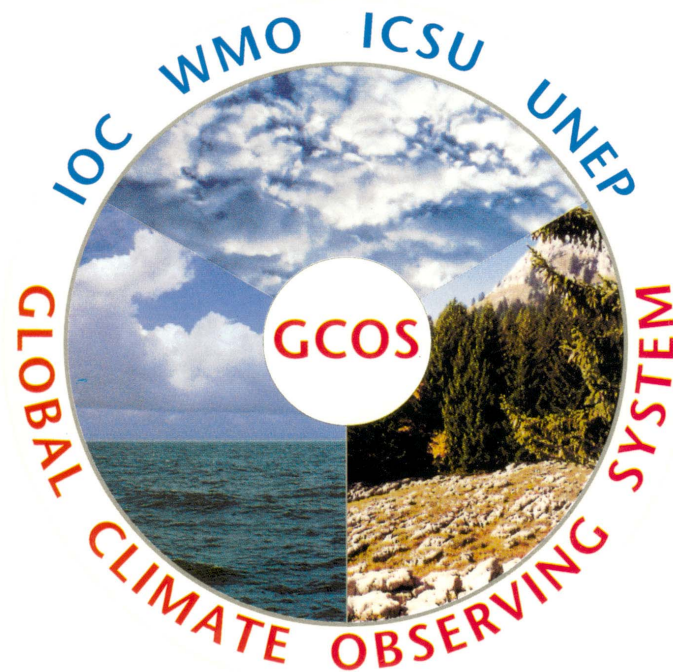


# Global Climate Observing System

## Improving Climate Observations in Support of the UNFCCC

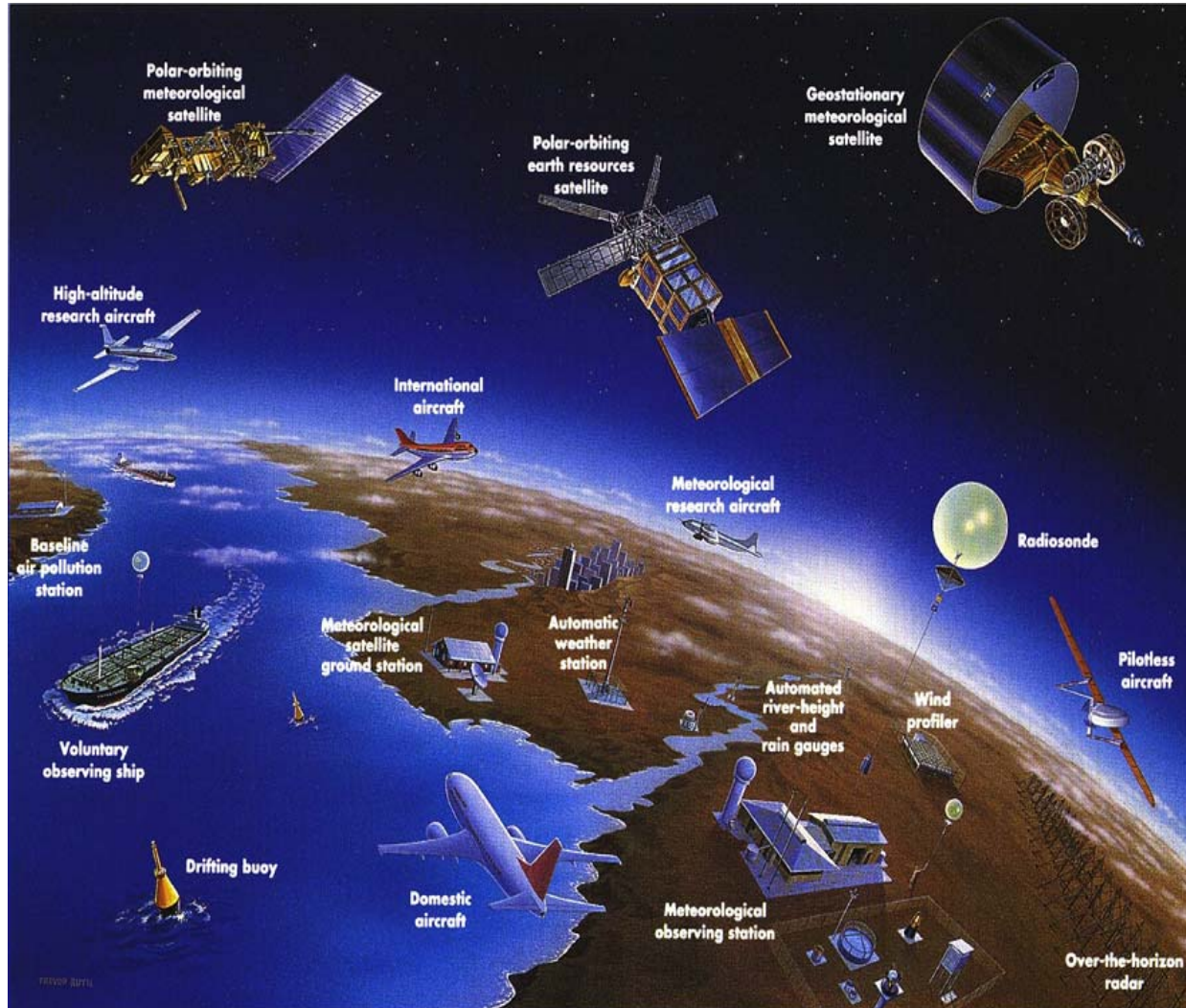
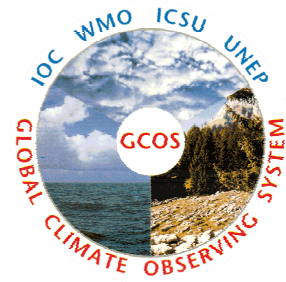


Carolyn Richter, Director GCOS Secretariat  
COP 15, Copenhagen, Denmark

December 2009



# The Mission of GCOS



- The mission of **GCOS** is to provide 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 to meet the totality of national and international user needs for climate observations.

