Jet Propulsion Laboratory
California Institute of Technology

Connecting Swath Satellite Data With Imagery in Mapping Applications

Charles Thompson, Jeffrey R. Hall, Joe T. Roberts, Paulo Penteado, Amy Zhou

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Outline

- Swath data in context
- Swath data as imagery for science applications
- Why swath data as imagery in mapping tools?
- R&D work supporting swath data as imagery
- Imagery examples
- Prototype web interface
- Future work

Swath data in context

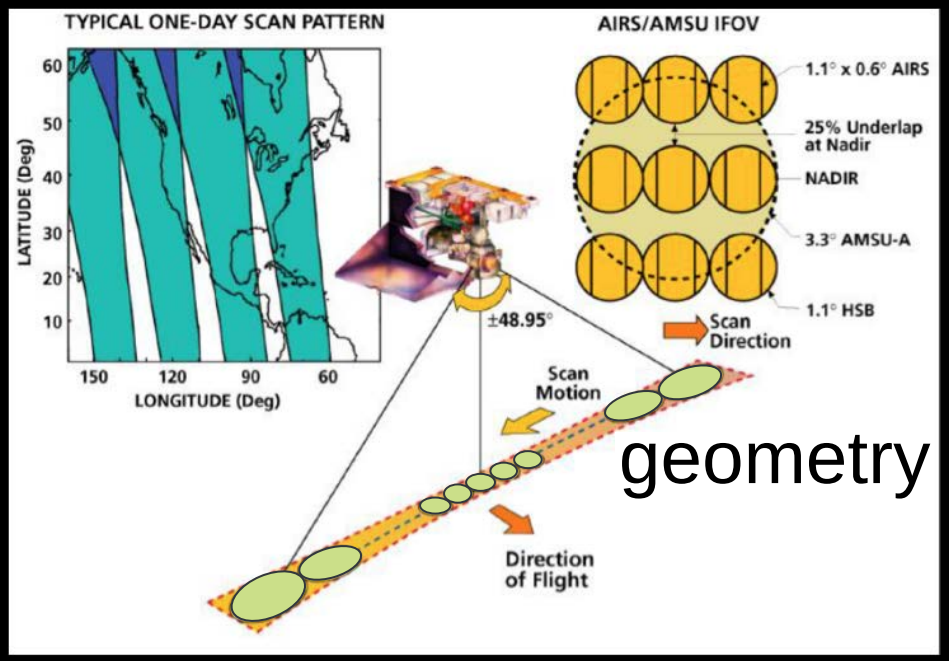
Levels of processing: L2 vs L3 vs L4

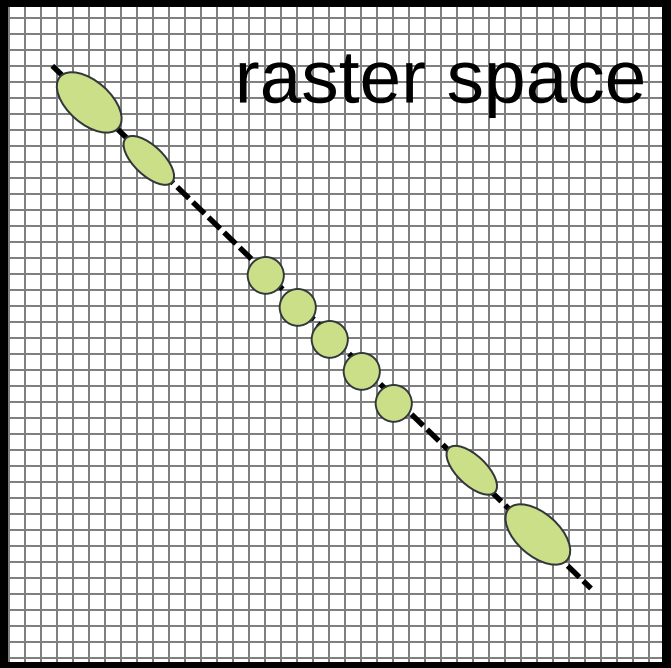
	Level 2 (swath)	Level 3/Level 4
Gridded or projected?	No	Yes
Typical data space/axes	Cross-track/along-track, or “instrument space”	latitude/longitude grid
Resampling/Interpolation?	No	Yes
Typical file organization	Sub-orbital chunks or “granules”	Global grids
Typical visualization technique	Symbolize discrete points or reproject entire granule	Data grid to raster image
Geolocation	At point of geophysical retrieval	On grid

