NOGGIn - NASA Open-access Geo-Gridding Infrastructure

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Motivation

The most common challenge to the systematic and routine comparisons of data from model simulation and analysis outputs with NASA remote sensing data is perhaps that of **homogenizing the diverse geometries involved**, resulting from model grid systems employed and observational geometric characteristics associated with the instruments and/or satellite platforms. This homogenizing is necessary to arrive at straightforward and meaningful interpretations.

Indeed, while a myriad of tools exists to locate, access, and visualize observational data, inter-comparison of disparate data sources requires tedious and often computationally intensive gridding or re-gridding operations, which are generally implemented in an ad hoc manner by individual users, becoming obstacles to reliable comparisons and integrative analysis.

In addition to the duplication of effort stemming from the lack of easy-to-use standard gridding services, expediency on the part of individual researchers often results in suboptimal gridded products that **(1)** reduce accuracy due to failure to adequately account for spatial/temporal sampling bias, **(2)** lack robust gridding uncertainty estimates, and **(3)** omit the provenance, all of which reduce the value of the products to other researchers. Simplicity and familiarity also tend to drive researchers to apply traditional (regular) latitude-longitude (lat-lon) grids rather than better alternatives.

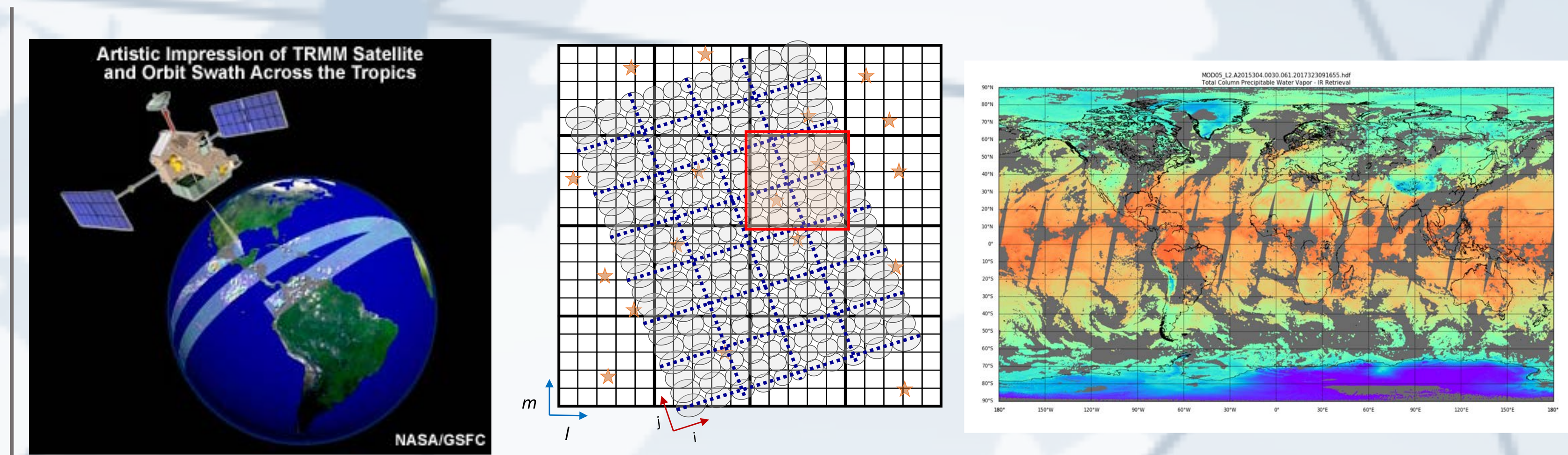
Lat-lon Grid   *Cube-sphere Grid*   *Geodesic Grid*

However, the trend in the modeling community is transitioning to next-generation grid systems, such as **geodesic** and **cube-sphere**, that possess superior quasi-equiareal, scalable characteristics. For higher-resolution models, to maintain numerical stability, the time step used for integration must decrease as the smallest grid length scale decreases. For lat-lon grid systems, the degeneracy of meridians at the poles drives up computational costs disproportionally, and high-frequency signal filtering approaches ameliorating this problem severely constrain parallel performance.

