

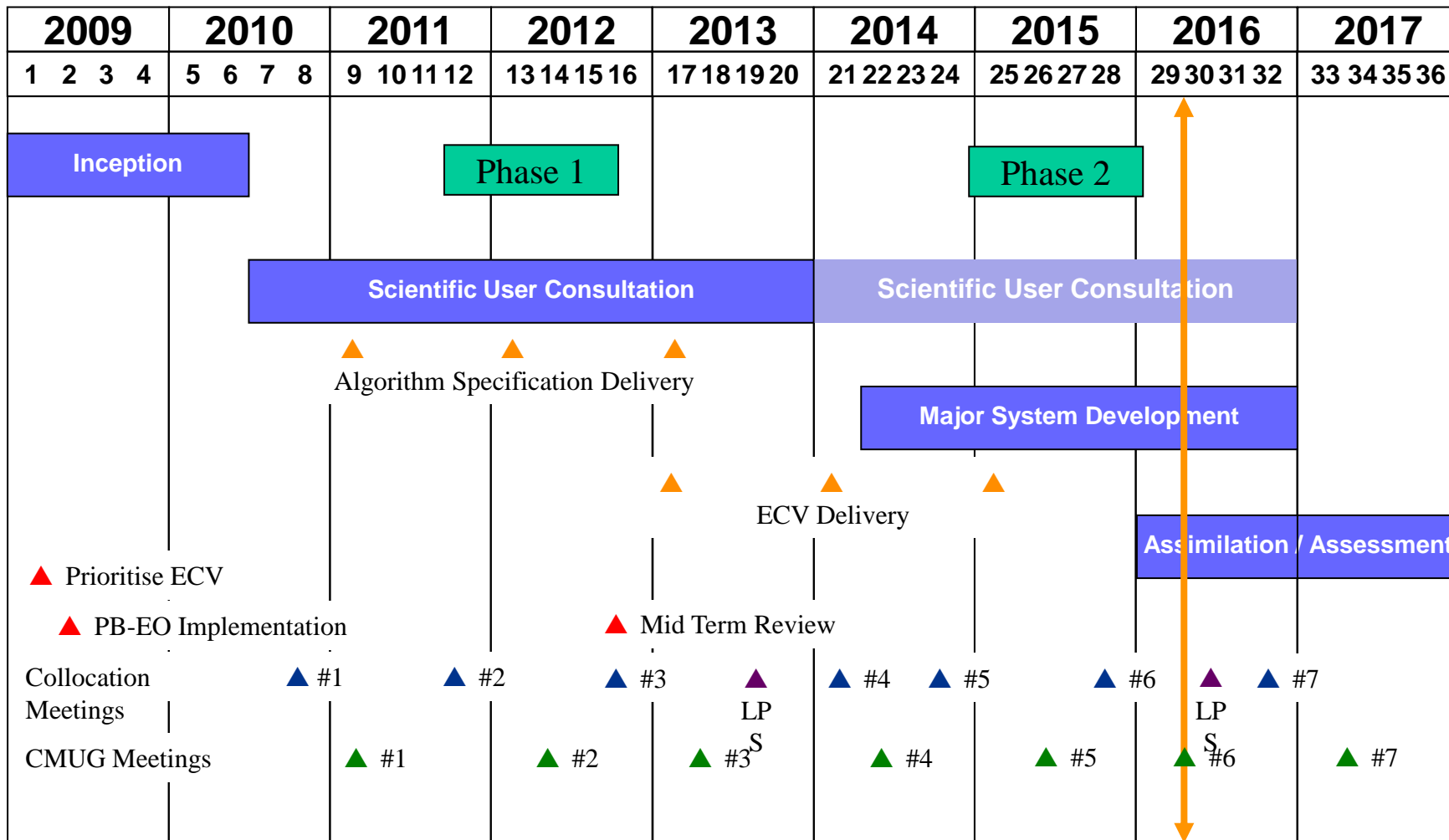
# Climate Change Initiative

**Pascal Lecomte**  
**Head of the ESA Climate Office**  
**CCI Programme Manager**

**CMUG Interaction Meeting**  
**Munich – March 14-16, 2016**

## **Current Status of the CCI Programme**

