Martian lower atmosphere: Current views and future directions

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There have been a variety of measurements and model development of the Martian atmosphere in the last few years. In this talk I shall focus on the Martian lower atmosphere, where the science is dictated by the coupling of physical, chemical, radiative and dynamical processes. In particular, I will talk about two particular aspects: (i) the odd oxygen dominated photochemistry and (ii) the dust cycle and its impact on the atmosphere.

Though the photochemistry of Mars is comparatively simple, the orbital properties of Mars and its exposure to solar influx lead to pronounced seasonal and latitudinal variations of short lived species (trace gases). In a recent analysis of SPICAM observations in the UV, we have studied spatio-temporal variability of ozone and found that it is anti-correlated with water vapour [1]. With the help of a photochemistry coupled GCM, we study in detail the important source and sink processes of odd oxygen (ozone and oxygen atoms), to identify different regimes based on locations and seasons [2].

Dust in the Martian atmosphere not only affects the radiation budget, but also the gaseous constituents. We have shown that dust storms can severely affect the D-region ionosphere of Mars [3]. On the other hand, we are currently studying the role of heterogeneous chemistry on dust in determining production of ozone and related tracers, by a 1D photochemical model developed at PRL and the LMD GCM.

Apart from regional and global dust storms in Mars, there is always a constant background haze. The dust devils play an important role to inject dust grains into the atmosphere. Their observations and modeling is still challenging. We identify short pressure drops that likely indicate the passage of convective vortices or dust devils in the data measured by the Mars Science Laboratory (MSL) rover Curiosity. I shall also discuss the modeling of dust devils that we have performed [4].

[1] Ashimananda Modak, Varun Sheel, Franck Montmessin (2019) *JESS, 128,* 144.
[2] Ashimananda Modak, Varun Sheel, Franck Lefèvre (2020) *PSS, 181,* 104783
[3] Varun Sheel and S.A. Haider (2016) *JGR, 121*, 9123-9141.
[4] Shefali Uttam, Deepak Singh, Varun Sheel (2020) *JESS, 129,* 2