

**Collaborative Research:
Producing an Updated Synthesis
of the Arctic's
Marine Primary Production
Regime and Its Controls**

(Preliminary Data)

Patricia Matrai - Bigelow

Lou Codispoti - HPEL

Michel Gosselin – U Quebec, Rimouski

Victoria Hill (c/o R. Zimmerman) - ODU

Bonnie Light – APL UW

Mike Steele – APL UW

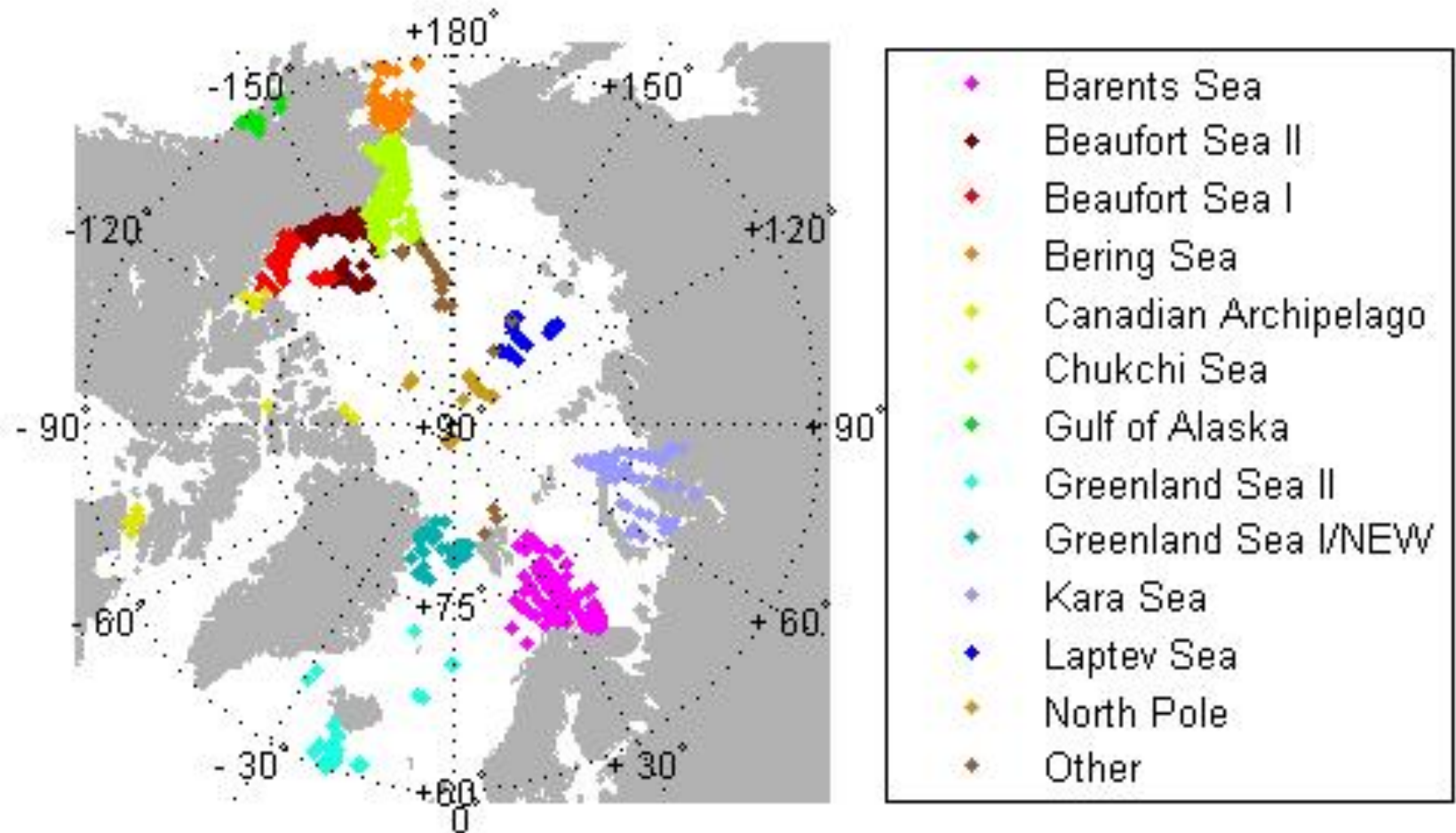
AO Primary production

- Synthesis of PP emphasizing different spatial and temporal scales into a consistent pan-AO data set (ARCSS-PP):
 - historical ^{14}C -PP (gross to net PP)
 - historical nutrients, O_2 and DIC fields (net community production, NCP)
 - satellite-derived surface PP (NCP) using chl and C algorithms
 - Bio-physical algorithms **SUNLIGHT project**
- Using ARCSS-PP, test hypotheses regarding the controls of PP
- Provide ARCSS-PP to AO modelers for calibration of biogeochemical numerical models **Ecosystem modeling project**
- Define functional regions of the AO that operate similarly with respect to PP with similar temporal and spatial variability.
- Investigate potential future changes in PP using analogues from the historical data record.

