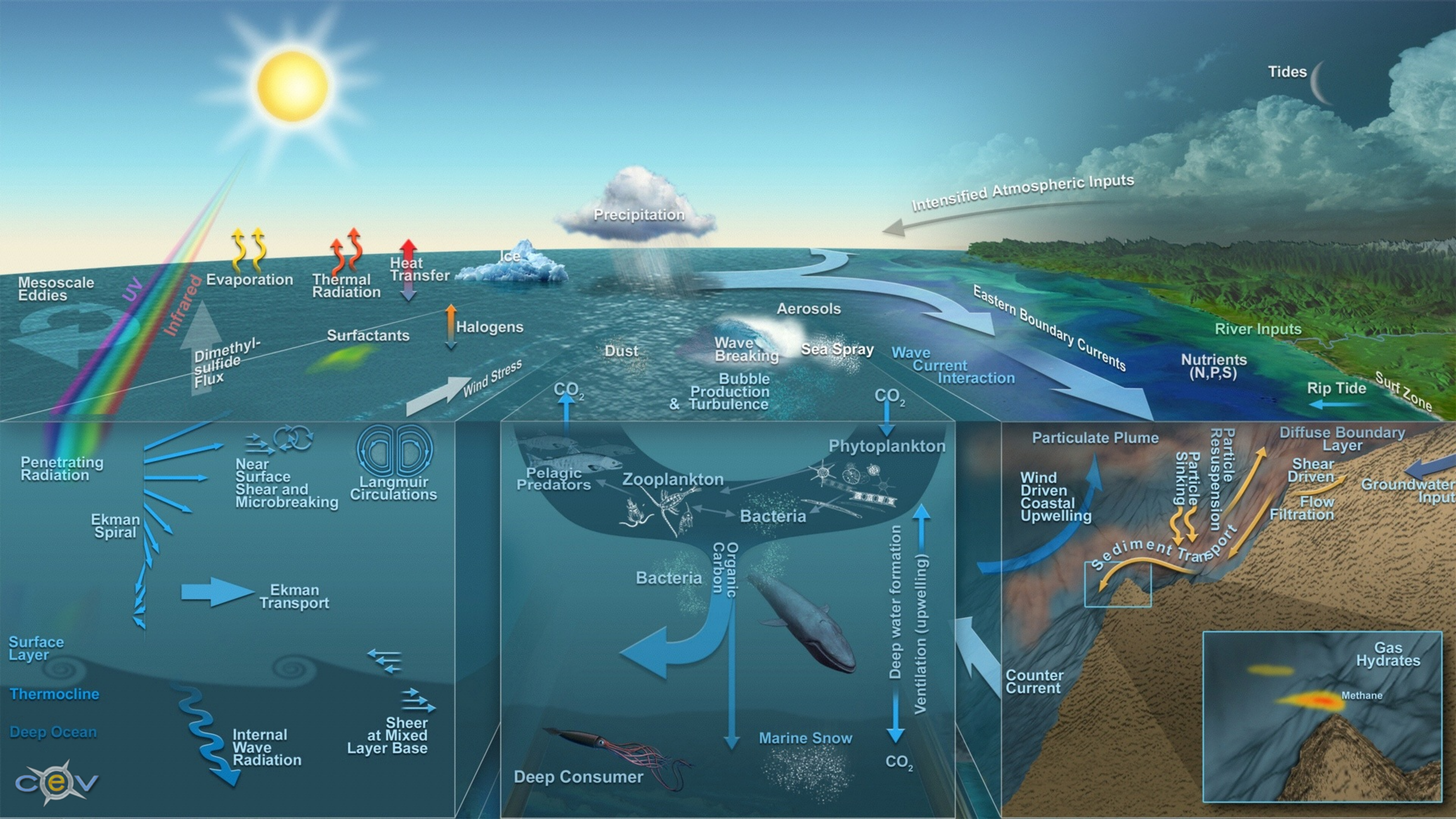


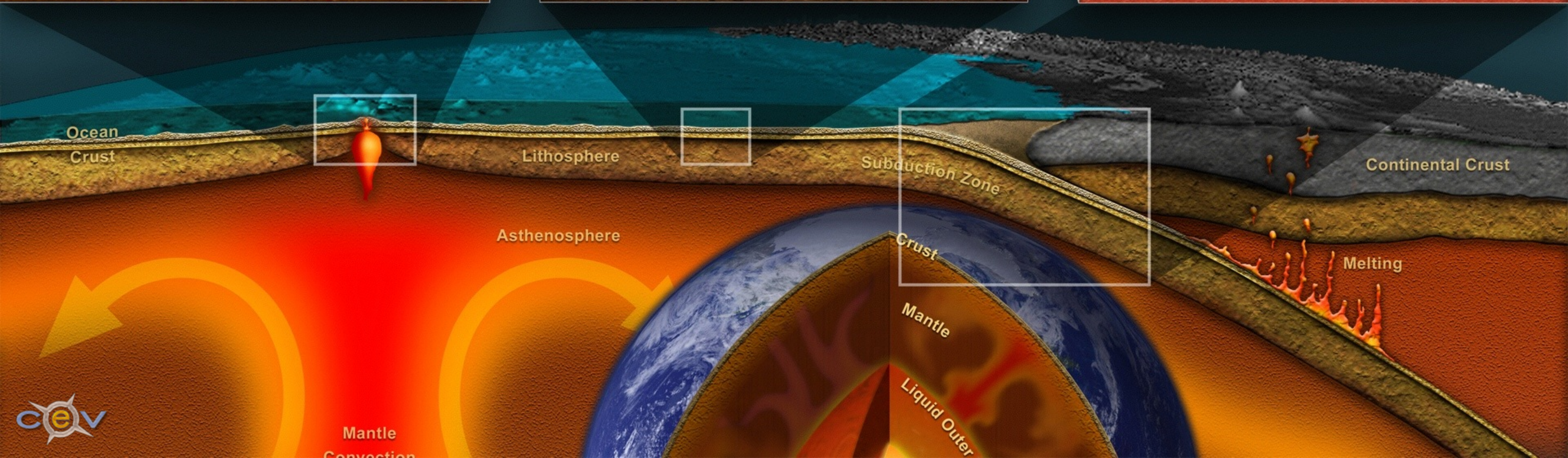
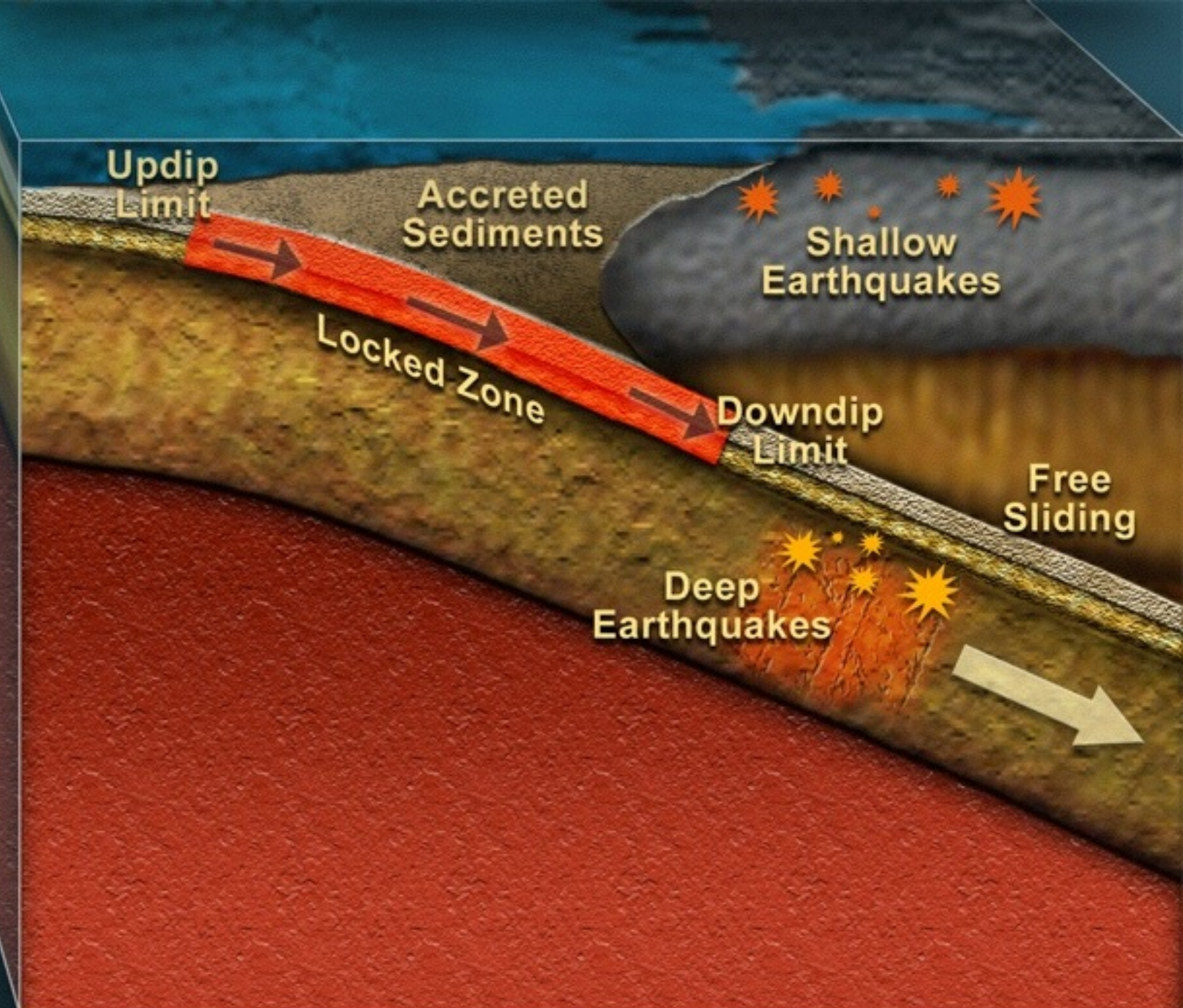
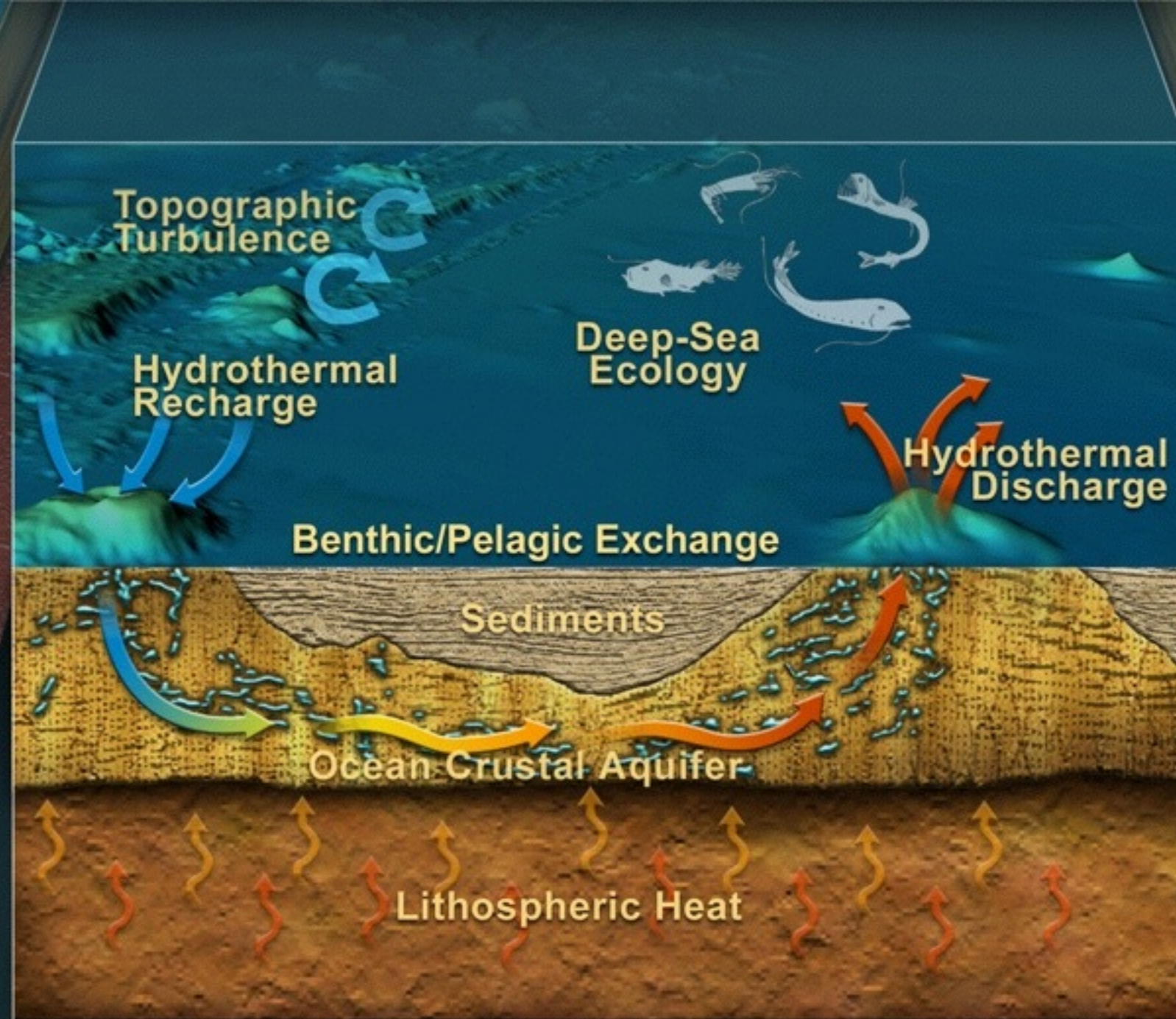
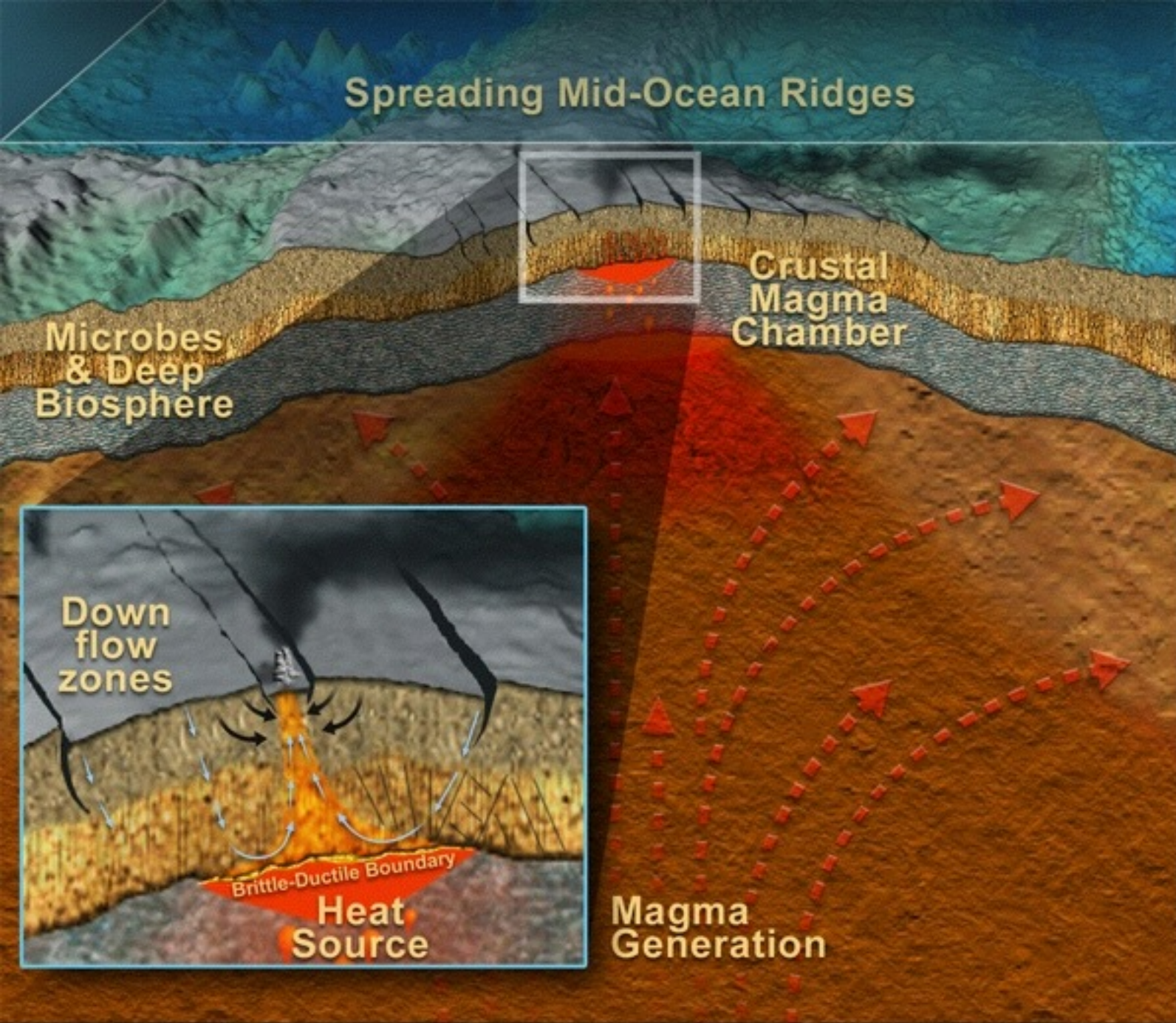
Changing ocean and changing technology

Oscar Schofield (rucool.marine.rutgers.edu)

