→ CLIMATE CHANGE INITIATIVE

supporting CCI science

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Showcasing CCI data, exploiting CCI data, and making CCI data available to all:

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Climate from Space: the CCI iPad App that visualises climate data sets from ESA's Climate Change Initiative programme is out in May 2016. The Tool has been developed by Planetary Visions Ltd. on behalf of ESA.

Visualising the CCI data sets

iPad App 'Climate from Space' is available, free to download from the App Store, from May 2016. Alongside the App, a tool for big-screen exhibition displays of the CCI data sets has also been developed.

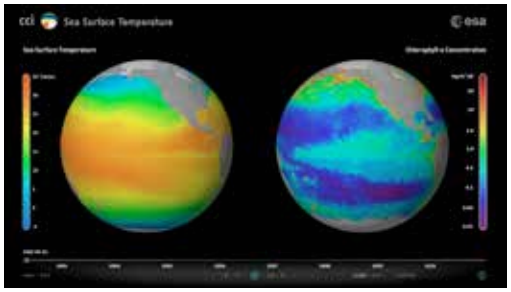
Visualisations of satellite data can reveal stunning images of the Earth but also demonstrate how much information we can gain about climate change from space. The interactive presentations of data from the Climate Change Initiative give a clear picture of the global nature of many of the data sets being developed in the programme, the detail attained and the increasing length of satellite data sets.

The range of advantages of using satellite data are clear to see: from the precise changes in sea surface height, measured in millimetres, to the daily information provided on sea surface temperature; from the global nature of increasing CO_2 emissions to the changes revealed from inaccessible areas, such as ice loss from the Greenland Ice Sheet.

More than a just a video, the visualisations are interactive, comparable and are rendered by taking information straight from the data sets. This allows for them to be easily expanded as further data is added, both from continuing updates from current or new satellite missions and by extending it further back in time, as the ESA's archives are explored.

The iPad App is aimed at explaining what Earth observation can tell us about our climate, to a public audience. Its interactive features allow the users to play around with and compare different satellite data. Key climate variables from the CCI programme are included, with explanations of their role in climate change and why the CCI datasets are valuable for climate science. It is scheduled for release at the Living Planet Symposium in May 2016.

The CCI visualisations are currently also being shown as an interactive exhibit at scientific conferences and meetings around the world. This version of the CCI Visualisation Tool showcases the whole range of CCI data products and gives scientists and data users information about how the data sets were developed and where they can be accessed.



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CCI Open Data Portal

Making CCI data products easily available to the climate science community is an important activity of the CCI programme. Started in April 2015, the CCI Data Access Portal project covers the development, implementation and operation of an online single point of access for the CCI ECV datasets from every CCI project in highest demand. This central archive complements the 14 current CCI sites independently addressing each CCI project. Version 1 of the Portal is due for formal release at the end of May 2016.

The aim of the CCI Open Data Portal is to make the CCI ECV data products in highest demand freely and easily accessible, at a **single point of access**, to the international climate user community.

The portal will provide a **common means of access** to this ECV data, drawn from 14 CCI projects. Similarly, this broad variety of ECV data will be discoverable via **common data interrogation** tools.

A **common CCI data catalogue** will, for the first time, allow climate users to conveniently explore, identify and download data for their multi-ECV activities (search interface illustrated below). This will support climate research on the interconnectedness between ECVs, an activity similarly targeted by the CCI Toolbox project that started at the end of 2015.

The updated web presence of the CCI programme (cci.esa.int) will feature a **dashboard** (right) to present this common CCI catalogue and its underlying archive of most useful CCI data. The dashboard is designed to be an intuitive and interactive 'big picture' of the centrally archived datasets presented by their type of ECV and by time. Other features designed to engage and support users will include a Helpdesk function and CCI Programme FAQ and Wiki pages.

It is an aim of the CCI programme to direct CCI ECV data products into the **Earth Science Grid Federation** (ESGF) federated data sharing infrastructure.

