ESA Climate Change Initiative

From Research to Operations

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ECSAT – Harwell - UK

Introduction

- Objective of the CCI
- CCI Context
- CCI Implementation => Phase1
- Phase 1 results
- CCI evolution Phase 2
- From Research to Operations

Objectives of the CCI

Realise the full potential of the long-term global EO archives that ESA, together with its Member states, has established over the last thirty years ...

... as a significant and timely contribution to the ECV databases required by the United Nations Framework Convention on Climate Change

6 Years 88 Meuro

Two climate action paths

GCOS GLOBAL CLIMATE OBSERVING SYSTEM

WMO of UNESCO UNEP ICSU

WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

THE SECOND REPORT ON THE ADEQUACY OF THE GLOBAL OBSERVING SYSTEMS FOR CLIMATE IN SUPPORT OF THE UNFCCC

EXECUTIVE SUMMARY

April 2003

GCOS – 82 (ES)

(WMO/TD No. 1143)

UNITED NATIONS ENVIRONMENT PROGRAMME

INTERNATIONAL COUNCIL FOR SCIENCE

UNESCO UNEP ICSU

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

FOR THE
FOR CLIMATE
NFCCC

INTERNATIONAL COUNCIL FOR SCIENCE

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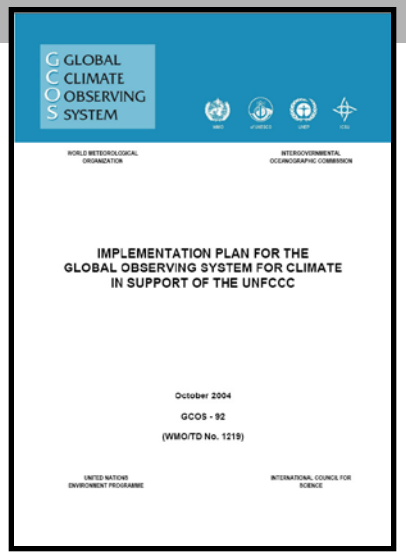
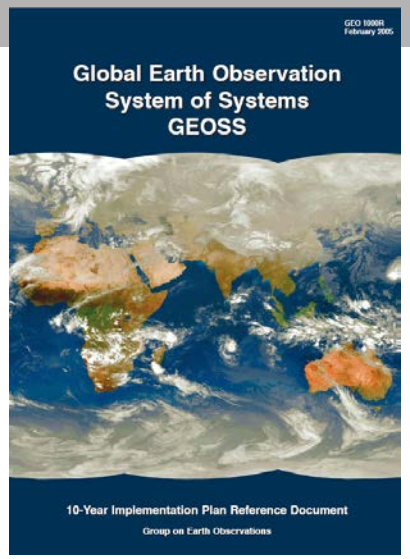
Convention on
l Advice (SBSTA)
legation

GCOS IP 2004

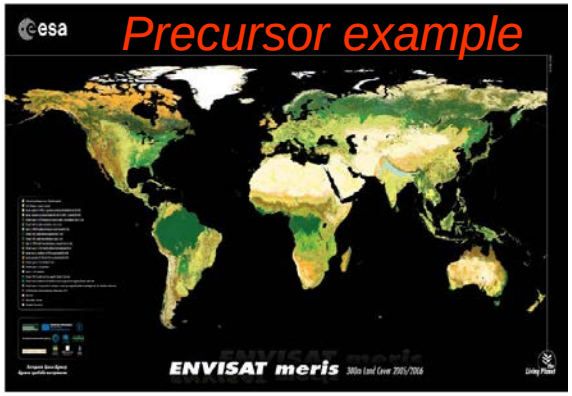


Part of GEO task CL-06-01

GEOSS IP 2005



ESA CCI: Production of Essential Climate Variables (ECV) according to GCOS requirements



ESA Ministerial Council, Nov 2008:
Approval of 75.5 M€ for a six year programme that will contribute to about twenty satellite-based ECVs. A strong interaction with the scientific community is an essential part of the programme. (Funding since increased to 95 MEuro)

The CCI initiative will ensure that ESA can play a full role in deriving relevant ECVs specified by GCOS, based on ESA current and archived EO data. ESA will work with CEOS agencies to ensure as complete a coverage of the entire suite of ECVs as possible.

