The Global Ocean Observing System

IOC / UNESCO

WMO

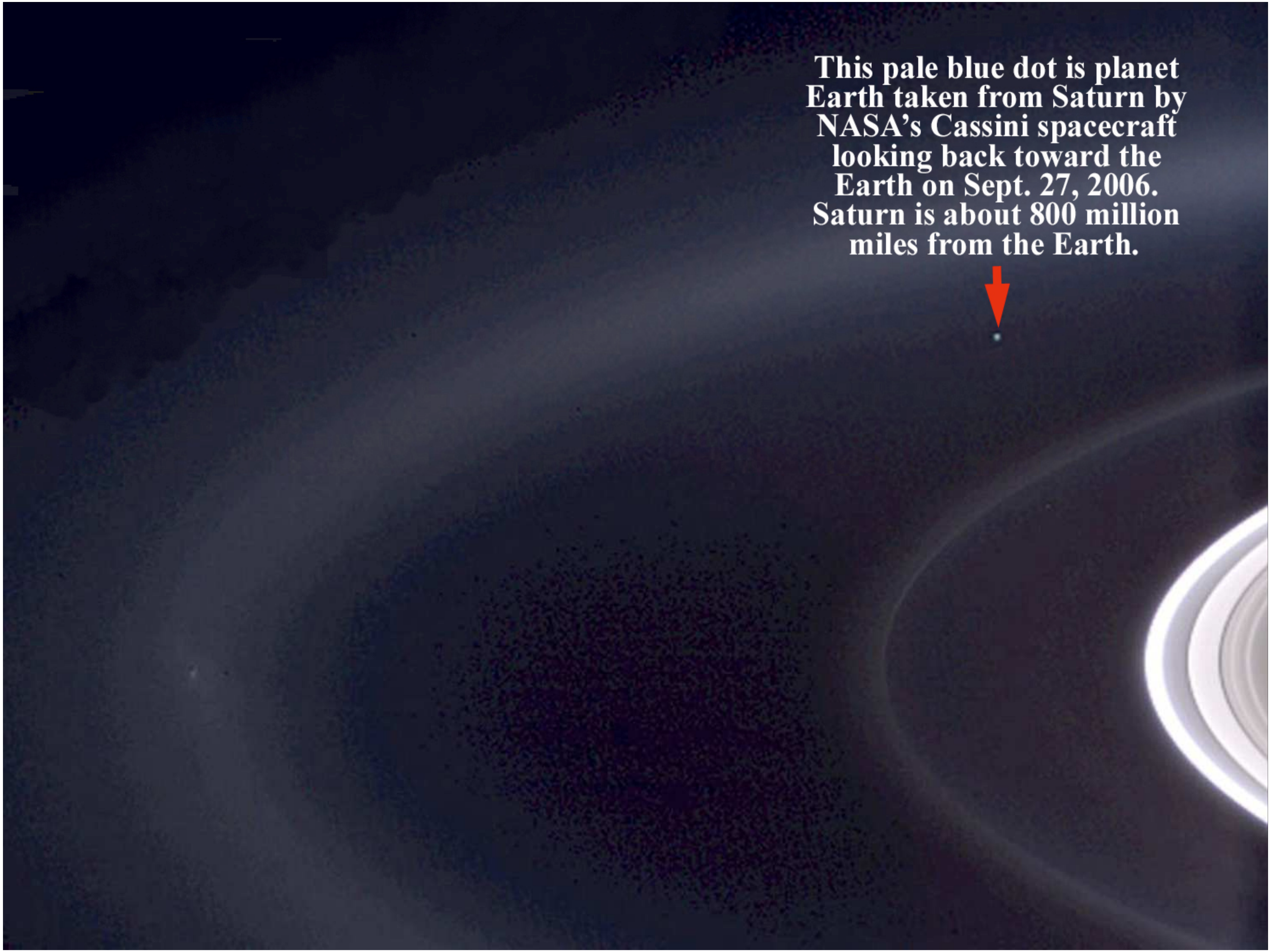
UNEP

ICSU

My role in GOOS

- Chair, Global Ocean Observing System Scientific Steering Committee
- US Integrated Ocean Observing System Industry Coordination and Outreach at Consortium for Ocean Leadership
- Chair, Defra Ocean Processes Evidence Group
- Member of European Marine Observation and Data Network

The Earth from 86 million miles


This pale blue dot is planet Earth taken from Saturn by NASA's Cassini spacecraft looking back toward the Earth on Sept. 27, 2006. Saturn is about 800 million miles from the Earth.

So let's dive in

- A bit of history
- Benefits of ocean observation and forecasting
- Ocean observation and forecasting today
- Future challenges

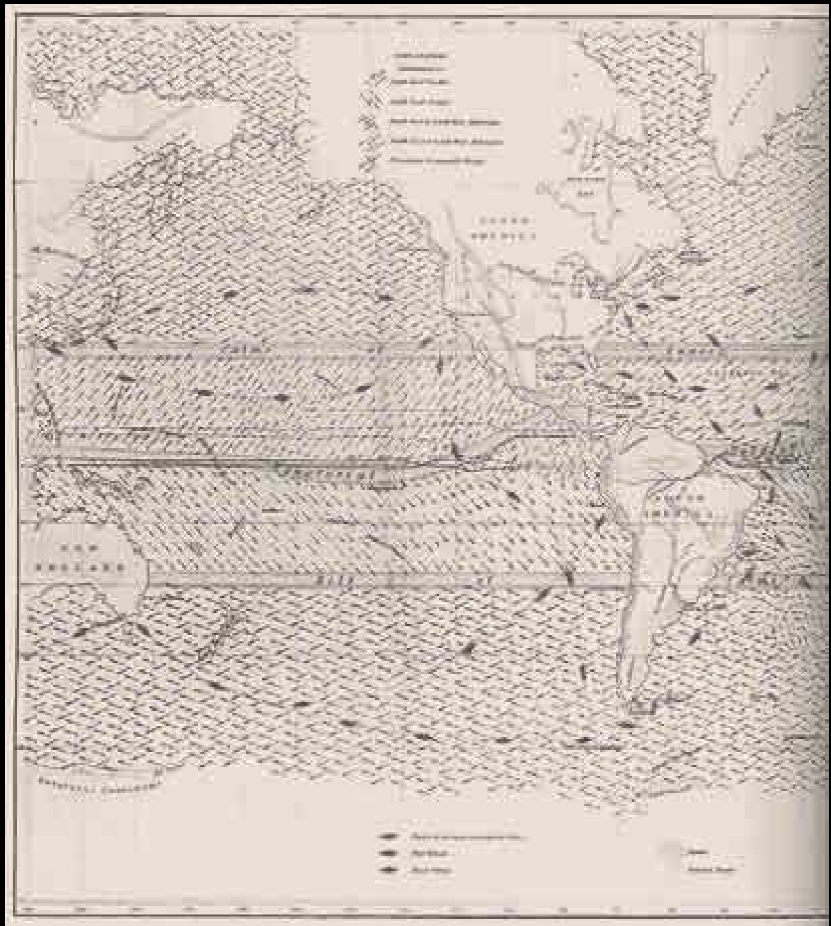
A Historical Perspective

‘We celebrate the past to awaken the future’

John F Kennedy, 14 August 1960


Cmdr. Matthew Fontaine Maury, USN
SOUTH AMERICA
AFRICA
UNITED STATES
FLORIDA

The first global operational system



More than 150 years ago Matthew Fontaine Maury set out a plan to organize accumulated information from ship's logs in a greatly simplified way, organized "in such a manner that each may have before him, at a glance, the experience of all."