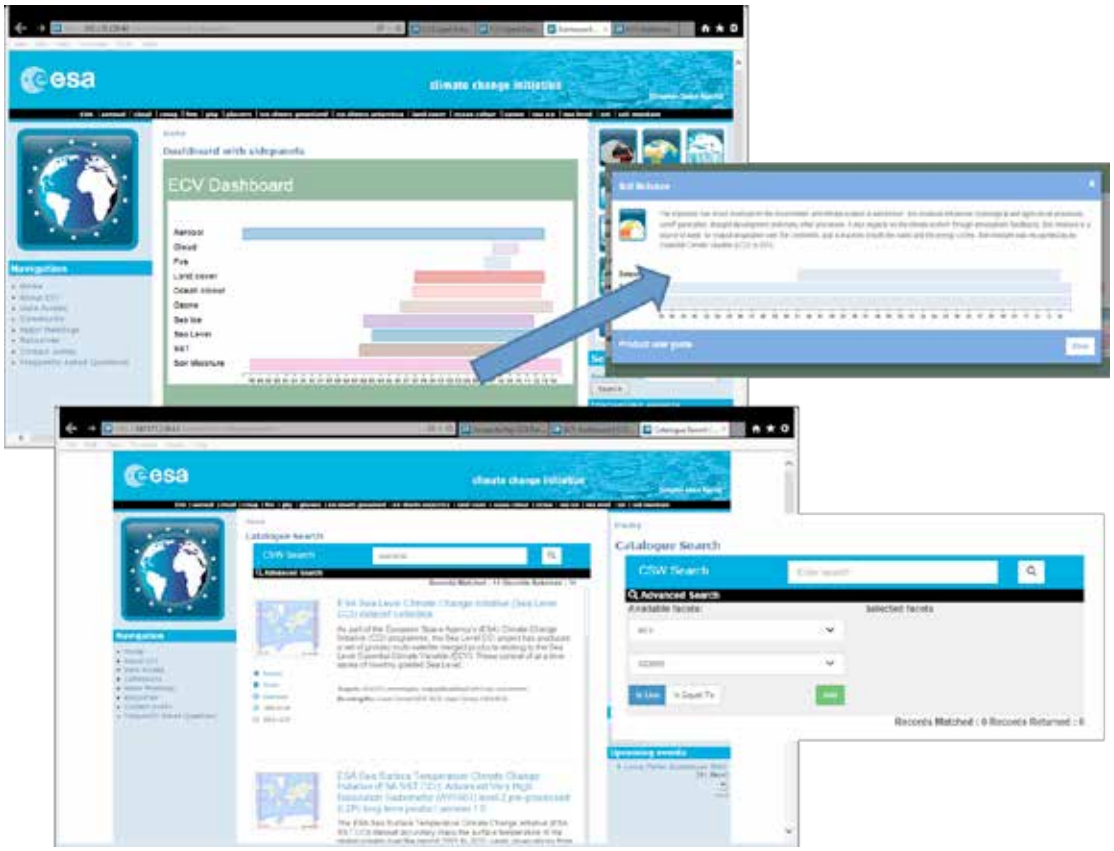
The CCI Open Data Portal project will drive this activity, have its own CCI tailored ESGF node, and therefore help ensure an optimal visibility of the CCI datasets to climate scientists.

This CCI ESGF node development accompanies the support provided to all CCI teams towards **Obs4MIPs**, an initiative of the Coupled Model Intercomparison Project (CMIP) community. Making CCI ECV data available to the climate modelling community, via CMIP5 and particularly **CMIP6**, are crucial to open CCI data to the IPCC and AR6.

The CCI Open Data Portal project is also tasked with exploring the broader application and **exploitation of Earth Observation data** for climate. A report dedicated to analysing and defining potential requirements to capitalise on computing technologies to maximize the exploitation of Earth Observation data for climate purposes has been compiled and is currently under review.

The project also includes other activities related to supporting the visibility of CCI ECV data, including Data Object Identifiers (DOIs) and the updating of CCI ECV project websites to achieve common style and content.

For further information contact Ed Pechorro (ed.pechorro@esa.int).



CCI Toolbox

Due to start in October 2015, the CCI Toolbox project is tasked to develop an extensible toolbox for the international climate research community, earth system science, climate service developers, earth system reanalysis and other climate users, to observe **multiple CCI ECVs in union**. Reuse of existing assets, cost efficiencies and value for money are atop the engineering agenda.

