There are 3 different ways to compute the thermospheric density at the position of the satellite:

* using the NRLMSIS-00e model
* using the GITM model
* directly using a file that gives the density at the position of the satellite as a function of time

Using NRLMSIS-00e model

The user inputs the values of the density drivers F10.7, 81-day average F10.7, and Ap.

There are 2 different ways to use the NRLMSIS-00e model:

* static: F10.7, 81-day average F10.7, and Ap are constant values during the entire propagation
* dynamic: F10.7, 81-day average F10.7, and Ap vary as a function of time

In the first case (static), indicate static at the second line of section #FORCES and indicate the constant values of F10.7, 81-day average F10.7, and Ap in the main input file (third, fourth, and fifth lines of section #FORCES).

In the second case (dynamic), indicate dynamic at the second line of section #FORCES and indicate the 3 names of the files that have the values of F10.7, 81-day average F10.7, and Ap as a function of time in the section #FORCES (third, fourth, and fifth lines). The propagator linearly interpolates in time the files to get the values at each time step of the simulation (therefore the files do not need to start (or end) at the exact same start (and end) times of the propagation). These files have to be in ./ input/density/density\_NRLMSIS00e/.

*2 possible formats for these three files (example with Ap here):*

*format 1:*

#BEGINNINGOFHEADER

*put your header here*

#ENDOFHEADER

YYYY-MM-DD HH:MM:SS Ap

*all values of Ap as a function of time*

#ENDOFFILE

*format 2 (Omniweb):*

#BEGINNINGOFHEADER

*put your header here*

#ENDOFHEADER

YEAR DOY HR 1

*all values of Ap as a function of time*

#ENDOFFILE

Examples of a F10.7, F10.7A and Ap files are provided: ./input/density/density\_NRLMSIS00e/example\_f107\_file.txt, ./input/density/density\_NRLMSIS00e/example\_f107A\_file.txt, ./input/density/density\_NRLMSIS00e/example\_ap\_file.txt .

Note: to compute the 81-day average F10.7, you can use the Python script ./python\_code/calculate\_f107\_average.py.

Using GITM

The propagator can read output GITM files. These files have to be binary files (.bin). The propagator interpolate in time (linear interpolation) and position (linear in latitude/longitude, exponential in altitude).

In section #FORCES, on the second line, indicate gitm. On the third line, indicate the path of the directory that has the GITM files (don't forget the last slash at the very end of the path). The propagator will automatically select all the .bin files of this directory to interpolate in time (the difference between 2 GITM files in a same directory is the time). Do not care about the fourth and fifth line but do not erase them (these lines are used for F10.7 average and Ap when using the NRLMSIS-00e model).

No example is provided because the files are usually very heavy. Email me if you want to get an example (cbv@umich.edu)!

Note: using GITM is a bit slower than using NRLMSIS-00.

Using a density as a function of time file *(you’ll probably never use this option)*

With this option, the propagator directly reads in the file that has the density at the positions of the satellite. For example, the CHAMP satellite measured the density at its position. For now, you can use this option only if the file has the same format as the one in the file provided as an example (./input/density/density\_density\_files/example\_density\_file.txt).

In section #FORCES, on the second line, indicate density\_file. On the third line, indicate the name of the density file to read. Do not care about the fourth and fifth line but do not erase them (these lines are used for F10.7 average and Ap when using the NRLMSIS-00e model).

The density file has to be in ./input/density/density\_density\_files/