5.17 File Format

The AENEAS HDF5 file format saves everything used by the model (including the data used by TIE-GCM). The overall structure is shown below. Bulleted lists show the internal directory structure:

AENEAS_version - version of AENEAS used in creating the file

altitude - 1D altitude grid for the model

analysis - Output including assimilated data

- mean - (if enabled in config via outputMeanStdVars, includes variables requested). Mean across ensemble members
  - DEN - Mean of total neutral mass density
  - NE - Mean of electron density
- std - (if enabled in config via outputMeanStdVars). Standard deviation across ensemble members
  - DEN - Standard deviation of total neutral mass density
  - NE - Standard deviation of electron density
- member000 - one group per ensemble member containing all the data
- ...
- memberXXX - members denoted with 3 digits (max commonly member031)
  - attributes
    - Conventions - TIE-GCM required parameter
    - create_date - time the file was created
    - CTP - crosstail potential value used for this ensemble member
    - delhist_mins - timestep (minutes) of the model
    - F10.7 - the observed 10.7 cm solar flux value for the time period ($1 \times 10^{-22}\, Wm^{-2}Hz^{-1}$)
    - history_type - TIE-GCM history type (primary)
    - host - computer hostname
    - HP - hemispheric power value used for this ensemble member
    - initial_mtime - the previous time step
    - lev_to_hPa_method1 - equation for converting levels to pressure ($p_0 e^{-lev(k)}$)
    - lev_to_hPa_method2 - equation for converting levels to pressure (($1 \times 10^{-3} p_{0_{model}} e^{-lev(k)}$)
    - missing_value - values to use if missing data (1e36)

    - model_name - background model name
    - nhist - number of TIE-GCM histories per file (1)
    - output_file - location of the model output
    - potential_model - which potential model was used (Heelis or Weimer)
    - source_file - source TIE-GCM file used for the model run
    - source_mtime - time of the source file
    - system - type of system the model was run on
    - tuv_lbc_intop - should lower boundary conditions of temperatures and wind speeds be stored in top k slots (1 or 0)
  - dimensions
    - datelen - maximum digits for a date (24)
    - dtidedim - dimensions of the tide array (2)
    - filelen - longest allowable filename length (1024)
    - ilev - number of TIE-GCM pressure levels (57 - resolution dependent)
    - imlev - number of AENEAS height levels
    - lat - number of latitude values
    - latlon - number of latitude and longitude grids (2)
    - lev - number of TIE-GCM pressure levels (57 - resolution dependent)
    - lon - number of longitude values
    - mlat - number of magnetic latitude value
    - mlev - number of magnetic altitude levels
    - mlon - number of magnetic longitude values
    - mtimedim - number of dimensions for time array (3 - day of year, hour, minute)
    - sdtidedim - number of values for each tide array (10)
    - time - maximum number of allowed dimensions for time (0 - unlimited)
  - grids (Variables of most interest to users)
    - AR - argon (mass mixing ratio (mmr))
    - HE - helium (mmr)
    - N2D - nitrogen, ^2D orbital (mmr)
    - N4S - nitrogen, ^4S orbital (mmr)
    - NE - electron density (m^{-3})
    - NO - nitric oxide (mmr)

        - O1 - atomic oxygen (mmr)
        - O2 - molecular oxygen (mmr)
        - O2P - molecular oxygen + ion (m^{-3})
        - OMEGA - vertical motion (s^{-1})
        - OP - atomic oxygen + ion (m^{-3})
        - POTEN - electric potential (volts)
        - TE - electron temperature (K)
        - TI - ion temperature (K)
        - TN - neutral temperature (K)
        - UN - neutral zonal wind (ms^{-1})
        - VN - neutral meridional wind (ms^{-1})
        - Z - geopotential height (km)
    - metadata
        - TIEGCM_primary_source - Filepath of the TIE-GCM primary netcdf file used to initialize the member
    - tiegcm_required
        - grids_nm
            - AR_NM - argon (time n-1)
            - HE_NM - helium (time n-1)
            - N4S_NM - nitrogen (time n-1)
            - NO_NM - nitric oxide (time n-1)
            - O1_NM - atomic oxygen (time n-1)
            - O2_NM - molecular oxygen (time n-1)
            - OP_NM - atomic oxgeyn + ion (time n-1)
            - TLBC - lower boundary conition of TN
            - TN_NM - neutral temperature (time n-1)
            - ULBC - lower boundary condition of UN
            - UN_NM - neutral zonal wind (time n-1)
            - VLBC - lower boundary condition of VN
            - VN_NM - neutral meridional wind (time n-1)
        - misc
            - Kp - Kp value used for the ensemble member

