

USGS Support of Small Bodies Research: A lot has changed in the last 18 months

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Acknowledgments

- Kristin Berry
- Lauren Adoram-Kershner
- Jay Laura
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USGS Supports all three SBAG Goals

- Goal 1: Small Bodies, Big Science.
 - **USGS Cartographic and Radiometric Software**
 - DTM Generating Software: GXP (follow-on to Socket Set)
 - Mapping Support & Nomenclature
- Goal 2: Defend Planet Earth.
 - See Next Slide
- Goal 3: Enable Human Exploration.
 - Resource Assessment – POC: Laz Kestay (laz@usgs.gov)

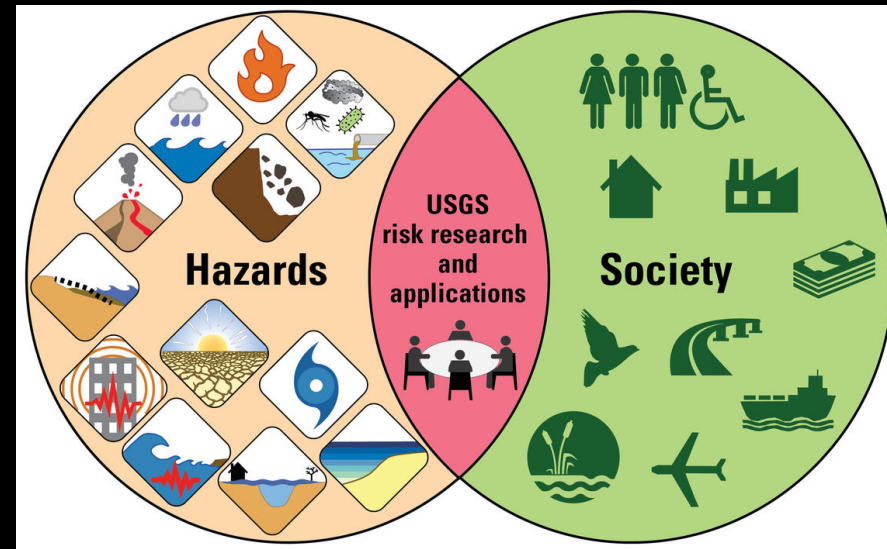
The USGS in support of Planetary Defense

Directives:

- Whitehouse Action Plan
 - 1.2 Identify technology and data processing capabilities and opportunities in existing and new telescope programs to enhance characterization of NEO composition and dynamical and physical properties.
 - 1.4 Establish and exercise a process for rapid characterization of a potentially hazardous NEO.
 - 2.4 Establish a suite of computer simulation tools for assessing the local, regional, and global risks associated with an impact scenario.
 - Continually assess the adequacy and validity of modeling and analysis through annual exercises, test problems, comparison to experiments, and peer review activities.
- SBAG Goal #2: Defend Planet Earth
 - 2.2. Characterize the properties of near-Earth objects
 - 2.3. Develop rigorous models to assess the risk to Earth from the wide-ranging potential impact conditions.
 - 2.5. Establish coordination and civil defense strategies and procedures to enable emergency response and recovery actions.

Capabilities

- Spacecraft Characterization
 - DART/DRACO
- Impact Hazard Modeling
 - Earthquake Modeling
 - Water Quality



Credit: <https://www.usgs.gov/media/images/venn-diagram-hazards-and-society>

Goal 1: Small Bodies, Big Science.

USGS Maintained Spatial & Radiometric Software

- Integrated Software for Imagers and Spectrometers (ISIS)
 - Cameras
 - Spectrometers
 - Radar

Tools, Geologic Mapping & Nomenclature Support

- GXP (Next Version of Socket set)
 - CSM – Dawn FC
- Geologic Mapping
 - Vesta – A. Yingst
 - Pluto – O. White
- Planetary Nomenclature

Integrated Software for Imagers and Spectrometers (ISIS)

- Map and Point Projections
- Create Mosaics
 - Color Mosaics (Filter Wheels)
- Data Fusion – Combining imaging and spectroscopy
- What do I need to make it work
 - Software – Download thru Anaconda
 - The images or spectra (PDS)
 - The SPICE (telemetry)
 - Automatically updated for many missions
 - Can use your own SPICE
 - The Shape (Triaxial Ellipsoids, DEM/DTM, DSK)
 - Can use the default
 - Or define your own

Migration to OPEN SOURCE

- Migration to GitHub 100% Complete
- All Development is transparent
- Actively working to reduce friction for all contributors (internal & external)

The Roadmap

- <https://github.com/USGS-Astrogeology/ISIS3/wiki/FY19-Roadmap>

Request For Comment (RFC)

- <https://github.com/USGS-Astrogeology/ISIS3/wiki/RFC3a:-SPICE-Modularization----Impact-on-Application-Users>

ISIS3.7.1 Released May 2019

Where do I download?

