

CCI Achievements and CCI+

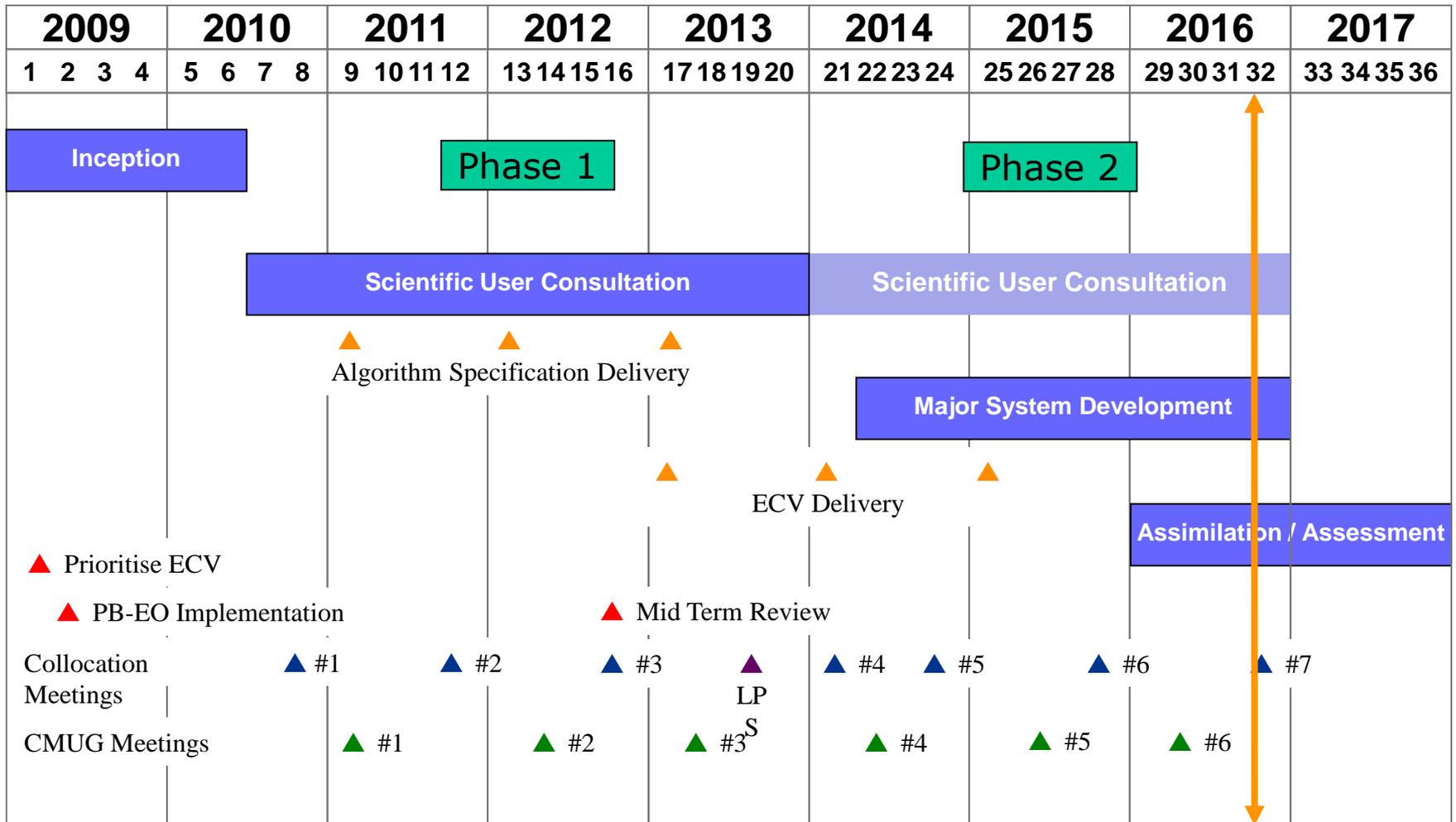
P. Lecomte
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Current Status of the CCI Programme



Horizontal Supporting Activities

- System Engineering WG
- Data Standards WG
- Colocation Meetings
- Integration Meetings



CCI ECV Projects

- Cloud
- Aerosol
- Greenhouse Gases
- Ozone

- SST
- Sea Level
- Sea Ice
- Ocean Colour

- Glaciers
- Ice Sheets

- Land Cover
- Fire
- Soil Moisture



Cross-ECV & Exploitation

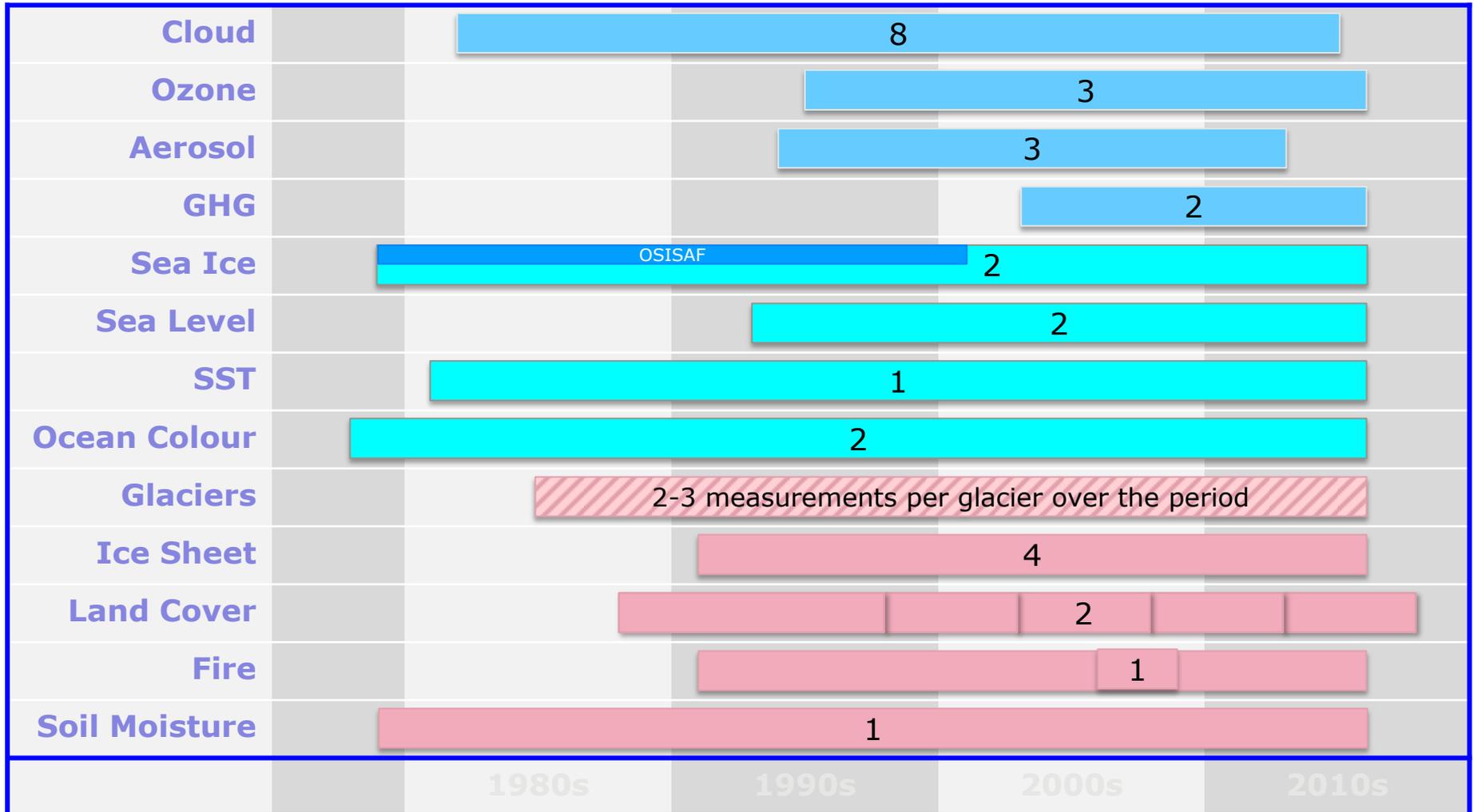
- Climate Modeller User Group
- Research Fellowships
- Ice Sheet Mass Balance Intercomparison Exercise
- Cross-ECV Workpackages



Communication and User Support

- CCI Visualisation Tool
- CCI Open Data Portal
 - CCI Toolbox

CCI Products Time Coverage



- The CCI has enabled more than 300 European scientists from over 100 research institutions and companies to work together in an integrated programme on ECV algorithm development, inter-comparison, validation, and large-scale EO data processing for 13 GCOS ECVs;
- All CCI ECV data products have been fully error characterised, are provided with quantitative uncertainty estimates, and have been evaluated by leading members of the climate research community;
- Prototype processing systems for each ECV have been developed and validated in phase 1, and are being further developed during phase 2 to become operationally sustainable. This is a major step in making them suitable for transfer into the Copernicus Climate Change Service (C3S);
- ECV products are being made available under an open and free data policy for uptake by the wider climate science community through the CCI Open Data Portal and via community initiatives such as ESGF and CMIP/obs4MIPs.

