

AMWG Diagnostics Framework: ADF

Next Generation of AMWG Diagnostics

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ADF Intro



<https://github.com/NCAR/ADF>

What is it?

Open source, community developed Python-based set of diagnostics tools aimed at replacing the old AMWG Diagnostics package (NCL-based)

Set of analysis (averaging), re-gridding, and plotting scripts

Designed to allow climatological comparison between different CAM simulations, or between CAM simulations and observational/reanalysis data

- ❖ Single Test vs Baseline or Multiple Tests vs Baseline

Only for CAM output data

- ❖ Initially for monthly mean data files but we are working towards different time slices

ADF Output



<https://github.com/NCAR/ADF>

Output

- ❖ Time Series, Climatology, and Re-Gridded netCDF files
- ❖ Plots
 - Global Lat/Lon & Lat/Lon Vector
 - NH & SH Polar
 - Zonal & Meridional
 - Taylor Diagram
 - QBO Time Series and Amplitude
 - AMWG Tables and Table Comparison
- ❖ Website generation

Key Features and New Features

Key Features:

- ❖ Flexible and Open Source
- ❖ Use of GeoCAT (limited)
- ❖ Use of YAML config file -> **help avoid changing source code**
 - Customizable Variable Configurations
- ❖ Option for use of Multiple Processors
- ❖ **Vertical Interpolation**
- ❖ Installation via Conda package manager - <https://github.com/NCAR/ADF#required-software-environment>
 - CISL machines are set to run out of the box

What's New:

- ❖ Jupyter Notebooks - `jupyter_sample.ipynb`
- ❖ Multi-Case Diagnostics
 - AMWG Table Comparison **
 - Multi-Case Difference Plots **
 - Multi-Case Regional Maps
- ❖ CVDP Extension
- ❖ QBO Diagnostics
- ❖ Transformed Eulerian Mean Diagnostics **
- ❖ Time Series Plots **

Vertical Interpolation

Key Features:

- ❖ Vertical Interpolation **

Centralize vertical interpolation

- Regridding and vertical interpolation script which interpolates all model variables with a vertical component onto a standard set of pressure levels.
- Allows 3D model variables comparison against 3D observations
 - ◆ assuming the observations are also on the same set of pressure levels.

Enable interpolation on MPAS vertical coordinate

- Checks for the MPAS height-based vertical coordinate, and if present to enable the pressure-to-pressure vertical interpolation required to get the MPAS data onto the standard pressure levels used by the ADF.

Custom Variable Configuration

lib/adf_variable_defaults.yaml

Set up your own custom plots!

- ❖ Colorbars
- ❖ Plot ranges
- ❖ Units/Labels
- ❖ Offsets, etc.

```
RELHUM:  
  colormap: "Blues"  
  contour_levels_range: [0, 105, 5]  
  diff_colormap: "BrBG"  
  diff_contour_range: [-15, 15, 2]  
  scale_factor: 1  
  add_offset: 0  
  new_unit: "Fraction"  
  mpl:  
    colorbar:  
      label: "Fraction"  
  obs_file: "ERA1_all_climo.nc"  
  obs_name: "ERA1"  
  obs_var_name: "RELHUM"  
  category: "State"
```

- ❖ Define your own configuration!

```
ICEFRAC:  
  category: "Surface variables"  
  LabSea:  
    w: -63.5  
    e: -47.5  
    s: 53.5  
    n: 65.5
```

In my time series plotting script:

```
# dict of variable-specific plot preferences  
res = adfobj.variable_defaults  
icefrac_subset_dict = {"n": res["ICEFRAC"]["LabSea"]["n"],  
                       "s": res["ICEFRAC"]["LabSea"]["s"],  
                       "e": res["ICEFRAC"]["LabSea"]["e"],  
                       "w": res["ICEFRAC"]["LabSea"]["w"]}
```

Custom Diagnostics Run Configurations

`config_cam_baseline_example.yaml`**

** Customize for *your* case(s)

```
#List of plotting scripts being used.
#These scripts must be located in "scripts/plotting":
plotting_scripts:
  - global_latlon_map
  - zonal_mean
  - meridional_mean
  - polar_map
  - global_latlon_vect_map
  - cam_taylor_diagram
  - qbo
  #- time_series

#This fourth set of variables provides settings for calling the Climate Variability
# Diagnostics Package (CVDP). If cvdp_run is set to true the CVDP will be set up and
# run in background mode, likely completing after the ADF has completed.
# If CVDP is to be run PSL, TREFHT, TS and PRECT (or PRECC and PRECL) should be listed
# in the diag_var_list variable listing.
# For more CVDP information: https://www.cesm.ucar.edu/working\_groups/CVC/cvdp/
diag_cvdp_info:

  # Run the CVDP on the listed run(s)?
  cvdp_run: false

  # CVDP code path, sets the location of the CVDP codebase
  # CGD systems path = /home/asphilli/CESM-diagnostics/CVDP/Release/v5.2.0/
  # CISL systems path = /glade/u/home/asphilli/CESM-diagnostics/CVDP/Release/v5.2.0/
  # github location = https://github.com/NCAR/CVDP-ncl
  cvdp_codebase_loc: /glade/u/home/asphilli/CESM-diagnostics/CVDP/Release/v5.2.0/

  # Location where cvdp codebase will be copied to and diagnostic plots will be stored
  cvdp_loc: ${diag_loc}

  # tar up CVDP results?
  #cvdp_tar: false
```

```
diag_var_list:
  #- AODDUST
  #- AODVIS
  - CLDHGH
  - CLDICE
  - CLDLIQ
  - CLDLW
  - CLDMED
  - CLDTOT
  - CLOUD
  - FLNS
  - FLNT
  - FLNTC
  - FSNS
  - FSNT
  - FSNTC
  - LHFLX
  - LWCF
  - OMEGA500
```

