

climate change initiative

→ **CLIMATE MODELLING USER GROUP**

How EO Can Support Climate Modelling

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also

Coordinating Lead Author AR6 WGI Atlas;
Coordinating Author Technical Summary;
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AR6 WGI-II Handshake team member.

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Assessing improvements and errors in model ensembles and related technical infrastructure

Evaluating the quality of observations for constraining climate models and processes studies

Detailed assessment of drivers of model biases, implications for and demonstration of model improvements

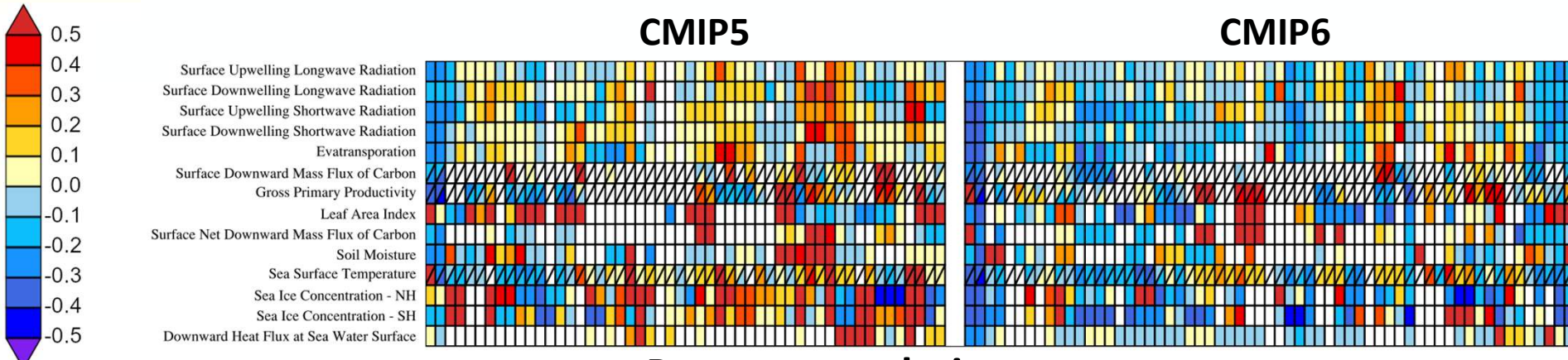
Exploring anthropogenic drivers of climate changes including sensitivity experiments and attribution of climate events and changes

