Climate Modelling User Group

LOLIPOP User Workshop
Amy Doherty
18 Nov 2025

1. Support integration within the CCI programme

2. Foster exploitation of satellite-derived ECVs

3. Assess quality and impact of CCI ECVs

European Space Agency

CMUG Activities

Science studies to assess quality and impact of CCI data	Engage with climate science community	Integration across the CCI programme	CCI ECV dataset user requirements
Advance ECV uncertainty characterisation	Build links with the climate modelling community	Promote CCI data use in climate models	Support model evaluation with CCI data
Provide feedback to CCI teams	Improve access to ECV datasets through tools and databases	Publish scientific papers	Gap analysis

European Space Agency

European Space Agency (ESA)

Simon Pinnock

33 ECV projects

Sea level
Land surface temperature
Sea ice
Antarctic ice sheet
Snow

Greenhouse gases
Sea surface temperature
Glaciers
Greenland ice sheet

Clouds
Water vapour
Sea state
Ocean colour

Above ground biomass
Fire
Ozone
Sea salinity

Soil moisture
Lakes
Other long-lived
greenhouse gases

tation parameters
River discharge
Precursors for aerosols
and ozone
Anthropogenic water use

CMUG Climate Modellers

Swedish
Meteorological
& Hydrological
Centre (SMHI)

European Centre
for Medium-Range
Weather Forecasts
(ECMWF)

Centro
Euro-Mediterraneo
sui Cambiamenti
Climatici (CMCC)

Deutsches
Zentrum
für Luft- und
Raumfahrt (DLR)

Institut
Pierre-Simon
Laplace (IPSL)

Barcelona
Supercomputing
Center(BSC)

NCEO (University
of Edinburgh)

NCEO (University
of Leicester)

Danish
Meteorological
Institute (DMI)

Météo-France
(MF)

Centre for
Environmental
Data Analysis
(CEDA)

Met Office
Hadley Centre
(MOHC)

Amy Doherty

Richard Jones

Hannah Findley

 WP5.1 Machine Learning for Process Understanding
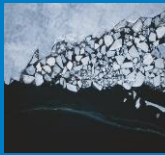
 WP5.2 Vegetation Phenology

 WP5.3 Land Cover

 WP5.4 Ocean Biogeochemistry

 WP5.5 Clouds and Aerosols

 WP5.6 Snow Dynamics

 WP5.7 Ice Sheets

 WP5.8 Machine Learning for Wetland Methane Emissions

 WP5.9 Vegetation and Hydrometeorology

- ESMValTool

- Climate community requirements collection and analysis

- Foresight Report https://climate.esa.int/media/documents/CMUG_D1.2-Foresight-Report-V4.1_8EMjc8o.pdf

- CMUG support to the future evolution of obs4MIPs

- Communications and outreach

- Climate Science Working Group

European Space Agency

Obs4MIPs (Observations for Model Intercomparisons Project) datasets:

- Formatted according to the Coupled Model Intercomparison Project (CMIP) model output requirements
- Available on the Earth System Grid Federation (ESGF)
- Documented in a standard format

Obs4MIPs underpins model evaluation in CMIP and beyond, contributing to assessment and improvement of Earth System Models (ESMs).
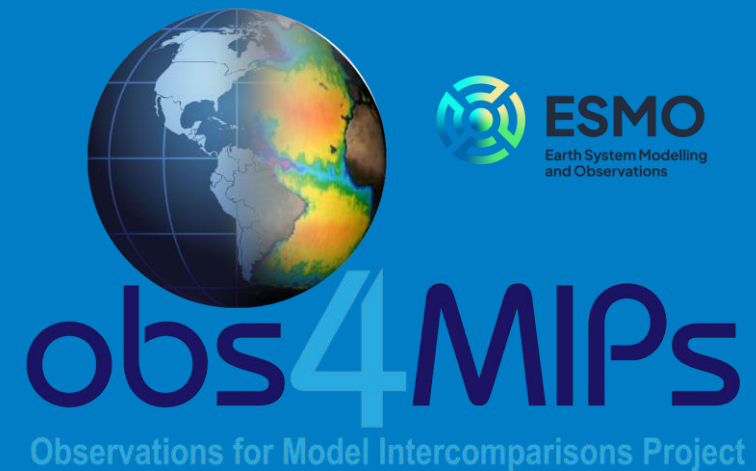
CCI ECV projects contribute selected ECV data sets of interest to the CMIP community, with CMUG assistance
https://www.wcrp-esmo.org/projects-and-panels/obs4mips