ESA CCI & EUMETSAT ECV capability

Atmosphere	Ocean	Terrestrial
Composition	**Surface**	
Aerosol Properties	Sea Surface Temperature	Land Cover
Methane & Long Lived GHGs	Sea Level	Fire Disturbance
Ozone	Sea Ice	Soil Moisture
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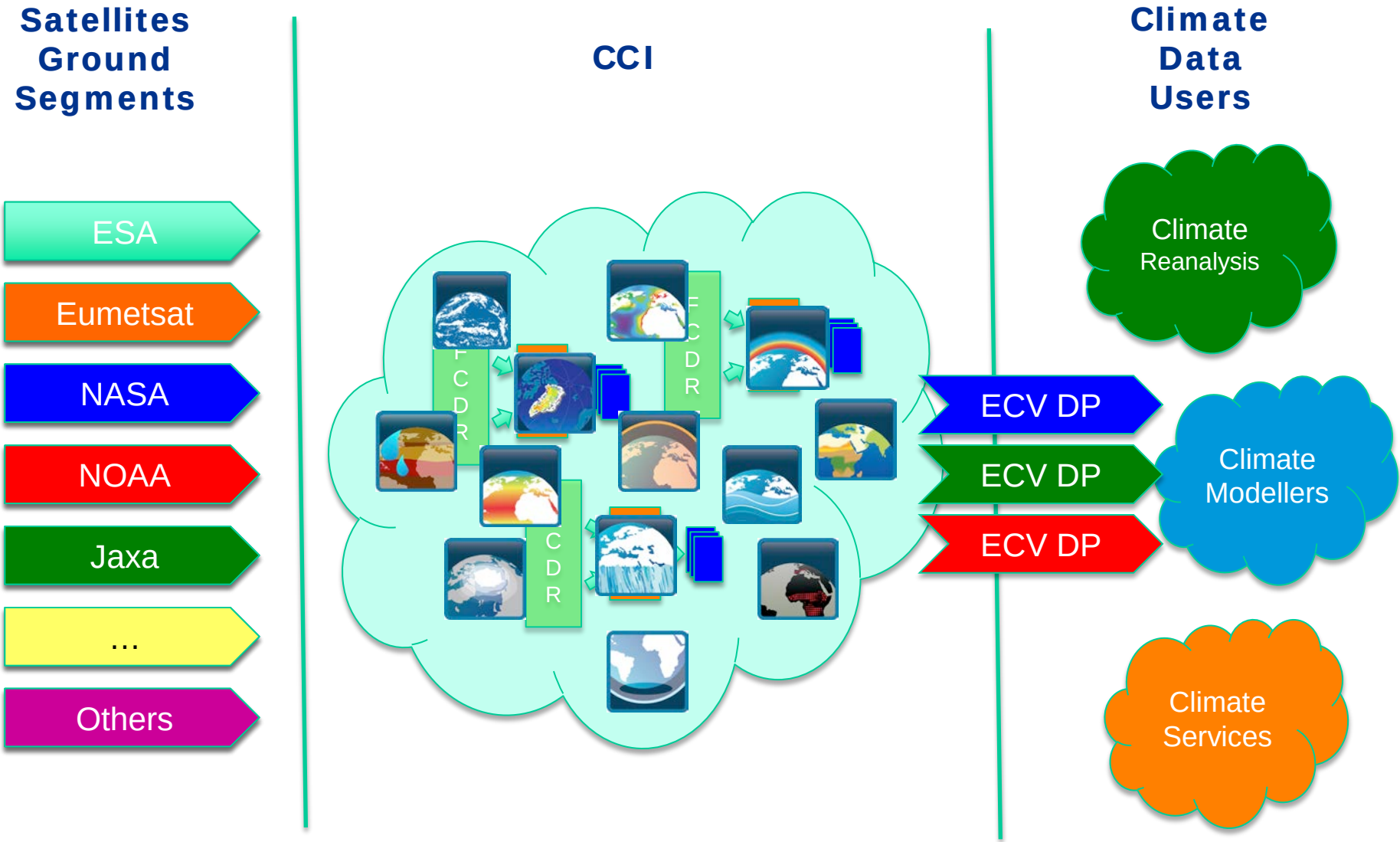
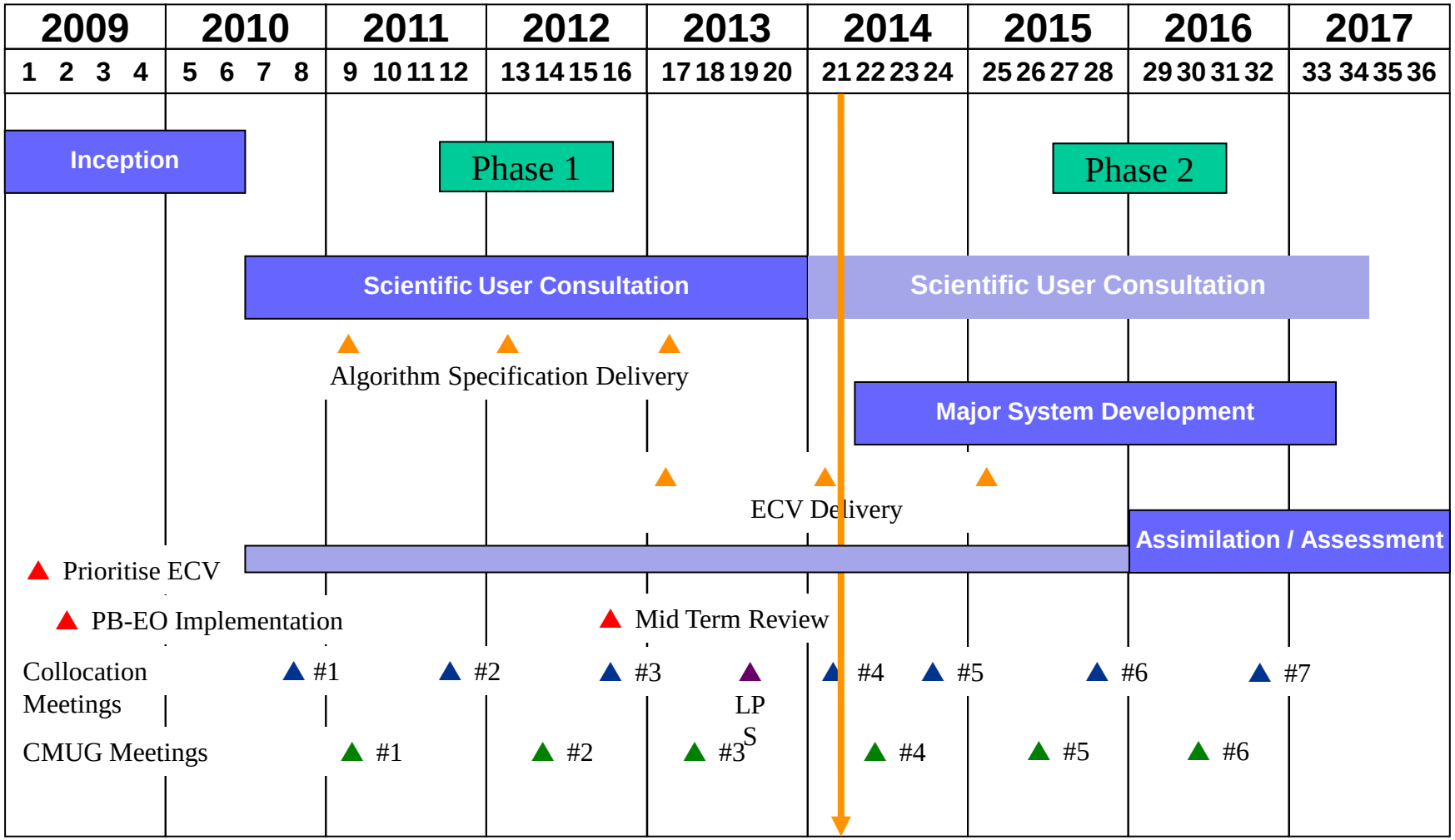
Near-surface Wind Speed	Temperature	
	Tracers	
	Global Ocean Heat Content	

