# Global Climate Observing System (GCOS)

## Essential Climate Variables and Systematic Observations

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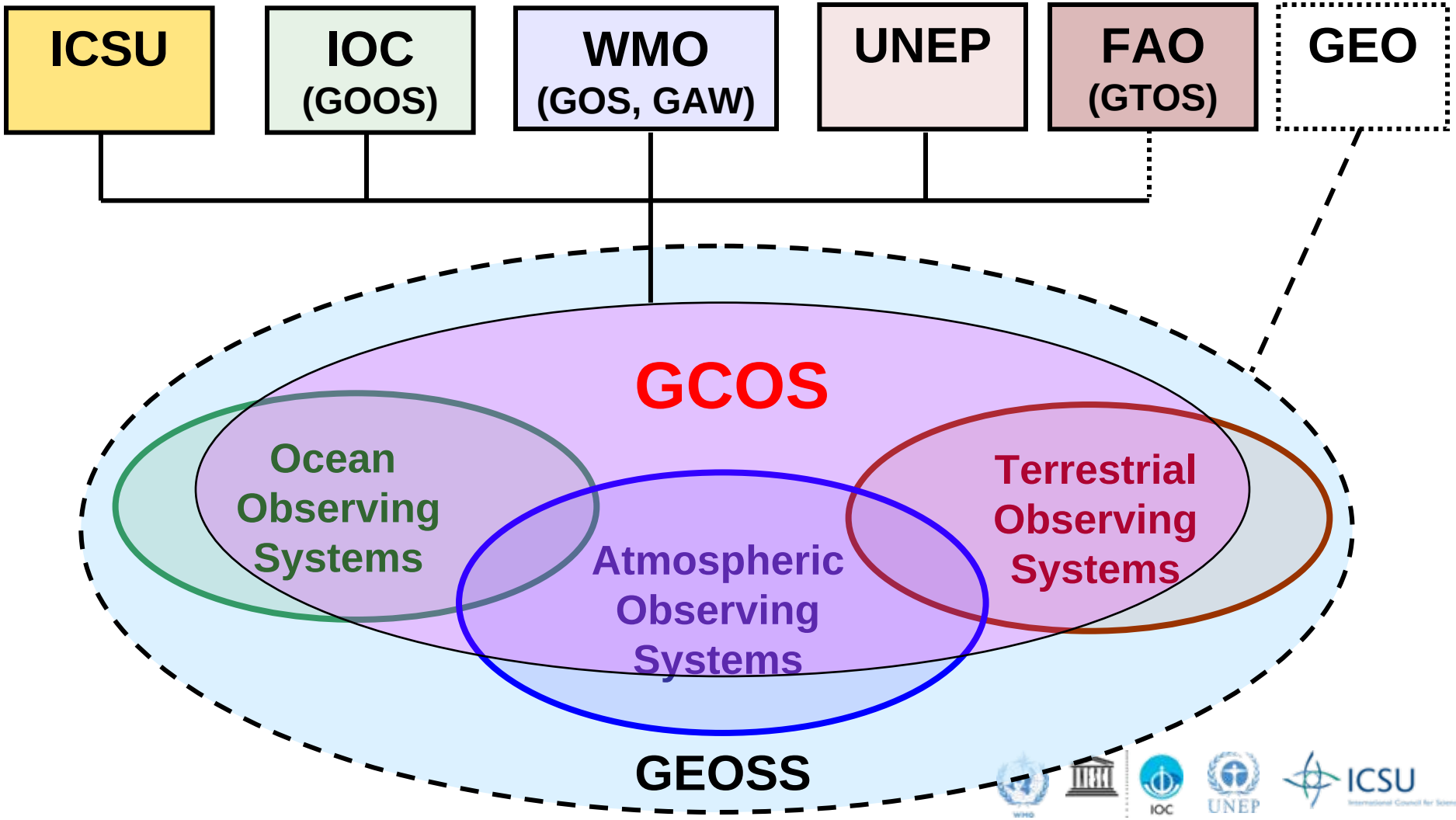
WMO IOC UNEP ICSU
International Council for Science

# The Mission of GCOS


- **Mission of GCOS** is to ensure the provision of continuous, reliable, comprehensive data and information on the state of the global climate system.
- GCOS consists of the **climate-relevant components of existing atmospheric, oceanic and terrestrial observing systems** (in-situ, space-based) to meet the totality of national and international user needs for climate observations.