CMUG has produced a report providing recommendations on the future evolution of obs4MIPs. This included:

- Results from interviews with 37 users of obs4MIPs
- A gap analysis of the current obs4MIPs datasets, identifying missing variables and out of data versions
- An in-depth examination of the importance and relevance of recent developments in the understanding of observational uncertainty to the provision of obs4MIPs data

https://climate.esa.int/media/documents/CMUG_FutureEvolutionofObs4MIPs_D5.7f_v1.2_ieS8qqu.pdf

ESMO
Earth System Modelling and Observations

obs4MIPs
Observations for Model Intercomparisons Project

European Space Agency

The Earth System Model Evaluation Tool

- open-source
- community-developed
- diagnostics and performance metrics
- evaluation and analysis of Earth System Models (ESMs)
- Tailored analysis of ESM components
- well-documented
- source code
- scientific background

CMUG supports ESMValTool by adding diagnostics and performance metrics using ESA CCI datasets, enabling tailored evaluation of models
https://esmvaltool.org/

Recent advances by CMUG include a prototype approach for utlising observational uncertainty and enhancing the range of earth system processes that can be evaluated in models.
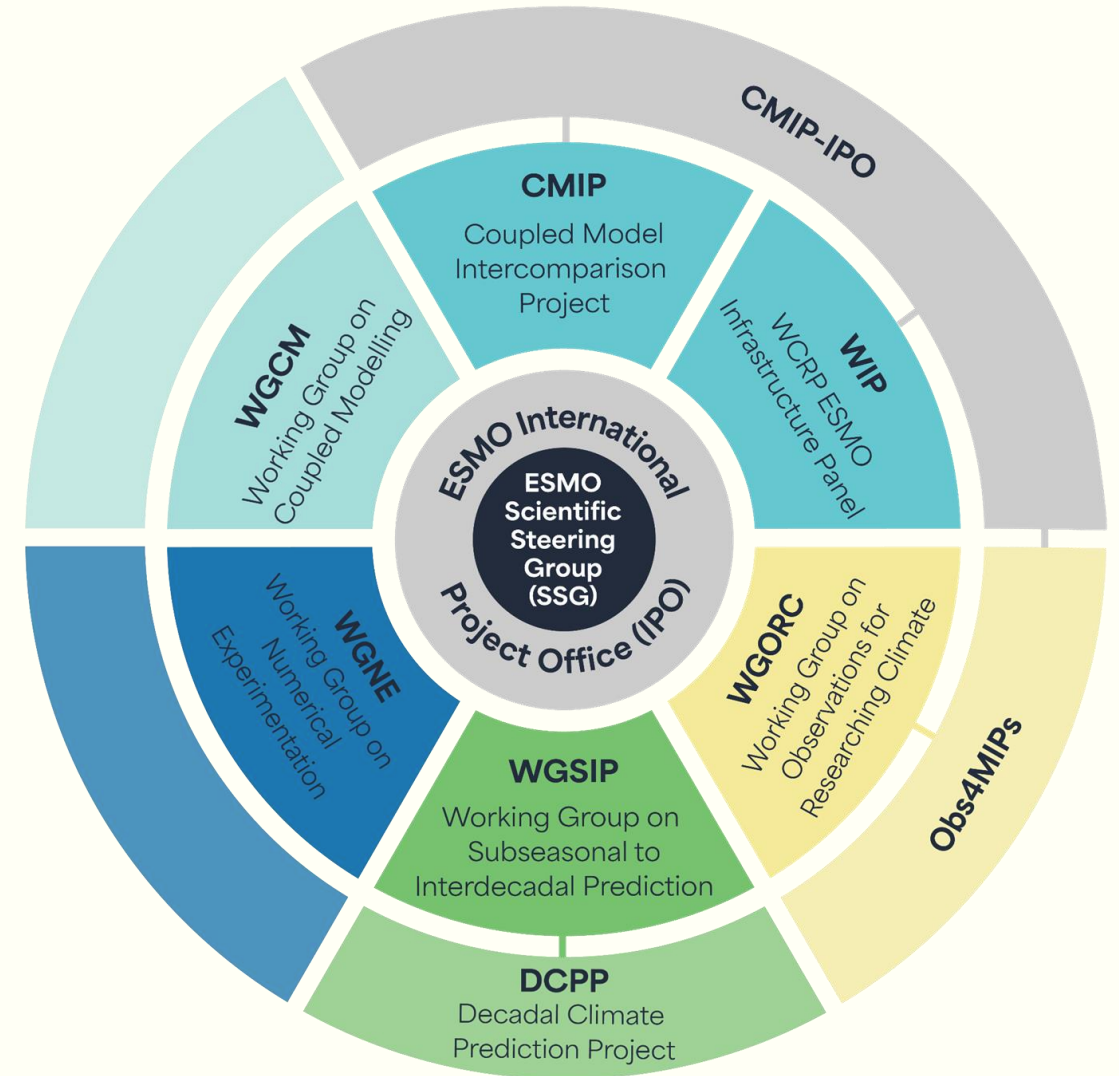
Take Home messages

