Mars Subsurface Water Ice Mapping (SWIM): The SWIM Equation and Project Infrastructure


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What is SWIM?
The Subsurface Water Ice Mapping (SWIM) in the Northern Hemisphere of Mars Project supports an effort by NASA’s Mars Exploration Program to determine in situ resource availability for future human missions. Using several techniques and instruments, we are performing global reconnaissance mapping as well as focused multi-dataset mapping from 0º to 60ºN. We present the project datasets and infrastructures as well as the SWIM Equation and the results of combining all datasets used in the current SWIM Northern Hemisphere study.

For results from the other datasets, see the other SWIM Project posters at this LPSC:
- Bramson et al. [1] (subsurface reflectors)
- Bain et al. [3] (surface reflectivity)
- Putzig et al. [4] (geomorphology)

As well as the talks by Morgan et al. [8] (overview) at 9:45 AM on Friday morning.

Final results will be presented at the next Human Landing Site Selection workshop. Our maps are being made available to the community on the SWIM Project website.

Follow us on Twitter for project news and product release information:
https://swim.psi.edu/ @RedPlanetSWIM

Extension Activities
- Add additional study regions
- In-depth analyses for regions of interest
- Incorporate ice-exposing impact locations to the SWIM Equation
- Advanced data analysis techniques. See other SWIM posters for data-set specific extension activities.

The SWIM Equation
We have developed the SWIM Equation, produced in the spirit of the famous Drake Equation [11] for conceptualizing the number of civilizations in our galaxy. In the case of the SWIM Equation, each of our terms is based on actual measurements and thus, we argue that the derived output is a tangible representation of the likelihood of shallow ice. We begin by defining for each dataset consistency values that range from -1 to +1, where -1 indicates that a given measurement is inconsistent with the presence of ice. In contrast, a +1 indicates that the measurement is consistent with the presence of ice. A value of 0 means the data is inconclusive.

The SWIM Equation
\[ C_s = \frac{C_N + C_I + C_G + C_R + C_DRD}{5} \]

To search for and assess the presence of shallow ice across our study regions, we are integrating multiple datasets to provide a holistic view of the upper 10s of meters of the Martian subsurface.

Right: Various depth resolutions of the data sets and surface features used in the SWIM project to search for ice within the Martian subsurface.

The SWIM Equation

<table>
<thead>
<tr>
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<th>Data Sets</th>
<th>Sensing Depth (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C_N</td>
<td>All</td>
<td>&lt; 5 and &gt; 5</td>
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<tr>
<td>C_I</td>
<td>Neutron-detected WEH (Water-equivalent hydrogen)</td>
<td>&lt; 1</td>
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<tr>
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<td>Ice-related geomorphology</td>
<td>All</td>
</tr>
<tr>
<td>C_RS</td>
<td>Radar surface returns with ice-like low power</td>
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<tr>
<td>C_RD</td>
<td>Radar subsurface dielectric constant estimates</td>
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Above: Explanation of SWIM Equation Terms and Sensing Depths

Data Sets and Techniques

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Results & Products

- Neutron-detected hydrogen in the form of ice consistency map adapted from Pathare et al. [13] Figure 11b. Description of the data on the panel to the right.

- Thermal (TES + THEMIS) Analysis Ice Consistency Map. Please visit Hoover et al. Poster #524 for an in-depth explanation of the data analysis and how this map was created.

- Geomorphology Analysis Ice Consistency Map. Please visit Putzig et al. (Poster #521) for a complete description of the data analysis and how this map was created.

- Radar Surface Power Return Analysis Ice Consistency Map. Please visit Bain et al. (Poster #522) for a complete description of how this map was developed.

- Radar Surface Dielectric Analysis Ice Consistency Map. Please visit Bramson et al. (Poster #520) for a complete explanation of the data analysis and how this map was created.

REFERENCES: