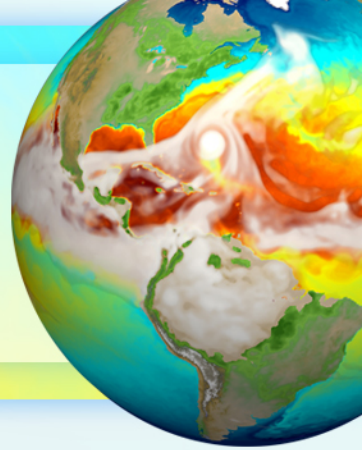

E3SM Diagnostics Package (e3sm_diags) 2018 Tutorial

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Lawrence Livermore National Lab

E3SM Energy Exascale Earth System Model

U.S. DEPARTMENT OF ENERGY

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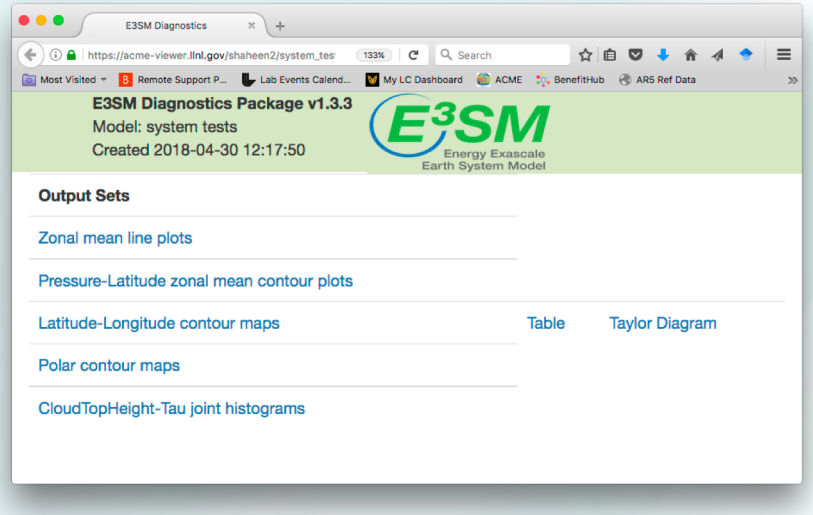
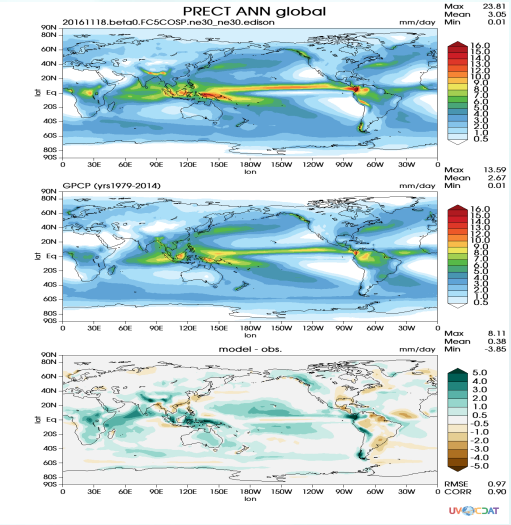
LLNL-PRES-763503

