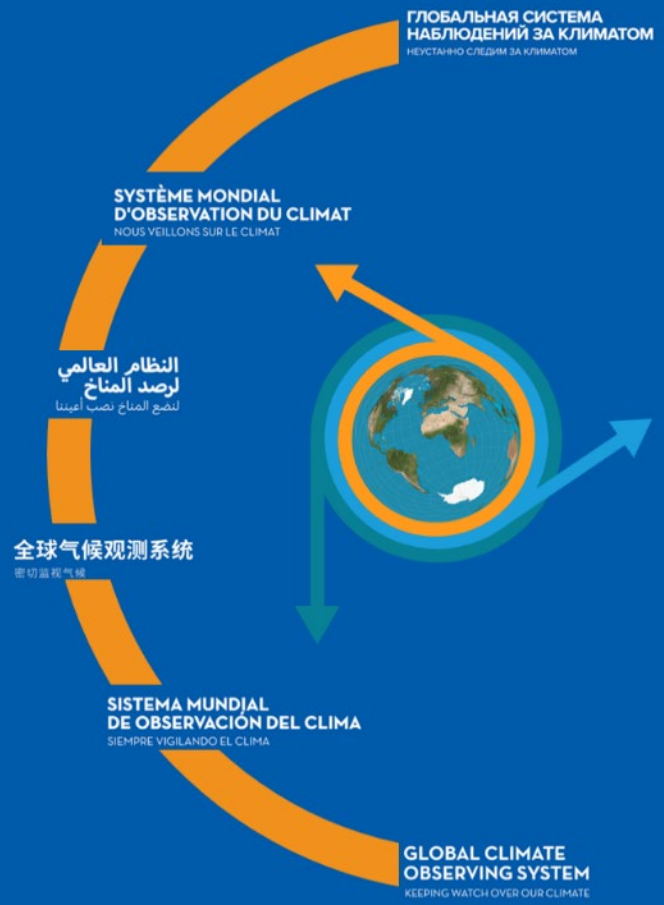


Climate Indicators
(item 7.8)

31st Session of the GCOS Steering Committee

Geneva, 2-5/07/2024

Martin Herold, TOPC Chair

GLOBAL CLIMATE OBSERVING SYSTEM
KEEPING WATCH OVER OUR CLIMATE

WMO

unesco
Intergovernmental Oceanographic Commission

International Science Council

UN environment programme

Supported by the European Union

opernicus
Europe's eyes on Earth

Global Climate Indicators

Temperature and Energy	Atmospheric Composition	Ocean and Water	Cryosphere
Surface Temperature	Atmospheric CO_2	Ocean Acidification	Glaciers
Ocean Heat	**No indicators from the biosphere!**	Sea Level	Arctic and Antarctic Sea Ice Extent

- **Defined by GCOS**
- **Endorsed by WMO**
- Describe climate change without reducing it to temperature only
- Comprise key information for the most relevant domains of climate change: temperature and energy, atmospheric composition, ocean and water, as well as the cryosphere
- They form the basis of the annual WMO Statement of the State of the Global Climate and are used by Copernicus C3S

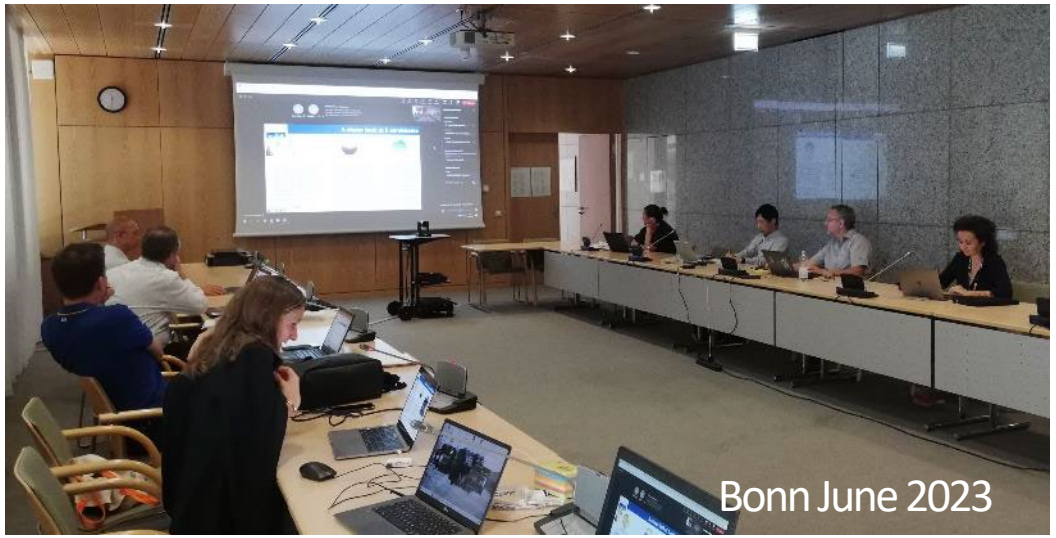
Addressing the GCOS Decision on Climate Indicators

2022 – Decision GCOS SC-30/4

"The Steering Committee decides that GCOS Secretariat works with WMO/Climate Services to explore the adoption of additional climate indicators. These new indicators could, for instance, cover new domains, reflect the earth cycles, and/or address extremes."

2023 – Cross Panel Group on Global Climate Indicators

GCOS Joint Panel Meeting, Bonn, 26-30 June 2023


Bonn June 2023

2024 – GCOS SC-31

The Steering Committee is requested to provide view and guidance to the GCOS Secretariat, especially on the fact-sheet template and proposed timeline for the development and inclusion of additional indicators.

Cross Panel Group on Climate Indicators

- GCOS Joint Panel Meeting, Bonn, 26-30 June 2023
- Cross Panel Group with 16 experts from the 3 GCOS Panels (AOPC, OOPC, TOPC)
- Chairs: Karina von Schuckmann and Martin Herold

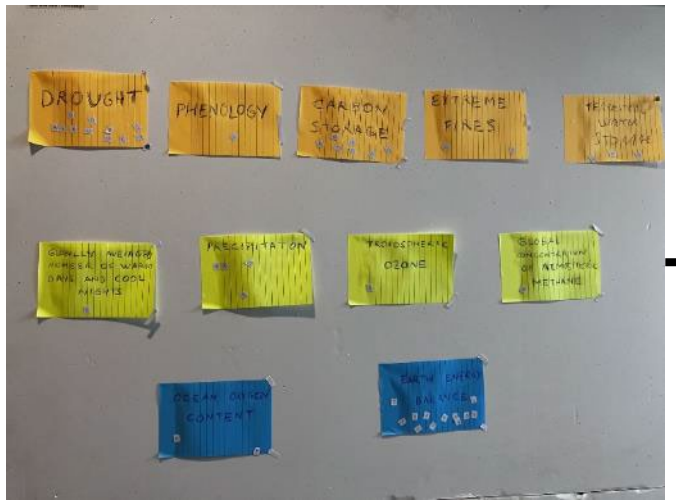
Main Outcomes:

- Global climate indicators to link science & policy
- 11 proposals for new indicators
- Revised definition of a global climate indicator
- Refined description of the 5 criteria to identify a global climate indicator
- Prioritization of the new proposed indicators

1. Ecosystem drought
2. Terrestrial carbon storage
3. Phenology
4. Extreme Fires
5. Terrestrial water storage

6. Globally averaged number of cold and warm days
7. Precipitation
8. Tropospheric Ozone
9. Global CH_4 concentration

10. Earth energy imbalance
11. Ocean oxygen content



proposed new indicators

Definition of Global Climate Indicators

A global climate indicator:

- informs on the observed change in the state of the Earth climate system in an easy-to-understand way for policymakers and the public;
- is based on robust, scientific-sound and timely data and methods;
- emphasizes detectable change in the state of the climate system in a comprehensive and holistic way across space and temporal scales.

