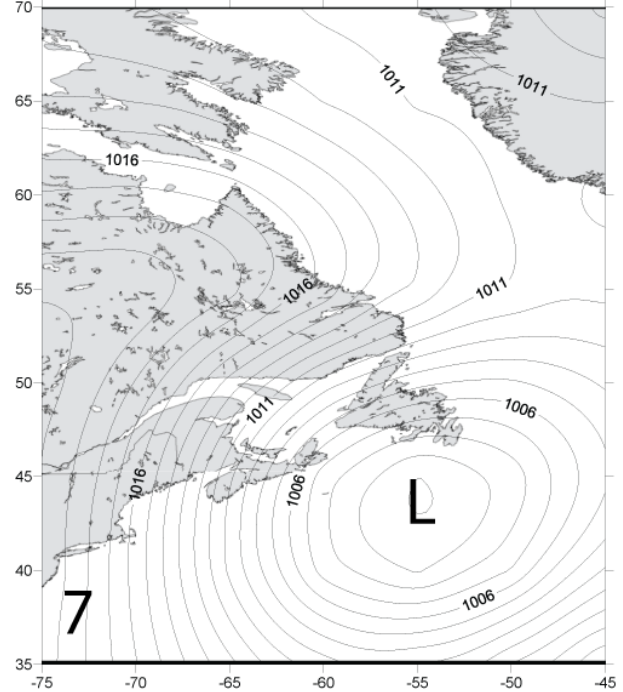












Summary

Weather Pattern	Season	Pressure	Winds	Air T
1	Sum	Trough	Weak NW/W	Warm
2	Win/Spr	Strong L	E/NE (in N), W/SW (in S)	Cool W, Avg E
3	Sum	Trough, weak L over continent	SW	Very warm
4	Win/Spr	Strong trough	NW/W	Very cool
5	Win/Spr	Weak L	NW (in N), S (in S)	Cool N, Avg S
6	Fall/Win	Strong H	S/SW	Slightly cool
7	Win/Spr	Strong L	N/NW (in N), W/SW (in S)	Cool W

Patterns and NAO/AO

Season	AO correlation (ρ)	NAO correlation (ρ)
Spr	WP7: -0.40	
Sum		
Fall	WP2: -0.30	WP2: -0.27
Win	WP2: -0.47 WP7: -0.34	WP2: -0.50 WP7: -0.31

Both WP2 and WP7 are winter, L pressure storm patterns.

Goals from the PRS Workshop in February

– 2. Compile surface condition data

- **Air Temperature** (NCEP-NCAR) all of N. Atlantic 1950-2007 – daily
- **u and v wind** (NCEP-NCAR) all of N. Atlantic 1950-2007 – daily
- **Mixed Layer Depth** (GODAS) most (some spatial limitations) of N. Atlantic 1980-2007 - monthly
- **Salinity** (SODA) all of N. Atlantic 1958-2007 - monthly
- **Sea Surface Temperature** (SODA) all of N. Atlantic 1958-2007 – monthly
- Need chlorophyll a (suggestions?)

Goals from the PRS Workshop in February

- 3. Show trajectory of some years and see how surface conditions respond
 - Two examples: SST and MLD

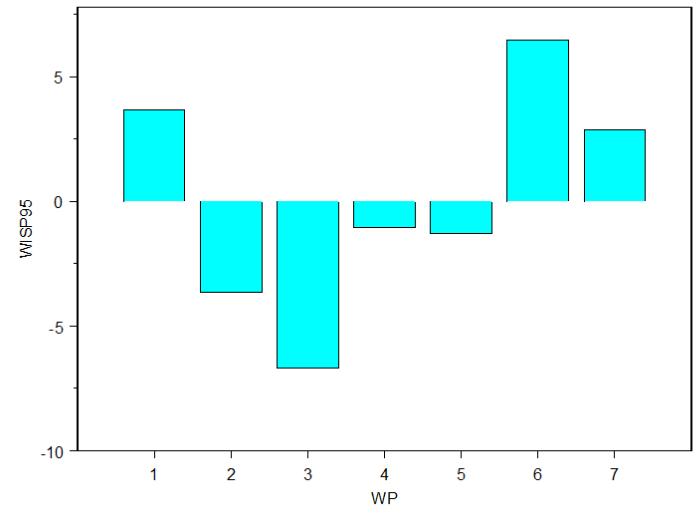
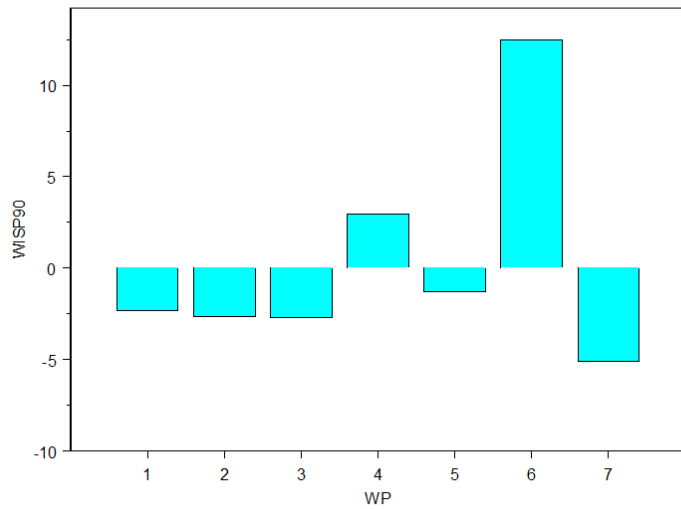
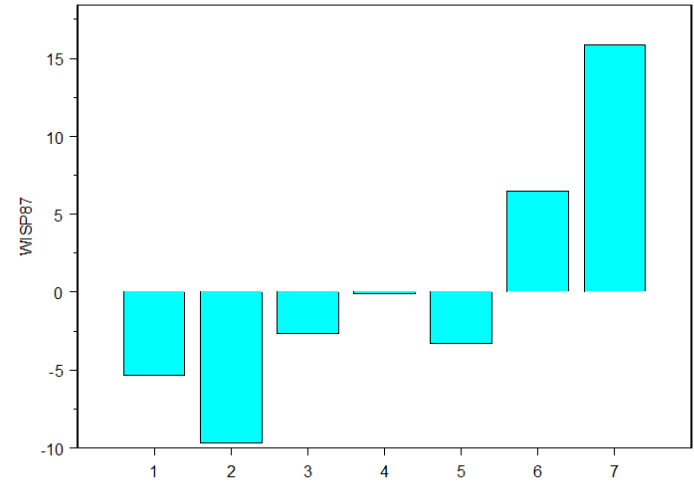
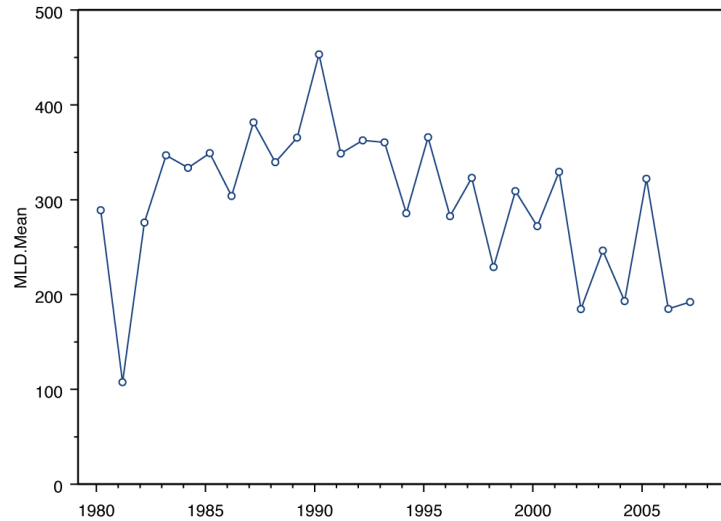
MLD and SST methods

