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CLIMATE-SPACE

Overview: background, objectives & rationale

CLIMATE SPACE

THE ESA CLIMATE OFFICE



- Focal point for climate activities in ESA
- Representing ESA's interests in the international climate (science, service and policy) network
- Observer at IPCC and UNFCCC
- Host to WCRP's CMIP-IPO since March 2022
- Link to Future Earth through secondment
- Flagship programme: Climate Change Initiative

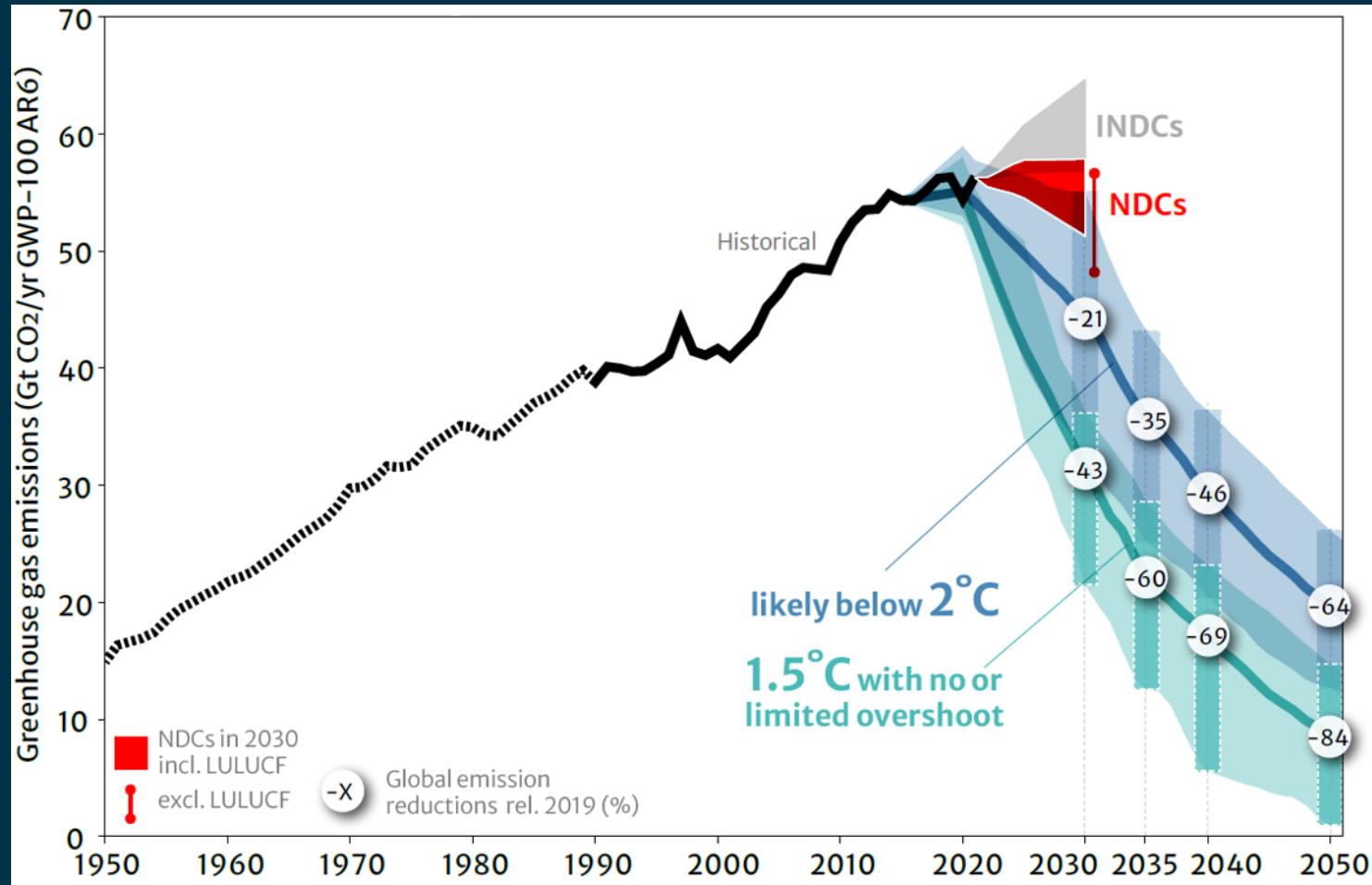
www.climate.esa.int

The CMIP International Project Office

- Coupled Model Intercomparison Project (CMIP) has expanded to a point where coordination of its elements requires dedicated secretariat support.
- Focal point for leading national and international entities in climate modelling
 - Emphasises role of EO datasets for model evaluation
 - Brings EO and modelling communities closer
- Main contributor to climate prediction and projection in IPCC
- ESA's Climate Office hosts the CMIP-IPO since March 2022
- IPO team consists of:
 - Director (Eleanor O'Rourke)
 - Programme Manager (Briony Turner)
 - Science & Communications Officer (Beth Dingley)
 - Technical Officer/Software Engineer (Daniel Ellis)
 - Team support (Alice Kolesnikov)



Staff from HE Space Operations under contract to ESA