Swath data as imagery for science applications

Key challenges

- Minimizing data transfer latency & archive storage
- Maintaining geometry of sensor measurements
- No interpolation when moving to raster space





Why swath data as imagery in mapping tools?

- Allows local dynamic manipulation & interaction
  - Scaling
  - Coloring
  - Data readout
  - Light analysis (histograms, transect plots)
- Supports science use cases and scenarios
  - Matchups with in situ data
  - Comparison to correlative L2, L3 & L4 data products
  - Ability to trace pixel back to source data value
  - Accurate views of spatial coverage

R&D work supporting swath data as imagery

Key technologies

- Global Imagery Browse Services (GIBS)
- Webification (w10n)
- DAta-to-Image-System (DAISY)

About Global Imagery Browse Services (GIBS)

NASA's visualization resource across its Earth science data holdings

- Supports WMTS & TWMS protocols
- Serves imagery up to full spatial resolution
- Provides NRT & historical image access
- Serves imagery in multiple projections with near-zero latency
- Utilizes Meta Raster Format (MRF)
- Google **gibs nasa**

http://worldview.earthdata.nasa.gov

Webification (w10n)

RESTful URL-based data access

- API allowing direct http access to hdf/netcdf arrays
- http://dataArchive/hdfFile/dataArray[]?output=json
- Two flavors
  - pomegranate (python)
  - Juneberry (Java)
- Open sourced
- Developed at JPL
- http://pomegranate.nasa.gov

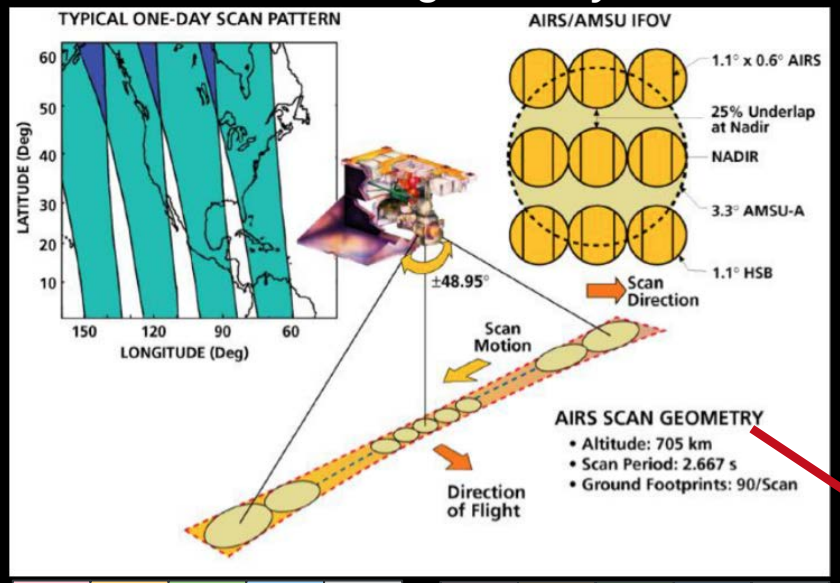
Data-to-Image-SYstem (DAISY)

GIBS R&D effort for creating and serving L2 science imagery

- Approach: indexing sensor footprints in image space
- No interpolation
- Accurate placement, size, & shape of each footprint
- Utilizes w10n for data access

DAISY: building the index image

instrument geometry

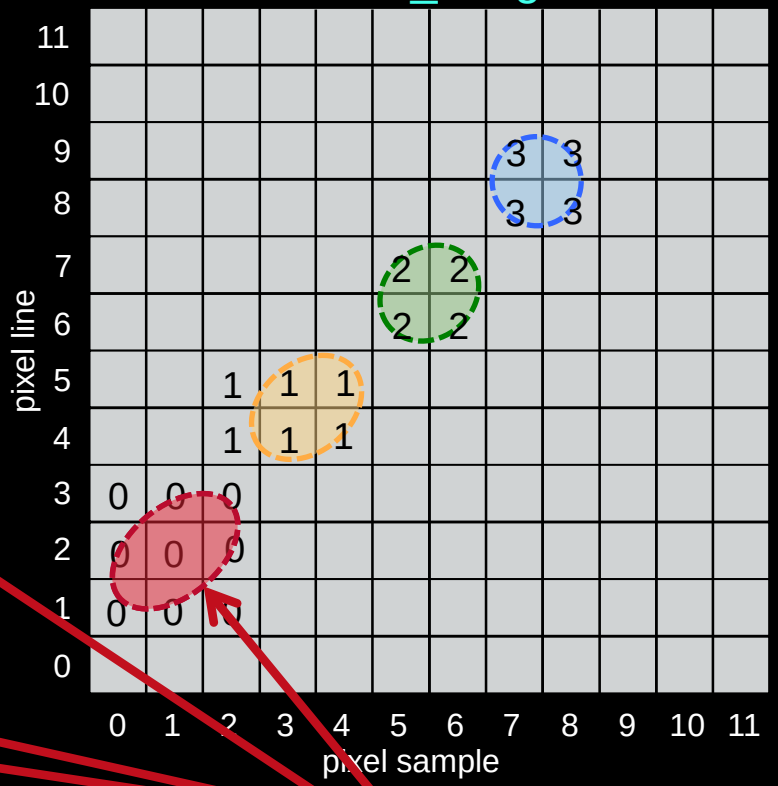


lat0	lat1	lat2	lat3	lat4
lat5	lat6	lat7	lat8	lat9

lon0	lon1	lon2	lon3	lon4
lon5	lon6	lon7	lon8	lon9

L2 geolocation arrays

index_image

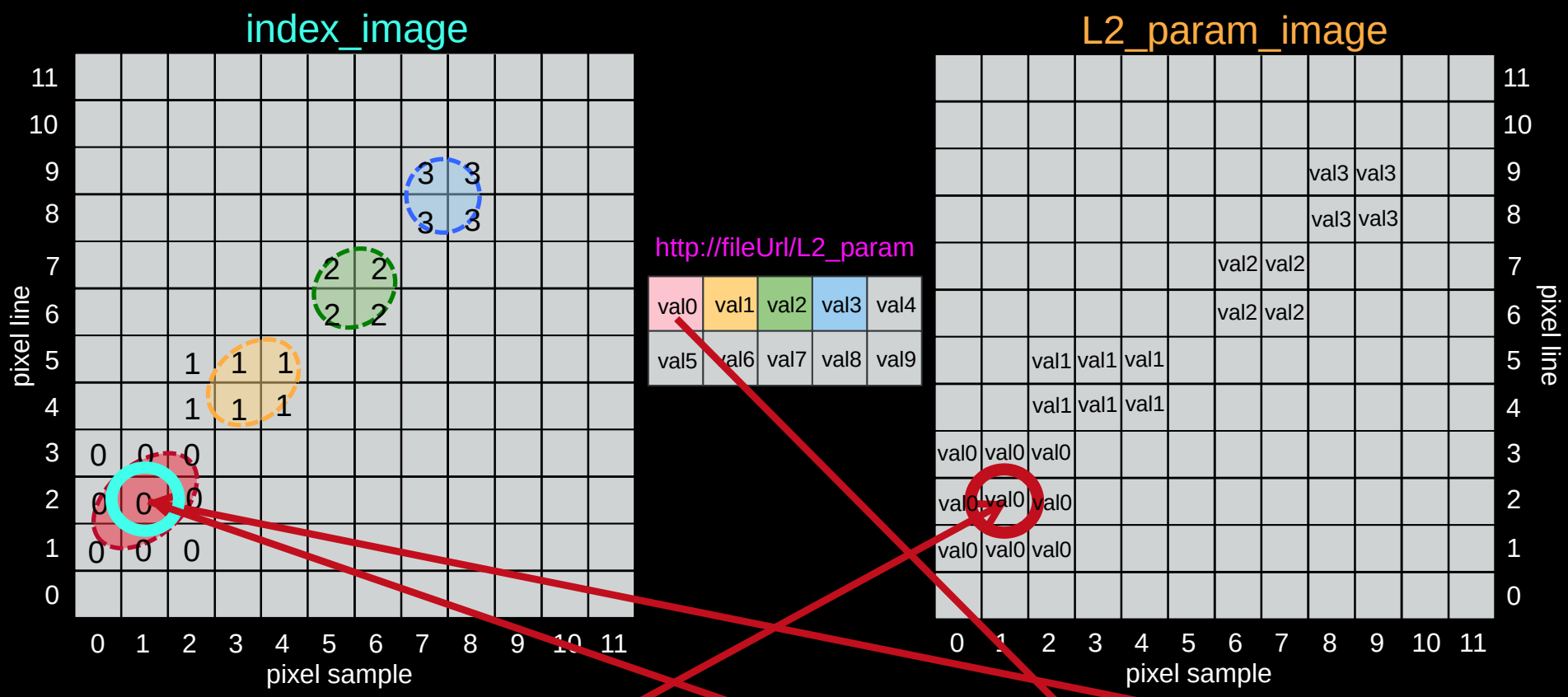


Step 1: calculate perimeter points of footprint polygon

Step 2: map perimeter points into index image

Step 3: assign all pixels intersecting polygon to index value

DAISY: using index image & w10n to map data



L2_param_image[1,2] = http://fileUrl/L2_param[index_image[1,2]]

L2_param_image[1,2] = http://fileUrl/L2_param[0] = val0

Summary: indexing sensor footprints

- Assumption: 1:1 correspondence between L2 data value & lat/lon
- Define geolocated output image space: projection and resolution
- For each geolocation value:
  - Calculate footprint perimeter utilizing spacecraft geometry & sensor information
  - Use perimeter geolocation values to identify intersecting pixels in output image
  - Populate identified pixels in output image with unique index value
- Index image used in conjunction with w10n URL to map data
  - mapped_data = http://dataArchive/granule_file_name/variable_name[index_list]
- Index image can be used in conjunction with all sensor parameters with the same geolocation!

Shoehorning dynamic swath imaging into GIBS

Standard image tiles versus swath image tiles

Raster Image

- Generate Raster Image
- Slice & Dice into Tile Pyramid
- Serve Raster Tiles via WMTS
- Client Renders Image Tiles

