

Open Research Online

The Open University's repository of research publications and other research outputs

Global variations in the vertical distribution of water on Mars from a reanalysis of multiple spacecraft observations

Conference or Workshop Item

How to cite:

Holmes, James; Lewis, Stephen; Patel, Manish; Alday, Juan; Aoki, Shohei; Liuzzi, Giuliano; Villanueva, Geronimo; Crismani, Matteo; Fedorova, Anna; Olsen, Kevin; Kass, David; Vandaele, Ann Carine and Korablev, Oleg (2022). Global variations in the vertical distribution of water on Mars from a reanalysis of multiple spacecraft observations. In: COSPAR 2022, 44th Scientific Assembly, 16-24 Jul 2022, Athens, Greece.

For guidance on citations see [FAQs](#).

© 2022 The Authors

Version: Accepted Manuscript

Link(s) to article on publisher's website:
<https://www.cosparathens2022.org/>

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online's data [policy](#) on reuse of materials please consult the policies page.

oro.open.ac.uk

Global variations in the vertical distribution of water on Mars from a reanalysis of multiple spacecraft observations

James A. Holmes¹, Stephen R. Lewis¹, Manish R. Patel^{1,2}, Juan Alday^{1,3}, Shohei Aoki^{4,5}, Giuliano Liuzzi^{6,7}, Geronimo L. Villanueva⁶, Matteo M. J. Crismani⁸, Anna A. Fedorova⁹, Kevin. S. Olsen³, David M. Kass¹⁰, Ann C. Vandaele⁵, Oleg Korablev⁹

¹The Open University, UK, ²Space Science and Technology Department, STFC/RAL, UK, ³Department of Physics, University of Oxford, Oxford, UK, ⁴JAXA, Japan, ⁵Royal Belgian Institute for Space Aeronomy, Belgium, ⁶NASA Goddard Space Flight Center, Planetary Systems Laboratory, Code 693, Greenbelt, MD, USA, ⁷American University, Washington, DC, United States, ⁸California State University, San Bernardino, Department of Physics, CA USA, ⁹Space Research Institute of the Russian Academy of Sciences (IKI RAS), Russia, ¹⁰Jet Propulsion Laboratory, USA

Global understanding of the horizontal and vertical transport of water on Mars is required to advance our incomplete understanding of key processes linked to the water cycle such as water escape throughout time and potential habitability. We analyse the global water cycle during the Mars Year 34 dusty season (April 2018-March 2019) from a reanalysis that combines a Mars global circulation model with retrievals of water vapour (column and vertical profiles), temperature profiles and dust column from several instruments on the ExoMars Trace Gas Orbiter and Mars Reconnaissance Orbiter. This reanalysis provides a robust constraint on the evolving 4-D distribution of water, especially when water vapour retrievals are combined with additional atmospheric properties (temperature and dust) that also exert an influence on the evolving global water distribution.

We investigate global transport processes and supersaturation, indicating northern polar latitudes are largely absent of water vapour below 20 km. Variations above this altitude are due to transport from mid-latitudes during a global dust storm, the downwelling branch of circulation during perihelion season and the intense southern summer regional dust storm in Mars Year 34. Evidence is also found of supersaturated water vapour breaking into the northern winter polar vortex.