- Took mean MLD and SST value for Western Atlantic region (35-70 N; 75-45 W)
 - Subregions will work better (you'll see why)
- Took cumulative frequency (days) of each weather pattern
- Constructed a monthly time series from 1950-2007
- Looked for correlations
- Compared different time periods using pattern anomalies

Correlations

Weather Pattern	MLD Correlation (ρ)	SST Correlation (ρ)
1	-0.41	0.47
2	0.43	-0.47
3	-0.76	0.75
4	0.63	-0.63
5	0.58	-0.54
6	0.34	-0.17
7	0.60	-0.64

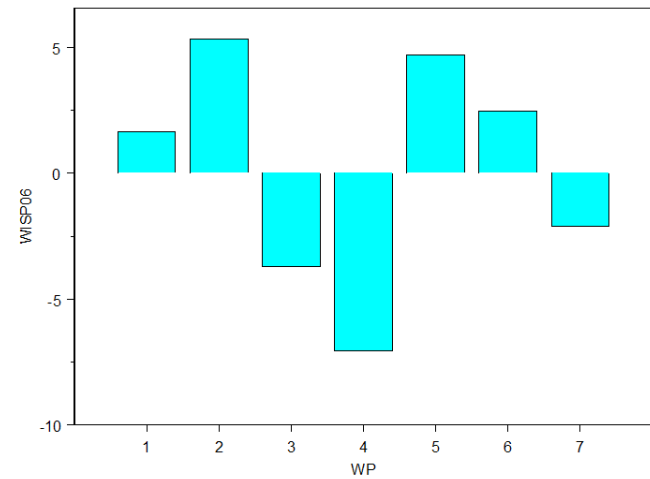
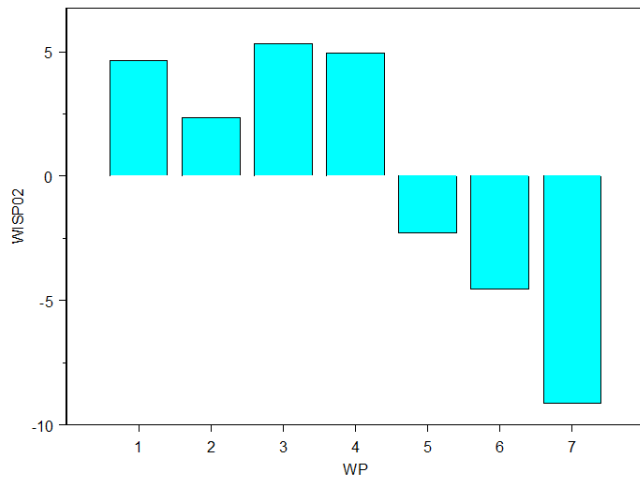
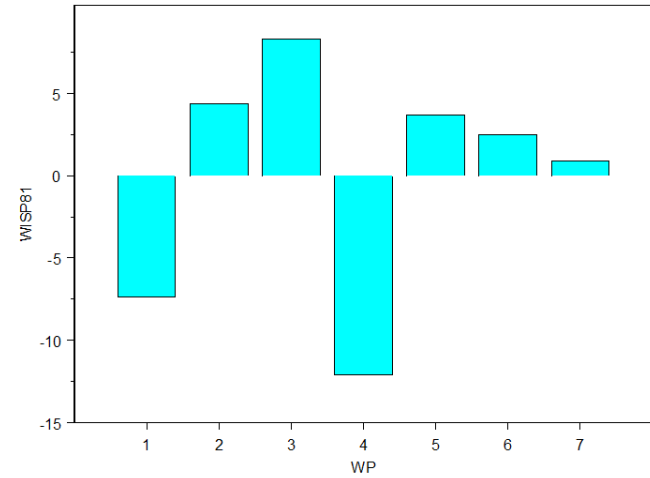
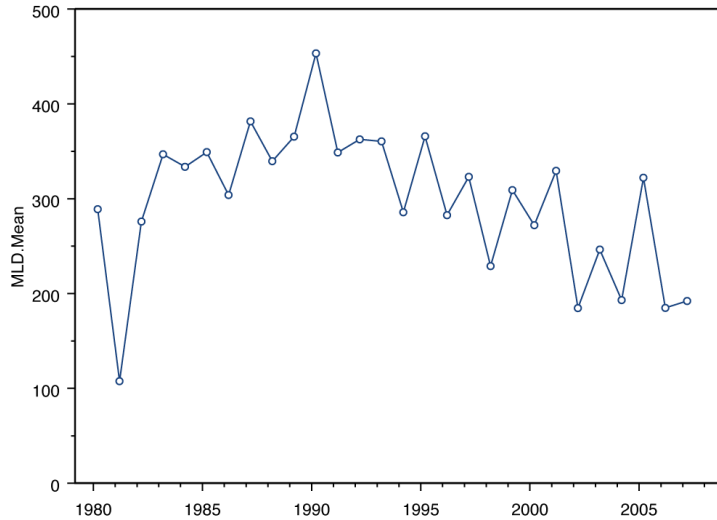
Max MLD Win/Spr



Win/Spr Max MLD

- Positive 6
 - Fall/Win, Strong H, S/SW, Slightly cool
- Positive 7
 - Win/Spr, Strong L, N/NW (in N), W/SW (in S), Cool W
- Negative 2
 - Win/Spr, Strong L, E/NE (in N), SW (in S), Cool W, Avg E
- Negative 3
 - Sum, trough, SW, very warm

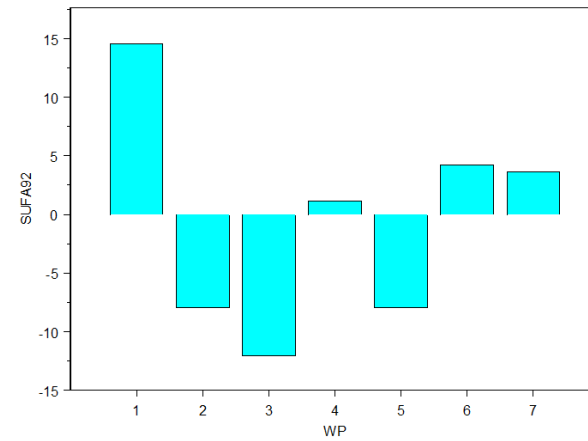
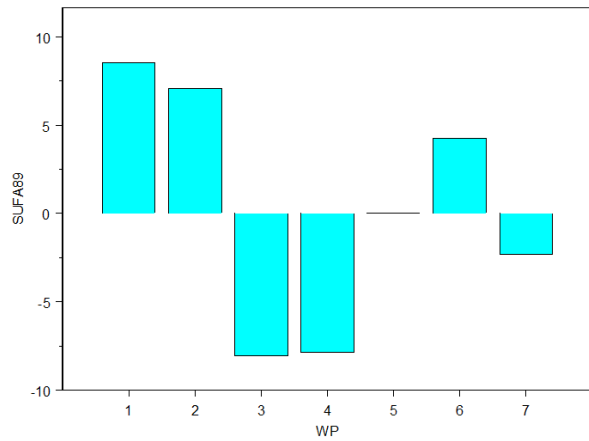
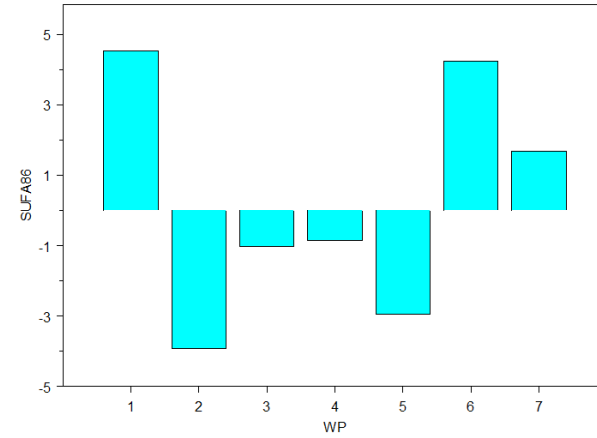
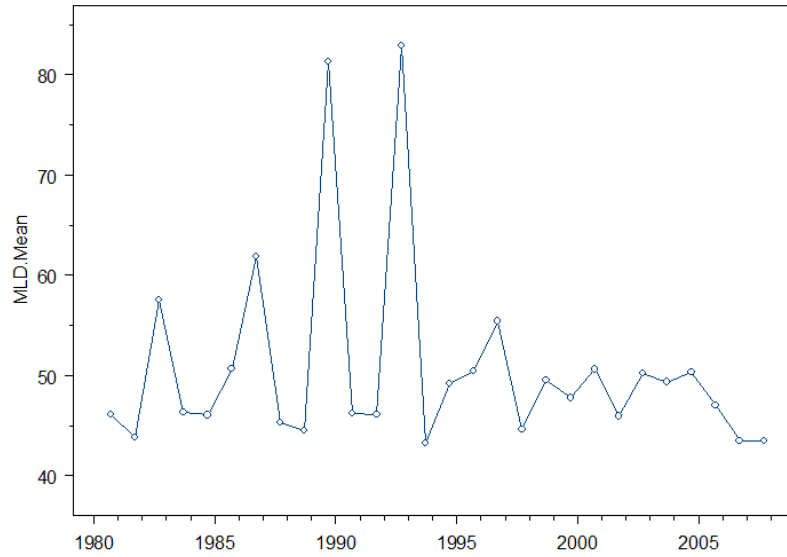
Min MLD Win/Spr



