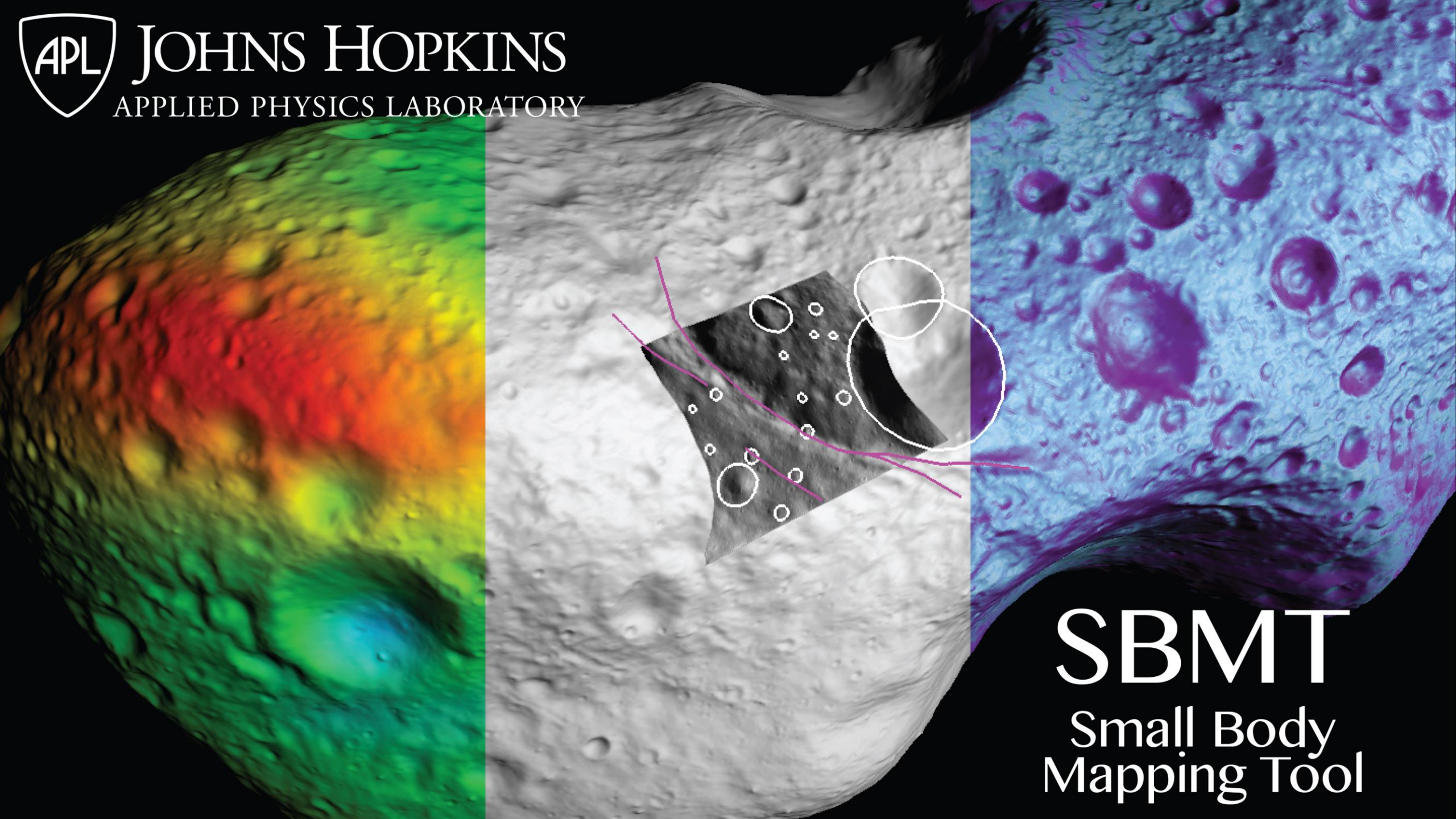
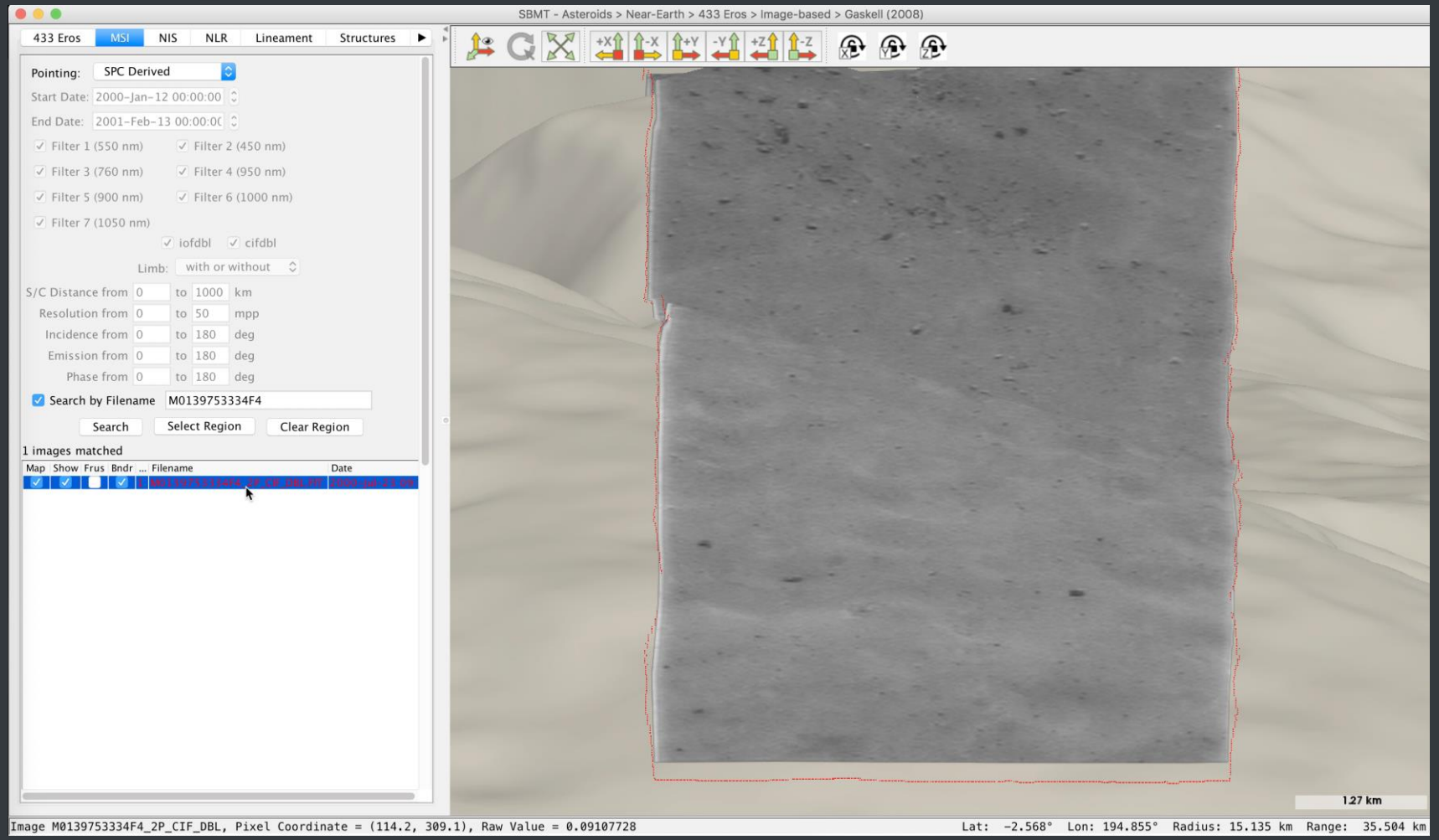
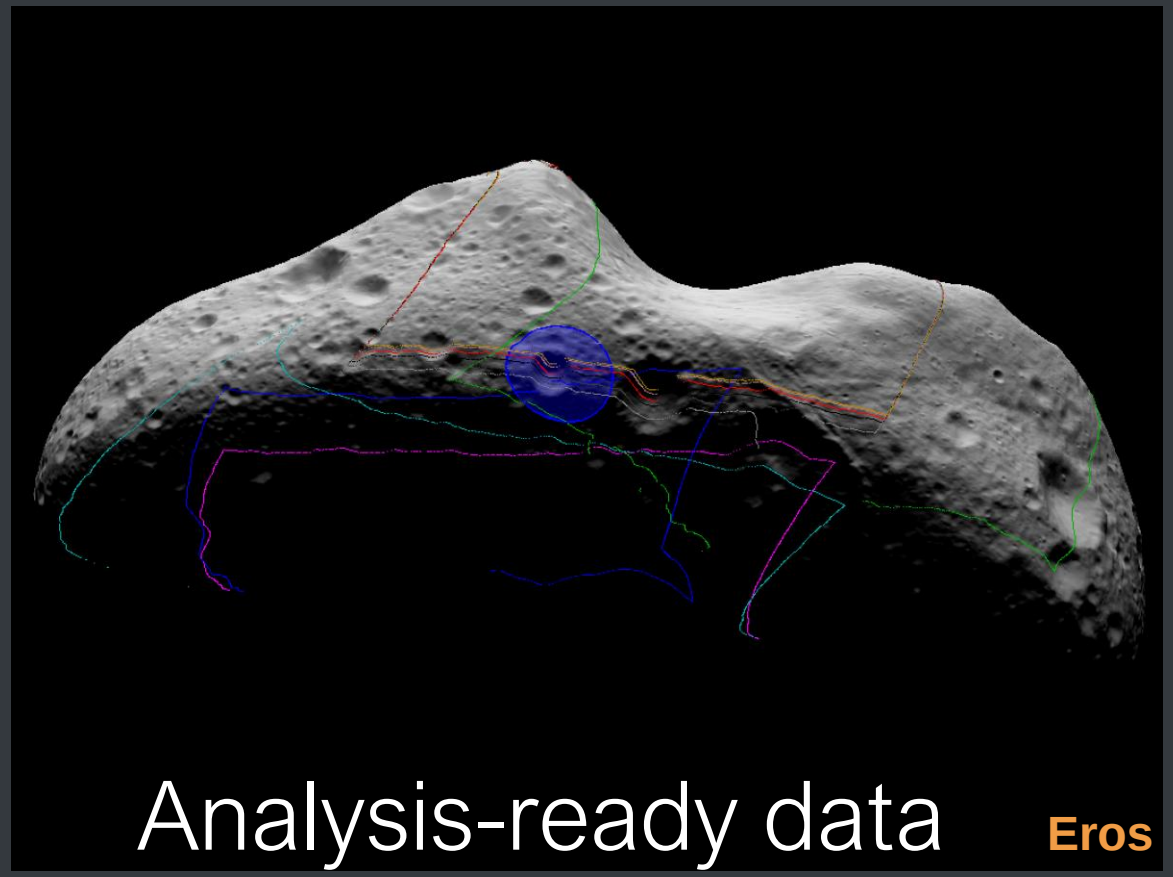

APL
JOHNS HOPKINS
APPLIED PHYSICS LABORATORY
SBMT
Small Body
Mapping Tool

Finding the right data and readying them for analysis is daunting.

The irregular shapes of small bodies pose additional challenges.

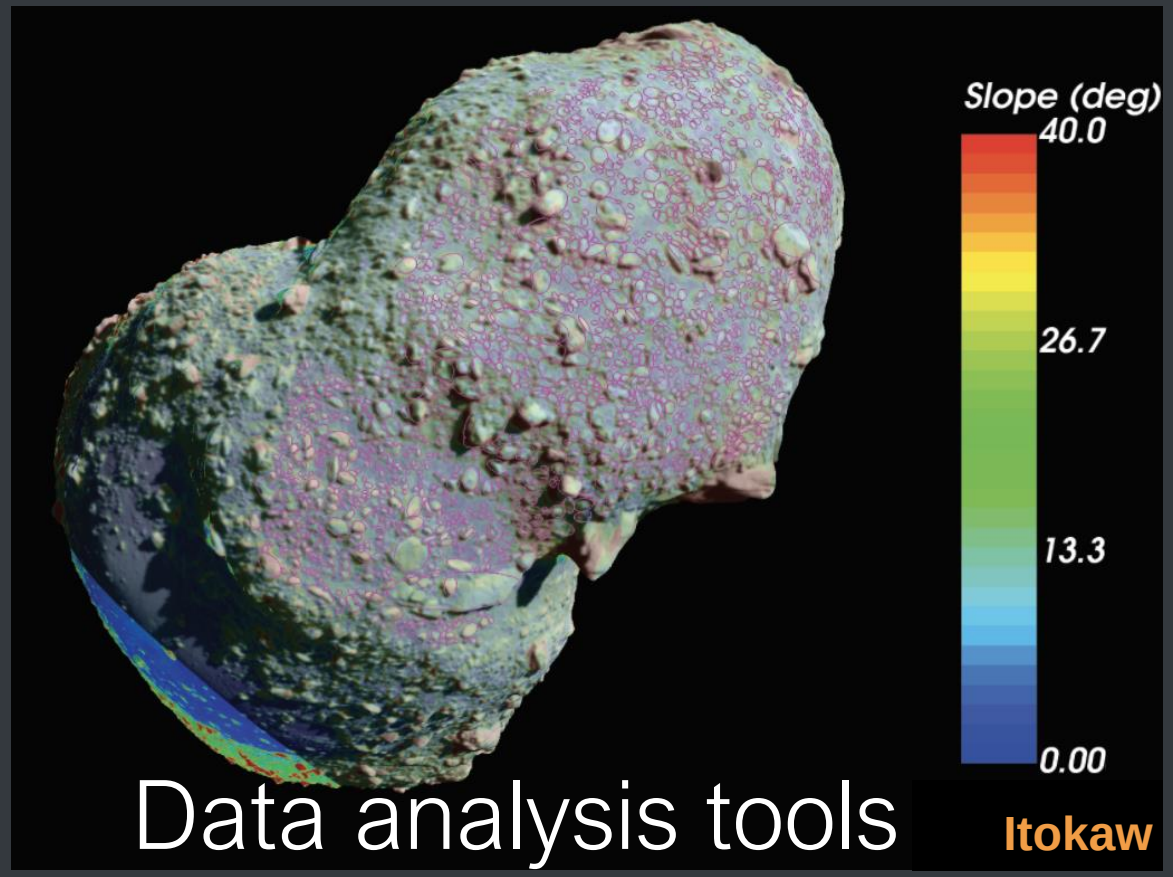


SBMT addresses these by linking spacecraft data to shape models.



Analysis-ready data

Eros



Data analysis tools

Itokawa

Case study: Lutetia

Buczkowski et al. (2012), *GRL,* doi: 10.1029/2012GL052959.

Besse et al. (2014), PSS, doi: 10.1016/j.pss.2014.07.007.

Scully et al. (2014), *Icarus,* doi: 10.1016/j.icarus.2014.01.013

Blewett et al. (2014), *Icarus,* doi: 10.1016/j.icarus.2014.03.007.

Mazrouei et al. (2014), Icarus, doi: 10.1016/j.icarus.2013.11.010.

Ruesch et al. (2014), *Icarus,* doi: 10.1016/j.icarus.2014.01.035.

Roberts et al. (2014), *Icarus,* doi: 10.1016/j.icarus.2014.07.004.

Roberts et al. (2014), *MAPS,* doi: 10.1111/maps.12348.

DeSouza et al. (2015), *Icarus,* doi: 10.1016/j.icarus.2014.10.009.

Denevi et al. (2016), *MAPS,* doi: 10.1111/maps.12729.

Hirata (2017), *Icarus,* doi: 10.1016/j.icarus.2017.01.035.

Rivkin et al. (2018), *Icarus,* doi: 10.1016/j.icarus.2017.04.006.