How Do You Run It?

Runs file from root ADF directory

```
$ ./run_adf_diag config_cam_baseline_example.yaml
```

```
ADF diagnostics is starting...
```

```
Generating CAM time series files...
```

```
Processing time series for case 'f.cesm3_cam058_mom_e.FWschIST.ne30_L58.26c_topofix.001' :
```

- time series for CLDHGH
- time series for CLDICE
- time series for CLDLIQ
- time series for CLDLOW
- time series for CLDMED
- time series for CLDTOT
- time series for CLOUD
- time series for FLNS
- time series for FLNT
- time series for FLNTC
- time series for FSNS
- time series for FSNT
- time series for FSNTC
- time series for LHFLX
- time series for LWCF
- time series for OMEGA500
- time series for PBLH

Website: Single Test Case

AMP Diagnostics Prototype



| [Case Home](#) || [Links](#) ▾ || [About](#) || [Contact](#) |

Test Case: f.cesm3_cam058_mom_e.FWschIST.ne30_L58.26c_topofix.001 - years: 1980 - 1999

Baseline Case: f.e20.FHIST.f09_f09.cesm2_1.001 - years: 1980 - 1999

Plot Types

Tables

LatLon

Zonal

Meridional

NHPolar

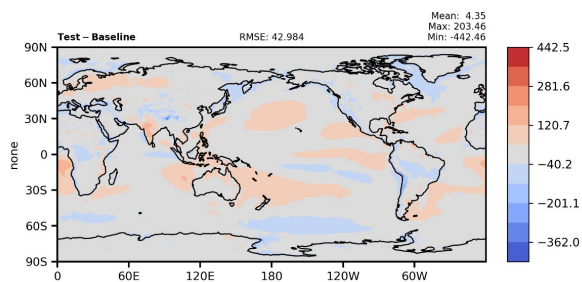
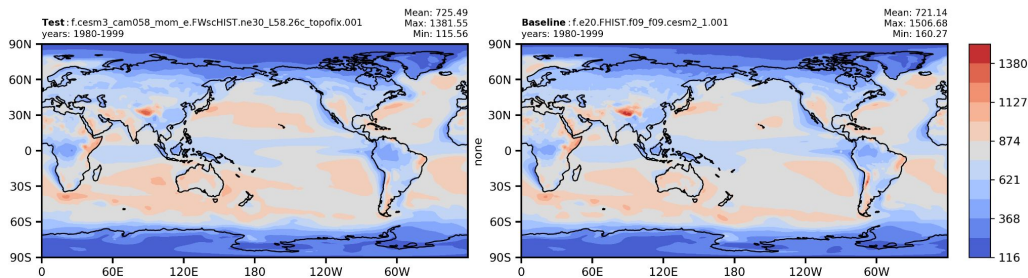
SHPolar

LatLon_Vector

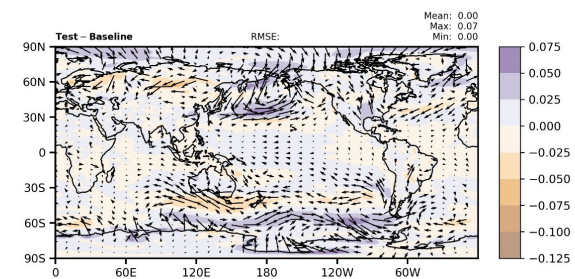
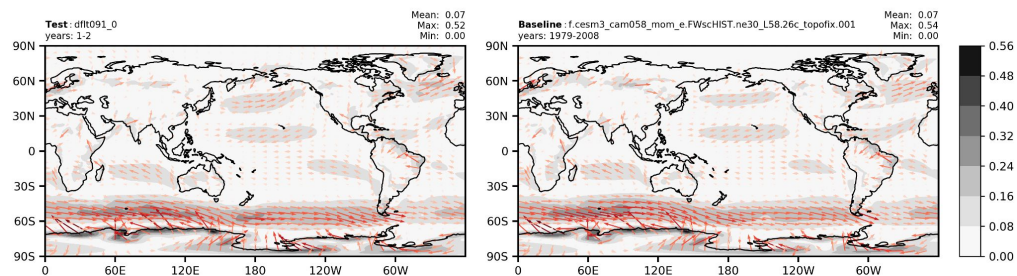
Special

