Hydrologic environments on Mars using GIS and topography data: An exercise in stream networks and drainage basins

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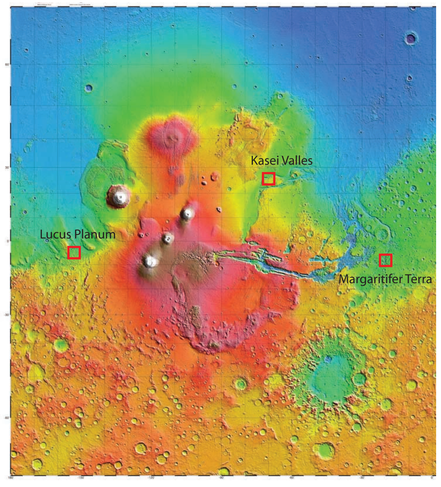
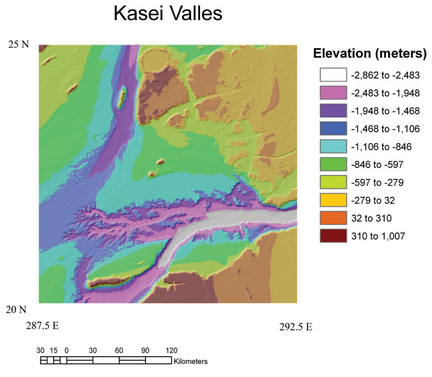
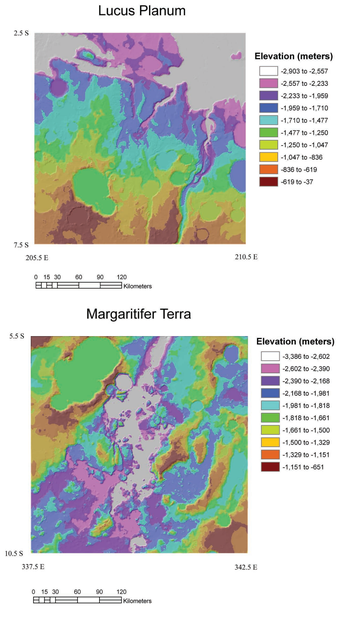






Mars Hydrology Lab

Kasei Valles, Lucus Planum and Margaritifer Terra all show evidence for surface water flow. Examine these areas in the context of stream development and basin shape. Students should discuss whether their results show evidence for a global hydrologic model and how the individual areas examined differ.

Before the Lab

Terminology: Stream, Drainage Basin, Confluence, Headwater, Source, Mouth, Meander, Oxbow, Watershed

Strahler Stream Ordering: Do a sample exercise so students understand how stream order is determined

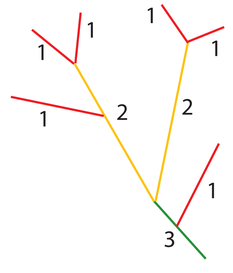
Developed vs Undeveloped Hydrologic Environments

Developed: Highly ordered streams, Basin boundaries mimic stream organization / development

Undeveloped: Lower order streams, Basin boundaries determined by pre-existing topography

Mars Global Hydrology: Discuss evidence for water, global hydrologic system.

Strahler Stream Order (1952)



Instructions

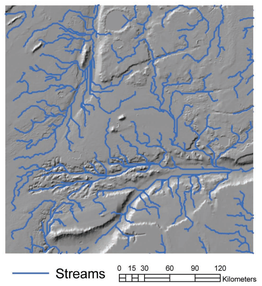
Streams:

* Map streams using topography data
* Order streams using the Strahler Method
* Calculate stream lengths (and % of total area)

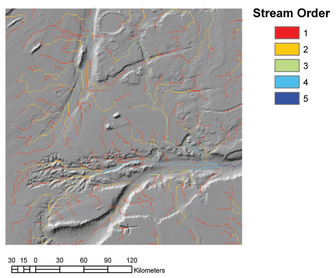
Basins:

* Find drainage divides
* Calculate basin area (and % of total area)
* Calculate drainage density

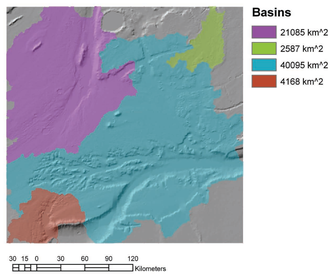
Kasei Valles



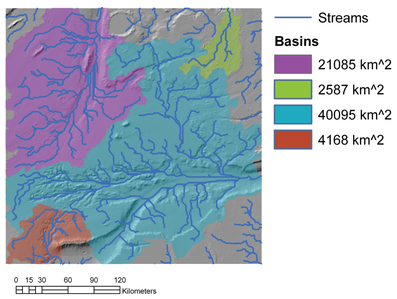
Kasei Valles



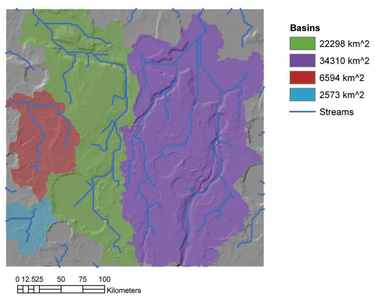
Kasei Valles



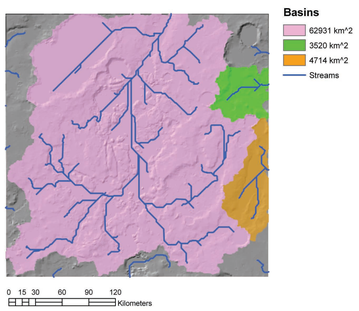
Kasei Valles



Lucus Planum



Margaritifer Terra



Questions

Local Hydrologic Environment (answer for each grid)

1. Which is the major direction of flow for this grid?
2. What % of the grid is covered by basins? by streams?
3. What is the highest stream order found?
4. Does the basin shape reflect topography or stream networks?
5. What is the drainage density for this grid?
6. From 3 and 4, would you say that this area has a highly or poorly developed stream network?
7. Suggest a comparable hydrologic environment on Earth.

Global Hydrology (using all grids)

1. Where would most water on Mars drain toward?
2. Do these systems connect?
3. Can you suggest a global history of surface flow for Mars based on these three different hydrologic environments?

Resources

On the internet:

Arwen Vidal's website
http://ucsub.colorado.edu/~vidala/mars/gis
MOLA data
http://pds-geosciences.wustl.edu/missions/mgs/megdr.html
USGS Planetary GIS Help
http://isis.astrogeology.usgs.gov/IsisSupport
Terrestrial Geomorphic Analysis
http://publish.uwo.ca/~icreed/Files

In print:

(1) Ancient geodynamics and global-scale hydrology on Mars. Phillips, R.J. et al., Science, vol. 291, no. 5513, pp. 2587-2591, 2001.
(2) Surface drainage on Mars. Banerdt, W.B. and A. Vidal, Abstracts of the LPSC, vol.32, abstr. no. 1488, 2001.
(3) Hypsometric analysis of Margaritifer Sinus and origin of valley networks. Lou, W., Journal of Geophysical Research, E, Planets, vol.107, no.10, Oct 2002.
(4) GIS modeling and analysis of branching valley network distribution on Mars. Baker, L. and K.F. Sprenke, Abstracts with Programs - Geological Society of America, vol.35, no.6, pp.21, Nov 2003.
(5) Drainage basins and channel incision on Mars. Ahranson, O. et al., PNAS, vol. 99, no. 4, 1780-1783, Feb 2002.
(6) Dynamic basis of geomorphology. Strahler, A. N., Geological Society of America Bulletin, 63, 923-938, 1952.

Comments