Challenges in Obtaining and Visualizing Satellite Level 2 Data in GIS

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Motivation

- Intensifying demand/inquiry for higher spatial/temporal data
- Increasing GIS tools usage
- Demographic trend of users is toward application
- Upcoming satellite missions and model runs provided capability of demand
- Compliment existing services (WorldView/Giovanni)

Objective

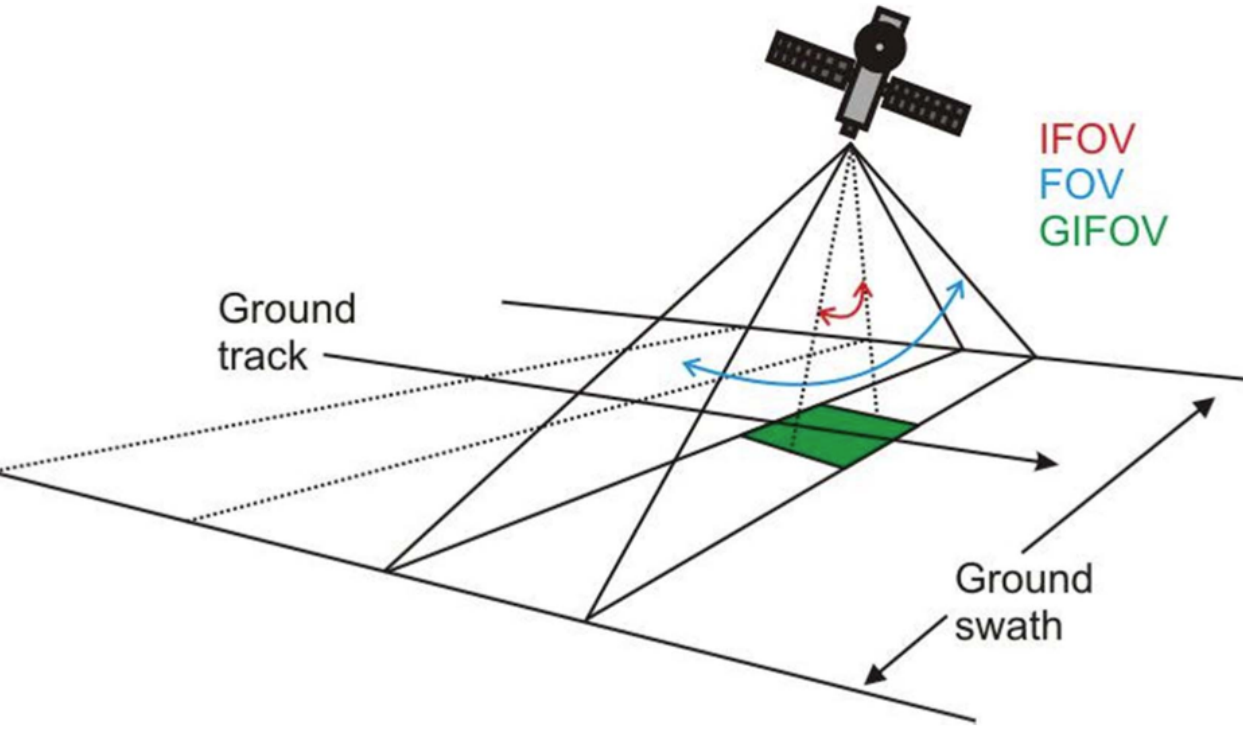
➔ Visualizing gridded data (geo-rectified) from swath data (geo-referenced) on-the-fly (without pre-gridding) at the global scale

- GIS: many applications require higher resolution data than pre-gridded (Level 3, L3)
- Cell sizes at pixel footprint level desirable
- Temporally continuous data not cut-off at UTC day boundary as in L3
- More flexible QA options in stead of only pre-defined QA in L3