# GCOS as a System of Climate Observing Systems



# Strategy of GCOS

- **Planning and advising on implementing Climate Observing Systems to “Climate” standards**
- **Based on advice from scientific panels and working with relevant technical bodies**
- **Engaging Intergovernmental International and National Bodies**
  - **UNFCCC / COP / SBSTA**
  - **Intergovernmental bodies of GCOS Sponsors (WMO, IOC, UNEP, ICSU)**
  - **GEOSS**
  - **CEOS**
- **Resource Mobilisation (“GCOS Cooperation Mechanism”)**
  - **Multi-governmental Voluntary Donor Fund**
  - **Mainly for developing countries**

# Climate information needs by society

- Basis: UN Framework Convention on Climate Change (1992):
  Article 2: "…achieve stabilization of GHG in atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system…"
  (re: food production, ecosystems, sustainable development)
- Kyoto protocol (1997; target: 2008-2012); Bali 2007; COP-15
- Information needs of the UNFCCC (Articles 4 & 5):
  - Understand the climate system and its variability
  - Find causes, explain, predict climate change
  - Downscale climate change information to regional and local scales
  - Characterize extreme events, for risk assessment
- GCOS de-facto reporting mechanism to UNFCCC on climate data and observations
- GCOS is an already existing framework for climate observations (« UN delivering as one »; GEOSS)

# Some GCOS Milestones

- GCOS 2nd Adequacy Report in Support of the UNFCCC (2003)
- GCOS Implementation Plan in Support of the UNFCCC (2004) : the 5-10 year roadmap for the global climate observing system (in situ, space-based, models, institutions, agents)
- September 2006: Publication of GCOS-107 “Systematic Observation Requirements for Satellite-based Products for Climate” (‘Satellite Supplement’ to GCOS IP)
- October/November 2006: Publication by Space Agencies (CEOS): “Satellite Observation of the Climate System”; as a response to space component of GCOS IP
- Adoption by UNFCCC (2007) of revised national systematic observation reporting guidelines – matching the GCOS IP
- 2009 Progress Report on GCOS IP, for SBSTA 30
- 2010 GCOS IP Update (open review)

# Essential Climate Variables (ECVs)

- **Considered as a minimum set of variables needed to describe the climate system**
- **Essential Climate Variables are Variables that are both currently feasible (practical and cost-effective) for global observation and have a high impact on UNFCCC requirements, climate research, and IPCC climate change assessments**
  - **Atmospheric: 15 surface, upper air, and composition ECVs***
  - **Oceanic: 19 surface and sub-surface ECVs***
  - **Terrestrial: 16 water and snow related, land cover, biomass ECVs***