Lat/Lon: Single Test Case

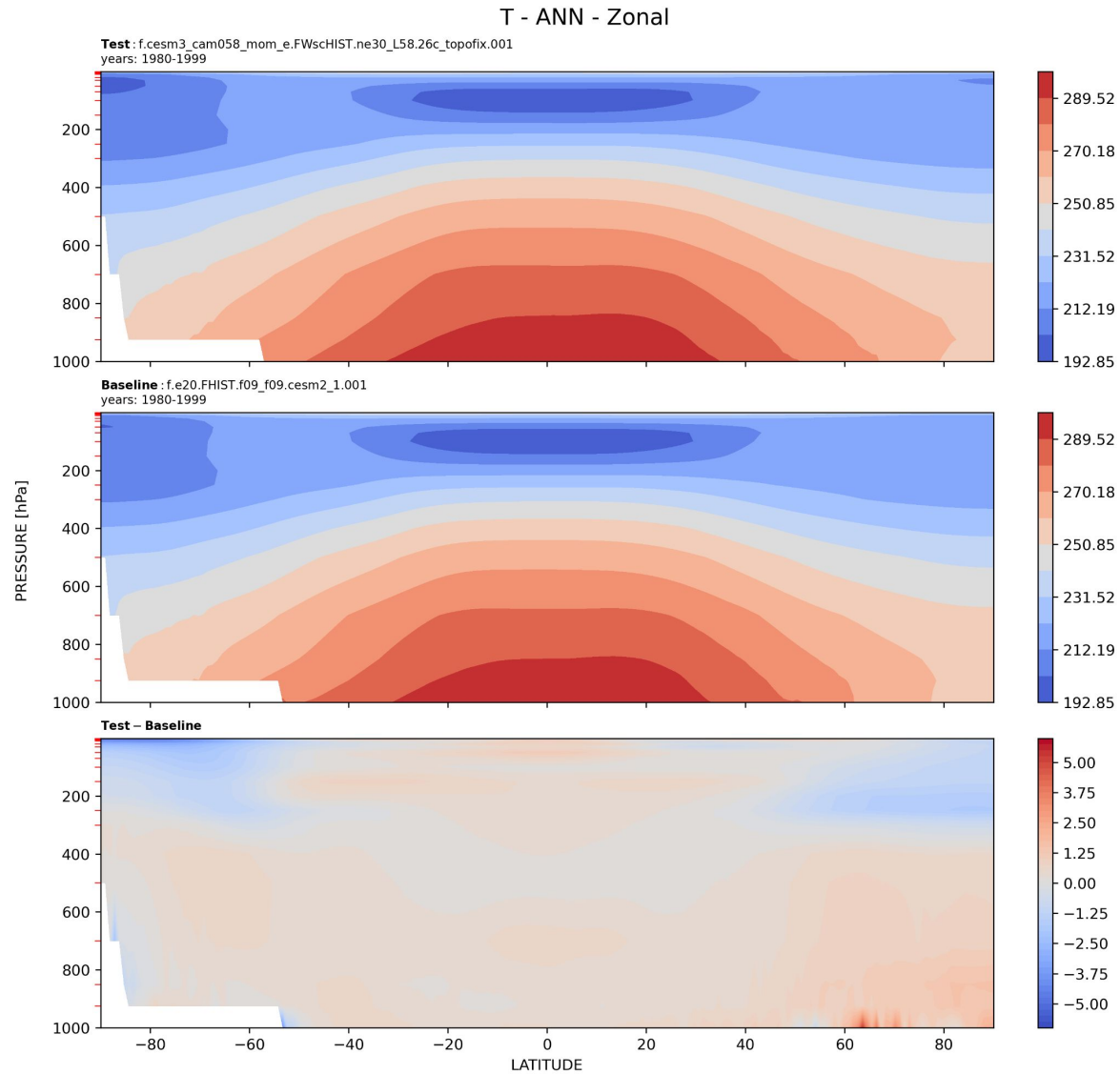
PBLH - ANN - LatLon



Surface - Wind - Stress - ANN - LatLon - Vector

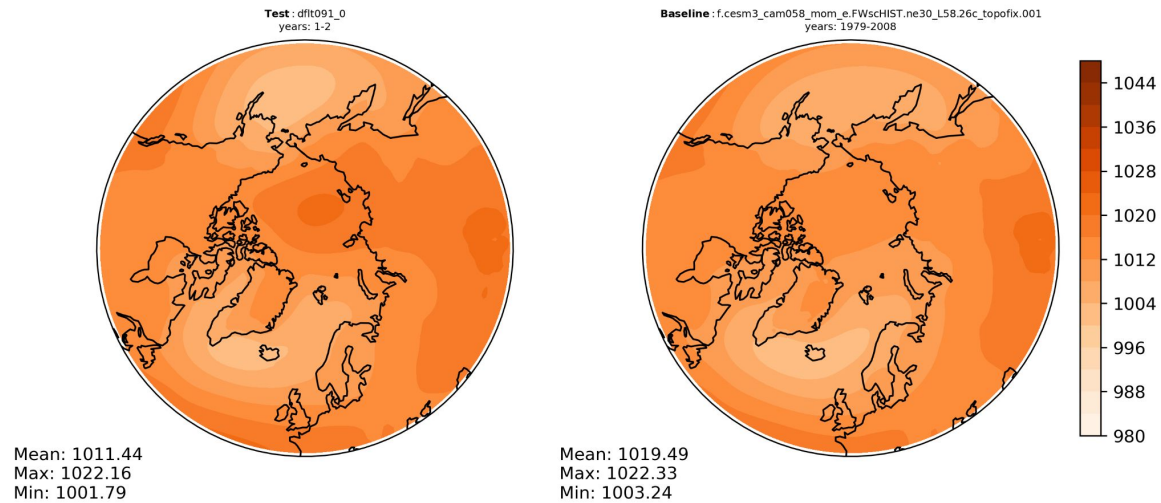


