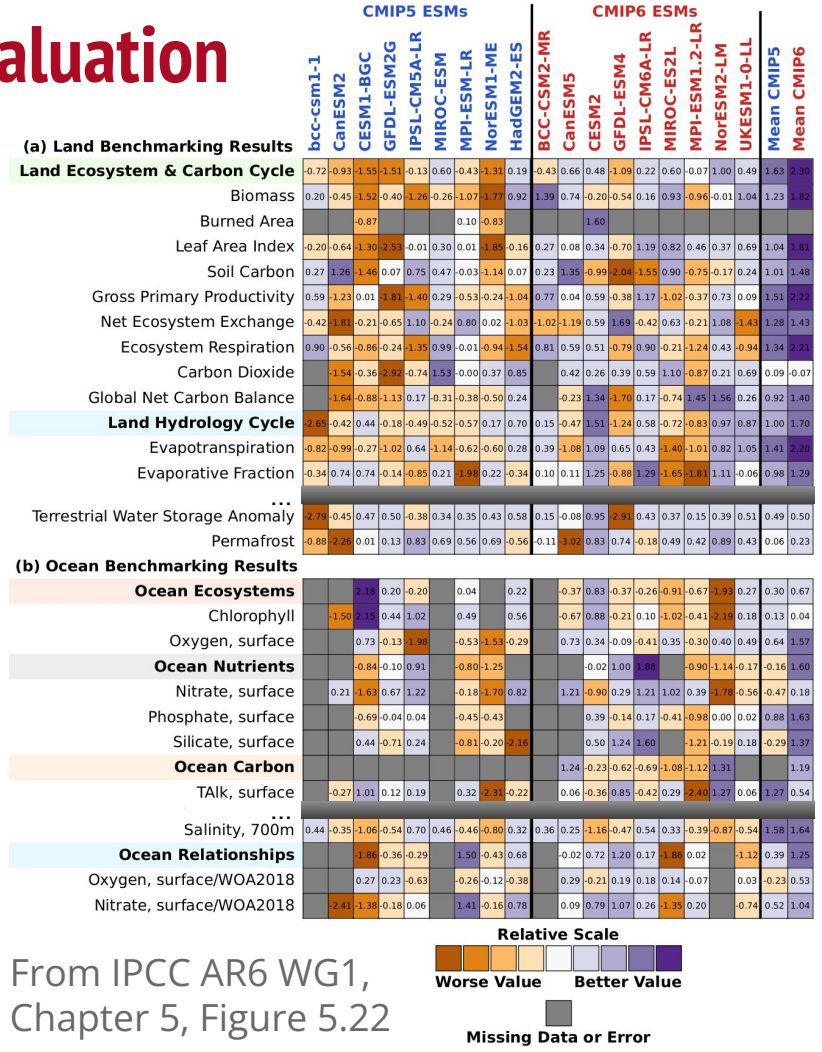
ILAMB & IOMB CMIP5 vs 6 Evaluation

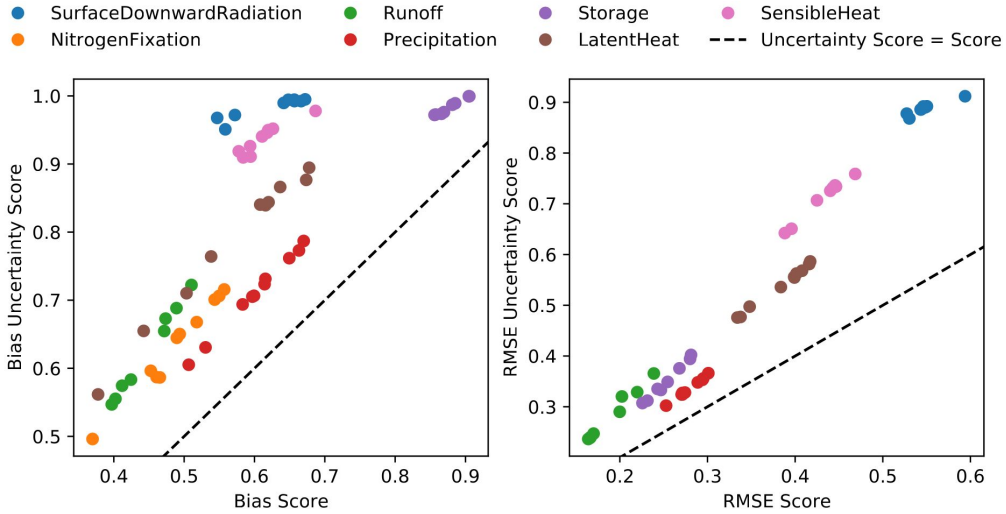
- (a) **International Land Model Benchmarking (ILAMB)** and (b) **International Ocean Model Benchmarking (IOMB)** packages used to evaluate how land and ocean model performance has changed from CMIP5 to CMIP6
  https://www.ilamb.org/CMIP5v6/historical/dashboard.html
- Model fidelity is assessed through comparison of historical simulations with a wide variety of contemporary observational datasets
- CMIP6 suite of land models (right) has improved over the CMIP5 suit of land models (left)
- ILAMB https://www.ilamb.org/ and GitHub code repo https://github.com/rubisco-sfa/ILAMB
- GitHub ILAMB-Data Project Board and Issues https://github.com/rubisco-sfa/ILAMB-Data



