Recent ADF developments

and collaboration with CUPiD

Jesse Nusbaumer,
Software Engineer, NCAR/CGD

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Credits

Lead roles

- Justin Richling
- Dani Coleman
- Brian Medeiros

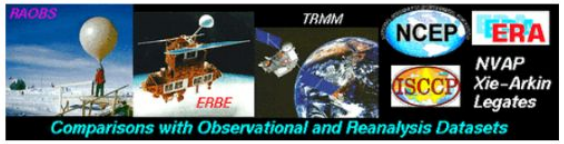
Supporting cast

- Rebecca Buchholz
- Julie Caron
- Will Chapman
- Andrew Gettelman
- Cecile Hannay
- Shawn Honomichl
- Teagan King
- Mike Levy
- Dan Marsh
- Lev Romashkov
- Isla Simpson
- Ben Stephens
- Adam Phillips
- Feng Zhu

Background (AMWG diagnostics)

AMWG Diagnostics Package

f.e21.FWscHIST.ne30_L48_BL10_cam6_3_035.tphysac_reorder_zm2_clubb-exp2.001.hf2
and
OBS data (info)



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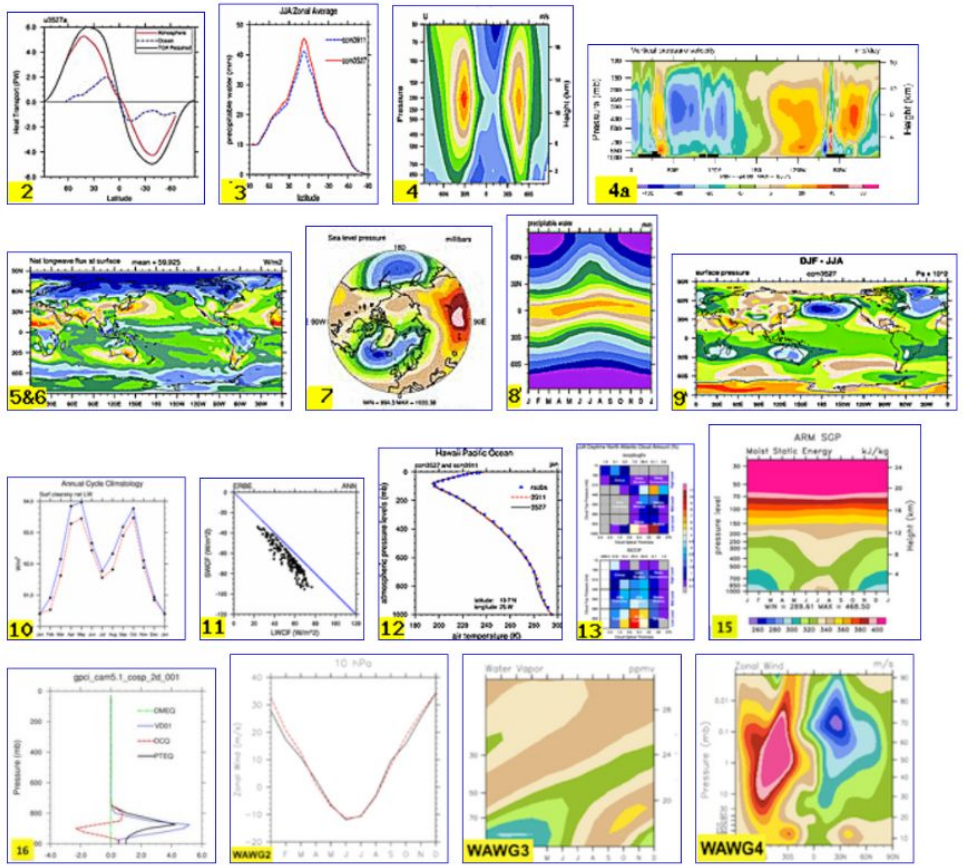
1 Tables of ANN, DJF, JJA, global and regional means and RMSE.
2 Line plots of annual implied northward transports.
3 Line plots of DJF, JJA and ANN zonal means
4 Vertical contour plots of DJF, JJA and ANN zonal means
4a Vertical (XZ) contour plots of DJF, JJA and ANN meridional means
5 Horizontal contour plots of DJF, JJA and ANN means
6 Horizontal vector plots of DJF, JJA and ANN means
7 Polar contour and vector plots of DJF, JJA and ANN means
8 Annual cycle contour plots of zonal means
9 Horizontal contour plots of DJF-JJA differences
10 Annual cycle line plots of global means
11 Pacific annual cycle, Scatter plot plots
12 Vertical profile plots from 17 selected stations
13 Cloud simulators plots
14 Taylor Diagram plots
15 Annual Cycle at Select Stations plots
16 Budget Terms at Select Stations plots

WAWG Set Description

1 Tables of regional min, max, means
2 Seasonal cycle line plots of SP, SM, EQ, NM, NP zonal means (vertical log scale)
3 Vertical season cycle plots of SP, SM, EQ, NM, NP zonal means (vertical log scale)
4 Vertical contour plots of JUN, DEC, DJF, MAM, JJA, SON and ANN zonal means (vertical log scale)

Click on Plot Type



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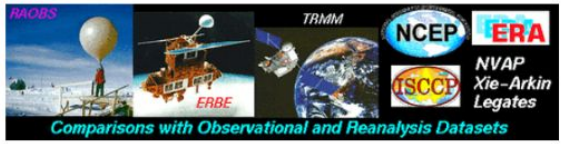

