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Beyond the equilibrium paradigm – Evidence for near surface ground ice deposits in the equatorial regions of Mars

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Since January 2004 the High Resolution Stereo Camera (HRSC) on MarsExpress reports mounting evidence for very recent glacial activity in the equatorial regions of Mars. At the same time the Planetary Fourier Spectrometer (PFS) reports localized enhancements in the near surface atmospheric water abundance. Under the assumption that Mars in not in an equilibrium state we will discuss scenarios which can explain these observations based on the assumption of longtime stable equatorial ice deposits.

Over the recent years we have developed the Berlin Mars near Surface Thermal model (BMST) to address this question [1]. Most models used up to now assume a thermophysical steady state for the Martian soil. Under such conditions ice could not be stable close to the surface in equatorial regions. There are observational evidences showing at least two climatic cycles on Mars. There is a long term cycle in the order of 5-10 Mio. years as shown by evidence of glaciation in equatorial regions [2] and a medium term cycle in the order of 100-300ka as shown for example by the layering in the polar caps. [3]

As examples we have studied two areas in the equatorial region of Mars, Terra Arabia and the flanks of Hecates Tholus. For Terra Arabia the SWC channel of the PFS instrument on MarsExpress has detected an enhancement in the atmospheric water vapor content close to the surface [4]. Interestingly this is one of the equatorial areas in which the Gamma and Neutron spectrometer (GRS/HEND) on Mars Odyssey reports increased water content in the soil. An analysis of data obtained by the HRSC camera on the flank of Hecates Tholus revealed morphological evidence for the existence of glacial deposits [5]. Their ages derived from crater counts are about 5 to 24 million years.

References

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