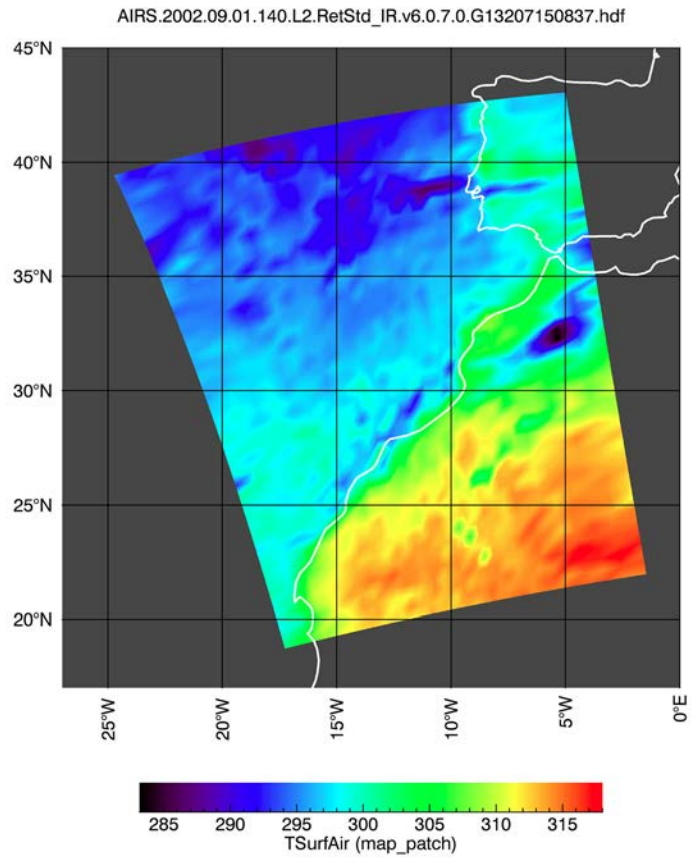
Index “Image”

- Generate Index Image
- Slice & Dice into Tile Pyramid
- Serve Index Tiles via W[MC]TS w/ w10n URL
- Client Requests Data Values from w10n URL using Index Image Values
- Client Renders Data Values Based on User-Defined Scaling/Coloring