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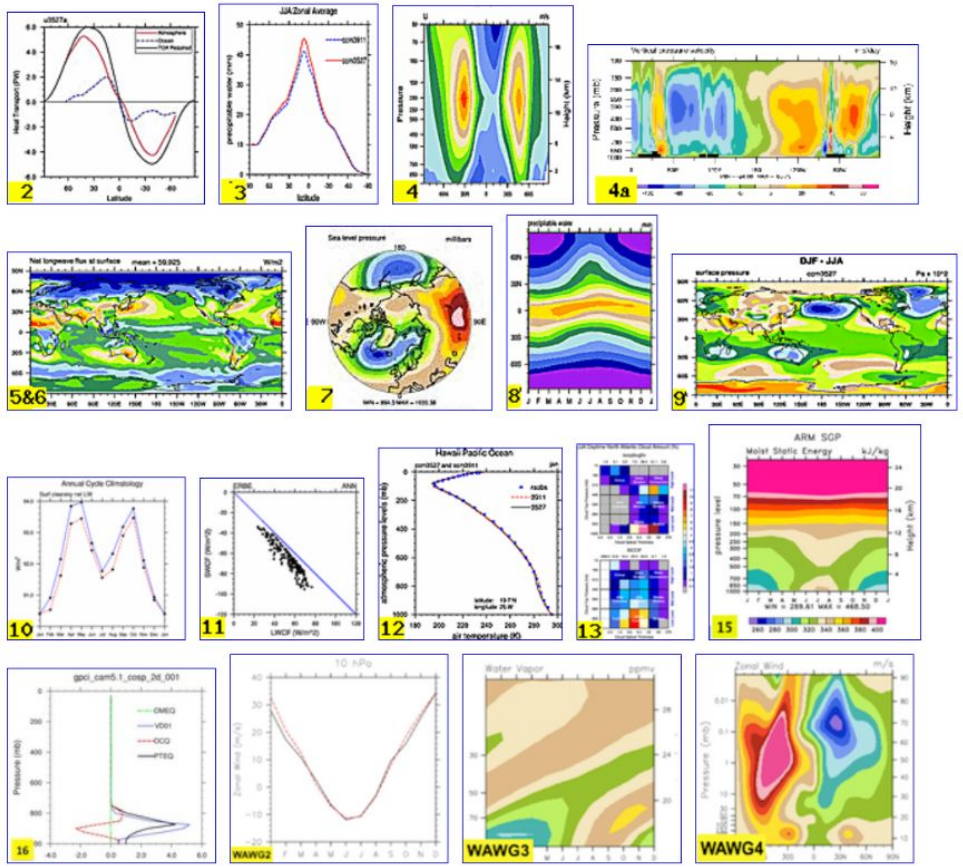

A collection of NCL scripts wrapped in a (C-)Shell Script. In other words unsustainable legacy code.

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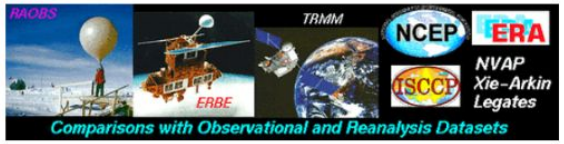

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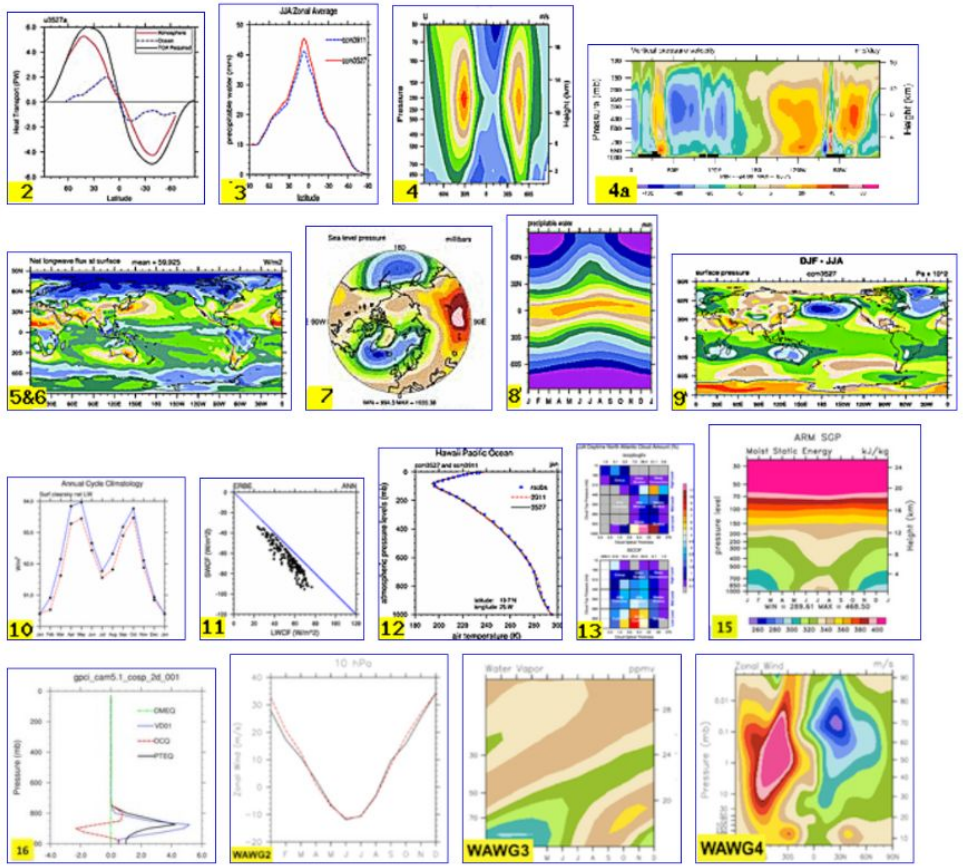

