CMUG Meeting Report

Name: Report on CCI Project Integration Meeting, 14-16 May 2012
Due date: 15 June 2012
Submission date: 23 July 2012
Version: 1.1

Climate Modelling User Group

Report on CCI Project Integration Meeting, 14-16 May 2012

Centres providing input: MOHC, MPI-M, ECMWF, MétéoFrance

Version nr.	Date	Status
0.1	25 May 2012	First draft for input by CMUG partners
0.2	07 June 2012	First draft to ESA for comment
0.3	15 June 2012	ESA comments addressed
0.4	21 June 2012	To meeting participants for comment
1.0	17 July 2012	Updated with input from participants
1.1	23 July 2012	Final submission to ESA

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Report on CCI project integration meeting

MétéoFrance, Toulouse, France,

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MétéoFrance, Toulouse, France,
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This document summarises the scientific content of the meeting from presentations and discussions, and captures key points noted by delegates.

1. Overview

This meeting organised by the CMUG and hosted by MétéoFrance described CCI project results to date, and brainstormed future CCI potential in the context of the science challenges that climate research faces. The meeting was also an opportunity for CMUG to present the first results from its work on precursor datasets. The aims for the meeting were considered and agreed by CCI project leads in advance of the meeting, and were as follows:

1. *CCI science leaders and climate research group members to explore the over-arching scientific challenges for research and identify how the CCI contributes to meeting them*
2. *CCI teams who have started producing ECV data to show their results to the CRG and CMUG and demonstrate the value in their product*
3. *CMUG to give a summary of its present state of assessment of precursor datasets including dealing with uncertainty*
4. *CMUG to demonstrate to the CCI teams how ECV data might be applied by researchers in the climate modelling and reanalysis communities including dealing with uncertainties in products*
5. *maintain oversight of the position within the international research framework in which CMUG/CCI is operating (e.g. FP, JRC, GMES-Climate, etc)*
6. *discussion on phase 1 strategy and phase 2 perspectives within the CCI*
7. *allow discussion to finalise the CCI science paper*

The meeting started with presentations from invited experts on the science challenges that climate research faces, including the provision of Earth observation data sets for climate studies. After this high level view there were parallel sessions on the marine, atmosphere and land domains allowing the teams to provide updates on how they are addressing these research challenges, and the outcomes from these sessions were presented at a plenary session.

Next on the programme were two parallel brainstorming sessions comprising a substantive part of the meeting, one for science leads and the other for the Climate Research Groups within the ECV projects. The free form discussion promoted in these groups allowed interesting ideas to develop on how both the existing work and CCI Phase 2 could evolve. Summary views from these brainstorming groups were presented at a final plenary session. Lastly there were presentations and discussion on the first results from CMUG work on SST, SSH, Clouds, Fire and Landcover precursor datasets. The key points from the presentations and the outcomes from discussions are summarised in this report.

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All the presentations from the meeting are available on the CMUG web site at:
http://dialspace.dial.pipex.com/prod/dialspace/town/estate/gtp89/cmug/integration2.html

2. Summary of presentations of invited experts

Key remarks on the programme
1. The mid-term review of the CCI will take place in November.
2. The success of the CCI depends on it demonstrating the utility of its outputs.
3. ECV projects which are successfully reviewed should in principle continue to Phase 2.
4. The content for Phase 2 is still being refined.
5. The timeline for starting Phase 2 is mid- to late 2013 (tender and contract award dates).

Key remarks on the scientific challenges facing climate research
1. Uncertainty in the contribution of glacier and ice cap melt to SLR.
2. Climate model resolution is not matched to ice observations resolution.
3. Differences between Ice Sheet Mass Balance measurements.
4. Climate models still cannot model key ocean processes (e.g. eddying) due to low resolution
5. Identifying the long term changes in carbon sources and sinks
6. Emissions should be included in the Fire CCI
7. Obs4MIPs international workshop in late 2013, CCI pre-cursor datasets could be included.

Philippe Bougeault (MétéoFrance) opened the meeting. **Mark Doherty (ESA)** then gave a presentation which set the scene on the end of phase 1 and start of phase 2 in the CCI, including a timetable for the next steps for phase 2 proposals. He noted that member states will get a mid-term progress report on the achievements so far in September, and that output from this meeting will be used to inform the content and organization of CCI phase 2, which member states will decide in late 2012 - early 2013. The ESA ministerial is in Italy on November 12th. For phase 2 he indicated that the ESA executive would advocate continuing all ECVs and CMUG, subject to positive mid-term reviews, compatibility with available funds, and member states' approval. ESA will aim to issue tenders in second quarter of 2013 and place contracts in late 2013. All the CCI projects, particularly their users, have to answer the question "what difference will it make?" and CMUG must provide “tools” to independently assess those improvements.

