

***PALMER, ANTARCTICA  
Long  
Term  
Ecological  
Research***



***PAL Summer Cruise  
LMG 05-01  
04 - 31 Jan, 2004***



# **PALMER, ANTARCTICA Long Term Ecological Research Program (LTER)**

- **Part of US LTER Network of 26 sites**
- **1991 – present, 14 January cruises**
- **Regional (200,000 km<sup>2</sup>) and local sampling**
- **Focus on sea ice dynamics, water column processes and apex predators**
- **Physics, remote sensing and ice, microbial biogeochemistry, sedimentation, primary production, krill, penguins**

**Aerial photo of Anvers Island and Gerlache Strait courtesy Chilean Navy**





**Eight Principal investigators:**

**Hugh Ducklow (VIMS): microbial biogeochemistry**

**Robin Ross & Langdon Quetin (UCSB): krill**

**Ray Smith (UCSB): bio-optics & remote sensing**

**Maria Vernet (Scripps): phytoplankton**

**Bill Fraser (Polar Res Inst): penguins**

**Doug Martinson (LDEO): physical oceanography**

**Karen Baker (Scripps): information management & outreach**

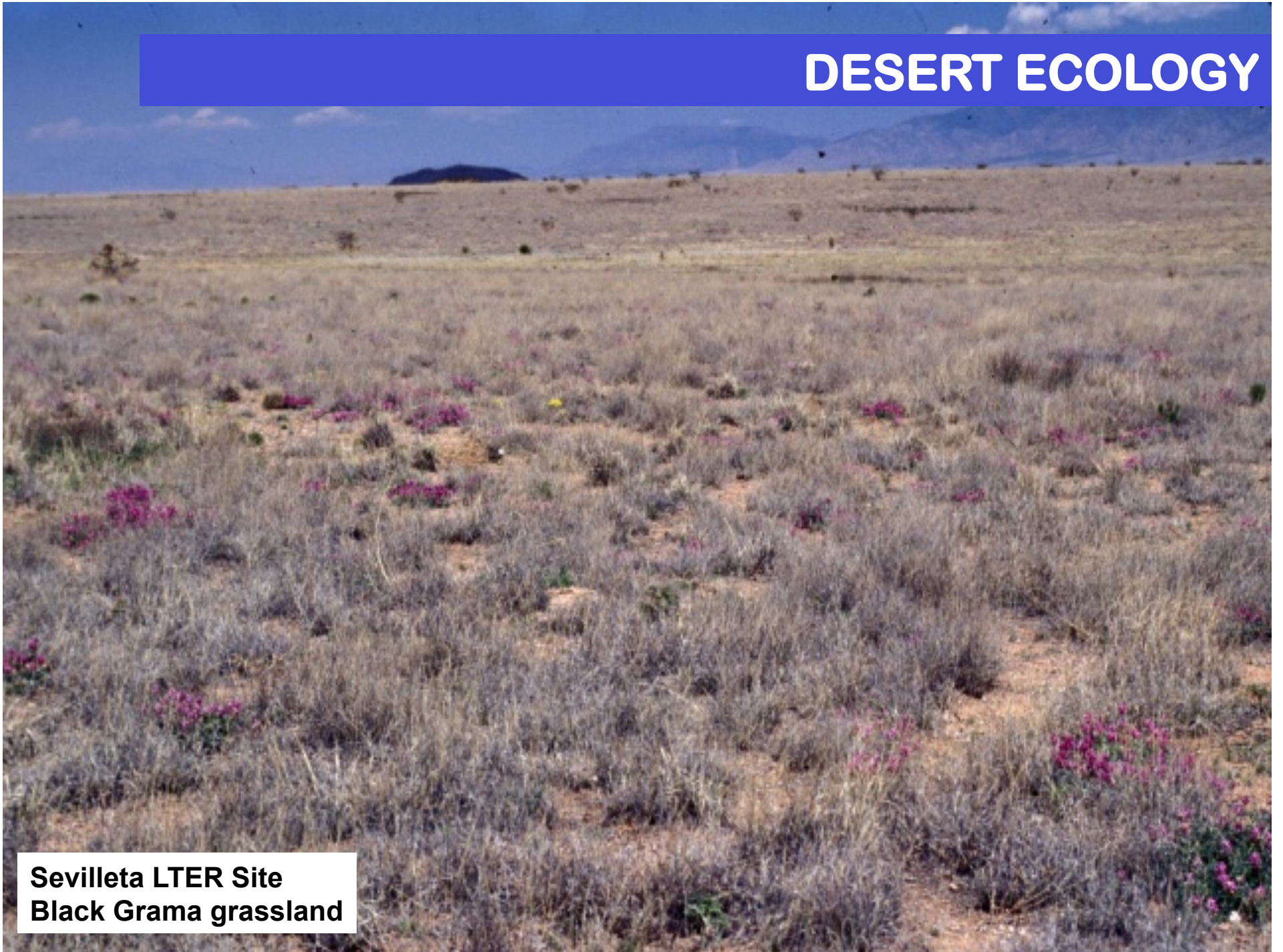






# DESERT ECOLOGY

**Sevilleta LTER Site  
Black Grama grassland**



***The central tenet of PAL is that the annual advance and retreat of sea ice is a major physical determinant of spatial and temporal changes in the structure and function of the Antarctic marine ecosystem...We now recognize the west Antarctic Peninsula (WAP) as a premier example of a climate-sensitive region experiencing major changes in species abundance and composition due to changes in range and distribution that are occurring in response to regional climate change manifested here primarily as a southern migration of principal climate characteristics (climate migration). In effect, the maritime system of the northern WAP is replacing the continental, polar system of the southern WAP along the peninsular climate gradient. This change is driven by regional warming, which is modulated by regional hydrography, sea ice processes and global teleconnections to lower latitude atmospheric variability...we seek to understand the full ecological implications of climate migration in the WAP, and uncover the mechanisms linking them through teleconnections to global climate variability.***

## **What we know:**

**Regional warming (+5C in winter; +2C annual) over past 5 decades**

**Sea ice extent, duration declining**

**These two highly correlated; mechanisms are beginning to be understood.**

**Interannual variability in sea ice behavior**

**Penguins declining locally (70% since 1975): but mechanisms and links to climate not clear...some factors may be terrestrial (e.g., snow).**