*** ECVs updated in IP 10**

# Essential Climate Variables (ECVs)*

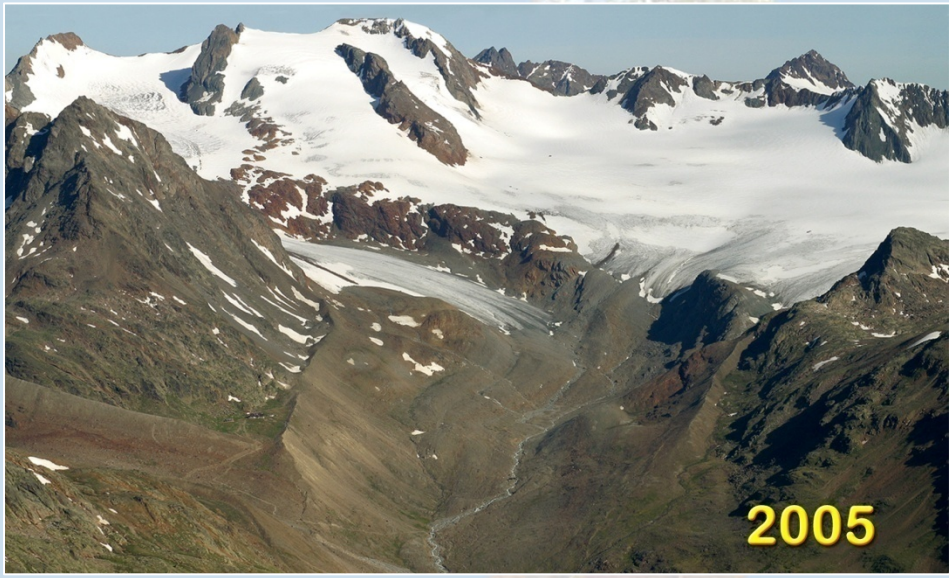

| Domain | Essential Climate Variables |
|---|---|
| **Atmospheric** (over land, sea and ice) | **Surface[1]:** Air temperature, Wind speed and direction, Water vapour, Pressure, Precipitation, Surface radiation budget.<br>**Upper-air:** Temperature, Wind speed and direction, Water vapour, Cloud properties, Earth radiation budget (including solar irradiance).<br>**Composition:** Carbon dioxide, Methane, and other long-lived greenhouse gases, Ozone and Aerosol, supported by their precursors[2] |
| **Oceanic** | **Surface[3]:** Sea-surface temperature, Sea-surface salinity, Sea level, Sea state, Sea ice, Surface current, Ocean colour (for biological activity), Carbon dioxide partial pressure, Ocean acidity,<br>**Sub-surface:** Temperature, Salinity, Current, Nutrients, Carbon dioxide partial pressure, Ocean acidity, Oxygen, Tracers, Phytoplankton; Marine biodiversity and habitat properties[4] |
| **Terrestrial** | River discharge, Water use, Ground water, Lakes, Snow cover, Glaciers and ice caps, Ice sheets, Permafrost, Albedo, Land cover (including vegetation type), Fraction of absorbed photosynthetically active radiation (fAPAR), Leaf area index (LAI), Above-ground biomass, Soil carbon, Fire disturbance, Soil moisture, Terrestrial biodiversity and habitat properties[4] |

[1] Including measurements at standardized, but globally varying heights in close proximity to the surface
[2] $NO_2$, $SO_2$, HCHO and CO in particular
[3] Including measurements within the surface mixed layer, usually within the upper 15m
[4] At selected sites and areas (e.g., coral reefs; boreal and tropical forest areas)

*** updated ECVs in Draft IP 10**

# Observation Systems: Land

- Global Terrestrial Network for Glaciers (GTN-G)

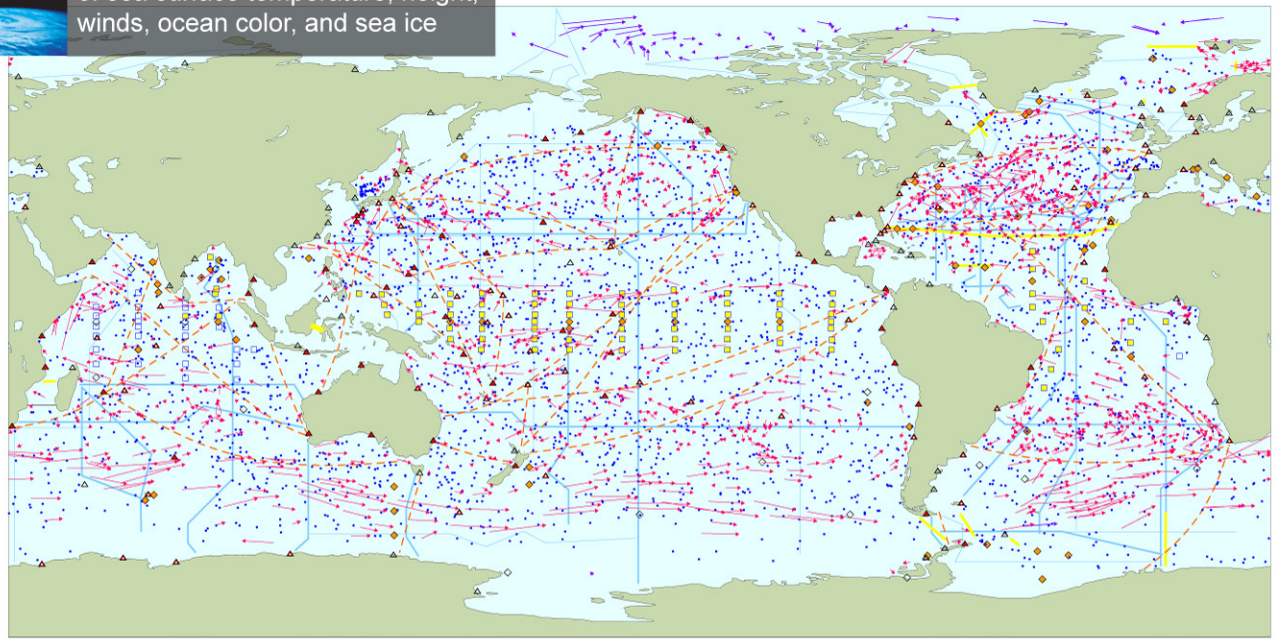

- Vernagtferner glacier (Eastern European Alps) is one of the glaciers monitored in the GTN-G (Weber, 2006)

# Observation Systems: Oceans

## GOOS – Global Ocean Observing System

continuous satellite measurements of sea surface temperature, height, winds, ocean color, and sea ice

Total *in situ networks* **61%** May 2009



87% **Surface measurements** from volunteer ships (VOS)

