

Locating new areas favourable for Recurring Slope Lineae formation in the northern hemisphere on Mars using GIS and the Mars Climate Database

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1. Introduction

Recurring Slope Lineae (RSL) are low-albedo markings found on slopes with a steepness of 25°-45°. Their width is between 0.5-5 m but they can become hundreds of meters long. They grow incrementally during warm seasons; fade during cold seasons and appear again the following martian year [1-2]. They occur mainly in the equatorial and southern mid-latitudes and appear less abundant in the northern hemisphere. After the first confirmed observations of RSL, research about them accelerated quickly. This is primarily due to their possible association with liquid water flows at the modern-day martian surface. The main scope of this study is to find new RSL candidate sites in the less investigated northern hemisphere with the use of an ArcGIS model and Mars Global Climate data base simulations. Furthermore, we explore whether potential candidate sites are likely wet- or dry flows, or a combination of both.

2. Data and Methods

In order to work with the available data sets several types of software's were used. The Mars Climate Database (MCD) was used in order to get temperature data for an analytic model in the first part of the study (Fig. 1). MCD provided "average max mean daily temperature" for the model at specific parameters found in literature. It was possible to retrieve information from MCD for parameters used in the third phase of the project (assessing wet- or dry flows) [3-4]. The near surface parameter was set to 2 meter above the surface. Most of the HiRISE images used in the study are taken in the afternoon by the instrument, which leads to a local time of Martian hour 15. The solar longitude was set to be during the summer season (110 Ls) in order to meet the utmost conditions for RSL. Data set coordinates were all set to match the extent of the study area [3-4].

Data processing for the first phase and image analysis were done in the Geographical Information System (GIS) ArcMap. All data coordinates from MCD used the "Inverse Distance Weighted" (IDW) Interpolation spatial analyst tool to display data on the GIS maps. The interpolation tool interprets values closer to each other to be similar than those further away. To obtain a value in an area where there is none, the tool uses measured values in close proximity to the unmeasured area to get a good prediction of a potential value. Values closer to an unmeasured site have a higher impact on the result than values further away. Distances to values are very important in this interpolation tool [5-6].

3. Results

By using an ArcMap GIS model, data from the High Resolution Imaging Science Experiment (HiRISE) instrument and parameters based on previous literature, 408 optimal sites for RSL were found with 29 of those being classified as new potential candidate RSL sites (Fig. 2).

4. Summary and conclusions

Analyses of candidate sites with modelled surface temperature, grain-size approximations, modelled water vapor and parameters derived from previous studies suggests that a combination of wet flows and dry flows may be responsible for the creation of RSL.

The reason for the scarcity in the northern region is due to less favorable RSL forming areas (less available slopes), poorer HiRISE coverage of existing topography and less favorable temperatures.

In our model we have identified 29 sites that fulfill the RSL criteria thus warranting more HiRISE images to be able to confirm the presence of RSL.

References

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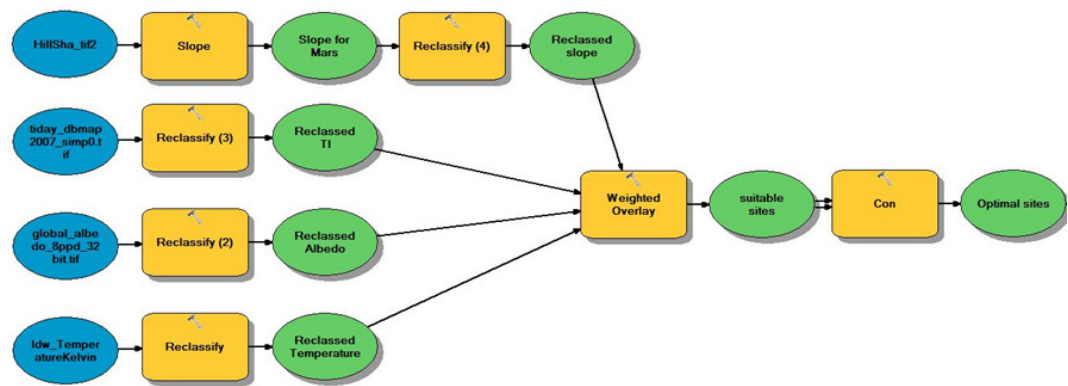


Figure 1: Flow chart for the model in the GIS software ArcMap. From top to bottom in the blue ellipses are the slope data, Thermal inertia, Albedo and Temperature data. All were reclassified and run in a weighted overlay. A condition value was set in order to find the most optimal sites from the suitable sites.

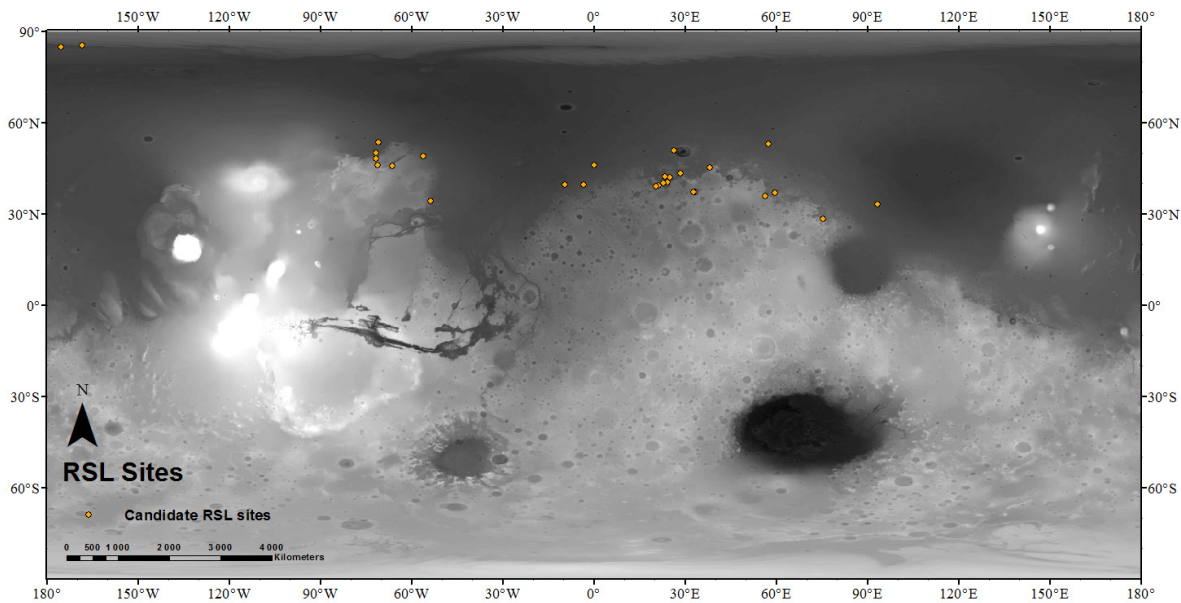


Figure 2: The location of all 29 new potential candidate RSL sites distributed on the northern hemisphere (yellow dots).