Technical dialogue of the first global stocktake, September 2023

Synthesis report by the co-facilitators on the technical dialogue

Historical emissions from 1950, projected emissions in 2030 based on nationally determined contributions) 2022 NDC synthesis report for 1990–2020;), and emission reductions required by the Sixth Assessment Report of the Intergovernmental Panel on Climate Change

The *GOLD STANDARD* of state of climate assessments



IPCC SYNTHESIS REPORT

Release date: 20 March 2023

Re-emphasise the call for action in terms of taking measures for adaptation and mitigation and identifies opportunities for both.

The report warns that

- *“Currently insufficient action to limit warming to even 2deg C”*
- *“Global GHG emissions must half by 2030, to stay below 1.5”*
- *“For any given future warming level, many climate-related risks are higher than assessed in AR5 and projected long-term impacts are up to multiple times higher than currently observed (high confidence)”*
- *“Some future changes are unavoidable and/or irreversible but can be limited by deep, rapid and sustained global greenhouse gas emissions reduction.”*

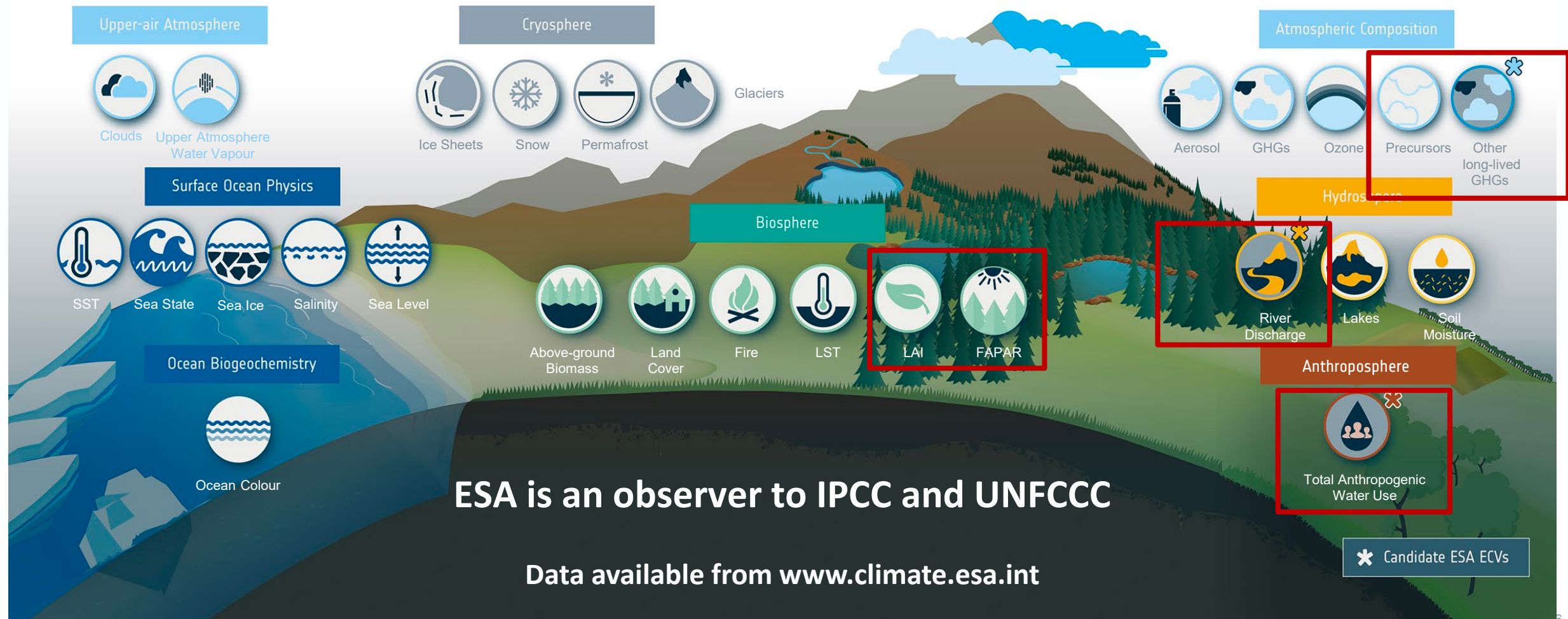
Note: Increased use of satellite data and new methodology in AR6