From IPCC AR6 WG1, Chapter 5, Figure 5.22

Addressing Observational Uncertainty

- Few observational datasets provide complete uncertainties, but some are appearing
- ILAMB uses multiple datasets for most variables and allows users to weight them according to a rubric of uncertainty, scale mismatch, etc.
- ILAMB can also use:
  - Full spatial/temporal uncertainties provided with the data
  - Fixed, expert-derived uncertainty for a dataset
  - Uncertainties derived from combining multiple datasets
- Experiments with self-consistent CLASS data (Hobeichi et al. 2020) and Barnard's nitrogen fixation data demonstrate that while scores shift, including uncertainty rarely alters the rank ordering of models (figure)



A Cross-Agency Solution to Diagnostics Interoperability

RUBISCO

Coordinated Model Evaluation Capabilities (CMEC)

e.g. CESM WG Diagnostics

Model Diagnostics Task Force (MDTF)

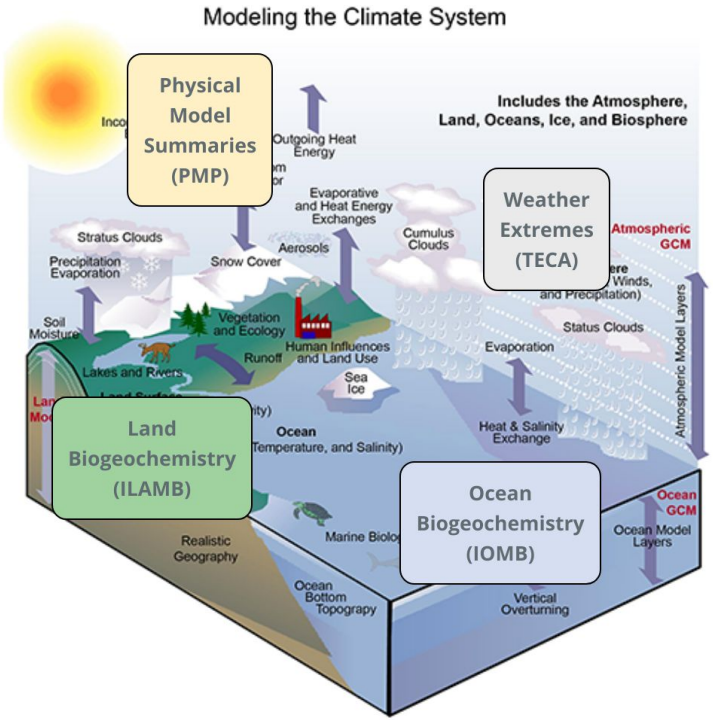
e.g. Regional Climate Model Evaluation System (RCMES)

Berkeley Lab · NCAR National Center for Atmospheric Research · Oak Ridge National Laboratory · Sandia National Laboratories · University of California Irvine · University of Michigan

https://cmec.llnl.gov/

Coordinated Model Evaluation Capabilities

Coordinated Model Evaluation Capabilities (CMEC) is an effort to bring together a diverse set of analysis packages that have been developed to facilitate the systematic evaluation of Earth System Models (ESMs). Currently, CMEC includes three capabilities that are supported by the U.S. Department of Energy, Office of Biological and Environmental Research (BER), Regional and Global Climate Modeling Program (RGCM). As CMEC advances, additional analysis packages will be included from community-based expert teams as well a efforts directly supported by DOE and other US and international agencies.