- Substantial community building has taken place to strengthen the relationship between satellite data product developers and climate scientists, and as a result of the multidisciplinary approach of the programme, strong links have also been forged spanning the land, ocean, atmosphere and cryosphere science communities.
- The CCI programme is contributing to a rapidly expanding body of scientific knowledge demonstrating new insights in climate research by maximising the scientific benefits that satellite observations can provide. This was shown through the important contributions CCI made to the IPCC's 5th Assessment Report (WG1, 2013)
- In all, 27 CCI scientists were involved as leaders, contributing-authors or editors in seven of the 14 chapters of the IPCC AR5 WG1 report, and CCI results were cited 59 times.
- The CCI scientific community have published 285 scientific articles in peer-reviewed journals (as of Dec 2015).

Proposal for a CCI Extension – CCI +

CCI+ Objectives:

- **research, development, qualification** and **delivery to users** of pre-operational ECV products
- **definition, sizing** and **demonstration** of ECV processing systems
- **transfer** of ECV production to operational entities outside ESA

Driven by **climate user requirements** defined by GCOS, under authoritative advice from CSAB, and strong coordination with the international Space Agencies response to GCOS via the Joint CEOS/CGMS Working Group on Climate (WGClimate).

CCI+ Scope:

- i. Development of new ECVs (i.e. ECVs that were not started in CCI so far)
- ii. New R&D on ECVs that were started in CCI
- iii. Cross-ECV scientific exploitation
- iv. Outreach and Communication

NB: CCI+ will not build operational processing systems

Atmosphere	Ocean	Terrestrial
Composition	Surface	
Aerosol Properties	Sea Surface Temperature	Land Cover
Carbon Dioxide & Methane	Sea Level	Fire Disturbance
Ozone	Sea Ice	Soil Moisture
Long-Lived Greenhouse Gases	Ocean Colour	Glaciers and Ice Caps
	Sea State	Ice Sheets
Upper Air	Current	Snow Cover
Cloud Properties	Sea Surface Salinity	Albedo
Temperature	Carbon Dioxide Partial Pressure	Leaf Area Index (LAI)
Water Vapour	Phytoplankton	FAPAR
Wind Speed and Direction	Ocean Acidity	Lakes
Earth Radiation Budget	Sub Surface	Above Ground Biomass
Surface	Carbon	Permafrost
Surface Air Pressure	Current	Ground Water
Surface Air Temperature	Nutrients	River Discharge
Surface Precipitation	Ocean Acidity	Soil Carbon
Surface Radiation Budget	Oxygen	
Water Vapour (Surface humidity)	Salinity	
Near-Surface Wind Speed, Dir	Temperature	
	Tracers	
	Global Ocean Heat Content	

Within scope of CCI

Started in CCI

Atmosphere	Ocean	Terrestrial
Composition	Surface	
Aerosol Properties	Sea Surface Temperature	Land Cover High Resolution
Carbon Dioxide & Methane	Sea Level	Fire Disturbance
Ozone	Sea Ice	Soil Moisture
Long Lived Greenhouse Gases	Ocean Colour	Glaciers and Ice Caps
Precursors (for Aerosols and Ozone)	Sea State	Ice Sheets
Upper Air	Current	Snow Cover
Cloud Properties	Sea Surface Salinity	Albedo
Temperature	Carbon Dioxide Partial Pressure	Leaf Area Index (LAI)
Water Vapour	Phytoplankton	FAPAR
Wind Speed and Direction	Ocean Acidity	Lakes
Earth Radiation Budget	Sub Surface	Above Ground Biomass
Surface	Carbon	Permafrost
Surface Air Pressure	Current	Ground Water
Surface Air Temperature	Nutrients	River Discharge
Surface Precipitation	Ocean Acidity	Soil Carbon
Surface Radiation Budget	Oxygen	Land Surface Temperature
Water Vapour (Surface Humidity)	Salinity	
Near Surface Wind Speed, Dir	Temperature	
	Tracers	
	Global Ocean Heat Content	

Within Scope of CCI	Started in CCI	Proposed in CCI+ Extension
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(ii) New R&D on ECVs already started in CCI



ESA/PB-EO(2015)24 Annex 2 lists many CCI ECV products expected to be sufficiently mature for pre-operational production by the end of CCI (2017-2018).