Zonal: Single Test Case

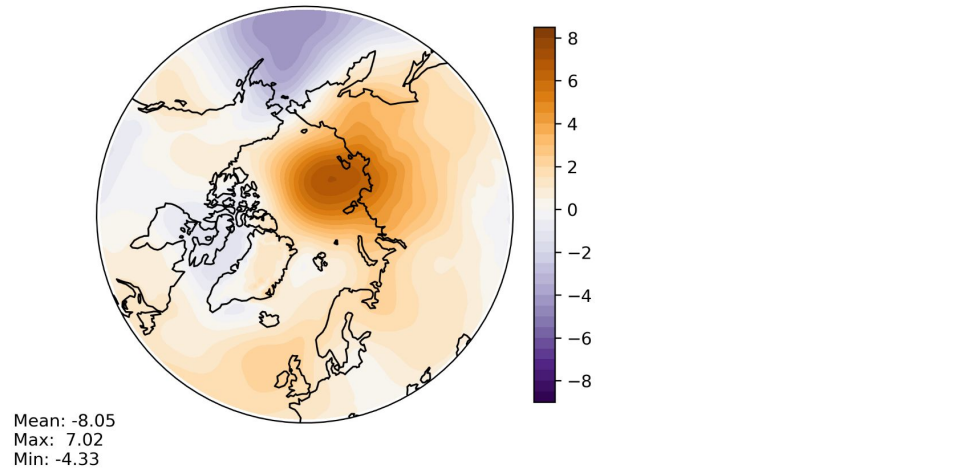


Polar: Single Test Case

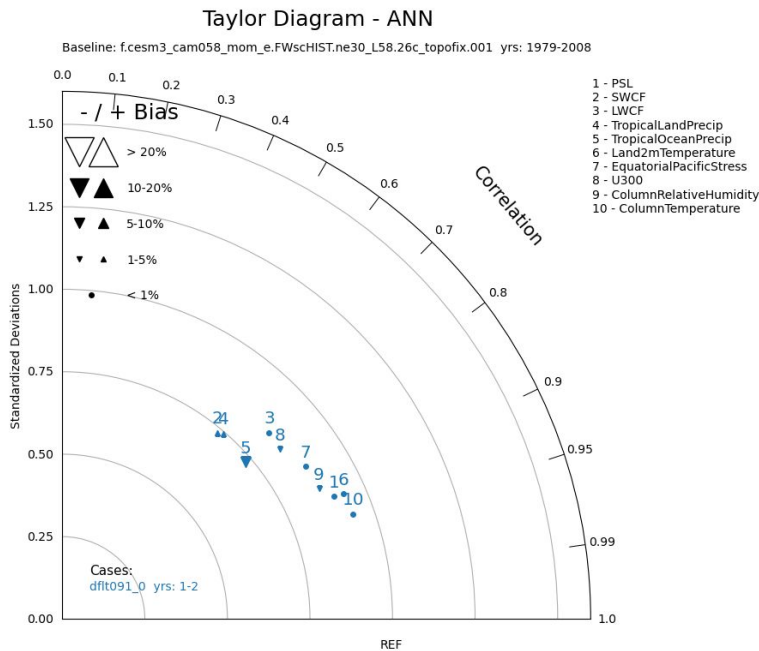
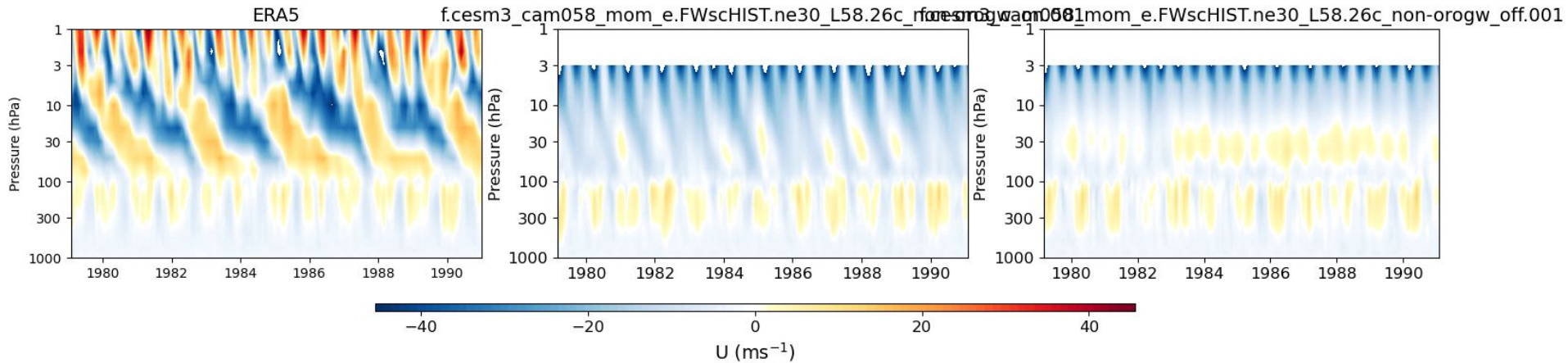
PSL - ANN - NHPolar