Win/Spr Min MLD

- Positive 2
 - Win/Spr, Strong L, E/NE (in N), SW (in S), Cool W, Avg E
- Negative 4
 - Win/Spr, trough, NW/W, very cool
- Negative 7
 - Win/Spr, strong L, N/NW (in N), W/SW (in S), cool W

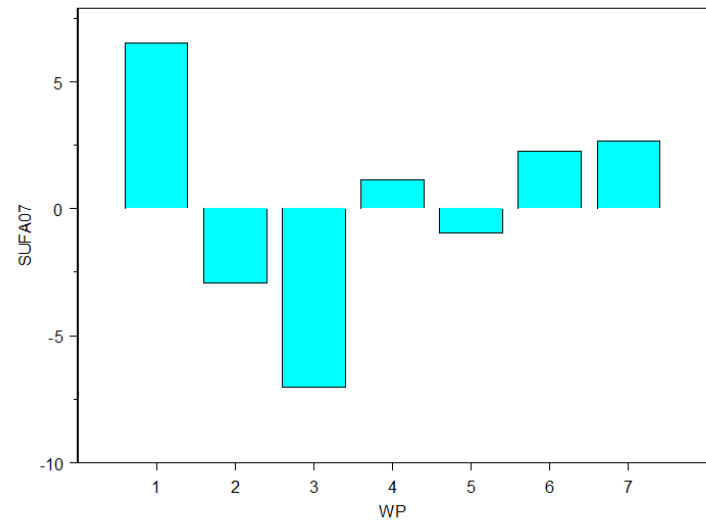
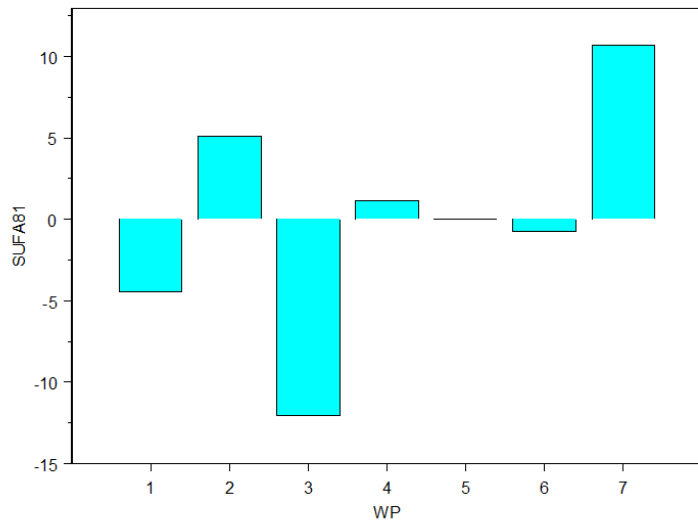
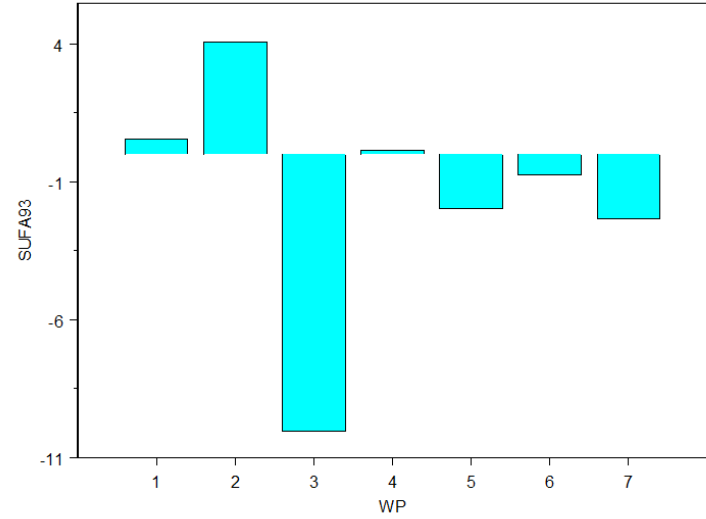
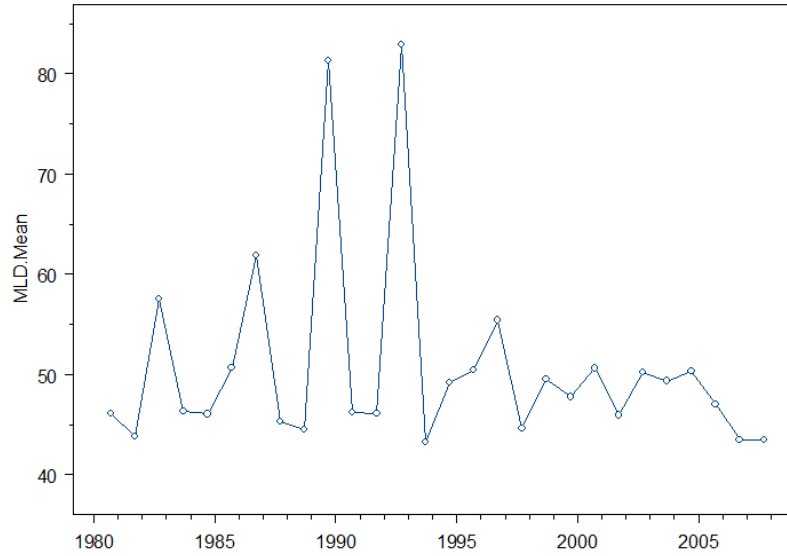
Max MLD Sum/Fall



Sum/Fall Max MLD

- Positive 1
 - Sum, trough, weak NW/W, warm
- Positive 6
 - Fall/Win, Strong H, S/SW, slightly cool
- Negative 3
 - Sum, trough, SW, very warm