## **What we think:**

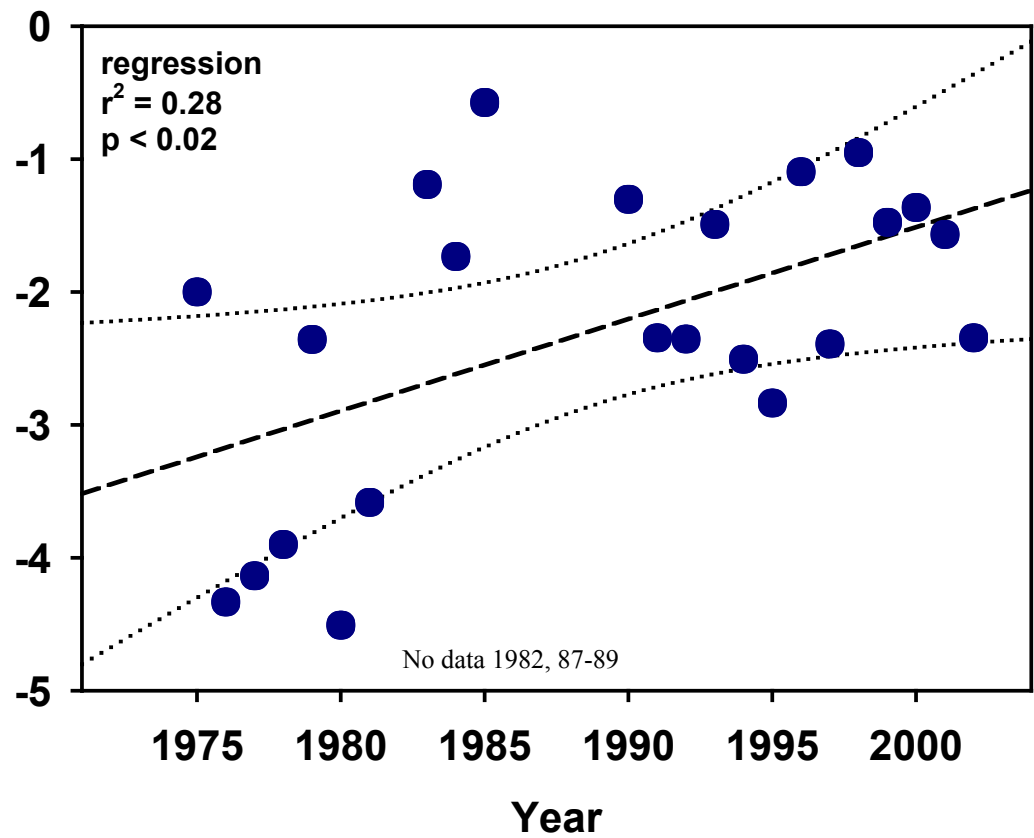
**Some relationship between sea ice variability and plankton dynamics:**

**High ice years → High PP (eg, 1996)    Low ice → low PP (eg, 1999)**

**But krill optimize on 'average ice years' ??? And no real highs, lows in the 1990s...**

**Links between lower trophic levels and penguins also unclear**

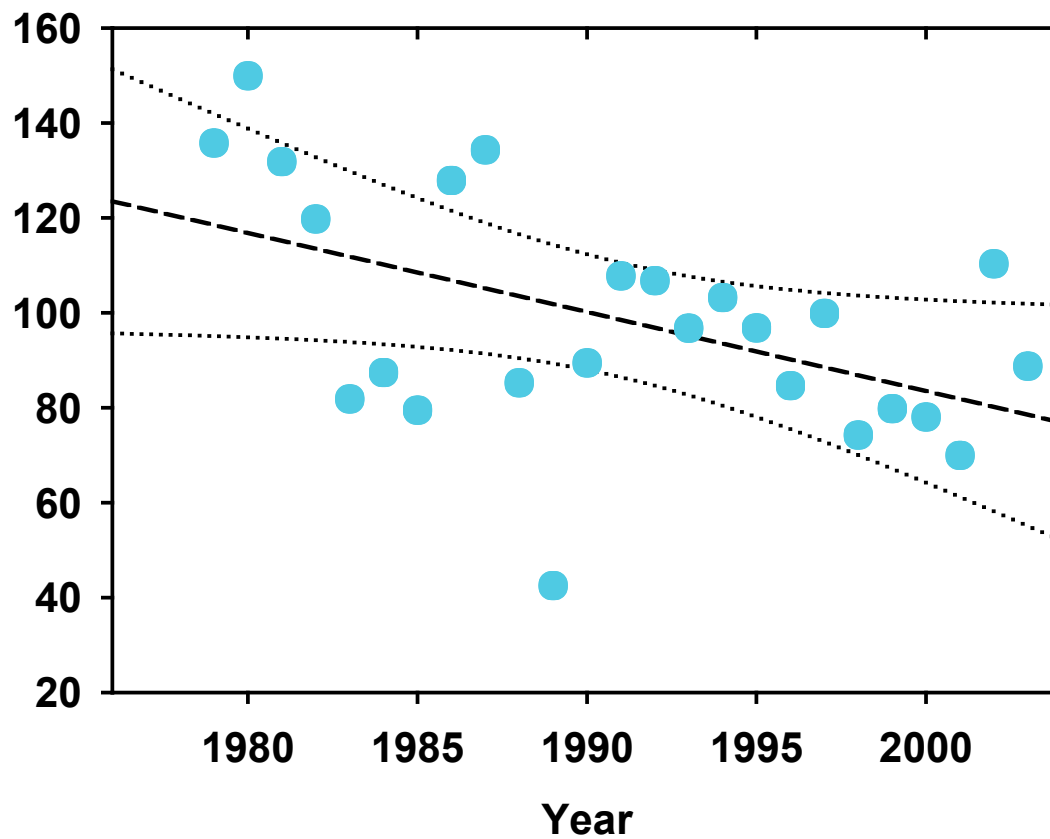
# Palmer temperature, 1975 - 2002 !



