Analysis Ready Data in Analytics Optimized Data Stores for Analysis of Big Earth Data in the Cloud

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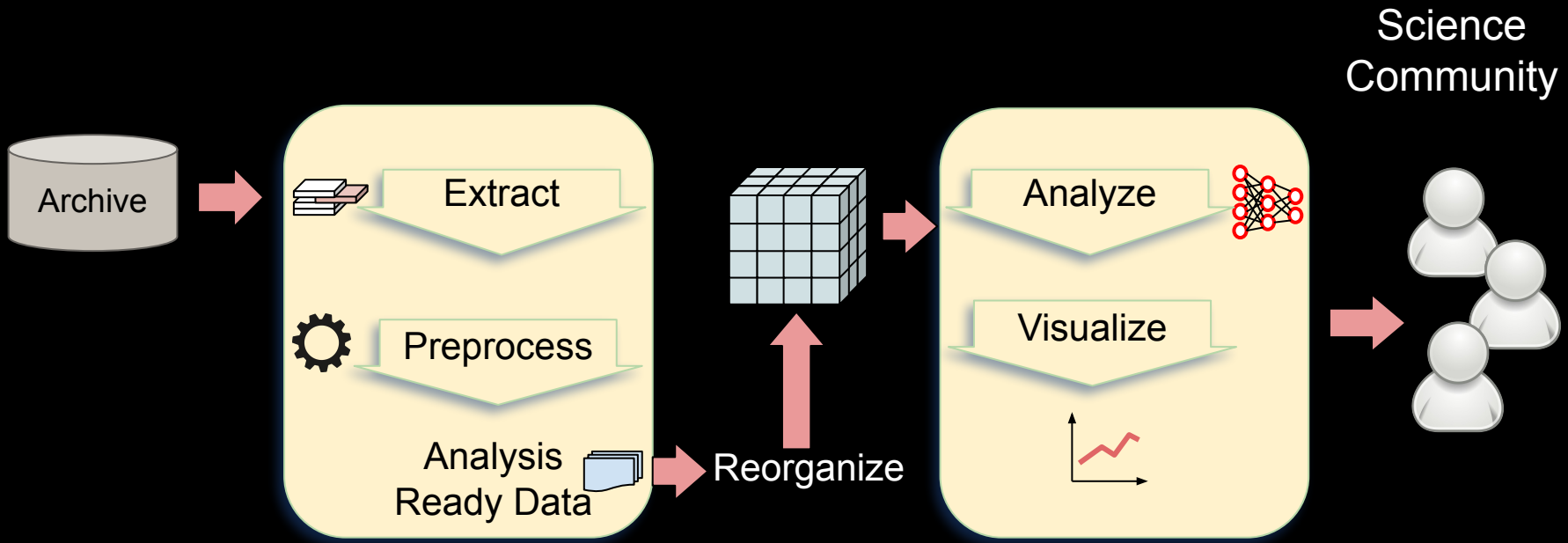
Analysis-Ready Data (ARD):

Data that have been preprocessed to a form that allows immediate analysis by the end user

Analytics Optimized Data Store (AODS):

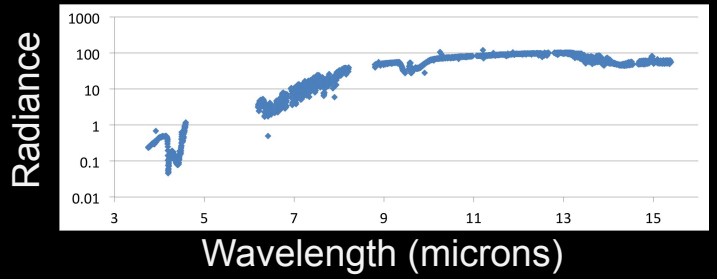
A storage arrangement of data that supports fast analysis of Big Data

Analysis-Ready Data vs. Analytics Optimized Data Stores



ARD and NASA Data Processing Levels

Level 1B - Calibrated + Geolocated
Calibrated radiance at a pixel



Atmospheric Infrared Sounder (AIRS) data for 1 pixel on 2011-08-11

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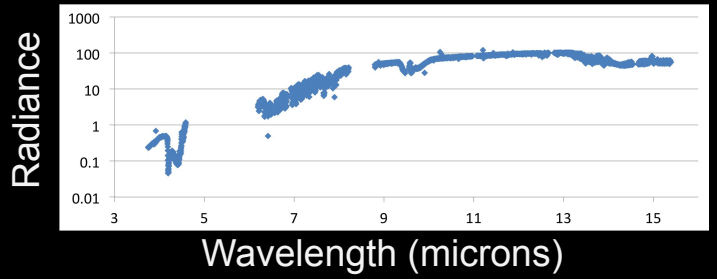
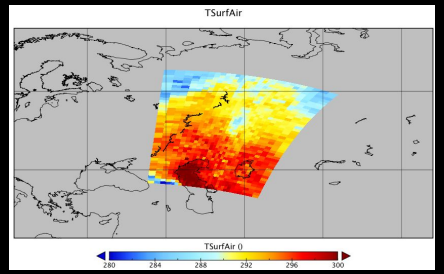


Level 2 - Geophysical Parameter
E.g., Surface air temperature for one scene



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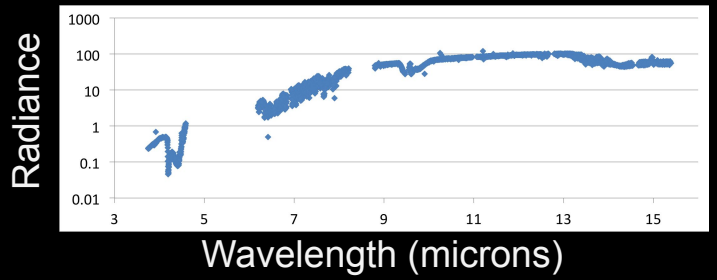