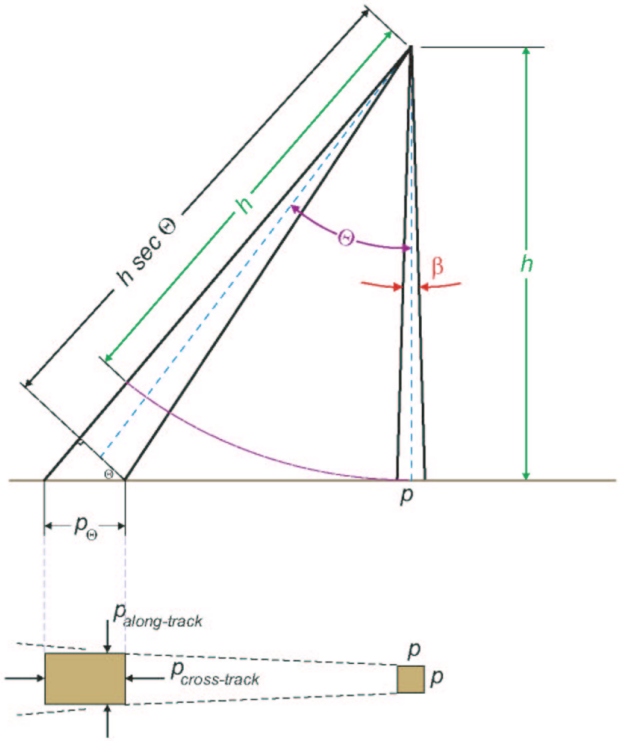
➔ User-defined L3 (flexible/scalable/extendable) service

Challenge #1:

Many Satellite Atmospheric Products do not comprise GIFOV as GIS required



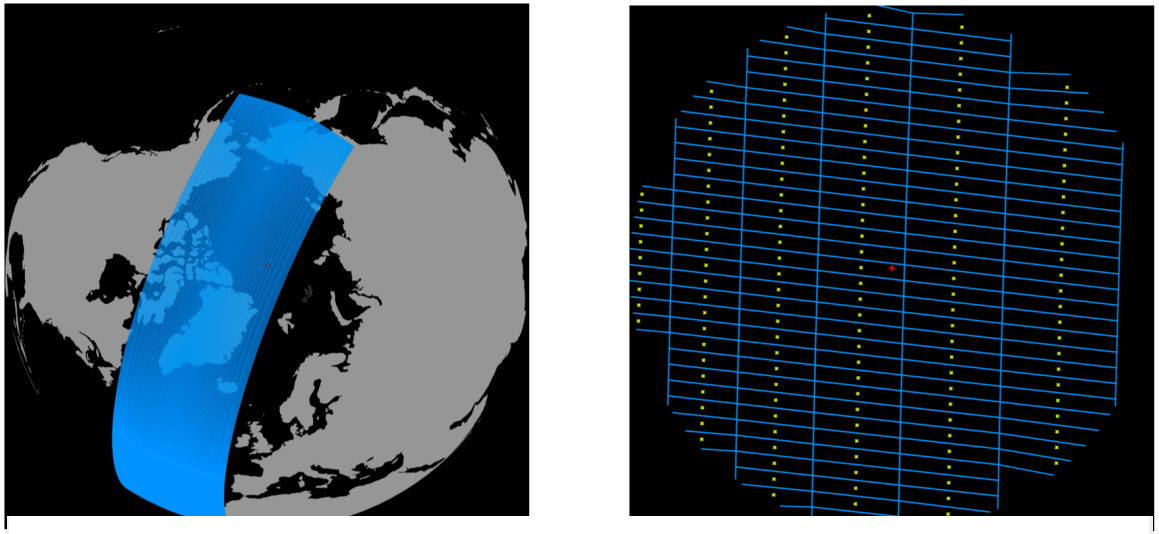
Off-nadir viewing geometry



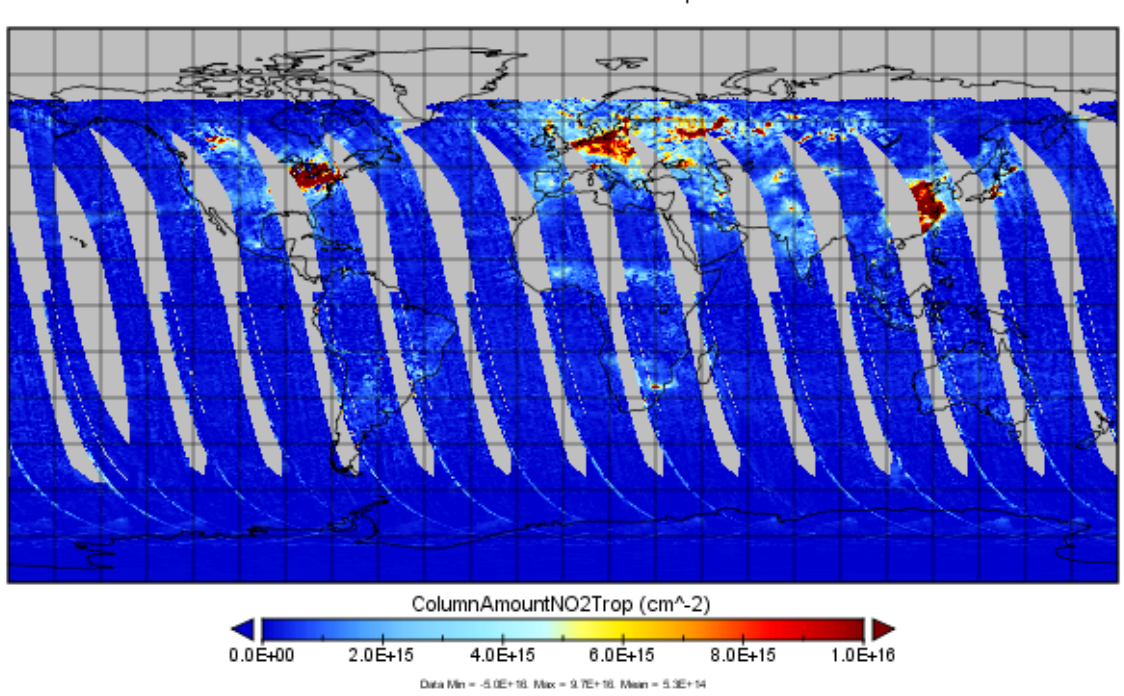
FOV: Field of View
IFOV: Instantaneous FOV
GIFOV: Ground-projected IFOV

1st Candidate: OMI provides GIFOV

OMPIXCOR



OMNO2
Tropospheric
NO_2
No QA



Challenge #2:

How to visualize L2 data quality?

- There are multiple QA flags/values
- Different algorithms & variables use different QAs
- Different combinations of QAs

➢ The above make QA screen in data requests difficult, especially in OGC WCS protocols:

Solution:

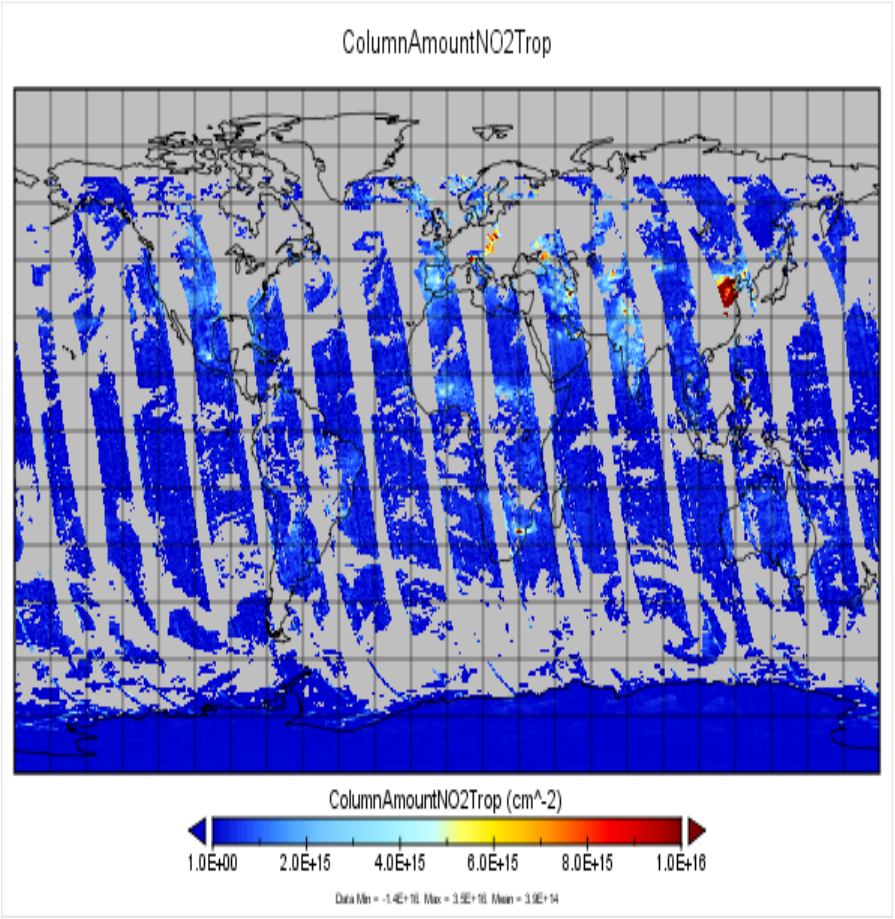
a) Use vendor-specific options, such as a “OA=value” KVP (or xml scheme), e.g. **QA=scr**, where string ***scr*** indicates applying **solar zenith angle**, **cloud fraction** and **root mean square** thresholds