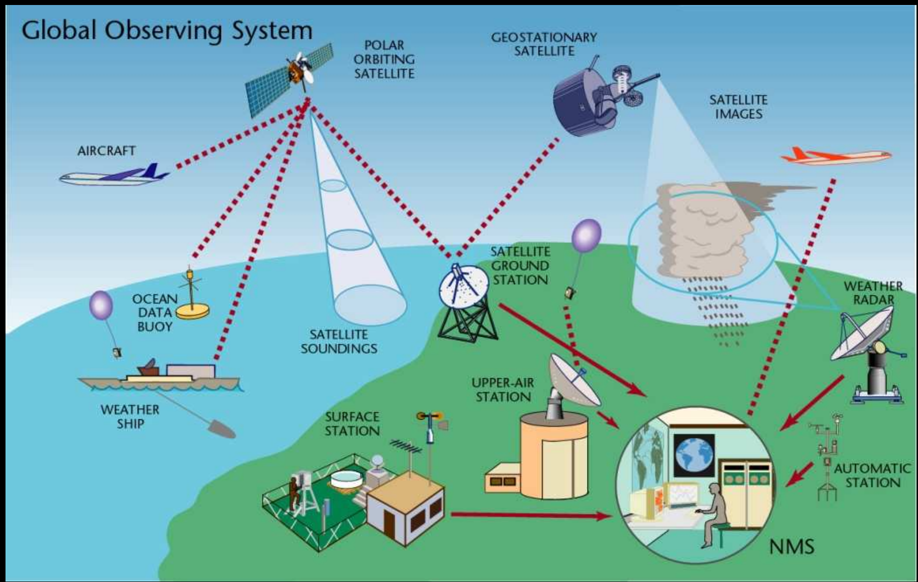
The first global operational system

Making improvements on the back of a big data set is not a Google monopoly, nor is the technique new. Maury created an early variant of a ‘viral’ social network, rewarding captains who submitted their logbooks with a copy of his maps.

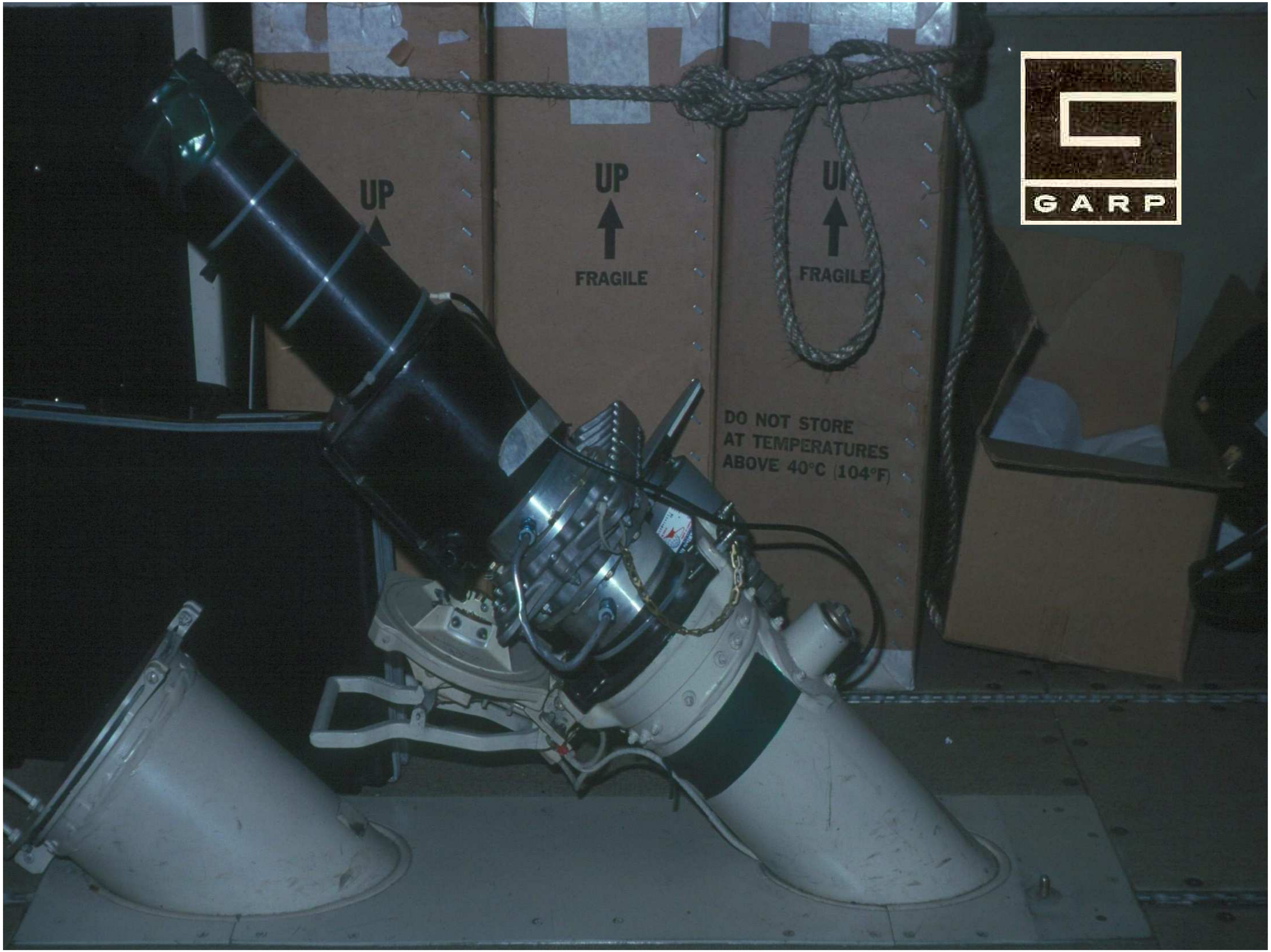
Maury and the 1853 Brussels Conference

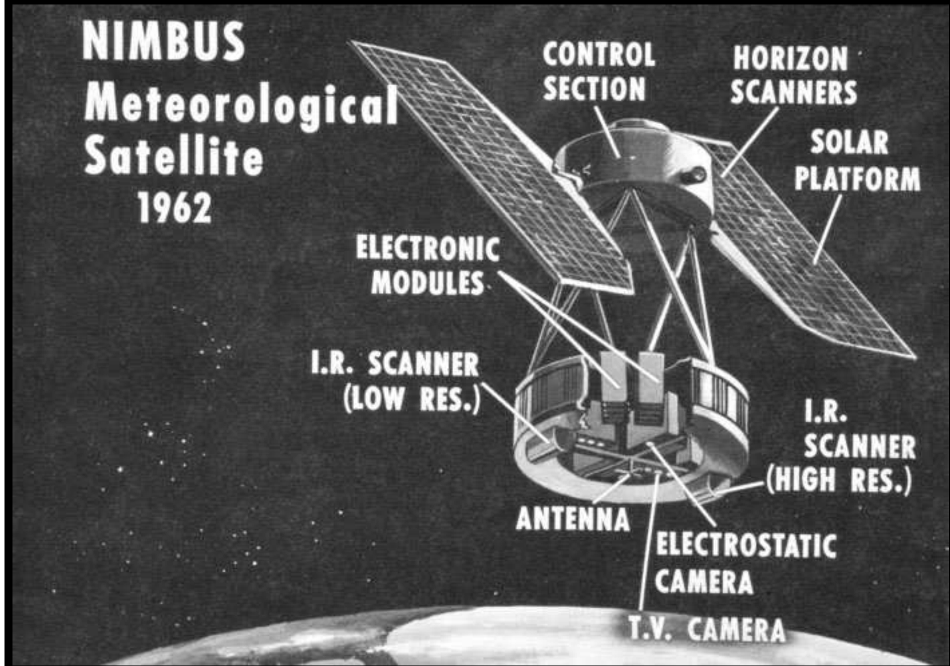
- Maury and others established the basic principles of operational meteorology and oceanography:
  - Common standards/formats for data collection
  - Common standards of data quality control and analysis
  - Free and open exchange of data/information for global public good
- Delivered the first systematically derived charts of global marine winds, waves and currents and laid the foundation for operational meteorology and oceanography
- Brussels conference led directly to the eventual formation of the WMO in 1947