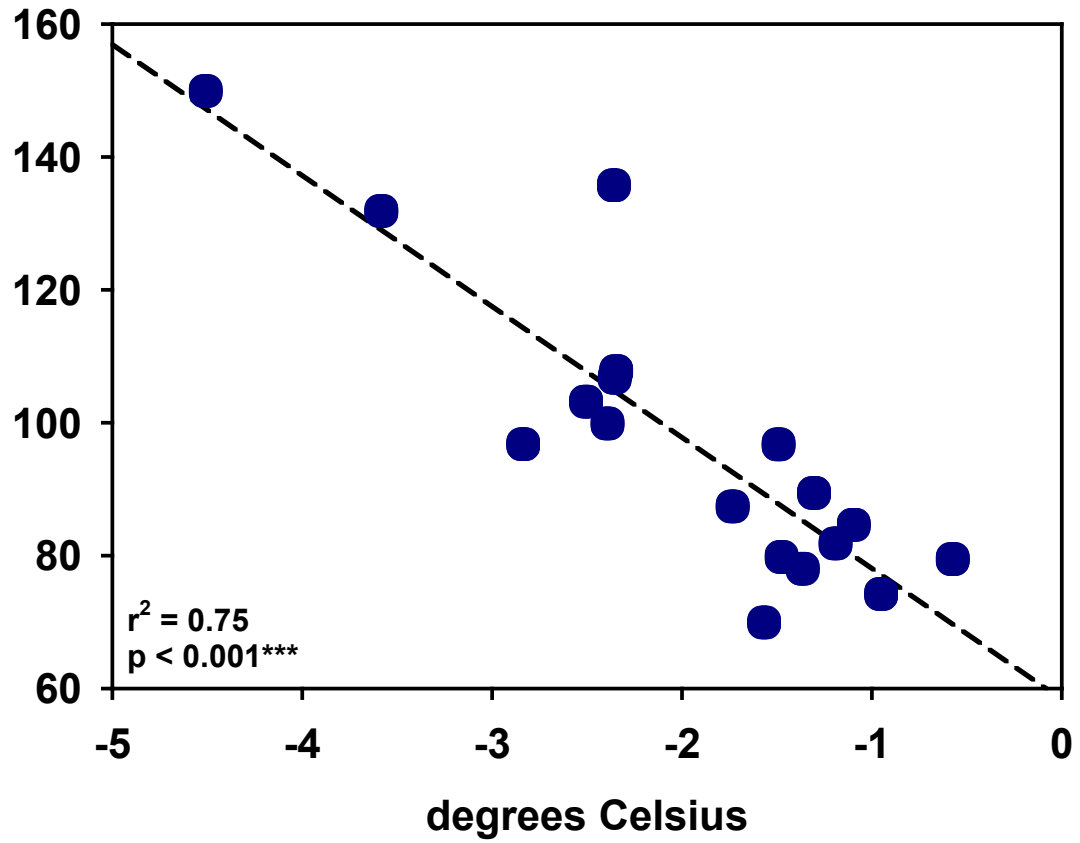
1980s: Hi/Lo temps  
1990s: Not



**Palmer annual mean ice extent, 1979 - 2003**



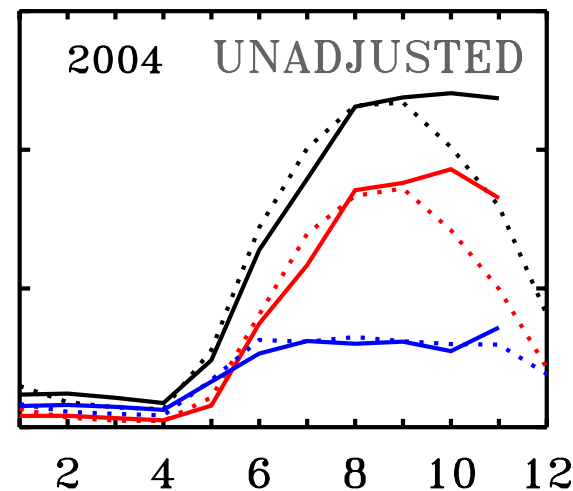
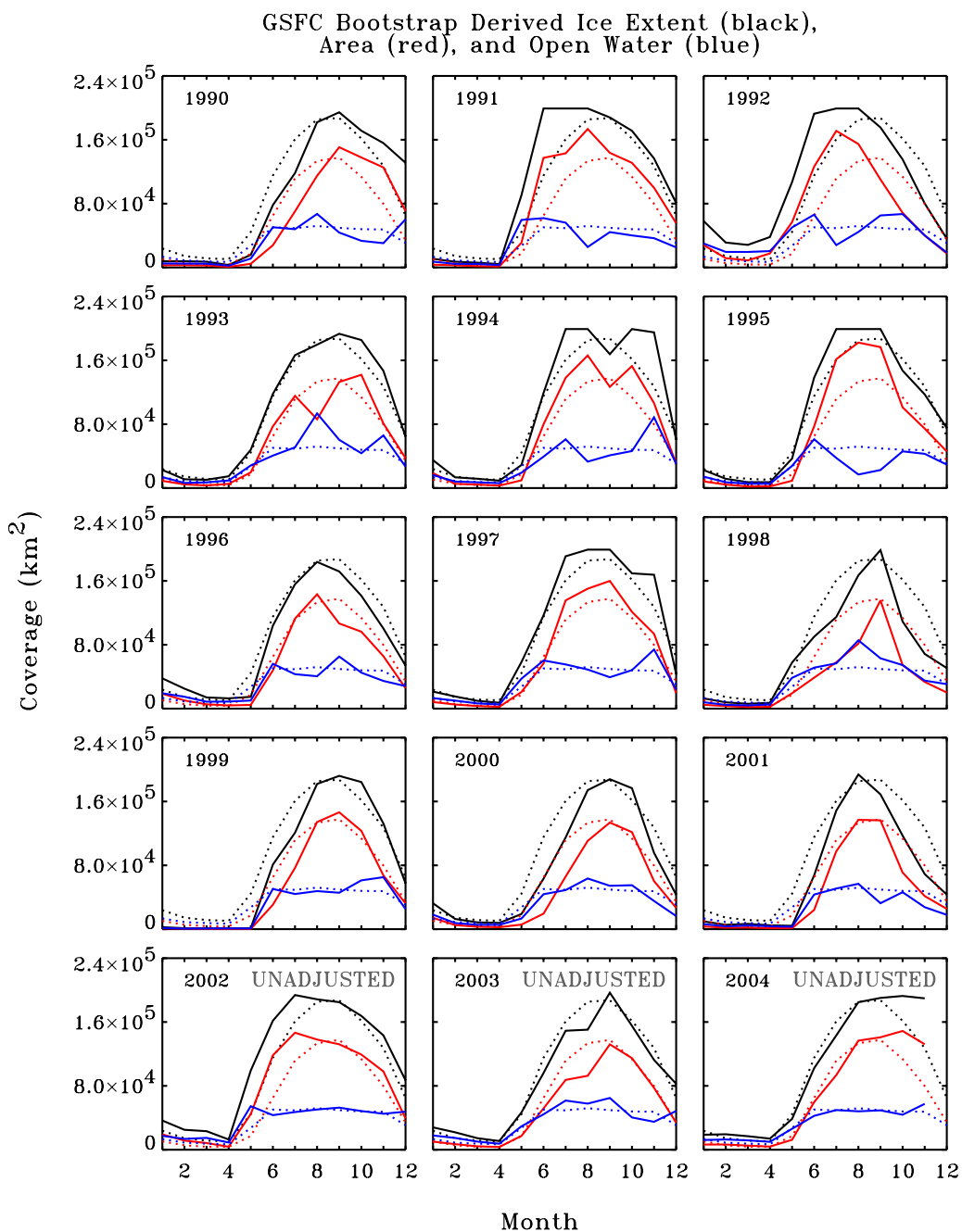
### Palmer sea ice & temperature, 1979 - 2001