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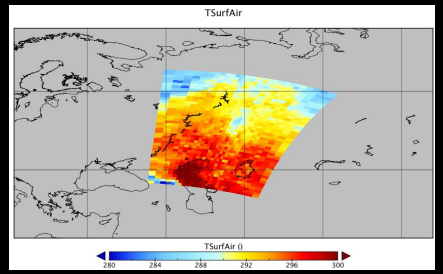
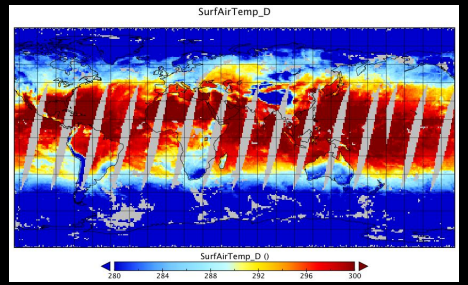
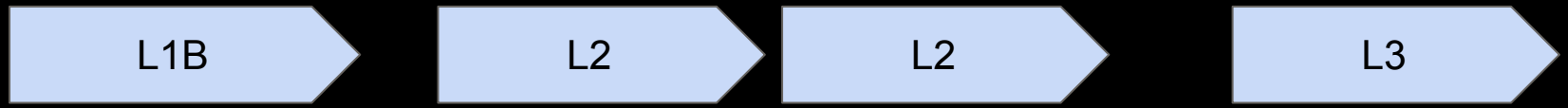


Level 3 - Spatio-temporally Averaged
E.g., Global surface air temperature for one night
(Almost-global coverage, rectilinear grid)



Analysis-Ready AIRS Data

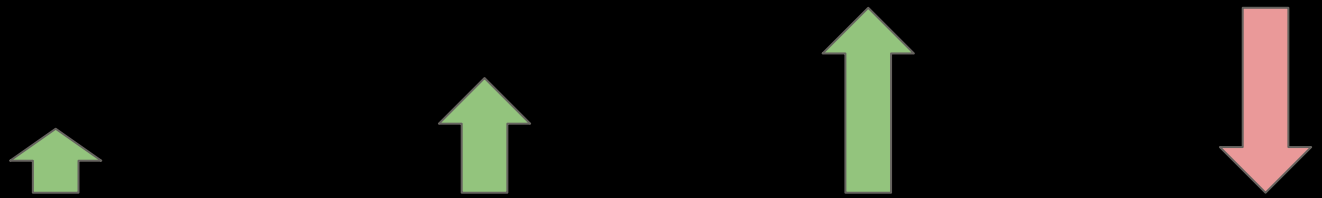


Geolocate
Apply calibration

Cloud Clearing

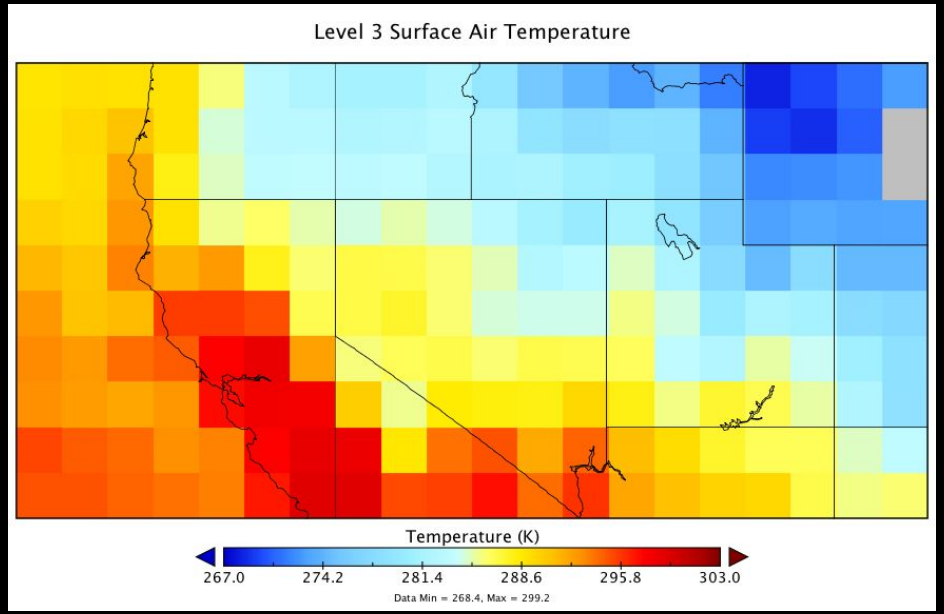
Physical Retrieval
- Temperature
- Moisture
- Methane
- Carbon Monoxide
- Carbon Dioxide
- Ozone
- ...

