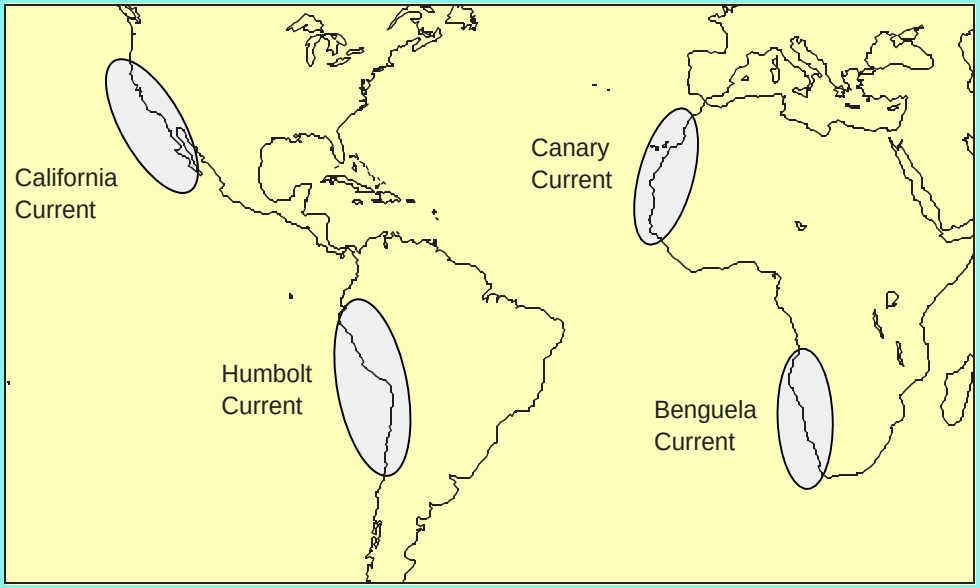
THE “CEOS” PROJECT

Climate and **E**astern **O**cean **S**ystems

The dynamics of marine resources and their exploitation in face of variability and changing climatic regimes

NOAA

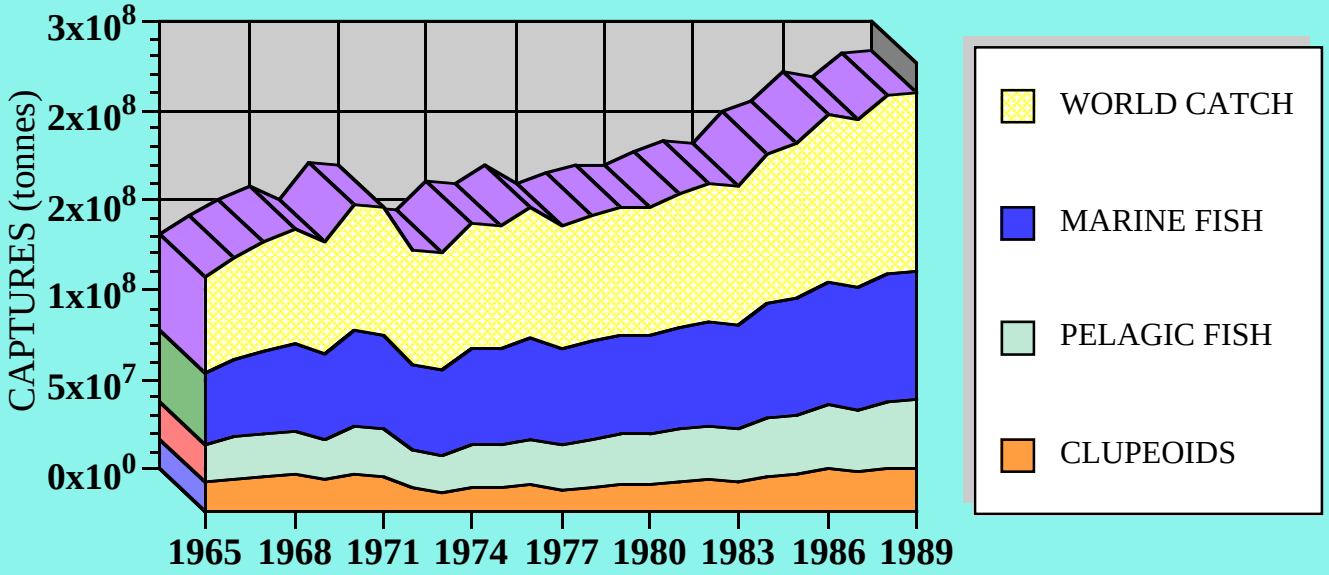


ORSTOM

ICLARM

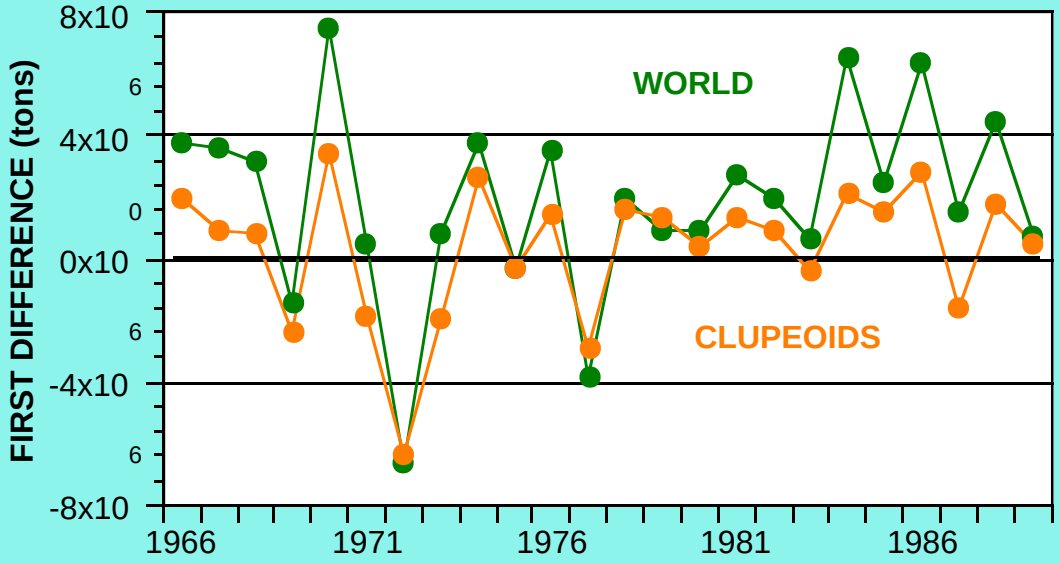
MARINE RESOURCES AND UPWELLING REGIONS

Almost 50% of the world's catch of fish are from upwelling regions.