Andy Shepherd (University of Leeds) presented on satellite observations of the cryosphere. Andy's work uses observations from GRACE to calculate contributions of glaciers and ice caps to sea level rise, including the problem of glaciers breaking up into smaller glaciers. CRYOSAT is doing well and can survey 80% of glaciers, where ICESAT cannot. It was pointed out that the ground resolution of observations of the Greenland ice sheet (250m) is much higher than climate models use. The IPCC reports that poor agreement between ice sheet mass balance and consequent sea-level rise is an area where reconciliation would benefit climate research, which is being attempted by the Imbie (Ice Sheet Mass Balance intercomparison) exercise. From 2004-2010 there are eight different types of concurrent measurements. Reconciled mass balance between all sensors shows good agreement. Early results from Imbie show the Greenland ice sheet has big mass loss but Antarctic ice sheets are fairly stable. Other summary points are that intercomparison exercises are useful and the Antarctic ice sheets need more measurements.

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Jonny Johannessen (NERSC) addressed the science challenges for the oceans. The first of these is that climate models today are not yet eddy permitting, and he also showed that Arctic sea-ice area models now agree with observed trends in AR5 in contrast to AR4 but there are still differences in amount. Freeboard heights from ICESAT show decline over recent years, but simulations versus tide gauges are in reasonable agreement for phase. He showed that trends in SST are from 0-1 degC from a range of different models, and also that SST gradients and the GOCE gravity field giving mean surface geostrophic current must be <30km. It was also shown that it is necessary to move to <30 km resolution to resolve structures. The contributions to sea-level rise from different areas of melting ice, and a map of sea-level trend over last 20 years were presented. He showed maps of ocean net productions compared with atmosphere/ocean CO2 exchange. Jonny also described and commented on the research links between ECVs.

Shaun Quegan (University of Sheffield) is Director of the Centre for Terrestrial Carbon Dynamics and his presentation focused on Fire to illustrate how the ECVs are connected. Firstly it was shown in the perturbed global carbon budget how land and atmosphere absorb extra CO2 from fossil fuels and changes in land use, but that an excess remains in the atmosphere. The importance of assimilating CO2 and CH4 in climate models was stressed, and hence the value of these ECVs to climate research. Some models show natural carbon cycle may result in land starting to emit CO2 which would greatly increase atmospheric concentrations of CO2. Sean raised the question of fire radiative power (FRP) consistency with emissions, and that the Fire CCI should include emissions. Fire is not a key control of the inter-annual variability of the net boreal flux. Thaw depth of active layer changes when fire has occurred. For carbon cycle the need is to get several quantities which all need to be consistent and researchers should assimilate these in their models. Sean promoted radiance assimilation in to climate models which should be an improvement because errors are much clearer.

Robert Ferraro (NASA/JPL) gave a presentation by video link on satellite observations for CMIP5, commonly known as the Obs4MIPS programme. (Obs4MIPS is on the Earth System Grid and provides Earth Observation data on the same grid and variable as climate model output.) Their target community is the analysis community writing papers on evaluation of models. A list of priority variables for comparing with models was given and of these the ocean surface winds and TOA fluxes have the highest priority for validation research. These data are produced from existing L2 satellite data products, and there is an extensive list of products already available, including AMSR-E SST, CERES TOA fluxes, QuikSCAT winds, and AVISO SSH. NASA products are freely available to all researchers, while AVISO has a non-commercial licence. International agencies are also contributing data to this programme. Robert outlined plans to have an international workshop in Autumn/Winter 2013. He showed an example of data documentation that is used to provide supporting information for climate researchers. There was time for an extensive question and answer session at the end of the presentation and this reflected the high level of interest by researchers in the CCI of the utility and benefits of this observation data serving initiative for climate modellers. Links to websites in the talk are:

- Obs4MIPs Front Page http://obs4mips.llnl.gov:8080/wiki/
- NASA ESG Gateway http://esg-gateway.jpl.nasa.gov/home.htm
- New ESG Interface (Beta) http://esg-datanode.jpl.nasa.gov/esgf-web-fe/

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3. Summary and outcomes of Earth domain parallel groups

3.1 Introduction

Three parallel sessions were conducted, for the domains of Land, Ocean and Atmosphere. The science leads for the ECV projects in these domains presented their results in the context of the scientific challenges seen in the key note presentations. Specific topics in the presentations were: 1) success stories to date; 2) meeting the needs of climate modellers; 3) added value of the ECV; 4) links to other ECVs; 5) common issues; and, 6) the first data outputs. The results were then summarised and presented at plenary to all delegates for information and discussion. This plenary discussion was especially important for progressing common issues between the domain groups (uncertainty representation, spatial-masks, data issues, etc) and highlighting areas of best practice.

