IVOA HiPS Implementation in the Framework of Worldwide Telescope

Chenzhou Cui, **Yunfei Xu**, Dongwei Fan, Changhua Li, Shanshan Li
China-VO WWT development team

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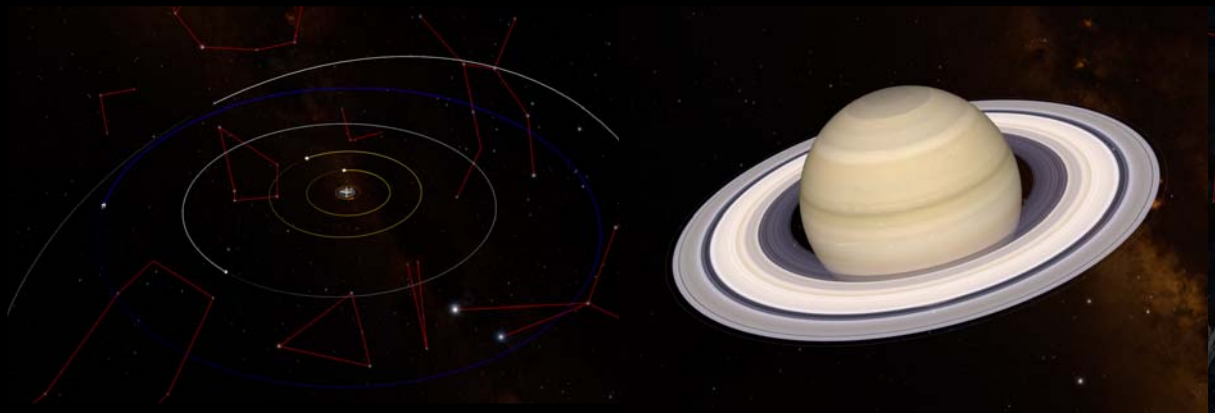
BACKGROUND

Worldwide Telescope (WWT)

- A scientific data visualization platform
- Launched in 2008 by Microsoft Research
- Open-sourced in 2015, project direction and management was taken up by the American Astronomical Society(AAS)
- The Chinese version is maintained by China-VO



BACKGROUND

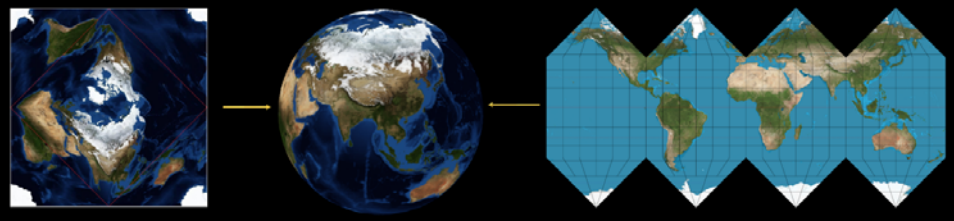
Why WWT needs HiPS

- An increasing number of astronomical data chose to be released in the form of HiPS
  - Till Dec 2018, there are already 500+ HiPS sky maps and 50+ HiPS planet maps
- HiPS also has been the main data release method in the astronomy world.
  - CDS, ESA, NASA, China-VO, JAXA
- Has the ability to visualize HiPS dataset will greatly expand the data source in WWT, and present the latest astronomical data to ordinary users.