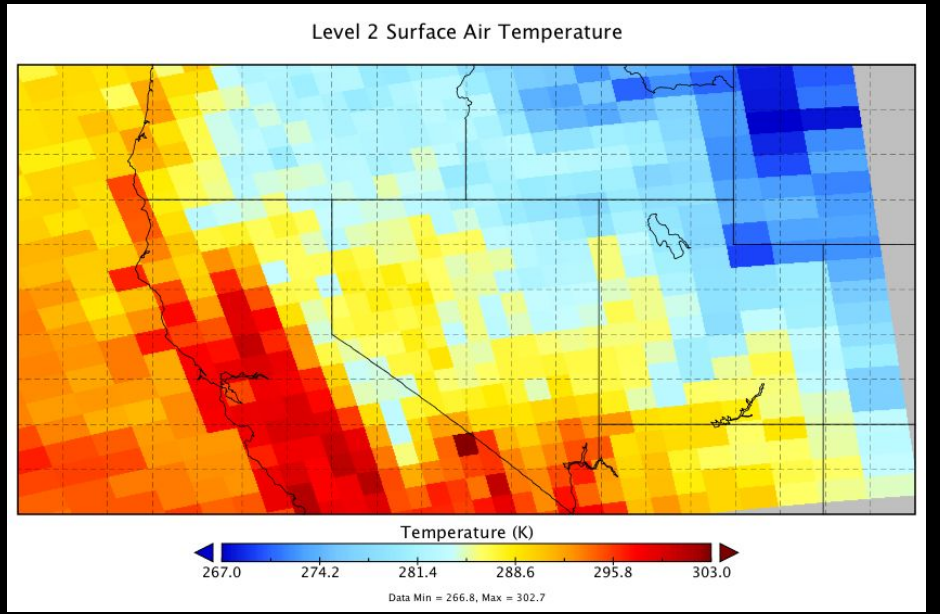
Spatio-temporal Average
1°x1° Grid
- daily
- 8-day
- monthly



