CMUG Meeting Report

Name:	Report on CCI Project Integration Meeting, 14-16 March 2011
Due date:	30 April 2011
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Climate Modelling User Group

Report on CCI Project Integration Meeting, 14-16 March 2011

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

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0.1	31 Mar 2011	Draft submission to ESA
0.2	13 Apr 2011	Address ESA comments
1.0	13 May 2011	Address comments from ECV PO's, ESA TO's and attendees to the meeting. Final submission to ESA.

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Report on CCI project integration meeting

ECMWF, Shinfield Park, Reading, UK, 14 - 16 March 2011

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ECMWF, Shinfield Park, Reading, UK,
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This document summarises the scientific content of the meeting from presentations and discussions, and captures key points noted by the CCI projects.

1. Overview

This meeting organised by the CMUG and hosted by ECMWF was to facilitate CCI project integration so as to achieve consistency and quality of output across the CCI. Representatives from all CCI projects attended and some of the ESA technical officers were also present. There were several aims of the meeting which the CCI projects were asked to consider before the meeting:

1. *Check ECV project URDs are consistent with the needs of Climate Research Groups (CRG) in the context of CMUG needs and GCOS requirements, including source traceability*
2. *First look at ECV product specifications (and check that the proposed products will be of use to CRGs in their applications) if available*
3. *Allow ECV teams to explain how their projects address the integrated perspective for consistency between the ECVS to avoid gaps*
4. *Discuss how to deal with uncertainties in products (how to capture and describe them for product users)*
5. *Develop / finalise the ECV projects data needs for ECMWF reanalysis data*
6. *Start a discussion on ECV data set validation*
7. *Maintain oversight of the position within the international framework in which CMUG/CCI is operating*

The meeting consisted of presentations from invited experts on various aspects of climate modelling and presentations from each of the ECV projects showing how they were addressing the above points. Due to the late availability of the product specification document this could not be considered in the meeting and validation was not really covered. The outcome from discussions on all the other items are summarised in this report. There were three splinter group meetings on marine, atmosphere and land to allow more focussed discussions on these particular areas and these are summarised in the annexes of this report and were presented to the final plenary session at the meeting.

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

The meeting was the first time that all CCI projects had met together since the colocation meeting in September 2010. The actions and outcomes arising from the colocation meeting, where relevant to the aims of this meeting, were also treated as an input to be addressed. The colocation meeting report was included in the hardcopy material provided to support delegates.

2. Summary of presentations of invited experts

Marco Giorgetta (MPI-M) gave an overview of climate models and the use of satellite data to test the understanding of the climate system. He reminded the audience that for CMIP5 most models assume GHGs are prescribed but a few are now starting to have them as prognostic variables, thus enlarging the set of prognostic variables which can be compared against satellite observations. The energy and hydrological cycles remains an area of concern. Important reference experiments for climate modellers are AMIP and coupled CMIP simulations, augmented by more specialized experiments as those of CFMIP with focus on clouds and the cloud feedback processes. The atmospheric model of the MPI-ESM originated from the ECMWF IFS dynamical model and the current version ECHAM6 is used mostly at two resolutions: T63 L47 and T127 L95. For precipitation verification they use the GPCP dataset. The land surface model JSBACH is integrated in the atmospheric GCM. The ocean model MPIOM is used at 1.5°and 0.4°resolution, and is compared to HadISST from MOHC and the Atlantic meridional overturning rates from the Rapid/MOCHA buoy array at 26N in the Atlantic. He stated modellers like merged datasets as they are simpler to use, and because modellers are not specialized in gridding original satellite data. Climate models are tuned so that the global mean near surface temp for pre-industrial conditions is near 13.7℃, net LW flux is 240W/m ^{2}, cloud cover 60-65% and many other variables to be in the right range. Beside mean values, attention is paid to the quality of the representation of climate variability as for example the Madden Julian Oscillation (MJO), which often is not well simulated in atmospheric models. The MJO is evaluated in observed OLR and 850hPa zonal wind anomalies, which moves eastward and last 30-80 days. Similarly the Quasi Biennial Oscillation (QBO) in zonal wind is a phenomenon which depends on the representation of tropical weather. The priority ECVs from his perspective are:

- Earth Radiation Budget at top of atmosphere and surface
- Water vapour profiles
- Precipitation/evaporation
- Wind and Temp at high resolution for spectra and eddies (at 3hr/10km)
- Cloud water, ice and cover vertical profiles
- Sea-ice area and volume.
- Ocean currents, temperature and salinity surface and subsurface
- CO2 net flux at surface (ocean and land)

With the first two being top priority. He showed the HOAPS precipitation and evaporation CDR as a good example of using satellite data to validate climate models (http://www.hoaps.org).

Veronika Eyring (DLR) described the use of performance metrics for assessing climate models such as those participating in CMIP5. The goal is to define the skills of the models relative to each other and compared to observations, as is already done for NWP. CMIP5 has around 20 groups and 40 models participating overall. Multi-model assessments are an essential component of international assessment reports, but currently all models are treated equally.
There is a need for information on the quality of each model so that strength and weaknesses can be assessed and the weighting based on model performance in the overall ensemble can be explored. An example was shown for CCMVal comparisons for which observationally-based performance metrics have been calculated for a set of process-oriented diagnostics.
The mean of the ensemble gave a better fit than individual models. For the particular example of total column ozone projections with CCMVal-1 models, the weighted mean did not differ substantially from the unweighted mean. Veronika reported on ongoing work from the WGNE/WGCM metrics panel that has the goal to apply performance metrics to CMIP5 model data. There will be a peer reviewed publication on this. She reported on the IPCC Expert Meeting on Assessing and Combining Multi-Model Climate Projections that was held in Boulder in January 2010 and the WCRP modelling coordination meeting in November 2010. A good practice guidance paper from the IPCC Expert meeting is available on the IPCC website (Knutti et al., 2010 see:

http://www.ipcc.ch/pdf/supporting-material/expert-meeting-assessing-multi-model-projections-2010-01.pdf) and a WCRP paper on promoting the synergism of models with observations and results of process studies is available on the WCRP website (Eyring et al., 2010).

Dick Dee (ECMWF) emphasised that reanalysis provides a unifying framework for integrating climate information from many sources. ECMWF is expanding its web services to allow users to more easily interact with the ERA-Interim fields. Precipitation over land is much better than over ocean in ERA-Interim which is surprising. This is partly due to a bug in the satellite rain retrievals assimilated.

George Tselioudis (Academy of Athens) described the IS-ENES EU FP7 funded infrastructure project to create a virtual Earth Resources Portal. He showed an example of using it for aerosol measurements for example. Data format needs are NetCDF (CMOR compliant). When their web portal is complete they will do a pilot study. More details at https://is.enes.org/.

Robert Ferraro (JPL/NASA) NASA are funding a project to provide existing level 3 datasets in the right format for CMIP5 model assessments. Comparing precipitation, ice water path and cloud fraction from all models shows ice water path is the parameter with largest discrepancies. The problem is how to bring models closer to the observational data. Most modellers are unsure what to do with data on the NASA DAACs. The IPCC AR5 is making better use of observations. This NASA JPL pilot project will provide a few selected datasets with the following guidelines:

- Use the CMIP5 protocol (Taylor et al 2009) and the target is monthly averaged 1x1deg gridded datasets.
- Provide short technical notes describing strengths and weaknesses of datasets
- Transform into CMIP5 file format so they look like the model outputs
- Access from Earth System Grid the same as the model portal
- Advertise availability

PCMDI have given a list of variables important to modellers. For temperature AIRS+MLS are used to cover all levels. For SST AMSR-E, for ERB CERES, for precip TRMM, for cloud fraction MODIS, for total column water SSM/I, for sea surface height TOPEX/Jason. For sea-ice there is no obvious match for the moment. For an example of a technical note see http://oodt.jpl.nasa.gov/wiki/display/CLIMATE . This may be a useful model for the CCI datasets. There is uncertainty whether NASA will fund this activity beyond the summer.