Technology

Anticipating the need for converting and adapting NASA Earth science remote sensing data for compatibility with results from these next-generation models, we are developing **NOGGIn as an open-access service to enable routine and systematic gridding, co-location, and comparison of remote sensing data** that not only makes adapting observations to these grids easy but also addresses a number of gridding issues that currently plague researchers. Specifically, a suite of regridding methods have been implemented for converting **between lat-lon, cube-sphere, and geodesic grid systems**, including the bilinear, nearest neighbor, high-order patch recovery, and first- and second-order flux conservative methods.

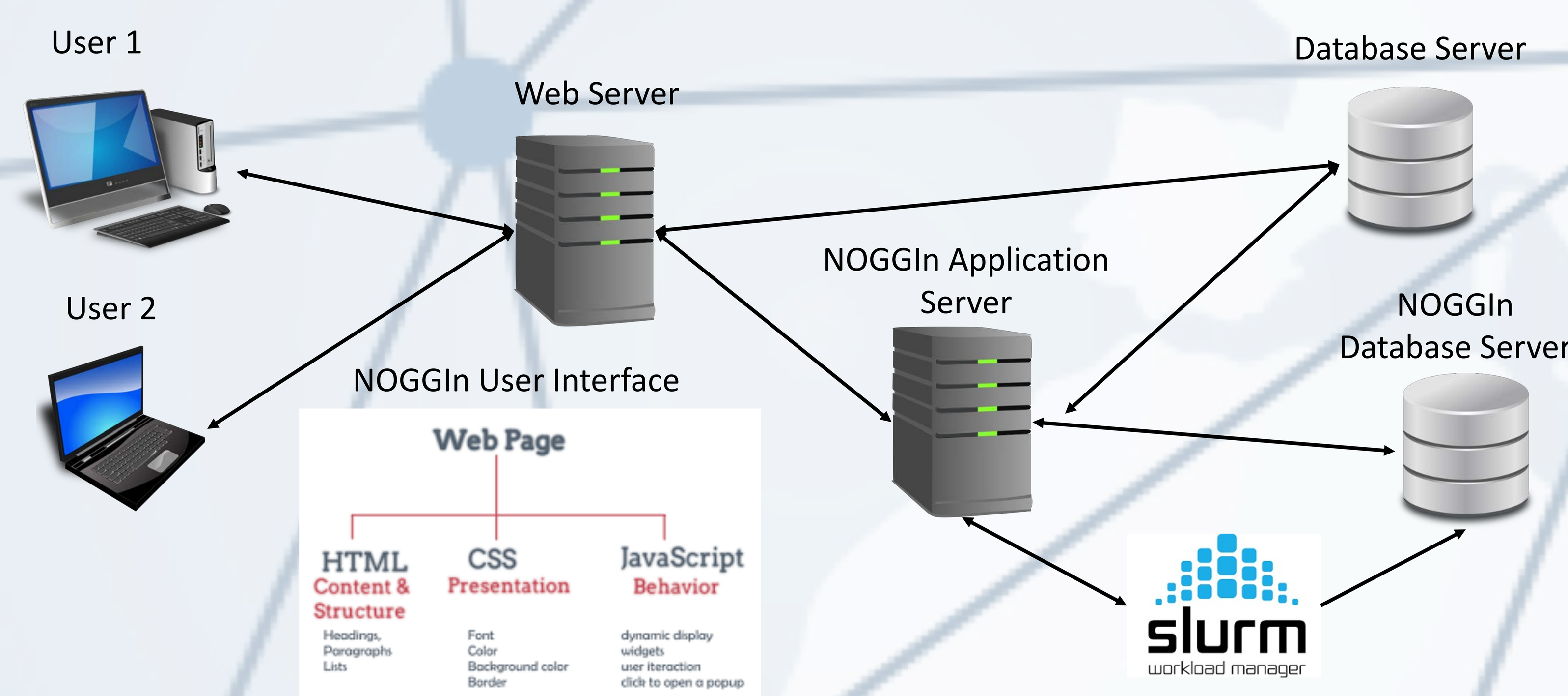
An intriguing and valuable capability is the use of lower level (L1 &L2) observational data in scientific work, which we have explored within NOGGIn via a **kriging** service for interpolating low level data to a grid. Kriging is particularly helpful in addressing gaps in actual coverage (e.g. gaps between ground tracks) and interpolating irregularly spaced data onto specialized, non-standard grids.