ILAMB

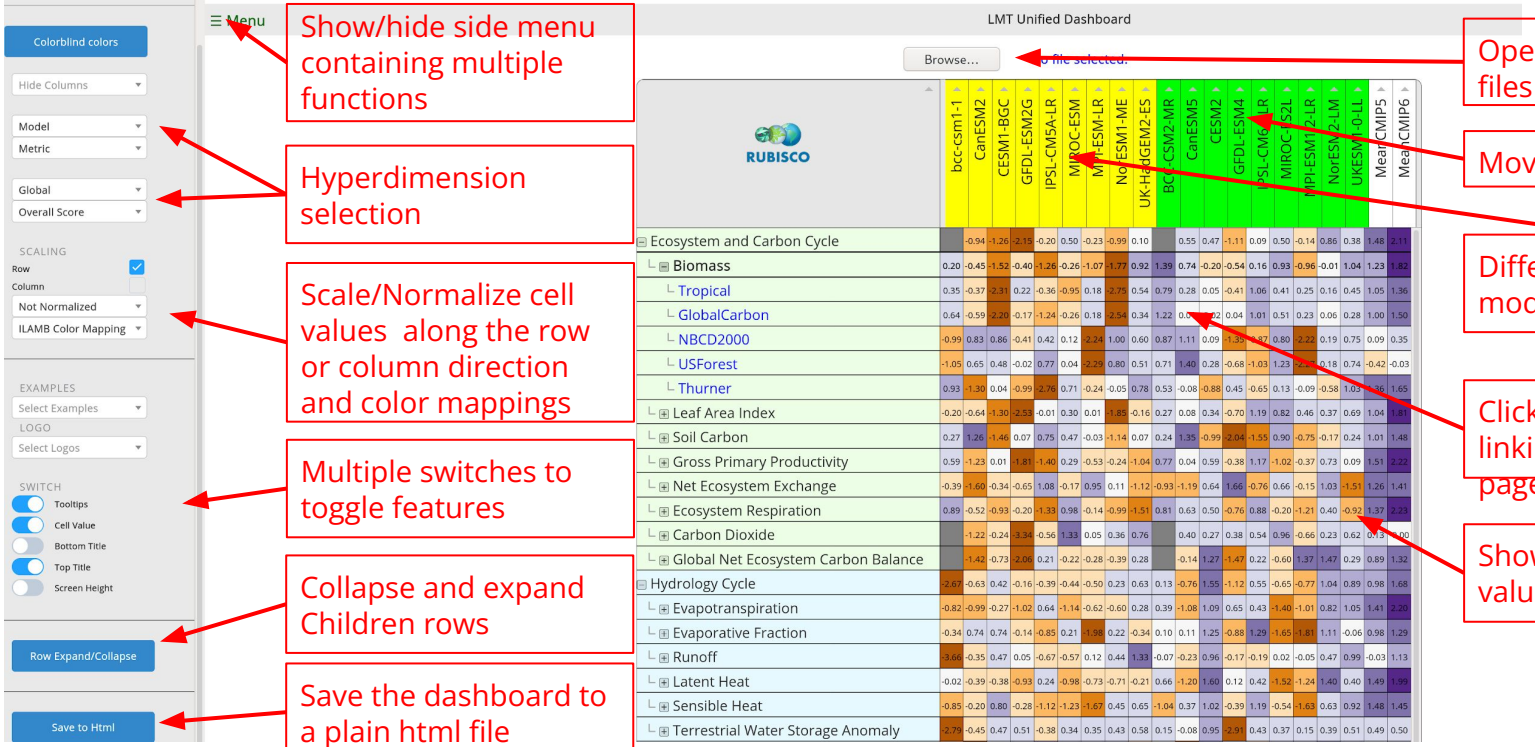
TEMPEST EXTREMES

TECA

Third-Party Contributors

A primary motivation for CMEC is to analyze model simulations that are contributed to the Coupled Model Intercomparison Project (CMIP). Virtually every institution worldwide involved in significant