250 ships in VOSclim pilot project

100% Global **drifting surface buoy** array

ice buoys

5° resolution array: 1250 floats

66% **Tide gauge** network (GCOS subset of GLOSS core network)

fast data, slow/no data, GPS

170 real-time reporting gauges

81% **XBT** sub-surface temperature section network

51 lines occupied

100% Argo **profiling float** network

3° resolution array: 3000 floats

**Transport monitoring** 24%

29 sites

54% Global **time series** network

58 moorings planned

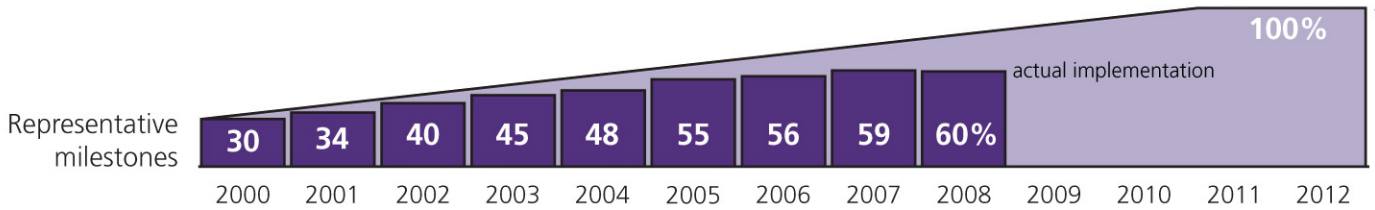
79% Global tropical **moored buoy** network

119 moorings planned

59% Repeat **hydrography** and **carbon inventory**

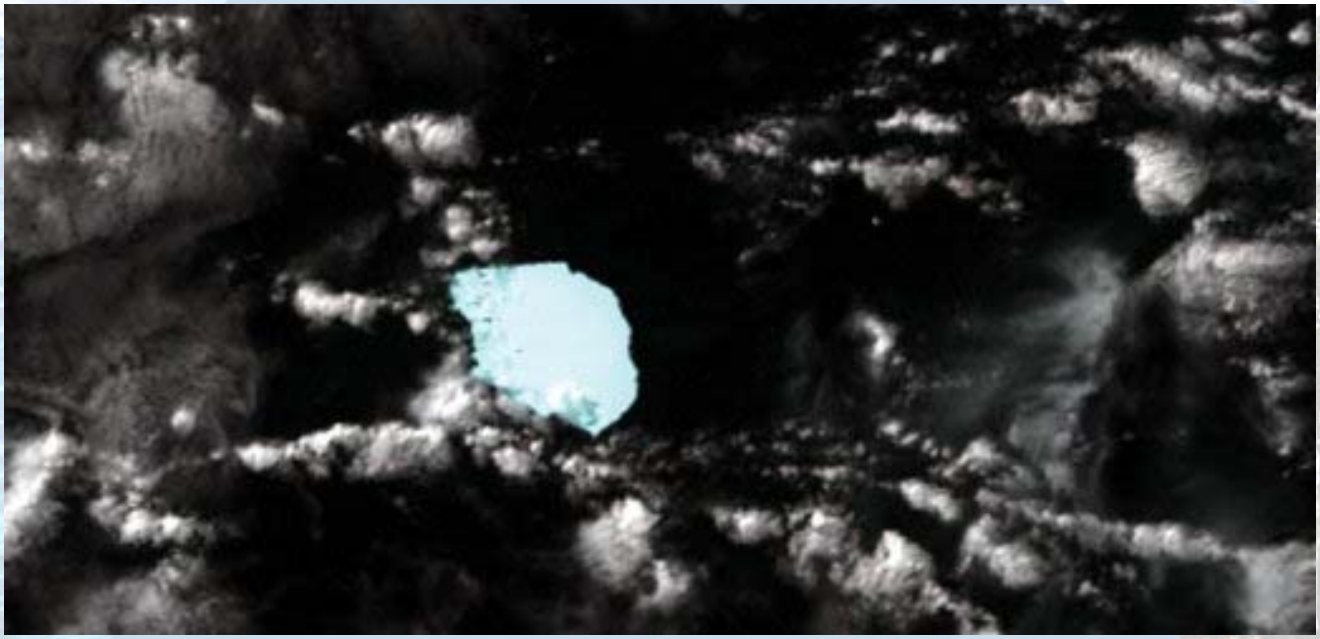
(planned)