EUMETSAT **CCI Started** **CCI Scope**

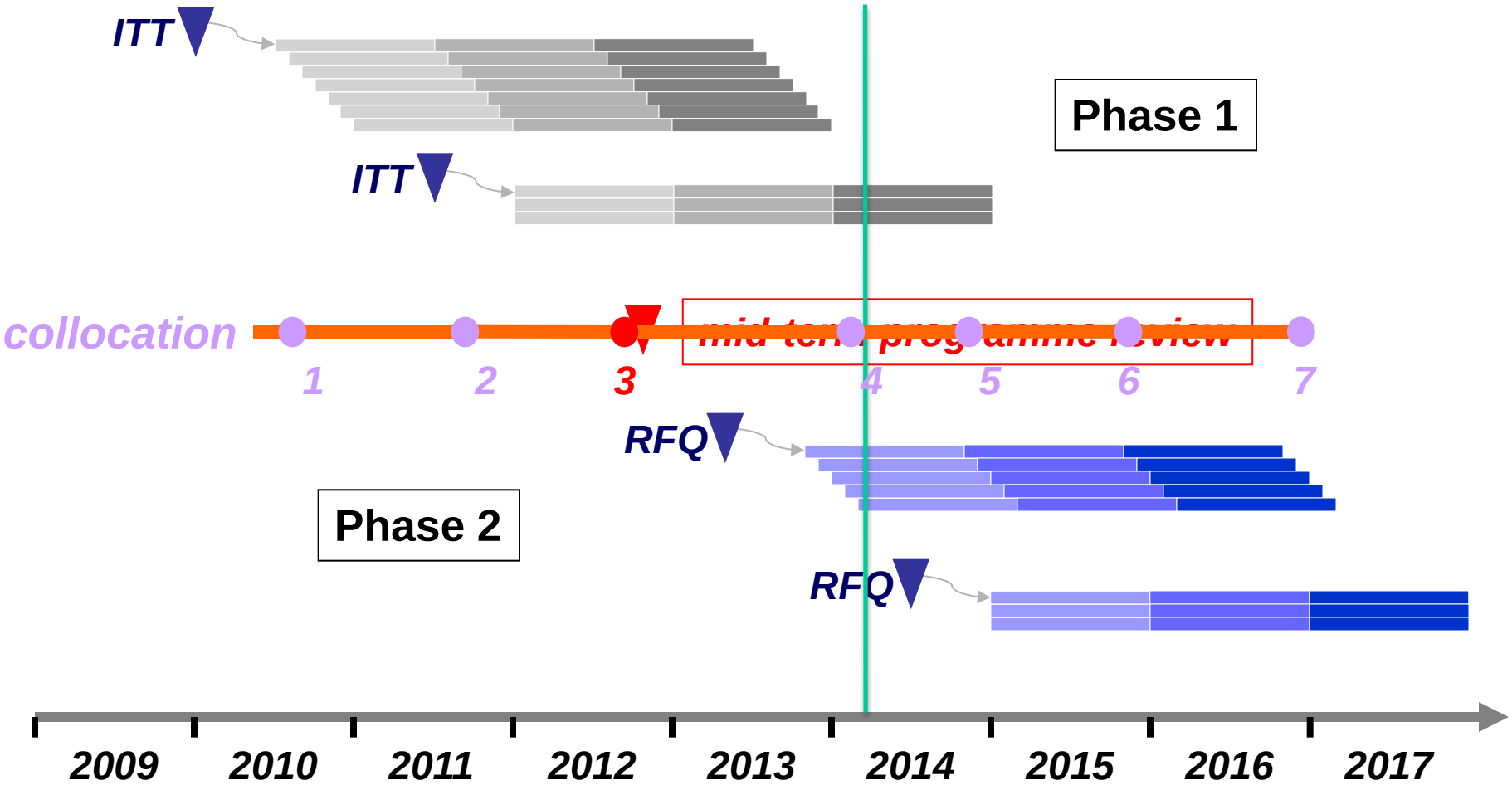
System Context



CCI Master Schedule



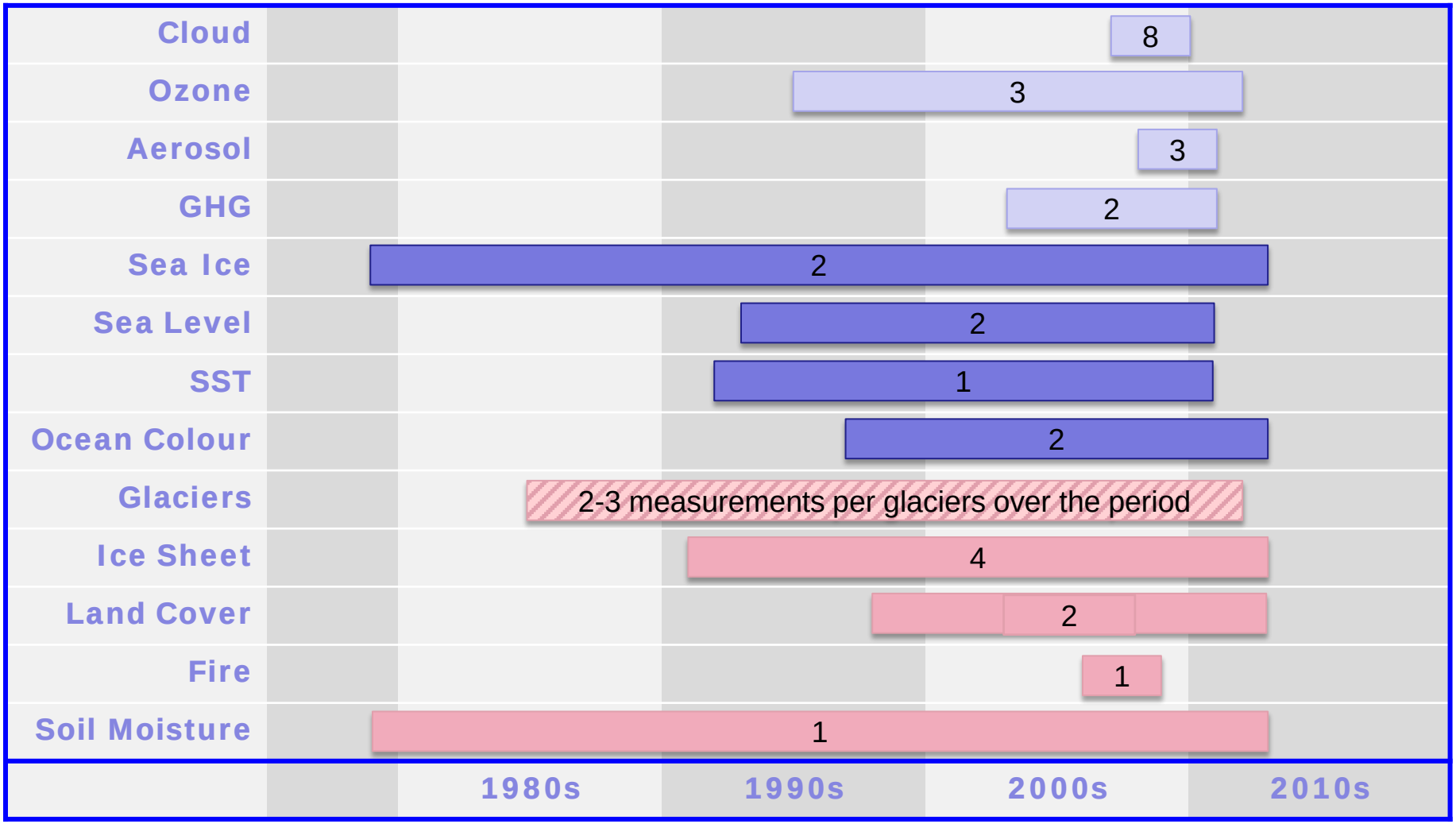
CCI Phase 2


ITT
ITT
Phase 1
collocation
1
2
3
4
5
6
7
RFQ
Phase 2
RFQ
2009
2010
2011
2012
2013
2014
2015
2016
2017

CCI Results of Phase 1

- **9 CCI projects have been completed**
  - Data are available via the CCI Web site (www.esa-cci.org)
  - Climate Assessment Reports are being produced
- **1 CCI project (Fire) still to be completed**
  - Mostly due to System Engineering aspects
  - Phase 2 of this project will be started with the last three projects
- **CMUG is completing his phase 1 activities end of March 2014**
- **3 CCI projects (which started in January 2012) are on schedule**

CCI Products Time Coverage



Where ESA data is cited in IPCC WGI AR5: highlights

Chapter 2: Observations: Atmosphere and Surface

- The *(A)ATSR series* of **sea surface temperature** measurements (the ARC data set) has improved understanding of uncertainties and biases in SST records.

Chapter 4: Observations: Cryosphere

- The cryosphere provides some of the most visible signatures of climate change. 20 years of *ESA altimetry* measurements have helped record the decline in Arctic **sea ice thickness and volume**.
- *Cryosat-2* is beginning to have an impact, providing more accurate measurements of Artic **sea ice at higher latitudes**.
- *Altimetry and SAR data from ERS-1, ERS-2 and Envisat* have been vital in measuring changes in **ice sheets.**
- The ESA/NASA Ice sheet Mass Balance Intercomparison Exercise (IMBIE) provided a reconciled estimate of **ice sheet mass balance changes** from the satellite community.

Chapter 13: Sea Level Change

- *Altimeters on ERS-1, ERS-2 and Envisat* not only provide a key role in measuring changes sea level but also the contributions to **sea level change** from **ice sheets** and **glaciers**.

The Climate Change Initiative in IPCC's WGI AR5

Results from the CCI are cited in AR5, notably:

- **CCI Glaciers** played a leading role in creating the first globally-complete glacier inventory, the Randolph Glacier Inventory.
- **CCI Sea Level** produced improved Global Mean Sea Level estimates using Envisat data.
- The **Ice sheets Mass Balance Intercomparison Exercise**, involving **CCI Ice Sheets**, has led to improved confidence in the measurement of ice sheet mass balance and the associated global sea level contribution.