Evaluation of CMIP6 models with ESMValTool

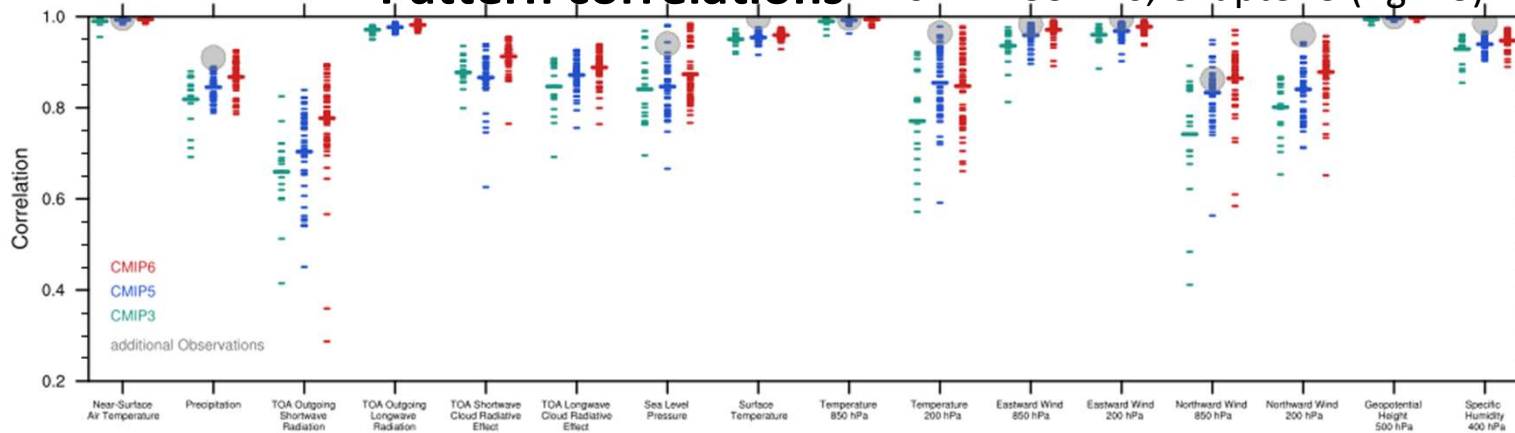


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Relative model performance (RMSD) From: IPCC AR6, Chapter 3 (fig. 42)



Pattern correlations From: IPCC AR6, Chapter 3 (fig. 43)



→ THE EUROPEAN SPACE AGENCY

EO data for evaluating CMIP models using ESMValTool

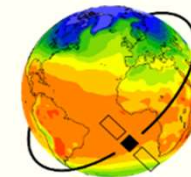


EO datasets¹ are vital for:

- 1) model development, highlighting areas for improvement future model versions;
- 2) assessment of model skill which informs interpretation of model future projections.

ESMValTool²: a tool for fast **and** easy evaluation and analysis of Earth system models

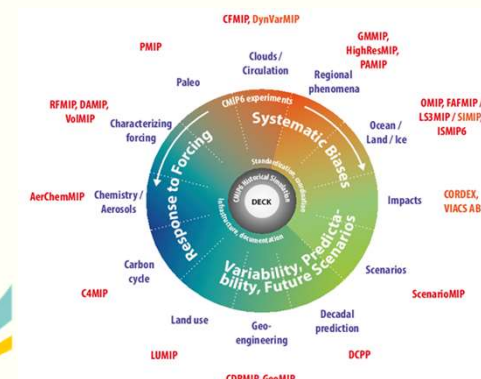
- Traceable and reproducible
- Model performance assessment and quality control
- Publicly available, international community effort



ESMValTool

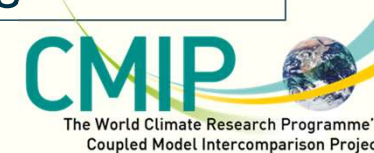
Earth System Model Evaluation Tool

CCI data were used in the recently released **IPCC AR6** report³. Increasing the number of CCI datasets available through ESMValTool provides additional lines of evidence for future IPCC and other such reports advising on policy changes.



References

- ¹ <https://climate.esa.int/en/odp/#/dashboard>
- ² <https://www.esmvaltool.org/>
- ³ <https://www.ipcc.ch/assessment-report/ar6/>



Eyring et al., Geosci. Model Dev., 2016



Obs4MIPs, making EO data easily accessible and deployable for model intercomparison projects



Obs4MIPs (Observations for Model Intercomparison Projects) is a climate model community initiative to encourage widespread uptake of satellite observations for climate model verification and development.

Example CCI products currently included ...

- Aerosol
- GHG (CO2 and Methane)
- SST
- Cloud

... more planned from all new CCI (ECV) projects

These data can easily be deployed, alongside other Obs4MIPs data, for individual and ensemble model and climate process diagnostic work