# SEA ICE EXTENT

area of coverage  
in sampling grid

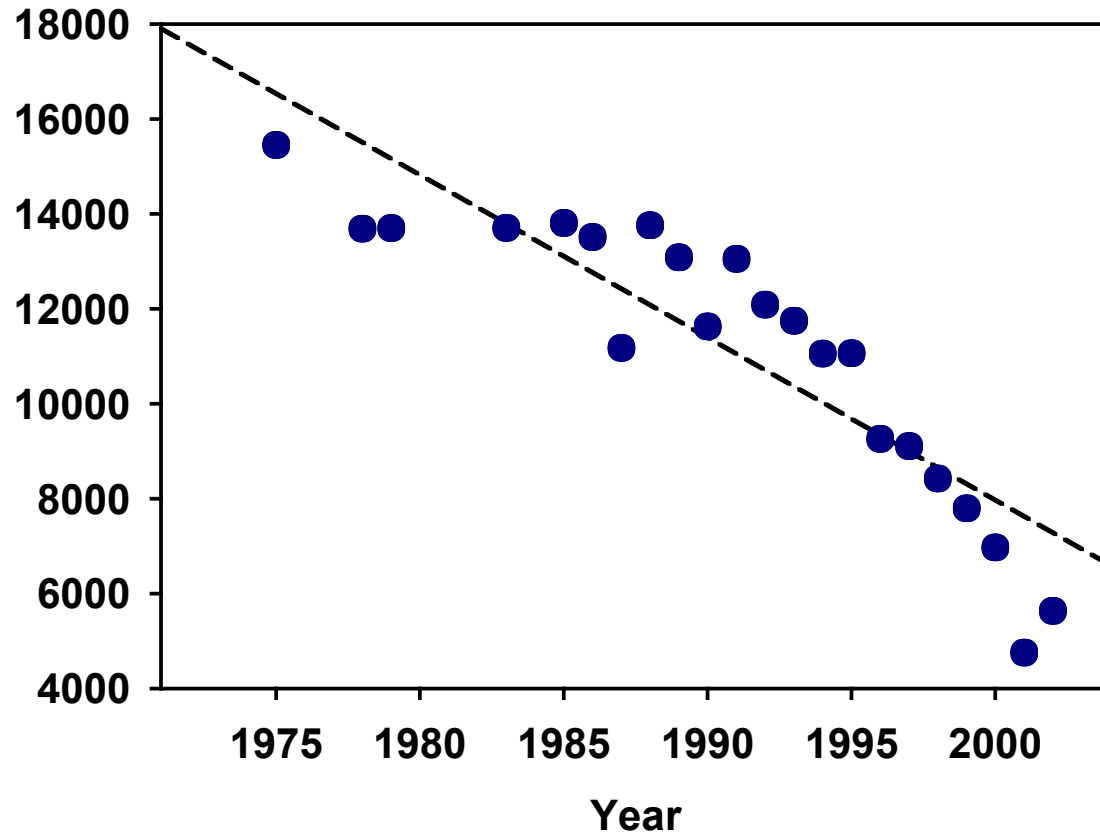


**Solid lines: coverage for current year**  
**Dotted lines: 1990-99 mean**

**Black: total extent**  
**Blue: open water within ice pack**  
**Red: Difference**

**Data courtesy S. Stammerjohn LDEO**

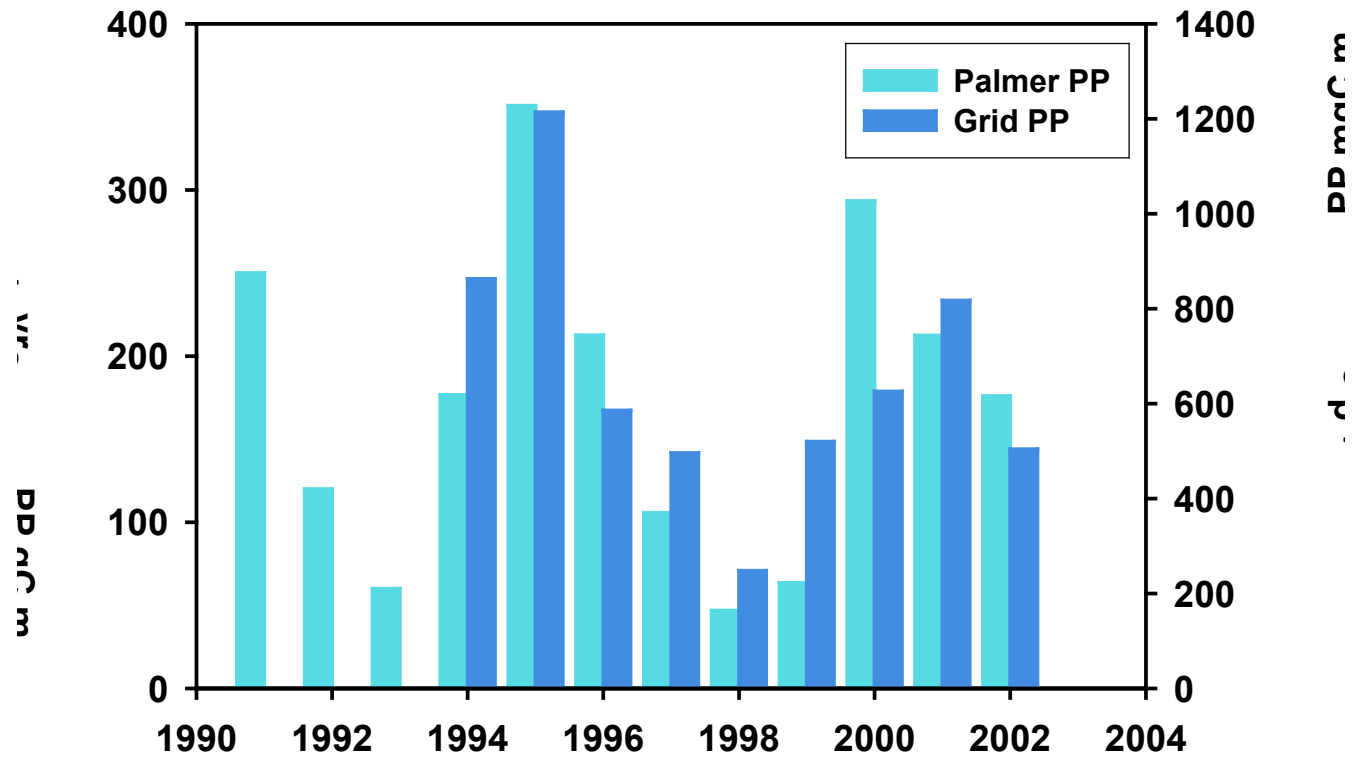
