

References for “Measuring Mars Atmospheric Winds from Orbit”

- [1] MEPAG (2020), Mars Scientific Goals, Objectives, Investigations, and Priorities: 2020. D. Banfield, ed., 89 p. white paper posted March, 2020 by the Mars Exploration Program Analysis Group (MEPAG) at <https://mepag.jpl.nasa.gov/reports.cfm>.
- [2] P-SAG (2012) Analysis of Strategic Knowledge Gaps Associated with Potential Human Missions to the Martian System: Final report of the Precursor Strategy Analysis Group (P-SAG), D.W. Beaty and M.H. Carr (co-chairs) + 25 co-authors, sponsored by MEPAG/SBAG, 72 pp., posted July 2012, by the Mars Exploration Program Analysis Group (MEPAG) at <http://mepag.jpl.nasa.gov/reports/>.
- [3] Hollingsworth, J.L., Haberle, R.M, Barnes, J.R., Bridger, A.F.C., Pollack, J.B, Lee, H. and Schaeffer, J. (1996). Orographic control of storm zones on Mars. *Nature*, **380**, 413–416. doi: 10.1038/380413a0
- [4] Kahre, M.A., Hollingsworth, J.L., Haberle, R.M., Wilson, R.J. (2015). Couling the Mars dust and water cycles: The importance of radiative-dynamic feedbacks during northern hemisphere summer. *Icarus*, **260**, 477-480. doi: 10.1016/j.icarus.2014.07.017
- [5] Kahre, M.A., Haberle, R.M., Hollingsworth, J.L. Wolff, M.J. (2020). MARCI-observed clouds in the Hellas Basin during northern hemisphere summer on Mars: Interpretation with the NASA/Ames legacy Mars global climate model. *Icarus*, **338**, 113512. doi: 10.1016/j.icarus.2019.113512
- [6] Kass, D. M., Schofield, J. T., Michaels, T. I., Rafkin, S. C. R., Richardson, M. I., and Toigo, A. D. (2003), Analysis of atmospheric mesoscale models for entry, descent, and landing, *J. Geophys. Res.*, 108, 8090, doi:10.1029/2003JE002065, E12.
- [7] Newman, C.E., J. Gómez-Elvira, M. Marin, S. Navarro, J. Torres, M.I. Richardson, J.M. Battalio, S.D. Guzewich, R. Sullivan, M. de la Torre, A.R. Vasavada, and N.T. Bridges (2017), Winds measured by the Rover Environmental Monitoring System (REMS) during the Mars Science Laboratory (MSL) Bagnold Dunes Campaign and comparison with numerical modeling using MarsWRF, *Icarus*, 291, 203-231, <https://doi.org/10.1016/j.icarus.2016.12.016>.
- [8] Rafkin, S. C. R., 2009: A positive radiative-dynamic feedback mechanism for the maintenance and growth of Martian dust storms, *J. Geophys. Res.*, 114, E01009, doi:10.1029/2008JE003217.

- [9] Spiga, A., Faure, J., Madeleine, J.-B., Määttänen, A., and Forget, F. (2013). Rocket dust storms and detached dust layers in the Martian atmosphere, *J. Geophys. Res. Planets*, 118, 746–767, doi:10.1002/jgre.20046
- [10] Gillespie, H. E., Greybush, S. J., & Wilson, R. J. (2020). An investigation of the encirclement of Mars by dust in the 2018 global dust storm using EMARS. *Journal of Geophysical Research: Planets*, 125, e2019JE006106. <https://doi.org/10.1029/2019JE006106>
- [11] Bertrand, T., Wilson, R. J., Kahre, M. A., Urata, R., & Kling, A. (2020). Simulation of the 2018 global dust storm on Mars using the NASA Ames Mars GCM: A multitracer approach. *Journal of Geophysical Research: Planets*, 125, e2019JE006122. <https://doi.org/10.1029/2019JE006122>
- [12] Newman, C.E. and co-authors (2020), Toward a more realistic simulation and prediction of dust storms on Mars, a White Paper submitted to the 2023-2032 Planetary Science and Astrobiology Decadal Survey.
- [13] Grotzinger, J. P., & Milliken, R. E. (2012). The sedimentary rock record of Mars: Distribution, origins, and global stratigraphy. In J. P. Grotzinger & R. E. Milliken (Eds.), *Sedimentary Geology of Mars (SEPM Speci*, pp. 1–48). Retrieved from <http://sp.sepmonline.org/content/sepsp102/1.toc>
- [14] Greeley, R., R. N. Leach, S. H. Williams, B. R. White, J. B. Pollack, D. H. Krinsley, and J. R. Marshall (1982), Rate of wind abrasion on Mars, *J. Geophys. Res.*, 87(B12), 10,009-10,024.
- [15] Armstrong, J., and C. Leovy (2005), Long term wind erosion on Mars, *Icarus*, 176(1), 57–74, doi:10.1016/j.icarus.2005.01.005.
- [16] Golombek, M. P., N. H. Warner, V. Ganti, M. P. Lamb, T. J. Parker, R. L. Fergason, and R. Sullivan (2014), Small crater modification on Meridiani Planum and implications for erosion rates and climate change on Mars, *J. Geophys. Res. E Planets*, 119(12), 2522–2547, doi:10.1002/2014JE004658.
- [17] Farley, K.A., Malespin, C., Mahaffy, P., Grotzinger, J.P., Vasconcelos, P.M., Milliken, R.E., Malin, M., Edgett, K.S., Pavlov, A.A., Hurowitz, J.A. and Grant, J.A., 2014. In situ radiometric and exposure age dating of the Martian surface. *science*, 343(6169), p.1247166.
- [18] Day, M., & Dorn, T. (2019). Wind in Jezero crater, Mars. *Geophysical Research Letters*, 46, 3099–3107. <https://doi.org/10.1029/2019GL082218>

