Updates on MERRA-2 Products and Cloud-based Data Services at NASA GES DISC

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Suhung Shen[1,2] , Christopher M. Battisto[1,3], Jennifer M. Adams[1,3], Xiaohua Pan[1,3], Michael Bosilovich[4] and Mahabal Hegde[1]
suhung.shen@nasa.gov (1) GSFC (2)George Mason University (3)ADNET Sys. Inc (4) GSFC

New: MERRA-2 Gridded Innovations and Observations (GIO) (coming soon)

The Gridded Innovations and Observations (GIO) dataset was created as part of the NASA MEaSUREs Program under the project titled 'Development of Gridded Innovations and Observations Supplement to MERRA-2 and Future,' led by Principal Investigator Michael Bosilovich at NASA GMAO.

The products consist of gridded satellite and conventional observation data used to assimilate MERRA-2. This dataset will help users understand how the presence and quality of observations directly affect reanalysis data.

The dataset includes monthly brightness temperatures from more than 70 satellite sensors, as well as hourly and monthly conventional measurements such as wind, surface pressure, and surface temperatures. In addition, this dataset provides key assimilation statistics including forecast departures, root mean square errors, data counts, and bias corrections for satellite radiances.

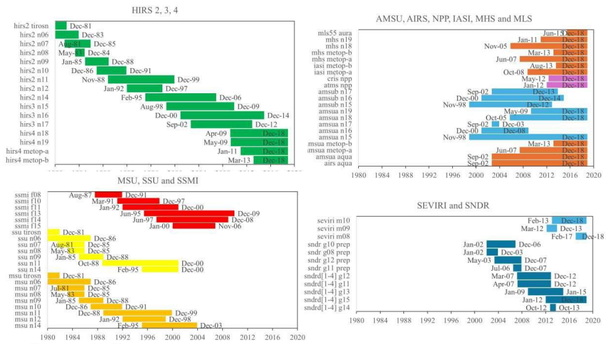


Figure 1: Example of the temporal coverage of satellite sensors used in MERRA-2 assimilation.

Table: variables in a satellite sensor file

Variable	Description	Unit
mean_bias	brightness temperature mean bias	K
mean_obs	brightness temperature mean observations	K
mean_oma	brightness temperature mean O-minus-A	K
mean_omf	brightness temperature mean O-minus-F	K
nobs_obs	brightness temperature number observations	count
stdv_bias	brightness temperature square root of variance bias	K
stdv_obs	brightness temperature square root of variance observations	K
stdv_oma	brightness temperature square root of variance O-minus-A	K
stdv_omf	brightness temperature square root of variance O-minus-F	K

O-minus-F (or omf): differences between the observations and the forecast background used for the analysis (the innovations)

O-minus-A (or oma): difference between the observations and the final analysis

Satellite Observation – AIRS/Aqua 15.36*μm (lev=1)* 2003.01 06Z

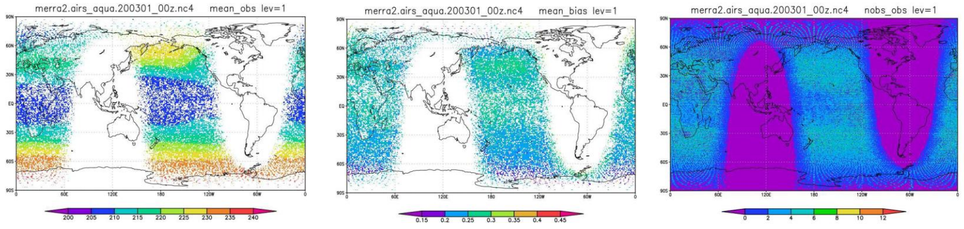


Figure 2: Sample images from left to right: monthly mean_obs (brightness temperature mean observations [K]), mean_bias (brightness temperature mean bias [K]), and nobs_obs (number of observations [count]) for January 2003 at 00Z from AIRS/Aqua, lev=1 (15.36*μm*). The monthly GIO data from satellite observations are assimilated at 00z, 06z, 12z, and 18z various levels (channels).

Conventional Observations PS over Land and Sea 2018.01 00Z

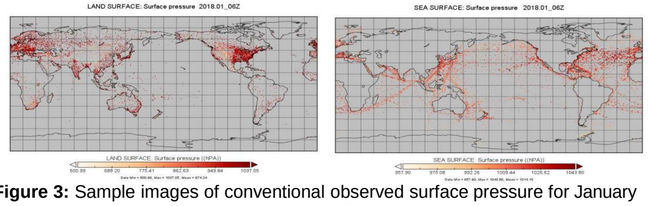


Figure 3: Sample images of conventional observed surface pressure for January 2018 at 06Z over land (left) and sea (right). Data are produced at the synoptic analysis times (00Z, 06Z, 12Z and 18Z) and where observations are assimilated