Full ocean survey in 10 years




**System % of initial goals**

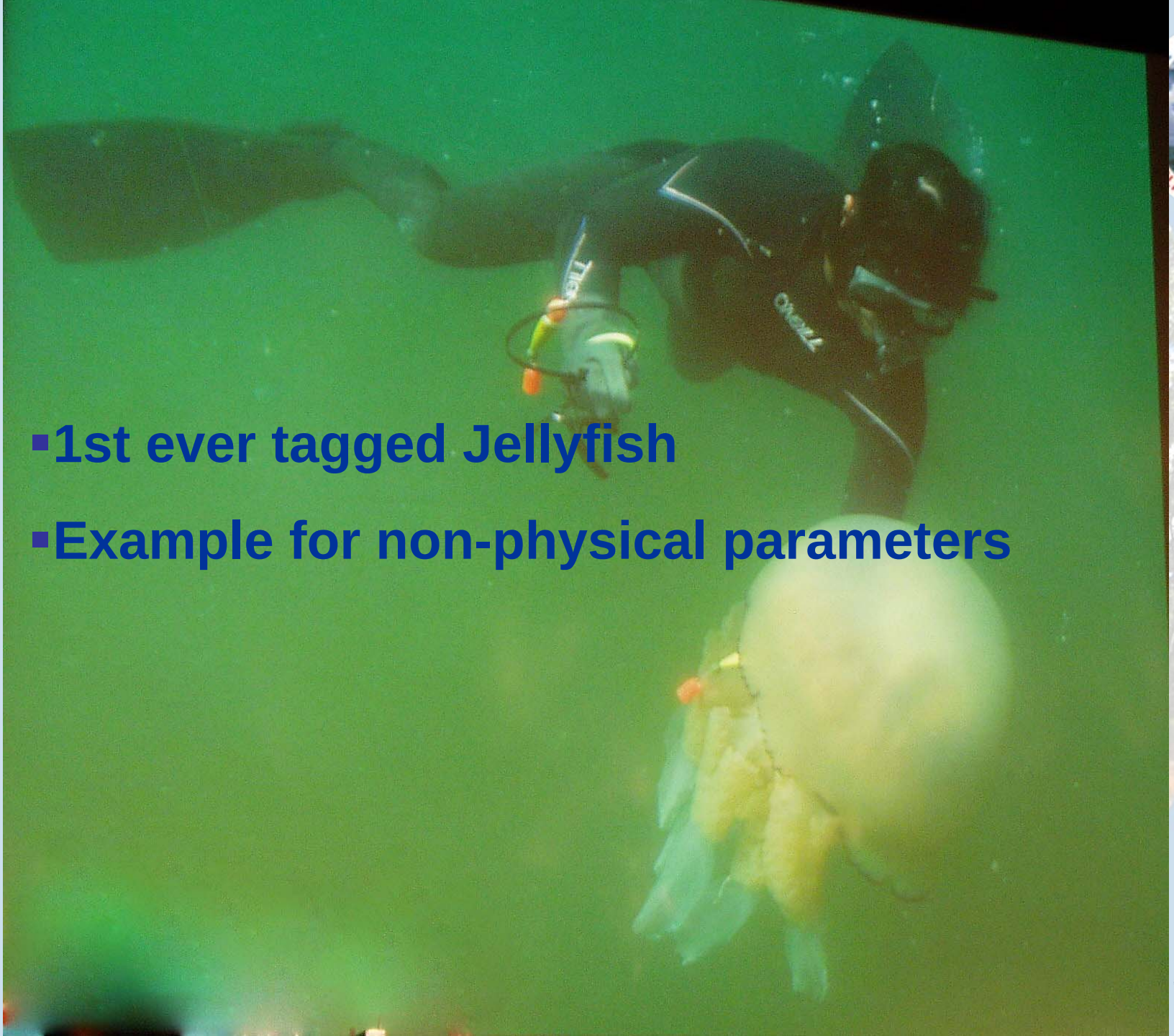
# Observation – Extreme Event



**Iceberg B17B (19 x 8 km), discovered 9 Dec 2009**

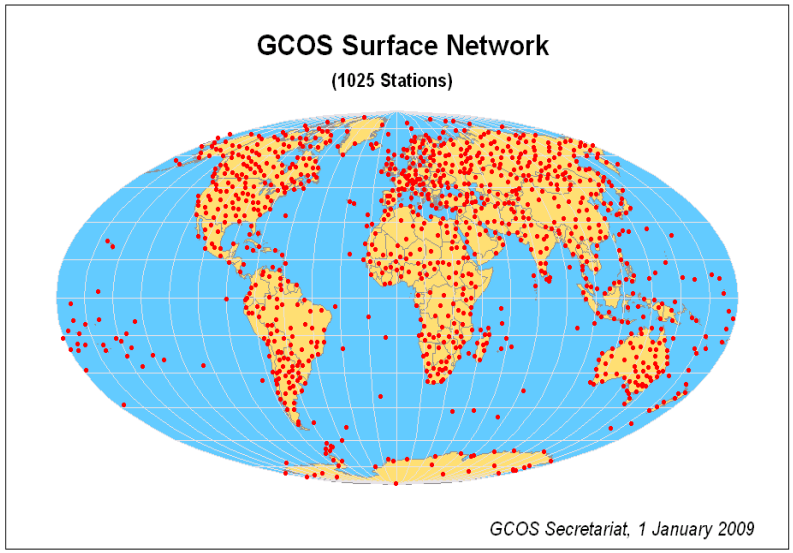
**Australian Antarctic Division, ESA / NASA**