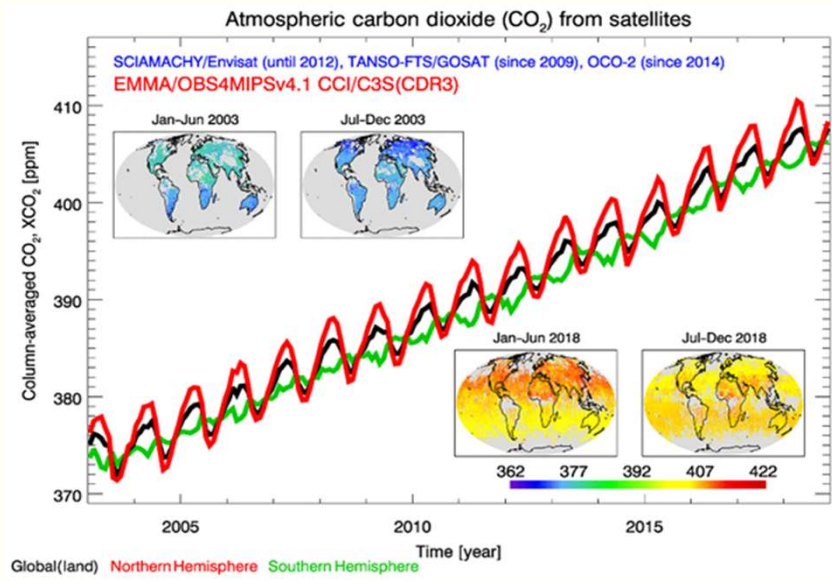


Figure 1: Overview of the XCO2 CCI_GHG data set from obs4MIPs. Shown are the time series over land for three latitude bands (global, black line; N (red) and S (green) Hemispheres green) and global maps (half-year averages at 1° x 1° obtained by gridding the merged Level 2 product). From Reuter et al. (2020).



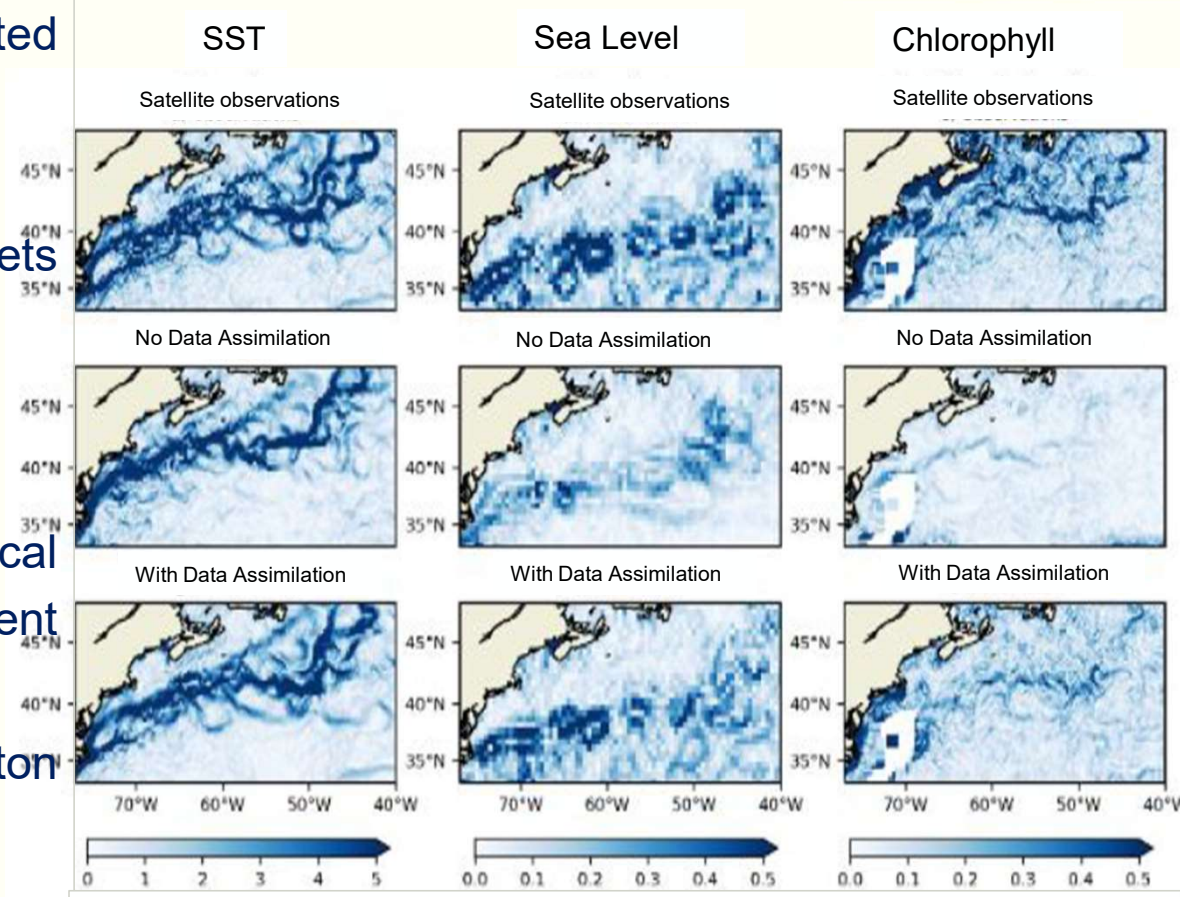
Using SST, Sea Level, Sea Ice, Ocean Colour in reanalysis with *in situ* measurements of temperature and salinity