World Weather Watch



- Established by WMO in 1963
- Creation of a globally coordinated system of observations, data communications, data processing and forecasting


UP
UP
FRAGILE
FRAGILE
DO NOT STORE
AT TEMPERATURES
ABOVE 40°C (104°F)
GARP


NIMBUS
Meteorological
Satellite
1962
CONTROL
SECTION
HORIZON
SCANNERS
SOLAR
PLATFORM
ELECTRONIC
MODULES
I.R. SCANNER
(LOW RES.)
I.R.
SCANNER
(HIGH RES.)
ANTENNA
ELECTROSTATIC
CAMERA
T.V. CAMERA


TIROS


GOES

Computing

- Meteorology took early advantage of the revolution in computing to deliver routine operational products

- By 1990 Operational meteorology firmly established with World Weather Watch, combining satellite and *in-situ* observing systems, telecommunications, data processing and operational models
- Operational oceanography still in its infancy

Why the difference?

- Need for operational meteorology more pressing than for equivalent capability for the oceans
- Features of the ocean on a finer scale than the atmosphere
- Oceans a more complex chemical and biological environment that the atmosphere
- Technology of ocean observations more challenging than for the atmosphere
- Ocean opaque to radio waves so potential of satellite observations limited

The oceans in weather and climate

- **Oceans are an enormous reservoir of heat**
- **Oceans contain 97% of Earth's water, hence they are fundamental in the global hydrological cycle.**
- **Oceans experience 86% of evaporation, hence they are central to energy exchange on planetary scales.**
- **Oceans receive 78% of planetary precipitation; for example, a 1% increase in Atlantic precipitation equals the annual Mississippi runoff.**
- ***The oceans control the timing and magnitude of changes in the global climate system.***

Operational oceanography finally became a global goal in 1990
43 years after the establishment of the WMO

GOOS

The Global Ocean Observing System
A joint initiative of:

IOC / UNESCO

WMO

UNEP

ICSU

Mission of GOOS

- Support monitoring, understanding and predicting weather and climate
- Describe and forecast the state of the ocean, including living resources
- Improve management of marine and coastal ecosystems and resources
- Mitigate damage from natural hazards and pollution
- Protect life and property on coasts and at sea
- Enable scientific research

A Global 'system of systems' linking together existing and planned observing systems around the world

GROUP ON EARTH OBSERVATIONS

The Open Ocean Implementation Plan

GLOBAL
CLIMATE
OBSERVING
SYSTEM

WMO
IOC of UNESCO
UNEP
ICSU

WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

IMPLEMENTATION PLAN FOR THE GLOBAL OBSERVING SYSTEM FOR CLIMATE IN SUPPORT OF THE UNFCCC

October 2004

GCOS - 92

(WMO/TD No. 1219)

UNITED NATIONS ENVIRONMENT PROGRAMME

INTERNATIONAL COUNCIL FOR SCIENCE

WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC

(2010 Update)