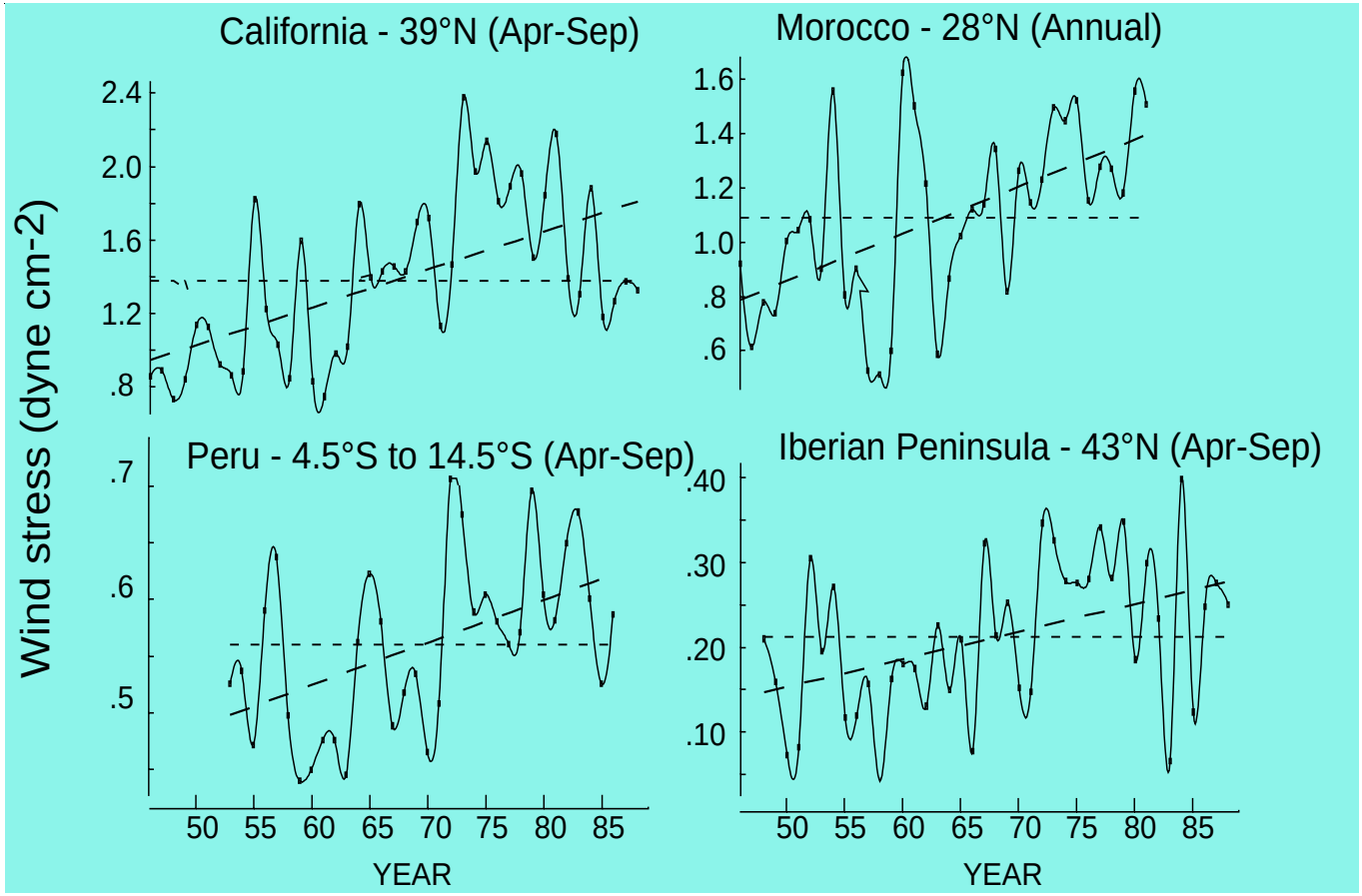


VARIABILITY OF MARINE RESOURCES IN UPWELLING REGIONS

The essential variability in the world fish catch is due to variability in coastal pelagic fish catches



ENVIRONMENTAL VARIABILITY IN COASTAL UPWELLING REGIONS



CEOS PROJECT OBJECTIVES

- Establish a network of researchers around the scientific themes of the CEOS Project;
- Assemble the historical datasets from the principal upwelling regions;
- Characterize the environmental fluctuations in the principal upwelling zones at different time and space scales;
- Identify the environmental processes that affect the dynamics of pelagic resources;
- Explore the relationships between global climatic fluctuations and local dynamics;
- Analyze the social and economic responses to resource variability;
- Construct exploratory scenarios of possible ecosystem responses in the face of climate change;

- **A THEME**
  - Variability and change;
- **THE DOMAIN OF APPLICATION**
  - Coastal upwelling systems;
- **RESEARCH ACTIONS**
  - Global climate change and the dynamics of coastal upwelling;
  - Resource dynamics and environmental variability;
  - Resource exploitation and use in the face of uncertainty.

CLIMATE CHANGE ?

- Change in level(s)
  - Need not be same in all areas
  - How much change in level is “normal” change
- Change in variance or spectrum
- Change in relationships and processes

CLIMATE CHANGE ? (cont.)

- El Nino and other such events
  - Part and parcel of the overall dynamic
  - “Independent” events that mask or distort underlying trends

METHODOLOGIES

Can't perform experiments at the ecosystem level;

Comparison and observation are as valid scientific research methods as experimentation;

Recognize the importance of the past history in ecosystem evolution.

- **COMPARATIVE APPROACH**
  - **Identify the emergent and contingent properties of ecosystems, as defined from "systems studies";**
- **HISTORICAL APPROACH**
  - **Study the past in order to identify possible system responses due to variability and change;**

METHODOLOGIES (cont.)

- **COMMON TRENDS**
  - Separating out global variability from local variability
  - Common components can be in long-term trend or in seasonal
  - Working in both time and frequency domains
- **NON-STATIONARY SPECTRA**
  - changes in the variance structure through time
- **HIDDEN MARKOV CHAINS**
  - possibility of testing for regime shifts
- **LONG-TERM MEMORY MODELS**

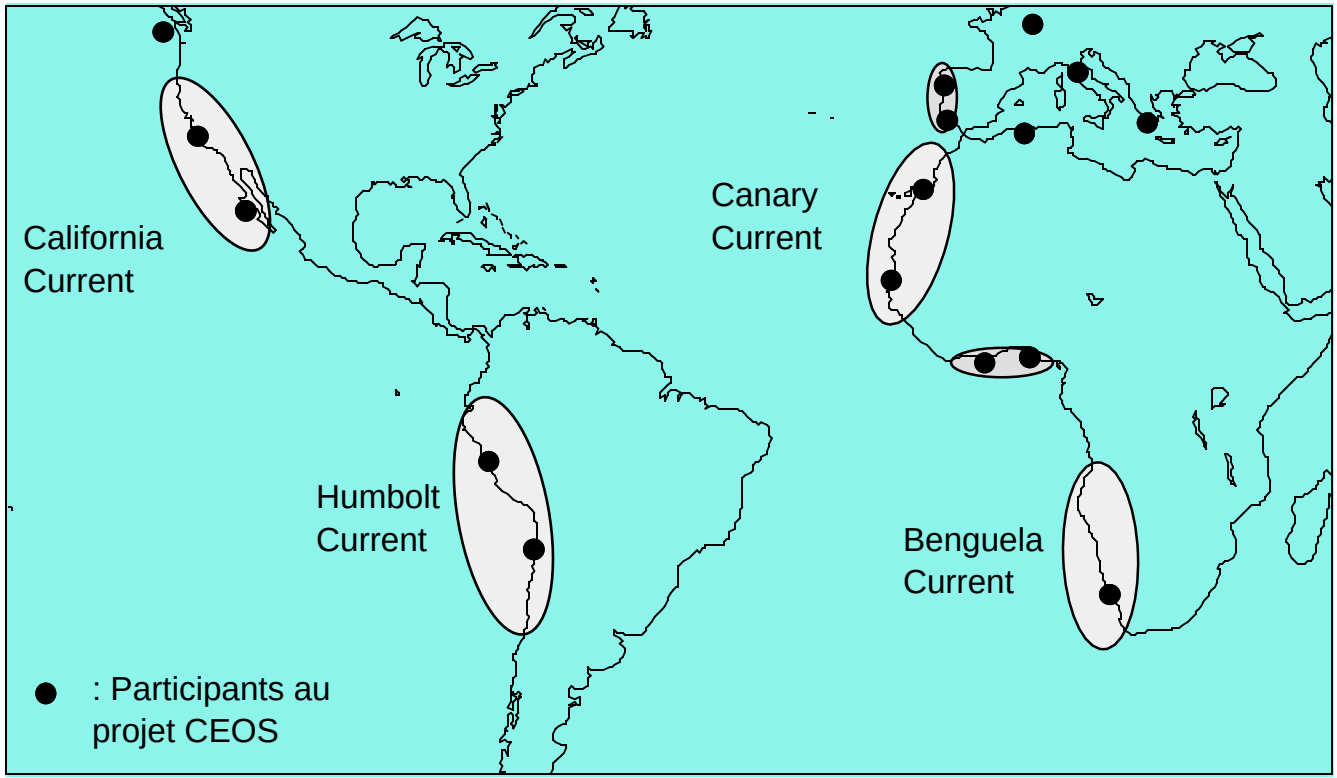
NEAR TERM APPLICATIONS

- West Coast shore station data (Frank Schwing)
- Regime Changes in South Pacific (with Chilean Scientists)
- Otolith Growth reflecting climate change (Mary Yoklavitch)

EXPECTED RESULTS

- A typology of the ecological characteristics of upwelling ecosystems;
- A typology of the responses of upwelling ecosystems and societies affected by them due to change;
- Develop conceptual bases for understanding the dynamics of persistence and change in complex systems;

THE CEOS NETWORK



Over forty participants from more than 15 countries.

