Explanation for the increase in high altitude water on Mars observed by NOMAD during the 2018 global dust storm

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Using the GEM-Mars three-dimensional general circulation model (GCM), we examine the mechanism responsible for the enhancement of water vapour in the upper atmosphere as measured by the Nadir and Occultation for MArs Discovery (NOMAD) instrument onboard ExoMars Trace Gas Orbiter (TGO) during the 2018 global dust storm on Mars.

Experiments with different prescribed vertical profiles of dust show that when more dust is present higher in the atmosphere, the temperature increases and the amount of water ascending over the tropics is not limited by saturation until reaching heights of 70-100 km. The warmer temperatures allow more water to ascend to the mesosphere. The simulation of enhanced high-altitude water abundances is very sensitive to the vertical distribution of the dust prescribed in the model.

The GEM-Mars model includes gas-phase photochemistry, and these simulations show how the increased water vapour over the 40-100 km altitude range results in the production of high-altitude atomic hydrogen which can be linked to atmospheric escape.

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