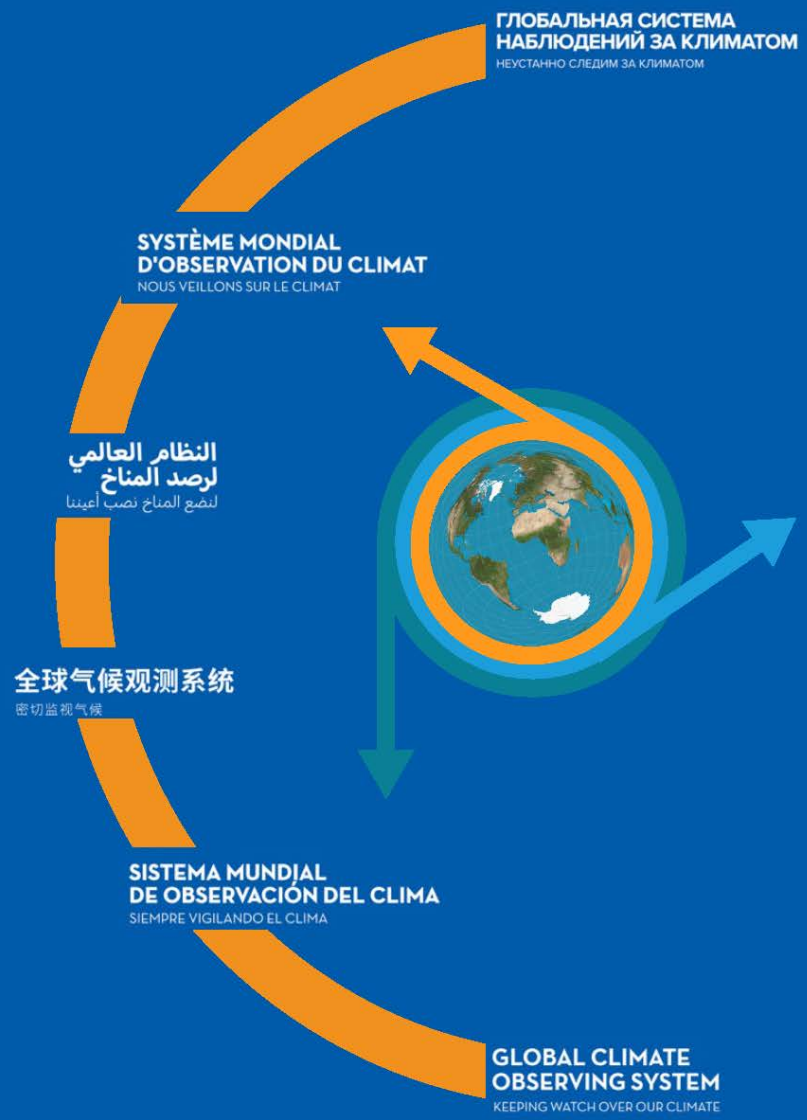


How GCOS and WCRP can work together

Han Dolman
Chair GCOS Steering Committee
Royal Netherlands Institute for Sea Research