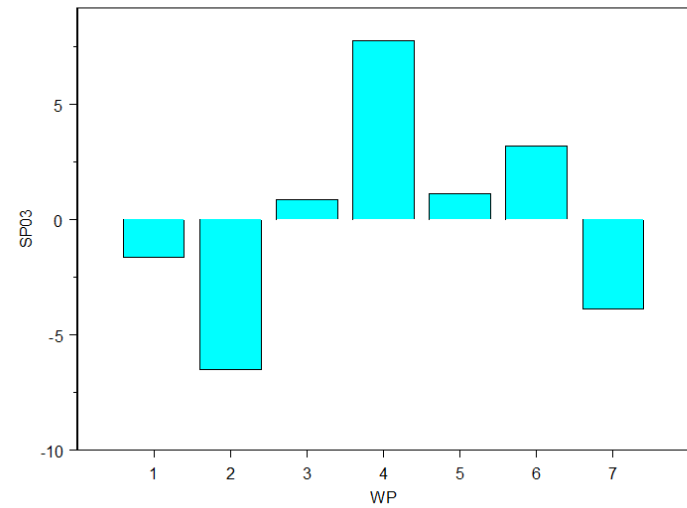
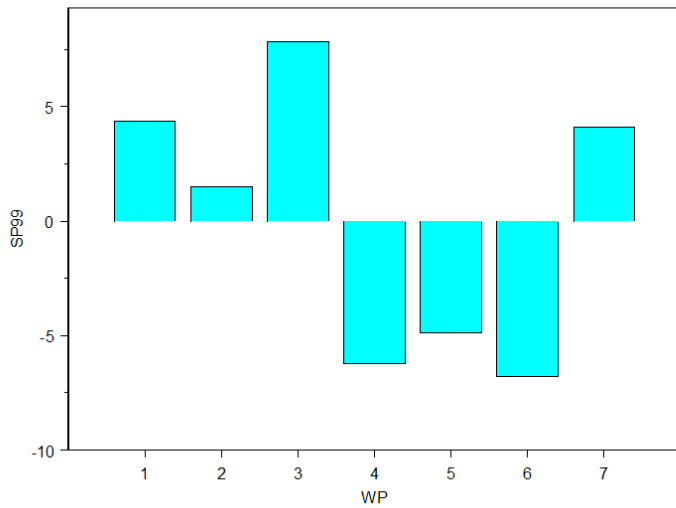
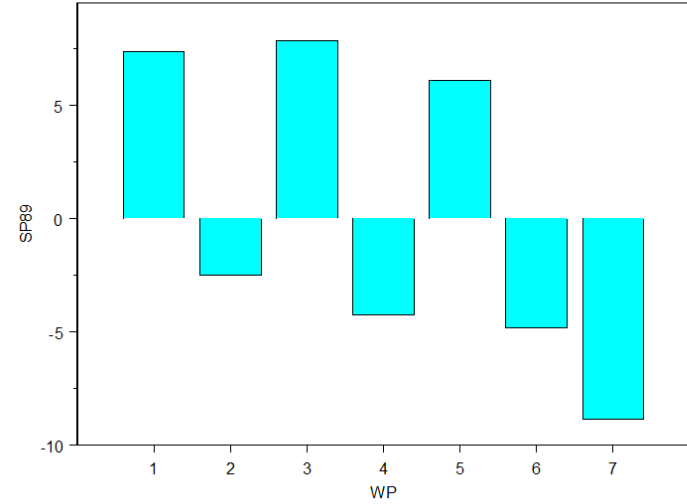
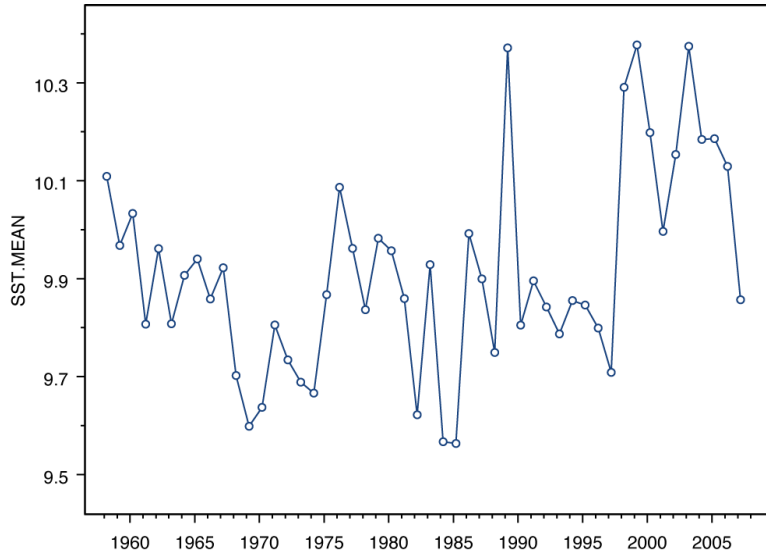
Min MLD Sum/Fall



Sum/Fall Min MLD

- Positive 3
 - Sum, trough, SW, very warm

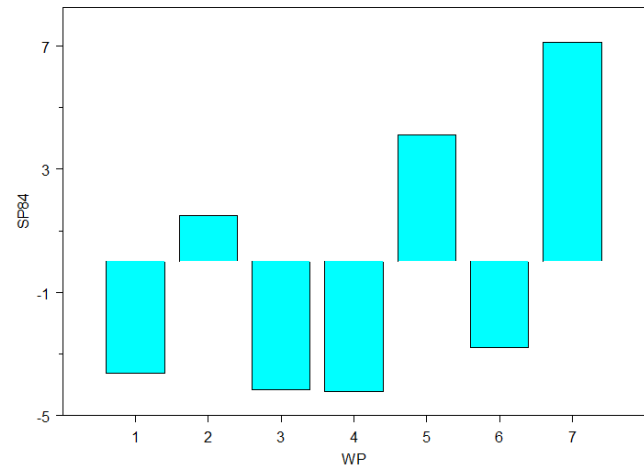
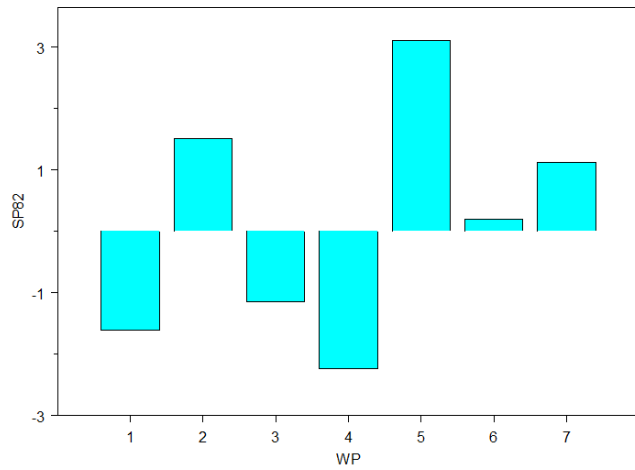
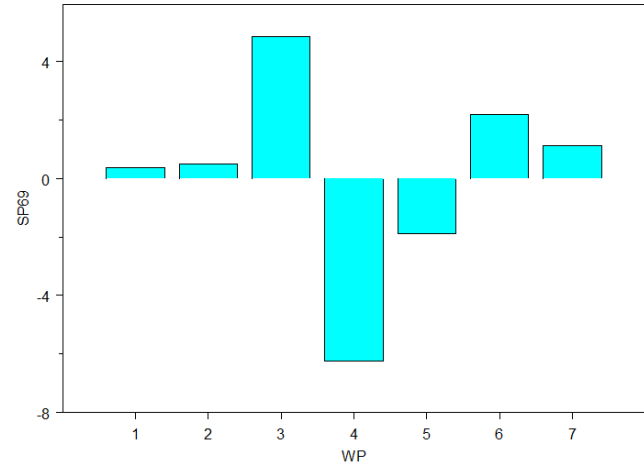
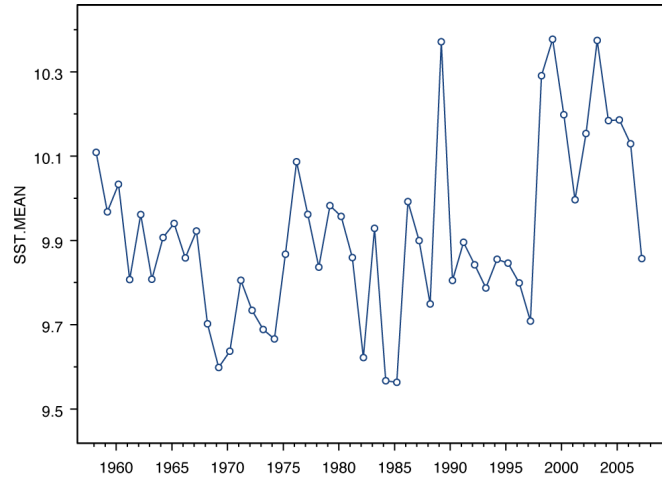
Spr Max SST