OUTREACH

- Create a short animation that describes the controls of primary production in the AO
- Create a website for research and educational outreach

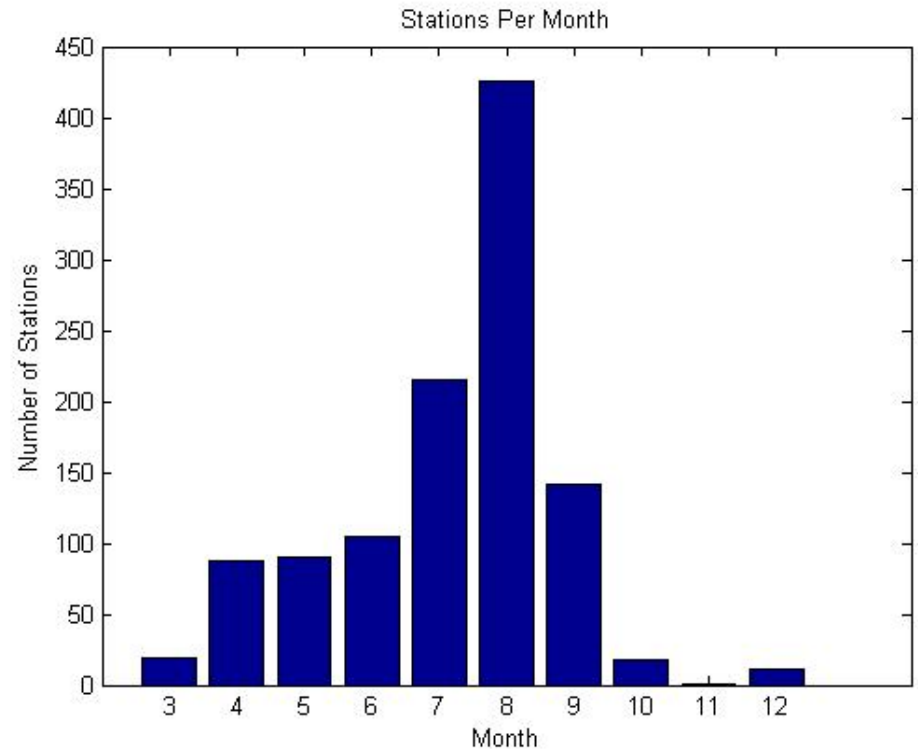
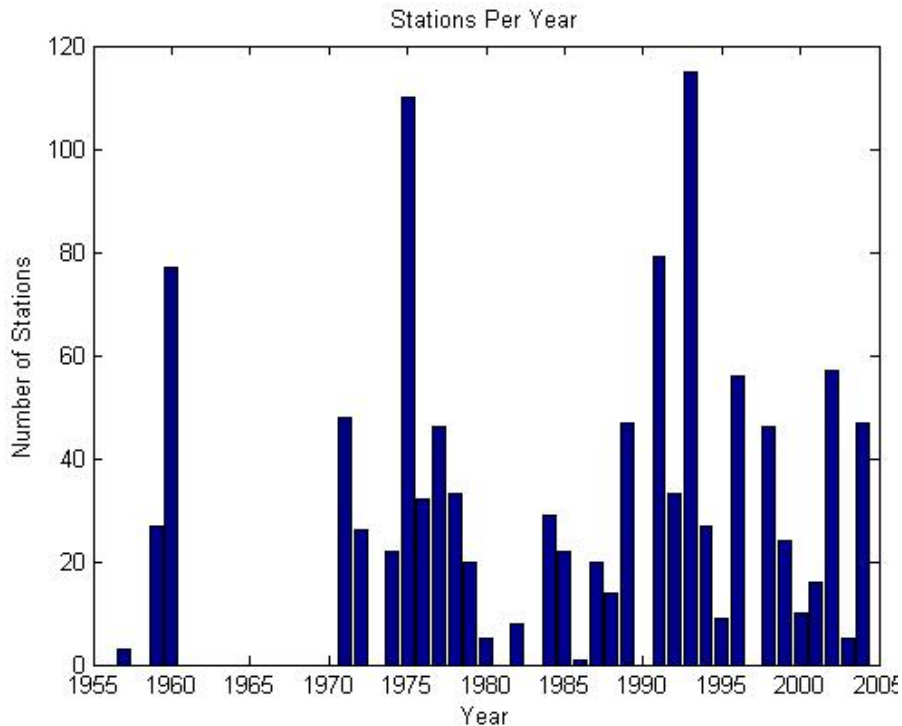
Region Identification Key



^{14}C -PP historical: All data points, all depths, all times

Database Statistics (up to now)

Stations with Primary Production Data (specific depth):	1084
Stations with Primary Production and Secchi Depth/ Transparency:	119
Stations with Primary Production and 0.1% Light Level:	27
Stations with Primary Production and Secchi Depth Or 0.1% Light Level:	146
Total Number of Primary Production Measurements in Database:	7174