# CCI Master Schedule



## 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

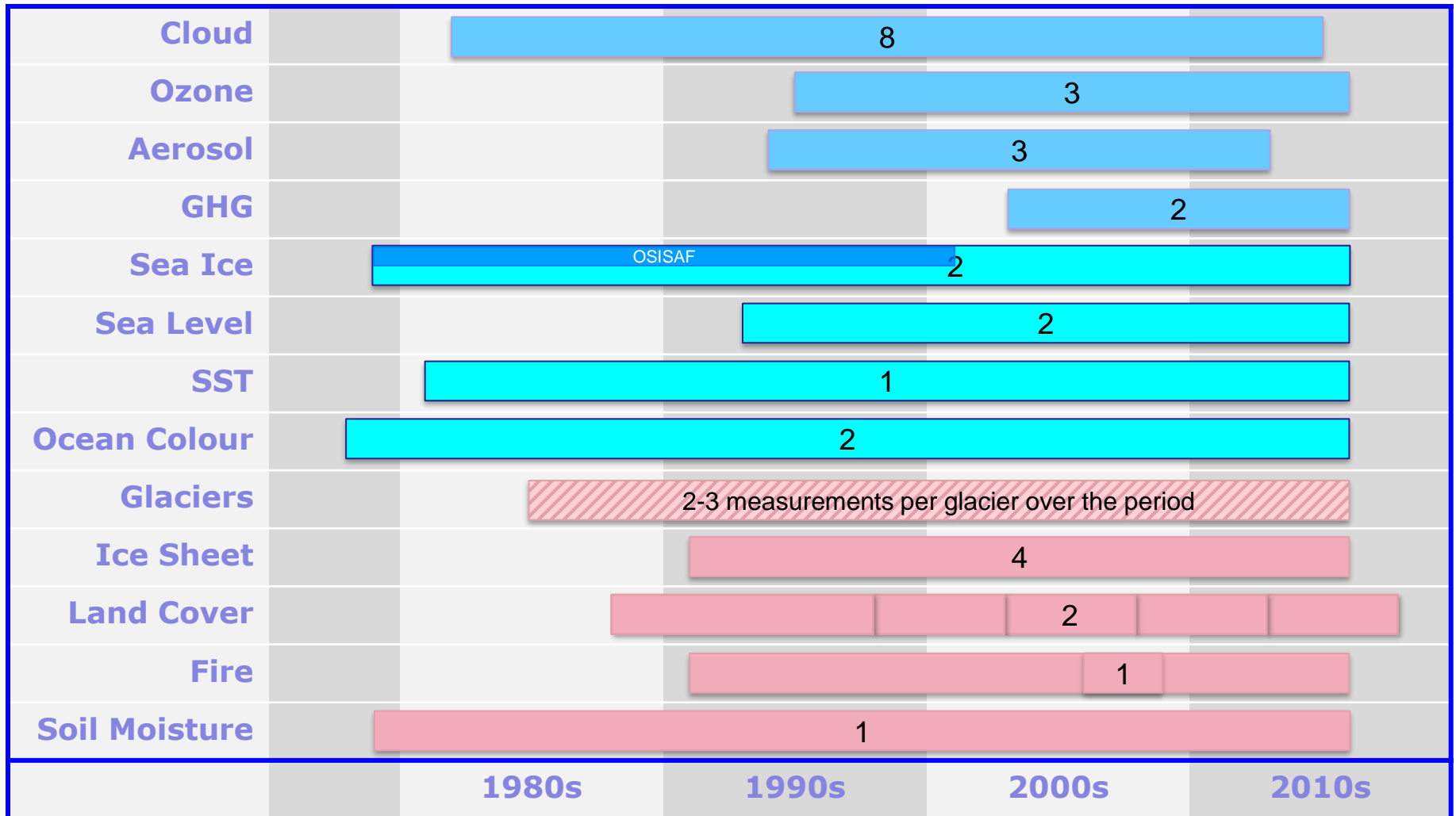
- Climate Modeller User Group
- Research Fellowships
- Ice Sheet Mass Balance Intercomparison Exercise
- Cross-ECV Workpackages



