"A dry martini," he said. "One. In a deep champagne goblet."

"Oui, monsieur."

"Just a moment. Three measures of Gordon's, one of vodka, half a measure of Kina Lillet. ***Shake*** it very well until it's ice-cold, then add a large thin slice of lemon-peel. Got it?"

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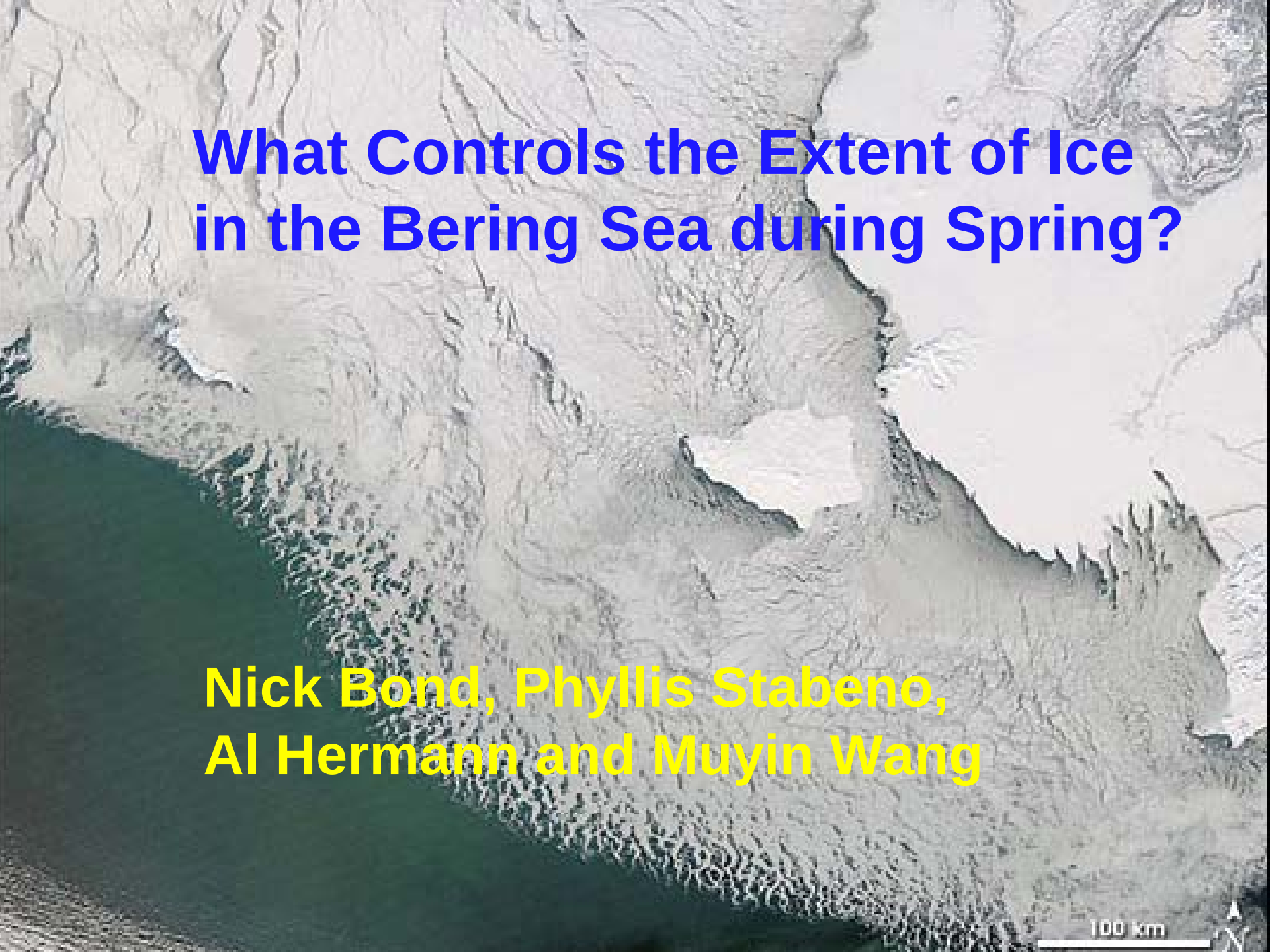
Ian Fleming gives a recipe for his Bond's preferred libation in the first Bond book, *Casino Royale* (1953), chapter 7

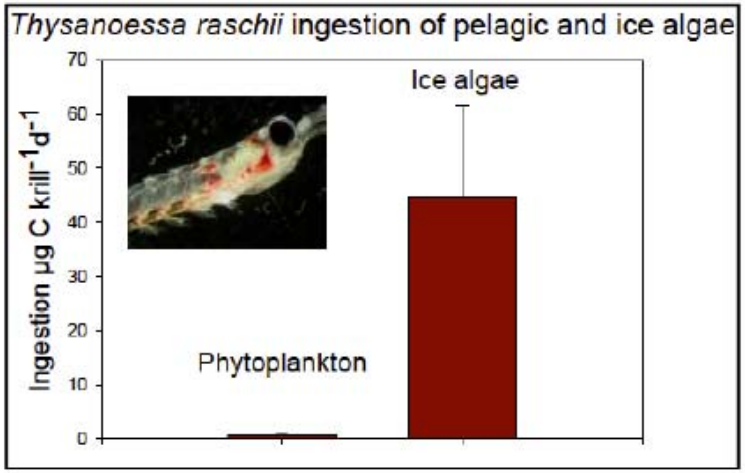
What Controls the Extent of Ice in the Bering Sea during Spring?



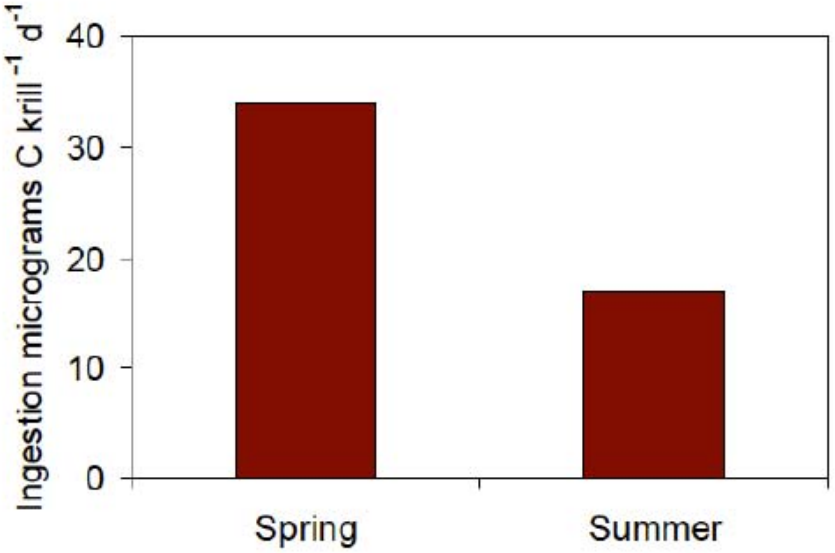
Nick Bond, Phyllis Stabeno,
Al Hermann and Muyin Wang

Ice algae were a significant food source for krill in early spring

In spring, euphausiids primarily feeding on ice algae, with some consumption of heterotrophs



In summer, chlorophyll ingestion rates were half spring rates, but growth rates the same or higher

