E3SM Diagnostics Package (e3sm_diags v2) 2020 Tutorial

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E3SM Energy Exascale Earth System Model

U.S. DEPARTMENT OF ENERGY

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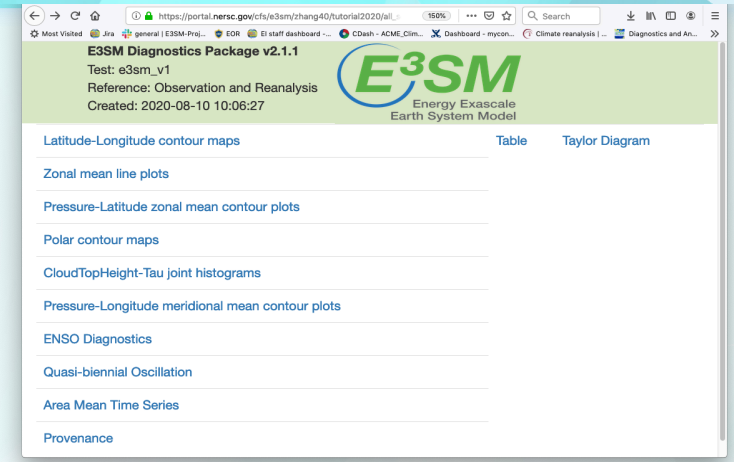
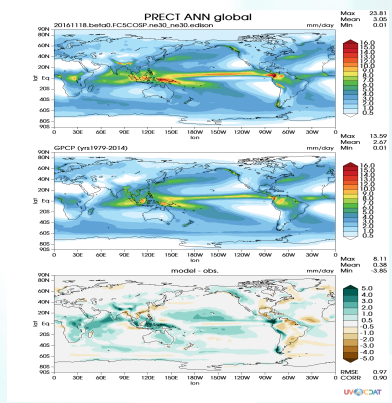
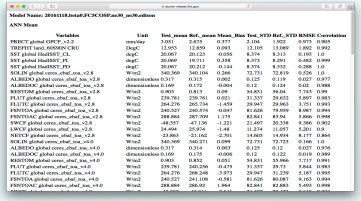
Introduction

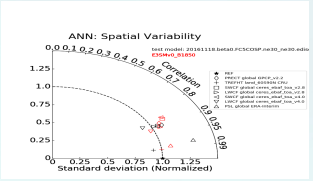


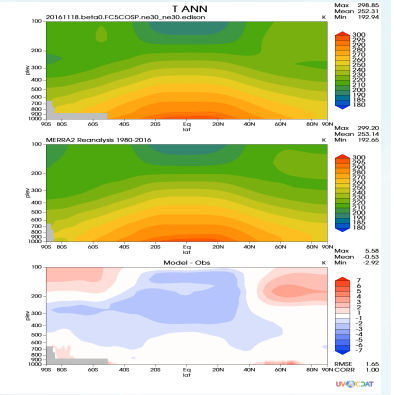
- A **modern, Python-based** diagnostics package developed for supporting E3SM model development.
- Modeled after NCAR's atmosphere diagnostics package with key sets implemented.
- Features:
  - ✓ Flexible to add new observational datasets/diagnostics, modify figures.
  - ✓ Easy installation, configuration, and execution.
  - ✓ Runs fast using multi-processing.
  - ✓ Provenance saved for reproducing diags figures.
- Maintain an **updated** observational data repository.
- A **community tool** that accommodates CMIP convention.

