GOES-R SUVI Atmospheric Density Data Release
Prototype Data Quality
January 16, 2024
Read-Me for Data Users

SUVI solar images, taken during the respective GOES-R satellite eclipse transitions, are used to derive vertical density profiles of atomic oxygen (O), molecular nitrogen (N_2), and neutral temperature profiles of Earth's upper atmosphere. This is done using a combination of GOES-R SUVI L1b 171 Å, 195 Å, 284 Å and 304 Å passband images, at the routine 1 second exposure level. When the satellite enters and exits eclipse, the solar signal is attenuated by Earth's upper atmosphere which, when measured at the above SUVI passbands, allows for the measurement of the dominate atmospheric species O and N_2, as well as the neutral species temperature profile. Due to the nature of these measurements, atmospheric density profiles are only available during GOES-R eclipse seasons (around the autumn and spring equinoxes), with a fixed eclipse entrance (dawn) and exit (dusk) longitude and local time each day of the eclipse season. In general, vertical atmospheric density profiles span between 180-500 km with a 0.5 km resolution, but the exact altitude coverage may vary depending on the timing of nominal SUVI measurements during a given eclipse.

SUVI atmospheric density files are provided in the netCDF format, with separate files for the dawn and the dusk terminator profiles for an observation day. Densities are reported for both O and N_2 independently, as both line-of-sight column density (units cm^{-2}) and locational number density (units cm^{-3}). Furthermore, vertical temperature profiles (units K) are provided over the observational range. Density metadata provide the average satellite position information and the spatial coordinate of the density measurement necessary for the line-of-sight and vertical profile information. Care should be taken when converting vertical profile spatial coordinates to other coordinate frames, as the profiles are reported in the geodetic WGS-84 coordinate system.

Prototype Quality means:

- Validation activities are ongoing and the general research community is now encouraged to participate.
- Product improvements are still occurring.
- Users are engaged and user feedback is assessed.
- Preliminary product performance has been demonstrated through analysis with empirical models and density measurements from satellite drag, but this process has not been exhaustive for all data or data fields.
- Not all known product anomalies are documented, as product is actively being validated and improved.

Users of the GOES-R SUVI Atmospheric Density data bear responsibility for inspecting the data and understanding the known caveats, and above prototype qualifiers prior to use. Below is the list of caveats that have been identified and are under analysis. Solutions are in development and testing:

1. The location of Sun center specified by the CRPIX1 and CRPIX2 keywords in the SUVI L1b data used by this product can be erroneous. Care has been taken to correct this before generating this data product, but errors may still persist. In that case, the spatial coordinate information may be incorrect. Users should validate that this information looks correct and that coordinate profiles are reasonable before performing calculations that require accurate information in these fields.
2. NRLMSIS 2.0 (https://doi.org/10.1029/2020EA001321) data corresponding to the SUVI atmospheric density measurement locations is provided in the netCDF files as a courtesy. These are determined using the pymsis python package (*doi:10.5281/zenodo.5348502*), which was developed by CU Boulder SWxTREC independently from NRL. Differences between this package and the NRL codebase has not been vetted by the developers of this product. Users bear all responsibility to verify these profiles with the NRLMSIS 2.0 empirical model before performing calculations that require accurate information in these fields.

Users are encouraged to contact LASP to report any problems and for guidance on possible workarounds.

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