DRAFT v1.0

13 November 2009

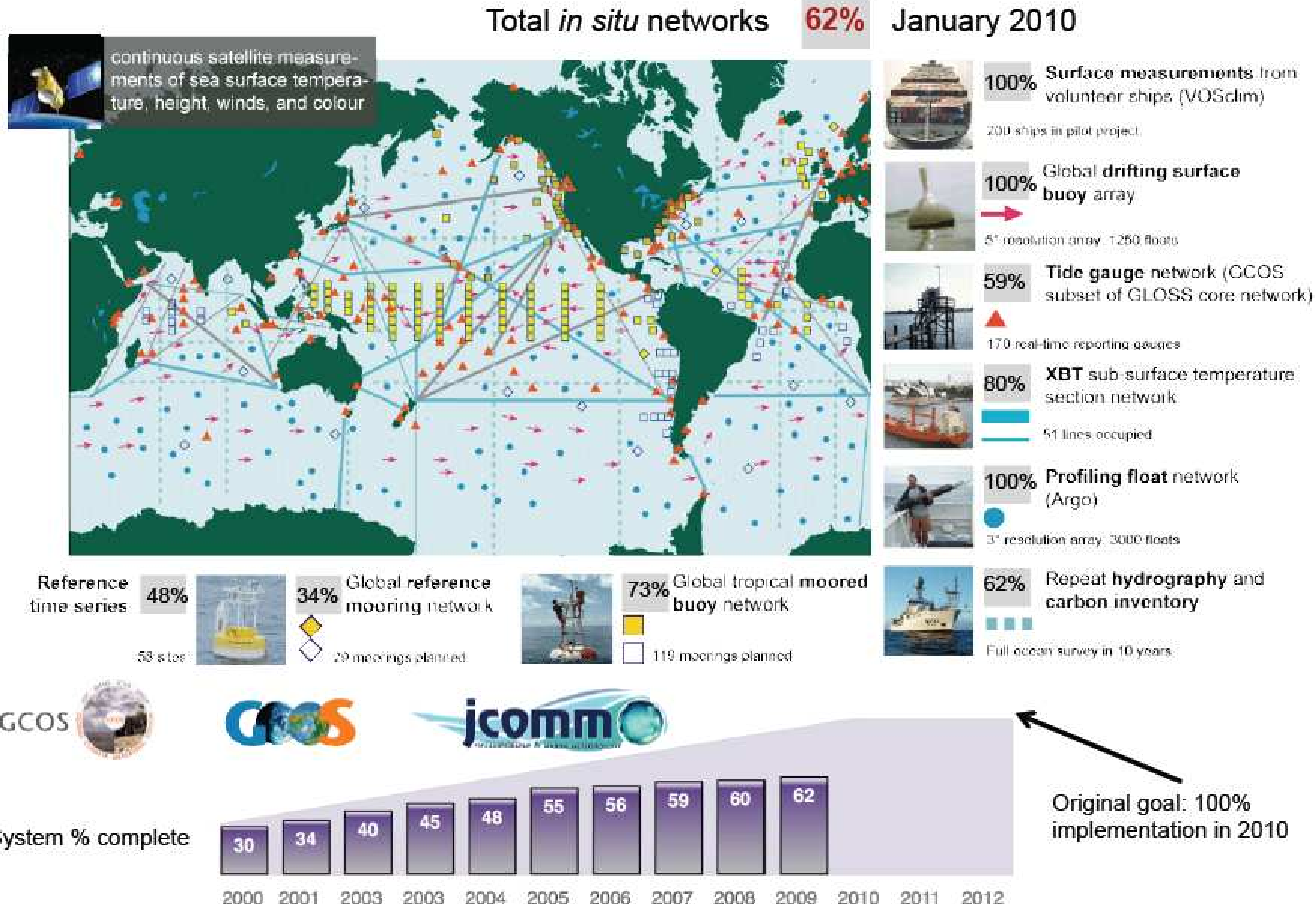
GCOS Secretariat

UNITED NATIONS ENVIRONMENT PROGRAMME

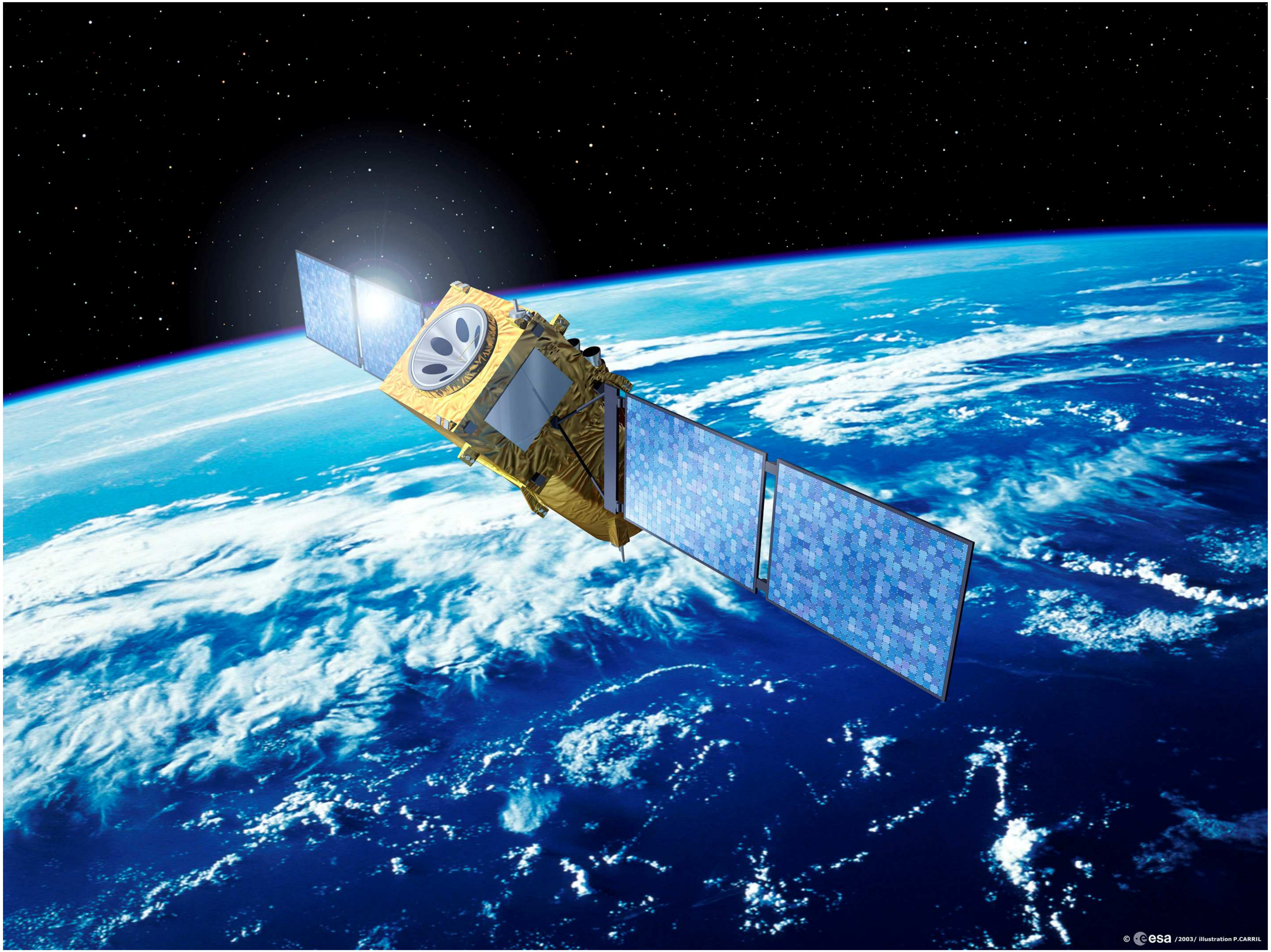
INTERNATIONAL COUNCIL FOR SCIENCE

Initial Global Ocean Observing System for Climate

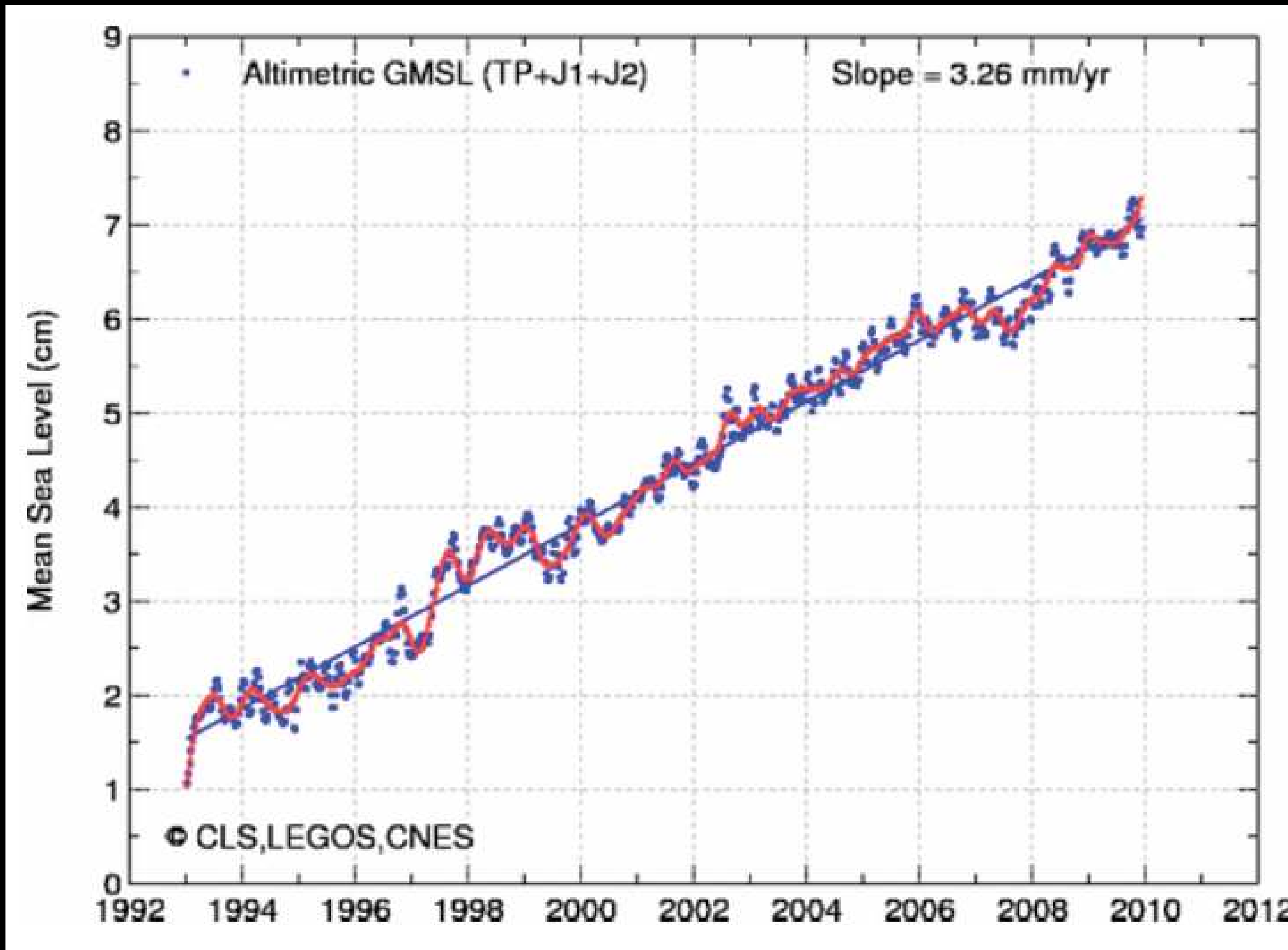
Status against the GCOS Implementation Plan and JCOMM targets




