HiRISE Anaglyphs

The HiRISE team has placed a major emphasis on stereo imaging needed to make small-scale topographic measurements, essential both to characterization of candidate landing sites and to the quantitative study of surface processes. During the first two years of operations ending November 2008, nearly 1000 stereo pairs have been acquired. Anaglyphs (http://en.wikipedia.org/wiki/Anaglyph_image) can be produced from these stereo observations.

A stereo color-anaglyph processing pipeline for latitudes 80 S to 80 N was completed in October 2008. MRO rolls off nadir in the direction across the orbit track and thus parallax is revealed in the cross-track direction. Our eyes are spaced horizontally, thus an anaglyph should be generated so that parallax remains in the horizontal direction. This means that a HiRISE anaglyph should be constructed so that the vertical edge of an image remains vertical. Because observations from stereo pairs differ in roll angle, the overall cross-orbit scaling differences need to be taken into account or the two images will not register in the anaglyph.

Our solution to these constraints is to generate products using a map projection that will allow rotation so that the vertical edge of the raw observation remains vertical in the map-projected image. The Polar Stereographic projection was selected because the ISIS routine for this projection makes it easy to rotate the images properly.

A standard longitude of projection is selected so that the vertical edge (of one of the images) remains vertical in the projected image. North is about 7 degrees to the right of up. Products are scaled to 25 cm/pixel if they contain any CCDs acquired at full resolution, or 50 cm/pixel if all CCDs were binned 2x2, and 100 cm/pixel for bin 4x4 imaging. These map projections do not use the full MOLA DTM – we don't want to orthorectify (remove terrain distortions) because that is the information anaglyphs are supposed to capture. Instead the planet is considered to be a sphere but using the local planet radius, in order to get good image registration.

The planet radius at the image center is extracted from the smoothed MOLA DTM. Uncertainties in the spacecraft pointing and ephemerides nevertheless can cause misregistration in some stereo pairs, so we use the ISIS "coreg" program on greatly reduced-scale images to shift one of the images to a better match. Anaglyphs with high relief and large stereo convergence angles can be difficult or impossible to view at full resolution unless sub-scenes are extracted or displayed and then the red (left eye) image is translated to better match the green and blue images. Note that the anaglyphs have variable degrees of vertical exaggeration, increasing with larger convergence angles. One qualitative calibration is to look for angle-of-repose slopes for dry, cohesionless materials, which should be ~35°.