# GLOBAL CLIMATE OBSERVING SYSTEM



## GCOS

THE ESSENTIAL FOUNDATION FOR MEETING THE NEEDS OF THE UN FRAMEWORK CONVENTION ON CLIMATE CHANGE

Sustained, High-Quality Climate Observations are the key to:

- Monitor the climate system
- Climate research and prediction
- Effective mitigation and adaptation policies
- Sustainable development



# GLOBAL OCEAN OBSERVING SYSTEM



GLOBAL MONITORING AND ASSESSMENT OF THE MARINE AND COASTAL ENVIRONMENTS, INCLUDING THEIR ROLE IN CLIMATE CHANGE

Today's Observations Record the Ocean's Ability to Absorb Carbon and Heat.



- 30% Anthropogenic Carbon Has Been Absorbed by the Oceans.
- 90% Greenhouse Warming Has Been Absorbed by the Oceans.
- Rates of carbon and heat absorption are highly variable.
- Observations are the only way to know if the oceans will continue to buffer the rate of Climate Change.



# GLOBAL TERRESTRIAL OBSERVING SYSTEM



INTEGRATING SPACE AND GROUND OBSERVATIONS TO ASSESS GLOBAL CHANGE IMPACTS ON TERRESTRIAL ECOSYSTEM SERVICES

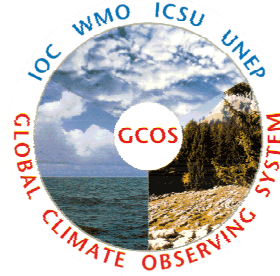
Improving the quality and coverage of data for understanding the terrestrial component of the climate system and supporting adaptation and mitigation policies.

Key issues of GTOS are:

- Climate change
- Terrestrial carbon stocks and fluxes
- Land degradation
- Loss of biodiversity



# Essential Climate Information Needs



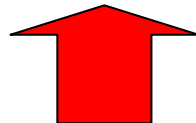
- Decisions for:**
- *Agriculture*
  - *Disaster risk reduction*
  - *Drought management*
  - *Ecosystems*
  - *Energy*
  - *Health*
  - *Water*



**INFORMATION  
& SERVICES**



**MONITORING,  
RESEARCH &  
PREDICTION**



**OBSERVATIONS**

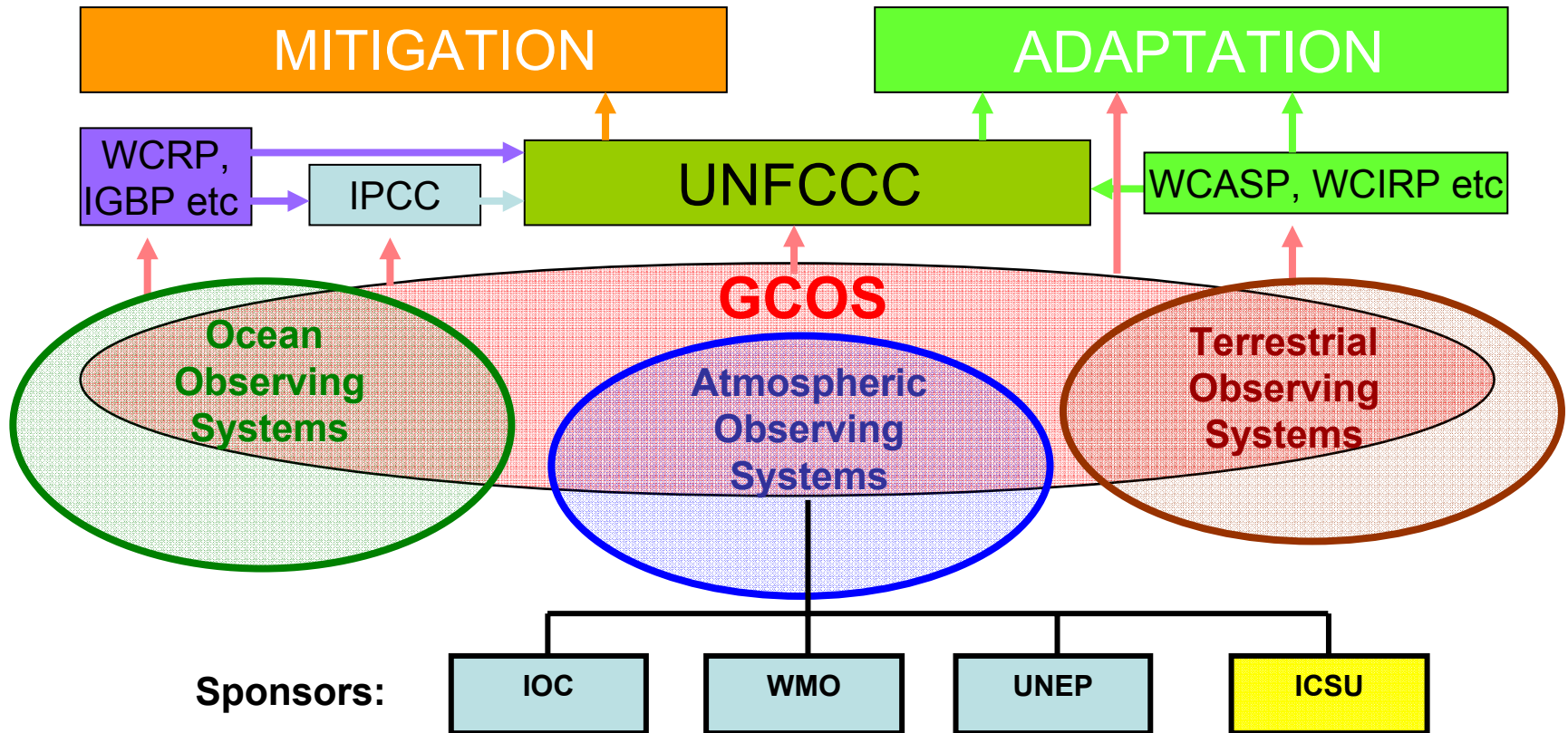
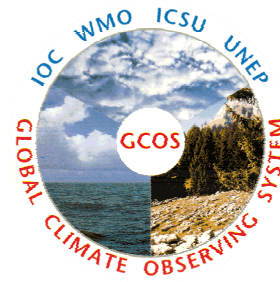
**Observations to meet the needs of  
the UNFCCC, IPCC**