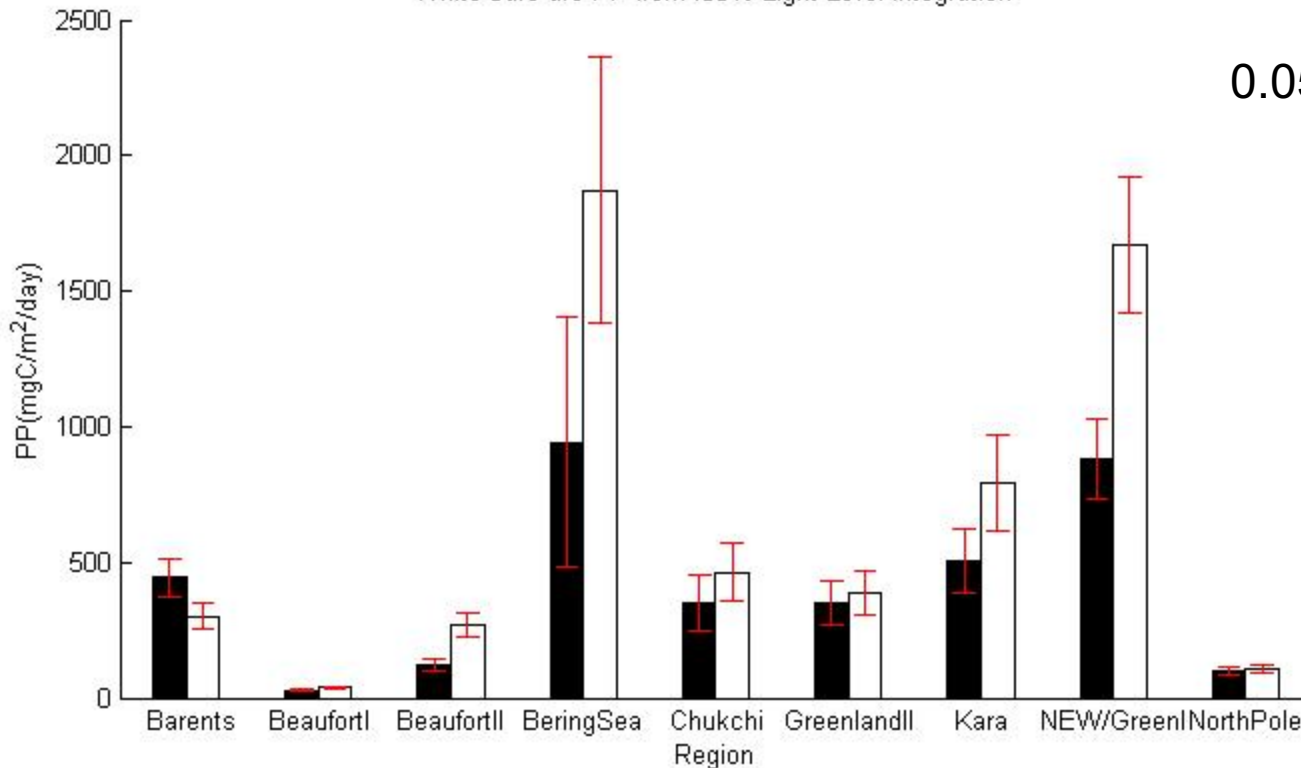


Integrated PP [$\text{mgC m}^{-3} \text{d}^{-1}$] by regions: MLD vs Euphotic zone

Preliminary Data

Comparison of MLD and .05% Light Level Integrations;
 Black bars are PP from MLD Integration and
 White bars are PP from .05% Light Level Integration

MLD ■
 0.05% I₀ □



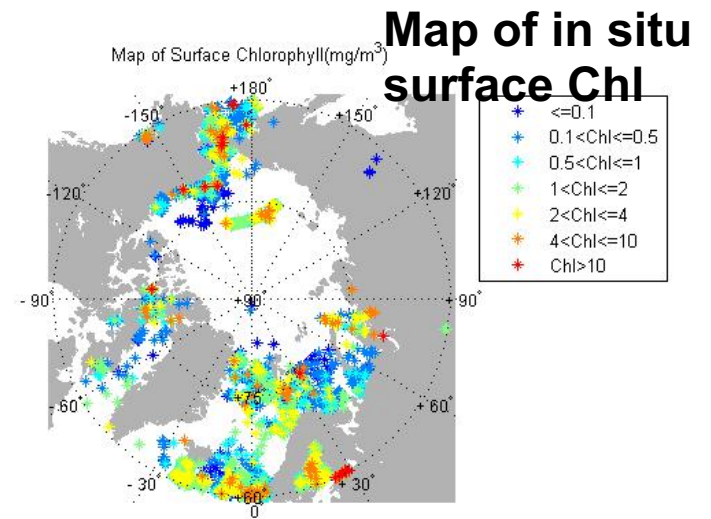
MLD integration:

MLD climatology
 from M. Steele for
 each region

Euphotic zone integration:

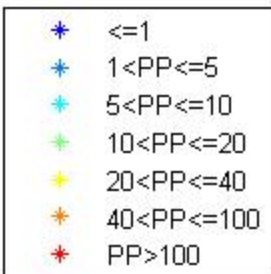
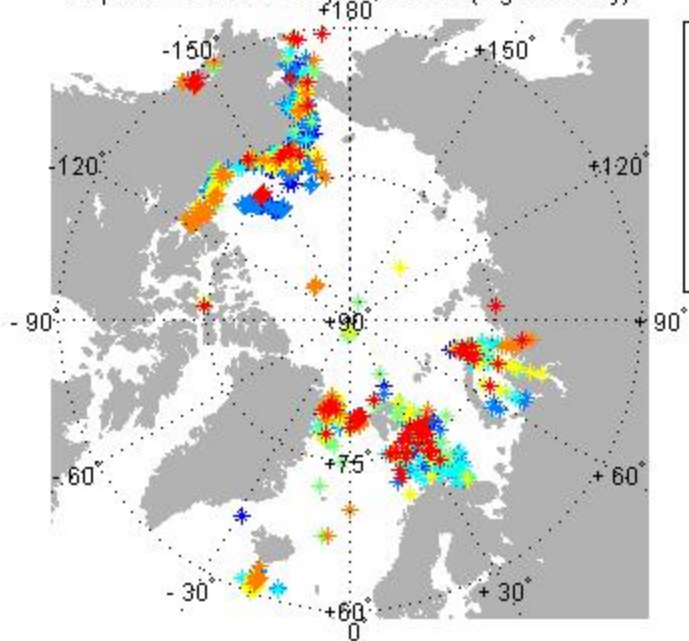
- K_d from V Hill (0.25 coastal) => (9-18m) } 15m
- %I_z = 0.1-0.01 } }
- K_d from V Hill (0.75 basins) => (30-61m) } 45m