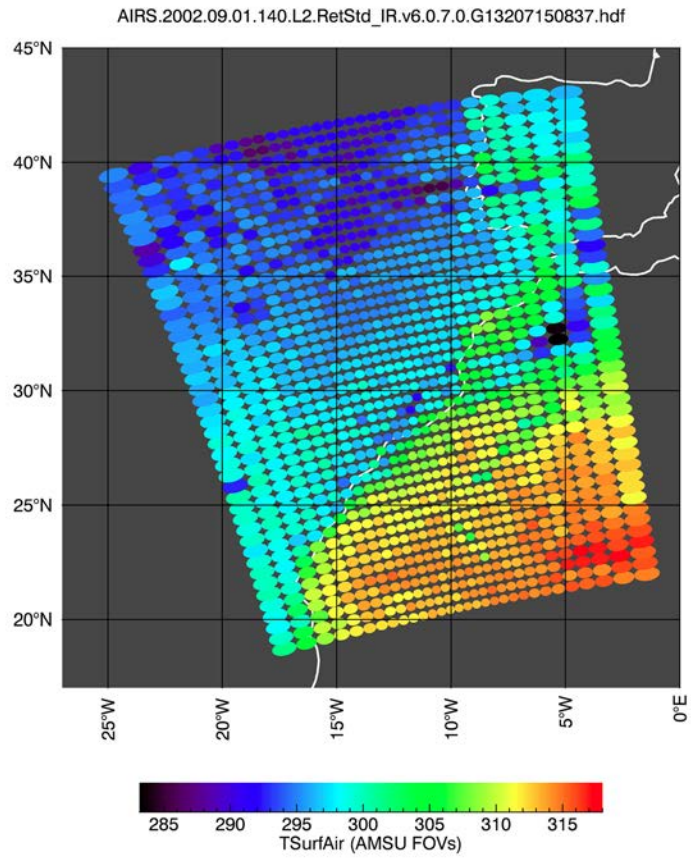
Example of AIRS L2 image generation

Air temperature at the surface

reprojection with interpolation



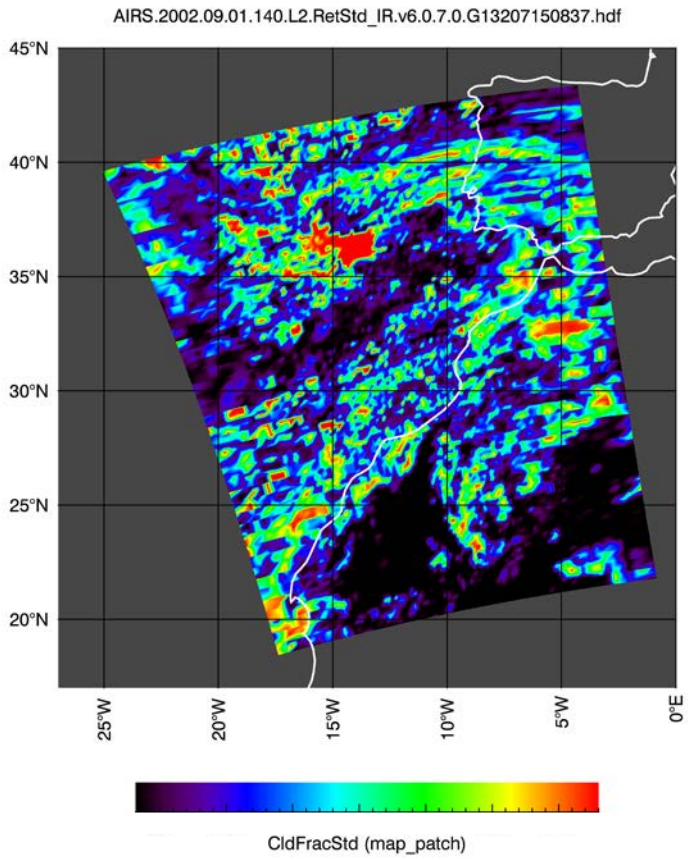
L2 footprint indexing



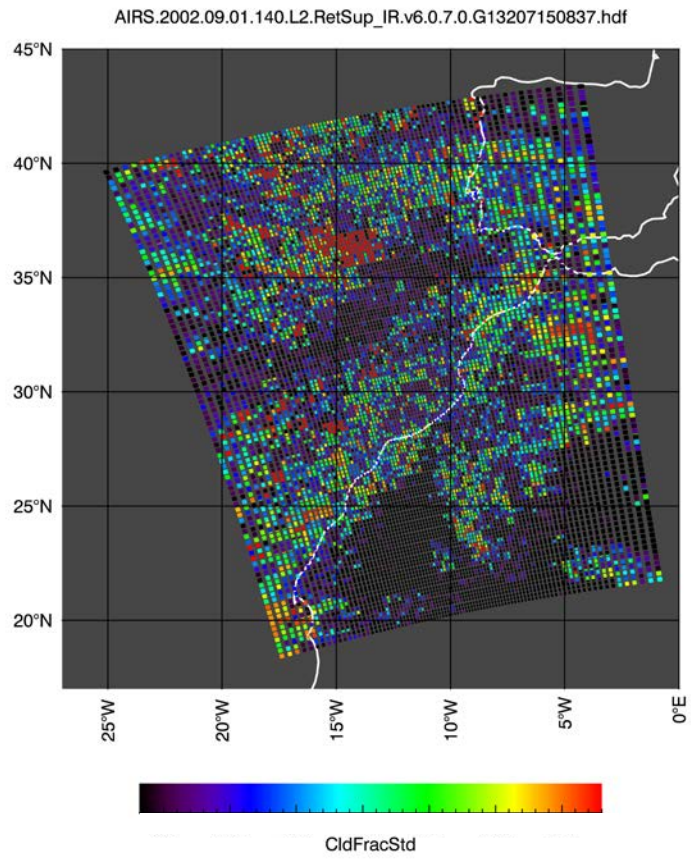
Example of AIRS L2 image generation

Cloud fraction

reprojection with interpolation



L2 footprint indexing



Prototype web interface

Future work

- Resolve multiple indices assigned to the same pixel
  - Currently using first or last value in
- Build index generators for additional sensors
- Characterize latency for multiple granules & larger regions
- Release web interface for comments and feedback
  - Includes time selector capability for individual footprints

Shameless plug…

- IN53A-1874 Prototyping Dynamic Earth Science Data Visualization on the Web

Additional thanks to…

- Earth Science Data and Information System (ESDIS)
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  - Ryan Boller

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