Palmer Adelie population, 1973 - 2002





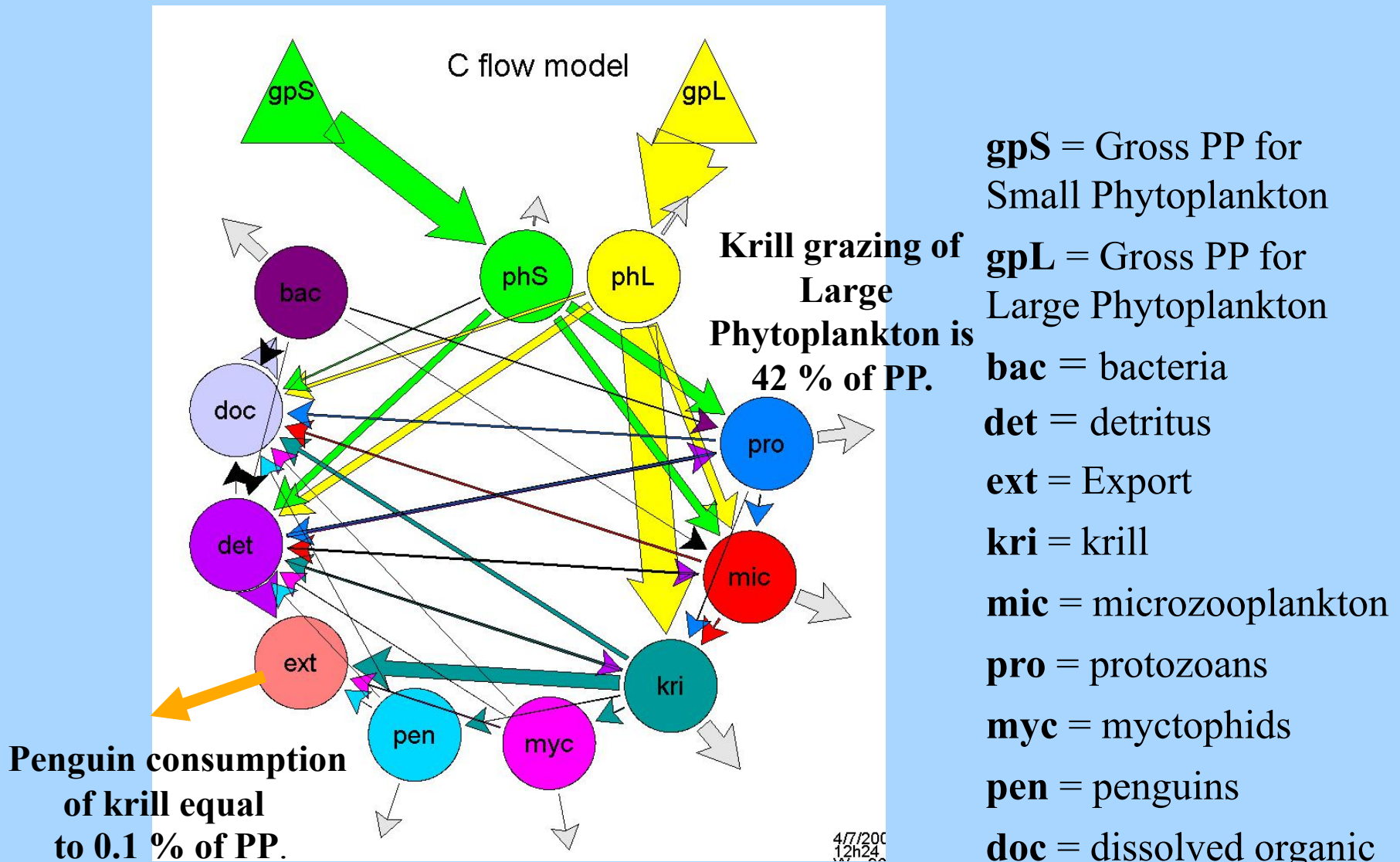


# Primary Production





# WAP 1996 Carbon Solution

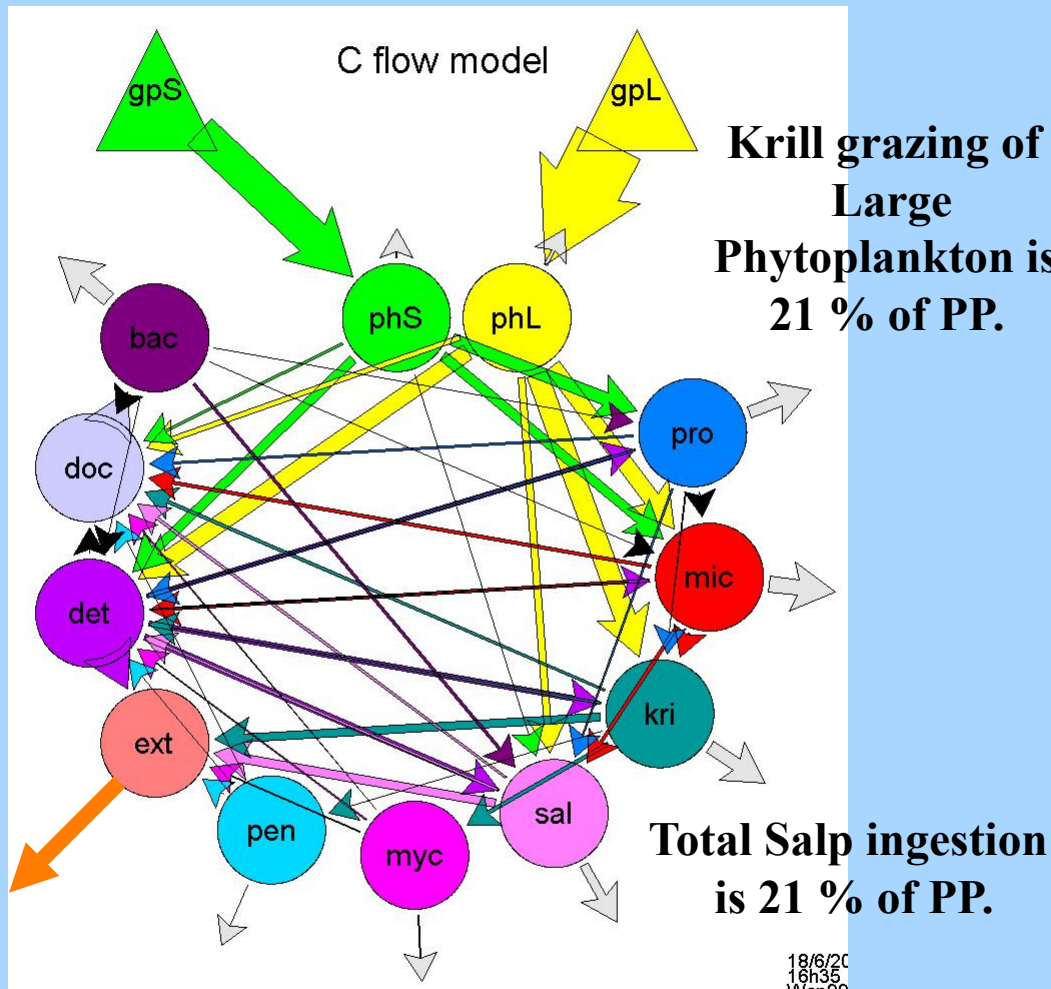


Largest flows are Krill grazing and respiration.

Upper Trophic level flows are very small.