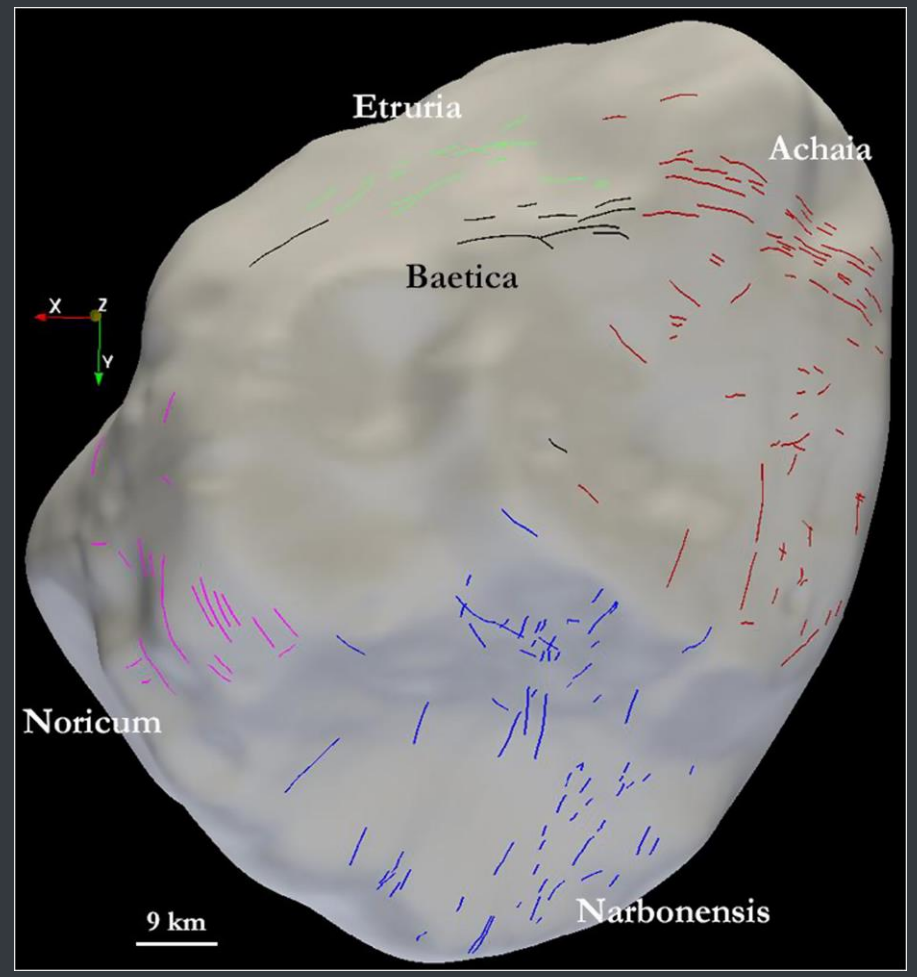


Fig. 2

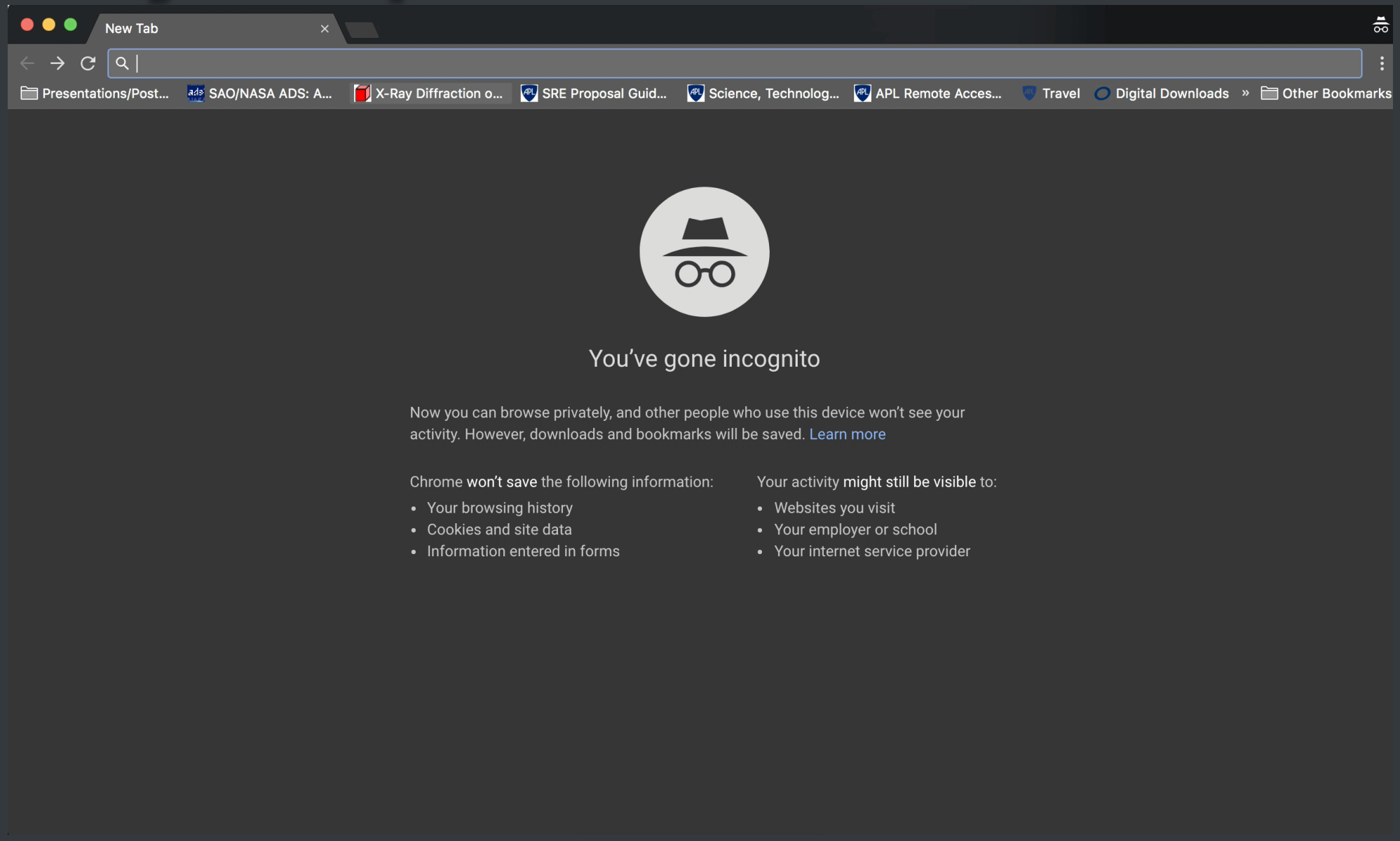
The SBMT architecture has 2 parts.

SBMT client runs locally.

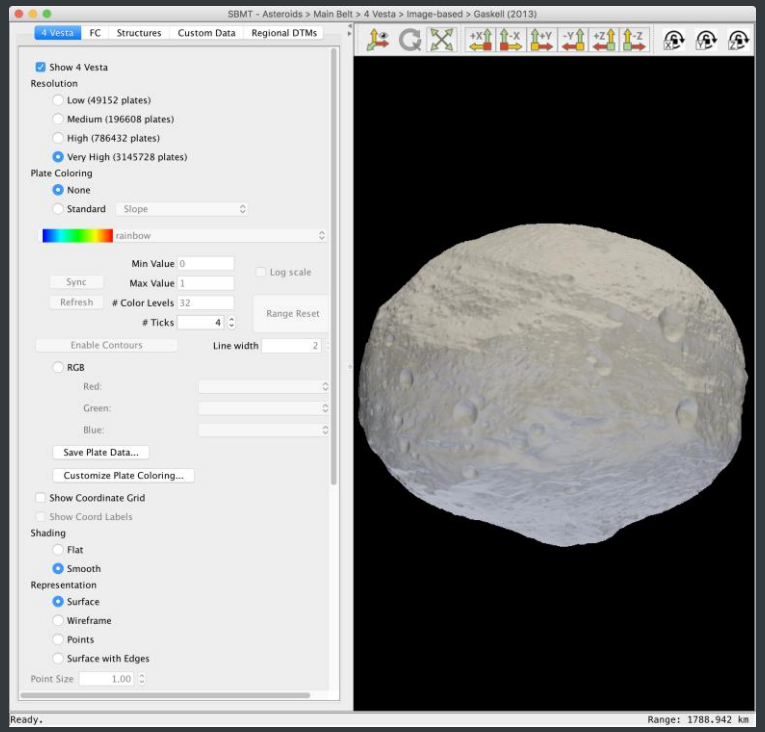
Web server hosts data.

Image credits: Wikimedia Commons user Rudloff (left) and icons8.com (right)

Download SBMT at sbmt.jhuapl.edu.

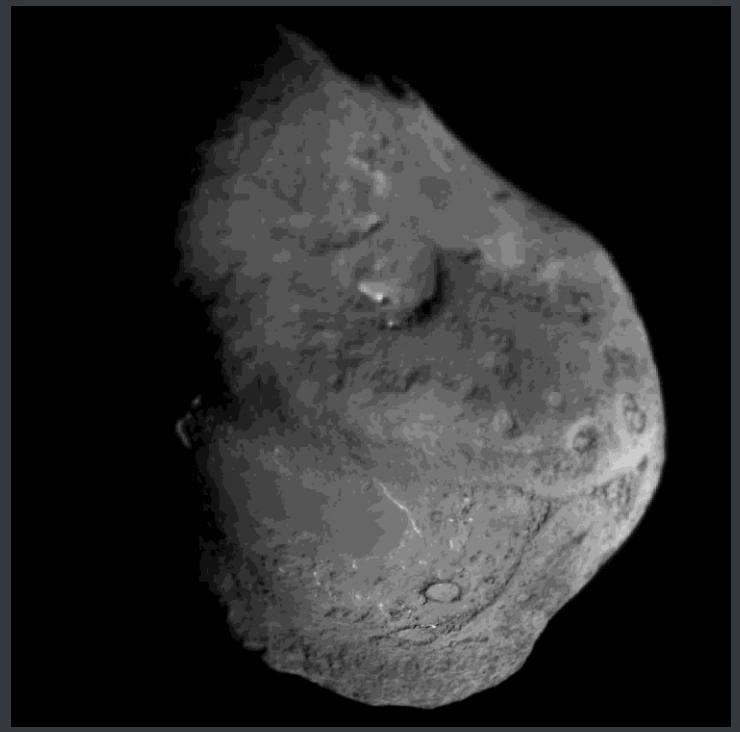


Outline



SBMT tour

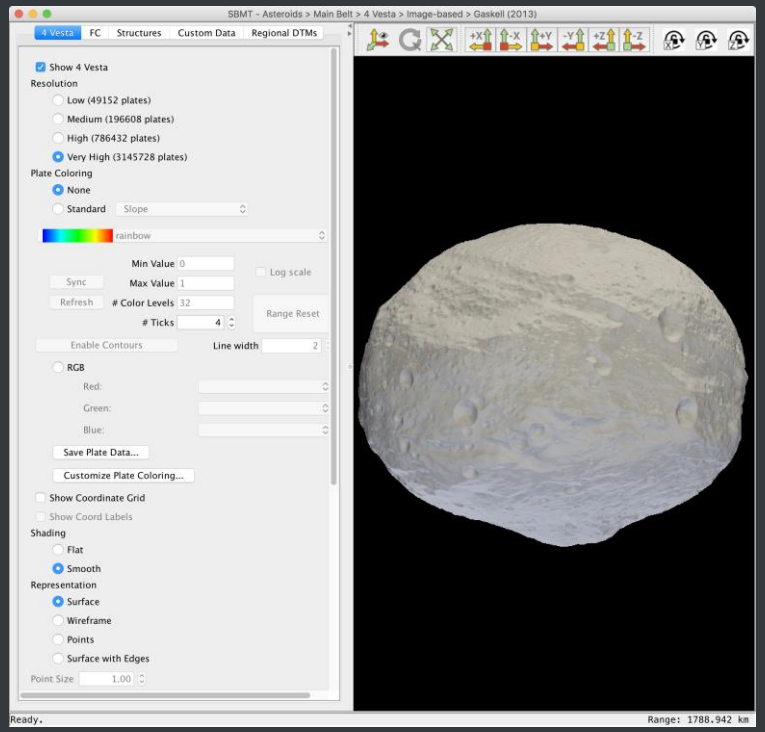
Available datasets



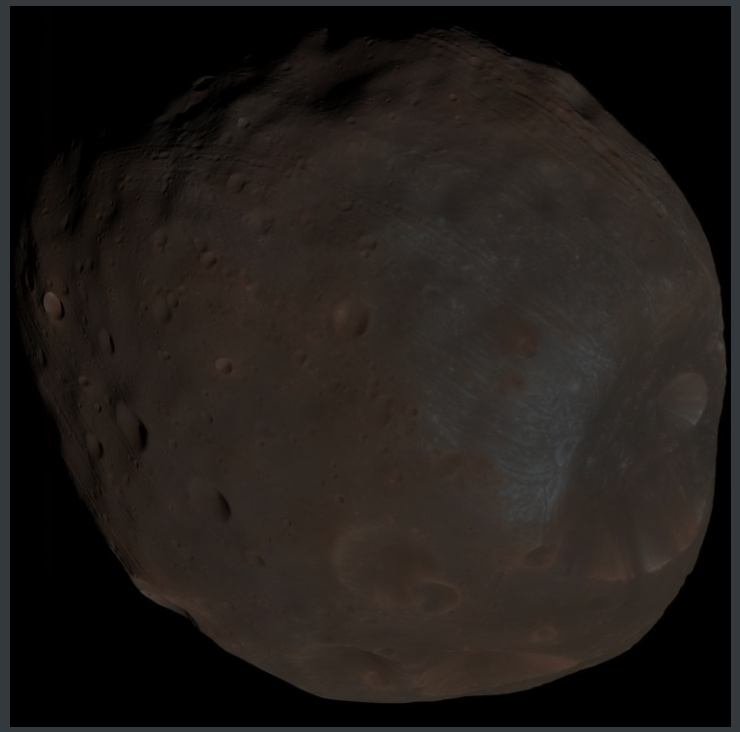
Future plans

Image credits: Phobos, NASA/JPL-Caltech/University of Arizona. Tempel 1, NASA/JPL/UMD

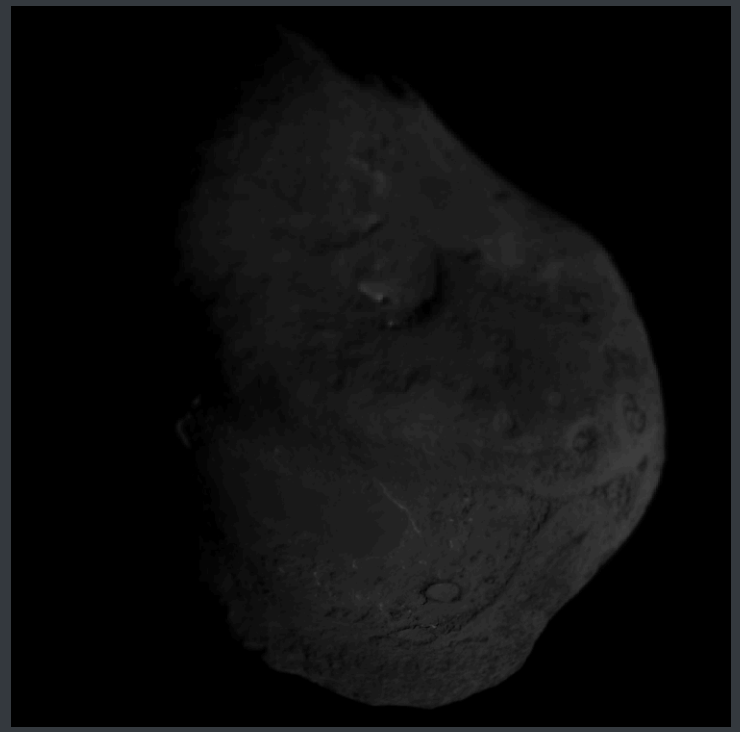
Outline



SBMT tour



Available datasets



Future plans

Image credits: Phobos, NASA/JPL-Caltech/University of Arizona. Tempel 1, NASA/JPL/UMD

Small Body Mapping Tool File Body Console Help

SBMT - Asteroids > Near-Earth > 433 Eros > Image-based > Gaskell (2008)

433 Eros | MSI | NIS | NLR ▶

Show 433 Eros

Resolution

- Low (49152 plates)
- Medium (196608 plates)
- High (786432 plates)
- Very High (3145728 plates)

