PTYS 442/542 – Mars
Homework #1 – Assigned 2/1, due 2/13

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1) HiReport is a online tool that will allow you to view HiRISE images of the martian surface. For this question, you'll open up HiReport and provide some comments about 2 previous suggestions for which HiRISE images have been acquired. First go to:

http://hireport.lpl.arizona.edu/hireport/hi

username: MarsClass
password: MarsClass2015

Scoll down the page a little to where you see '**Bookmarklets'** and click on '**Last 10 Days'**. This will open up a table of observations recently acquired on Mars.

Pick 2 images from the list and click on their **'OBSERVATION ID'** to bring up a page on that image (choose something where the STATUS says COMPLETE). You should click through several images until you find one that looks interesting. On the right of the image page is thumbnail version of the image, in the drop down box above the image change the image selection to RED. You can click on the thumbnail to bring up a browse image (still not full resolution).

Based on your examination of the image as well as the title and science rationale on the image page write a short paragraph about what you see for each of the images you chose. What would you interpret to have happened in this location on Mars? Does is agree with what was expected in the science rationale? The context map on the left of the image page shows the HiRISE image location and can also help interpret what you're seeing.

This is hard to do at first so don't worry too much about getting the interpretations of what's in the image correct, but do worry about accurately describing what you see. We'll repeat this exercise in every homework set – I guarantee you'll see a big increase in how sophisticated and accurate your interpretations get as the course moves forward.

You need only look at monochrome browse images for this homework (I'll show you in class how to go beyond this though). In future homework, we'll expand this to color products, full resolution data and 3D anaglyphs.

2) Here we'll think a little about insolation conditions on the martian surface. It will help to sketch cross-sections of Mars to figure out the geometry and consult the lecture slides for the description of where the sub-solar latitude is at different seasons.

Let's say it's summer solstice (L_s 90) at the north pole of Mars.

- How many degrees above the horizon is the Sun?

- What range of seasons (in degrees of L_s) is it daylight for?
- How steep would a slope have to be here for the Sun to be shining directly on it (i.e. if you were lying on that slope the Sun would appear to be directly overhead)

At the Equator:

- What L_s is it when the sun directly overhead (there are two answers)?
- If a 25° slope there points South, then what season does the sunlight most directly shine on it?

There are streaks that grow incrementally on slopes in Eastern Coprates Chasma in Valles Marineris at a latitude of 15° South that we call Recurring Slope Linae (RSL). In this location, they are on north-facing slopes of approximately 40°. We suspect these streaks are formed by liquid water.

- In what season do these slopes have the most direct insolation?
- The RSL are actively elongating during L_s 50-196, does this agree with your calculation?
- Either way, what other factor controls the insolation?

It's currently about L_s 280 on Mars.

- What is the subsolar latitude on Mars now?
- What does this mean for picking your HiRISE targets? What parts of the planet are off limits?

3) Thermal behavior of martian surface materials. Thermal inertia differences are mostly driven by thermal conductivity differences as the product of density and heat capacity remains nearly constant (about 10^6 J m^{-3}). From the info and formula in the lecture notes,

Find the thermal conductivity of typical martian dust.
Look up the thermal conductivity of Styrofoam online and compare it to this. If a dusty surface gets hot during the day then would it also be warm below the surface?

Temperature changes generally penetrate into the surface to a depth called the thermal skin depth. This depth depends on both the timescale of the temperature changes and the thermal inertia of the material.

- What are typical thermal skin depths of dust and rock (basalt) for daily temperature variations? Remember a day on Mars, one sol, is about 24.5 hours.
- What are these depths for the temperature variations over the entire year (668 sols)?
- Based on this, if you had to bury astronaut accommodations on Mars to keep temperatures stable then would you prefer to use dust or rock?