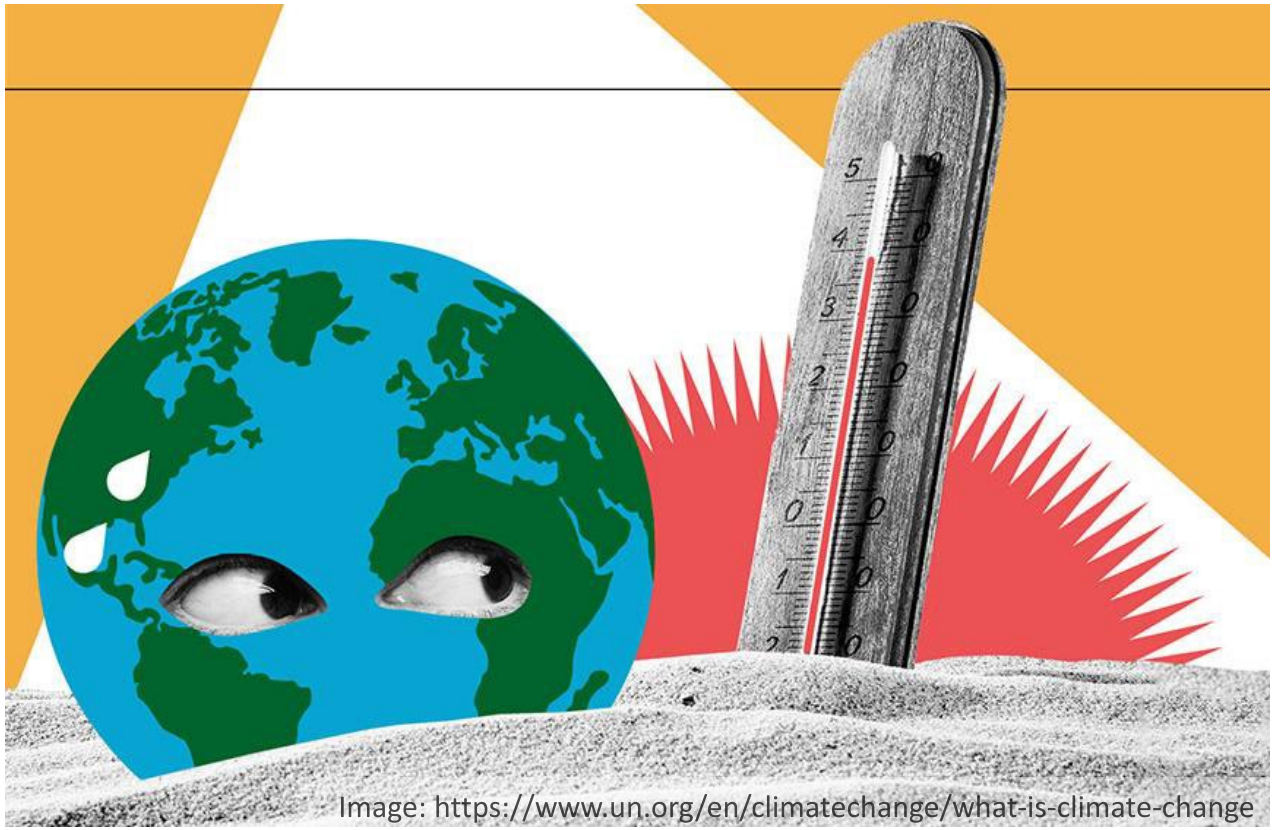
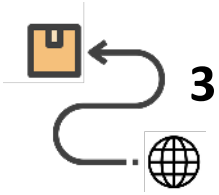


Image: https://www.un.org/en/climatechange/what-is-climate-change

Criteria for Global Climate Indicators

1. **Relevance:** it should inform on observed change in the state of the Earth climate system in an easy-to-understand way relevant for policymakers and the public. It should also serve to guide on observing system gaps across time and space scales.

2. **Representativeness:** it represents change in the Earth climate system at global scale and can be also used at regional scale. It integrates detectable change in the state of the climate system in a comprehensive and holistic way and will have value across temporal scales.



3. **Traceability:** it should be calculated using commonly endorsed and transparent scientific-sound methods.

4. **Timeliness:** it should be possible to calculate it regularly, annually at least, and with a short lag between the end of the period and the publication of the data.