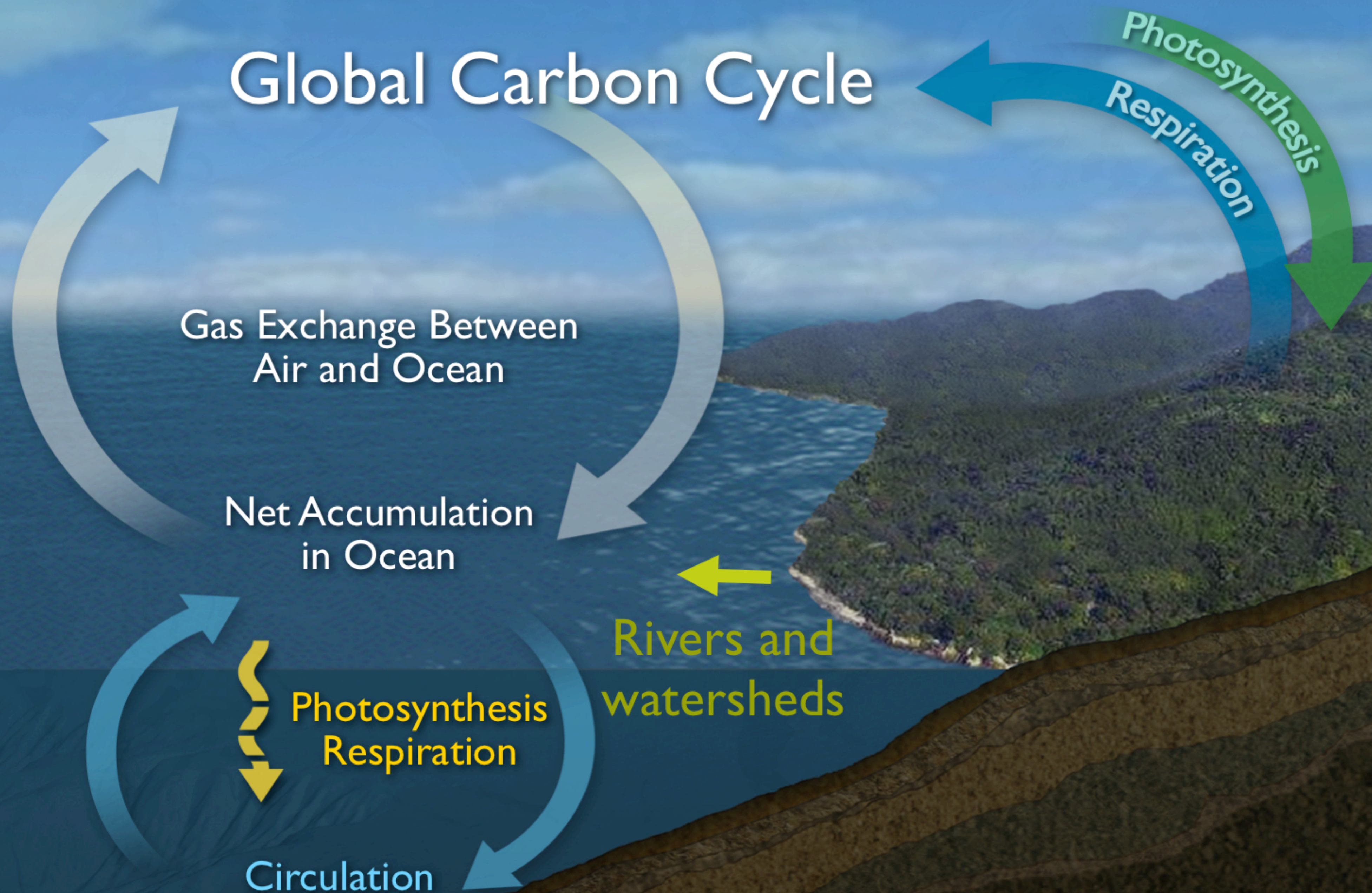


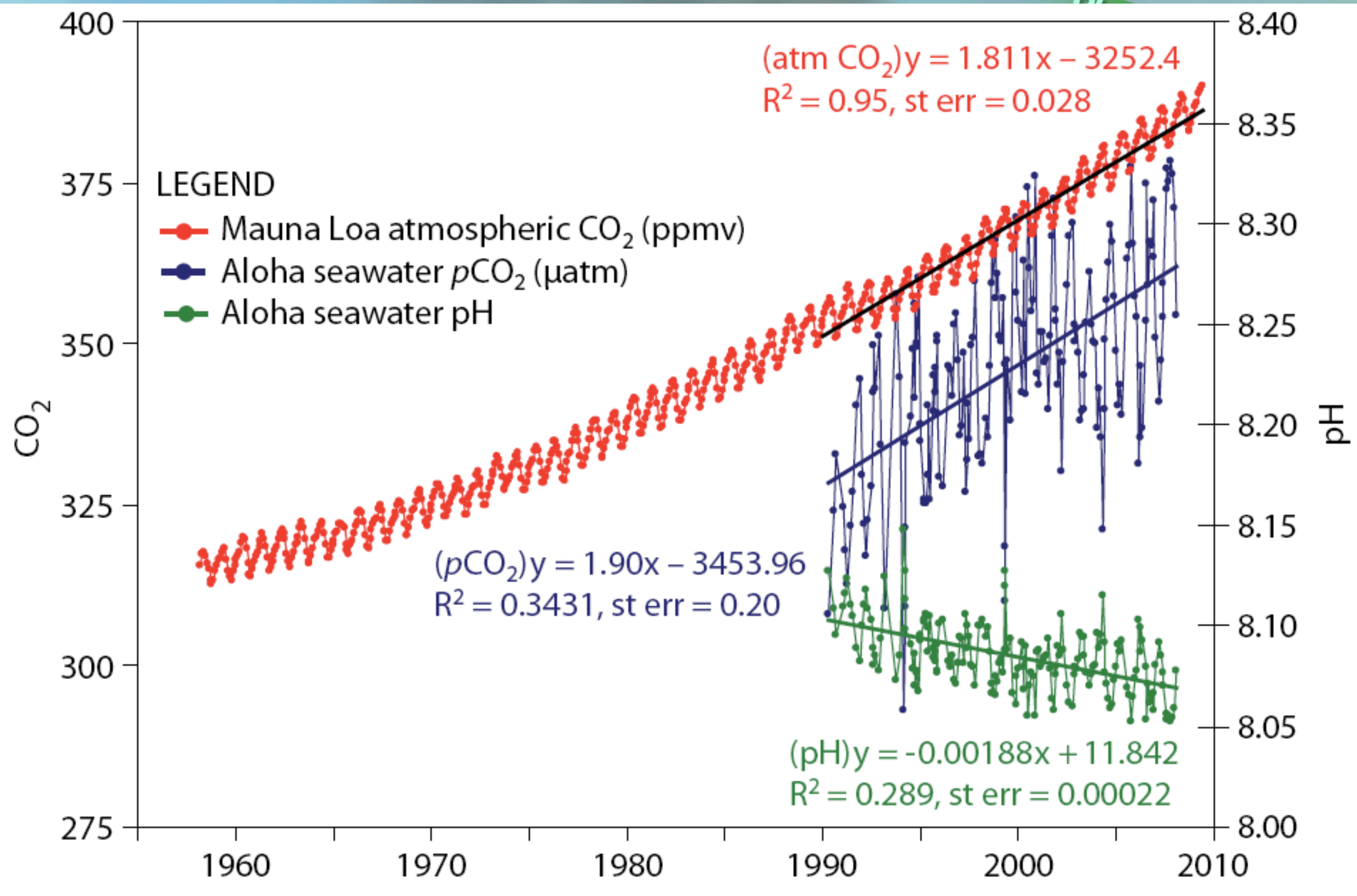
thanks to Grace Saba





Global Carbon Cycle





This oceans
are changing
in our lifetime

Annual Sea Ice Minimum - 1980

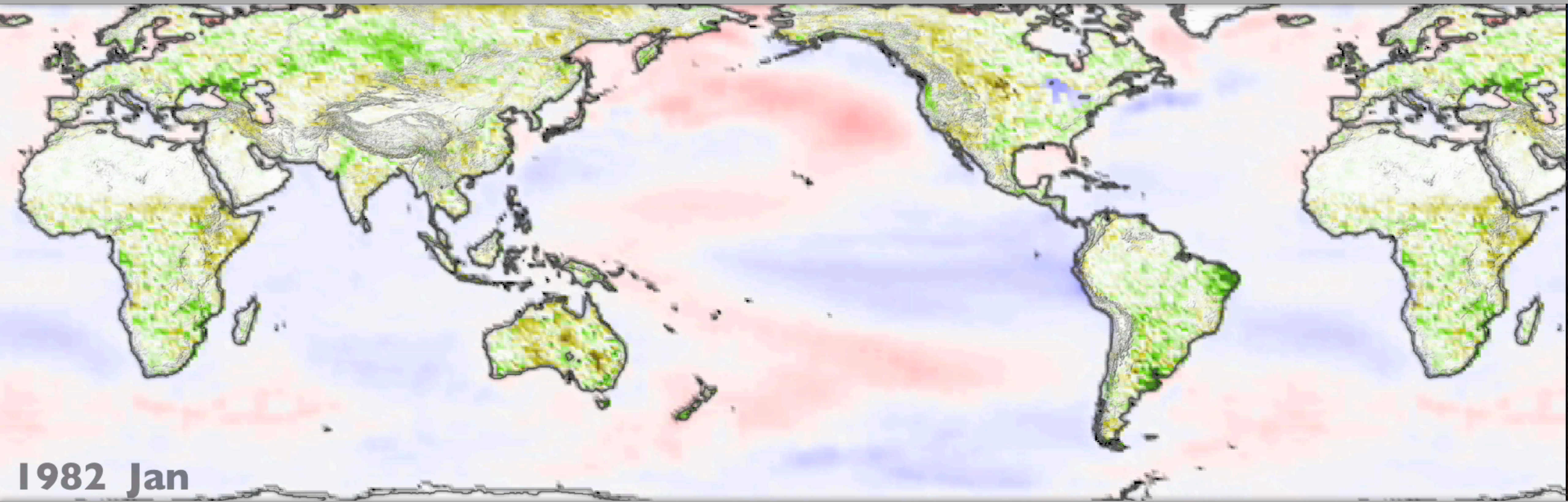
Image Source: NASA (svs.gsfc.nasa.gov)

This oceans
are changing
in our lifetime

Annual Sea Ice Minimum - 2007

Image Source: NASA (svs.gsfc.nasa.gov)

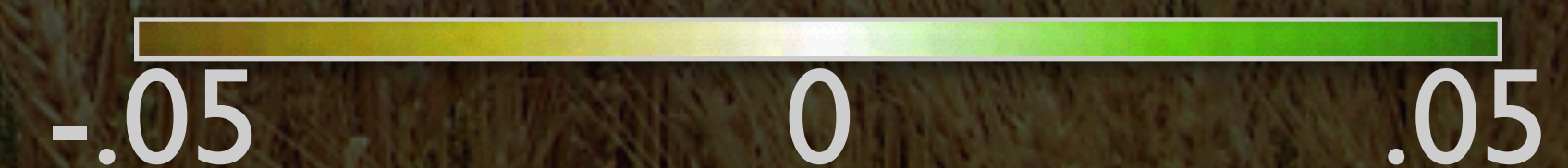
This is important for ALL humans who rely on the weather
to provide them food.... Everybody



Sea Surface Temperature Anomolies

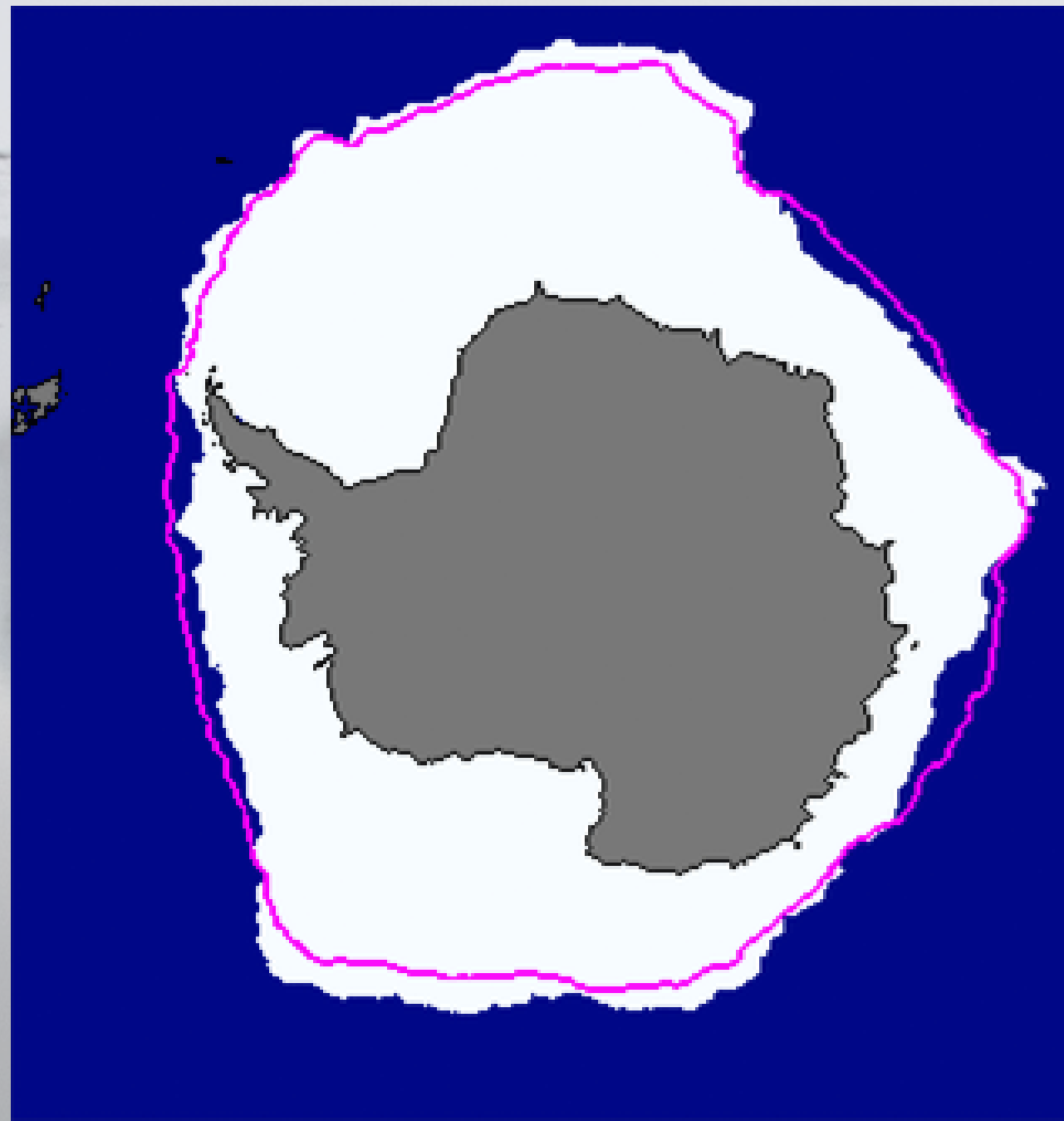


Vegetation Index Anomolies

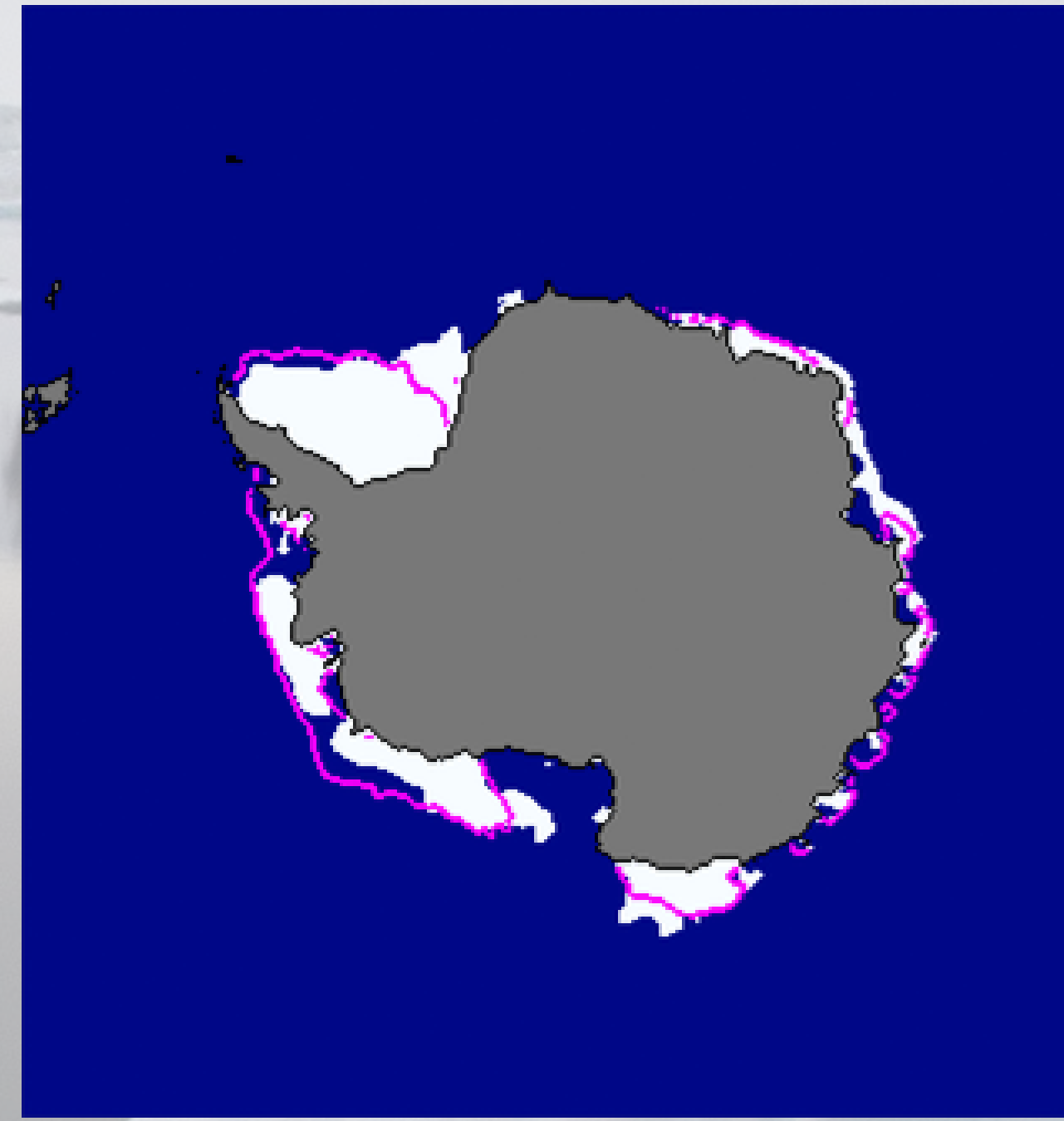


Adapted from, Earth Observatory story:
“Watching Plants Dance to the Rhythms of the Ocean”
<http://earthobservatory.nasa.gov/Study/SSTNDVI/>

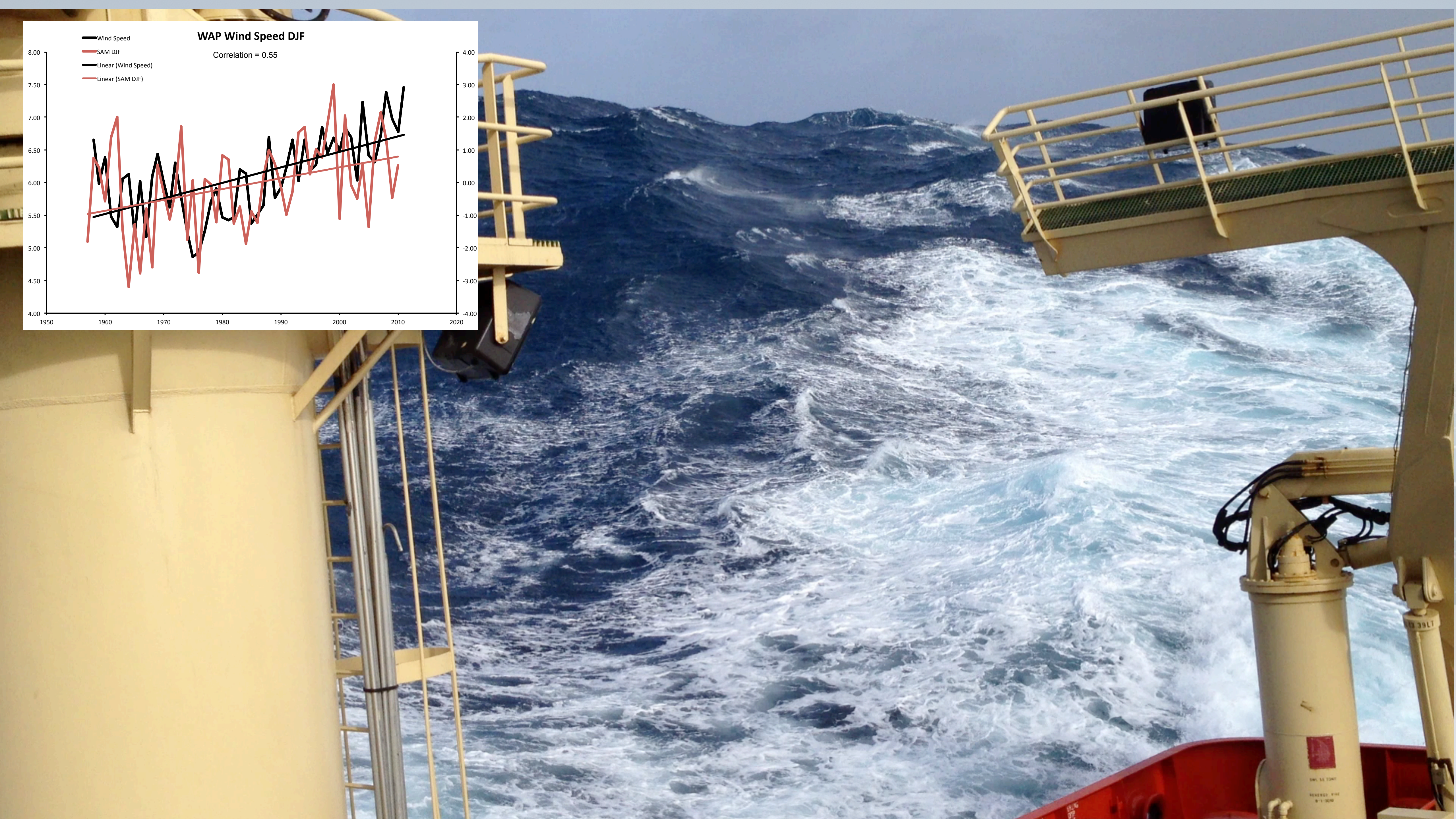
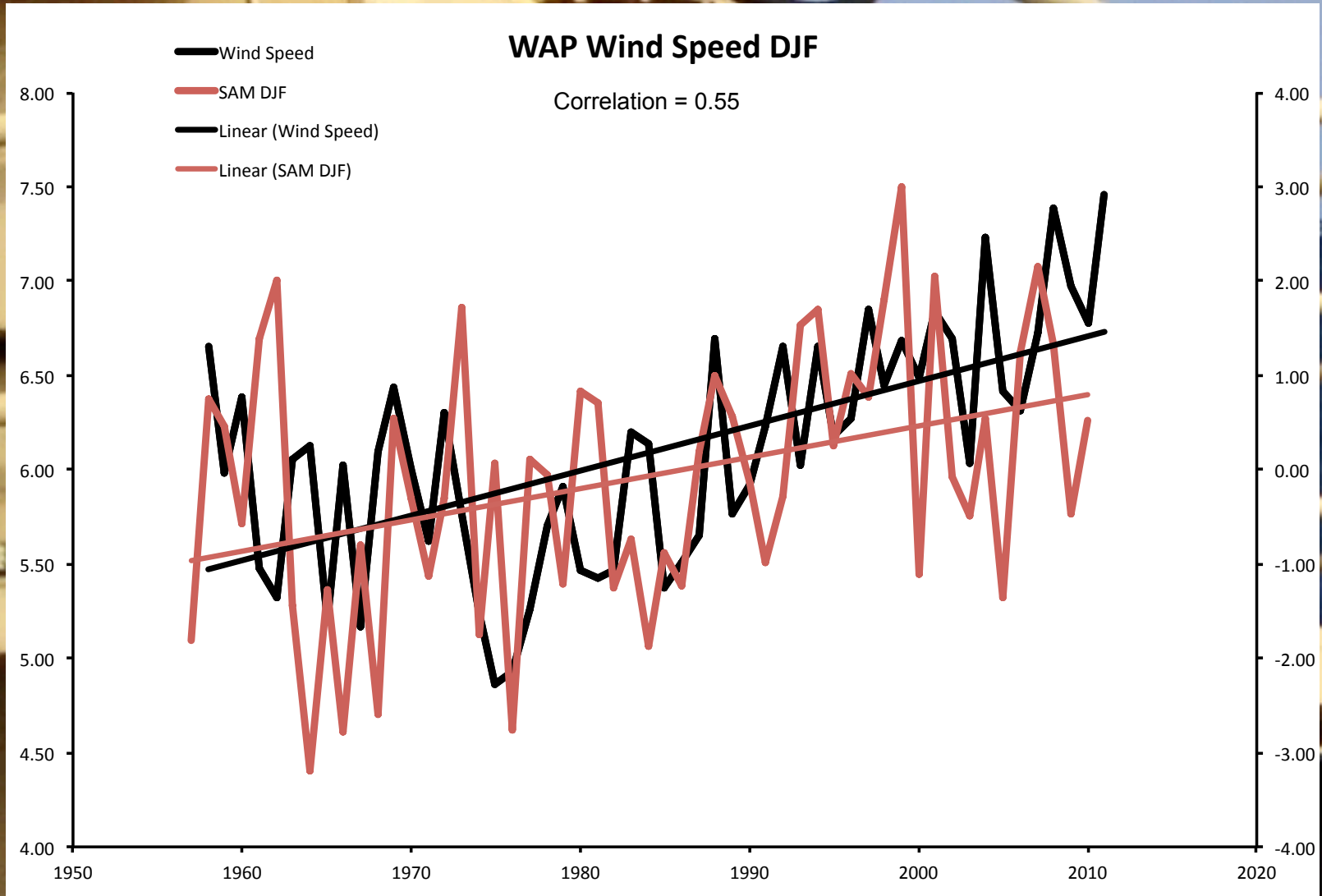
The central hypothesis when the LTER began was that sea ice timing and magnitude structure the productivity and composition of the Antarctic ecosystem. The ice dynamics are driven by large-scale interactions of the atmosphere and ocean.