Further CCI projects are also cited in the report:

Glaciers_cci
- Observations: Cryosphere
- Sea Level Change

Greenhouse_Gases_cci
- Carbon and Other Biogeochemical Cycles

Ice_Sheets_cci
- Observations: Cryosphere
- Sea Level Change

Ozone_cci
- Evaluation of Climate Models

Sea_Level_cci
- Observations: Cryosphere
- Sea Level Change

Sea_Surface_Temperature_cci
- Observations: Atmosphere and Surface

Soil_Moisture_cci
- Observations: Atmosphere and Surface

Phase 2 activities

- **Extract from GMECV - Further Implementation Steps ESA/PB-EO(2012)64**

  - The next stage of the programme will be implemented along the following lines of action:
    1. *Development of ECV data products*
    2. *ECV data access and user tools*
    3. *Promotion of ECV data exploitation*

1. Development of ECV data products

   In conformance with the programme objectives, the bulk of resources will continue to be devoted to development of ECV data products. Projects will be maintained on all thirteen ECVs currently addressed, with the aim of providing the most complete possible response to the user requirements for these ECVs

Phase 2 activities

2. ECV Data Access and User Tools
   - ***Data Access Portal*** *- In the next stage of CCI a dedicated web portal will be set-up to provide a single point of access for all CCI data products.*
   - ***User Tools*** *- Software tools to simplify handling, inspection and analysis of the CCI data products will be developed and made freely available to users.*

3. Promotion of ECV data exploitation
   - *Generation of* ***ECV Promotional Materials*** *- Brochures, reports, web and mobile-based materials will be generated, to demonstrate the quality and features of the CCI data products, and their relevance for climate monitoring.*
   - *A suite of opportunities will be provided for young scientists to carry out* ***Post-Doctoral Research Projects*** *on climate science topics for which the ECV data products are relevant. The research topics will include the 'Scientific grand Challenges for Global Climate Research' identified by WCRP and scientific questions arising from the 5th IPCC Assessment Report*

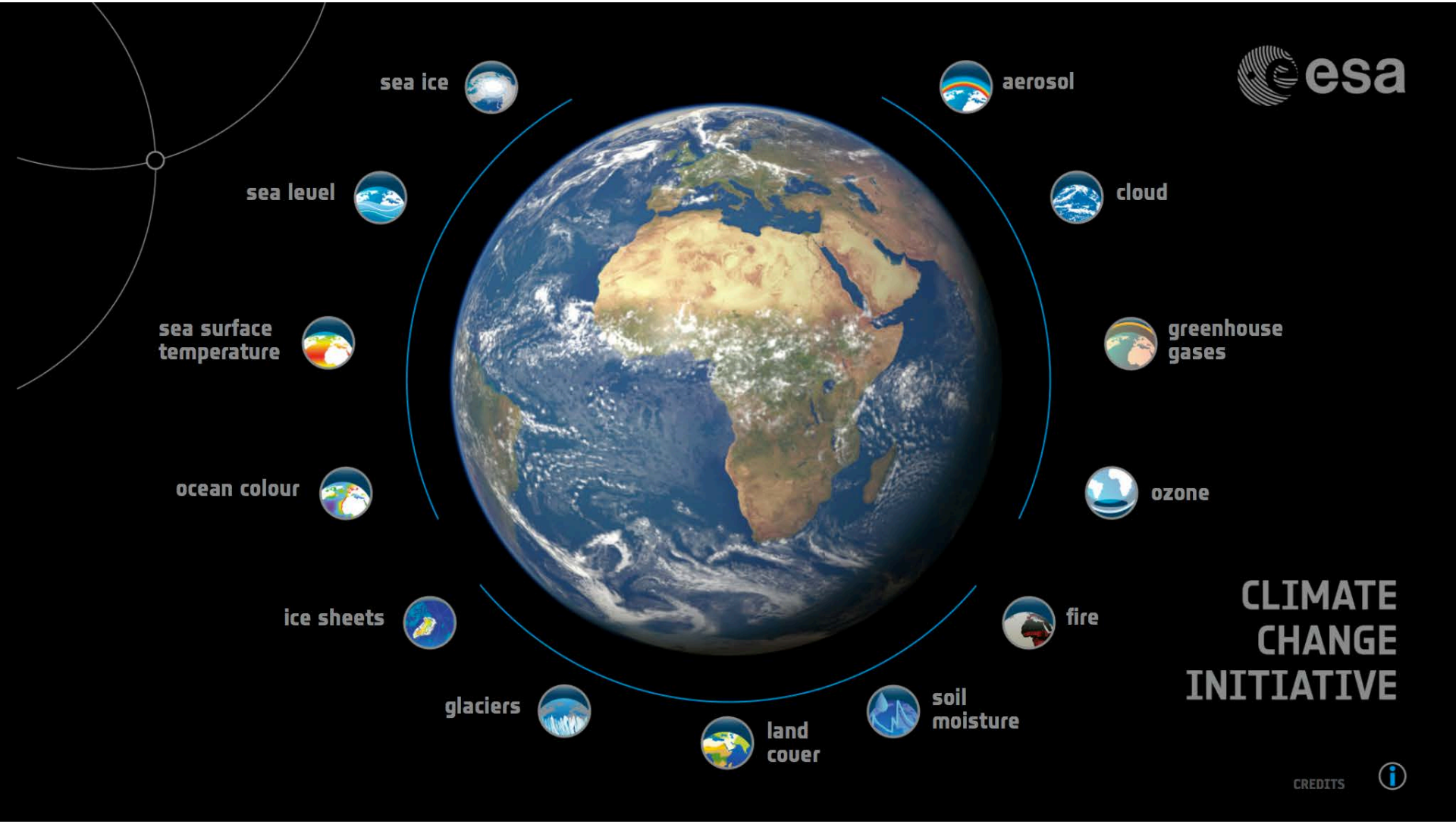
Phase 2 Status

- **Development of ECV Data Product**
  - This is the continuation of the ECV Projects

- **ECV Data Access and User tools**
  - Marie-Claire has joined the ESA Climate Office and will be dedicated to these two activities.
  - Two calls for tender will be issued on these two aspects in 2014.

- **Promotion of ECV data Exploitation**
  - A “CCI Visualisation Corner” is being developed. A first version was presented at the Living Planet Symposium further work will be done in that area.
  - The Post-Doc scheme is in preparation and should be issued during the first quarter 2014.

CCI Visualisation Corner



CCI Postdoctoral Scheme

Support for up to 10 2-year postdoctoral positions to undertake research activities relevant to the Climate Change Initiative (www.esa-cci.org).

Focus on projects dedicated to:

- Exploiting Essential Climate Variable (ECV) products from CCI for improved understanding of the Earth System;
- Examining Cross-ECV consistency and multiple ECV use (those under the CCI Programme in particular).
- Enhancing interactions between CCI members and other Earth science laboratories, research centres and universities.

