Next Generation Datasets for Forcing Ocean/Sea-ice-only and Land-only CMIP models

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Ocean/seaice-only (**OMIP**) and land-only (**LMIP**) simulations rely on long and accurate historical forcing datasets

- Based on reanalysis products (e.g., NCEP-NCAR, 20CRv3, JRA-55, or ERA5)

- Bias-corrected for precipitation, solar radiation, longwave radiation, …

- Long and self-consistent datasets (with no discontinuities) required for spinup and studies of ocean and land historical trends

For CMIP6

- OMIP relied on JRA-55-do
- LMIP used GSWP3 (default), CRUNCEP, Princeton, and WATCH-WFDEI

A CLIVAR Working Group on Ocean Model Development (WGOMD) / Ocean Model Development Panel (OMDP) Effort
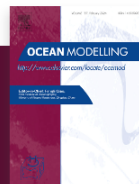
Coordinated Ocean-ice Reference Experiments (COREs)

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Coordinated Ocean-ice Reference Experiments (CORE-II)

Edited by
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- Will Perrie

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Coordinated Ocean-ice Reference Experiments (COREs) were proposed by the WCRP/CLIVAR Working Group on Ocean Model Development (WGOMD) as a venue for comparing global ocean-sea ice models run under a common prescribed atmospheric state, with boundary fluxes computed via the same bulk formulae. CORE simulations complement the coupled climate and earth system models run for the Coupled Model Intercomparison Project (CMIP). Efforts across a broad community of modelling groups have produced CORE simulations (CORE-II) using 60 years (1948-2007) of inter-annual forcing, with details of the protocol and participating groups available from the WGOMD website (http://www.clivar.org/wgomd/core/core-2).

This Special Issue of Ocean Modelling aims to document aspects of the CORE-II simulations, publishing papers which compare simulations across a suite of models as well as to observation analyses where available.

NCEP – NCAR re-analysis-based datasets (Large & Yeager 2004 & 2009)

11 manuscripts with 20+ participating groups

Multi-decadal ocean and land simulations are useful for many reasons:

- Evaluation, understanding, and improvement of components of Earth system models;

- Investigation of mechanisms for seasonal, inter-annual, and decadal variability;

- Attribution of ocean-climate events;

- Evaluation of robustness of mechanisms across models;