GLOBAL CLIMATE OBSERVING SYSTEM
KEEPING WATCH OVER OUR CLIMATE

WMO IOC International Science Council UN environment

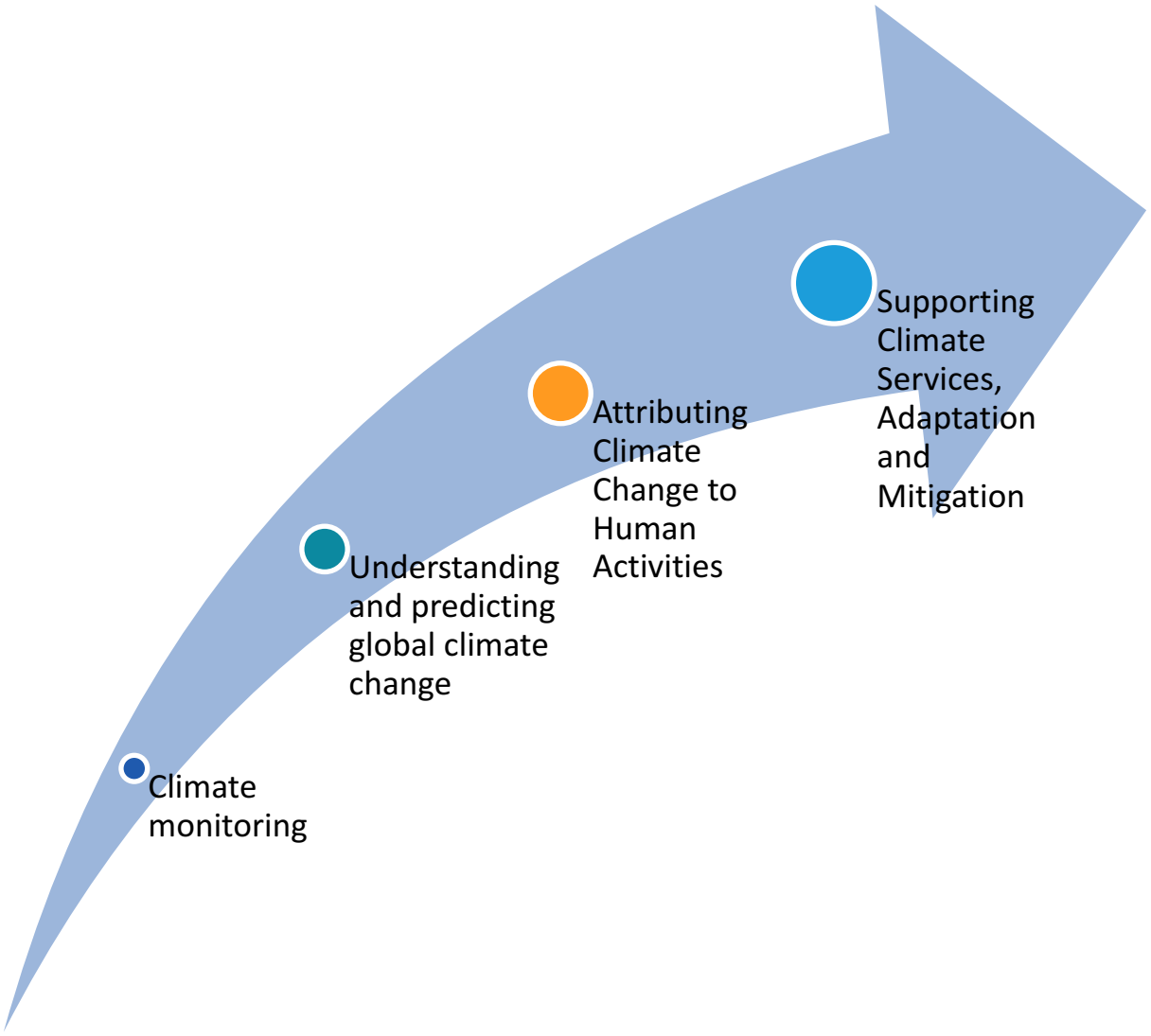
Supported by the European Union
Copernicus Europe's eyes on Earth

Demand for information about climate and its impacts is increasing and changing

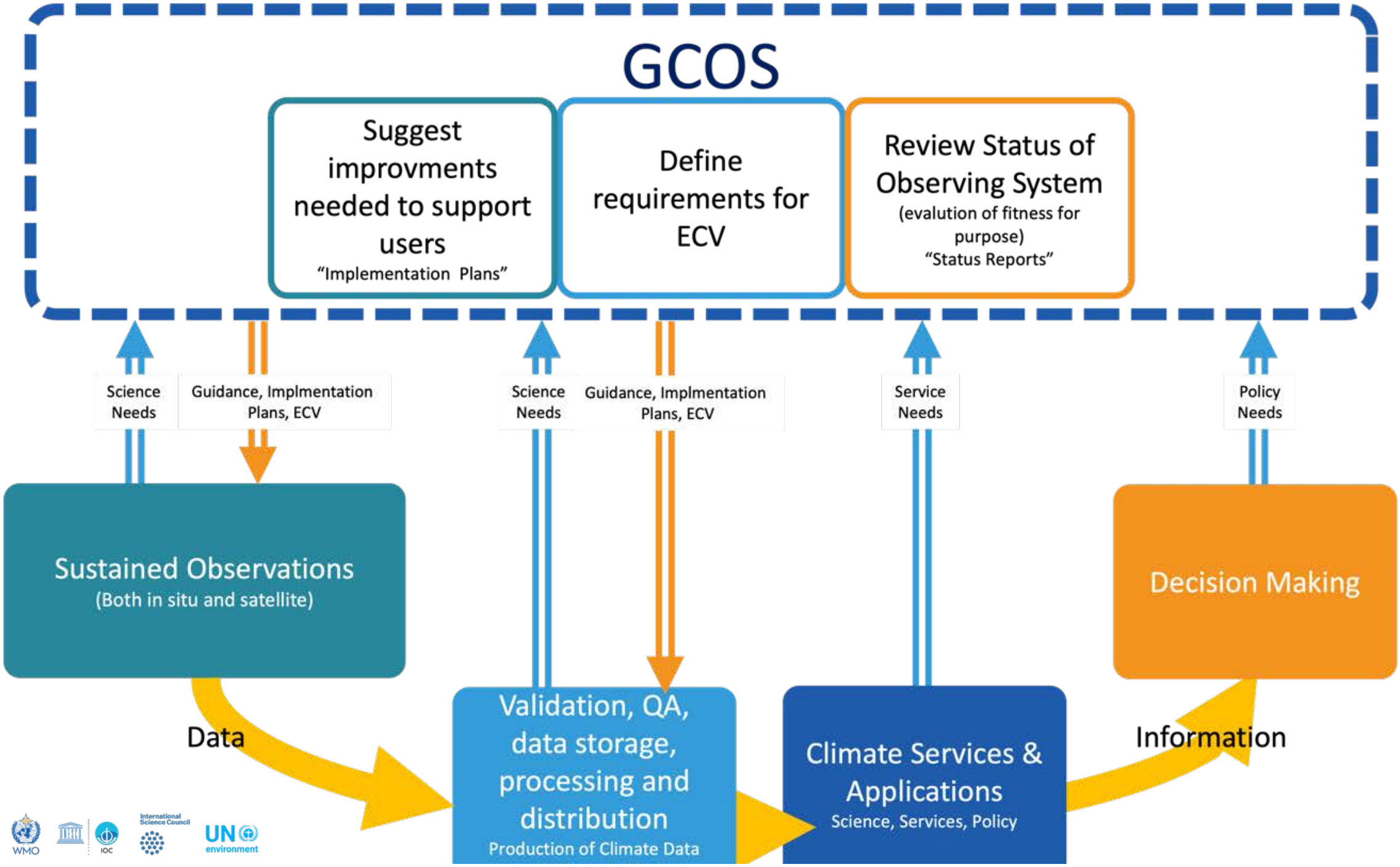
- The Global Climate Observing System has been very sucessful in allowing the IPCC to identify and project climate change and attribute this to human activities