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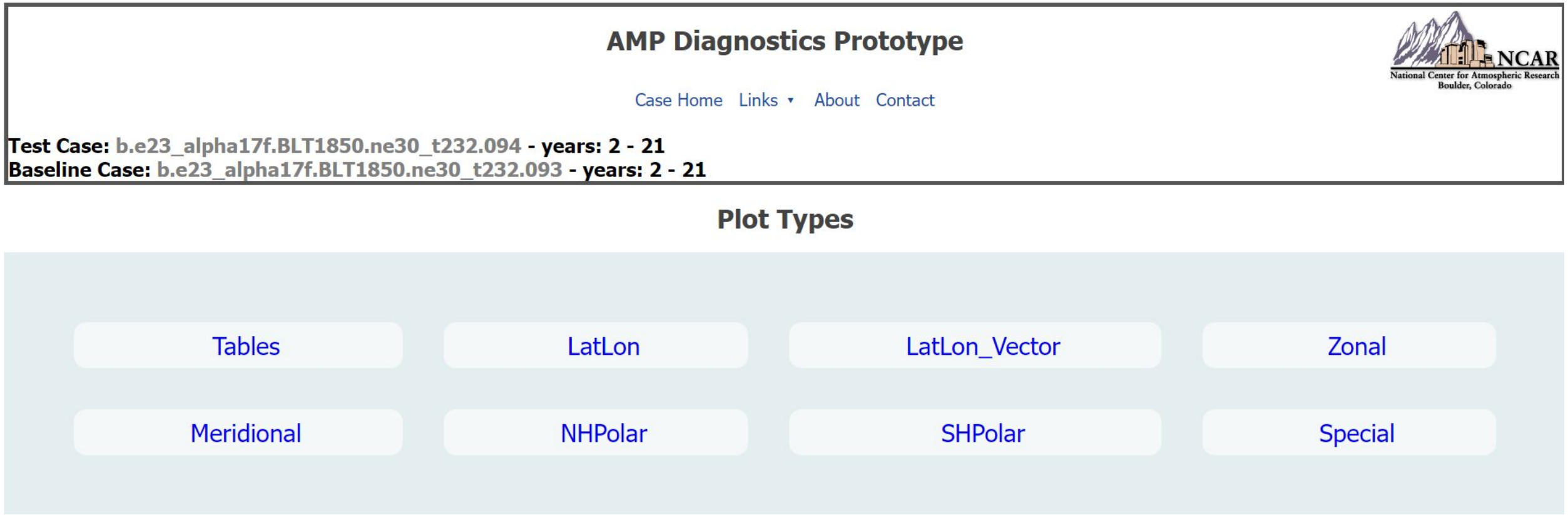
Also an incredible success, was used by scientists for over 20 years.

So we needed a replacement.