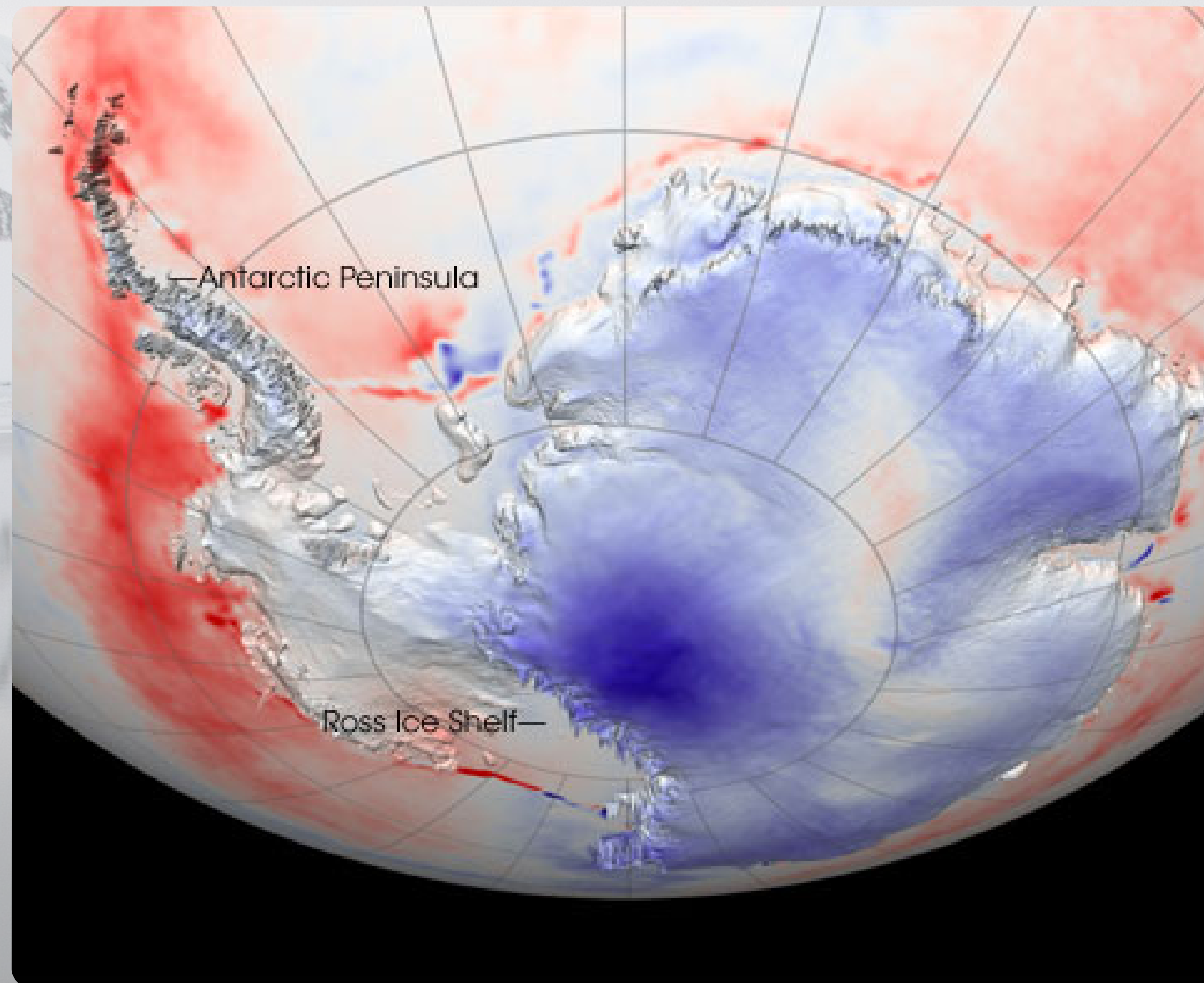


Winter 2007



Summer 2007





Temperature Trends (degrees C per year)



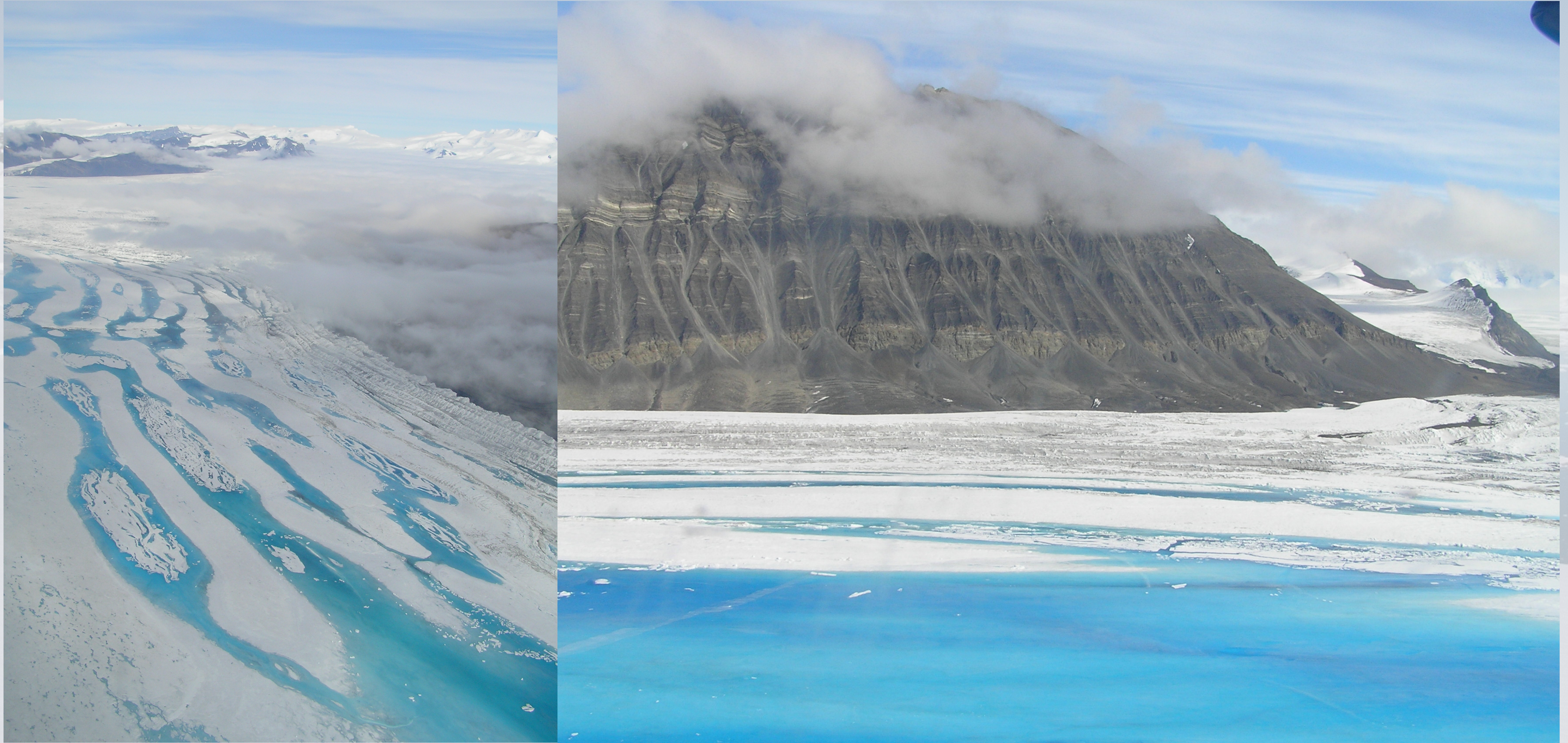
The WAP peninsula is experiencing the largest winter warming on Earth

Larson-B ice shelf after its collapse
Thanks to BAS & A. Clarke



Melt pools on surface of King George VI Sound

(from a BAS twin otter, January 2004)



Palmer Station in the present



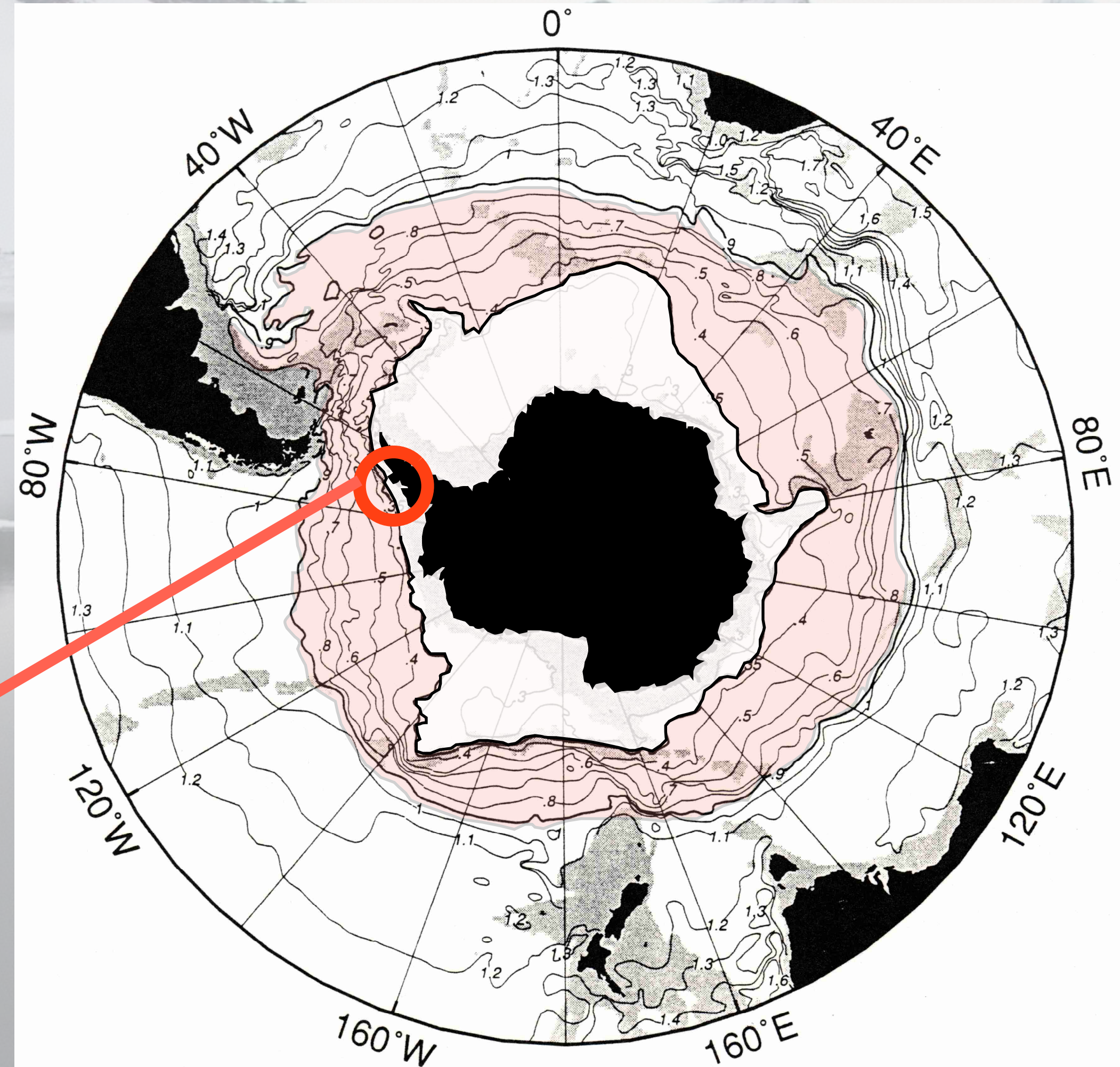
photo by Bill Fraser

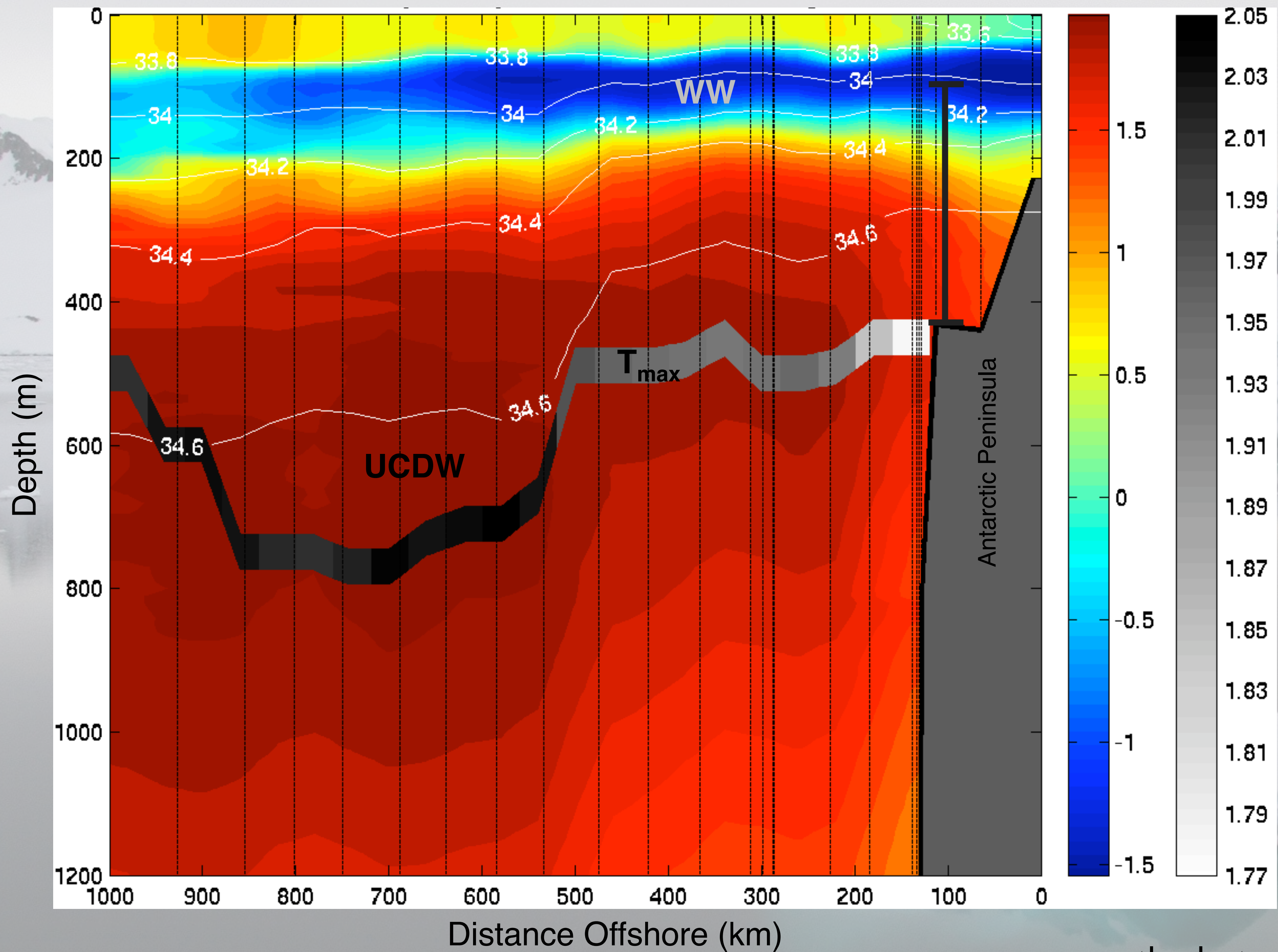
Plants at Palmer Station, the greening of Antarctica



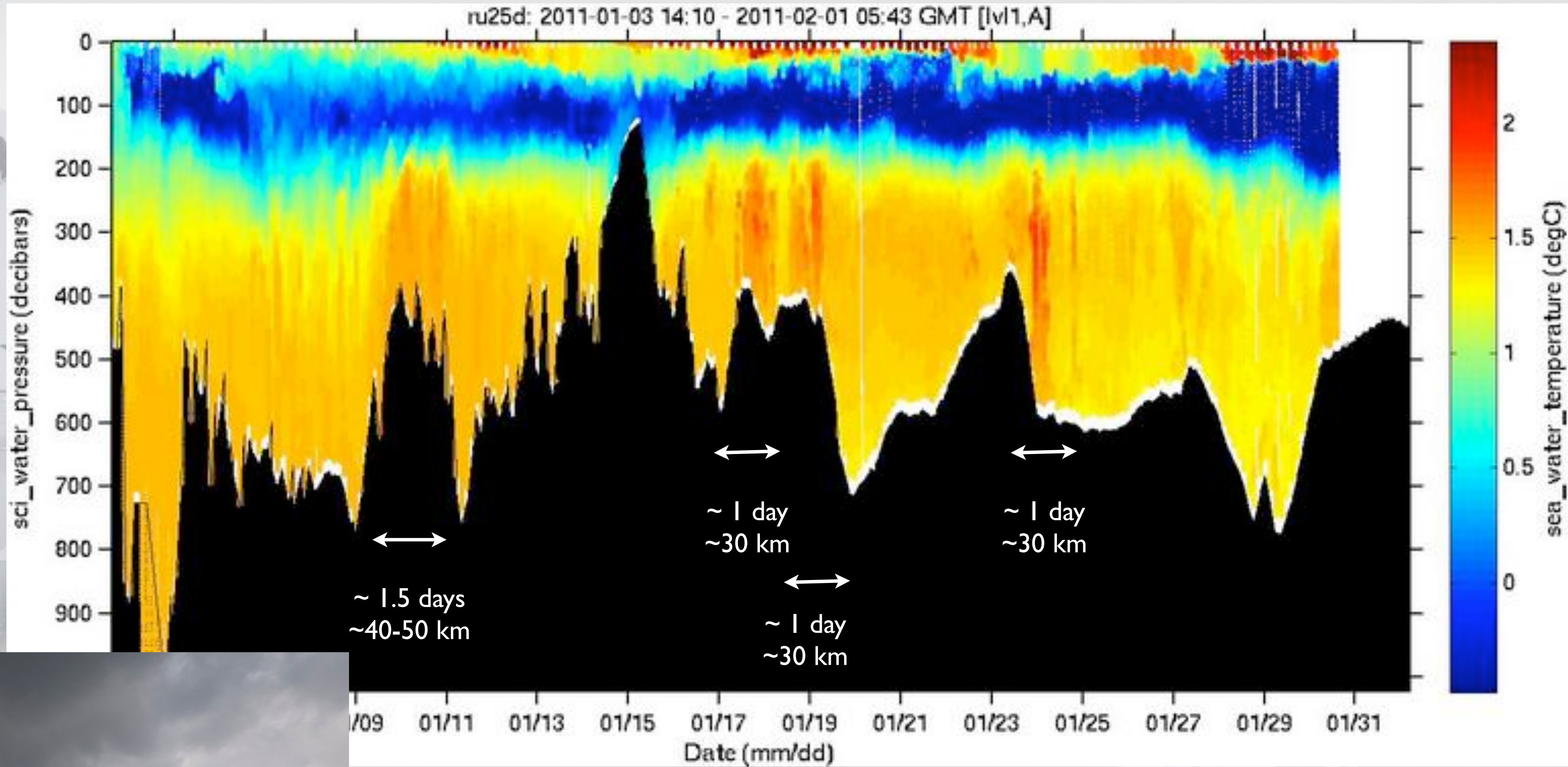
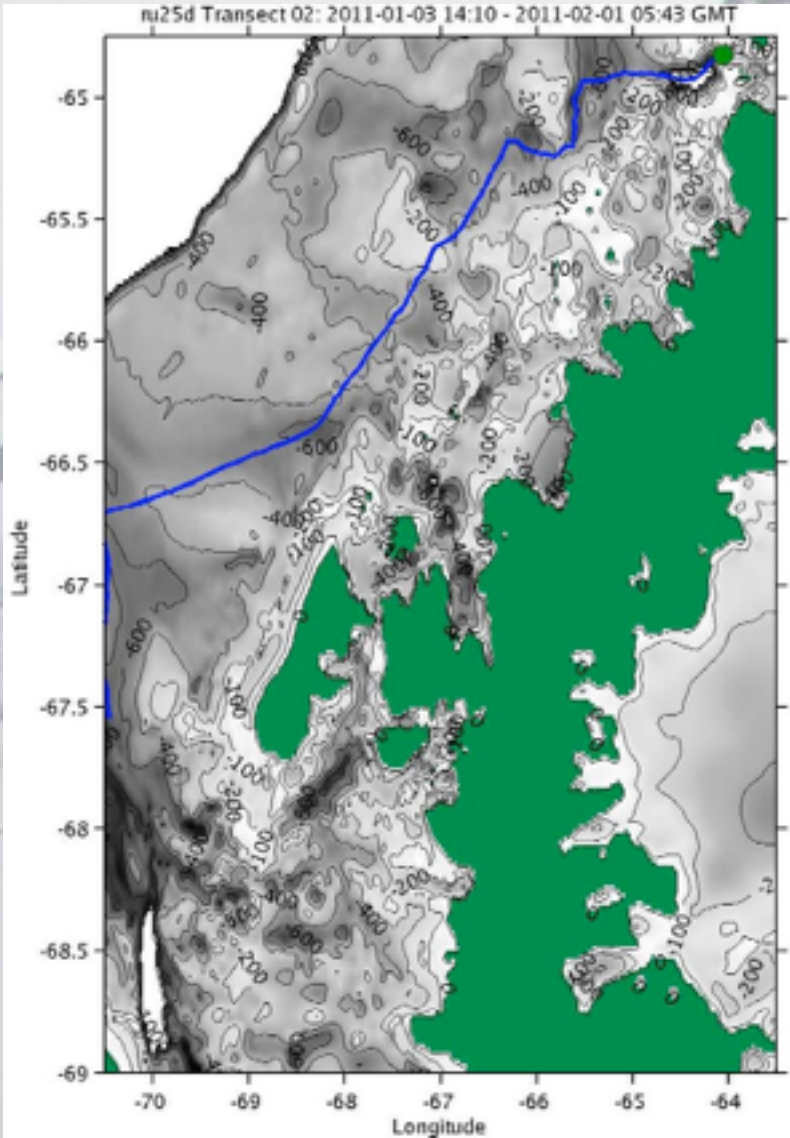
Heat input from Antarctic Circumpolar Current (ACC - world's largest ocean current = ~30,000 Niagara Falls). The heat is driven onto the shelf by intensification of upwelling-favorable winds.

