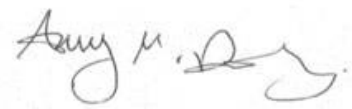
CCI

CMUG

Report of CMUG Integration Meeting Oct 2024

ECSAT Centre, Harwell, Oxfordshire, UK, 16th October 2024

Accepted by:	Institute / project	Signature
Amy Doherty	Met Office / CMUG	
Simon Pinnock	ESA / CMUG	Simon Pinnock Digitally signed by Simon Pinnock Date: 2025.01.20 09:55:54 Z

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1. Introduction

The Integration Meeting, held October 2024, was organised by the Climate Modelling User Group (CMUG) of ESA's Climate Change Initiative (CCI) programme. The meeting was held in-person at ESA-ECSAT Conference Centre in Harwell, Oxfordshire, UK, with online streaming, on 16th October 2024 from 09:00 to 18:30 BST.

The meeting included participants from a range of communities, including CMUG project partners, CCI ECV Science Leads, Climate Research Group (CRG) members, Climate Science Working Group (CSWG) members, ESA Technical Officers, and other participants from the wider CCI community.

The all-day Integration Meeting on 16th October began with opening and welcome presentations by Head of the ESA Climate Office, and the CMUG Project Manager. The morning continued to primarily focus on the CMUG science studies and relevant work packages, for which each study representative presented latest updates and scientific highlights. Further details on the individual studies can be found on the CMUG website here, under the 'Studies' tab. The afternoon then consisted of a joint CMUG-CMIP session commencing with some introductory talks on observation requirements from the modelling community as well as a talk on the role of observations in CMIP7. The afternoon continued to breakout sessions, organised by the CMIP International Project Office (IPO), followed by a plenary session during which a spokesperson from each breakout group would feedback the main discussion points. The day concluded with a poster session and drinks reception at the conference centre.

The meeting webpage is available on the CMUG website here, including links to the meeting agenda, presentations and posters. The event page for both the CMUG Integration Meeting and CCI Colocation Meeting, produced by ESA, can be accessed here.

2. Meeting aims

The aim of the Integration Meeting was to provide a space for CMUG study representatives to provide updates to ESA and the CCI community, report on any programme-wide issues, and ensure best practice across areas of common interest. The Integration Meeting supports continued and close coordination between CMUG partners, the wider CCI community and also the CMIP IPO. This meeting specifically provided the opportunity for CMUG science study teams to present updates and highlight scientific progress and results thus far to facilitate further discussion and constructive feedback. The joint CMUG-CMIP breakout sessions during the afternoon provided the opportunity to discuss in small groups any recommended variables to include, processes to consider, related discussions around evaluation with observation data, and suggestions for moving forward.

3. Meeting agenda

The Integration Meeting agenda is outlined in the table below.

Oct. 16, 2024 Morning	CMUG Integration	
09:00-09:30	Registration & Networking	
09:30-09:35	Opening & Welcome	Susanne Mecklenburg, ESA
09:35-09:45	CMUG Introduction & Status	Amy Doherty, Met Office
09:45-11:00	CMUG Science Studies Pt1	CMUG study representatives
11:00-11:30	Coffee Break	
11:30-12:30	CMUG Science Studies Pt2	CMUG study representatives
12:30-14:00	Lunch & Posters Put on Display	
Oct. 16, 2024 Afternoon	**Joint CMUG-CMIP Session**	
14:00-14:10	Welcome to CMUG-CMIP Session	Eleanor O'Rourke, CMIP IPO
14:10-14:35	Observation Requirements from the Modelling Community	Amy Doherty, CMUG; Rajini Swaminathan, CMIP Model Benchmarking Task team
14:35-14:55	The Role of Observations in CMIP7	Eleanor O'Rourke, CMIP IPO
14:55-15:05	Introduction to Breakout Sessions	Briony Turner, CMIP IPO
15:05-15:30	Breakout Session 1	
15:35-16:10	Breakout Session 2	
16:10-16:40	Feedback from Breakout Sessions by Thematic Group chair	
16:40-17:00	Looking Forward & Opportunity Identification	Eleanor O'Rourke, CMIP IPO
17:00-18:30	Poster Session & Drinks Reception	ECST Conference Centre

4. Integration Meeting

4.1 Introductory Presentations

Opening & Welcome – Susanne Mecklenburg, ESA

No further comments or questions.

