The Global Climate Observing System and the role of Satellite Data in Climate Monitoring

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On behalf of
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GLOBAL CLIMATE OBSERVING SYSTEM
KEEPING WATCH OVER OUR CLIMATE

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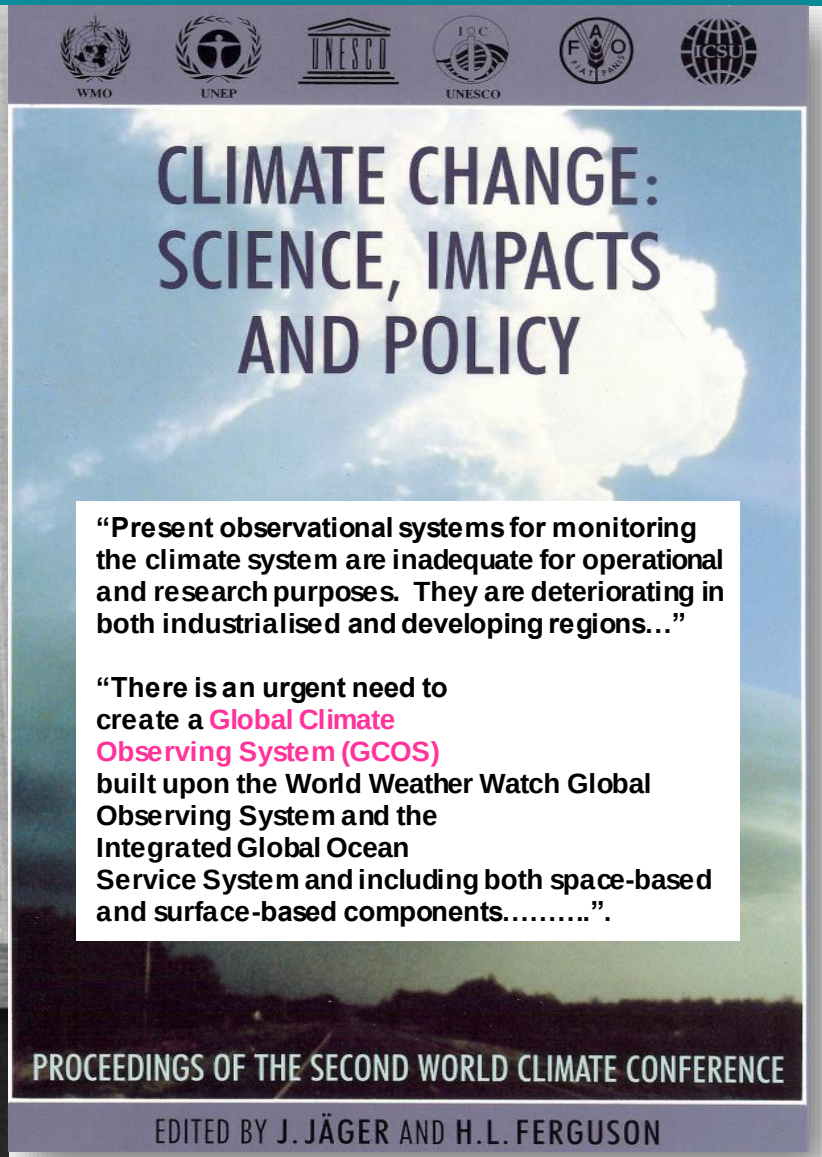
Second World Climate Conference (WCC-2) Ministerial Session in 1990

The Secretary-General of WMO, G.O.P. Obasi, addressing the opening of the ministerial sessions of the Second World Climate Conference in the Palais des Nations, Geneva, on 6 November 1990. Behind him (left to right) are the Hon. E. Fenech-Adami, Prime Minister of Malta; the Rt Hon. M. Thatcher, Prime Minister of the United Kingdom; HM King Hussein I of Jordan; Federal Councillor A. Köller, President of the Swiss Confederation; M. Rocard, Prime Minister of France; and the Rt Hon. B. Paeniu, Prime Minister of Tuvalu.



GCOS established in April 1992

ENSURING THE AVAILABILITY OF GLOBAL OBSERVATIONS FOR CLIMATE

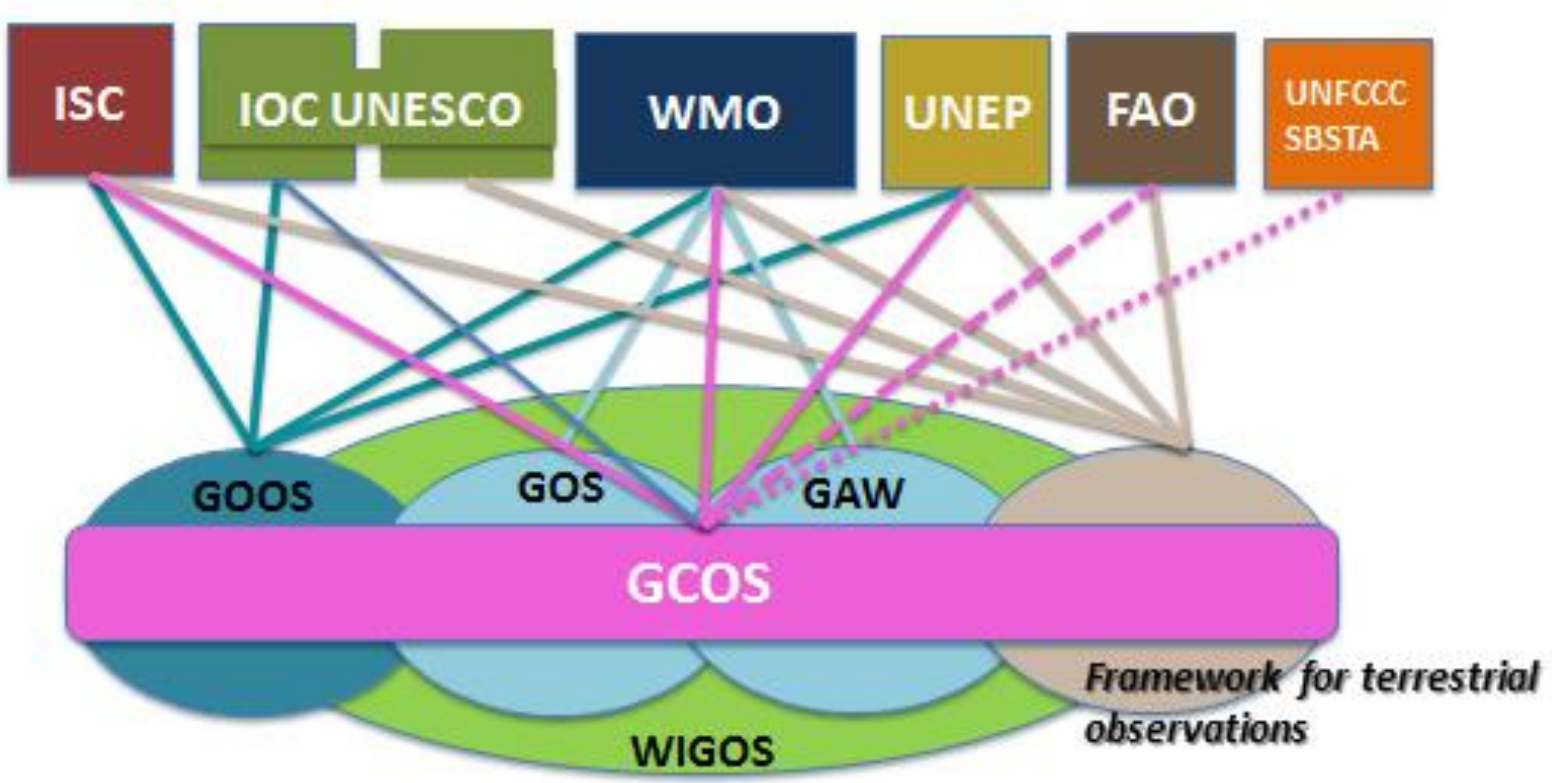
GCOS vision: a world where climate observations needed to address climate-related issues are accurate and sustained, and access to climate data is free and open.