The WAP is the only location in the Antarctic where the ACC is adjacent to the shelf break. The ACC is Antarctica's warmest water





thanks to Doug Martinson

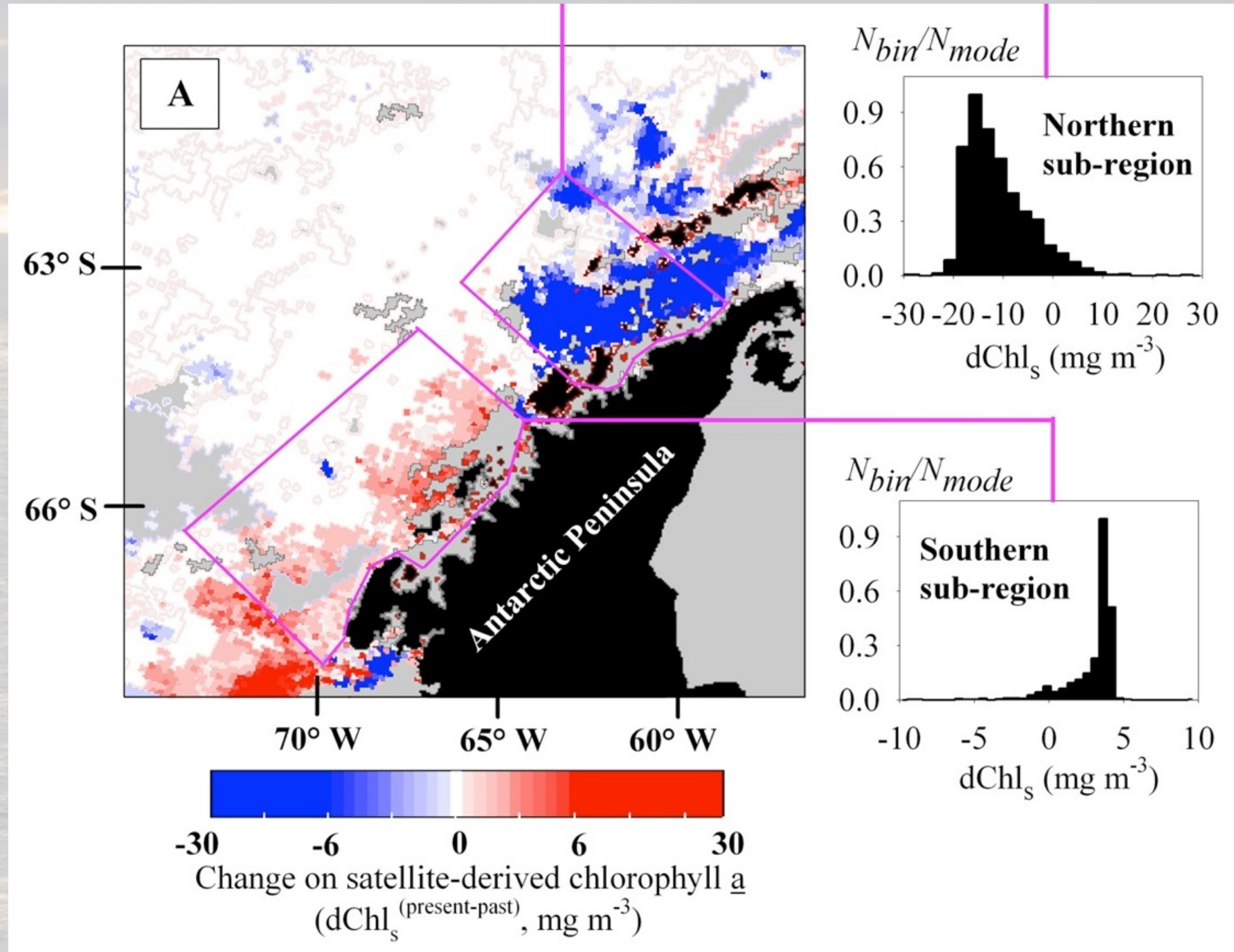


2011: Eddies moving across shelf?

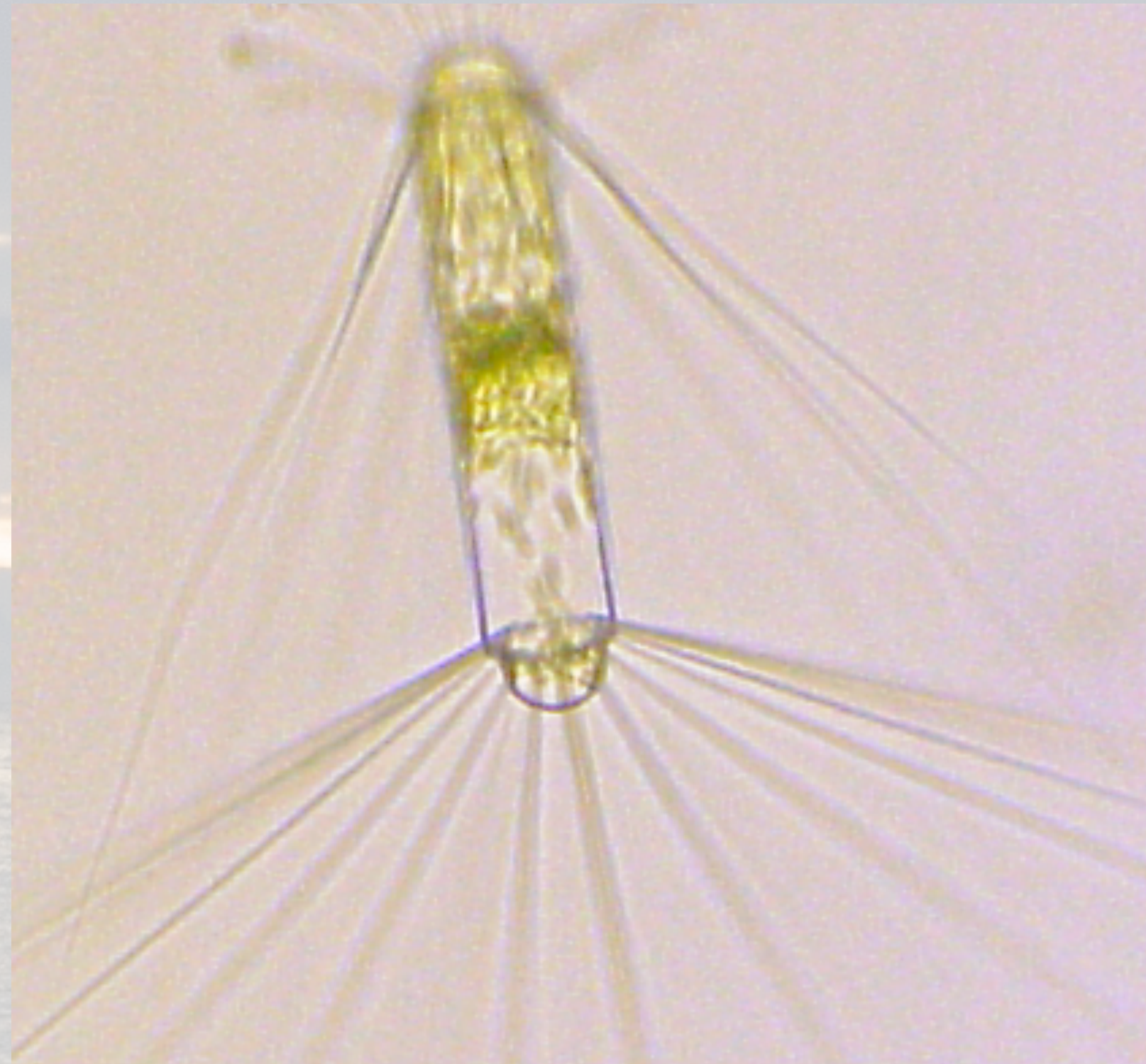


The decadal changes have resulted changes in the phytoplankton

Montes Hugo et al. Science 2009



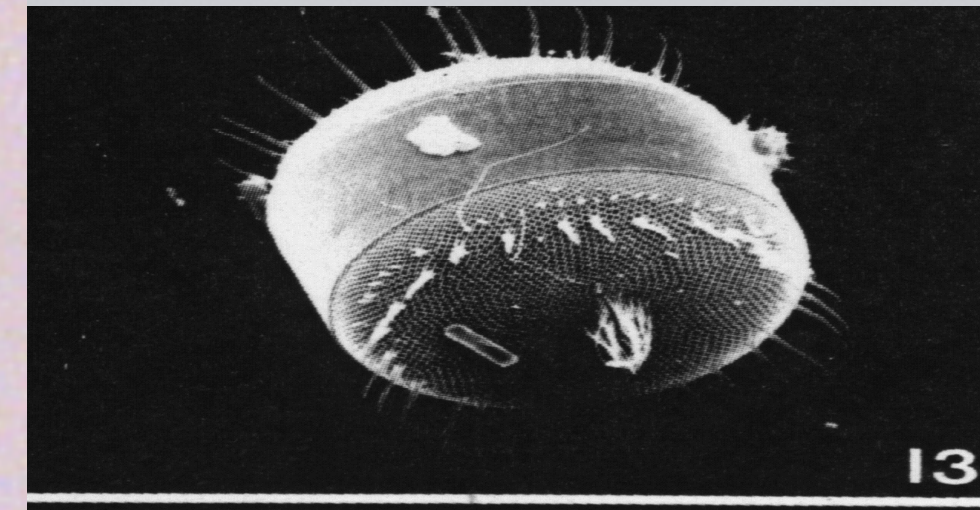




Corethron criophilum

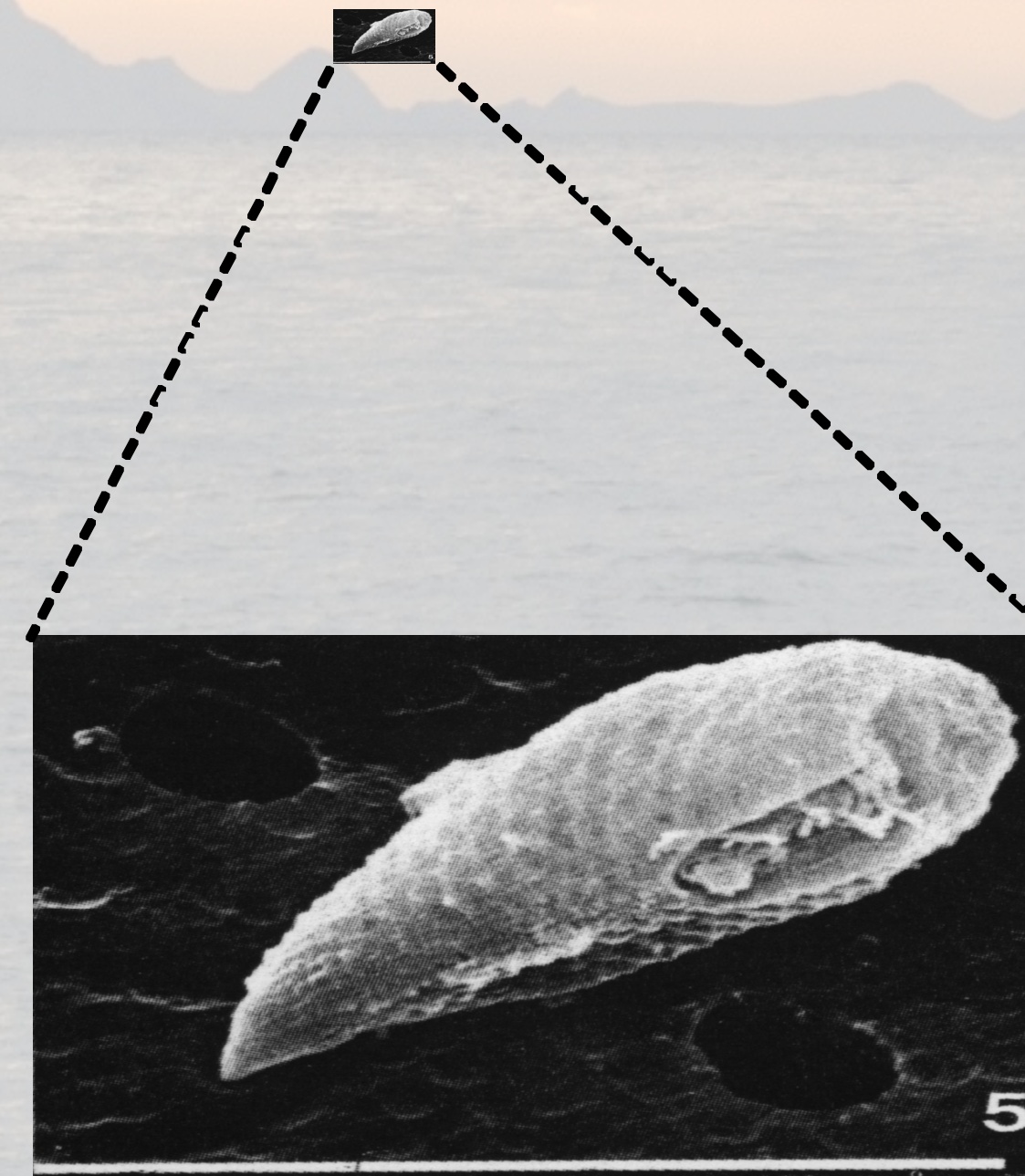
Palmer Cryptophytes --> $8 \pm 2\mu\text{m}$

