Engaging with the Problem of Metadata Heterogeneity

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An archivist's job can be complicated

- If data were all of the same type
  - Simply maximize usage of a one-size-fits-all container
  - Users come to the archive knowing what Qs to ask

What fun would that be?

Image from metrohighschool.files.wordpress.com

An archivist's job can be complicated

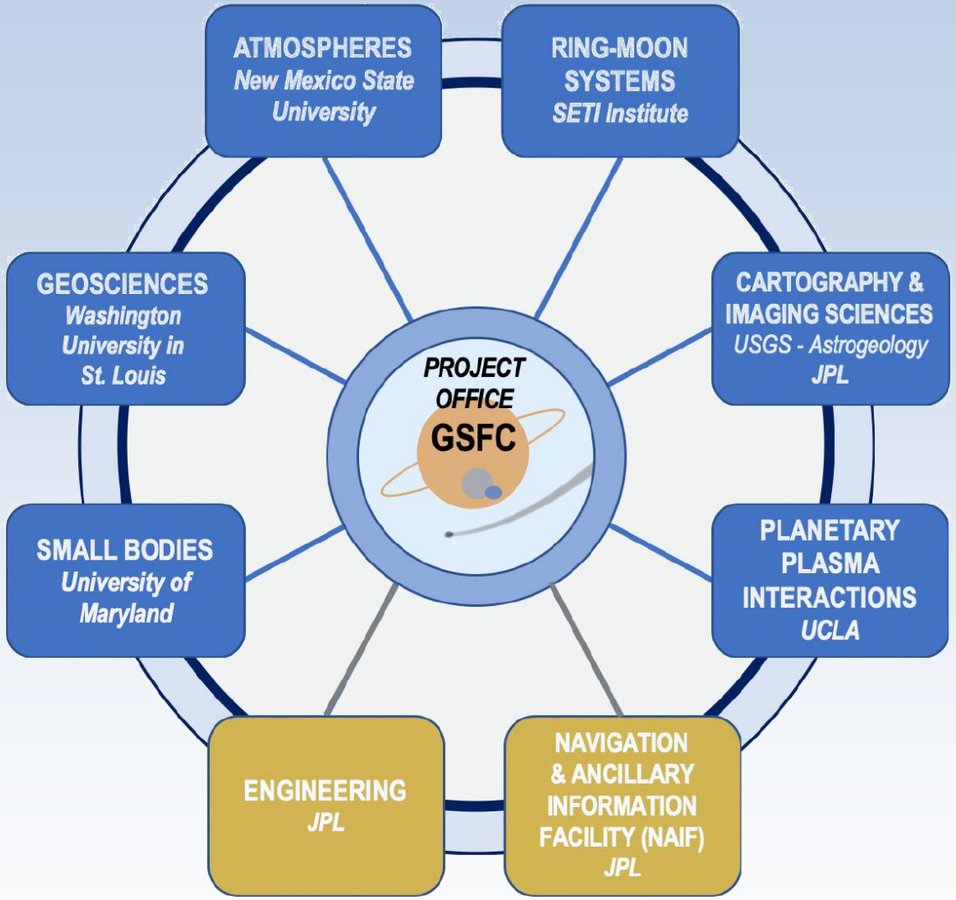
- Reality: Data is diverse
  - Many different kinds of things may be part of one archive
  - Some more than others
  - Containers must allow for all possibilities
  - Users come to the archive with diverse things in mind

This makes our job challenging (and interesting!)

Image from essexnewsdaily.com

The Planetary Data System and PDS4

- PDS is NASA's archive for Planetary Science
- The PDS4 Information Model provides framework
  - Rigorous structure and definition of metadata
  - Simplified file structures
  - Designed to remain functional for decades to come
- But is it enough?