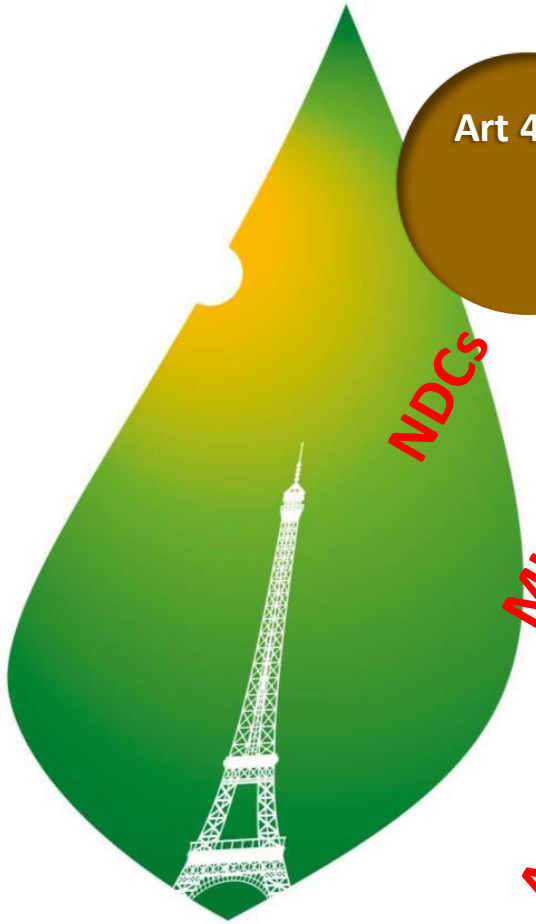
GCOS users include individuals, national and international organizations, institutions and agencies.

GCOS role: work with partners to ensure the sustained provision of reliable physical, chemical and biological observations and data records for the total climate system, across the atmospheric, oceanic and terrestrial domains, including hydrological and carbon cycles and the cryosphere.

Partnerships

GCOS assesses progress and requirements, advises on implementation, and reports to UNFCCC on the status of observing systems for climate.





Art 4 NDCs

Art 5 MITIGATION

Art 7 ADAPTATION, EWS, RSO…

Art 8 LOSS&DAMAGE, EWS,..

Art 9 FINANCE

Art 10 TECH TRANSFER

Art 11 CAPACITY BUILDING

Art 12 COMMUNICATIONS

Art 13 REPORTING/TRANSPARENCY

Art 14 GLOBAL STOCKTAKE

A major driver for climate observation needs. Adaptation, a significant element of the new GCOS Implementation Plan is an extremely important aim of the Paris Agreement.

COP21 · CMP11

PARIS 2015

UN CLIMATE CHANGE CONFERENCE

***Paris Agreement Article 7 (7c): Strengthening scientific knowledge on climate, including research, systemic observation of the climate system and early warning systems.**

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From observations to implementation

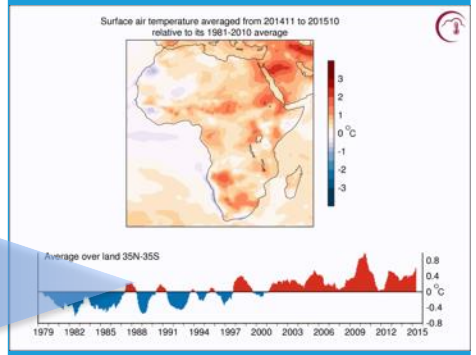
GCOS Supports observations and production of climate data records that underpin service delivery

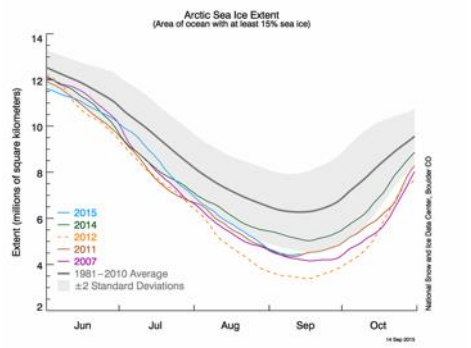
Sensing

- Observation of the Earth System

Data Records

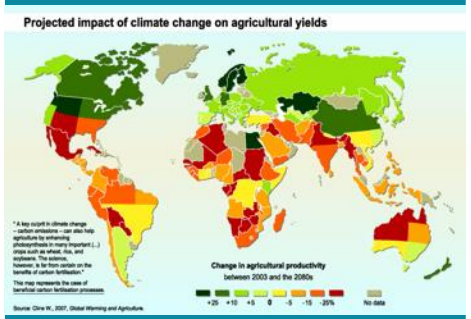
- Preparation of Climate Data records
- Archiving,
- Reanalysis,
- Production of long datasets





Delivery of Services

- Delivery of targeted information for specific applications or to inform decisions



Decision Making and Implementation

- Implement actions based on the information

Feedback from users

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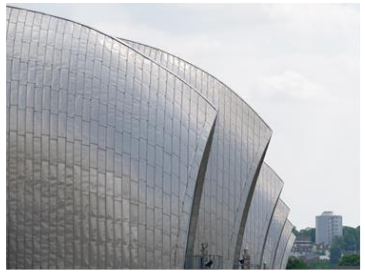
Financial Support

Systematic Climate Observations

Capacity Building

Monitoring for planning adaption to climate change: projections and risk estimation



Monitoring of implementation of adaption (urban change, infrastructure, agriculture, …)

Monitoring of Land categories and forests: Mitigation, Adaptation, …

Monitoring for Emergency Warning systems, projections and risk assessments

Monitoring anthropogenic fluxes of GHGs, natural sources and sinks, & carbon cycle

Monitoring global temperature

Overall impact of NDCs: state of the climate, global water cycle and energy fluxes

Monitoring to support renewable energy, winds, water etc.

Paris Agreement and its Global Stocktake

- Provision of Capacity Building
- Technology Transfer
- Mitigation
- Adaptation
- Transparency framework: reporting
- Measuring progress towards temperature goal
- Provision of financial support

Systematic Observations are fundamental to implementing the Paris Agreement and monitoring its progress.

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ECVs

THE CONCEPT OF ESSENTIAL CLIMATE VARIABLES IN SUPPORT OF CLIMATE RESEARCH, APPLICATIONS, AND POLICY

BY STEPHAN BOJINSKI, MICHEL VERSTRAETE, THOMAS C. PETERSON, CAROLIN RICHTER, ADRIAN SIMMONS, AND MICHAEL ZEMP

Described is the concept of Essential Climate Variables developed under the Global Climate Observing System for a range of applications, as well as to provide an empirical basis for understanding past, current, and possible future climate variability and change.