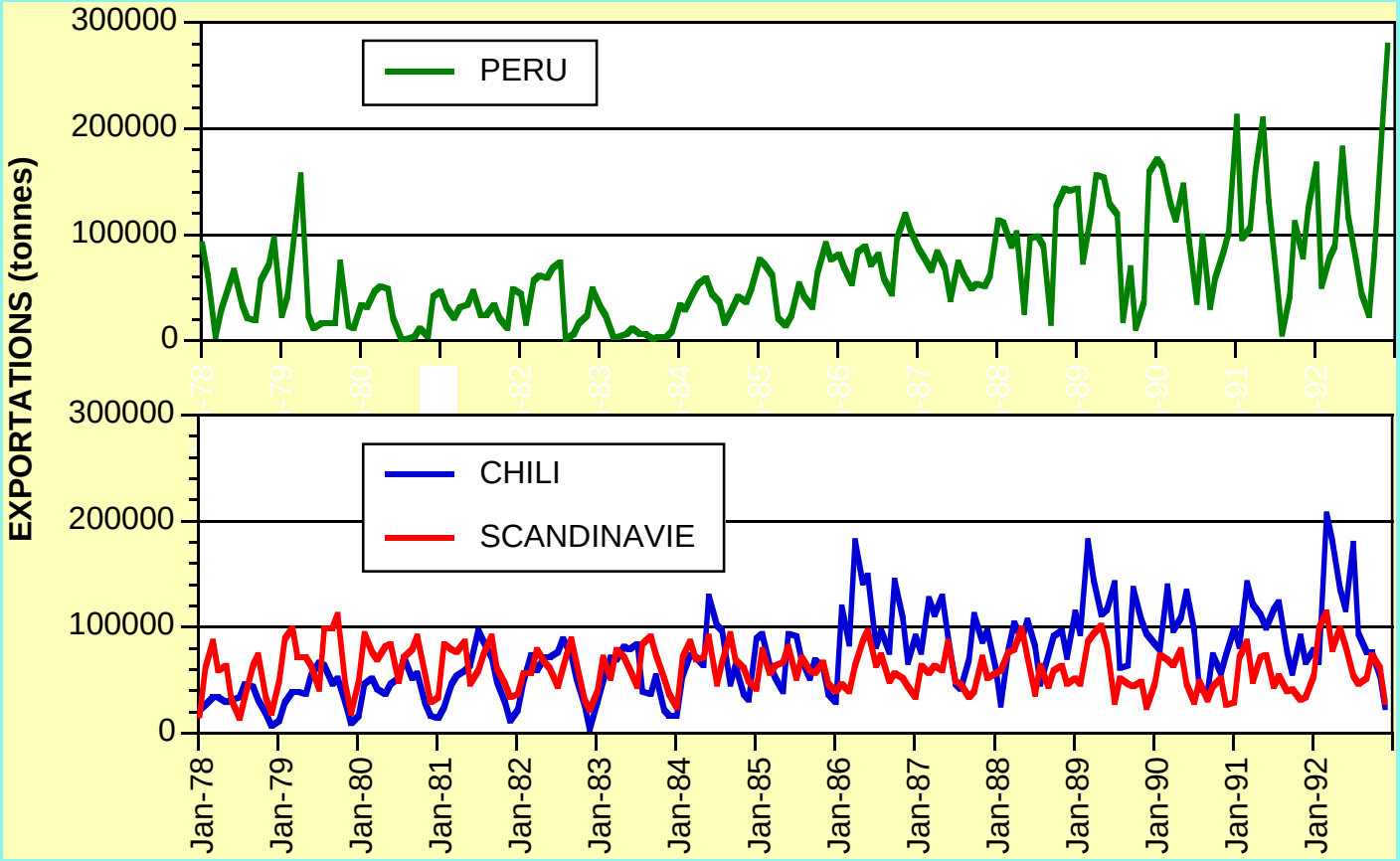
ACTIVITIES OF THE CEOS NETWORK

- Develop comparative studies between the different upwelling regions;
- Promote scientific exchanges (databases, methodologies, knowledge...);
- Coordinate and encourage research on the theme of global versus local changes in upwelling systems (meetings, working groups...);
- Develop new research themes: spatial approaches (teleconnections, ...), renewable resources and biodiversity, long-term changes and resource exploitation.

Some results from the CEOS Project

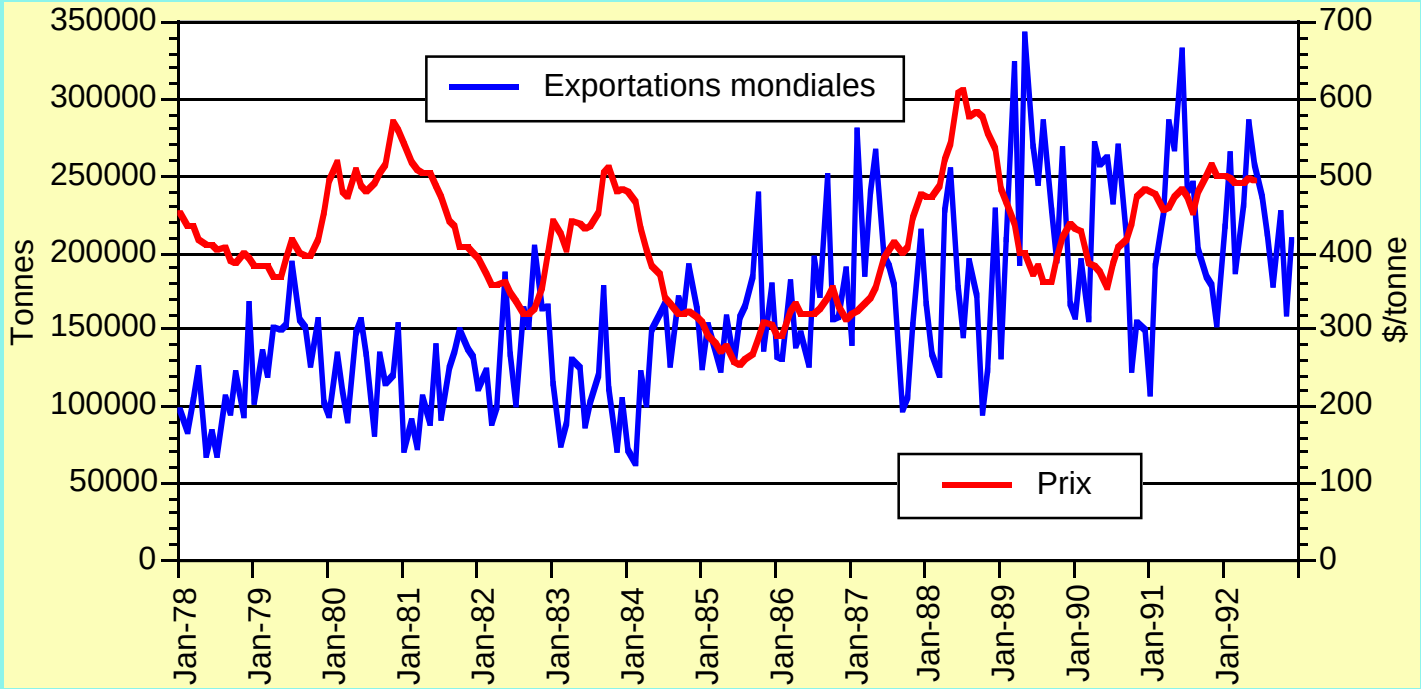
- Dynamics of the world market for fish meal (ORSTOM-FEO);
- Time series and climate change : reality and artifacts (ORSTOM-PFEG);
- “ECOPATH” models of the major upwelling regions (ICLARM);
- Spatial dynamics of the Moroccan pelagic fishery (ISPM-ORSTOM);
- Major ecological changes and the dynamics of the ivoiro-ghanian fishery (CROA-FRU-ORSTOM);
- Databases (PFEG-ORSTOM + CEOS participants).