Plate Coloring

- None
- Standard — Slope

rainbow

Min Value 0

Sync — Max Value 1

Refresh — # Color Levels 32

Ticks

Enable Contours

RGB

Red:

Green:

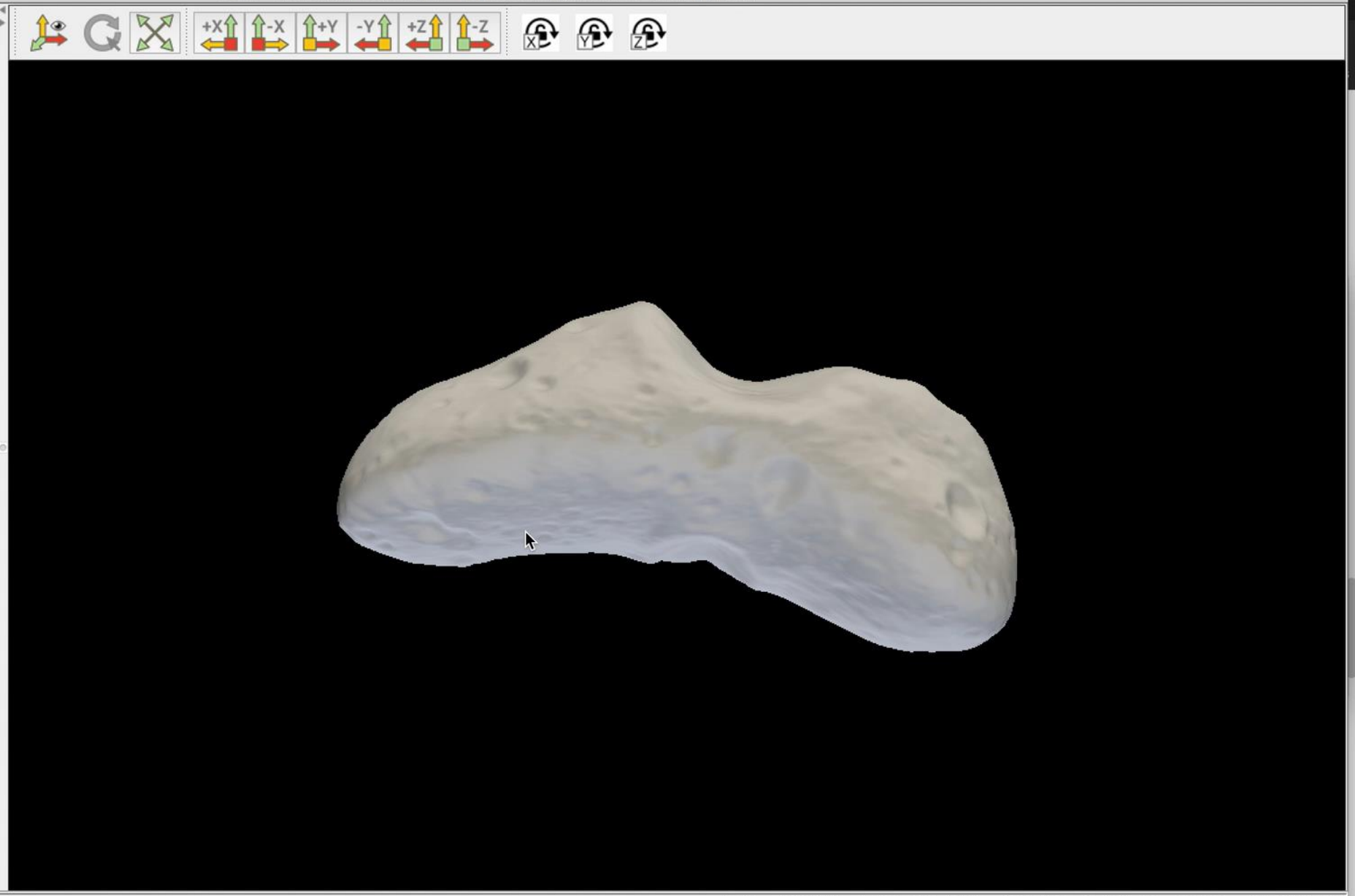
Blue:

Save Plate Data...

Customize Plate Coloring...

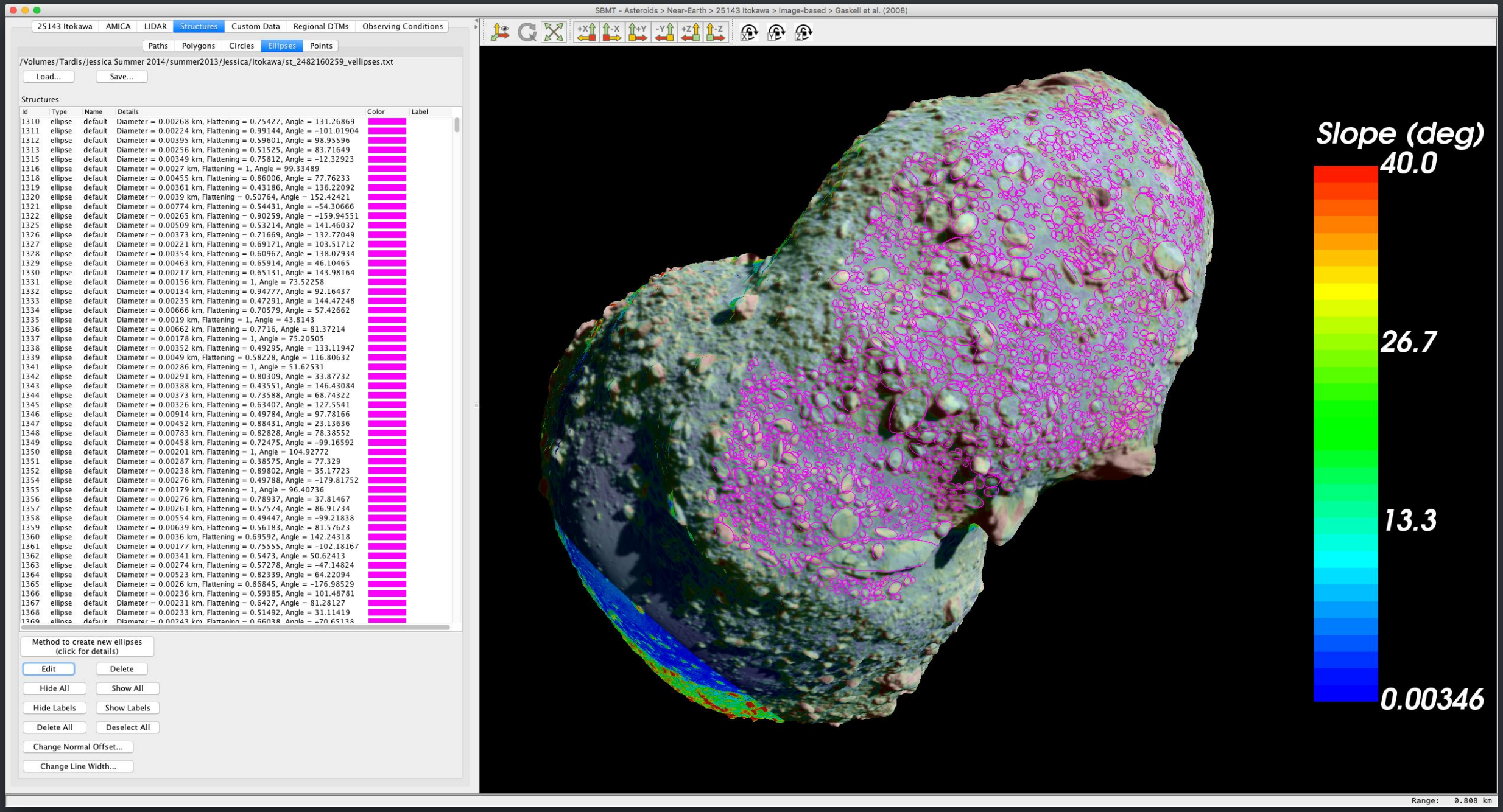
Show Image Map

Image opacity 1.00



Ready.