Heterogeneity in Data Type

- Many observing platforms
  - Astronomy
  - Spacecraft
  - Landed stations
  - Biology
  - Laboratories on Earth
  - and more…

To our knowledge, there is <u>no</u> single metadata attribute that applies to <u>every</u> data product in PDS

- Many types of instruments
  - Cameras
  - Spectrometers
  - Dust particle detectors
  - Charged particle detectors
  - Magnetic field detectors
  - Electric field detectors
  - Seismometers
  - and more…
- Many types of targets
  - Planets
  - Moons
  - Asteroids
  - Comets
  - Surface features
  - Magnetospheres
  - Weather stations
  - and more…
- Many targets within each type
  - Layered portable chemistry equipment
- Many coordinate systems
  - The naked eye
- and more…
  - and more…

Heterogeneity in Data Type

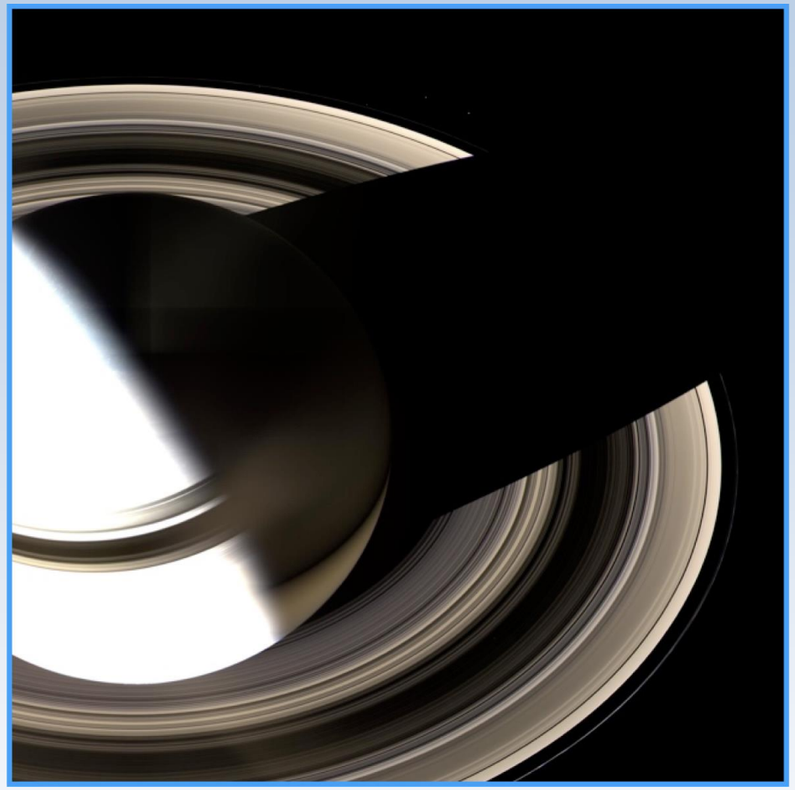
- Data diversity poses challenges for discoverability
- "One-stop shopping" is a great concept
  - Is it practical? Will it work?
  - The more diverse the data, the more merit in diverse discovery tools
  - Requires educating users