FUTURE
PAST
PRESENT

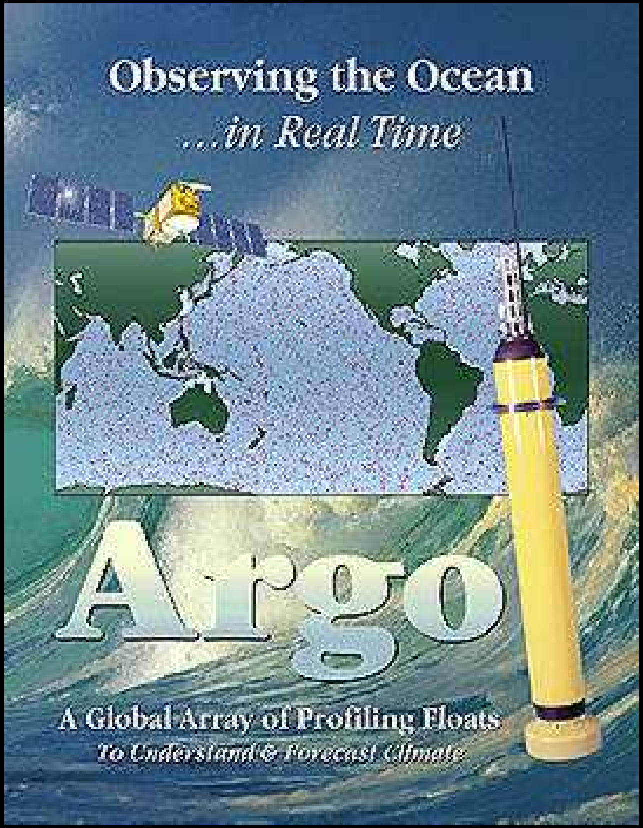

© esa /2003/ illustration P.CARRIL

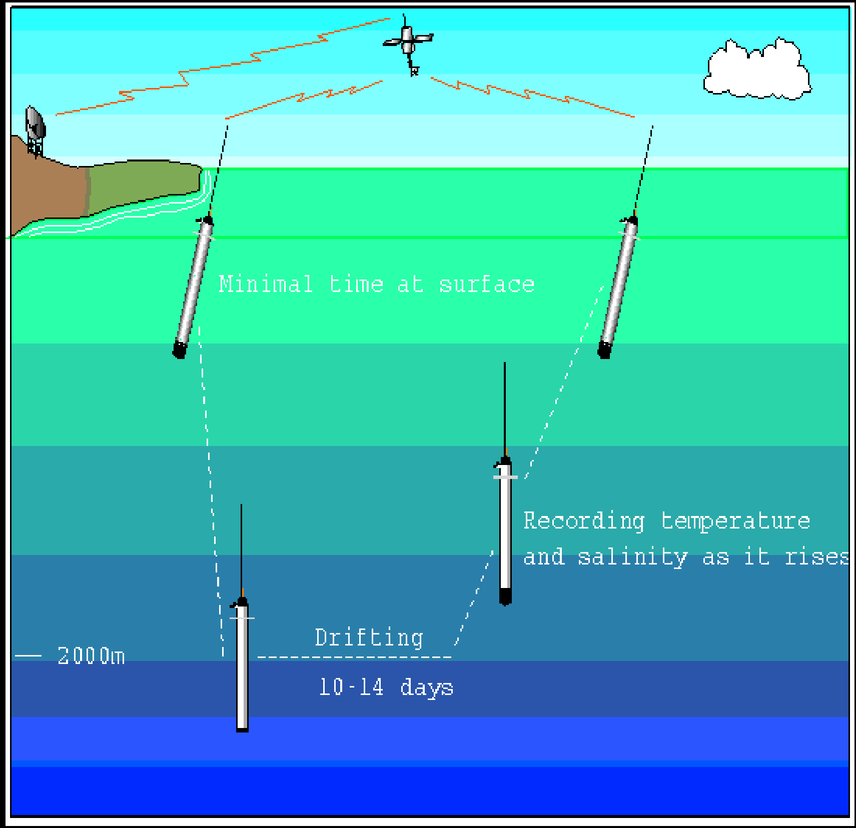
Altimetric sea level

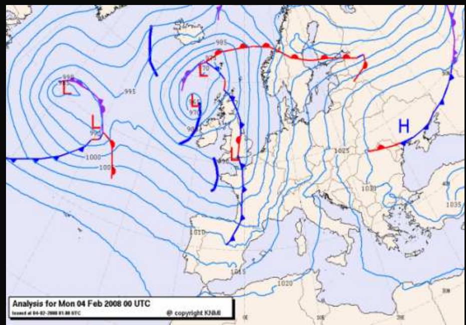
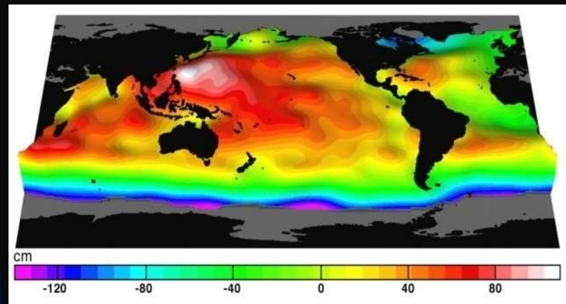
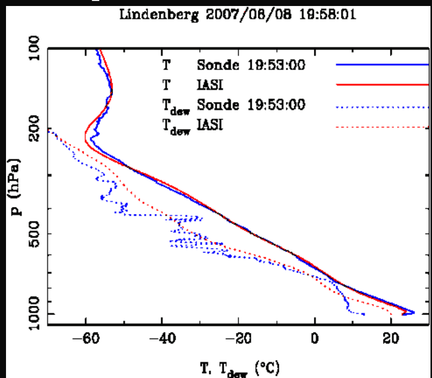


Technology

- Comprehensive array of technologies for *in-situ* measurement
- Many emerging technologies transitioning into operational use