Lat: 18.912° Lon: 197.451° Radius: 9.097 km Range: 74.579 km


SBMT - Asteroids > Near-Earth > 25143 Itokawa > Image-based > Gaskell et al. (2008)
25143 Itokawa
AMICA
LIDAR
Structures
Custom Data
Regional DTMs
Observing Conditions
Paths
Polygons
Circles
Ellipses
Points
/Volumes/Tardis/Jessica Summer 2014/summer2013/Jessica/Itokawa/st_2482160259_vellipses.txt
Load...
Save...
Structures
Id Type Name Details Color Label
1310 ellipse default Diameter = 0.00268 km, Flattening = 0.75427, Angle = 131.26869
1311 ellipse default Diameter = 0.00224 km, Flattening = 0.99144, Angle = -101.01904
1312 ellipse default Diameter = 0.00395 km, Flattening = 0.59601, Angle = 98.95596
1313 ellipse default Diameter = 0.00256 km, Flattening = 0.51525, Angle = 83.71649
1315 ellipse default Diameter = 0.00349 km, Flattening = 0.75812, Angle = -12.32923
1316 ellipse default Diameter = 0.0027 km, Flattening = 1, Angle = 99.33489
1318 ellipse default Diameter = 0.00455 km, Flattening = 0.86006, Angle = 77.76233
1319 ellipse default Diameter = 0.00361 km, Flattening = 0.43186, Angle = 136.22092
1320 ellipse default Diameter = 0.0039 km, Flattening = 0.50764, Angle = 152.42421
1321 ellipse default Diameter = 0.00774 km, Flattening = 0.54431, Angle = -54.30666
1322 ellipse default Diameter = 0.00265 km, Flattening = 0.90259, Angle = -159.94551
1325 ellipse default Diameter = 0.00509 km, Flattening = 0.53214, Angle = 141.46037
1326 ellipse default Diameter = 0.00373 km, Flattening = 0.71669, Angle = 132.77049
1327 ellipse default Diameter = 0.00221 km, Flattening = 0.69171, Angle = 103.51712
1328 ellipse default Diameter = 0.00354 km, Flattening = 0.60967, Angle = 138.07934
1329 ellipse default Diameter = 0.00463 km, Flattening = 0.65914, Angle = 46.10465
1330 ellipse default Diameter = 0.00217 km, Flattening = 0.65131, Angle = 143.98164
1331 ellipse default Diameter = 0.00156 km, Flattening = 1, Angle = 73.52258
1332 ellipse default Diameter = 0.00134 km, Flattening = 0.94777, Angle = 92.16437
1333 ellipse default Diameter = 0.00235 km, Flattening = 0.47291, Angle = 144.47248
1334 ellipse default Diameter = 0.00666 km, Flattening = 0.70579, Angle = 57.42662
1335 ellipse default Diameter = 0.0019 km, Flattening = 1, Angle = 43.8143
1336 ellipse default Diameter = 0.00662 km, Flattening = 0.7716, Angle = 81.37214
1337 ellipse default Diameter = 0.00178 km, Flattening = 1, Angle = 75.20505
1338 ellipse default Diameter = 0.00352 km, Flattening = 0.49295, Angle = 133.11947
1339 ellipse default Diameter = 0.0049 km, Flattening = 0.58228, Angle = 116.80632
1341 ellipse default Diameter = 0.00286 km, Flattening = 1, Angle = 51.62531
1342 ellipse default Diameter = 0.00291 km, Flattening = 0.80309, Angle = 33.87732
1343 ellipse default Diameter = 0.00388 km, Flattening = 0.43551, Angle = 146.43084
1344 ellipse default Diameter = 0.00373 km, Flattening = 0.73588, Angle = 68.74322
1345 ellipse default Diameter = 0.00326 km, Flattening = 0.63407, Angle = 127.5541
1346 ellipse default Diameter = 0.00914 km, Flattening = 0.49784, Angle = 97.78166
1347 ellipse default Diameter = 0.00452 km, Flattening = 0.88431, Angle = 23.13636
1348 ellipse default Diameter = 0.00783 km, Flattening = 0.82828, Angle = 78.38552
1349 ellipse default Diameter = 0.00458 km, Flattening = 0.72475, Angle = -99.16592
1350 ellipse default Diameter = 0.00201 km, Flattening = 1, Angle = 104.92772
1351 ellipse default Diameter = 0.00287 km, Flattening = 0.38575, Angle = 77.329
1352 ellipse default Diameter = 0.00238 km, Flattening = 0.89802, Angle = 35.17723
1354 ellipse default Diameter = 0.00276 km, Flattening = 0.49788, Angle = -179.81752
1355 ellipse default Diameter = 0.00179 km, Flattening = 1, Angle = 96.40736
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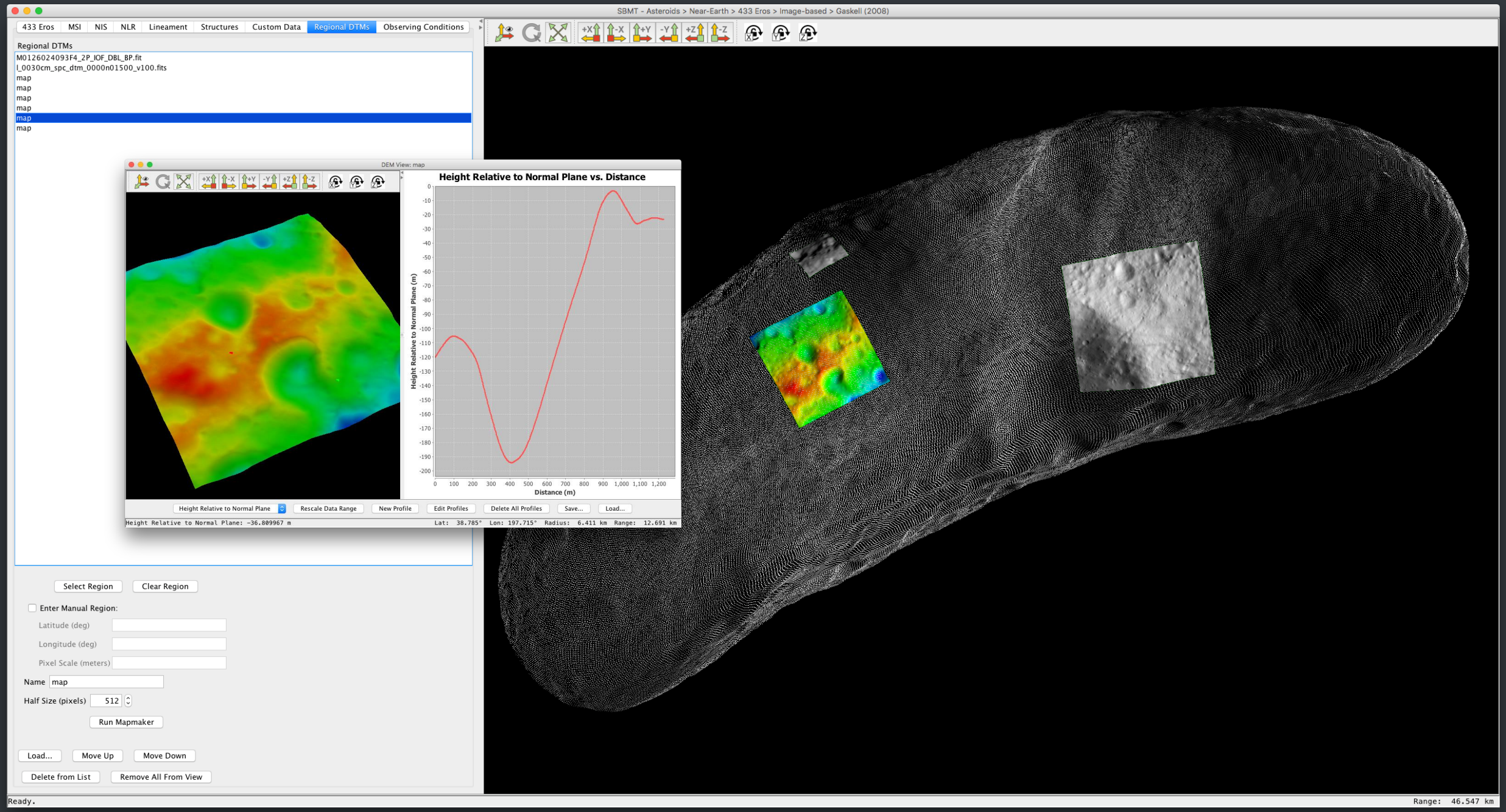
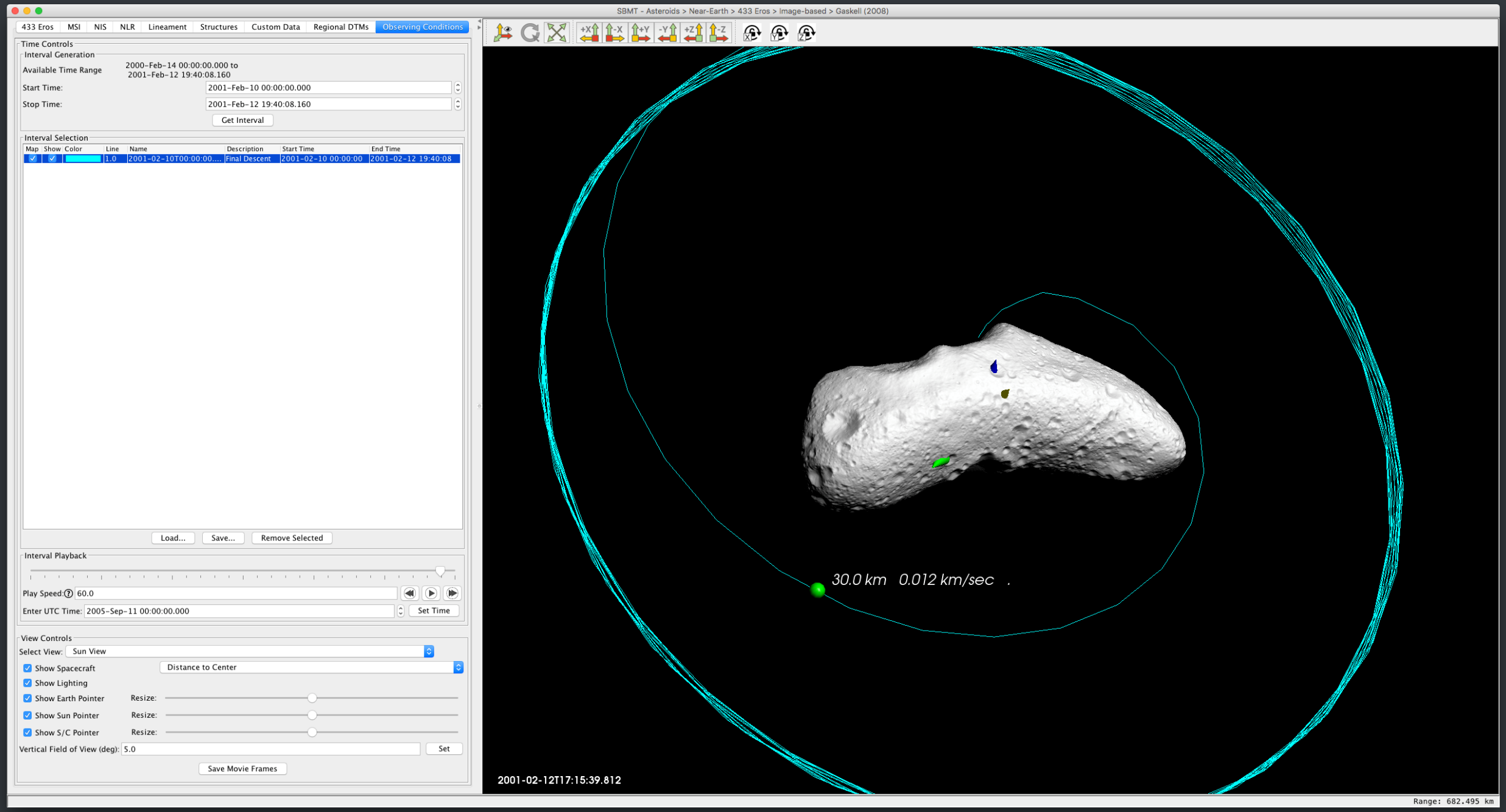
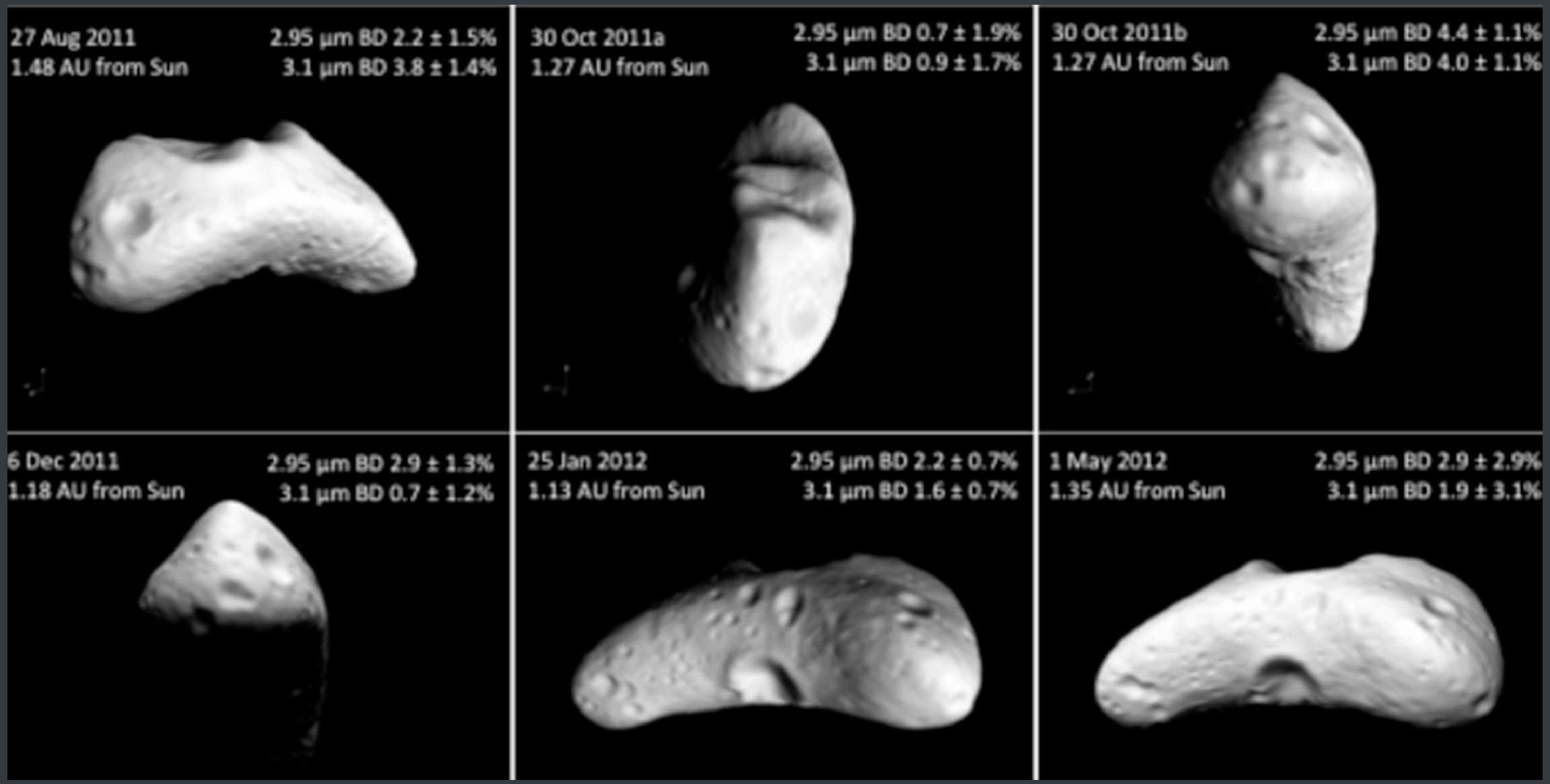
1357 ellipse default Diameter = 0.00261 km, Flattening = 0.57574, Angle = 86.91734
1358 ellipse default Diameter = 0.00554 km, Flattening = 0.49447, Angle = -99.21838
1359 ellipse default Diameter = 0.00639 km, Flattening = 0.56183, Angle = 81.57623
1360 ellipse default Diameter = 0.0036 km, Flattening = 0.69592, Angle = 142.24318
1361 ellipse default Diameter = 0.00177 km, Flattening = 0.75555, Angle = -102.18167
1362 ellipse default Diameter = 0.00341 km, Flattening = 0.5473, Angle = 50.62413
1363 ellipse default Diameter = 0.00274 km, Flattening = 0.57278, Angle = -47.14824
1364 ellipse default Diameter = 0.00523 km, Flattening = 0.82339, Angle = 64.22094
1365 ellipse default Diameter = 0.0026 km, Flattening = 0.86845, Angle = -176.98529
1366 ellipse default Diameter = 0.00236 km, Flattening = 0.59385, Angle = 101.48781
1367 ellipse default Diameter = 0.00231 km, Flattening = 0.6427, Angle = 81.28127
1368 ellipse default Diameter = 0.00233 km, Flattening = 0.51492, Angle = 31.11419
Method to create new ellipses (click for details)
Edit
Delete
Hide All
Show All
Hide Labels
Show Labels
Delete All
Deselect All
Change Normal Offset...
Change Line Width...
+X -X +Y -Y +Z -Z
Slope (deg)
40.0
26.7
13.3
0.00346
Range: 0.808 km


SBMT - Asteroids > Near-Earth > 433 Eros > Image-based > Gaskell (2008)
433 Eros
MSI
NIS
NLR
Lineament
Structures
Custom Data
Regional DTMs
Observing Conditions
Regional DTMs
M0126024093F4_2P_IOF_DBL_BP.fit
l_0030cm_spc_dtm_0000n01500_v100.fits
map
map
map
map
map
map
DEM View: map
Height Relative to Normal Plane vs. Distance
Height Relative to Normal Plane (m)
Distance (m)
Height Relative to Normal Plane
Rescale Data Range
New Profile
Edit Profiles
Delete All Profiles
Save...
Load...
Height Relative to Normal Plane: -36.809967 m
Lat: 38.785° Lon: 197.715° Radius: 6.411 km Range: 12.691 km
Select Region
Clear Region
Enter Manual Region:
Latitude (deg)
Longitude (deg)
Pixel Scale (meters)
Name map
Half Size (pixels) 512
Run Mapmaker
Load...
Move Up
Move Down
Delete from List
Remove All From View
Ready.
Range: 46.547 km

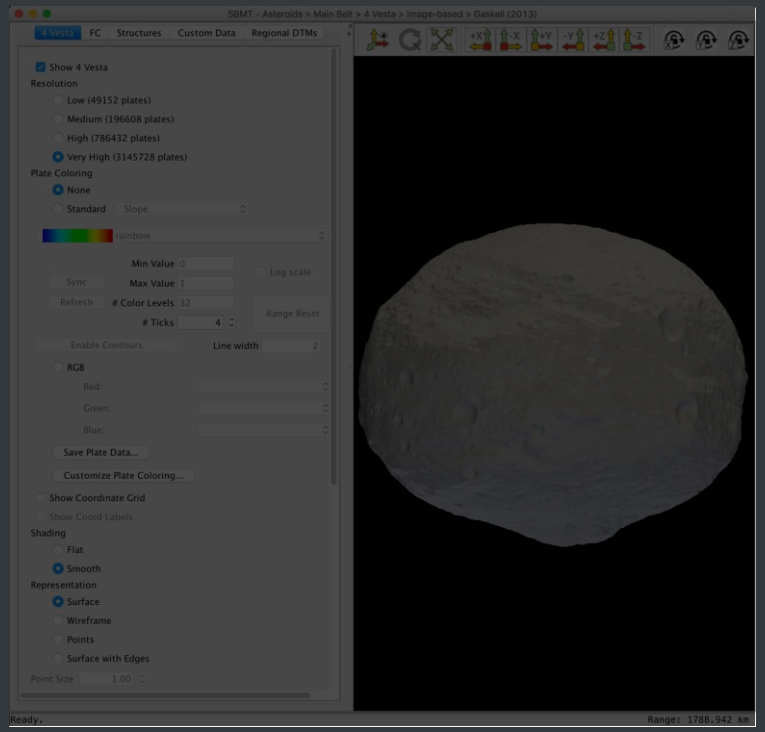

SBMT - Asteroids > Near-Earth > 433 Eros > Image-based > Gaskell (2008)
433 Eros
MSI
NIS
NLR
Lineament
Structures
Custom Data
Regional DTMs
Observing Conditions
Time Controls
Interval Generation
Available Time Range
2000-Feb-14 00:00:00.000 to
2001-Feb-12 19:40:08.160
Start Time:
2001-Feb-10 00:00:00.000
Stop Time:
2001-Feb-12 19:40:08.160
Get Interval
Interval Selection
Map
Show
Color
Line
Name
Description
Start Time
End Time
1.0
2001-02-10T00:00:00....
Final Descent
2001-02-10 00:00:00
2001-02-12 19:40:08
Load...
Save...
Remove Selected
Interval Playback
Play Speed:
60.0
Enter UTC Time:
2005-Sep-11 00:00:00.000
Set Time
View Controls
Select View:
Sun View
Show Spacecraft
Distance to Center
Show Lighting
Show Earth Pointer
Resize:
Show Sun Pointer
Resize:
Show S/C Pointer
Resize:
Vertical Field of View (deg):
5.0
Set
Save Movie Frames
30.0 km 0.012 km/sec .
2001-02-12T17:15:39.812
Range: 682.495 km



Rivkin et al. (2018), Icarus, doi: 10.1016/j.icarus.2017.04.006.