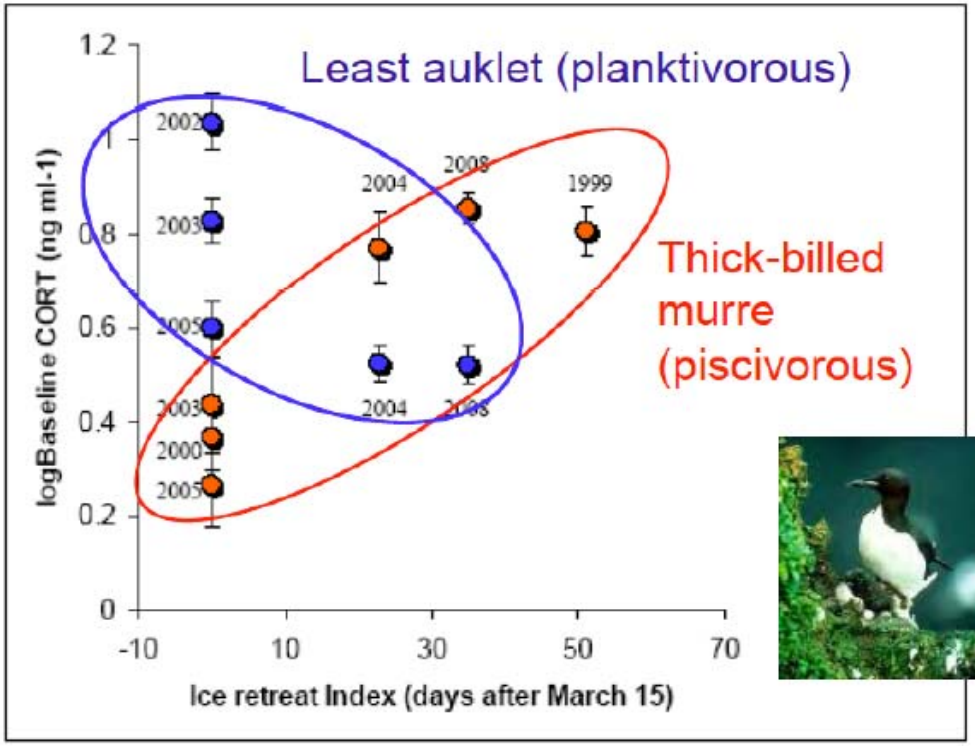


Heterotrophic protists and copepods likely contribute to summer diet (analysis in progress)

Trophic role of euphausiids: Lessard, Harvey

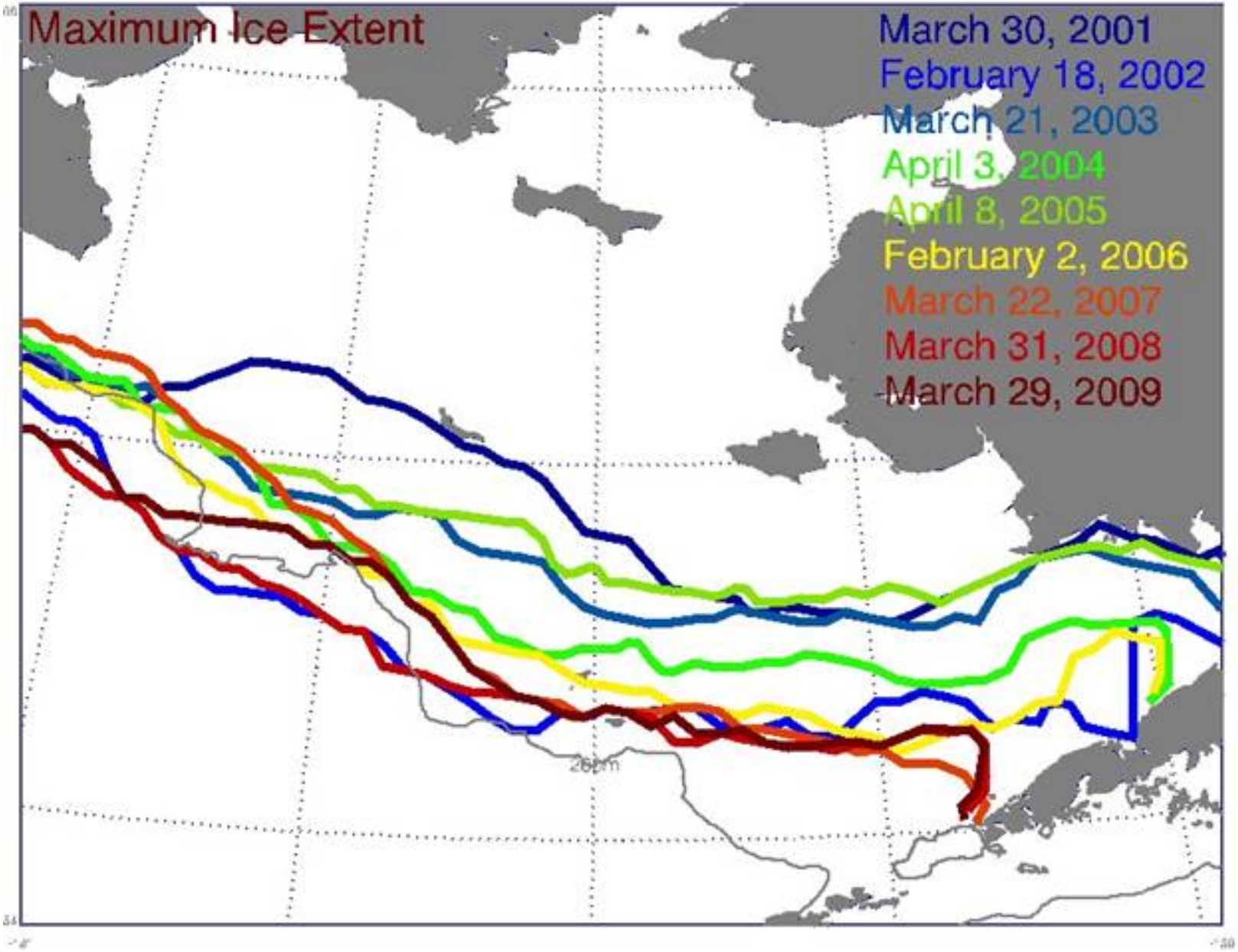
School of Oceanography
University of Washington

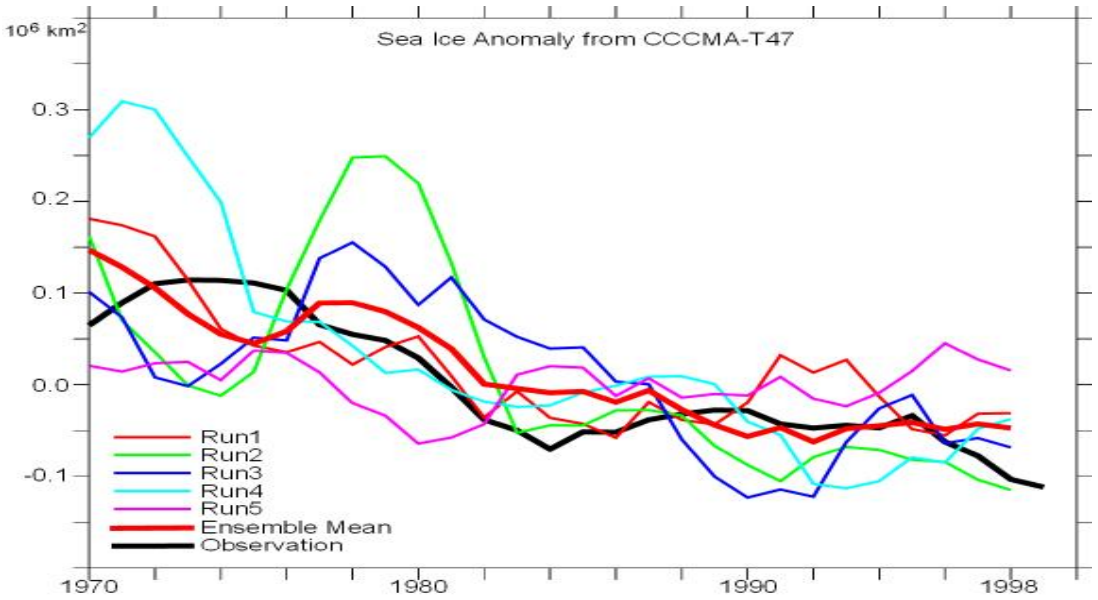
Less nutritional stress for planktivorous seabirds and more nutritional stress for piscivorous seabirds with later ice retreat



Timing of sea ice retreat (IRI: NOAA) and nutritional stress in planktivorous least auklets (LEAU) and piscivorous thick-billed murres (TBMU) breeding on St. Paul I.