- Bridging observations and modeling; and

- Providing initial conditions for the ocean, sea-ice, and land components of coupled Earth system prediction simulations.
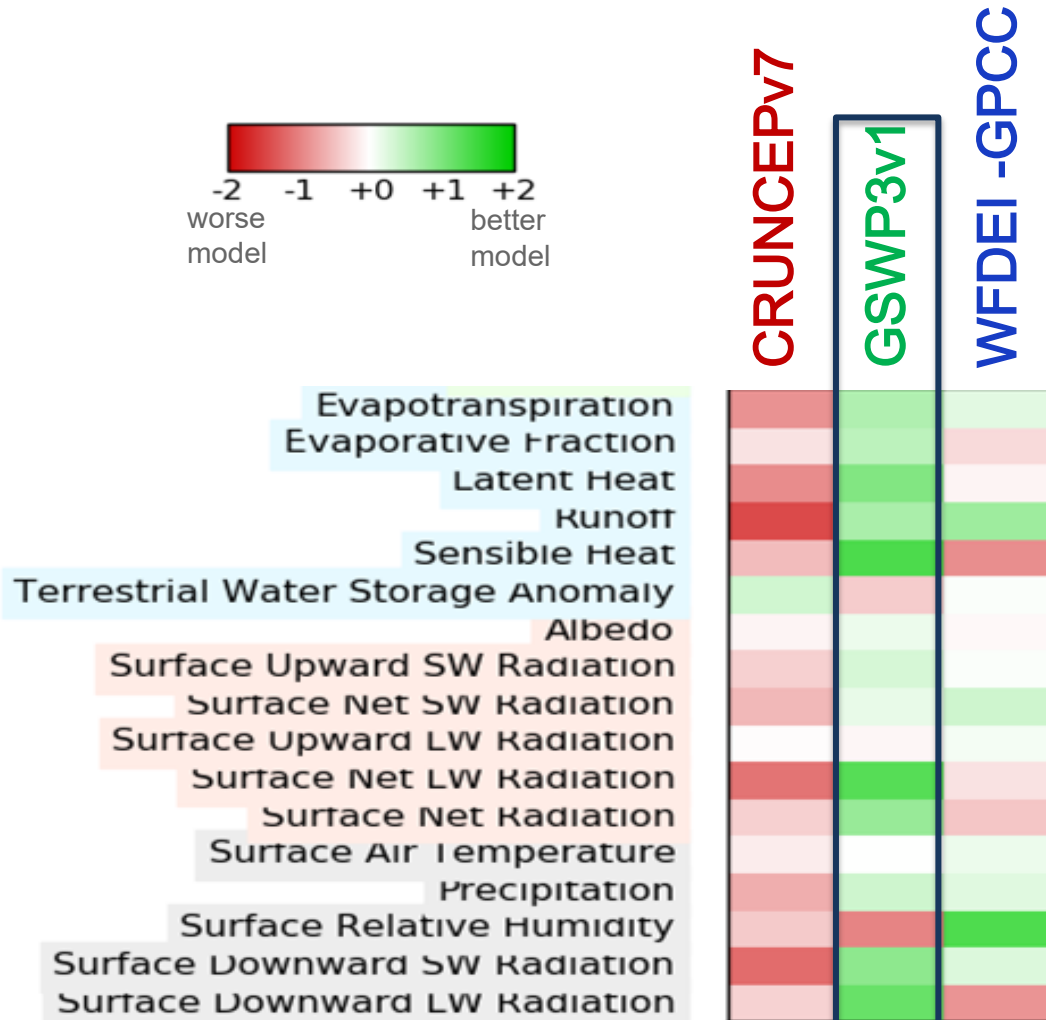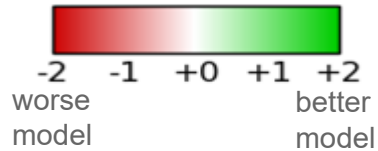
Land-only CMIP6 (ILAMB)
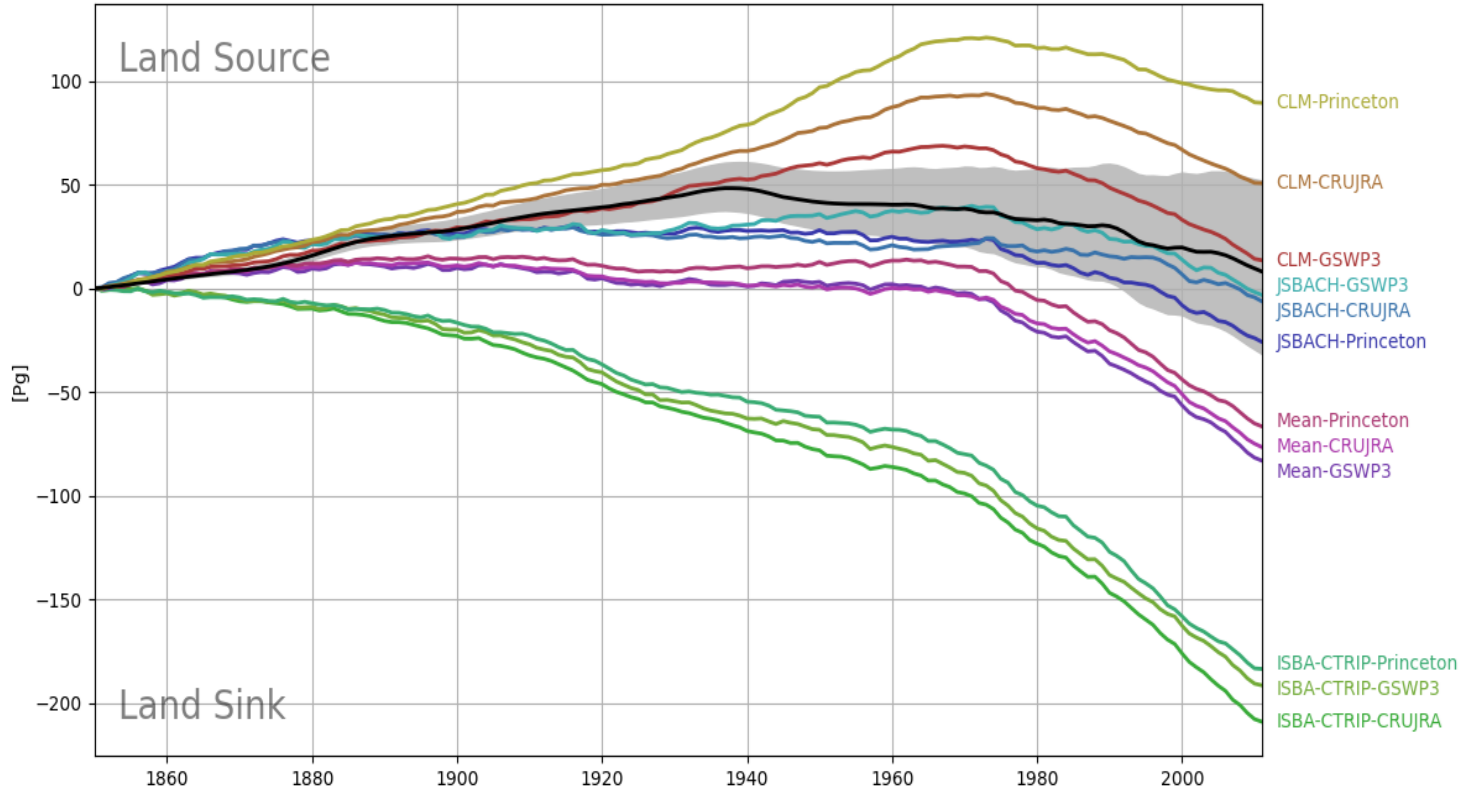
Trajectory of land carbon sink is variably dependent on forcing dataset