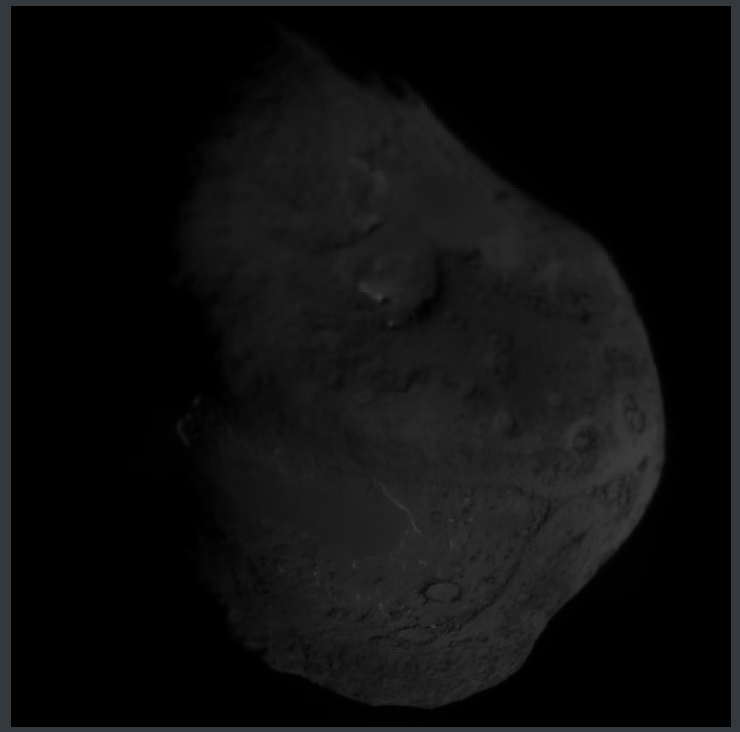
Excerpts from Fig.3

Outline



SBMT tour

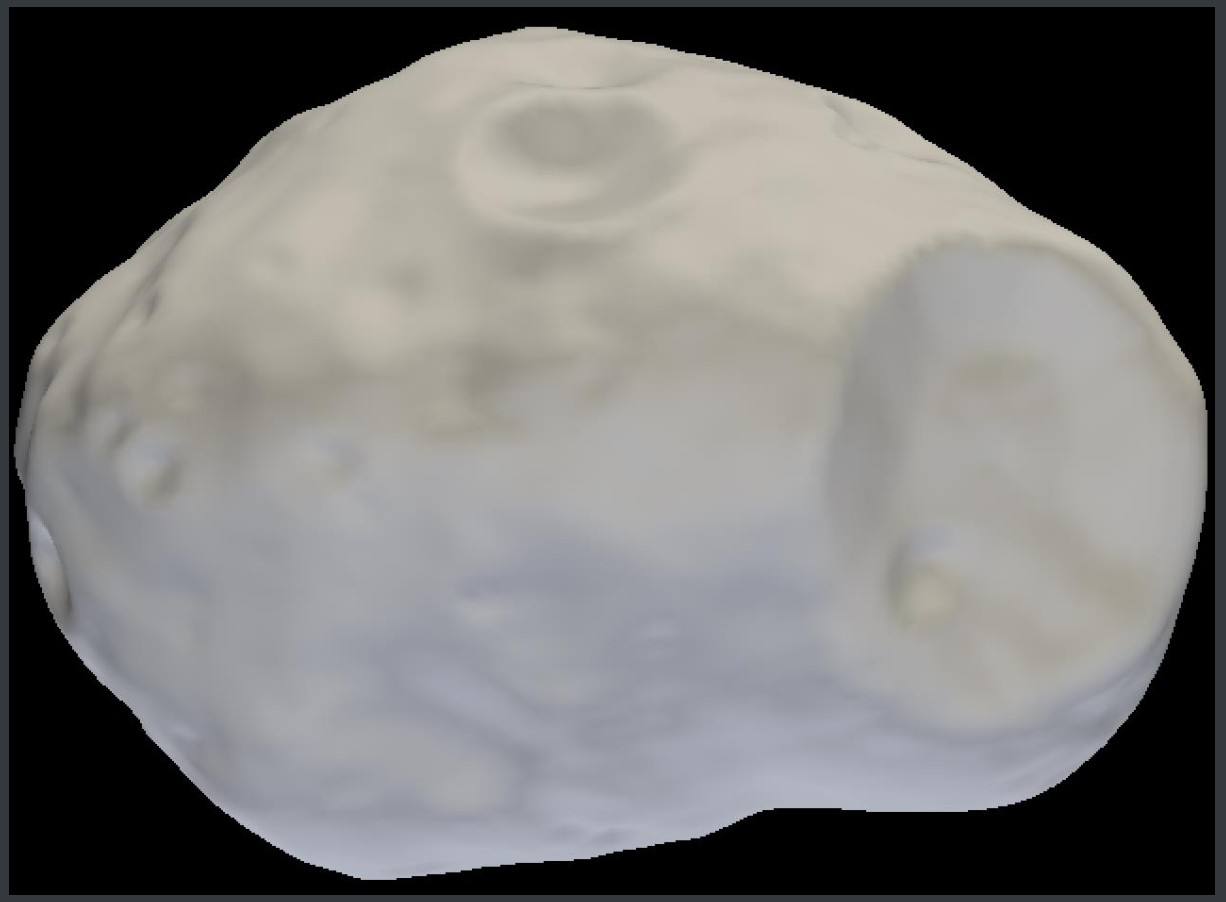
Available datasets



Future plans

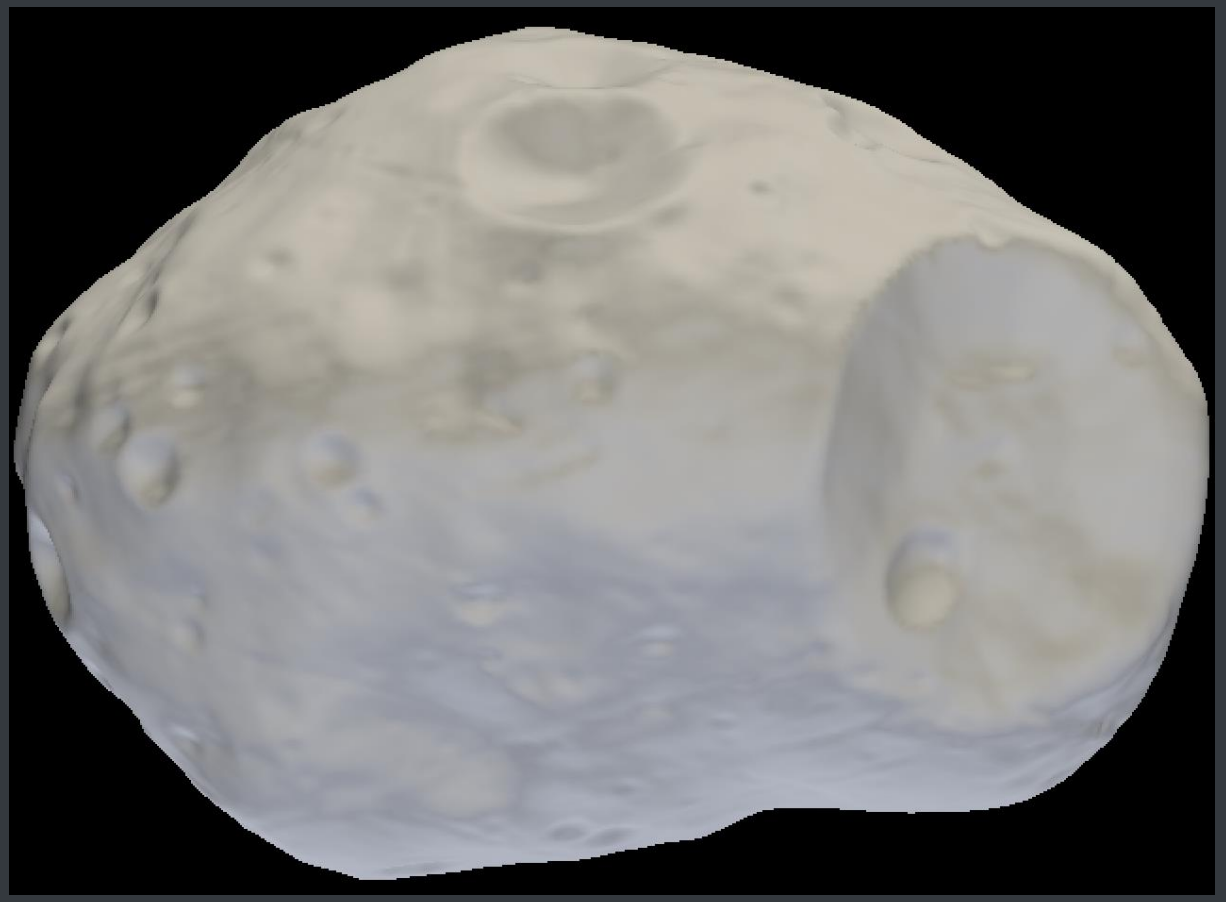
Image credits: Phobos, NASA/JPL-Caltech/University of Arizona. Tempel 1, NASA/JPL/UMD

Most shape models are available at several resolutions.



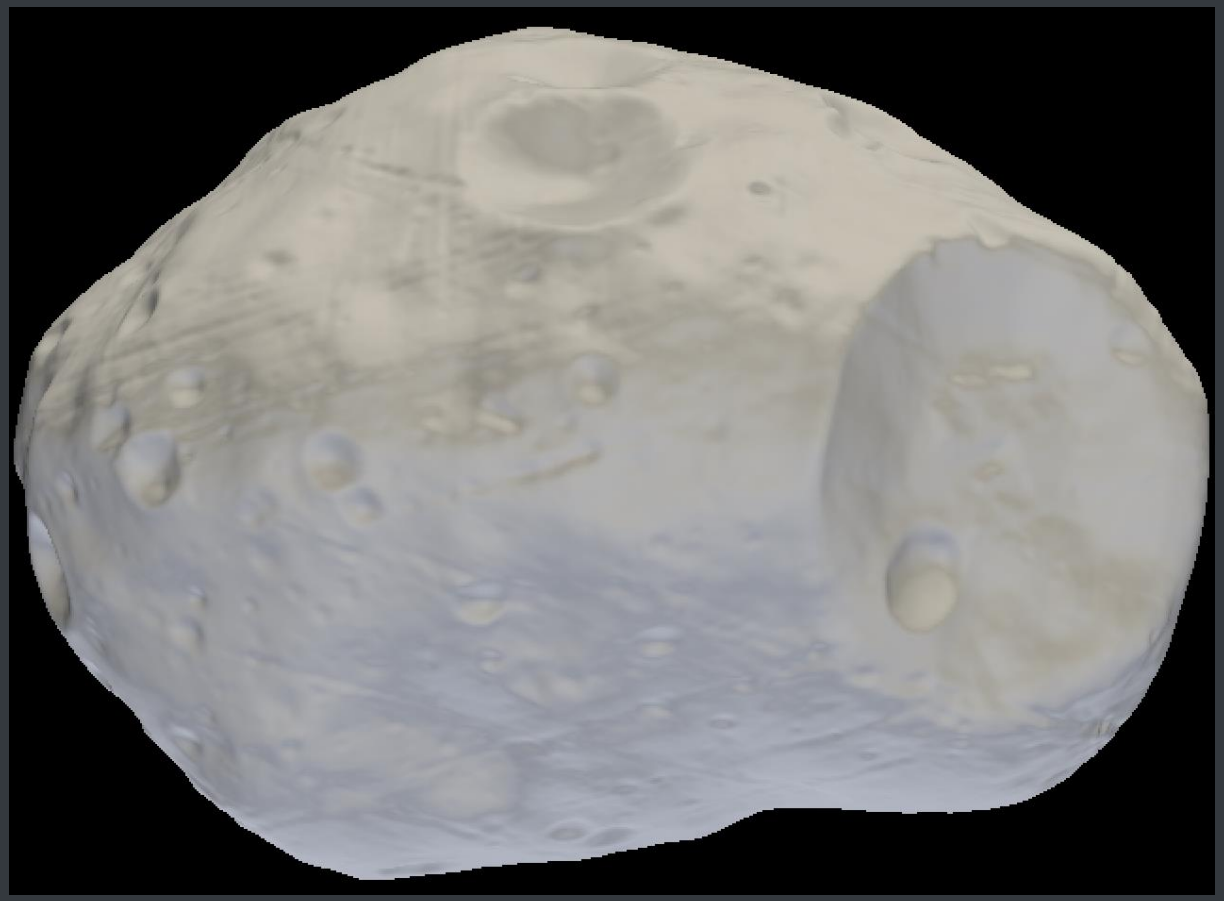
49152 plates

Most shape models are available at several resolutions.



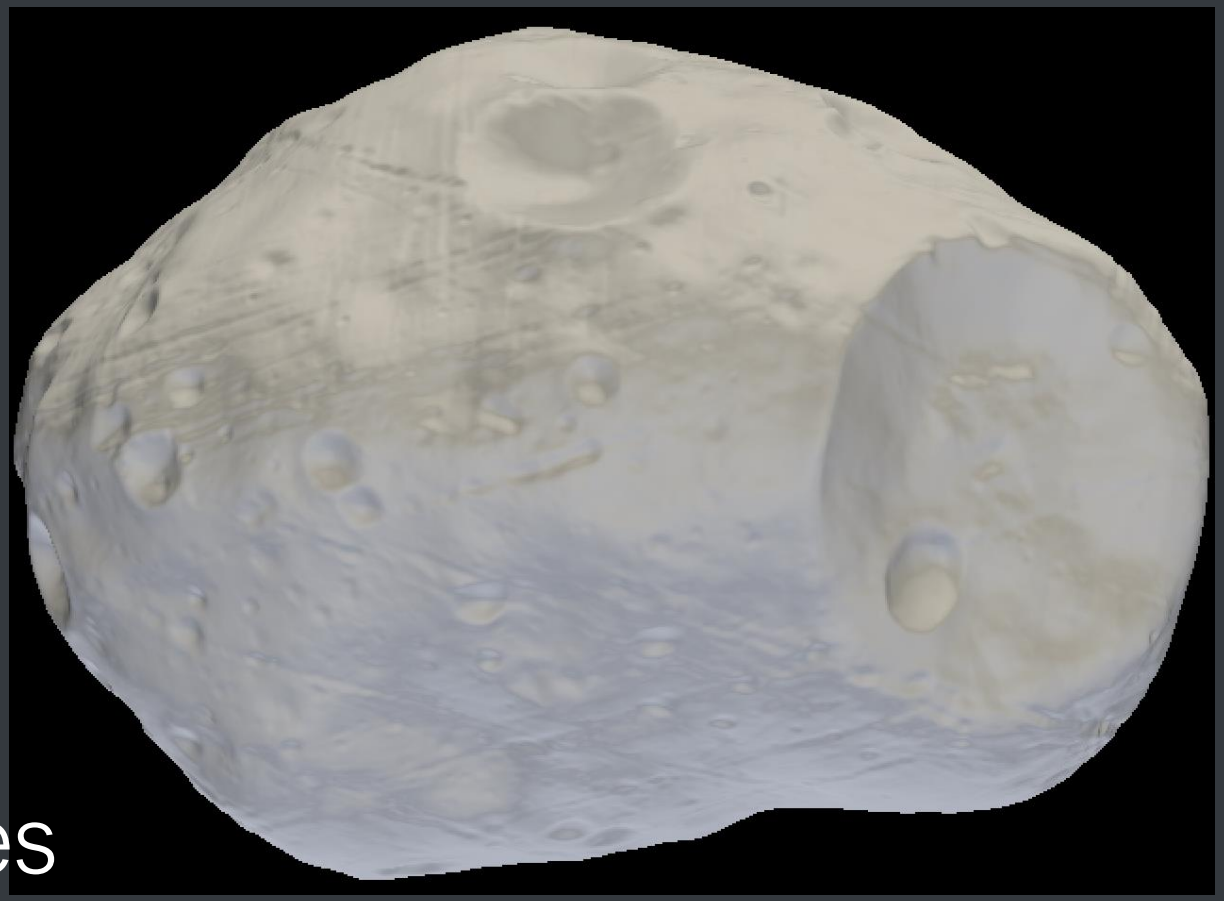
196608 plates

Most shape models are available at several resolutions.



786432 plates

Most shape models are available at several resolutions.

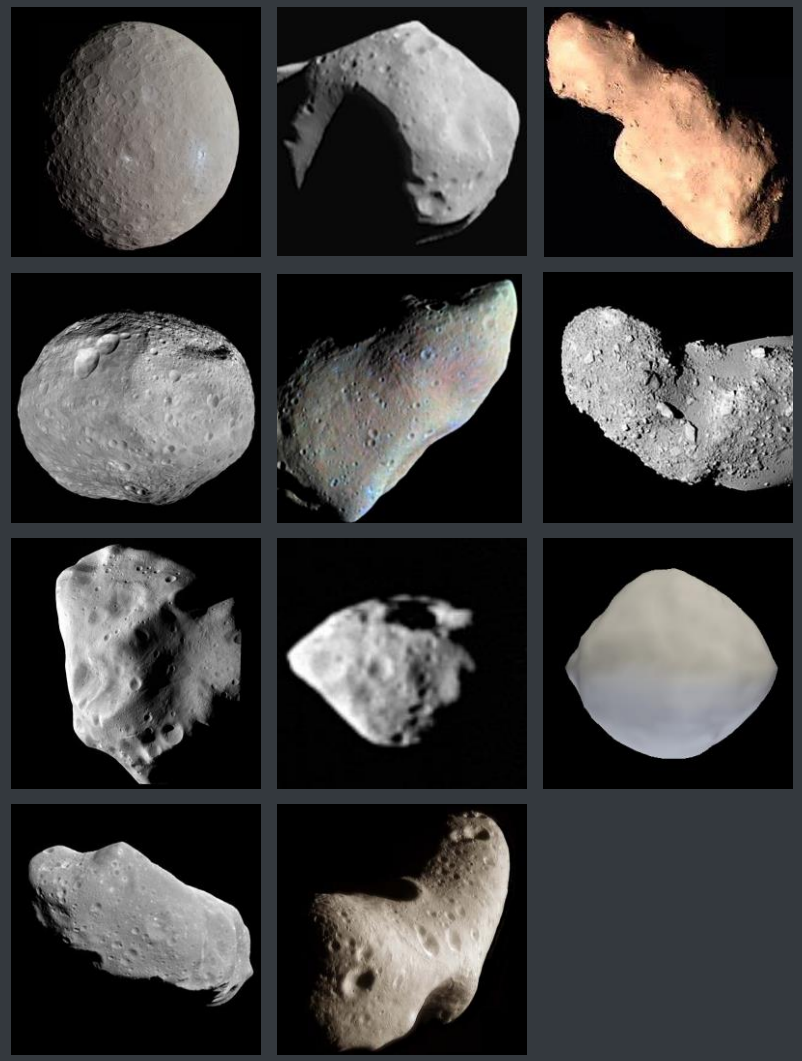


3145728 plates

The SBMT contains diverse objects.