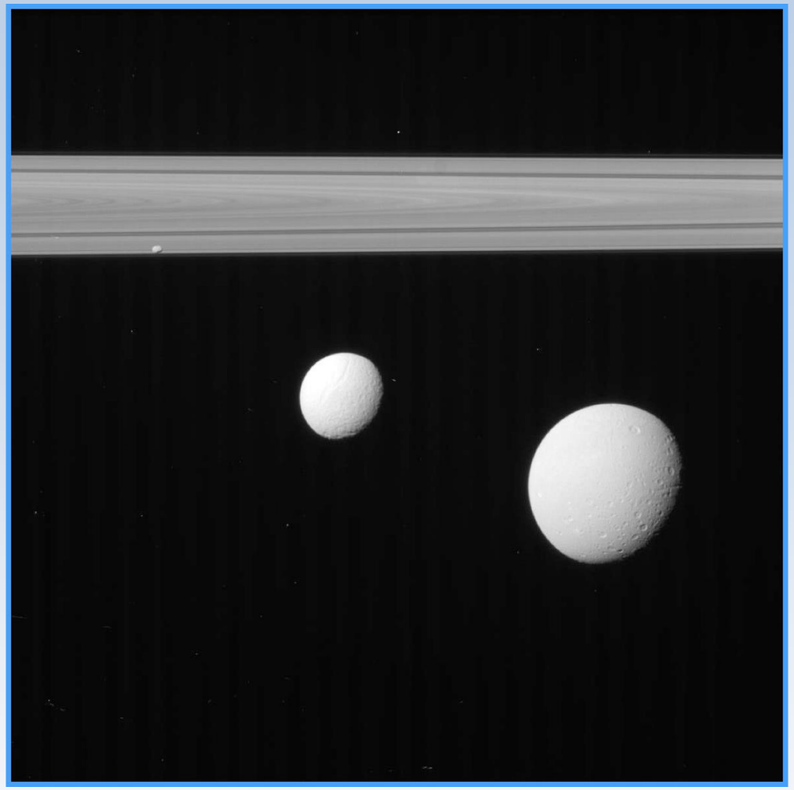
Image from one-stop-shop-online.com

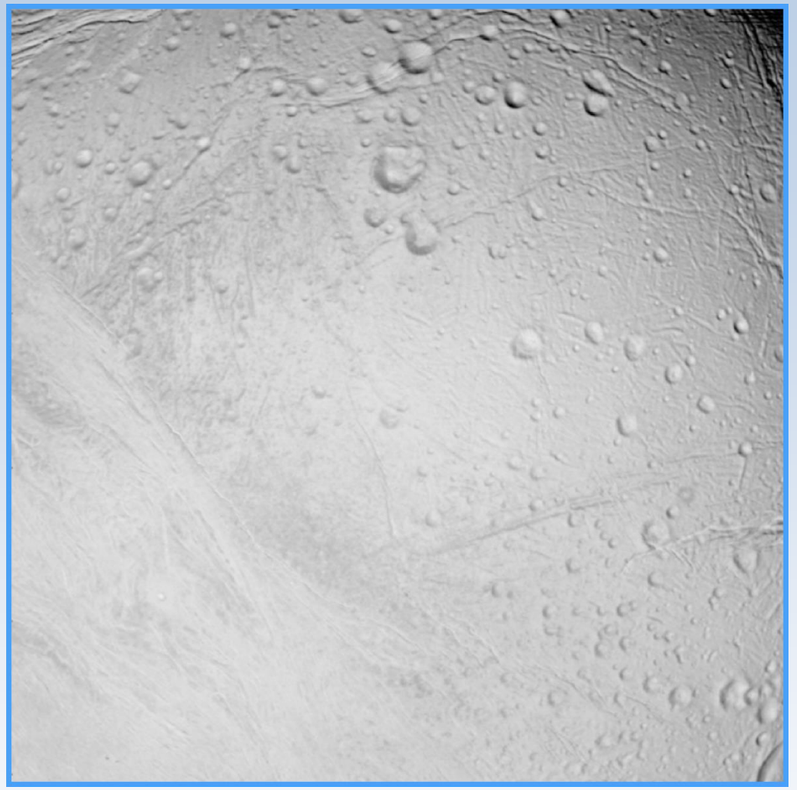
Heterogeneity in Detail

- A different kind of heterogeneity
  - Every data provider has their own context
  - Teams develop a characteristic way of doing things
  - Similar concepts and quantities expressed differently in archived metadata
- Example: Spectral Filters
  - Cassini ISS had a filter called RED, covering 0.57 μm to 0.72 μm
  - Hubble WCF3 has a filter called F689M, covering 0.65 μm to 0.72 μm
  - Archived metadata alone may not help you link these related observations
- Example: Coordinate Systems
  - One data provider gives planetocentric lat/lon, another planetographic
  - One data provider gives solar hour angle in hours, another longitude in °