3.2 Land

Key remarks
1. Fire, Soil Moisture and Land Cover project data products will be applicable to climate modellers directly for process/feedback studies. Glaciers and Ice Sheets will provide information to modellers mainly for albedo and freshwater fluxes.
2. All Land Cover ECV projects will produce CCI datasets that are better than existing state of the art.
3. In-common links between other projects are established and need to be exploited in full to achieve the goal of data product consistency.
4. First sample CCI datasets will be available over the next 9 months (except for ice sheets)

The Land domain group comprised the ECV projects for Land Cover, Fire, Soil Moisture, Ice Sheets, and Glaciers, and the summary presentation back to plenary for this group was made by Emilio Chuvieco.

Success stories to date: Development of a unique inland water mask for Landcover, and a validation dataset for Fire. Ice sheets and Glaciers have made significant contributions to the IPCC AR5. Soil Moisture will soon their first data set: http://multimedia.esa.int/Videos/2012/06/Thirty-Years-of-Global-Soil-Moisture-Measurements-from-Space

Meeting the needs of climate modellers: Land Cover project data will be a useful contribution to land surface dynamics schemes in climate models. The Fire project will contribute information on GHG emissions, and vegetation dynamics to climate modellers. Soil Moisture will contribute information on water-energy-carbon cycle feedbacks for process work by climate modellers. A preliminary Soil Moisture data set will be delivered very soon. Glaciers will provide information on the surface fraction, and Ice Sheets will give information on topography, albedo, and freshwater fluxes to climate modellers.

Added value of the ECVs: The added value of the Land Cover and Soil moisture ECVs above current state of the art is in providing temporally and spatially consistent datasets. For Fire it is in providing a merged product. For Ice Sheets and Glaciers it is about providing datasets that are not currently available, as well as adding new parameters and temporal trends. For all the Land ECV projects their is an added value in a quantified uncertainty characterisation and validation.

Links to other ECVs: All the Land ECVs have links between themselves and the other ECVs in the Ocean and Atmosphere domains. At one level this exists for masking (e.g. glacier-ice mask for land cover) but links are also needed for verification such as Fire needing to access Aerosol and Soil Moisture.

Common issues: Data issues were the largest group identified, including: accessibility, bulk processing, shared pre-processing (with common corrections and masks), formats and metadata. Other common issues identified within the land ECV projects were validation protocols and consistency in temporal trends.

First data outputs: Land Cover - September 2012 (2010); Fire - August 2012 (2008); Soil moisture - June 2012 (1978-2010); Ice sheets – TBD; Glaciers - February 2013 (1950-2010).

3.3 Ocean

Key remarks
1. Selection of final algorithms for marine ECVs is completed for ocean colour and SSH and almost completed for SST
2. Teams agreed to converge on common grids for L3/L4 products for temporal and spatial trend analyses
3. Each team defined the added value of their CDRs relative to existing datasets
4. First samples of CCI datasets will be available in the next 12 months except for sea-ice.

The Ocean domain group comprised the ECV projects for Ocean Colour, Sea Level, SST, and Sea Ice, and the summary presentation back to plenary for this group was made by Shubha Sathyendranath.

Success stories to date: SST, Sea Level and Ocean Colour report conceptual developments in their research methods, product improvements, and benefits accrued from working with precursor datasets. Sea Ice project started later but reports that it expects its results to be: better estimates of Arctic and Antarctic sea ice, better characterisation of uncertainty in products, and more products of a derived nature (e.g. budgets, fluxes etc.).

Meeting the needs of climate modellers: The Ocean domain ECV projects report that their products will meet the needs of climate modellers by providing consistency between datasets, a high level of error characterisation and better integration with other ocean datasets (e.g. salinity, ocean winds) for process studies (e.g. ocean heat content). One example for climate studies is the change in frontal systems with the SST data.

Added value of the ECV: The added value of the ECV data from projects in the Ocean domain relative to the current state of the art is in providing temporally and spatially consistent datasets. For Sea Ice and SST this includes mass balance research. For Sea Level it is to improve trend accuracy from 0.6mm/yr to 0.3mm/yr, and improved accuracy of regional trends to <1mm/yr.

Links to other ECVs: All the Ocean ECV projects have links to the other ECV projects especially for masking (eg land-sea mask and cloud masks). Other links to atmospheric ECVs were also identified (e.g. aerosols, clouds and GHG).

Common issues: Defining a common temporal and spatial resolution for products. Achieving a common approach to trend analyses.

First data outputs: SST - February 2013; Sea Ice - TBD; SSH - September 2012; Ocean Colour - September 2012.

3.4 Atmosphere

Key remarks
1. The value of these ECVs to climate modellers will be through better uncertainty characterisation, consistency between datasets, and longer terms over what is currently available.
2. First data is estimated to be over August to September 2012.