Test - Baseline

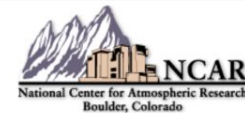


Others: Single Test Case



Website: Multiple Test Case

ADF Diagnostics



| [Multi-Case Home](#) || [Links](#) ▾ || [About](#) || [Contact](#) |

Click on case name for that ADF vs baseline page

Test Case 1: [b.cesm3_cam058_mom_e.B1850MOM.f09_L32_t061.cam6_cice5.016](#) - years: 30 - 40

Test Case 2: [b.cesm3_cam058_mom_e.B1850WscMOM.ne30_L58_t061.camdev_cice5.023](#) - years: 30 - 40

Test Case 3: [b.cesm3_cam058_mom_e.B1850WscMOM.ne30_L58_t061.camdev_cice5.026a](#) - years: 30 - 40

Test Case 4: [b.cesm3_cam058_mom_e.B1850WscMOM.ne30_L58_t061.camdev_cice5.026b](#) - years: 30 - 40

Baseline Case: [b.cesm3_cam058_mom_c.B1850WscMOM.ne30_L58_t061.009](#) - years: 30 - 40

All Case Comparison Plot Types

Tables

LatLon

TimeSeries

AMWG Tables: Multiple Test Case Comparison

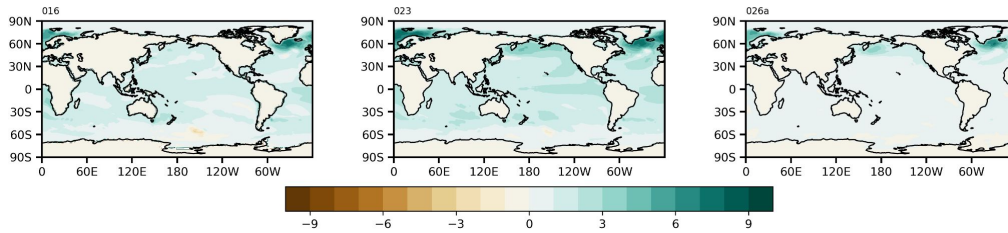
b.cesm3_cam058_mom_e.B1850MOM.f09_L32_t061.cam6_cice5.016
b.cesm3_cam058_mom_e.B1850WscMOM.ne30_L58_t061.camdev_cice5.023
b.cesm3_cam058_mom_e.B1850WscMOM.ne30_L58_t061.camdev_cice5.026a
b.cesm3_cam058_mom_e.B1850WscMOM.ne30_L58_t061.camdev_cice5.026b
b.cesm3_cam058_mom_c.B1850WscMOM.ne30_L58_t061.009
all_case_comparison