- [19] Bridges, N. T., Bourke, M. C., Geissler, P. E., Banks, M. E., Colon, C., Diniega, S., ... & Mellon, M. T. (2012). Planet-wide sand motion on Mars. *Geology*, 40(1), 31-34.
- [20] Chojnacki, M., Banks, M. E., Fenton, L. K., & Urso, A. C. (2019). Boundary condition controls on the high-sand-flux regions of Mars. *Geology*, 47(5), 427-430.
- [21] Baker, M. M., Newman, C. E., Lapotre, M. G. A., Sullivan, R., Bridges, N. T., & Lewis, K. W. (2018). Coarse sediment transport in the modern Martian environment. *Journal of Geophysical Research: Planets*, 123(6), 1380-1394.
- [22] Greeley, R., Leach, R., White, B., Iversen, J., & Pollack, J. (1980). Threshold windspeeds for sand on Mars: Wind tunnel simulations. *Geophysical Research Letters*, 7(2), 121-124.
- [23] Shao, Y., & Lu, H. (2000). A simple expression for wind erosion threshold friction velocity. *Journal of Geophysical Research: Atmospheres*, 105(D17), 22437-22443.
- [24] Kok, J. F. (2010). Difference in the wind speeds required for initiation versus continuation of sand transport on Mars: Implications for dunes and dust storms. *Physical Review Letters*, 104(7), 074502.
- [25] MEPAG NEX-SAG Report (2015), Report from the Next Orbiter Science Analysis Group (NEX-SAG), *Chaired by B. Campbell and R. Zurek*, 77 pages posted December, 2015 by the Mars Exploration Program Analysis Group (MEPAG) at <http://mepag.nasa.gov/reports.cfm>.
- [26] MEPAG ICE-SAG Final Report (2019), Report from the Ice and Climate Evolution Science Analysis group (ICE-SAG), *Chaired by S. Diniega and N. E. Putzig*, 157 pages posted 08 July 2019, by the Mars Exploration Program Analysis Group (MEPAG) at <http://mepag.nasa.gov/reports.cfm>.
- [27] National Research Council. 2011. *Vision and Voyages for Planetary Science in the Decade 2013-2022*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/13117>.
- [28] Martínez, G. M., et al. "The modern near-surface Martian climate: A review of in-situ meteorological data from Viking to Curiosity." *Space Science Reviews* 212.1-2 (2017): 295-338.
- [29] Spiga, Aymeric, et al. "Atmospheric science with InSight." *Space Science Reviews* 214.7 (2018): 109.
- [30] Manfredi, J. A., et al. "MEDA: The Mars Environmental Dynamics Analyzer. A suite of sensors for the Mars 2020 mission". *Space Science Reviews* (2020; under review).