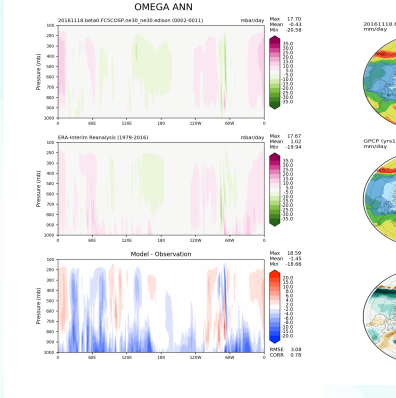
Current Available Sets

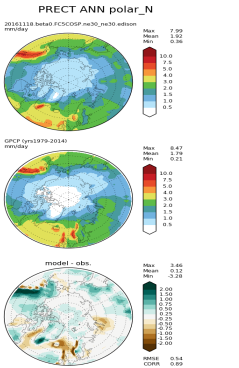


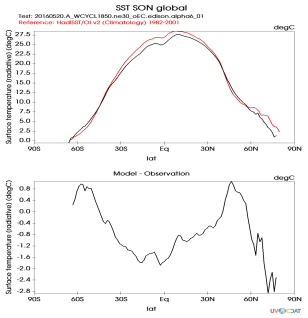


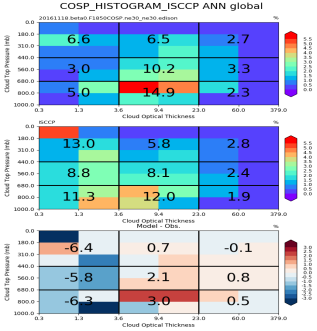




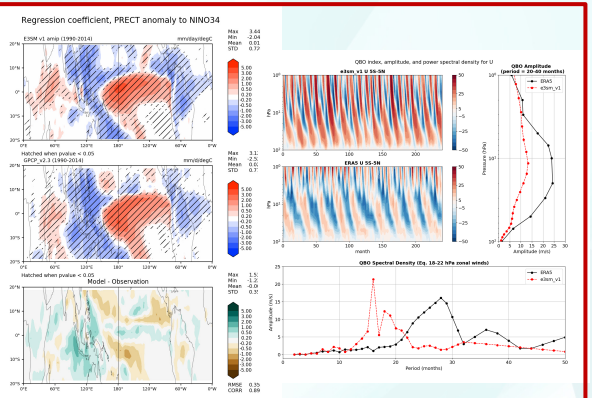


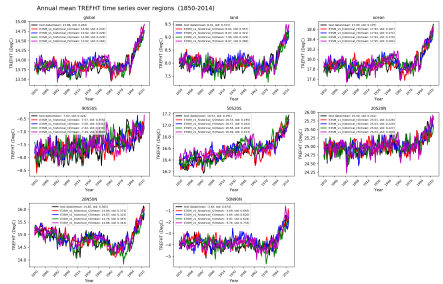






Basic Sets





ENSO diags and QBO diags
Annual mean time series

Input Data Requirement

- Support data on regular latitude-longitude grids (not support raw EAM output)
  - Preprocessing through NCO to get regrided climo and time series files

- Use seasonal climatology data as input

  20160520.A_WCYCL1850.ne30_oEC.edison.alpha6_01_ANN_climo.nc
  20160520.A_WCYCL1850.ne30_oEC.edison.alpha6_01_DJF_climo.nc
  20160520.A_WCYCL1850.ne30_oEC.edison.alpha6_01_JJA_climo.nc
  …

- Use monthly time series data as input

  TS_185001_201312.nc
  TREFHT_185001_201312.nc
  U_185001_201312.nc
  …

- Example data

Installation

- On E3SM supported machines (Cori, Compy, Acme1, Anvil, Cooley, Rhea)
  - e3sm_unified: A conda environment pulls together python and other E3SM analysis tools such as E3SM_diags, MPAS-Analysis, NCO, CDAT and processflow.
  - **source <activation_path>/load_latest_e3sm_unified.sh**
  - Paths to activation scripts of different machines (only accessible by E3SM members)

- Observation data and example data for testing are available on these machines (data path for each machine).

Installation

- Run on other Linux or MacOS machines/ or use the latest version
  1. Install Miniconda and initialize conda.
  2. Create conda env from an environmental.yml file
     - Download the e3sm_diags_env.yml file from e3sm_diags Github repo
     - conda env create -f e3sm_diags_env.yml

     Alternatively:
     - conda create -n e3sm_diags_env e3sm_diags=**2.1.1** python=3 mesalib \

     -c conda-forge -c cdat/label/v82 -c e3sm
  3. Activate conda env
     - conda activate e3sm_diags_env
- Download obs and sample model data for testing available from E3SM data server
  - Obs: climatology and time-series
  - Example testing data

Configuration and Run: basic sets

- **Run: Python `tutorial_2020_climo_sets.py`**
-

```
import os
from acme_diags.run import runner
from acme_diags.parameter.core_parameter import CoreParameter

param = CoreParameter()

param.reference_data_path = '/global/cfs/cdirs/e3sm/acme_diags/obs_for_e3sm_diags/climatology'
param.test_data_path = '/global/cfs/cdirs/e3sm/acme_diags/test_model_data_for_acme_diags/climatology/'
param.test_name = '20161118.beta0.FC5COSP.ne30_ne30.edison'
param.seasons = ["ANN","JJA"]
prefix = '/global/cfs/cdirs/e3sm/www/zhang40/tutorial2020'
param.results_dir = os.path.join(prefix, 'climo_sets')
param.multiprocessing = True
param.num_workers = 32

#Additional parameters:
#param.short_test_name = ‘e3sm_v1’
#param.run_type = 'model_vs_model’
#param.diff_title = 'Difference’
#param.output_format = ['png’]
#param.output_format_subplot = ['pdf’]
#param.save_netcdf = True

runner.sets_to_run = ['lat_lon','zonal_mean_xy', 'zonal_mean_2d', 'polar', 'cosp_histogram', 'meridional_mean_2d']
runner.run_diags([param])
```