- Now that
  - the frequency of extreme weather events is increasing
  - the vulnerability of people living in high-risk areas is growing.
  - concerns are increasing about issues such as food security and migration
  - UNFCCC Paris Agreement focuses on adaptation and mitigation

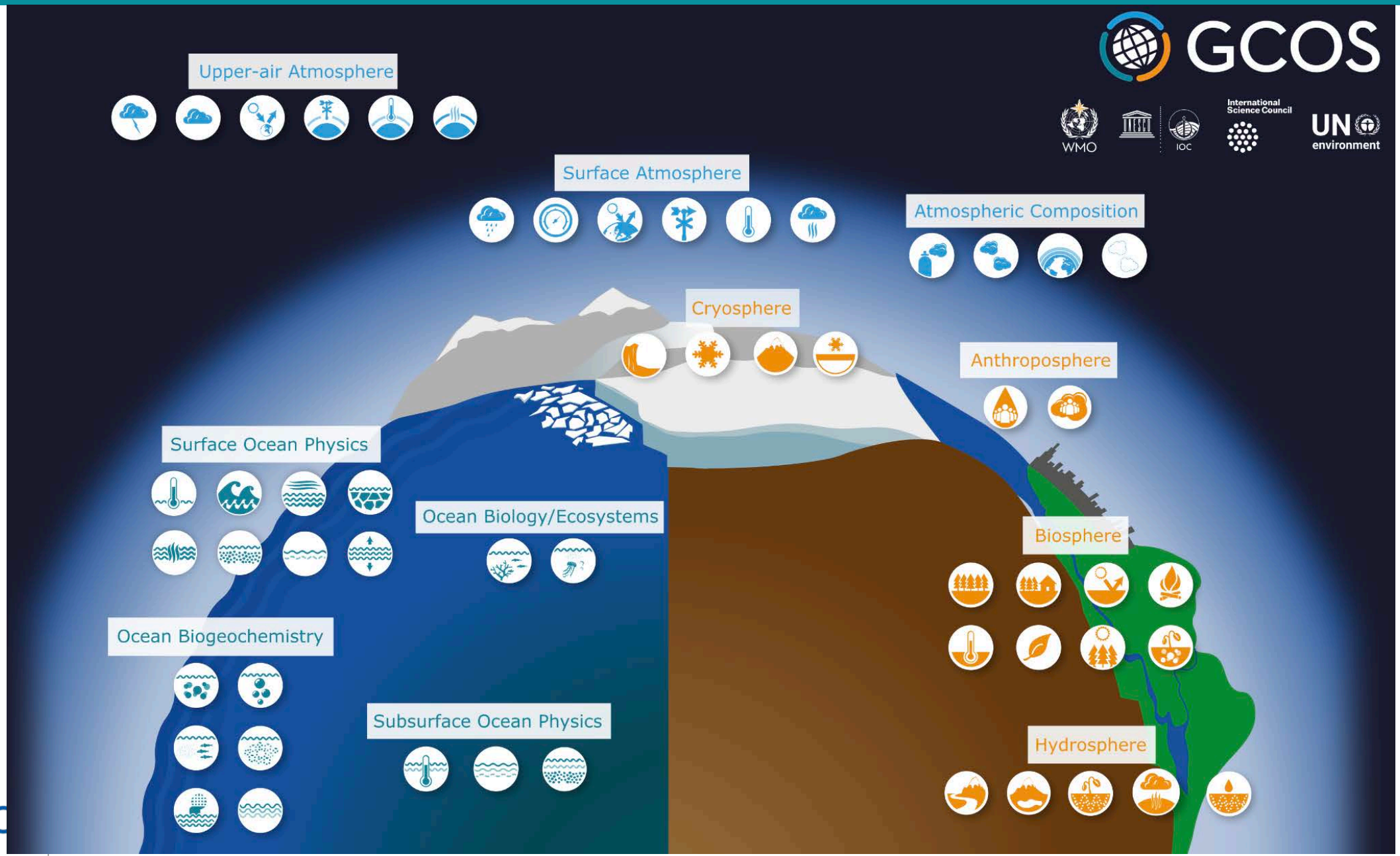
- This demands higher resolution climate observations and occasionally variable specifications (e.g for GHGs)



