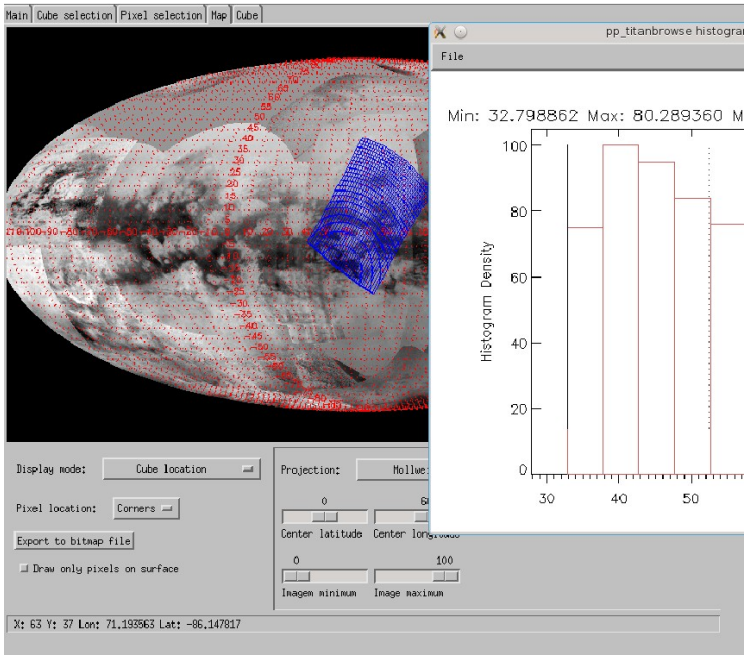
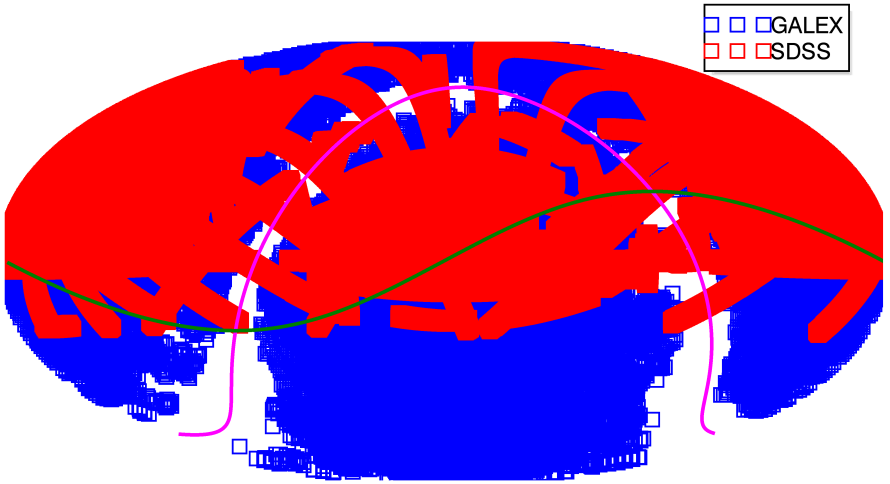
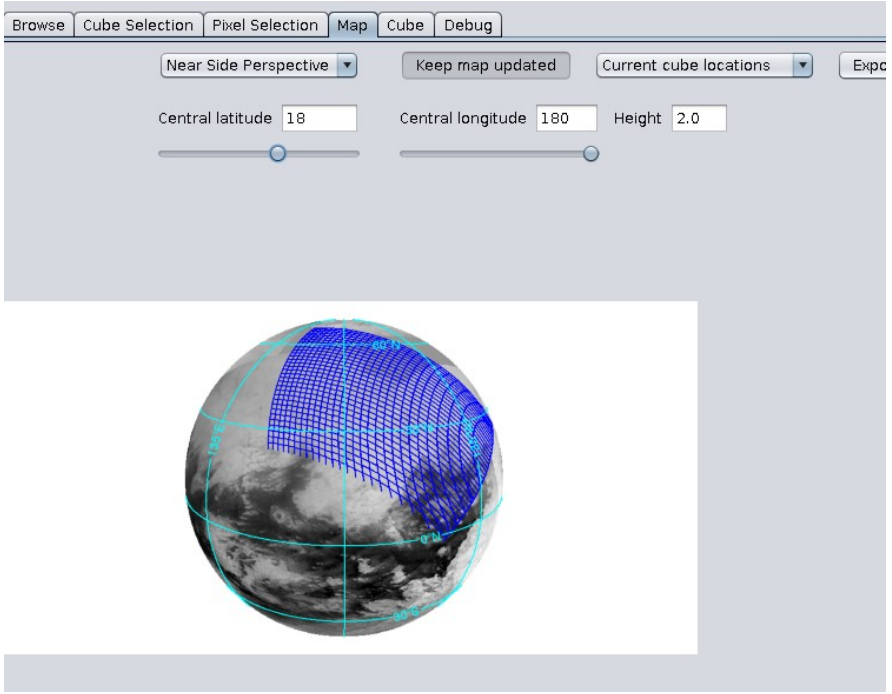
Data mining for the Solar System