Information Content Increase / Decrease

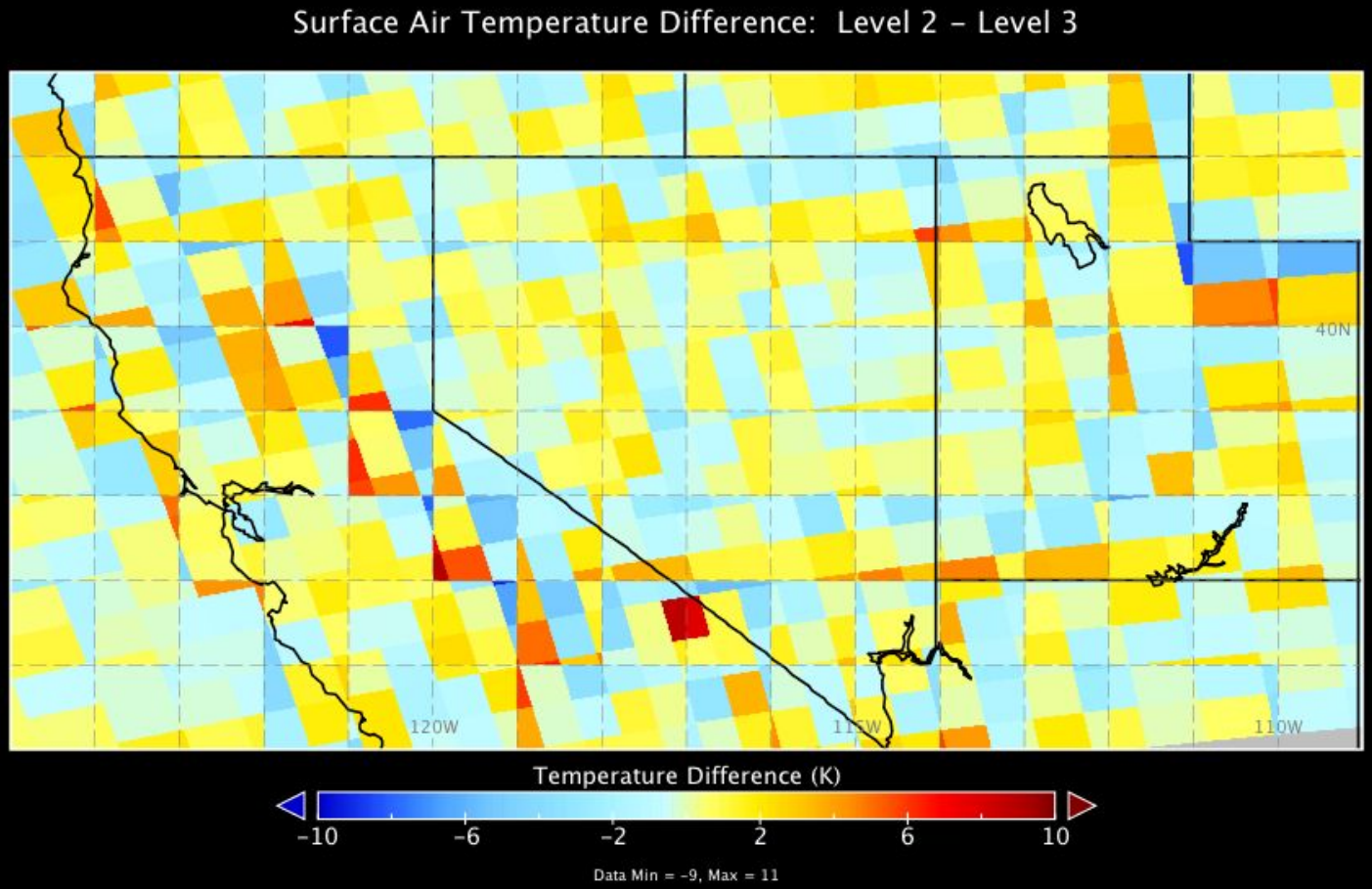
Caveats regarding gridded (L3) data





Sacrificing spatial resolution for convenience

Caveats regarding gridded (L3) data