Observations are fundamental to advancing scientific understanding of climate (Doherty et al. 2009; Shapiro et al. 2010) and delivering the vetted, timely, and purposeful climate information needed to support decision making in many sectors. Observations and monitoring are key elements of the emerging Global Framework for Climate Services (WMO 2011a) and more generally support climate research, the assessment of climate change, and the development of policy responses (Fig. 1). For these purposes, observational datasets in general need to be traceable to quality standards, be readily interpretable and freely available, and cover sufficiently long periods: for example, the 30 years traditionally used for calculating climate normals (WMO 2011b). Transparency in the generation of climate datasets is

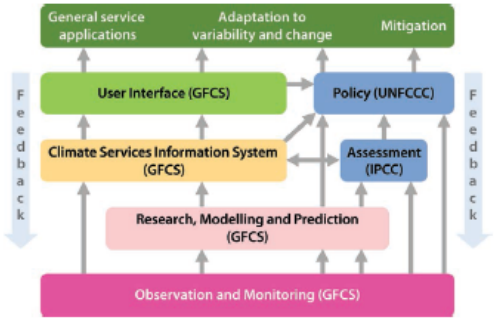


FIG. 1. The role of observation within the Global Framework for Climate Services (GFCS) and in support of research; the assessment of climate change, in particular as undertaken by the IPCC; and the development and implementation of policy responses, in particular under the UNFCCC. Gray arrows denote the main directions of flow of climate data and derived information. Feedback for system improvement flows mainly in the opposite direction. The GFCS includes a substantial capacity-development component that underlies all illustrated components. Adapted from WMO (2009, 2011a).

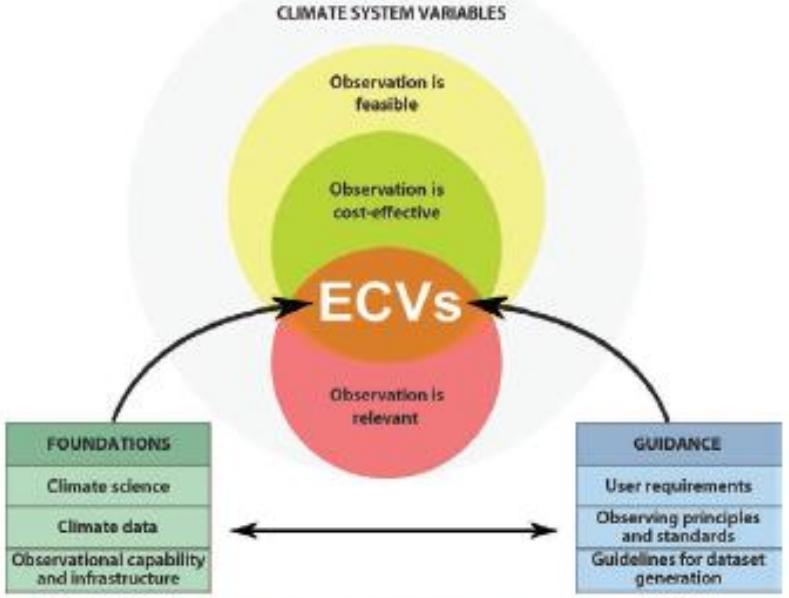
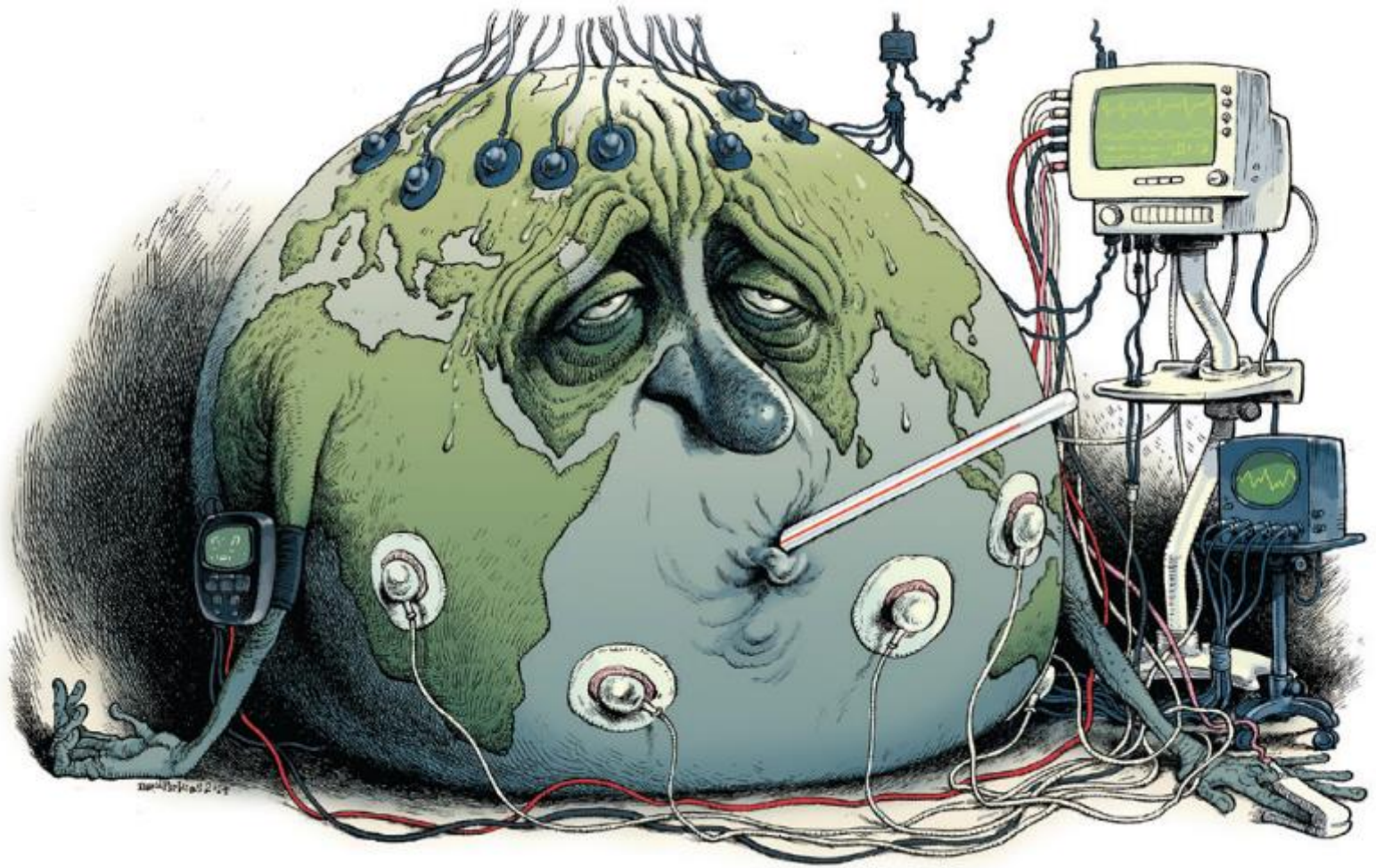


FIG. 2. Schematic of the ECV concept: knowing existing climate-relevant observing capabilities, climate datasets, and the level of scientific understanding of the climate system are the foundations (lower-left box) necessary for selecting the ECVs from a pool of climate system variables. In addition, guidance is needed to make practical use of the ECVs (lower-right box): user requirements capture the data quality needs of science, services, and policy; climate-specific principles guide the operation of observing systems and infrastructure; and guidelines facilitate the transparent generation of ECV data records. The latter address the availability of metadata, provisions for data curation and distribution, and the need for quality assessment and peer review.

https://doi.org/10.1175/BAMS-D-13-00047.1
Published Online: 30 October 2014

The importance of observations……



Credit: Victor & Kennel, Nature Climate Change, 2014.

