Reappraising the Production and Transfer of Hydrogen to the Upper Atmosphere at Times of Elevated Water Vapor

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We have used a 1D hybrid model to represent the ascent of a wet air parcel at times of intense dust and transport activity. This model combines observations of the ACS instrument that measured, for the first time, water vapor abundance from 20 to 120 km. These observations enable the in-depth study of how the water vapor penetration to high altitude contributes to hydrogen production above 80 km. In contrast with other 1D models that have been used to explore Mars' photochemistry, our model represents the vertical transport through advection with a constant velocity of 10 cm/s up to 100 km. Our results imply that, contrary to a common assumption made in models used to study Mars' photochemistry and escape processes, the region between 60 and 80 km cannot be neglected in the production and migration of hydrogen to the upper atmosphere. In particular, these results imply that upper atmosphere photochemistry models intending to capture Southern Summer conditions need to carefully consider the flux boundary condition for H at the lower boundary if it is higher than 80 km. Testing a variety of configurations, from the MY34 GDS to the recent MY35 perihelion period, we have been able to assess how the hydrogen upward flux from above 60 km varies with events. Stochastic events (GDS and A, B, C- storms) have a strong imprint on the escape budget, but our results suggest perihelion remains the dominant escape component on the long term.