b) Define a set of coverage/layer names for certain QA or QA combinations: ColumnAmount, ColumnAmount_CloudSC, ColumnAmount_TerrainRefSC

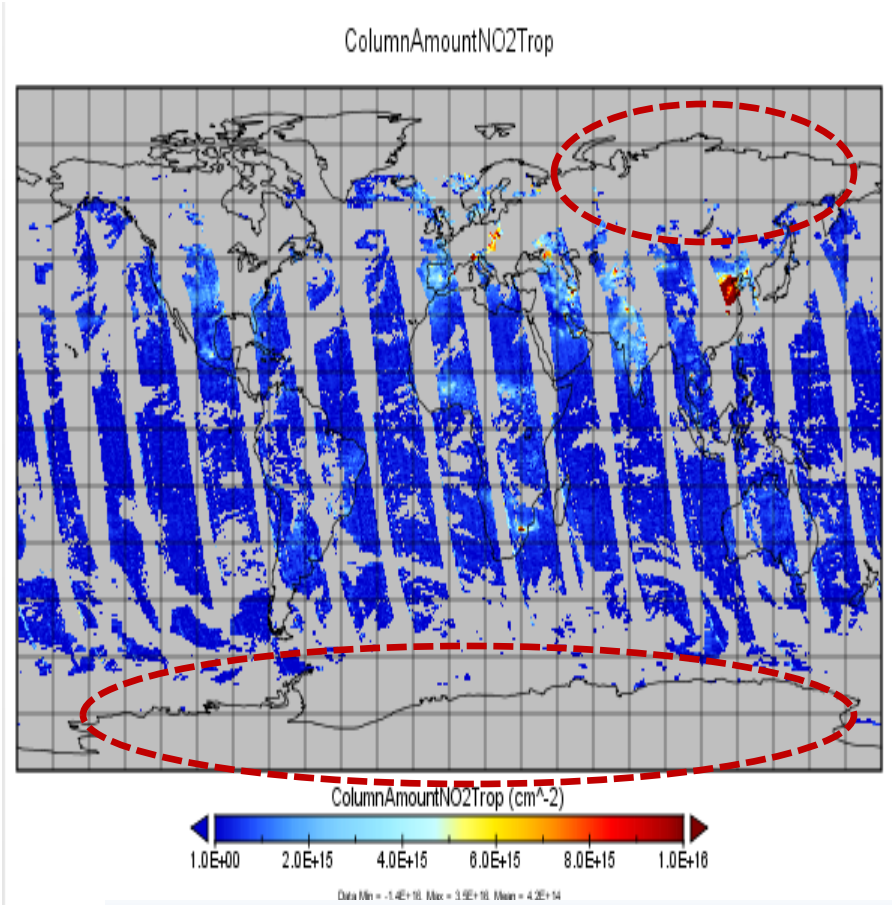
c) May need more KVPs if not just QA vs no QA, e.g., not only cloud screen but allow different cloud fraction threshold values: “cloudFraction=x%” KVP

d) Use processing protocol such as OGC Web Processing Service (WPS)