Heterogeneity in Detail: Geometric Metadata

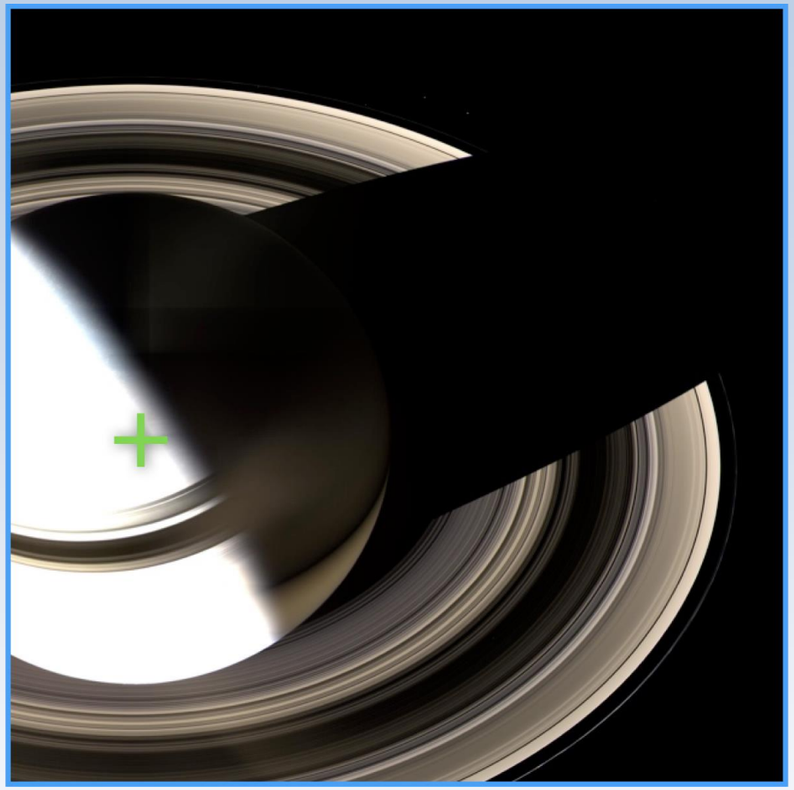


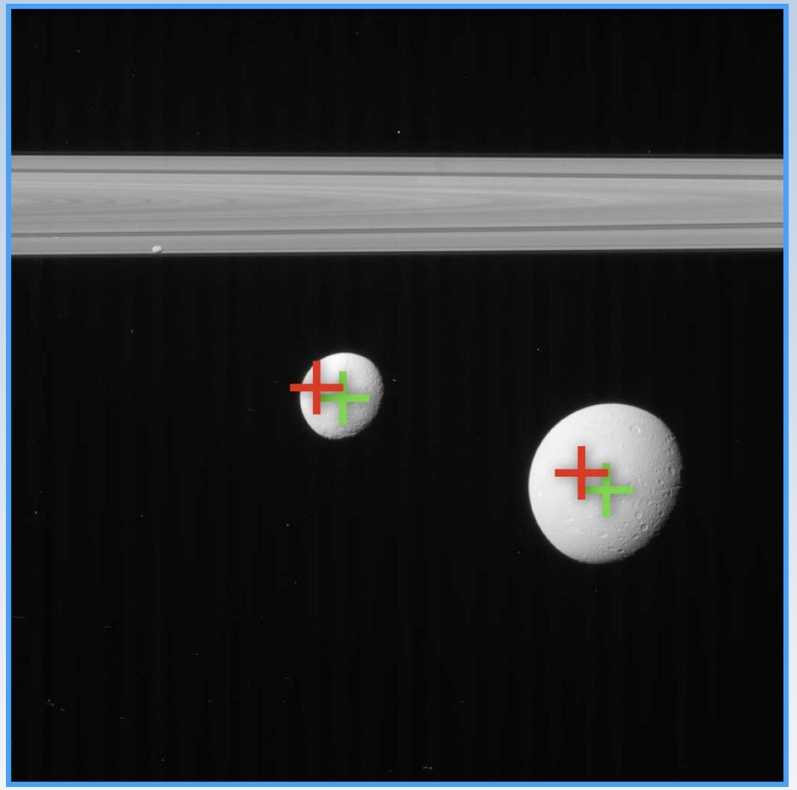


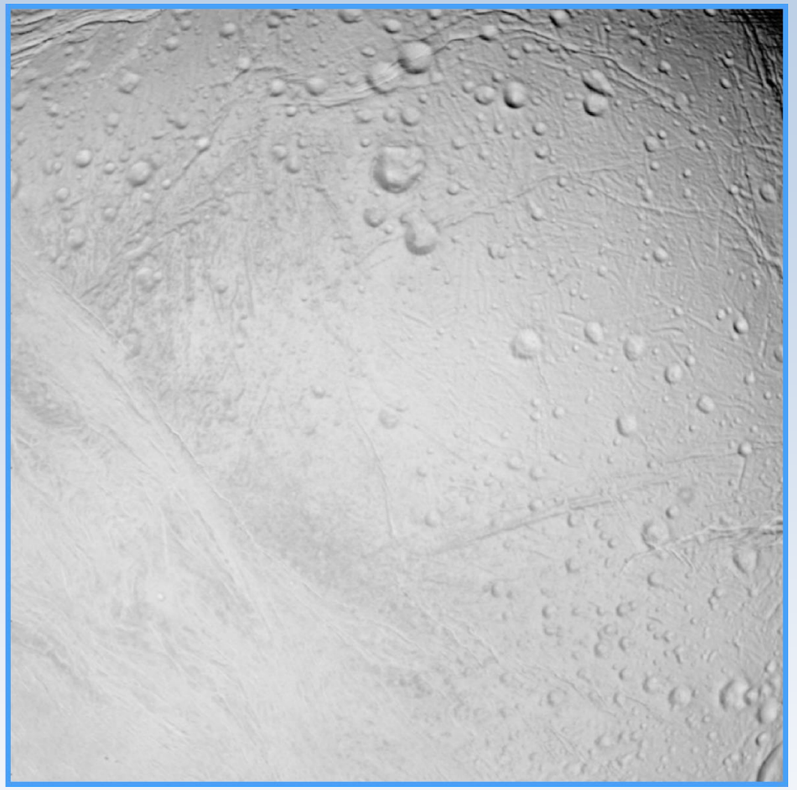


- Spacecraft teams generally provide metadata indicating the intended scientific target of each data product
  - But many products contain information relevant to more than one body
  - Moreover, serendipitous detections may not have metadata provided