all case comparison

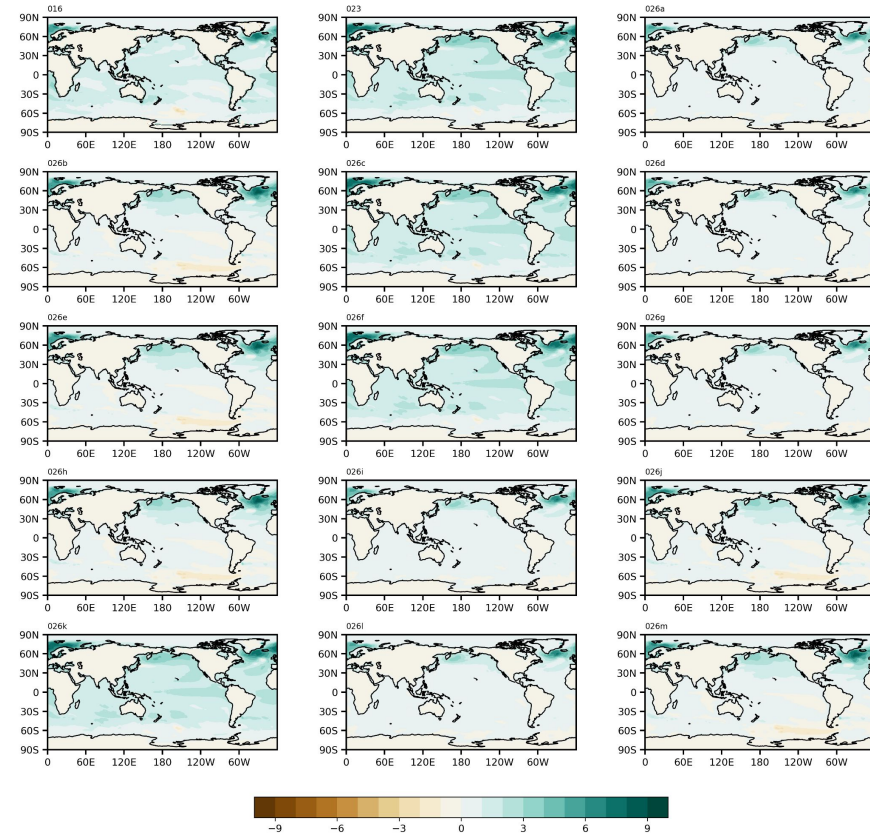
variable	unit	case 1	case 2	case 3	case 4	baseline
FLNT	W/m2	239.296 (1.255)	244.288 (6.247)	240.296 (2.255)	240.563 (2.522)	238.041
FSNT	W/m2	240.022 (1.131)	245.807 (6.916)	240.938 (2.047)	241.397 (2.506)	238.891
SST	K	215.809 (1.019)	216.057 (1.267)	215.152 (0.362)	215.213 (0.423)	214.79
TS	K	288.360 (1.518)	289.219 (2.377)	287.645 (0.803)	287.854 (1.012)	286.842
PSL	Pa	101134.260 (32.087)	101123.343 (21.170)	101106.024 (3.851)	101106.210 (4.037)	101102
RESTOM	W/m2	0.727 (-0.123)	1.519 (0.669)	0.642 (-0.208)	0.834 (-0.016)	0.85

Lat/Lon: Multiple Test Case Comparison

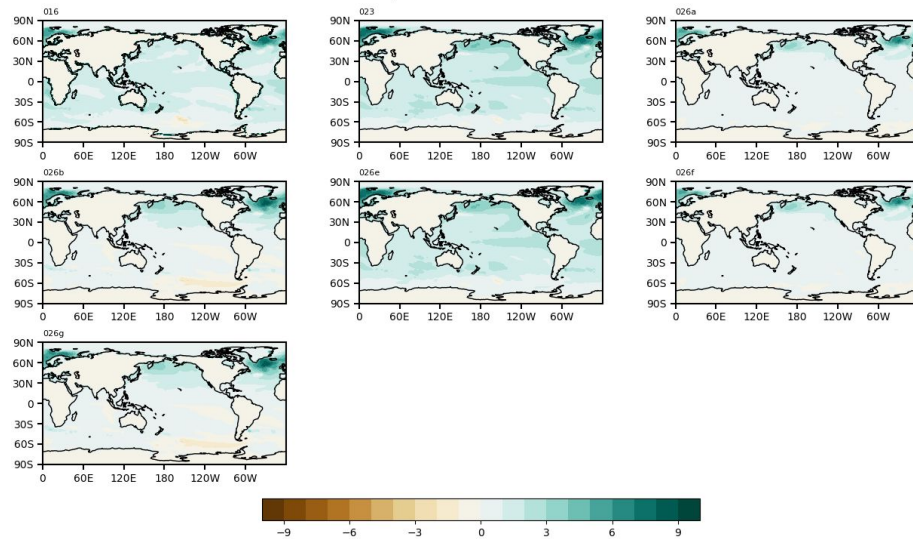
All Case Comparison: (Test - Baseline) SST ANN



