Global Climate Observing System Implementation Plan

Albert Fischer
Director, WMO Integrated Global Observing System (WIGOS) Branch

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Executive summary

GCOS published its Implementation Plan in 2022. It provides a set of **high priority actions** which if undertaken will **improve global observations of the climate system and our understanding of how it is changing**. This plan is mainly based on the latest 2021 GCOS Status Report, released in 2021, that identified the successes and gaps in the existing observing systems; the implications arising from the Intergovernmental Panel on Climate Change (IPCC) 6th assessment report and recent special reports; and recent scientific studies.

This plan has a different form to earlier plans. It is more targeted at observing systems (including Space Agencies), it has fewer, more focused, and integrated actions, with clearer means of assessment. The plan identifies six major themes that should be addressed: ensuring sustainability, filling data gaps, improving data quality, availability and utility, including reprocessing, managing data, engaging with countries and other emerging needs.

16 of the 31 actions are relevant to Space Agencies. WGClimate is now preparing the response to the GCOS Implementation Plan, which includes, additionally to a formal response, a living document that will be updated regularly and made available to GCOS panels.

The updated **ECV requirements** are presented in a separate document - The 2022 GCOS ECVs Requirements (GCOS 245), which presents ECV product requirements covering all ECV products. Requirements were defined by GCOS expert panels members, informed by the wider community and underwent two public reviews. GCOS provides requirements for several of the WMO Rolling Review Requirements Application areas. Additionally, **37 out of 55 ECVs are observed also from space, making the updated requirements relevant for space agencies.**

GCOS at a glance

- Established in 1992 to address the UNFCCC systematic observation agenda
- co-sponsors:
  - WMO
  - Intergovernmental Oceanographic Commission of UNESCO - IOC
  - UN Environment Programme – UNEP
  - International Science Council – ISC
- GCOS is governed by a Steering Committee and has panels of experts
  - AOPC Atmospheric Observation Panel for Climate
  - OOPC Ocean Observations Physics and Climate Panel
  - TOPC Terrestrial Observation Panel for Climate

  All panels co-sponsored by WCRP – OOPC also sponsored by GOOS
- **The main contributors to GCOS are the US State Department, the EU Commission, NOAA, WMO, Germany, EUMETSAT.**

GCOS Strategy

VISION: a world where users have free access to the climate-related information they need

AIMS: to ensure the availability and quality of observations necessary for climate data so that people can live successfully with climate variability and change

ACTIVITIES

Identify user needs. for climate monitoring - adaptation, sustainable development, the UNFCCC and other MEA

ensure that climate **observations are enhanced and continued into the future**

Advocate for **free and open access to relevant data**

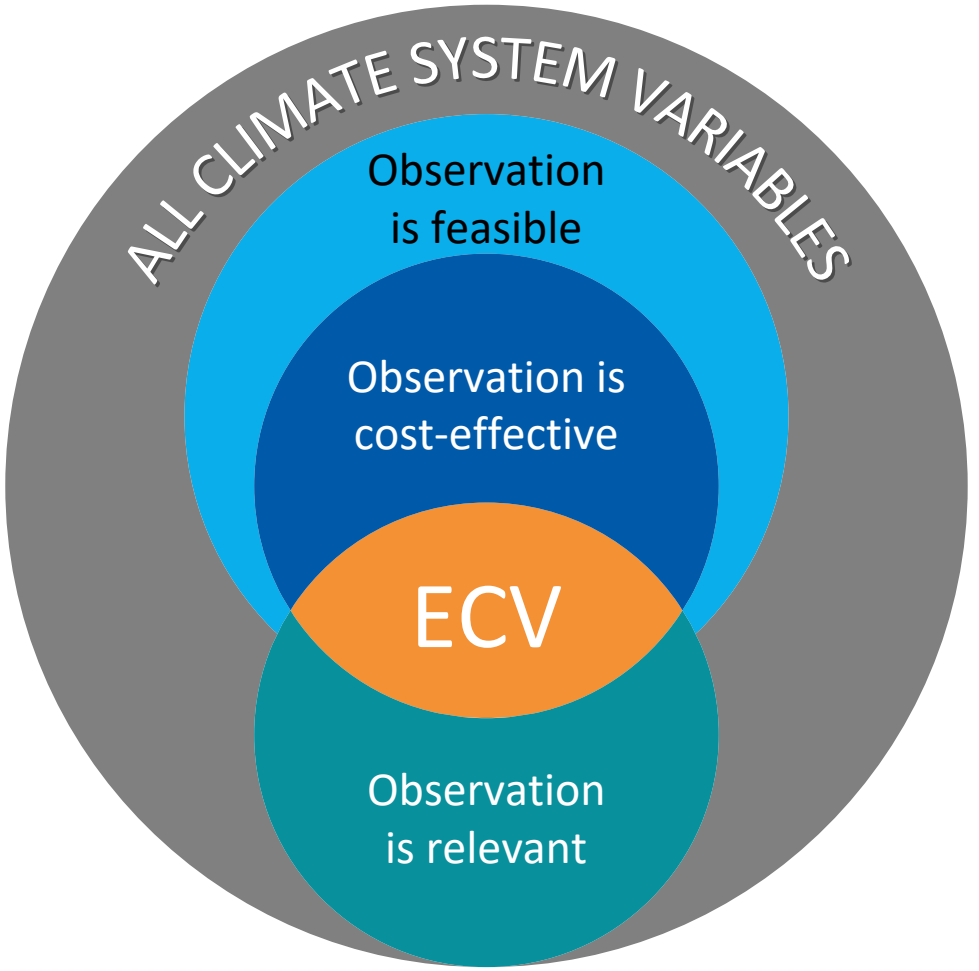
Essential Climate Variables (ECV)