SEM Micrographs from McMinn and Hodgson 1993



100 μm

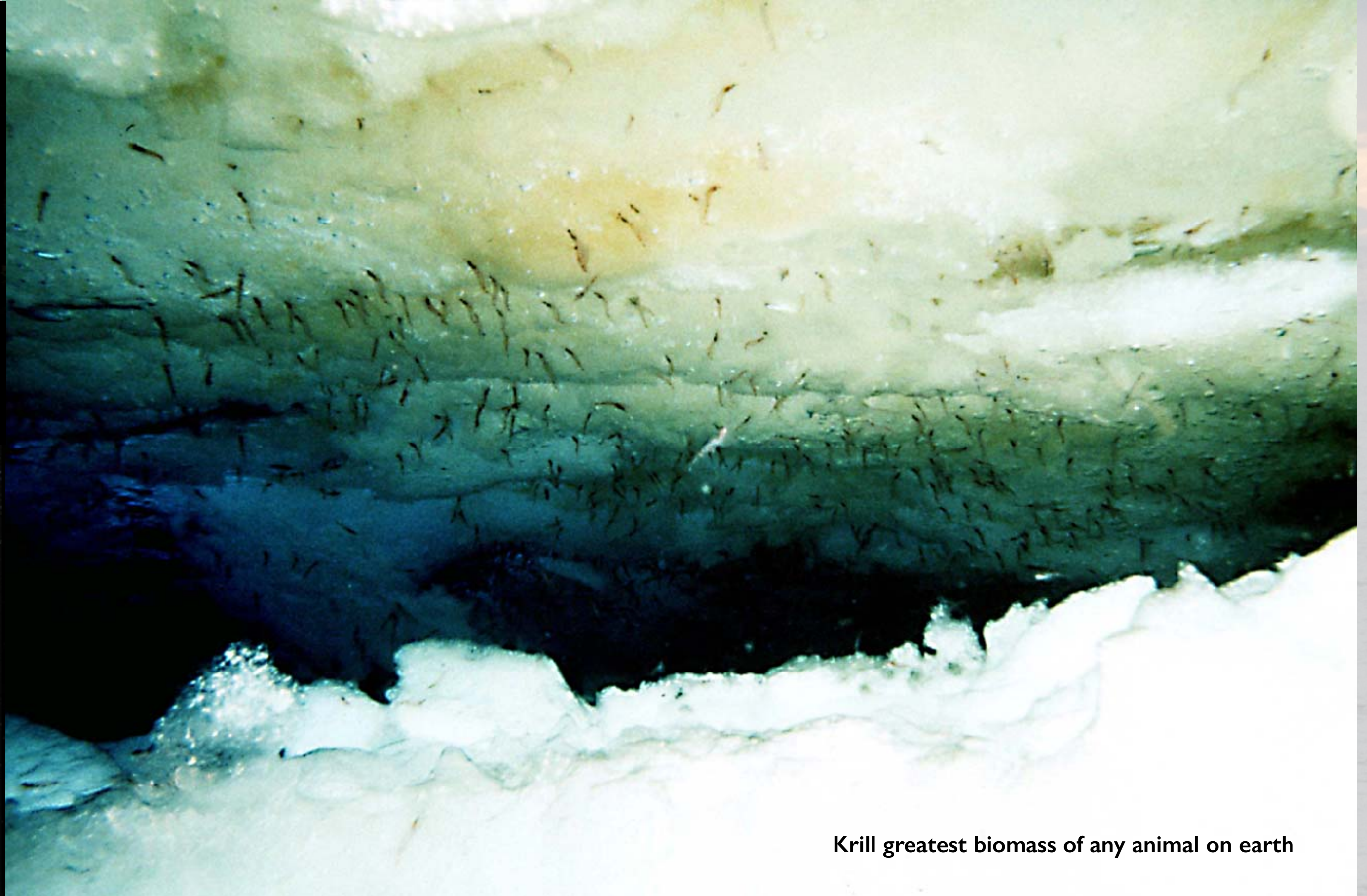
Thalassiosira antarctica



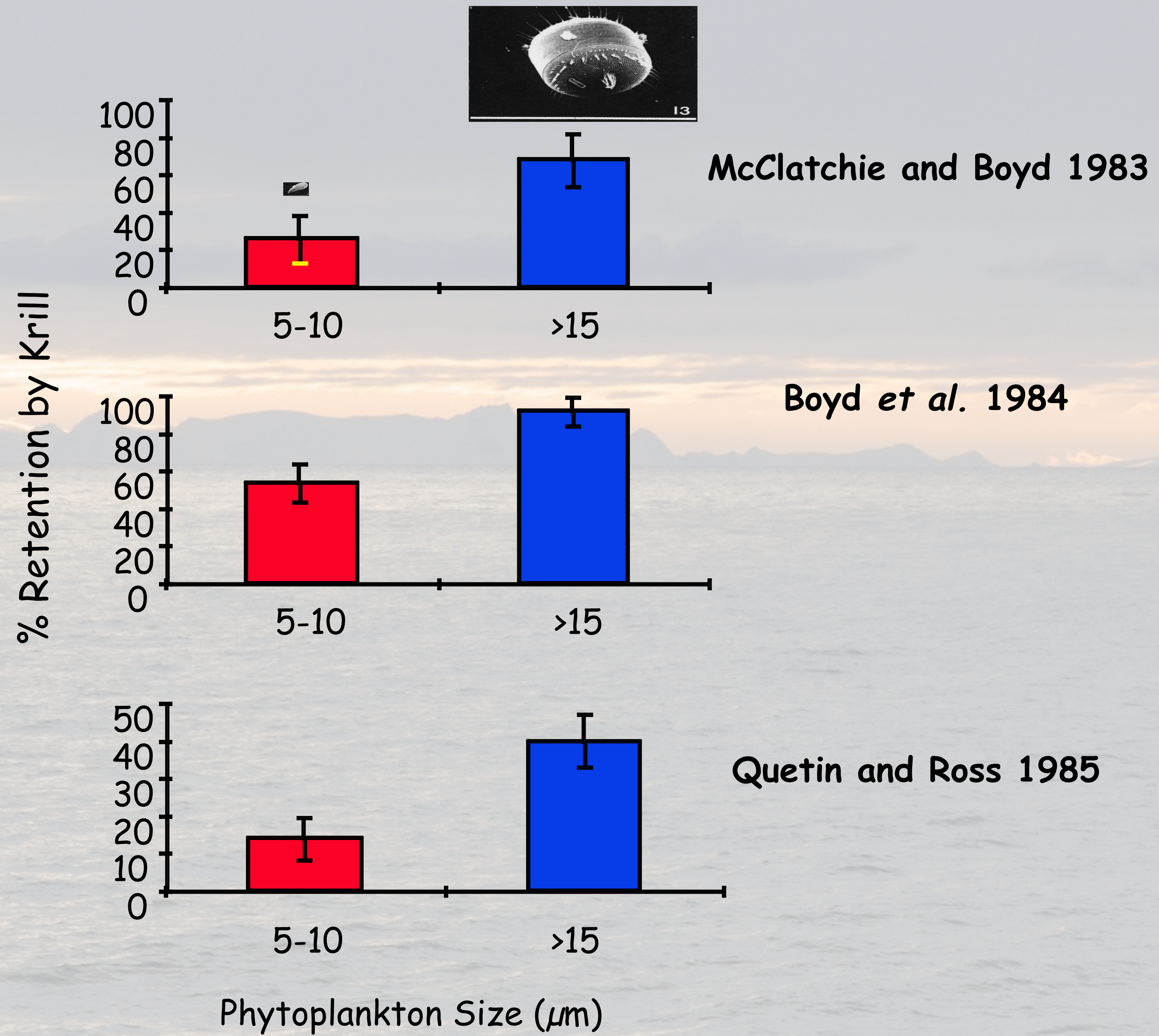
10 μm

Cryptomonas cryophila

Zooplankton are dominated by krill or salps



Krill greatest biomass of any animal on earth



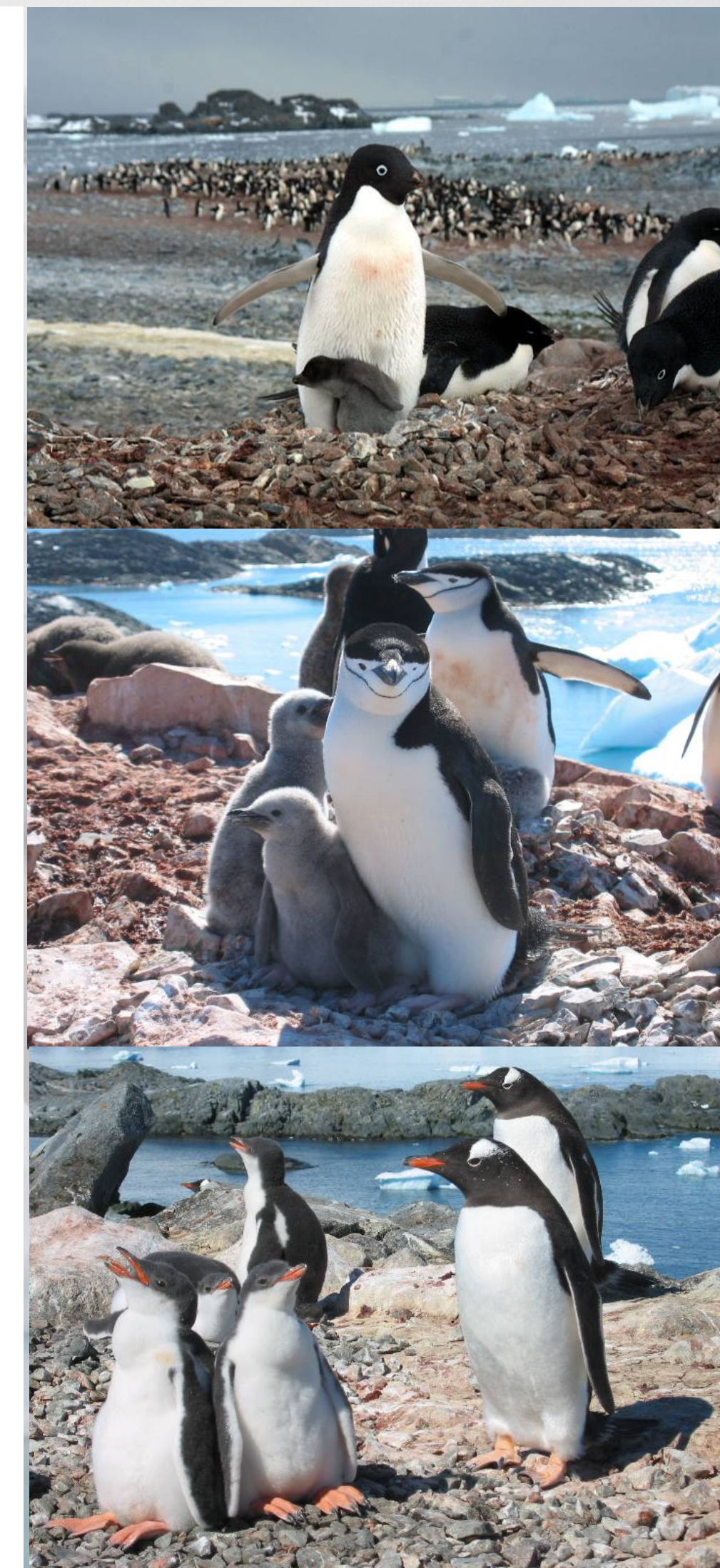
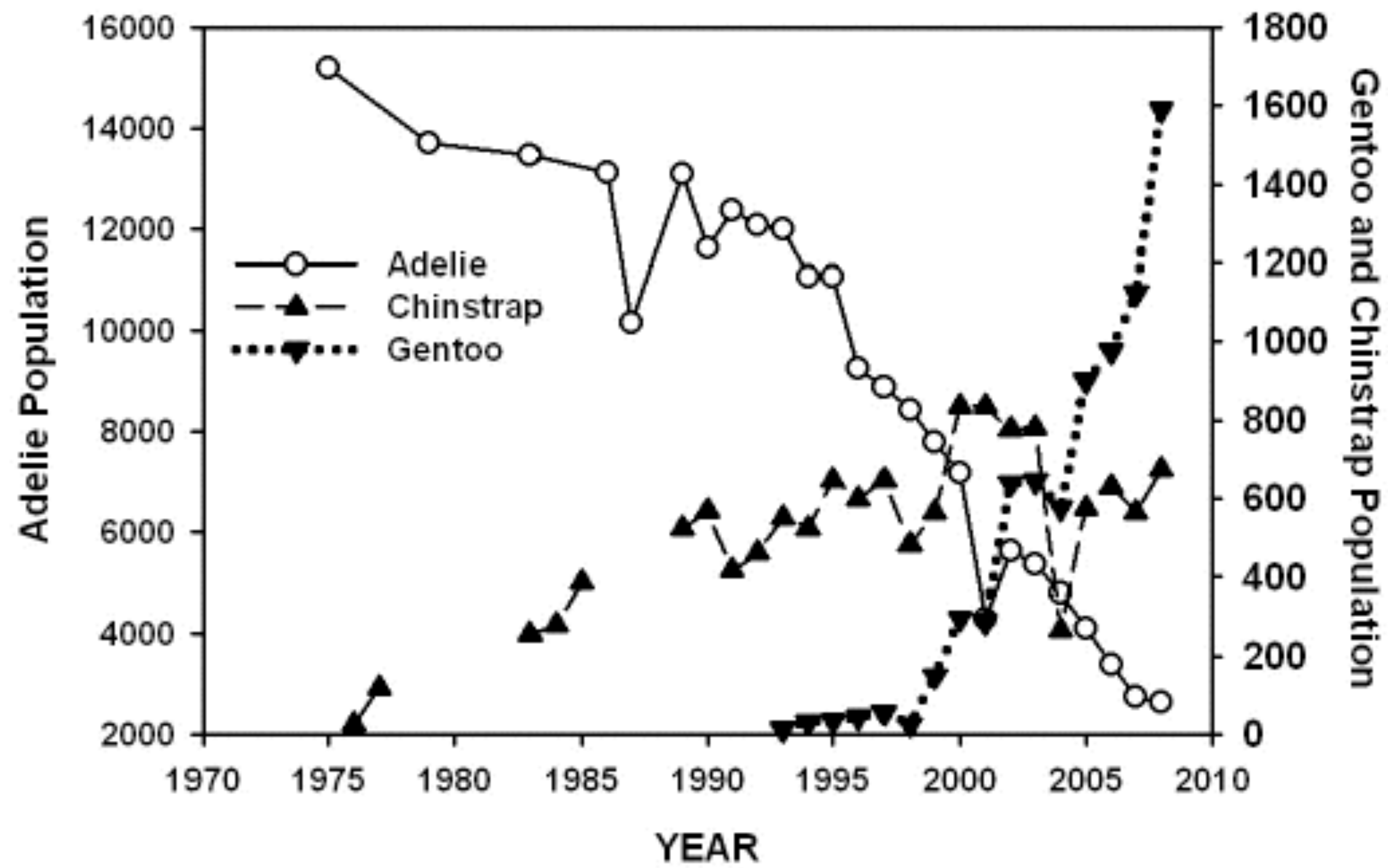




Is there an impact on higher trophic levels?

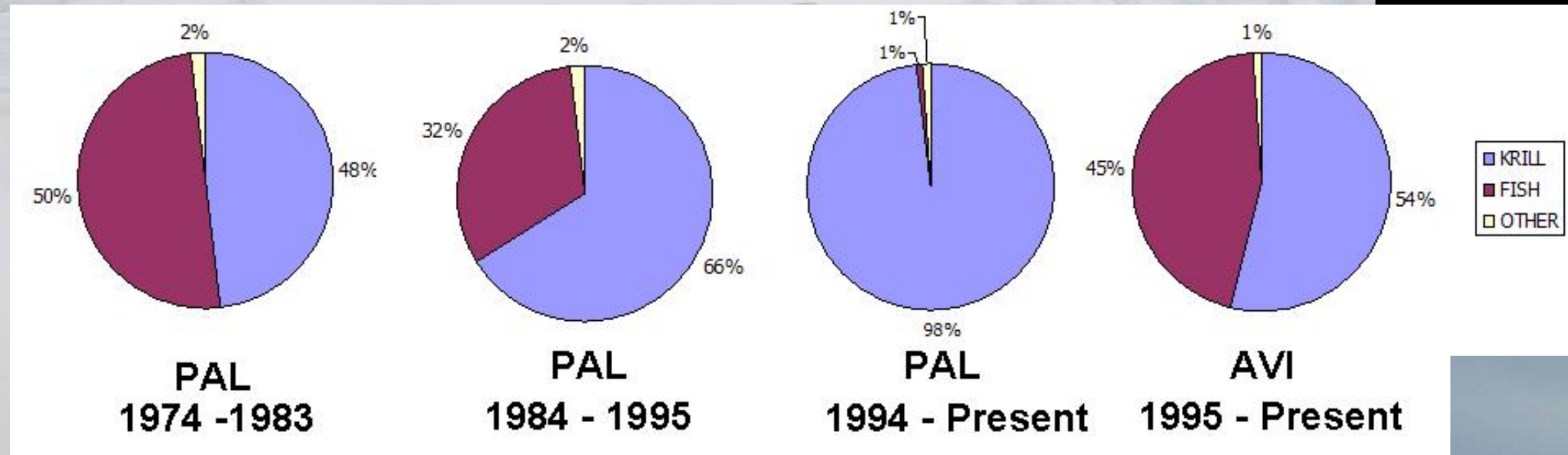
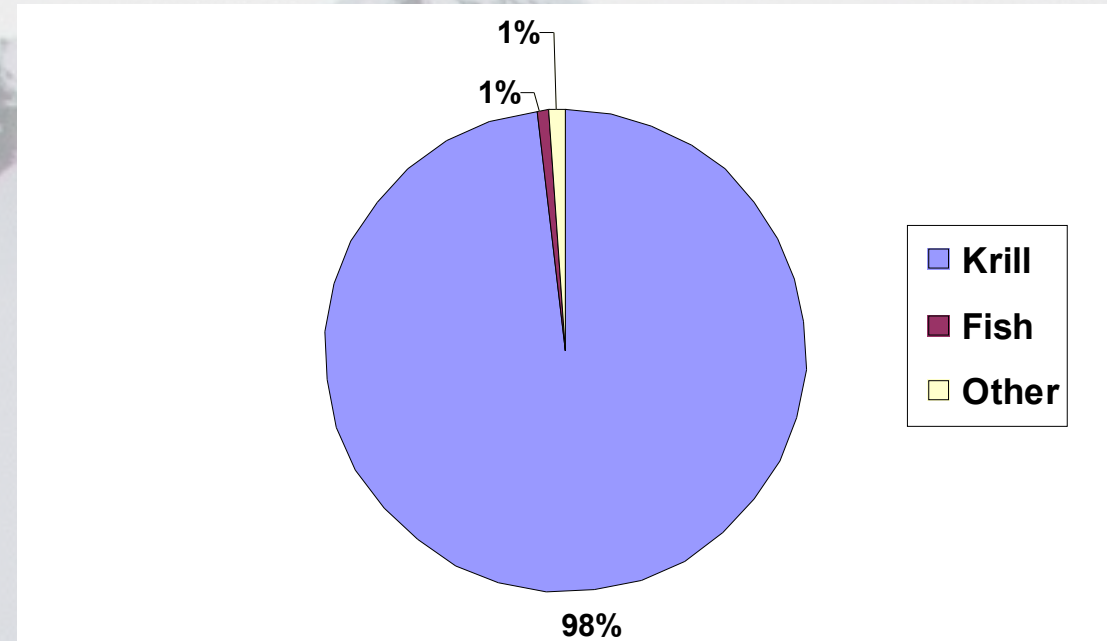




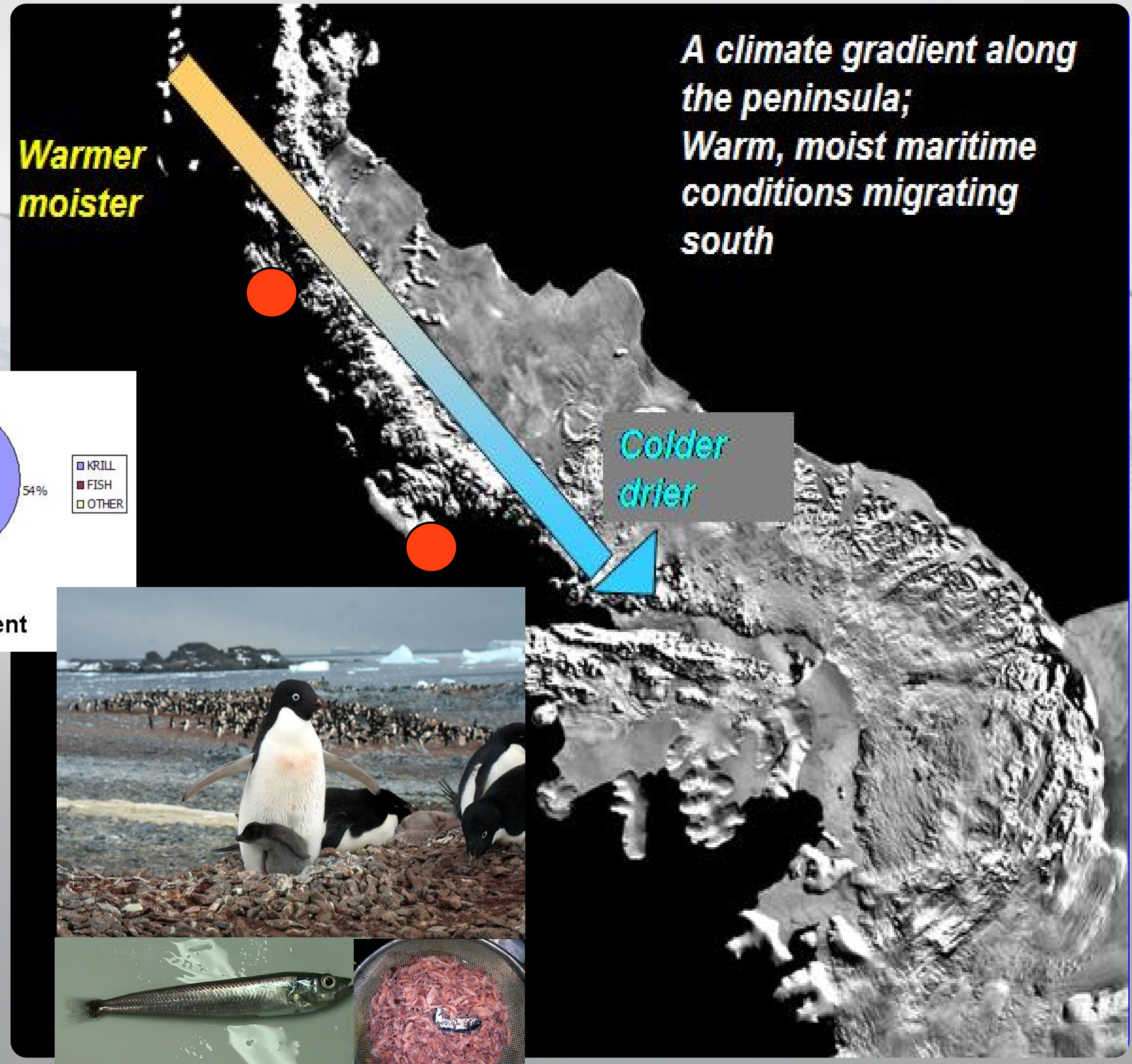
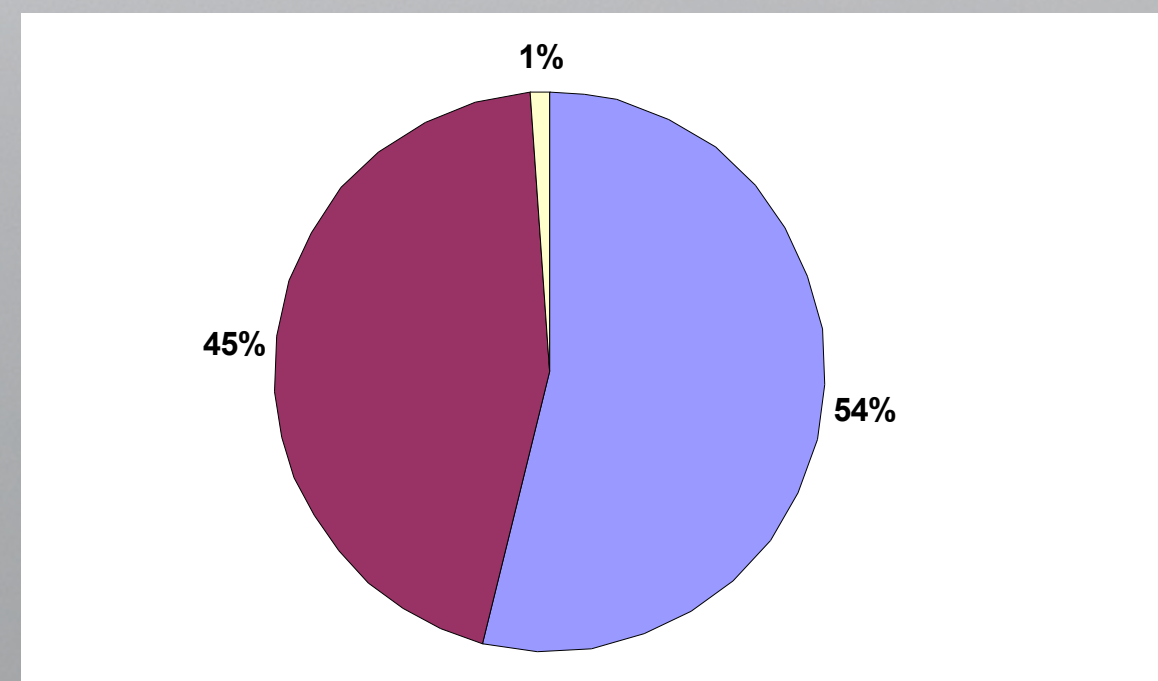


Changing diets for the Adelie penguins

1994-present

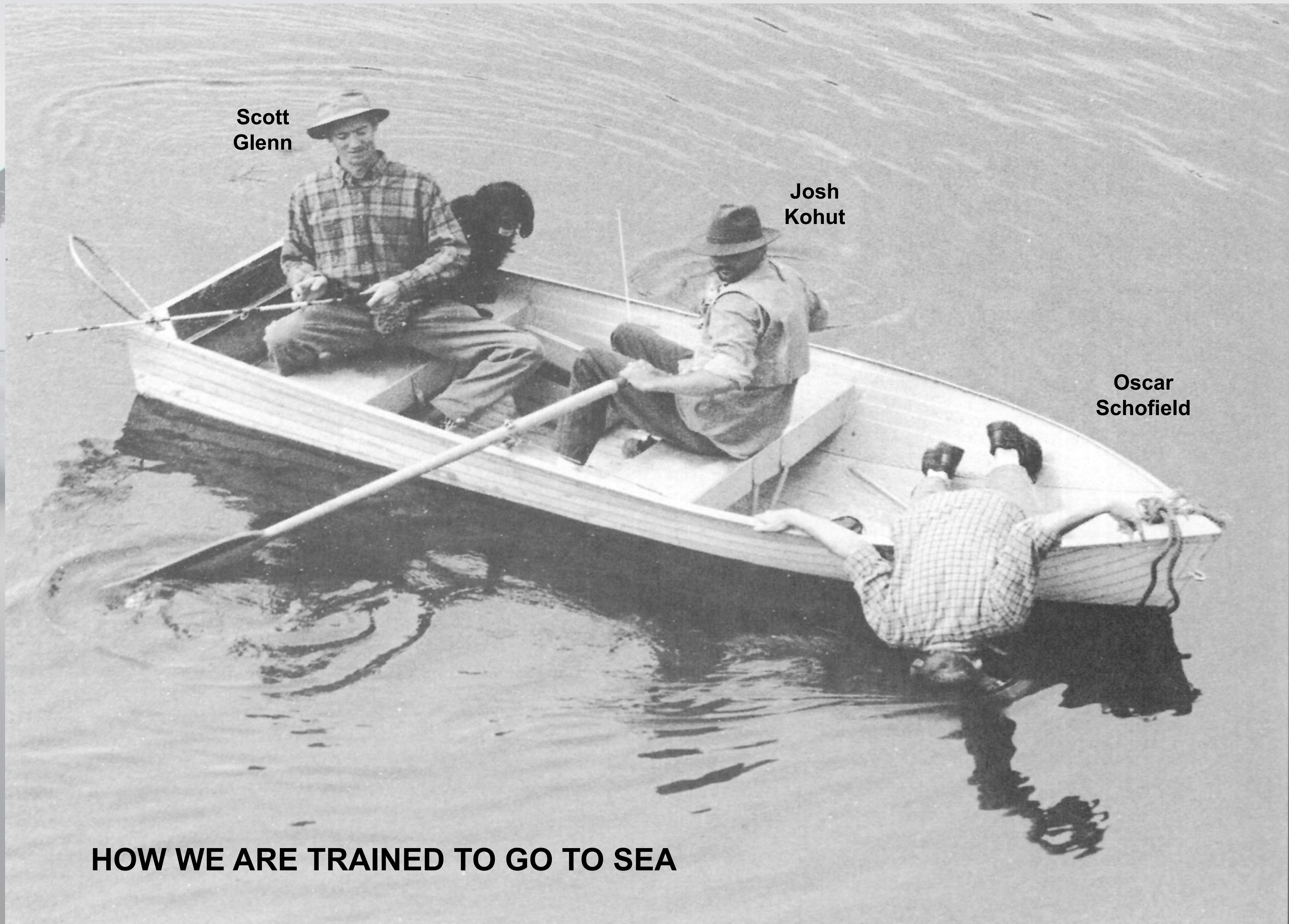


1995-present



If that was not enough, warmer temps leads to more moisture and more snow. Breeding failure.....