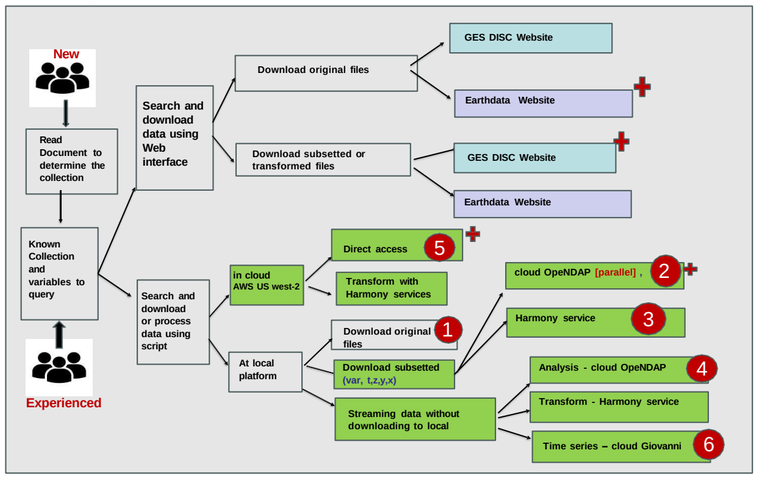
Example Conventional Measurements:
- tv : virtual temperature
- qv : specific humidity
- u: zonal wind
- v: meridional wind
- ps: surface pressure
- sst: sea surface temperature

Example Conventional Sources:
- RADIOSONDE
- AIRCRAFT
- PROFILER
- SCATTEROMETER
- PAOB SURFACE
- LAND SURFACE
- SEA SURFACE
- SSMI
- ATMOS MOTION VECTORS
- MLS
- Drifting Buoy

AWS-hosted Data Archives and Services for MERRA-2 Data at GES DISC

- All MERRA-2 standard products have been successfully migrated to Earthdata Cloud (AWS us-west-2)
- The free data distribution policy remains unchanged
- Enablement of cloud data services, including OPeNDAP and Harmony, is in progress

Pathway to find and access MERRA-2 data in Earthdata Cloud

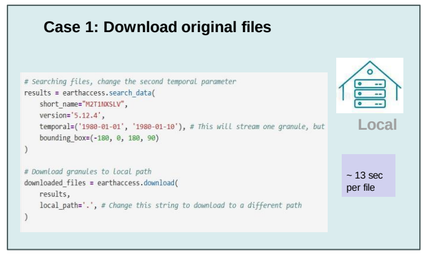


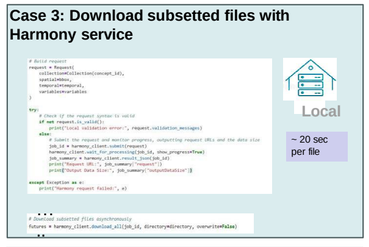


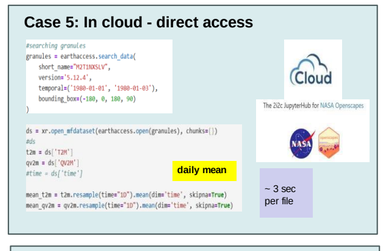
The web page content and data services at GES DISC are in the process of migrating to the Earthdata Search Website

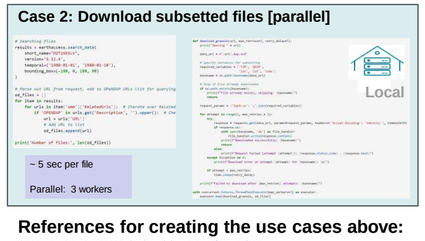


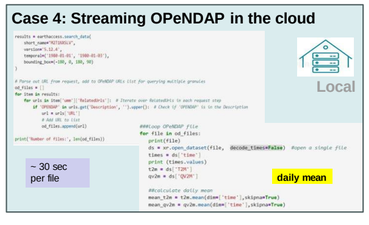
- Green-shaded items indicate data and services newly available from the Earthdata Cloud for MERRA-2.
- Finding data files by scripting filenames based on filename pattern and data paths is not recommended, as it may result in failure to find reprocessed data.
- Parallel downloading from the Earthdata Cloud is supported; however, please limit concurrent downloads to **no more than five** to help maintain healthy system load and network traffic.

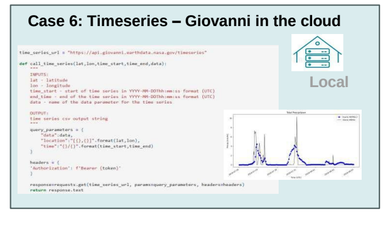












References for creating the use cases above:

Case 1: How to Access GES DISC Data Using Python
Case 2: How to Access M2T1NXSLV Cloud OPeNDAP Granules using Python
Case 3: How to Subset and Download Level 2, 3, and 4 GES DISC Data Using Python .
Case 4: a) How to Access GES DISC Data Using Python ;
b) How to Access M2T1NXSLV Cloud OPeNDAP Granules using Python
Case 5: How To Directly Access MERRA-2 Data from an S3 Bucket with Python from a Cloud Environment
Case 6: a) Giovanni In The Cloud: Time Series Service ;
b) How to Access the "Giovanni in the Cloud: Time Series" Service Using Python

Note: The OPeNDAP in the cloud needs to be enabled for case 2,3,4. Please read How to Search and Load GES DISC Cloud OPeNDAP Collections Using Python

Additional references for cloud data access:

MERRA-2 : Data access quick start guide
GES DISC data access: https://disc.gsfc.nasa.gov/information/documents?title=Data%20Access
GES DISC Cloud Migration: Migrating to the Cloud
GES DISC How-tos: https://disc.gsfc.nasa.gov/information/howto
CMR API: https://cmr.earthdata.nasa.gov/search/site/docs/search/api.html
Harmony API: https://harmony.earthdata.nasa.gov/
NASA Earthdata Cloud Cookbook: EarthData Cloud Cookbook - NASA Earthdata Cloud Cookbook