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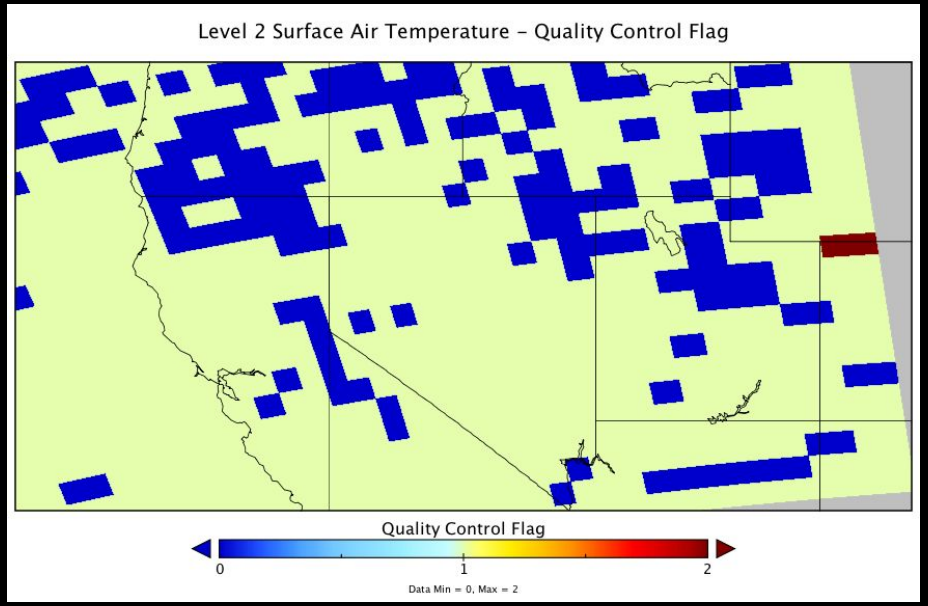
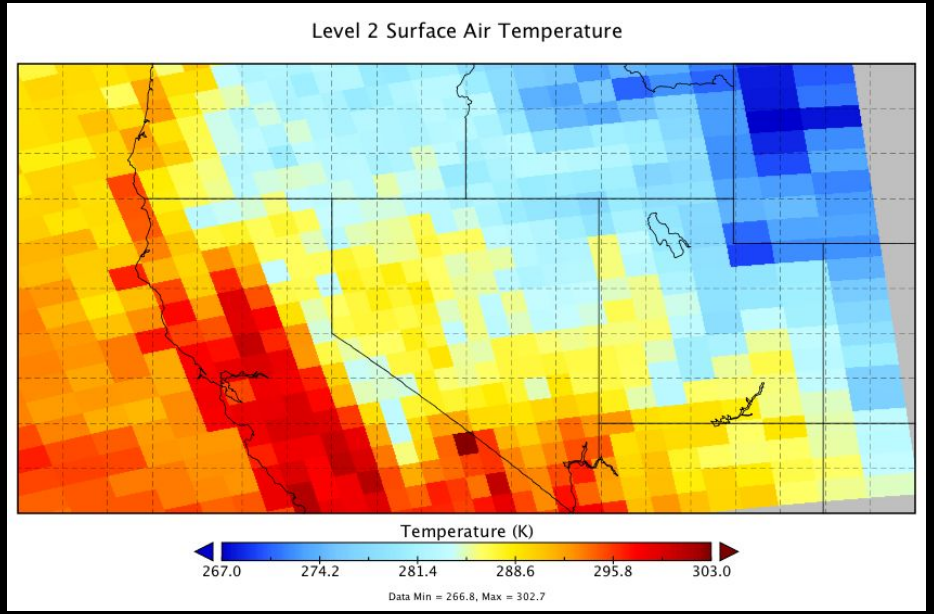
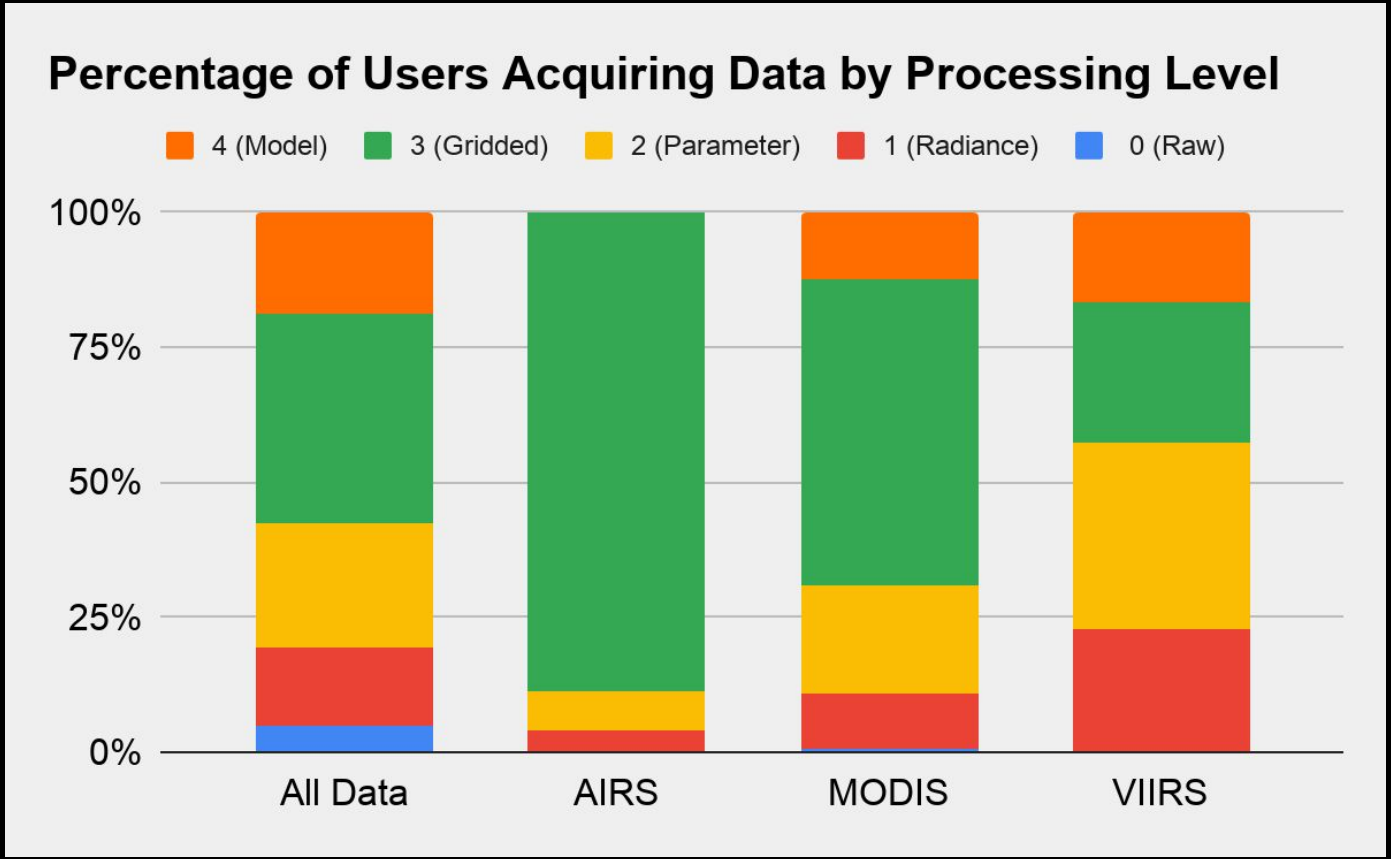