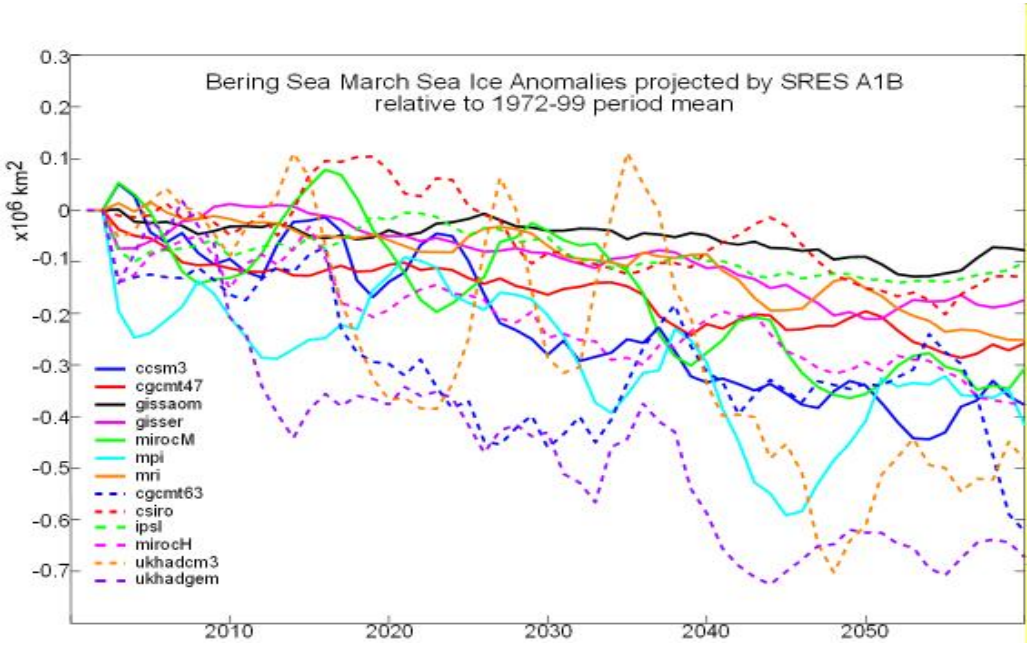
Seabird patch dynamics (stress): Kitaysky


Maximum Ice Extent
March 30, 2001
February 18, 2002
March 21, 2003
April 3, 2004
April 8, 2005
February 2, 2006
March 22, 2007
March 31, 2008
March 29, 2009