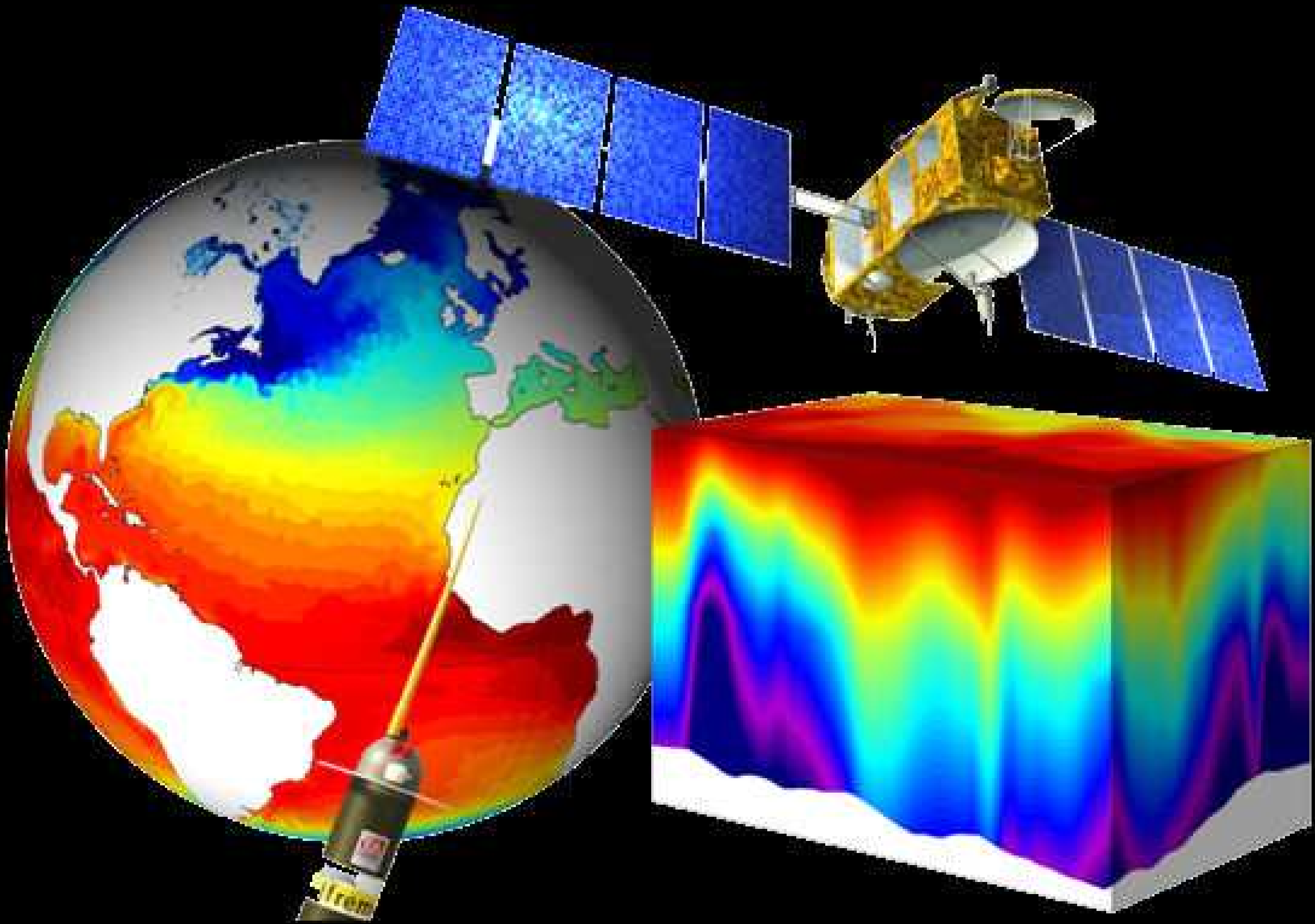

Observing the Ocean
...in Real Time
Argo
A Global Array of Profiling Floats
To Understand & Forecast Climate

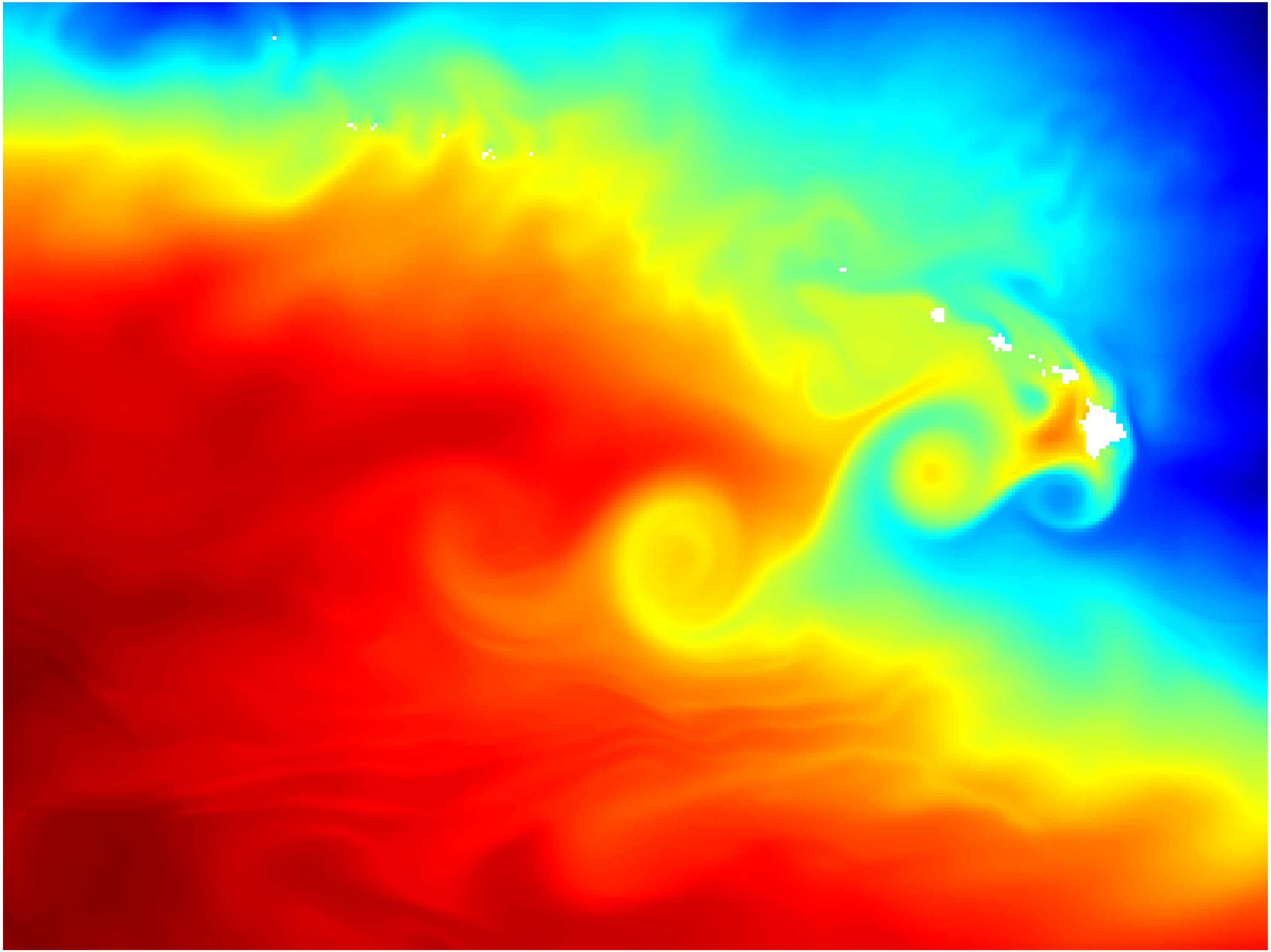

Minimal time at surface
Recording temperature
and salinity as it rises
Drifting
2000m
10-14 days

	Atmosphere Dynamics	Ocean Dynamics
1.Pressure	**Sea level air pressure**  Observations: buoy, ship and dropsondes	**Surface Height**  Observations: Satellite Altimetry
2.Density	**Temperature & Humidity**  Observations: IASI on METOP	**Temperature & Salinity**  Observations: Argo floats