Heterogeneity in Detail: Geometric Metadata

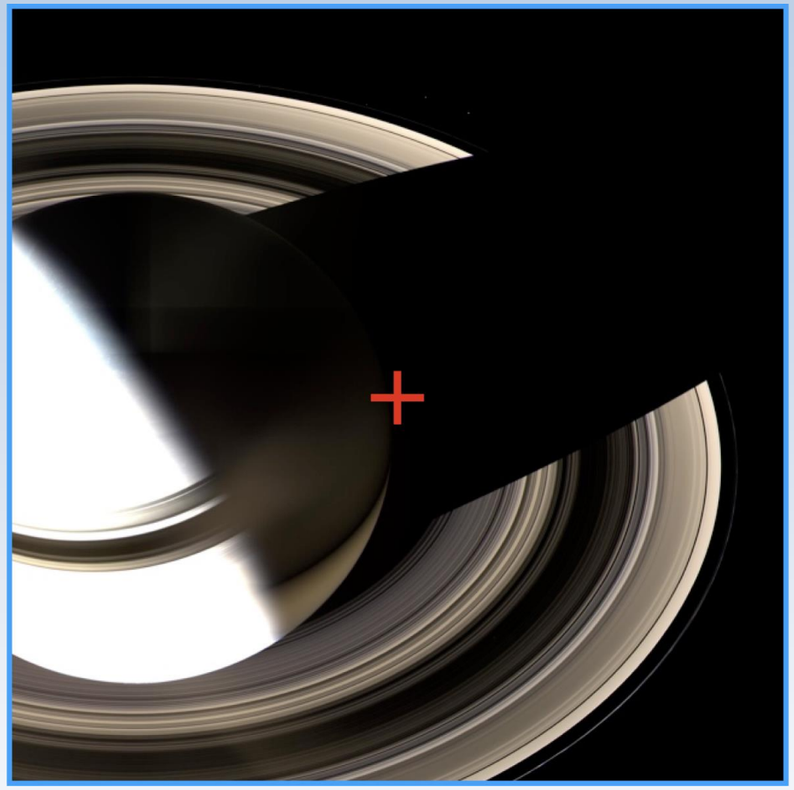


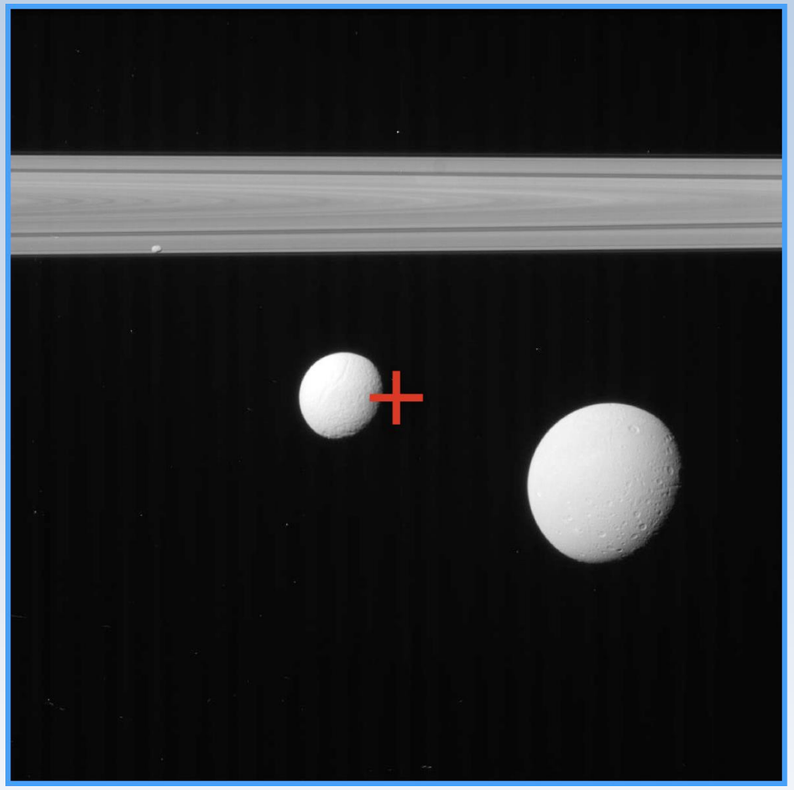


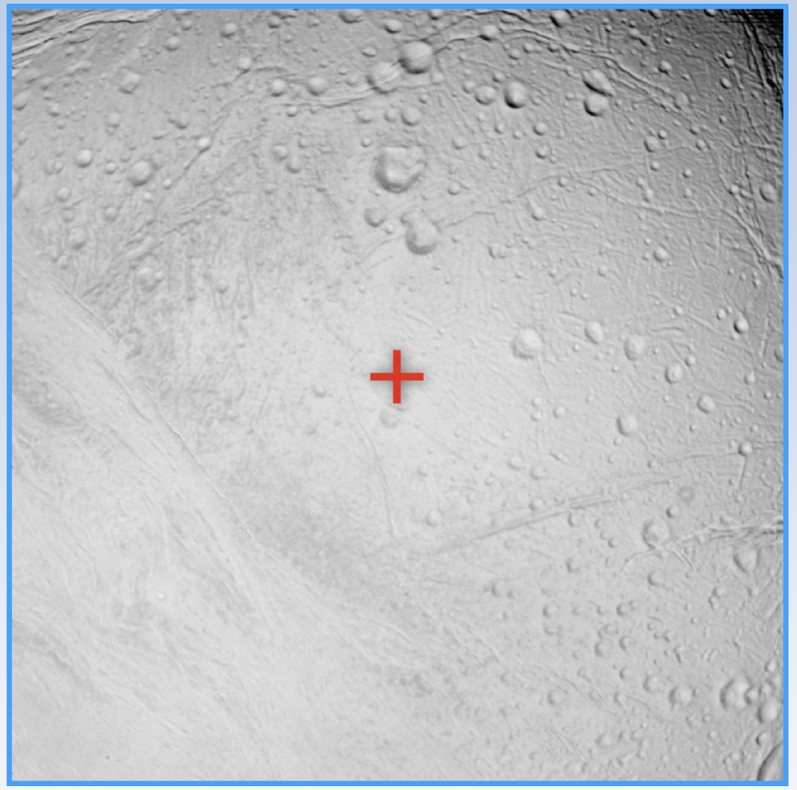


- Sometimes, team-provided metadata identifies the sub-spacecraft and sub-solar coordinates
  - However, this does not tell us whether the specified locations fall inside the field of view