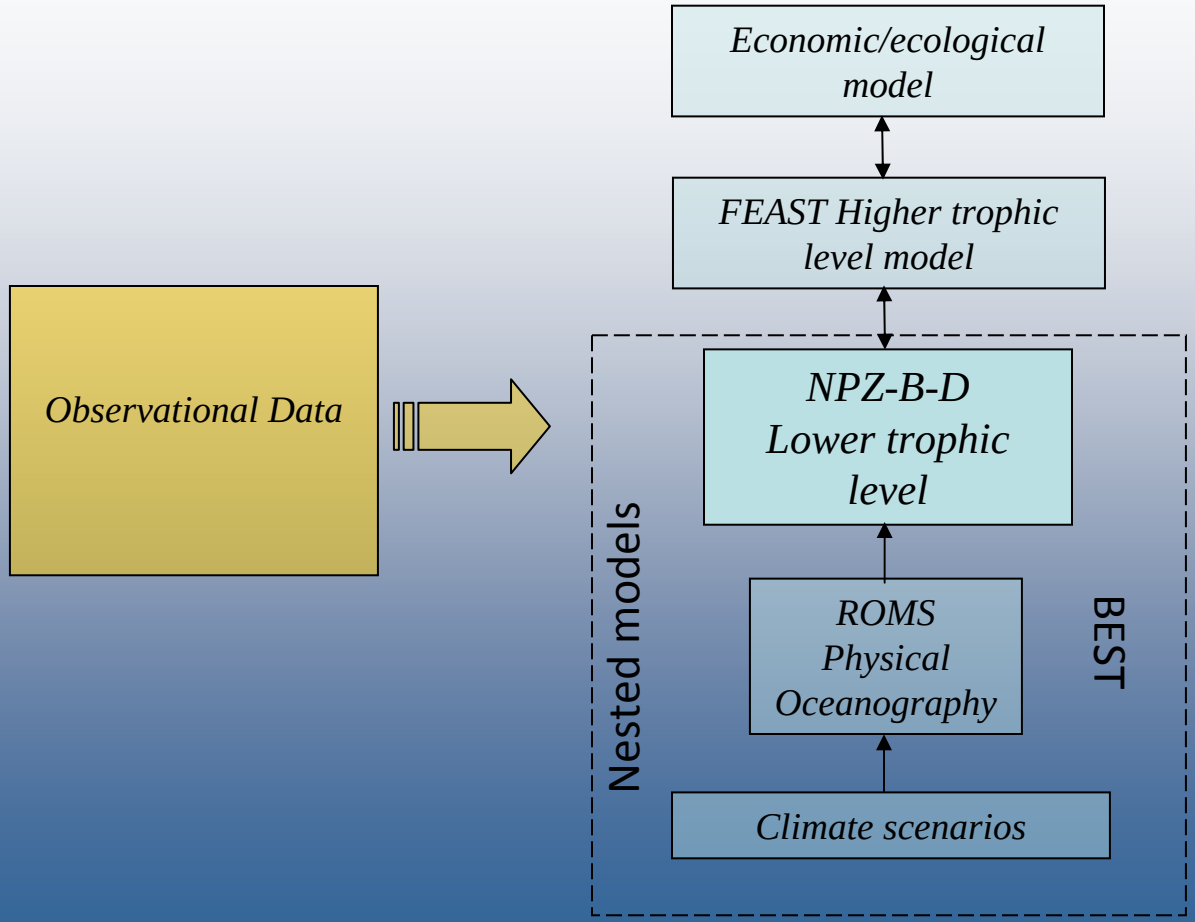


Bering Sea Ice Projection
Under A1B scenario

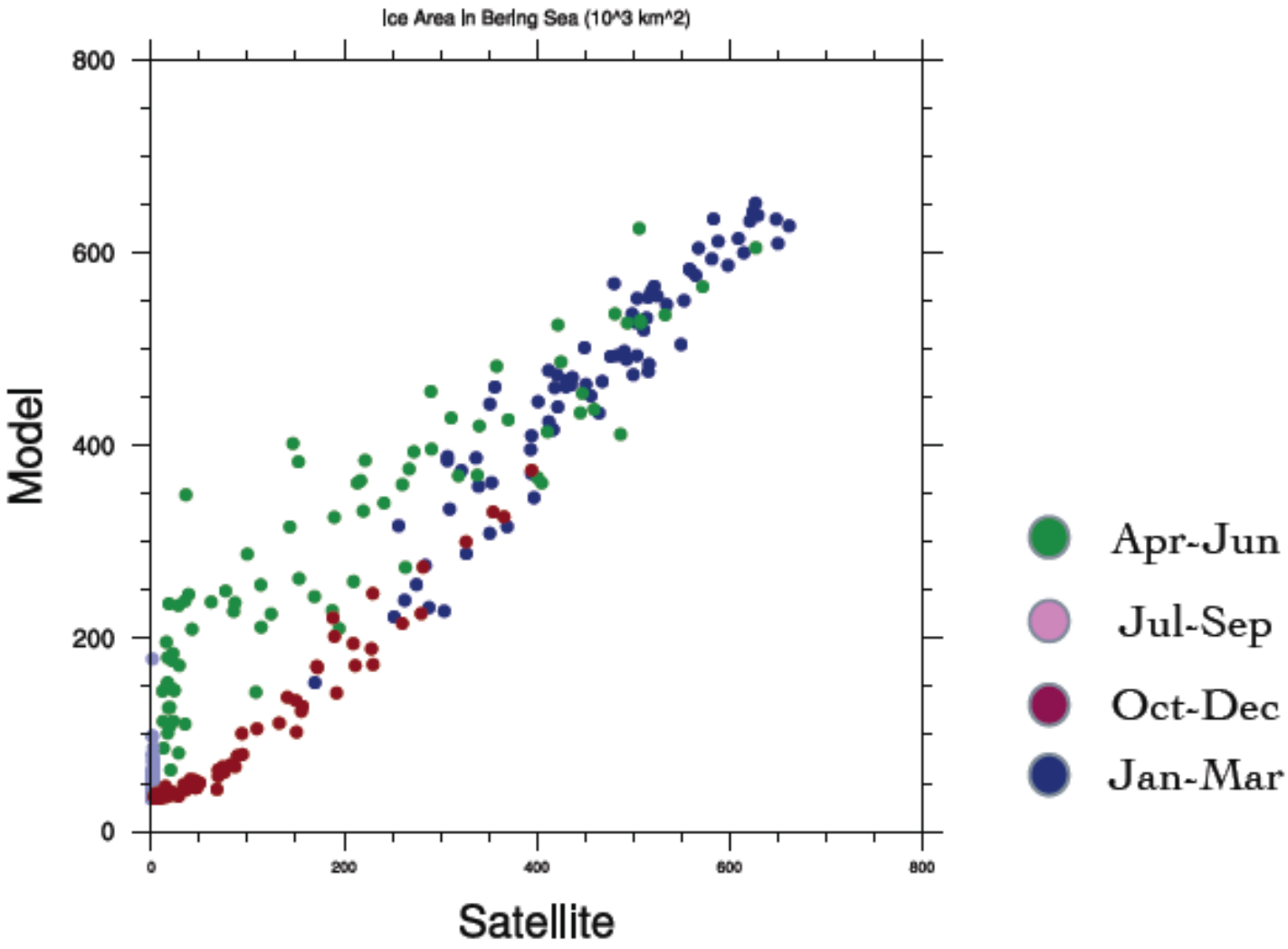
Wang and Overland



BSIERP Integrated modeling

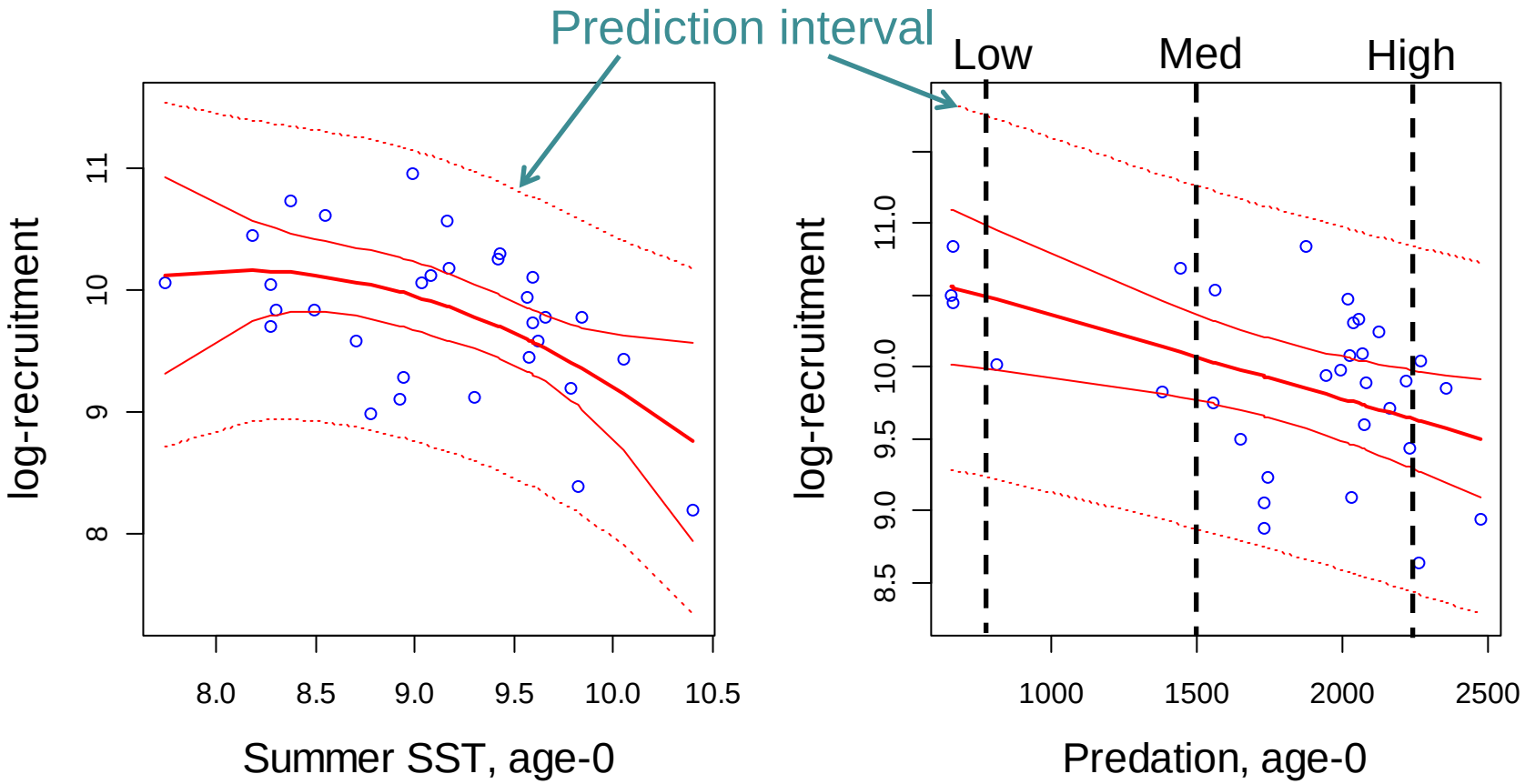


Seasonal sea ice extent



Mueter et al.

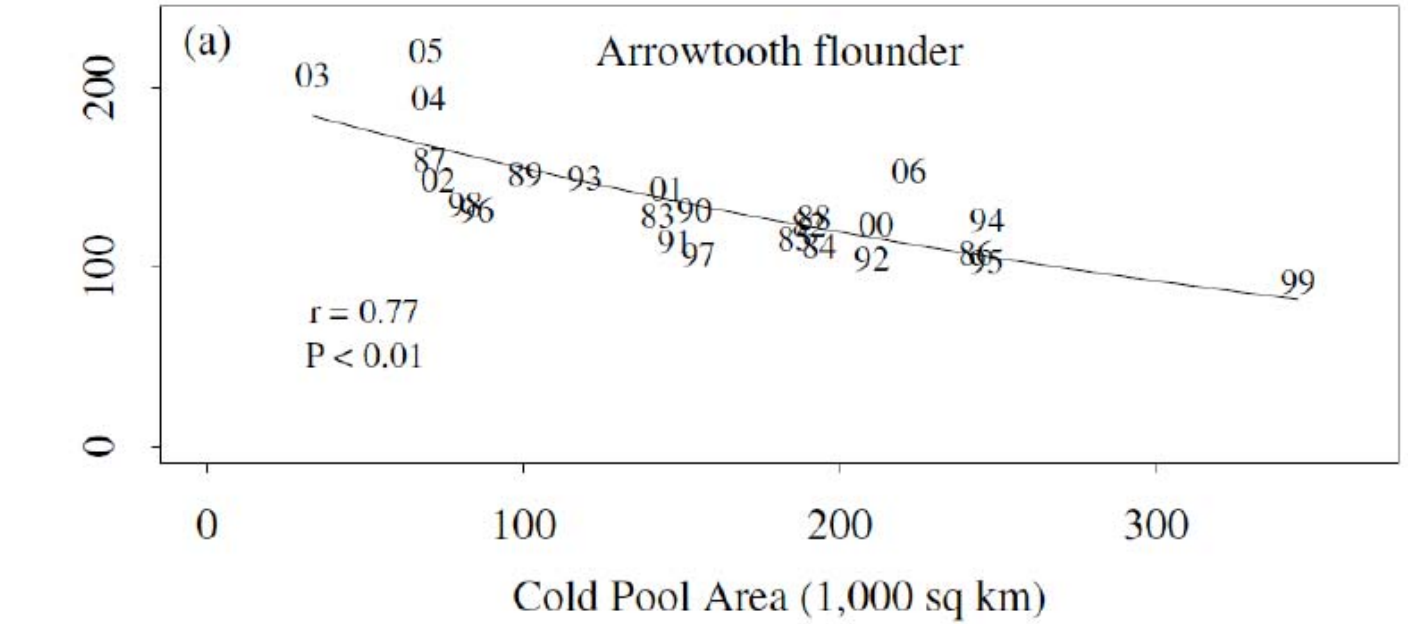
Estimated effects of summer SST & predation on log-recruitment