Also mentioned was the NASA Earth system MEaSUREs program https://community.eosdis.nasa.gov/measures/index.html which are a set of projects to reprocess satellite datasets with climate applications in mind similar to the CCI.

Technical page for JPL/NASA climate observation project website:
http://oodt.jpl.nasa.gov/wiki/display/CLIMATE

3. Review of user requirements

Key remark:
Datasets generated in the first phase of CCI cover limited time periods for most of the ECV projects. The CMUG requirements of the climate modelling community identified the need of long term CDRs. A transition from ECV products to CDRs is therefore needed after phase 1 of CCI.

All the ECV projects have produced a URD, but through different routes. Some canvassed a broad cross section of potential users, some contacted a known user base, while one worked mostly from existing requirements. This results in variability across the ECVs with respect to representativity of the user community and traceability of requirements in the URDs. There also needs to be a common view of the different categories for applications across the URDs. The treatment of uncertainties across ECVs is not uniform, the SST project gave a good example of an error analysis. There is also a need to better describe the "rationale" supporting the requirements.

It should be clear that the URDs should be technology independent and just reflect the user need. The PSDs then translate the URDs into feasible specifications for a product. This approach was not always adopted across projects, sometimes some user requirements documents have been based on what is feasible in terms of the current technology. There was also some concern expressed as to whether the climate impacts community (mainly related to IPCC WG II) has been well addressed during the user requirements gathering. Also, it was stressed that an important part of the climate modelling community has requirements for model development, which need "process-studies" (for example for clouds), and thereby lead to observational requirements being different from the ones of long-term monitoring.

The requirements for all the CCI projects used the GCOS requirements and those developed by the CMUG as a starting point and all the presentations at the meeting compared their final user requirements with these. The GCOS requirements are going through an update and in most cases the CCI projects were aware of the updated requirements. All the WMO based requirements can be found linked from this page: http://www.wmo.int/pages/prog/sat/RRR-and-SOG.html . The CMUG requirements are linked from http://www.cci-cmug.org/ (click on ECV project resources and select document D1.2). A full review of the ECV project URDs (and later PSDs) is given in CMUG Deliverable 2.1.

It was agreed that it is important to be clear about the added value that the new CCI products will provide by describing the current state of the art of existing datasets and how the CCI datasets will improve over the existing datasets. Potential users will then clearly see the benefits. A possible document to describe the added-value could be the PSD.

The suggestion from Robert Ferraro of providing a short simple technical description of each ECV product for non-specialist users to read before accessing the data was endorsed at the meeting. Such documents should be prepared at the public release of the datasets.

Each of the CCI projects gave presentations where they described the user requirements exercise they had gone through. The main points for each ECV are summarised here based on the presentations. A technical note providing feedback on the URDs and PSDs will be available soon from CMUG.

For ***SST*** a comprehensive online survey was carried out with a wide range of different users. The team specified a criterion that the datasets provided must satisfy 67% of the user community which is an interesting metric that could be considered more widely. The concept of looking at the PDF of user requirements was also mentioned. In addition to the NetCDF format the GHRSST Data Specification 2.0 compatibility is also a strong requirement from the users. Clarity on the various levels on which to specify the SST in the top layers of the ocean is still required.

For ***Ocean Colour*** the users were separated into EO scientists and modellers and the needs characterised for both. There is a list of parameters in addition to chlorophyll alpha concentration which the modellers need to consider. The IOCCG will review the URD to give it the international stamp of credibility. An unresolved issue was whether CZCS data should be used to extend the time series. Some of the parameters described are not GCOS requirements.

The ***Sea Level*** team are still refining their detailed requirements as they plan to provide 'oceanic indicators' which summarises the sea level trends in different regions. The team is attempting to separate out the time and spatial scales in specifying the requirements. It was not clear all the applications for climate model studies and ocean reanalysis have been taken into account. These new applications are starting to be developed in climate modelling centres.

Greenhouse Gases plan to provide users with an ensemble of different retrievals to allow the users to select the most appropriate one. Averaging kernels are an important element of the data provided to the users to allow the information to be distributed in the vertical.

Clouds are planning to provide both single sensor and merged cloud products. Many of the CCI products have requirements on the Clouds CCI products (i.e. land cover fire, aerosol and SST). Proper tools, such as observation simulators, can be needed by climate modellers to make effective comparisons between satellite-based products and climate models.

The ***Ozone*** project presented their requirements which were taking into account what is feasible with the current technology. It seems there are no immediate plans to include any infrared sensors which will mean a daytime only product. There are plans to use limb viewing measurements however to provide high vertical resolution measurements.

Aerosols found the CMUG URD a useful starting point and have now developed a document with traceability of the rationale for the requirements. A limitation of this project is the fact that only 1 year will be processed initially during phase 1. Although this affects the determination of any 'golden year' the choice of 2008 is based on availability and quality of several input and reference datasets.

Glaciers and Ice caps conducted a questionnaire and concluded that there is a strong demand to complete the global inventory (GCOS T2.1). Also strong support to also investigate elevation changes and velocity fields, get feedback from the community about ongoing work (to avoid overlap) and to create a new overview of key regions with some level of completeness.

Land Cover asked the users what they use now, what would improve their current models and what would improve future models. They concluded from their user requirement analysis that the key is for long term consistency of land cover together with a dynamically varying component as modellers need information of land surface parameters rather than land cover information alone. Consistency is often more desirable than accuracy! The variables are land cover state, land cover condition and land cover change. Land cover state translates into plant functional types. Land cover change is a permanent reclassification of the land cover type and is not part of the CCI. Land cover condition is the dynamically changing part from albedo, green vegetation phenology, snow cover, dynamic inland water and fires.

Fire Burnt Area divided their user community into Earth Observation Scientists, Data Assimilation and Modelling. The main problem from the users perspective is the lack of detection of small fires which can be up to 40% of the total in reality. Generation of long term products is foreseen for selected test sites and global coverage is foreseen for 5 individual years.

The cross cutting ECV requirements on data formats, naming conventions and access are summarised in Section 6.

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4. Consistency between ECVs

One of the main aims of the integration meeting was to consider the consistencies between the different CCI ECV projects, and this covers a number of different issues which were addressed during the meeting. They are summarised below and in Annex A.

4.1 Temporal Consistency

In order to explore cross-ECV dependencies, analyse consistency in features, examine prognostic variables and initial assumptions etc, it is important to ensure there is a 'golden year' for which all ECVs process their data and provide datasets. The current processing plans for all ECVs are given in Table 1 below. This golden year should avoid anomalous periods (e.g. El Nino, Pinatubo) and be recent enough to include some of the new technology in orbit (e.g. ENVISAT, AURA and METOP).

The major constraint is the aerosol project which is only processing data for 2008 due to the availability of best quality and reference data. Fire burnt area however is processed in the first half of the decade only and may not require too many resources to process some of 2008.
[N-01]: Explore the opportunity for the fire ecv to consider adding 2008 as another year to process

The CCI projects should also be encouraged to liaise with each other regarding common datasets they might both be able to use. Without the possibility of a common year it will be very difficult to investigate the synergies between the ECV projects.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Comments
SST													**starts in 1991**
Sea level													
Ocean colour													
Clouds													
GHG													
Aerosol													
Ozone													
Fire													
Landcover													
Glaciers													

Table 1: Planned time series of ECVs from 1999

4.2 Consistent use of level 1 data and processing between ECVs

To ensure a basic level of consistency between products the common level 1 datasets on which they are based must be the same for all ECV projects as far as is possible. This is not only important for consistency of products after the first processing but when the 'official' level 1 datasets are reprocessed with improved calibration and navigation all the ECV projects using that dataset will easily be able to ingest the newly reprocessed level 1 data and provide corresponding improvements in their own products. In an attempt to show which ECV projects will have common needs in terms of level 1 datasets Table 2 shows an attempt at identifying common sensors

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between different ECV projects. Until the DARD's from each ECV are finalised this can only be a preliminary analysis. It will be important that the DARD's are scrutinised to ensure the different ECV projects are using the same level 1 data.
[N-02]: The CMUG will do an analysis for ESA sensors as part of its review of the URDs and PSDs.