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Posterior likelihoods change faster than prior probabilities

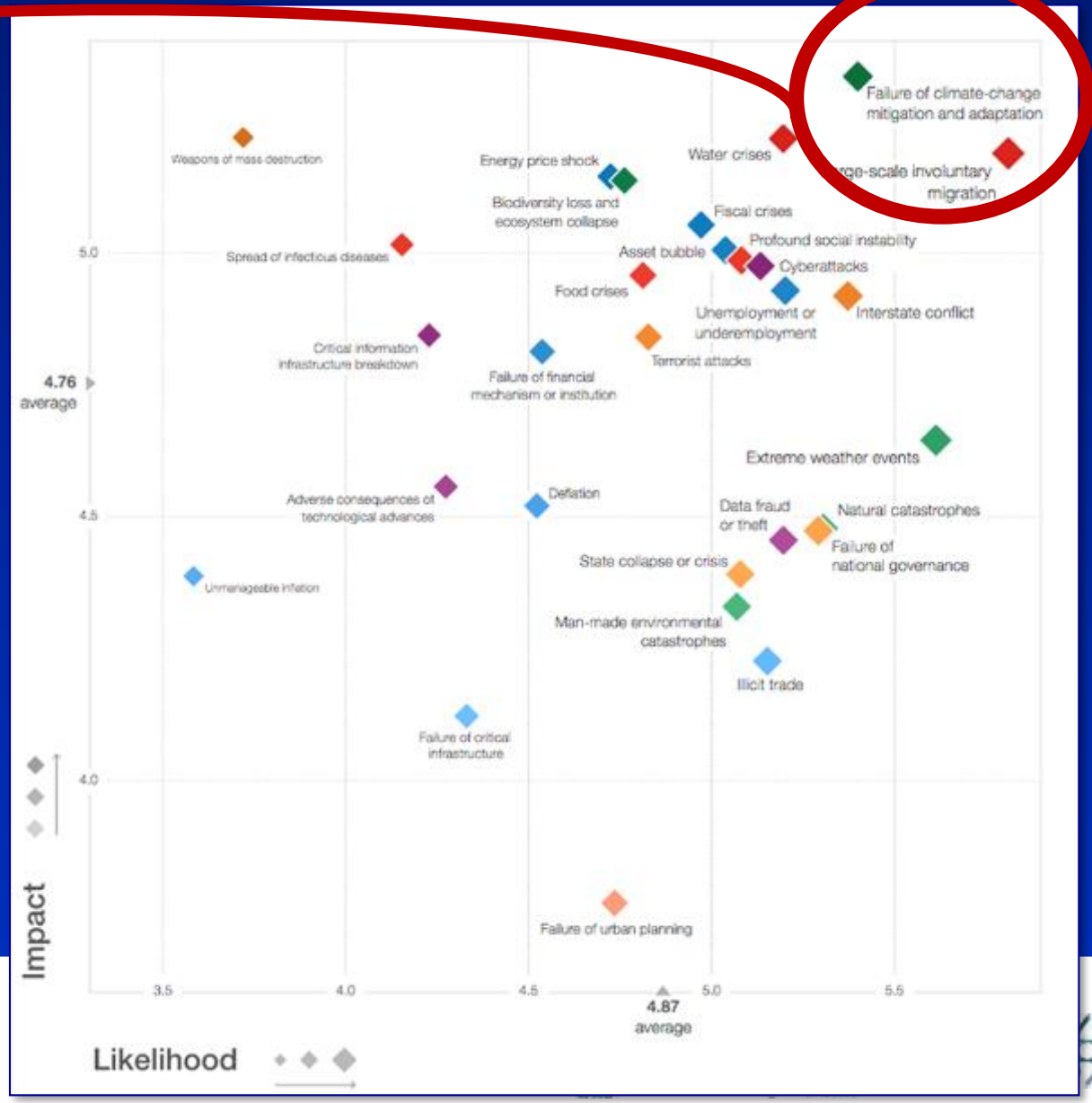
2003 European heatwave - likelihood:

- **1900: 1 in 100**
- **2000: 1 in 50 (Stott et al, 2004)**
- **2015: 1 in 5 (Christidis, Jones & Stott, 2015)**
  - **("we find that events that would occur twice a century in the early 2000s are now expected to occur twice a decade")**
- **(Statistics of 2040: 1 in 2, 2100: 1 in 1)**

While Ts "only" increased by 0.8C in period 1900-2000.

Global Risks Landscape 2016

Failure of climate-change mitigation and adaptation



Source World Economic Forum Global Risks Report 2016

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http://www.weforum.org/reports/the-global-risks-report-2016

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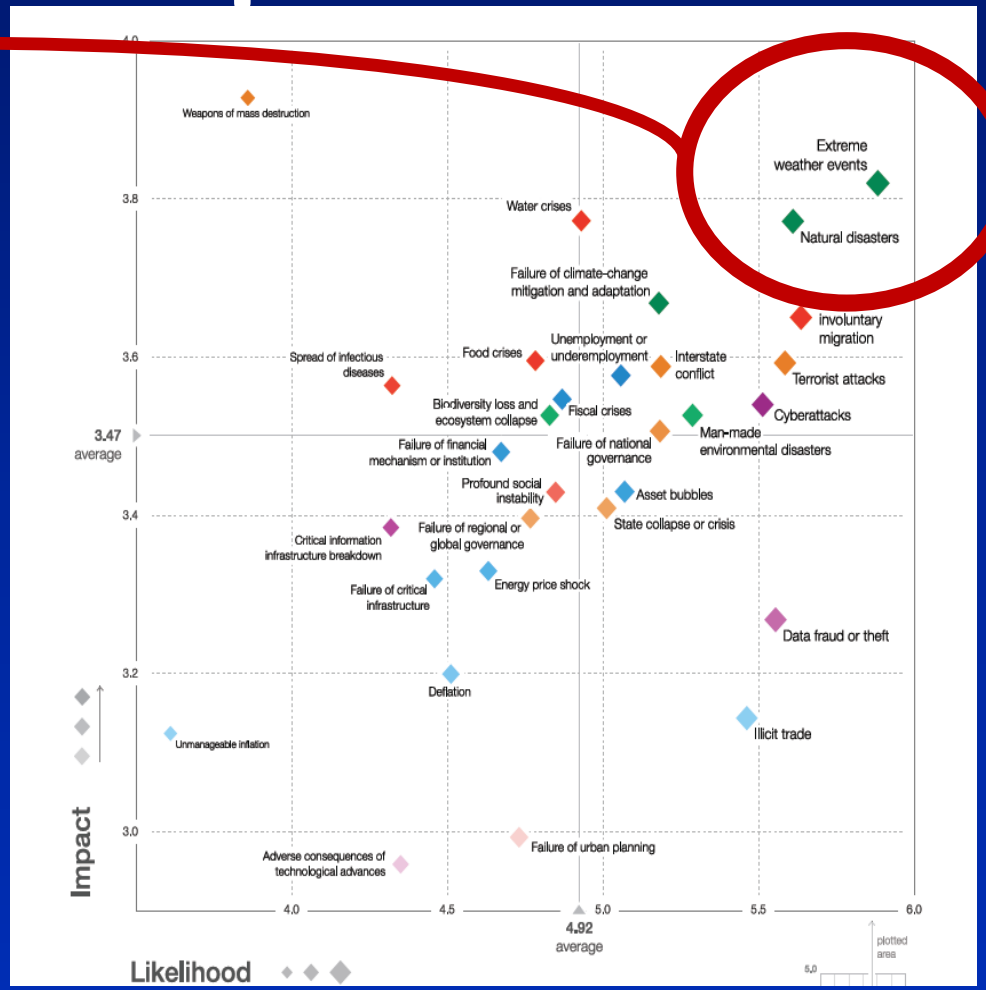
ICSU