GCOS Role


GCOS
Suggest improvments needed to support users
"Implementation Plans"
Define requirements for ECV
Review Status of Observing System
(evalution of fitness for purpose)
"Status Reports"
Science Needs
Guidance, Implmentation Plans, ECV
Science Needs
Guidance, Implmentation Plans, ECV
Service Needs
Policy Needs
Sustained Observations
(Both in situ and satellite)
Data
Validation, QA, data storage, processing and distribution
Production of Climate Data
Climate Services & Applications
Science, Services, Policy
Information
Decision Making

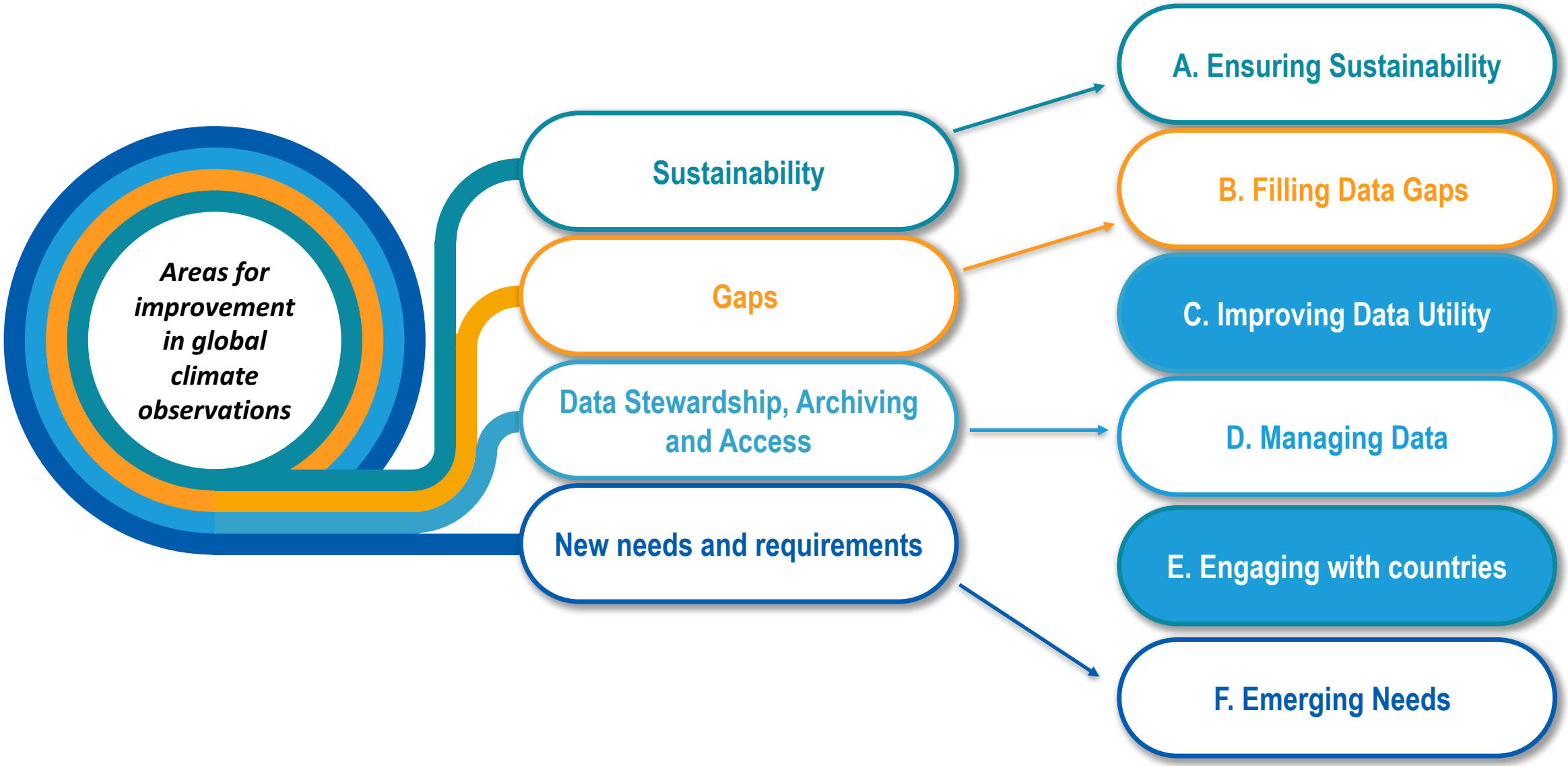
GCOS ECVs “monitor” the Earth’s water, energy and carbon cycle



- Every 5 years, Implementation Plans are prepared to address gaps and improvements in the observing system. This will be the fourth such plan and submitted to the UNFCCC before COP27

- It provides guidance to the component observing systems that contribute to global climate monitoring e.g. WMO, GOOS, WGClimate, Global Terrestrial Networks …