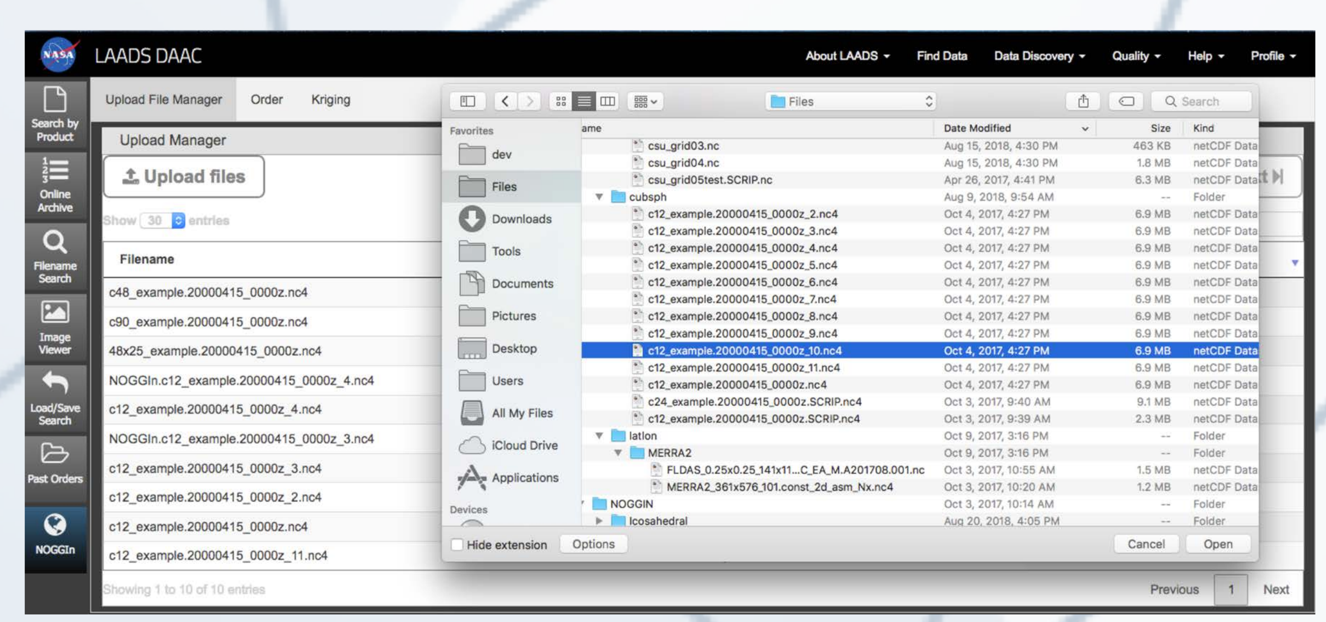
Infrastructure

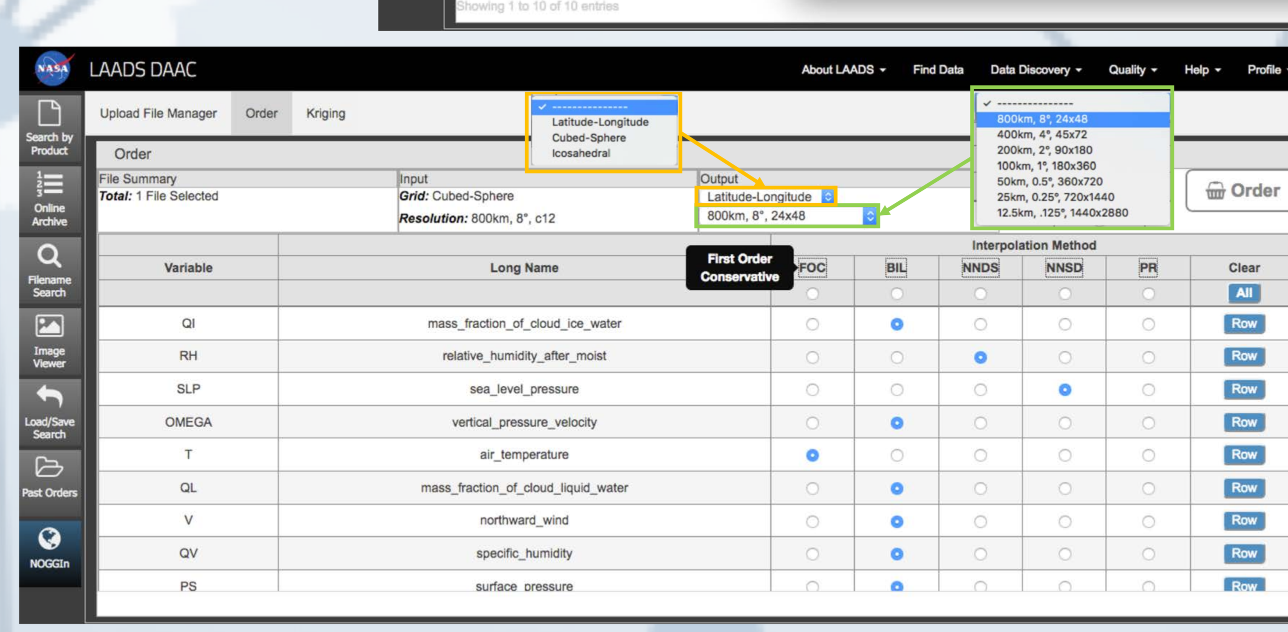
We leverage NASA's MODIS Adaptive Processing System (MODAPS) to augment its existing map projection web servicesand have a plan to extend NOGGIn as a service in the cloud. We have developed aweb clientthat provides a user interface to these services, integrated with NASA Level-1 and Atmosphere Archive and Distribution System web service (LAADSWEB), making them accessible through a web browser. For even more automated or scripted interaction, a RESTful interface has been designed and implemented. In this presentation, we discuss the NOGGIn architecture and the performance of our initial tests.