DYNAMICS OF THE WORLD FISH MEAL MARKET

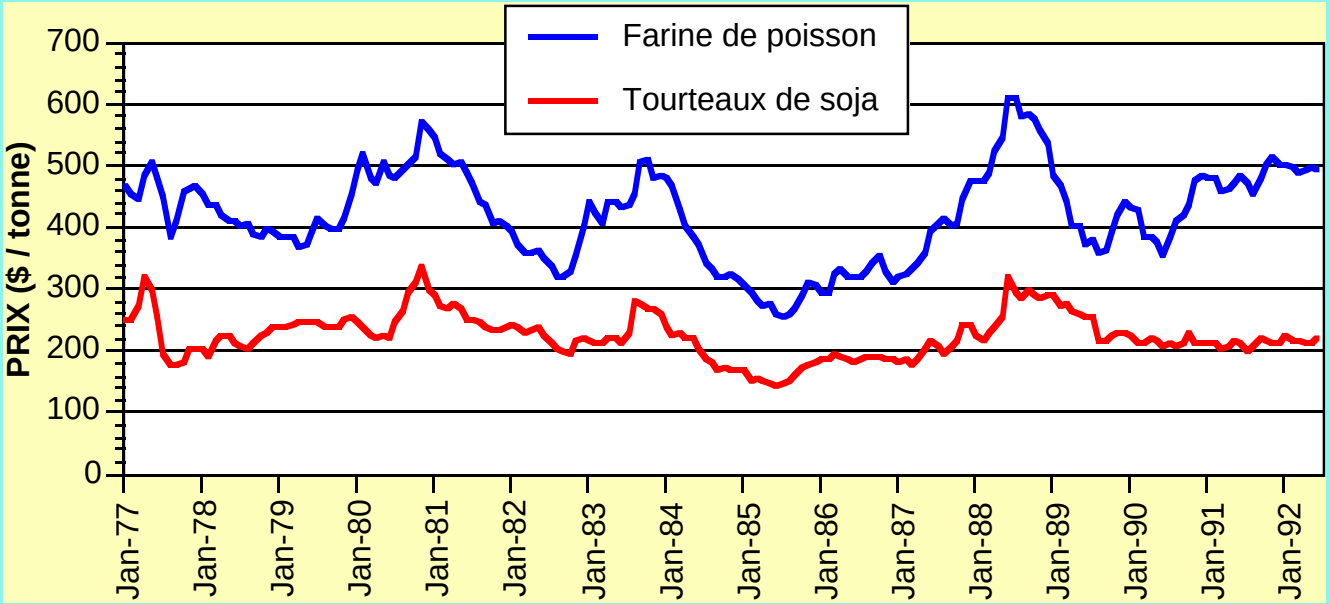


WORLD EXPORTS AND PRICE OF FISH MEAL

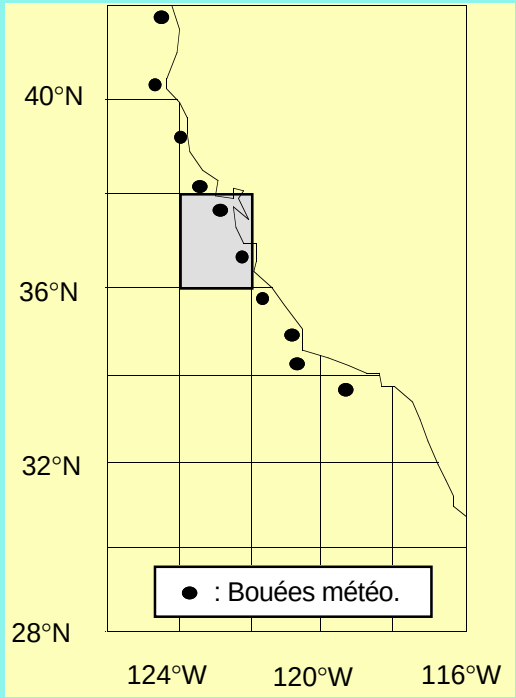
A complex dynamic

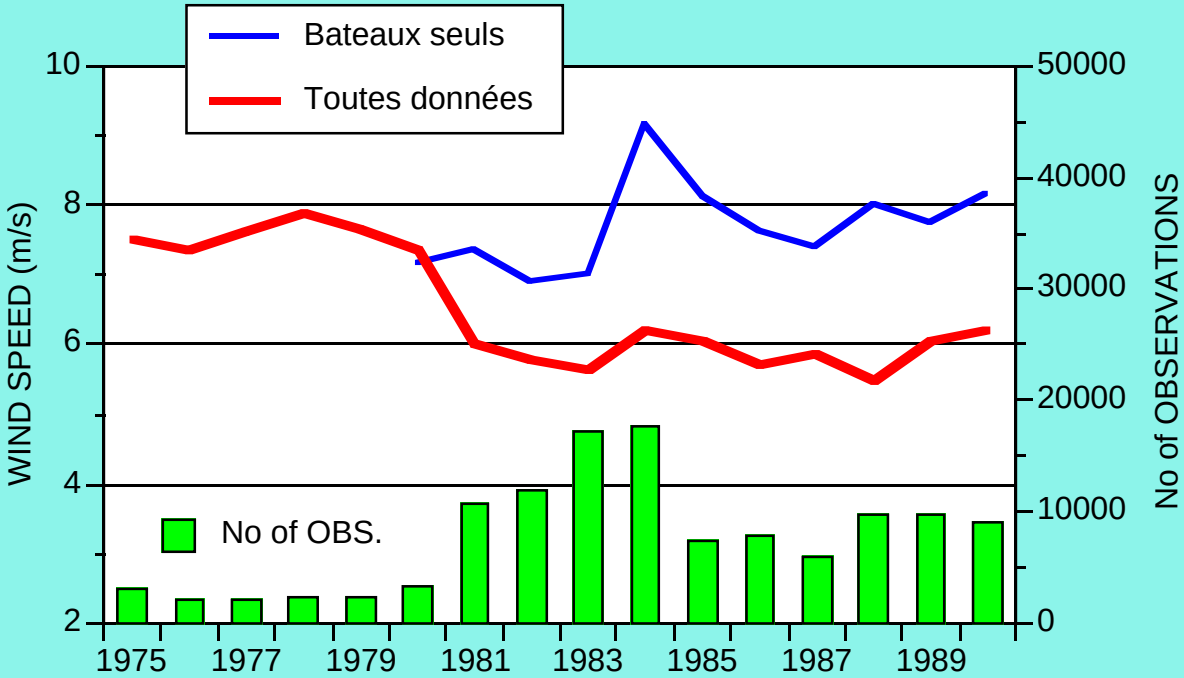


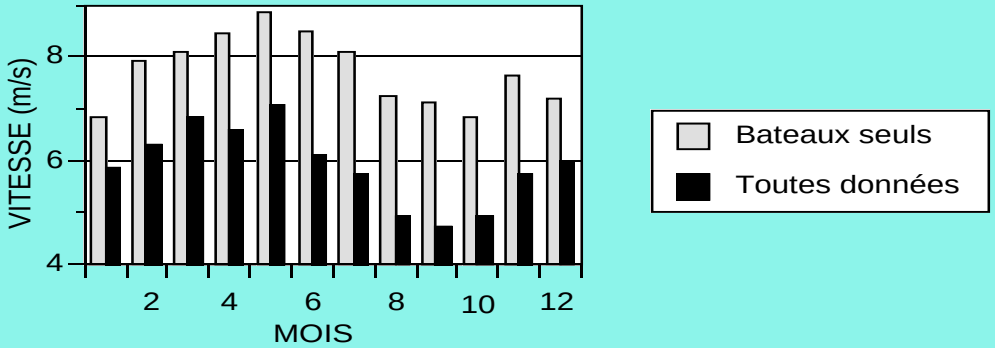
Fish meal and soy beans : interdependence of the two markets

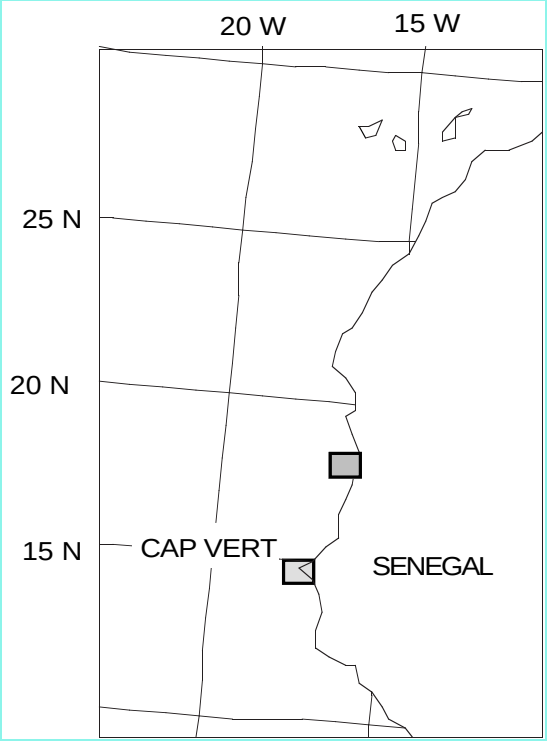


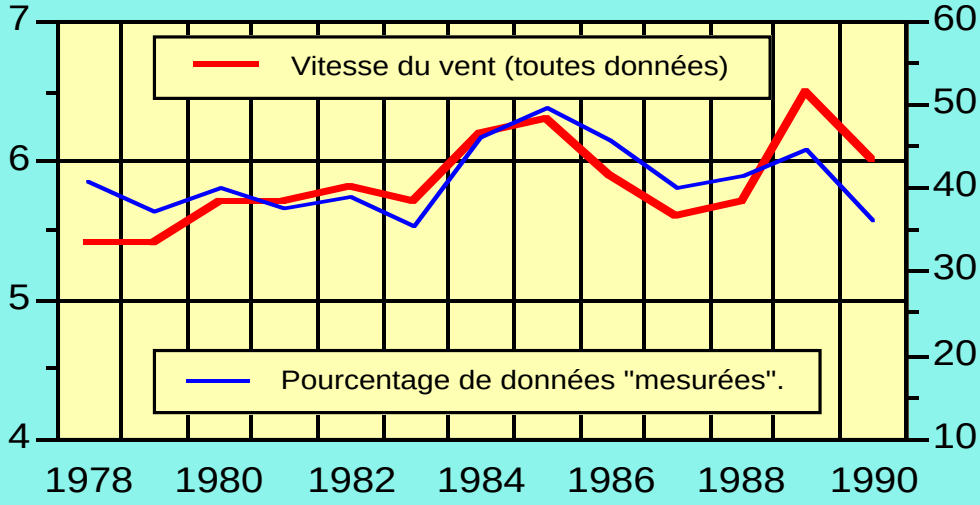
Time series and climatic trends: Reality and artifact