Preliminary Data

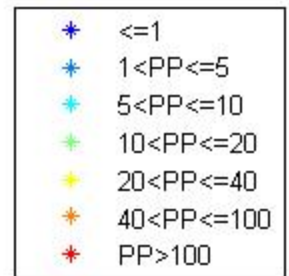
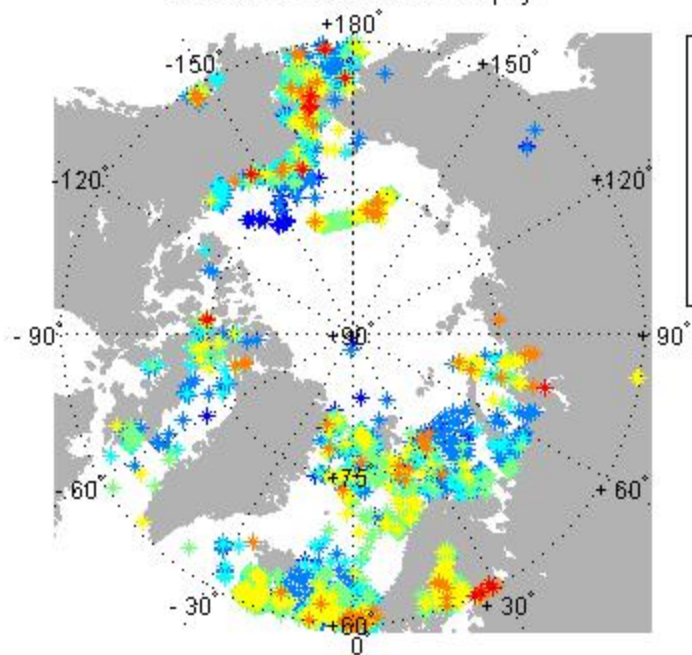


Preliminary Data

Map of Surface Primary Production(mgC/m³/day)