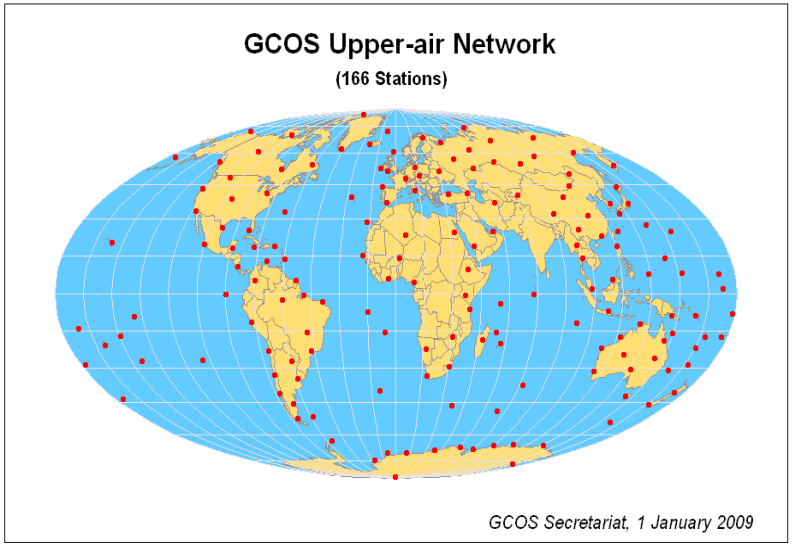
**Position 48,8 S, 107,5 E**



- 1st ever tagged Jellyfish
- Example for non-physical parameters

# Observation Systems: Atmosphere – WMO GOS, GAW

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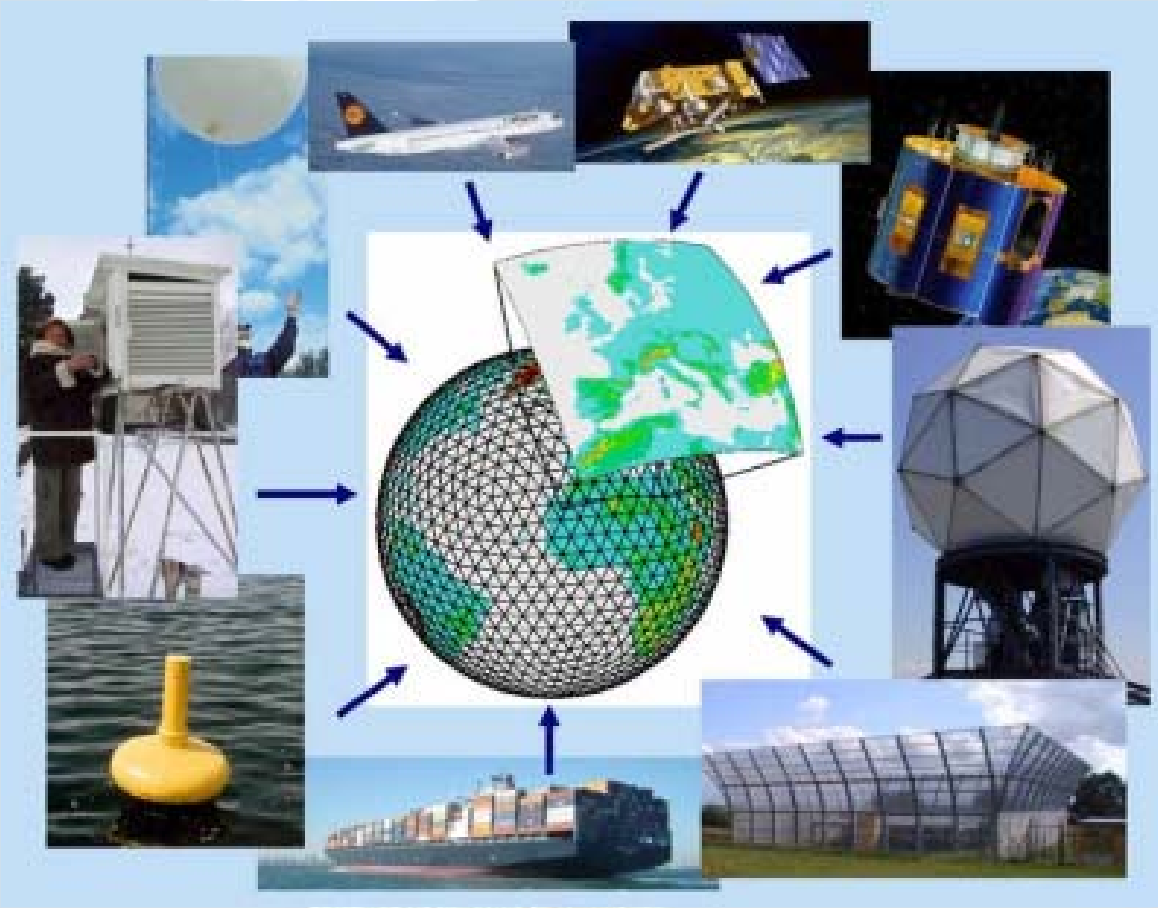
# Observations used in Forecast models