- [31] Banfield, D., Spiga, A., Newman, C. *et al.* The atmosphere of Mars as observed by InSight. *Nat. Geosci.* 13, 190–198 (2020). <https://doi.org/10.1038/s41561-020-0534-0>
- [32] Benna M, Bougher SW, Lee Y, et al. Global circulation of Mars' upper atmosphere. *Science*. 2019;366(6471):1363-1366. doi:10.1126/science.aax1553
- [33] Lellouch, E., Rosenqvist, J., Goldstein, J.J., Bougher, S.W., Paubert, G., 1991. First absolute wind measurements in the middle atmosphere of Mars. *Astrophys. J.* 383, 401–406.
- [34] Cavalié, T., F. Billebaud, T. Encrenaz, M. Dobrijevic, J. Brillet, F. Forget and E. Lellouch (2008), Vertical temperature profile and mesospheric winds retrieval on Mars from CO millimeter observations - Comparison with general circulation model predictions. *A&A*, 489 2, 795-809, DOI: <https://doi.org/10.1051/0004-6361:200809815>.
- [35] Moreno, R., E. Lellouch, F. Forget, T. Encrenaz, S. Guilloteau, E. Millour (2009), Wind measurements in Mars' middle atmosphere: IRAM Plateau de Bure interferometric CO observations, *Icarus* 201, 2, pp. 549-563. <https://doi.org/10.1016/j.icarus.2009.01.027>.
- [36] Sonnabend, G., Sornig, M., Krötz, P. J., Schieder, R. T., and Fast, K. E. (2006), High spatial resolution mapping of Mars mesospheric zonal winds by infrared heterodyne spectroscopy of CO₂, *Geophys. Res. Lett.*, 33, L18201, doi:10.1029/2006GL026900.
- [37] Wang, H., and Ingersoll, A. P. (2003), Cloud-tracked winds for the first Mars Global Surveyor mapping year, *J. Geophys. Res.*, 108, 5110, doi:10.1029/2003JE002107, E9.
- [38] McConnochie, T. H., J.F. Bell III, D. Savransky, M.J. Wolff, A.D. Toigo, H. Wang, M.I. Richardson, and P.R. Christensen (2010), THEMIS-VIS Observations of Clouds in the Martian Mesosphere: Altitudes, Wind Speeds, and Decameter-Scale Morphology, *Icarus*, 820 210, 545-565, doi 10.1016/j.icarus.2010.07.021
- [39] Hernández-Bernal, J., Sánchez-Lavega, A., del Río-Gaztelurrutia, T., Hueso, R., Cardesín-Moinelo, A., Ravanis, E. M., et al. (2019). The 2018 Martian global dust storm over the South Polar Region studied with MEx/VMC. *Geophysical Research Letters*, 46, 10330–10337. <https://doi.org/10.1029/2019GL084266>
- [40] Levrard, B., Forget, F., Montmessin, F. et al. (2004). Recent ice-rich deposits formed at high latitudes on Mars by sublimation of unstable equatorial ice during low obliquity. *Nature* 431, 1072–1075., <https://doi.org/10.1038/nature03055>

- [41] Newman, Claire E.; Lewis, Stephen R. and Read, Peter L. (2005). The atmospheric circulation and dust activity in different orbital epochs on Mars. *Icarus*, 174(1) pp. 135–160.
- [42] Mischna, M. A., V. Baker, R. Milliken, M. Richardson, and C. Lee (2013), Effects of obliquity and water vapor/trace gas greenhouses in the early martian climate, *J. Geophys. Res. Planets*, 118, 560–576, doi:10.1002/jgre.20054.
- [43] Lewis, S. R., Read, P. L., Conrath, B. J., Pearl, J. C., & Smith, M. D. (2007). Assimilation of thermal emission spectrometer atmospheric data during the Mars Global Surveyor aerobraking period. *Icarus*, 192, 327–347. <https://doi.org/10.1016/j.icarus.2007.08.009>
- [44] Hoffman, M. J., Greybush, S. J., John Wilson, R., Gyarmati, G., Hoffman, R. N., Kalnay, E.,...Szunyogh, I. (2010). An ensemble Kalman filter data assimilation system for the Martian atmosphere: Implementation and simulation experiments. *Icarus*, 209, 470–481. <https://doi.org/10.1016/j.icarus.2010.03.034>
- [45] Lee, C., Lawson, W. G., Richardson, M. I., Heavens, N. G., Kleinböhl, A., Banfield, D.,...Toigo, A. D. (2009). Thermal tides in the Martian middle atmosphere as seen by the Mars Climate Sounder. *Journal of Geophysical Research*, 114, E03005. <https://doi.org/10.1029/2008JE003285>
- [46] Greybush, S. J., Wilson, R. J., Hoffman, R. N., Hoffman, M. J., Miyoshi, T., Ide, K.,...Kalnay, E. (2012). Ensemble Kalman filter data assimilation of Thermal Emission Spectrometer temperature retrievals into a Mars GCM. *Journal of Geophysical Research*, 117, E11008. <https://doi.org/10.1029/2012JE004097>
- [47] Greybush, S.J., H.E. Gillespie, R. J. Wilson (2019), Transient eddies in the TES/MCS Ensemble Mars Atmosphere Reanalysis System (EMARS), *Icarus*, 10.1016/j.icarus.2018.07.001, 317, 158-181.
- [48] Navarro, T., Forget, F., Millour, E., and Greybush, S. J. (2014). Detection of detached dust layers in the Martian atmosphere from their thermal signature using assimilation. *Geophys. Res. Lett.*, 41, 6620-6626.
- [49] Smith, M. D., Pearl, J. C., Conrath, B. J., & Christensen, P. R. (2001). Thermal emission spectrometer results: Mars atmospheric thermal structure and aerosol distribution. *Journal of Geophysical Research*, 106, 23,929– 23,945. <https://doi.org/10.1029/2000JE001321>