X.Calbet, EUMETSAT, 2008

Operational Systems

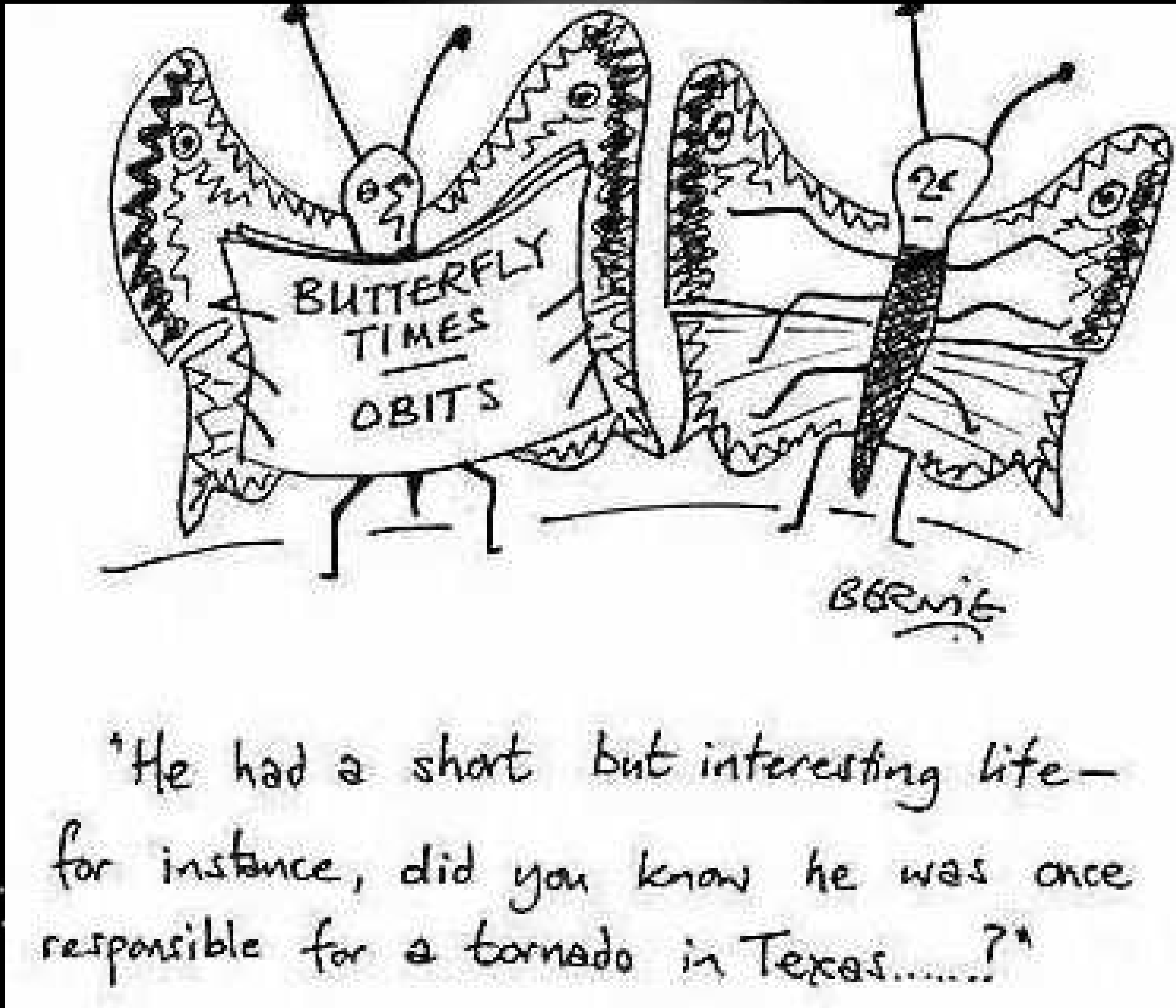


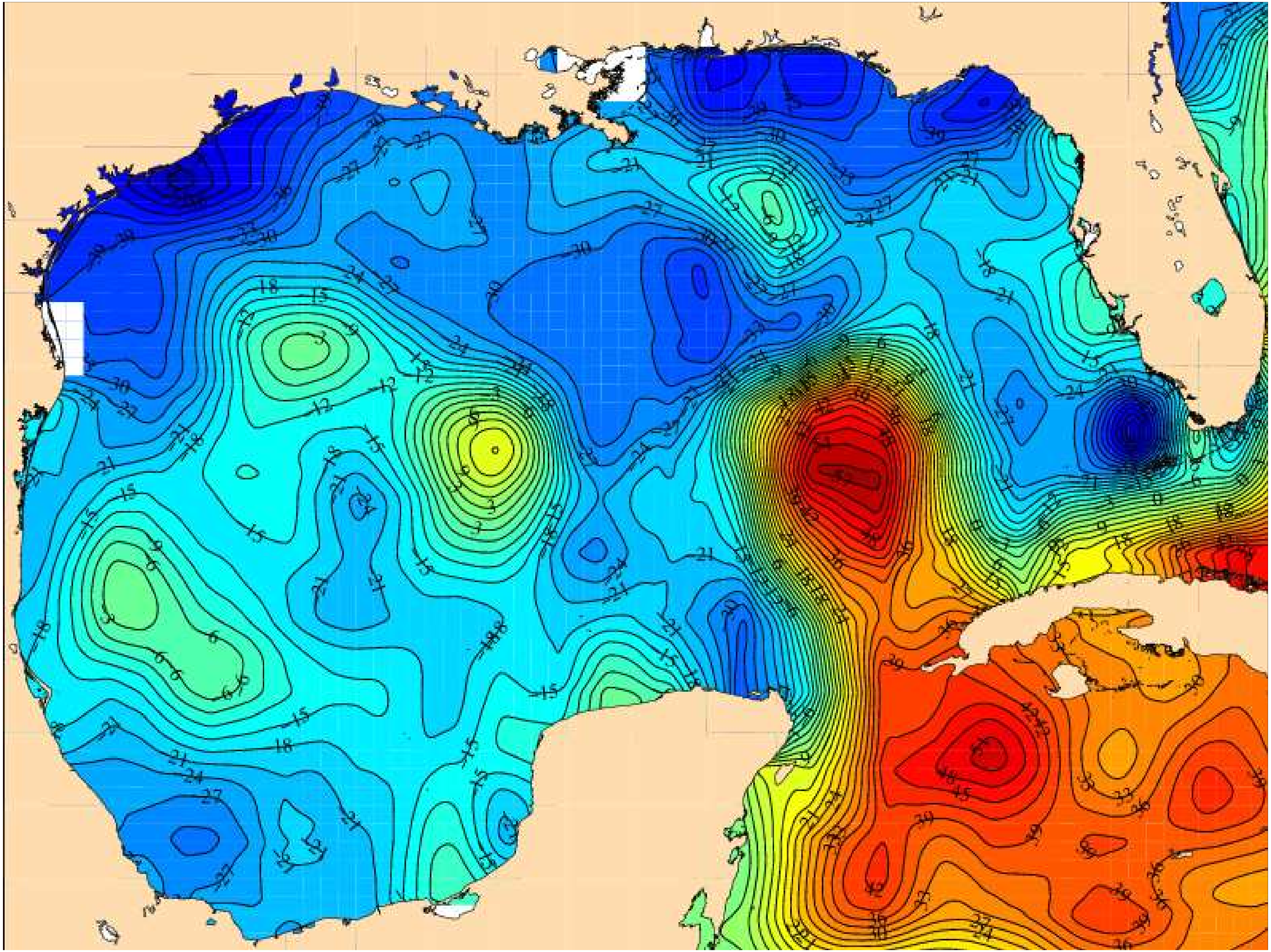


Future challenges

Making predictions is difficult – especially about the future

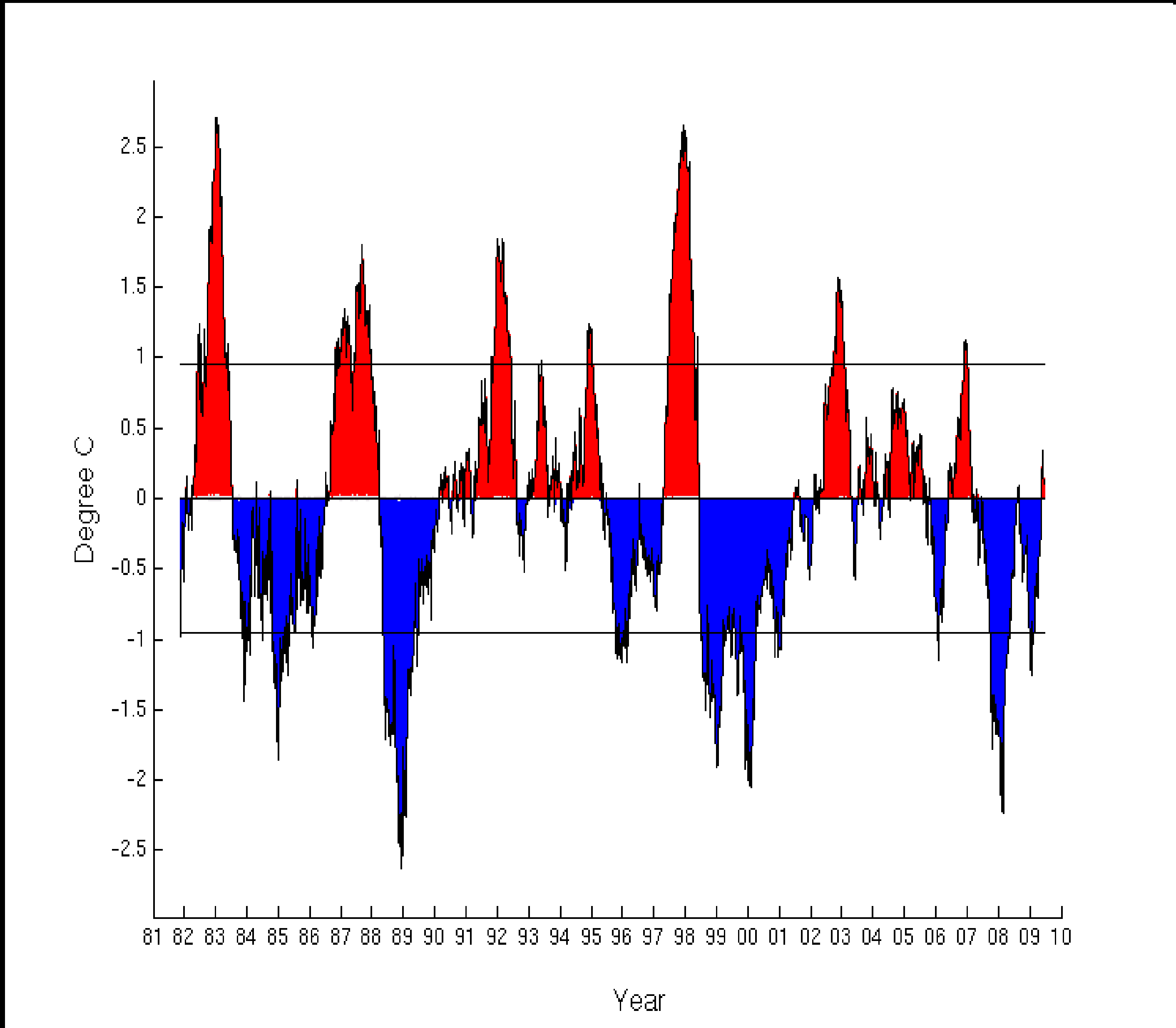
Nils Bohr


BUTTERFLY TIMES
OBITS
BERNIE
"He had a short but interesting life — for instance, did you know he was once responsible for a tornado in Texas......?"