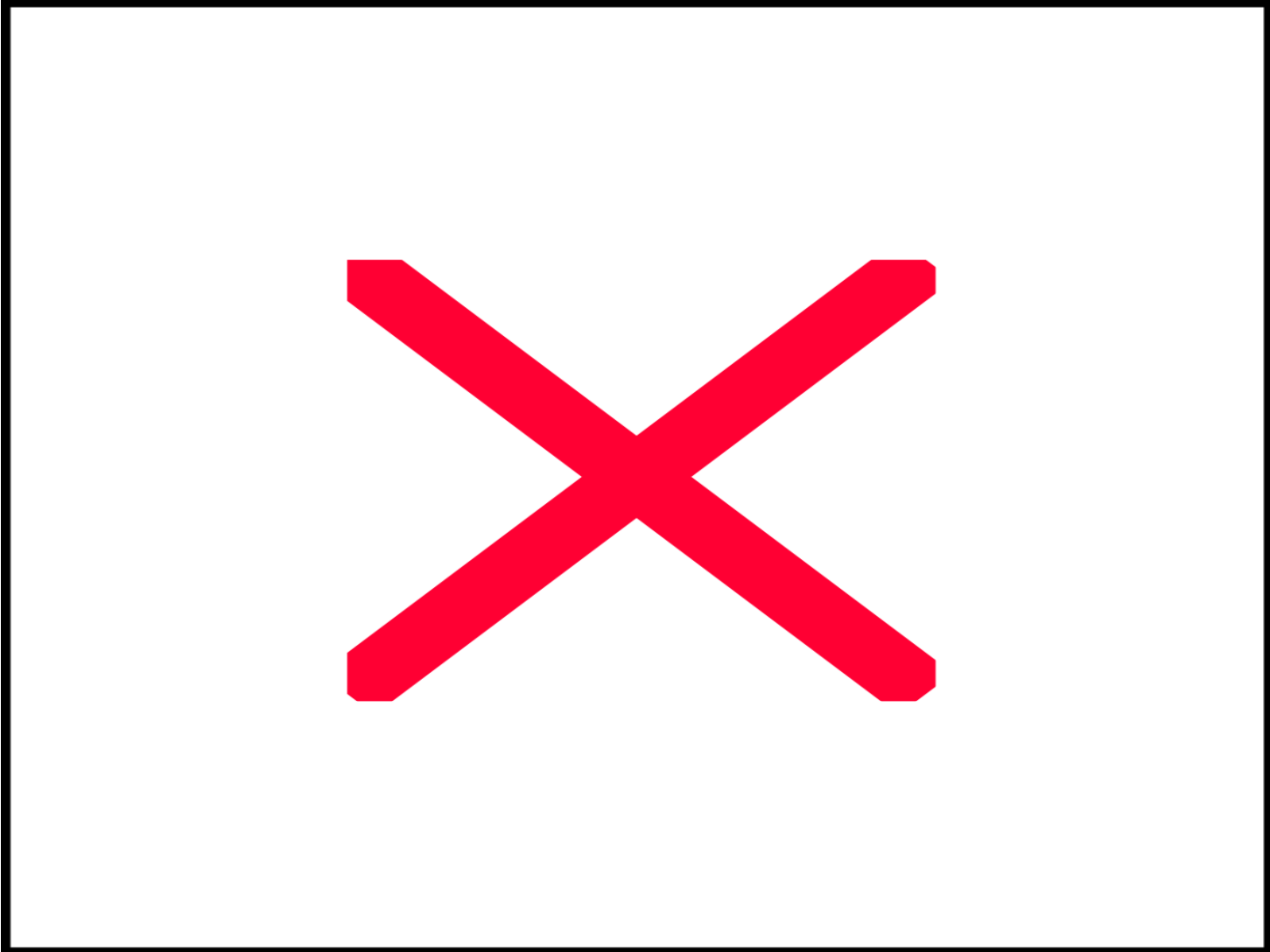


Map of Surface Primary Production(mgC/m³/day)
Derived from Surface Chlorophyll



Next: AO satellite-derived chl, PP

Preliminary Data

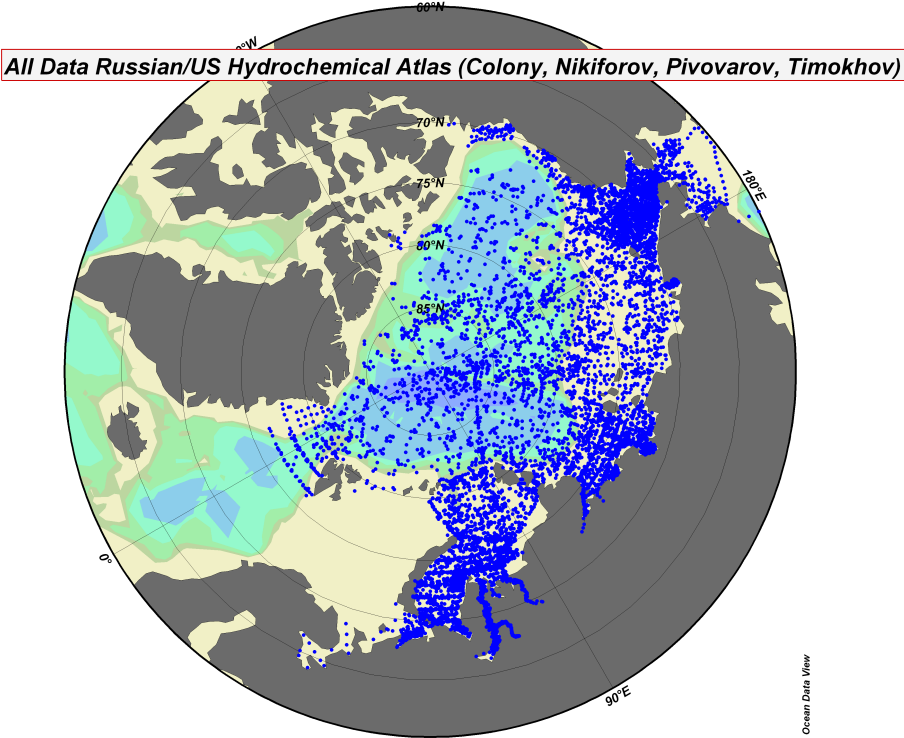
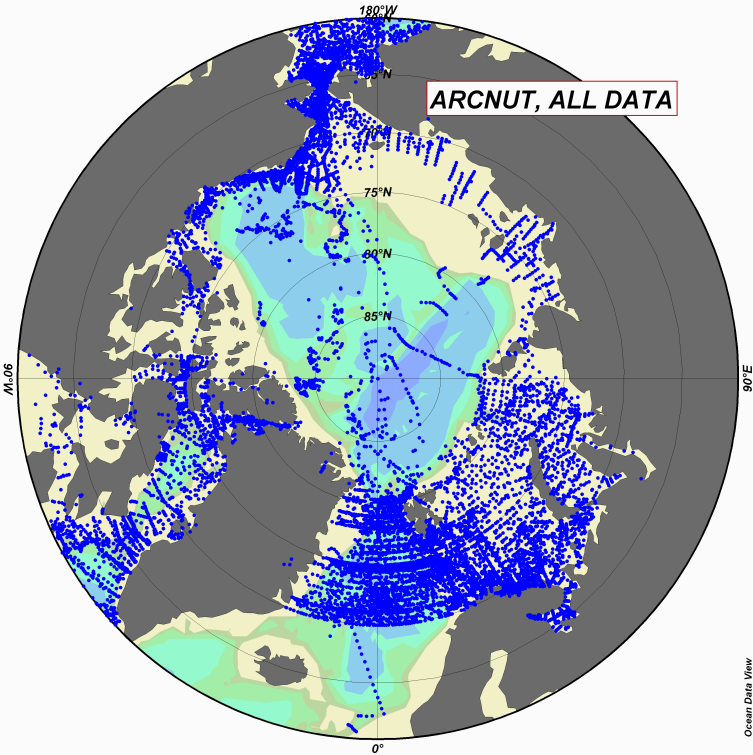