**Observations for national  
economic development**

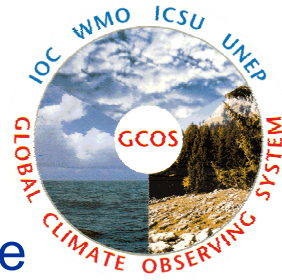
**Observations for assessment of  
impacts, vulnerability, adaptation**

**Observations for modelling,  
detection, attribution, prediction**

# GCOS Contributing to the UNFCCC



# Essential Climate Variables (ECVs)

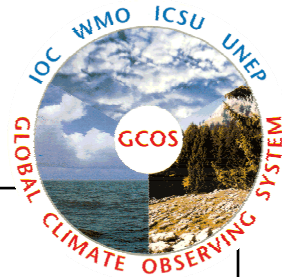


- Considered as a minimum set of variables needed to describe the climate system
- Essential Climate Variables are Variables that are both currently feasible (practical and cost-effective) for global observation and have a high impact on UNFCCC requirements, climate research, and IPCC climate change 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



# 50 Essential Climate Variables (ECVs)\*



Domain	Essential Climate Variables
<b>Atmospheric</b> (over land, sea and ice)	<p><b>Surface<sup>[1]</sup>:</b> Air temperature, Wind speed and direction, Water vapour, Pressure, Precipitation, Surface radiation budget.</p> <p><b>Upper-air:</b> Temperature, Wind speed and direction, Water vapour, Cloud properties, Earth radiation budget (including solar irradiance).</p> <p><b>Composition:</b> Carbon dioxide, Methane, and other long-lived greenhouse gases. Ozone and Aerosol, supported by their precursors<sup>[2]</sup></p>
<b>Oceanic</b>	<p><b>Surface<sup>[3]</sup>:</b> 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,</p> <p><b>Sub-surface:</b> Temperature, Salinity, Current, Nutrients, Carbon dioxide partial pressure, Ocean acidity, Oxygen, Tracers, Phytoplankton; Marine biodiversity and habitat properties<sup>[4]</sup></p>
<b>Terrestrial</b>	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 <sup>9</sup>

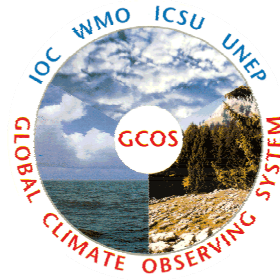
<sup>[1]</sup> Including measurements at standardized, but globally varying heights in close proximity to the surface

<sup>[2]</sup> NO<sub>2</sub>, SO<sub>2</sub>, HCHO and CO in particular

<sup>[3]</sup> Including measurements within the surface mixed layer, usually within the upper 15m

<sup>[4]</sup> At selected sites and areas (e.g., coral reefs; boreal and tropical forest areas)

# GCOS Climate Monitoring Principles



Effective monitoring systems for climate should adhere to GCOS Climate Monitoring Principles

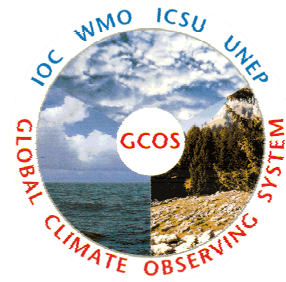
The ten basic principles (in paraphrased form) were adopted by the COP-5 in November 1999 (decision 5/CP.5).

The complete set of 20 principles, comprising ten basic principles and ten for operators of satellite systems, was adopted by the Congress of the World Meteorological Organization (Resolution 9, Cg-XIV) in May 2003; agreed by the Committee on Earth Observation Satellites (CEOS) at its 17th Plenary in November 2003; and adopted by COP-9 in December 2003 (decision 11/CP.9).