In addition to ensuring the same basic level 1 processing there may be other components of the processing which should be made common for example cloud detection (but we need to be careful that, for example, a cloud mask for cloud properties and a cloud mask for aerosol properties must have different optimization) and removal of atmospheric correction effects (e.g. gaseous absorption, aerosol scattering) for surface products. This ensures the same cloud-free data are used for the various ECVs which are using the same sensor. One example is the use of MERIS for the Land Cover and Fire ECV projects and another might be the use of ATSR for cloud and SST.

	(A)ATSR	MERIS	SPOT VGT	Landsat TM	ASAR	SEVIRI	MODIS	Sciamachy	GOSAT	GOME-1/2	AVHRR	GOMOS	IASI	AIRS	AMSU	ACE	SeaWIFS	MIPAS	OMI	RADALT	TMI/AMSR-E	PARASOL
SST	■					■					■										■	
Sea level																				■		
Ocean colour		■					■										■					
Clouds	■	■					■				■											
GHG								■	■				■	■	■	■		■				
Aerosol	■	■						■		■	■	■							■			■
Ozone								■		■		■						■	■			
Fire	■	■	■																			
Landcover		■	■		■																	
Glaciers				■																		

Table 2. Sensors used by each ECV (first assessment).

Another important consideration for some products will be the influence of the background or a-priori fields in the retrieval. Some products are more influenced by the background (e.g. GHG, ozone) than others (SST, SL) due to the differences inherent in the background used, which can be reanalysis fields, climatology or even NWP fields for assimilation. The background used and its associated errors should be well documented. Again consistency in background fields will ensure more consistent products. To maximize the traceability for the user about how much information is coming from satellite data and how much from the prior information taken from re-analysis, the sensitivities of the products with respect to the background data needs to be known (e.g. how do differences between NCEP/ECMWF reflect on the products?).

Another longer term requirement will be for some ECV projects who require products produced by other ECV projects to ensure they can do this whenever possible. In practice this will usually mean that the primary ECV product (e.g. Ocean Colour) will use the previous version of the required ECV (e.g. aerosol). Careful timing of the ECV production taking into account the availability of secondary ECVs will optimise the use of most recent ECVs. Consistency in time is of course crucial here.

4.3 Consistent use and impact of auxiliary data

A consistent use of auxiliary data to define boundary conditions as distinct from a-priori data is also of major importance. It was accepted that the use of ECMWF re-analysis data will ensure a consistent use of ancillary data in the different processing chains of the CCI projects.

A clear need for a common land/sea mask was also expressed by various projects. As the land/sea mask depends on the resolution of the data analyzed, different approaches were discussed (e.g. use of shoreline vector data and definition of a buffer zone in coastal areas; definition of fractional thresholds of land). No consensus was found and the following action was raised

[N-03]: Consider the definition and implementation of a consistent land/sea mask applicable to all projects (covering, if possible fresh water and tidal zones) and downscaling methodologies. This falls outside the remit of the DSG.

The use of auxiliary data is very different in the different projects. Some of the CCI projects do not rely on auxiliary data at all while e.g. re-analysis data is of major importance for other projects. It is also of particular importance to be able to translate uncertainties in the used auxiliary data into product uncertainties. A corresponding sensitivity analysis should be part of the algorithm selection procedure in CCI.
[N-04]: CCI projects to identify weak and strong links between product and auxiliary data and their respective sensitivities.

4.4 A roadmap for consistency

All CCI projects see the potential for the incorporation (starting with comparisons of interim and ECV fields between different ECV projects) of data from other ECV projects into their work. However, the discussion made clear that a full integration is not achievable at the current stage of CCI as the individual projects need to focus on their core activities, but can be considered in Phase 2. An implementation of harmonized products between the different CCI projects therefore needs to be weighted in accordance with the expected benefit from these integrated activities.

	Actions	Responsibility	Importance	Status	Remark
Phase 0	Joint use of ancillary data	CCI projects	High	Implemented through use of ECMWF data in some cases	
	The same pre-processing of ancillary data	CCI projects	High	Discussion of using cdo as a universal interpolation tool	
	Identification of weak and strong links between CCI projects	CMUG / CCI projects	High	Review of URDs, DARDs and PSDs	
	Consistent L1 data	ESA to lead	High	Documented in DARDs	
	Consistent L1 data processing	CCI projects	Medium	Sensitivity studies to be	Perhaps critical for high

				performed	resolution data
	Comparison of products and by-products				Comparison of e.g. cloud masks, aerosol used in pre-processing
	Consistent land/sea mask	CCI projects	Medium	Action Data working group	should (i) cover inland water, and (ii) identify tidal areas of significant extent (e.g., those resolved at say 1 km)
	Temporal coverage: Golden year	CCI projects to agree by consensus	High	Analysis underway	Fire asked for 2008 processing. Must take data constraints in to account.
	Actions	Responsibility	Importance	Status	Remark
Phase 1	Evaluation of joint retrieval potentials	CCI			with clouds (around cloud edges, thin cirrus)
	Definition of best practice how to integrate CCI products in processing chains of other projects				e.g. use of ozone data directly or as output from an improved ECMWF analysis?
	Temporal coverage: as consistent as possible	ESA/CCI			
	Actions	Responsibility	Importance	Status	Remark
Phase 2	Joint retrievals	CCI			Only where feasible

Table 3. A roadmap for achieving best consistency between the different projects in CCI .

5. Addressing uncertainties

In his introduction of this meeting, Roger Saunders recalled the following points about the errors on the CDRs

- An estimate of the errors for each CDR produced is *essential* for use in climate applications
- There are different types of error to document. Terminology used by GCOS and other bodies must be unified (Accuracy, precision, stability).
- The importance of specifying each depends on the application

- Errors should be specified on *a FOV basis* and for aggregated products. Aggregated error estimates only are not sufficient

- Single sensor products are simpler than merged products

- Error correlations are also important to document

Veronika Eyring stressed the issue of uncertainties, e.g. biases in the observation data sets. She pointed out that long-term consistent, error-characterized global and regional Earth observations for ECVs, but also for process-oriented evaluation are needed. A systematic comparison of existing observations is required in order to underpin future model evaluation efforts, by providing a more accurate assessment of measurement uncertainties.

The uncertainties on the products have been thoroughly considered by each ECV. Their analysis exhibit some common points but also some discrepancies. There is also probably a difference of maturity for the ECVs. All groups agree on the necessity to have reliable error bars, to know about their evolution and the correlation between the errors. All groups have listed the major contributors but the SST ECV has probably the more advanced analysis on the various causes and nature of error. They propose to quantify each source and treat it separately, as they have different correlation properties, in order to avoid propagation when going to L3 or 4. The types of error coming from the instrument, the sampling, the inversion technique, the contaminants, the external sources should be distinguished. An additional cause of uncertainty is the measurement technique itself which also can lead to errors on the observed variables (e.g. unresolved clouds due to coarse resolution, or spectral band, etc.).

Generally the way proposed to deal with the uncertainties is validation by confronting with other measurements, round robin etc. Some projects proposed some complementary outputs to characterize the uncertainties : quality flags, error covariance matrix, averaging kernels (for profiles) etc. It was suggested in the discussion to have an estimate of the uncertainties using an ensemble technique.
The issue of a common approach to uncertainties was not discussed in the terrestrial ECV group and only briefly by the atmosphere group. It was discussed in more detail in the Marine group. The report contains the following statements:

- There were different and complementary approaches for the evaluation of uncertainties: in the view of the SST group each component of the uncertainty will be modelled, SL group proposed a common set of validation diagnostics, the ocean colour group suggest multiple approaches for different algorithms.

- Concerning commonalities, the ensemble approach is already used in some respect: implicitly in the SST group approach; and in some cases for the ocean colour group for physical algorithms .