Physical–biogeochemical ocean model assimilated different combinations of the ESA CCI ECVs

The aims of the study were to assess:

- The impact of assimilating the ESA CCI datasets on the marine carbon cycle and showed
- ESA CCI dataset consistency
- Consistency of physical–biogeochemical relationships in reanalyses assimilating different combinations of data
- strong positive correlation between phytoplankton and net air–sea heat flux
- seasonal variations in carbon-to-chlorophyll ratio



Temperature, sea level and chlorophyll in the Gulf Stream region during December 2010



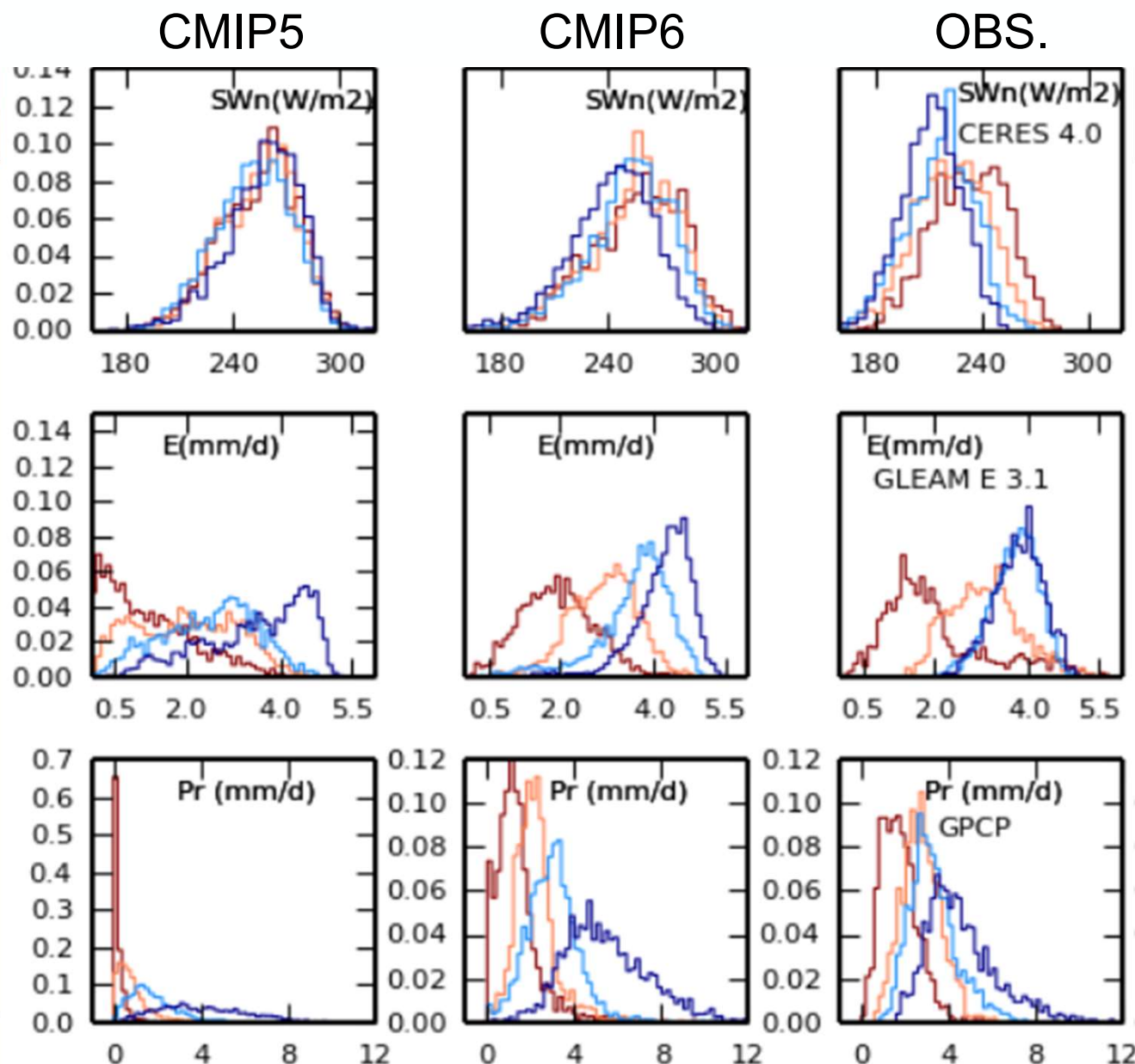
ESA CCI Soil Moisture product demonstrating improvement in a CMIP6 atmosphere-land surface model