ESA'S CLIMATE CHANGE INITIATIVE



GCOS defined **55** Essential Climate Variables | **36** benefit from space observations | **27** generated by ESA Climate Change Initiative

**Newly added ECVs
2022-2023**



ESA is an observer to IPCC and UNFCCC

Data available from www.climate.esa.int

THE INTERNATIONAL CLIMATE NETWORK

Policy drivers for CLIMATE-SPACE

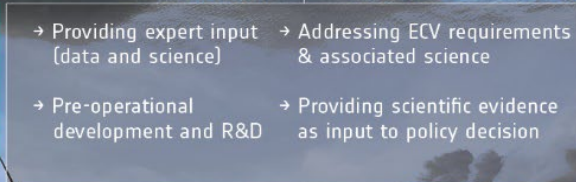
- GCOS & WCRP requirements
- UNFCCC Paris Agreement
- IPCC Assessment Reports
- New users: tipping points, biodiversity & ecosystems, health
- *2030 Agenda for Sustainable Development*
- *Sendai Framework for Disaster Risk Reduction 2015–2030*
- *EU's Green Deal*

Focus on Collaboration & Complementarity & Synergy

STAKEHOLDERS



ESA'S ROLE



USERS



GATHERING EVIDENCE FROM



Expert advice

- Climate Science Advisory Board

Science community

- CCI Science Leads' interaction and feedback, www.climate.esa.int

Stakeholders

- Climate Modelling User Group's "Foresight Report" led by UK Met Office
- https://climate.esa.int/media/documents/CMUG_D1.2-Foresight-Report-V4.1_8EMjc8o.pdf
- ESPI "Horizon Study", EO to support climate policies in Europe
- Workshops with Copernicus services and EUMETSAT

Preparing CLIMATE-SPACE

- RECCAP-ESA <https://climate.esa.int/en/projects/reccap-2/>
- Tipping Points in the Earth's Climate <https://climate.esa.int/en/news-events/remote-sensing-tipping-points-climate-system/>
- Space-based Earth observation in support of the UNFCCC Paris Agreement, Hegglin M et al., Front. Environ. <https://doi.org/10.3389/fenvs.2022.941490>

Member States

- CCI Mid-Term Review (ESA/PB-EO(2021)9)
- Bilateral "Climate Days" with ESA member states