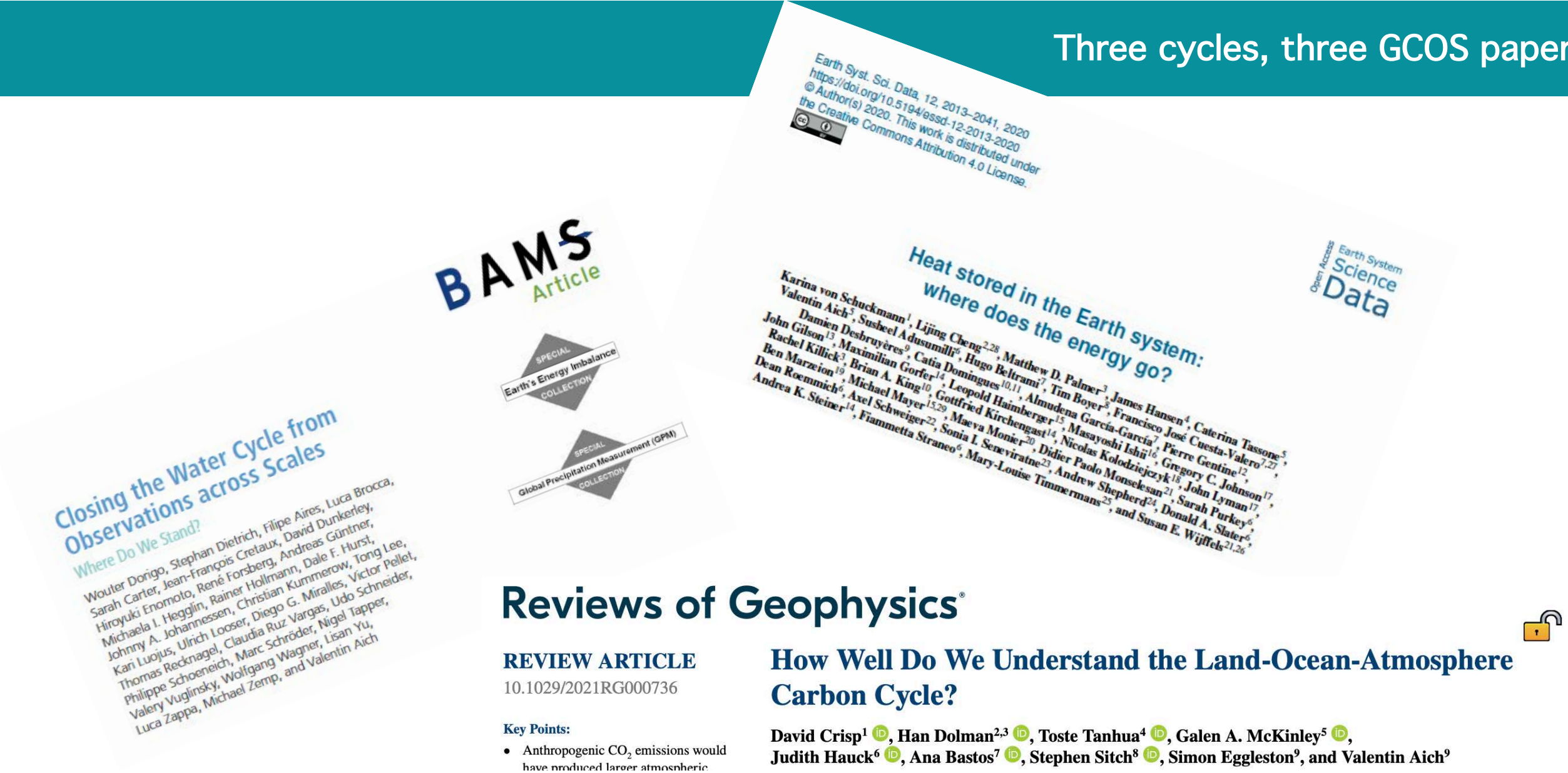
Themes for action identified in the GCOS IP



GCOS Status Report

GCOS IP

Three cycles, three GCOS papers



Earth Syst. Sci. Data, 12, 2013–2041, 2020
https://doi.org/10.5194/essd-12-2013-2020
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Heat stored in the Earth system: where does the energy go?

Karina von Schuckmann[1], Lijing Cheng[2,28], Matthew D. Palmer[3], James Hansen[4], Caterina Tassone[5], Valentin Aich[5], Susheel Adusumilli[6], Hugo Beltrami[7], Tim Boyer[8], Francisco José Cuesta-Valero[7,27], Damien Desbruyères[9], Catia Domingues[10,11], Almudena García-García[7], Pierre Gentine[12], John Gilson[13], Maximilian Gorfer[14], Leopold Haimberger[15], Masayoshi Ishii[16], Gregory C. Johnson[17], Rachel Killick[3], Brian A. King[10], Gottfried Kirchengast[14], Nicolas Kolodziejczyk[18], John Lyman[17], Ben Marzeion[19], Michael Mayer[15,29], Maeva Monier[20], Didier Paolo Monselesan[21], Sarah Purkey[6], Dean Roemmich[6], Axel Schweiger[22], Sonia I. Seneviratne[23], Andrew Shepherd[24], Donald A. Slater[6], Andrea K. Steiner[14], Fiammetta Straneo[6], Mary-Louise Timmermans[25], and Susan E. Wijffels[21,26]

Earth System Science Data

BAMS Article

SPECIAL Earth's Energy Imbalance COLLECTION

SPECIAL Global Precipitation Measurement (GPM) COLLECTION

Closing the Water Cycle from Observations across Scales

Where Do We Stand?

