SOFTWARE DEVELOPMENT CHANGES AT THE USGS ASTROGEOLOGY SCIENCE CENTER. J. R. Laura[1], R. L. Fergason[1], and the ASC Development Team[1] [1]U.S. Geological Survey, Astrogeology Science Center, Flagstaff, AZ (jlaura@usgs.gov);

Introduction: The Open Source Initiative (OSI) defines open source software as fulfilling the following criteria: (1) free distribution, (2) source code availability, (3) permission for the creation of derived works, (4) allowances for the integrity of the author's source code, (5) free from discrimination against persons or groups, (6) free from discrimination against fields of endeavor, (7) distribution of license, (8) license freedom that does not couple the license to a particular omnibus software distribution, (9) license from restriction on other software, and (10) license free from coupling to specific technologies [1]. The Astrogeology Science Center (ASC) is actively transitioning our software to a collaborative, open source model whereby we support and grow a community of open source contributors.

What is a contributor?: Coming from a domain external to the broad open source community can be challenging due to perceived or actual barriers to entry such as a relatively domain specific vocabulary ('jargon') or the myriad of different techniques and rapidly changing technologies used to support a collaborative, asynchronous community. For someone wishing to contribute to an open source project (i.e., a contributor) this barrier can appear large. First, a contributor is not defined as a person who submits code changes to a project. The definition is significantly more broad as the scope of activity to build and foster a successful open source community is broad. The open source guide [2] provides one enumeration of the tasks that support an open source community. These include: (1) organization of workshops, meetups, or events centered around some open source project, (2) community support to identify conferences where 'birds-of-a-feather' can meet to discuss a project, (3) creation, updates, and maintenance of the visuals used by a project such as webpage design, logos, etc., (4) improvements to a projects documentation, creation of examples, development of a newsletter, highlight reel or translation of documentation into another language, (5) copy editing and issue maintenance to help organize a project, (6) code reviews and code mentoring, (7) answering questions in discussion forums or issues, and (8) submitting code, improving testing, or improving tooling. Anyone, engaging in one or more of the above activities is an open source contributor and ASC is seeking to both build out our own open source presence and help bootstrap a planetary science open source community.

ASC Open Source Initiatives: ASC is actively transitioning our software development processes to an open source model and is seeking to build a community

around some of our software (e.g., ISIS). Herein, we describe proposed changes to better support an open source community.

ISIS: Several significant changes are planned for our flagship ISIS software that we believe will better support our user community and actively engage interested code contributors that have identified far too many barriers for code contribution in the past. These changes are in line with many of the findings from the MAPSIT Special Action Team Report on Cartography and Image Processing Software at the Astrogeology Science Center [3]. Changes include:

- Deployment of http://astrodiscuss.usgs.gov a discussion and question-and-answer forum for planetary software and science.
- The use of a Request-for-Comment (RFC) model for potential changes to ASC software. An RFC is a technical document that is presented to community about proposed changes to software governance, behavior, or capability for peer-review by the entire community. We publicize RFCs through the aforementioned discussion forum, the planetary exploration newsletter (PEN), and our GitHub organization. We intend that RFCs are well developed proposals that are ready for peer-review; the polish of an RFC should never discourage critical feedback. We also solicit external participation in the RFC process including submission of new RFCs for changes to our software. For more information, see: https://github.com/USGS-Astrogeology/ISIS3/wiki (Open RFCs / Archived RFCs).
- The adoption of semantic versioning [4] that serves to alert programmatic API consumers and application users when bug fixes, new features, and API (pipeline) breaking changes are introduced into the software. The adoption of semantic versioning means that the ISIS library and application suite will be incrementing the major version number in early 2020 to ISIS version 4.x.x. For more information, see: https://github.com/USGS-Astrogeology/ISIS3/wiki/RFC2:-Release-Process
- Acceptance (solicitation) of pull requests (PRs) to the software addressing issues, adding new community supporting capability, and contributing in any of the aforementioned ways (e.g., documentation updates, etc.).

- Adoption of a quarterly release cycle where a release candidate (RC) is labelled at the start of the month for internal and external testing. Issues identified during the RC month will be addressed (by either fixing the bug or removing the added capability that introduced said bug). At the conclusion of the RC month, a new version if ISIS (e.g., ISIS 3.8.0 or ISIS 4.1.0) will be released. For more information, see: https://github.com/USGS-Astrogeology/ISIS3/wiki/Release-Road-Map.

- Release of the ISIS software package using the cross platform Anaconda package management solution. We are deprecating the use of *rsync* for ISIS download and have switched to using Anaconda in order to significantly reduce the complexity for both developers and users working with ISIS. For more information, see: https://anaconda.org/usgs-astrogeology/isis3

- (Future) Transition of the ISIS data (test data and spice kernels) to a Git Large File Storage (LFS) solution. At the time of writing, we anticipate getting all ISIS related data under version control thereby making external development, use, and testing significantly easier.

- (Future) Publication of yearly software development roadmap for ASC software akin to the roadmaps used by other open source projects (e.g., Microsoft Code: https://github.com/Microsoft/vscode/wiki/Roadmap)

- (Future/Ongoing) Continue migration of ISIS testing to the GTest framework. This migration is supporting marked improvement in the overall quality of the ISIS tests resulting in less false positive test failures that require developer attention, a reduction in the overall test volume to support easier testing by internal and external contributors, and a means by which we can support a programmatic interface to the ISIS application layer.

Other ASC Software: As we transition our flagship software to an open source model, we are also identifying and life-cycling other ASC software that will adopt similar governance models. These projects include the Community Sensor Model (*usgscsm and swigcsm)*, the our Planetary I/O library (*plio)*, the Python Planetary Hyperspectral Analysis Toolkit (PyHAT), and the Automated Control Network generation tools (*autocnet).*

Technical Steering Committee (TSC): The ASC has bootstrapped a TSC (https://github.com/USGS-Astrogeology/TSC) using the Node.js Foundation model as a reference implementation with the goal of helping to build a planetary open source community. This effort seeks to exist outside and beyond ASC specifically and we hope that by the time of the Data Users Workshop conference, the above linked TSC documentation will live under an organization agnostic home. The goals of the TSC are two-fold. First, the TSC seeks to provide a location where planetary science community members know to seek out software solutions to problems that they may be facing. For example, if one wishes to make a basic data processing pipeline using python, the currently might visit the planetarypy organization to get the PVL library, a personal git page (AndrewAnnex) to get the spiceypy library, and then either the USGS-Astrogeology organization or another personal page (wtolson) to get the pysis library. The TSC seeks to support organization of the open source software solutions available to the planetary science community (external to any single organization, e.g., USGS, a NASA center, a university lab, etc.). Second, the TSC seeks to provide projects with an off-the-shelf governance model that includes a universal code of conduct, clearly defined project lifecycle documents, means to identify code contributors and maintainer roles, and a method for dispute resolution when consensus seeking may fail.

Future work: ASC will continue to seek to build and foster an open source planetary science software community both around our own software packages and within the broader community. We do not seek to be the clearinghouse through which software is collected and offered. Rather, we seek support bootstrapping a broader community without any singular institutional representation. Our goals writing this abstract are to alert the community to potential changes and to solicit contribution to **any** open source planetary science software project.

References: [1] https://opensource.org/osd
[2] https://opensource.guide/how-to-contribute/
[3] https://doi.org/10.5281/zenodo.2280984 [4] https://semver.org/