Paulo Penteado
David Trilling
Northern Arizona University
J. Barnes, V. Pasek, A. Szalay,
T. Budavári, C. Fuentes

pp.penteado@gmail.com

http://www.ppenteado.net

Why new tools?

Many astronomical and planetary archives (SDSS, PDS, MAST,...) have enabled new research possibilities.

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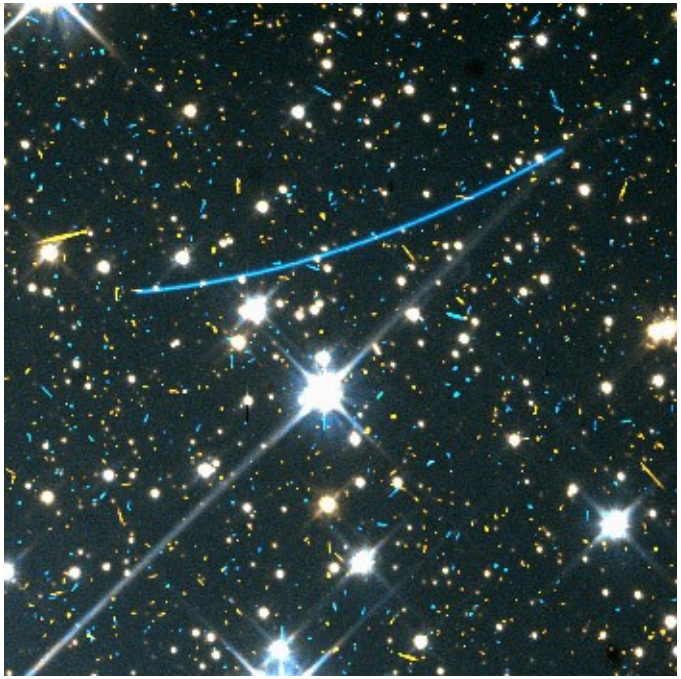
Many astronomical and planetary archives (SDSS, PDS, MAST,...) have enabled new research possibilities.

They still lack functionality in two areas:

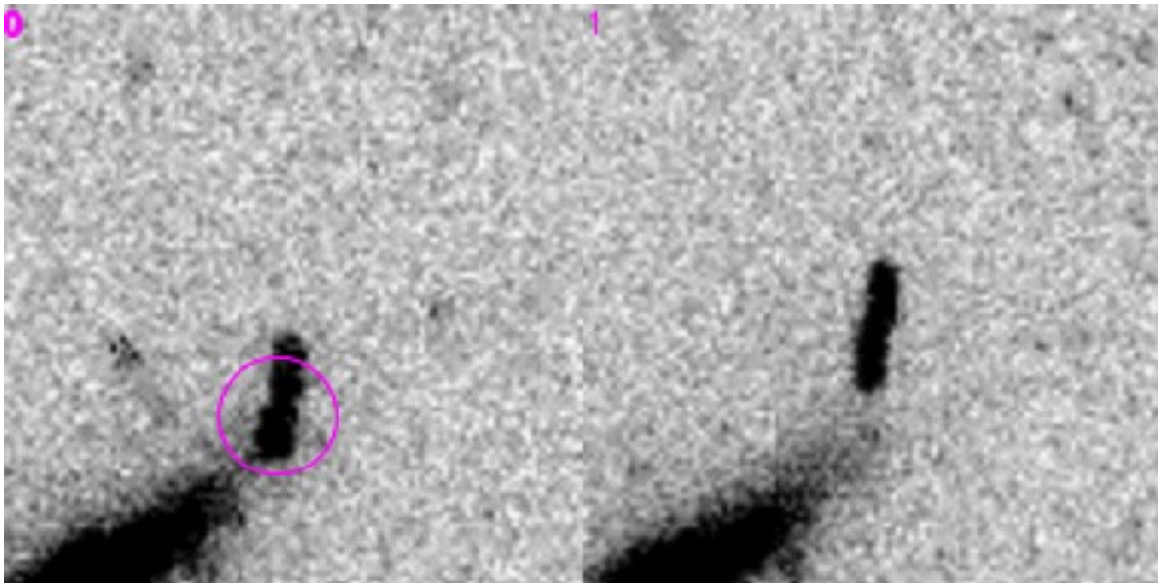
- Astronomical archives index images by position in the sky – cannot search for Solar System objects.
- Planetary remote sensing archives do not have common interfaces and do not support well hyperspectral observations.