# Observation Systems: Land

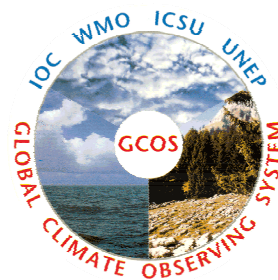


## Global Terrestrial Network for Glaciers (GTN-G)



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



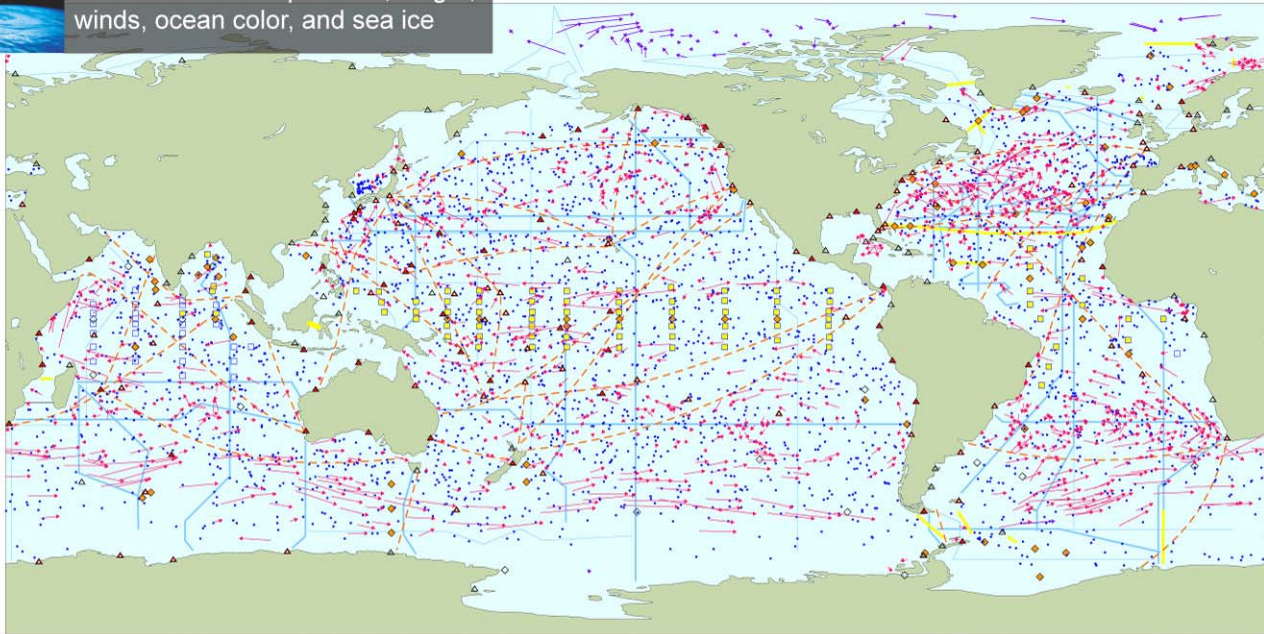


# Observation Systems: Oceans

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  
 5° resolution array: 1250 floats  
 ice buoys



**66%** Tide gauge network (GCOS subset of GLOSS core network)  
 170 real-time reporting gauges  
 fast data slow data GPS



**81%** XBT sub-surface temperature section network  
 51 lines occupied



**100%** Argo profiling float network  
 3° resolution array: 3000 floats



**59%** Repeat hydrography and carbon inventory  
 (planned)  
 Full ocean survey in 10 years

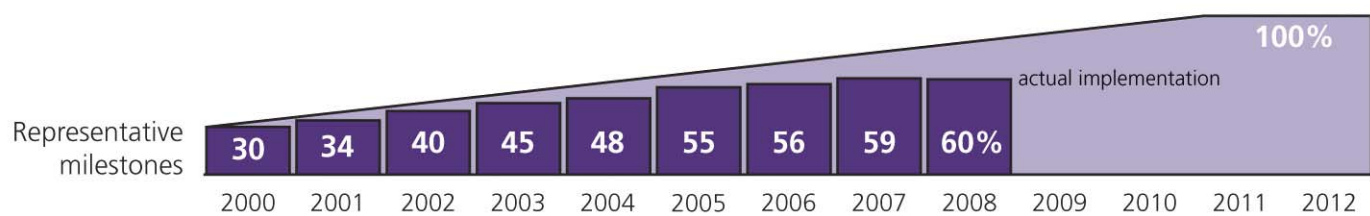
**24%** Transport monitoring  
 29 sites



**54%** Global time series network  
 58 moorings planned



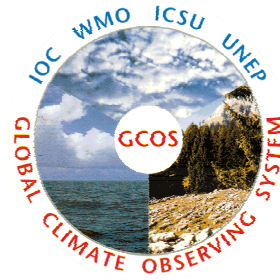
**79%** Global tropical moored buoy network  
 119 moorings planned



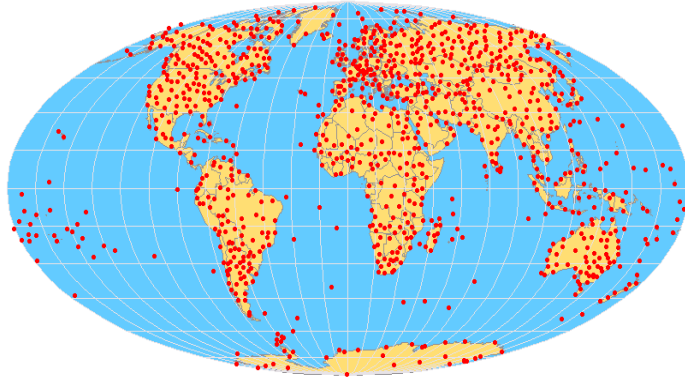
original goal for full implementation by 2010

