Mock abstract:

Geologically recent, originally ice-rich, surface deposits on Mars have been observed down to latitudes of 30°. Their properties are latitudinally dependent, suggesting a link between their formation and climate. They may have formed in recent ice ages when water ice and dust was redistributed around Mars due to changes in its spin axis and orbit. Understanding these deposits could therefore be vital to a better understanding of the processes guiding martian climate history. However, previous work using global climate models (GCMs) has not been able to fully explain this latitude dependent mantle (LDM). We propose to run cutting-edge simulations, using a refined GCM that includes important overlooked processes, to understand their impact on martian climate history and the formation of the LDM. We will implement cloud microphysics, including the nucleation and growth of water ice onto dust particles, as well as radiatively active clouds (RACs), which will depend on the water ice particle size. By varying the obliquity between 15° and 35°, as it has ranged in the past 5 million years, we will examine how climate and ice distribution have varied over time. These simulations will revolutionize our understanding of Mars’ recent climate history and how ice may be accumulated and preserved on the surface of Mars to form features such as the LDM. These refinements to global climate modeling are also vital to better understand the processes driving climate changes and water distribution on Mars throughout its history.

Link to paper: ﻿http://doi.wiley.com/10.1002/2014GL059861

Original abstract: ﻿

Global climate models (GCMs) have been successfully employed to explain the origin of many glacial deposits on Mars. However, the latitude-dependent mantle (LDM), a dust-ice mantling deposit that is thought to represent a recent “Ice Age,” remains poorly explained by GCMs. We reexamine this question by considering the effect of radiatively active water-ice clouds (RACs) and cloud microphysics. We find that when obliquity is set to 35◦, as often occurred in the past 2 million years, warming of the atmosphere and polar caps by clouds modifies the water cycle and leads to the formation of a several centimeter-thick ice mantle poleward of 30◦ in each hemisphere during winter. This mantle can be preserved over the summer if increased atmospheric dust content obscures the surface and provides dust nuclei to low-altitude clouds. We outline a scenario for its deposition and preservation that compares favorably with the characteristics of the LDM.