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Enhanced water loss during the Mars Year 34 C storm

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We investigate the evolving water vapour and hydrogen distribution in the martian atmosphere and their associated effect on hydrogen escape during the Mars Year (MY) 34 C storm (a late winter regional dust storm that occurs every Mars year). Improved calculation of the integrated loss of water throughout Mars‘ history (that is currently not well constrained) is possible through tracking the water loss through time from global simulations constrained by available observations. Through constraining water loss we can provide better insight into planetary evolution.

The Open University modelling group global circulation model is combined with retrievals from the ExoMars Trace Gas Orbiter (temperature and water vapour profiles from the Atmospheric Chemistry Suite and water vapour profiles from the Nadir and Occultation for Mars Discovery instrument) and the Mars Climate Sounder (temperature profiles and dust column) on the Mars Reconnaissance Orbiter. This multi-spacecraft assimilation provides the best possible replication of the evolving lower atmosphere.

The unusually intense dusty conditions during the MY 34 C storm led to increased amounts of water vapour and hydrogen above 80 km compared to a more typical C storm, which had an important impact on the amount of water escaping Mars' atmosphere. Modelled hydrogen escape rates during the MY 34 C storm peaked at around 1.4 x 10^9 cm^{-2} s^{-1}, three times the escape rate calculated in the MY 30 C storm scenario and equivalent to those found during previous global-scale dust storms. The weak MY 30 C storm and strong MY 34 C storm can be seen as a bracketing pair of events and therefore the calculated escape rates represent the interannual variabiity expected during C storm events.

Our results indicate water loss during the C storm event each year is highly variable, and must be considered when calculating the integrated loss of water through Mars' history.