Further R&D on ECVs is needed in CCI+ to:

- Improve quality of ECV products closer to meeting GCOS goals (e.g. accuracy, spatial resolution, long term stability), and improve cross-ECV consistency.
- Develop algorithms for "difficult" ECV variables required by GCOS, e.g. regional sea-level, coastal ocean colour, aerosol absorption, sea-ice drift.
- Extend ECV length by developing methods to bring older less well-calibrated satellite instruments into the time series (e.g. AVHRR), and develop corrections for future instrument degradation.
- Fully exploit the new capabilities of Sentinel and Earth Explorer instruments, e.g. new types of measurement, new spectral bands, wider swaths, higher resolution.
- Develop climate-quality methods to join-up multi-mission time series, especially where there are gaps, e.g. Envisat to Sentinel-1/3.
- Increase maturity of ECV product uncertainty estimates.
- Develop better merged ECV products.
- Perform algorithm round-robins to assess promising new ECV retrieval techniques.

Cross-ECV activities are a key strength of CCI and CCI+

CCI has succeeded to build an active multi-disciplinary community fostering dialogue and cooperation between the EO and climate science – as recommended by both CSAB and ESAC.

1. CMUG-type activity providing

- an integrated climate user perspective across all ECVs
- demonstration exploitation of the CCI+ ECV products
- feedback to the CCI+ teams on ECV quality and consistency
- outreach to the wider climate user community

2. Cross-ECV targeted scientific studies

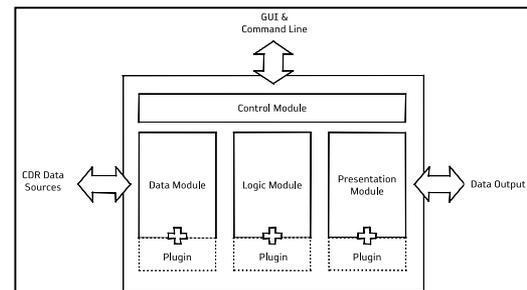
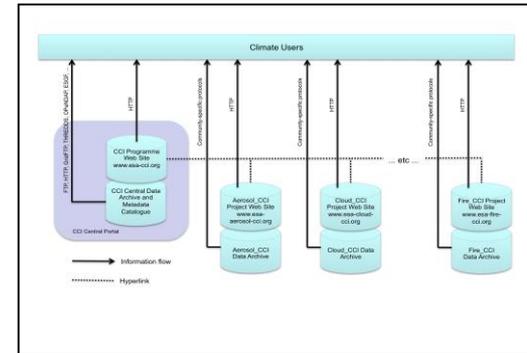
- Demonstrate the value of the CCI and CCI+ ECVs and to strengthen uptake by the wider climate community
- E.g. Assembly and analysis of multiple ECVs for sea-level budget closure, permafrost, air-sea mass and energy fluxes, etc.

3. Young Scientist Research Fellowship Scheme

- To stimulate exploitation by the next generation of climate scientists.

Continue the CCI activities on:

- Open Data Portal**
 ... to provide open, free, and easy access to the CCI+ ECVs via multiple standard climate community interfaces.
- Visualisation Tool**
 ... to provide interactive visualisations of the ECVs to help communicate the types of climate information satellites can provide.
- Software Toolbox**
 ... to equip users at all levels with the tools they require to visualise, analyse and manipulate the ECV data.