Funding available: 40kEuro/year

Call for proposals: April 2014

Start date: October 2014

The CCI Objectives

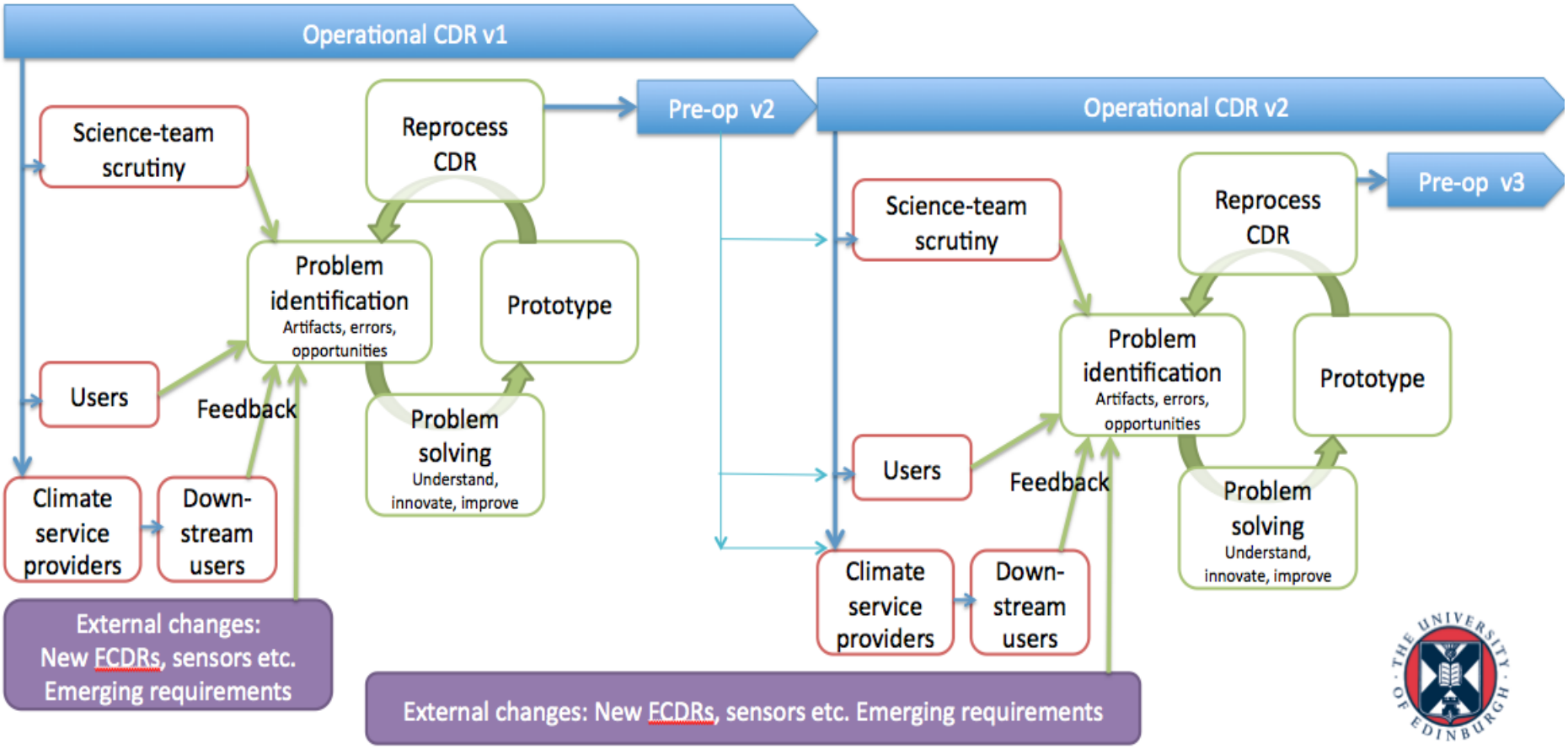
Realise the full potential of the long-term global EO archives that ESA, together with its Member states, has established over the last thirty years ...

... as a significant and timely contribution to the ECV databases required by the United Nations Framework Convention on Climate Change

Climate Change Initiative

- **Based on this analysis the following five main activities are being implemented to achieve the overall objective:**
  - Gathering, collating and preserving the long-term time series in ESA's distributed archives.
  - (Re-)Processing periodically the basic EO-data sets from each individual mission and applying the most up-to-date algorithms and cal/val corrections.
  - Integrating the calibrated data sets derived from individual contributing EO mission and sensors to constitute the most comprehensive and well-characterized global long term records possible for each ECV.
  - Assessing the trends and consistency of the ECV records in the context of climate models and assimilation schemes.
  - Developing improved algorithms and data models for production of the required variables from emerging data sources, consistent with the long term record

Climate Operations Model



Example of Operational Models

- **Three example Models**

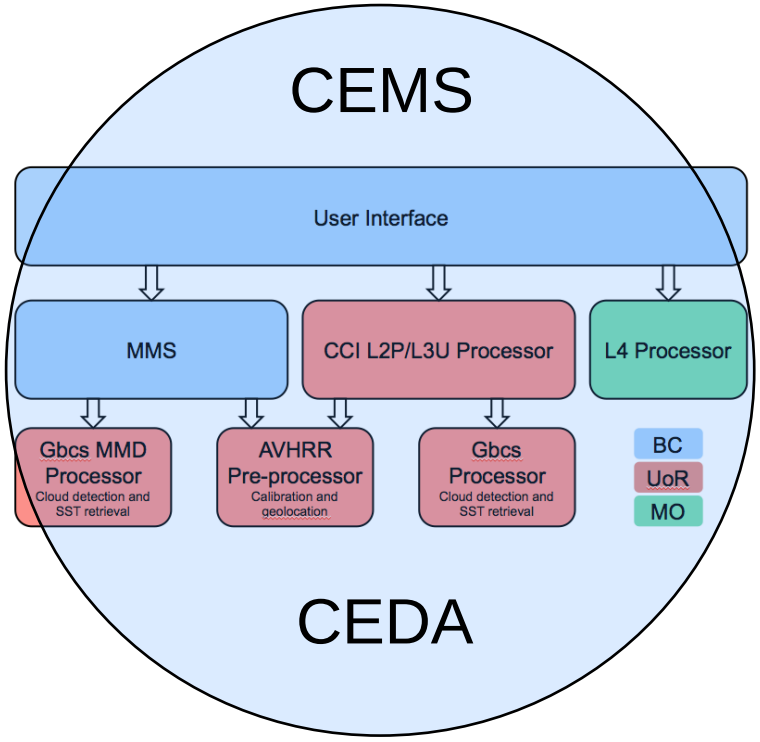
- **Preparation for an operational solution funded by EC**
  - The CEMS – CEDA solution [SST, …]
  - The Earth Observation Data Centre for Water Resources monitoring (EODC-Water) [Soil Moisture]

The Solution proposed by SST

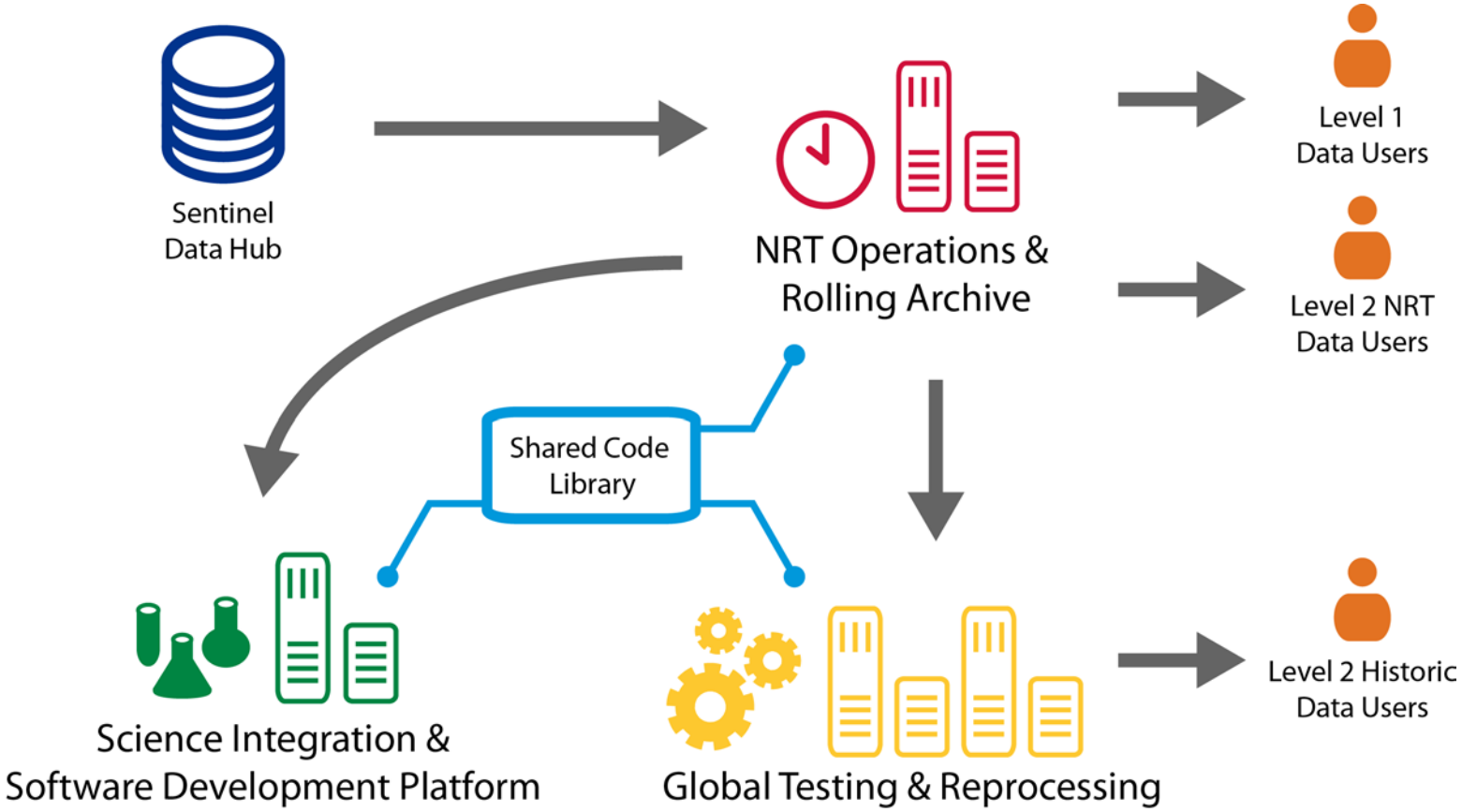
- **Integrated implementation at CEMS**
  - Fully functional (re-runable) Multi-Sensor Match-up System
  - Updated NEMOVAR-based OSTIA implemented as stand-alone (better connection to assimilation systems)
  - Fast: Able to process ATSR-series in <3 days

