MERRA-2 Reanalysis and FLEXPART Trajectory Products for ACTIVATE

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1) ACTIVATE MERRA-2 Data Sampled Along the Falcon (HU-25) Flight Tracks
(https://www-air.larc.nasa.gov/cgi-bin/ArcView/activate.2019?MODEL=1)

❑ **Description**: MERRA-2 (Gelaro et al., J. Climate, 2017) is NASA's latest reanalysis produced with the GEOS-5 atmospheric data assimilation system. It assimilates AOD from ground and satellite-based remote sensors.

❑ **Product**: Selected MERRA-2 3-D fields of trace gases and aerosols and meteorological parameters are sampled for each 60-sec along the Falcon (HU-25) flight tracks during ACTIVATE. Data format: ICARTT file format standards V2.0.

3-D Fields
CO
Ozone
DMS
MSA
SO_2
Sulfate
Sea salt (5 bins, 0.03-10μm)
Dust (5 bins, 0.1-10μm)
Hydrophilic BC
Hydrophobic BC
Hydrophilic OC
Hydrophobic OC
Factor used to convert μg m^{-3} to μg std m^{-3}
Relative humidity
Air temperature
Mass fraction of cloud ice water
Mass fraction of cloud liquid water
Specific humidity

❑ **Applications**: Compare measurements with reanalysis; provide quantities not measured during ACTIVATE; perform statistical analysis of aircraft in-situ (vs. reanalysis) data.
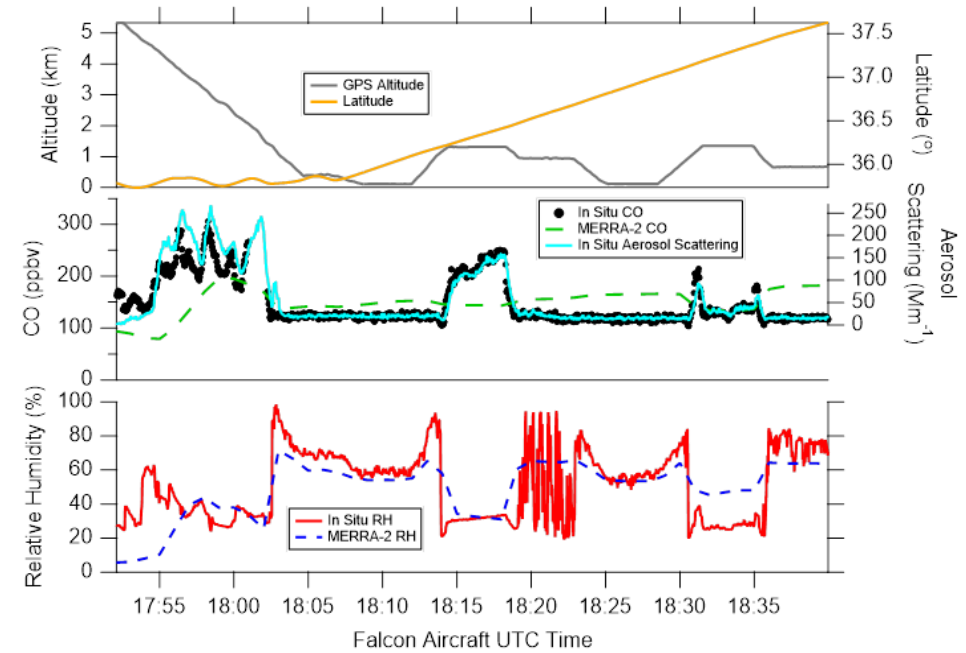
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❑ **Model Description:**

- FLEXPART v9 ("FLEXible PARTicle dispersion model", https://www.flexpart.eu/) simulates transport and turbulent diffusion.
- Driven by Global Forecast System Analysis (GFS-ANL 003, 1° by 1°, 26 levels, 3-hourly).
- Each trajectory (20,000 inert air parcels) is released every 10 mins along the flight track. Transport of the air parcels is simulated backward in time for 20 days.
- Model output contains a 4-D field of air mass residence time.
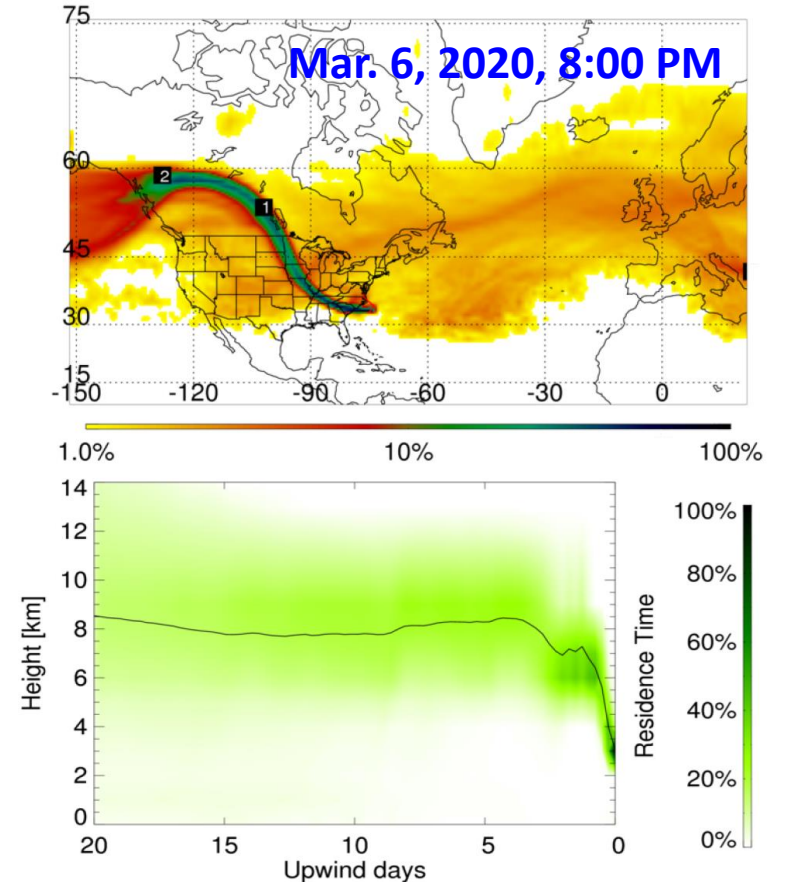- Product data format: NetCDF.

❑ **Data Download:**

- Both model output (NetCDF files) and plots are available.
- Each output file corresponds to a release point along the flight track.
- URL: https://www-air.larc.nasa.gov/cgi-bin/ArcView/activate.2019?TRAJECTORY=1

❑ **Applications:**

- Residence time indicates air mass transport pathways.
- When coupled with emission (e.g., CO) inventories, residence time may be used to determine pollution sources and their relative contribution.

Example Figure: Horizontal and vertical views of simulated air mass residence time during transport. The labels on the map indicate the approximate locations of the center of the plume. Residence time is color coded by logarithmic grades representing its ratio to the location of maximal integrated residence time (100 %).

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