HiRISE and MSL Candidate Landing Sites

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1. HiRISE image data characteristics
2. What HiRISE can do for you
3. What HiRISE can do to you
4. Safe-haven landing sites

Ancient bedrock in Uzboi Valles, PSP_3499_1520
HiRISE “Pushbroom” Imaging

• S/C orbital motion (Nadir) “pushes” sensor projection across ground

• Line integration timing is identically matched to orbital ground speed (~3.2 km/s or 19,200 mph!)

• 25-32 cm/pixel

• Sensor (linear array of pixels) integrates during motion of single pixel: ~0.0001 second!
HiRISE at Mars: October 2007

- ~3800 Mars images returned
- ~9 Tb of data, 2900 Giga-pixels
  - Covers <0.3% of Martian surface
- ~390 stereo pairs completed
- Prints in this room show < 0.01% of the HiRISE data
HiRISE Characteristics at 300 km altitude

<table>
<thead>
<tr>
<th>Ground Sampling Dimension</th>
<th>30 cm/pixel</th>
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</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>~90 cm (3 pixels across object)</td>
</tr>
<tr>
<td>Swath width (Red)</td>
<td>6 km</td>
</tr>
<tr>
<td>Color swath width</td>
<td>1.2 km</td>
</tr>
<tr>
<td>Maximum image size</td>
<td>20K x 120K pixels</td>
</tr>
<tr>
<td>Signal:Noise Ratio</td>
<td>&gt;100:1</td>
</tr>
<tr>
<td>Color Bandpasses</td>
<td>Red: 550-850 nm, Bl-Gr: 400-600 nm, NIR: 800-1000 nm</td>
</tr>
<tr>
<td>Stereo topographic precision</td>
<td>~20 cm vertical over 1 m² areas</td>
</tr>
</tbody>
</table>

Terra Sirenum, chloride?
PSP_5680_1525, IRB color
HiRISE PDS Products

- EDRs--raw data, 28 channels per image
- RDRs - Reduced Data Records
  - Radiometrically calibrated to I/F
  - Geometrically reprojected and rectified via smoothed MOLA (do not use for stereo)
  - Grayscale (full swath width) and color
  - Eventually:
    - stereo pairs with precision geometric corrections but no reprojection
    - ~20 Digital Elevation Models (DEM)
- Extras - reduced scale or slightly lossy JPEG2000 compression
  - Browse jpegs (2048 pixels wide)
  - Lossy JPEG2000 version of RDRs
  - NOMAP products--CCDs stitched together but raw geometry
    - Grayscale and IRB and RGB color
- Note that weekly sets of captioned image releases are full PDS releases.
HiRISE Color Notes

• IRB = Infrared, Red, Blue-Green
• RGB = Red, Blue-Green, synthetic blue
• PDS color RDR given one min-max stretch for all 3 color bands
  – Consistent color from image to image
• Extras: Each channel is given an independent min-max stretch
  – Enhancement depends on scene.
Stereo Data Acquisition

- Acquire ~1000 stereo pairs in 2 years
- Digital Elevation Model (DEM) resolution ~1 m
- Require $\theta_1 + \theta_2 > 15^\circ$ for 0.2 m vertical precision

Left: DEM of part of Columbia Hills (Kirk et al., submitted.)
HiRISE Stereo Notes

- Anaglyphs appear vertically exaggerated to varying degrees
  - Look for angle-of-repose slopes (30-35º) for qualitative interpretations
- HiRISE team produces DEMs for science only, not landing site characterization.
  - CPD funds landing site work
- Do not use HiRISE RDRs for DEM production or stereo viewing
  - They have been orthorectified via a smoothed MOLA dataset for better correlation with other map products like CRISM and THEMIS.
VL-1 Lander and Backshell
VL-2 Lander
Pathfinder Landing Site in Ares Valles
Search for Mars Polar Lander
Nili Fossae Trough
Green = low-Ca pyroxene
Blue+magenta = smectite-bearing clays
Subsurface stratigraphy exposed in Ritchey Crater central uplift

THEMIS-HiRISE Coanalysis
SW Candor Chasm

View to the southeast
No vertical exaggeration
Happy Halloween!

Prediction: HiRISE DEMs will be the grim reaper of candidate MSL landing sites.

Oblique view of a portion of Mojave crater
How to find safe-haven landing site candidates:

High-contrast THEMIS night-IR almost always corresponds to terrain that is rough at the scale of meters.
Candidate Safe Haven Landing Site

Bland THEMIS nighttime IR is no guarantee that the surface will be smooth at the scale of meters.
Bakhuysen Crater Safe Haven Candidate

Edge of alluvial fan (Moore and Howard, 2005)
Bakhuysen fan

Mostly infilled by eolian sediments so it’s safe to land here, but there are outcrops of light-toned materials, probably phyllosilicates (TBD CRISM)