- **CEMS will be integrated in UK Collaborative Ground Segment, therefore "future proof" of concept in preparation for Copernicus missions**

- **Create a system which is "Sustained" beyond CCI Phase 2**



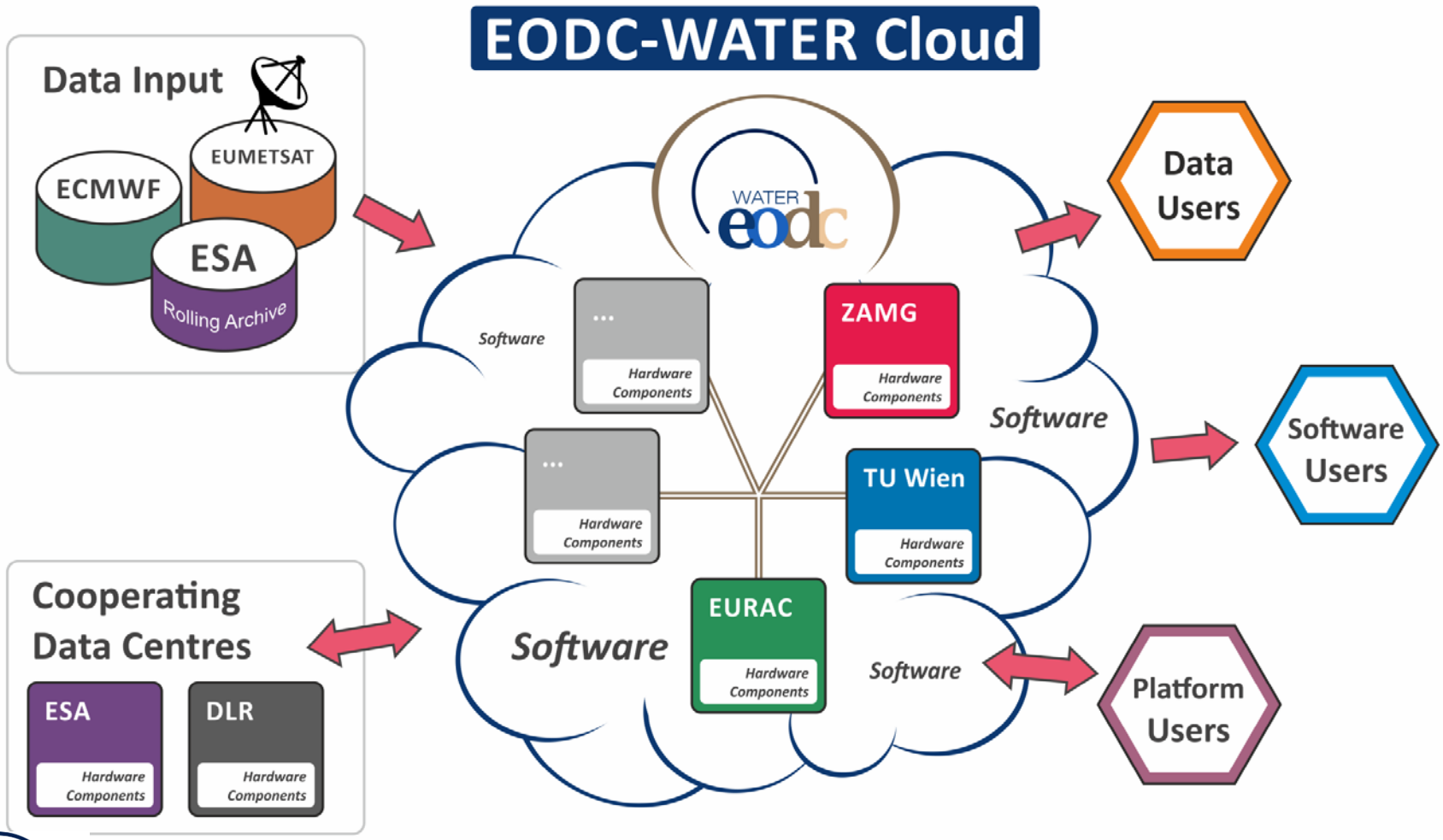
EODC-Water
Earth Observation Data Centre for Water Resource Monitoring



Connecting Science and Operations:

keeping scientists in the loop

EODC-Water
Open & Collaborative Data Centre



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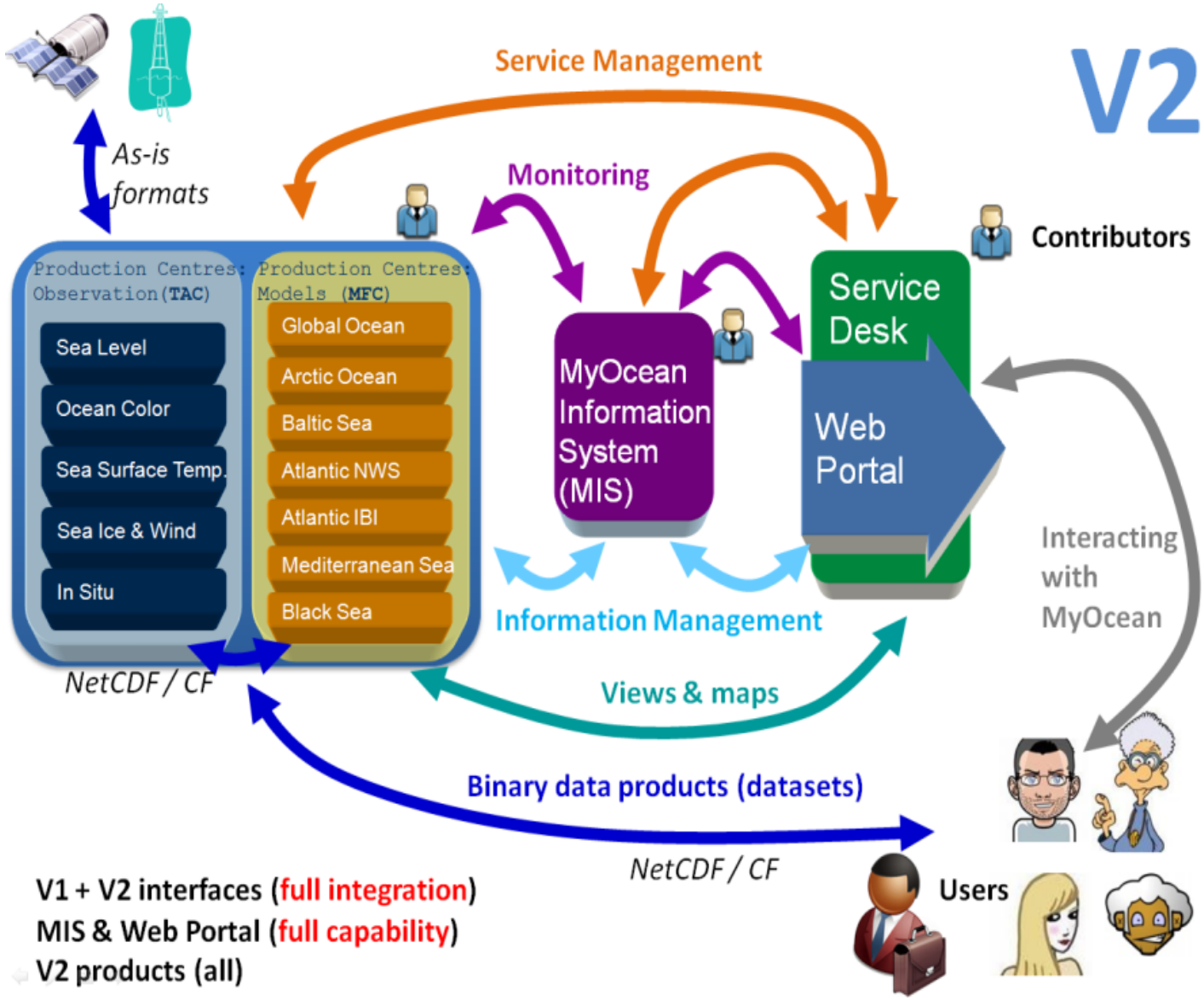
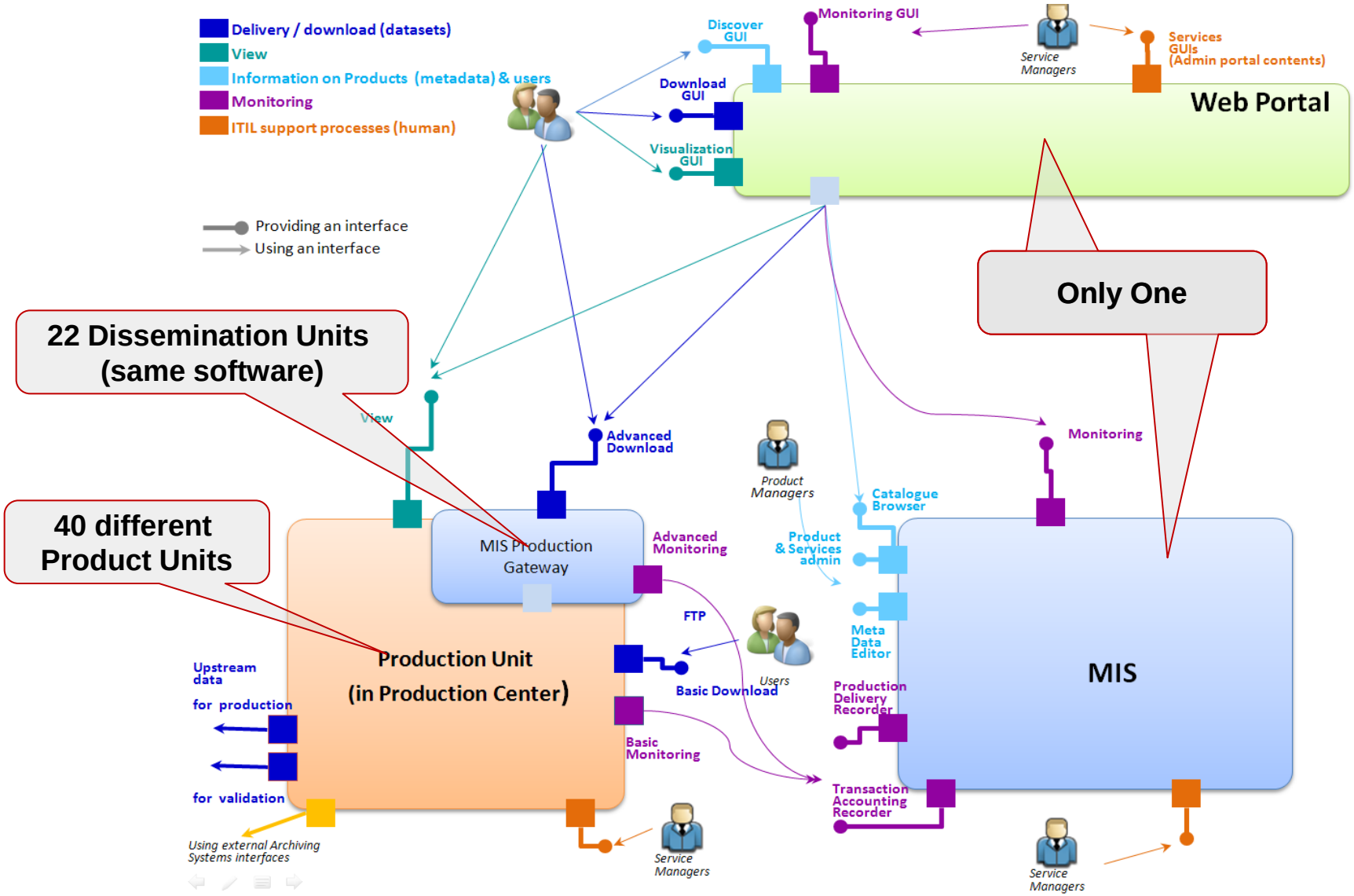
- **Integration in an already existing System**
  - MyOcean [Sea Level, …]

