THE E3SM DIAGNOSTICS PACKAGE FOR EARTH SYSTEM MODEL EVALUATION

In the development cycle of an earth system model, like the Energy Exascale Earth System Model (E3SM), an important step is performing diagnostics by comparing the model to observational or reanalysis data or by comparing it to another model. E3SM_diags is a diagnostics software package that can be used alone or embedded into the E3SM workflow to enable seamless transition between model runs and diagnostics. The package includes a group of the most up-to-date analysis datasets to facilitate model validation. Example diagnostics include the global precipitation contour plot in Figure 1, the Taylor diagram in Figure 2 and the cloud 2D histogram plot from simulator output in Figure 4.

FLEXIBLE SOFTWARE

E3SM Diagnostics is designed to be adjustable and modular, enabling users to manipulate different aspects of the diagnostics workflow. Numerous configuration options exist to customize data processing and metric computation as well as data visualization. Users can select pre-defined geographic

Get E3SM Diagnostics

- Code – https://github.com/E3SM-Project/e3sm_diags
- Docs – https://e3sm.org/resources/tools/diagnostic-tools/e3sm-diagnostics/
regions and generate derived variables. Though designed for E3SM, the package can be easily expanded to accommodate output from other earth system models. Written with parallel computing in mind, the package can manage a multiprocessing pool to speed up diagnostics processes (see Fig. 3).

**DIAGNOSTIC PLOTS**

The software supports diagnostics based on seasonal or annual climatology data, including:

- Latitude-Longitude contour maps (Fig. 1)
- Polar contour maps
- Zonal mean line plots
- Pressure-Latitude zonal mean contour plots
- Cloud Top Height - Optical Thickness (Tau) joint histograms (Fig. 4)
- Tables summarizing metrics
- Taylor Diagrams for spatial variability (Fig. 2)

**AVAILABLE DATASETS**

The E3SM Diagnostics Package includes up-to-date analysis datasets for earth system variables:

- GPCP for precipitation
- CERES_EBAF for radiation
- Hadley Center data for sea surface temperature
- WHOI-OAFlux for ocean surface latent and sensible heat fluxes
- ERA-Interim and MERRA2 for reanalysis datasets
- ISCCP, MISR and MODIS for satellite simulator datasets

**SUPPORT**

DOE Office of Science, Biological and Environmental Research (BER)

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