- LBC - interface level of t,u,v lower boundary condition
- al - lower magnetic auroral activity index (nT)
- alfac - characteristic Maxwellian energy of polar cusp electrons (keV)
- alfad - characteristic Maxwellian energy of drizzle electrons (
- bximf - Bx component of IMF (nT)
- byimf - By component of IMF (nT)
- bzimf - Bz component of IMF (nt)
- colfac - ion/neutral collision factor
- coupled_cmit - couple with CISM/CMIT (1 or 0)
- crit1 - critical cross over latitude 1 (deg)
- crit2 - critical cross over latitude 2 (deg)
- ctmt_ncfile - location of ctmt netCDF file
- ctpoten - cross-tail potential value used by ensemble member (kV)
- day - calendar day
- dtide - amplitude and phase of diurnal tide model (1,1)
- e1 - peak energy flux in noon sector of the aurora ($ergs\,cm^{-2}\,s^{-1}$)
- e2 - peak energy flux in midnight sector of the aurora ($ergs\,cm^{-2}\,s^{-1}$)
- ec - column energy input of polar cusp electrons ($ergs\,cm^{-2}\,s^{-1}$)
- ed - column energy input of drizzle electrons ($ergs\,cm^{-2}\,s^{-1}$)
- f107a - 81-day average 10.7 cm solar flux ($1 \times 10^{-22}\,Wm^{-2}Hz^{-1}$)
- f107d - daily 10.7 cm solar flux ($1 \times 10^{-22}\,Wm^{-2}Hz^{-1}$)
- gpi_ncfile - location of the GPI netCDF file
- grav - gravitational acceleration
- gswm_mi_di_ncfile - global scale wave model migrating diurnal tide file
- gswm_mi_sdi_ncfile - global scale wave model migrating semi-diurnal tide file
- gswm_nm_di_ncfile - global scale wave model non-migrating diurnal tide file
- gswm_nm_sdi_ncfile - global scale wave model non-migrating semi-diurnal tide file
- h1 - Gaussian half-width of the noon auroral oval (deg)
- h2 - Gaussian half-width of the midnight auroral oval (deg)
- hpower - hemispheric power (GW)

- ilev - the interface levels
- imf_ncfile - location of the IMF netCDF file
- imlev - magnetic interface levels
- iter - number of time steps from model time 0,0,0
- joulefac - joule heating factor
- lev - midpoint levels
- mag - lat, lon coordinates of South and North magnetic poles
- mlat - magnetic latitude (deg north)
- mlev - magnetic midpoint levels
- mlon - magnetic longitude (deg east)
- mtime - model times (day, hour, minute)
- ncep_ncfile - location of NCEP netCDF file
- ntask_mpi - number of MPI tasks the member was run with
- p0 - reference pressure (millibars)
- p0_model - reference pressured (as used by the model) (microbars)
- saber_ncfile - location of saber netCDF file
- sdtide - amplitudes and phases of semi-diurnal tide
- see_ncfile - location of SEE netCDF file
- swden - solar wind density (cm^{-3})
- swvel - solar wind velocity (kms^{-1})
- tidi_ncfile - location of TIDI netCDF file
- time - time since 00:00:00
- timestep - model timestep (seconds)
- ut - universal time (from model time hour and minute) (hours)
- year - calendar year

background - Pre-assimilation data (TIE-GCM output mapped onto AENEAS grid)

- Same structure as the analysis group.

background_model - what background physics model was used for AENEAS (currently only TIE-GCM available)

data - Copy of the data file used in assimilation. Included if saveAssimData is True in the config file. Structure can change depending upon incoming data, so below is common example (STEC)

- recID - Receiver ID

- rxLoc - Receiver Location
- satID - Satellite ID
- satLoc - Satellite Location
- STEC - Slant Total Electron Content

latitude - 1D latitude grid of the model

longitude - 1D longitude grid of the model

TIEGCM_altitudes - TIE-GCM altitude grids required for reconstruction of TIE-GCM primary files from AENEAS

- member000
- ...
- memberXXX
  - ZG - Geometric altitude of TIE-GCM members, with AENEAS topside added

Global Attributes - Global attributes of HDF5 file, rather than the other groups above

- time - Model time of the output
- AENEAS_version - Version of AENEAS used to generate the output
- randomSeed - The random seed used to initialize NumPy in the step. Generated based on model time and shifted by randomSeedShift in the config file.
- NEQuickStartAlt - Altitude at and above which NeQuick electron densities were used.