OMI NO2Trop – QA screened



30% cloud fraction screened

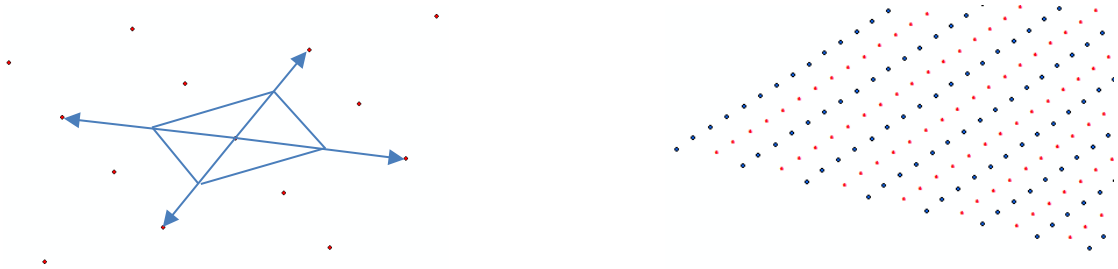


30% cloud fraction +
30% terrain reflectance
screened

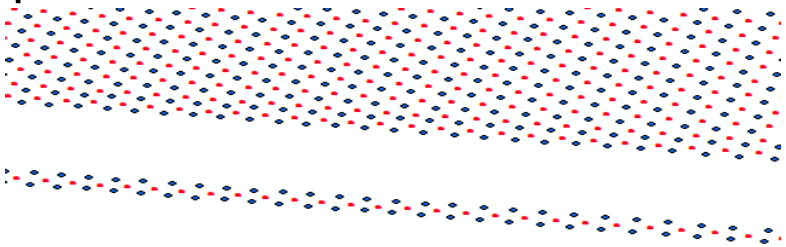
Challenge #3:

Most of Atmospheric Products do not have GIFOV

- Estimate Pixel Corners if not available in data
  - Derive pixel corners based on centers of the four neighboring pixels
  - Edge scan/frame: reverse vectors from the last two scans/frames