Spr Max SST

- Positive 1
 - Sum, trough, weak NW/W, warm
- Positive 3
 - Sum, trough, SW, very warm
- Negative 2
 - Win/Spr, Strong L, E/NE (in N), SW (in S), Cool W, Avg E

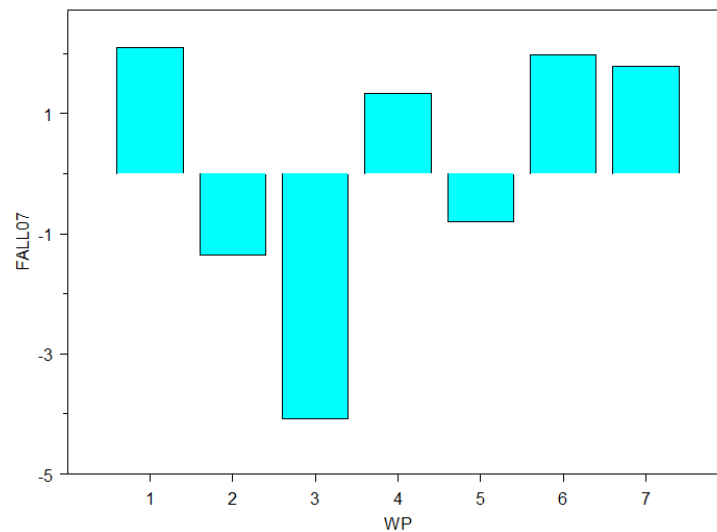
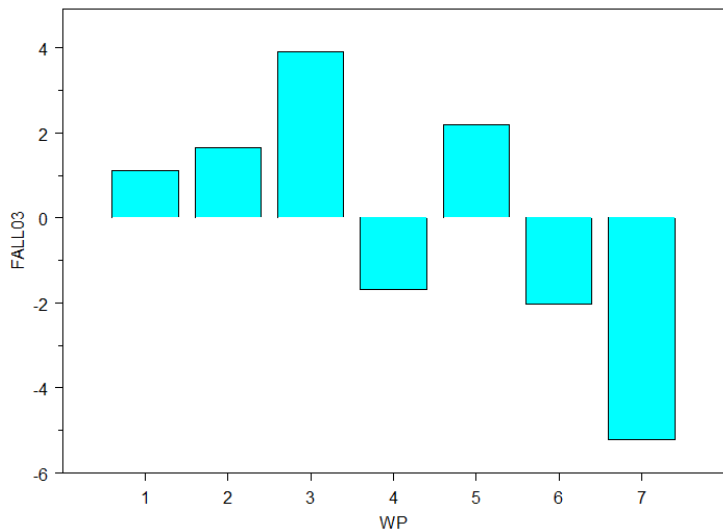
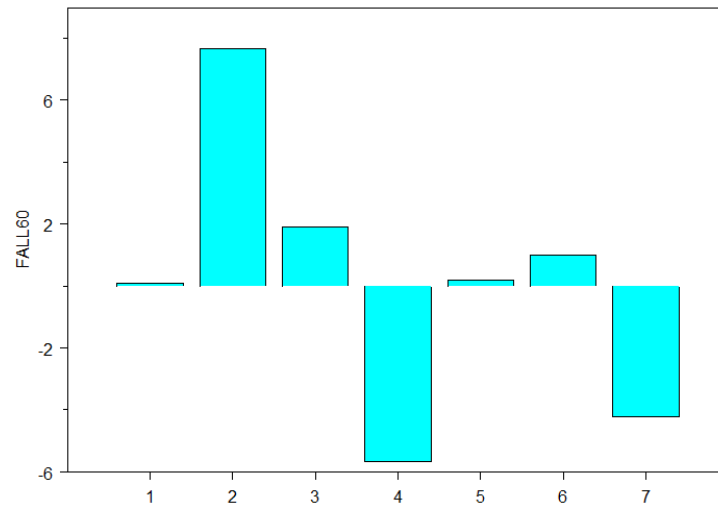
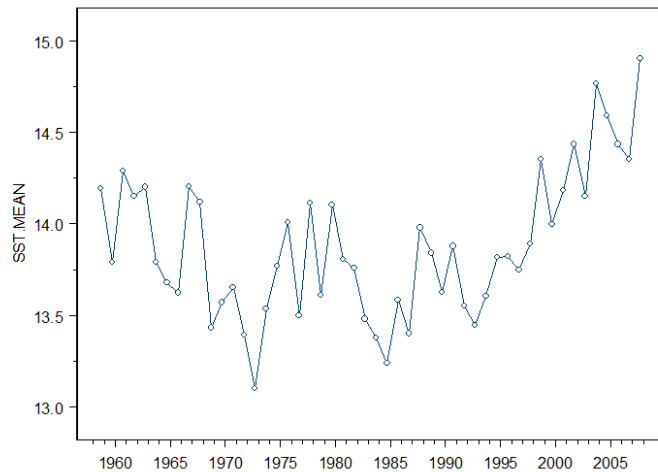
Spr Min SST



Spr Min SST

- Positive 2
 - Win/Spr, Strong L, E/NE (in N), SW (in S), Cool W, Avg E
- Positive 7
 - Win/Spr, Strong L, N/NW (in N), W/SW (in S), Cool W
- Negative 1
 - Sum, trough, weak NW/W, warm
- Negative 4 (?)
 - Win/Spr, trough, NW/W, very cool