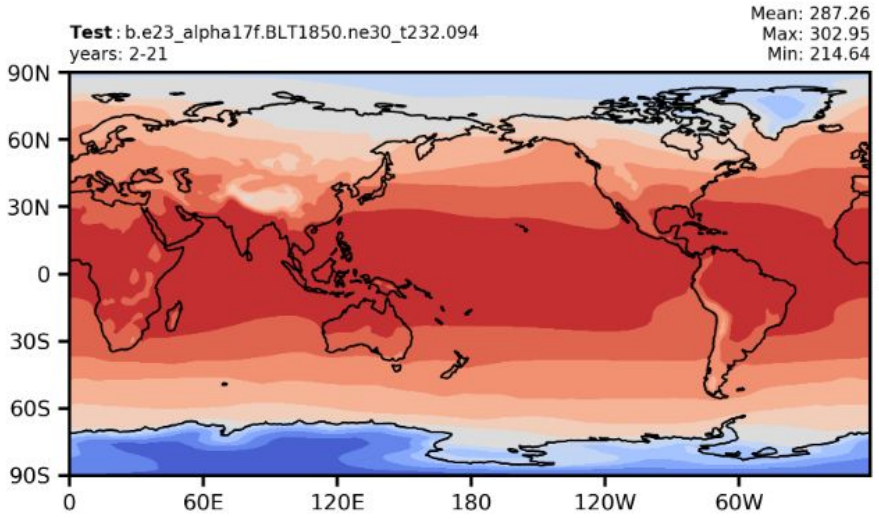
ADF Intro

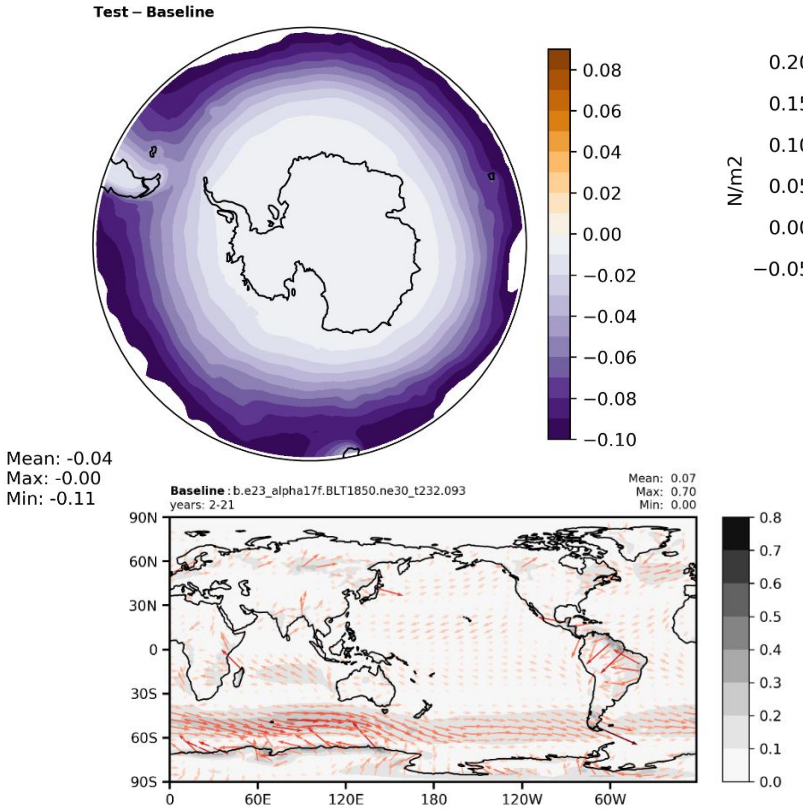


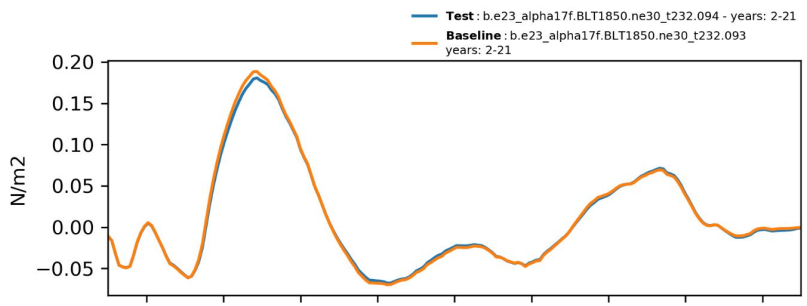
The AMWG Diagnostics Framework (ADF) is a Python-based replacement for the original diagnostics, including an attempt to use widely-supported tools (e.g. xarray) and more modern software practices (e.g. OOP).

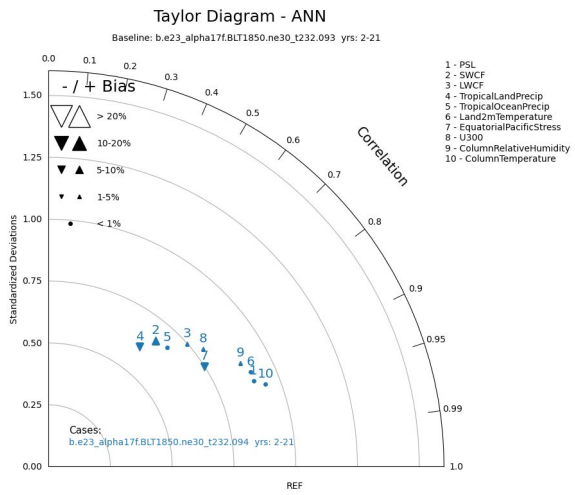
ADF Intro

VARIABLE	UNIT	CASE	BASELINE	DIFF
RESTOM	--	-0.243	0.198	-0.441
FLNT	W/m2	241.478	241.877	-0.399
FLNTC	W/m2	264.464	264.355	0.109







