CMUG - Legacy from CCI projects
Some History

Climate models started to be developed in the 1980s and the Hadley Centre was opened in 1990.

The IPCC first session was in Geneva in 1988. Agreed aims:
1. Assessment of available scientific information on climate change
2. Assessment of environmental and socio-economic impacts of climate change
3. Formulation of response strategies
Creation of Early Satellite Climate Datasets

First Satellite data used to validate climate models
Earth Radiation Budget Measurements
Nimbus-6 ERB 1975 → S-NPP CERES 2016

ISCCP Project started in 1982 but it took 15 years for modellers to use ISCCP data from Geo imagers 1983 – 2009 thanks to COSP ISCCP simulator
Model development: Pre-CCI focus on Radn Budget

*Mark Ringer showed this at Coloc-1*

Development of Hadley Centre climate model

- Shortwave radiation at TOA
- ISCCP $\rightarrow$ model improves
- CERES $\rightarrow$ model gets worse
Models are increasing in complexity and resolution
- From AOGCMs to Earth System Models with biogeochemical cycles -

130 km resolution orography

25 km resolution orography

Growth of Climate Modeling

https://www2.ucar.edu/news/understanding-climate-change-multimedia-gallery
CMIP Continuity

A common suite of experiments for each phase of CMIP provides an opportunity to construct a multi-model ensemble using model output from various phases of CMIP.

Eyring et al., GMD, in prep., 2015
Post – CCI landscape

Many user needs

• Long time series
• Uncertainties
• Consistency

• Model development & evaluation, improving parameterizations
• Development of metrics for multi-model inter-comparisons
• Testing benefit of increasing horizontal & vertical resolution
• Seasonal to decadal prediction
• Generation of model ensembles, e.g. SSTs, land cover, PFTs,...
• Detection & attribution of climate change
• Constraining climate projections, etc
Where we are now: Model assessment

ESA CCI datasets
- greenhouse gases
- ozone
- aerosol
- soil moisture
- sea ice
- cloud
- SST

Assessment of climate models using ESMVal tool for several CCI datasets

From: Lauer et al. (2016), Remote Sensing of Environment (manuscript in preparation)
Where we are now: Better Trends

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<th>Year</th>
<th>BESD</th>
<th>NOAA</th>
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<tr>
<td>2011</td>
<td>1.68</td>
<td>1.92</td>
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</table>
Where we are now: Better uncertainties

Where we are now: Better uncertainties

Sensitivities in Albedo of Land Cover Fractions
Where we are now: Better consistency
Horizontal gradients - June 2009
Calculated at binned observation locations

<table>
<thead>
<tr>
<th>SST</th>
<th>SLA</th>
<th>( \log_{10}(\text{chlorophyll}) )</th>
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<tr>
<td>Obs</td>
<td>Obs</td>
<td>Obs</td>
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<tr>
<td>Free run</td>
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<tr>
<td>Assim all ECVs</td>
<td>Assim all ECVs</td>
<td>Assim all ECVs</td>
</tr>
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Observed SST and SLA gradients seem consistent

Observed OC gradients likely consistent given expected nutrient concentrations, but further investigation needed

Model better matches observed gradients for all fields with assimilation
How to bring as much observational scrutiny as possible to the CMIP/IPCC process?

- Obs4MIPs has defined a set of technical specifications and criteria for developing observational data sets that are technically aligned with CMIP model output (with common file format, data and metadata structure).
- Over 50 datasets that conform to these standards are now archived on the ESGF alongside CMIP model output (Teixeira et al., 2014), including ESA CCI data.
- Data users have enthusiastically received Obs4MIPs 😊😊😊
Our climate research scientists can now access good datasets to evaluate their models thanks to the ESA CCI