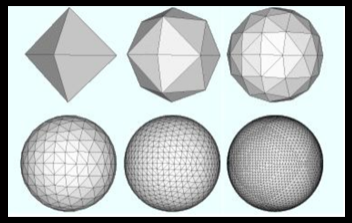
METHOD

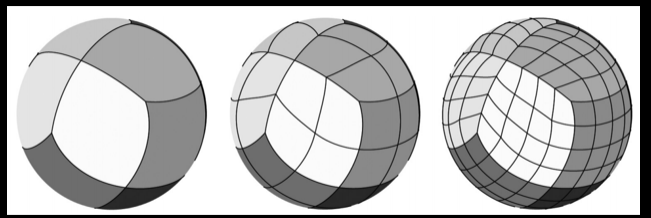
Differences between WWT Data and HiPS

- Different projections:
  - TOAST vs. HEALPix

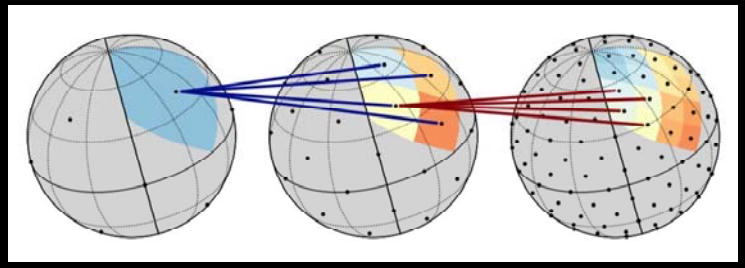


- Different 3D meshes:
  - Hierarchical Triangular Mesh vs. HEALPix Rhombic Mesh





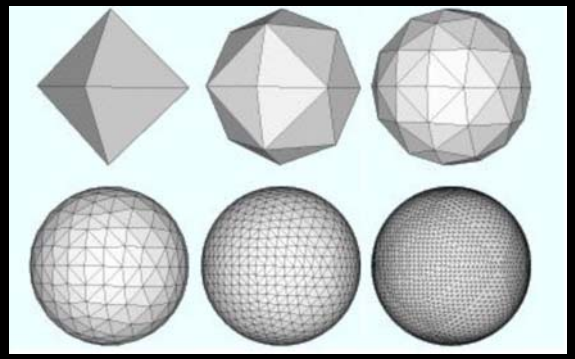
- Different data index methods:
  - WWT Data index vs. HEALPix index

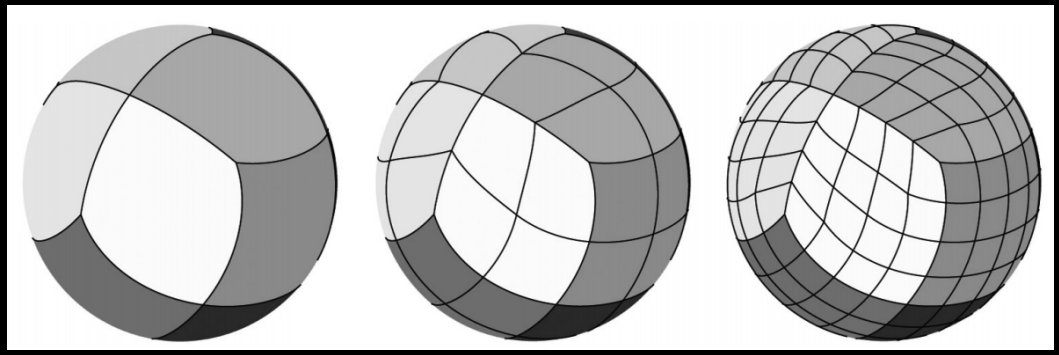


Implementing the HEALPix Projection in WWT

METHOD

- Due to the different data organization methods between TOAST and HEALPix projection, converting the HEALPix projected data into the TOAST projected data is not a good idea.
- As WWT is a 3D visualization software, the data is displayed as textures on the virtual celestial sphere. Therefore, implementing the HEALPix projection is actually the rendering of the HEALPix mesh.





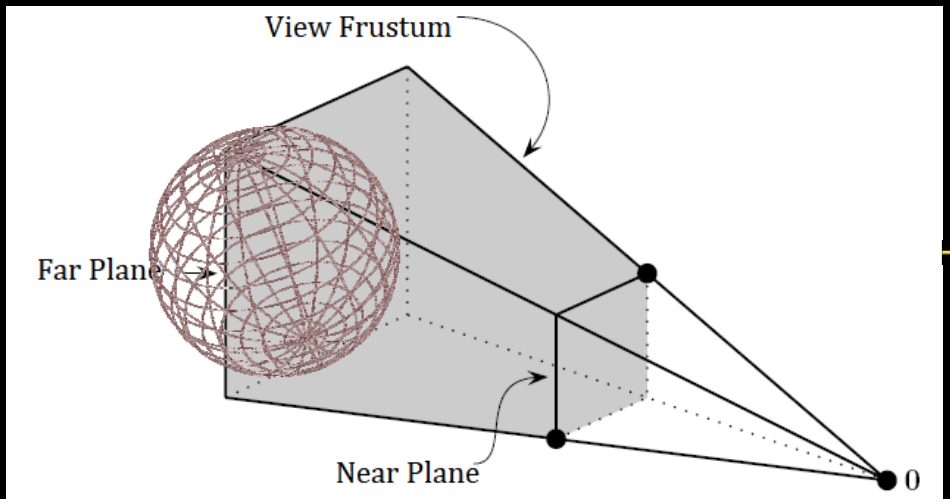
Progression of mesh of TOAST(left) and HEALPix(right) at different resolutions