Global Risks Landscape 2017

Extreme Weather
&
Natural Disasters



Source World Economic Forum Global Risks Report 2017
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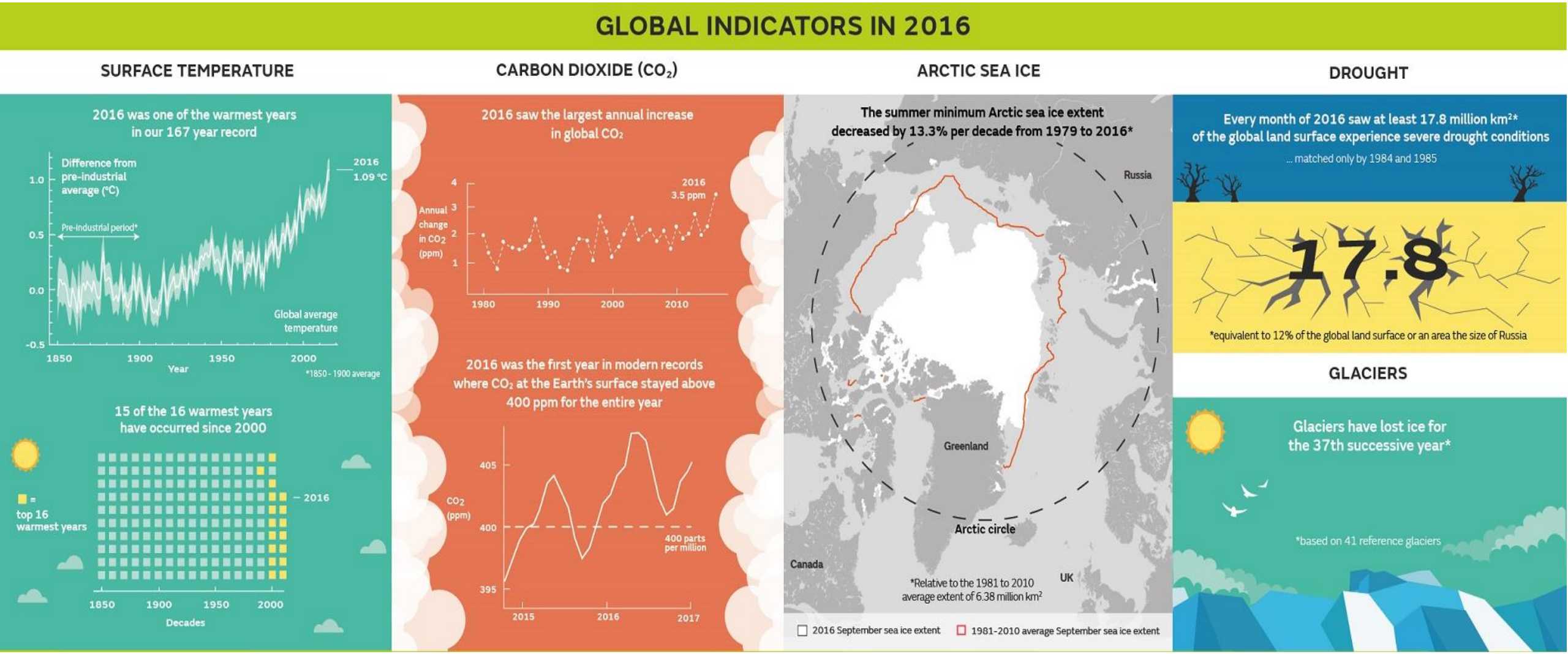
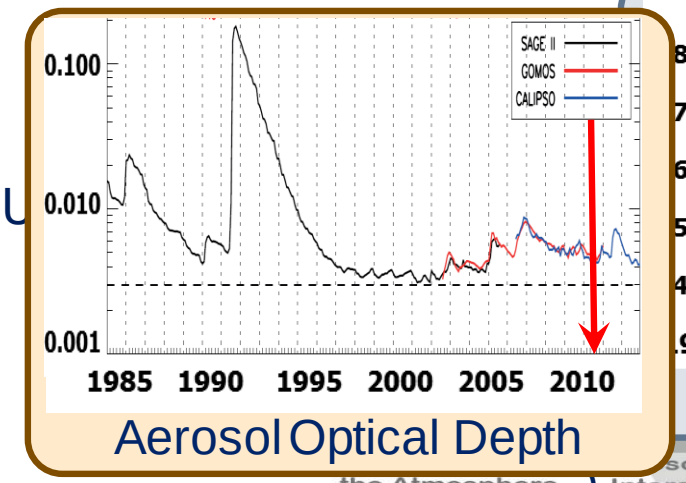
Climate Change - Facts

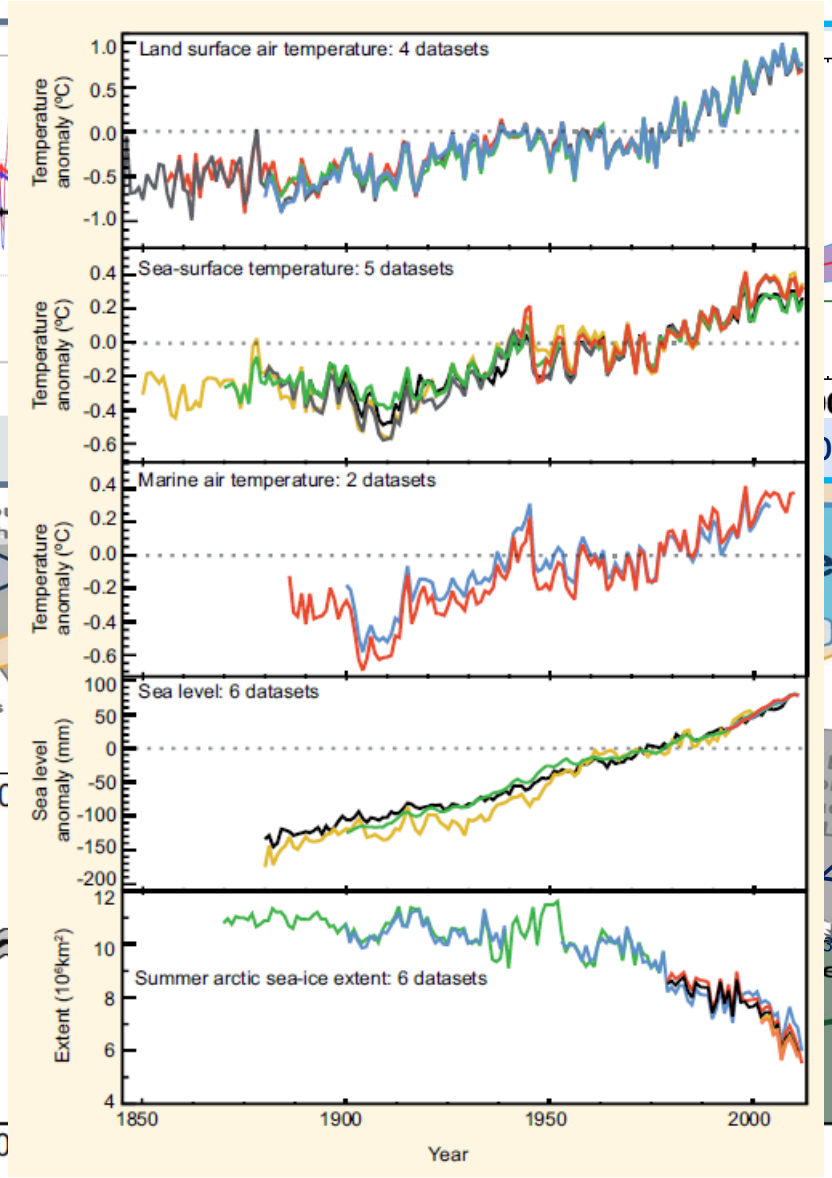


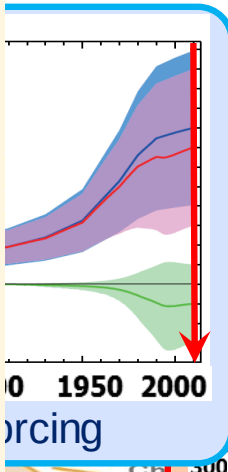
UK-MetOffice, 2017

EUMETSAT

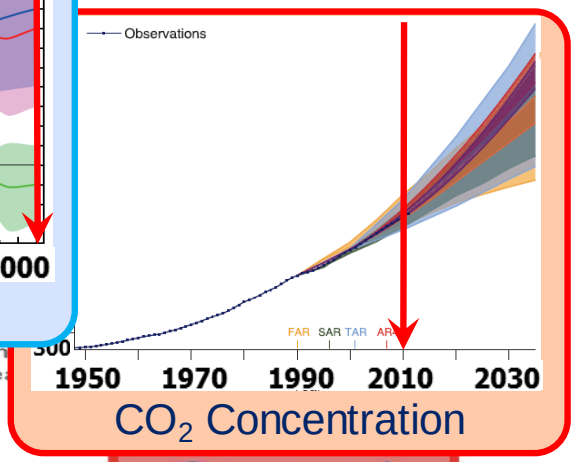
Climate System: What needs to be observed?