MyOcean System Architecture



MyOcean System Architecture



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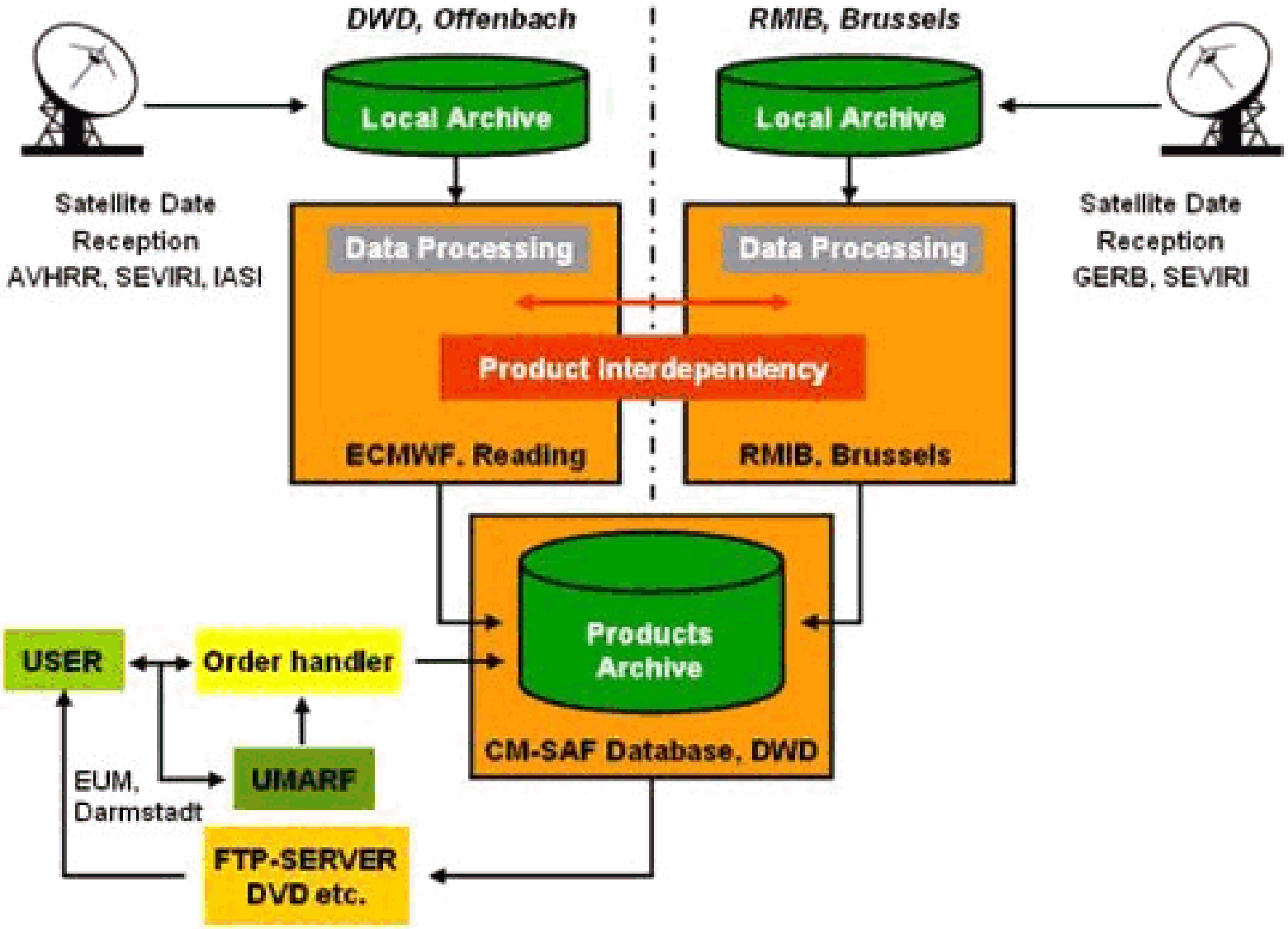
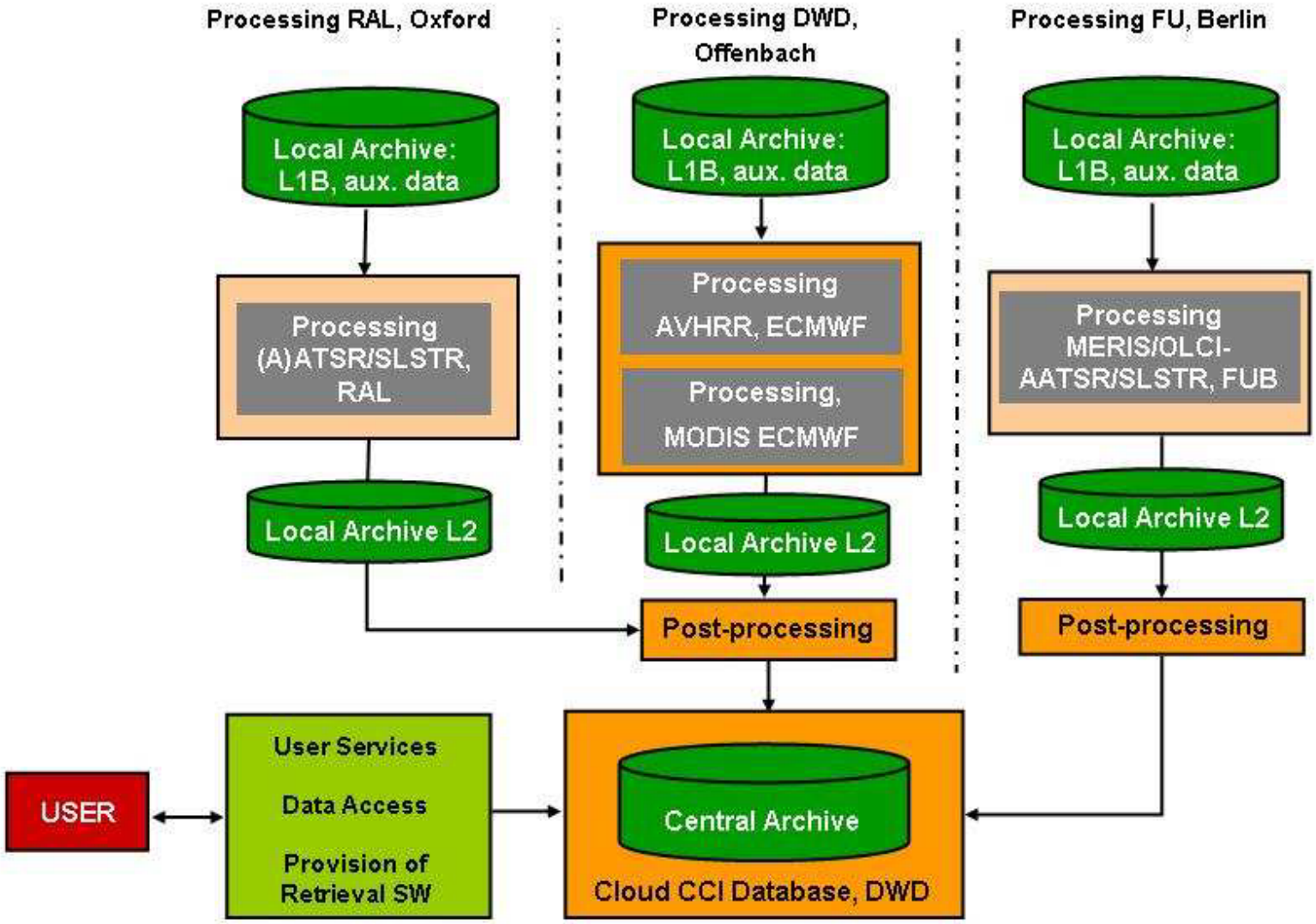
- **Integration in an existing EUMETSAT SAF**
  - CM-SAF [Cloud, Aerosol, …]
  - OSI-SAF [Sea-Ice]
  - O_3M-SAF [Ozone, …]
  - LSA-SAF [Fire, …]

The CM-SAF


DWD, Offenbach
RMIB, Brussels
Local Archive
Local Archive
Satellite Date Reception AVHRR, SEVIRI, IASI
Satellite Date Reception GERB, SEVIRI
Data Processing
Data Processing
Product Interdependency
ECMWF, Reading
RMIB, Brussels
Products Archive
CM-SAF Database, DWD
USER
Order handler
UMARF
EUM, Darmstadt
FTP-SERVER DVD etc.

The current Cloud-CCI



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EUMETSAT **CCI Started** **CCI Scope**

Conclusions

- The CCI has allowed progress on 14 ECV (35 variables).
- During Phase 2, even better results with be achieved.

- ESA doesn't have the mandate to "Operate" ECV production systems and the current funding will be consumed by 2018.

- Operational "homes" should found for all of the 14 ECVs.
- A potential extension of the CCI is in preliminary discussion for new ECVs and/or new variables (CCI-2).

- The CM-SAF should be that operational "Home" for the results achieved in Cloud (certainly), Aerosol (?), other ECVs
- Input on what could be CCI-2 is welcome (New ECVs, new variables).