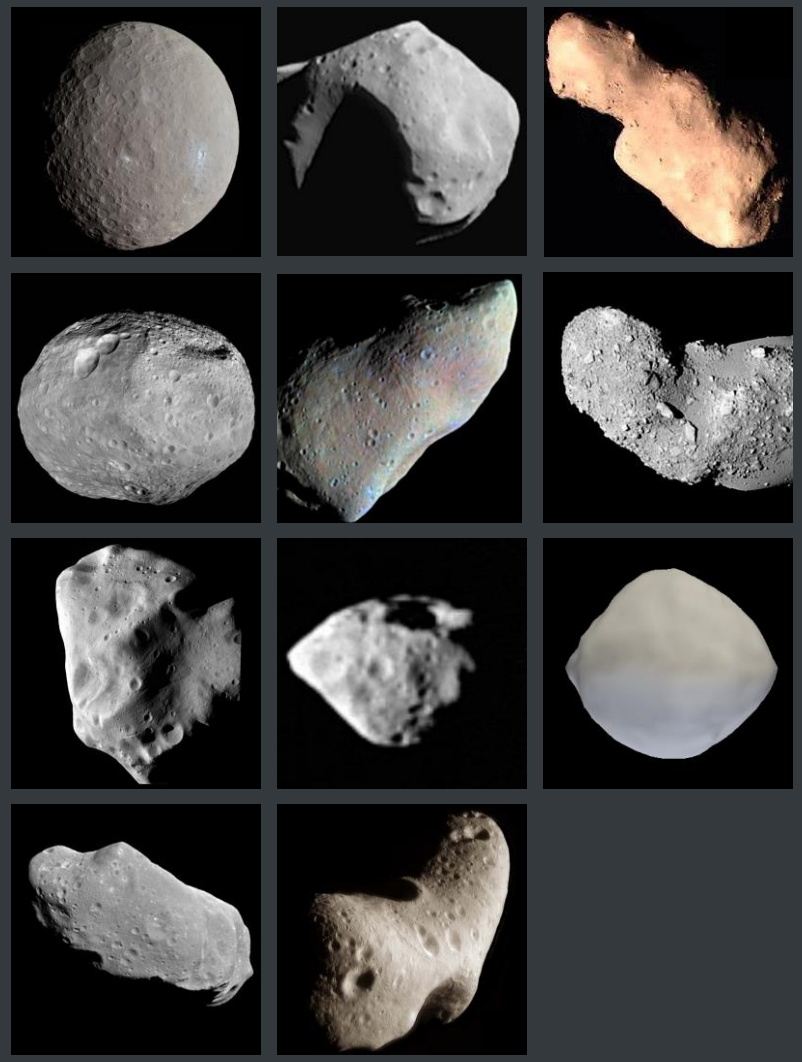
Asteroids

The SBMT contains diverse objects.



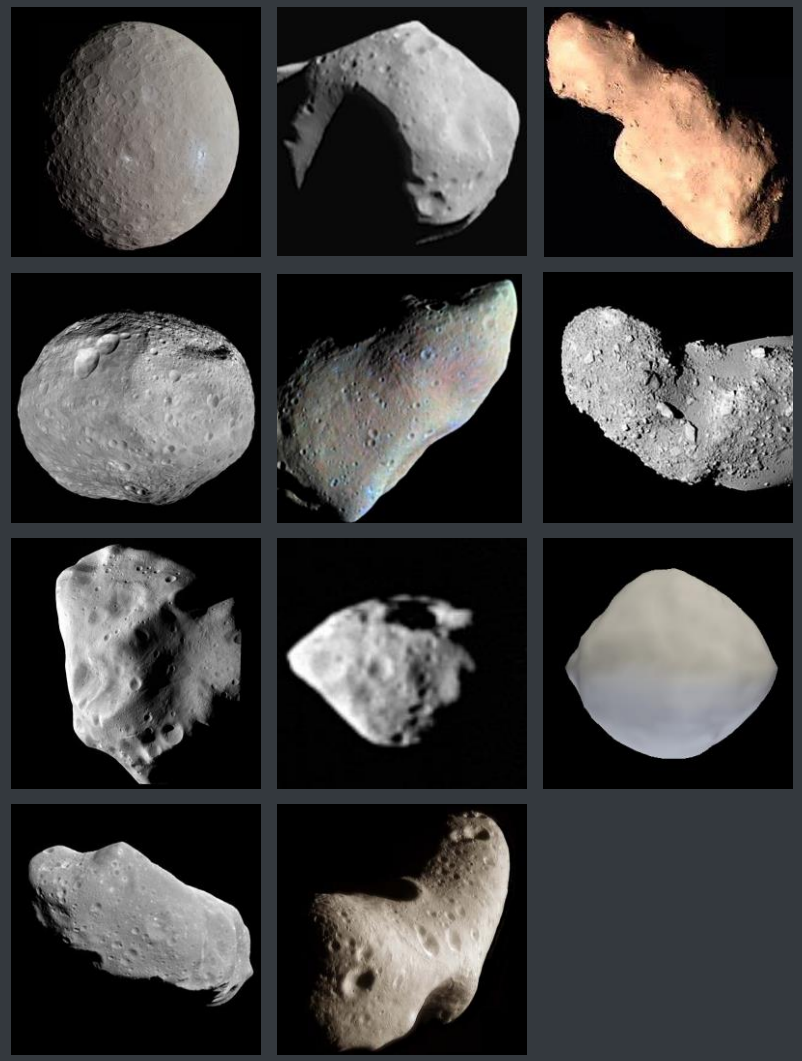
Comets

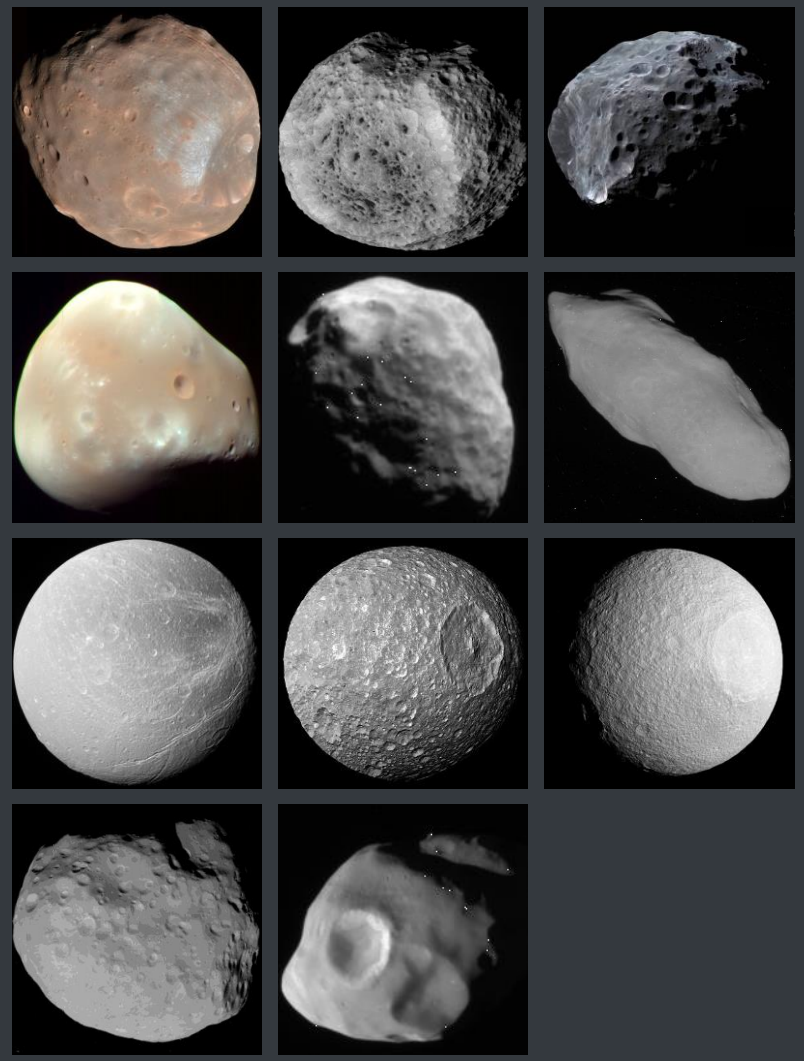
The SBMT contains diverse objects.



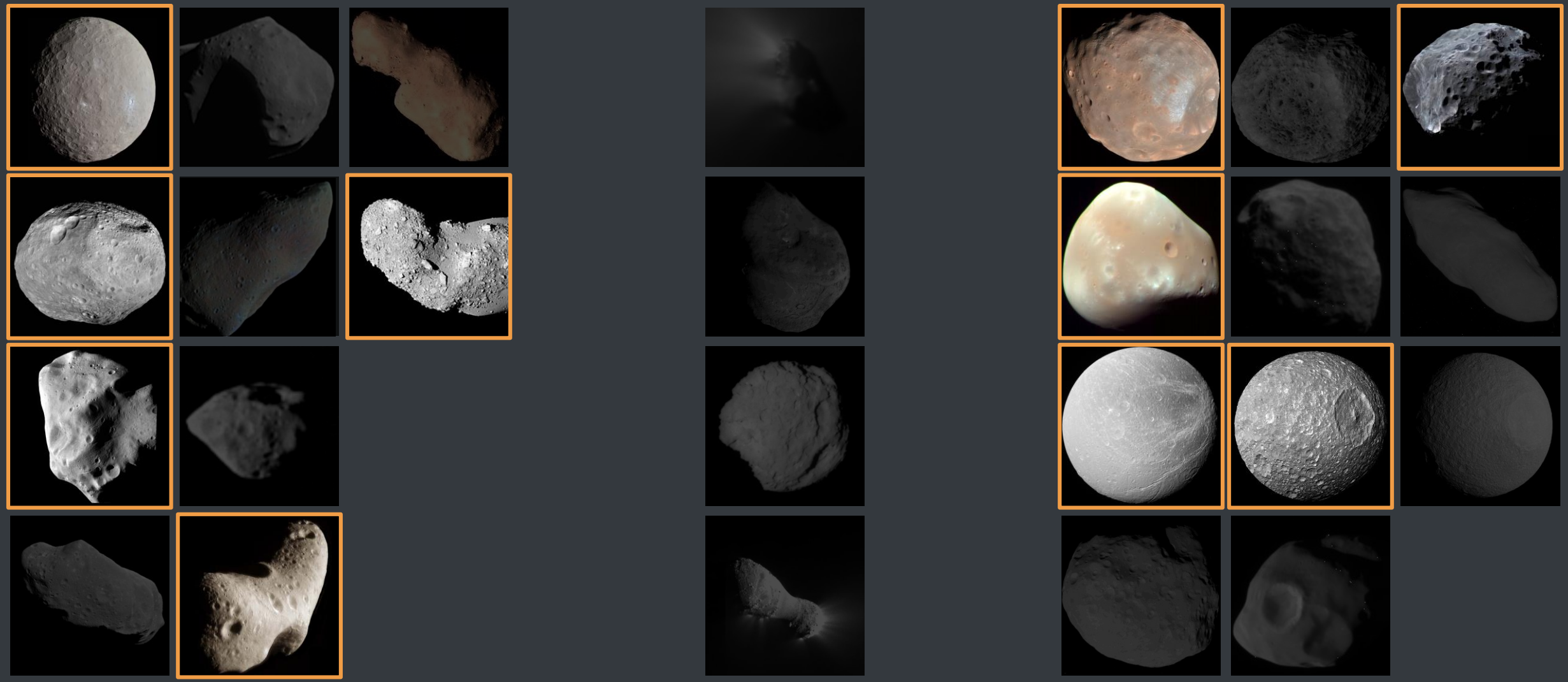
Moons

The SBMT contains diverse objects.

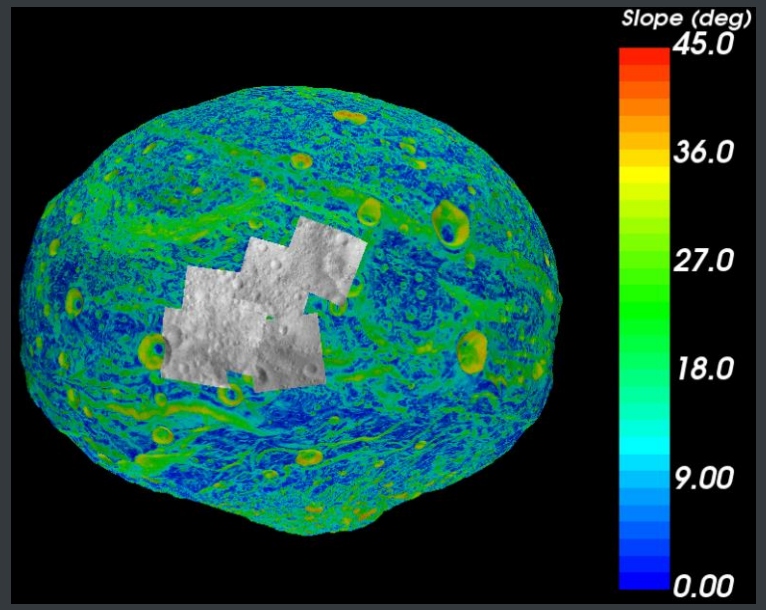




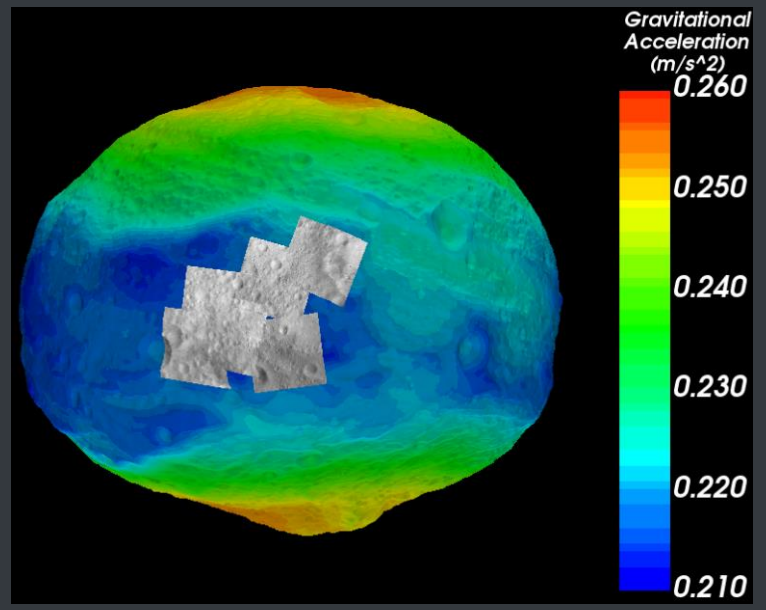
The Tool has co-registered datasets.



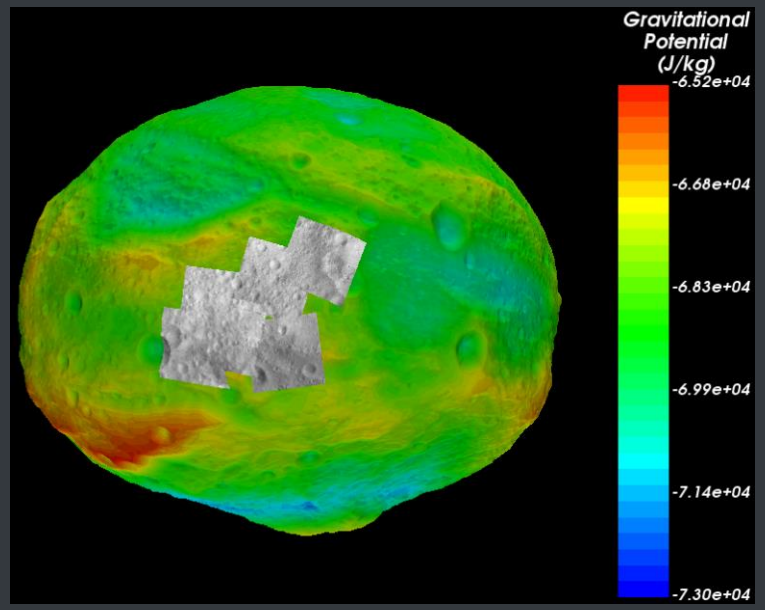
Many bodies include backplanes with geophysical information.