Heterogeneity in Detail: Geometric Metadata

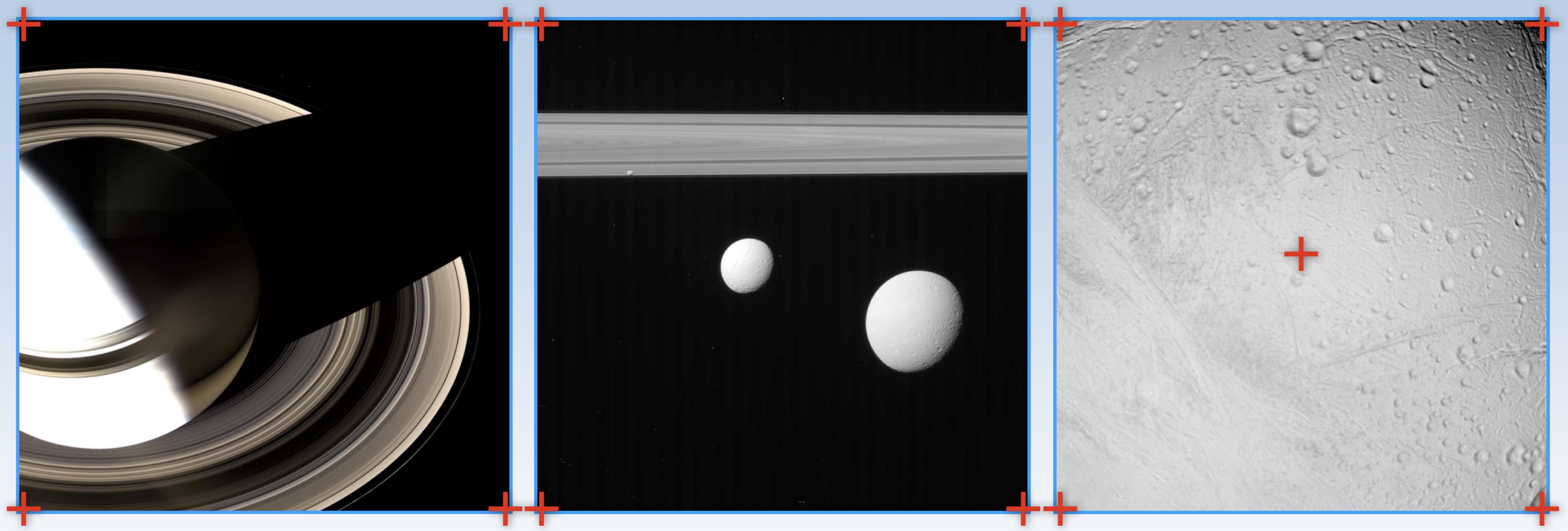






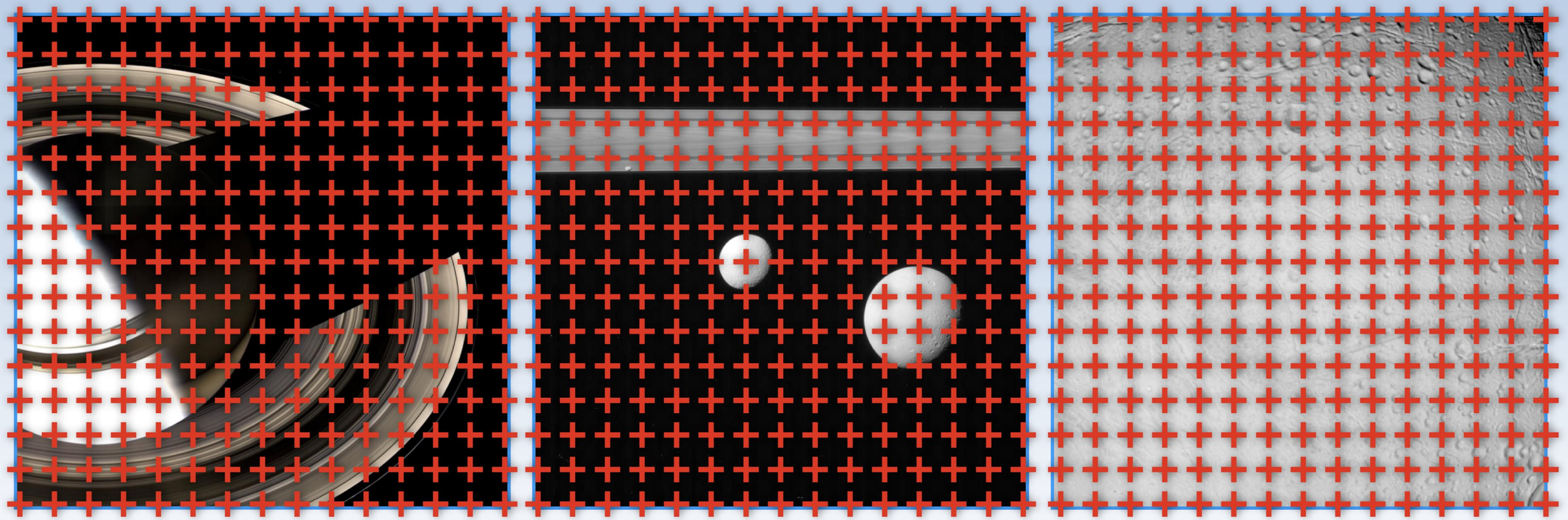
- Sometimes, team-provided metadata provides information about the center of the field of view
  - However, we cannot assume that these values are in any way representative of the product's actual content