- <https://github.com/USGS-Astrogeology/ISIS3/blob/dev/README.md##Installation>

Where do I get Help?

- <https://Astrodiscuss.usgs.gov>

Bug Reporting?

- <https://github.com/USGS-Astrogeology/ISIS3/issues>

Overview of recent changes

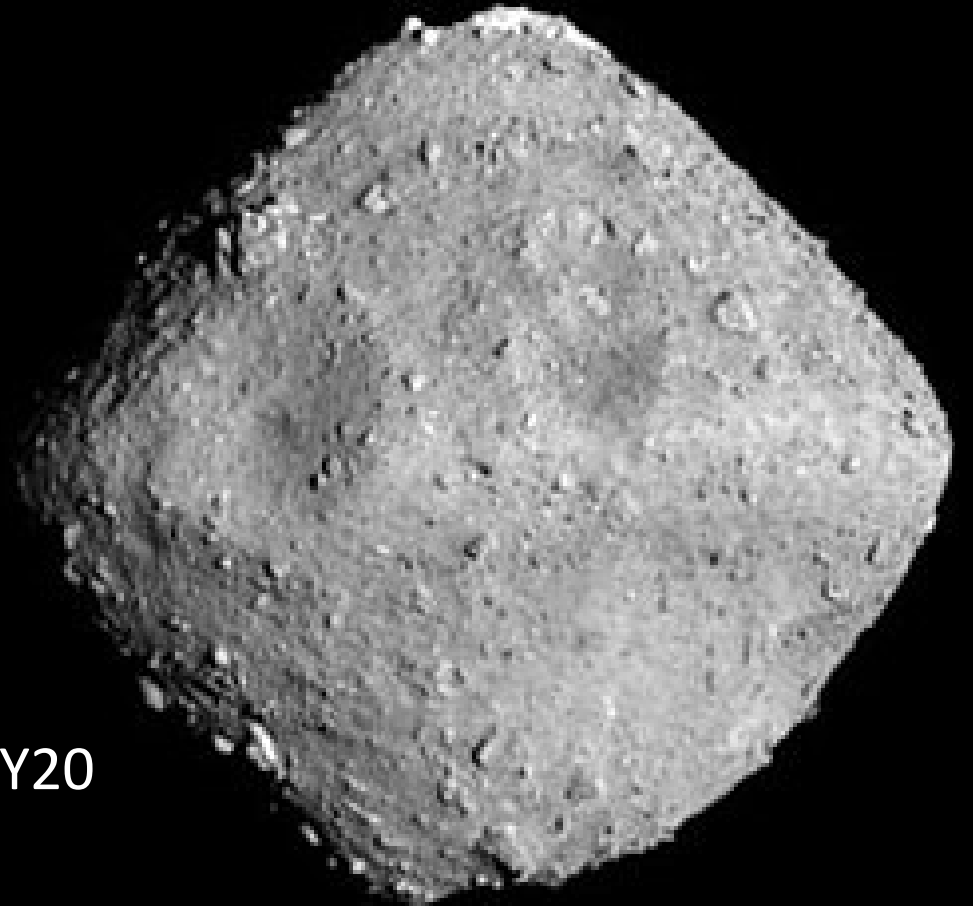
- <https://www.hou.usra.edu/meetings/planetdata2019/pdf/7087.pdf>

Small Bodies Mission Support: Missions/Instruments

- Dawn
 - FC
 - VIR
- Hayabusa 1
 - AMICA
 - NIRS
- Haybusa 2
 - ONC
- NEAR
 - MSI
- Rosetta
 - OSIRIS
 - *VIRTIS*
- New Horizons
 - LEISA
 - LORRI
 - MVIC
- OSIRIS REx
 - OCAMS
- Voyager ISS

Hayabusa 2

- Hyb2onc2isis
- Hyb2onccal
 - Improved calibration planned for FY20
- Low-res DSK shape model
 - Improved Higher resolution DSK planned for FY20



Credit: Hayabusa 2's Optical Navigation Camera captured this image of Ryugu on June 26, 2018.