Slope



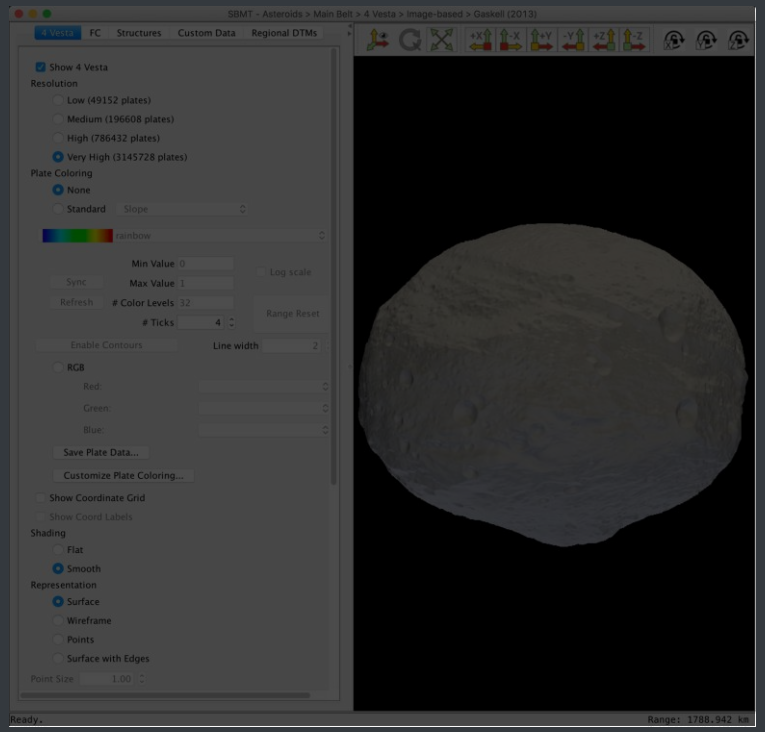
Gravitational acceleration



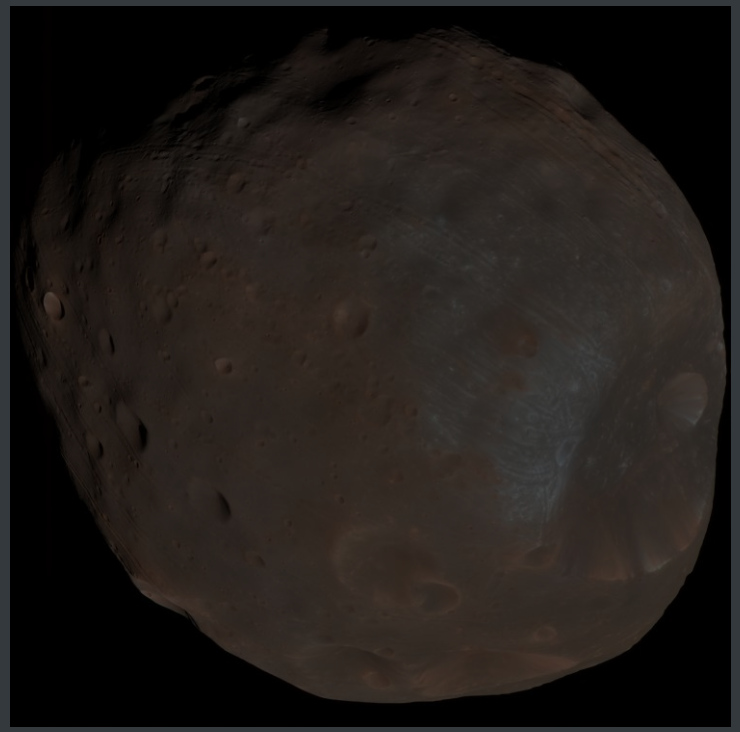
Gravitational potential

Several missions have used, do use, or will use the SBMT.

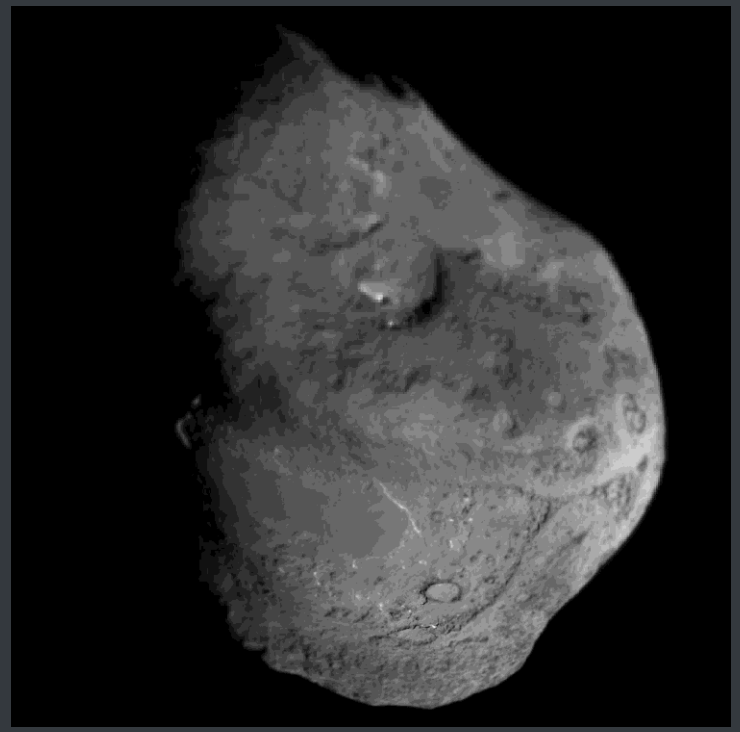
Outline



SBMT tour



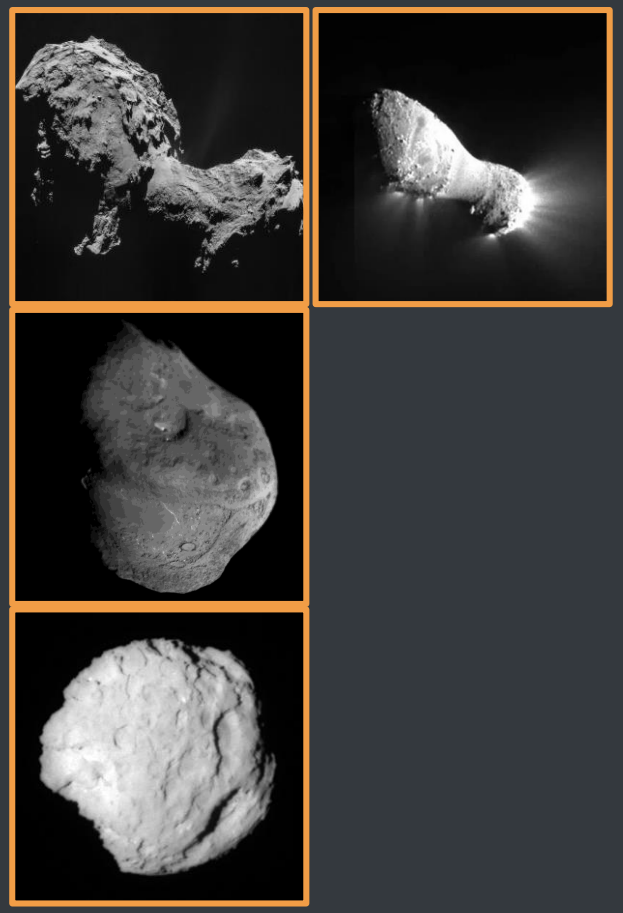
Available datasets

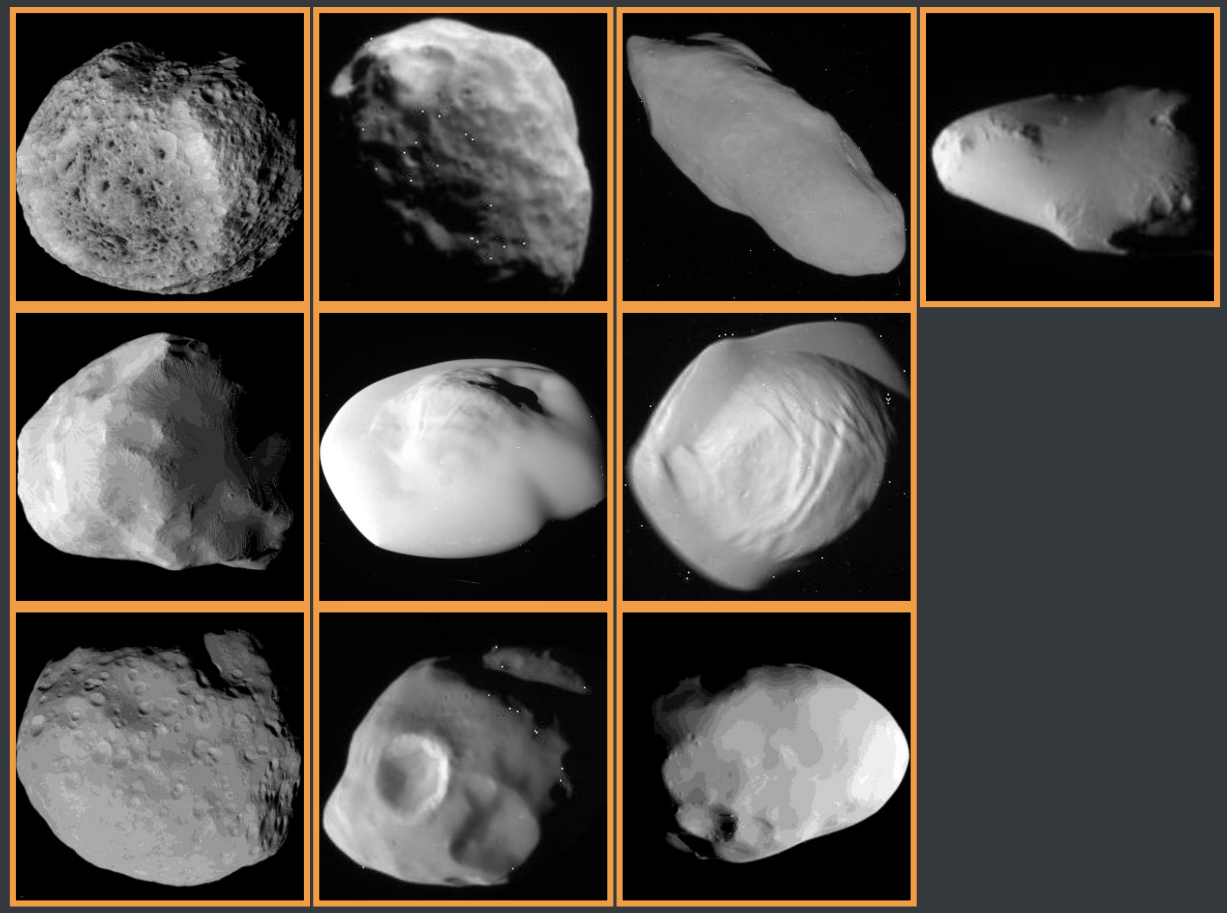


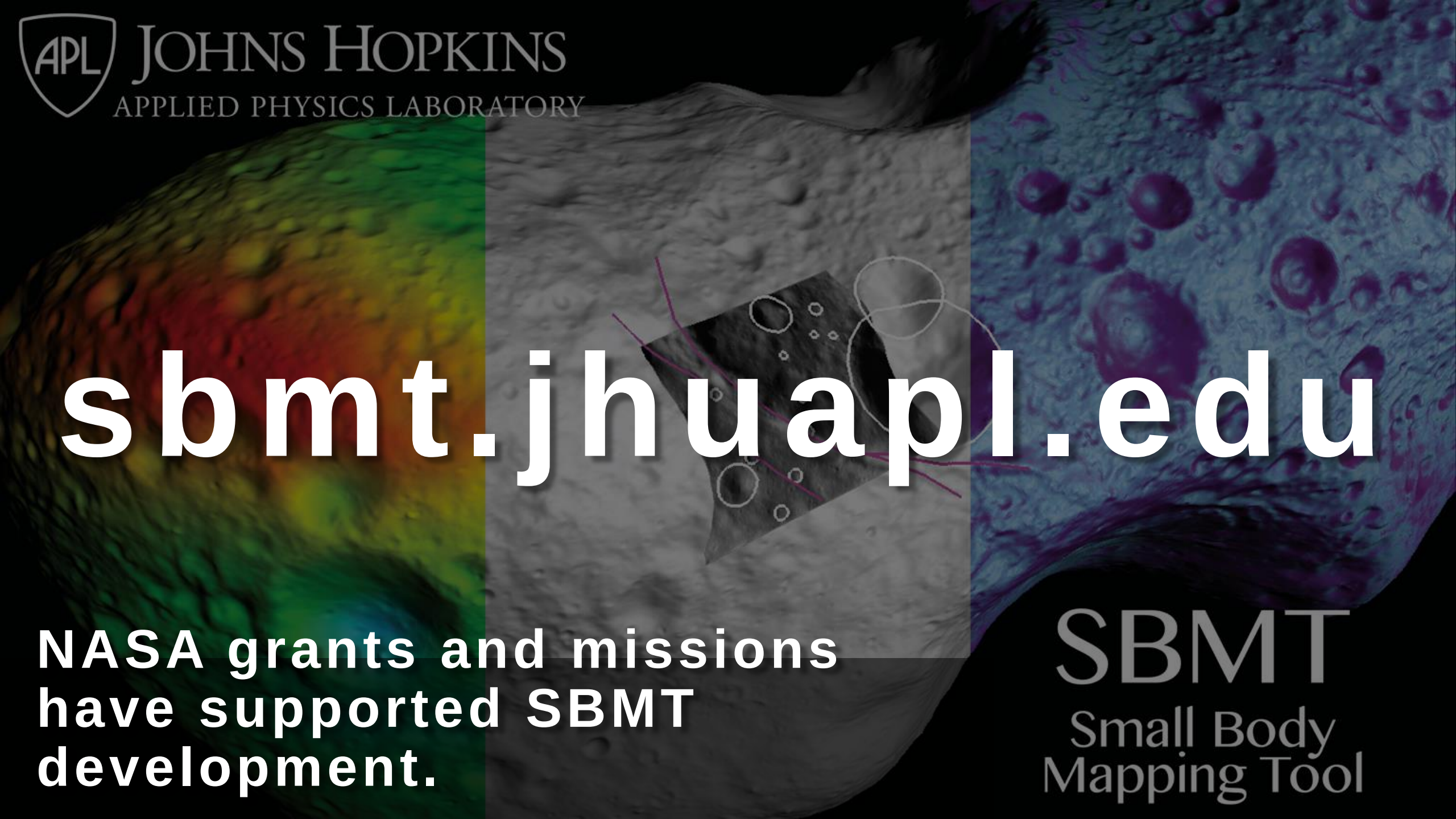
Future plans

Image credits: Phobos, NASA/JPL-Caltech/University of Arizona. Tempel 1, NASA/JPL/UMD

New SPC shape models & registered spacecraft data will be forthcoming.






APL
JOHNS HOPKINS
APPLIED PHYSICS LABORATORY
sbmt.jhuapl.edu
NASA grants and missions have supported SBMT development.
SBMT
Small Body Mapping Tool

The irregular shapes of small bodies pose additional challenges.