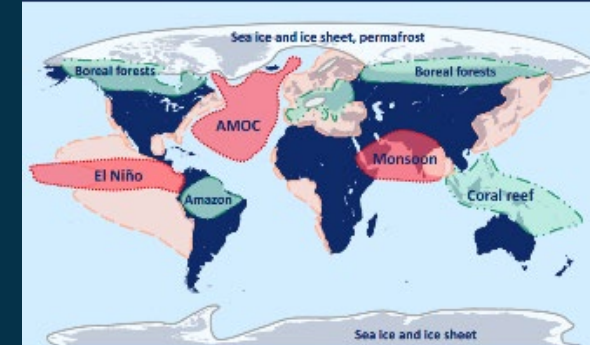
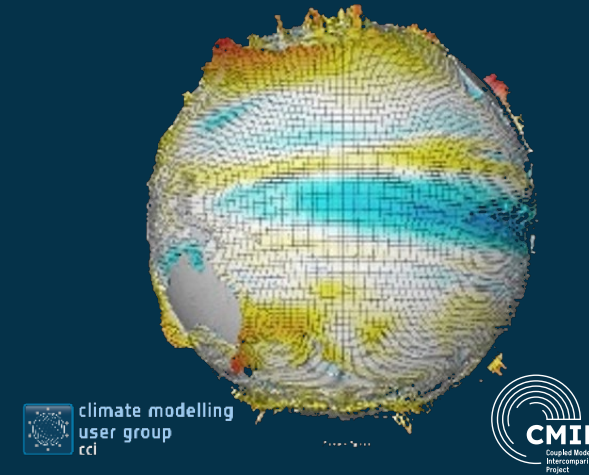
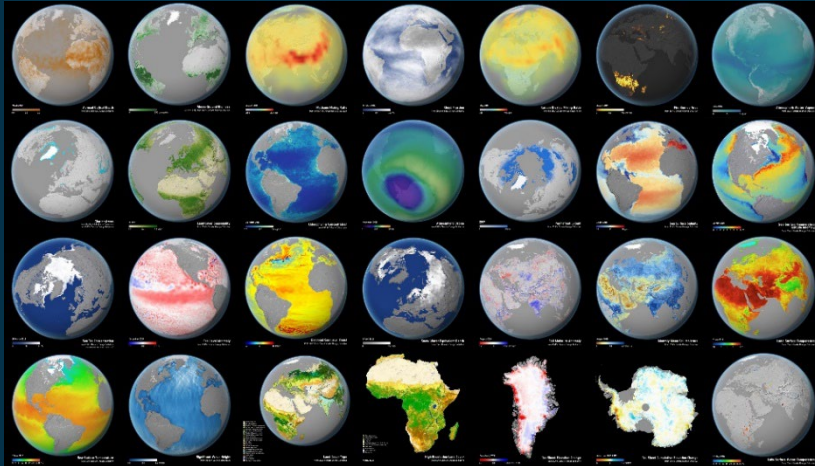
Hegglin et al. (2022) Front. Environ



EXPANDING ESA's CLIMATE CHANGE INITIATIVE



Duration: 2023-2029 | Funding: phase 1 ~90 Meuro ; phase 2 – TBD at CMIN 2025



- Providing **physical evidence** for a changing climate, R&D for **operational climate services**
- Earth observation data support and verify the **UNFCCC Paris Agreement** pledges
- **Linking observations with modelling** provides trustworthy climate predictions and projections
- **Cross-ECVs and Tipping Points**

Further information on upcoming opportunities

<https://climate.esa.int/en/esa-climate/climate-space-information-day-10-may-2023/>

- **Theme I** – The excellence base – ECVs
- **Theme II** - Cross-ECV applications
 - Support to climate policy needs: UNFCCC Paris Agreement
 - Cross-ECVs
 - Tipping Points
- **Theme III** - Linking climate observations & modelling
- **Theme IV** - Knowledge Exchange

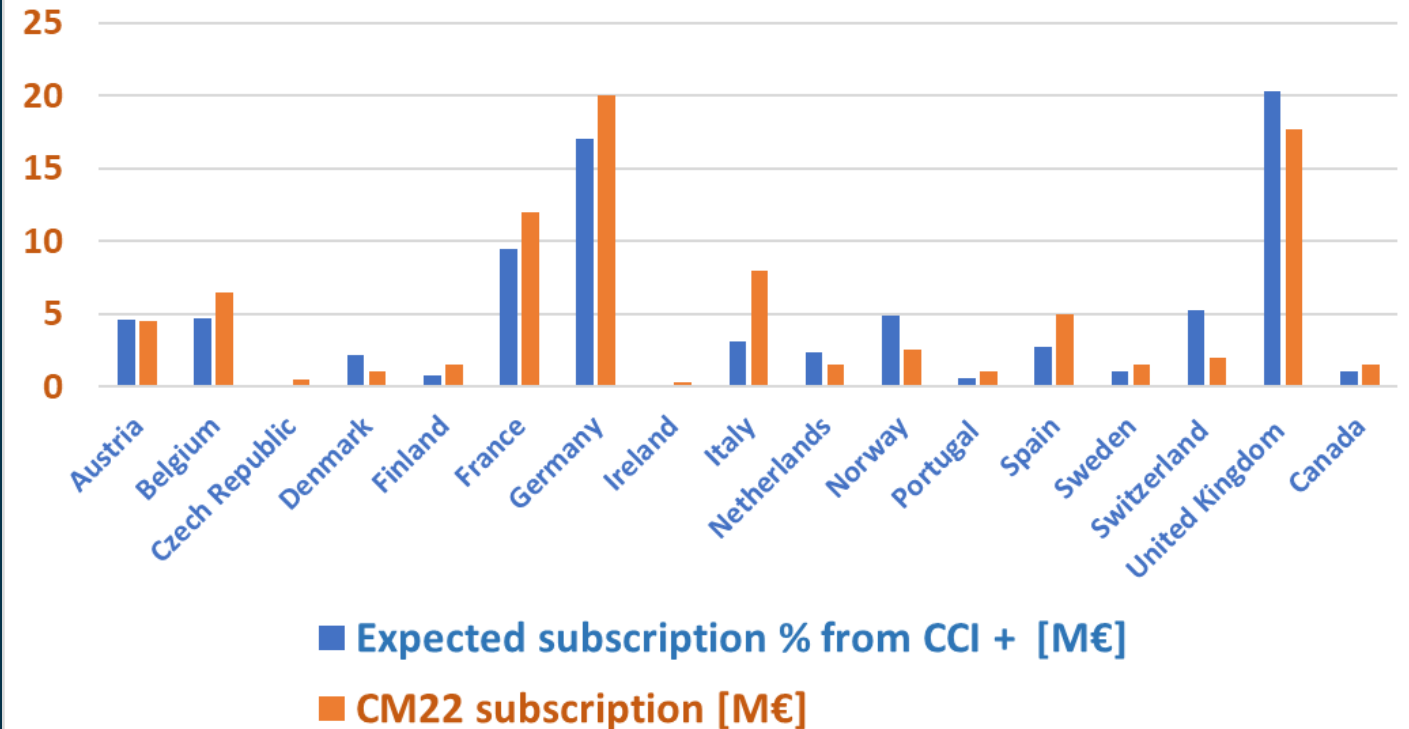
Implementation approach (in a nutshell)