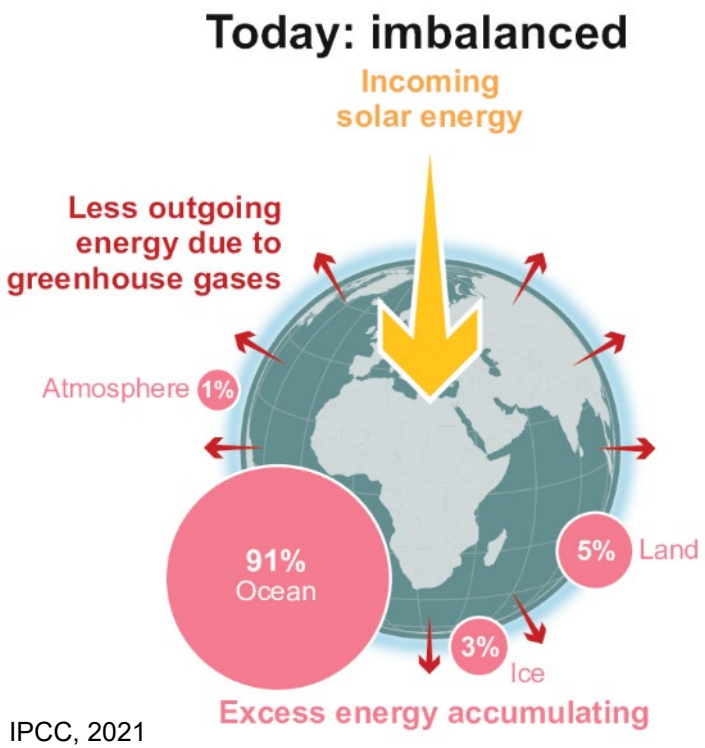
5. **Data adequacy:** the needed data and method must be sufficiently robust, verified and accessible.

New Indicators Factsheet

1. **Introduction –** with a brief summary describing the background, including complementary with existing indicators.
2. **Short description –** responding to the question: what is ‘new indicator name’?
3. **Sound justification –** providing scientific evidence – responding to the question: why is ‘new indicator name’ important?
4. **How it is measured –** including data sources, level of operationality.
5. **Criteria –** a paragraph (or a matrix) showing how the new indicator matches with the 5 criteria.
6. **Message –** what easy-to-communicate information can deliver (message to bring to the general public and decision makers)?

Earth Energy Imbalance

What does this indicator tell us?

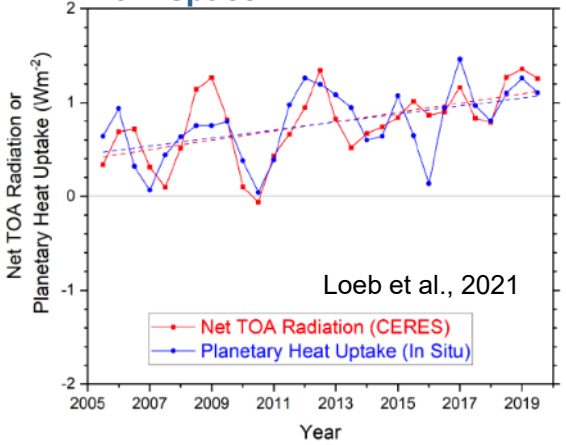


IPCC, 2021

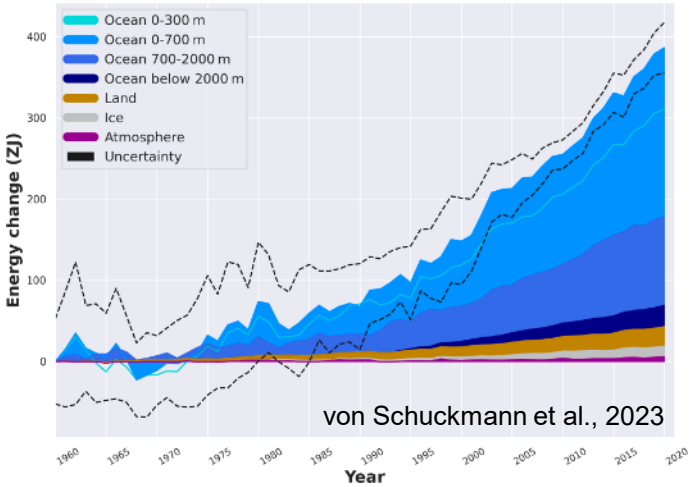
This indicator tells us how the Earth is out of energy balance, and how much and how fast Earth climate warms.

How is this indicator measured?