4/7/2006  
12h24m

# WAP 1999 Carbon Solution



**gpS** = Gross PP for Small Phytoplankton

**gpL** = Gross PP for Large Phytoplankton

**bac** = bacteria

**det** = detritus

**ext** = Export

**kri** = krill

**mic** = microzooplankton

**pro** = protozoans

**myc** = myctophids

**pen** = penguins

**doc** = dissolved organic matter

**sal** = salps

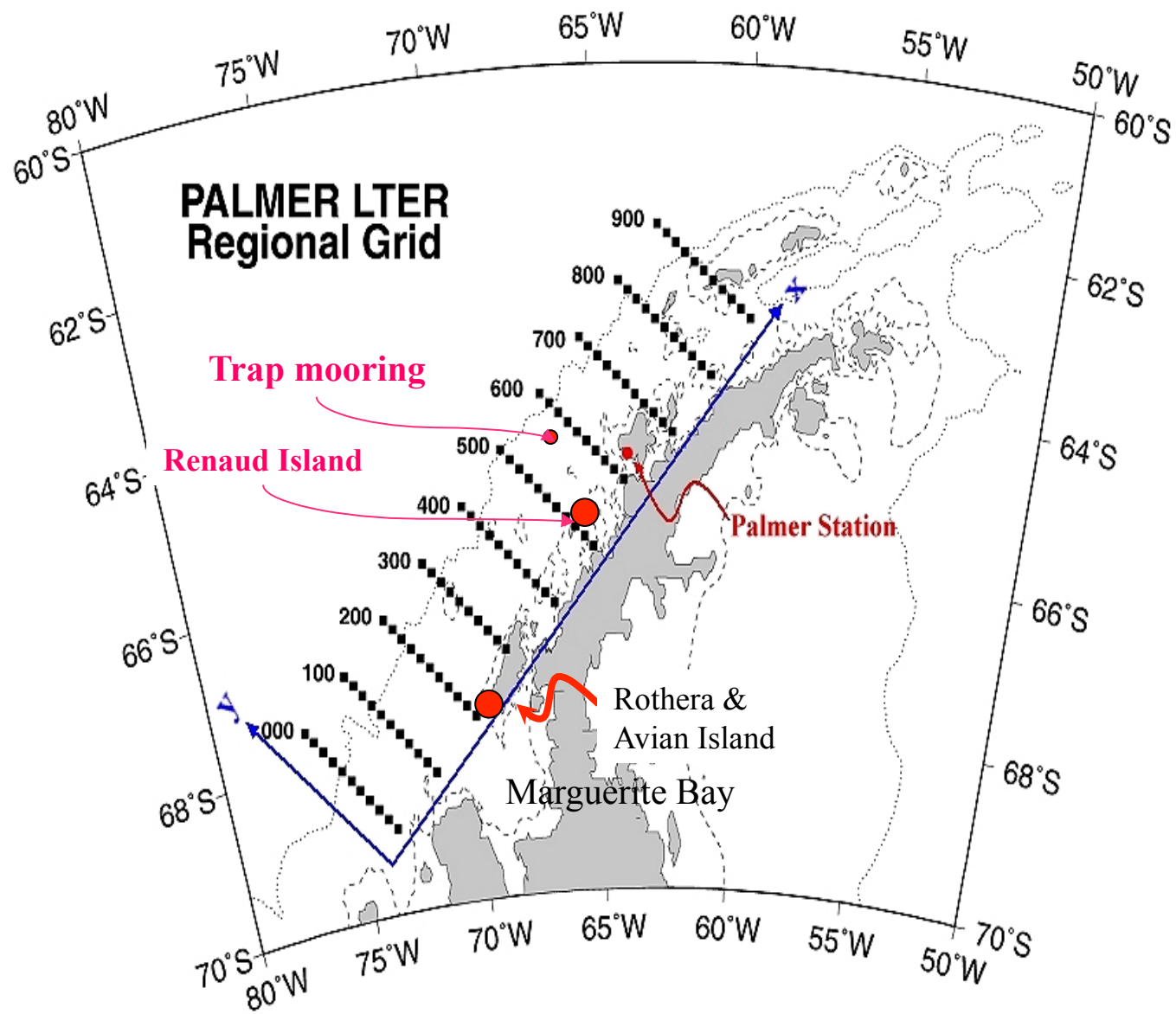
Salps have significant role in food web.

# The Cruise...

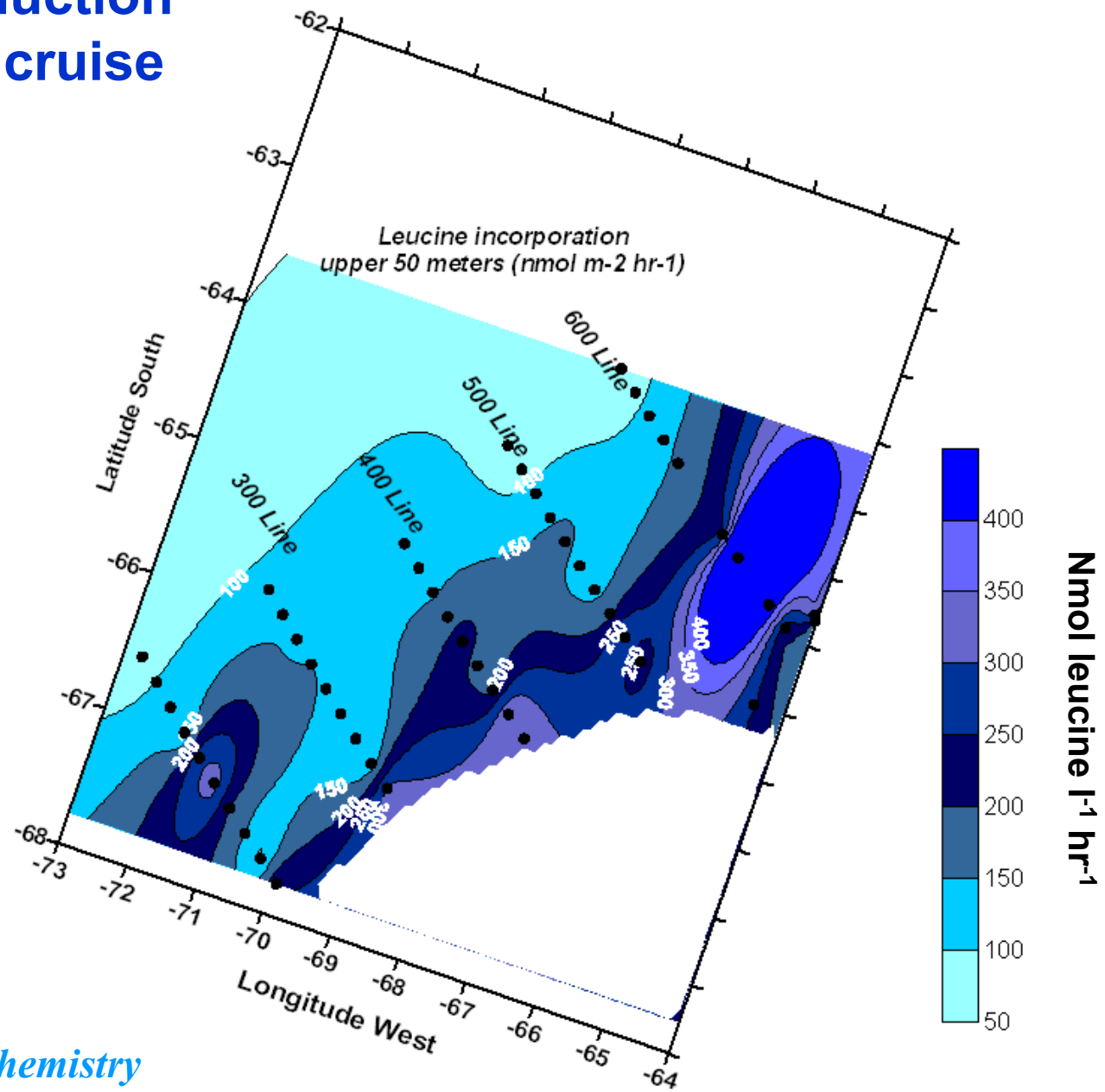
1. The Grid
2. Process Stations
3. Sediment Trap
4. "Inside" stations
5. Rothera
6. King Neptune