- are physical, chemical or biological variables that critically contribute to the characterization of Earth's climate.
- are not stand-alone variables; they are part of a wider concept.
- are founded on climate science and observational capability and infrastructure.

ECV datasets provide the empirical evidence

- to understand and predict the evolution of climate,
- to guide mitigation and adaptation measures,
- to assess risks,
- to enable attribution of climatic events to underlying causes,
- to underpin climate services.

SOURCE: Bojinski, S. et al., 2014



ECVs should meet these principles

Free and Open, data is openly available to all users

Transparent, the methods and assumptions are clear, with standardised metadata, where possible

Accurate, climate data needs high accuracy to distinguish small trends from larger annual variability

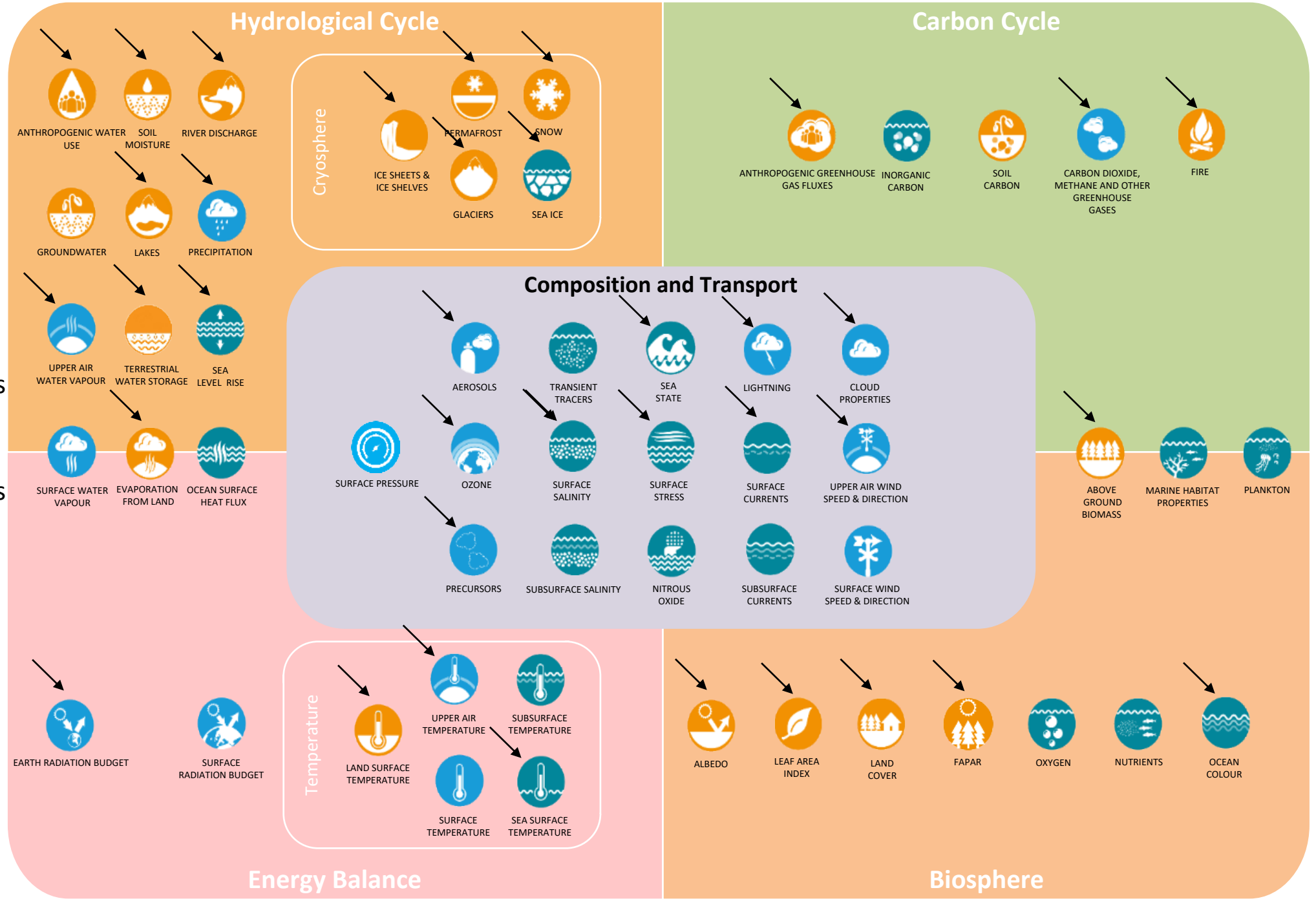
Useful, there should be a clear demand from users

