Climate Modelling User Group

D6.2 CMUG Poster
V2.0: January – July 2024

esa

What is CMUG?

CMUG is the Climate Modelling User Group, set up by ESA to facilitate communication between the providers of the CCI ECV datasets and the climate modelling, research and service communities. CMUG provides feedback in the form of user requirements and assessments of the ECV datasets to ESA's CCI projects and carries out research on the effectiveness of the ECVs when used in climate modelling. The diagram to the top right shows CMUG's objectives, to the middle right CMUG's project structure, and to the bottom right CMUG's partner institutes. CMUG's three primary objectives are given on the right.

1. Support integration within CCI programme

2. Foster exploitation of satellite-derived ECVs

3. Assess quality and impact of CCI ECVs

Scientific Studies CMUG CCI+ Phase 2

WP5.1 Machine Learning	WP5.5 Clouds and Aerosols
WP5.2 Vegetation Phenology	WP5.6 Snow Dynamics
WP5.3 Land Cover	WP5.7 Ice Sheets
WP5.4 Ocean Biogeochemistry	WP5.1 Wetland Methane

Evolution of Obs4MIPs

Obs4MIPs for Model Intercomparisons Project) refers to a limited collection of documented datasets that have been formatted according to the Coupled Model Intercomparison Project (CMIP) model output requirements and made available on the Earth System Grid Federation (ESGF). This effort was initiated with support from NASA and the U.S. Department of Energy (DOE) and has now expanded to include contributions from a broader community including ESA. Obs4MIPs underpins model evaluation in CMIP (and beyond) and thus makes a significant contribution to the assessment of and sustained improvement in model quality, e.g., as reported by IPCC. CCI projects of most interest to the CMIP community contribute datasets to obs4MIPs.

ESMO Earth System Modelling and Observations

obs4MIPs Observations for Model Intercomparisons Project

Progress to date:
- CMUG held obs4MIPs work package kick-off meeting Feb 2024
- Interviews agreed as method to collate obs4MIPs requirements and interviews carried out with sign up from ESMO, CORDEX, CMIP IPOs, CMUG partners, and relevant Met Office colleagues. Findings will be collated into a report.

ESMValTool

The Earth System Model Evaluation Tool (ESMValTool) is an open-source community-developed diagnostics and performance metrics tool for the evaluation and analysis of Earth System Models (ESMs). ESMValTool allows for a comparison of single or multiple models against predecessor versions and observations. The aim of the ESMValTool is to take model evaluation to the next level by facilitating analysis of many different ESM components, providing well-documented source code and scientific background of implemented diagnostics.

CMUG's role regarding ESMValTool is to enhance the ESMValTool with additional diagnostics and performance metrics enabling tailored analysis for the evaluation of models with ESA CCI and CCI+ data.

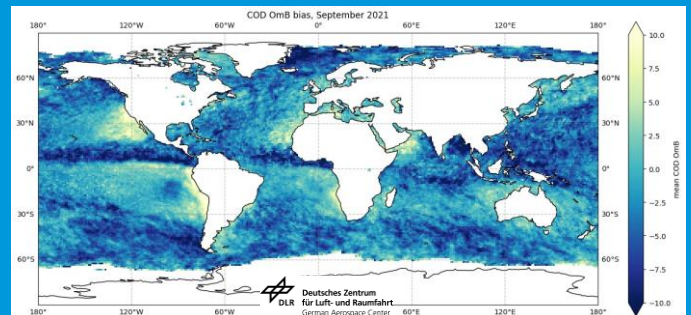**ESMValTool** Earth System Model Evaluation Tool

Progress to date:
- ESMValTool v2.10.0 released Jan 2024
- snow_cci v2.0 daily values of snow area fraction and snow water equivalent implemented Feb 2024
- permafrost_cci v3.0 yearly values of active layer thickness, permafrost extent and permafrost ground temperature implemented Mar 2024
- Emulating cloud properties from reanalyses using cloud_cci presented at EGU24 in Apr 2024
- ESMValTool Community Workshop, Germany May 2024
- Prototype for calculation of permafrost extent from CMIP models implemented Jun 2024
- ESMValTool 2.11.0 released Jul 2024
- Exploration of possibilities to take advantage of uncertainty information provided by CCI datasets for model evaluation using LST data (in progress as of Jul 2024)

Scientific Studies – results as of July 2024

WP5.5 Cloud and Aerosol Analysis – results

Data sets for aerosol and cloud optical depth (AOD and COD) from Sea and Land Surface Temperature Radiometer (SLSTR) have been evaluated and tested for assimilation in the ECMWF 4DVar system. While AOD observations from other instruments are operationally used in the Copernicus Atmosphere Monitoring Service (CAMS) configuration, CODs are a new source of information and provide an interesting avenue for assimilation of cloud information into the system. Figure 1 (right) shows observation minus model background (OmB) mean difference from a passive monitoring experiment for CODs. The statistics indicate positive mean difference over regions where there is typically persistent marine stratus. Negative mean difference on the other hand is seen in the inter-tropical convergence zone. The results are in line with similar monitoring done for Ocean and Land Colour Instrument (OLCI) reflectances, indicating that the mean differences would originate from the lack of stratiform clouds in the model rather than an observational or retrieval problem. Monitoring of the CCI SLSTR AOD observations indicates good and homogeneous data quality over sea, except the regions where bias related to desert dust is present.

Impact studies have been performed in depleted observing system framework to emphasise the impact originating from the new data sources. The baseline experiment includes assimilation of conventional and gps observations and the AODs and CODs are added on top of the baseline experiment. Assimilation of the CCI AODs generally decreases the magnitude of the modified normalised mean bias as well as the fractional gross error with respect to independent AERONET AOD data. Experimenting with CODs indicates that strict quality screening of the observations is required and even so, some degradation is seen especially in the short-range temperature forecasts as verified using independent observations. The final experimentation with joint use of AODs and CODs is currently ongoing.

COD OmB bias, September 2021

Met Office · BSC Barcelona Supercomputing Center · ECMWF · METEO FRANCE · SMHI · cmcc · THE UNIVERSITY of EDINBURGH · DMI Danish Meteorological Institute · National Centre for Earth Observation · IPSL · UNIVERSITY OF LEICESTER · UKRI Science and Technology Facilities Council RAL Space

European Space Agency