Mining astronomical archives

Archives have millions of images.
We know over 600 thousand Solar System objects.



(Evans & Stapelfedlt, 2012)



(Fuentes et al., 2010)

Which images contain Solar System bodies?
How can we search them? What can they tell us?

Data ingestion and processing

NASA/JPL and IAU/MPC databases, for orbital, physical and taxonomic data.

Calculate orbits of all known objects into the past.

Match trajectories with survey footprints:

1) **GALEX**: 0.15, 0.23 μm, 4"/pix <~21 mag, allsky

2) **SDSS DR10**: 0.36, 0.47, 0.62, 0.75, 0.89 μm, 0.4"/pix, < ~22 mag

3) **2MASS**: 1.25, 1.65μm, 2.17 μm, 1"/pix, < ~ 16 mag, allsky

4) **WISE**: 3.4, 4.6, 12, 22 μm, 6.1-12“/pix, < ~8-17 mag, allsky

Data ingestion and processing

NASA/JPL and IAU/MPC databases, for orbital, physical and taxonomic data.

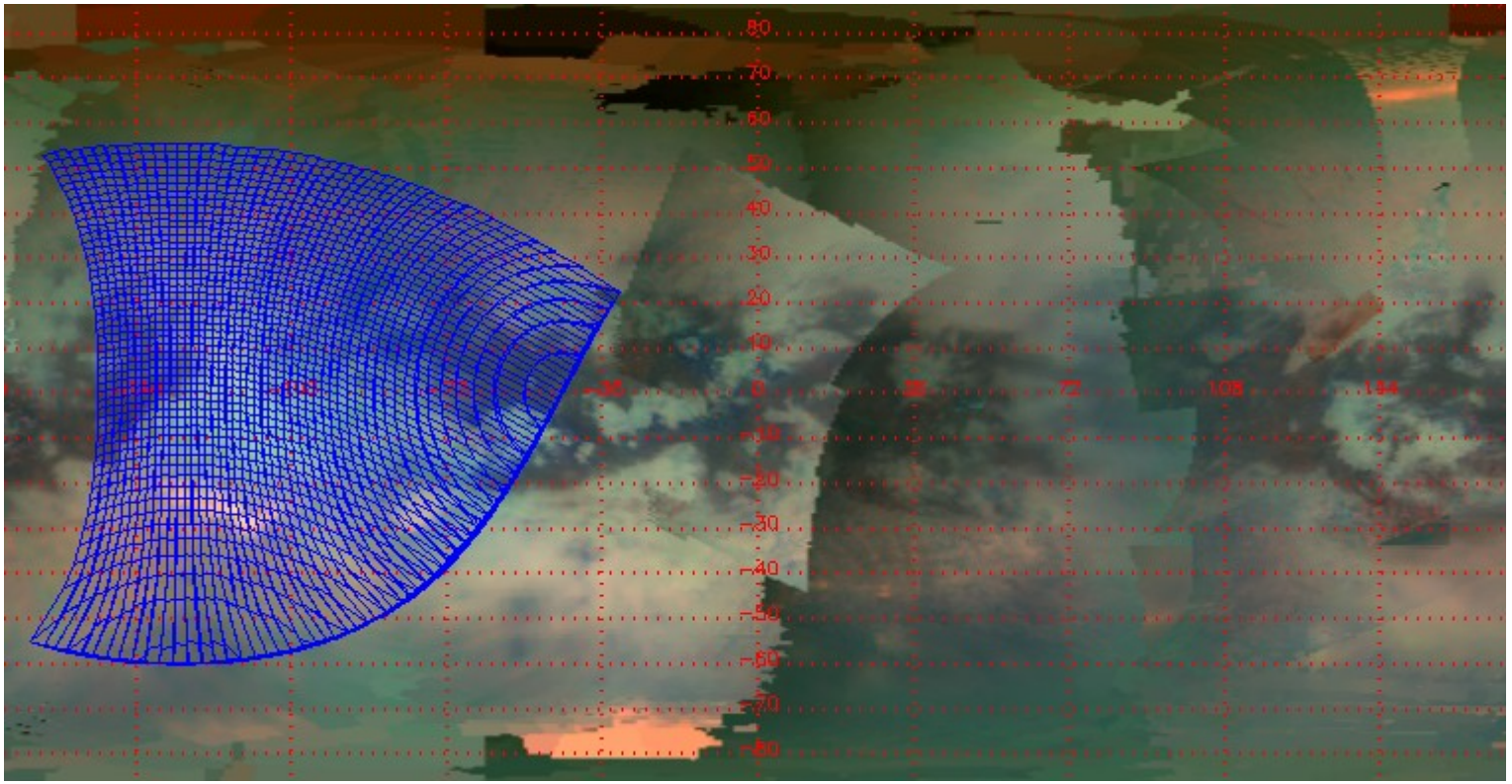
Calculate orbits of all known objects into the past.