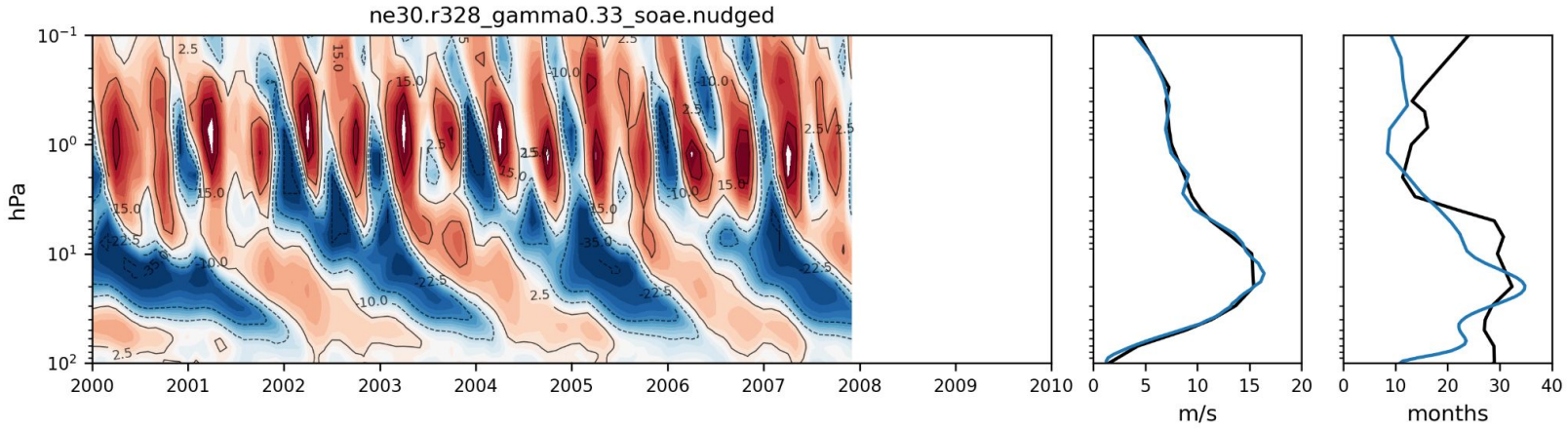


Examples of standard output from the ADF

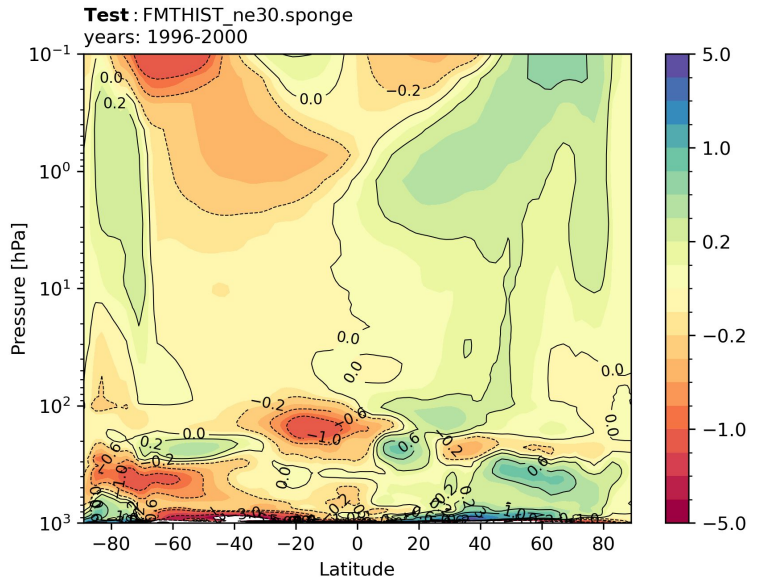
New ADF features

High-top CAM/WACCM plots

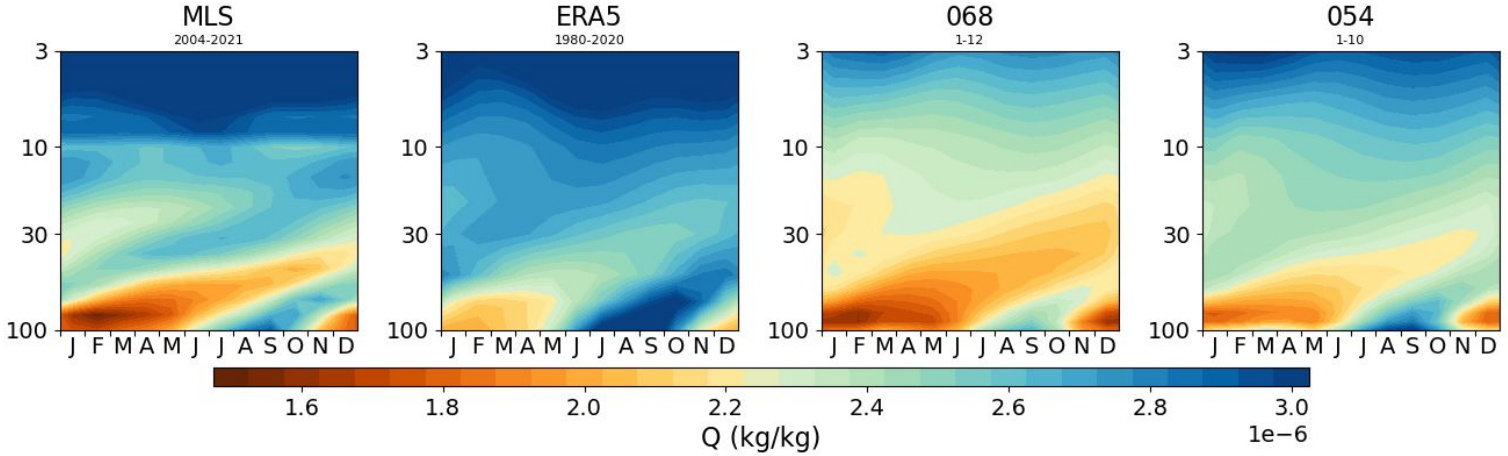
QBO



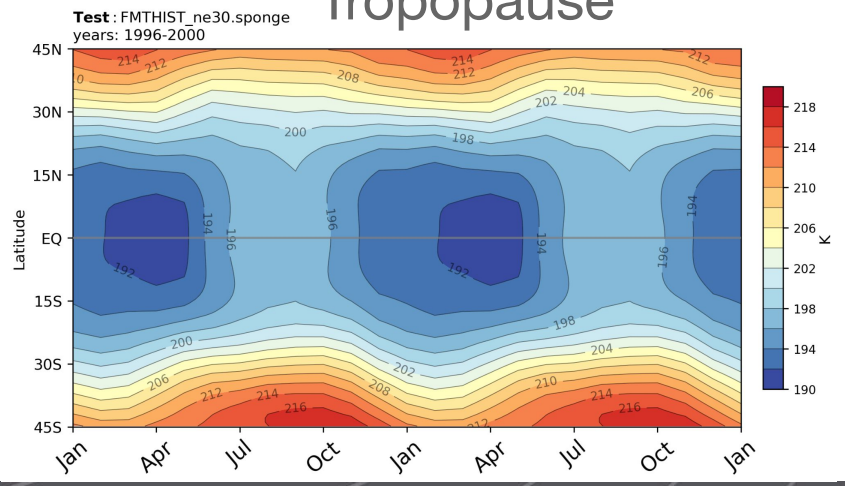
TEM



Tape Recorder

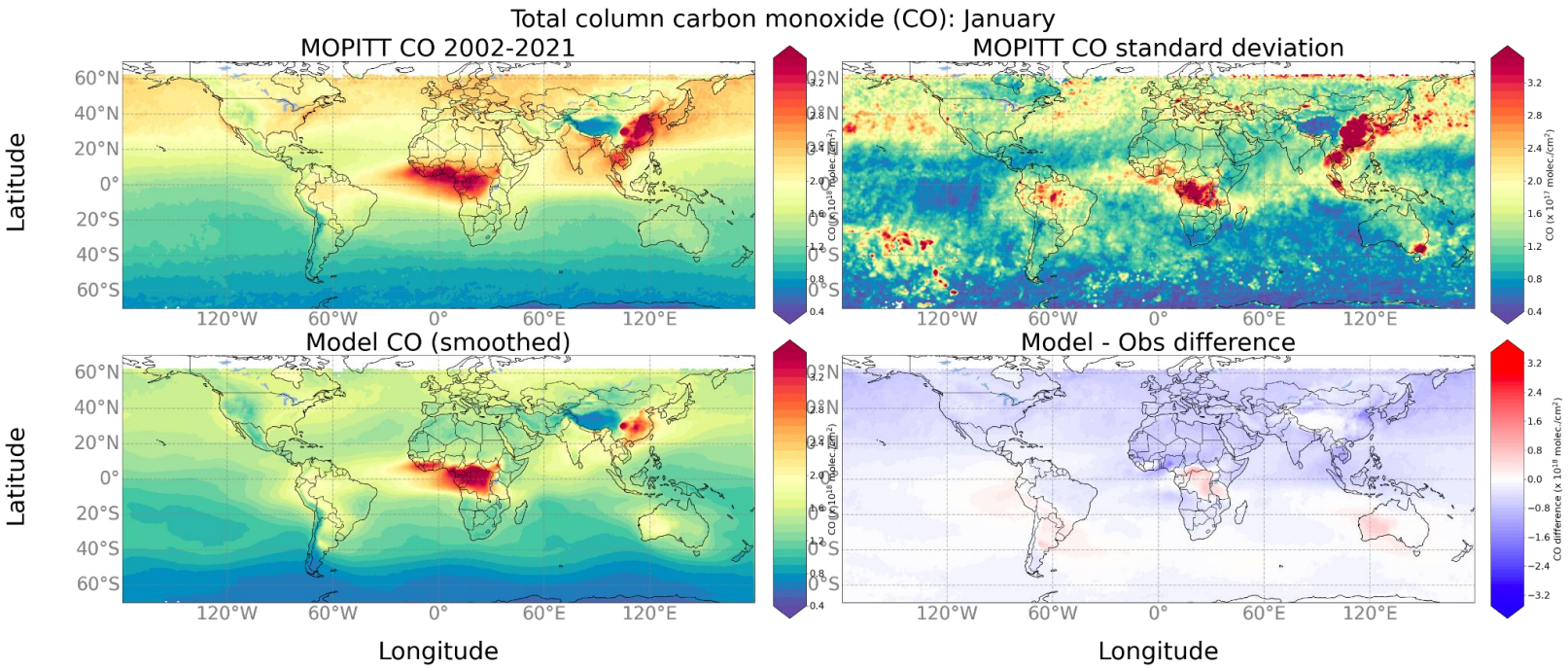


Tropopause

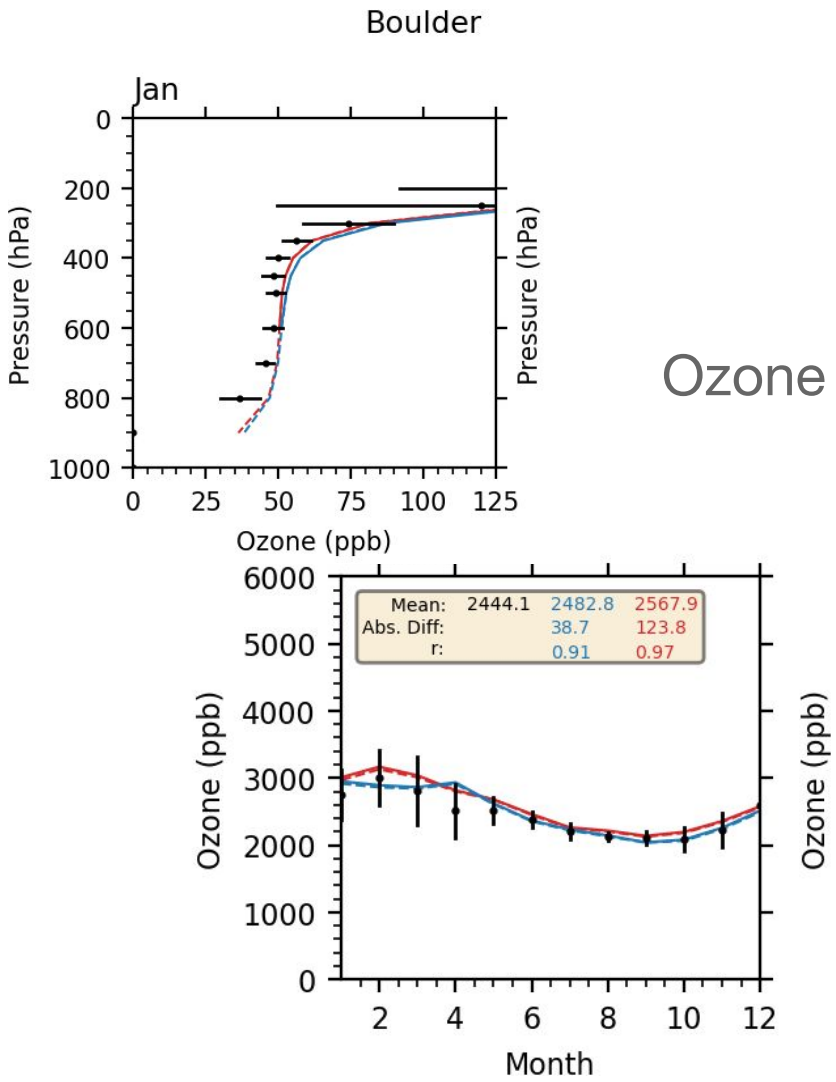


CAM-Chem

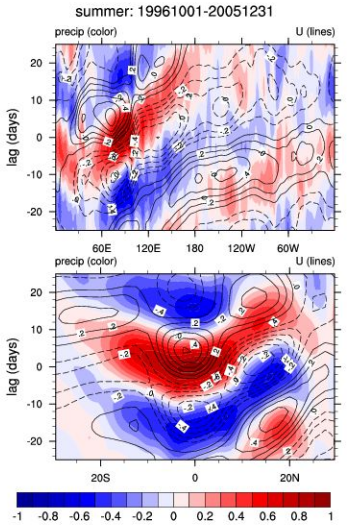
Carbon Monoxide

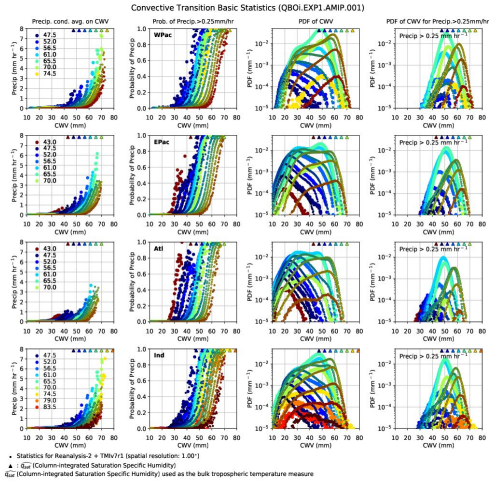


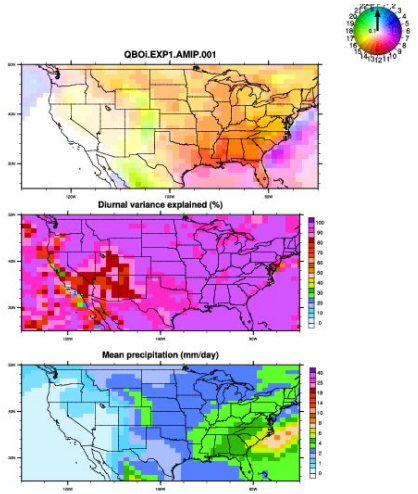
Ozone

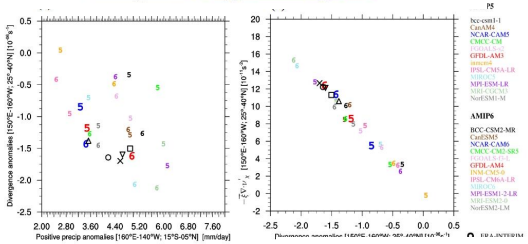


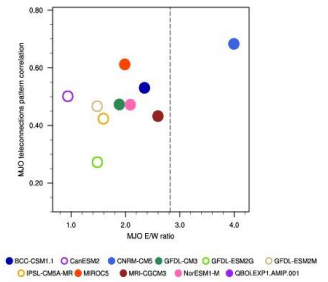
NOAA Model Diagnostic Task Force (MDTF)
Process-Oriented Diagnostics
Available by running ADF