Forgoing control over quality flag handling

Yet: Level 3 (Gridded) data is the most popular



Just how inconvenient ARE Level 2 Swaths???

Example: Surface Temperature Trends over the Globe

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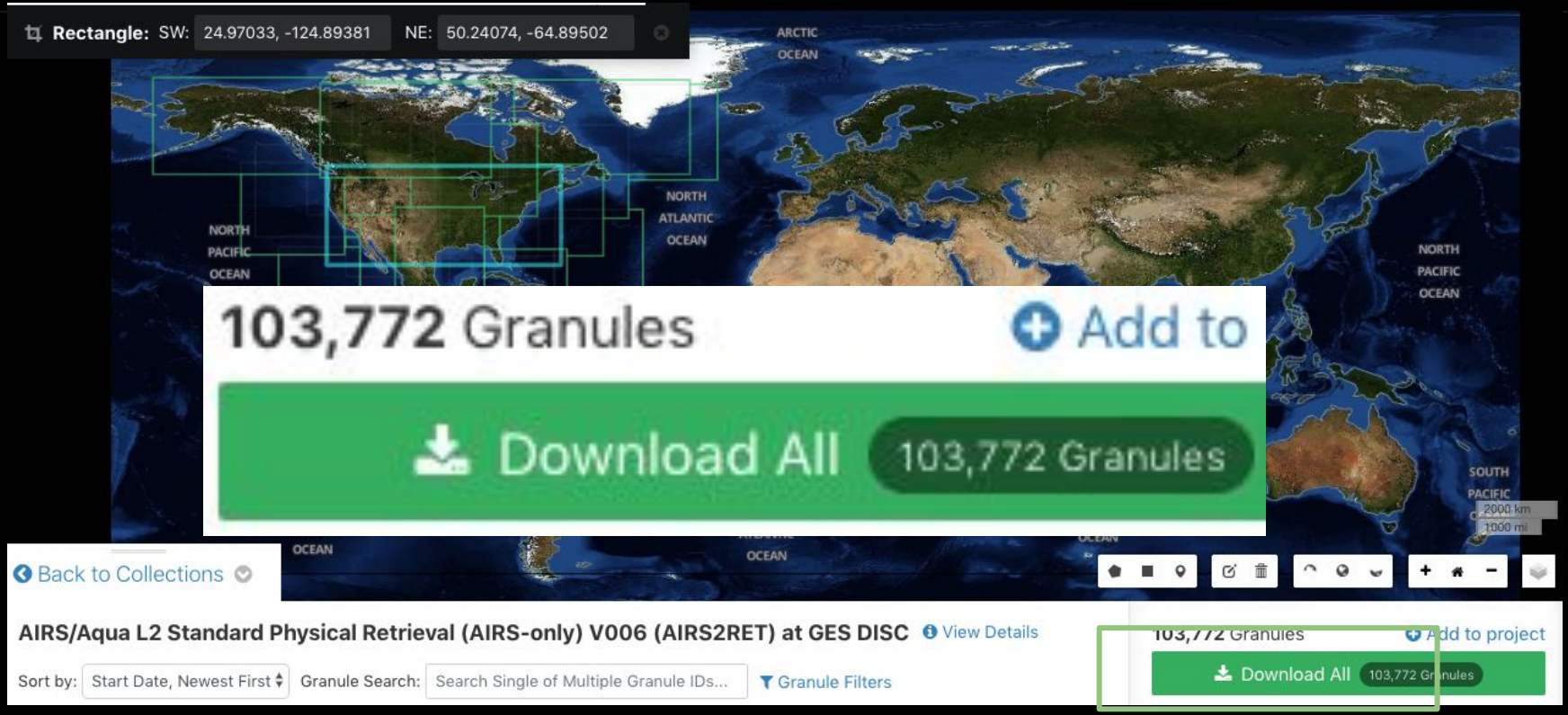
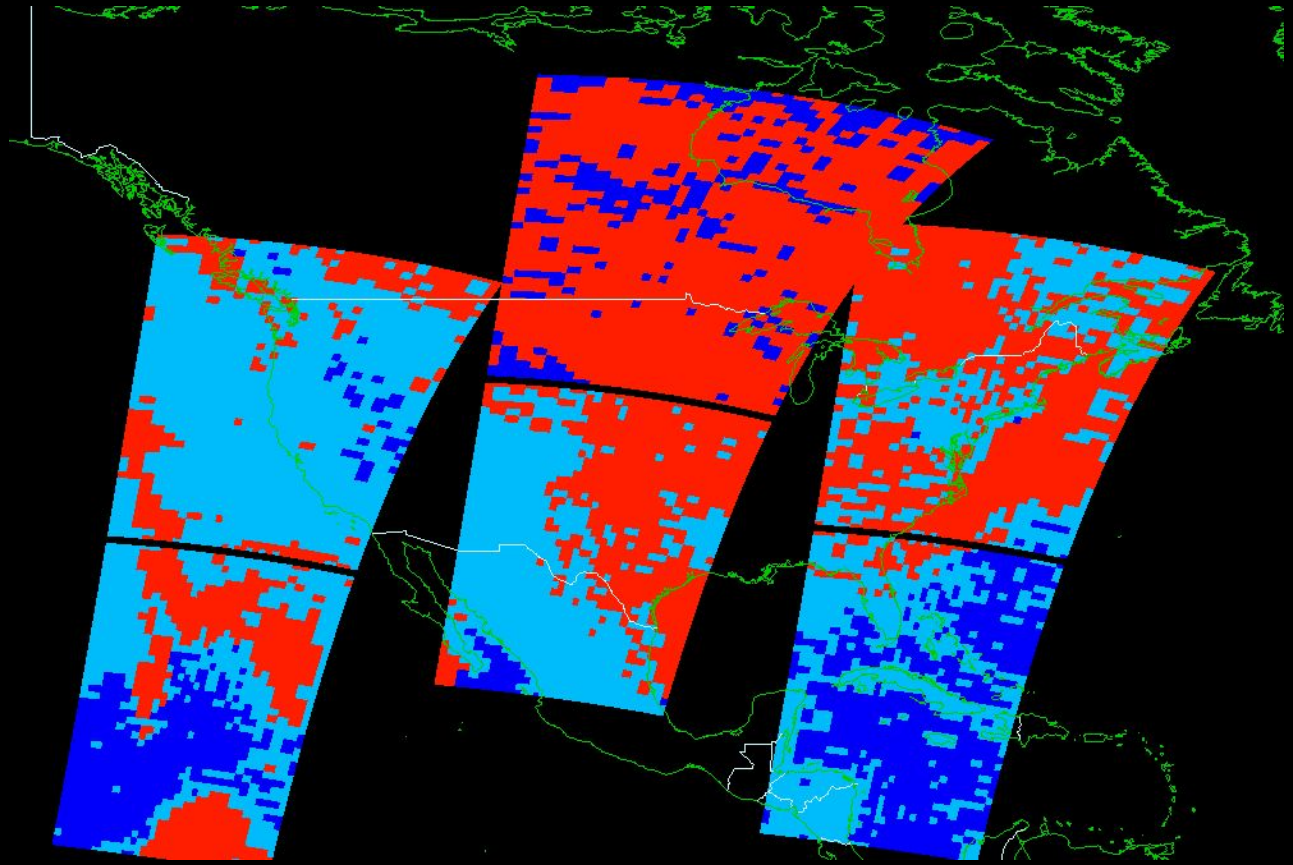
Example: Surface Temperature Trends over the ~~Globe~~ Continental United States