Tackling cross-ECV challenges is an important endeavour of the CCI programme, requiring the scientific analysis, processing and comparison of **multiple ECVs in union.**

However, the current tooling for this activity is limited in the means to: ingest data spanning different ECV types into a common data model; to apply algorithms homogeneously across data associated with different ECV types, and to conveniently analyse and visualise the resulting output.

The main objective of the CCI Toolbox project is to equip climate users with the means to operate on CCI ECV data, overcoming these three challenges above, as follows:

1. **Ingest different ECV products into a common data model**. Although in principle the CCI community largely adhere to a common NetCDF-CF file format tailored to fit all CCI ECVs, the ingestion of all CCI ECV types into a single common data model is non-trivial. ECV data products differ significantly in their structure, spanning a variety of vector and scalar representations and differing dimensionality. The CCI Toolbox will include a common data model for ECV data products and the means to ingest any CCI ECV data product into the model.

2. **Compute algorithms homogeneously across a common data model.** The CCI Toolbox shall include functions, or Processors, each homogeneously applicable to any ECV data product. These Processors include, for example, geospatial polygon filtering, ensembles and the analysis, filtering, exploration and propagation of uncertainties that accompany ECV data.

3. **Support ECV analysis and visualisation.** The CCI Toolbox will provide a means to visualise and analyse the output from Processors. The toolbox will also provide the means to reapply this output, including its analysis by the user, as new input back into Processor(s).

Flexibility for the climate scientist is a critical consideration in the development of the toolbox. A good toolbox must adapt to the needs of the climate user, and not the other way round whereby the user bends to the toolbox. **A plugin facility,** for instance, will provide the climate user with the capability to integrate the toolbox with their own existing suite of tools.

An equally important factor in the CCI Toolbox development will be the interaction of the project team with climate users. The project will not only involve climate users for community outreach and to gather feedback. **Climate users will be embedded into the development team throughout the whole development process**, working in rapid iterations with the development engineers.

This contemporary, proven, tailored approach to agile development mitigates a variety of different project risks, promotes cost effectiveness and delivers efficiencies. **Financial prudence** in the toolbox development will leave more resources for the climate science, where it primarily belongs.

Moreover, reuse of existing European computing assets will feature prominently in the CCI Toolbox development. No tooling exists which directly meets the objectives. Nevertheless a number and variety of climate tooling already exist, and the project team will plan to provide significant value for money through software reuse.

The CCI Toolbox project kicked off in October 2015. For further information contact Ed Pechorro (ed.pechorro@esa.int).

An Example Use Case

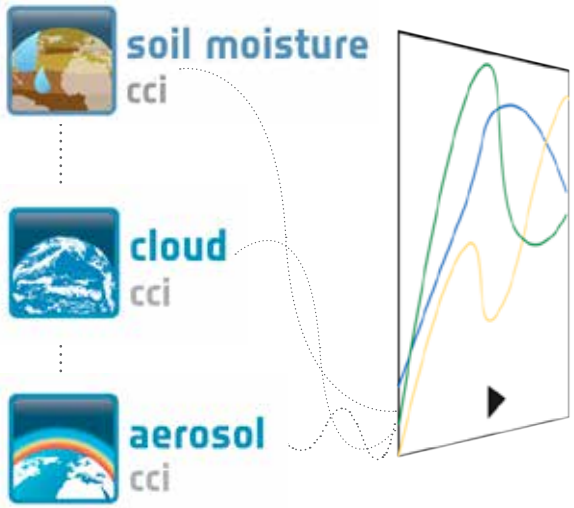
A climate scientist wishes to analyse potential correlations between Aerosol Optical Depth, Cloud Fraction and Volumetric Soil Moisture, and uses the CCI Toolbox to perform the following:

1. Generate a shared-axes time series of aerosol optical depth (Aerosol CCI), cloud fraction (Cloud CCI), and volumetric soil moisture (Soil Moisture CCI) data products for a given geospatial area defined on a rotatable globe and specified time range.

2. Generate a scatter-plot and correlation statistics between the aerosol optical depth (Aerosol CCI), cloud fraction (Cloud CCI), and volumetric soil moisture (Soil Moisture CCI) data products.

