External Geolocation for Swath Data
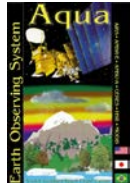
ESIP Federation Meeting

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Robert Wolfe

MODIS Production and
Distribution Team Member

NASA GSFC Code 619

Why External Geolocation?

- Swath products (called Level 1 and Level 2 by NASA) are in the original instrument geometry (not gridded)
- Geolocation information is needed for remapping but also understanding the product
- Geolocation data can be as large or larger than some L2 products
- Storing this information in each L1/L2 product increases archive volume and for users who work with multiple products, the information would be duplicated
- In this talk, MODIS is used as an example – other satellite and aircraft instruments have similar issues

NASA MODIS Instruments
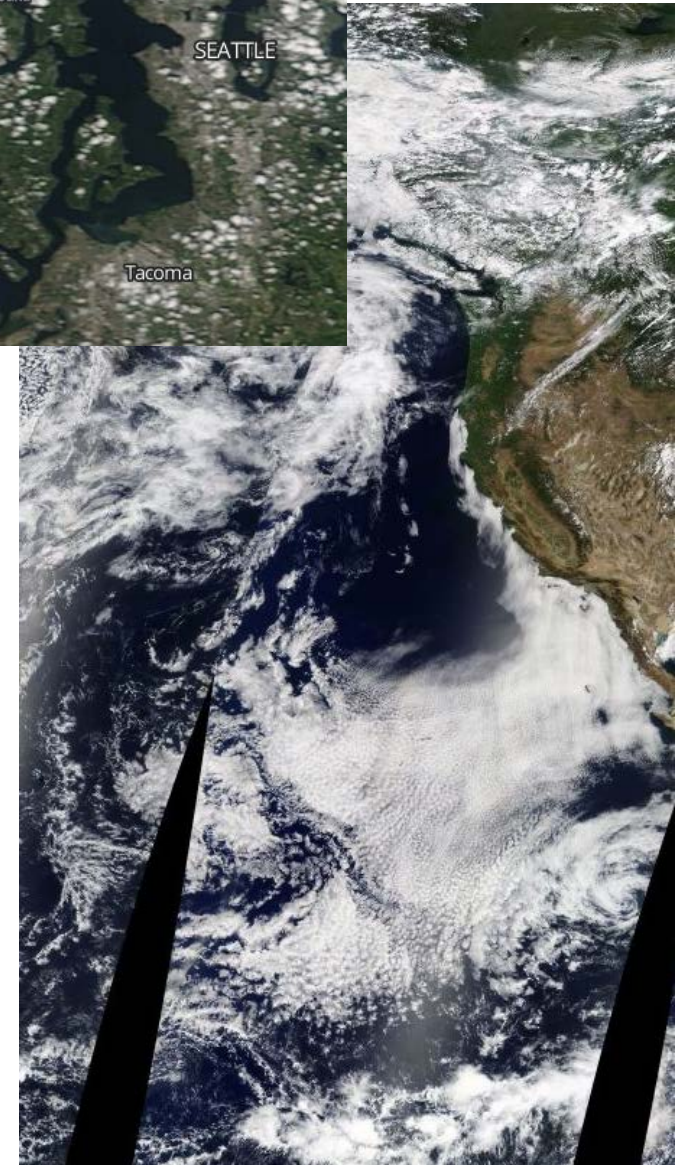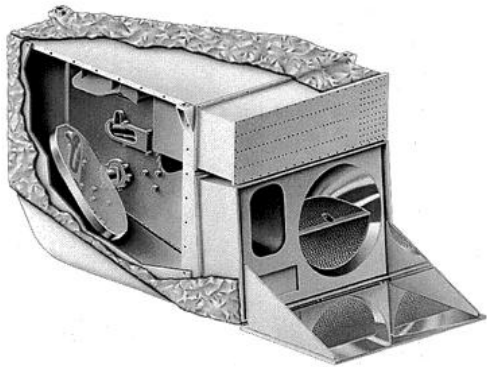
- Moderate Resolution Imaging Spectroradiometer
  - 36 Spectral Bands from 0.4 to 14.3 μm
  - Nadir spatial resolution 250 m to 1 km
  - Daily global coverage (day and night)
  - Swath width 2330 km
- First launched in 1999 on Terra satellite
  - 10:30 am local equatorial crossing time
- Second launched in 2002 on Aqua satellite
  - 1:30 pm local equatorial crossing time

Geolocation means?