JAXA / University of Tokyo and collaborators

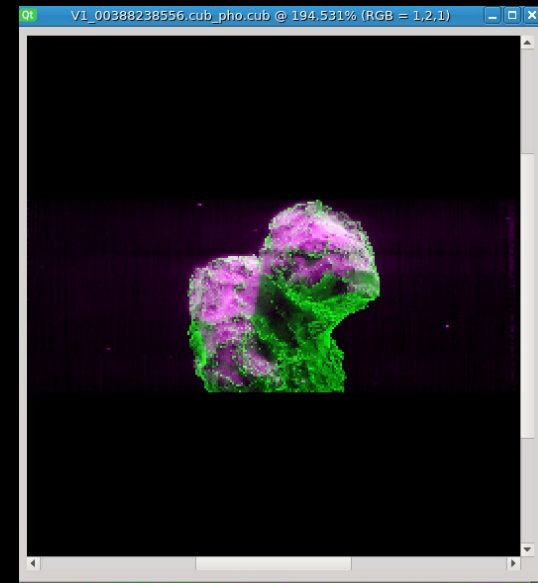
Rosetta Support

OSIRIS

- rososiris2isis
- Both Wide-Angle and Narrow is Supported
- Works well with DSK
- Example for color mosaics

VIRTIS

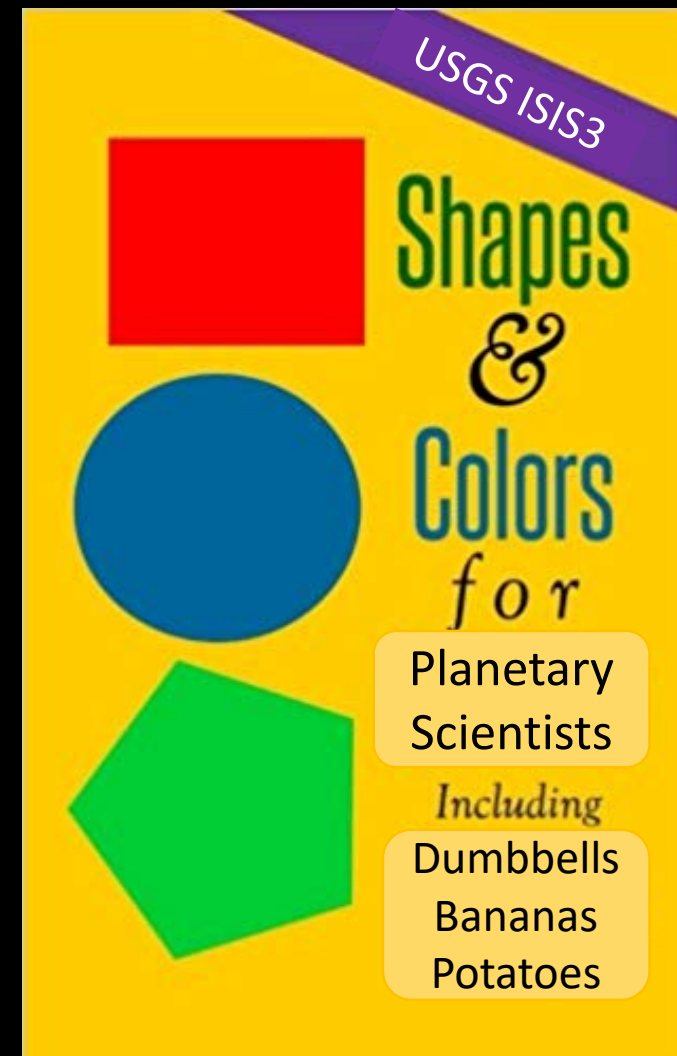
- rosvirtis2isis
- Will be support for
 - VIRTIS-M-VIS
 - VIRTIS-M-IR
 - (Planned release in next 6 months)



Credit: Kristen Berry

Digital Shape Kernel (DSK) Support

If you want color –
you gotta have shape!



Credit: Figure modified from
<http://booklaunch.io/BooksByRichards/5483529605c86d8266502461>

DSK Support

- Bullet Library
 - Now supports segmented DSKs
- NAIF Tool kit
 - DSK2ISIS – DSK into a DTM
 - Does not currently support segmented DSKs
 - Less features than bullet
- Bundle – Adjustment X Y Z
- More details at [Astrodiscuss](#)

Example: True Color Mosaic of 67P/C-G



True Color Image

RED: FFP-Vis Red

GREEN: FFP-Vis Green

BLUE: FFP-Vis Blue

All Images projected to a FFP-Vis

Orange Image

[N20140806T001914558ID30F22]

So this color image is quite gray.