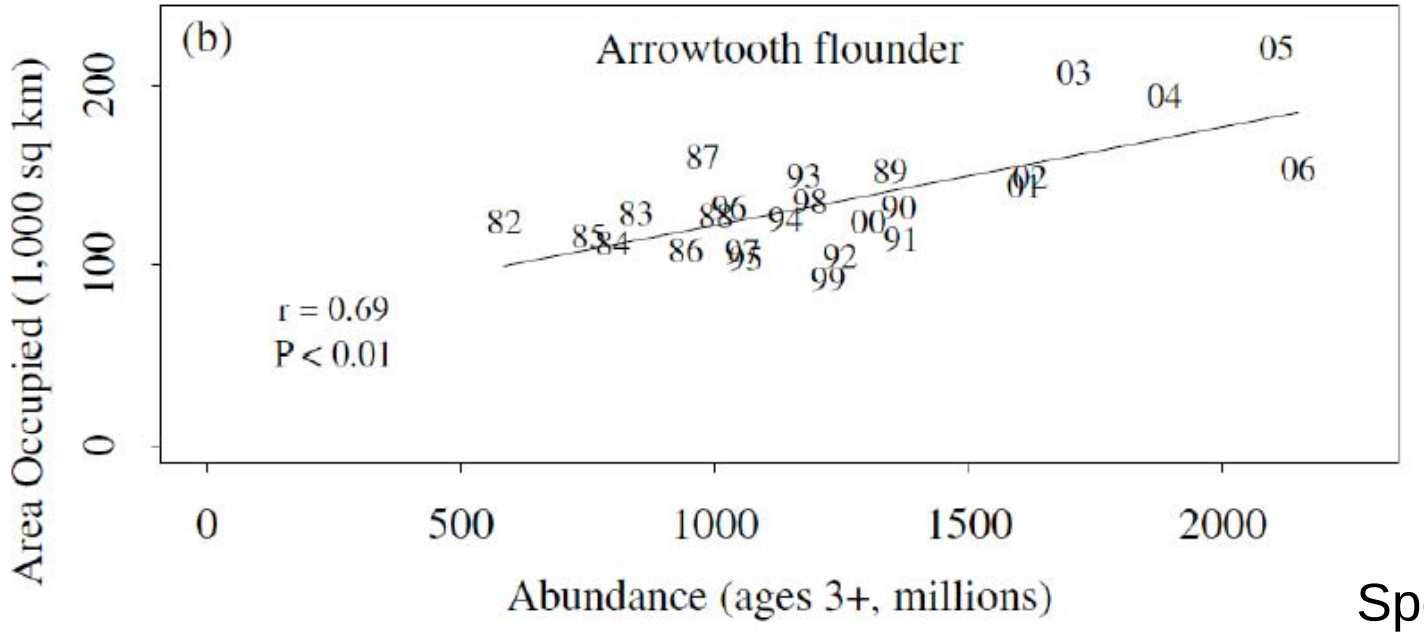


$R^2 = 0.44$

$P = 0.001$

⇒ Simulate effect of increase in average SST on recruitment at three levels of predation