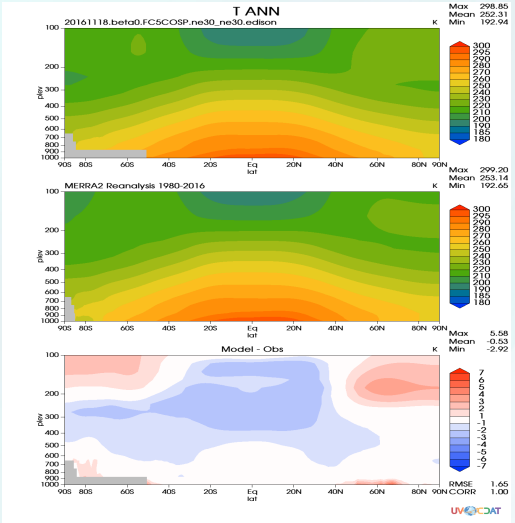
Introduction

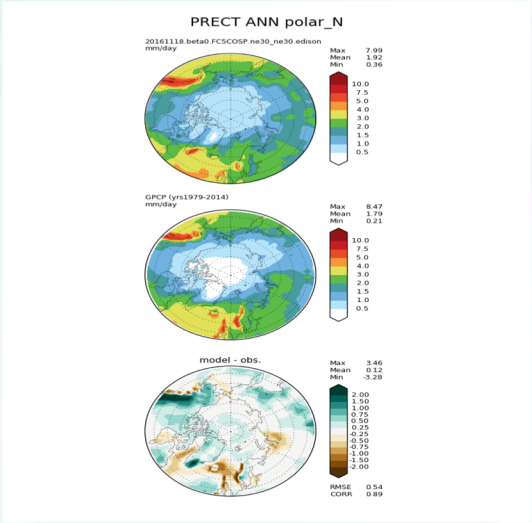


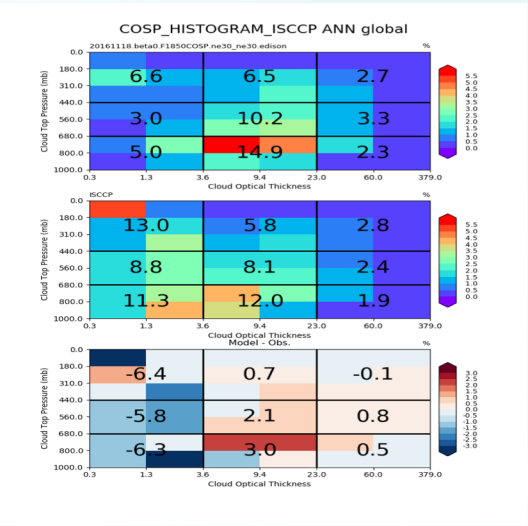
- A **modern, Python-based** diagnostics package for evaluating earth system models.
- Modeled after NCAR's atmosphere diagnostics package with added features:
  - ✓ Flexible to add new observational datasets/diagnostics.
  - ✓ Modifiable figures.
  - ✓ Easier installation, configuration, and execution.
  - ✓ Runs faster using multi-processing .
- Maintain an **updated** observational data repository.
- A **community tool** that accommodates CMIP convention.

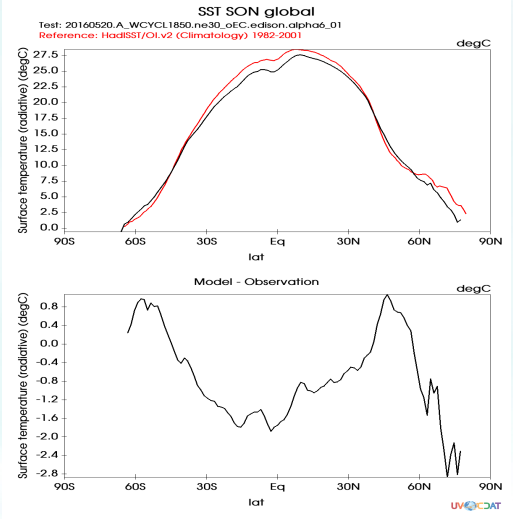
Current Status: Diagnostics Sets

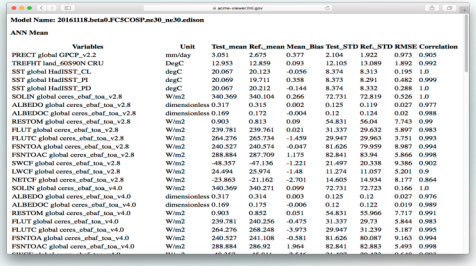


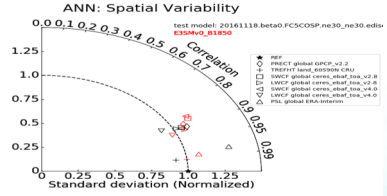












How to Run

Run: `e3sm_diags -p myparams.py` `[-d mydiags.cfg]`

A Python script: `myparams.py`

```
reference_data_path = '/space1/obs_data_20140804/'
test_data_path = '/space/golaz1/acme_simulations/'
test_name = '20160520.A_WCYCL1850.ne30_oEC.edison.alpha6_01'
sets = ['lat_lon']
Seasons =["ANN", "DJF",  "JJA"]
multiprocessing = True
num_workers = 6
```

