A STRATEGY FOR MANAGING NASA’S LONG TAIL OF PLANETARY RESEARCH DATA

The Astrobiology and Habitable Environments Database (AHED) is a repository and productivity platform for the storage, discovery and analysis of data relevant to the field of astrobiology.

Astrobiologists often rely on a patchwork of diverse data types in their research. AHED is designed to accommodate data diversity and empower a broad user base using a powerful backend dataset publisher (Open Data Repository - ODR) coupled with an astrobiology specific front-end (AHED Portal) for guided dataset creation and search.
AHED Implications and Resources

• Although AHED focuses on astrobiology, the challenges the AHED project is addressing are non-unique. Long-tail research takes place in other planetary science disciplines and is an important part of the Planetary Data Ecosystem as a whole. Therefore, we think the strategies, tools, and overall framework developed for AHED have wider applications.

• To find out more about AHED you can access the Portal at: https://ahed.nasa.gov

• More information, including videos demonstrating the system, at: https://www.nasa.gov/ames/ahed

• More information about the ODR: https://www.opendatarepository.org/
Planetary data in the Virtual Observatory: **VESPA**
(Virtual European Solar & Planetary Access)

Stéphane Erard
Baptiste Cecconi
Pierre Le Sidaner
Angelo Pio Rossi
Carlos Brandt
Hanna Rothkhael
Lukasz Tomasik
Vincent Génot
Nicolas André
Pierre Fernique
Stavro Ivanovski
Marco Molinaro
Markus Demleitner
Mark Taylor

Observatoire de Paris (PADC)
Jacobs Univ, Bremen
CBK-PAN, Warsaw
IRAP/CNRS, Toulouse (CDPP)
CDS/CNRS, Strasbourg
OATS/INAF, Trieste
Heidelberg Univ
Bristol Univ

Bernard Schmitt
Ricardo Hueso
Anni Määttänen
Ehouarn Millour
Frédéric Schmidt
Chloé Azria
Manuel Scherf
Ann Carine Vandaele
Loïc Trompet
Mario d’Amore
Ingo Waldman
Nicolas Manaud
Igor Alexeev

IPAG, Grenoble
EHU/PVU, Bilbao
IPSL/CNRS (LATMOS), Paris
IPSL/CNRS (LMD), Paris
IPSL/CNRS (GEOPS), Paris
OeAW/IWF, Graz
IASB-BIRA, Brussels
DLR, Berlin
UCL, London
Spacefrog, Toulouse
SINP/MSU, Moscow

**PSIDA conference**
2 July 2021

stephane.erard@obspm.fr
VESPA: infrastructure

Maintenance functions

3 VESPA hubs (gitlab)

version control

VESPA-cloud

authentification

deployment

command line
Jupyter notebooks workflows...

on-line codes

OPUS

data services

registry (IVOA)

portal

SAMP

tools: VO, GIS...

EPN-TAP

EPN-TAP as API

VESPA: infrastructure
Take away ideas

• VESPA adapts the Virtual Observatory infrastructure to handle Solar System data
  Currently 56 data services open, 15 more in development
  Includes ESA’s PSA and large data centres in Europe

• The Virtual Observatory is flexible and mature - a set of standards and protocols to connect databases worldwide (managed by the IVOA consortium)
  => Contributive, interoperable, Open Science system, providing FAIR access to the data
  Efficient search system based on harvested registries

• The basic setup is light enough to allow contributions from small research teams, as well as space agencies

• Teams can also contribute with tools honoring the standards - including GIS, radio, experimental work...

• VESPA’s EPNcore vocabulary: provides a set of metadata in this field, based on thematic extensions — in review phase to become an IVOA Recommendation
Analysis Ready Data: Applying STAC to Planetary Images

Robin Fergason, Jason Laura, Marc Hunter, Trent Hare
U.S. Geological Survey Astrogeology Science Center, Flagstaff, Arizona
Planetary Data Workshop / PSIDA Meeting
July 2, 2021

Preliminary Information-Subject to Revision. Not for Citation or Distribution.
• Redundant efforts are spent processing planetary image data
  • Scientists spend a significant amount of time processing their own data. This was necessary in the past.
  • Data providers/portals also process and store their own data.

• The bar for planetary data use is high.
  • High level of expertise is assumed to process, calibrate, and geometrically project image data and for generating higher-order data products.
  • The burden is disproportionately felt by those new to a field or data set.

*How are these factors impacting our ability to increase knowledge and understanding?*
USGS Uncontrolled Kaguya Terrain Camera DTMs, Generated Using the NASA Ames Stereo Pipeline.