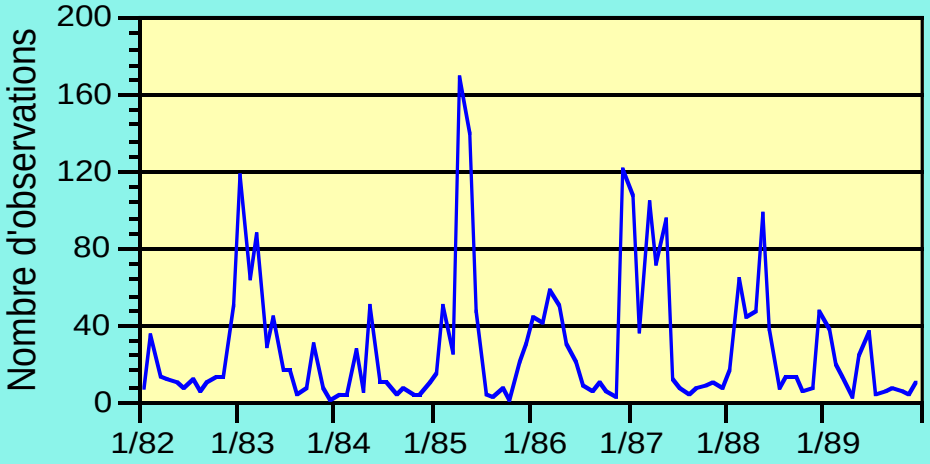








Vitesse moyenne du vent et pourcentage de données "mesurées". Données COADS.



Nombre d'observation par mois devant les côtes de Mauritanie. (données COADS).

The CEOS Project Databases

- **Fishery and biological** : FAO data, national data, biological sampling;
- **Economic**: international markets, national statistics;
- **Environmental** : COADS data, meteorological stations, NODC data.

COADS Data [1]:

100 million surface meteorological observations from the world's oceans collected by merchant ships and other vessels of opportunity since 1854 which have been validated and coded.

[1] **C**omprehensive **O**cean-**A**tmosphere **D**ata **S**et, a joint project of NOAA-NCDC-CIRES-NCAR (USA).

Distribution of the COADS Data

- Individual observations : LMR5 format (the basic meteorological message), CMR5 format (a compressed binary format containing the most commonly used parameters);
- Derived products : monthly means by 2°x2° squares, 2°x2° climatology, ...
- Access to individual observations is difficult (48 magnetic tapes for the LMR5 format, 18 the CMR5 format, the structure of the data varies through time).

The CMR5 Format

- Date, time, position;
- Sea surface temperature;
- Air temperature and dew point;
- Wind speed and direction;
- Atmospheric pressure;
- Cloud cover;
- For each observation, the parameters allow you to identify the origin, the measurement device etc. .; a statistical measure of the quality of the observation is also available.

The COADS data on a micro-computer : a product of the CEOS Project.

- Transferred the COADS data (CMR5 format) onto a microcomputer with the collaboration of NCAR;
- Sorted data into a tree structure : 10°x10° folders contain 25 2°x2° files. The CMR5 format is preserved.
- Developed a program to access and summarize the data (CODE).
- Distribution of the database and the access program (Macintosh, DOS, WINDOWS) on CD-ROM's.

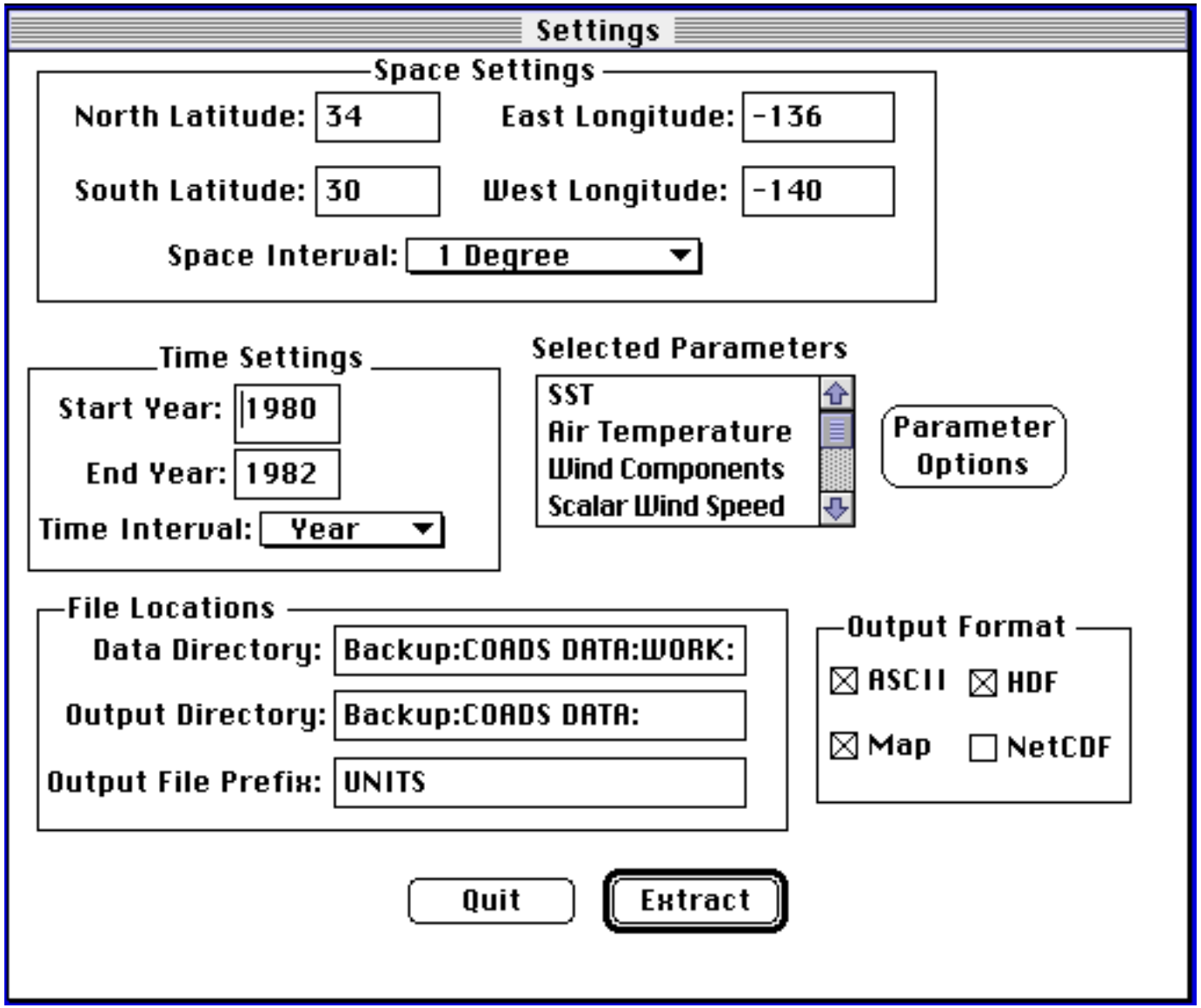
- **access to the original observation allows:**
  - **taking into account the changes through time in the instruments and procedures used to measure the data;**
  - **calculation of new parameters (eg : a wind mixing index);**
  - **adapt the spatial grid to the density of the data, to the configuration of the coastline, or to the temporal changes in the shipping lanes.**