HEALPix rhombic meshes implemented in WWT, including the sky model(left) and planet model(right). Note that all rhombus in the 3D environment are made up of triangles.

HEALPix Data Organization and Indexing

METHOD

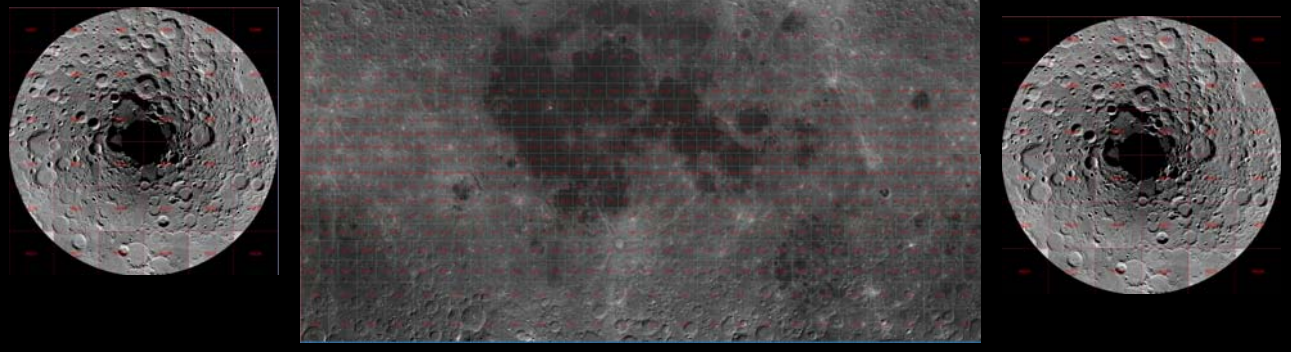
- By modifying the WWT data management related methods, the HiPS data can be read, cached and rendered.
- When users change the view in the 3D virtual environment, tiles in the view frustum are read into memory, and rendered as the textures of corresponding HEALPix meshes.



APPLICATIONS

Chang’e 2 lunar surface data as a HiPS

- The 7-meter resolution data was acquired at a track height of 100 km by Chang’e 2’s CCD stereo camera.
- The lunar surface data have been released includes two parts, which are divided by projection methods, based on the longitudes of images.
- The first part of data is in Mercator projection, the longitudes are between 70° S-70° N, and the other part is in Polar Azimuth projection in polar areas.

