PROTOTYPE PLANETARY IMAGE CAPTION WRITER. L. P. Keszthelyi1, B. Kindrick[1,2], C. Frasier[2], Y. Zhu[2]. U.S. Geological Survey Astrogeology Science Center, 2255 N. Gemini Dr., Flagstaff, AZ 86001 (laz@usgs.gov); [2]School of Informatics, Computing, and Cyber Systems, Northern Arizona University, 1295 S. Knowles Dr., Flagstaff, AZ. 86011.

The Problem: The old adage "a picture is worth a thousand words" is very true in planetary science. Figures in peer-reviewed publications, professional presentations, and public releases are central in conveying information about geologic features across our solar system. The overwhelming majority of the image data from planetary surfaces in NASA's archives have been processed through the USGS's Integrated Software for Imagers and Spectrometers version 3 (ISIS3) [1]. The image labels of ISIS3 files are chock full of all kinds of essential geospatial information about the image – latitude and longitude, the elevation of the sun, the size of the pixels, which way is north, etc. – but there is no *convenient* way to extract this meta-information. The metadata can be extracted manually (e.g., using a binary editor on the ISIS3 file or running a series of ISIS3 applications) and then typed into a document. Annotations on images are manually constructed as custom additions created in other software packages such as Adobe Photoshop after the data has been exported from ISIS3. This process is so tedious that researchers never do this in a systematic and complete way. As a result, the rich metadata contained in ISIS3 cubes remains under-utilized ...therefore scientific publications often lack pieces of information that the reader needs to make full sense of what they are looking at in a published figure.

Functional Requirements: What is needed is a user-friendly "viewer tool" for interactively exploring ISIS3 images and converting subscenes into publication-ready figures and captions that contain the key metadata in a systematic and complete form. Specifically, the tool would allow users to load up one or more ISIS3 images, have the geospatial metadata for those images automatically extracted and/or calculated, allow the user to view and interact with the data, and export both the image and metadata in easily usable standardized formats. This will greatly facilitate clear and complete communication with technical and non-technical audiences.

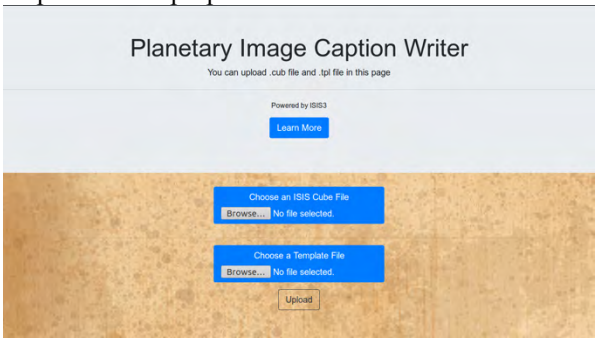
This problem is being addressed as a "capstone" project by undergraduate students from Northern Arizona University (NAU) [2]. At the start of the project, the requirements were divided into three levels which would translate to "threshold," "baseline," and "enhanced" deliverables in typical NASA language:

- Threshold: a software tool that opens and displays an ISIS3 image, while extracting geospatial information out of ISIS3 binary headers and:
  - adds standardized graphical symbols for certain geospatial information (e.g., a north arrow and scale bar) to the image;
  - calculates additional geospatial information for user defined subsection(s) of the file;
  - shows extracted metadata in nicely-formatted fashion. Should also be able to export extracted metadata into a plain text file in human-readable format;
  - adds geospatial annotations to the output image file, as specified by user;
  - provides a way to save off the resulting image for sharing/publication;
  - reliance on the user having ISIS3 installed (i.e., can use ISIS3 tools for some functions) is acceptable.
- Baseline: A tool that wraps the core capabilities outlined in the last bullet in an interactive WYSIWYG graphical interface. This allows users to view the image, interactively make modifications to image parameters, and view the resulting modifications in real-time.
- Enhanced: ISIS3 can only be installed on linux and MacOS machines, excluding users of Windows and mobile operating systems. The team will be asked to consider what it would take to make the tool run without having a full ISIS3 install on the users' computer. There are complex trade-offs in picking the most viable path to making this tool be able to stand alone, and the team will explore how this could be accomplished most easily.