THE CODE PROGRAM

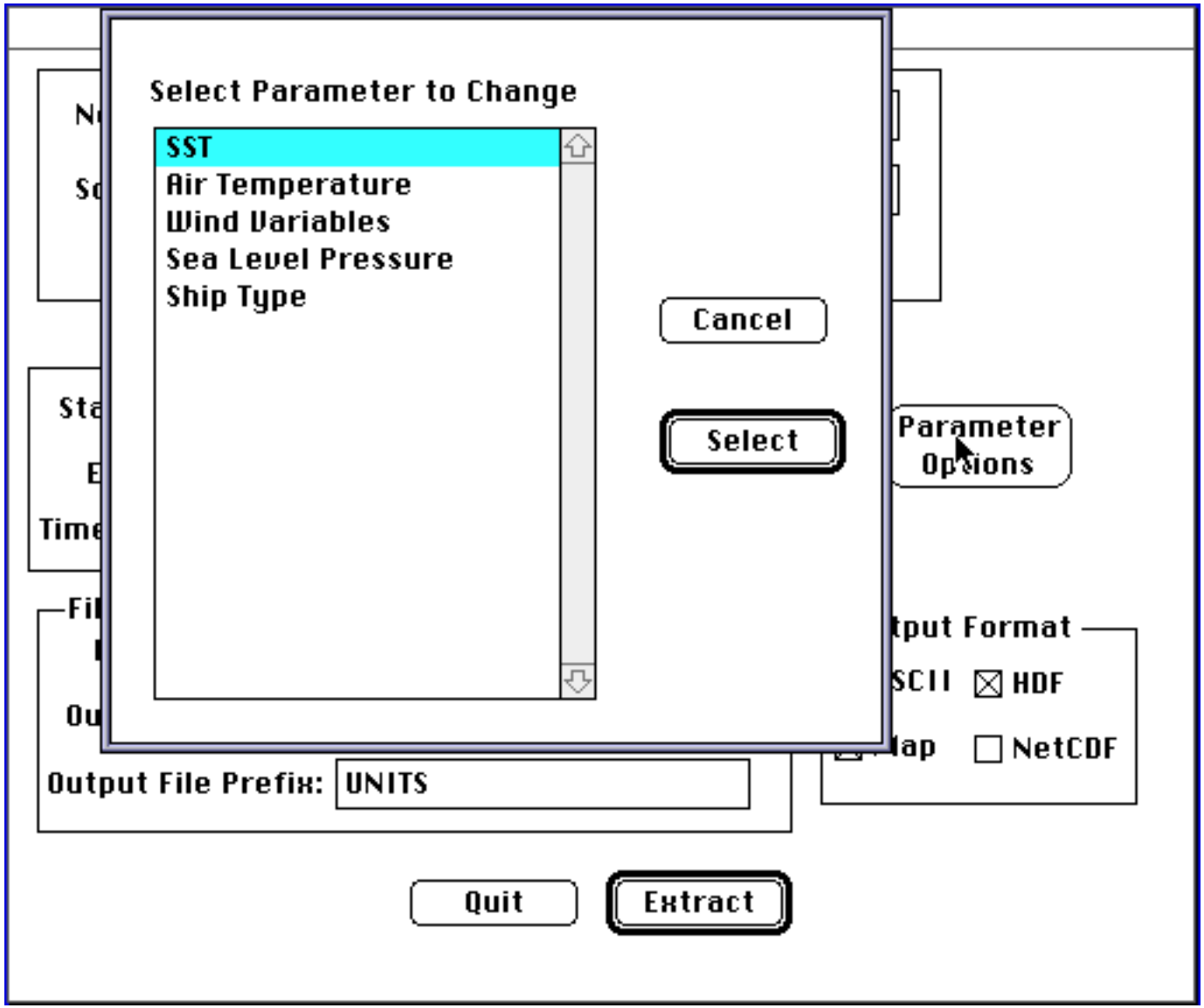
(COADS DATA EXTRACTION)

- **Language FORTRAN, interface XVT (portable to a variety of platforms)**
- **Select the region, the time period, the parameters to process, the options for calculating the means and the output format.**