- A suggestion of a specific analysis of the products over a short well observed period and region was made. It was however considered that it would be difficult to make use of a small number of regional data, statistically speaking.

- Concerning the strategies for uncertainties at different processing levels, all the marine groups will propagate uncertainty information estimated for lower level products through to higher levels.

The need for a common approach of dealing with uncertainties is accepted. Defining the contributions and their impact in the same way would help to clarify their impact. The ensemble

technique to estimate the uncertainties would certainly be worthwhile and would easily be an output of the round robin comparisons.

An option suggested in the atmosphere group meeting was also to quantify the uncertainties in relation with the application intended, i.e. horizontal resolution or temporal span. Thus, some measurements can be more appropriate in some regions than others even if they are of lower accuracy in general.
[N-05]: The definition of terms to characterize the quality of the measurements has still to be harmonized.

A proposal for a short guidance paper on handling data quality & uncertainty was put forward during the meeting. This includes guidelines for proper use and meaning of the terms accuracy and stability in order to be in line with both the CCI colocation meeting report and the recently updated definition of terms from GCOS.

6. Data needs

6.1 Requirements for ECMWF reanalysis data

Requirements are now consolidated for most of the projects, and Science Leaders have been provided with an account to download data from the ECMWF data server.

Of the ten current ECV projects, the two that have declared that they have no needs for ECMWF data are Fire and Glaciers. The requirements of the other ECV projects - synthesised in Table 4 - have been gathered through the Data Access Requirements Document and refined through direct discussion amd email exchanges with ECMWF.

ECV projects are asked to conform to the ECMWF data policy in their use of ERA data. As such it is acceptable use to make interpolated ERA-interim data available to participants in the Round Robin exercise.

ECMWF/CMUG has been advising ECV teams that common and consistent use of ECMWF data contributes to the overall consistency of CCI ECV products. By adopting the Climate Data Operators package [https://code.zmaw.de/projects/cdo] for interpolating ECMWF data to the satellite observation locations, four ECV teams (SST, Cloud, Sea Level and Ocean Colour) are working towards common and consistent practices in this regard. Other teams will explore the implications of the interpolation strategy

6.2 Requirements on data formats and access

For data formats all CCI datasets were agreed to be made available in CF compliant NetCDF formats as a baseline. Most ECVs also had other format requirements for supporting their diverse user base.
[N-06]: It was agreed that CCI projects register any new parameter names not in the CF database [http://cf-pcmdi.llnl.gov/documents/cf-standard-names/] so that they can be compliant under the NetCDF CF convention (All CCI projects).

The Data Standards WG undertook to provide sample code and a sample dataset in the correct format provided to all CCI projects in order to serve as a template which would be a basis on which to develop their own data production systems.
[N-07]: Provide sample code and datasets to all CCI projects (Data standards WG).

Another issue is the use of a consistent land/sea (land/freshwater and possibly sea-ice) mask. If different datasets have different masks then large anomalies can be seen caused only by this inconsistency. Land/sea masks are obviously dependent on the resolution of the dataset being distributed but at the 1km scale they should be consistent and then downscaled in a consistent manner for all ECVs. The Land Cover group offered to provide such a mask to all the CCI consortia.
[N-08]: The Land cover group offered to provide a land/sea mask (see also Section 4.3) to the CCI projects.

Regarding the requirements on access to the data the need for a common data access point was expressed by users being present at the meeting. At least on the metadata level, the CCI products should be accessible through a single data portal. It was accepted to follow the example of the implementation of the Earth System Grid (ESG) which is widely used in the climate research community and is being adopted by the NASA (observations) and CMIP5 (modelling) communities.

It was brought up in the land surface break out group that a set of command line operators to manipulate and analyse climate data has been developed and is maintained at MPI-M. The supported data formats are GRIB 1/2, netCDF 3/4, SERVICE, EXTRA and IEG, and there are more than 400 operators available. Guidance on installation, use and development is given through comprehensive online help and documentation pages on the project website. This open source tool and supporting resources are available at: https://code.zmaw.de/projects/cdo

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CCI	Data set/s	Parameter	Obs Cycle	Coverage (always global)	Time Span	Data Vol	Format	Status
SST	ERA-interim	Temperature	AN: 4/day (00,06,12,18UTC)	All levels (60)	01-Jan-1991 to 31-Dec-2010, 01-Oct-2011 to 31-Mar-2012	330 Gbytes	GRIB	Account activated Data accessible
		Specific Humidity				330 Gbytes		
		Ozone (mass mixing ratio)				330 Gbytes		
		28 other parameters	AN: 4/day (00,06,12,18UTC), FC: 8/day ([00,12]+[03,06,09,12])	Surface or single level		460 Gbytes		
Aerosol	ERA-interim, ERA-40	10-m wind (u,v)	4/day	Surface or single level	1997 and 2008 (contradicts URD = 10 years?)	16 Gbytes?	GRIB	Account activated Data accessible
GHG	ERA-interim	Temperature	AN: 4/day (00,06,12,18UTC), FC: 8/day ([00,12]+[03,06,09,12])	All levels (60)	01-Jan-2002 to 31-Dec-2012	510 Gbytes	GRIB	Account activated Data accessible
		Specific Humidity				510 Gbytes		
		4 other parameters	AN: 4/day (00,06,12,18UTC), FC: 8/day ([00,12]+[03,06,09,12])	Surface or single level		33 Gbytes		
		Same but from Operational data stream		All levels (91)	2010	500 Gbytes		
Cloud	ERA-interim	Temperature	AN: 2/day (00,12UTC)	All levels (60)	2007 to 2009 (contradicts URD = 25 years?)	24-200 Gbytes?	GRIB	Account activated Data accessible
		Specific Humidity				24-200 Gbytes?		
		Geopotential				24-200 Gbytes?		
		9 other parameters	AN: 2/day (00,12UTC), FC: 4/day ([00,12]+[06,12])	Surface or single level		11-90 Gbytes?		
		Total column water vapour	Monthly mean	Surface or single level		0.07 Gbytes		

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Ozone		Total column ozone	not yet clarified	Surface or single level	not yet clarified	< 20 Gbytes?	GRIB	Access to data through met service
Sea Level	ERA-interim	Temperature, specific humidity	AN: 4/day (00,06,12,18UTC)	Model levels (number tbc)	2010 to present (1991-2009 already obtained under other project)	32 Gbytes	GRIB	Requirements under refinement
		Significant wave height etc	AN: 4/day (00,06,12,18UTC)	Surface or single level	1991 to present	36 Gbytes		
LandCover	ERA-interim	Total column ozone	AN: 4/day (00,06,12,18UTC)	Surface or single level	2005, potentially 1998 to 2012	< 15 Gbytes?	GRIB	Requirements under refinement
OceanColour	ERA-interim	10m wind, etc	AN: 4/day (00,06,12,18UTC) FC: not clarified	Surface or single level	1996 to present For period 1978-1986, choice of ERA-Interim/ERA-40 not clarified	TBC		Requirements under refinement
Glaciers	N/A	Has declared "No needs"						
Fire	N/A	Has declared "No needs"						

Table 4. Requests for ECMWF reanalysis data as of 13 May2011.

7. International perspectives

The primary aim of this meeting was for promoting consistency and integration across the CCI, so that ECV products better meet the EO needs of climate modellers. The success to which these climate modelling needs are met will be judged in the context of the CCI and its position in the international arena of climate change research and climate services. It was against this backdrop and the need for CMUG to engage with international players in climate research that the meeting programme was constructed.

International organisations represented at the meeting by experts who gave presentations and/or participated in the discussions included: JPL-NASA, WOAP, GCOS and the IGBP. The EC FP7 project ES-INES was present through one of its Work Package leaders, while additional input was given by experts from MPI and DLR. CMIP participation at the meeting did not occur due to a last minute cancellation. Other project perspectives e.g. MACC, CFMIP, EUCLIPSE are already embedded in CMUG through members of its consortium.