*Looked towards the terrestrial community to gain insight into methodologies*

- Provide Analysis Ready Data (ARD) in a format that is reliable, easy to discover, and straightforward to use.

*Selected the Spatio-Temporal Access Catalog (STAC) as a method to prototype.*

- Prototype #1: STAC Catalog of Cloud-Optimized GeoTIFFs in S3 bucket
- Prototype #2: Ingesting Cloud-Enabled Data into a GIS

*Responsive to recommendations from the Planetary Data Ecosystem IRB report.*
Initiating a lunar SDI (Planetary Spatial Data Infrastructure)

Trent Hare, USGS
and Mapping and Planetary Spatial Infrastructure Team (MAPSIT)
MAPSIT encourages the creation of a **PSDI for the Moon**, in collaboration with LEAG, LSIC, and other appropriate parties.

- With numerous lunar efforts from NASA, the commercial sector, and other space agencies underway, now is the ideal time to establish a lunar SDI that benefits all.
- Note the workload required to create a lunar SDI will be non-trivial; will likely have to proceed as a funded effort rather than staffed via volunteers on a best-effort basis.
Spatial data infrastructure (SDI) is the enabling collection of
(1) spatial data users,
(2) data interoperability agreements,
(3) policies and standards,
(4) data access mechanisms, and
(5) the spatial data themselves

To learn more about existing SDIs, you are encouraged to visit the
Artic SDI: https://arctic-sdi.org/

Rajabifard et al., 2002; Laura et al.,
2018 ESS; Laura and Beyer 2021 PSJ
The Io GIS Database, V. 1.0: A Proto-Io Planetary Spatial Data Infrastructure

David A. Williams¹, David M. Nelson¹, Moses P. Milazzo²

¹School of Earth and Space Exploration, Arizona State University, Tempe, AZ
(David.Williams@asu.edu)
²OtherOrb, LLC., Flagstaff, AZ

5th Planetary Data Workshop/PSIDA Meeting
July 2, 2021
Concept of Io GIS Database

- Build on existing Io GIS
  - *Galileo-Voyager* global mosaics (5) & ancillary products (Becker and Geissler, 2005) - **Foundational Data Products**
  - Global geologic map (Williams et al., 2011), including maps of all hot spots and mountain locations
- Add in other GIS-ready data products
  - *Voyager*-era map (Crown et al., 1992)
  - *Galileo* SSI medium-resolution mosaics (reproduced by M. Milazzo, OtherOrb LLC)
  - Regional geologic maps by Williams & colleagues
  - Stereo topography (White et al., 2014)
  - *Galileo* NIMS NITED database (A. Davies)
  - Post-*Galileo* Earth-based telescopic data & interior models
- Pre-PDS review copy of Arc project can be downloaded: [https://rpif.asu.edu/downloads/ PDART_Io_DB_GIS_data.zip](https://rpif.asu.edu/downloads/PDART_Io_DB_GIS_data.zip)

Modified from Laura et al. (2017)
Data & Methods

- **Build on existing GIS Io project from 2011 global geologic map**
- **Work with existing GIS data tools**
  - ArcGIS™
  - JMARS
- **Begin with a manageable subset of known Io data**
- **Use only peer-reviewed and published data**
- **Use USGS Galileo-Voyager mosaics as Foundational Data Products**, as recommended by Laura & Beyer (2021)
- **Want to add additional Io data in future versions**
- **Paper in press at Planet. Sci. Journal**