**Scott
Glenn**

**Josh
Kohut**

**Oscar
Schofield**

HOW WE ARE TRAINED TO GO TO SEA

Ocean is hard to sample



Bring in the Robots



Old Day Communication



HAM Operator Coms Palmer Station 1988

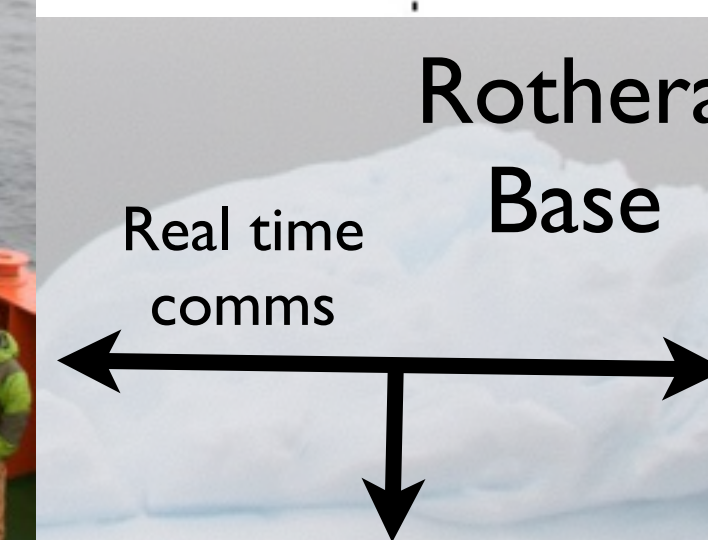
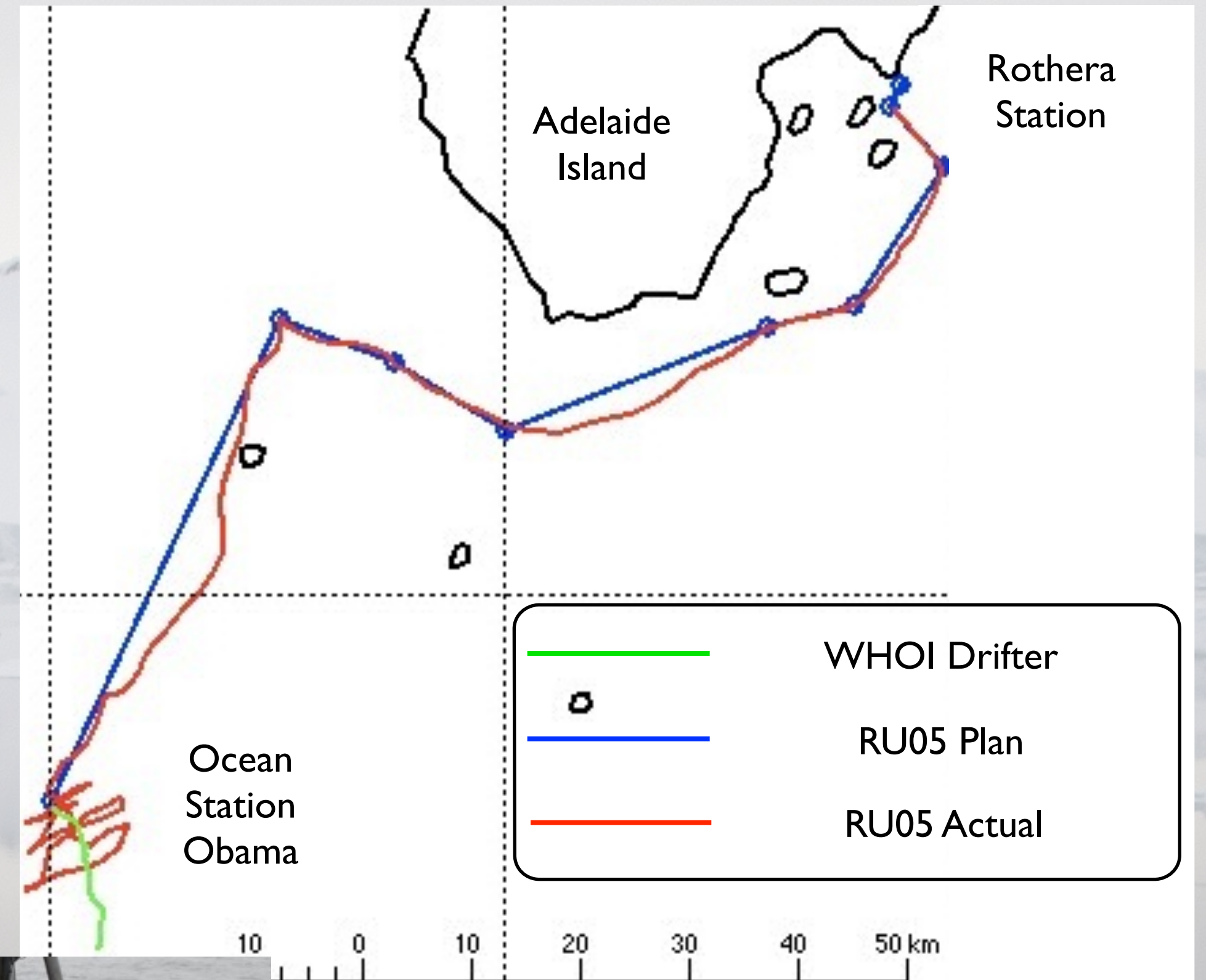
Brave New Day



RV Gould

70 West

69 West



Rutgers
COOLroom



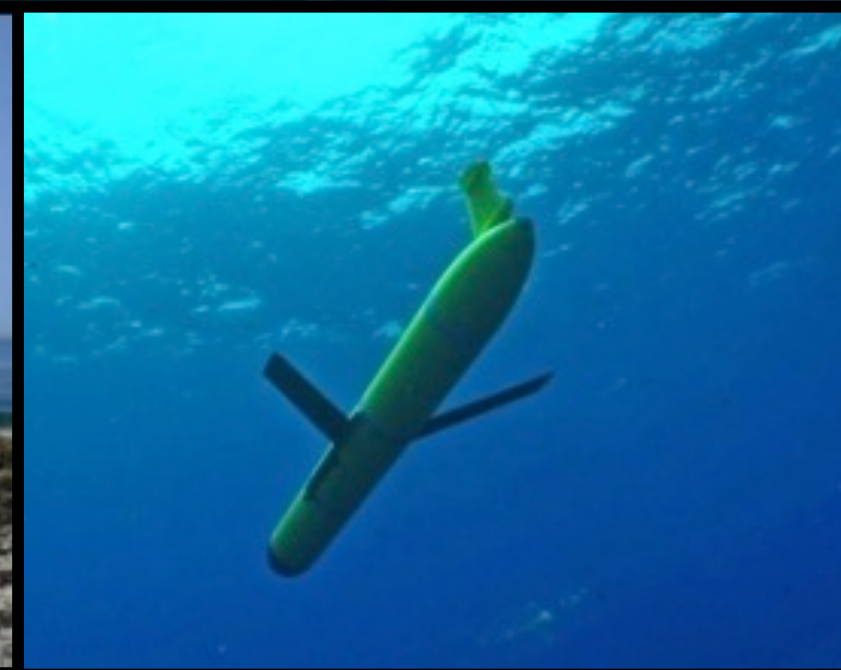
The COOL Room



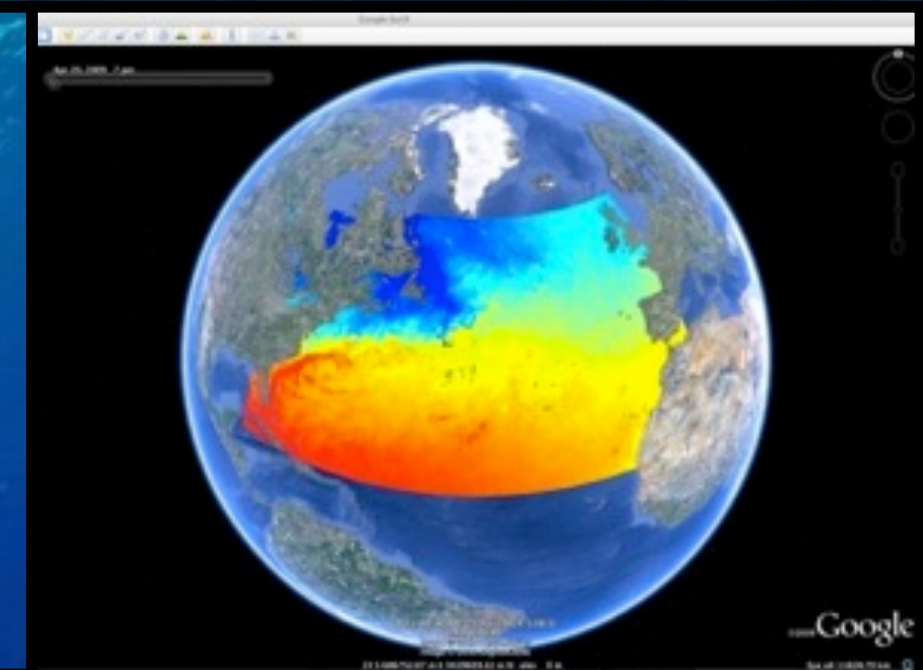
Satellite Data Acquisition Stations



CODAR Network



Glider Fleet

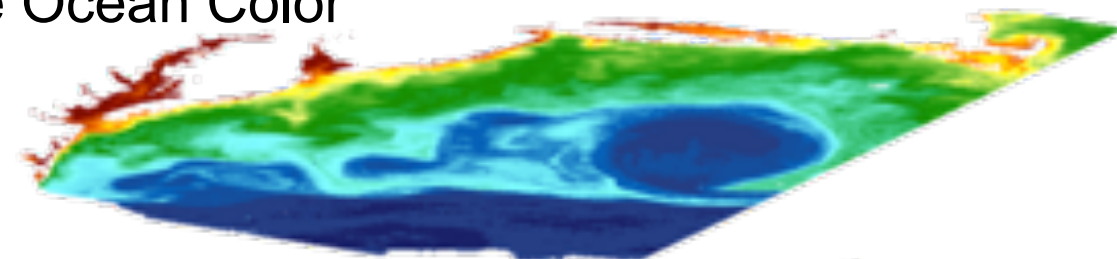


3-D Forecasts

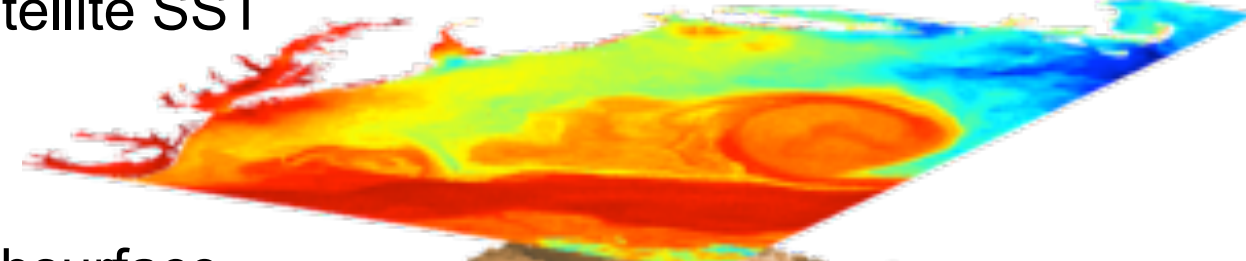
Subsurface glider network



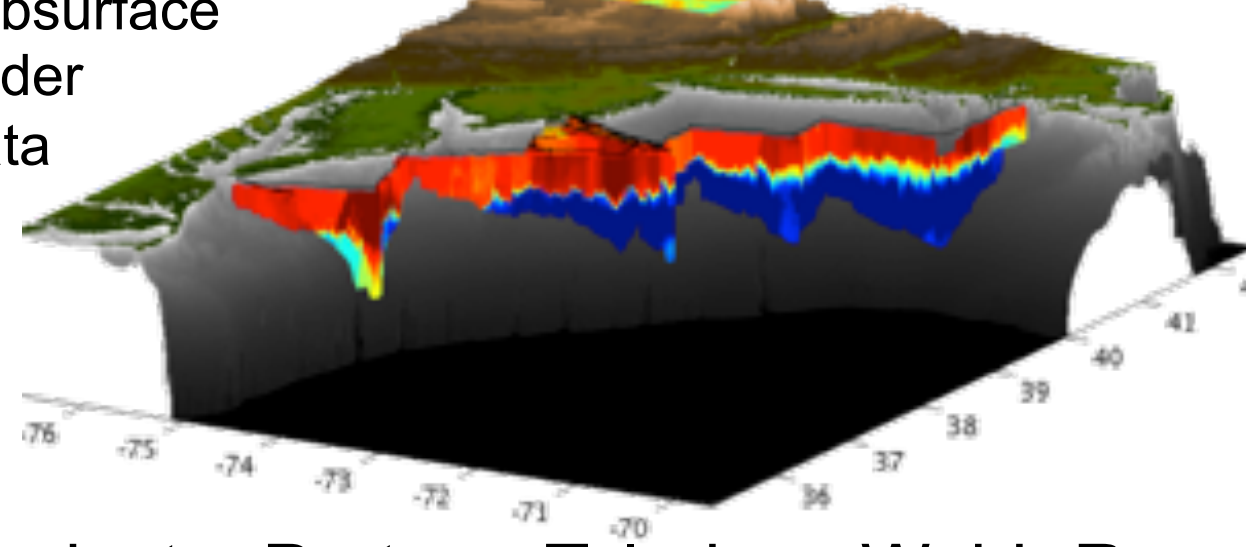
Satellite Ocean Color



Satellite SST

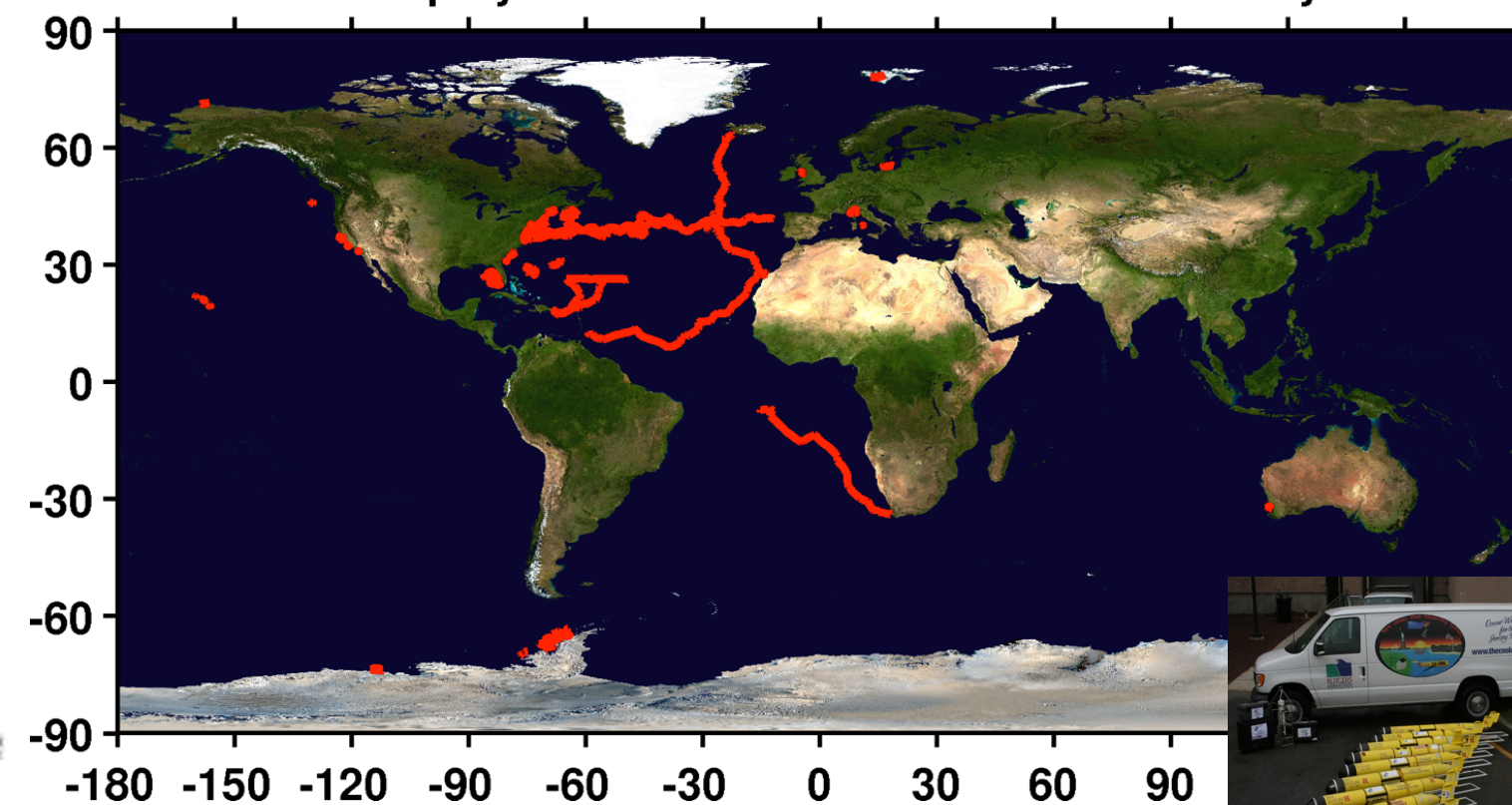


Subsurface
Glider
Data



Industry Partner: Teledyne Webb Research

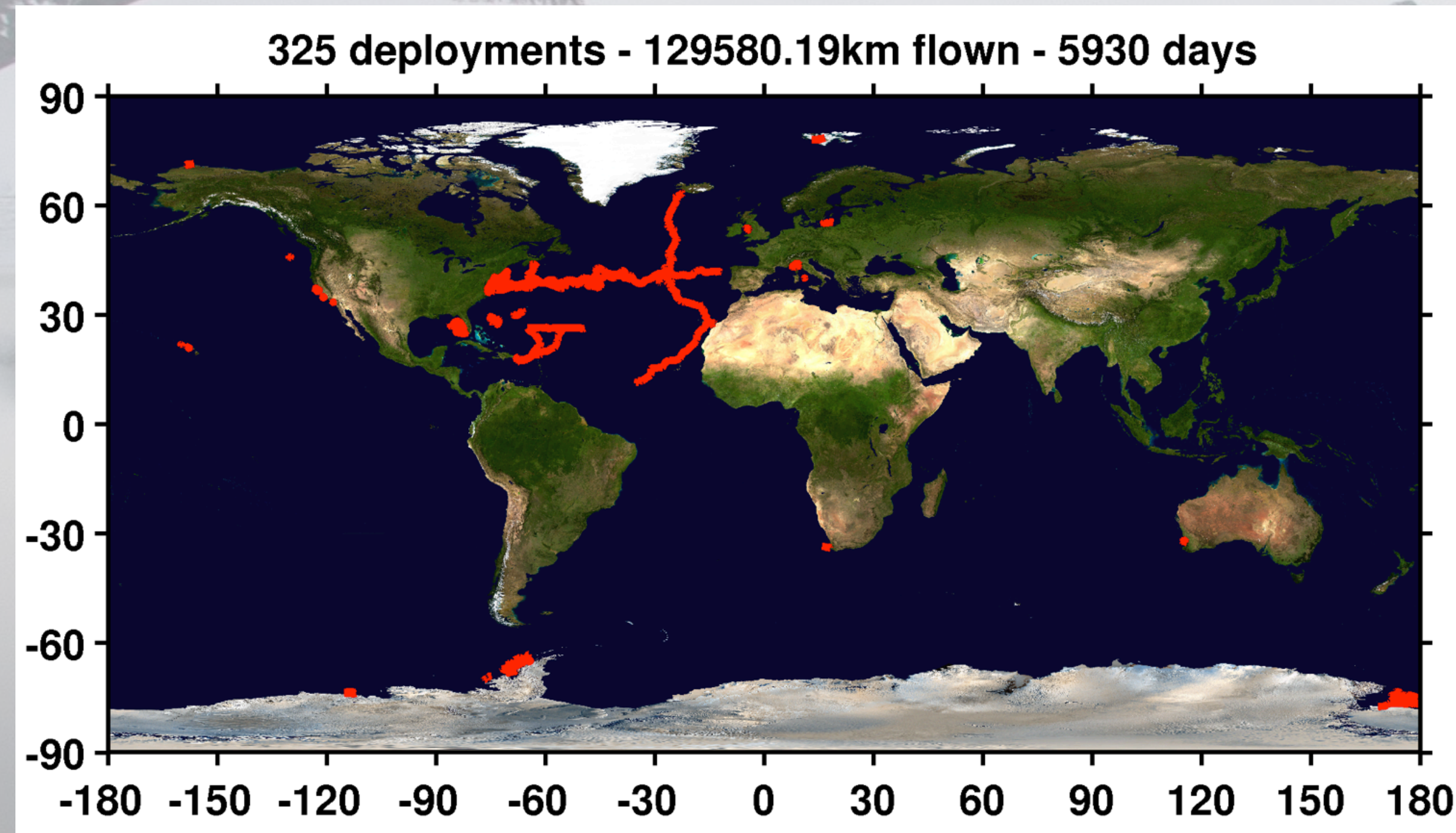
349 deployments - 148603.54km flown - 7011 days