The links now established between CMUG and international organisations and projects will be maintained and stronger interactions with the wider climate community (including *inter alia*: the IPCC, METAFOR, EC-EARTH, ERA-CLIM) would enhance the uptake of project results. Similar work to the CCI is being conducted in the USA (NOAA CDR programme, the NASA-JPL effort, the MEaSUREs collaboration) and it is essential to maintain an ongoing dialogue with the centres involved in that work so as to learn from and support (through review, testing, knowledge exchange etc) each other.

Some high level messages emerged from the meeting, namely that the satellite observations community would like to know more about how climate modellers intend to use and apply the products; the need for continual two way communication with experts working on similar programmes in the USA; and how the long term CCI goals would feed in to a wider international application for the benefit of society through climate services (for example through GMES).

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Annex A Table of ECV cross-linkages

	SST	Sea level	Clouds	Sea ice	Ocean colour	Aerosol	GHG	Landcover	Fire	Ozone	Glaciers
SST		x	x	X	X	x				x	
Sea level	x			x							
Clouds	x			x	X	x	x	X	x	X	
Sea ice	x	x	x		X					x	x
Ocean colour	X		x	x		x					
Aerosol			x		X			X	x	x	
GHG			x			x			x	X	
Landcover			x			x			x		x
Fire			x			x	x	X		x	
Ozone			x			x	X				
Glaciers				x				X			

Table A1. An analysis of cross linkages between ECVs indicating where comparisons need to be made to ensure consistency. The left hand column is the project with the identified need, the top horizontal row is the provider. The larger crosses indicate where the CDRs generated by that ECV project would potentially be of use in the retrieval of the ECV listed on the left side.

Ancillary field	SST	Sea level	Clouds	Sea ice	Ocean colour	Aerosol	GHG	Landcover	Fire	Ozone	Glaciers
Land sea mask	x	x	x	x	x	x		x	x		x
Sea ice	x	x	x	x	x						x
Cloud mask	x				x	x	x			x	
Wind fields	x					x					

Table A2. The needs of each ECV project for ancillary fields to use in the retrieval.

Annex B Summary of Land Breakout Group

The discussions in the land breakout group focused on the following topics:

User requirements and product specification:
A clear differentiation between URD and PSD is feasible for terrestrial ECV's. The rationale for a specific product should be given by user needs. As not all user requirements can be fulfilled, the rationale for deviations from specific user needs is given in the URD.

Re-iteration with the community: It was discussed that there is the problem that some of the users did not clearly define their respective needs and there might be the risk of a misinterpretation of the user requirements. As an example, the definition of the term "accuracy" was mentioned. The detailed user needs in terms of e.g. geometric accuracy as well as its definition on a particular spatial scale (e.g. product accuracy on pixel basis or gridded product basis) might result in difficulties to define the actual product specification.
It was therefore proposed to generate a sample data product based on the most recent version of the PSD using artificial or existing data. The sample data set should have the format of the expected final product and be provided as soon as possible to the users to evaluate if the product matches their expectations. This proposal is consistent with ongoing effort to generate sample data sets by the Data standards group.

- [N-09]: generate sample data set of respective products as soon as possible and get feedback from the user community (all projects / Data standards group).

CCI merit
It was clearly recognized that CCI products need to provide added value compared to existing data sets. All CCI projects have outlined the general additional value in their proposals. However, it was discussed that there is currently no single place for a user to get information on the additional merit of the CCI programme in general as well as for the individual data products. It was proposed to include **a one sentence summary** of the additional merit of each CCI product into a concise workshop summary. It was further discussed in the plenary to include a clear statement on the added value of each product in one of the CCI documents, the PSD was suggested.

- [N-10]: CCI projects to include added value statement compared to existing data product in their PSDs.

Consistency between CCI projects
The land ECV projects considered a joint assessment of different ECV products to be useful (e.g. landcover, fire, aerosols, GHG). However, the respective needs of a joint assessment are not yet well defined. An integrative assessment of ECV variables will be part of the analysis made by CMUG. However it was further discussed if the different users associated to the individual projects could probably develop a stronger link. It was proposed to evaluate the need for a joint user workshop at a later stage of the project.

Required input data for the processing of terrestrial ECVs comprises e.g. aerosols and ozone which are both needed for atmospheric correction. The fire and land cover projects emphasised the importance of aerosol data in their data processing chains.

However, an analysis of the years currently covered by the different projects revealed that the synergies between the different projects cannot be exploited in the current phase of the programme due to the different temporal coverage of the different projects (see Table 1). It was proposed that a

'golden year' should be defined that all projects will use to generate a data product. The discussions lead to the conclusion that the year 2008 might be a suitable candidate for that purpose. Major additional effort would then be needed by the fire_cci project to integrate that additional year into their respective processing which was considered to be feasible but would need the allocation of additional resources.

- [N-11]: CMUG to organize a dedicated user integration workshop at a later stage of the project if required.
- [N-12]: CCI teams to identify in agreement with ESA a potential golden year 2008 and iterate its implementation within the projects.

Data processing: It was recognized that the land ECV projects are somehow special in the sense as they are working with spatially high resolved data. It was recognized that the different products use different processing chains for their atmospheric and geometric correction of L1 data. The impact of these different processing approaches on the final products are unclear and might result in difficulties when making a combined analysis of different products (e.g. land cover and fire). It was agreed to evaluate the impact of the L1 data processing for some test data sets (geometric and radiometric performance).

- [N-13]: Land cover CCI and fire CCI to evaluate the impact of L1 data processing on surface reflectance products.

Projection: The high resolution data generated by the land ECV projects requires a tiling approach to provide the user with the highest resolution data. It was agreed that a common tiling for fire and land cover ECV projects should be used. A MODIS like tiling approach was proposed.

- [N-14] Fire and land cover project to agree on a common tiling approach.

Data maintenance
Some of the Land ECV projects did express the need for a common CCI data portal. It was emphasised that a long term data provision to users can not be ensured by the projects. The discussion in the plenary showed that some of the CCI projects are able to host large data volumes and provide the data to the users while the resources for other projects seem to be limited. The users in the plenary did express the wish for a single data portal solution that might be based on distributed nodes. As an example the Earth System Grid (ESG) was given which is widely used.

- [N-15] ESA and data standard group to identify possibilities for data provision at the end of phase 1 of CCI and develop a mid-term strategy.

Annex C Summary of Atmosphere Breakout Group

The main outcomes of the Atmospheric Breakout Sessions were presented to the Plenary as follows:

1. Integration and cross-ECV consistency: there is a strong interest in establishing scientific consistency across the various ECV projects, but the projects mentioned the challenge of allocating adequate time for translating the interest into specific activities within the current project schedules. Priorities envisaged for CCI Phases 1 and 2 are given below.

2. Consistent adoption of Level-1 input data: The atmospheric ECVs see the need for consistent adoption of Level-1 input data (especially when data from a single instrument is being used by several ECVs). The issues and requested action are given below.

3. Science Agenda: The atmospheric ECVs see the potential to bring together the Ozone user communities from Climate Research and Ozone Modelling.

4. Discussion of the 5 “Seed questions:

    i. User Requirements Documents: Atmospheric ECV projects will take CMUG comments in the next round of updates.
    ii. Product Specification Documents: there were some queries on whether some suggested content belongs in other documents. These queries were discussed further in the subsequent Plenary with Marine and Land ECVs.
    iii. Cross-ECV consistency: see above.
    iv. Uncertainties: the Atmospheric ECV teams place high priority on establishing the leading order terms in the error budgets.
    v. No major points to raise.

Further details are given below.

B.1 Integration and cross-ECV consistency

The discussion in the Atmosphere breakout group started with a tour de table where each ECV attendee mentioned what they saw as the most pressing issues. Integration between ECV projects was a recurring theme: there is a strong interest in establishing scientific consistency amongst the various ECV projects, but the projects mentioned the challenge of allocating adequate time for translating the interest into specific activities within the current project schedules.