Wouter Dorigo, Stephan Dietrich, Filipe Aires, Luca Brocca, Sarah Carter, Jean-François Cretaux, David Dunkerley, Hiroyuki Enomoto, René Forsberg, Andreas Güntner, Michaela I. Hegglin, Rainer Hollmann, Dale F. Hurst, Johnny A. Johannessen, Christian Kummerow, Tong Lee, Kari Luojus, Ulrich Looser, Diego G. Miralles, Victor Pellet, Thomas Recknagel, Claudia Ruz Vargas, Udo Schneider, Philippe Schoeneich, Marc Schröder, Nigel Tapper, Valery Vuglinsky, Wolfgang Wagner, Lisan Yu, Luca Zappa, Michael Zemp, and Valentin Aich

Reviews of Geophysics

REVIEW ARTICLE

10.1029/2021RG000736

Key Points:

- Anthropogenic CO_2 emissions would have produced larger atmospheric

How Well Do We Understand the Land-Ocean-Atmosphere Carbon Cycle?

David Crisp[1], Han Dolman[2,3], Toste Tanhua[4], Galen A. McKinley[5], Judith Hauck[6], Ana Bastos[7], Stephen Sitch[8], Simon Eggleston[9], and Valentin Aich[9]

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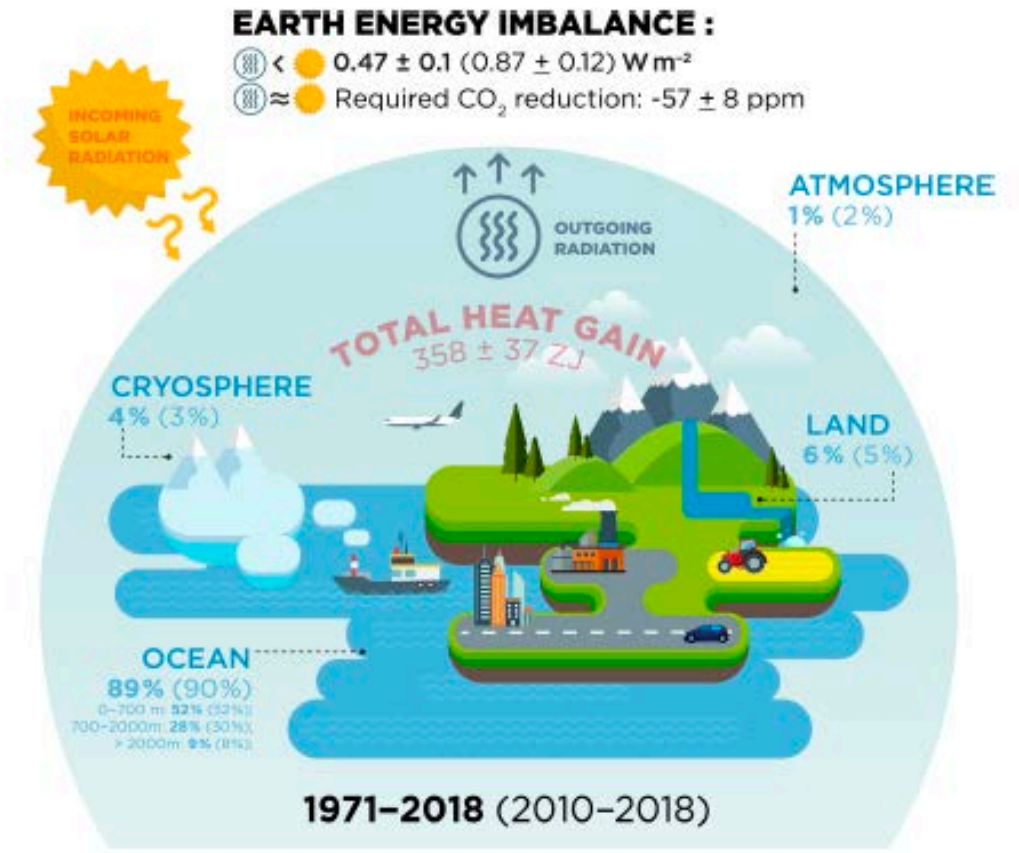
Water and Energy: Implications for observations