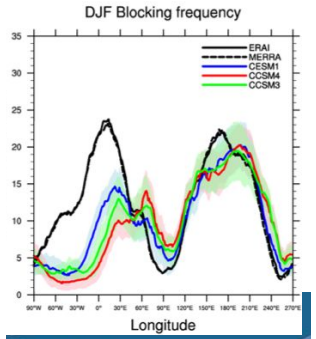


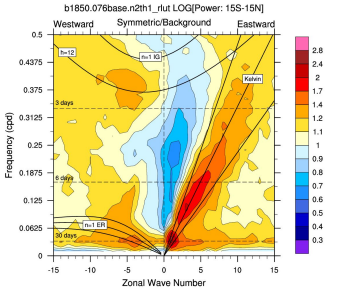












Diagnostic
Blocking Neale
Convective Transition Diagnostics
Diurnal Cycle of Precipitation
Eulerian Storm Track
Extratropical Variance (EOF 500hPa Height)
Forcing Feedback Diagnostic
Mixed Layer Depth
MJO Propagation and Amplitude
MJO Spectra and Phasing
MJO Teleconnections
Moist Static Energy Diagnostic Package
Ocean Surface Flux Diagnostic
Precipitation Buoyancy Diagnostic
Rossby Wave Sources Diagnostic Package
Sea Ice Suite
Soil Moisture-Evapotranspiration coupling
Stratosphere-Troposphere Coupling: Annular Modes
Stratosphere-Troposphere Coupling: Eddy Heat Fluxes
Stratosphere-Troposphere Coupling: QBO and ENSO stratospheric teleconnections
Stratosphere-Troposphere Coupling: Stratospheric Ozone and Circulation
Stratosphere-Troposphere Coupling: Stratospheric Polar Vortex Extremes
Stratosphere-Troposphere Coupling: Vertical Wave Coupling
Surface Albedo Feedback
Surface Temperature Extremes and Distribution Shape
TC MSE Variance Budget Analysis
Top Heaviness Metric
Tropical Cyclone Rain Rate Azimuthal Average
Tropical Pacific Sea Level
Wavenumber-Frequency Spectra

How to call: PR in revision that adds controls to ADF yaml file, ability to make timeseries from a list of history files

```
diag_cam_climo:
    hist_str: [cam.h2,cam.h0]
diag_mdtf_info:
    mdtf_run: True
    pod_list      :  [ "MJO_suite" ]
```