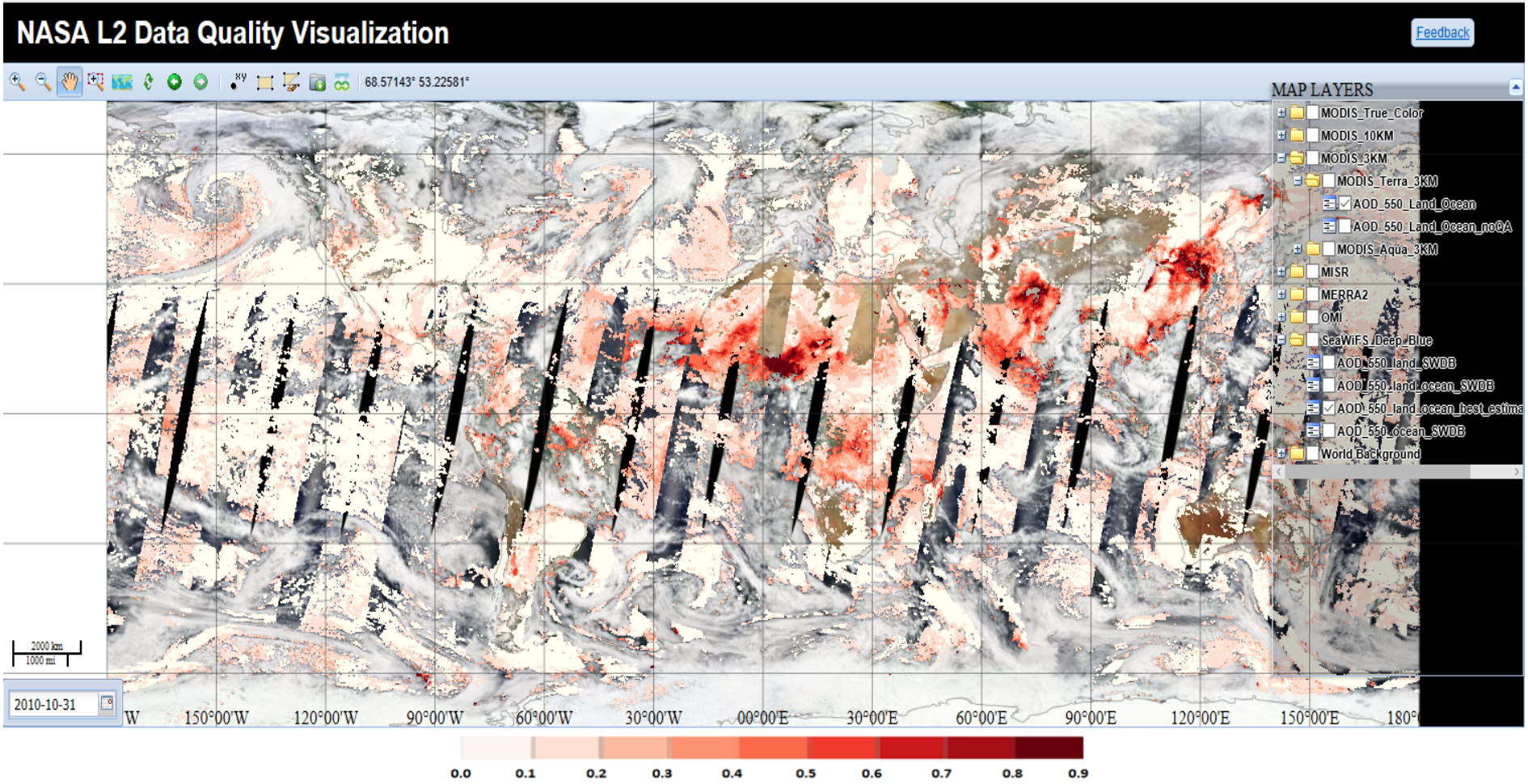


- Missing or discontinuous scans: vectors estimated from two neighboring pixels and from the nearest two continuous scans



1st Estimated Pixel Corners Products: SWDB

SeaWiFS Deep Blue AOT 550 nm



- MODIS AOT Products
- MERRA-2 Aerosol Products

Grand Challenge:

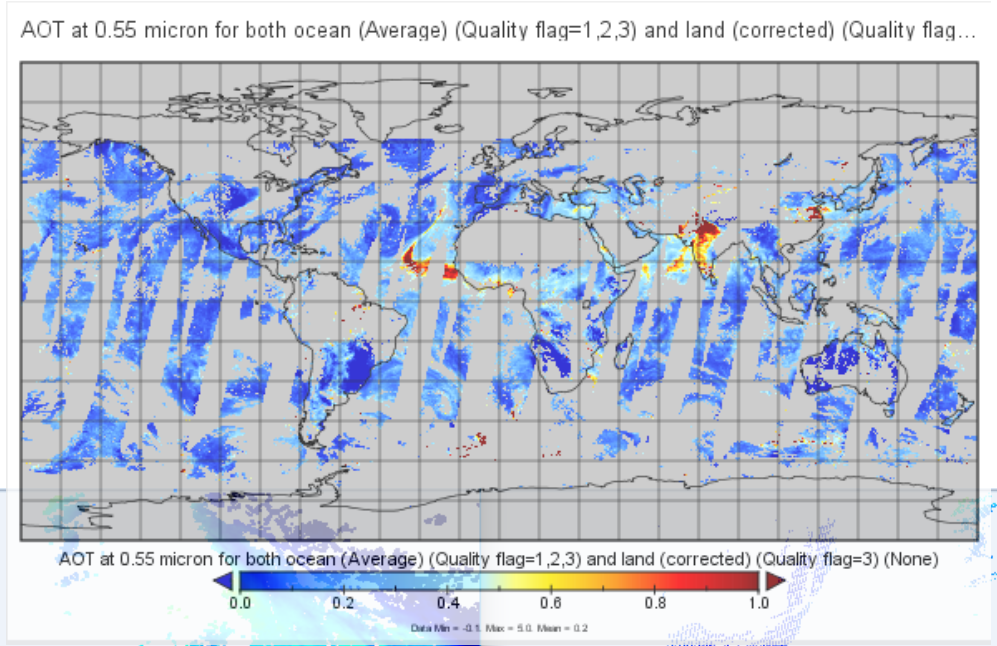
How to make operationally feasible and scalable for high spatial/temporal datasets to meet the web service requirement

- Mapping technique: Footprint/Inverse mapping vs Forward/Center mapping
- High spatial resolution at large area, such as 3-km global for MODIS AOT data, may cause server timeout →Extend timeout period, e.g., to 180 seconds
- Limit temporal range → not exceeding 1-day
- Limit spatial range, e.g., only a limited bbox if requested output cell size is small
- Pre-generate pixel corners
- Pre-cache certain frequently requested data based on service log metrics
- Asynchronous Service, requiring OGC to develop new extensions