The study

Evaluating the evaporation and precipitation responses in CMIP5 and 6 versions of the IPSL land-atmosphere model (IPSL-CM6) for different soil moisture states (from very dry to very wet).

Results

- Significant improvement from CMIP5 to CMIP6
- Progress due to better atmosphere and land surface process modelling

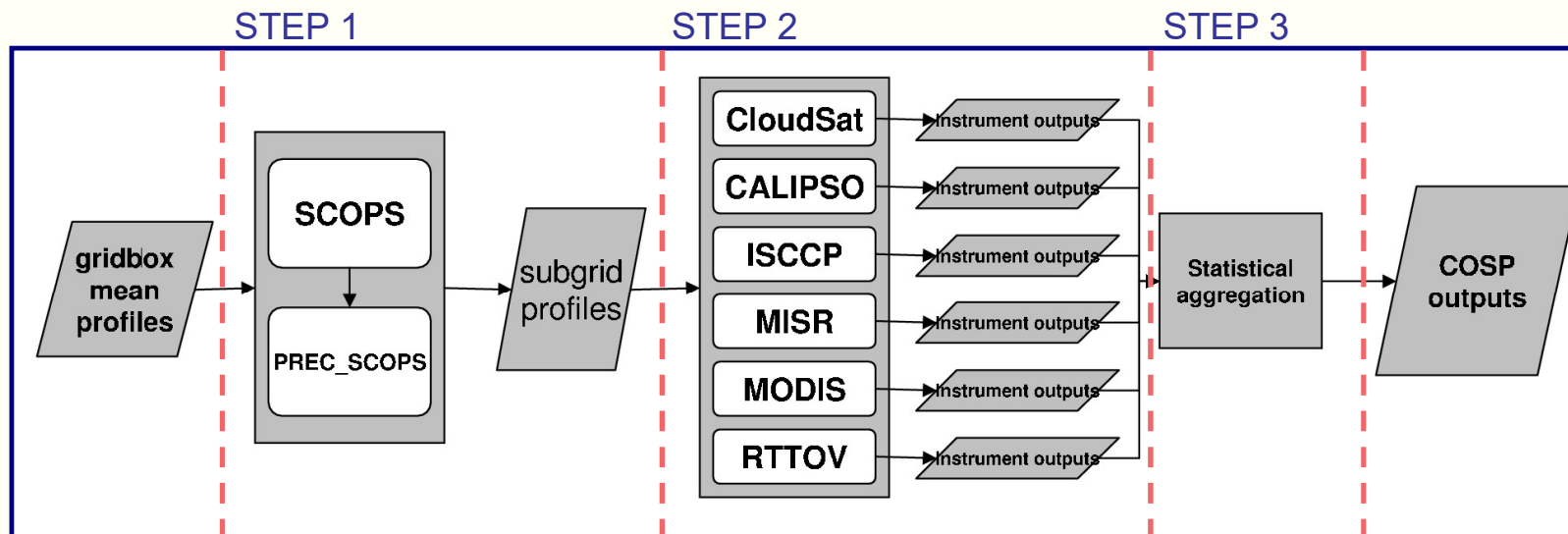