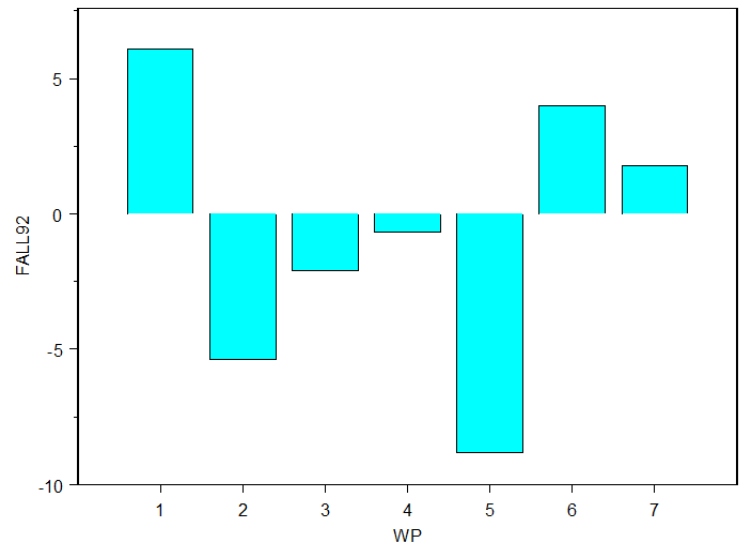
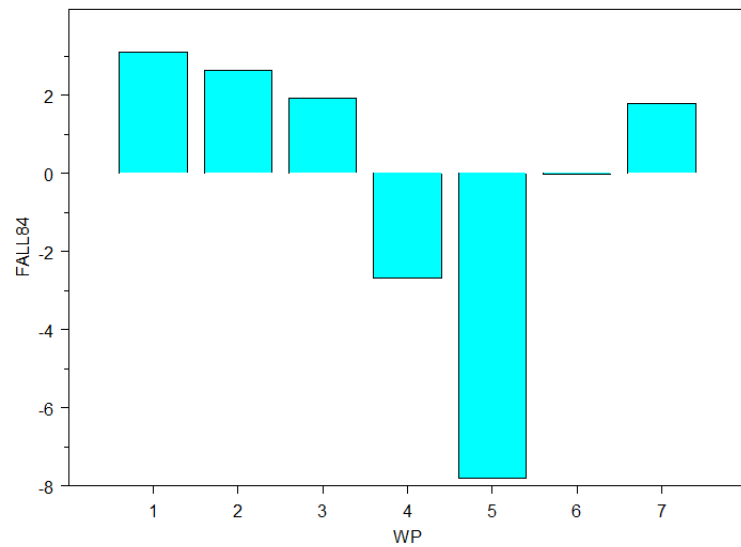
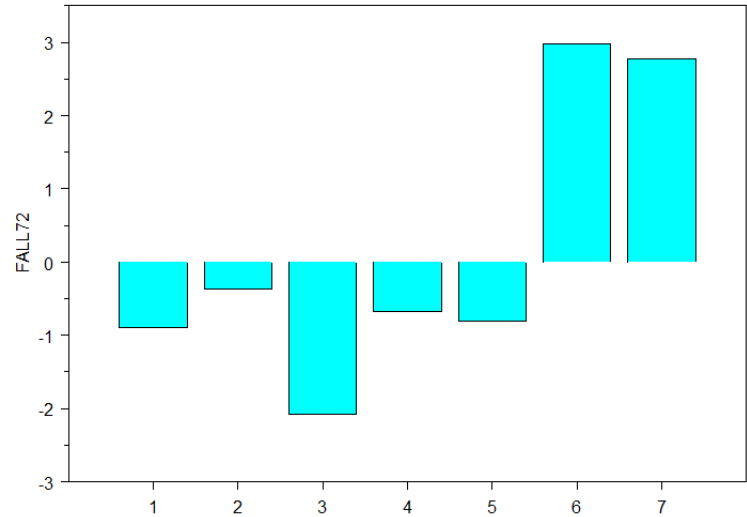
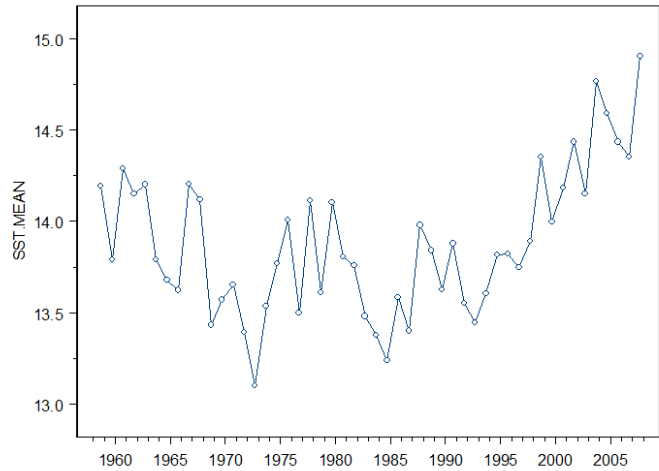
Fall Max SST



Fall Max SST

- No real consistency
 - Probably a strong lag from summer

Fall Min SST

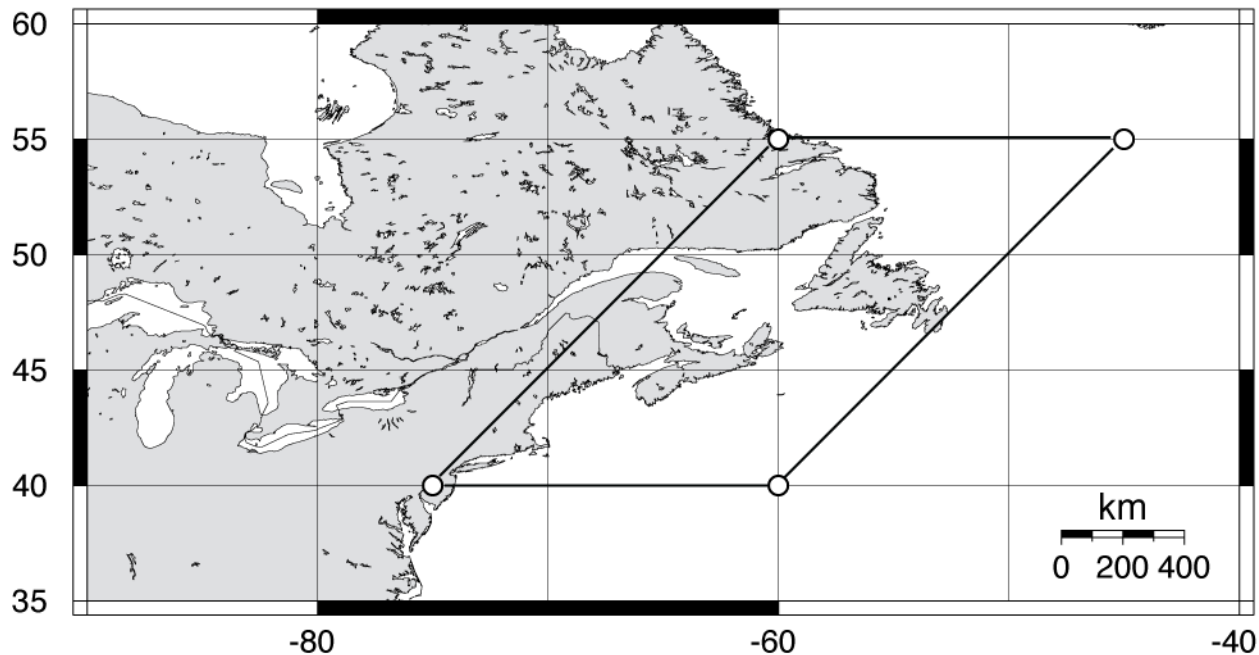


Fall Min SST

- Positive 1
 - Sum, trough, weak NW/W, warm
- Positive 7
 - Win/Spr, Strong L, N/NW (in N), W/SW (in S), Cool W
- Negative 5
 - Win/Spr, Weak L, NW (in N), S (in S), Cool N, Avg S