**System % of initial goals**

# Observation Systems: Atmosphere

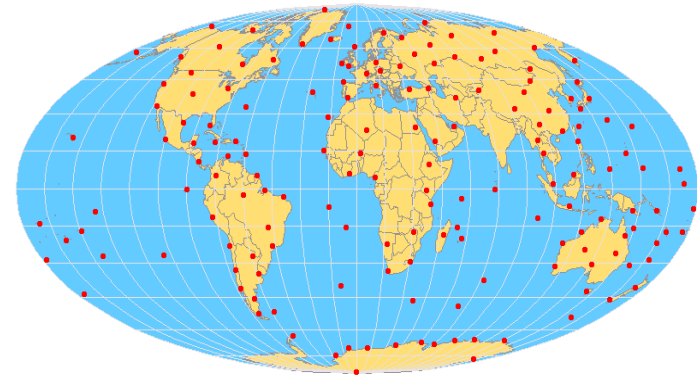


**GCOS Surface Network**  
(1025 Stations)

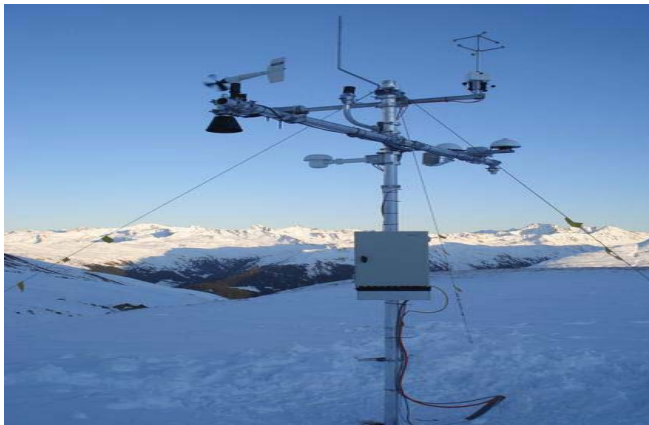


GCOS Secretariat, 1 January 2009

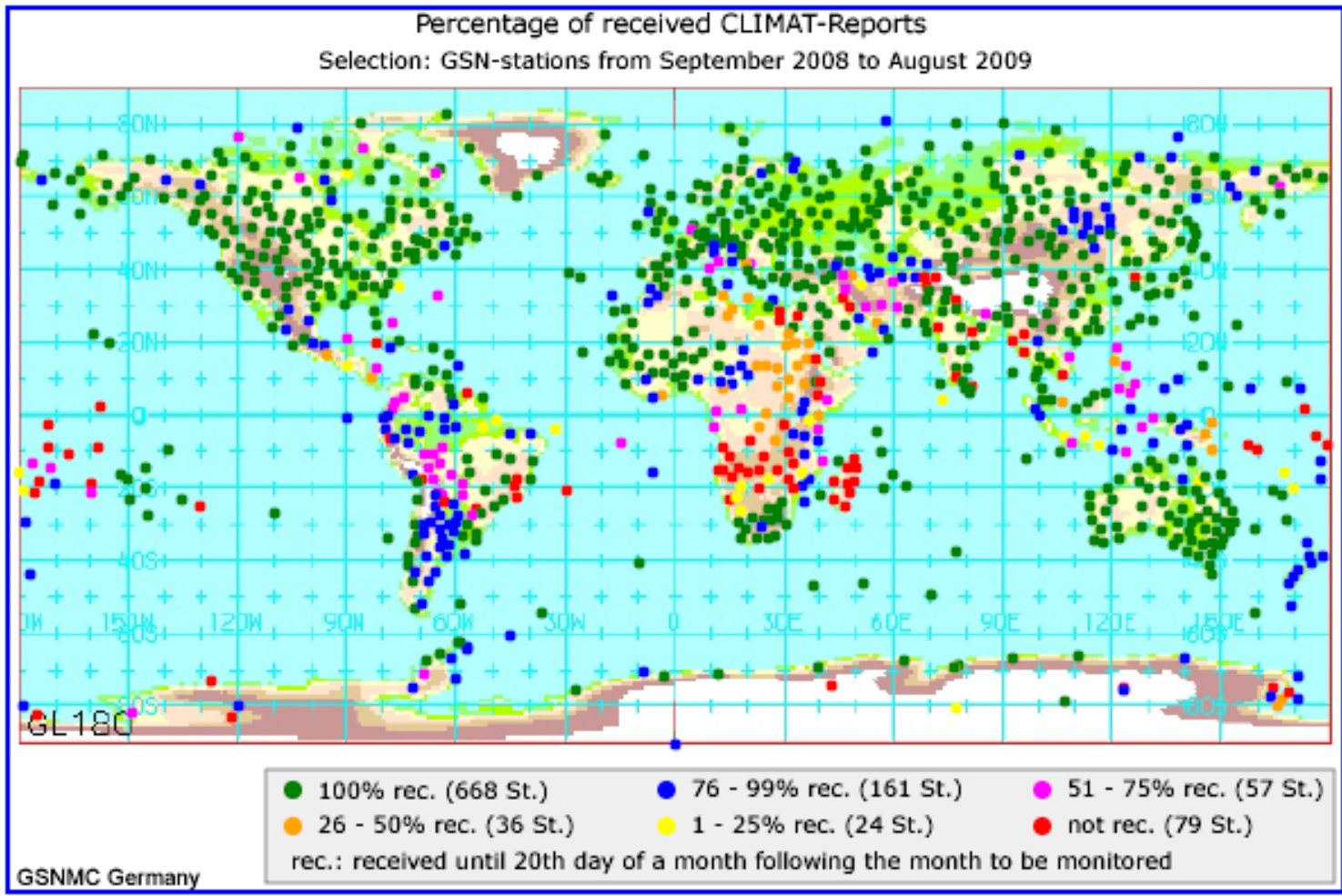
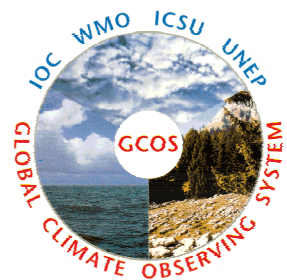
**GCOS Upper-air Network**  
(166 Stations)