- CMUG want to help connect you with users
- CMUG want to get you talking to other CCI projects
- Initiatives such as obs4MIPs and ESMValTool can get your data to users

- Please keep in touch!

ESMO: Earth System Modelling and Observations, a WCRP Core Project

Objectives:

- Advancing predictions and projections of the Earth system

- Improving monitoring, understanding and attribution of climate system changes and impacts

- Advancing and harnessing emerging technologies

Working Group on Observations for Researching Climate (WGORC)

- A new ESMO working group to identify and address **research gaps in climate observation data** and act as a facilitator for **collaboration at the interface between models and observations.**

- WGORC will advance both the use and development of observations to support **reanalysis, model initialization, and prediction** and enhance Earth system modeling capabilities.

- WGORC will also explore how **emerging technologies**, such as machine learning and AI, can enhance the use and application of observations for climate research.

https://www.wcrp-esmo.org/working-groups/wgorc

ESMO Earth System Modelling and Observations

WCRP World Climate Research Programme

More information on CMUG:

https://climate.esa.int/en/projects/cmug/

Contact Amy Doherty: Amy.Doherty@metoffice.gov.uk

Extra slides

CMUG – Cloud and Aerosol Analysis Study
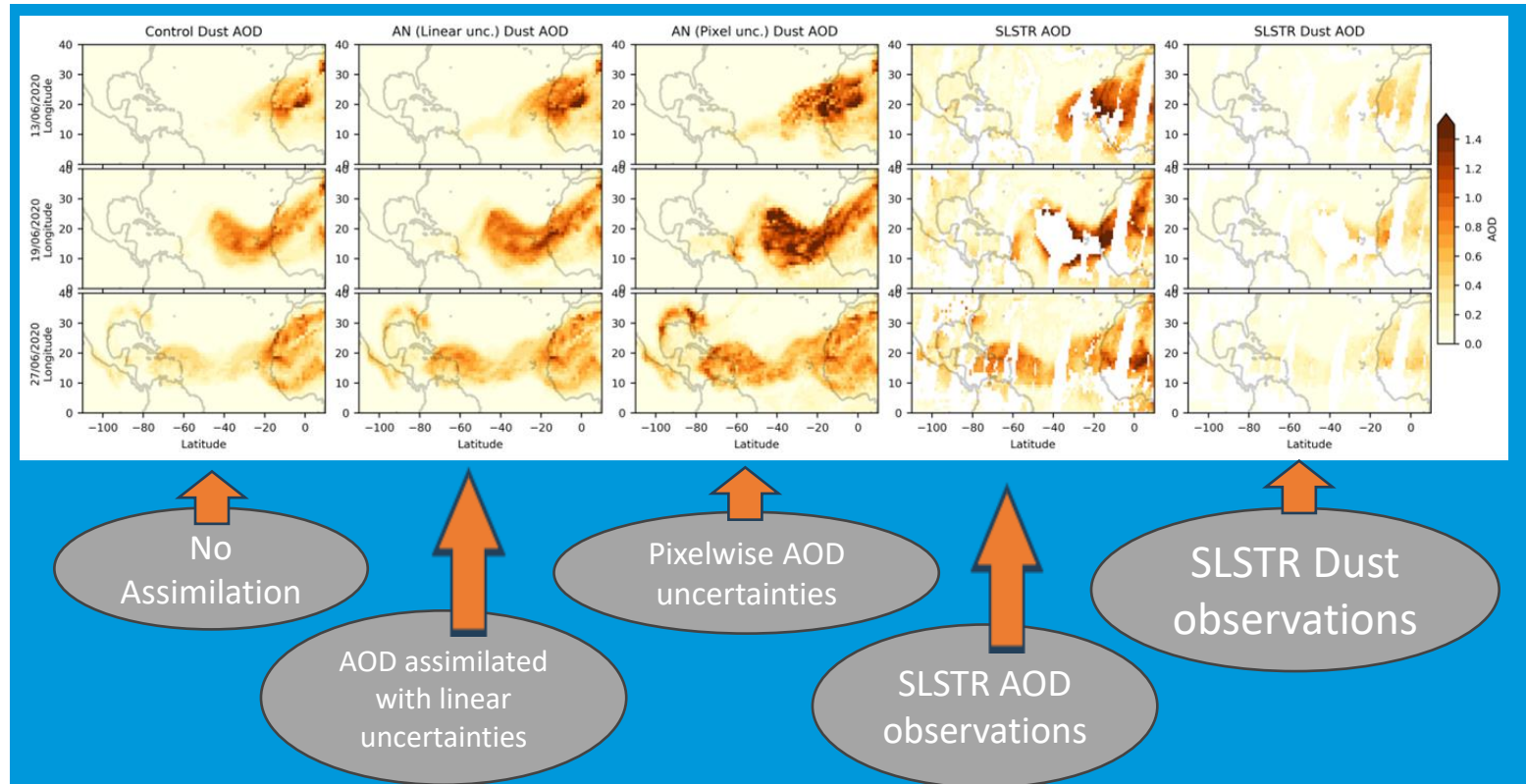## Jeronimo Escribano (BSC)

During the Godzilla dust event in June 2020 the BSC MONARCH model underestimated the Atlantic dust plume heading towards the Caribbean. The event was analysed again in this study, assimilating the CCI SLSTR aerosol optical depth (AOD) from SU algorithm v1.14 product. The first experiment used a linear model of uncertainties and the second used the uncertainties provided with the CCI product.

Improved agreement between model and independent observations when CCI AOD is assimilated

Pixel wise uncertainties supplied by CCI perform better than linear model uncertainties – larger increments and finer spatial structure

Forecast and analysis skill may be improved if uncertainties over the ocean are inflated by 2-4 times