LAADSWEB and NOGGIn Architecture



Uploading a netCDF data file

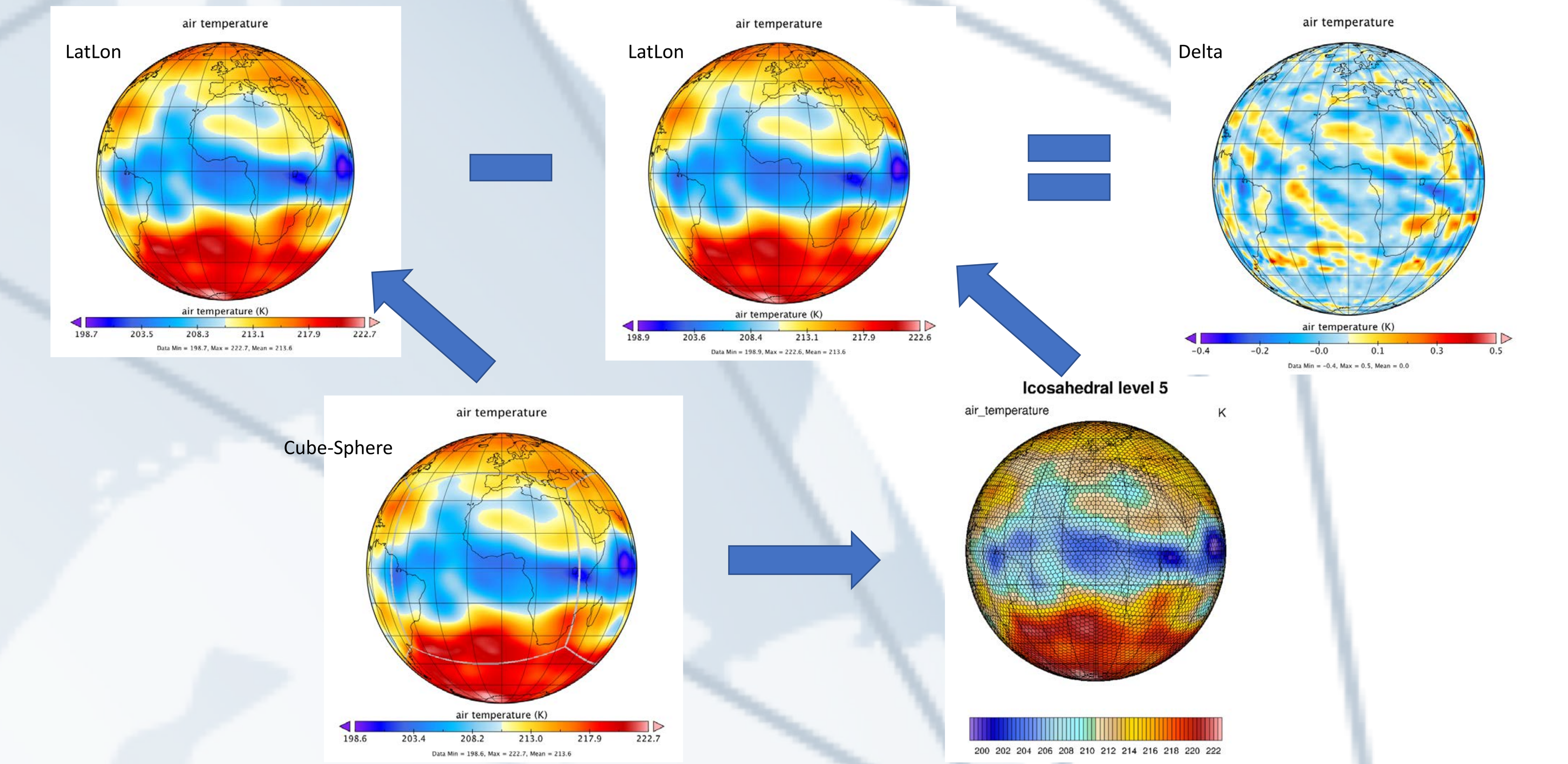




