

# → CLIMATE CHANGE INITIATIVE

## [CMUG] CCI Newsletter

Issue 3 | January 2013

### Background to CMUG

The European Space Agency (ESA) has established the "Climate Modelling User Group" (CMUG), to ensure a climate system perspective at the centre of its Climate Change Initiative (CCI) programme, and to provide a dedicated forum through which the Earth Observation Data Community and Climate Modelling Community can work closely together. Visit the CMUG website at: <http://www.esa-cmug-cci.org/> for the latest news.

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### Soil Moisture: ECV Assessment and Application

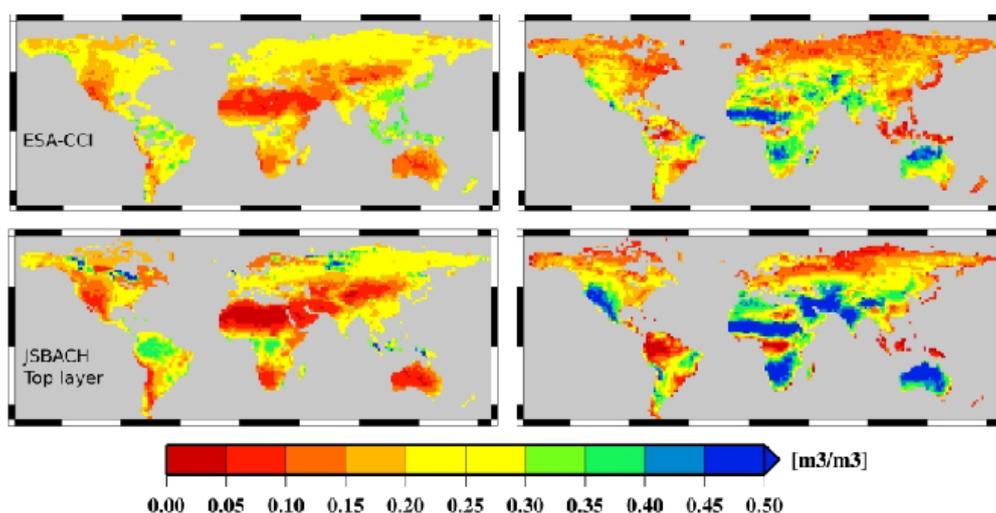
The CMUG have performed an extensive assessment on soil moisture, an important Essential Climate Variable (ECV) with regional and global implications on water, energy and carbon fluxes. Recent satellite based observations have provided us with the first multidecadal soil moisture record. The purpose of the CMUG assessment is to evaluate potential applications of this dataset within the climate modelling community (specifically, model evaluation and development), and analyse the use of long-term soil moisture data for future climate studies.

#### *Data and research methods*

Before comparison with climate model simulations, the multidecadal ESA-CCI satellite observation dataset is subjected to various data pre-processing techniques to create a heterogeneous dataset, such as orbital overlaying, data regriding, and

temporal filtering. These techniques are a way of rectifying missing data due to effects from snow/ice cover, dense vegetation and orbital characteristics (among other factors). Climate simulations have also been performed using a global land surface model (JSBACH – part of MPI-ESM) forced with observed meteorological data (Watch Forcing Data – WFD), in

order to compare soil moisture results with those obtained from pre-processed satellite observations. Specifically, this study investigates the reliability of simulated soil moisture patterns, long-term memory effects, and soil moisture dynamics, as well as the relationship between soil moisture and precipitation.



*Figure 1: Comparison of mean surface soil moisture (left) and temporal variability (right), across the ESA-CCI observational dataset and top layer of JSBACH model results, for the years 2003-2009. Modified version of Figure 10 in the CMUG report.*

### *Comparison of soil moisture from satellite observations and climate model simulations*

When directly comparing global mean surface soil moisture, we can see a good spatial agreement between satellite and climate model datasets (see left hand panels of Figure 1). This agreement is especially apparent over semiarid areas in Africa, Australia, and western North America. Comparison at northern hemisphere high latitudes shows the least agreement, possibly arising from the difficulty in producing satellite observations over this region. Temporal variability (measured by the coefficient of variation, see right hand panels of Figure 1), also shows good agreement across both datasets, which again is most pronounced over semiarid African regions

In general, good agreement has been found between the first JSBACH soil moisture layer and subsequently deeper soil layers within the model. As satellite observations only provide information on soil moisture for the upper few centimetres of ground, these initial results indicate that satellite observations of soil moisture might be a reasonable proxy for deeper soil moisture dynamics, which is linked to the long-term memory effects of soil moisture. Direct comparison of soil moisture fields indicate very good skill in both the observational and modelling datasets to reproduce soil moisture dynamics at the model grid scale (apart from Northern Latitudes, which are often under widespread influence of snow and ice cover).