- Maintain and extend the existing Excellence Base T-I
- Focus on establishing new activities under T-II/ III
- Evolve and adapt T-IV

A few observations

- **Over-subscription** additional ~ 6 M€ (total ~87 M€)
- **Larger financial envelop** CCI+ ~8 M€ /y → CLIMATE-SPACE 14 M€ /y
- **National funding distribution** largely maintained

Subscription to CLIMATE-SPACE CM22



Funding Member States

Main F, DE, UK

New CZ, IE

More BE, FI, F, DE, I, E, S

Less DK, N, NO, CH, UK

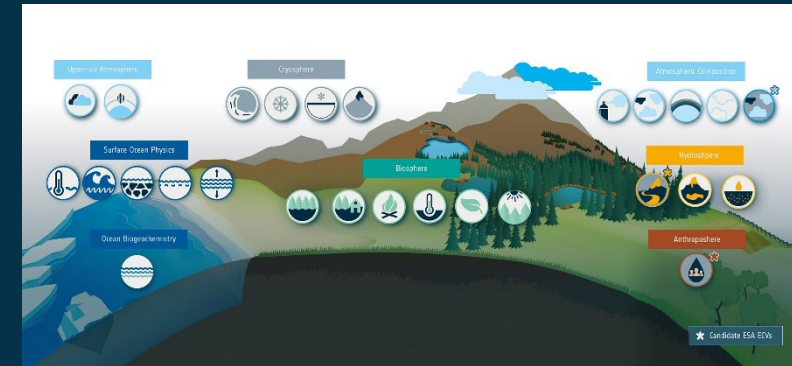
THEME I – The Excellence Base

Two objectives

1. **Extending** the existing portfolio of 28 Essential Climate Variables projects based on **evolving** user requirements (e.g., GCOS, IPCC, UNFCCC, Paris Agreement, CMIP-7, R&D for operational services etc) as well as exploiting ESA's new satellite missions until end of 2026.

2. **Expanding** the existing portfolio of Essential Climate Variables responding to **new** requirements (e.g. evapotranspiration, turbulent fluxes-ocean, fluorescence, lightning etc); new additions to the ECV portfolio to be chosen according to pre-defined selection criteria (defined in implementation plan)

Anticipated CCNs: 28
RFQ released starting Q1 2024 | 0.5-2 M€
Procurement mechanism: Direct negotiation



Anticipated Contracts: 3
ITT to be released in Q2 2024 | 0.5-2 M€
Procurement mechanism: Open competitive tender

THEME II – Cross-ECVs

- Support to climate policy needs: UNFCCC Paris Agreement
 - *Global land carbon budget and its attribution to regional drivers (Clément Albergel)*
 - *Regional Climate process study, field campaign over the Amazon (Clément Albergel)*
 - *GHG Emissions (Simon Pinnock)*
- Cross-ECVs (Anna Maria Trofaier)
- Tipping Points (Claire MacIntosh/ Sophie Hebden)