## Communication and User Support

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

# CCI Products Time Coverage



# CCI Living Planet Fellowship

N.	Title	Name	Surname	Host Institution	MS
48	Swarm as an Auroral Mission	Megan	Gillies	University of Calgary	CD
23	Is The Earth's Magnetic field POtentially reversing? New insights from Swarm mission	Francisco Javier	Pavón Carrasco	INGV	IT
7	Sea level reconstructions from altimetry and tide gauges with improved methods	Sandra-Esther	Brunnabend	University of Bonn	DE
29	Reconstruction of 3D time-series of the West Spitsbergen Current using altimetry combined with in situ data and a numerical model	Anna Izabela	Bulczak	IsardSAT Sp. z o.o.	PL
26	Synergistic use of SMOS data to Study Slippery Layers In the eastern tropical pacific fresh Pool	Sébastien	Guimbard	IFREMER	FR
32	The interconnectivity of magma reservoirs: independent component analysis of satellite radar imagery	Susanna	Ebmeier	University of Bristol	UK
4	Developing a CryoSat-2/GRACE product to spatially partition surface mass balance and ice dynamic mass loss across Greenland and Antarctica	William	Colgan	Geological Survey of Denmark and Greenland	DK
58	improving the Predictability Of WatEr Resources	Miguel	de Oliveiros Vieira	University of Lisbon	PO
47	Sea ice breakup during large wind-wave events	Peter	Sutherland	Université Pierre et Marie Curie	FR
1	Extending the Performance of AerGom to explore New aerosol related Species and to Improve OzoNe retrieval	Charles	Robert	Institut d'Aéronomie Spatiale de Belgique (BIRA-IASB)	BE
5	A new method for assessing mineral dust sources using vertical profile information retrieved from IASI radiances	Sophie	Vandenbussche	Institut d'Aéronomie Spatiale de Belgique (BIRA-IASB)	BE
2	Statistics of AeRosol and Clouds INteractions from satellites	Luca	Lelli	University of Bremen	DE
4	CCI data for assessing SOil moisture controls on Fire Emissions	Matthias	Forkel	Vienna University of Technology (TU Wien)	AT

# CCI Achievements

- **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**

# (i) New ECVs in CCI+

**Selection will be based on criteria already defined by Member States [ESA/PB-EO(2009)32, rev. 1]:**

- **Response to GCOS requirements (to be revised in 2016)**
- **Availability, quality, uniqueness and importance of the satellite data**
- **Maturity of retrieval algorithms**
- **Ability to capitalise on European scientific expertise**
- **Prospects for transition to an external operational context**

**Taking into account:**

- **Overall level of Member States contributions**
- **Need for complementarity with other ECV activities in Europe (C3S, CDOP-3, H2020, etc.)**

**List of new ECVs will be selected in early 2017, after CMIN-16.**

- **CSAB meeting in early 2017 to support Executive in formulating...**
- **GMECV Evolution Implementation Plan to be presented to PB-EO in 2017 Q1**

# Preliminary analysis of new ECVs in CCI+

Atmosphere	Ocean	Terrestrial
<b>Composition</b>	<b>Surface</b>	
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
<b>Upper Air</b>	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	<b>Sub Surface</b>	Above Ground Biomass
<b>Surface</b>	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	
<b>Within scope of CCI</b>	<b>Started in CCI</b>	

# Preliminary analysis of new ECVs in CCI+

Atmosphere	Ocean	Terrestrial
<b>Composition</b>	<b>Surface</b>	
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
<b>Upper Air</b>	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	<b>Sub Surface</b>	Above Ground Biomass
<b>Surface</b>	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.

# (iii) Cross-ECV Activities

**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.**

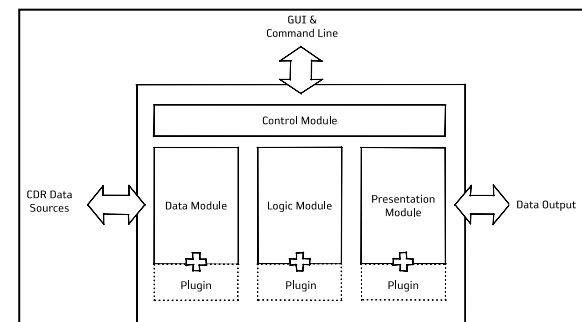
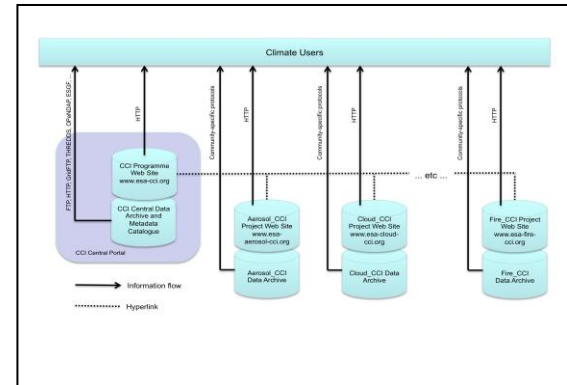
## **3. Young Scientist Research Fellowship Scheme**

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

# (iv) Outreach and Communications

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.