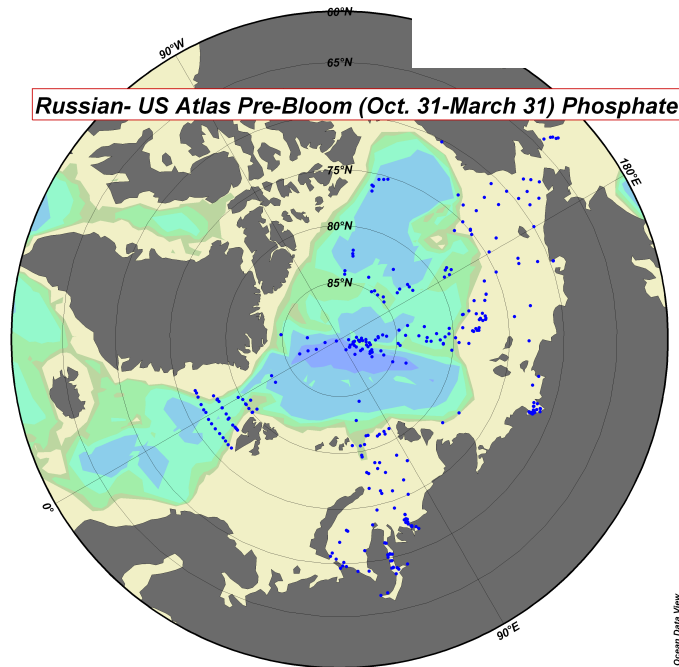
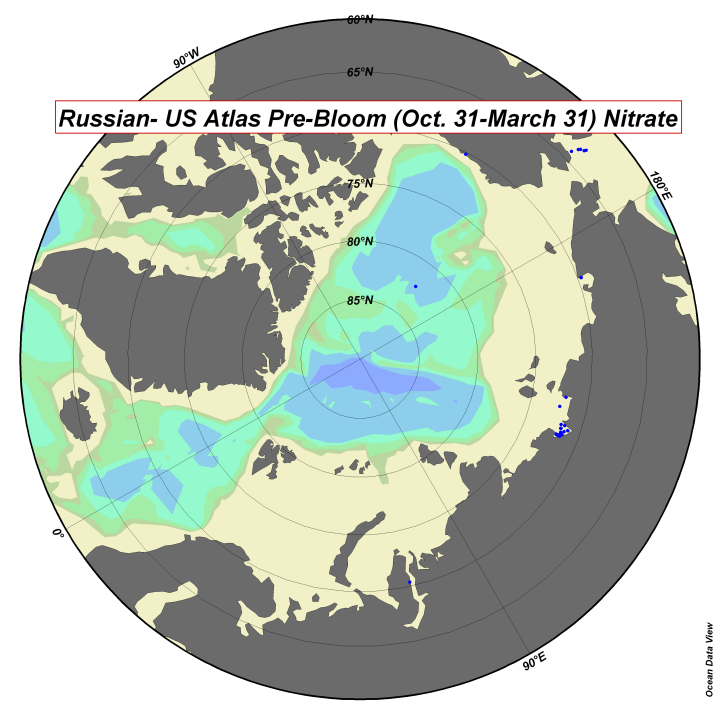
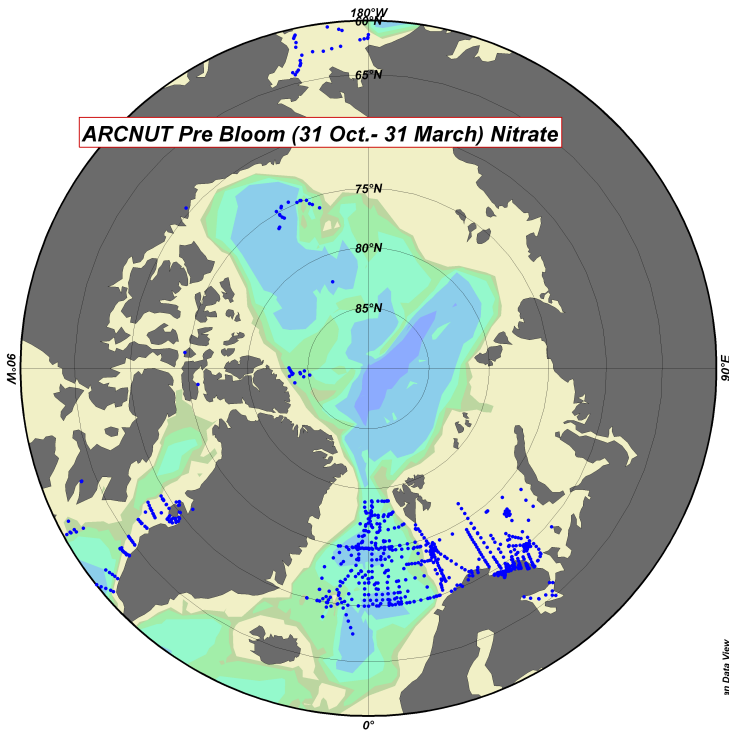
- $NCP = f(\text{satellite chl} - \text{PP algorithm})$
- $NCP = f(\text{Carbon \& sat chl algorithm})$

Nutrient Based Estimates of Primary Production

- Team = L. Codispoti, V. Kelly, A. Thessen, Horn Point Lab.
- To date have been adding and QC ARCNUT data base
- Re-formatting and QC Russian-USA Hydrochemical Atlas to merge with modified ARCNUT data base.
- Co-ordinating with a DIC oriented data base effort at Princeton (R.Key)
- Initially, data looked abundant, but not much pre-bloom nitrate data
- After QC and data building efforts, develop pre-bloom nitrate proxies for several regions based on TS and phosphate, sub-euphotic zone values, etc.

ARCNUT (originally developed by G. Cota and L. Pomeroy)





Pre-bloom
nutrient data
coverage

Interfacing Sunlight Synthesis (SS) Project with PP

Goal of SS: Produce pan-Arctic maps of shortwave flux variables (1979 - present)

- $F_{sw} \downarrow$ from ERA-40 (1979-2001), ECMWF (2002-present)

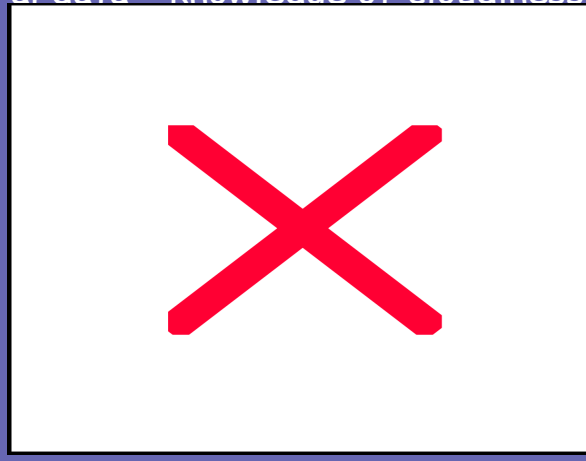
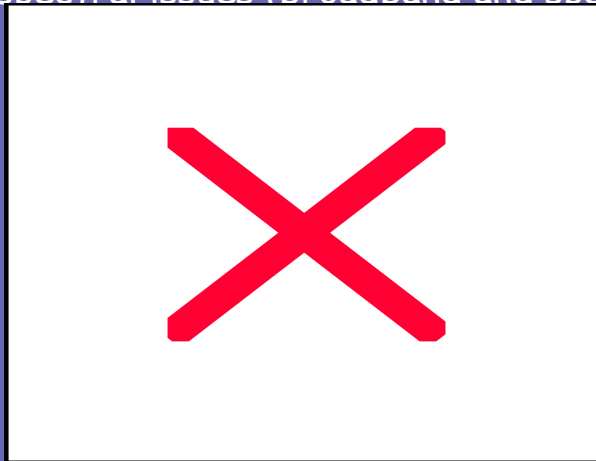
- Account for
Ice and
Snow
• Light tra

BIO-PHYSICAL ALGORITHMS:

Using ARCSS-PP and SS results, test hypotheses regarding the controls of PP

Goal of the interface: "Make sure that ice/ocean light data are optimally relevant to issues of PP over our domain of interest"

- temporal and spatial coverage
- units! (MJ m^{-2} vs. $\mu\text{E m}^{-2} \text{s}^{-1}$)
- spectral issues (broadband and spectral data + knowledge of cloudiness \rightarrow PAR)



e.g., incident spectra measured during HOTRAX (2005 Arctic basin transect) from Grenfell and Perovich (in prep.)

