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Investigation of water vapor exchange on Mars:Implication from variations of surface properties at Arabia Terra

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The characteristic of Martian climate system is famous for its unstable nature. The exchange of carbon dioxide between the regolith and the atmosphere occurs actively. The main reservoir is polar caps, but regolith layer is also considered as a potential reservoir. Water is another important component of the atmosphere, which is quite minor but believed to circulate with seasons. Recently, PFS/LW aboard Mars Express observed spatial and temporal variations of water vapor in the atmosphere. The geographical distribution shows two local maxima. They are the regions of over Arabia Terra and Tharsis. After estimation of horizontal transportation from polar caps by GCM, Fouchet et al. (2007) suggest the exchange of water occurs between the atmosphere and the regolith at Arabia Terra.
Although the atmosphere-regolith exchange has been argued for a long time, this is still unresolved problem. Arabia Terra is located in northern low-mid latitude, which has low thermal inertia and high albedo. They mean the surface is covered by thick dust. GRS aboard Mars Odyssey reports high concentration of hydrogen in Arabia Terra.
We investigated seasonal variation of the surface temperature at the target area in Arabia Terra using THEMIS IR and TES images. To compare this we selected a reference area at same latitude outside of high vapor concentration area. At the target area midday temperature is higher by 5-10 K than the reference area and nighttime temperature is lower by 10-20K than the reference area, which mean the target area has large diurnal variation of the surface temperature. This is consistent with the properties such as high albedo and low thermal inertia. High temperature at midday would promote sublimation of ice contained in regolith layer, and low temperature at night would promote deposition into the regolith. We considered repetition of sublimation/deposition would induce local maxima of water vapor in the atmosphere. The key factor of the scenario is variable response of thermal inertia to the sublimation/deposition of water ice. Since ice condenses preferentially grain-contact area, even minor amount of water increases thermal conductivity of regolith. Putzig and Mellon (2007) report unresolved variation of thermal inertia at Arabia Terra, which supports our scenario.
We will discuss the possibility of water exchange between the atmosphere and the regolith from characteristics of variation of surface properties at Arabia Terra.

Keywords: Mars, Arabia Terra, water vapor exchange, thermal inertia