**Observational data is used to determine Initial Conditions.**

**Attention is given to:**

- **Time / Spatial scales**
- **Gaps**

**Predictions/Forecasts→ Tools for Decision maker**

# GCOS Climate Monitoring Principles and Data Exchange

## GCOS Climate Monitoring Principles (GCMPs) (10+10)

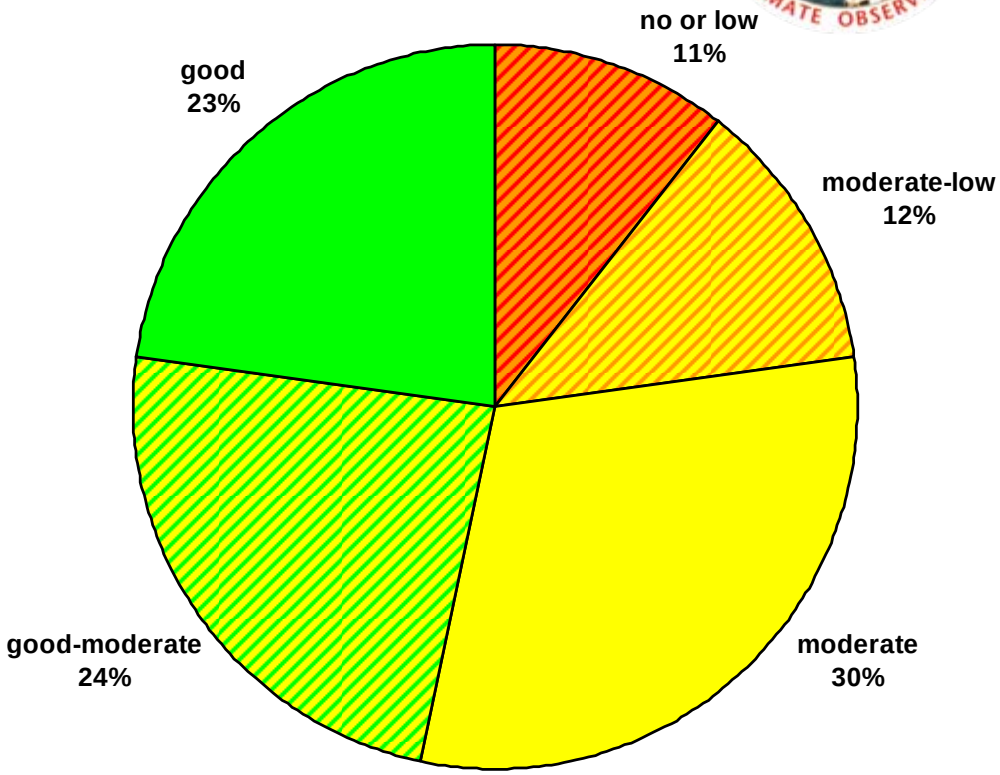
- Endorsed in their basic form by the UNFCCC in 1999
- Completed by satellite specific monitoring principles in 2003
- Provide overall guidance for the design and implementation of GCOS observing systems

## Data Exchange

- Aim to ensure the free and unrestricted availability of data from all observing networks (WMO Resolutions 25 and 40)
- Unrestricted exchange of all GCOS data as a global public good

# GCOS Progress Report on 2004 Implementation Plan: Some Key Findings

- **Developing Countries have only made limited (in-situ) progress, with decline in some regions, and capacity building support remains small in relation to needs**
- **Operational and Research Networks show increasing regard to climate needs; long-term continuity still a challenge**
- **Satellite agencies have improved both mission continuity and capability and are increasingly meeting climate needs**
- **GCOS has progressed, but still falls short of meeting all UNFCCC needs**




Summary of progress on all 131 Actions in GCOS IP

# What next?
# 2010 Update of the GCOS Implementation Plan

- Basis:
  - Existing Implementation Plan and Satellite Supplement
  - Update, not rewrite

- Recognizing progress and changes in:
  - Science (e.g., IPCC AR4, Sydney workshop “Learning from the AR4”)
  - Technology (e.g., satellite sensors, ocean in-situ platforms)
  - Needs (e.g., stronger focus on adaptation and mitigation options)
  - International coordination (e.g., GEO/GEOSS, UN System “Delivering as One” on Climate Change)

- Noting:
  - Views expressed in National Reports on GCOS
  - Views by space agencies
  - Expert advice (3 task team meetings in 2009)