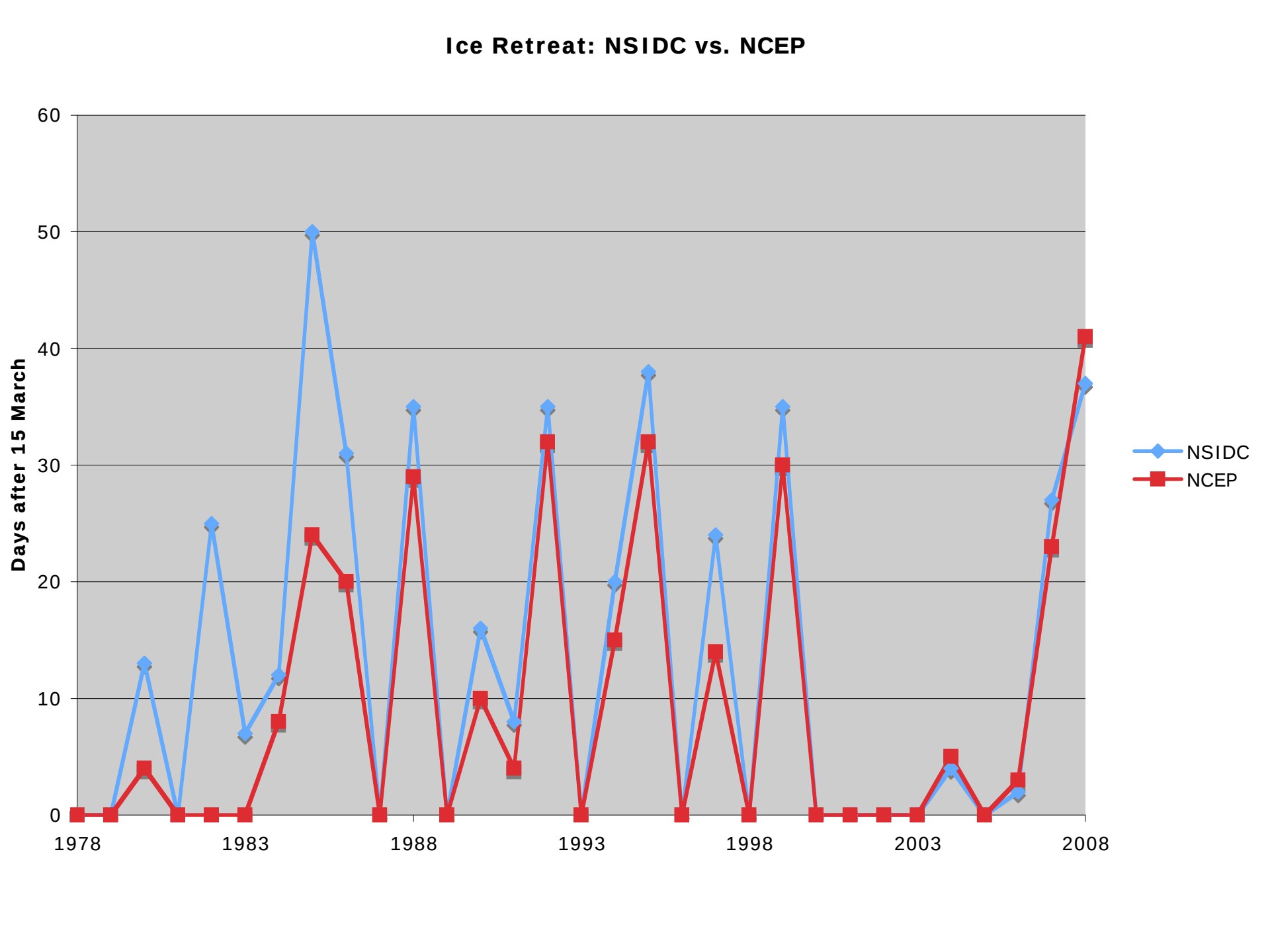


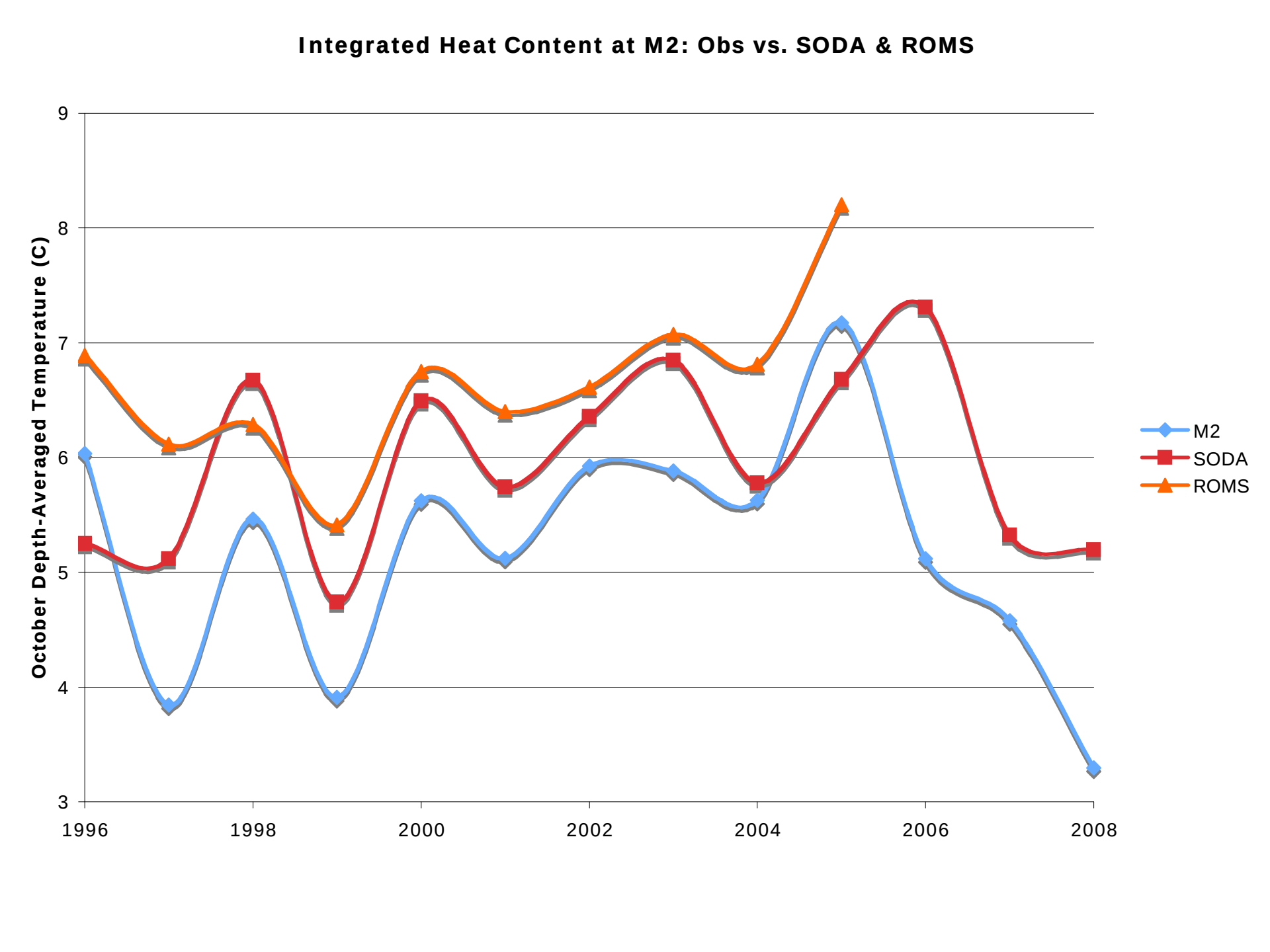


Spencer (2008)

Procedure

- Evaluation of Input Data - Compared atmospheric and oceanic reanalyses and models with observations
- GAM Development: Using entire data set, added variables sequentially, examined the physical plausibility of each variable's functional form.
- GAM Testing: Trained model for a period 1972-1995; tested predictions for 1996-2008.


Ice Retreat: NSIDC vs. NCEP
Days after 15 March
60
50
40
30
20
10
0
1978
1983
1988
1993
1998
2003
2008
NSIDC
NCEP

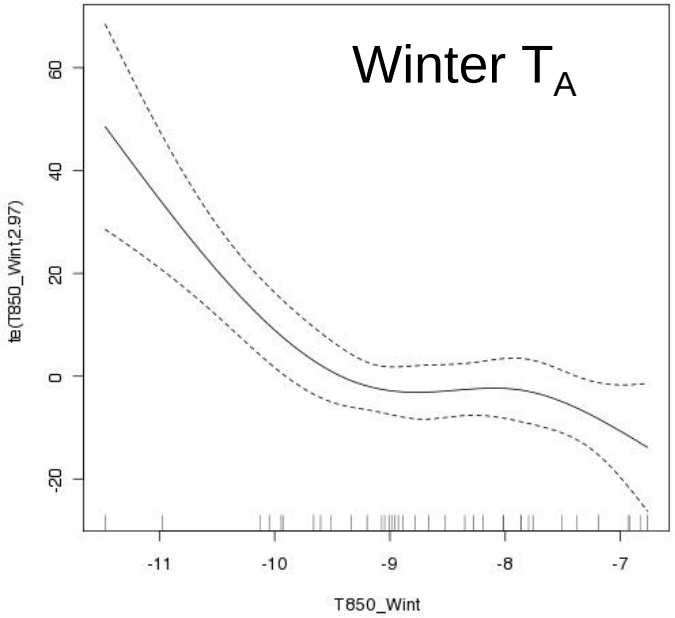

Integrated Heat Content at M2: Obs vs. SODA & ROMS
October Depth-Averaged Temperature (C)
9
8
7
6
5
4
3
1996
1998
2000
2002
2004
2006
2008
M2
SODA
ROMS

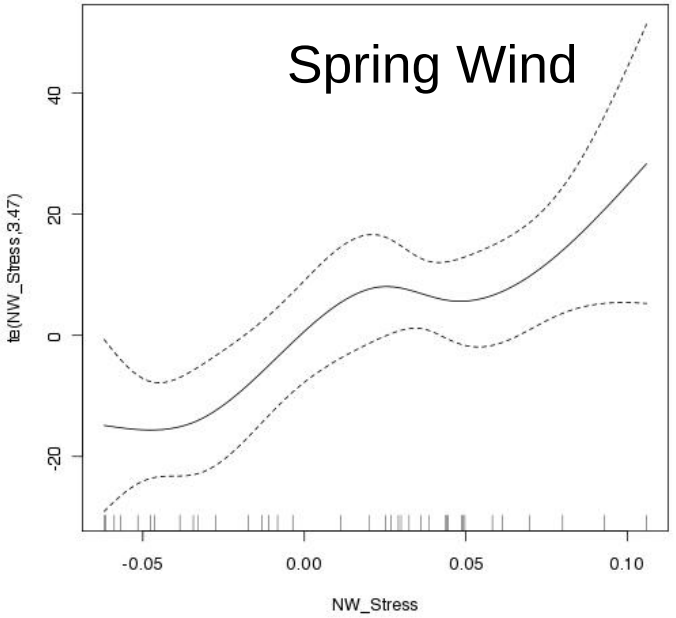
Variables considered relating to the timing of ice retreat

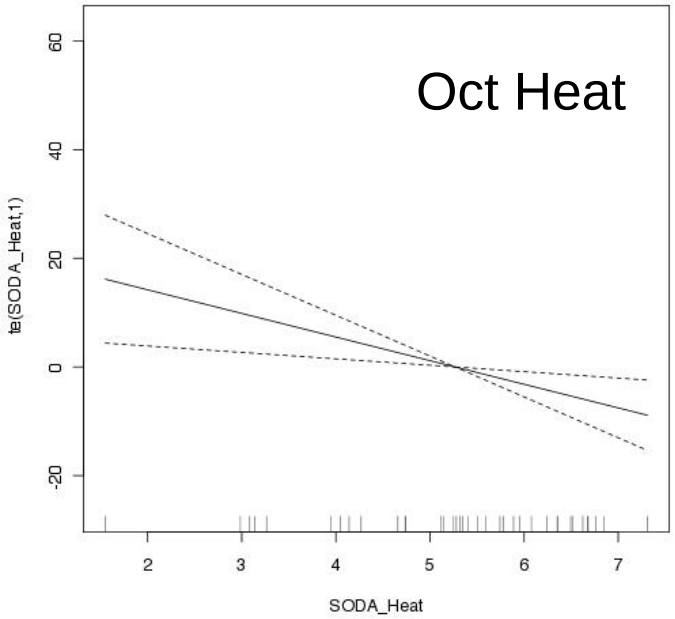
- Previous October Heat Content at M2
- Winter (Nov-Mar) 850 hPa Wind
- Winter (Nov-Mar) 850 hPa Air Temperature
- Winter (JFM) St. Paul SST
- Mar-Apr V currents at M2 (SODA)
- Mar-Apr NW Component of Surface Stress
- Mar-Apr Clouds
- April 850 hPa Air Temperature