- Latitude and longitude of observation (sample/pixel)
  - Terrain corrected for terrestrial applications
- Other observation geometry information
  - Height, sensor range, sensor view and solar angles, quality fields
  - Useful for understanding observation context
- Typically computed and used for every observation

MODIS L1/L2 Products

ESDT	Name	Granules /day	Granule size (MB)	Daily volume (GB/day)
L1				
MOD03	Geolocation Fields 5-Min L1A Swath 1km	288	29.6	8.3
MOD021KM	Calibrated Radiances 5-Min L1B Swath 1km	288	111.1	31.2
MOD02HKM	Calibrated Radiances 5-Min L1B Swath 500m	162	130.9	20.7
MOD02QKM	Calibrated Radiances 5-Min L1B Swath 250m	162	141.0	22.3
Atmos L2				
MOD07_L2	Temperature and Water Vapor Profiles 5-Min L2 Swath 5km	288	6.5	1.8
MOD35_L2	Cloud Mask and Spectral Test Results 5-Min L2 Swath 250m and 1km	288	7.4	2.1
MOD04_3K	Aerosol 5-Min L2 Swath 3km	160	7.3	1.1
MOD04_L2	Aerosol 5-Min L2 Swath 10km	160	2.3	0.4
MOD05_L2	Total Precipitable Water Vapor 5-Min L2 Swath 1km and 5km	288	3.4	1.0
MOD06_L2	Clouds 5-Min L2 Swath 1km and 5km	288	60.6	17.0
Land L2				
MOD09	Atmos. Corrected Surface Reflectance 5-Min L2 Swath 250m, 500m, 1km	158	322.6	49.8
MOD10_L2	Snow Cover 5-Min L2 Swath 500m	158	7.2	1.1
MOD11_L2	Land Surface Temperature/Emissivity 5-Min L2 Swath 1km	252	2.6	0.6
MOD14	Thermal Anomalies/Fire 5-Min L2 Swath 1km	288	0.3	0.1
MOD21	Land Surface Temperature/3-Band Emissivity 5-Min L2 1 km	229	4.7	1.0
MOD29	Sea Ice Extent 5-Min L2 Swath 1km	178	1.7	0.3

Volume With and Without Geolocation

Type	Number of Products	Current volume	Embeded Geo Subset	w/o Embed Geo Subset	With Partial Geolocation
L1 Geo	1	8			
L1 Cal	3	74	6 (+ 9%, range + 1% to + 13%)	69	83 (+26 %, range +10 % to +14 %)
L2 Atmos	6	23	2 (+6 %, range +2 % to +35 %)	22	37 (+58 %, range +0 % to +575 %)
L2 Land	6	52	4 (+7 %, range +5 % to + 55 %)	49	73 (+38 %, range +4 % to +5913 %)
Total	**16**	**159**	**11 (+ 7%)**	**140**	**207 (+ 30%)**

- Volume units are GB/day (internal compression)
- Embeded geolocation is a subset, e.g. lat/lon only, reduced resolution (5 km)
- Partial geolocation: lat/long at 1 km and sensor/solar view angles at 5 km (replaces embedded geolocation)

- Current MODIS L1, L2 Land/Atmos Volume

  20 years of Terra — 1.13 PB

  18 years of Aqua — 1.02 PB

  38 Total mission years — 2.15 PB

Better support is needed

- Data distributers should give options for users to automaticity download external geolocation granules with L1 and L2 granules

- Formats (e.g. NetCDF) should include identifiers (pointers) for external geolocation granules (files)

  - In NetCDF, external variables are allowed, but granule/file identifiers are missing

- User tools and libraries should allow for external geolocation

Questions?