Climate Change Initiative

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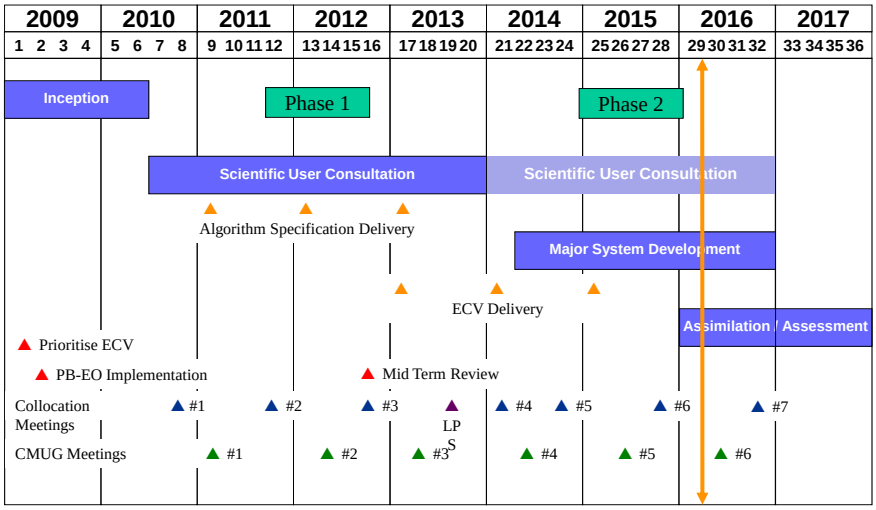
GCOS Science Conference
Amsterdam – March 2nd, 2016

Current Status of the CCI Programme

CCI Master Schedule



CCI Programme (2010-2017)

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

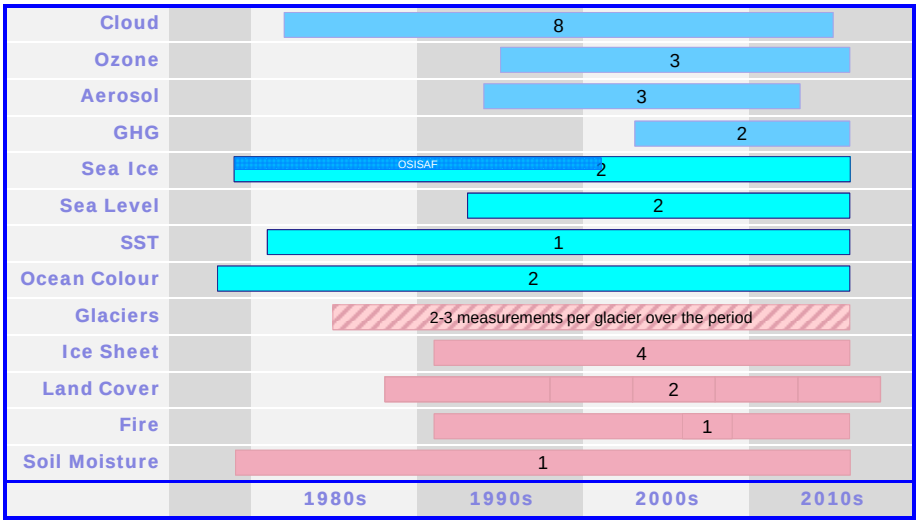
Cross-ECV & Exploitation

- 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 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 furthered 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.**

CCI Achievements

- 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 233 scientific articles in peer-reviewed journals (as of Aug 2015).

Proposal for a CCI Extension – CCI +

CCI+ Objectives & Scope

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
Composition	**Surface**	
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 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	

Preliminary analysis of new ECVs 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.**

(iii) Cross-ECV Activitie

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.**

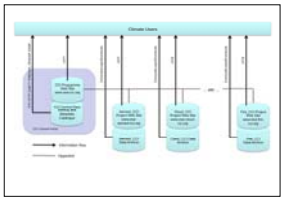
3. Young Scientist Research Fellowship Scheme

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

(iv) Outreach and Communications

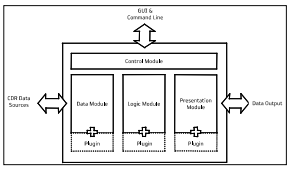
Continue the CCI activities on:

- **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**

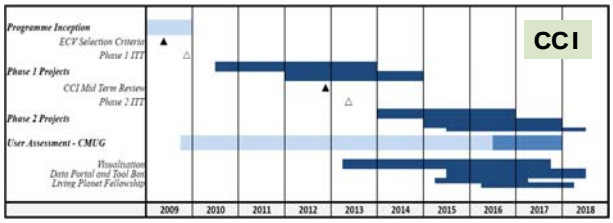
Copernicus Climate Change Service

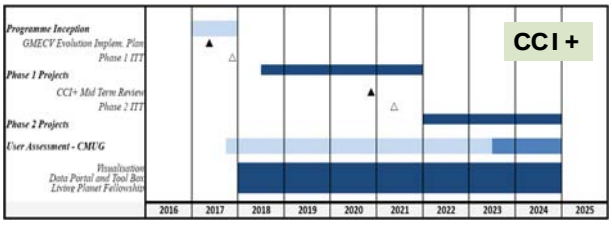
- **Operational production of ECVs, but no R&D**
- **First call for 9 ECVs announced on 13 Jan 2016 (sea ice, sea level, sea surface temperature, ozone, aerosol, CO_2 and CH_4, soil moisture, glaciers and ice caps, albedo-LAI-FAPAR)**
- **Expect further C3S calls for ~20 more ECVs by end 2017**

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 2017-2022 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