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# MAIC-2, a Latitudinal Model for the Martian Surface Temperature, Atmospheric Water Transport and Surface Glaciation

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The Mars Atmosphere-Ice Coupler MAIC-2 is a simple, latitudinal model, which consists of a set of parameterisations for the surface temperature, the atmospheric water transport and the surface mass balance (condensation minus evaporation) of water ice. It is driven directly by the orbital parameters obliquity, eccentricity and solar longitude (Ls) of perihelion. Surface temperature is described by the Local Insolation Temperature (LIT) scheme, which uses a daily and latitude-dependent radiation balance, includes a treatment of the seasonal CO2 cap, and has been validated against the surface temperatures from the Mars Climate Database (Lewis et al. 1999; J. Geophys. Res. 104, 24177-24194). The evaporation rate of water is calculated by an expression for free convection, driven by density differences between water vapor and ambient air (Ingersoll 1970; Science 168, 972-973), the condensation rate follows from the assumption that any water vapour which exceeds the local saturation pressure condenses instantly, and atmospheric transport of water vapour is approximated by instantaneous mixing. Glacial flow of ice deposits is neglected. Simulations with constant orbital parameters show that low obliquities favour deposition of ice in high latitudes and vice versa. A transient scenario driven by a computed history of orbital parameters over the last 10 million years (Laskar et al. 2004; Icarus 170, 343-364) produces essentially monotonically growing polar ice deposits during the most recent 4 million years, and a very good agreement with the observed present-day polar layered deposits. The thick polar deposits sometimes continue in thin ice deposits which extend far into the mid latitudes, which confirms the idea of "ice ages" at high obliquity (Head et al. 2003; Nature 426, 797-802).

Keywords: Mars, Planetary ice, Obliquity, Ice cap, Polar layered deposits, Ice age