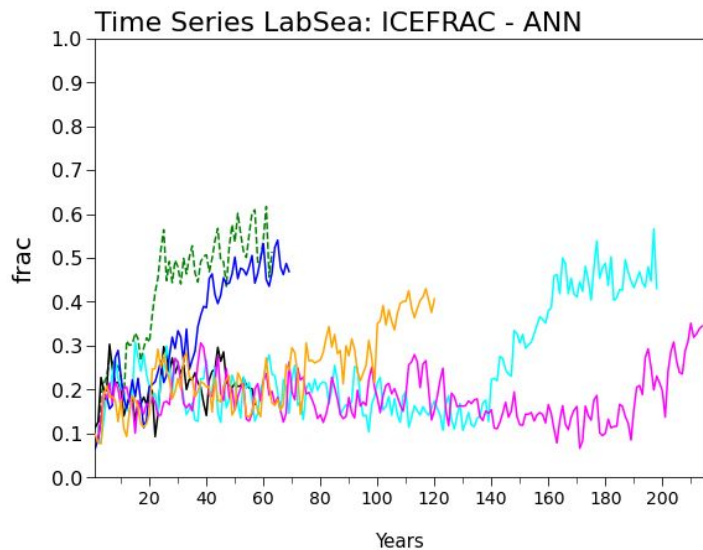
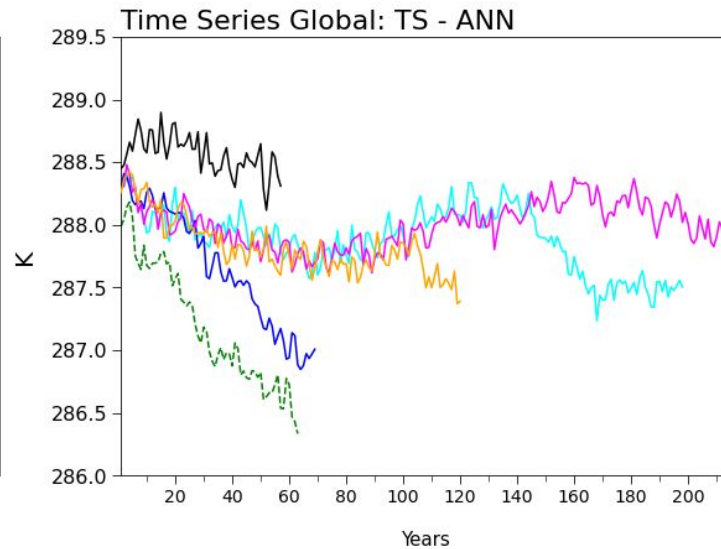
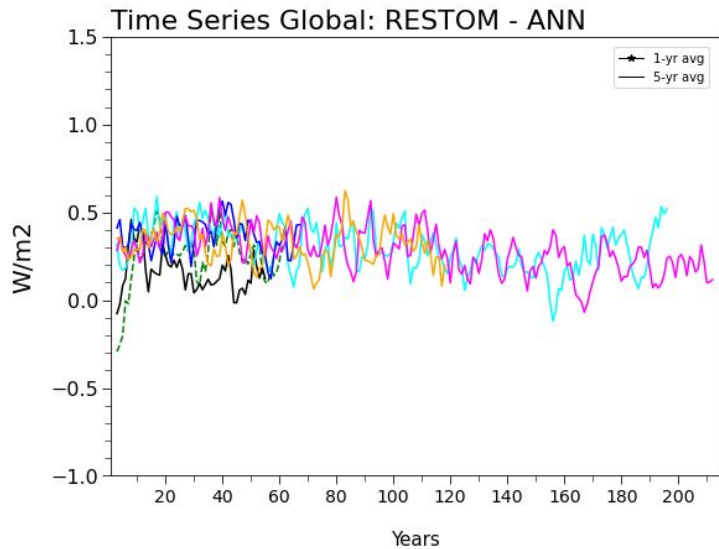
All Case Comparison: (Test - Baseline) SST ANN



All Case Comparison: (Test - Baseline) SST ANN



Timeseries: Multiple Test Case Comparison

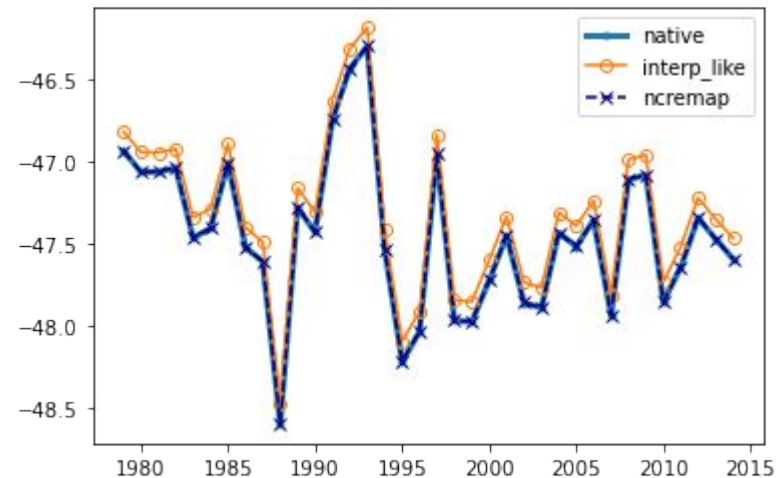


- b.cesm3_cam058_mom_c.B1850WscMOM.ne30_L58_t061.009
- b.cesm3_cam058_mom_e.B1850MOM.f09_L32_t061.cam6_cice5.016
- b.cesm3_cam058_mom_e.B1850WscMOM.ne30_L58_t061.camdev_cice5.026c
- b.cesm3_cam058_mom_e.B1850WscMOM.ne30_L58_t061.camdev_cice6.026e
- b.cesm3_cam058_mom_e.B1850WscMOM.ne30_L58_t061.camdev_cice5.026f
- b.cesm3_cam058_mom_e.B1850WscMOM.ne30_L58_t061.camdev_cice5.026g

What's Next?