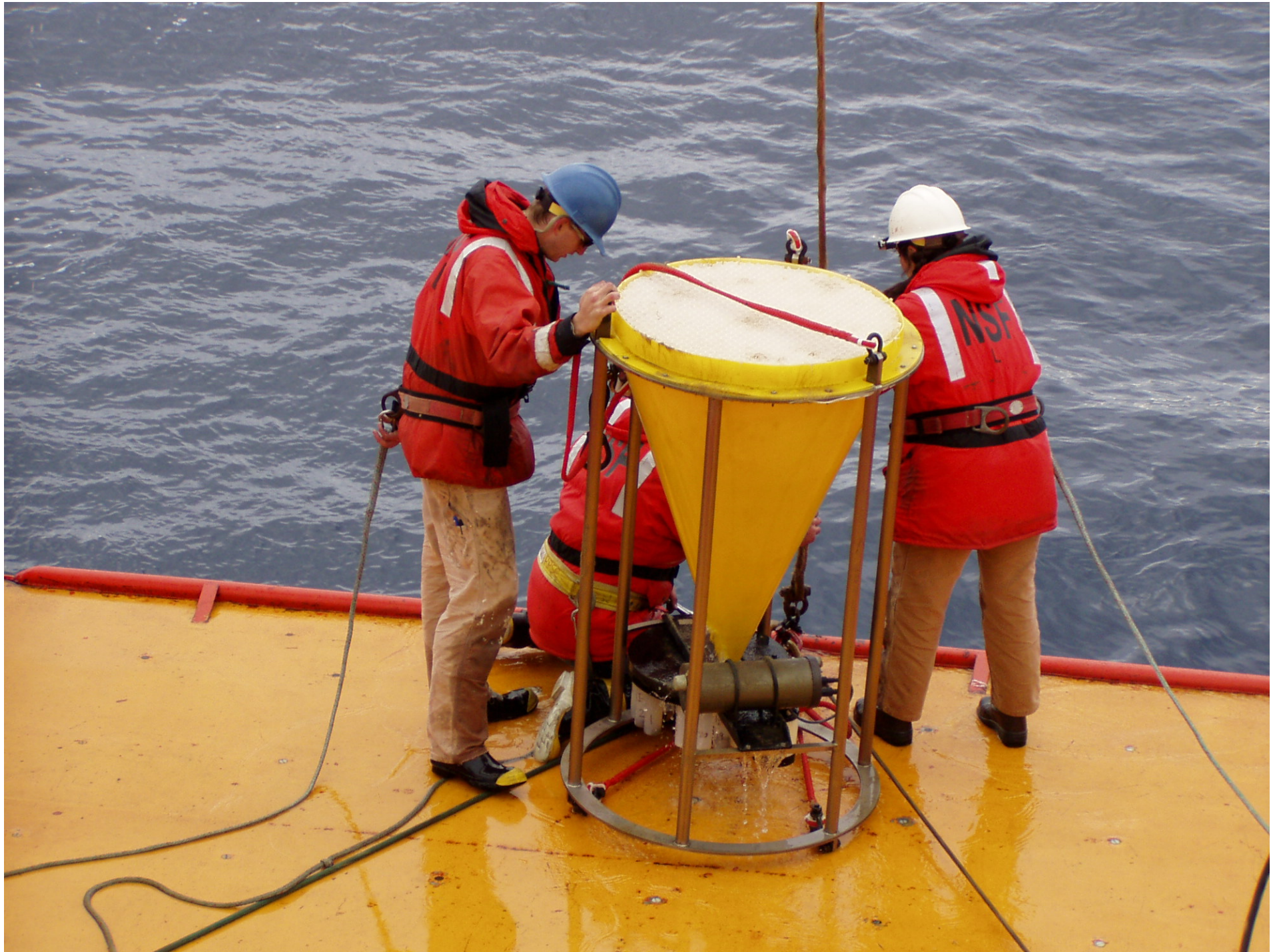


# Bacterial production January LMG cruise 2003



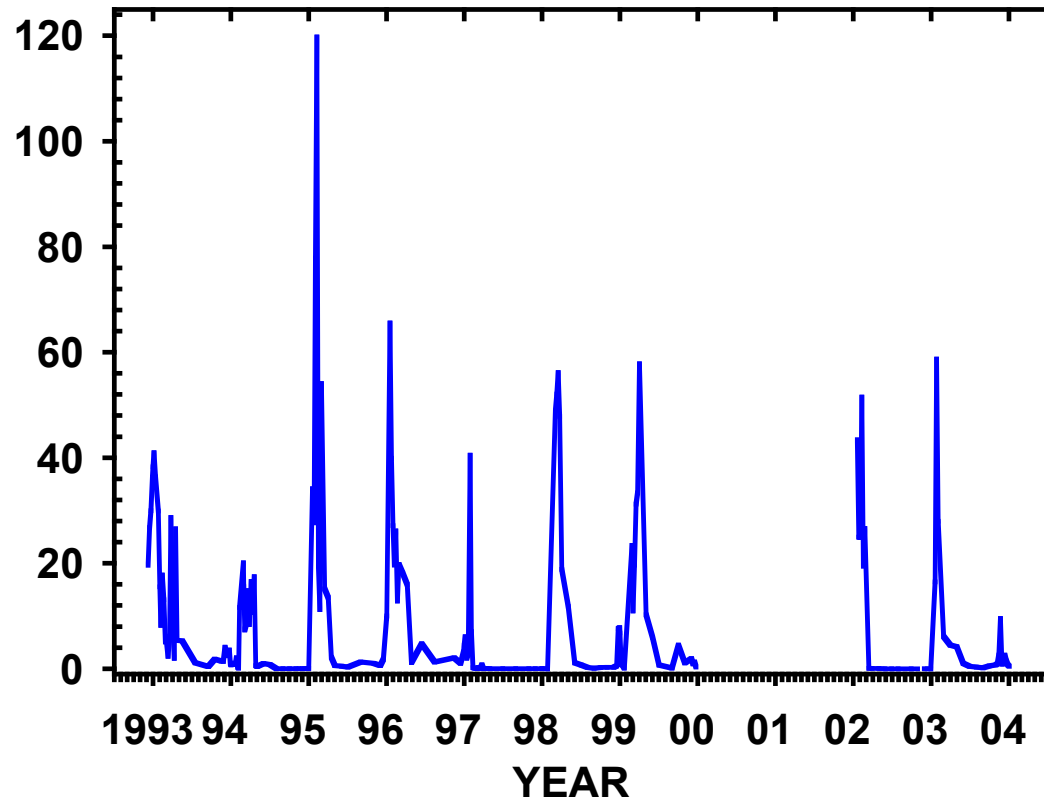
*Microbes & biogeochemistry*  
*PAL-LTER annual meeting 2003*