CMUG Introduction & Status – Amy Doherty, Met Office slides

No further comments or questions.

4.2 CMUG Science Studies

ESMValTool – Latest Updates (Axel Lauer, DLR) slides

No further comments or questions.

Study 5.1 Machine Learning to Advance Climate Model Evaluation and Process Understanding (Lisa Bock, DLR) slides

Linkages to land cover types was not part of the first study.

Study 5.2 Vegetation Phenology and Vegetation / Hydrometeorology (Daniele Peano, CMCC) slides

No further comments or questions.

Study 5.3 Impact of Integration CCI Land Cover Data in ISBA Land Surface Models (Jean-Christophe Calvet, Météo-France) slides

It was clarified that the reason this study didn't include any parameter tuning was because it is based on an uncalibrated model and the study relies on model parameters found in the literature. When this method is applied, the model performs sufficiently so model parameters don't need to be tuned.

Study 5.4 Seasonal Predictability of Ocean Biogeochemistry and Potential Benefits of ESA CCI Data Assimilation (David Ford, Met Office) slides

No further comments or questions.

Study 5.5 Cloud and Aerosol Analysis (Jeronimo Escribano, BSC; Kirsti Salonen, ECMWF) slides

No further comments or questions.

Study 5.6 Snow Dynamics Impacts on Temperate / High Latitude Climate (Amélie Cuynet and Catherine Ottlé, IPSL) slides

The new vegetation albedo parameters have not yet been tested so comments cannot be made on the impact of this new scheme on the results and how this works. However, it is hoped that this can be investigated in the coming months.

Study 5.7 Atmospheric Drivers and Feedback Processes Affecting the Greenland and Antarctic Ice Sheets in Observations and Regional Climate Models (Ulrika Willén and Shuting Yang, SMHI) Ulrika's slides, Shuting's slides

No further comments or questions.

Study 5.8 Using Machine Learning to Evaluate and Understand our Capability to Model Tropical Methane Emissions (Cristina Ruiz Villena and Rob Parker, NCEO – University of Leicester) slides

The emulator is driven with earth observation data, meaning that there will inevitably be gaps because earth observation data isn't everywhere and at every time, therefore wetland fluxes produced will have gaps if it is cloudy, for example. The study can do a lot of smoothing and gap filling, as leaving the users to do this themselves could be dangerous, so the study strongly encourages engagement with CCI team users to be able to advise on the best way to accomplish this. One of the best ways to interpolate the data is by taking data from other sources and combining multiple satellite data. The key is understanding how to combine all of the aspects from LST data from eight or nine different products, and understanding how to retrieve what is needed to drive the emulator. These are existing questions that aren't currently solved, because the data simply is what it is and it's often cloudy, especially in the tropics, so understanding how best this can be overcome is key. Obs4MIPs could be used as driving data but going directly to earth observation data is better, if it can be done consistently. Talking to different teams will ensure this can be done consistently.

The study used data from 1980 up to 2016, so approximately 35 years, to train the emulator for some variables. It has proven almost trivially easy to produce an emulator, with 20 years of data being the ballpark for what the study has been using and that has worked well. For example, for soil moisture data, 20 years of data was used for over Africa. The study team trained an emulator based on the 20 years of soil moisture data and that emulator was able to simulate for a future 100-year time period. This was likely due to phase spacing and that space is sampled well enough. 10 years is a minimum length of timeseries to train the emulator but at least 20 is best practice and has been used by the team in previous work.

4.3 Joint CMUG-CMIP Session

Observation Requirements from the Modelling Community – Amy Doherty, Met Office slides

CMUG has been producing a report highlighting observation (specifically obs4MIPs) requirements from the modelling community. For this, numerous interviews were undertaken. This meeting session discussed the main points from these interviews as well as provided an opportunity for meeting participants to contribute feedback. A summary of these discussions are provided below.

Knowing which dataset to use is an issue which came up a number of times in the interviews for this deliverable. For example, the LAI data has many datasets. From the interviews, there was an apparent ask for a top-level page for obs4MIPs guidance on appropriate ways to use the datasets, with links to papers which have used that data before. This would be very useful when users are

starting out with a new dataset for the first time, for users to be able to see how other people have dealt with the data and the uncertainty, for example. The existing 3-page technical notes which accompany the obs4MIPs datasets have proven useful but could contain more information and be updated to be more useful. Interviewees also asked for comparison information between datasets, but it is unclear who would be responsible for providing that information.