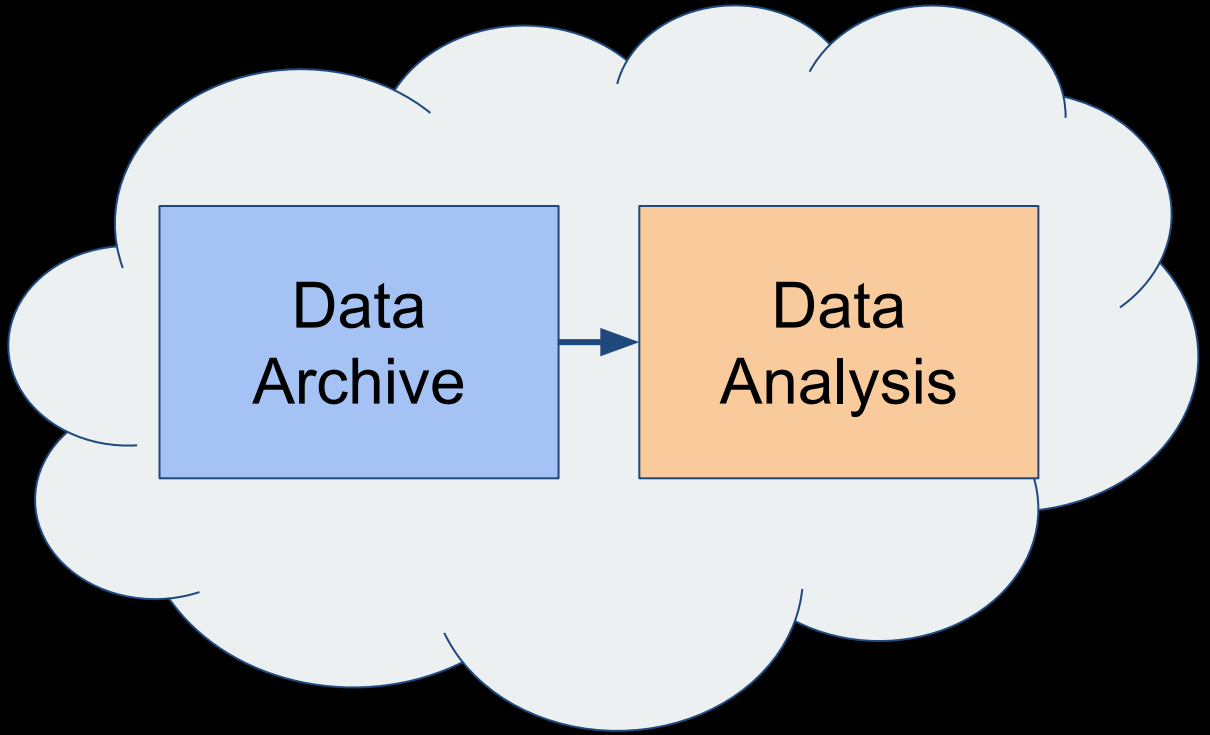


Assembling proper pixels is no picnic either...

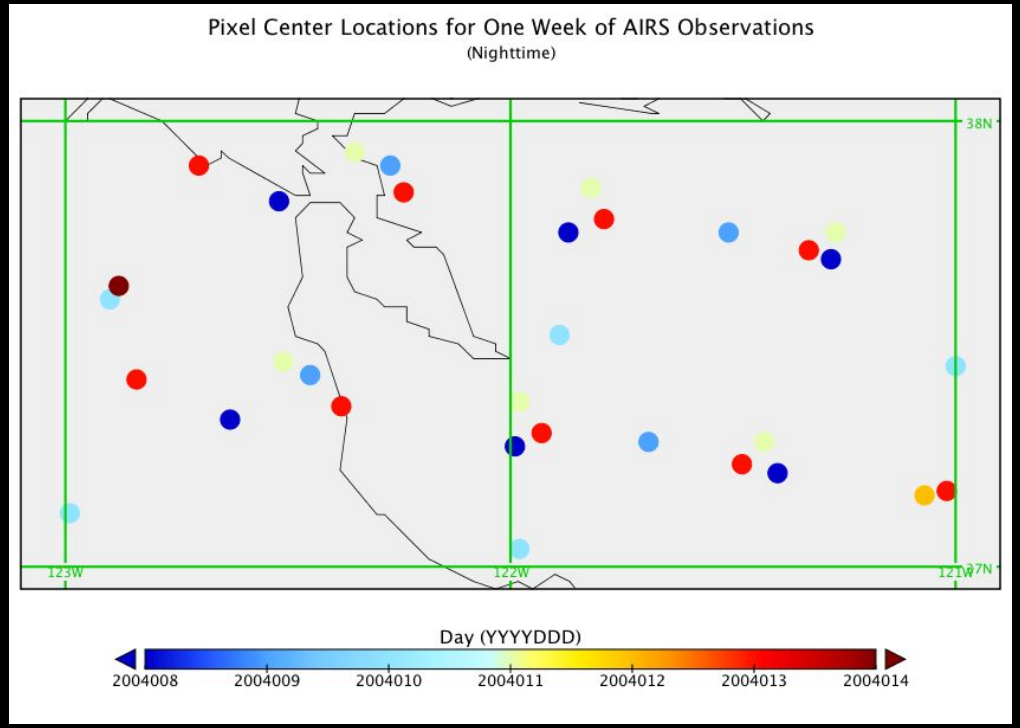


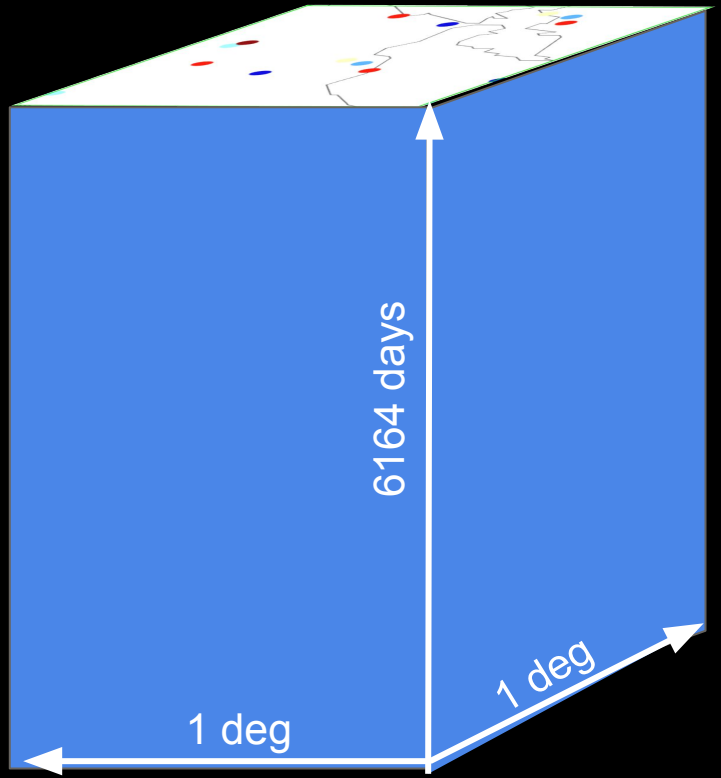
How do we remove the pain points to make Level 2 Swath data both Analysis-Ready and Analytics-Optimized?