From space

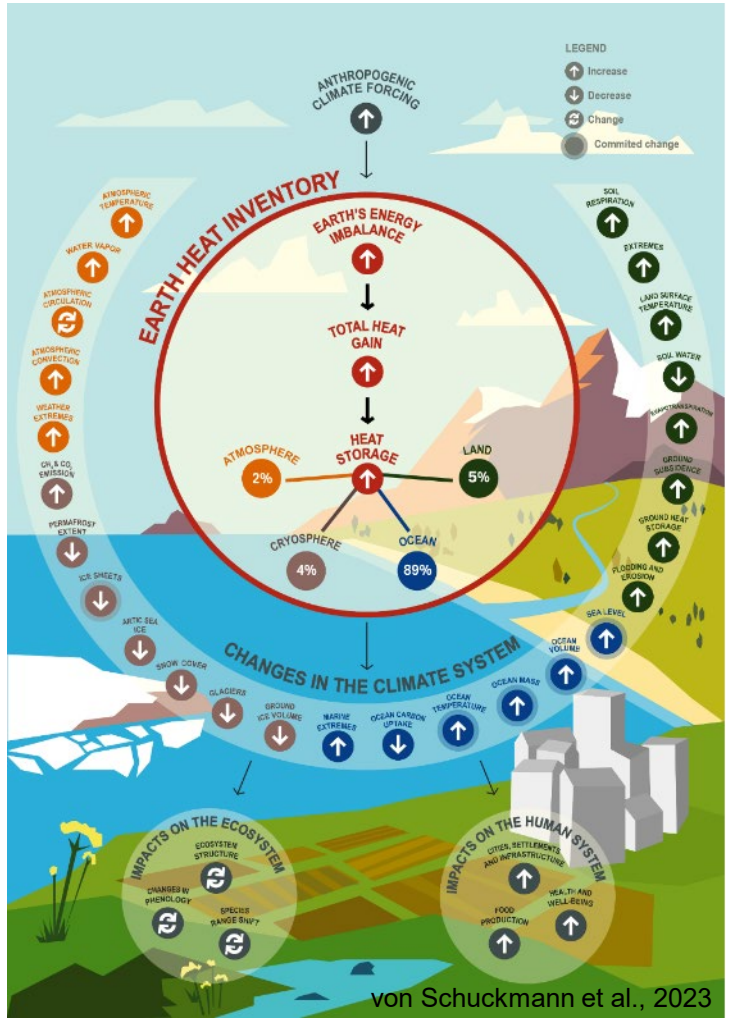


From space, in situ, models



Monitoring & assessing GCOS capacity

Why should we care?



Quantify the current and future state of global warming

Ecosystem Drought

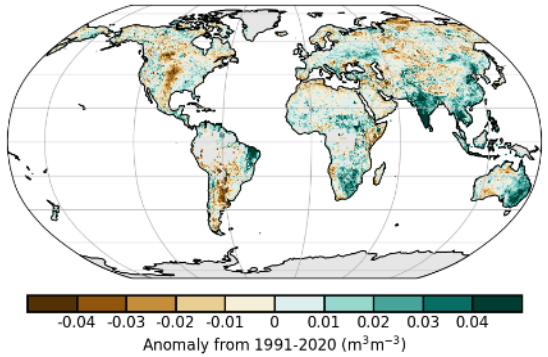
Indicator shows **impacts of water shortage on biosphere**

We propose to focus on **soil moisture drought**

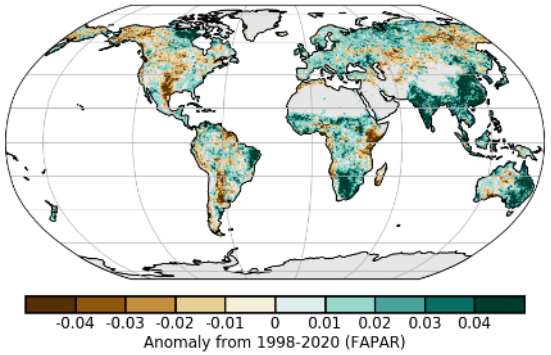
- This is a *direct indicator* of the effects of water shortage
- More *immediate* than e.g. runoff (hydrological drought)
- High *socioeconomic and ecosystem relevance* (affecting yield, food prices, famine, etc.)
- Based on *well-established soil moisture ECV*