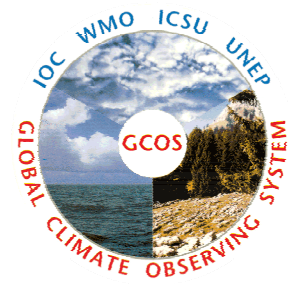


GCOS Secretariat, 1 January 2009

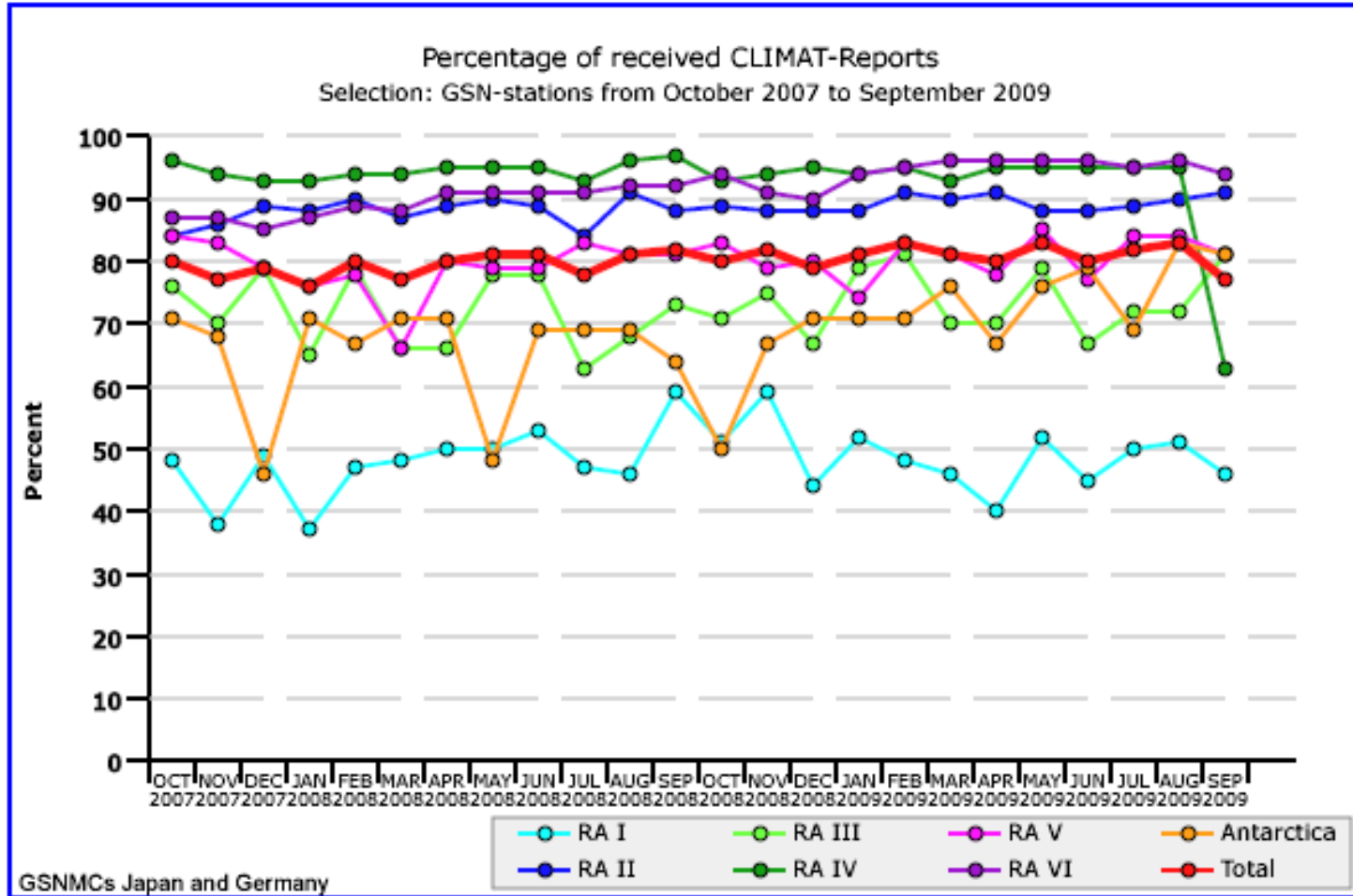


"There is a notable lack of geographical balance in the data and literature on observed changes in natural and managed systems, with a marked scarcity from developing countries."  
 IPCC, 2007



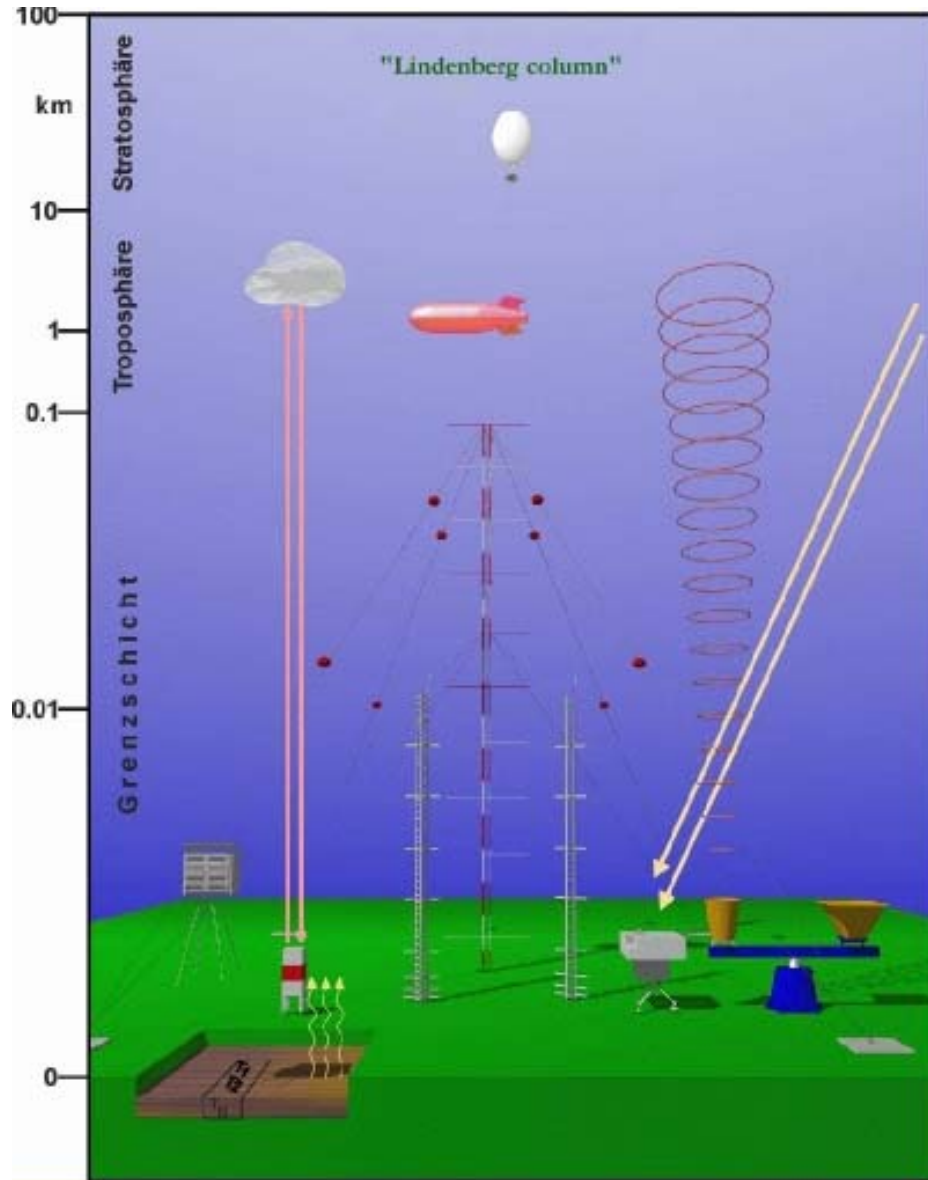
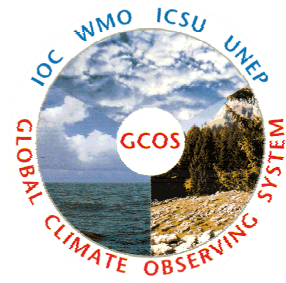