All available parameters

See output results

Configuration and Run: all sets

- **Run: Python `tutorial_2020_all_sets.py`**
-

```
import os
from acme_diags.run import runner
from acme_diags.parameter.core_parameter import CoreParameter
from acme_diags.parameter.area_mean_time_series_parameter import AreaMeanTimeSeriesParameter
from acme_diags.parameter.enso_diags_parameter import EnsoDiagsParameter
from acme_diags.parameter.qbo_parameter import QboParameter

param = CoreParameter()

param.reference_data_path = '/global/cfs/cdirs/e3sm/acme_diags/obs_for_e3sm_diags/climatology'
param.test_data_path = '/global/cfs/cdirs/e3sm/acme_diags/test_model_data_for_acme_diags/climatology/'
param.test_name = '20161118.beta0.FC5COSP.ne30_ne30.edison'
param.seasons = ["ANN","JJA"]

prefix = '/global/cfs/cdirs/e3sm/www/zhang40/tutorial2020'
param.results_dir = os.path.join(prefix, 'all_sets_10yr')
param.multiprocessing = True
param.num_workers = 32
```

Continue
Configuration and Run: all sets

- **Run: Python `tutorial_2020_all_sets.py`**
-

```
#Set specific parameters for new sets
enso_param = EnsoDiagsParameter()
enso_param.reference_data_path = '/global/cfs/cdirs/e3sm/acme_diags/obs_for_e3sm_diags/time-series/'
enso_param.test_data_path = '/global/cfs/cdirs/e3sm/acme_diags/test_model_data_for_acme_diags/time-series/E3SM_v1/'
enso_param.test_name = 'e3sm_v1'
enso_param.start_yr = '1990'
enso_param.end_yr = '1999'

qbo_param = QboParameter()
qbo_param.reference_data_path = '/global/cfs/cdirs/e3sm/acme_diags/obs_for_e3sm_diags/time-series/'
qbo_param.test_data_path = '/global/cfs/cdirs/e3sm/acme_diags/test_model_data_for_acme_diags/time-series/E3SM_v1/'
qbo_param.test_name = 'e3sm_v1'
qbo_param.start_yr = '1990'
qbo_param.end_yr = '1999'

ts_param = AreaMeanTimeSeriesParameter()
ts_param.reference_data_path = '/global/cfs/cdirs/e3sm/acme_diags/obs_for_e3sm_diags/time-series/'
ts_param.test_data_path = '/global/cfs/cdirs/e3sm/acme_diags/test_model_data_for_acme_diags/time-series/E3SM_v1/'
ts_param.test_name = 'e3sm_v1'
ts_param.start_yr = '1990'
ts_param.end_yr = '1999'

runner.sets_to_run = ['lat_lon','zonal_mean_xy', 'zonal_mean_2d', 'polar', 'cosp_histogram', 'meridional_mean_2d','enso_diags', 'qbo','area_mean_time_series’]
runner.run_diags([param, enso_param, qbo_param, ts_param])
```

See output results

Quick Guide on Cori NERSC

- SSH to cori
- Download tutorial examples: wget https://raw.githubusercontent.com/E3SM-Project/e3sm_diags/master/examples/tutorials/tutorial_2020_all_sets.py
- Edit script: tutorial_2020_climo_sets.py
  - Change results_dir
- salloc --nodes=1 --partition=debug --time=00:30:00 -C haswell
- conda activate /global/cfs/cdirs/e3sm/zhang40/conda_envs/e3sm_diags

(Alternatively,

source /global/cfs/cdirs/e3sm/software/anaconda_envs/load_latest_e3sm_unified.sh)

- python tutorial_2020_climo_sets.py
- Go through output at https://portal.nersc.gov/cfs/e3sm/zhang40/tutorial2020/all_sets/viewer/

Documentation

- Quick Guides
- More examples
- Developer Guide

Thank you!

Please try it out and give us your feedback ☺
GitHub: https://github.com/E3SM-Project/e3sm_diags