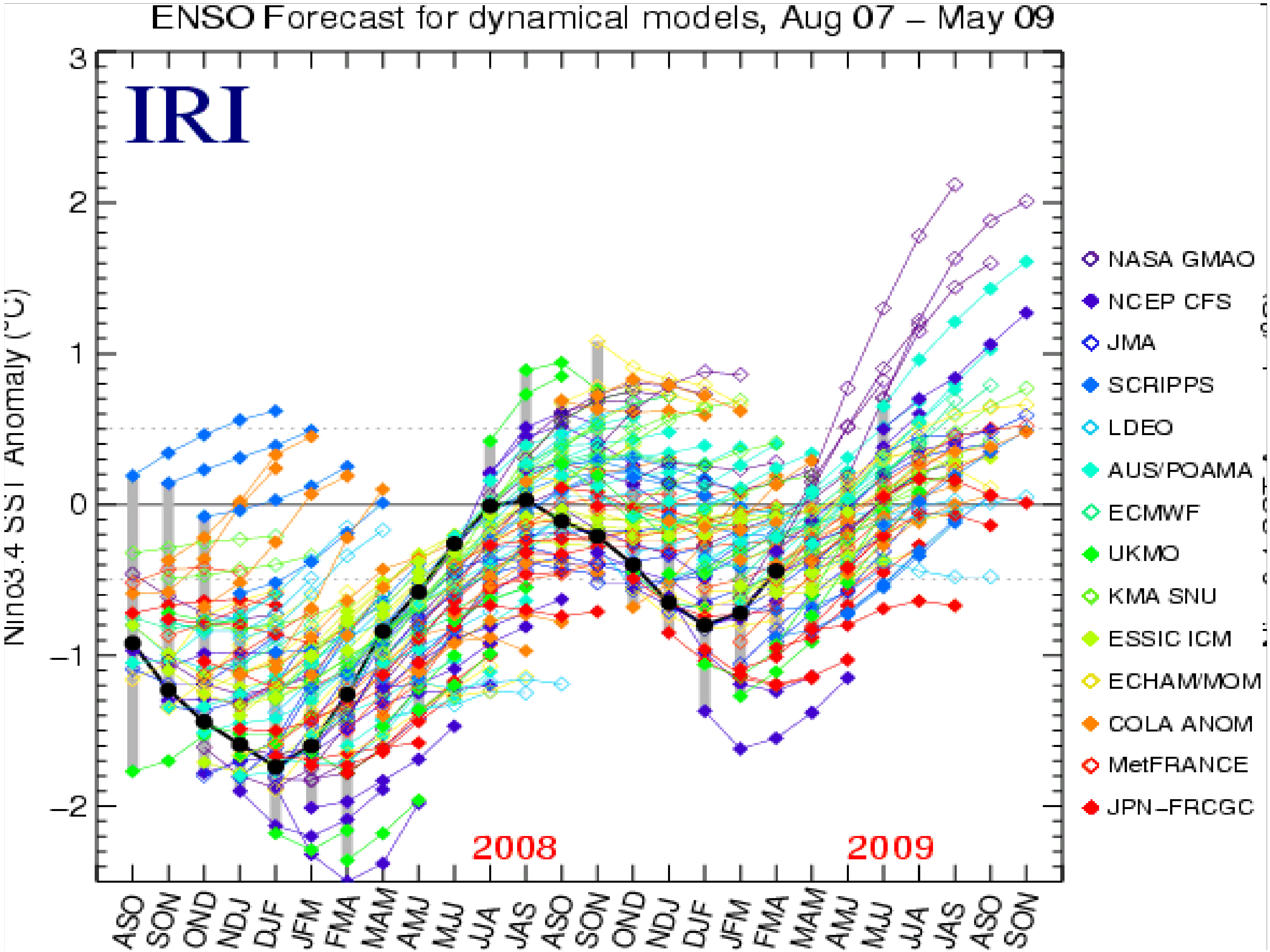



DOCKWISE
BLUE MARLIN

Nino SSTA



Degree C
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10
Year


ENSO Forecast for dynamical models, Aug 07 – May 09
IRI
Nino3.4 SST Anomaly (°C)
3
2
1
0
−1
−2
2008
2009
ASO
SON
OND
NDJ
DJF
JFM
FMA
MAM
AMJ
MJJ
JJA
JAS
ASO
SON
OND
NDJ
DJF
JFM
FMA
MAM
AMJ
MJJ
JJA
JAS
ASO
SON
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
JPN−FRCGC

Scientific Challenges