A cfg script: `mydiags.cfg`

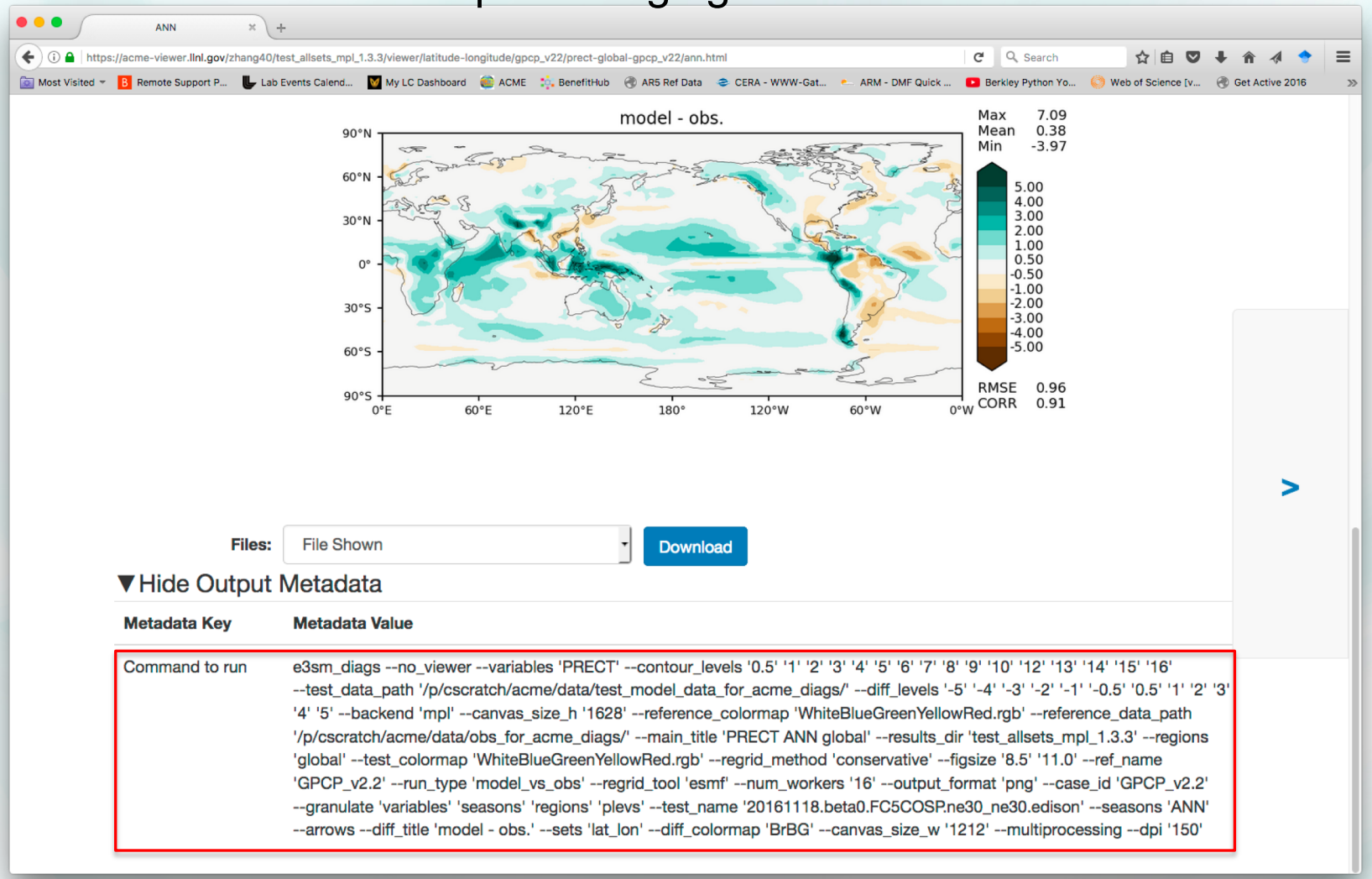
```
[description]
case_id = "GPCP_v2.3"
variables = ["PRECT"]
ref_name = "GPCP_v2.3"
reference_name = "GPCP precipitation"
regions = ["global" ,"ocean_TROPICS","TRMM_region" ]
diff_colormap = "BrBG"
contour_levels = [0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 16]
diff_levels = [-5, -4, -3, -2, -1, -0.5, 0.5, 1, 2, 3, 4, 5]
```