The Atmosphere domain group comprised the ECV projects for Aerosols, Clouds, Ozone, and Green House Gases, and the summary presentation back to plenary for this group was made by Rainer Hollmann.

Success stories to date: Improved retrieval methods and better coordination across all ECVs in this domain.

Meeting the needs of climate modellers: This will be met by setting the product technical specifications to improve uncertainty characterisation, and create a long term data record with bias correction, allowing trend analysis.

Added value of the ECVs: The added value of the ECV data from projects in the Atmosphere domain above current state of the art is in providing temporally and spatially consistent datasets. This will be built upon by some of the projects adopting a common approach (e.g. Aerosol and Cloud).

Links to other ECVs: Some of the Atmosphere ECV projects described their links to the other ECV projects, through masking (e.g. cloud mask) or verification (e.g. Aerosol and Fire),

Common issues: How to achieve consistency.

First data outputs: Aerosol – October 2012; Clouds – August 2012; Ozone - November 2012; GHG - September 2012.

4. Summary and outcomes of brainstorming groups

4.1 Introduction

A key point arising from the second colocation meeting was for the science leads and climate research groups of the ECV projects to have some time for dedicated brainstorming at the next integration meeting. This was requested to allow free form discussion to scope ideas for the future direction of the projects. It was also used to find solutions to issues within and between projects which if left unresolved may have constrained the CCI outputs. The Science Lead brainstorming group was led by Chris Merchant, and the CRG group by Alex Loew. Both leads reported back to plenary by presenting a summary of their groups discussions which was followed by a plenary question and answer discussion. The full discussion (from both group and plenary sessions) for each brainstorming group is described below.

4.2 Science Leads brainstorming group

Key remarks
1. A review of science opportunities for exploiting the CCI datasets was made.
2. Longer term funding opportunities for the CCI activities and related FP7 EU projects were identified.
3. The aspirations of the ECV teams for phase 2 of the CCI were clarified.
4. The possibility of sharing IT infrastructure in phase 2 was discussed and possible clusters of ECV teams identified.
5. Suggestions for the agenda of the 3rd collocation meeting in September were provided.
6. Final changes to the draft of the BAMS CCI paper were agreed and it will be submitted within 2 weeks.

This was a thought to be a useful exercise and ESA initially excluded from the meeting then gave some good feedback to the team on preparing bids for the second phase of the CCI which includes CMUG. A summary of the session under the agenda items is given here.

Science Opportunities beyond the CCI programme
Possibilities for exploiting the CCI datasets beyond the CCI programme were considered. The areas specifically mentioned were the **hydrological cycle** for which soil moisture and inland water (from land cover) and the feedback to clouds and precipitation were seen as important. Another component is the **cryosphere** with links between sea-ice, glaciers, ice sheets and snow cover. The Arctic – freeze – thawing cycle, water balance, CH4 release, sea-ice and sea-level was mentioned. Retreating sea-ice can have interesting effects for ocean colour and SST. Also one should look at asymmetric climate signals (e.g. change in sea-ice) between the Arctic and Antarctic. **Aerosol interactions** with other ECVs (ocean colour, SST, clouds) were also highlighted as important. The **carbon cycle** provides interactions between GHGs and soil moisture. **Fire** provides direct links to GHGs, ozone, aerosol, land cover and soil moisture. Indirect links to SST through seasonal prediction. Alaskan wild fires may be an interesting cross-ECV case study. **Food security** was another general area mentioned where some of the ECVs can play a role such as land cover, soil moisture and fire.

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Aspirations for phase 2

The group attempted to divide the CDR generation planned for phase 2 into two different modes. Climate data record mode which is just providing a CDR but not updated in real time and climate service mode where a near real time service in the CDR update is provided. Landcover, ice sheets, glaciers, ozone and aerosol were in the former category whereas soil moisture, SST and sea ice had aspirations to provide a real time service. The remaining ECVs were not certain which category their production would be in at this time.

The general concern was expressed of getting the balance right between science and engineering resources in phase 2 and a plea for only useful documentation to be included in phase 2 projects. There were also recommendations to resource cross-ECV working groups from the start of phase 2.

Each science lead was then asked what aspirations they had for phase 2 of the CCI. A summary for each ECV is:

Aerosol: a time series of all ATSR/SLSTR+MERIS/OLCI.

Fire: Extend time series back 15 years with improved algorithms.

Land Cover: Extend back by including AVHRR back to 1992 and develop land cover change products.

Ozone: Make full time series from ESA sensors and link with US datasets back to 1980s.

Clouds: Create time series from 1982-2014 with AVHRR, MODIS and (A)ATSR and for 2002-2012 with AATSR and MERIS. Provide cloud masking information to other ECV's.

GHG: Provide dataset from 2003-2015 using Sciamachy and GOSAT plus several new sensors when launched.