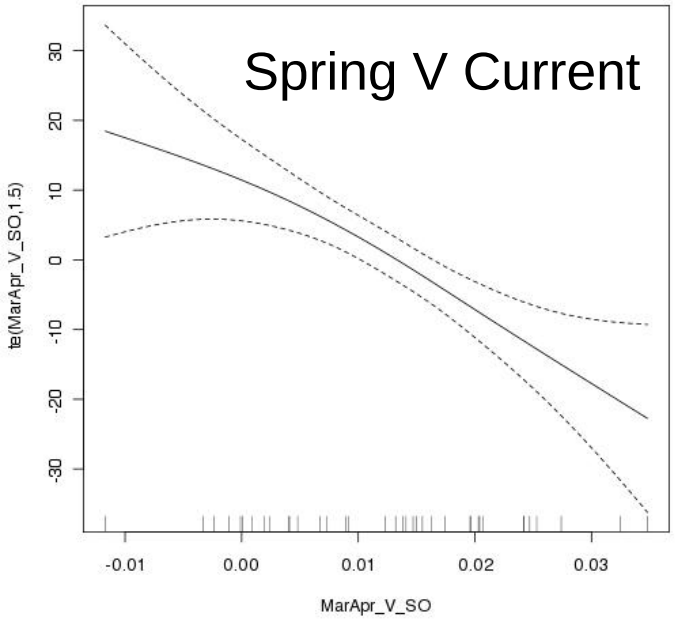
Evaluation of Variables

- Best predictors: Spring V Current and Spring NW Wind (explained about 40% of variance)
- Worst predictors: Spring Air Temperatures and Spring Cloud Cover
- Better 2-variable combinations explained 63-78% of variance
- Some 3-variable combinations produced odd functional relationships

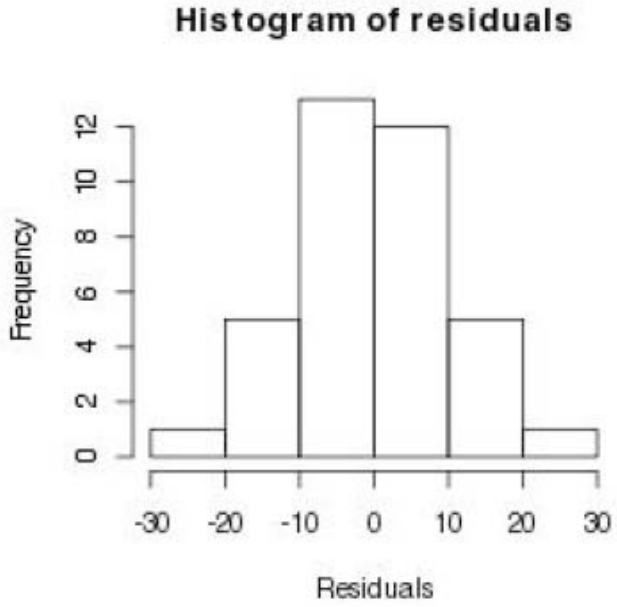

Winter T_A
te(T850_Wint,2.97)
60
40
20
0
-20
-11
-10
-9
-8
-7
T850_Wint

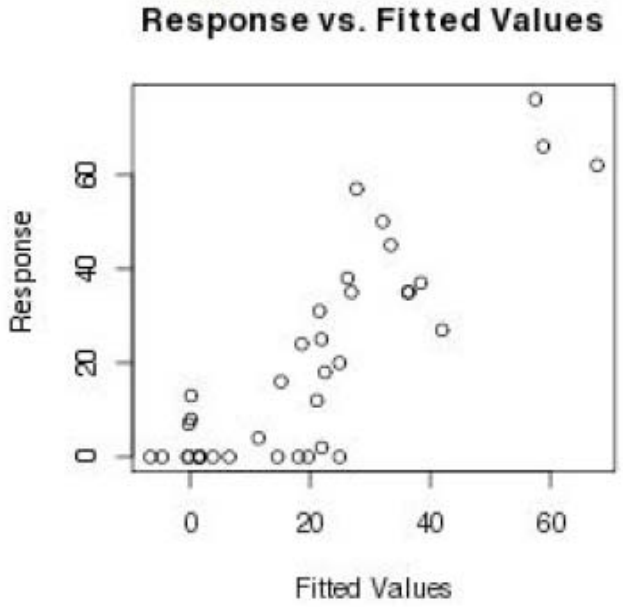

Spring Wind
te(NW_Stress,3.47)
40
20
0
-20
-0.05
0.00
0.05
0.10
NW_Stress


Oct Heat
te(SODA_Heat,1)
60
40
20
0
-20
2
3
4
5
6
7
SODA_Heat

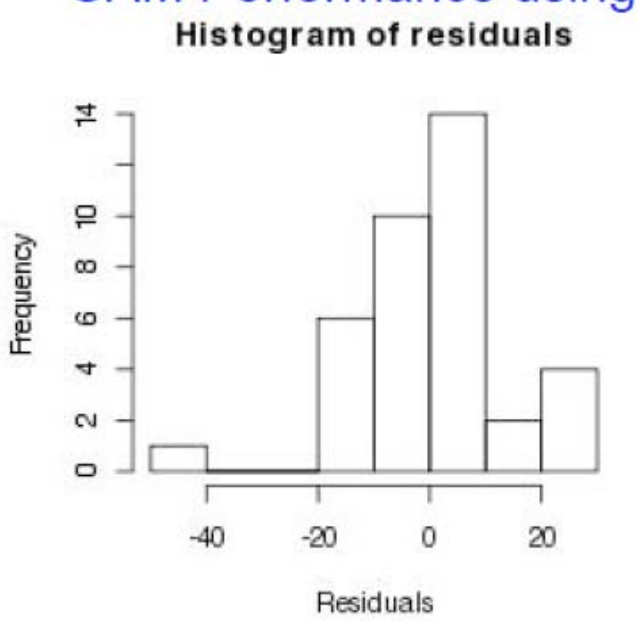

Spring V Current
te(MarApr_V_SO,1.5)
30
20
10
0
-10
-20
-30
-0.01
0.00
0.01
0.02
0.03
MarApr_V_SO

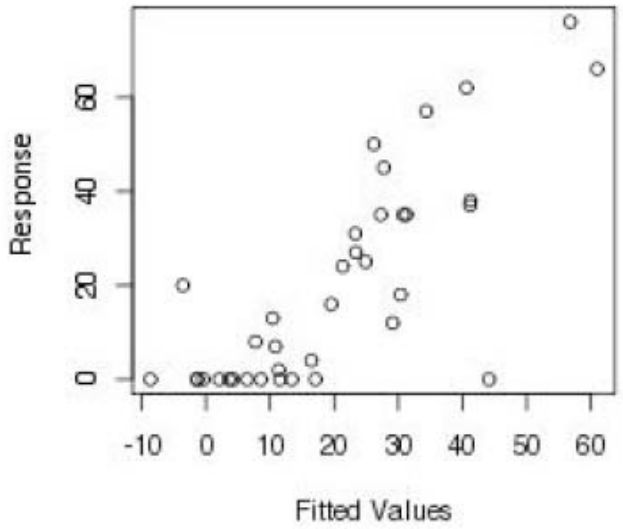
GAM Performance using Winter T_A and Spring Winds