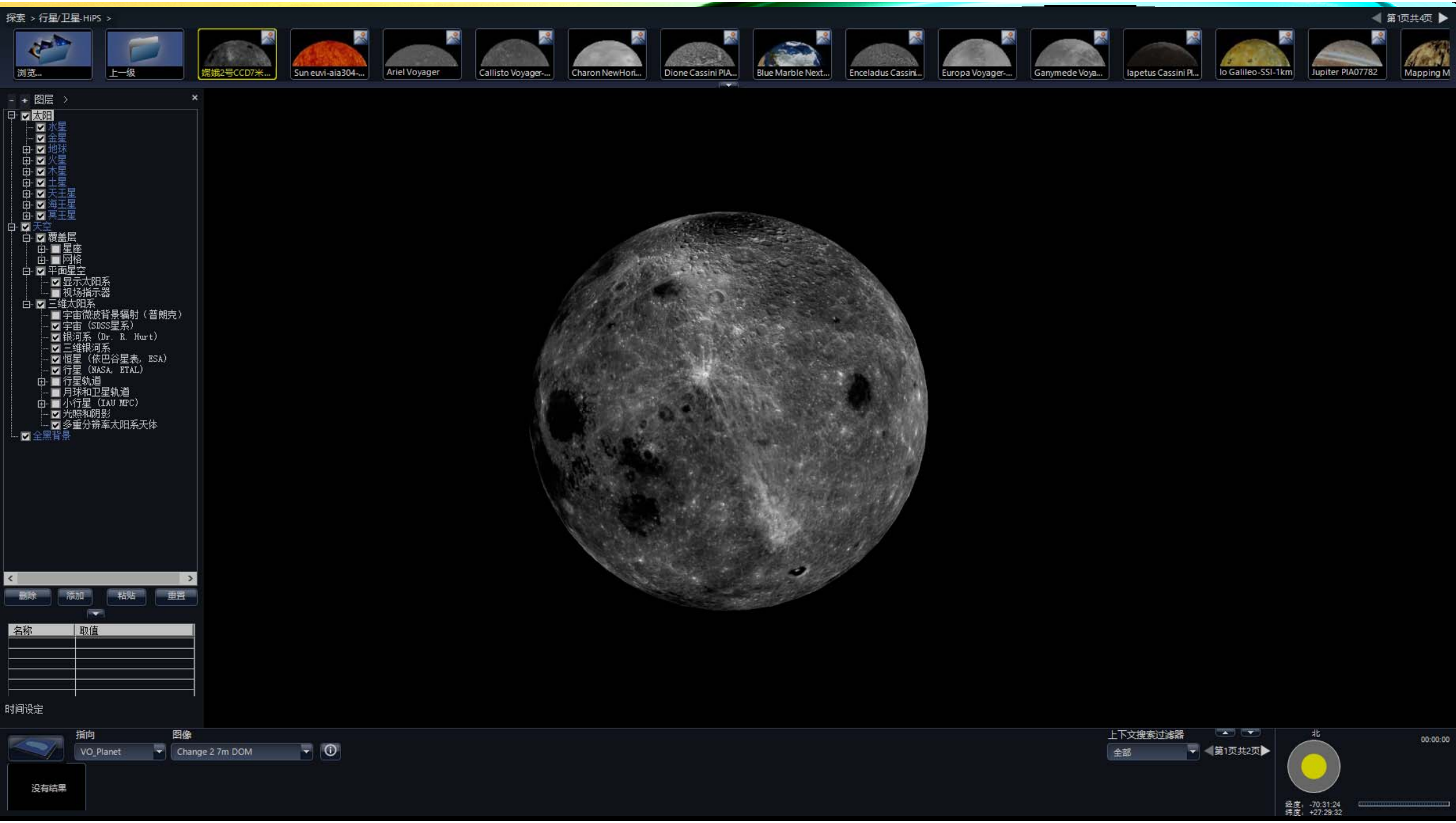


APPLICATIONS

Chang'e 2 lunar surface data as a HiPS

Processing details:

- Convert data group(tiff, prj, tfw) into GeoTiff
- Keep the north & south polar data's projection
- Convert the Mercator projected data into polar stereography projection
- Then convert all data's into HEALPix projection by using 'gdalwarp' lib
- Convert all GeoTiff into fits
- Generating HiPS: by using Aladin HiPSGen.jar
- Deploy the data in Nginx
- Modifying the WWT data config file, add the data into WWT's HiPS list.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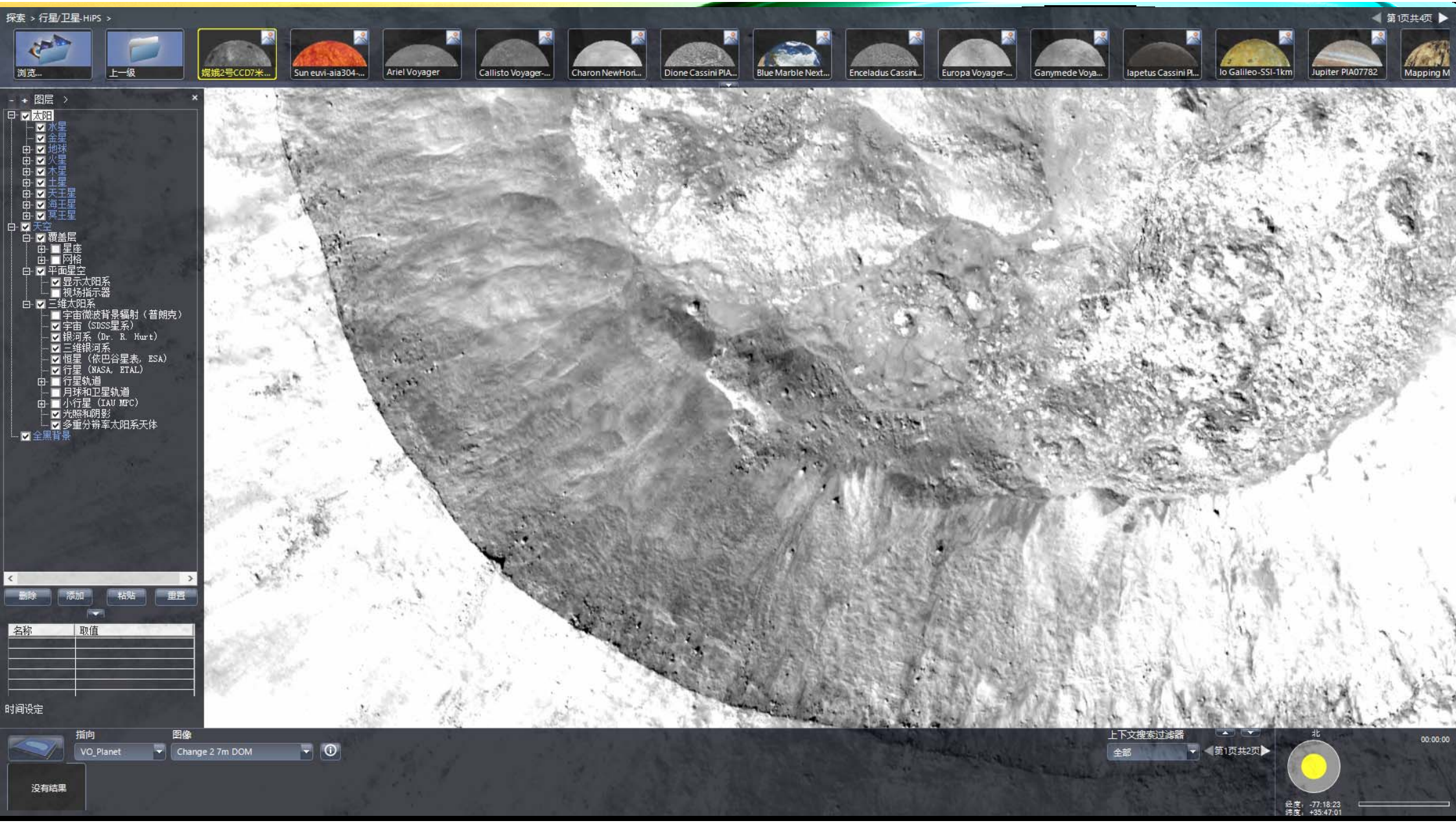
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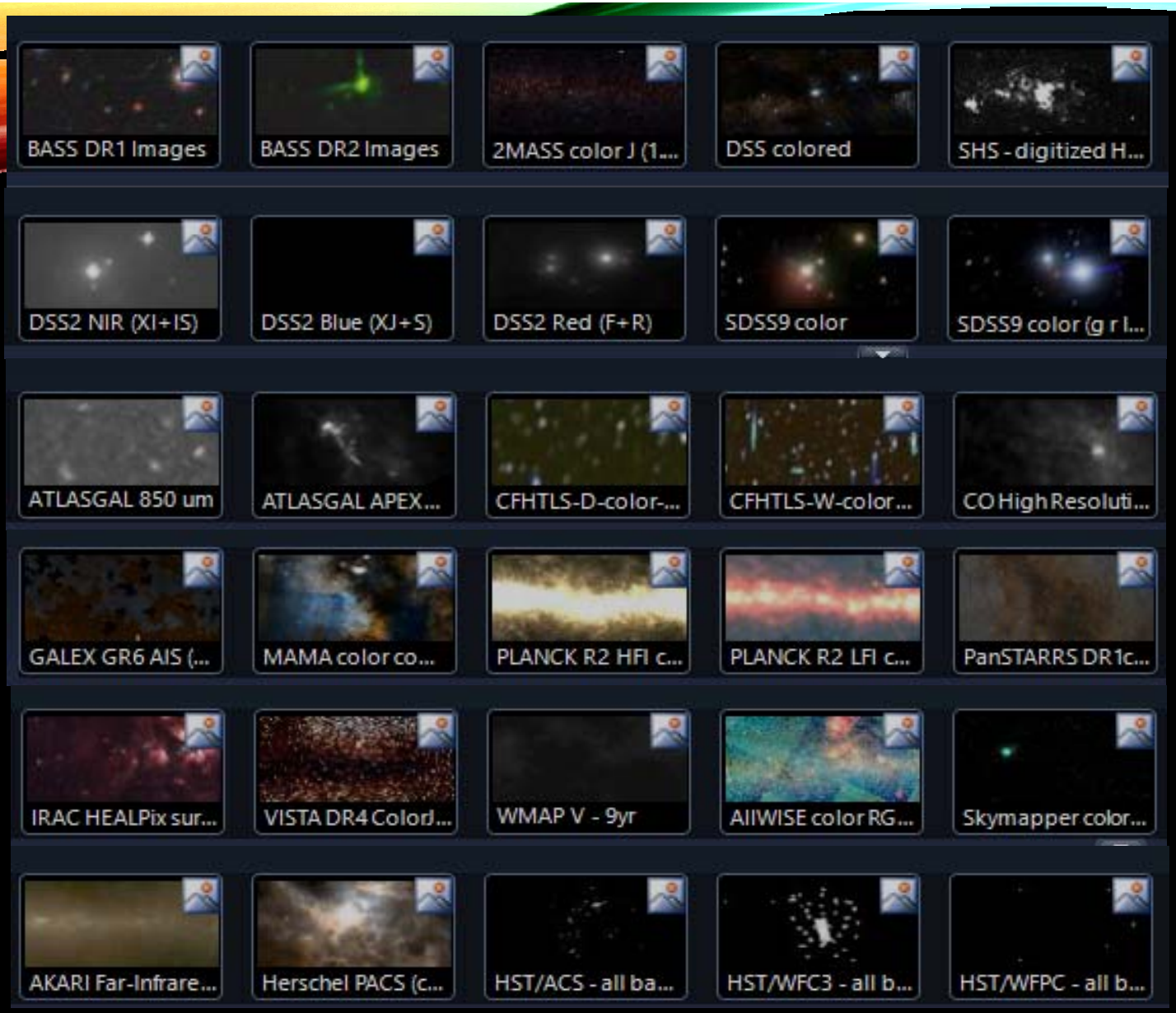
CONCLUTION