For CCI Phase 1 activities on integration and cross-ECV consistency, the Atmospheric ECV projects see the following aspects as having highest priority:

- Continue to investigate the extent to which cross-ECV consistency is critical to the individual ECV projects.
- Be realistic about what is feasible within the current Phase 1 schedule.
- Perform initial intercomparisons of ECV products and/or by-products.
- Phase 1 intercomparisons to be restricted initially to small datasets, for example:
    - Cloud mask for one day from Cloud and Aerosol
    - Comparison of GHG aerosol by-product and Aerosol product

- Use of Aerosol product to interpret GHG product (possibly identifying aerosol-related GHG errors)
- Other small activities with Land/Marine ECVs, to be formulated on a bilateral basis

- Formulating follow-on Phase 2 activities near the end of Phase 1, on a bilateral basis.

The Atmospheric ECV projects noted that further potential benefits would arise from collaborative sensitivity studies that have already been proposed to ESA as options. It remains to be seen whether these options are exercised.

For CCI Phase 2 activities on integration and cross-ECV consistency, the Atmospheric ECV projects see the following aspects as having highest priority:

- Extension of Phase 1 intercomparisons to larger datasets
- Options to use Aerosol product in GHG retrieval
- Prioritization of other ideas

B.2 Consistent adoption of Level-1 input data

The Atmospheric ECV projects discussed the need for consistent adoption of Level-1 input data, especially when data from a single instrument is being used by several ECVs – e.g. ATSR, MERIS, AVHRR etc. The main issues are:

- Whether to always use the same versions across ECVs or to let teams make their own improvements.
- How to exchange new information when learned. This is currently done on a bilateral and informal basis but needs to be documented in a traceable way.
- Who should take the lead - possibly one person per instrument.

The projects took the view that the issues need to be addressed before the Production phase, so that the reference Level-1 datasets are clearly defined at production start. To ensure adequate preparation, they requested that this be an agenda item for the next colocation – how to organize communication and responsibilities.

[N-16] ESA: To include agenda item for the next colocation on Consistent adoption of Level-1 input data – how to organize communication and responsibilities.

B.3 Science Agenda

The Atmospheric ECV projects discussed the potential to bring together the Ozone user communities from Climate Research and Ozone Modelling. Martin Dameris (CCI_Ozone CRG) pointed out the potential use of CCI Ozone products in WMO evaluations of chemistry-climate models, e.g. the use of ozone profiles for validation, and the potential to improve/replace climatological ozone fields by exploiting CCI products. The relevant timeframe was considered to be from the end of Phase 1. Possibilities to make advances sooner, even with datasets of just one year duration, are not ruled out.

B.4 Discussion of the 5 “seed” questions

The remainder of the discussion addressed the 5 questions prepared in advance for all three breakout groups. These questions and their background motivation were:

User Requirements Documents:

Is it possible to agree on a definition of URD as the expression of needs of end-users over a range of times t? This is consistent with established notions of Goal/Breakthrough/Threshold requirements. Furthermore, should the requirements be "technology neutral" in the sense of not being restricted to any specific measurement technique or existing satellite mission? Within this approach, satisfying the user requirements may require the mixing satellite data with other data. It would then follow that the CCI can only partially meet the User requirements, and the rationale for selecting partial requirements for each ECV project would need to be clearly explained in the Product Specification Document. The previous Plenary session had noted that this was the approach outlined by ESA at the Frascati Co-location Meeting (October 2010).

Given that data needs of Climate Research and Modelling span diverse applications such as
Model assessment and improvement (process studies)
Seasonal/regional forecast
Projections
Long term trends
Impacts/attributions

have they been sufficiently considered in the current version of ECV URDs? Has any CCI team the feeling that iteration will be necessary and that the URDs are living documents?

- Product Specification Documents

Following on from the concept of the URDs being focussed on end user needs, user expectations are that the PSDs will describe the satellite level 2, 3 or 4 products to meet UR to the extent that this is possible based on existing data sets. Here it should be very clear what are the targets for CCI Phases 1 and 2. To provide rationale for which URs are being addressed and which are not, users expect the PSDs to include the current state of the art. At the user and programmatic levels, interest will be enhanced if PSDs provide a longer-term perspective based on the premise of a sustained re-processing activity beyond CCI Phases 1 and 2. In particular, building up data series based on new or recent satellite data (e.g. IASI) for future applications should be considered and outline details provided. Choice of products must consider what is existing/available and describe benefit of CCI to the end user (within CCI or without!) (see use of satellite products in IS-ENES).
The question for the ECV teams was whether they are willing to write their PSDs in this way.

- Integration:

Some CDR (ECV) are by-products for other ECVs. Sensitivity studies can help to establish the impact of uncertainties in related parameters which in principle can be translated into needs for consistency. But at which product level (level 1, level 2?), and on which characteristics (resolution, timeliness,…)? Where climate correlations between variables exist (e.g. Ozone and SST in tropics, Ozone and ice in polar regions), is there an impact on the requirements for simultaneity in products, on choice of the instrument data, the algorithm, the performances?

- Uncertainties

What approaches to uncertainty characterization are being taken by the ECV projects? Do the approaches take into account that algorithm performance can vary with the applicable conditions (region, time, resolution, etc.)? Under what circumstances is an ensemble approach suitable? What metrics? What contribution to uncertainty comes from the instrument measurement technique, from L1 to L2 processing, from L2 to L3, etc?

- Use of Re-analysis:

If reanalysis data are used in the ECV retrieval algorithms, does it affect objective assessment of climate impact?

After a first round the ECV gave some interesting propositions on integration. A first outcome was that the contracts with ESA have a very tight schedule which makes it difficult to devote extensive effort on this aspect. Should it be considered in phase 1 or phase 2? It is acknowledged that it is important to establish whether cross consistency of ECVs is critical or not and to what extent. Several small studies to examine this question can be carried out during phase 1. In terms of potential collaborations between ECVs, several ideas were proposed to intercompare on small datasets products or by-products. For example, clouds and aerosols can explore consistency of products (cloud mask), GHG aerosol by-product with aerosol product, use of aerosol to interpret GHG, etc..

Most of the time, the integration consists in trying to have ECV by-products used to get an ECV consistent with the relevant ECV.

Potential benefits would come from collaborative studies (some already proposed to ESA). Then phase 2 plans will have to be established for submission to ESA.

A discussion was started also on considering the process to select the data and processing which could be applied to permit the study of interlinked variables, e.g. SSH and SST in ENSO situations, Ozone and SST in the tropics or Ozone and ice. But this aspect has to be matured by discussion between the ECV science groups and with the CMUG.

The idea of a golden year where consistent products would be produced and tested to evaluate their necessity was welcomed. It was also proposed that products derived from sensors on the same platform like Meris, AATSR, Sciamachy on Envisat are elaborated consistently.

About the URDs, everybody agrees that the URDs should reflect only end-user needs and not be biased by satellite technique. This would need some URDs to be modified to well distinguish the two aspects. The method used to transfer the needs on satellite products at levels 2 to 4 must be clearly described. A state of the art has to be written and the approach from it to what will be specified should be clarified. Amongst the Atmospheric ECV teams there was no consensus to include a summary of the state of the art in the Product specification document and it was decided to refer this back to the Plenary and further clarification from ESA.

On the uncertainties, there was some discussion. The various sources of errors contributing to the total uncertainties are partially described in the URDs of the Atmosphere ECVs. The attendees re-affirmed the comment made in earlier plenary sessions, that the priority is to establish quantitative values for the leading order terms in the error budgets for the ECV products.

The issue of the possible climatic bias introduced when using reanalysis as first guess in the retrievals has not been discussed and could deserve a dedicated point at a future meeting.

Annex D Summary of Marine Breakout Group

The discussion in the Marine Breakout group was focussed on 4 of the five questions communicated to the CCI groups before the meeting and that they addressed in their individual presentations. The main objective was to analyse and complete answers to these questions and identify commonalities between ECVs. Some common views between the participants were agreed and some actions for the future were suggested. They are classified below according to the main topic of each question.

