Physical Variables written by CTIPe simulations

The **coordinate system** (geographic) consists of

- Geographic longitude **Lon** with **positive** vector components meaning **eastward**,
- Geographic latitude **Lat** from -90 at the south pole to 90 at the north pole with **positive** being **northward**,
- pressure level **IP** or height **H** in km.

Vector (arrow) plots of the velocities only make sense as:

- **vertical cuts** (meridional or at constant-latitude) if **UseHeight** is selected,
- **synoptic maps** of velocity vectors (over local time and latitude) if plotted at **constant height** (not constant pressure level IP).

The **basic plasma and electrodynamic field variables in 3D** are:

- Neutral mass density **rho** in [kg/m^3].
- **H (**height) in [km] corresponding to pressure level number **IP**
  The height of a pressure level varies spatially and with time. Heights covered start at about 80 km (**IP**=0) and reach a few hundred km above ground (the maximum found for **IP**=14, the top layer, is typically between 450 km and 1000 km).
  The height can be used as an alternative 3rd coordinate for plotting.
- Particle number density **N** in [m^{-3}] with species identifier (after the "_"):
  - **e**: electrons,
  - **O**: atomic oxygen,
  - **N2**: nitrogen molecules,
  - **O2**: oxygen molecules,
  - **NO**: nitric oxide,
  - **NO+**: nitric oxide ion,
  - **N2+**: molecular nitrogen ion,
  - **O2+**: molecular oxygen ion,
  - **N+**: atomic nitrogen ion,
  - **O+**: atomic oxygen ion,
  - **H+**: atomic hydrogen ion.
- Neutral gas temperature **T_n** in [K].
- Mean molecular mass **Rmt** in [amu].
- Hall and Pedersen conductivities **sigma_H**, **sigma_P** in [mho/m].
- Neutral gas velocity **Vn** in [m/s] with its three components
  Vn_Lat (meridional; CTIP name "V_x"),
  Vn_Lon (zonal, longitudinal; CTIP name "V_y") and
  Vn_IP (vertical, radial; CTIP name "V_z").
- Plasma (ion) velocity **Vi** in [m/s] with its components
  Vi_Lat ("Vi_x"),
  Vi_Lon ("Vi_y").
  Vi_IP ("Vi_z") is missing in the model output and assumed to be zero for vector arrow plots.
- Heating energy
  Psolar: solar heating in [J/(kg·sec)]

Pjoule: joule heating in [J/(kg·sec)]
Prad: radiation heating/cooling in [J/(kg·sec)]

- Electric field
  E140_theta: latitudinal component of electric field at 140 km in [V/m]
  E140_lambda: longitudinal component of electric field at 140 km in [V/m]
  E300_theta: latitudinal component of electric field at 300 km in [V/m]
  E300_lambda: longitudinal component of electric field at 300 km in [V/m]

Height-integrated quantities in 3D data
available at each position in local time and latitude (obtained from 3D CTIP variables above)

- **NmF2**: maximum electron density **N_e** in [m^{-3}] in the vertical profile,
- **HmF2**: height in [km] of the maximum of **N_e** (see **NmF2**),
- **TEC**: integrated total electron content in [TECU=10^{16} electrons/m^2] in the altitude range of 80 km - 2000 km.

Height-integrated quantities

- **Wjoule**: Joule heating [mW/m^2],
- **Win**: Energy flux [mW/m^2],
- **En_avg**: Mean particle energy [keV],

Energy deposition rates (in GW)

- **P_tot** : auroral energy input over both the northern and southern hemispheres
- **P_euv,N** : extreme ultraviolet solar radiation ($\lambda < 102.7$ nm) integrated over northern hemisphere
- **P_euv,S** : extreme ultraviolet solar radiation ($\lambda < 102.7$ nm) integrated over southern hemisphere
- **P_uv,N** : far ultraviolet solar radiation (102.7 nm $< \lambda <$ 200 nm) integrated over northern hemisphere
- **P_uv,S** : far ultraviolet solar radiation (102.7 nm $< \lambda <$ 200 nm) integrated over southern hemisphere
- **P_J.E,N** : sum of Joule heating and kinetic energy dissipation in northern hemisphere
- **P_J.E,S** : sum of Joule heating and kinetic energy dissipation in northern hemisphere
- **P_Joule,N** : joule heating integrated over the northern hemisphere
- **P_Joule,S** : joule heating integrated over the northern hemisphere
- **P_kin,N** : kinetic energy in the northern hemisphere
- **P_kin,S** : kinetic energy in the southern hemisphere
- **P_kin** : kinetic energy in both the southern and northern hemispheres

Changes in output parameters from geomagnetic quiet condition (Kp ~3) : **rd**(output parameter)
(e.g: rd(T_n) = T_n (current condition) – T_n (geomagnetic quiet condition))