Ocean Colour: Provide dataset from 1997-2016 with OLCI, MERIS, and OCM-2.

SST: Dataset from 1979-2016 using AVHRR, ATSR, SLSTR, IASI and exploit higher level products with uncertainties.

Glaciers: Extend the global inventory with Landsat data continuity, cryostat and Tandem-X DEM. Provide glacier velocity and elevation change.

Sea-ice: provide more parameters such as ice drift, fluxes and exploit Cryosat and Sentinel-3 data.

Ice sheets: Provide velocity maps for more epochs and exploit Cryosat and Sentinel-3 data. Suggest a new project for Antarctica.

SSH: Provide dataset from 1982 to 2016 with improved atmospheric correction. Exploit data from HY-2A, Cryosat, Altika and Sentinel-3.

Soil Moisture: Extend to METOP-B ASCAT and AMSR-2, SMOS, SMPA and Aquarius.

Longer term opportunities for the CCI project

There are future EU FP7 calls which are related to the CCI. One call concerns running reanalyses (e.g. ERA-CLIM, EURO4M) and generation of new ECV datasets not in the CCI, QA for multi-decadal datasets and climate related ocean processes. A second call relates to assessment of global water resources through use of EO data and modelling. It was agreed that the science leads would keep each other informed on what they plan to engage in.

GMES climate services is another area where funding from EU may be forthcoming in the longer term. It is not yet clear how the CCI will be positioned in this activity.

Finally coordination to further the CCI goals was discussed and it was mentioned the CCI programme has already brought together a diverse community of scientists which has been of great benefit. Submitting good quality CDRs to the Obs4MIPS initiative was thought to be desirable and CMUG with Chris Merchant will co-ordinate any submissions.

Suggestions for 3rd Colocation Meeting

As the “brainstorming” time was thought to be valuable it was suggested the Monday morning before the meeting could be used by science leads to meet again and continue these discussions. The Wednesday afternoon would be for a final review of the presentations for the mid-term review. The ESRIN office may be able to help in providing professional graphics support. It was also suggested that rather than presenting each ECV one at a time that presentations should be based on themes which speak to the delegates and allow visibility of all 13 ECVs.

Possible themes were **Science** (e.g. arctic, confrontation of data and models, carbon cycle, chemistry and climate, hydrology) or **Programme Success** (e.g. international co-operation, algorithm selection, user engagement, data vs models). It could also be based on the AR5 report with additional messages.

Suggestions for 3rd Integration Meeting

It was requested to provide more opportunities to improve the dialogue with modellers and also retain the full day for science lead discussions.

Clustering Options for Phase 2

The possibility of creating clusters of ECV teams for the IT infrastructure for phase 2 was discussed to provide some efficiency savings but the teams will need clarity on how to achieve this contractually. Thematic clusters won’t deliver efficiencies as effectively as ECVs with common input datasets. The science leads were asked what their preferred cluster option would be based on common sensors. The following groupings were identified:
Radar Altimetry – Sea-ice, SSH, Glaciers, ice sheets
VIS/IR sensors – SST, Ocean colour, clouds aerosols, *ozone GHGs*
Landsat – Land cover, fire , glaciers
SAR – Land cover, sea-ice, glaciers, ice sheets

An action was agreed to develop this cluster concept further for each of above groupings by end of July 2012.

4.3 Climate Research Group brainstorming group

Key remarks
1. CRG users see added value of ECV data for climate researchers above present day state of the art data sets.
2. Using the Obs4MIPS portal to serve some ECV data would be beneficial to users.
3. The potential for exploiting synergies within the CCI remains high.
4. Users have various concepts to exploit uncertainty information coming with CCI data products
5. Diversity of data products remains essential beyond CCI
6. Links to ECV data products outside of CCI are important
7. No single data access point for CCI phase1 defined yet

The brainstorming session for the Climate Research Group was well attended with 26 experts contributing to the discussion which was chaired by Alex Loew. The group had been primed with questions in advance of the meeting and by issues raised in preceding presentations (key notes and domain groups) and discussions at the meeting.