Match trajectories with survey footprints:

Remote sensing observations

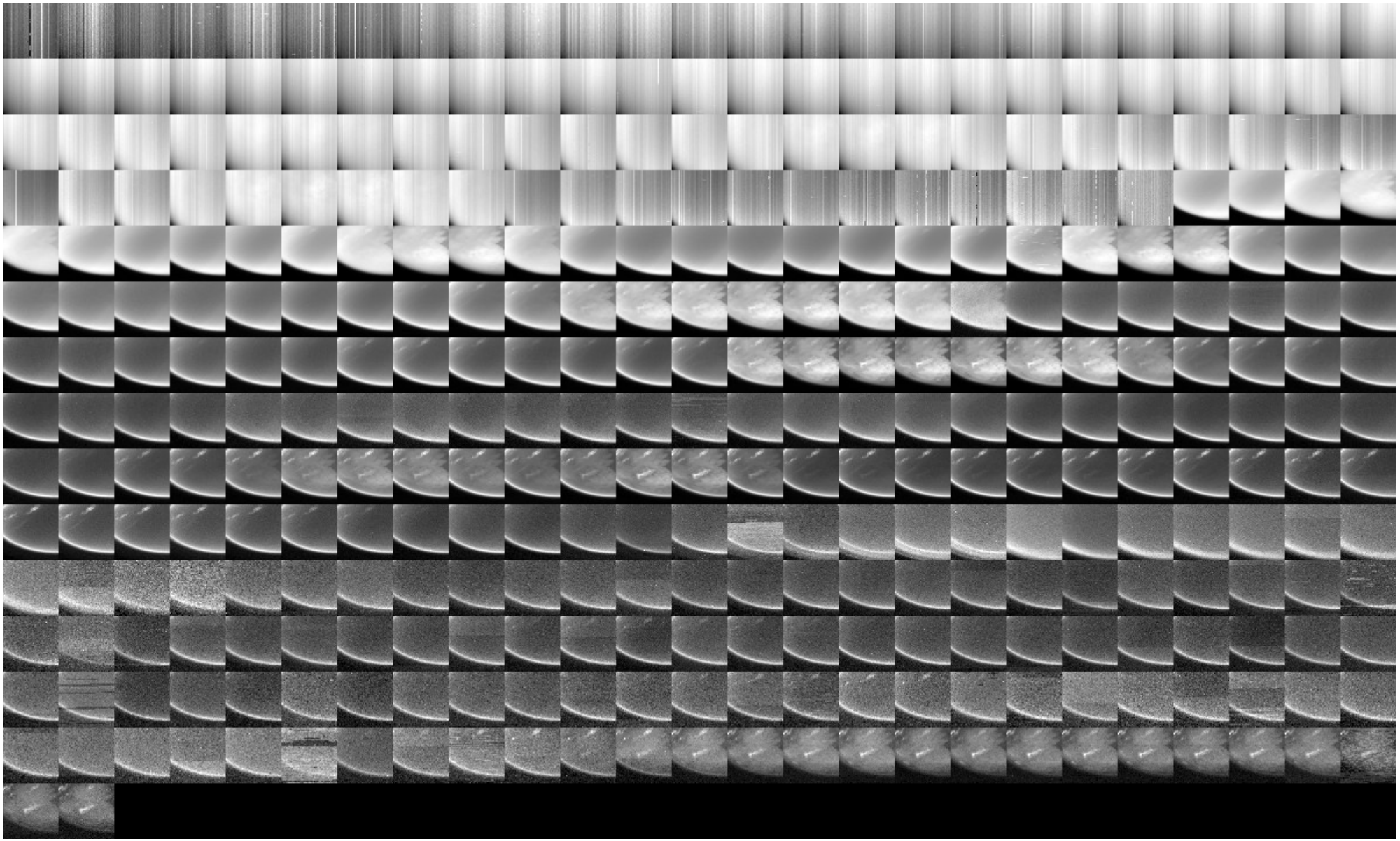
Some objects are visited by spacecraft.