Users requirements

The differences between the User Requirements (UR) and GCOS-2006 identified in some of the URDs will be reduced with the new iteration of the GCOS requirements. This is already the case for some of them.

The CCI group cannot guarantee to deliver products satisfying the requirements but there is a need to keep a clear separation between instrument capabilities and actual user requirements. GCOS requirements are science requirements and don't relate to capabilities and the CCI URDs should be the same but this was not the case in all CCI URDs.

Regarding the extension of existing user requirements to mesoscale ocean features, Sea Level (SL) and Sea Surface Temperature (SST) groups will have a dialogue with representatives of this community (e.g. trend analysis, tropospheric corrections, sea surface dynamics). SST and Ocean Colour (OC) will have a continuing dialogue with users at later stages of the project thanks to the network of users that has been established.

Product specifications

There is an interest in including the current state of the art in the PSD in order to assess how the CCI dataset will improve over existing datasets.

Integration between the ECVS

On synergy, we need to discuss conventions and terminology. We need to be clear between the CCI participants and be clear to users. This implies in particular to keep and use the definitions as documented in the collocation report. Terms not included have to be considered (e.g. SL group need to clarify what is meant about global and regional products). There is a proposal for a shared document including those definitions focussed on error characteristics and uncertainties (with a draft from the collocation report).

Different levels of consistencies can be identified at different levels of development of the product: joint retrieval (e.g.; between SST, cloud and aerosols), consistent format of delivered data, spatiotemporal consistency between products, etc.

Concerning joint retrievals, at the end of the first phase the products could be revisited with a view to producing more consistent retrievals.

Concerning spatial consistency, the question was raised to use ECMWF CDO interpolation tool (e.g. for total column ozone). SST and OC groups will use CDO tool and SL will investigate implications.

It is suggested that if one group finds sensitivity to a parameter that is different between ECMWF and NCEP reanalyses, then he shares that information with the other groups if relevant.

A common agreement is found for a convergence towards a use of NetCDF CF format. A proposal is made by SST group to share their metadata standard that could be considered by the other groups. Before changing format it is recommended to check that this also conforms to INSPIRE and others standards that are needed to conform to, and that this change brought benefits.

Demonstration of the consistency of CCI marine products could also be a result of data assimilation in ocean models (e.g. MyOcean2 as a user of CCI).

Uncertainties in products
There are different and complementary approaches for the evaluation of uncertainties: in the view of the SST group each component of the uncertainty will be modelled, SL group proposes a common set of validation diagnostics, OC group suggests multiple approaches for different algorithms.

Concerning commonalities, ensemble approaches are already used implicitly in the SST group approach and done in some cases for the OC group for physical algorithms.

A suggestion of a specific analysis of the products over a short well observed period and region was made. It was however considered that it would be difficult to make use of a small amount of regional data, statistically speaking.

Concerning the strategies for uncertainties on different processing levels, all the marine groups will propagate uncertainty information estimated for lower level products through to higher levels.

Other issues
It was agreed that more presentations from the modelling community will be made in future collocation meetings.

Annex E List of Notes Arising

[N-01]: The Fire ECV group are encouraged to consider adding 2008 as another year to process or (a part of the year is not sufficient due seasonal effects).

[N-02]: The CMUG will do an analysis for ESA sensors as part of its review of the URDs and PSDs due in May 2011.

[N-03]: Consider the definition and implementation of a consistent land/sea mask applicable to all projects (covering, if possible fresh water and tidal zones) and downscaling methodologies. This falls outside the remit of the DSWG.

[N-04]: CCI projects to identify weak and strong links between product and auxiliary data and their respective sensitivities.

[N-05]: The definition of terms to characterize the quality of the measurements has still to be harmonized.

[N-06]: It was agreed that CCI projects register any new parameter names not in the CF database [http://cf-pcmdi.llnl.gov/documents/cf-standard-names/] so that they can be compliant under the NetCDF CF convention (All CCI projects). (Data Standards Working Group)

[N-07]: Provide sample code and datasets to all CCI projects (Data Standards Working Group).

[N-08]: The Land cover group was asked to provide a land/sea mask (see also Section 4.3) to the CCI projects.

[N-09: generate sample data set of respective products as soon as possible and get feedback from the user community (all projects / Data Standards Working Group)

[N-10]: CCI projects to include added value statement compared to existing data product in their PSDs.

[N-11]: CMUG to organize a dedicated user integration workshop at a later stage of the project if required.

[N-12]: CCI Projects in agreement with ESA to decide on a golden year 2008 and iterate its implementation with the projects.

[N-13]: Land cover CCI and fire CCI to evaluate the impact of L1 data processing on surface reflectance products.

[N-14] Fire and land cover project to agree on a common tiling approach.

[N-15] ESA and data standard group to identify possibilities for data provision at the end of phase 1 of CCI and develop a mid-term strategy.

[N-16] ESA: To include agenda item for the next colocation on Consistent adoption of Level-1 input data – how to organize communication and responsibilities.

Annex F List of Participants

CMUG
Roger Saunders, Met Office
Paul van der Linden, Met Office
Alex Loew, MPI-M
Iryna Khlystova, MPI-M
Stefan Kinne, MPI-M
Serge Planton, Météo-France
Thierry Phulpin, Météo-France
David Tan, ECMWF
Dick Dee, ECMWF

ESA
Mark Doherty
Pierre-Philippe Mathieu

Pascal Lecomte
Stephan Bojinski
Victoria Bennett
Stephen Plummer
Craig Donlon
Cat Downy ESA and IGBP

ECV projects
Emilio Chuvieco, UAH
Martin Schulze, Juelich
Arnd Berns-Silva, GAF
Frank Paul, UZH
Sven Kotlarski, ETHZ
Pierre DeFourny, Université catholique de Louvain
Dimitri Lederer, Université catholique de Louvain
Thomas Holzer-Popp, DLR
Michel van Roozendael, Aeronomie
Martin Dameris, DLR
Rainer Hollmann, DWD
Colin Jones, SMHI
Michael Buchwitz, University of Bremen
Harmut Boesch, Leicester University
Michaël Ablain, CLS
Joel Dorandeu, CLS
Magdalena Balmaseda, ECMWF
Chris Merchant, Edinburgh Univeristy
Nick Rayner, Met Office
Shuba Sathyendranath, PML
Mike Grant, PML
Stefano Ciavata, PML

Experts
Marco Giorgetta, MPI
Robert Ferraro, NASA JPL
Veronika Eyring, DLR
George Tselioudis, Athens Academy, IS-ENES
Adrian Simmons, ECMWF, WOAP

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Annex G Programme

CCI project integration meeting

ECMWF, Shinfield Park, Reading, RG2 9AX, UK, 14 to 16 March 2011

Aims and Programme

This meeting is to facilitate CCI project integration so as to achieve consistency and quality of output across the CCI. The CMUG will facilitate the discussions.

A. Aims of the meeting are to:

- check ECV project URDs are consistent with the needs of Climate Research Groups (CRG) in the context of CMUG needs and GCOS requirements, including source traceability
- First look at ECV product specifications (and check that the proposed products will be of use to CRGs in their applications) if available
- allow ECV teams to explain how their projects address the integrated perspective for consistency between the ECVS to avoid gaps
- discuss how to deal with uncertainties in products (how to capture and describe them for product users)
- develop / finalise the ECV projects data needs for ECMWF reanalysis data
- start a discussion on ECV data set validation
- maintain oversight of the position within the international framework in which CMUG/CCI is operating

Success in fulfilling these aims will be evidenced by the subsequent direction of the CCI projects.