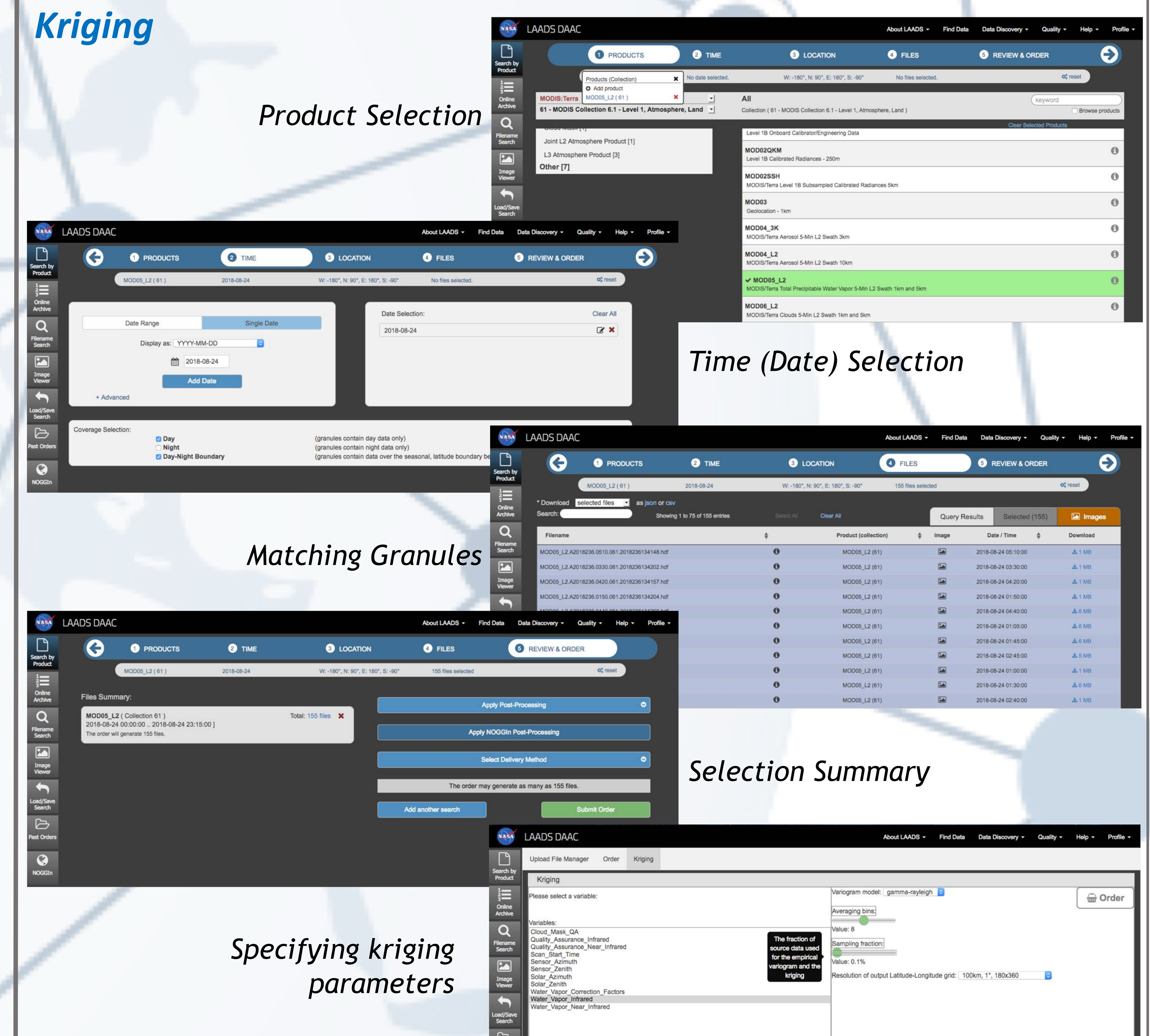
Selecting output grid and regridding method for each variable