No Assimilation

AOD assimilated with linear uncertainties

Pixelwise AOD uncertainties

SLSTR AOD observations
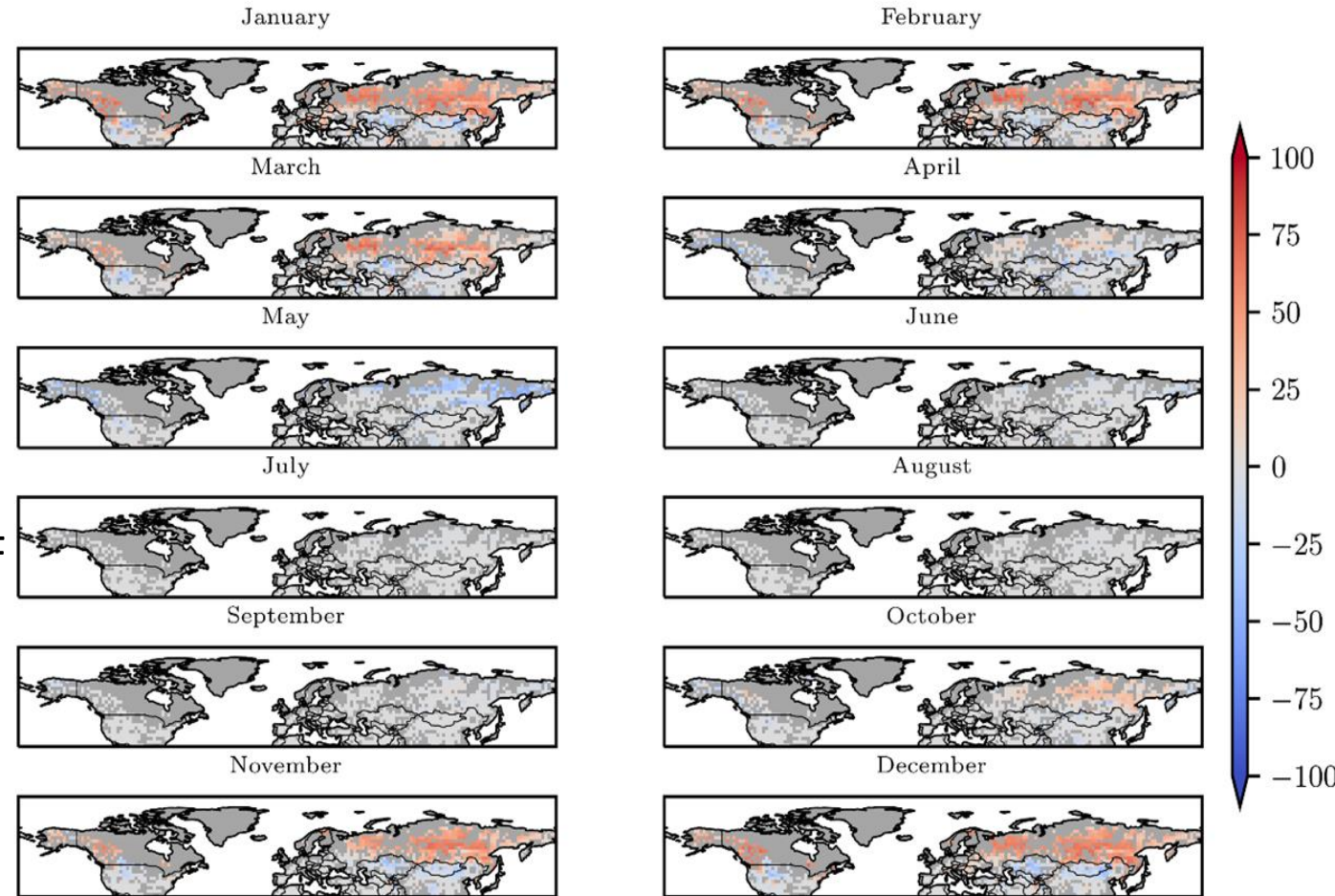
SLSTR Dust observations

Analysis of the observation products: impact of the vegetation on snow behaviour

- snow behaviour is strongly influenced by plant functional type (PFT)
- snow coverage varies with vegetation type
- Snow Cover Fraction (SCF) and albedo model parameters should be adapted for each PFT.

Comparison of CCI Snow products with ORCHIDEE simulation outputs

ORCHIDEE v4 without optimised snow compared with obs (CCI Snow and MODIS albedo products)
Above 30°N the model SCF is

1) overestimated in areas with year-round snow and
2) underestimated in May due to early onset of snow melt in the simulation.

Snow cover fraction (SCF) monthly differences [%] between Model [ORCHIDEE v4] and Observations [Snow CCI - 2011-2019]. The regions in grey correspond to pixels where data were unavailable

- More CCI projects, less need for CMUG?
  OR
- More CCI projects, more need for CMUG?

- Cross-ECV projects (6)
- Interfacing Obs/Modelling projects (5)
- Biodiversity studies
- Climate change and Cities
- Climate change and Health
- Supporting the Paris Agreement (3)
- CMIP forcings (2)
- Tipping Elements projects (6)

CMUG strengths
- Broad view
- Connections between projects
- Connections with external activities
- Bringing together
- Identifying gaps.

Way forward:
- Build on CMUG experience and CMUG partners deep familiarity with CCI
- CMUG Science studies continue
  - Strategically chosen to fill gaps in other CCI activities
  - Reach out to modelling centres with relevant expertise
- Include CCI CRG reps in CMUG consortium
- Include external partner organisations (CMIP, CORDEX) in design phase

"Inception Phase": 6 months to a year interacting with existing and potential new partners, identifying the current gaps in CCI activities and designing a work plan.