The discussions were open ended and at the close of the meeting were summarised and grouped in to four topics: Phase 1, Phase 2, 'Technical' and 'Synergies'. The key points for these four topics are described below:

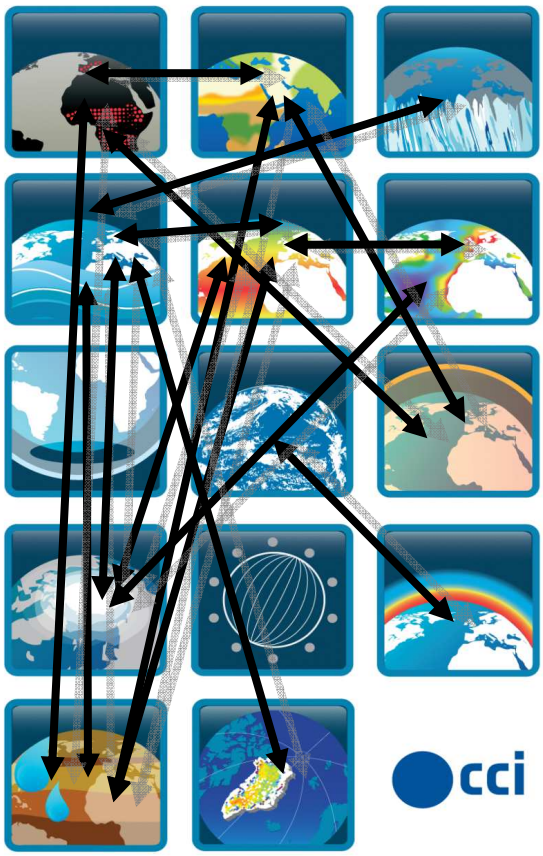
Phase 1
This discussion focused on plans for data analysis; production of uncertainty characterisation; use and application of uncertainty; access and use of L2/L3 data; and the impact of ENVISAT failure on data exploitation. The definition of uncertainty was discussed by CRG users and there was a consensus that the uncertainty information provided with the data products needs to contain random as well as systematic error characterization. The added value of ECV datasets above the current state of the art was discussed and the CRG representatives provided at least one example from their project for users.

Phase 2
The topics discussed here were: funding; the role of the CRG in phase 2; evolution of the development cycle; dataset assessment (eg by GEWEX); and the usefulness of single products. There was consensus that a strong involvement of CCI data users in phase 2 is essential. It was also discussed whether one should aim for a single dataset for a particular ECV that is compiled from all existing sensors and agreed by different space agencies. It was agreed that a diversity of data products is in general useful and that the CCI ECV data products will be one of a few existing climate data records in the future.

Technical
The technical discussion was on: data access and type; the use of metrics; and the data product sheet for providing relevant information about data on a server. The merits of using the NASA JPL data portal (Obs4MIP) to serve ECV data were agreed, but it was also clear that ESG should be one option for providing the data It was also identified that there is no single data access point for data generated in phase 1 of CCI yet. Each project is responsible for data delivery.

Synergies
Cross ECV perspectives were discussed briefly and the potential for synergies is recognised, especially for the goal of consistency. However there was insufficient time to map them all, but some links were noted, and shown at plenary in the following diagram which however does not provide a full comprehensive survey. It was also emphasised that the incorporation of ECV data products

which are not part of the CCI yet are important (e.g. surface albedo, atmospheric humidity and temperature profiles). Synergies with datasets from other data providers might be as important as the synergies within CCI.



5. Summary CMUG Precursor datasets

Key remarks
1. CMUG results on all precursor datasets demonstrated a utility in their application to climate models.
2. It was demonstrated that not only the parameter but its associated uncertainty should be assessed.
3. All CMUG precursor evaluations will be carried out on CCI datasets when available.
4. CMUG assessment of precursor datasets is in *Deliverable 3.1: Quality Assessment Report v1a*

Introduction
CMUG has prepared a report *Deliverable 3.1: Quality Assessment Report v1a* which will be available in June 2012 from the CMUG website (http://www.esa-cmug-cci.org). This report describes in detail the use of precursor datasets to assess seven ECVs especially for the following: uncertainty characterisation, error analysis, temporal consistency, consistency between precursor datasets and utility for climate modellers.

Clouds
Mark Ringer summarised his work using the ISCCP cloud dataset precursor to assess six CMIP5 climate models. The need by climate modellers for a cloud dataset to help understand feedback processes was stressed. Plots of ISCCP cloud amount and albedo were compared with the multi-model mean. For cloud amount the models generally under-estimate globally, except at the poles, where they over-estimate. For albedo the models generally over-estimate, except at the poles where they under-estimate. Climate modellers are aware that this compensating under/over-representation is from unrealistic feedbacks in the models. Individual model diagnostics for these properties were then also described. Other diagnostic cloud datasets were then shown: cloud radiative effect at top-of-atmosphere (CERES), cloud top pressure (ISCCP), cloud liquid water path, cloud water, cloud ice, and cloud droplet (MODIS, CloudSat, ATSR, SSM/I). ENSO cloud plots were also shown. All gave insight in to the strengths and weaknesses of climate models in representing clouds.