B. Inputs of the meeting are:

CMUG Deliverables to date [D1.1, 1.2, 4.1 available at www.cci-cmug.org and D2.1]
Official URDs from ECV projects [available from ESA]
Official DARDs from ECV projects [available from ESA]
Draft PSDs from ECV projects if available [available from ESA]
ESA CCI Project Guidelines [output from colocation meeting, ref. EOP-DTEX-EOPS-SW-10-0002]
GCOS requirements [see: http://www.wmo.int/pages/prog/gcos/Publications/gcos-107.pdf]

C. Outputs of the meeting will be (see page 4 for meeting outlines)**:**

1. Meeting report of actions agreed by ECV projects [including updates to URDs and Product Spec. docs]
2. Meeting report describing strategic position of the CMUG, within CCI, in the international arena
3. Material to inform revision of CMUG D1.2, D2.1 and D2.2

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4. Input to CMUG D3.1
5. Clarity on requests for ECMWF reanalysis data
6. Clarity on early demonstration of products (if feasible) to modellers.

D. Programme

Each ECV project is asked to give a 20 minute presentation demonstrating how it will address the following questions:

1. **Is your URD consistent with the needs of Climate Research Groups (CRG) in the context of CMUG needs and GCOS requirements, including source traceability?**
2. **How are your product specifications developing to meet the needs of your individual Climate Research Group (will the CRG use the proposed products in their applications)?**
3. **How will you address the integrated perspective for consistency between the ECVs, including identification of gaps?**
4. **How will you deal with uncertainties in products?**
5. **What are your data needs for ECMWF reanalysis data?**

(Each presentation will be followed by 10 minutes plenary Q+A.)

Monday p.m.	
12:00-13:00	Registration and lunch
13:00-13:15	▪ Welcome and outline the of the meeting [*Presentation: ECMWF, Mark Doherty ESA*]
13:15-13:45	▪ Agree the aims of the meeting, with plenary discussion [*Roger Saunders, Met Office*]
13:45-14:15	**SESSION 1: Climate Modelling perspectives**
14:15-14:45	▪ Climate modelling perspectives [*Marco Giorgetta, MPI*]
14:45-15:15	▪ Metrics and data in global model evaluations [*Veronika Eyring, DLR*]
15:15-15:30	▪ Reanalysis: when observations meet models [*David Tan, ECMWF*]
	Tea / coffee
15:30-16:00	**SESSION 2: URDs and products specifications and validation** [*20 minute presentation by each CCI leader to address the questions in the blue box, and 10 minute discussion*]
16:00-16:30	▪ Sea level
16:30-17:00	▪ SST
17:00-17:30	▪ Ocean colour
17:30-18:00	▪ Discussion session on common issues for marine ECVs [*MétéoFrance to lead*]

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	▪ GHG
Monday evening "an Integrating Reception" drinks and nibbles courtesy of ECMWF	
Tuesday a.m.	
09:00-09:30	▪ Cloud
09:30-10:00	▪ Ozone
10:00-10:30	▪ Aerosol
10:30-11:00	▪ Discussion session on common issues for atmosphere ECVs [*ECMWF to lead*]
11:00-11:30	Tea / coffee
11:30-12:00	▪ Glaciers
12:00-12:30	▪ Land cover
Tuesday p.m.	
12:30-13:30	Lunch
13:30-14:00	▪ Fire
14:00-14:30	▪ Discussion session on common issues for land ECVs [*MPI to lead*]
14:30-15:00	Tea / coffee
	SESSION 3: CMUG: Facilitation and support
15:00-15:30	▪ ECMWF reanalysis data which ECV projects need [*David Tan or Dick Dee, ECMWF*]
15:30-16:00	
16:00-16:30	▪ Confronting models with observations [*Robert Ferraro, JPL / NASA*]
16:30-18:00	▪ The IS-ENES approach to model evaluation [*George Tselioudis, Academy of Athens*]
	SESSION 4: Integration and commonality towards achieving the goals of the CCI
	▪ Discussions in three parallel breakout groups (land, marine, atmos) – on the issues presented in Sessions 1, 2 and 3.
Tuesday evening "an Integration Dinner" (self-funded dinner at a local restaurant)	
Wednesday a.m.	
09:00-10:00	▪ Discussion groups continue by preparing the written notes of their discussions which will form the Meeting Report. People can move between groups if they wish.
10:00-11:00	
11:00-11:30	▪ Plenary session reporting back on breakout groups [*Rapporteur from each breakout group to present results, RS to lead*] Plenary discussion on all reports.
11:30-12:00	Tea / coffee
12:00:12:15	▪ Future promotion and links to modelling groups [*Roger Saunders, Met Office*]
	▪ Conclusion [*CMUG / ESA*]

Annex H Acronyms

AIRS+MLS	Atmospheric InfraRed Sounder + Microwave Limb Sounder
AMIP	Atmospheric Model Intercomparison Project
AMSR-E	Advanced Microwave Scanning Radiometer - Earth
ATSR	Along Track Scanning Radiometer
CCI	Climate Change Initiative
CCMVal	Chemistry Climate Model Validation
CDR	Climate Data Record
CERES	Clouds and the Earth's Radiant Energy System
CFMIP	Cloud Feedback Model Intercomparison Project
CMIP	Coupled Model Intercomparison Project
CMOR	Climate Model Output Rewriter
CMUG	Climate Modelling User Group
CRG	Climate Research Group
CZCS	Coastal Zone Colour Scanner
DAAC	Distributed Active Archive Center
DARD	Data Access Requirements Document
DLR	Deutsches Zentrum für Luft- und Raumfahrt (German Aerospace Center)
ECHAM6	European Centre Hamburg Model (version 6)
ECMWF	European Centre for Medium-Range Weather Forecasts
ECV	Essential Climate Variable
EO	Earth Observation
ERA	ECMWF ReAnalysis
ERA-CLIM	European Reanalysis of Global Climate Observations
ERB	Earth Radiation Budget
ESA	European Space Agency
ESM	Earth System Model
EU FP7	European Union Framework Programme Seven
EUCLIPSE	EU Cloud Intercomparison, Process Study & Evaluation Project
FOV	Field Of View
GCOS	Global Climate Observing System
GHG	Greenhouse gas
GHRSST	GODAE High Resolution Sea Surface Temperature
GMES	Global Monitoring for Environment and Security
GPCP	Global Precipitation Climate Program
HadISST	Hadley Centre Ice coverage and Sea Surface Temperature
HOAPS	Hamburg Ocean Atmosphere Parameters and fluxes from Satellite data
IGBP	International Geosphere Biosphere Programme
IOCCG	International Ocean Colour Coordinating Group
IPCC	Intergovernmental Panel on Climate Change

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IPCC AR5	Intergovernmental Panel on Climate Change Fifth Assessment Report
IS-ENES	Infrastructure for the European Network for Earth System Modelling
JPL-NASA	Jet Propulsion Laboratory - National Aeronautics and Space Administration
JSBACH	Jena Scheme for Biosphere-Atmosphere Coupling in Hamburg
MACC	Modelling Atmospheric Composition and Climate
MEaSUREs	Making Earth Science Data Records for Use in Research Environments
MERIS	Medium Resolution Imaging Spectrometer
METAFOR	Common METAdata FOR Climate Modelling Digital Repositories
MJO	The Madden Julian Oscillation
MODIS	Moderate Resolution Imaging Spectroradiometer
MOHC	Met Office Hadley Centre
MPI-M	Max Planck Institute for Meteorology
MPIOM	Max Planck Institute Ocean Model
NCEP	National Centers for Environmental Prediction
NetCDF	Net Climate Data Format
NWP	Numerical Weather Prediction
OC	Ocean Colour
OLR	Outgoing Longwave Radiation
PCMDI	Program for Climate Model Diagnosis and Intercomparison
PSD	Product Specification Document
SPARC	Stratospheric Processes And their Role in Climate
SSM/I	Special Sensor Microwave Imager
SST	Sea Surface Temperature
TOPEX	TOPography EXPeriment
TRMM	Tropical Rainfall Measuring Mission
URD	User Requirements Document
WCRP	World Climate Research Program
WGNE	Working Group on Numerical Experimentation
WOAP	WCRP Observations and Assimilation Panel