# 2010 Update of the GCOS Implementation Plan

- Request for Updated IP by UNFCCC SBSTA 30 includes:
  - Request for cost estimations to implement GCOS, broken down by region, observing system, and between developing and developed countries
  - Draft by 2 November 2009, for consideration at COP 15
  - Open review November 2009 – January 2010 at http://gcos.wmo.int
  - Final by April 2010

- Current draft Updated IP includes:
  - Some new ECVs (Ocean oxygen, Soil Moisture, Soil Carbon), additions (Precursors to Aerosols, O3) and some refined ECVs terms
  - Actions, with Agents, Timelines, Performance Indicators, Costings (extra costs to meet climate needs)
  - More emphasis on Earth system cycles
  - More emphasis on regional and local networks
  - More emphasis on reanalysis, reprocessing and research

# Thank you

For more information about the GCOS programme
please visit our website

**http://gcos.wmo.int**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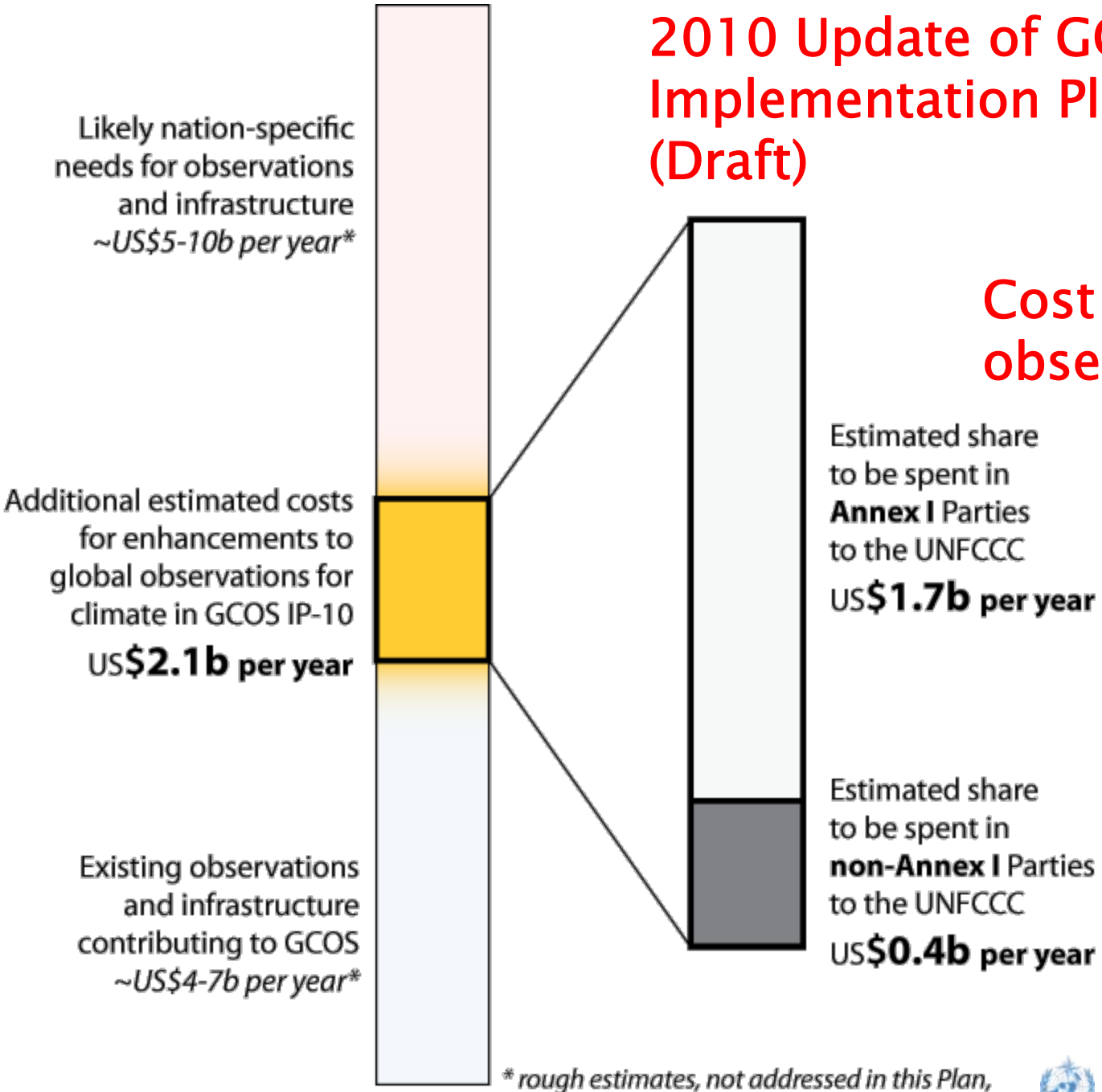
# 2010 Update of GCOS Implementation Plan (Draft)

## Cost estimations for observing systems




* rough estimates, not addressed in this Plan, not necessarily secured