<table>
<thead>
<tr>
<th>Item Name</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Heat Flux based on Interior Models</td>
<td>Extracted from Figure 2.</td>
<td>Hamilton et al. (2013), Earth and Planetary Science Letters: <a href="https://doi.org/10.1016/j.epsl.2012.10.032">https://doi.org/10.1016/j.epsl.2012.10.032</a></td>
</tr>
<tr>
<td>2001-2016 Data Tables 3,4, A1, Figure 1</td>
<td>Cantrill et al. (2018), Icarus: <a href="https://doi.org/10.1016/j.icarus.2018.04.007">https://doi.org/10.1016/j.icarus.2018.04.007</a></td>
<td></td>
</tr>
<tr>
<td>2010 Data Figure 3</td>
<td>de Pater et al. (2014), Icarus: <a href="https://doi.org/10.1016/j.icarus.2013.06.019">https://doi.org/10.1016/j.icarus.2013.06.019</a></td>
<td></td>
</tr>
<tr>
<td>2001 Data Figure 3</td>
<td>Marchis et al. (2005), Icarus: <a href="https://doi.org/10.1016/j.icarus.2004.12.014">https://doi.org/10.1016/j.icarus.2004.12.014</a></td>
<td></td>
</tr>
<tr>
<td>Additional Data on Io’s Hot Spots:</td>
<td>Table S1. Hot spot data from Galileo Near Infrared Mapping Spectrometer (NIMS) observations</td>
<td>Veeder et al. (2015), Icarus: <a href="https://doi.org/10.1016/j.icarus.2014.07.028">https://doi.org/10.1016/j.icarus.2014.07.028</a> also SOM in: Davies et al. (2015), Icarus: <a href="https://doi.org/10.1016/j.icarus.2015.08.003">https://doi.org/10.1016/j.icarus.2015.08.003</a></td>
</tr>
<tr>
<td></td>
<td>Cullum-Tohill map</td>
<td>Williams et al. (2004), Icarus: <a href="https://doi.org/10.1016/j.icarus.2003.08.024">https://doi.org/10.1016/j.icarus.2003.08.024</a></td>
</tr>
<tr>
<td></td>
<td>Zamara-Thor map</td>
<td>Williams et al. (2005), Icarus: <a href="https://doi.org/10.1016/j.icarus.2005.03.005">https://doi.org/10.1016/j.icarus.2005.03.005</a></td>
</tr>
<tr>
<td></td>
<td>Amrani-Desh Bar map</td>
<td>Williams et al. (2007), Icarus: <a href="https://doi.org/10.1016/j.icarus.2006.08.023">https://doi.org/10.1016/j.icarus.2006.08.023</a></td>
</tr>
<tr>
<td>Mission Image Data</td>
<td>New Horizons LORRI mosaic</td>
<td>Extracted from Figure 1A</td>
</tr>
<tr>
<td></td>
<td>LEISA hotspot data</td>
<td>Table 2, Figure 10</td>
</tr>
<tr>
<td></td>
<td>Digital Elevation Model</td>
<td>Stereo photodocinetry, Figure 5A</td>
</tr>
<tr>
<td>Galileo regional mosaics</td>
<td>SSI Orbit I05 observations</td>
<td>I25ISEM0NG02, 146 m/pix</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I25SISGANT01, 166 m/pix</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I25SISCUAN01, 205 m/pix</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I25SISTERN_01, 259 m/pix</td>
</tr>
<tr>
<td></td>
<td>SSI Orbit I07 observations</td>
<td>I25STSTHL_01, 200 m/pix</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I25SICAMAOX01, 230 m/pix</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I25SISMBRANO101, 230 m/pix</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I25STVASHIO1, 450 m/pix</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I25SIZALTRMO1, 300 m/pix</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I25SISSHM01, 340 m/pix</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I25SISSSPOLE1, 520 m/pix</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I25STVASHIO1, 380 m/pix</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I25SISBBAR01, 340 m/pix</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I25SISALTRMO1, 340 m/pix</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I25SISBBAR01, 370 m/pix</td>
</tr>
</tbody>
</table>

**Gallileo-Voyager Mosaics**

1a) Image mosaics

- a) SSI only monochrome
- b) SSI only color
- c) SSI-VOY monochrome
- d) Merged SSI-VOY monochrome and SSI color


1b) Ancillary data maps

Maps of Emission angle, Incidence angle, Phase angle, & Spatial resolution for component images making up mosaics a-c in 1a (above)


**NOTES:** (1) Galileo SSI I24 observations were damaged by radiation exposure to the camera electronics, and were only partially recoverable. There were insufficient resources to include them in this project. (2) Cori Millazadeh thinks Io mosaics better than 200 m/pix would require too much time to tie to this database, so they are not included in this version of the Database.
The NEO Physical Properties database of the NEOROCKS EU project

A. Zinzi\textsuperscript{1,2}, M. Giardino\textsuperscript{1,2}, A. Giunta\textsuperscript{1,2}, E. Perozzi\textsuperscript{2}, A. Di Cecco\textsuperscript{2}, G. Polenta\textsuperscript{1,2}
and the NEOROCKS team

1) Space Science Data Center – ASI; 2) Agenzia Spaziale Italiana

angelo.zinzi@ssdc.asi.it
NEOROCKS will address the challenge of improving our knowledge on the physical characterization of the Near Earth Objects (NEOs) population and of the implications for their origin and evolution as well as for planetary defense. 

Horizon 2020
Grant Agreement No 870403

Call: SU-SPACE-23-SEC-2019

NEOROCKS - The NEO Rapid Observation, Characterization and Key Simulations

NEOROCKS will address the challenge of improving our knowledge on the physical characterization of the Near Earth Objects (NEOs) population and of the implications for their origin and evolution as well as for planetary defense.

NEOROCKS (or "My FAIR Planetary Defense")

The use of a well-defined and known standard, makes it possible to exploit functionalities of already existing tools.