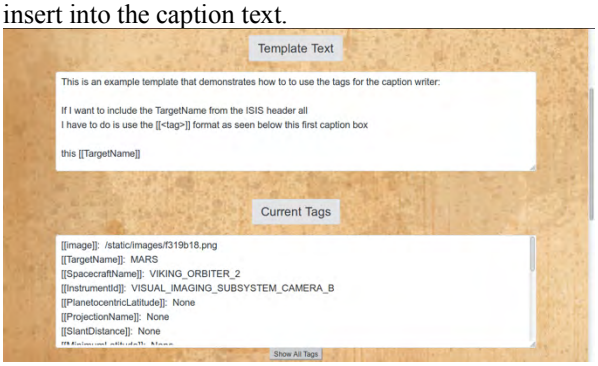
Progress! The team of software developers adopted the name "Orion" and have been appropriately successful at hunting down solutions to the problem they were handed. Their prototype design is a webapp that accepts any ISIS3 file (i.e., .cub format), displays the image, and provides multiple views of the relevant metadata.

In the following, we describe some of the steps a user will go through to produce an image and caption appropriate for inclusion in a scientific publication.

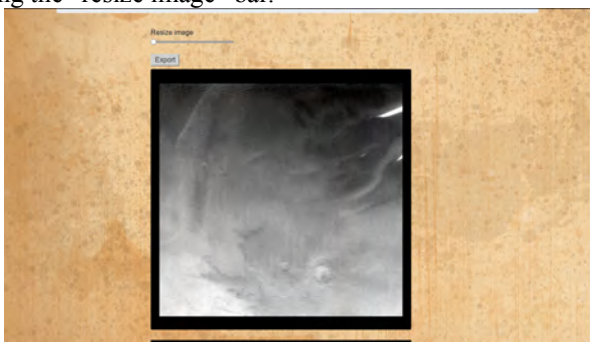
First, the user is prompted to upload an ISIS3 cube file, and if they wish, a template file to customize the output for their purposes.



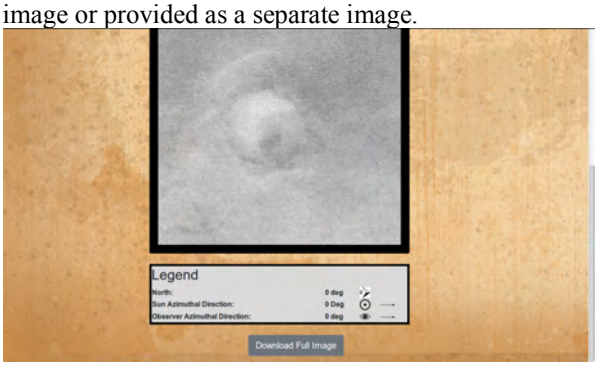
An example is provided to help users understand how the templates can be built as well as the full list of parameters that the user can have the tool search for and insert into the caption text.



The image is displayed and can be explored (pan and zoom). The ability to select and crop is currently achieved through zooming to a feature on the image, using the "resize image" bar.



At the bottom of the display is a legend that displays the north arrow. The indicators for the position of the observer (spacecraft) and sun are being added as of this writing and a scale for the brightness values is still to be implemented. The legend will be either appended to the image or provided as a separate image.



Next Steps: In the short term, the goal is to have the tool completed by the 4th Planetary Data Workshop where it should be possible to demonstrate it in use on a Windows OS laptop. Key work to complete include at least one default template for the caption text, finalizing the legend graphics, and outputting the image products.

In the medium term, our focus is on integrating the ability to crop subscenes using the ISIS crop application. There is a possibility that this work will uncover aspects of the ISIS3 *crop* application that need to be adjusted to properly propagate the geospatial information for the subscene.

On the longer term, our goal is to integrate this tool with online data discovery tools such as PILOT [3]. This would realize a vision where the user (scientist) seamlessly moves from data discovery, through data processing and analysis, and all the way to the creation of publication-ready figures in an intuitive and friendly online environment.

References: [1] https://isis.astrogeology.usgs.gov/ [2] https://nau.edu/school-of-informatics-computing-and-cyber-systems/capstone/. [2] https://pilot.wr.usgs.gov/