On Deck

- ❖ Limited functionality with CMIP6 time series files
- ❖ Dask - multiprocessing for plots
- ❖ Interface more with GeoCAT
- ❖ MDTF to run in ADF
- ❖ ncremap regridding (currently using xarray's interp_like)
- ❖ Limited set of default observational dataset
 - ERAI_all_climo.nc
 - U_ERA5_5S_5N_1979_2019.nc
 - CERES_EBAF_Ed4.1_2001-2020.nc
- ❖ Updated website



Feedback & Contributions

Weekly Hack-a-thons (Zoom, every Thurs. 2-4pm) - [Readme](#)

- ❖ Dedicated time for learning and improving the new package
- ❖ Open to all skill levels and experts are available to help
- ❖ Please stop by with any problems, suggestions, or if you want to know more about the ADF package

Have comment/suggestion?

- ❖ Post a [GitHub Discussion](#)

Something broken/incorrect?

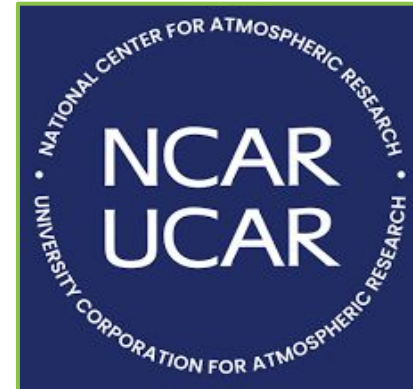
- ❖ Make a [GitHub Issue](#)

Community repo for ADF-related code: https://github.com/NCAR/AMP_toolbox

- ❖ Place designed for community to post helpful code, ideas, etc.
 - Provided as-is, AMP staff won't vet this like ADF
 - Potential for ideas to be added to ADF

Thanks to many for the hard work:

- ❖ Cecile Hannay
- ❖ Jesse Nusbaumer
- ❖ Brian Medeiros
- ❖ Julie Caron
- ❖ Dani Coleman
- ❖ Andrew Gettleman
- ❖ Isla Simpson
- ❖ Dan Marsh
- ❖ Judith Berner
- ❖ Will Chapman
- ❖ Probably more that will remind me later...



Questions?

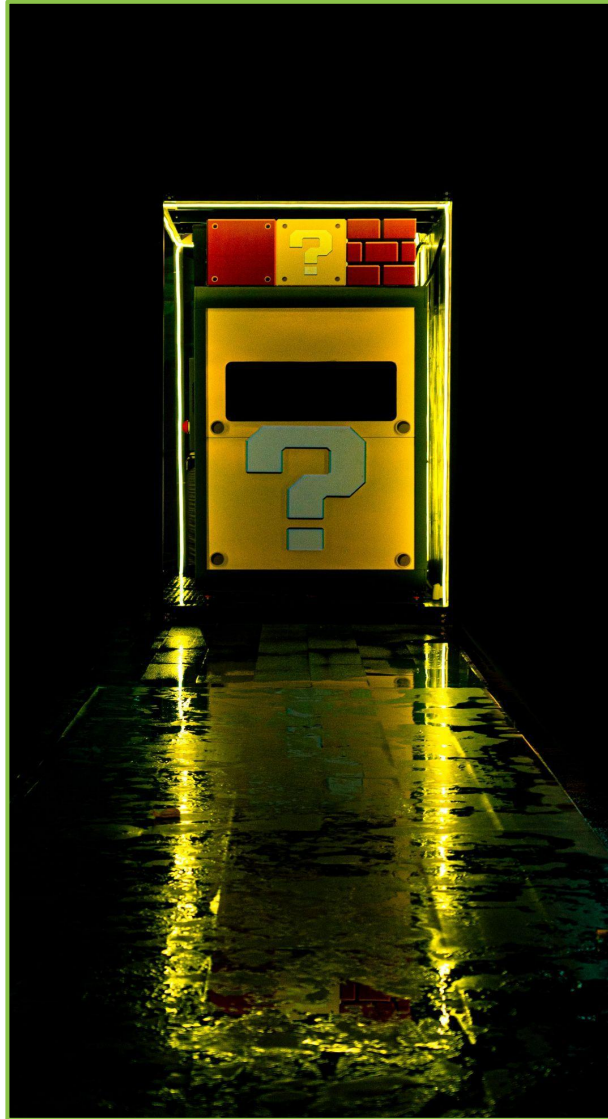


Photo by [Minator Yang](#) on [Unsplash](#)