COSP: CFMIP Observation Simulator Package



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Used in the CFMIP2 and CMIP5 experiments



CFMIP web: <https://www.earthsystemcog.org/projects/cfmip/>

User group: <http://groups.google.com/group/cosp-user>

Code: : <https://github.com/CFMIP/>



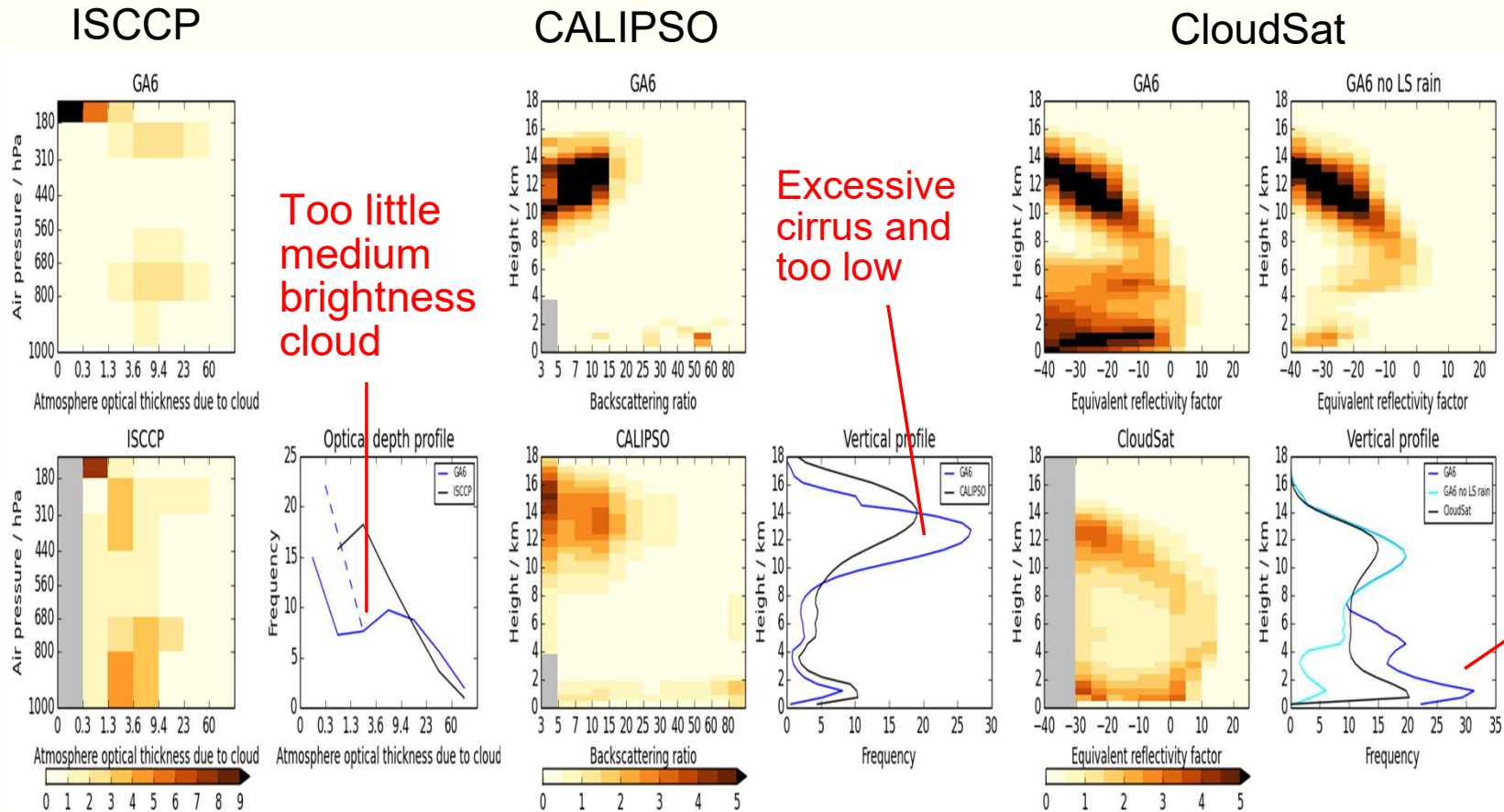
Comparison against satellite data over the tropics