Expanding on results from RECCAP-2 and working with operational climate services

1. ITT on Global land carbon budget and its attribution to regional drivers

Anticipated Contracts: 1
Release Q4 2023 | 2-3 M€ | 3 years
Open competitive tender

Bastos, A., Ciais, P., Sitch, S. et al. On the use of Earth Observation to support estimates of national greenhouse gas emissions and sinks for the Global stocktake process: lessons learned from ESA-CCI RECCAP2. Carbon Balance Manage 17, 15 (2022). <https://doi.org/10.1186/s13021-022-00214-w>



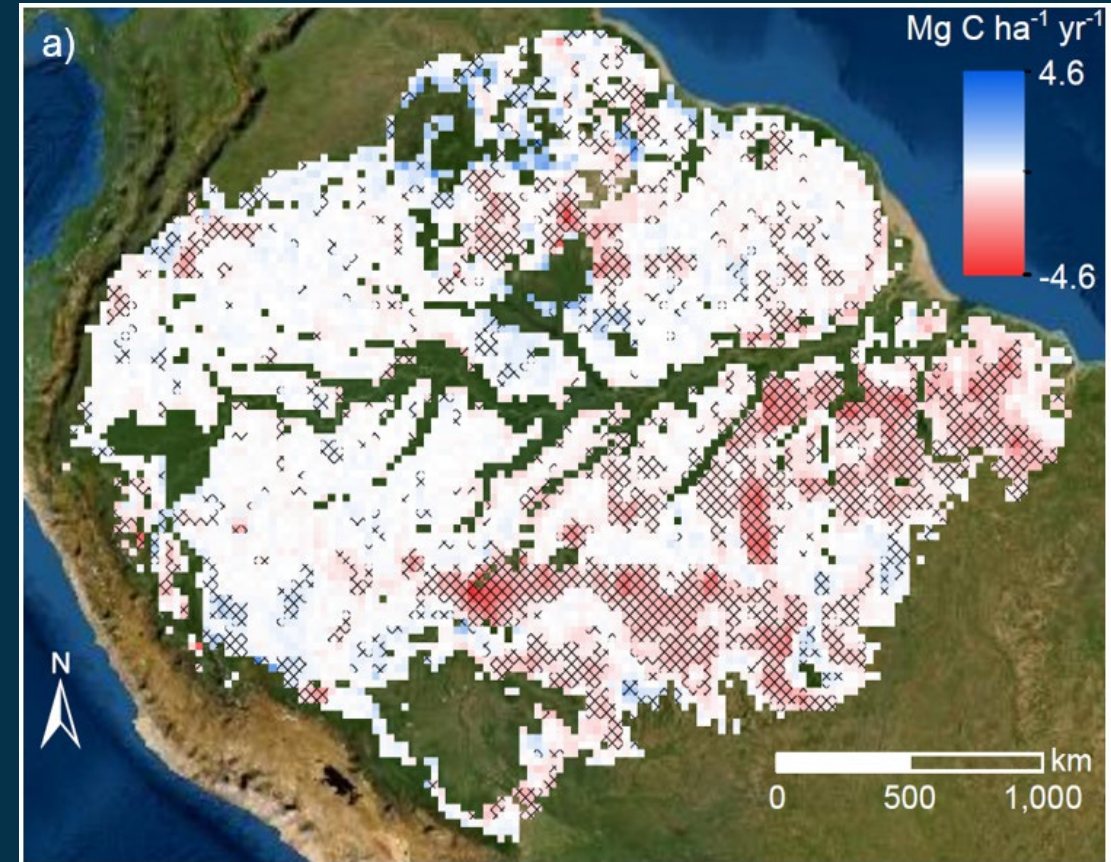
2. ITT on GHG Emission

Anticipated Contracts: 1
Release Q3 2023 | 2-3M€ | 3 years
Open competitive tender

Scoping an Amazon field campaign

- **CEOS strategy** to support GST under Paris Agreement recommended campaigns in focal areas on the globe where there is greater modelling uncertainty, e.g. Amazon Basin and the Siberian tundra.
- Better understand the **spatio-temporal variation in carbon stocks and fluxes (CO₂, CH₄) associated with different land cover** types and changes (fires, deforestation, forest degradation etc)
- Set up a **field experiment** covering local to regional scales with long-term ground-based (proximal sensing + in-situ) and air- and space borne observations.
- The activity will be performed in **cooperation** with Brazilian partners, NASA and selected Partners from Europe
- **Location:** Tapajos (Para state)
- **Status:** in definition phase