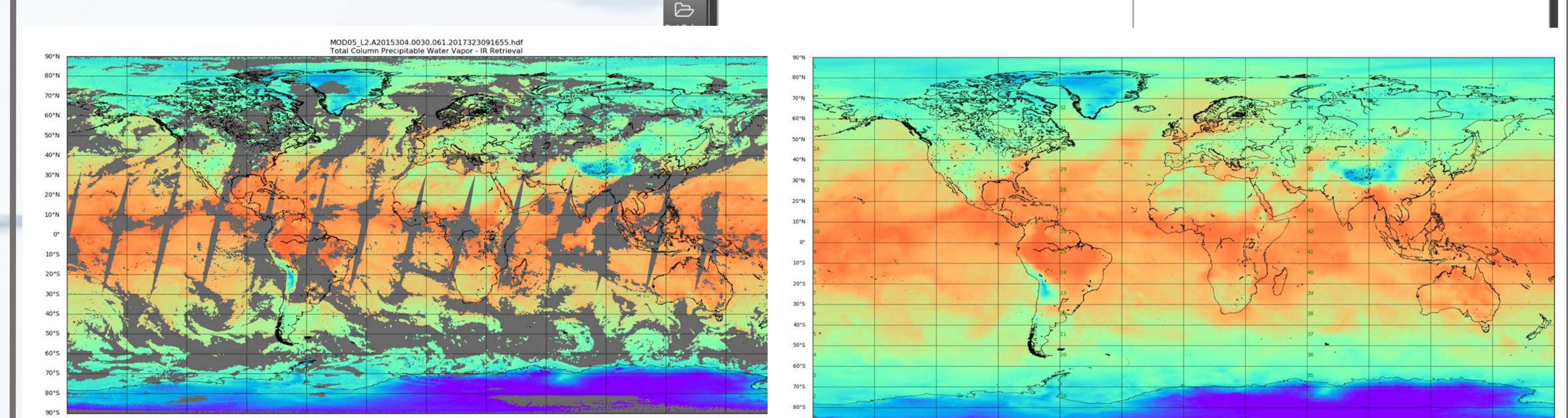
Acknowledgement

We are grateful for the funding provided by the NASA Advancing Collaborative Connections for Earth System Science (**ACCESS**) program for this effort.



Kriging





Composite of Level-2 Source Granules   *Kriged*

The figures above demonstrate an example of kriging Level 2 (Swath) MODIS Total Column Precipitable Water Vapor to a ½-degree lat-lon grid. The left panel shows swath composite of the source data, whereas the right panel shows the kriged result. The same color scale is used in both panels, where warmer colors denote higher TCPWV. Note that some gaps in the source data are due to observational conditions (e.g. clouds) which could be masked out also in the kriged result or handled by other means.