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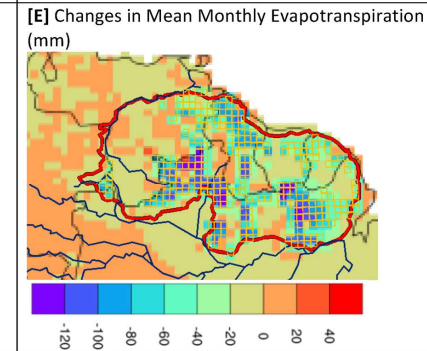
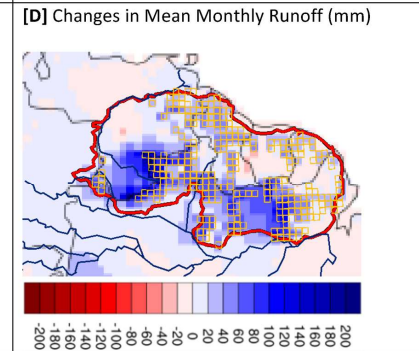
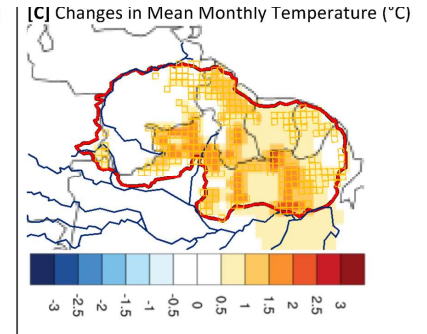
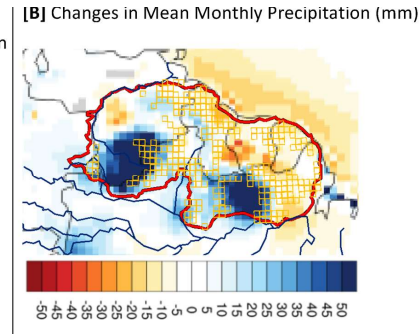
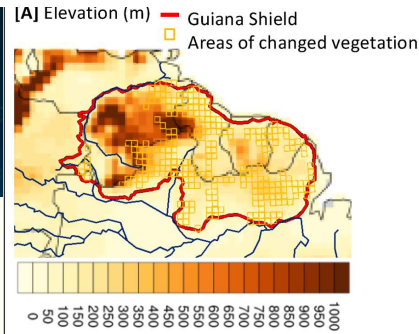
Model simulated EO data