When relating simulated and observed soil moisture to regional precipitation fields over the Sahel region, it was found that satellite observations show reasonably good skill in reproducing the Sahelian interannual rainfall anomalies. However, significantly higher correlations were found within the climate model simulations. This could be arising either from a weaker observed relationship between soil moisture and precipitation (implying a reduced correlation due to noise), or due to the effect of other relevant processes such as vegetation dynamics and evapotranspiration.

### *Advantages and deficits of dataset application*

The objectives of this study were to assess potential applications of a multidecadal soil moisture dataset derived from satellite observations. The key advantages of utilisation were found when assessing soil moisture's long-term memory effect, as well as regional soil moisture dynamics, both of which could be used to improve specific parameters within climate models. However, this study has also identified several deficits when using this dataset in application with climate models. These include, but are not limited to, sparse coverage before 1987, temporal inconsistencies, lack of information over snow and ice cover, and the use of a matching technique (dependent on Noah land surface model dynamics) for soil moisture statistics.

**Overall, the soil moisture dataset derived from satellite observations is a unique dataset providing relevant information for climate studies. There is strong indication that this information may have further application in climate model initialization and development on seasonal and multiannual time scales.**

The report is available here as [Deliverable 3.1 V1\\_B](#) or on the ECV project resources page on the [CMUG website](#).

## Recent CMUG Publications

CMUG scientists have contributed to two scientific papers: an upcoming BAMS article describing the CCI, and a published paper on the assimilation of ocean colour data from the GlobColour project (a precursor for the ocean colour ECV product).

### BAMS: The ESA Climate Change Initiative

R. Hollmann, C. Merchant, R. Saunders, C. Downy, M. Buchwitz, A. Cazenave, E. Chuvieco, P. Defourny, G. deLeeuw, R. Forsberg, T. Holzer-Popp, F. Paul, S. Sandven, S. Sathyendranath, M. van Roozendaal, W. Wagner, (In review). The ESA Climate Change Initiative: Satellite data records for essential climate variables.

The Bulletin of the American Meteorological Society (BAMS) will shortly publish a paper describing the CCI, including the important role of the CMUG within this initiative. This paper, co-authored by CMUG scientists, describes the objectives of the CCI, outlining the approach for delivering climate data derived from satellite data, optimised for climate research applications. All marine, atmospheric, and terrestrial ECV's are described in detail, along with a description of the work in progress for each ECV. This paper highlights that close involvement of the climate modelling community, through the CMUG, will ensure CCI outcomes reflect the best available methodologies for creating climate-quality datasets.

This paper is currently under review, and will be available in early 2013 from the BAMS website.

### Assimilation of GlobColour data into FOAM-HadOCC

D. A. Ford, K. P. Edwards, D. Lea, R. M. Barciela, M. J. Martin, and J. Demaria, 2012. Assimilating GlobColour ocean colour data in a pre-operational physical-biogeochemical model, Ocean Science Discussions, vol. 9, pp. 687-744.

A group of Met Office scientists have successfully published a paper in Ocean Science Discussions on the topic of GlobColour data assimilation in a physical-

biogeochemical model, in order to investigate any potential improvements to model errors and biases. The most realistic representation of ocean biogeochemistry can be obtained through the assimilation of data from both models and observations, which when combined can produce results which are more accurate than either models or observations alone. This study aims to assess the impact of assimilating GlobColour ocean colour data, derived from satellite observations, into the FOAM-HadOCC ocean model.

Results show that model simulations using assimilated GlobColour data demonstrate considerable improvements in model bias, root mean square error (RMSE) and correlation with observations when compared to a control run without data assimilation (see Figure 2). Improvements are immediate and sustained in all ocean basins through the simulation time period. These results demonstrate a capability of considerably improving a coupled physical-biogeochemical model through the assimilation of model data and satellite observations, which should be promoted in the future delivery of reanalyses products. However, it is also noted that significant focus is still needed on reducing underlying model biases through model development initiatives. As seen in Figure 2b, using a model alone results in large biases, which currently prevent the results obtained from data assimilation from being consistently more accurate than climatology.

Further investigation will be performed as an extension to this work, which will involve multi-year reanalyses with and without assimilation, with aims to investigate interannual variability. In addition to this, forecasts produced by the assimilative system will be assessed for investigation into any improvements in forecast skill versus using persistence or climatology methods.