SST and Ocean Colour
Roger Saunders first outlined the various ways in which the different CCI ECV CDRs will be assessed by the CMUG. He then summarised the Met Office assessment of the ARC SST pre-cursor dataset using in-situ observations. A key point was to assess the uncertainties provided with the ARC SSTs in addition to the SSTs themselves. Secondly a preliminary version of the HadISST2 SST analysis was assessed by examining the fidelity of the ensemble of SST analyses provided using the new ECMWF climate monitoring database. Finally an assessment of the assimilation of the GlobCOLOUR ocean colour pre-cursor dataset was presented which showed how the GlobCOLOUR data can provide more realistic ocean analyses of chlorophyll concentration.

SSH
Serge Planton compared the AVISO SSH with GLORYS and COMBINE SSH reanalyses over the period 2002-2008. The GLORYSv2 SSH reanalysis produced results closest to data. Serge conducted a similar exercise with with the NEMO-MED8 ocean regional model, and that showed greatest correlation (0.95) with relaxation to GLORYS. The SSH CCI dataset could be evaluated with a regional climate model to demonstrate the added value of the new product (improved resolution, better accuracy, etc), especially as two new Mediterranean focussed projects will be starting this year (MedCORDEX and HyMEX) that could be involved with this.

Fire
Iryna Khlystova looked at comparisons of GFEDv3 burned area with the MPI JSBACH fire model. The fire observations were integrated into MPI-ESM as boundary condition. She illustrated the importance of

combining fire and land cover information to get reliable estimates of carbon emissions. Details of the data analysis can be obtained from CMUG D3.1 v1: ECV Quality Assessment Report

Land Cover
Iryna also talked about the integration of novel landcover information into MPI-ESM using GlobCover dataset. Results show considerable differences for PFT distributions compared to the currently used PFT distribution in MPI-ESM. Details of the data analysis can be obtained from CMUG in the report D3.1 v1: ECV Quality Assessment Report.

Ozone
Work on Ozone precursor datasets by MétéoFrance will be available in CMUG report *Deliverable 3.1 v1: ECV Quality Assessment Report* (http://www.esa-cmug-cci.org) in June.

6. Conclusions

Key remarks
1. The meeting was successful in achieving its aims and furthering the work of the CCI projects
2. It provided an opportunity for the science leads to meet together and share common problems and plan the way forward.
3. ECV teams agreed on common formats and time periods to facilitate joint assessments of CDRs.
4. The Climate Research Groups also shared their progress and plans together
5. CMUG showed their trial assessments of precursor datasets
6. Suggestions were made to ESA for the collocation meeting and mid-term review in Sept 2012.

The meeting achieved its aims, which means the CCI programme is keeping its momentum towards a successful execution of Phase 1.

The context for this meeting was it was held about half way through Phase 1 of the CCI programme, with all ECV projects underway. Progress by ECV projects is at different stages (three had late start dates) but the majority are now finalising their algorithm selection and directing work to data production. Against this background the integration meeting was organised by the CMUG, in consultation with ESA and ECV project leads, to "*discuss the over-arching scientific challenges for research, identify how the CCI contributes to meeting those challenges, allow a focus on the climate perspective in the CCI, and examine future possible scientific directions for the CCI*" (quote taken from the Aims foreword on the full programme).

Some of the key scientific challenges for the CCI were presented by invited experts in several fields of research. Andy Shepherd (University of Leeds) covered the cryosphere and challenges of making satellite observations in this region. Jonny Johannessen (NERSC) addressed the science challenges for ocean research and Shaun Quegan (University of Sheffield) focussed on the carbon budget for land surface processes. Robert Ferraro informed the meeting about the latest developments in the U.S. which are similar to the CCI objectives.

The three ECV domains met (ocean, atmosphere, terrestrial) and agreed some common formats and time periods to exchange results between related ECVs. They also announced when their first datasets would become available in the coming months for early assessments.

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The meeting also provided the opportunity for two parallel brainstorming groups, that were for the Science Leads and Climate Research Groups. The brainstorming session for Science Leads allowed a free debate of the high level issues which they perceive in the CCI programme, including directions for Phase 2. Appropriately timed input from ESA management helped to inform this debate. The discussion in the Climate Research Groups brainstorming session was structured around a programmatic theme covering issues on Phase 1, Phase 2, technical topics and synergies between projects. As with the other group new ideas were put forward for addressing the issues raised, and the presence of the independent climate experts kept the focus on climate research.

In summary, the meeting was a key focus in the CCI Phase 1 timeline for creating a collective sense of purpose to the climate-focused research aims of the project, with the bonus of accessing the intellectual views of the science leaders for CCI Phase 2.