Trends in Amazon AGC 2011-2019 using satellite L-VOD

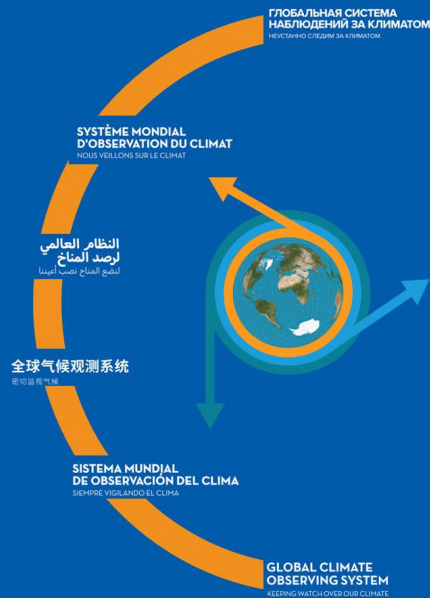


Fawcett et al., GCB, [Amazon biomass in decline due to deforestation and degradation](https://www.esa.int/ESA/Earth_Engineering_and_Technology/Earth_Engineering/Amazon_biomass_in_decline_due_to_deforestation_and_degradation) (esa.int)

THEME II – Cross-ECVs

- Support to climate policy needs: UNFCCC Paris Agreement (Clément Albergel, Simon Pinnock)
- **Cross-ECVs (Anna Maria Trofaier)**
- Tipping Points (Claire MacIntosh/ Sophie Hebden)

The 2022 GCOS Implementation Plan



GCOS – 244
GOOS – 272



Issues identified

- Uncertainties associated with the terms of the budget,
- The possibility and need to look at regional instead of global budgets, particularly the Arctic,
- The important role of the ocean in all cycles (particularly ocean-air fluxes and storage),
- The important role of atmospheric circulation.
- Energy, the role of clouds,
- Water,
 - determining regional budgets,
 - the estimation of evaporation (both on land and ocean)
- Carbon,
 - determining the role of the CO₂-fertilisation effect on land
 - the uptake of anthropogenic CO₂ by the ocean

(from workshop summary presentation by Han Dolman, personal communication)

ESA ITT on cross-ECV
Anticipated Contracts: 2-4 | 0.5-2 M€ per contract
Release in Q4 2023
Open competitive tender

THEME II – Cross-ECVs

- Support to climate policy needs: UNFCCC Paris Agreement (Simon Pinnock Clément Albergel)
- Cross-ECVs (Anna Maria Trofaier)
- **Tipping Points (Claire MacIntosh/ Sophie Hebden)**

With this ITT we aim to improve the observational evidence in support of IPCC science to address uncertainties relating to potential tipping points in the climate system, their interactions and impacts.

ITT to be released in Q1 2024 | 0.5-2 M€ per contract

Ecosystem state

Perturbation

Conditions

F_1

F_2

Scheffer et al., 2001

THEME III – Linking observations and models

CCI Climate Modelling User Group: Phase 2 project (2023-2026)

Further ITT in 2024 (IPCC, CMIP-7, CORDEX, climate reanalysis, support to ESMO, ESMValtool, obs4MIPs etc)



CMUG will continue to bring an integrated climate system perspective within ESA's Climate programmes and provide a forum for the climate modelling and reanalysis communities to work together with the satellite ECV community.

Workplan 2023-2026:

- Clarify **climate modelling user requirements**
- Support to the **future evolution of WCRP obs4MIPs** initiative
- Contribute to the **integration and use of satellite ECVs in ESMValTool**
- Perform **cross-ECV science studies** on:
 - Machine Learning for climate model evaluation and process understanding (DLR)
 - Vegetation phenology for modelled land-atmosphere processes (CMCC, Met Office)
 - Impact of integrating CCI LC data in the ISBA land surface models (Météo France)
 - Seasonal predictability of Ocean Biogeochemistry and CCI data assimilation (BSC, Met Office)
 - Cloud and Aerosol Analysis (ECMWF, BSC)
 - Snow dynamics impacts on temperate / high latitude climate (LSCE)
 - Atmospheric drivers and feedbacks on ice-sheets in regional climate models (SMHI, DMI)
 - Machine Learning for tropical wetland methane emissions (U.Leicester, U. Edinburgh, Met Office)