3. Analyse pixel-by-pixel correlation between the aerosol optical depth (Aerosol CCI), cloud fraction (Cloud CCI), and volumetric soil moisture (Soil Moisture CCI) data products.

4. Generate a side-by-side animation of the three products for a given geospatial area and specified time range, on the same axis.



CCI Living Planet Fellowship postdoctoral positions

The Living Planet Fellowships (LPF) are designed to support young researchers initiating a scientific career in the Earth Observation to conduct research exploiting Essential Climate Variable (ECV) products generated by the ESA's CCI for improved understanding of the climate system and/or examining cross-ECV consistency and multiple ECV use (those under the CCI Programme in particular).

The first LPF call in 2014 was open to candidates from institutions within member states in the CCI and resulted in support for 9 post-doctoral positions, 4 in the UK, 2 in Germany, 1 in Finland, 1 in France and 1 in Spain. The projects cover atmosphere, cryosphere, land and ocean domains and their interfaces and incorporate most of the CCI projects (see Table below).

Most of the candidates are working alongside the CCI projects as well as engaging with external collaborations, for example the VERITAS project is based in an institution (IC3) whose primary work is in creating products using SMOS data to generate soil moisture and sea surface salinity products while ELEGANCE is based in the NERC National Centre for Earth Observation (NCEO) working on land system modelling and the carbon cycle.

Name	Project Title	CCI Project
Martin Hieronmyi	LowSun-OC - Ocean Colour at low sun and high waves	OC_cci
Omar Bellprat	VERITAS CCI - VERification of high-resolution climate forecasts on intra-seasonal to inter-annual timescales with Advanced Satellite datasets of the Climate Change Initiative	SST_cci
Robert Parker	ELEGANCE - Exploring the Global Carbon Cycle through atmospheric greenhouse gas variability	GHG_cci Fire_cci
Jens Heymann	CARBOFIRES - Carbon dioxide emissions from fires	Fire_cci GHG_cci
Tero Mielonen	ITICA - Does increasing Temperature Increase Carbonaceous Aerosol Direct Radiative Effect over Boreal Forests?	Aerosol_cci
Simon Munier	GIEMS-SAR - Surface water and climate variability from a high resolution GIEMS-SAR merged product	SM_cci
Marie-Fanny Racault	CLIMARECOS - CLimate Impact on MARine ECOsystem State in the global oceans	OC_cci
Adam Povey	ERACE - Environmental Response to aerosols	Aerosol_cci
Anna Hogg	CryoShelf - CryoSat measurements of Antarctic Ice Shelf thickness change	AIS_cci

First Results

The projects were started between February and August 2015 and thus results to date are preliminary. However early results have been generated by both LowSun_OC and VERITAS-CCI. In LowSun-OC the effects of waves and low solar angles on ocean colour and the need to address corrections in regions of high wind speed - the Roaring Forties, Furious Fifties and Screaming Sixties - have been identified.

In VERITAS_CCI hindcasts with the EC-Earth model have been conducted to understand the importance of land surface and sea ice initialisation and the role of increasing model resolution on sea Ice Extrent, Air temperature and Seas Surface Temperature. These were evaluated using prediction skill of the El Niño Southern Oscillation (ENSO). Early results indicate higher horizontal resolution improves prediction skill significantly while improved land surface initialisation greatly improves summer air temperature prediction skill in Europe.

Forward Look and Call for 2015

All the CCI Living Planet Fellows will attend the 6th CCI Colocation meeting in ESRIN in September to present their research to reinforce the integration wih the wider CCI Project Teams. This will also present a first opportunity for the Fellows to meet up and present their work in more detail through a specific meeting immediately before the main Collocation.

A meeting of all postdoctoral fellows across the three ESA programmes (CCI, STSE and SEOM) is planned for Spring 2016 when most projects will be at the mid-term review stage and will have consolidated results to present.

The second call for postdoctoral fellowships under CCI was opened on 24th June 2015 with the intention to support up to a further 6 fellows. This closed on 30th August, and is scheduled to place contracts in the fourth quarter of 2015.