Satellite data

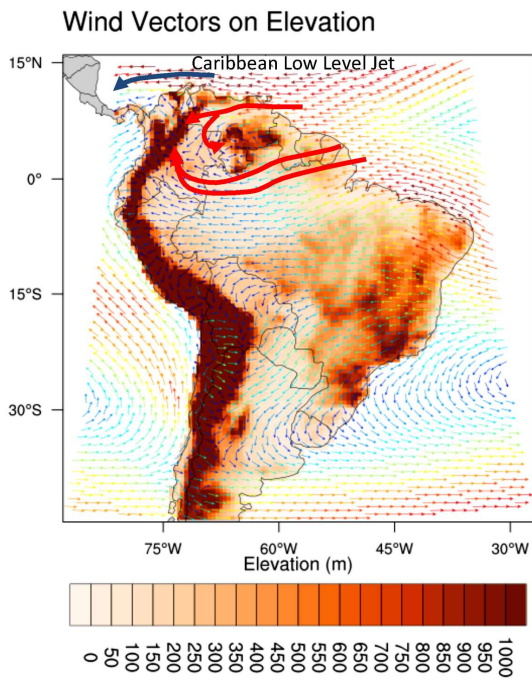


Modelling experiments

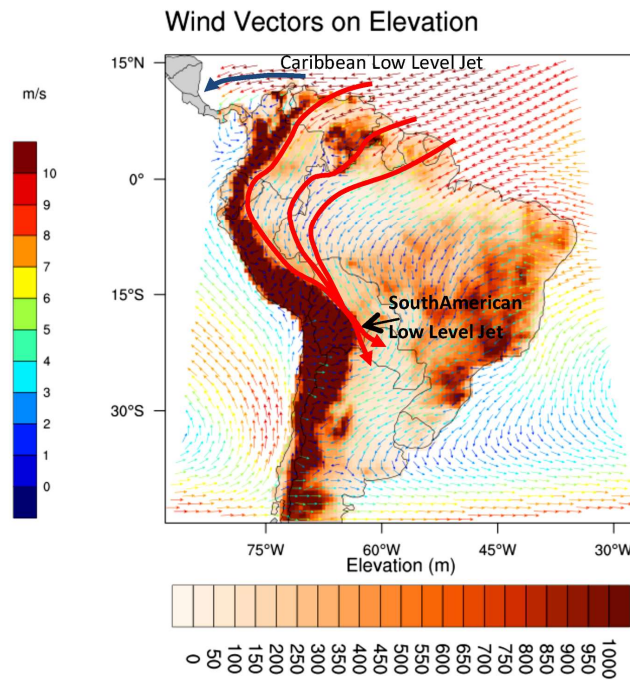
Deforesting the Guinea Shield and its implications for Amazon rainfall



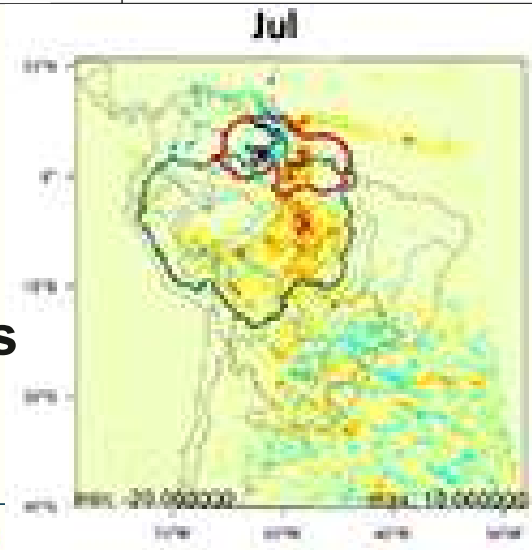
6 Months (Apr-Sep) CONTROL
[a]



6 Months (Oct-Mar) CONTROL
[b]



Change in number of dry months (<100mm)



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