- "Better" forcing corresponds with "Better" model output

LMIP:
- None of the forcing datasets used for LMIP in CMIP6 are being updated to present day
- CRUJRA from Global Carbon Project available through 2023
- CRUJRA has limitations, including that it is 6-hourly, no data for Antarctica, and can't be extended due to JRA-55 reanalysis being discontinued

OMIP:
- JRA-55 reanalysis has been discontinued going forward, but JRA55-do will be used since it goes through 2023

In both cases, the inability to extend to present-day impacts efforts to run near real-time decadal, multi-year, or S2S prediction experiments

CFORCE: Creating the Next Generation Datasets for Forcing Ocean – Sea-ice Coupled Models based on ERA5

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US NSF National Center for Atmospheric Research (NCAR)

Advantages of ERA5 as the basis:

- A trusted reanalysis product

- Spatial and temporal resolutions of the datasets must be as sufficient as possible for forcing high-resolution (e.g., eddying, coastal) ocean and sea-ice models (0.25^o and hourly)

- All bias correction datasets must be available up-to-date / near real time

- Going back in time as far back as possible (1940 – present)

- Buy-in / support / collaboration from the institution producing the reanalysis product

- Institutional commitment for continued production of the reanalysis datasets

- No redistribution issues

Disadvantages of ERA5 as the basis:

- Preference for 1900 start date for land, but can live with 1940

- The effort just started with funding from the US Department of Energy (DOE) and the US National Oceanic and Atmospheric Administration (NOAA).
- NSF NCAR, NOAA GFDL, and DOE LANL will lead this effort in collaboration with the CLIVAR OMDP and international ocean modeling community.
- Forcing over land not explicitly part of the proposal, but NCAR team will try to leverage

The new CFORCE ERA5-based forcing dataset is anticipated to be available in early 2026 at which time OMIP/LMIP may switch to these new products

Datasets: A complete dataset for forcing ocean-ice and land simulations for the 1940-present period for use of the world-wide community in their evaluations and benchmarking of ocean, sea-ice, and land models.

Scripts and Tools: Open-access scripts and tools (python-based) extendable for use in creation of future datasets, for example with ERA6.

Manuscript: A manuscript describing the dataset and the adjustments used. This manuscript will serve as the primary reference for this dataset.

OMIP-Future and LMIP-Future

- CFORCE will provide solid baseline forcing dataset for the ocean-ice research community

- CFORCE may potentially be suitable for land research community

- Emphasis on extendability

- Nonetheless, ongoing extensions will require resources which ideally would be part of any centralized CMIP forcing datasets support
    - Not sure of cost, but potentially in the range of 1-2 months of effort per year, more with additional emphasis on improvement
    - Scientifically, an expansion of CFORCE to account for observational uncertainty would be highly beneficial (e.g., an ensemble of historical forcing datasets that span this uncertainty)