- WWT is astronomical visualization software that can directly link to all levels of scientific and education.
- HiPS is widely used to publish astronomical data. Implementing HiPS data visualization in WWT requires the realization of HEALPix projection, mesh creating and rendering, and data organization and indexing.
- 39 selected HiPS Sky maps and 49 selected HiPS planet maps have been added into China-VO version WWT.
- The most recent scientific outcome also can be published in WWT with the help of HEALPix feature. e.g. displaying the sky maps of gravitational wave detection.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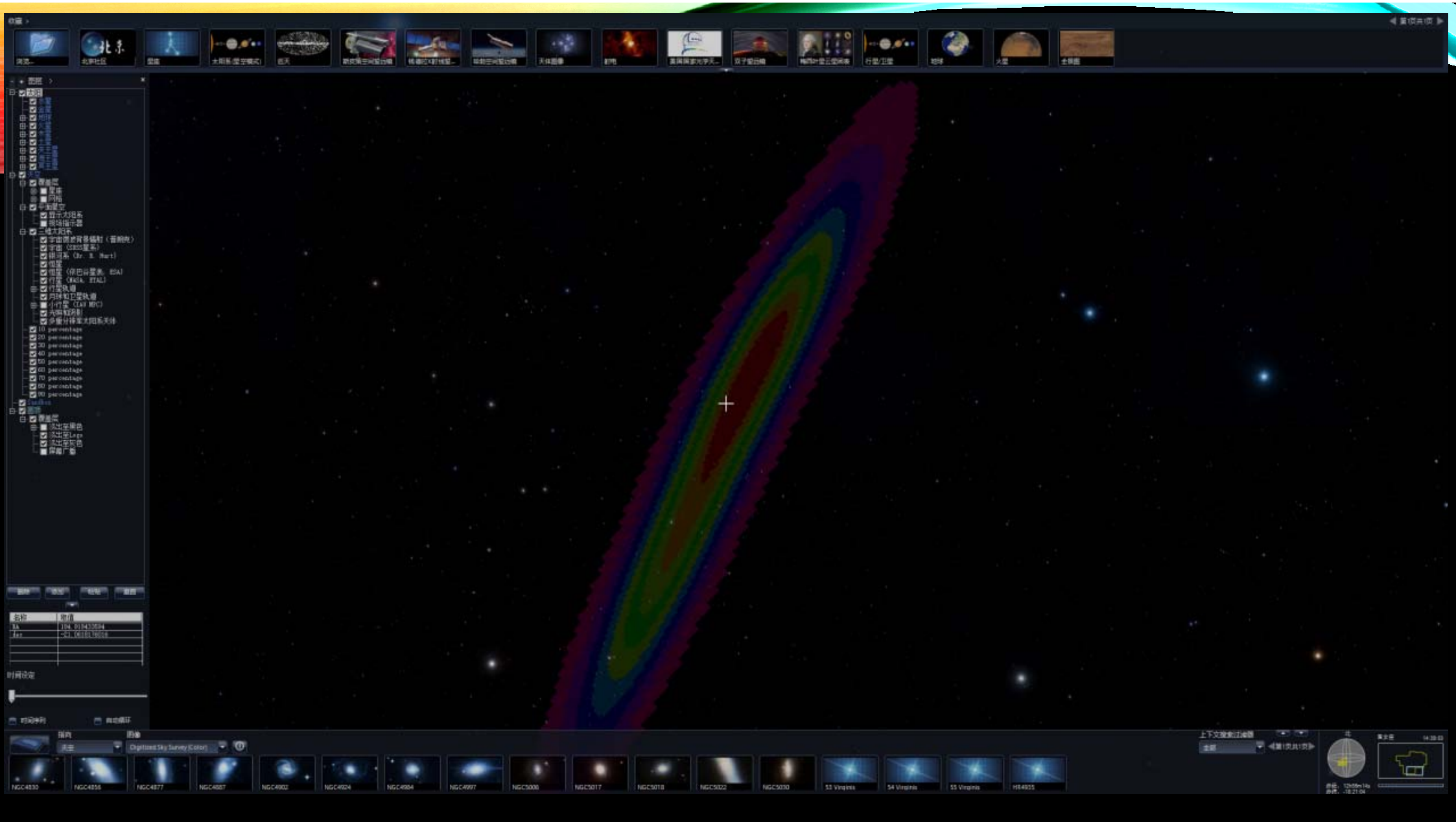

The latest CDS HiPS update

- The CDS is presently processing a big update all its HiPS by adding the low HiPS orders (Norder0 to 2).
- Fifty main used HiPS have been updated by now, others will be updated within this month.
- With this update, the low orders data can be loaded and rendered by WWT, which means less computer memory consume and faster data displaying.
- China-VO will also update his HiPS to be compatible with the HiPS network.

The China-VO Version WWT can be download via the link below:
http://wwt.china-vo.org
Contact: ccz@nao.cas.cn, xuyf@nao.cas.cn

Thanks!
Q & A