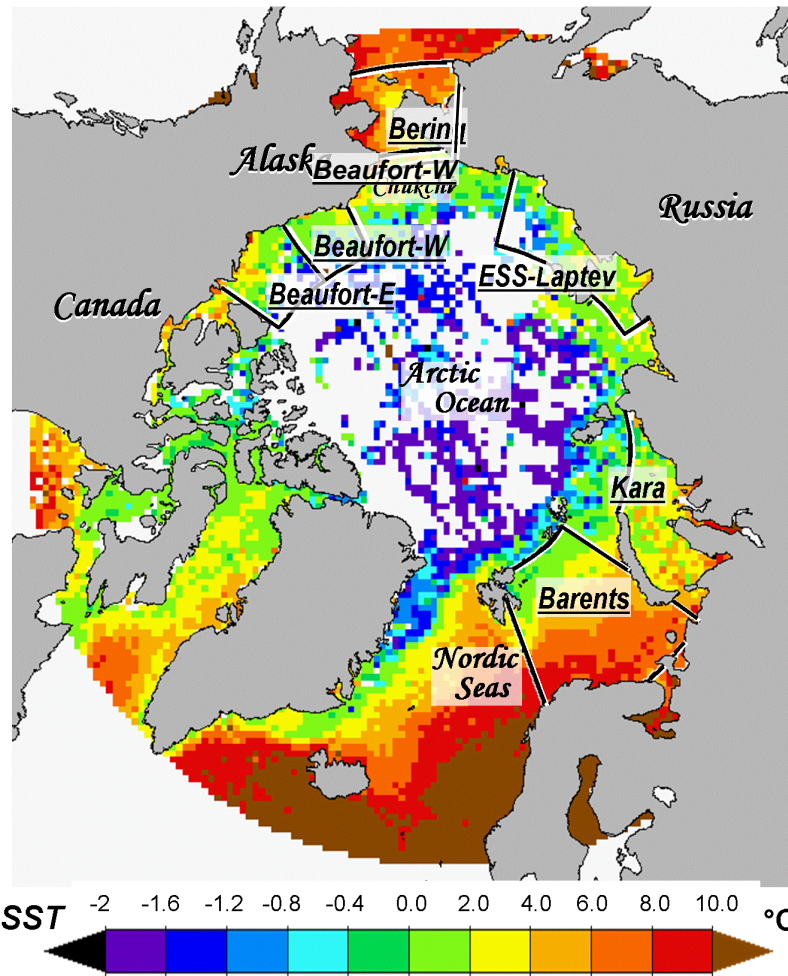
Arctic Seas Ocean Surface Warming

over the 20th century

Regional anomaly

Steele, Ermold, Zhang
(GRL submitted '07)

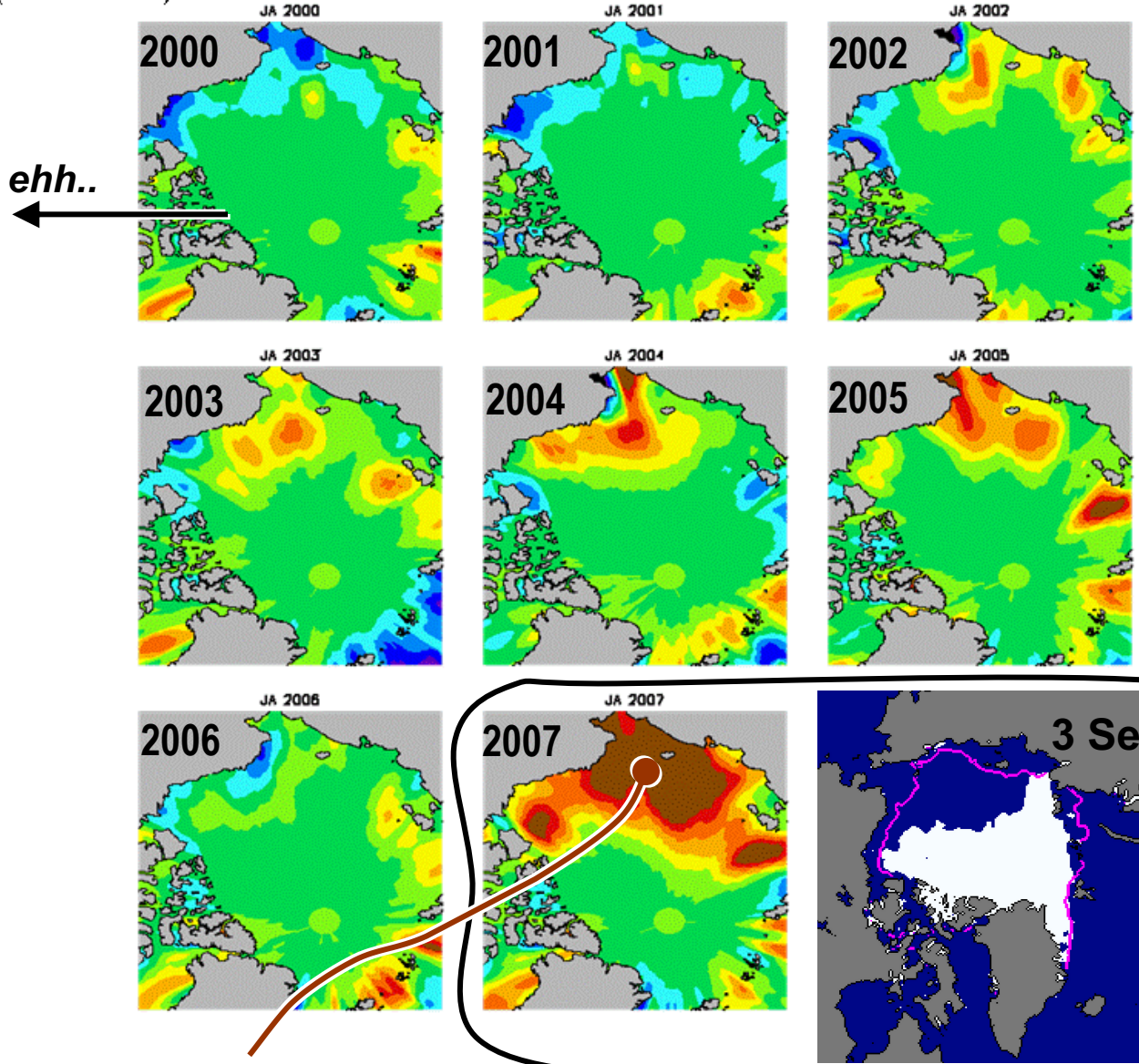
Mean
SST
(0-10 m)