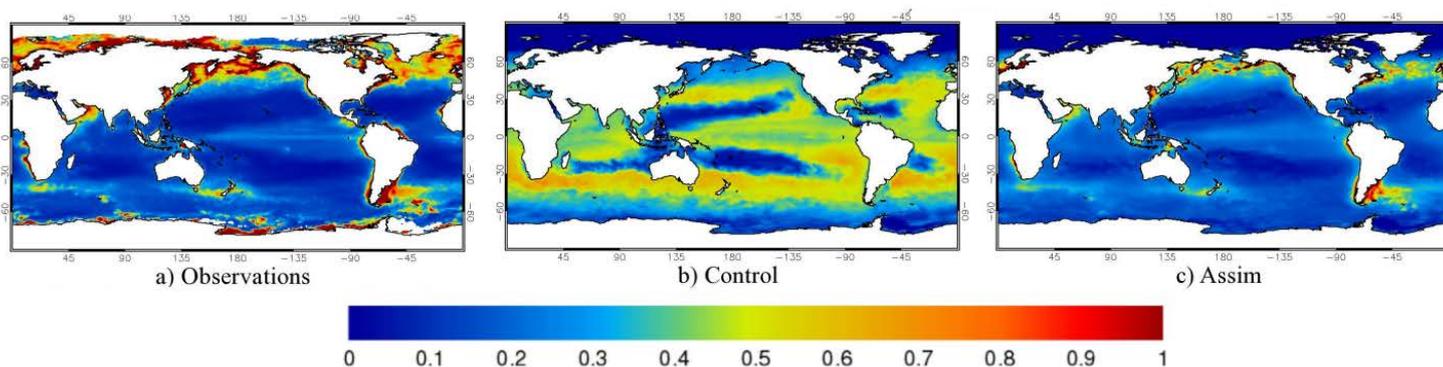


Figure 2: Mean surface chlorophyll ( $\text{mg m}^{-3}$ ) for 2008. Comparison between observations, model control run and model assimilation run. Modified from Figure 4 in Ford et al. (2012).

## CMUG Reports and Deliverables

All reports listed below can be found on the [CMUG website](#).

### D1.2: User Requirement Document

This CMUG deliverable highlights the needs of the Climate Modelling Community (CMC), with respect to the usability of CCI datasets in climate modelling experiments. Through conducting surveys of the CMC, user requirements for the 13 ECVs were compiled and analysed. Key findings suggest the majority of climate modellers hope to use CCI datasets for climate model validation and development. However, it is recognised that user requirements of the CMC will change as time progresses, which will require CMUG to re-consult with the CMC as more CCI datasets become available.

### D2.4: Technical note: Analysis of how the CCI datasets will meet climate modellers needs

For this deliverable, the CMUG addresses the application and added value of each ECV CCI dataset for the climate modelling and reanalysis communities within the CCI project time frame. For each ECV, the report summarises the potential applications, current usage, how the new CCI datasets will

build upon various existing datasets, and documents areas where improvement is needed to achieve widespread use for climate modelling purposes.

### D3.1\_A: Technical note on CMUG ECV Quality Assessment Report

The purpose of this CMUG deliverable is to assess the quality of CCI climate data records (CDRs), and their use with coupled Earth System Models (ESMs). These CDRs will ultimately be used for comparison with CCI datasets as they become available, to ensure the quality is maintained throughout the creation of CCI datasets, allowing for use in climate modelling applications.

### D3.1\_B: Technical note on CMUG ECV Soil Moisture Assessment Report

Please see the first section of this newsletter for a brief review of this CMUG ECV assessment. This deliverable will soon be available on the CMUG website.

## ESA CCI 2012 Colocation Meeting and Mid Term Review meetings

In September 2012, the CCI held its 3<sup>rd</sup> Colocation Meeting in conjunction with a Mid Term Review (MTR) in Frascati, Italy. Scientists from the CMUG and all 13 ECV projects participated in discussions on project status and updates, as well as participating in an external MTR, carried out by delegates from the 15 countries which fund the CCI.

### 3<sup>rd</sup> Colocation Meeting

The primary aim of the 3<sup>rd</sup> Colocation Meeting was to provide an opportunity for discussion on the status and progress of all aspects of the CCI (specifically, the CMUG and the 13 ECV projects). During this 3-day meeting, scientists with involvement across all CCI objectives were asked to present on their contribution to the initiative, along with any recent progress and initial results. These presentations allowed for cross-project discussion and collaboration, ultimately leading to a better understanding of individual project tasks and upcoming goals for teams across the CCI.