"There is a notable lack of geographical balance in the data and literature on observed changes in natural and managed systems, with a marked scarcity from developing countries."  
 IPCC, 2007



ICSU  
 International Council for Science

# Observing Systems – a Supersite

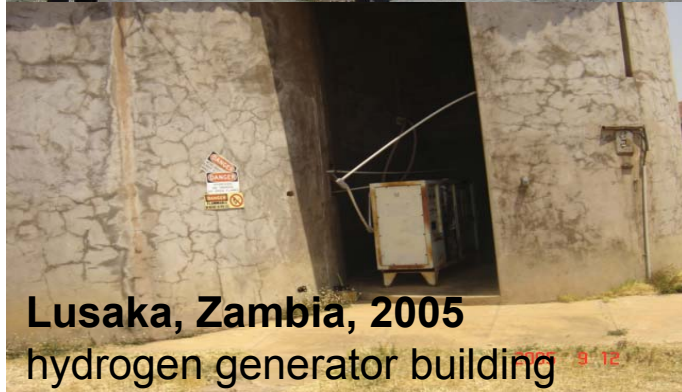
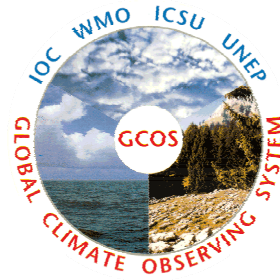


Example of a Supersite:  
The Richard-Aßmann  
Observatory of the German  
Weather Service, DWD, is  
observing the atmospheric  
column by a range of different  
insitu and remote sensing  
instruments.



ICSU  
International Council for Science

# Observing Systems – the Reality



Observations  
not made  
today will  
never be  
available to  
help inform  
us about  
future  
changes.

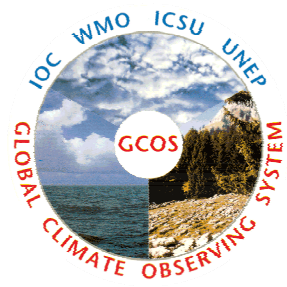
# GCOS Cooperation Mechanism

- GCM is a multi-governmental funding mechanism established in 2003 to identify and make effective use of resources available for improving global observing systems for climate in developing countries... *“to enable them to collect, exchange, and utilize data on a continuing basis in pursuance of the UNFCCC”*
- Recent Contributors: Mainly US, UK, Germany, Spain, Netherlands, Canada, and Switzerland, but the Governing Board is seeking additional donor countries, private organizations, and other NGOs to help
- Recent focus has been on atmospheric domain but many system improvement needs exist for oceans and land
- An important need for full-time project implementation managers





# Observing Systems Improvement



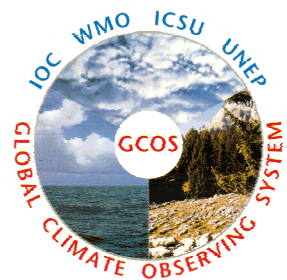
before

after



Mt. Aragats, Armenia, 2008

# Observing Systems Improvement



before

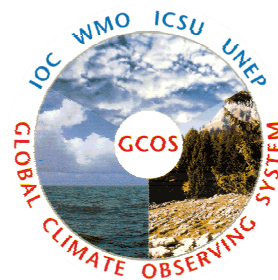


after



Rain Gauge Measurements,  
Luanda, Angola, 2005

# Observing Systems Improvement - much remains to be done

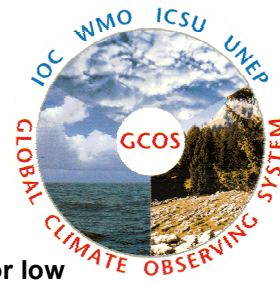


Climate Observation Training  
Work-shop on the Maldives, 2004

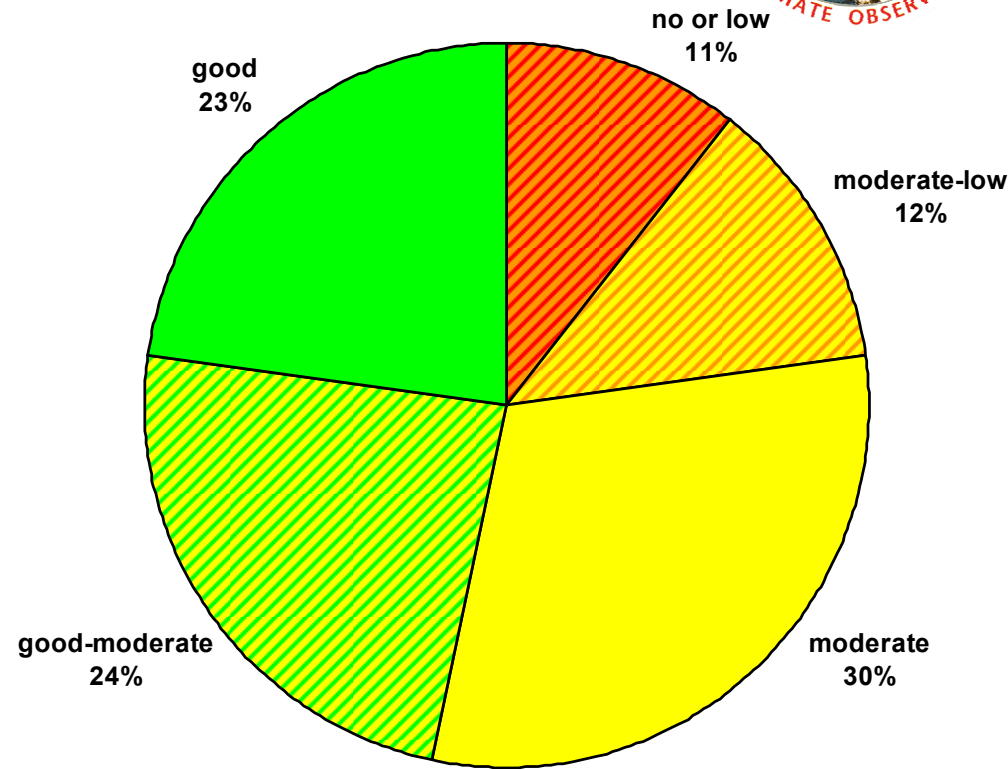
Climate Data Archive waiting for rescue  
and digitization in Tanzania, 2004



