

Thermodynamic Stability of Liquid Water on Present-Day Mars: Surface Retrievals from the Mars Climate Sounder

Paul O. Hayne, John T. Schofield, Armin Kleinböhl, David A. Kass, and Daniel J. McCleese

Jet Propulsion Laboratory, California Institute of Technology

Abstract: Summertime surface temperatures and pressures at low latitudes on Mars are known to rise well above the triple point of water, allowing the possibility of transient fluvial activity under present conditions. Evidence for such activity includes gullies and recurring slope lineae (RSL), which form preferentially on equator-facing slopes at mid-latitudes. Equatorial temperatures are high enough that the near surface is likely desiccated, whereas models suggest the mid-latitudes may harbor icy brines responsible for RSL. Due to the sparse data available, studies of liquid water stability typically rely on thermal model calculations, rather than actual measurements. Here, we present surface temperatures and pressures retrieved from Mars Climate Sounder (MCS) data, which show the locations and seasons where liquid water is expected to be thermodynamically stable on the surface of Mars. These extensive observations cover all seasons and latitudes, with a typical spatial resolution of a few kilometers. Although gullies and RSL occur in regions of seasonal liquid water stability, they are clearly not correlated with the warmest temperatures at any latitude. These results suggest that present day fluvial activity on Mars may be associated with discharge from aquifers supplied during seasonal or inter-annual climate cycles, rather than ubiquitous ground ice.