# Related European Activities on ECVs

## **H2020**

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

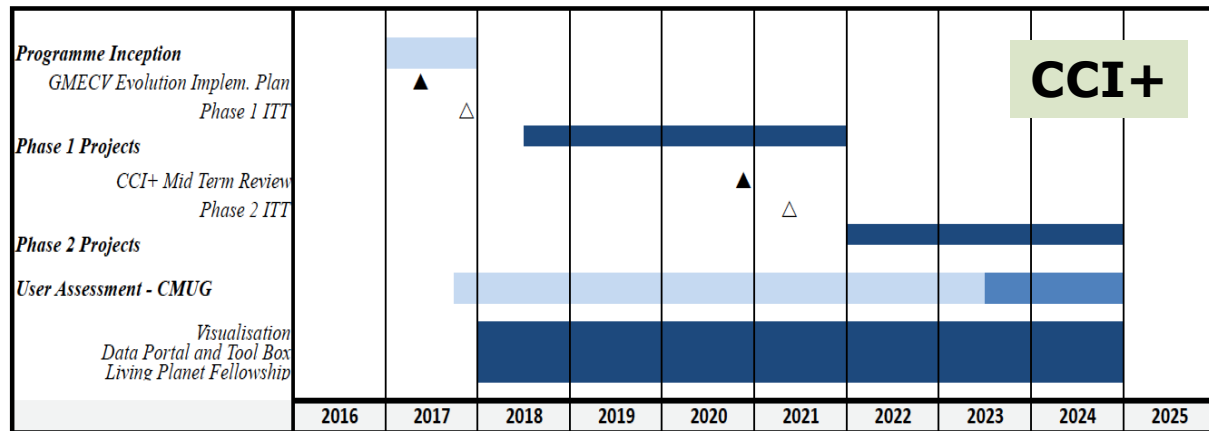
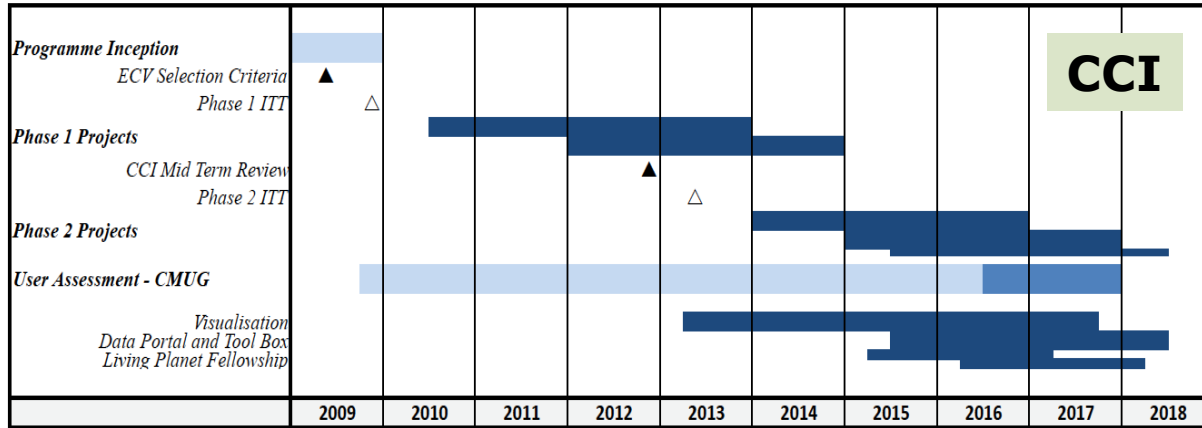
## **Copernicus Climate Change Service**

- **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, CO<sub>2</sub> and CH<sub>4</sub>, 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+ Schedule



# CCI+ Summary

- **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



**CLIMATE  
CHANGE  
INITIATIVE**