Timely & Long-term, aim to maintain and/or develop long-term climate data records

Based on best **available science**

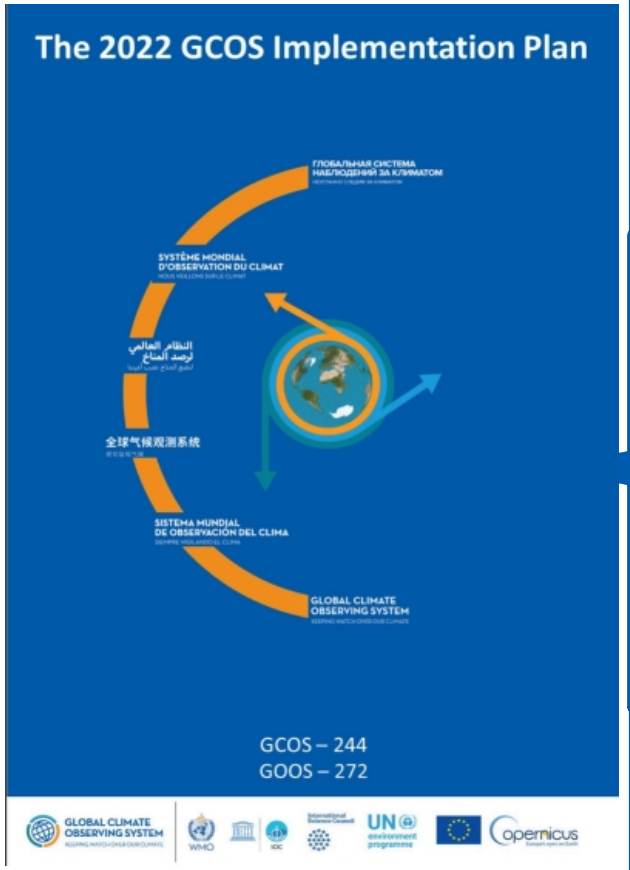
55 ECVs
37 can be measured from space

- ECVs aim to monitor the climate system as a whole covering the interlinked Earth's energy balance and the carbon and water cycles
- The biosphere is very important for the carbon and water cycles while many variables cover composition and transport that impact all aspects of climate change



ECV Domain (Panel Responsibility):
- Land ECVs (TOPC)
- Water ECVs (OOPC)
- Atmosphere ECVs (AOPC)