Communication of known issues with datasets is another issue that was raised during meeting discussions. For example, for the LST_CCI data an approach has been taken to log known issues and new data versions. This approach could usefully be applied to other datasets. However, this sort of database needs to be regularly updated because as soon as it becomes even slightly out of date it is not useful.

Some meeting participants highlighted their surprise that there seemed to be the implication that obs4MIPs hasn't been used much in practice, because it looks like it addresses almost all of the requirements being asked for, in principle. The obs4MIPs documentation gives useful notes, according to some meeting participants. A significant consideration for improvement would be to include information on data versions and time periods. The rule of thumb is usually to find the longest dataset possible but that is a relatively easy aspect to update. It is crucial to next understand and get to the crux of why it isn't being well used, despite the central concept being sound. In theory it should be relatively easy to address some of the main barriers listed for obs4MIPs use:

- Up-to-date datasets (updated at least once a year)
- Related to the above: a smoother and faster process for adding datasets
- Clear top-level contents' descriptions, which clearly state the version of the dataset available and time period it is available for
- Guidance on appropriate use of the datasets
- Links to verification studies and other published applications of the data

A secondary list of barriers will be more difficult to overcome, but still are not insurmountable:

- Higher temporal and spatial resolution
- Tools to allow subsetting of the data (temporally and spatially) before download
- Provide uncertainty data with every dataset
- Address the mismatch between model and observation variables – allowing those that can be compared to be found without disguising them as exactly the same parameter, which can be misleading to new users

The Role of Observations in CMIP7 – Eleanor O'Rourke, CMIP IPO

No further comments or questions.

4.4 CMUG-CMIP Breakout Sessions & Feedback

The meeting then introduced the afternoon breakout session. There were nine breakout groups: one group for land and land ice, one group for ocean and sea ice, two groups for Earth system, two groups for atmosphere, two groups for impacts and adaptation, and one group for online participants.

The top-level takeaway variables which breakout groups felt should be considered for REF++ include, ocean biogeochemistry, clouds, variables associated with fire, such as fuel moisture content, and sea-level height. Specifically, variables or datasets which participants felt should be included in addition to what already exists, either as only means/standard deviations or as part of new diagnostics, include land, ocean, and atmospheric variables. The land variables included fire, biomass, vegetation, vegetation with topology, phenology, evaporation, surface roughness, surface albedo, snow mass, burnt area, soil loss, ground water storage, river discharge, and LAI. The ocean variables included sea ice volume and thickness, ocean colour, significant wave height, as well as 3D variables for the ocean. The atmospheric variables included temperature and outgoing radiation for Arctic amplification, cloud variables, radiation at the top of the atmosphere, ozone, as well as general higher resolution for atmospheric variables.

Processes which participants considered important for inclusion include fire processes, including variables for vegetation and vegetation moisture; diurnal cycles and extreme events which can be missed when looking at only monthly means; sea-level height change which has a lot of available earth observation data; biogeochemistry (ocean and land); cloud, ozone, and methane processes; monsoons and floods with impacts and adaptation diagnostics; and energy budget variables.

Further discussion around evaluation with observations data resulted in useful takeaway points: a) it's important to be careful during evaluation due to differences between what observations measure and what models simulate; b) there needs to be harmonisation in the way different resolutions are handled between observations data and model simulations; c) ESA CCI datasets are not very visible in the REF plans; d) users need to be using the latest versions of CCI datasets; e) it is recommended to use the full suite of observation products for evaluation, including in-situ, earth observations, and reanalysis; f) there needs to be a common platform for evaluation tools; and g) the stability of time series of datasets used needs to be considered.

4.5 Looking Forward & Opportunity Identification

Suggestions from participants regarding the way forward include: common funding; geostationary missions to cover areas with gaps such as Africa; co-designing projects from the start with modellers and observation scientists to achieve shared objectives; workshops focused on targeted questions instead of general interactions; reaching out to the computer science and AI community; and that the observation community would like to better understand where significant climate signals are coming out from the models so they can better respond with products.

4.6 Poster Session

The Integration Meeting day concluded with a poster session, accompanied by a drinks reception, at the ECSAT Conference Centre. Posters were presented by CMUG study representatives. This time also provided an opportunity for further networking. CMUG posters are available on the meeting webpage here.