Soil moisture and ecosytem functioning very **strongly coupled** around the globe:

Soil moisture anomaly 2022



fAPAR anomaly 2022

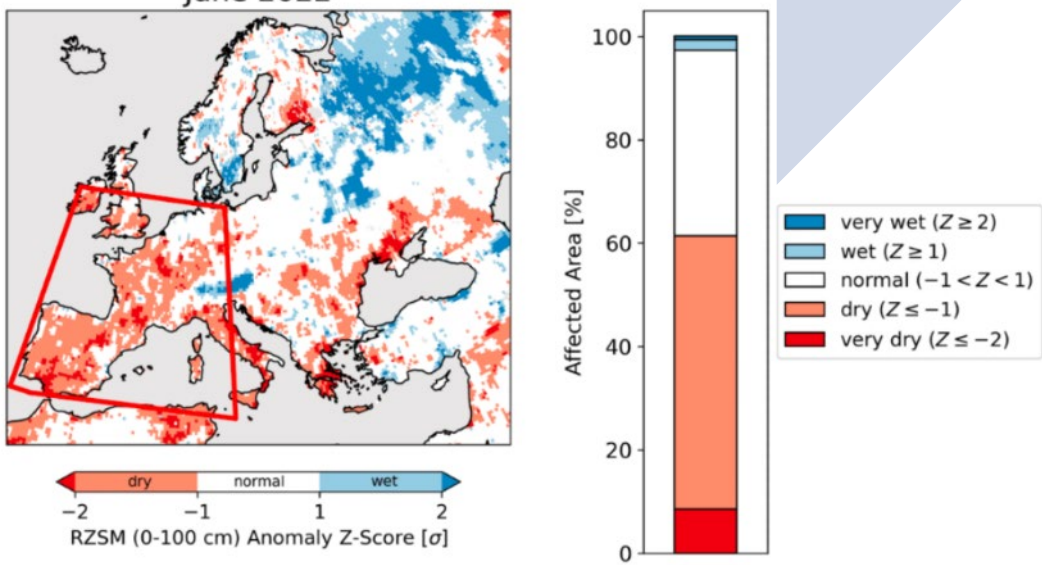


[From BAMS state-of-the-climate in 2022]

How is it measured?

Soil Moisture	Z-score	Drought index	Categori-sation	Aggregat-ion
measured by single satellites	severity of anomaly, for single satellites	Combined z-scores	(e.g. moderate, severe, extreme drought)	for climate dashboard: **X% of ecosystems under drought**

June 2022



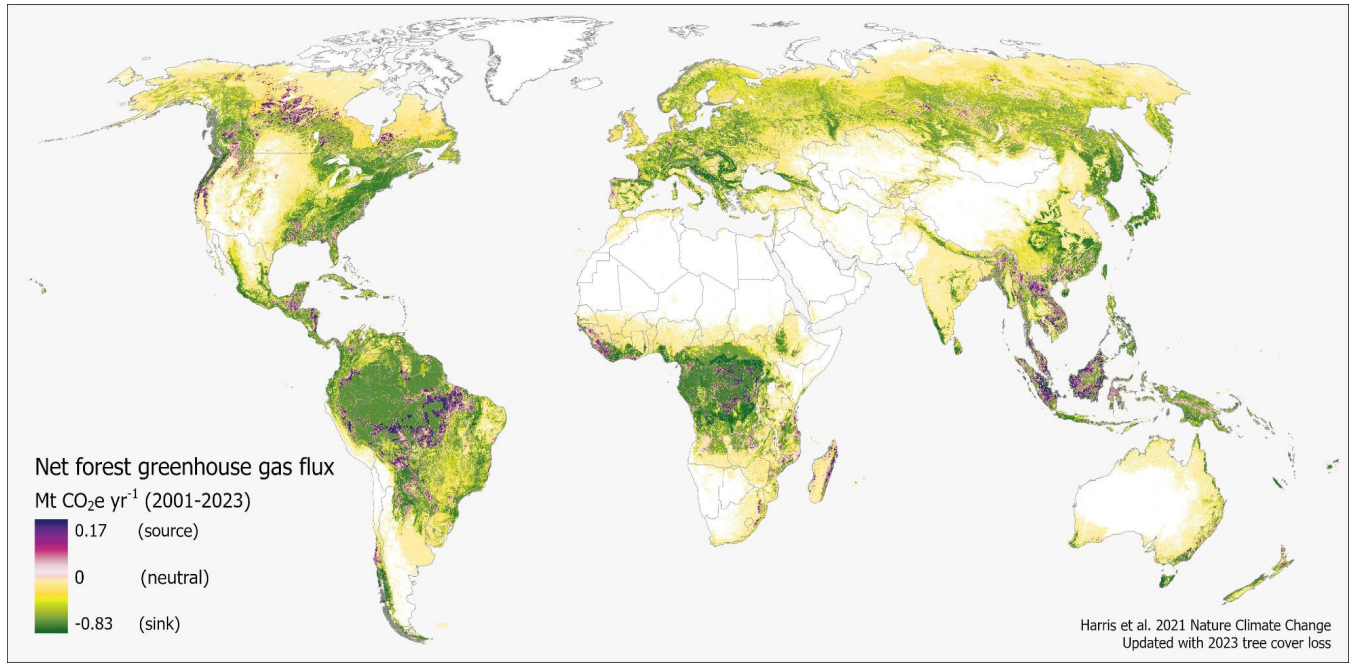
Data source: C3S v202012 PASSIVE | Credit: C3S/TU Wien | Reference Period: 1991-2020