Producing the GCOS Implementation Plan



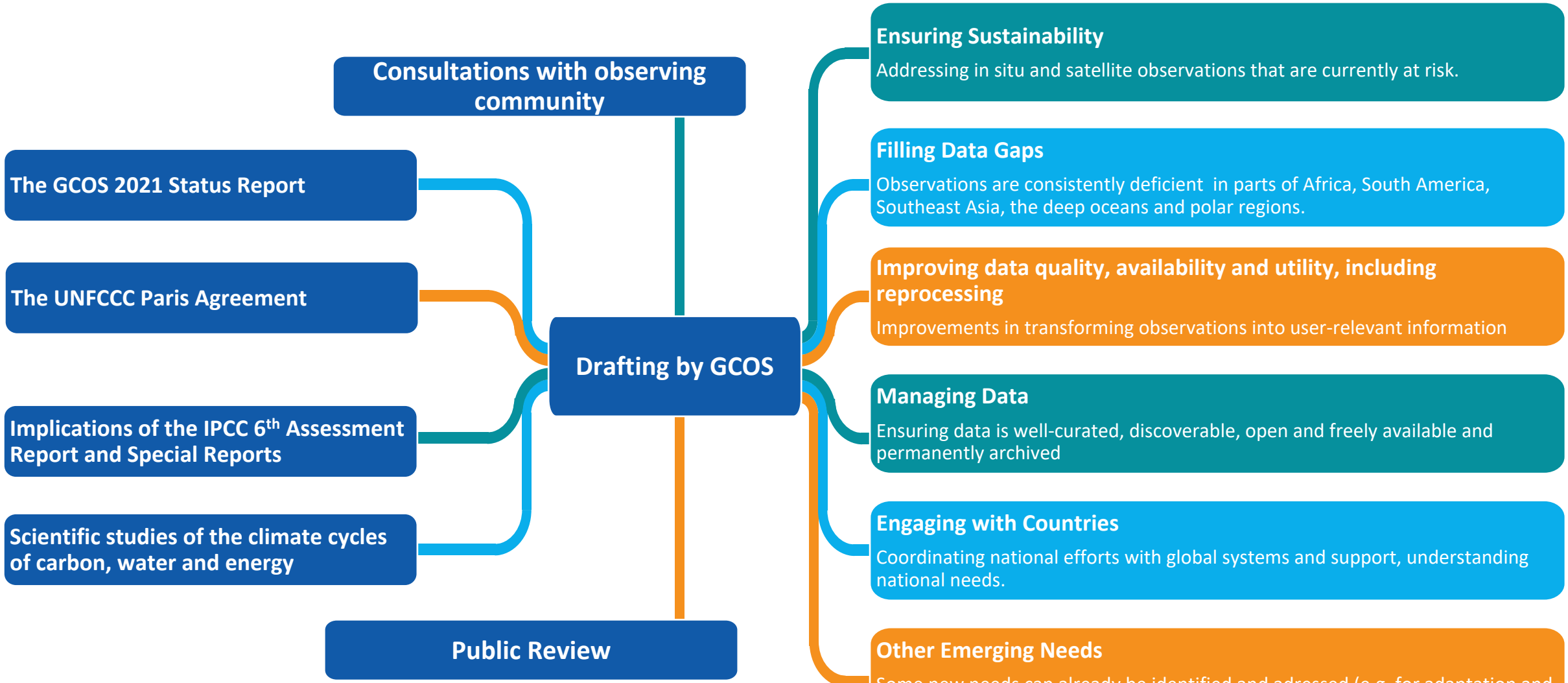
- More targeted at observing systems (including Space Agencies)
- Shorter and more concise: only 31 actions
- Actions more integrative, cross-domain
- Explicit attention to the earth cycles
- Updated set of 55 ECV Requirements by panels (A, O, T)

Preparation of draft with contributions from expert panels, invited experts, GCOS Editorial Board → Public review and revision by experts → Publish report following approval by Steering Committee and Editorial Board