The CMUG contributions to this meeting included a detailed project status update by Roger Saunders. CMUG-related presentations were given on the use of observational uncertainty in climate modelling and reanalysis (Mark Ringer, Met Office), as well as climate and long-term satellite records within the Sahel region (Alex Loew, MPI-M).

### Mid Term Review

The CCI MTR process was held in conjunction with the 3<sup>rd</sup> Colocation Meeting, and involved a comprehensive external review of all CCI projects (including the CMUG). This was to ensure consistency in project goals across the teams, while maintaining initial project objectives. While information was given about each project, there was also an emphasis on cross-project collaborations and achievements, and what further benefits can be gained from close cooperation in CCI Phase 2. With respect to the CMUG, the MTR highlighted the importance of adequate connection and responsiveness to international climate research programs and the wider climate science community. The interface between climate modellers and the CCI, provided by the CMUG, has been highlighted as an important factor to maintain as the initiative progresses into Phase 2, with a need for continual promotion of CCI data exploitation for use in future climate modelling studies.

## Forthcoming CMUG Events

**3<sup>rd</sup> Meeting of CEOS WGClimate will be held in Geneva, Switzerland from February 20<sup>th</sup> – 21<sup>st</sup>, 2013.**

This meeting of the CEOS Working Group on Climate, which is by invitation only, will consist of various themes set up to encourage collaborative activities between international space agencies involved in climate monitoring. Roger Saunders (Met Office) will be giving a CMUG-related presentation in the theme focussed on ECV assessment in the CCI. Marine ECVs will also be a theme focus, among various additional topics.

**18<sup>th</sup> Session of the GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC) will be held in Geneva, Switzerland from April 2<sup>nd</sup>-5<sup>th</sup>, 2013.**

This meeting of the AOPC, which focuses on atmospheric observations for climate within GCOS, will promote collaboration and discussion on recent AOPC-related activities. Roger Saunders (Met Office) will be updating the panel on the latest results from the CCI programme.

**EGU General Assembly will be held in Vienna, Austria from April 8<sup>th</sup> – 12<sup>th</sup>, 2013.**

Presentations will be made from two CMUG scientists, both relevant to the Fire ECV within the CCI. Specifically, these presentations will be in the "Fire in the Earth system" session (BG2.3), to be presented by Silvia Kloster (MPI-M), and the "Fire information needs for global modelling of fire effects" session (NH7.2), to be presented by Iryna Khlystova (MPI-M).

**4<sup>th</sup> Working Group on Numerical Experimentation (WGNE) will be held in Exeter, UK from April 15<sup>th</sup>-19<sup>th</sup>, 2013.**

This workshop is focussed on systematic errors in weather and climate models. Presentations will include a CMUG presentation entitled "New Satellite Datasets for Diagnosing Model Errors" (R. Saunders), and two presentations which include some CMUG results, entitled "Quantitative Evaluation of the Seasonal Variations in Climate Model Cloud Regimes" (Y. Tsushima et al.), and "Solar radiation biases over the Southern Ocean in CMIP5 models" (A. Bodas-Salcedo et al.).

**3<sup>rd</sup> CMUG Integration Meeting will be held in Hamburg, Germany from June 3<sup>rd</sup>-5<sup>th</sup>, 2013.**

As with previous CMUG Integration Meetings, the aim is to facilitate an exchange of ideas and information between climate modellers and the climate data producers of the CCI. It will provide an opportunity to further discuss challenges that face climate research, in the context of CCI aims and objectives. This meeting will also provide an opportunity for the CMUG to further demonstrate the application of CCI products in climate modelling studies (initial CMUG results from precursor datasets were presented at the 2<sup>nd</sup> Integration meeting).

Detailed objectives for this meeting will be decided upon in the coming months, with additional information being made available nearer to date on the CMUG website (<http://www.esa-cmug-cci.org/>). Attendance of this meeting is by invitation only.



*The CCI Science Leaders and Programme Managers: Left to right: S. Sandven, G. de Leeuw, R. Forsberg, P. Defourmy, R. Saunders, E. Chuvieco, A. Cazenave, C. Merchant, M. Doherty, F. Paul, P. Lecomte, W. Wagner, M. van Roozendaal, R. Hollman, T. Holzer-Popp, M. Buchwitz, A. Shepherd*

The CMUG project office can be contacted at: [cmug@metoffice.gov.uk](mailto:cmug@metoffice.gov.uk)