Investigate potential future changes in PP using analogues from the historical data record.

World Ocean Database '05
(in situ data)

Temperature Anomaly (°C)

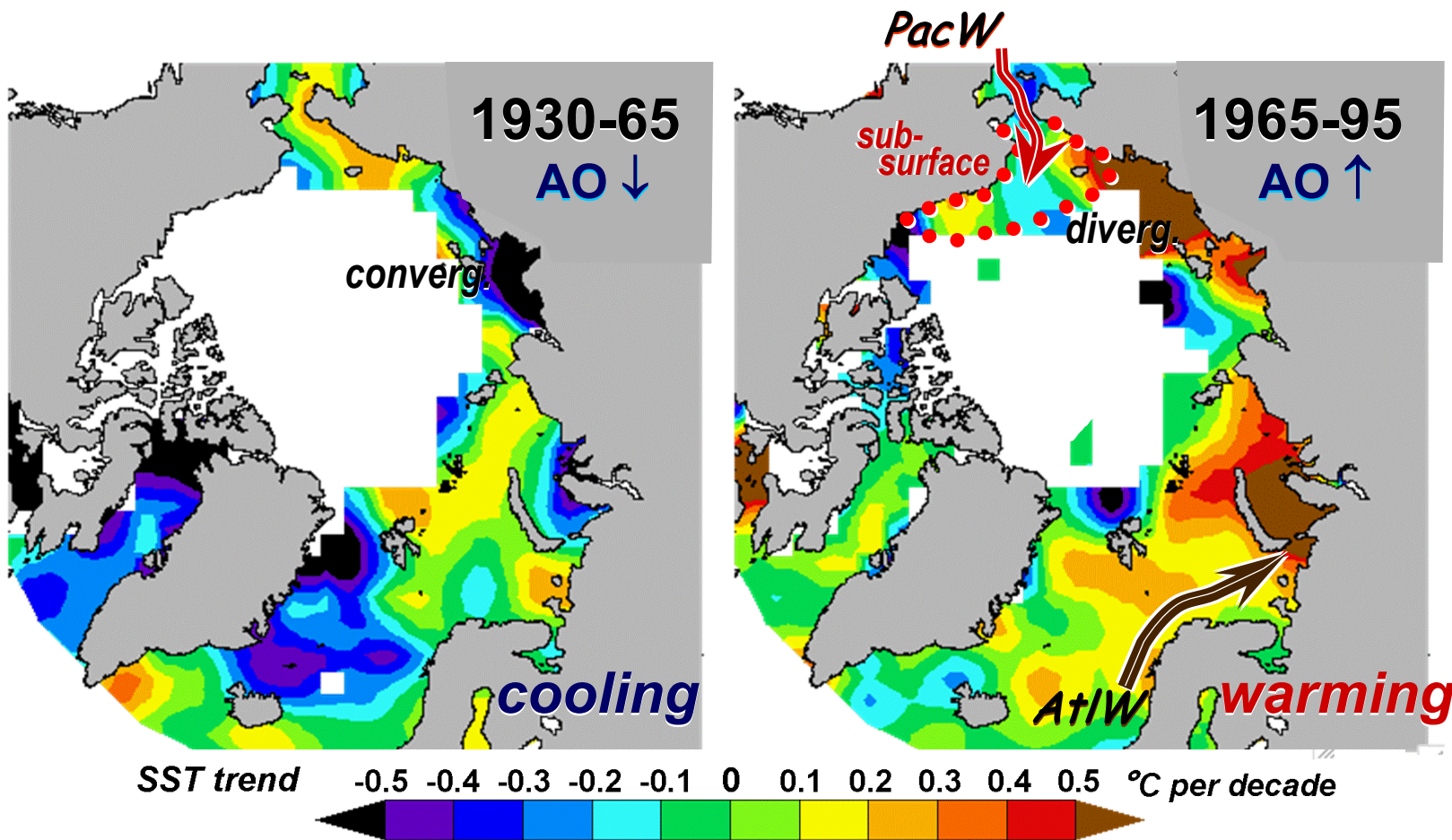


**July-Aug
SST
interannual
anomalies
(rel. to 1982-2007)**

**2007:
What a year!**

Max Anom. \approx 5°C

SST trends & the AO



- Ocean advection influence
- Ice advection influence

Define functional regions of the AO that operate similarly with respect to PP with similar temporal and spatial variability