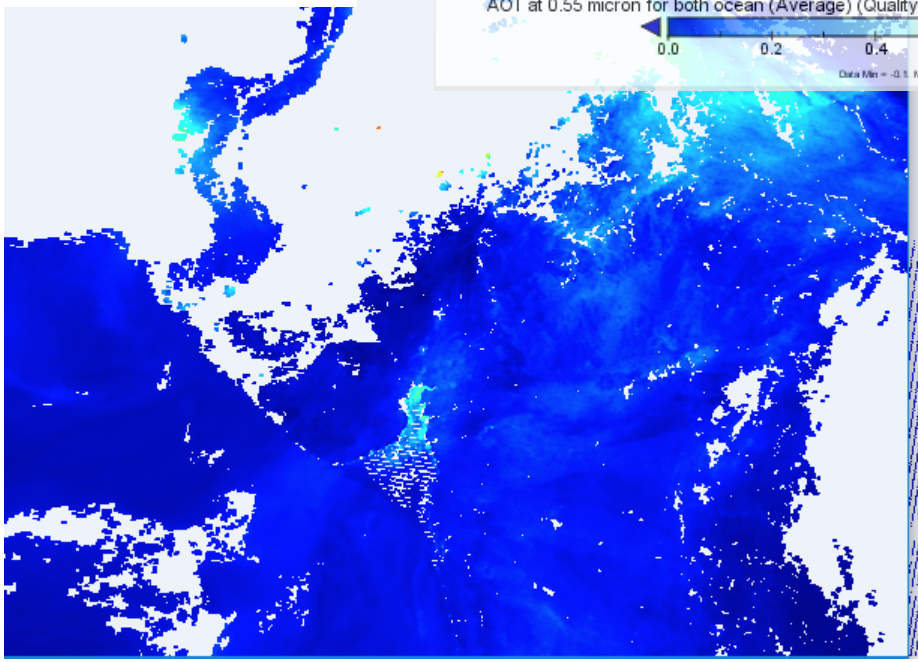
Note: WCS1.1 is still synchronous although it allows server to store output for client to fetch. It can be to extend it to synchronous response with asynchronous fetch, which might easier than dealing with asynchronous notification but requires server to make good estimation of processing time needed to generate the requested data.

Footprint vs Center Mapping

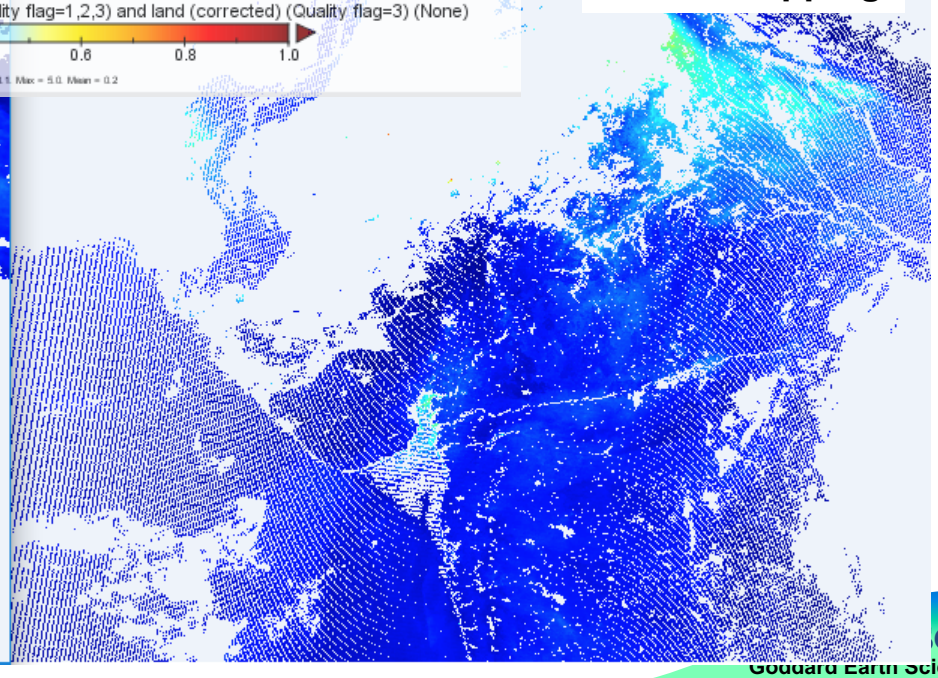
MOIS L2 AOD 3KM
(MOD04_3KM)