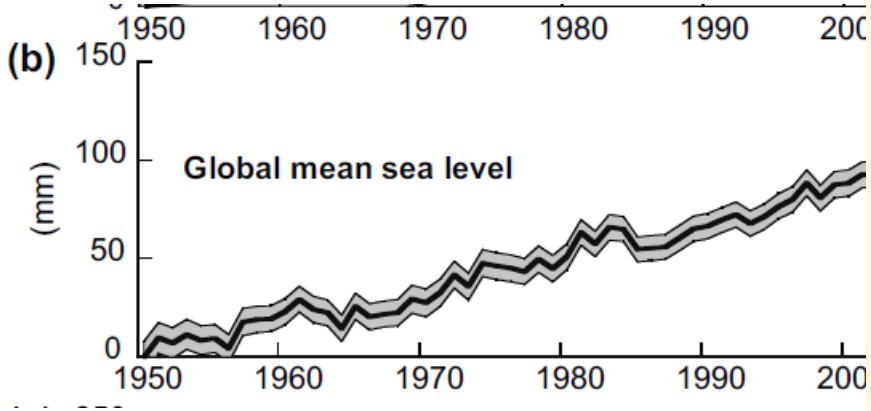


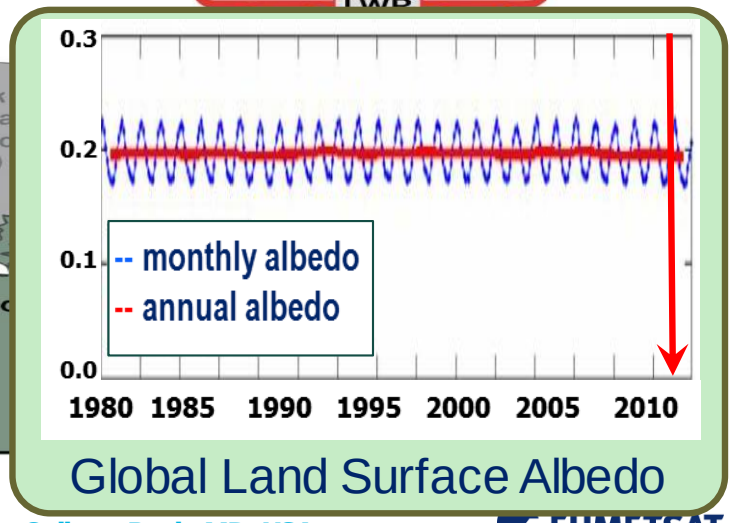
IPCC Physical Science Basis, Chapter 1 &2 , 2013, Liang et al. , J. of Dig. Earth, 2013



Gases and Large Aerosols

LWR





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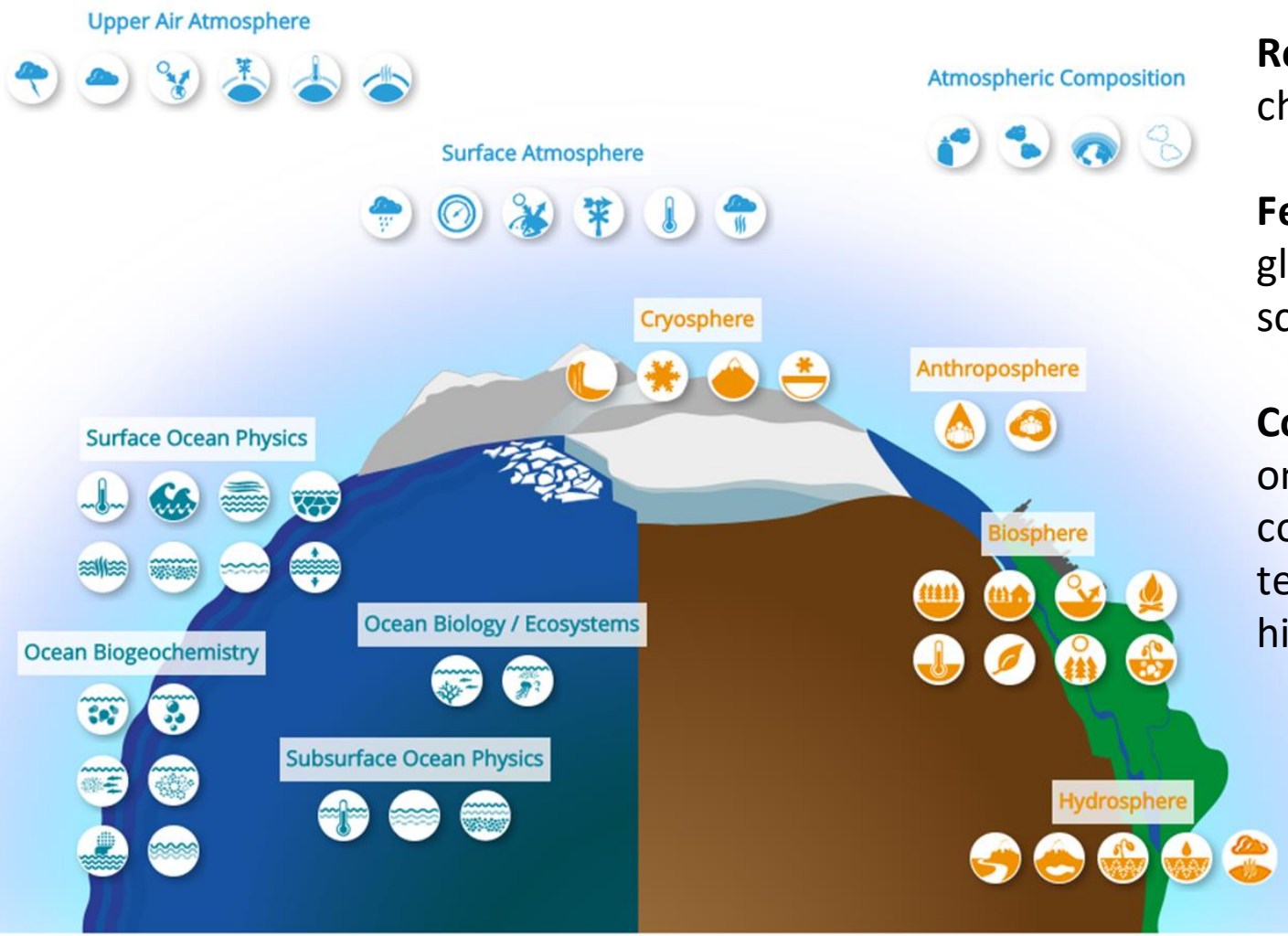
GCOS currently specifies 54 ECVs.



ECV are identified based on the following criteria:

Relevance: The variable is critical for characterizing the climate system and its changes.

Feasibility: Observing or deriving the variable on a global scale is technically feasible using proven, scientifically understood methods.