Goals from the PRS in February

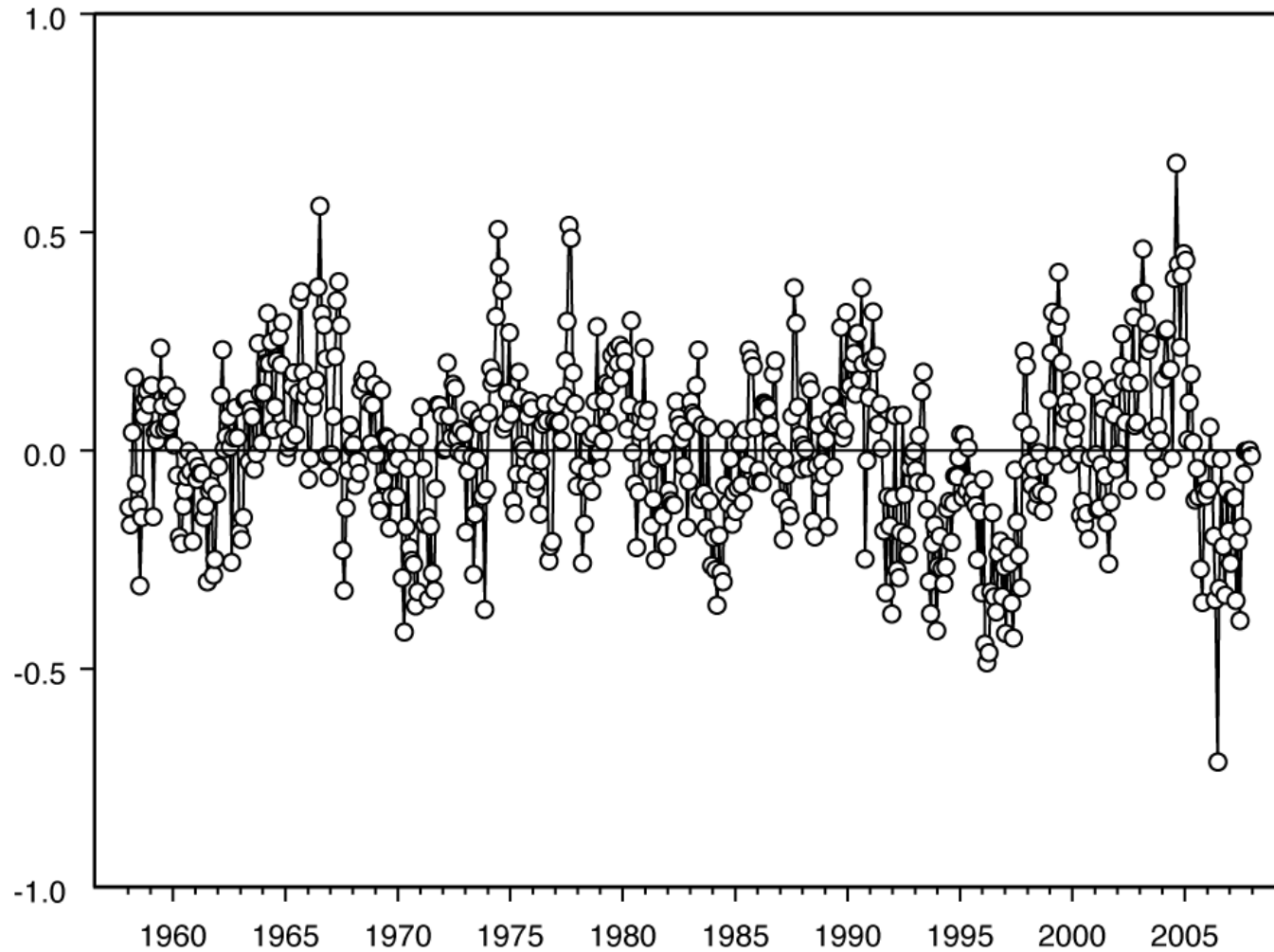
- 4. Relate synoptic climatologies to freshening events of the 1990s in W. Atlantic



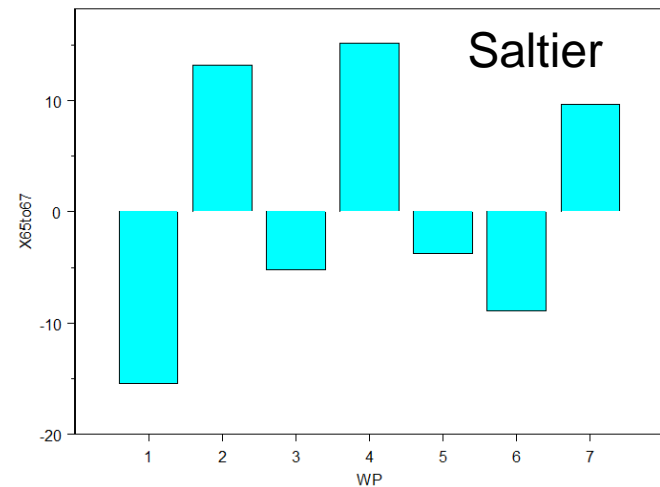
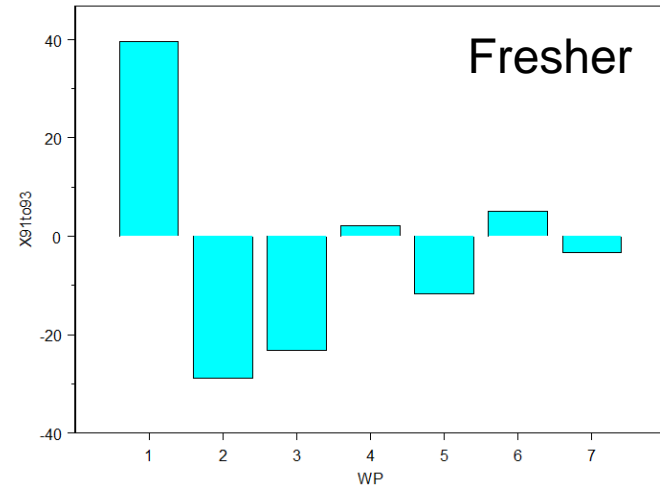
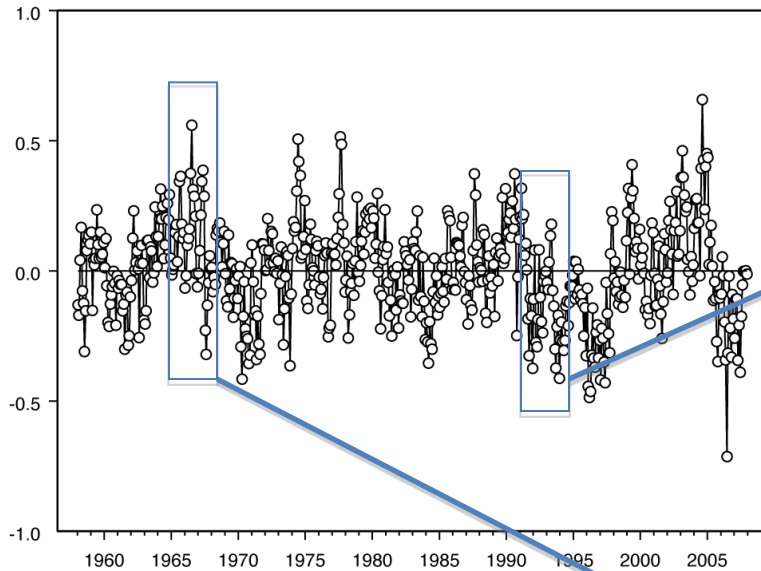
Salinity correlations

Weather Pattern	Salinity correlation (ρ)
1	-0.37
2	0.38
3	-0.65
4	0.57
5	0.46
6	0.16
7	0.58