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Annex A List of Participants

1. CMUG

Roger Saunders, Met Office
Mark Ringer, Met Office
Paul van der Linden, Met Office
Alex Loew, MPI-M
Iryna Khlystova, MPI-M
Serge Planton, MétéoFrance / CNRM
Thierry Phulpin, CNES
Elodie Lamri, CNES
Paul Poli, ECMWF

2. ESA

Mark Doherty
Pierre-Philippe Mathieu
Pascal Lecomte
Victoria Bennett
Cat Downey
Stephen Plummer

3. ECV projects

CCI	Project Lead	CRG Representative
Fire	Emilio Chuvieco	Chao Yue
Glaciers	Frank Paul	Tony Payne
Landcover	Pierre Defourny	Benjamin Poulter
Aerosol	Thomas Holzer-Popp	Gerrit de Leeuw
Ozone	Michel van Roozendael	Martin Dameris
Clouds	Rainer Hollmann	Claudia Stubenrauch
GHG	Michael Buchwitz	Frederic Chevallier
SL	Michaël Ablain	Gilles Larnicol & Yannice Faugere
SST	Chris Merchant	Nick Rayner
OC	Shubha Sathyendranath	Ehouarn Simon
IS	Andy Shephard	Christine Hvidberg
SI	Peter Wadhams & Stein Sandven	Stefan Kern
SM	Wolfgang Wagner	Heidi Mittelbach

4. Experts

Sophie Belamari, MétéoFrance
Stephan Bojinski, WMO
Philippe Bougeault, MétéoFrance
Jean-Christophe Calvet, MétéoFrance
Matthieu Chevallier, MétéoFrance
Hervé Douville, MétéoFrance
Robert Ferraro, JPL (presented remotely)
Johnny Johannessen, NERSC
Shaun Quegan, Sheffield University / NCEO
Philippe Ricaud, MétéoFrance
Patricia de Rosnay, ECMWF
Jerôme Servonnat, IPSL
Andy Shephard, Leeds University

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Annex B Programme

Monday 14th – afternoon	
12:00-13:00	Registration
	SESSION 1: Key Note Presentations:
	Identification of the over-arching science challenges that the CCI will help address
13:00-13:15	1. CCI update *Mark Doherty, ESA*
13:15-13:45	2. Cryosphere *Andy Shepherd, Leeds University*
13:45-14:15	3. Oceans *Johnny Johannessen, NERSC*
14:15-14:45	4. Carbon cycle *Shaun Quegan, Sheffield University / NCEO*
	SESSION 2: CCI progress in the context of key note presentations in 3 parallel sessions
	Presentations are 20 minutes plus 10 minutes for Q+A, 30 minutes total. They should cover: • the over-arching science challenges • CCI project response to those challenges • CCI project success stories to now • the anticipated outcomes of each CCI project, starting with current prototype data
14:45-15:00	Tea / coffee
15:00-17:00	**LAND** Chair: *Emilio Chuvieco* 5. Land cover [*PD*] 6. Fire [*EC*] 7. Soil moisture [*WW*] 8. Ice sheets [*CH*] 9. Glaciers [*FP*] **OCEAN** Chair: *Shubha Sathyendranath* 10. Ocean colour [*SS*] 11. Sea level [*MA*] 12. SST [*CM*] 13. Sea ice [*SS*] **ATMOSPHERE** Chair: *Rainer Hollman* 14. Aerosols [*GdL*] 15. Clouds [*RH*] 16. Ozone [*MvR*] 17. GHG [*MB*]
17:00-17:30	**Key Note Presentation:** CMIP and observations *Robert Ferraro, NASA-JPL*
Monday evening "an over-arching Reception" drinks and snacks	
Tuesday 15th – morning	
09:00-10:00	**SESSION 3: Report back to plenary** Chairs from Land, Ocean and Atmosphere sessions report key points from the presentations and discussions (10 minutes each). Plenary discussion to include cross cutting issues.
10:00-13:00	**SESSION 4: Brainstorming** Two parallel groups as follows:
Tea/coffee **11:00-11:30**	**Group A – CCI Science Leads** Chair: *Chris Merchant* Rapporteur: *Roger Saunders* **Group B – Climate Research Group** Chair: *Alex Loew* *Rapporteur: Paul van der Linden*
Tuesday 15th – afternoon	
13:00-14:00	Lunch
14:00-17:30	Brainstorming groups **A** and **B**
15:30-16:00	Tea / coffee
Tuesday evening "an Integrating Dinner" Dinner at the Allouch Brasserie Les Arcades, Place du Capitole.	
Wednesday 16th – morning	
	SESSION 5: Climate data – international perspectives and CMUG precursors
09:00-09:30	18. Clouds precursor dataset *Met Office*
09:30-10:00	19. SST precursor dataset *Met Office/ECMWF/MétéoFrance*
10:00-10:30	20. Landcover and Fire precursor dataset *MPI-M*
10:30-11:00	Tea / coffee
	SESSION 6: Conclusions
11:00-11:45	21. Presentations of outcomes from the brainstorming groups (20mins each inc. Q&A)
11:45-12:00	22. CCI next steps *Pascal Lecomte, ESA*
12:00	**Meeting ends**