NEAR Image

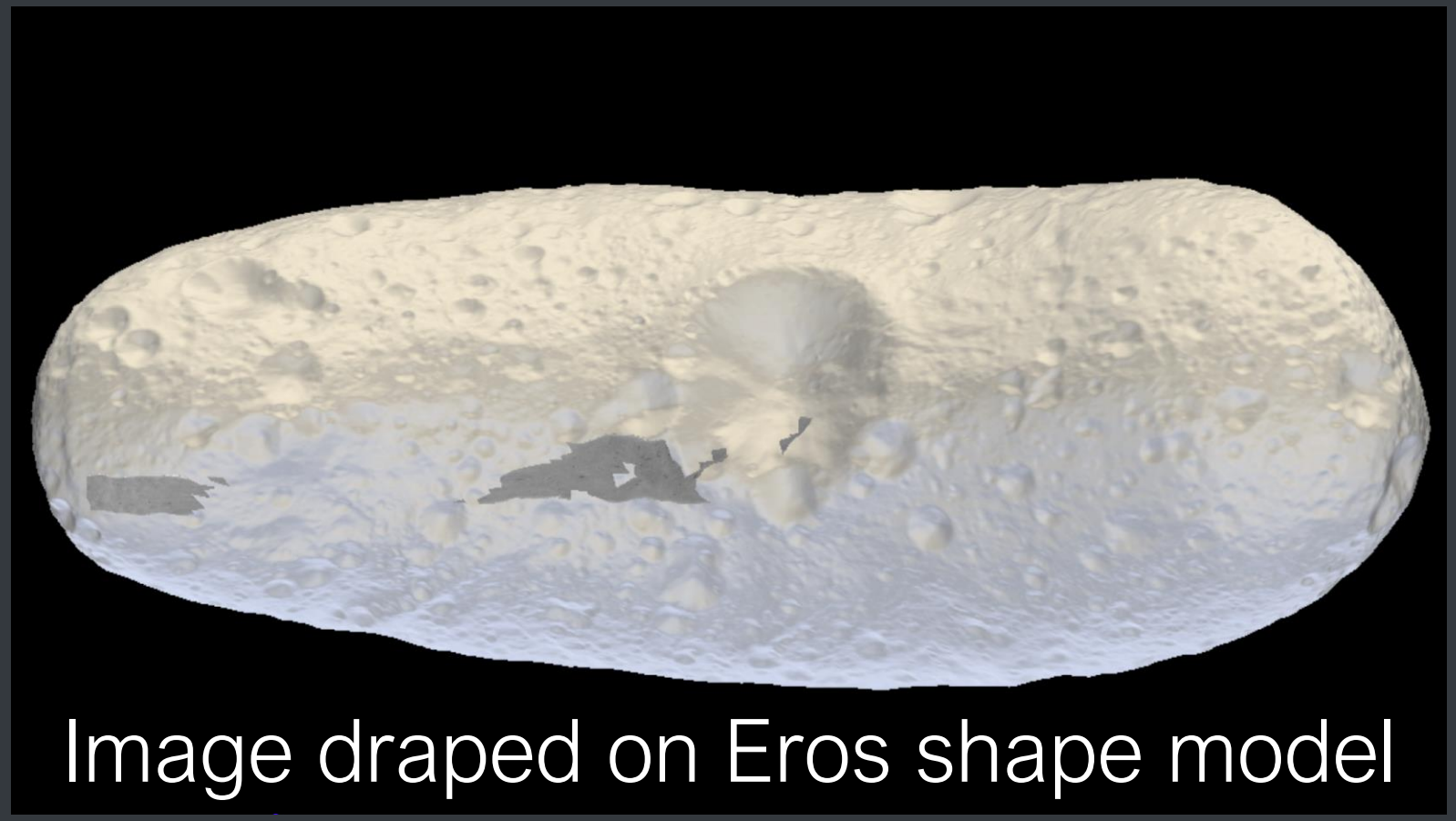


Image draped on Eros shape model

SBMT - Planets and Satellites > Saturn System > Phoebe > Image-based > Gaskell (2013c)

Phoebe | Imaging Data | Structures | Custom Data | Regional DTMs

Show Phoebe

Resolution
- Low (49152 plates)
- Medium (196608 plates)
- High (786432 plates)
- Very High (3145728 plates)

Plate Coloring
- None
- Standard

rainbow

Min Value 0
Max Value 1
Color Levels 32
Ticks 4
Log scale
Sync
Refresh
Range Reset

Enable Contours
Line width 2

RGB
Red:
Green:
Blue:

Save Plate Data...
Customize Plate Coloring...

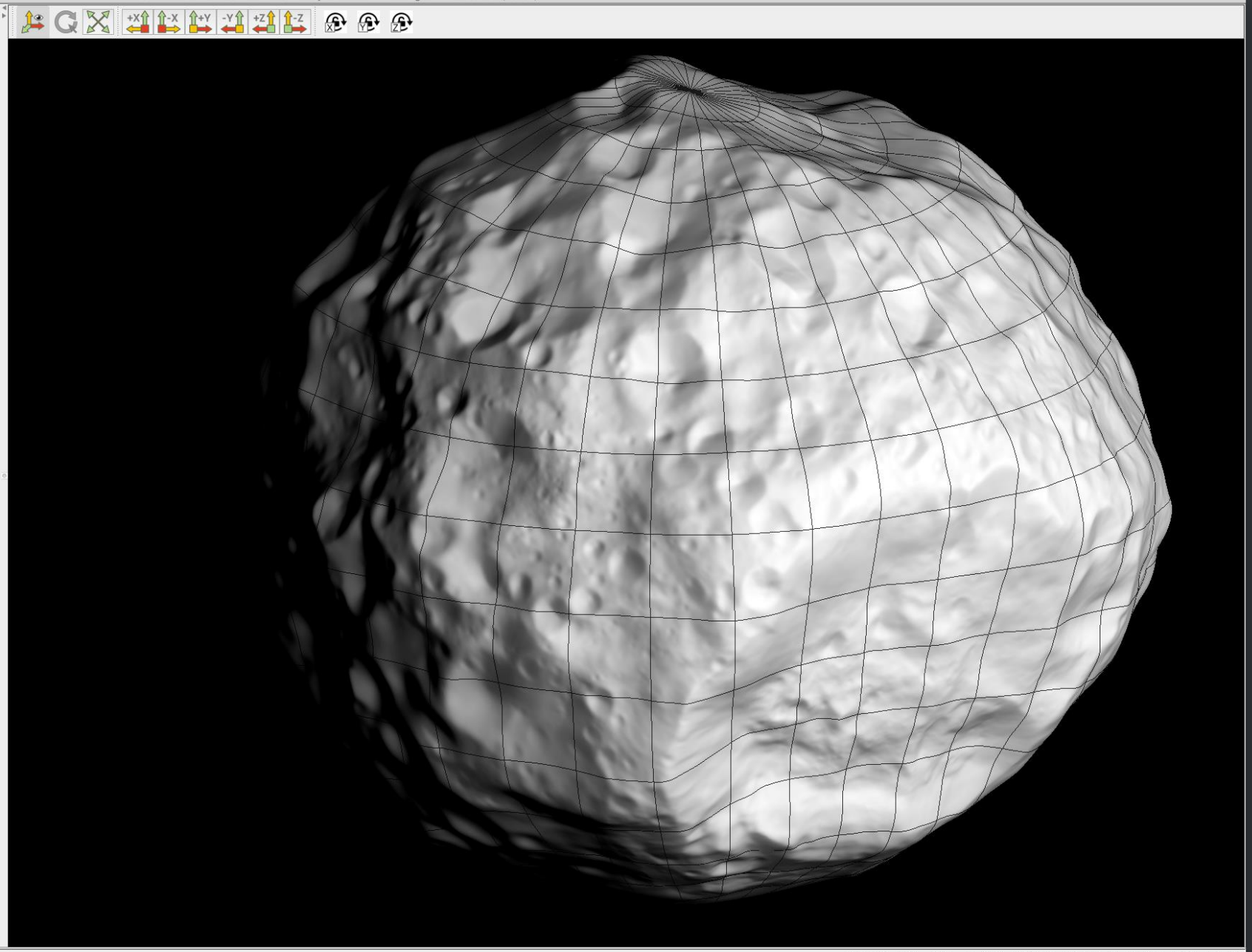
Show Coordinate Grid
Show Coord Labels

Shading
- Flat
- Smooth

Representation
- Surface
- Wireframe
- Points
- Surface with Edges

Point Size 1.00
Line Width 1.00
Shape model opacity 1.00

Statistics:
Number of Plates: 3145728
Number of Vertices: 1579014
Surface Area: 148655.6 km^2
Volume: 5069964 km^3
Plate Area Average: 47256.34 m^2
Plate Area Minimum: 28115.97 m^2
Plate Area Maximum: 80138.80 m^2
Extent:
X: [-108.8914, 117.2308] km
Y: [-111.6282, 116.8046] km

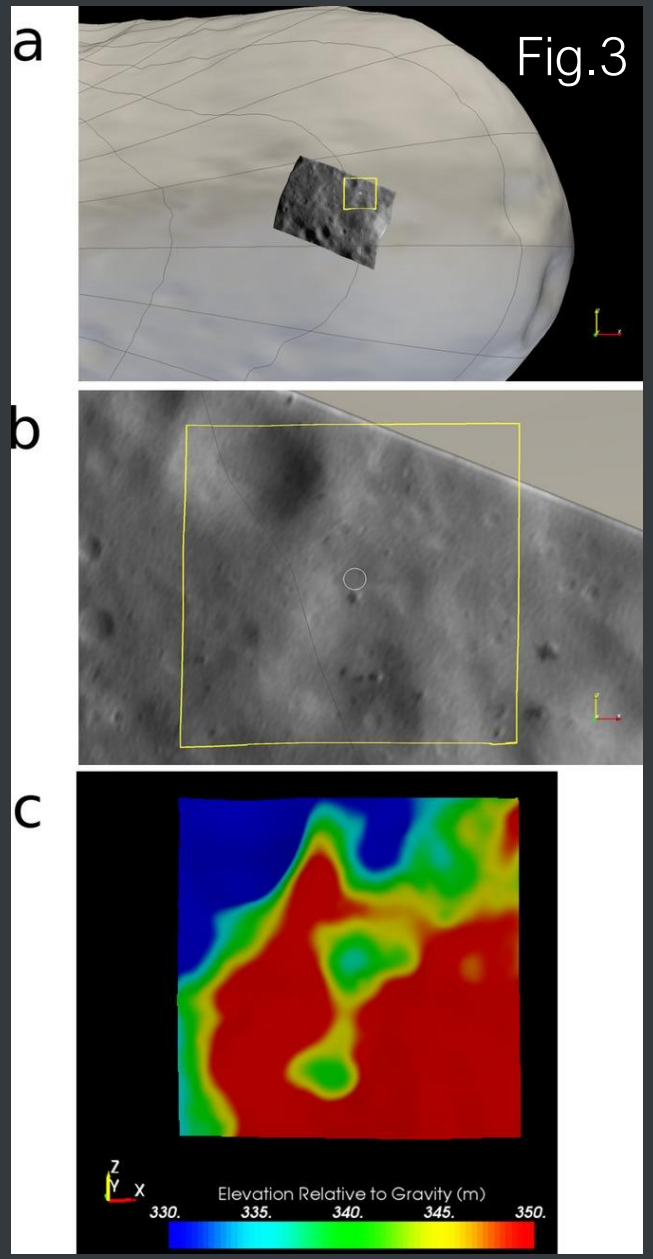


Ready.

Lat: -20.332° Lon: 57.304° Radius: 110.044 km Range: 35901.386 km

Case study: Eros

Buczkowski et al. (2012), *GRL,* doi: 10.1029/2012GL052959.
Besse et al. (2014), PSS, doi: 10.1016/j.pss.2014.07.007.
Scully et al. (2014), *Icarus,* doi: 10.1016/j.icarus.2014.01.013
Blewett et al. (2014), *Icarus,* doi: 10.1016/j.icarus.2014.03.007.
Mazrouei et al. (2014), Icarus, doi: 10.1016/j.icarus.2013.11.010.
Ruesch et al. (2014), *Icarus,* doi: 10.1016/j.icarus.2014.01.035.
Roberts et al. (2014), *Icarus,* doi: 10.1016/j.icarus.2014.07.004.
Roberts et al. (2014), MAPS, doi: 10.1111/maps.12348.
DeSouza et al. (2015), *Icarus,* doi: 10.1016/j.icarus.2014.10.009.
Denevi et al. (2016), *MAPS,* doi: 10.1111/maps.12729.
Hirata (2017), *Icarus,* doi: 10.1016/j.icarus.2017.01.035.
Rivkin et al. (2018), *Icarus,* doi: 10.1016/j.icarus.2017.04.006.



Case study: Deimos

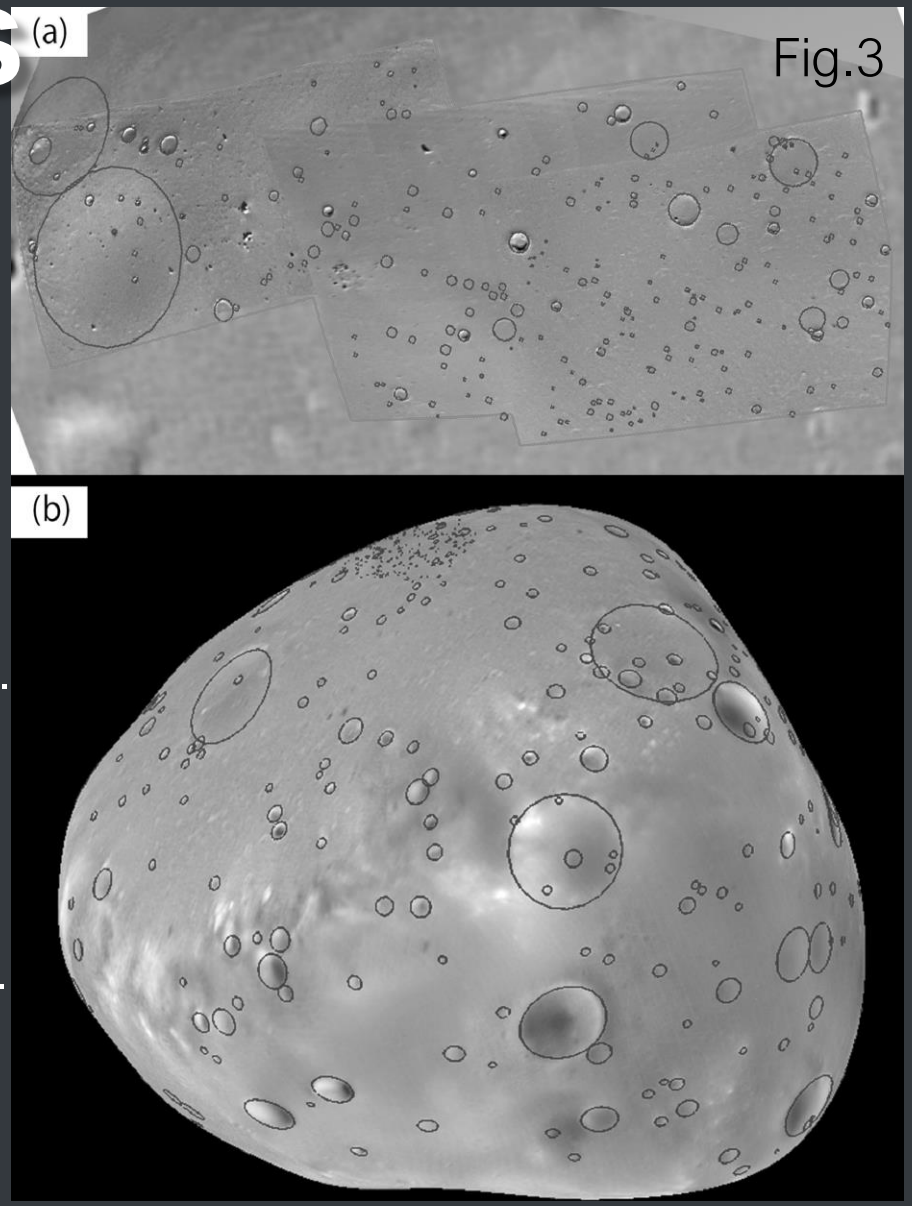


Fig.3

Buczkowski et al. (2012), *GRL,* doi: 10.1029/2012GL052959.
Besse et al. (2014), PSS, doi: 10.1016/j.pss.2014.07.007.
Scully et al. (2014), *Icarus,* doi: 10.1016/j.icarus.2014.01.013
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Hirata (2017), Icarus, doi: 10.1016/j.icarus.2017.01.035.
Rivkin et al. (2018), Icarus, doi: 10.1016/j.icarus.2017.04.006.