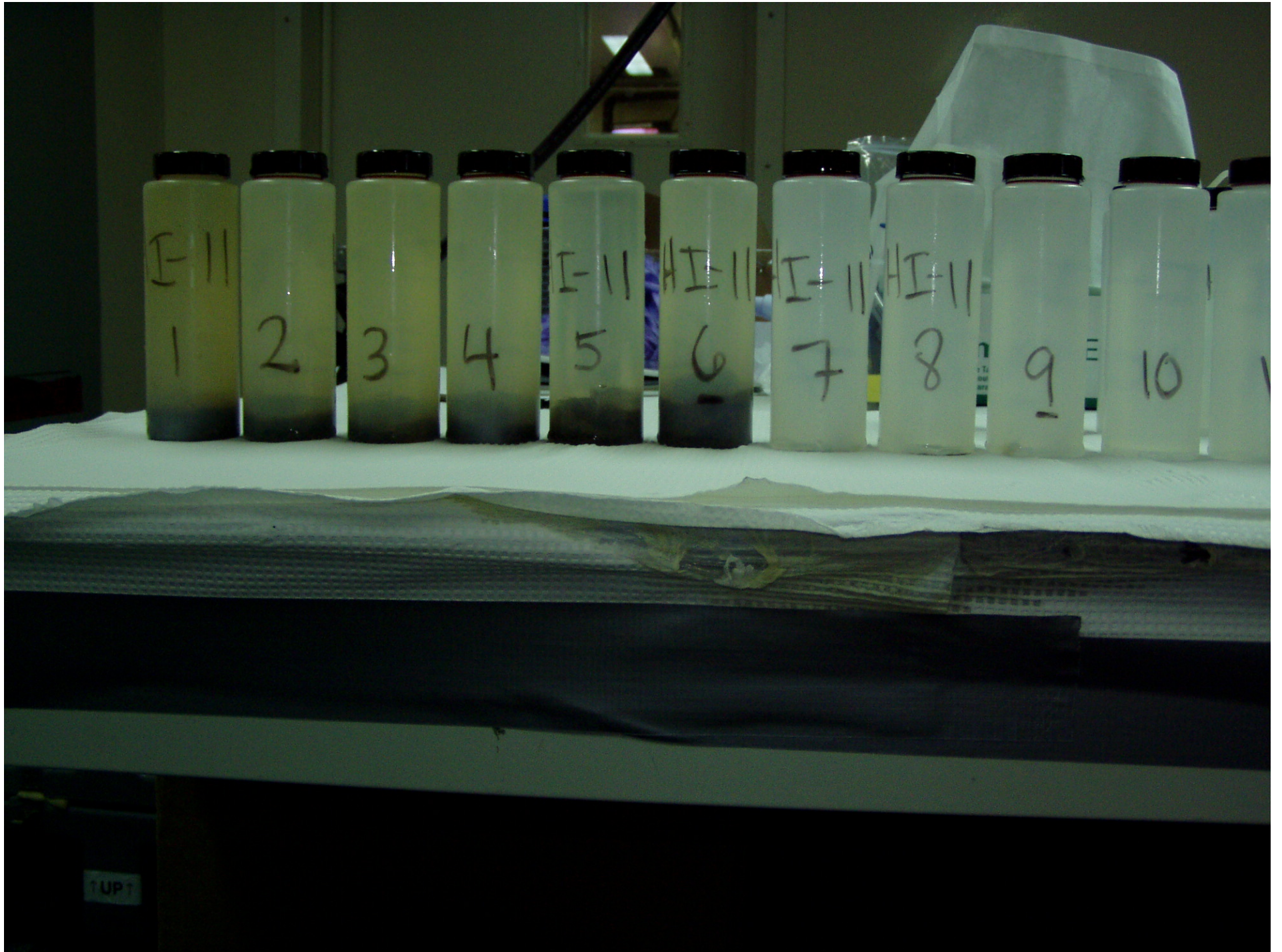






**Sedimentation rate at 170 meters**





I-II

1

I-II

2

I-II

3

I-II

4

HI-II

5

HI-II

6

I-III

7

I-III

8

I-III

9

I-III

10

TUP1

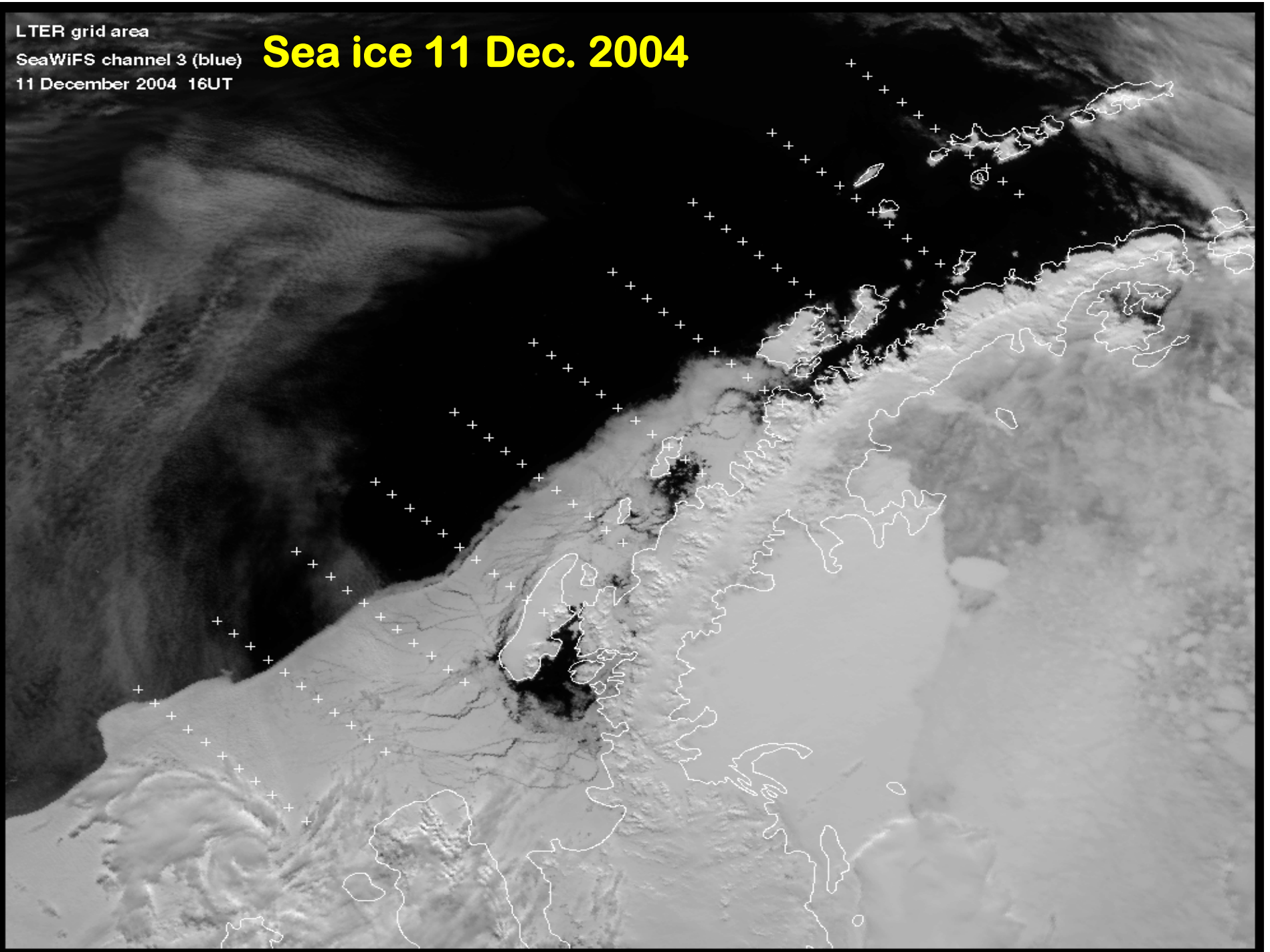


LTER grid area

SeaWiFS channel 3 (blue)

11 December 2004 16UT

# Sea ice 11 Dec. 2004





## **General structure of the cruise**

### **Sample LTER Grid Stations**

top-to-bottom CTD cast with 12 samples  
zooplankton tows  
revisit Palmer Stations B, E 3 times  
routine, “core” measurements  
3-4 stations per day

### **Recover and redeploy Sediment Trap Mooring (15 Jan)**

### **3 Process Stations**

north, middle and south regions on grid  
ca. 24 hours each  
experimental work and repeat sampling

### **Deploy birders**

Renaud Island (1 day)  
Avian Island (4 days)

## **General structure of the cruise, continued**

### **High resolution grid near Palmer Station**

**CTD and nets**

**around 13 Jan**

**personnel swap (krill group)**

### **Visit Rothera Station Saturday 22 Jan.**

**Exchange personnel**

**Local CTD sampling & intercalibration**

**Party!**

**Depart 0600 Sunday, resume operations**

### **King Neptune visits vessel 01 Feb.**

#### **Caveats:**

**Expect 2-3 days lost to storms**

**Expect to lose stations due to ice**