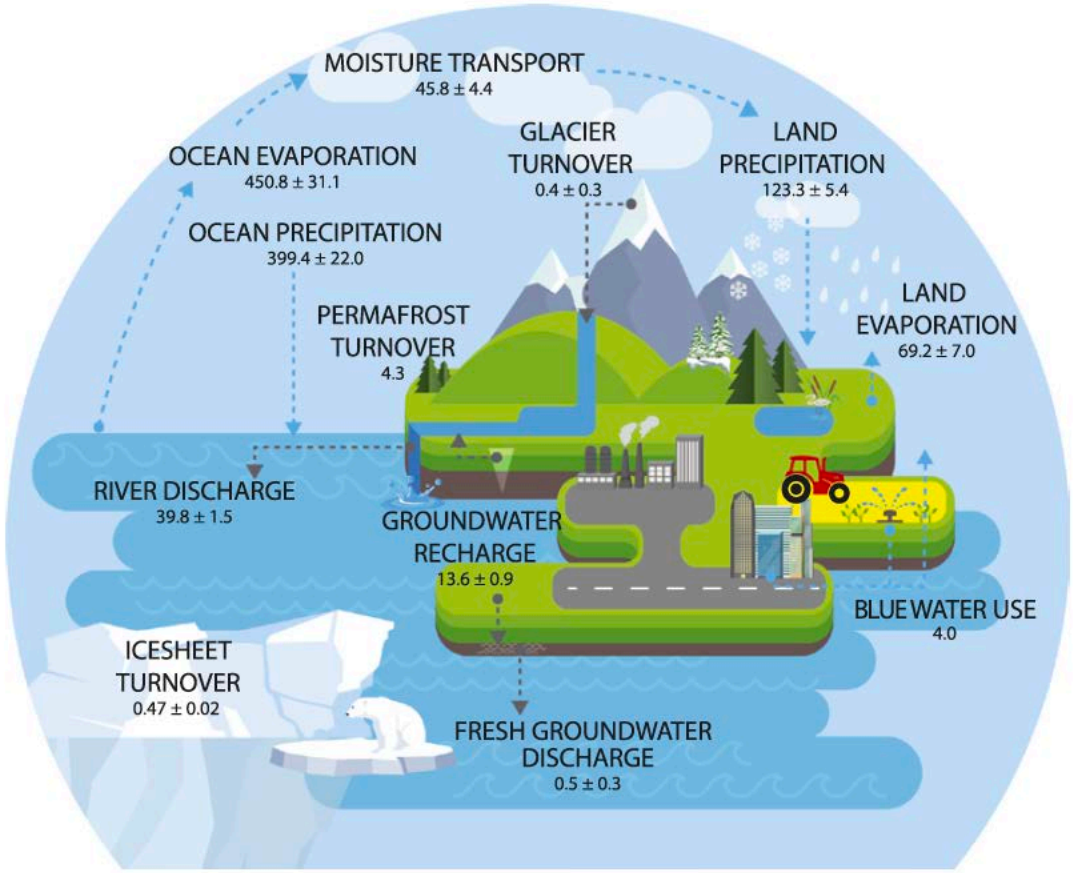
Von Schuckmann et al., 2020

Since >90 % of the excess *energy* goes into the ocean it is critically important to sustain and extend an *integrated ocean observing system* (ARGO, Satellites). Turbulent fluxes of latent and sensible heat are one of the critical uncertainties.

To be able to better close the global hydrological budget a new terrestrial ECV, *terrestrial total water storage*, has been agreed that integrates over the land hydrological cycle. It can be observed from space over large areas (GRACE and GRACE-FO) and links directly to one of the more uncertain ECVs: evaporation

Melting glaciers contribute about 50% of the total sea level rise. *Continuous monitoring*, satellite and in situ, of the large ice sheets and glaciers remains therefore critically important.

