Aerosol Diagnostic Package

This document describes the structure of this diagnostic package for aerosols and aerosol-cloud interactions, as well as the direction of how to run and modify this package. More functions and updates are under development.

The code is available on Github. Observational data is currently privately available on NERSC (/global/cfs/cdirs/m3662/sqtang/Aerosol_diag_pkg/data/). Currently there are six field campaigns (HSICALE, ACEENA, CSET, MAGIC, MARCUS, SOCRATES) available. The total observational data volume is ~24G.

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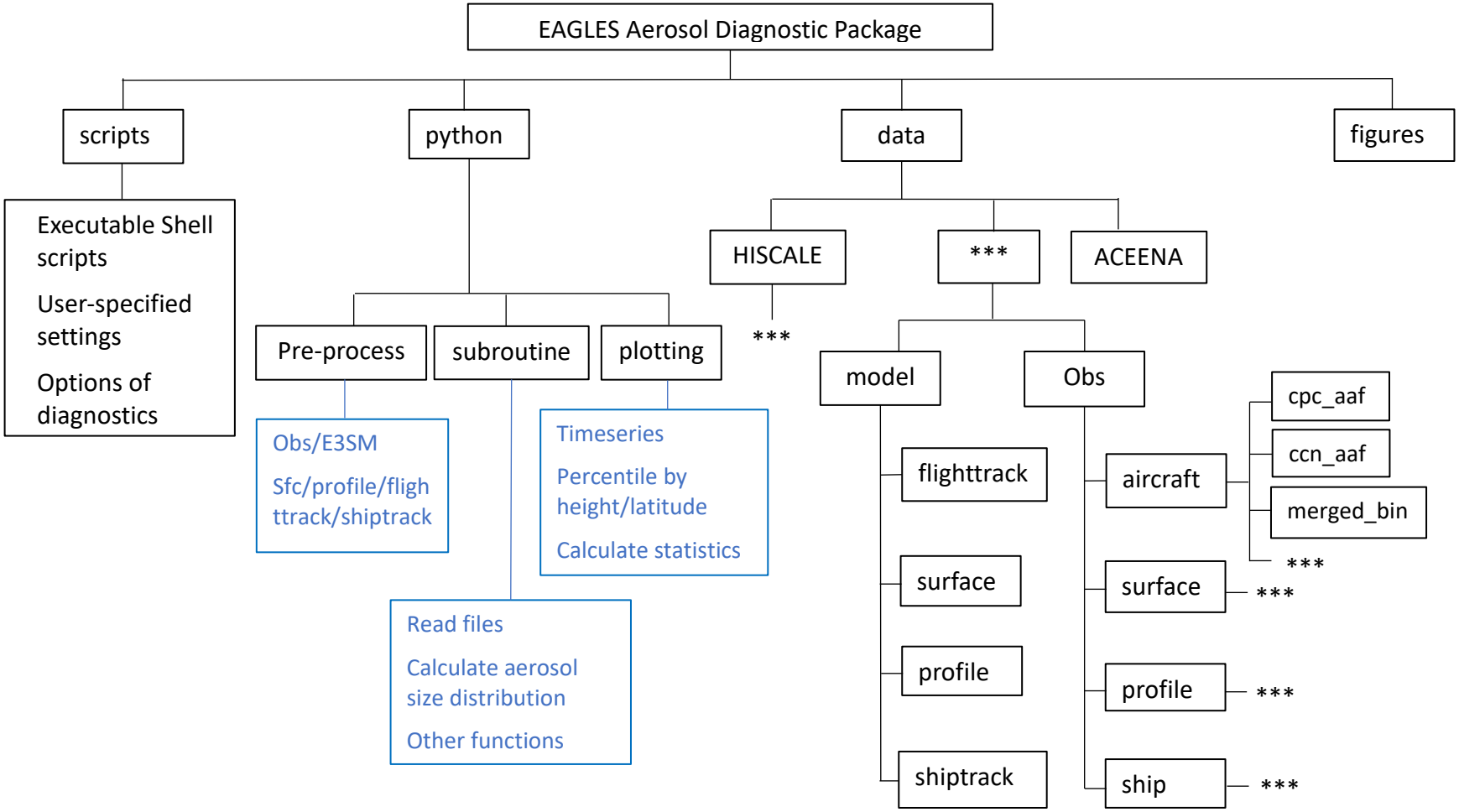
EAGLES Aerosol Diagnostic Package
scripts
python
data
figures
Executable Shell scripts
User-specified settings
Options of diagnostics
Pre-process
subroutine
plotting
Obs/E3SM
Sfc/profile/flighttrack/shiptrack
Timeseries
Percentile by height/latitude
Calculate statistics
Read files
Calculate aerosol size distribution
Other functions
HISCALE
***
***
ACEENA
***
model
Obs
flighttrack
surface
profile
shiptrack
aircraft
surface
profile
ship
cpc_aaf
ccn_aaf
merged_bin
***
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***
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Preprocessing:

The preprocessing code starts from daily E3SM output data in 1hr resolution. Because of large size of model output, we only need the output in the regions covering the field campaign sites (or flight/ship tracks). The E3SM running script should contain field campaign domain information as below:

```
nhtfrq       = 0,-24,-3,-1
mfilt        = 1,1,8,24
                …     …       …
fincl4       = 'PS',       !! dynamical fields
               'U',        !! …
                …     …       …
fincl4lonlat = '260e:265e_34n:39n',  ! SGP (~5x5 degs)
               '330e:335e_37n:42n',  ! ENA
               '202e:240e_19n:40n',  ! CSET
               '202e:243e_20n:35n',  ! MAGIC
               '60e:160e_42s:70s',   ! MARCUS
               '133e:164e_42s:63s',  ! SOCRATES
```

With the above setups, the model output files *.cam.h3.yyyy-mm-dd-00000.nc will contain hourly variables for each field campaign domain (e.g., “PS_ 260e_to_265e_34n_to_39n” for PS at SGP region). In this preprocessing step, we extract the model variables at the surface site, along the flight tracks or along the ship tracks depending on what measurements are available for each field campaign.

Most of the observations are directly read from the “raw” (ARM standard or NCAR standard) files. However, aircraft platform usually includes a few different types of instruments measuring aerosol size distribution in different size ranges. Merging them to create a broader size distribution is useful to evaluate model results. This is included in the preprocessing step. Note: the merged size distribution data also includes flight information, cloud flag and CVI mode status. Currently it is used for all plotting code of aircraft data in HSICALE and ACEENA to provide flight information.

To run the preprocessing code:

1. Enter scripts/ directory
2. Edit settings.py to setup the data paths. Campaign names, model labels and IOPs do not need to change since they will be overwritten by the .csh file
3. Edit scripts_preprocess.csh to choose the campaign names, model labels, IOPs and the types of preprocesses you want to perform.
4. Run scripts_preprocess.csh

5. Check data/*campaign*/model/ and data/*campaign*/obs/aircraft/merged_bin/ for the output data

an alternative way to run the preprocessing code is to run individual python code:

1. Enter python/preprocessing
2. Edit settings.py
3. Run the preprocessing code you want:

```
>> python prep_*.py
```

Plotting:

Current diagnostic package contains several types of plots/statistics:

For aircraft measurements:

- height/location of aircraft trajectories
- timeseries of aerosol number, CCN number, aerosol composition concentration for each flight
- timeseries of aerosol size distribution for each flight
- mean aerosol size distribution for each IOP
- percentiles of aerosol properties in different heights
- vertical profiles of cloud fraction and LWC
- statistics of Aerosol number (mean, bias, correlation, RMSE) output as txt file

for surface measurements:

- timeseries of aerosol number, CCN number, aerosol composition concentration for each IOP
- timeseries of aerosol size distribution for each IOP
- diurnal cycle of these surface measurements for each IOP
- mean aerosol size distribution for each IOP
- statistics of Aerosol number (mean, bias, correlation, RMSE) output as txt file.

For ship measurements:

- latitude, temperature and RH for each ship trip
- timeseries of aerosol number and CCN number for each ship trip
- timeseries of aerosol size distribution for each ship trip
- mean aerosol size distribution
- percentiles of aerosol properties in different latitudes

To run the plotting code:

1. Enter scripts/ directory
2. Edit settings.py to setup the data paths. Campaign names, model labels and IOPs do not need to change since they will be overwritten by the .csh file
3. Edit scripts_plotting_jobsubmit.csh to choose the campaign names, model labels, IOPs and the types of figures you want to plot
4. Submit job:
   >> sbatch scripts_plotting_jobsubmit.csh
5. Check figures/*campaign*/ for the figures

an alternative way to make plots is to run individual python code:

1. Enter python/plotting
2. Edit settings.py
3. Run the plotting code you want:
   >> python xxx.py

Note: on Constance sometimes there could be memory errors ("Bus error") for one or two .py files. This can be solved by running the code interactively. You can download the package and run it in local machine, or do the following on Constance:

1. Remove the line of "matplotlib.use('AGG')" in the *.py file
2. Open a "Xming" on PC (on Mac, make sure X window is connected)
3. Run the plotting code interactively (>>./scripts_***.csh or >>python ***.py)