Cost effectiveness: Generating and archiving data on the variable is affordable, mainly relying on coordinated observing systems using proven technology, taking advantage where possible of historical datasets

GCOS Essential Climate Variables – ECVs

grouped by measurement domain and area covered.

	Atmosphere	Terrestrial	Ocean
Energy & Temperature	Surface Radiation Budget, Earth Radiation Budget, Surface Temperature, Upper Air Temperature, Surface and Upper Air Wind Speed	Albedo, *Latent and Sensible Heat* fluxes, Land Surface Temperature	Ocean Surface Heat Flux, Sea Surface Temperature, Subsurface Temperature
Other Physical Properties	Surface Wind, Upper Air Wind, Pressure, Lightning, Aerosol Properties		Surface Currents, Subsurface Currents, Ocean Surface Stress, Sea State, Transient Traces
Carbon Cycle and other GHGs	Carbon Dioxide, Methane, Other long-lived GHG, Ozone, Precursors for Aerosol and Ozone	Soil Carbon, Above-ground Biomass	Inorganic Carbon, Nitrous Oxide
Hydrosphere	Precipitation, Cloud Properties, Water Vapour (Surface), Water Vapour (Upper Air), Surface Temperature,	Soil Moisture, River Discharge, Lakes, Groundwater,	Sea Surface Salinity, Subsurface Salinity, Sea Level, Sea Surface Temperature
Snow & Ice		Glaciers, Ice Sheets and ice shelves, Permafrost, Snow	Sea Ice
Biosphere		Land Cover, Leaf Area Index (LAI), Fraction of Absorbed Photosynthetically Active Radiation (FAPAR), Fire	Plankton, Oxygen, Nutrients, Ocean Colour, Marine Habitat Properties
Human Use of Natural Resources		Water Use, Greenhouse Gases (GHG) Fluxes	Marine Habitat Properties

Part 1 - Information on gaps and needs:

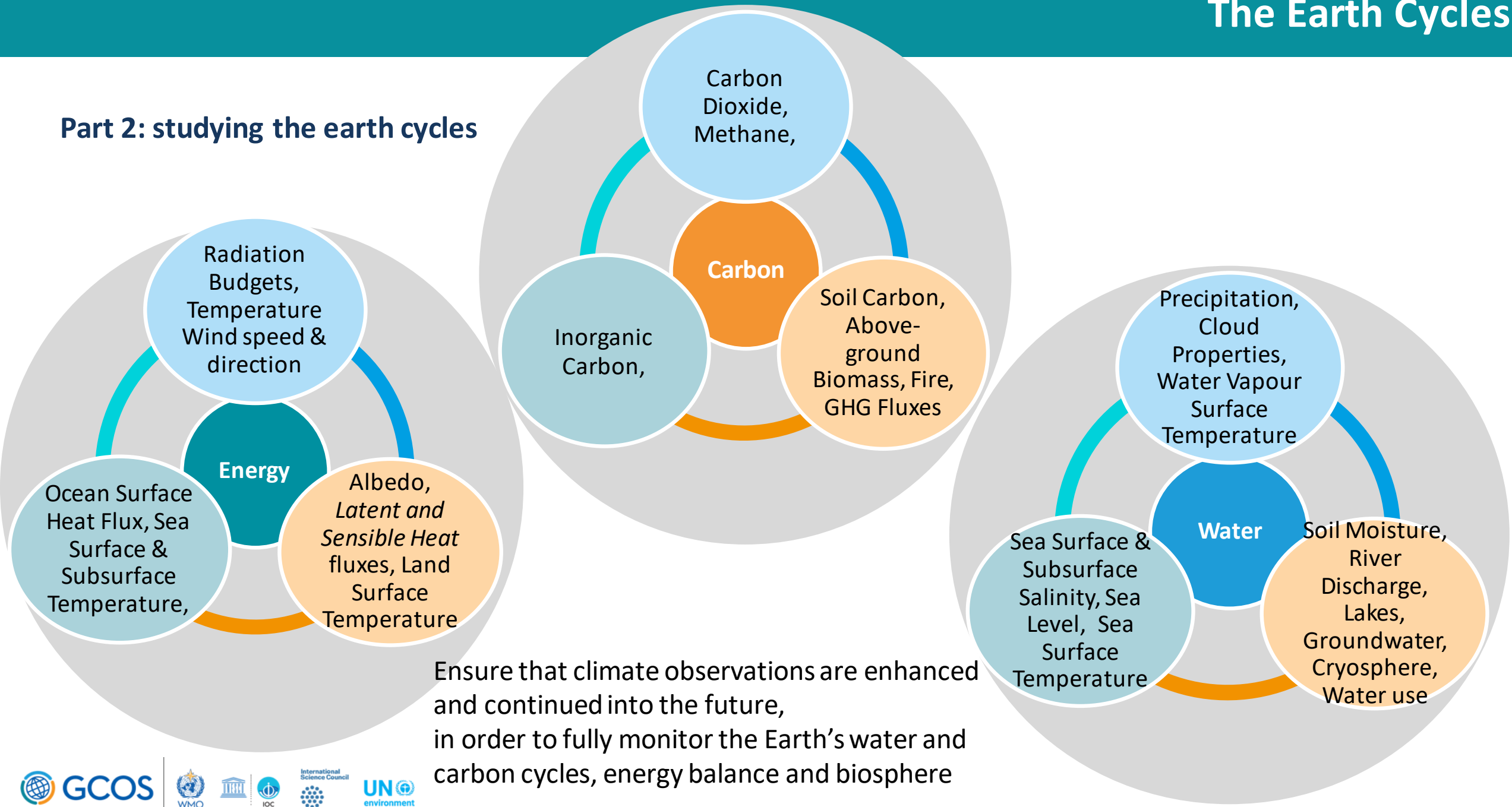
→ GCOS community discussion on Observation and science priorities to inform GCOS and WCRP

Main overarching conclusions:

- need for commitment to long-term, sustained climate observation systems
- need for open access to climate observations, irrespective of source
- need to have traceable observations for accurate long-term monitoring
- Conference on Observations for Climate (Partnership GCOS + GOOS / Copernicus / WGClimate)
  - Report in next GCOS Status Report, and include actions in revised Implementation Plan

The Earth Cycles

Part 2: studying the earth cycles



Ensure that climate observations are enhanced and continued into the future,
in order to fully monitor the Earth's water and carbon cycles, energy balance and biosphere