THEME IV – Knowledge Exchange

- A Data Management Centre
 - Data curation, discoverability, access, metadata, quality control, interoperability, standards. To FAIR.
- A Data Tool
 - Analysis and manipulation of ESA ECV datasets for scientific use particularly in a multi-ECV context.
- A Storytelling Tool
 - Communicating role of satellite-derived data in climate science to the general public.
- A Data Visualisation Innovation Lab
 - Identifying, cultivating and scaling-up knowledge exchange innovation.
- Digital Media Presence & Management
 - Multiple channels. **Analytics**
- Public Events
 - Interactive public installations. Culturally impactful.
- Training and Education Resources
 - Building knowledge and skills across multiple types of stakeholders including general public.
- Realisation of a Knowledge Exchange Strategy
 - To attain very high reach in support of Paris

Pro

| **Crucial** |

Multi-
Deep
Certif
PRIN
ISO 2
Tailor

| **Crucial** | # Specialist management by major cross-sector international commun
Scaling-up via partnerships
Scaling-up via leading & supporting collaborations across sectors.

| Crucial |

- # Multi- & cross- sector management.
- # Deep management expertise.
- # Certification & standards typically - PRINCE2 Practitioner, PMP ISO 21500, ISO 21502, ISO 21503
- # Tailored Agile | FFP

Anticipated Contracts: 1

ITT to be released in Q4 2023 | 7-8 M€ | 3 years

Procurement mechanism: Open competitive tender

Relevant background documents

- Website - climate.esa.int | CCI Open Data Portal – climate.esa.int/data | Climate from Space - cfs.climate.esa.int
- CCI KE @ CCI Colocation 2022 - climate.esa.int/media/documents/Session5_v1PF_FINAL_1.pdf
- CCI KE @ CCI Colocation 2021 - climate.esa.int/media/documents/2021-10-06_CCI_Colloc_CCI-KE_v2.pdf
- CCI animations - [www.esa.int/ESA_Multimedia/Keywords/System/Climate_Change_Initiative/\(result_type\)/videos](https://www.esa.int/ESA_Multimedia/Keywords/System/Climate_Change_Initiative/(result_type)/videos)
- Climate from Space application @ GitHub - github.com/ubilabs/esa-climate-from-space
- CCI Open Data Portal paper @ Data Science Journal - datascience.codata.org/articles/10.5334/dsj-2020-016
- CCI Toolbox @ GitHub - github.com/ccj-tools
- CCI Data Ontology @ GitHub - github.com/cedadev/ccj-vocabularies
- CCI Data Standards - climate.esa.int/media/documents/CCI_DataStandards_v2-3.pdf
- Tertiary education training kit - climate.esa.int/educate/climate-for-science-excellence/tertiary-training-kit/
- Journey of a Pixel @ LPS22 - climate.esa.int/JourneyOfAPixel

ESA MATCH – FINDING POTENTIAL PARTNERS



ESA's industry matchmaking tool

Supports the visibility of ESA-registered entities

Facilitates partnering/teaming between companies

Includes:

- searchable **space industry directory**
- **marketspace** for organisations to advertise offers and needs
- ability to **send messages** to other entities via the tool



Register to can make full use of all functionalities

→ <https://doing-business.sso.esa.int>

Summary of tender opportunities & timescales: 2023-24

Procurement	Type of procurement	Schedule	Number of contracts	Contract value [M€]
Extension of existing ECV contracts	Direct negotiation	Q1 2024	28	0.5-2
New ECV	Open competitive tender	Q2 2024	3	0.5-2
Global land carbon budget and its attribution to regional drivers	Open competitive tender	Q4 2023	1	3
GHG emissions	Open competitive tender	Q3 2023	1	3
Regional Climate process study, field campaign over the Amazon	Open competitive tender	Q3-Q4 2023	1	2
Cross-ECV	Open competitive tender	Q4 2023	2-4	0.5-2
Tipping Points	Open competitive tender	Q1 2024	2-4	0.5-2
Linking Observations and Models	Open competitive tender	Q2 2024	3-6	0.5–1.5
Knowledge Exchange	Open competitive tender	Q4 2023	1	7-8

Further information on upcoming opportunities

<https://climate.esa.int/en/esa-climate/climate-space-information-day-10-may-2023/>

Further opportunities for project working with new user communities to be announced in the course of 2023/24

Thanks for your attention

www.climate.esa.int

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