 **TELEDYNE
WEBB RESEARCH**
Everywhere you look™



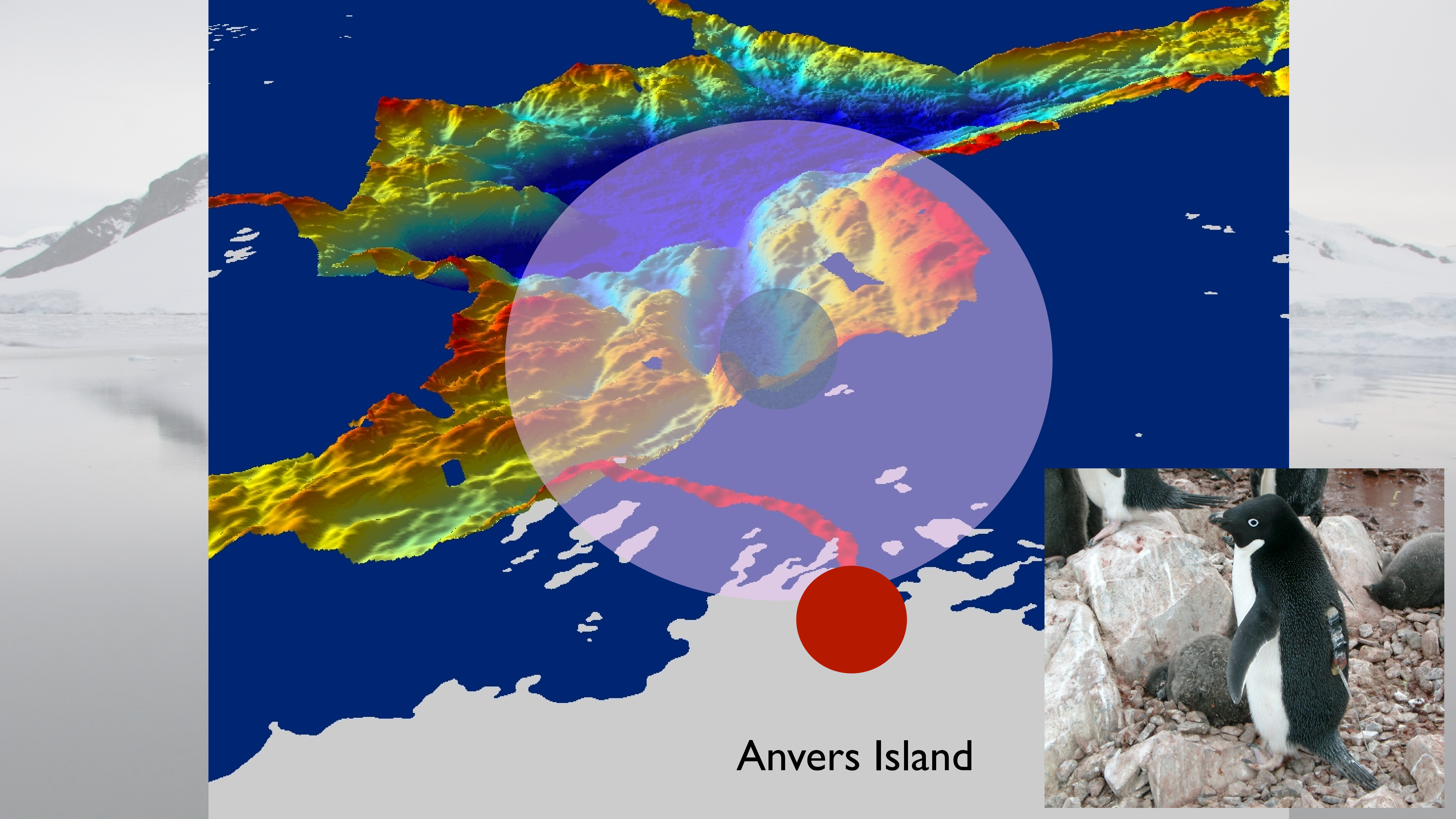
Your Labs will be everywhere all the time



RU-COOL Deployments by Year

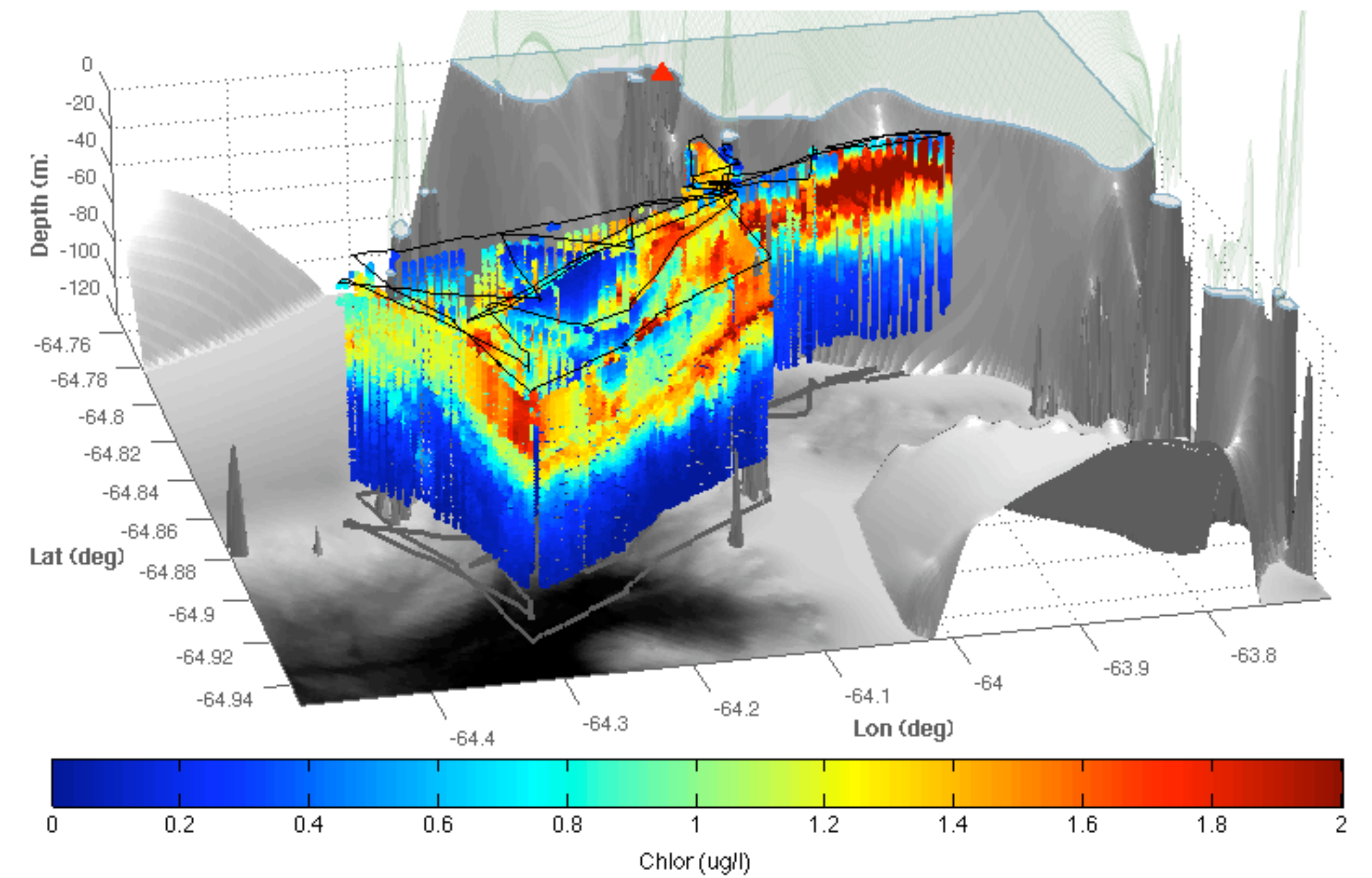
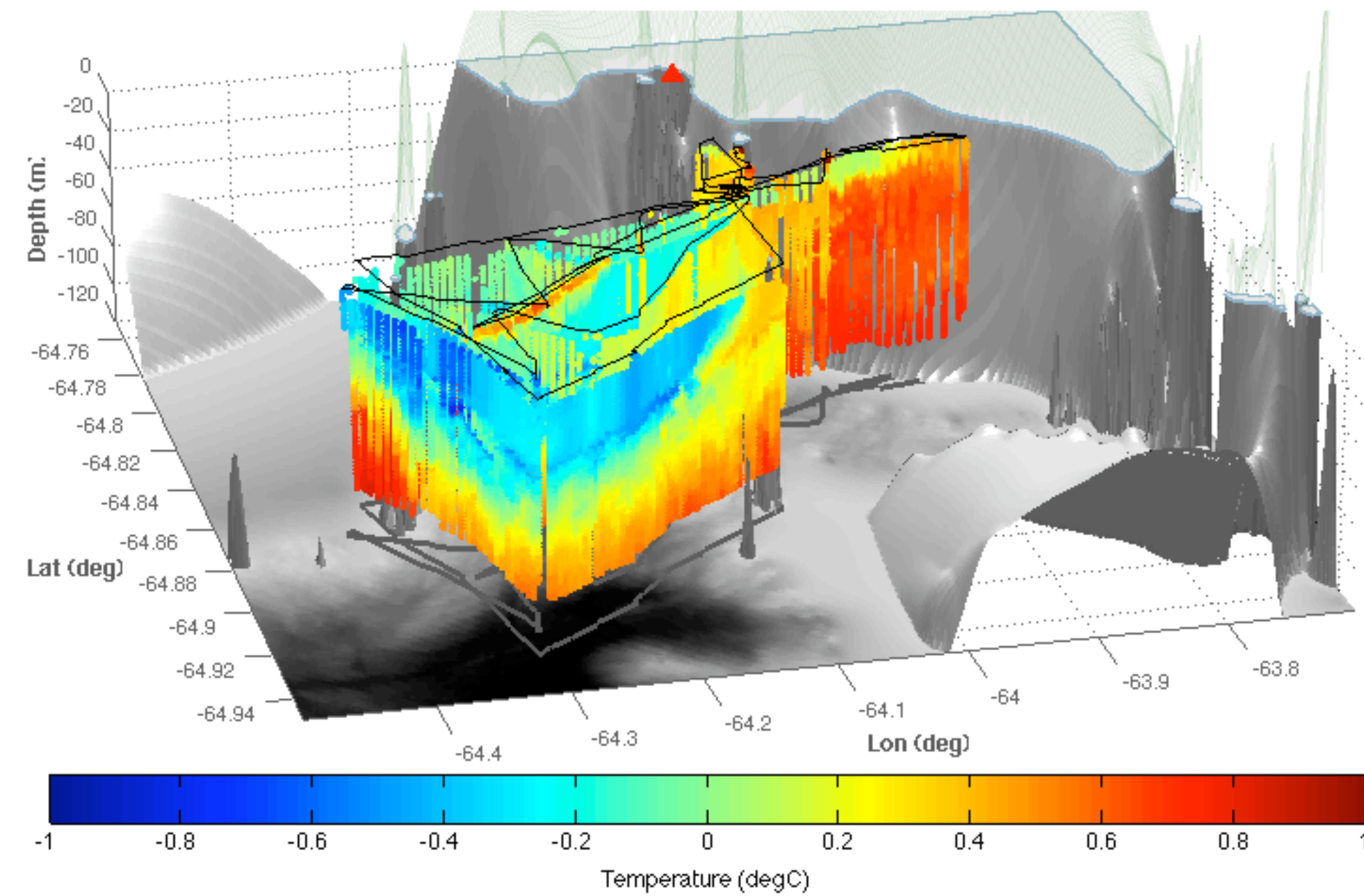
Year	Number	Distance (km)	Days
2012	19	5054.31	290.3
2011	37	11975.53	624
2010	46	17003.36	876.6
2009	30	18114.34	761.1
2008	28	16642.28	604.7
2007	27	10277.99	462.9
2006	38	9745.88	538
2005	16	4113.87	207.1
Totals	241	92927.56	4364.8

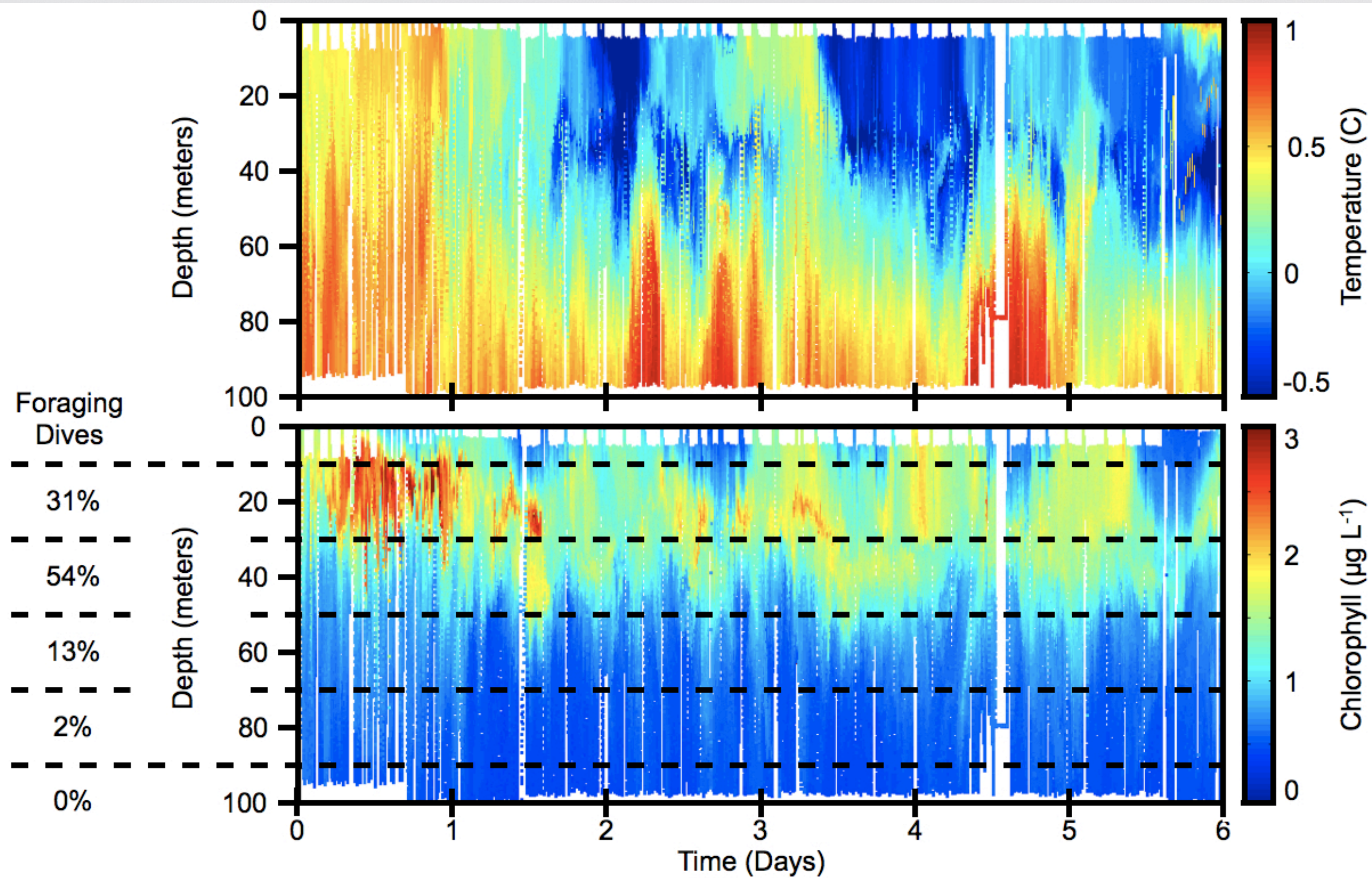
Includes all Global deployments



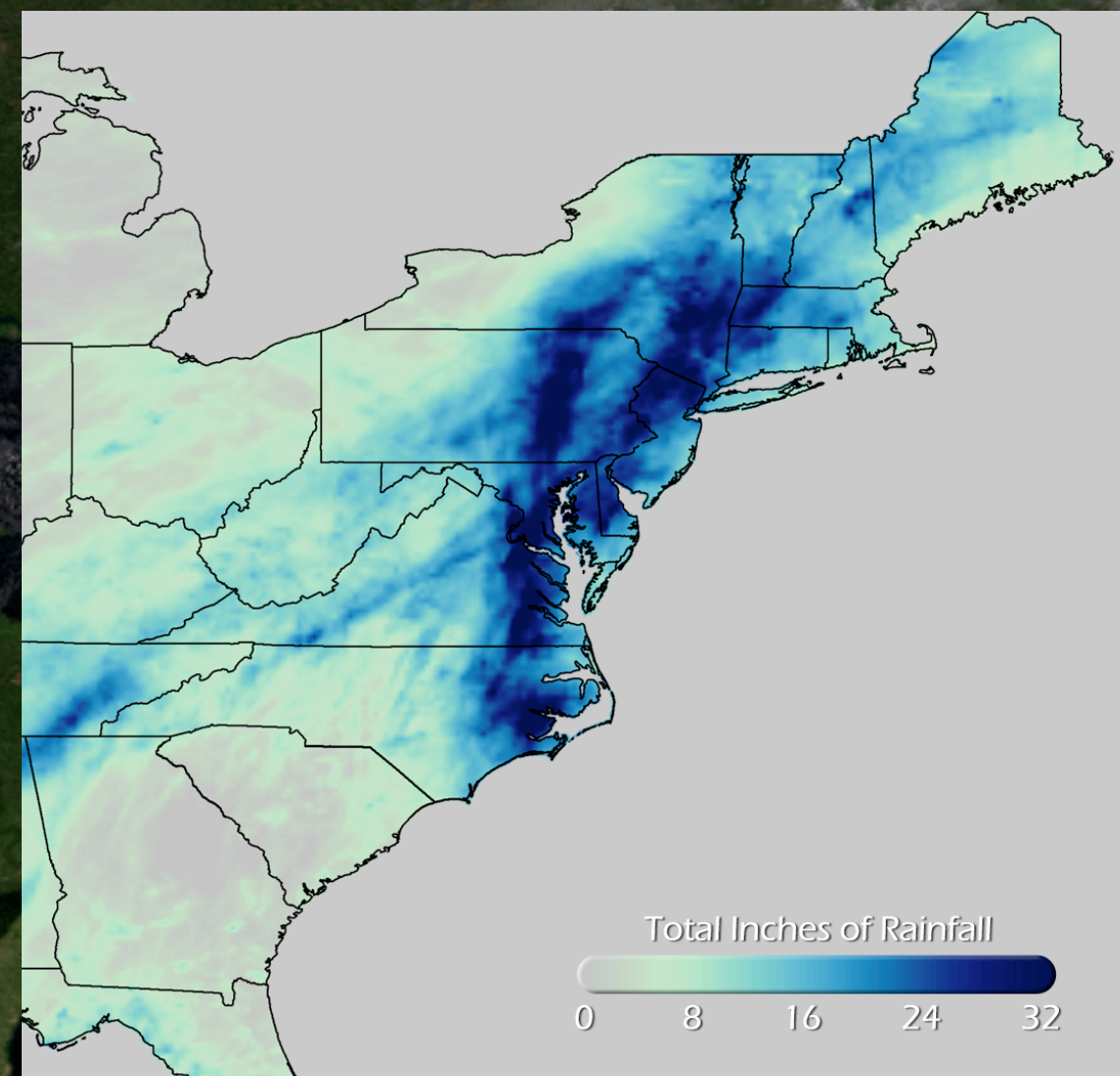
Anvers Island

Enhanced productivity is associated with the warm upwelled water

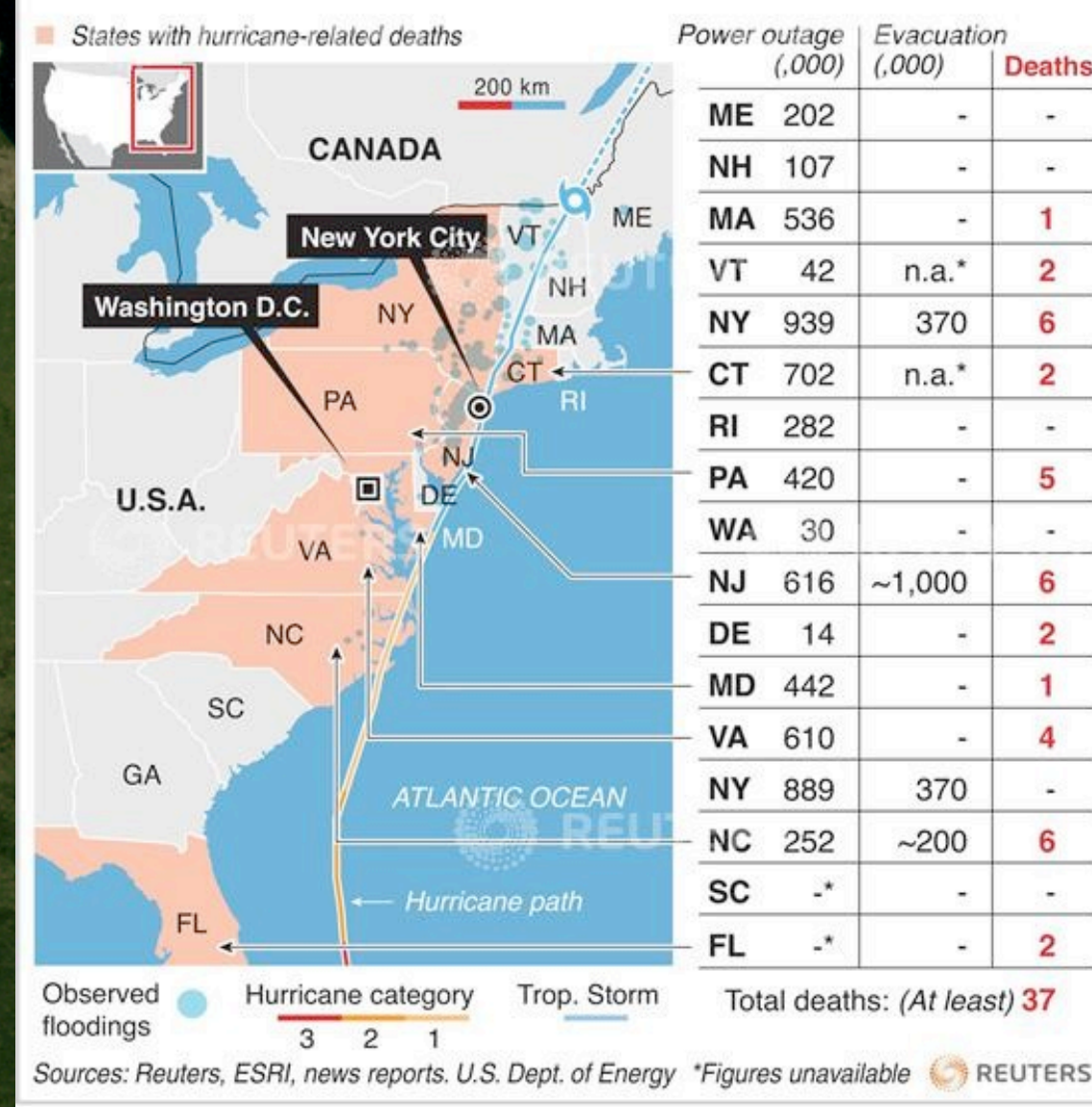




Hurricane Irene



HURRICANE IRENE AFTERMATH



- First tropical storm to threaten NYC since Hurricane Gloria in 1985
- Flooding records broken in 26 rivers
 - Caused at least 56 deaths
 - Damage nearly \$8 billion