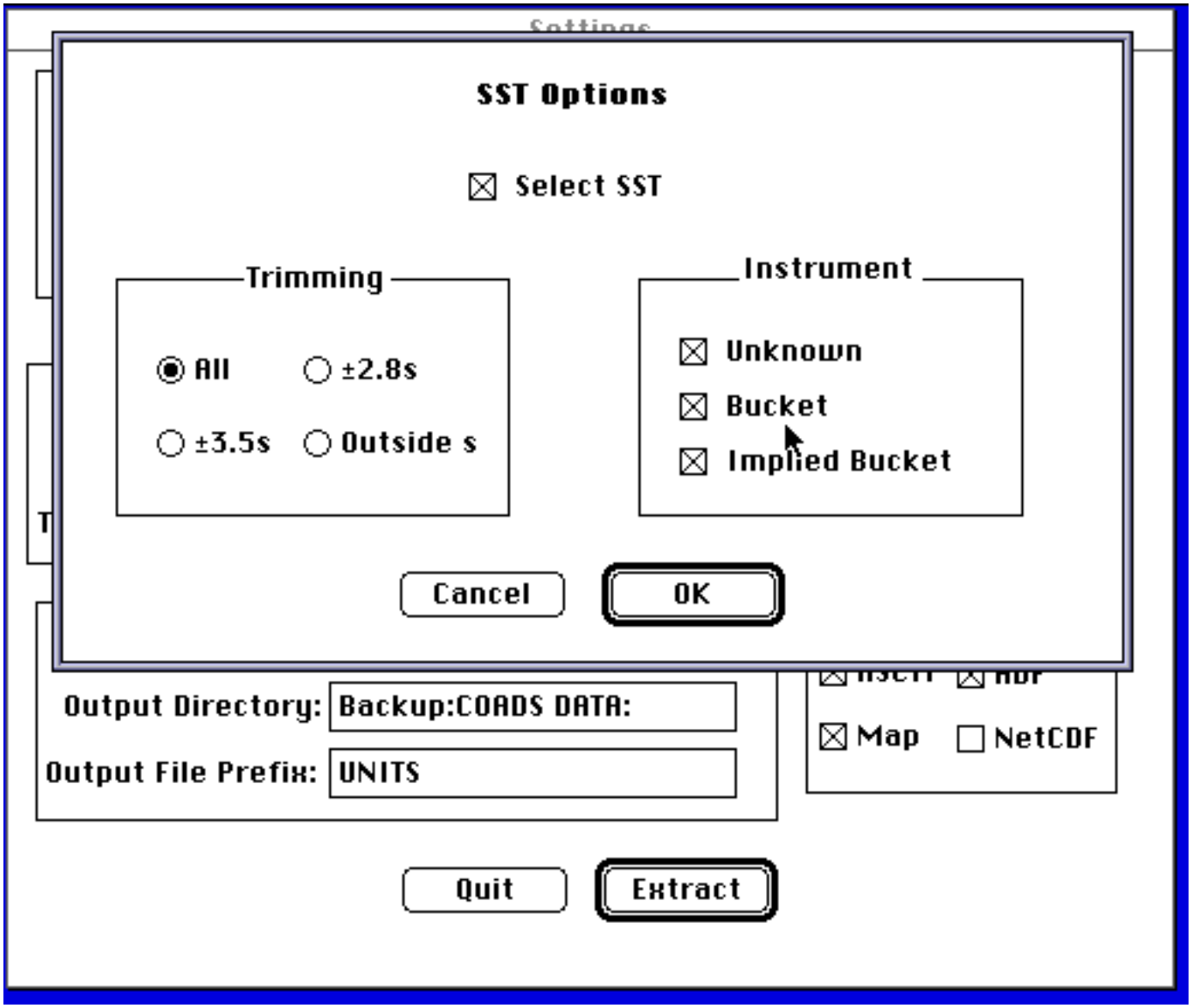
THE DIFFERENT OPTIONS



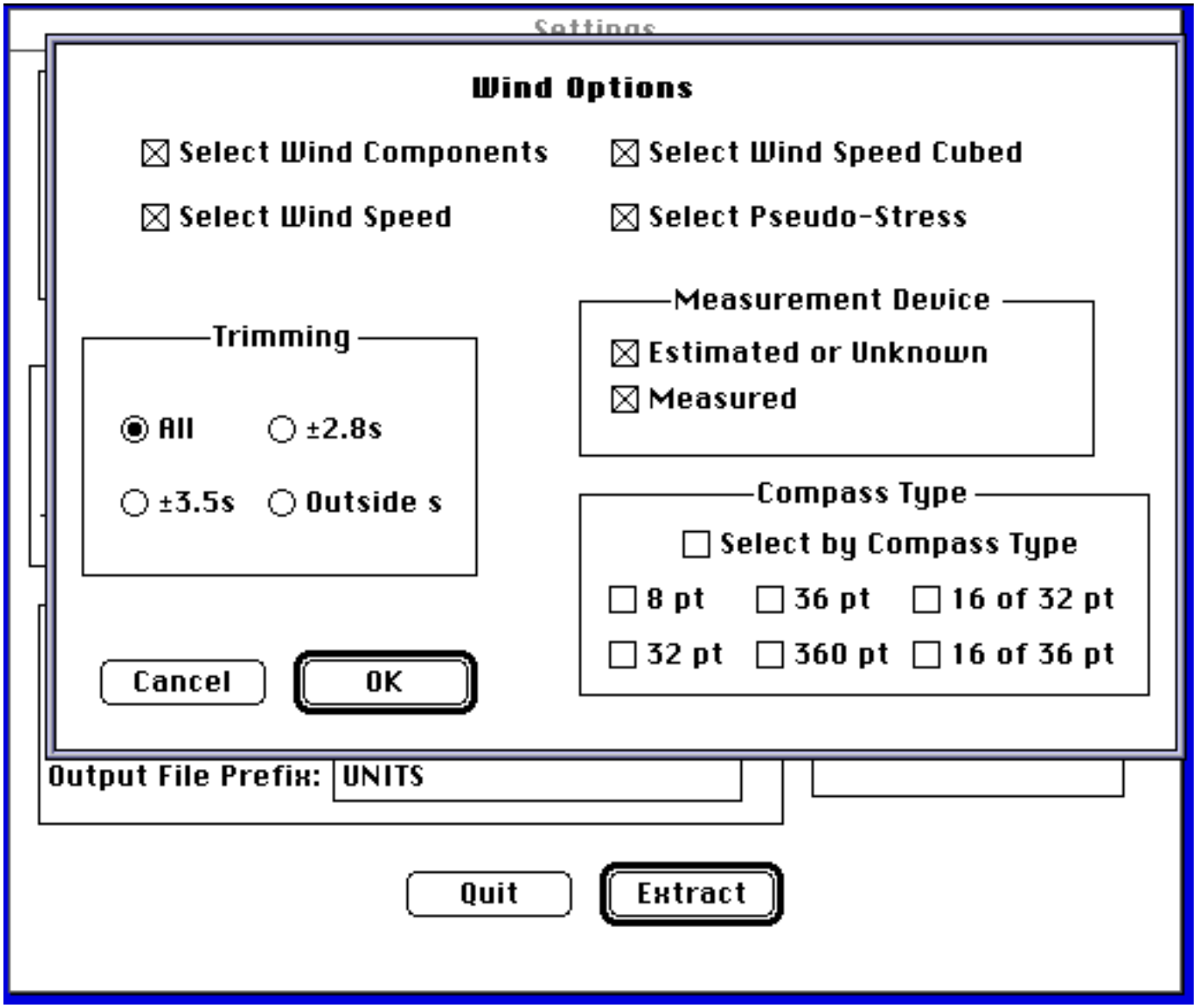
PARAMETER SELECTION



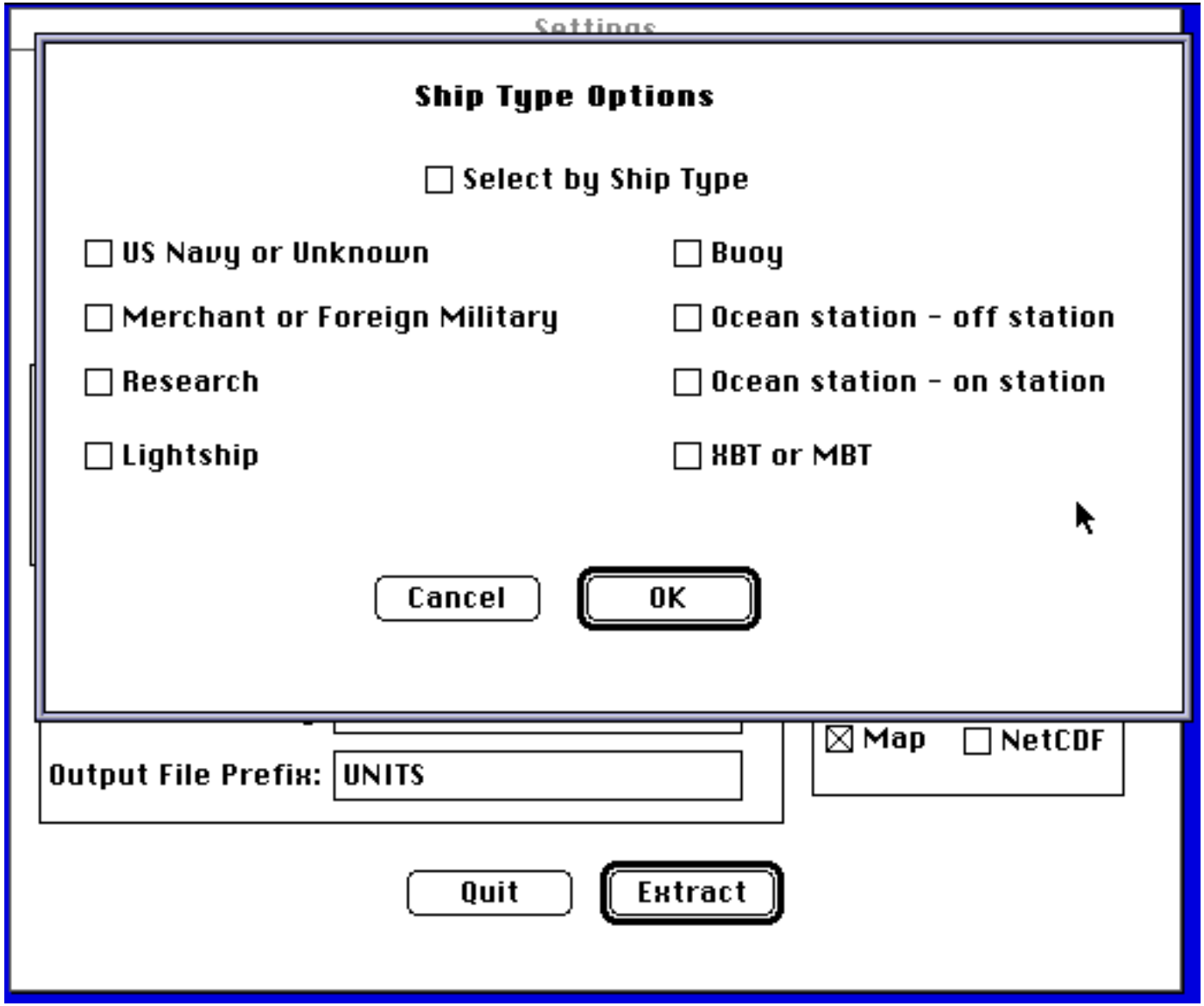
SEA SURFACE TEMPERATURE



WIND AND DERIVED PARAMETERS



ORIGIN AND TYPE OF PLATFORM



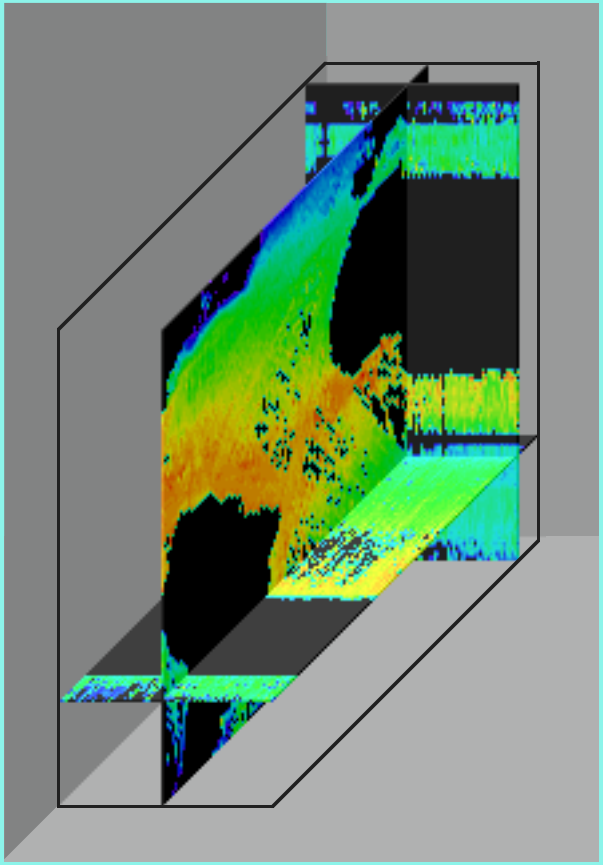
BENEFITS TO SWFSC FROM CEOS

- **FUNDING FROM NOAA (NON-NMFS)**
  - Initial Funding - $141.8K
  - Enhancement - $ 43.2K
- **SALARIES OF FRENCH SCIENTISTS**
  - At PFEG - $108K per year
  - In Paris - $ 24K per year
- **OTHER FUNDING FROM FRENCH GOVERNMENT**
  - TOA - $48K since 1991
  - DURR - $25K since 1992
  - ORSTOM in Ivory Coast - $7K in 1992