Terrestrial Carbon Storage

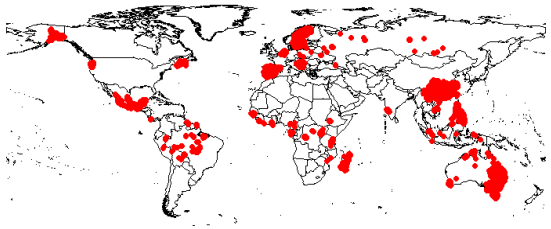
Indicator shows overall changes and regional sinks and sources in terrestrial carbon storage

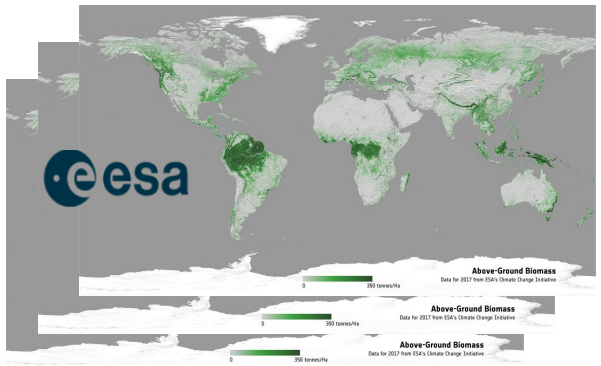
We propose to focus on **forests (as a start):**

- A *direct indicator* of the effects of climate extremes and human activities on land (annual, since 2000)
- Related to national LULUCF inventories
- High *socioeconomic and ecosystem relevance* as both cause of climate change and climate solution
- Based on well-established aboveground biomass ECV space and ground-based monitoring, can be expanded to include belowground and soils



Space-based and on the ground monitoring has improved around the globe:





ESA Global aboveground biomass for 2010, 2015-2022
100m spatial resolution, http://cci.esa.int/biomass
Santoro et al., 2021, ESSD

Next steps:

- Mobilize terrestrial carbon monitoring community to refine indicator
- Integration with in-situ data and reducing uncertainties
- CEOS GST biomass harmonization exercise that one can capitalize on

Proposed Timeline

Time	Activity	Responsible
Q4 2024	Prepare Fact-Sheet	GCOS Sec + Panel Experts
Q1 2025	Present the findings and proposals to WMO Services for their consideration.	GCOS Sec
Q2 2025	Discuss the need and development of information sheets (e.g., policy brief style) for informing on current indicators, and for the proposed ones.	Panel Experts
Q4 2025	Present the new indicators at the Earth Information Day, UNFCCC COP-30	GCOS Sec + GCOS Chair
Q4 2025	Face the opportunity of regionalization of global climate indicators in the future (to be discussed).	Panel Experts

Thank you!

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