Hurricanes

Sunday, 02.19.12 Welcome Guest •

HOME NEWS SPORTS ENTE

Miami-Dade | Broward | Keys |

Posted on Friday, 09.02.11

HURRICANE SEASON

Intensity remain

f Like 1

The National Hurricane Center says it wasn't the first time — but the increasing standards of

BY CURTIS MORGAN
MORGAN@MIAMIHERALD.COM

WORLD U.S. N.Y. / REGION BUSINESS TECHNOLOGY SCIENCE HEALTH SPORTS OPINION

POLITICS EDUCATION BAY AREA CHICAGO TEXAS



Challenges in Predicting the Intensity of Storms

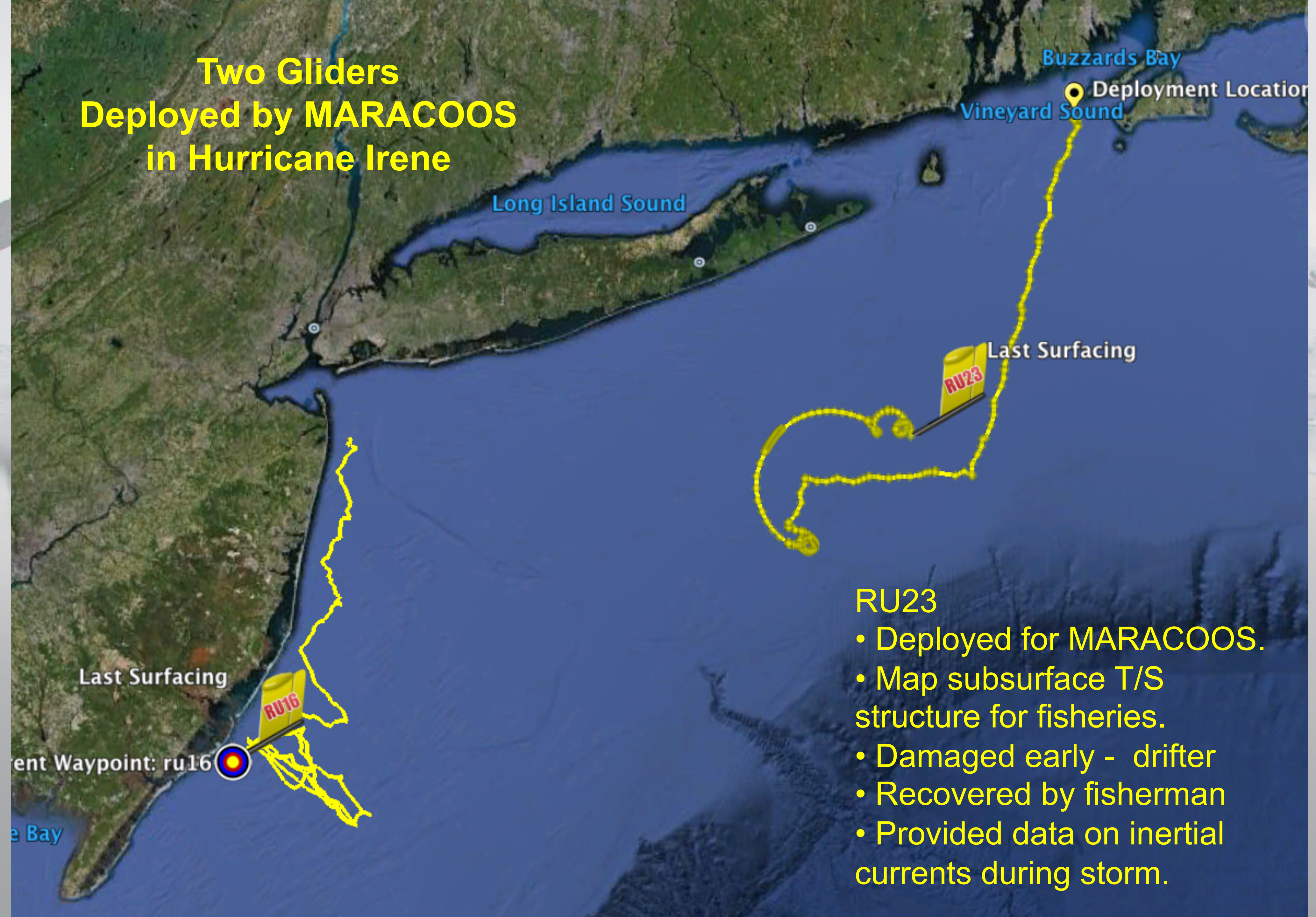


Andy Newman/Associated Press

Scientists say that it is much easier to accurately predict what path a hurricane will take.

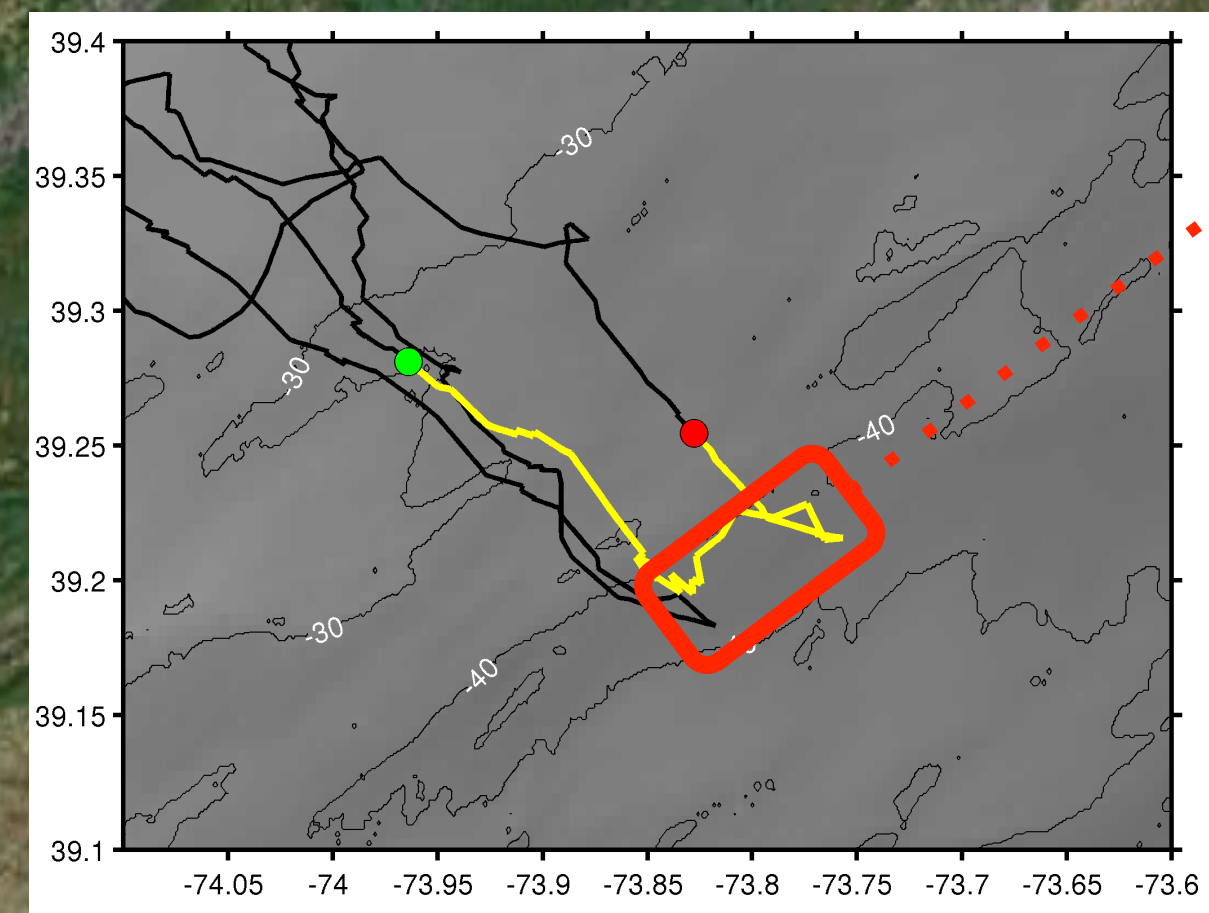
By HENRY FOUNTAIN
Published: August 27, 2011

Two Gliders Deployed by MARACOOS in Hurricane Irene



RU23

- Deployed for MARACOOS.
- Map subsurface T/S structure for fisheries.
- Damaged early - drifter
- Recovered by fisherman
- Provided data on inertial currents during storm.



Hurricane Irene

Long Island Sound

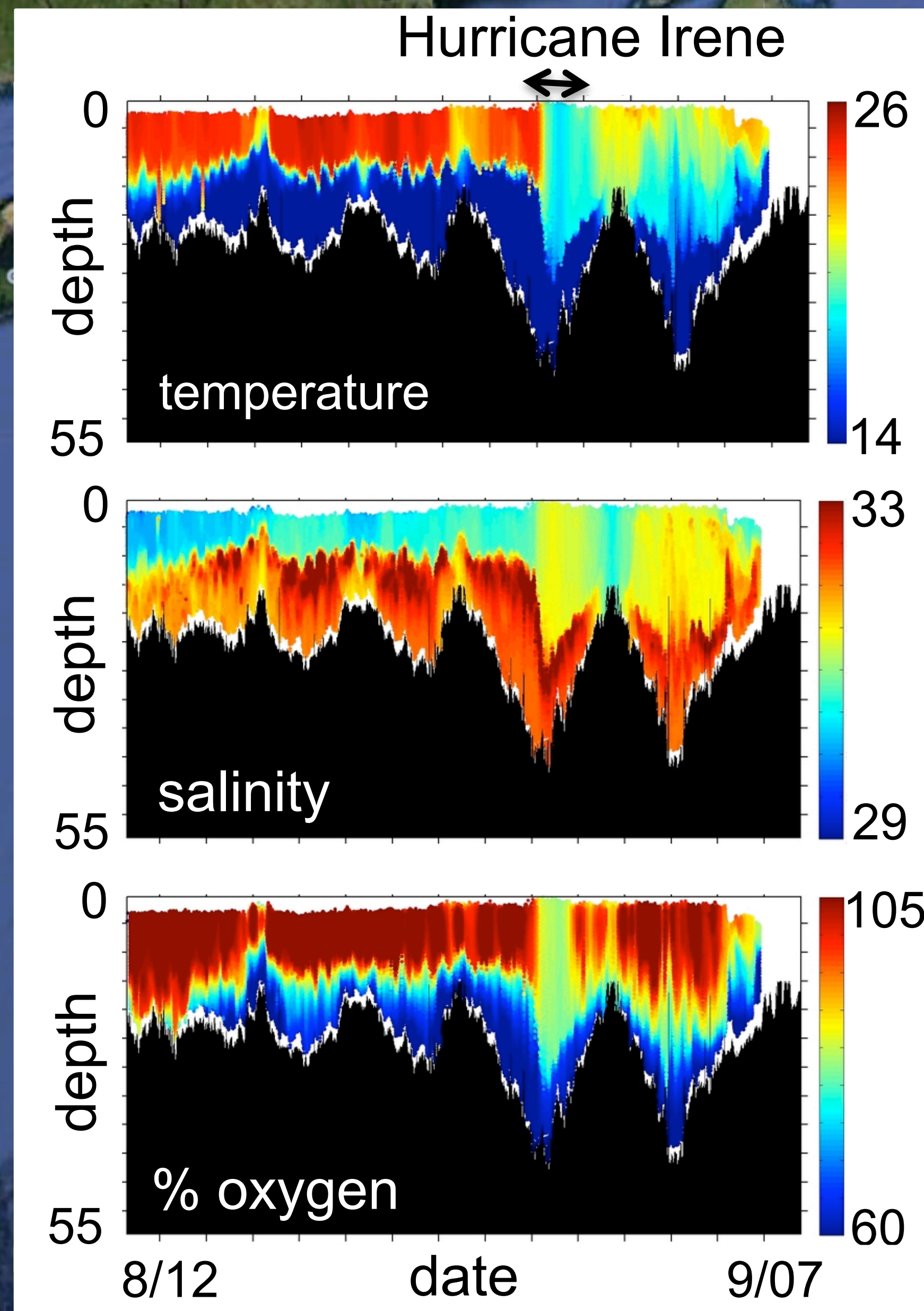
Buzzards Bay

Last Surfacing

Current Waypoint: ru16

Delaware Bay

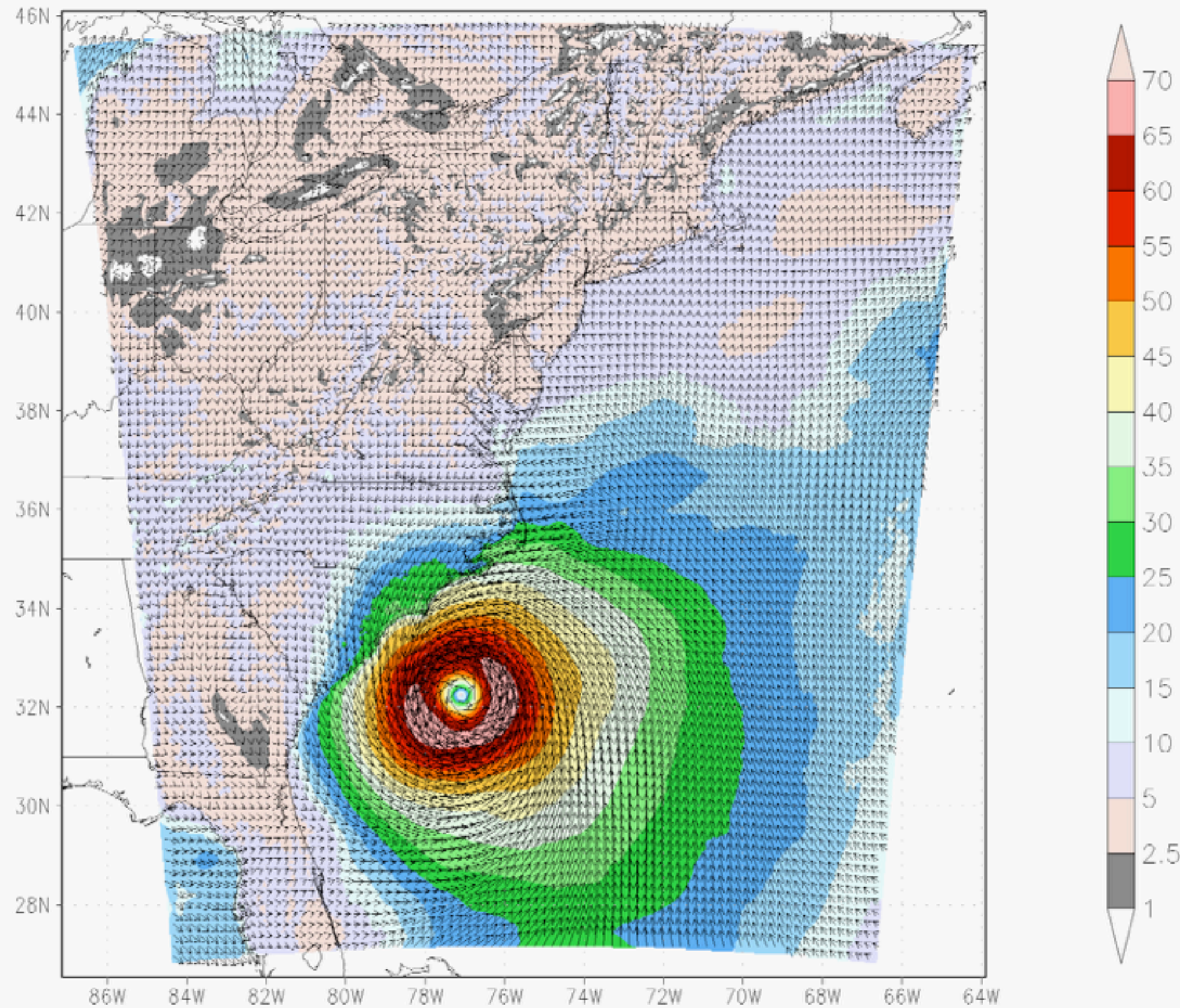
RU16



Warm water (standard)

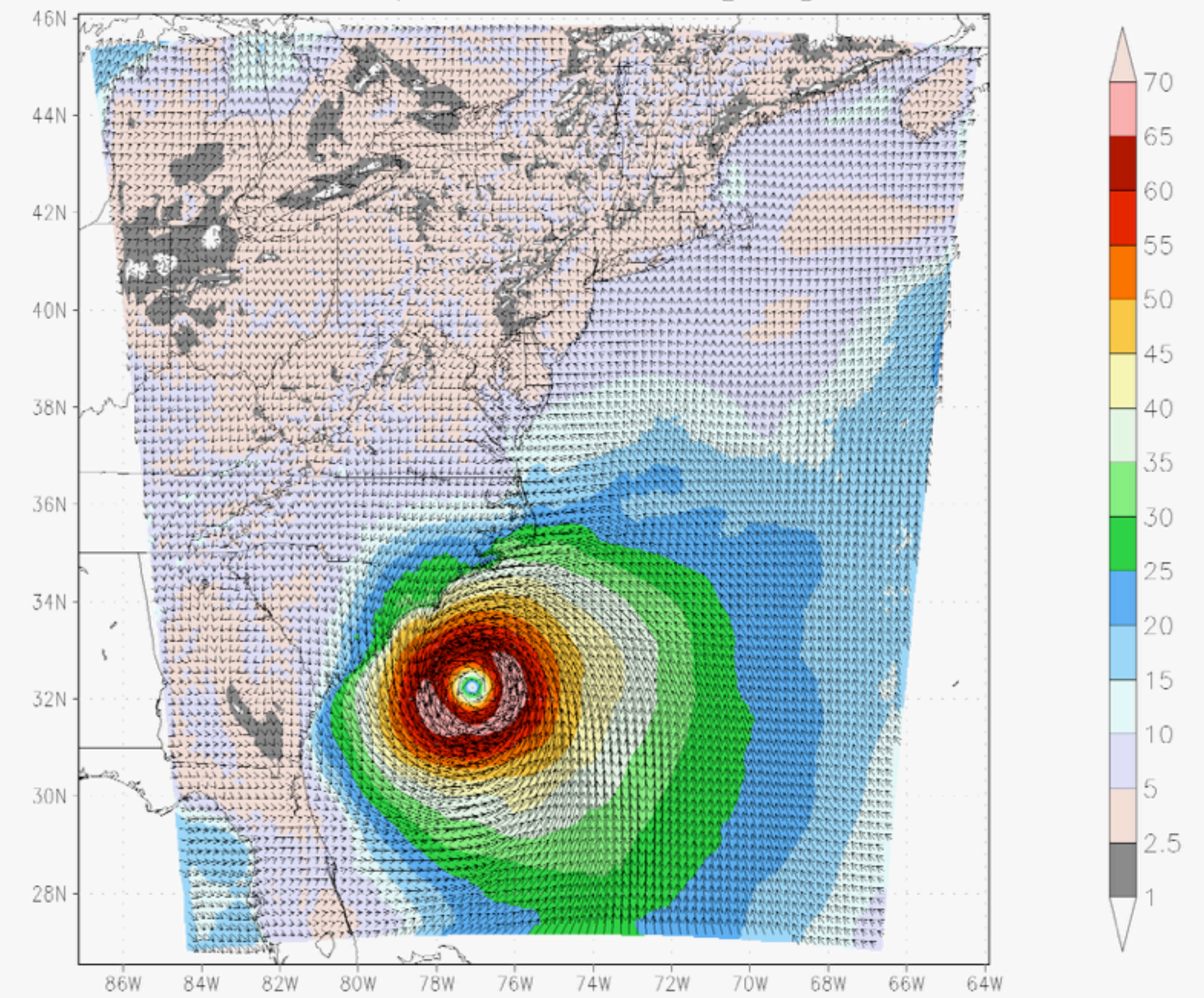
Cold water (glider)

Wind Speed at 10 m [kts]



RU Coastal Ocean Observation Lab: WRF-ARW 6 KM
<http://marine.rutgers.edu/cool/weather>
Model Initialized 00Z27AUG2011
Valid 00Z27AUG2011 (Sat) | Forecast Hour 0

Wind Speed at 10 m [kts]



RU Coastal Ocean Observation Lab: WRF-ARW 6 KM
<http://marine.rutgers.edu/cool/weather>
Model Initialized 00Z27AUG2011
Valid 00Z27AUG2011 (Sat) | Forecast Hour 0

Conclusions:

Minor variations in the ocean state can have profound impacts on polar ecosystems

These profound changes are occurring in many polar oceans, changes appear to be accelerating

New technologies offer a mode to study and understand these changes, so it is time hopefully to speed up our uphill quest to know where this planet is going

where this planet is going

can be used to help understand the changes that are occurring in the polar oceans