Water Cycle Assessment and recommendations



GLOBAL WATER CYCLE FLUXES

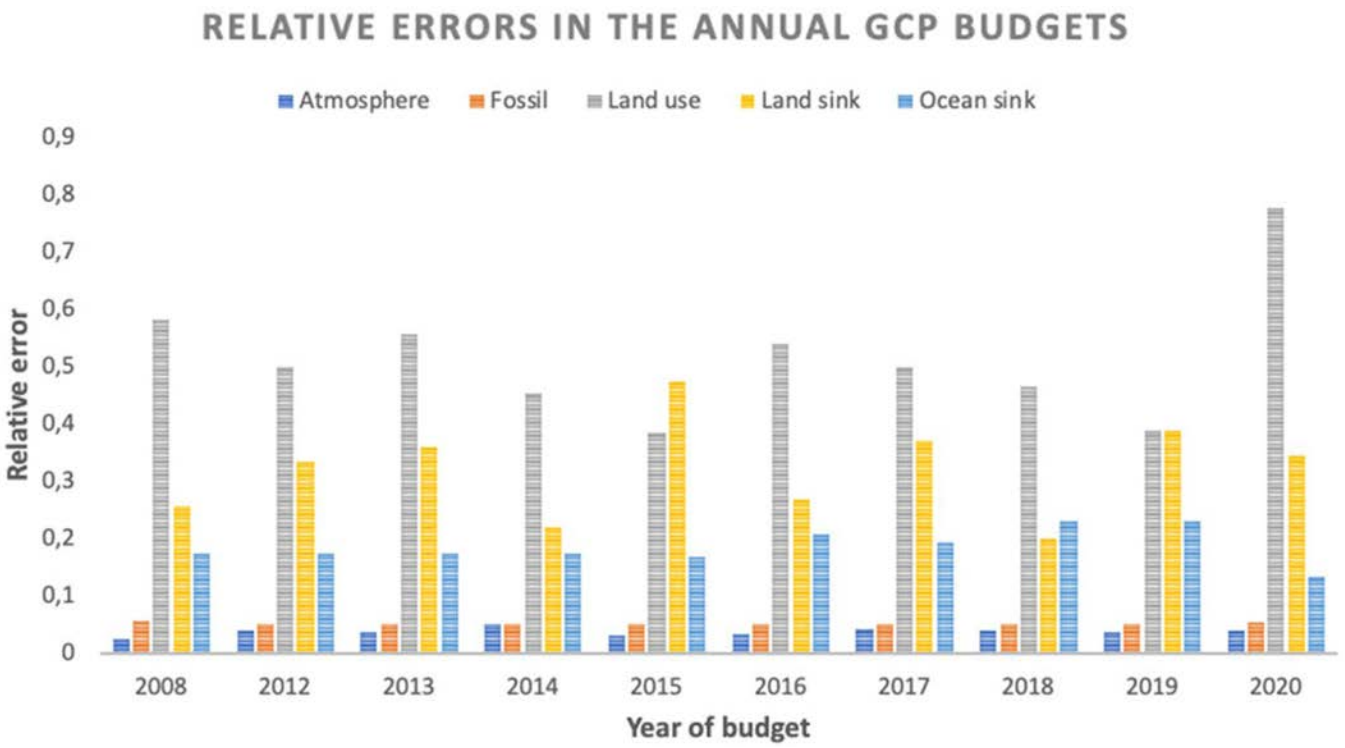
Dorigo et al., 2021

Trends in water cycle components can only be observed with great uncertainty, mainly due to insufficient length and homogeneity.

An advanced closure of the water cycle requires improved model–data synthesis capabilities, particularly at regional to local scales.

The definition of future observation systems should consider following a more integrated approach and observe water cycle components as part of their global cycle and assess its variability in conjunction with the energy and carbon cycles.

GCOS Carbon cycle error assessment



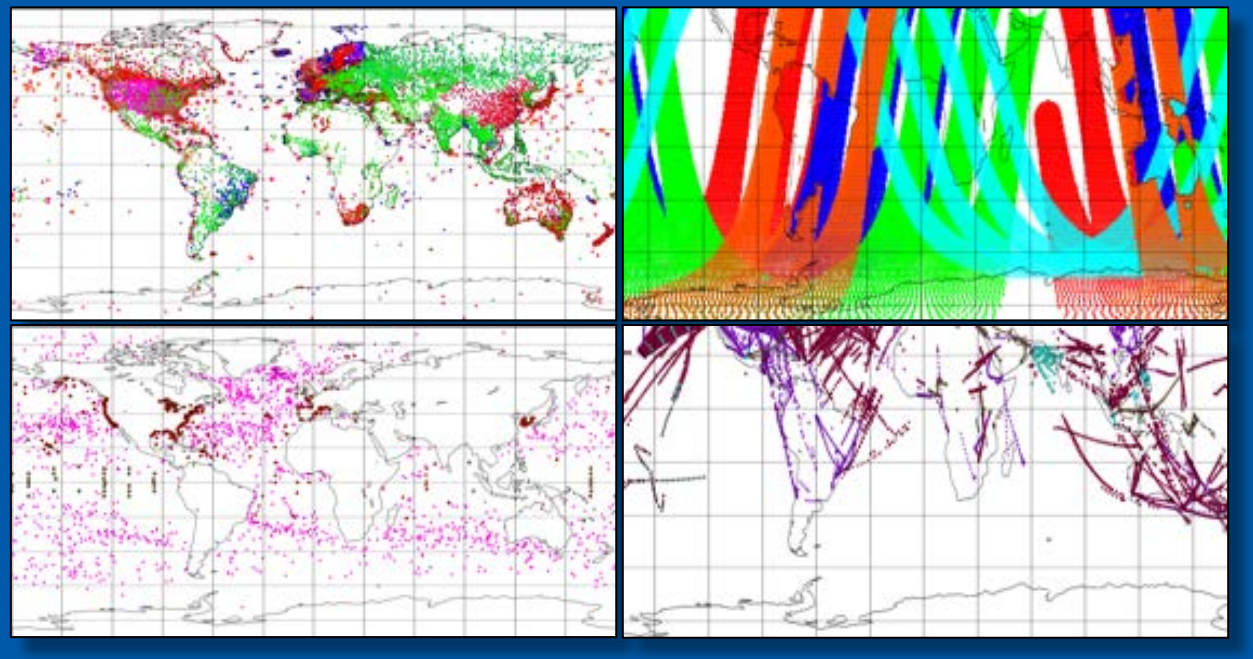
Crisp et al., 2022 Rev. Geophys. 2022

https://gcos.wmo.int/en/gcos-status-report-2021

- The discrepancy in observations of the carbon cycle between sources and sinks, reflects the overall uncertainty of observations and is 0.4 Gton C yr-1, or 3% of the global emissions.
- This uncertainty is caused by uncertainty in both the *land sink and land use change*. This hampers our ability to detect interannual changes and reduction impact
- **One cannot observe the anthropogenic cycle without knowing the natural cycle.**

GCOS and WCRP

- We are, by and large, complementary programs
- We have a lot in common, we should try to reinforce each other's messages
- We should relate to each other's WG and homes, conferences (ESMO)
- We should look at common themes
  - On the cycles we could work together:
    - After analysis of WCRP projects
    - Plan for a joint workshop later this year
    - Work on a joint program involving observations, models etc.
  - But we are also executing a similar exercise for adaptation



Thank you

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