Supported by GCOS Secretariat

GCOS | WMO | unesco | International Science Council | UN environment programme

Wide range of views and inputs condensed into 6 themes



Main Inputs → **Broad Engagement** → **Themes for Action**

GCOS IP and space agencies

31 actions
16 (>50%) relevant to space agencies

Theme	Actions	WMO	NMHS	Space agencies	GOOS	Reanalysis Centers	Global Data Centers	Research organizations	National Agencies	Parties to UNFCCC	Academia	Funding Agencies	GCOS
A: ENSURING SUSTAINABILITY	A1. Ensure necessary levels of long-term funding support for in situ networks, from observations to data delivery	x	x					x			x	x	x
	A2. Address gaps in satellite observations likely to occur in the near future			x									
	A3. Prepare follow-on plans for critical satellite missions			x									
B: FILLING DATA GAPS	B1. Development of reference networks (in situ and satellite Fiducial Reference Measurement (FRM) programs)	x	x	x				x				x	x
	B2. Development and implementation of the Global Basic Observing Network (GBON)	x	x		x								x
	B3. New Earth observing satellite missions to fill gaps in the observing systems			x									
	B4. Expand surface and in situ monitoring of trace gas composition and aerosol properties		x					x	x			x	
	B5. Implementing global hydrological networks	x	x	x			x						
	B6. Expand and build a fully integrated global ocean observing system		x	x	x			x	x		x		
	B7. Augmenting ship-based hydrography and fixed-point observations with biological and biogeochemical parameters				x			x					
	B8. Coordinate observations and data product development for ocean CO_2 and N_2O	x			x			x	x				
	B9. Improve estimates of latent and sensible heat fluxes and wind stress		x	x	x			x			x		
	B10. Identify gaps in the climate observing system to monitor the global energy, water and carbon cycles							x				x	x
C: IMPROVING DATA QUALITY, AVAILABILITY AND UTILITY, INCLUDING REPROCESSING	C1. Develop monitoring standards, guidance and best practices for each ECV	x		x	x								x
	C2. General improvements to satellite data processing methods			x				x			x		
	C3. General improvements to in situ data products for all ECVs		x					x			x		
	C4. New and improved reanalysis products			x		x					x		
	C5. ECV-specific satellite data processing method improvements			x		x							
D: MANAGING DATA	D1. Define governance and requirements for Global Climate Data Centres	x					x						x
	D2. Ensure Global Data Centres exist for all in situ observations of ECVs	x	x		x				x			x	x
	D3. Improving discovery and access to data and metadata in Global Data Centres						x					x	x
	D4. Create a facility to access co-located in situ cal/val observations and satellite data for quality assurance of satellite products	x	x	x				x					
	D5. Undertake additional in situ data rescue activities	x	x							x		x	x
E: ENGAGING WITH COUNTRIES	E1. Foster regional engagement in GCOS	x			x					x			x
	E2. Promote national engagement in GCOS		x							x	x		x
	E3. Enhance support to national climate observations									x		x	x
F: OTHER EMERGING NEEDS	F1. Responding to user needs for higher resolution, real time data	x	x	x				x			x		x
	F2. Improved ECV satellite observations in polar regions			x				x			x		
	F3. Improve monitoring of coastal and Exclusive Economic Zones		x	x	x			x			x		
	F4. Improve climate monitoring of urban areas	x	x					x	x		x		x
	F5. Develop an Integrated Operational Global GHG Monitoring System	x		x				x	x		x		x

GCOS

IP Actions with relevance for Space Agencies

16 (>50%) relevant to Space Agencies

Theme A: Ensuring Sustainability

Action A2: Address gaps in satellite observations likely to occur in the near future

Action A3: Prepare follow-on plans for critical satellite missions

Action B1: Development of reference networks (in situ and satellite Fiducial Reference Measurement (FRM) programs)

Action B3: New Earth observing satellite missions to fill gaps in the observing systems

Action B5: Implementing global hydrological networks

Action B6: Expand and build a fully integrated global ocean observing system

Action B9: Improve estimates of latent and sensible heat fluxes and wind stress

Theme B: Filling Data Gaps

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IP Actions with relevance for Space Agencies

Theme C: Improving Data Utility

Action C1: Develop monitoring standards, guidance and best practices for each ECV

Action C5: ECV-specific Satellite Data Processing Method Improvements

Action C2: General Improvements to Satellite Data Processing Methods

Action C4: New and improved reanalysis products

Theme D: Managing Data

Action D4: Create a database of co-located in situ cal/val observations and satellite data for quality assurance of satellite products

Theme F: Emerging Needs

Action F1: Responding to user needs for higher resolution, near real time data

Action F2: Improved ECV satellite observations in polar regions

Action F3: Improve monitoring of coastal and Exclusive Economic Zones

data

Action F5: Develop an Integrated Operational Global GHG Monitoring System

data

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Action A3: Prepare follow-on plans for critical satellite missions