Useful Parameters

- Main parameters:
  - Sets to run: **['zonal_mean_xy', 'zonal_mean_2d', 'lat_lon, 'polar', 'cosp_histogram']**
  - Seasons: **["ANN", "DJF", "MAM", "JJA", "SON"]**
  - Regions: **["global"** ,"ocean_TROPICS","TRMM_region"] # Can add more
  - Pressure levels: [850.0, 200.0]
  - Regrid tool: **'esmf' ;** with Regrid method: 'linear', **'conservative'**
  - Save Netcdf: True, **False**
  - Multi-processing**:** True, **False;** with Number of Workers: **4**
- Plotting parameters:
  - Backend: vcs, matplotlib
  - Output format: **png**, pdf, svg
  - Colormaps: 'cet_rainbow.rgb'
  - Contour levels: [0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16]
- All available parameters: https://e3sm-project.github.io/acme_diags/docs/html/available-parameters.html

New: More Provenance Saved

- For **running the package**:
  - Command line for reproducing figures.



New: More Provenance Saved

- For **running the package**:
  - Command line for reproducing figures.
  - Data (optional) and metrics of resulting diagnostics.
  - Environment and configuration files.
- For **analysis datasets**:
  - Original data and processing script for analysis datasets.

New: Containerization (v1.5.0)

- e3sm_diags can now be ran as a container.
- Containerization technology allows a process and its dependencies to run in isolation.
  - Further simplify user's installation process.
  - Avoid unexpected installation failure.
  - Help with distributing the software across various machines.
- Run with a container on **NERSC Edison**:
  - Download the container and auxiliary script.
  - Run using: `e3sm_diags_container.py` **`--shifter`** `-p params.py`
  - Quickstart guide on documentation website.
- Alternative installation: **conda env** and **e3sm_unified**

New: Analysis datasets in time series (v1.6.0, coming soon)

Data sets	Years Available	Climatology	Time series
GPCP2.3	1979 - 2017	✓	✓
WHOI-OAFlux	1979 - 2013	✓	✓
HadISST	1870 - 2016	✓	✓
CERES-EBAF TOA 2.8 and 4.0	2001 - 2015	✓	✓
CERES-EBAF Surface 2.8 and 4.0	2001 - 2015	✓	✓
MERRA2	1980 - 2016	✓	✓
ERA-Interim	1979 - 2016	✓	✓
AERONET AOD 550nm	N/A	✓	x

* CRU_IPCC, cloud simulators related[COSP], SSMI data are from AMWG package.

New: Support time-series input (v1.6.0, coming soon)

In addition to climo files, time-series as input data, allowing for **user-specified years:**

- Ex: Compare years averaged (2001-2016) and (1850-1865) from the **same model run**.
- Ex: Compare 1980 climatology between **model and obs.**
- Climate variability diagnostics.
- Applicable to monthly time series from any **CMIP** class models data archived on ESGF.

Example Use Cases Available as Jupyter Notebooks

- **Documentation website** (https://e3sm-project.github.io/e3sm_diags/docs/html/index.html)
- Jupyter notebooks with **climatology file** as input:
  - Model vs Obs
  - Model vs Model
- Jupyter notebooks with **time-series files** as input (coming soon):
  - Model vs Model
  - Model vs Obs
- Example output:
  - Documentation Site -> Examples
  - historical_H1 avg (2011-2013) vs historical_H1 avg (1850-1852)

Thank you!

- Please try it out and give us your feedback ☺

GitHub: https://github.com/E3SM-Project/e3sm_diags