These observations (remote sensing) need cartography.



Titan (Cassini VIMS)

Hyperspectral remote sensing



Titan, 0.35 to 5.1 µm (Cassini VIMS)

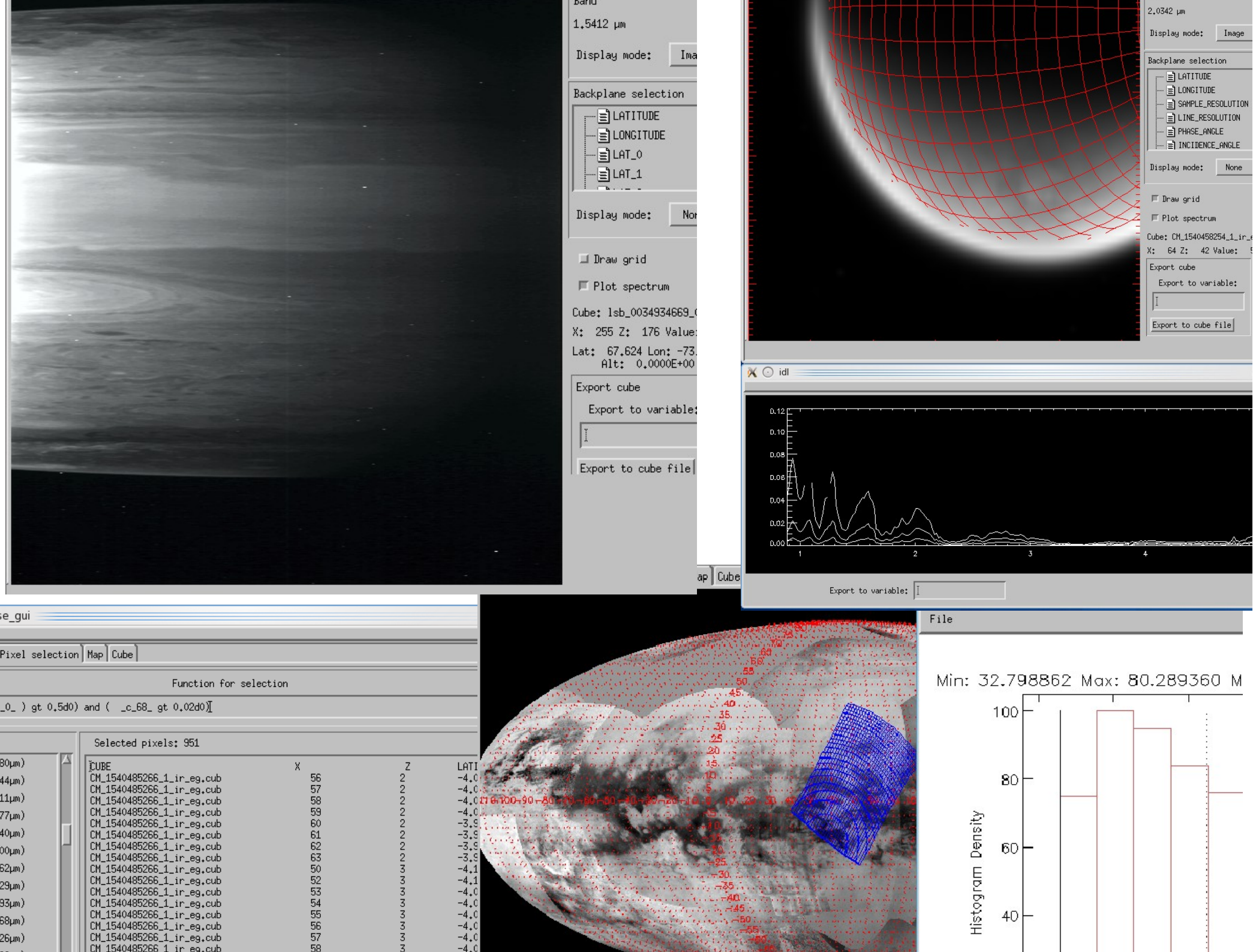
titanbrowse

Hyperspectral remote sensing archive.

Allows for arbitrary complex queries based on metadata **and spectra (fluxes)**

Integrated interactive visualization with correct cartography.

Demonstration online system: jtitanbrowse (Cassini VIMS Titan observations)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LONGITUDE
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Lat: 67.624 Lon: -73.
Alt: 0.0000E+00
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File
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