LMT Dashboard: https://lmt.ornl.gov/unified-dashboard/



Show/hide side menu containing multiple functions

Hyperdimension selection

Scale/Normalize cell values along the row or column direction and color mappings

Multiple switches to toggle features

Collapse and expand Children rows

Save the dashboard to a plain html file

Open local json files

Moveable columns

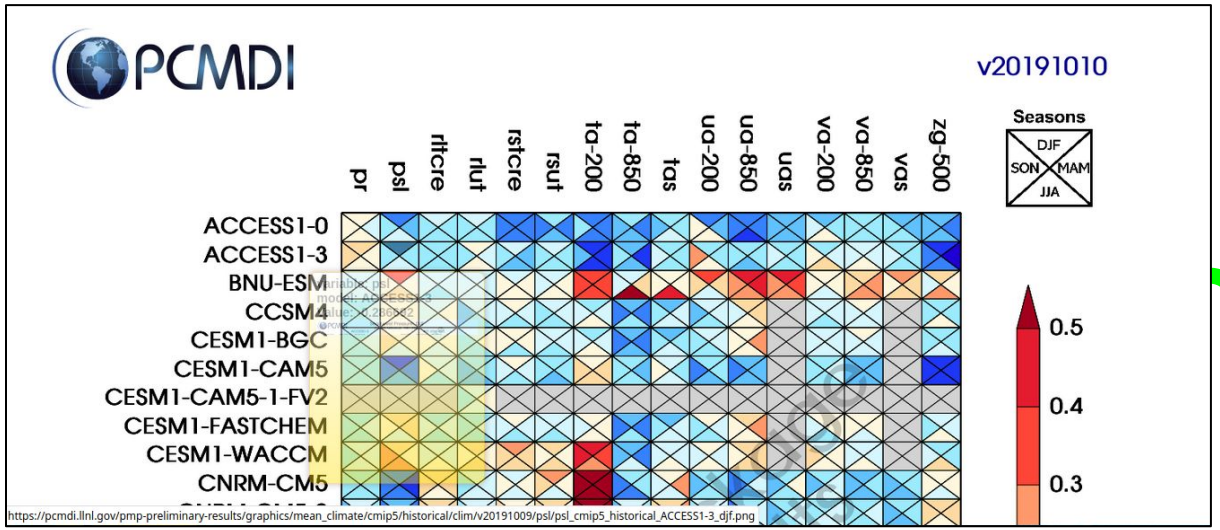
Different colors for model groups

Clickable cell linking to metric page

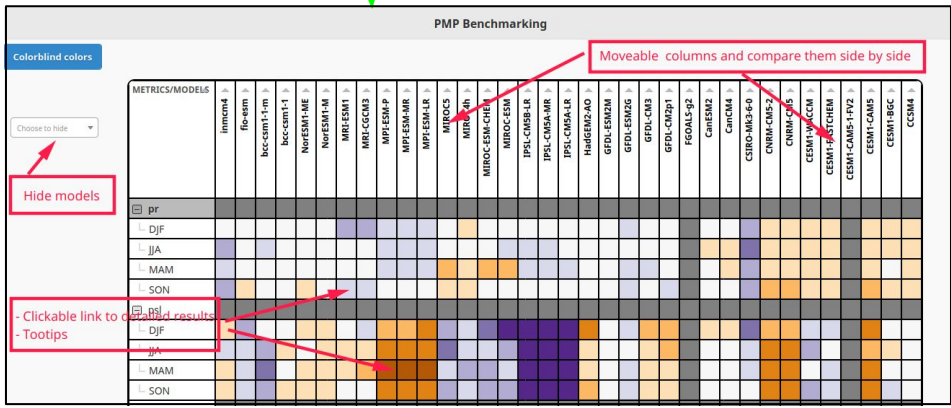
Show/Hide cell values

- **Tooltips:** show scores when mouse hovers the cells.
- **Column Hiding:** hide some models (columns) to focus into models of interest.
- **Column sorting:** sort the scores along the columns/models to see the best metric for the model.

Convert other diagnostic results for use in LMT dashboard



https://lmt.ornl.gov/tab_pmp



PMP: The Program for Climate Model Diagnostics and Intercomparison (PCMDI) Metrics Package (PMP)

- Clicking cell will go to maps of geographic distributions generated by PMP
- Our LMT dashboard can be used to study science questions like ENSO-BGC feedbacks

Standards for Metrics/Diagnostics Interoperability

- **Compatibility with CMEC/MDTF effectively requires:**
  - A JSON file that provides metadata on the package being executed
  - A bash script that allows for "lowest common denominator" execution of the metrics module
  - Metrics output compatible with the package
- **"Lowest common denominator" (LCD) execution** – modules run over:
  - Path to the base directory of the metric module
  - Path to the observational data and model data
  - Path where output should be written
  - List of modules to be executed (and their configuration name)