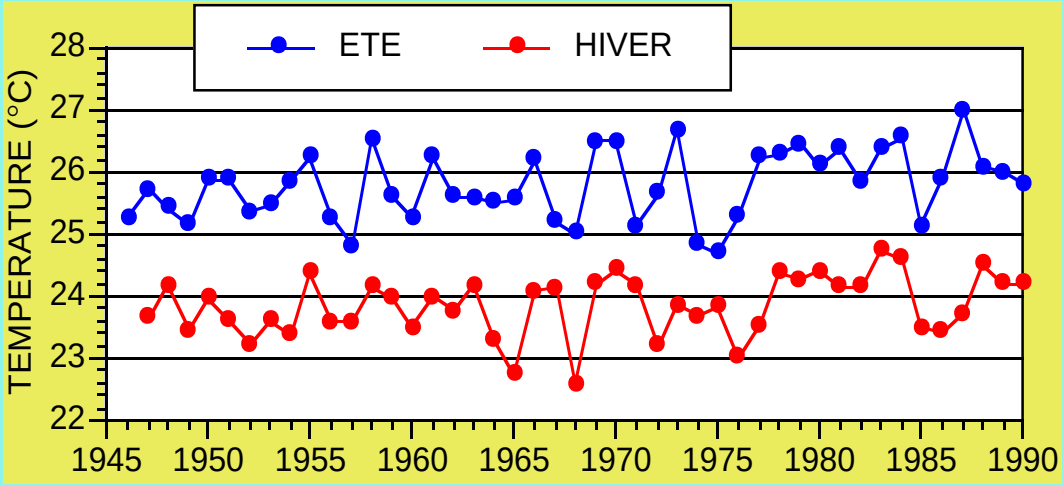
BENEFITS (cont.)

- **VISITORS TO PFEG THROUGH CEOS**
  - O. Pezennic (ORSTOM Ivory Coast) - 1 month
  - S. Kifani (Morocco) - 2 weeks
  - J. Schweigart (Canada) - 1 week
  - J. Mendo (Peru) - 2 weeks
  - E. Yanez & M. Barbieri (Chile)- 2 weeks
  - F.X. Bard (ORSTOM Ivory Coast) - 1 week
  - K. Stergiou (Greece) - 2 weeks

VISUALIZATION OF DATA

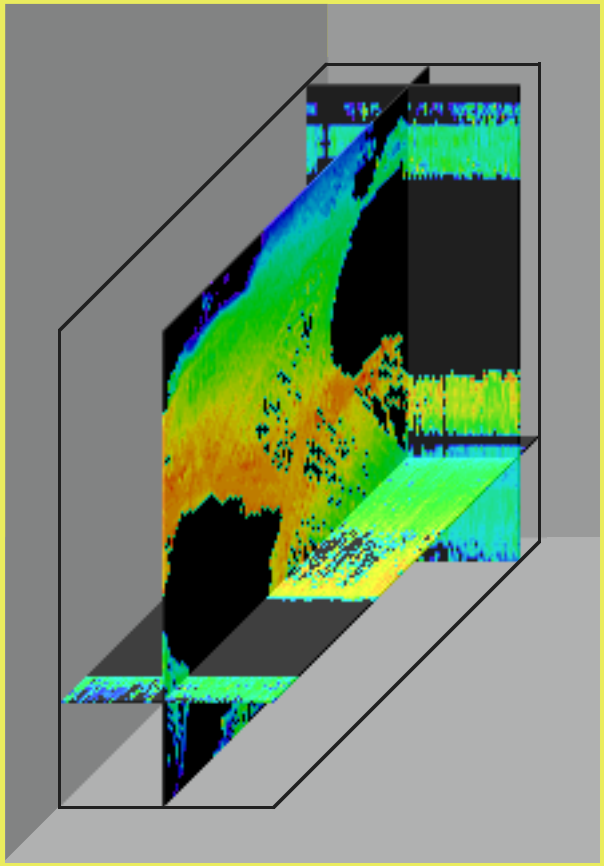


Data From 2x2 Box With SW Corner:		Longitude:	342	Latitude :	12	
		JAN	**FEB**	**...**	**DEC**	
SST	**1946**	17.2	22.2	**...**	24.76	
SST	**1947**	21.38	19.14	**...**	24.71	
...	**...**	**...**	**...**	**...**	**...**	
SST	**1949**	21.24	20.64	**...**	25.14	

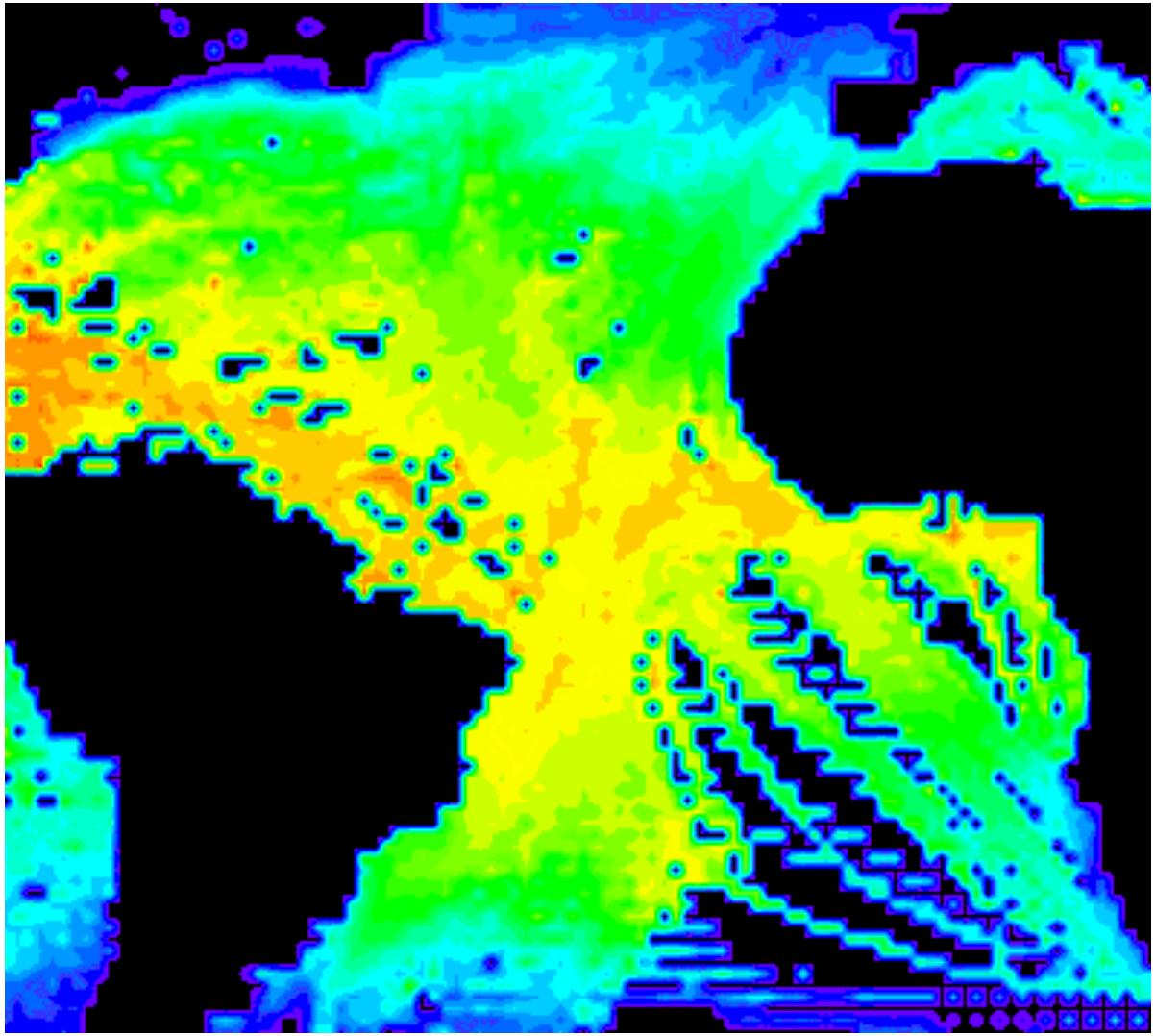


Reconstructing the ocean climate since 1854: the COADS data on a micro-computer

Claude ROY
ORSTOM
France



Roy MENDELSSOHN
PFEG / NOAA
USA

Almost 100 million observations are accessible from a micro-computer.

YEARLY MEAN SST: 1911-1990