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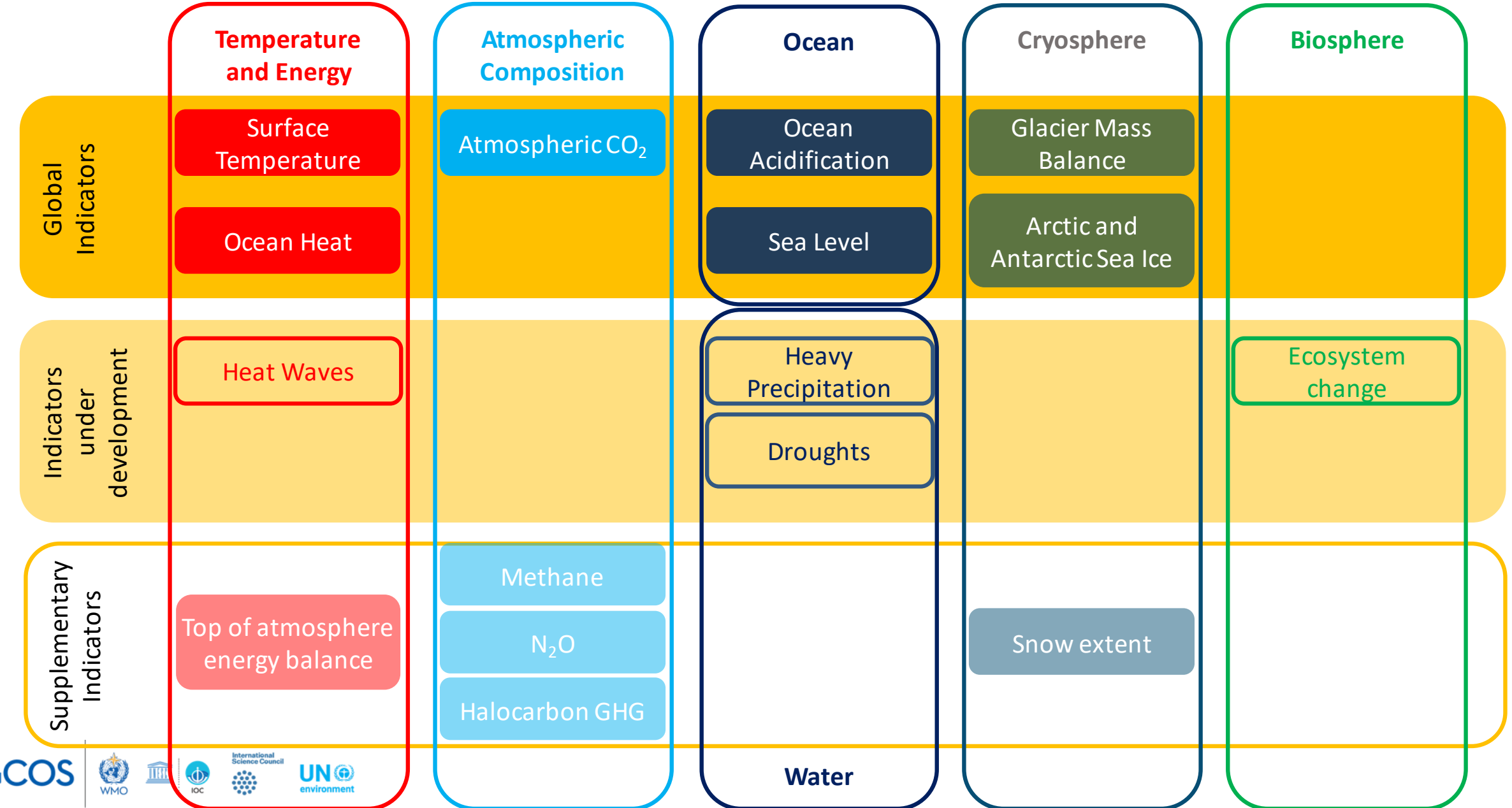
Climate Indicators



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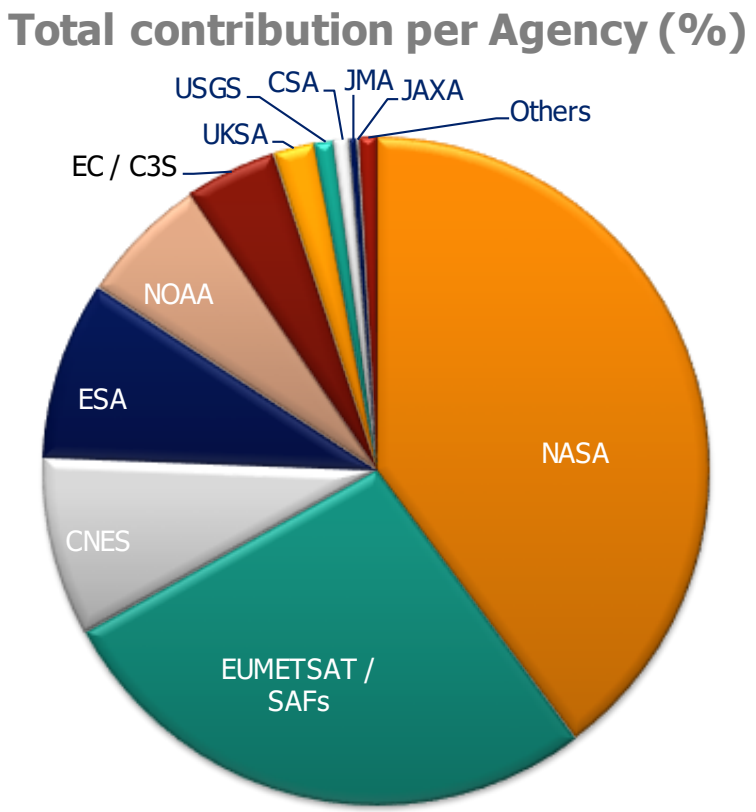
EUMETSAT and its SAFs produce 26% of Climate Records of Essential Climate Variables observable from space



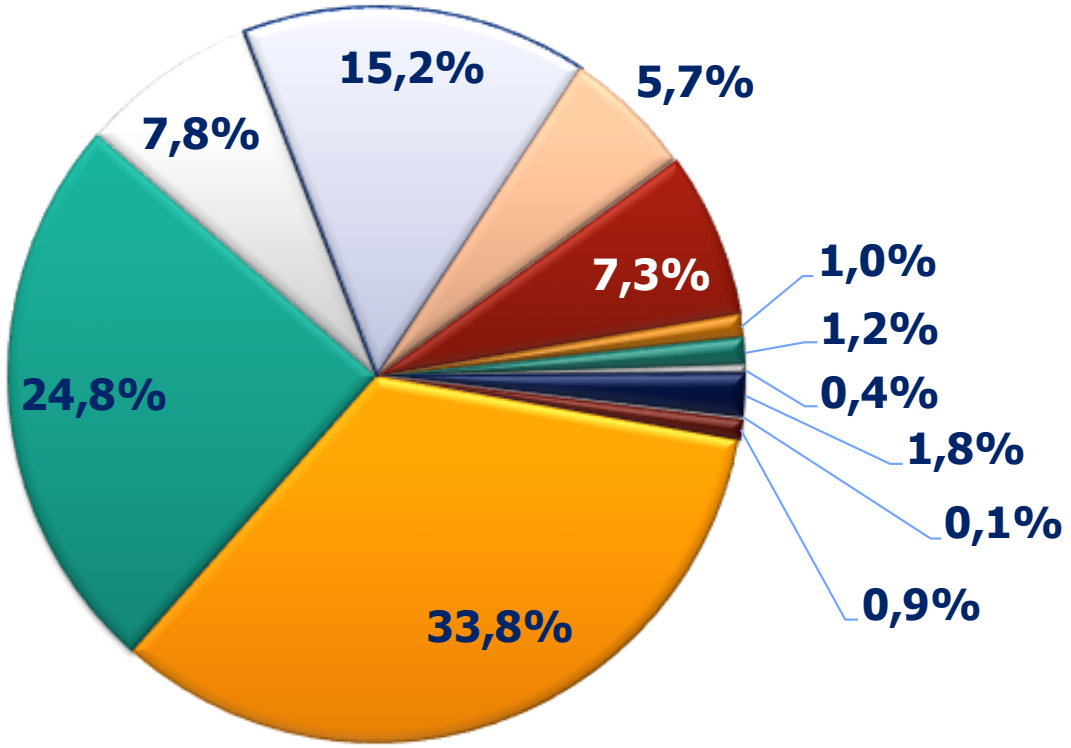
- Existing & planned records
- Entries from 11 space agencies
- 913 entries
  - 496 existing records
  - 417 planned records
- 26% from EUMETSAT and its SAFs
- 30 ECVs covered, out of 37 possible

http://climatemonitoring.info/ecvinventory

EUMETSAT and its SAFs produce 25% of Existing Climate Records of Essential Climate Variables observable from space

Inventory #3

817 Data Records



EUMETSAT

Climate observations also support:

- Energy & Temperature
- Other Physical Properties
- Carbon Cycle and other GHGs
- Hydrosphere
- Snow & Ice
- Biosphere
- Human Resource Use

Thank you

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