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



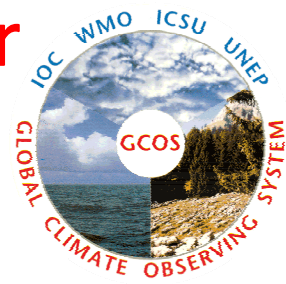
- **Developing Countries** have only made limited (in-situ) progress, with decline in some regions, and capacity building support remains small in relation to needs
- **Operational and Research Networks** show increasing regard to climate needs; long-term continuity still a challenge
- **Satellite agencies** 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



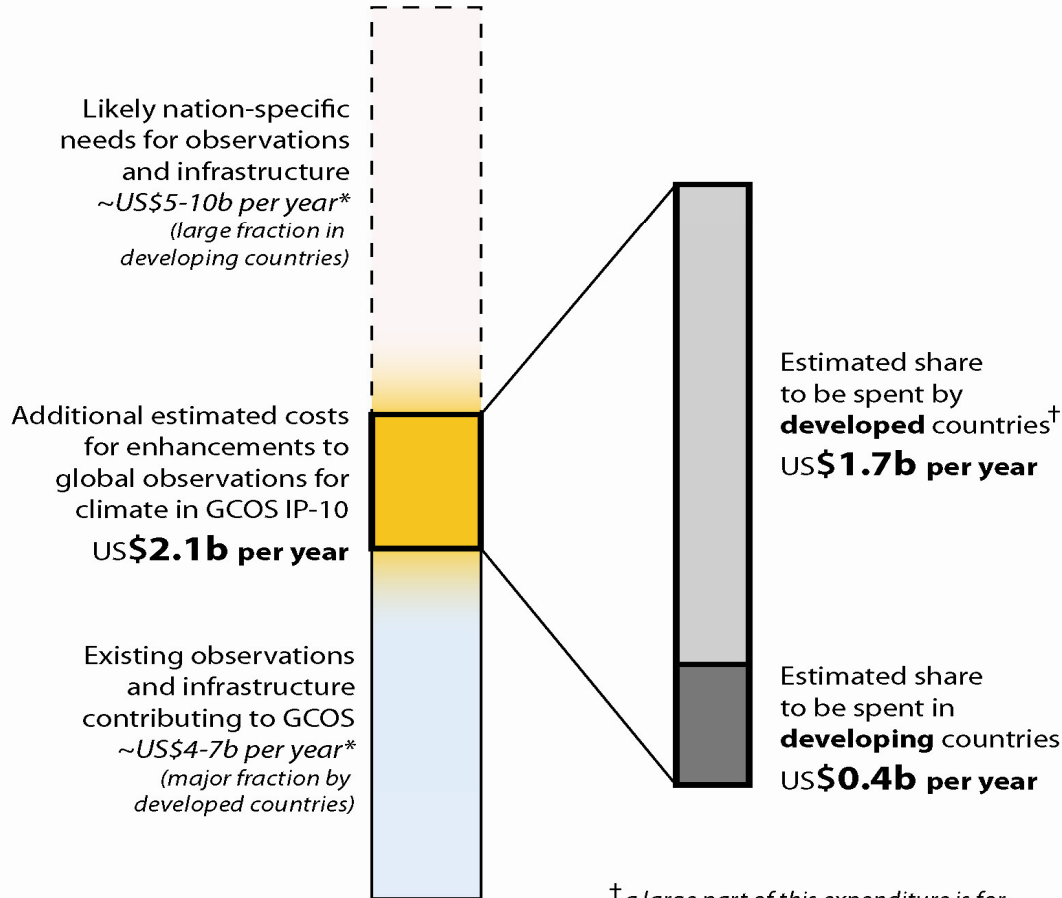
# 2010 Update of the Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC



- **Purpose:** To provide an updated set of actions required to implement and maintain a comprehensive global observing system for climate that will address the needs of the UNFCCC for climate observations to fulfill the objectives of the Convention
- **Implementation of Actions in Plan in 2010-2015 would be a major contribution to:**
  - Global observations addressing Essential Climate Variables
  - Analysis, research, infrastructure and capacity building, in support of the monitoring, adaptation, and mitigation needs of the UNFCCC



# 2010 Update of the GCOS Implementation Plan in Support of the UNFCCC

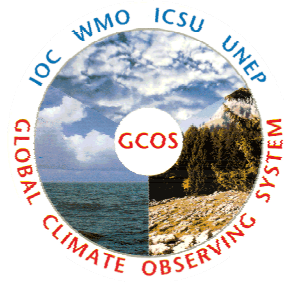


\* rough estimates, not addressed in this Plan, not necessarily secured

<sup>†</sup> a large part of this expenditure is for networks and systems in extra-territorial areas (e.g., satellite, open-ocean, polar observing systems) for the benefit of all countries

Estimated global cost in addition to already existing observation systems  
**US\$ 2.1 billion per year.**

# Summary

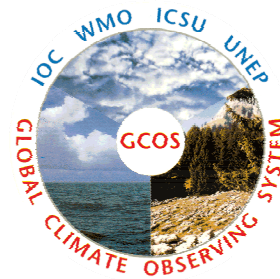


- High quality observations are the foundation on which successful management of climate change rests.
- Good observations don't just happen! Governments are responsible for supporting and maintaining observing networks for climate.
- Improving and sustaining networks to meet the needs of the UNFCCC is not free!
- ...But the costs are affordable and the return on investment will pay for itself many times over.



***“If Parties live up to the commitments they have already made in COP Decisions, observing systems could be greatly improved in the next five years.”***





# Thank you

For more information about the GCOS programme  
please visit our website

<http://gcos.wmo.int>

## Contact Information

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