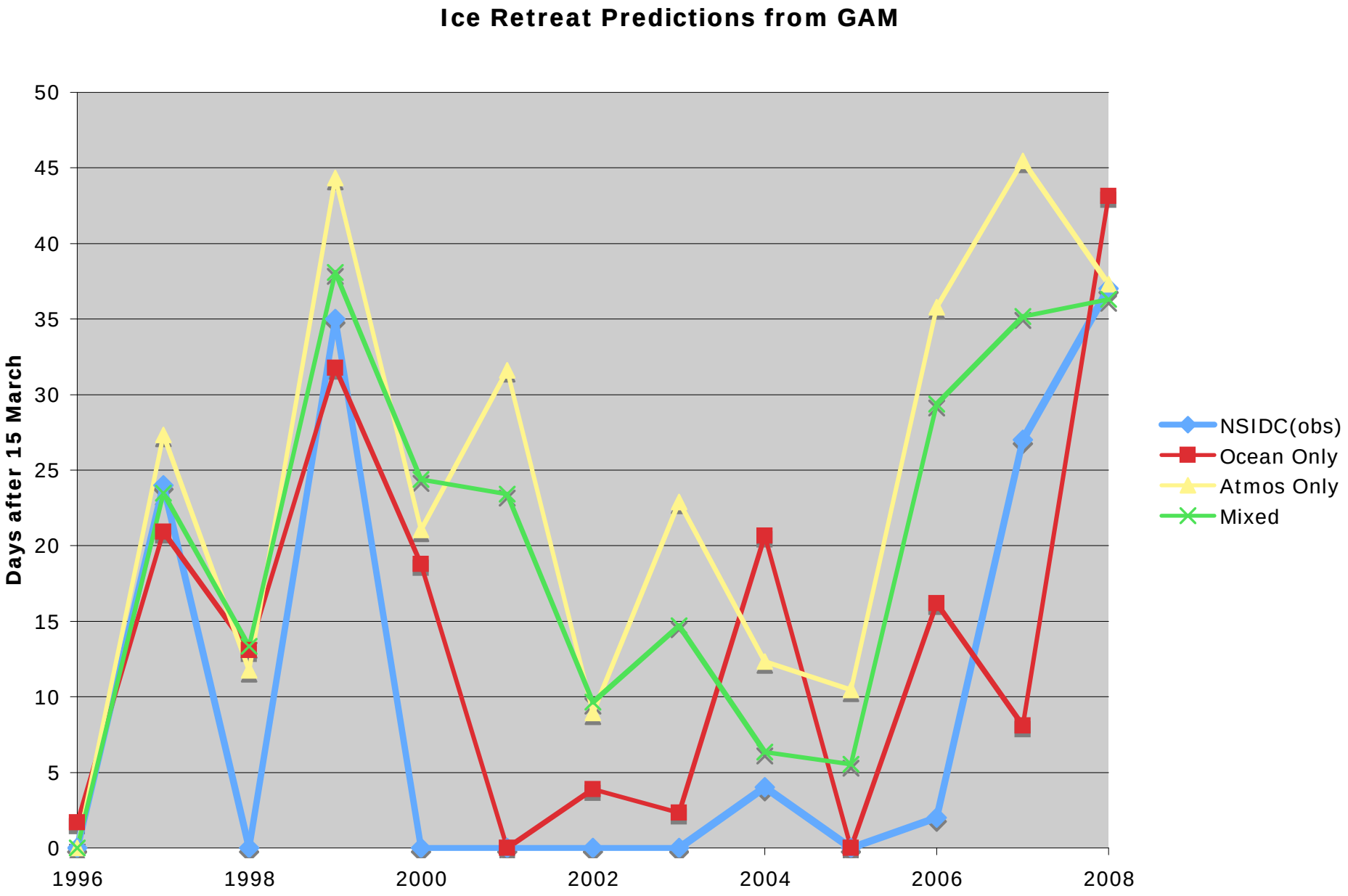




GAM Performance using St. Paul SST and Spring Currents

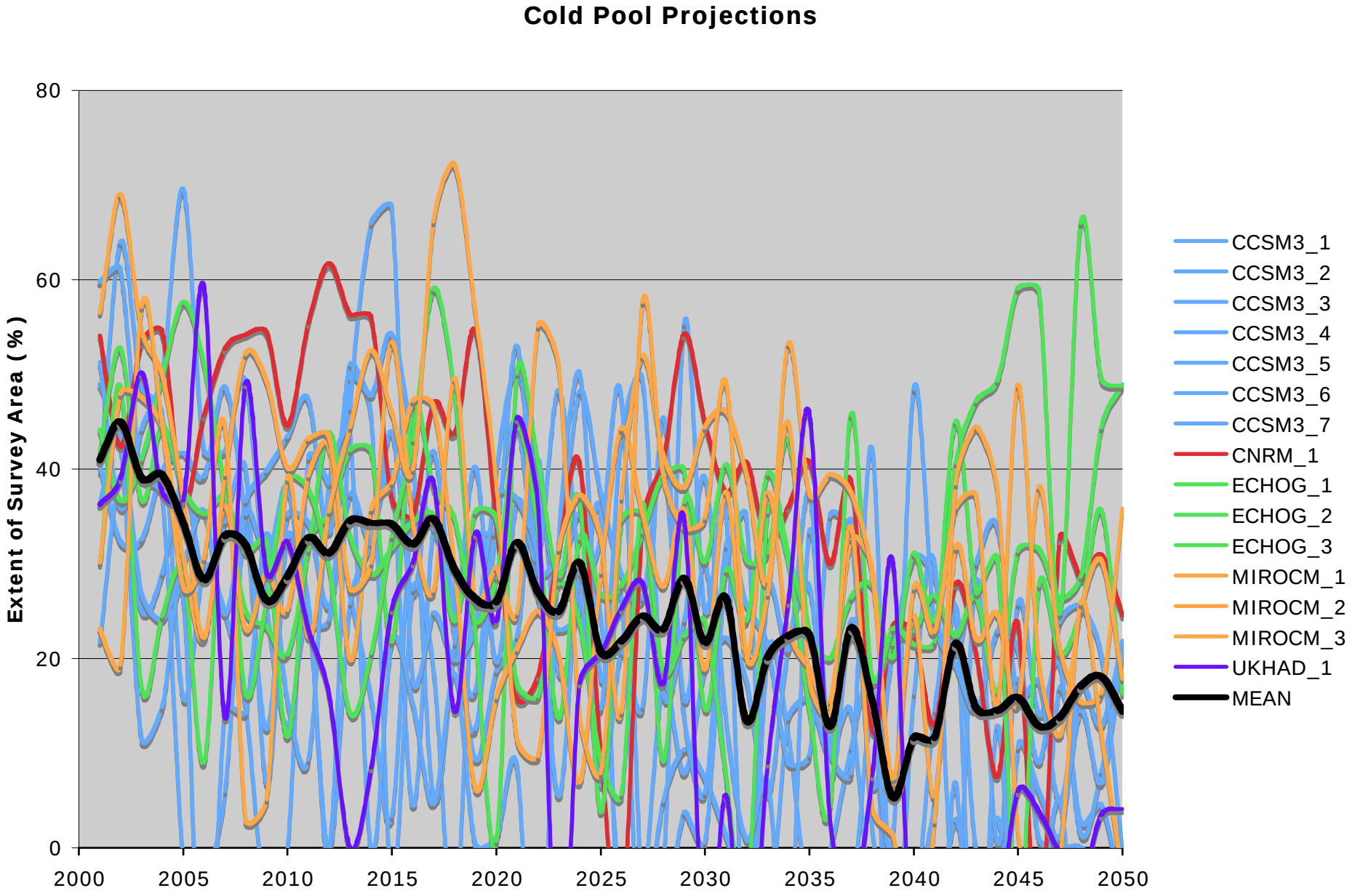





Ice Retreat Predictions from GAM
Days after 15 March
50
45
40
35
30
25
20
15
10
5
0
1996
1998
2000
2002
2004
2006
2008
NSIDC(obs)
Ocean Only
Atmos Only
Mixed

Final Remarks

- The timing of ice retreat is important to the marine ecosystem of the Bering Sea shelf.
- The factors related to the timing of ice retreat have been examined using a GAM incorporating retrospective observational and reanalysis data.
- The upper layer currents and winds in spring are the most important factors, with the winter weather, and to a lesser extent, the previous fall's heat content playing significant roles.
- Projections of the timing of sea ice retreat may be feasible using a GAM and global climate model output.


Cold Pool Projections
Extent of Survey Area (%)
80
60
40
20
0
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
CCSM3_1
CCSM3_2
CCSM3_3
CCSM3_4
CCSM3_5
CCSM3_6
CCSM3_7
CNRM_1
ECHOG_1
ECHOG_2
ECHOG_3
MIROCM_1
MIROCM_2
MIROCM_3
UKHAD_1
MEAN