Heterogeneity in Detail: Geometric Metadata



- Sometimes, team-provided metadata provides information about what falls at the four corners of the image
  - However, we cannot assume that these values are in any way representative of the product's actual content

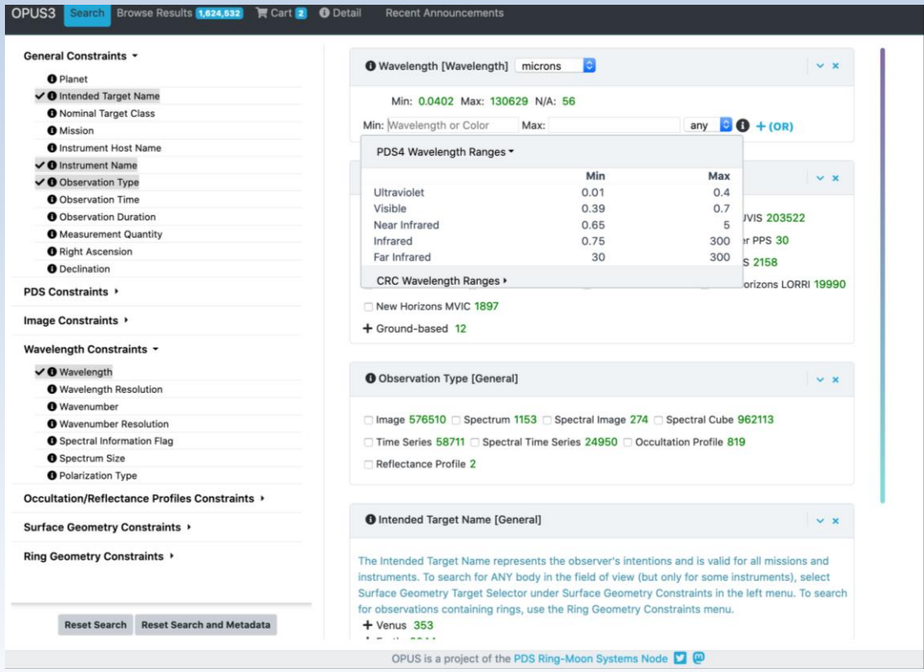
Heterogeneity in Detail: Geometric Metadata



- OPUS metadata identifies every body/ring inside the field of view
- OPUS metadata is derived by densely sampling the field of view, and describing images by a range rather than a single value
- This approach provides a much more accurate description of the field of view

Mitigating Metadata Heterogeneity

- Maximizing the usefulness of cross-mission search requires
  - Curation,
  - Interpretation, and
  - Standardization of metadata
- At the PDS Ring-Moon Systems Node (RMS), we prioritize
  - Generating our own supplemental metadata
  - Using standardized attributes
  - Carrying out detailed geometric re-calculations



- This approach drives improved cross-mission (even cross-discipline) search on our OPUS search tool (opus.pds-rings.seti.org)

Mitigating Metadata Heterogeneity

- However, our approach is not well-suited to every data set
- Within PDS, other Discipline Node teams operate other data discovery tools that serve the needs of their user communities
- There is room for improvement
  - Better user education
  - Better common entry point
- We believe the best common entry point
  - Is not a single unified tool
  - But a platform that quickly guides users to the existing focused tool that best meets their needs

How Data Discovery Tools Proliferate