Action A3: Prepare follow-on plans for critical satellite missions	
Activities	Develop follow-on plans to ensure medium and long-term continuity of the following satellite observations: 1. Earth Radiation Budget (ERB) measurements. 2. Cloud profiling. 3. Cloud lidar. 4. Global Precipitation Measurement (GPM) consisting of a dual-frequency precipitation radar and passive microwave measurements to provide sufficient temporal and spatial sampling of rain areas. 5. Sea ice and icebergs (or floating ice).
Issue/Benefits	Monitoring of many ECVs which are critically important to climate science are now dependent on satellite observations. The lack of confirmed plans for follow-on missions for some of these observations leaves the climate data records for some ECVs at risk. The continuity of these measurements is essential to develop and extend the long time series needed for climate monitoring.
Implementers	From 1 to 5: Space agencies
Means of assessing progress	From 1 to 5: Established (long-term) plans of Space agencies demonstrating the continuation of satellite missions for earth radiation budget, cloud profiling radar, cloud lidar, GPM and floating ice.

Addressing the actions- GCOS Panels

Panels are starting addressing the IP actions:

1. For actions to be started in 2023 or 2024 IP rapporteurs have been assigned
2. IP rapporteurs are asked to prepare a workplan/timeline for monitoring/addressing the action
3. Workplans and way forward are being discussed at the JPM in Bonn
4. Progress on action will be assessed and discussed at panel meetings every 6 months

Coordinated by WGClimate

Structured response: a systematic approach to address actions.

Living document: updated regularly and made available to our panels.

More interactive process involving WGClimate and the GCOS panels:

- Regular meeting between WGClimate chairs and GCOS Secretariat (already in place)
- Regular reporting on progress on actions to GCOS experts and GCOS Secretariat
- WGClimate ex-officio members in AOPC and TOPC ensure links
- For each action/activity, one or two experts from GCOS panels have been identified. They will follow up progress and be available for questions by the satellite experts.
- Ad-hoc teleconferences involving experts if needed (GCOS Sec to facilitate if needed)
- Organizing a workshop that can focus on actions where input from GCOS experts is needed or on identified cluster of actions.

Suggested template (to be completed by WGClimate)

Action A3:	Action A3: Prepare follow-on plans for critical satellite missions
Activity A3.5	Sea ice and icebergs (or floating ice)
Means of assessing progress	Established plans of Space agencies that ensure the continuation of satellite missions for floating ice
WGClimate Coordinators	
GCOS IP rapporteur(s)	
Priority for WGClimate	Level of priority for WGClimate: 2023
Feasibility	Is this activity feasible, will it be successful? If not, what are the reasons that would make this activity not feasible (technical, budget..). Is it only partially implementable? If this is the case, reformulate feasible part of activity If it is totally feasible, by when can the action be accomplished?
Collaboration with GCOS	Would this activity benefit or require a tight collaboration with GCOS? If yes, how (see above)
Connections with other IP actions	Are there any connections to other GCOS IP actions and activities? If yes, would it be better to address these activities together? If yes, reformulate
Timeline and milestone for this activity	
Date	Milestone
Date	Milestone
Date	Milestone

Progress report on June 2023:

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Progress report on December 2023:

ECV Requirements

- GCOS specifies 55 ECV variables, for most of the ECVs there are one or more ECV products.
  - ECV product: measurable parameter needed to characterize the ECV.

- GCOS routinely maintain, review and revise the list of ECV product requirements.

- The 2022 GCOS ECV Requirements presents ECV product requirements covering all ECV products.

- GCOS provides requirements for the WMO RRR Application area:
  - 2.5 Atmospheric Climate Forecasting and Climate monitoring
  - 3.3 Oceanic Climate Monitoring and Services
  - 4.2 Hydrological and Terrestrial Climate Monitoring
  - 5.3 Cryospheric Climate Monitoring

- Requirements were defined by GCOS expert panels members, informed by the wider community.
  - 1st public review in 2020: comments were addressed by panel members
  - 2nd public review in 2022 as part of the GCOS IP
  - WGClimate provided several comments that were addressed by experts

To be considered by CGMS:

- Consider climate (monitoring, mitigation, adaptation) as a key user of your data in forward planning.
- Support the work of CGMS-CEOS WGClimate in developing and maintaining response to GCOS IP
- Coordinate joint and national messages to SBSTA / COP-28