H2020

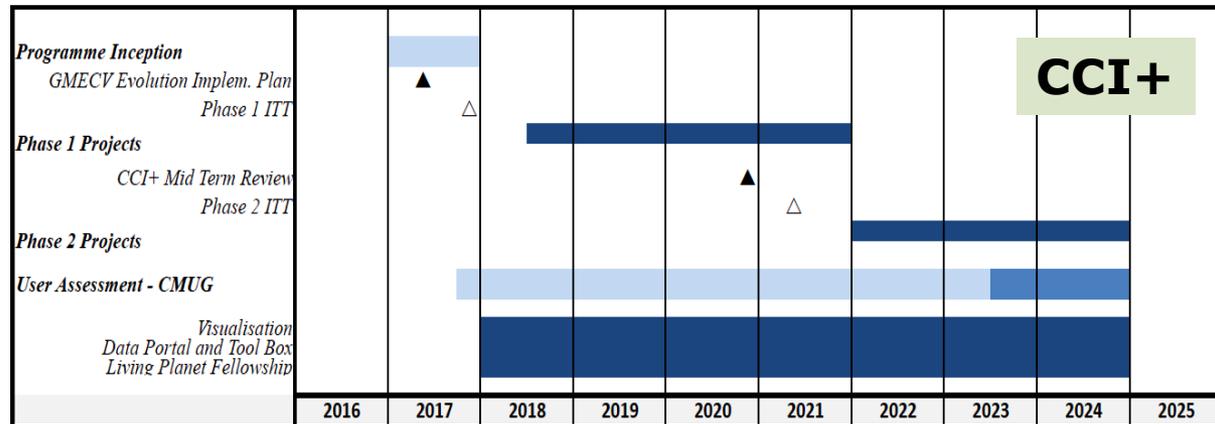
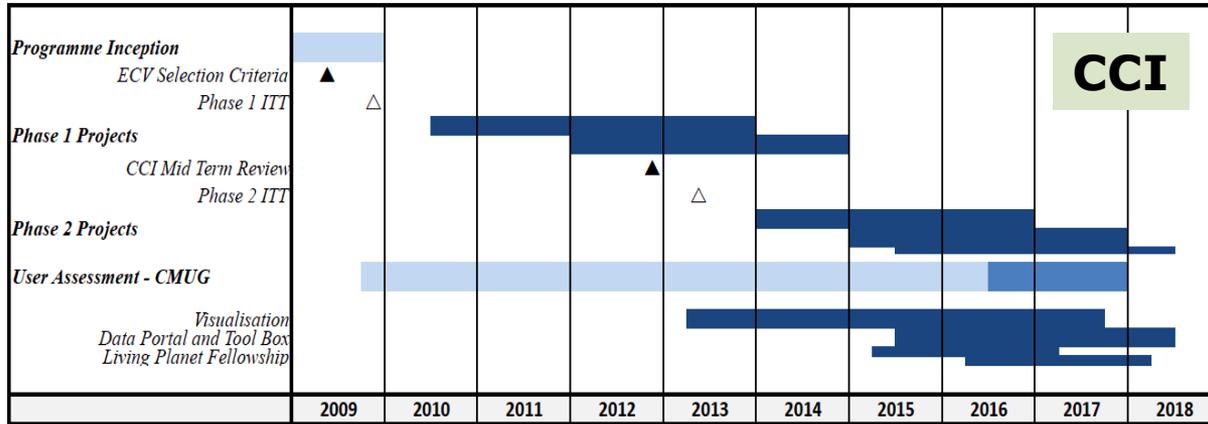
- R&D exploiting ECVs
- Some complementary work on developing ECVs

Copernicus Climate Change Service

- Operational production of ECVs, but no R&D
- First call for 9 ECVs announced on 13 Jan 2016 (sea ice, sea level, sea surface temperature, ozone, aerosol, CO₂ and CH₄, soil moisture, glaciers and ice caps, albedo-LAI-FAPAR)
- Expect further C3S calls for ~20 more ECVs by end 2017

EUMETSAT Satellite Application Facilities

- New SAF CDOP-3 programme starts 2017 (approval in mid-2016)
- ESA is working closely with EUMETSAT to ensure full complementarity on the development of ECVs, on a case-by-case basis.



- CCI+ is a proposal for the evolution of CCI over the period 2017-2024 to develop new ECV data products required by **climate science** and for use in **climate services**.
- As for CCI, the objective is to **transfer the R&D results into an operational context** outside ESA once the ECV algorithms and pre-operational processing systems are sufficiently mature.
- CCI+ will enhance the contribution of European EO science to future **IPCC assessments**, as part of the international coordinated action on climate observations through CEOS and GCOS.
- Both **new ECVs** as well as **new R&D on ECVs already started in CCI** are included, complemented by supporting activities providing an integrated climate user perspective, on cross-ECV exploitation, communications and outreach.
- The proposed CCI+ activities are **complementary** to other activities on ECVs in Europe (e.g. C3S, H2020, EUMETSAT SAFs) , and will be closely linked with international climate science programmes.

Thank you for your attention



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