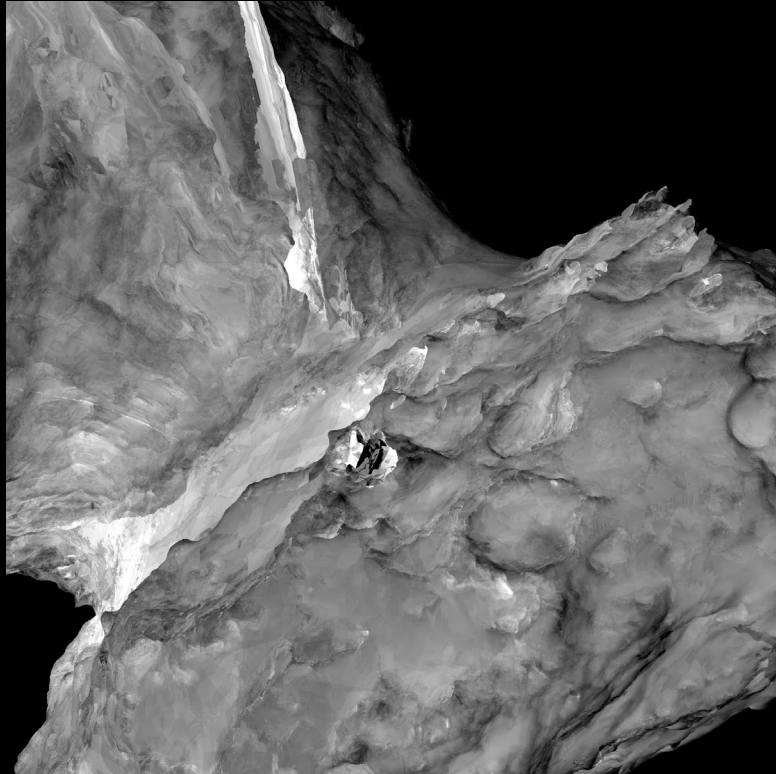
Color fringing is due to slight misalignments between dead-reckoned images and the DSK. The use of Bundle Adjustment X Y Z will fix this.

Credit: Mapel & Adoram-Kershner

Scripts: Projecting Rosetta OSIRIS Images

Perspective 1: N20140821T144254648ID30F22

Credit: Mapel & Adoram-Kershner



Perspective 2: N20140816T145914556ID30F22

Credit: Mapel & Adoram-Kershner

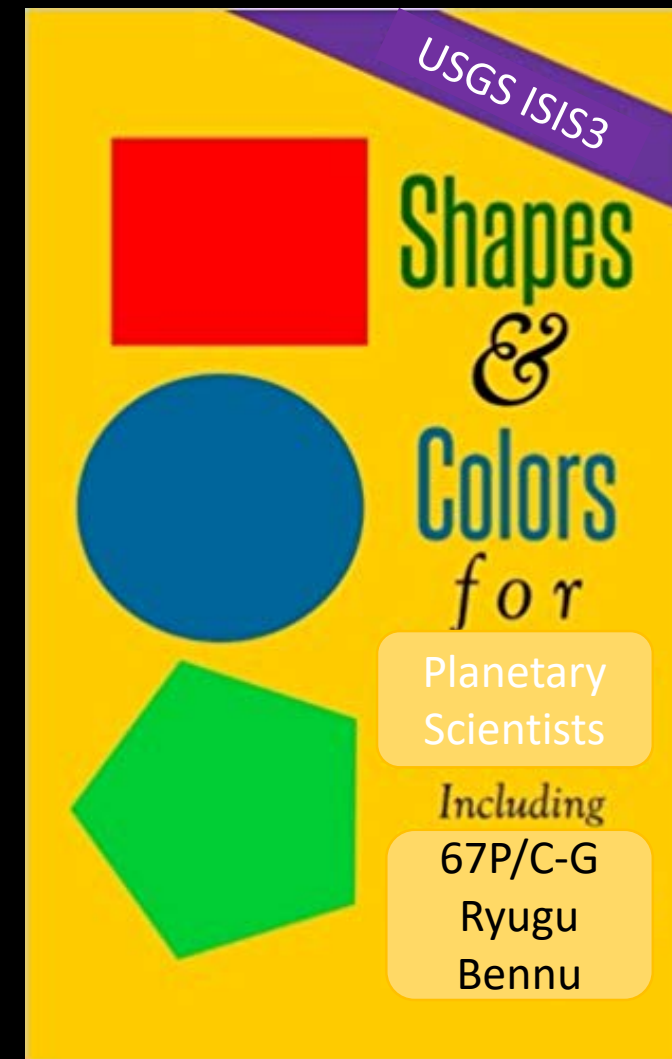
https://github.com/USGS-Astrogeology/ISIS3_mission_processing_scripts/tree/master/rosetta_scripts

Summary

- USGS Increasing our support for all three SBAG Goals
- Moving to OPEN SOURCE
 - GitHub
 - Road Map
- Improving Shape
 - Bullet Libraries – DSK Support
 - Bundle Adjust X Y Z
 - Enables Color



Credit: Mapel & Adoram-Kershner



Credit: Figure modified from <http://booklaunch.io/BooksByRichards/5483529605c86d8266502461>