Salinity anomaly time series

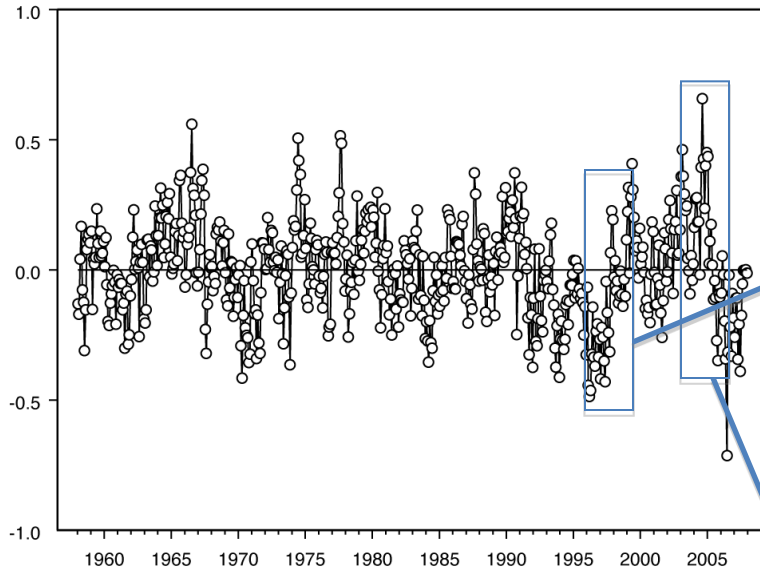


1990s Freshening

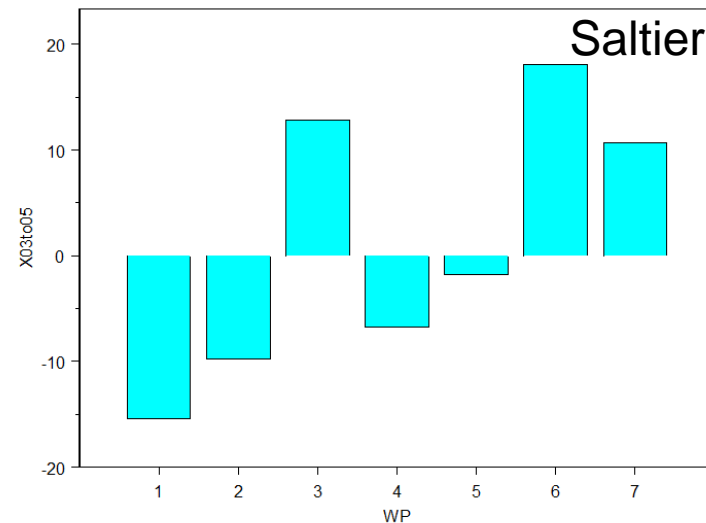
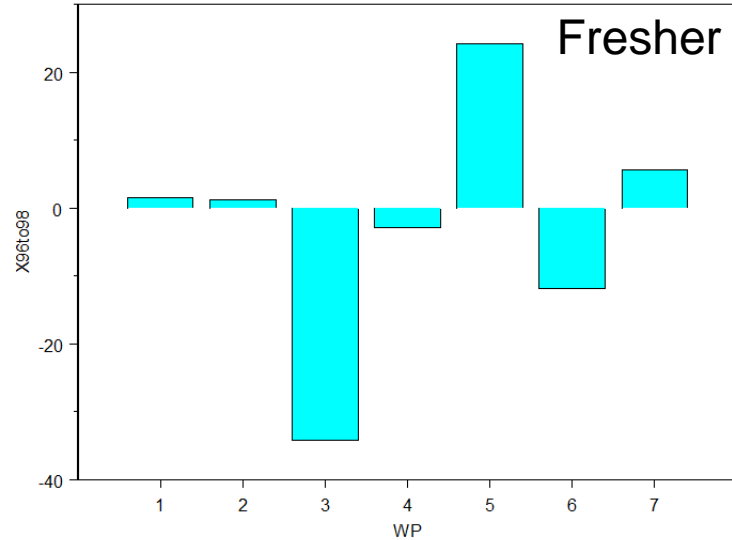


- 1 - Summer pattern, strong winds from NW, warm
- 2 - Win/Spr pattern, strong L, winds from S, SE, cool
- 4 - Win/Spr pattern, trough, strong winds from NW, cold
- 7 - Winter pattern, strong L, winds from S, SW

1990s Freshening



- 1 - Summer pattern, strong winds from NW, warm
- 3 - Summer pattern, strong H, winds from SW, very warm
- 5 - Win/Spr pattern, strong L, winds from S and NW
- 6 - Win/Spr pattern, strong H, winds from SW-W

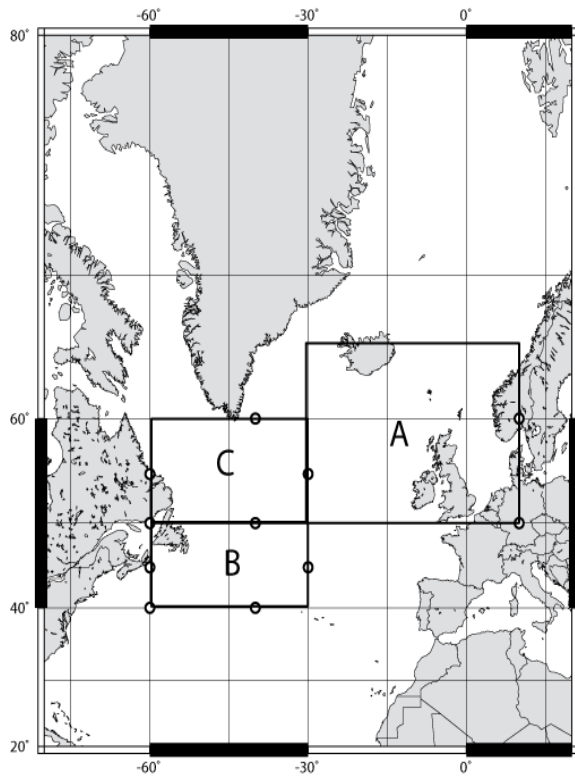


Next steps

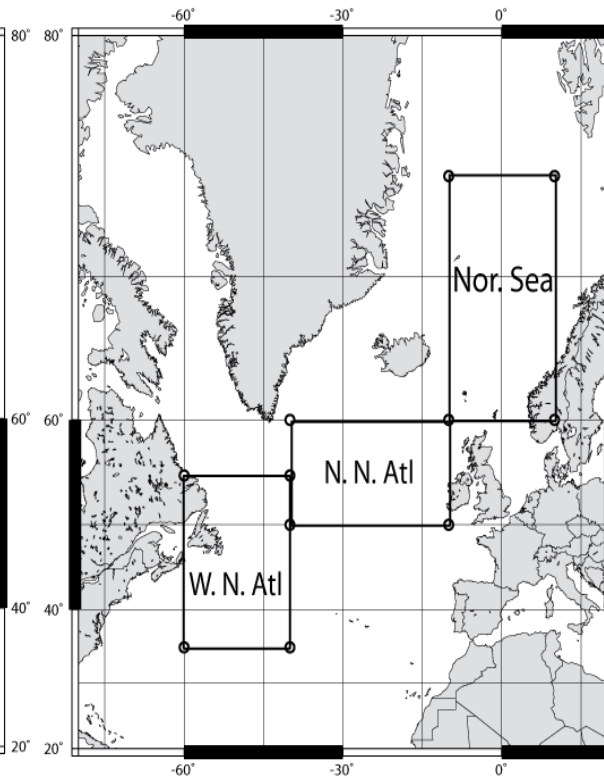
- Need chl a data
- Investigate lags for specific variables in more depth
- Investigation of particular regions (lat-long boundaries) for relationship to *Calanus*
 - Test specific hypotheses
 - Fit some generalized linear models *or* simple time-series predictors
- Other thoughts?

Downscaling Regions

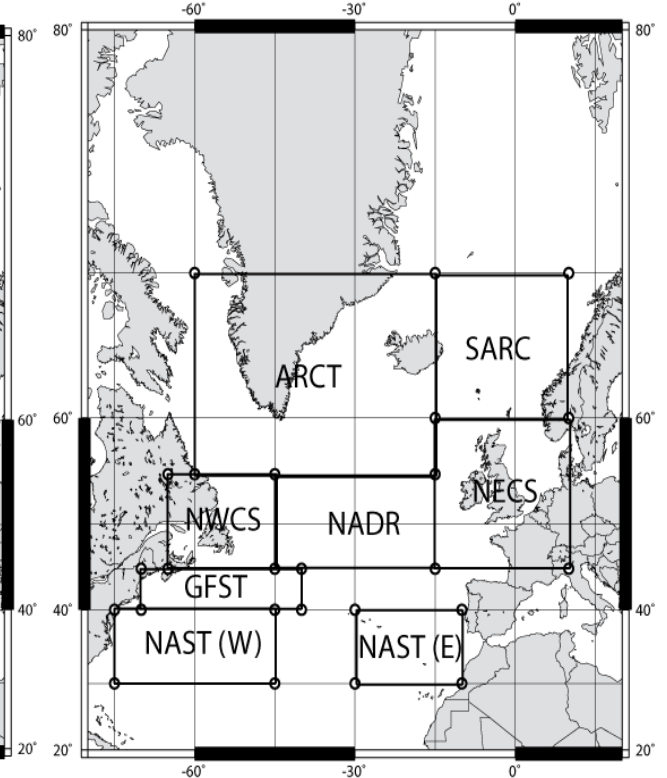
Planque et al. 1997



Bucklin et al. 2000



Helaouet & Beaugrand 2007



Year 2005