Footprint Mapping

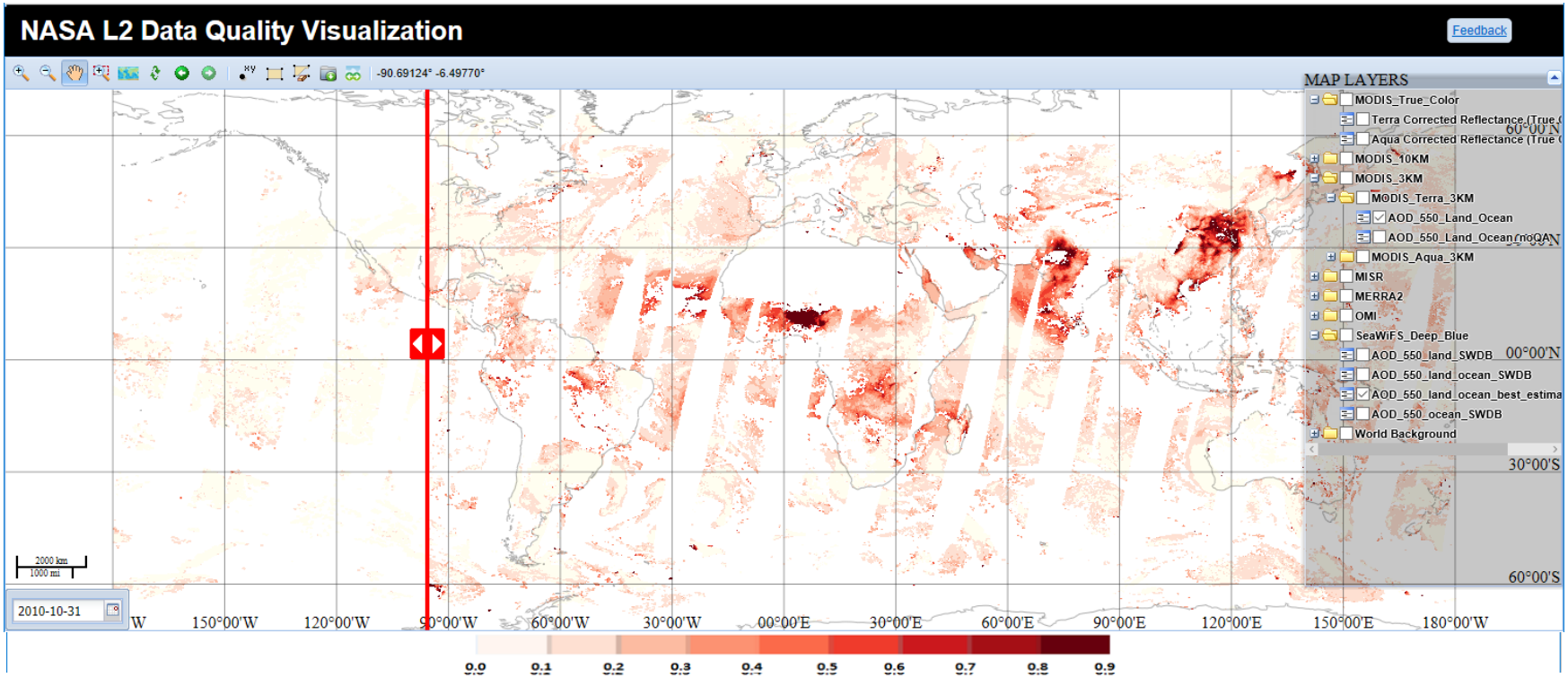


Center Mapping



NASA L2 Data Quality Visualization Tool

AOD 550nm
SWDB vs MOD04 3KM



Swipe: showing MOD04
Swipe: showing SWDB

Information

Current Status and Future Plan on this DQViz:

- In progress of implementing User Registration for Earthdata Account
- New WCS version (2.X?)
- Visualize L2 data in Portal for ArcGIS through the L2 WCS
- More data types

Additional GES DISC Level 2 Subset Service

Day/Time: **Thursday, 14 December 2017: 08:00 - 12:20**

Abstract Title: **IN41B-0038: Complexities in Subsetting Satellite Level 2 Data**

GES DISC: https://disc.gsfc.nasa.gov

Comments and suggestions:

- **Help Desk (gsfc-help-disc@lists.nasa.gov)**
- **Jennifer Wei (jennifer.c.wei@nasa.gov)**