Step 1: Cloudify data and analysis to analyze in-place, without moving the data.



Step 2: Reorganize Level 2 swath data to make spatial data access easier and faster





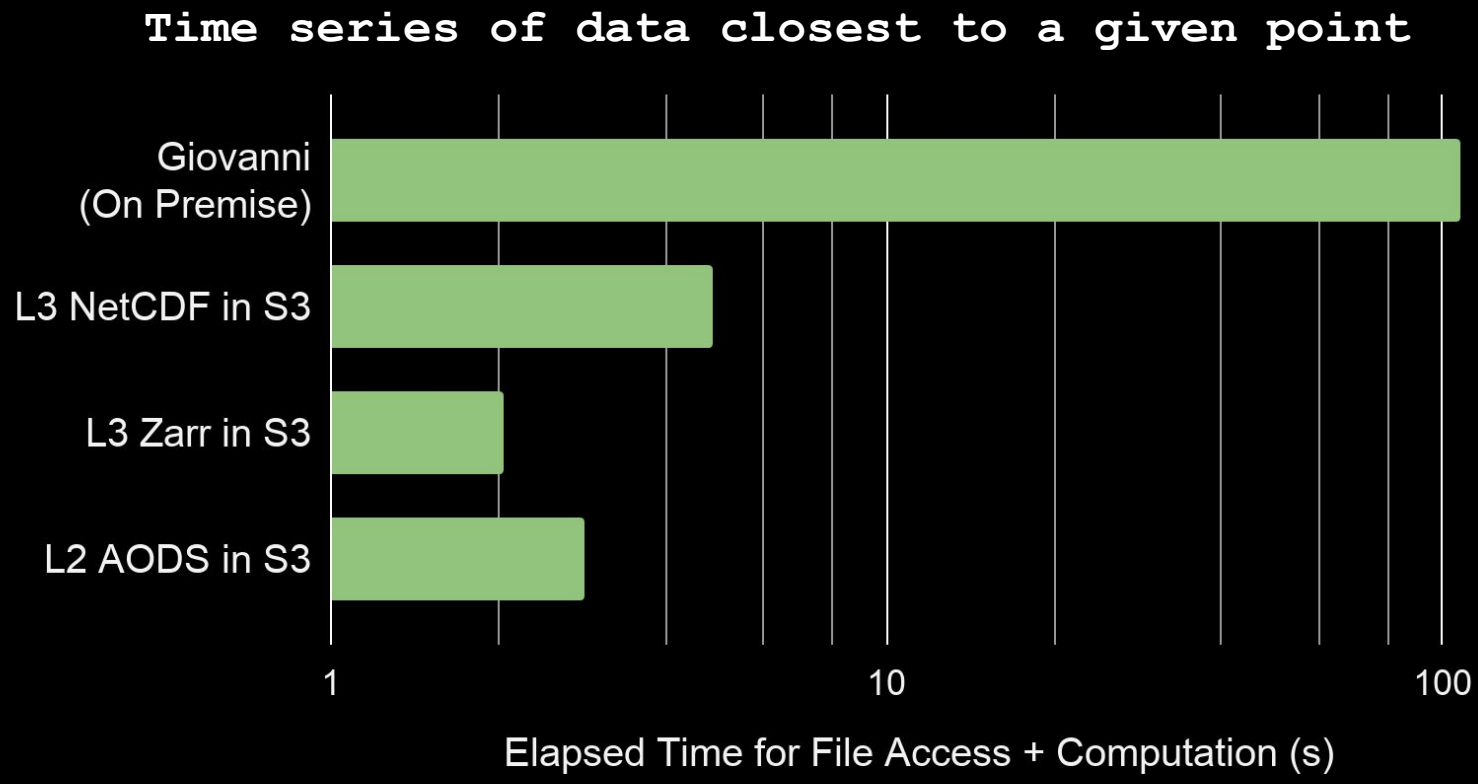
Columnar bins of L2 data: lat_lon


```
$ ls -x TSurfAir.D
+24_-065   +24_-066   +24_-067   +24_-068   +24_-069
+24_-070   +24_-071   +24_-072   +24_-073   +24_-074
+24_-075   +24_-076   +24_-077   +24_-078   +24_-079
+24_-080   +24_-081   +24_-082   +24_-083   +24_-084
+24_-085   +24_-086   +24_-087   +24_-088   +24_-089
...
```

Step 3: Use Python Application Program Interfaces to simplify spatial processing


```
# Time series of data closest to a given point
ds['xdist'] = (ds['Longitude'] - my_lon)* \
                m.cos(my_lat * m.pi/180.)
ds['ydist'] =  ds['Latitude']-my_lat
ds['sq_dist'] = xr.ufuncs.square(ds['ydist']) \
              + xr.ufuncs.square(ds['xdist'])
df = ds.to_dataframe()
closest_idx = df.groupby("dataday")['sq_dist'].idxmin()
closest = df.loc[closest_idx,['dataday','TSurfAir']]
...
```

How well does this L2 AODS perform?



NetCDF = Network Common Data Form S3 = Simple Storage Service

How do we make swath (L2) data easier and more performant to use?

1. Move data and analysis to the Cloud
2. Reorganize data for faster spatial access
3. Encapsulate geolocation irregularity with a Python API for geospatial access and computing
4. *Examples*. Lots and lots of examples.