Coupling with CUPiD

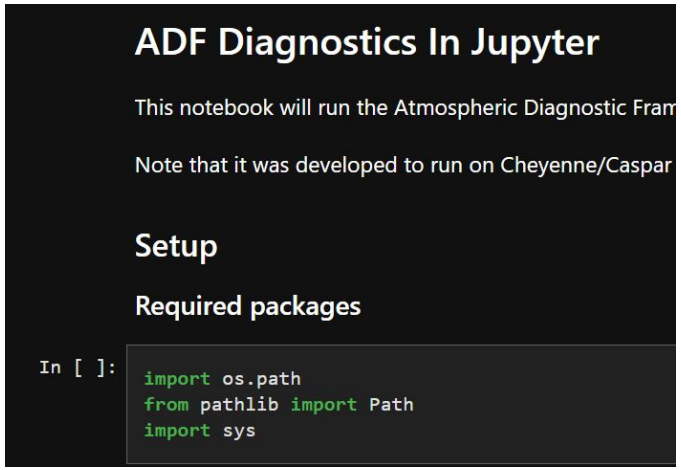
Current Status

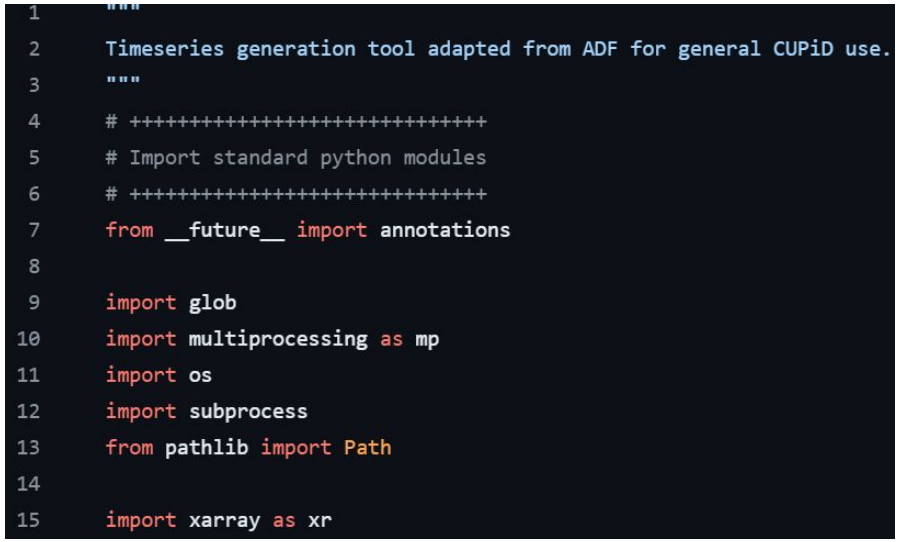
- Example ADF Notebook implemented in CUPiD
- Time Series functionality pulled out into core CUPiD code so all components can use it (or so that it can be easily replaced with a better system).

Future Efforts

- Run ADF as a script instead of as a notebook (which should provide CUPiD full ADF functionality).

- Pull out additional ADF-internal routines (e.g. climatology generation) to make them available CUPiD-wide.



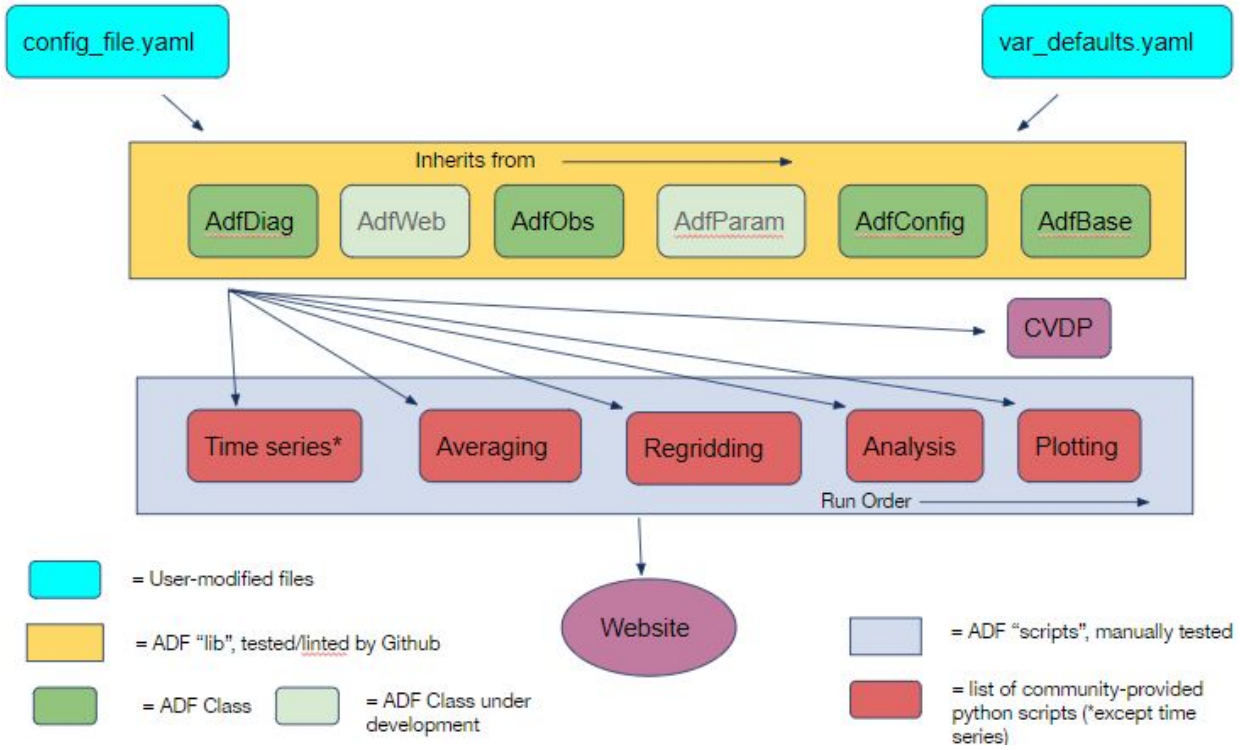


Future Design plans

- Reduce amount of class inheritance (instead make more independent classes that use each other).
- Implement more dask (distributed parallel computing) functionality
- Implement more automated unit testing

CUPiD-ADF

- Allow ADF to be configured via python dictionary (so CUPiD can control high-level configuration).
- Allow ADF to use provided computing/dask environment.



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- Hackathons and Interns will not save the day.
- It is still unclear to me where to draw the line between what should be in a diagnostics package and what should just stay with a particular scientist/journal article.
- High resolution is going to just mess all our stuff up.

Thanks for listening!

Any Questions?

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