- [50] Kleinböhl, A., et al. (2009), Mars Climate Sounder limb profile retrieval of atmospheric temperature, pressure, and dust and water ice opacity, *J. Geophys. Res.*, 114, E10006, doi:10.1029/2009JE003358.
- [51] Kleinböhl, A., A. J. Friedson, and J. T. Schofield, Two-dimensional radiative transfer for the retrieval of limb emission measurements in the Martian atmosphere, *J. Quant. Spectrosc. Radiat. Transfer*, 187, 511-522, doi:10.1016/j.jqsrt.2016.07.009, 2017.
- [52] Prince JL, Desai PN, Queen EM, Grover MR. Mars phoenix entry, descent, and landing simulation design and modeling analysis. *Journal of Spacecraft and Rockets*. 2011 Sep;48(5):756-64.
- [53] Dust in the Atmosphere of Mars and its Impact on Human Exploration, edited by J.S. Levine, D. Winterhalter, and R.L. Kerschmann, 2018, Cambridge Scholars Publishing.
- [54] McClean, J.B. and W.T. Pike (2017), Estimation of the Saltated Particle Flux at the Mars 2020 In-Situ Resource Utilization Experiment (MOXIE) Inlet, presented at the Dust in the Atmosphere of Mars and Its Impact on Human Exploration Workshop, Abstract #6025.
- [55] Heavens, N.G., Kleinböhl, A., Chaffin, M.S. *et al.* Hydrogen escape from Mars enhanced by deep convection in dust storms. *Nat Astron*, 126–132 (2018). <https://doi.org/10.1038/s41550-017-0353-4>
- [56] Chaffin, M., Deighan, J., Schneider, N. *et al.* Elevated atmospheric escape of atomic hydrogen from Mars induced by high-altitude water. *Nature Geosci* 10, 174–178 (2017). <https://doi.org/10.1038/ngeo2887>
- [57] Fedorova, A.A. et al. (2020), Stormy water on Mars: The distribution and saturation of atmospheric water during the dusty season, *Science*, DOI: 10.1126/science.aay9522.
- [58] Montabone, L. and N.G. Heavens et al. (2020), Observing Mars from Areostationary Orbit: Benefits and Applications, a White Paper submitted to the 2023-2032 Planetary Science and Astrobiology Decadal Survey.
- [59] Cremons, D.R., Abshire, J.B., Sun, X. *et al.* Design of a direct-detection wind and aerosol lidar for mars orbit. *CEAS Space J* 12, 149–162 (2020). <https://doi.org/10.1007/s12567-020-00301-z>
- [60] Waters, J.W., Froidevaux, L., Harwood, R.S., Jarnot, R.F., Pickett, H.M., Read, W.G., Siegel, P.H., Cofield, R.E., Filipiak, M.J., Flower, D.A., Holden, J.R., Lau, G.K., Livesey, N.J.,

Manney, G.L., Pumphrey, H.C., Santee, M.L., Wu, D.L., Cuddy, D.T., Lay, R.R., Loo, M.S., Perun, V.S., Schwartz, M.J., Stek, P.C., Thurstans, R.P., Chandra, K.M., Chavez, M.C., Chen, G., Boyles, M.A., Chudasama, B.V., Dodge, R., Fuller, R.A., Girard, M.A., Jiang, J.H., Jiang, Y., Knosp, B.W., LaBelle, R.C., Lam, J.C., Lee, K.A., Miller, D., Oswald, J.E., Patel, N.C., Pukala, D.M., Quintero, O., Scaff, D.M., Snyder, W.V., Tope, M.C., Wagner, P.A., Walch, M.J., 2006. The earth observing system microwave limb sounder (EOS MLS) on the Aura satellite. *IEEE Trans. Geosci. Remote Sens.* 44 (5), 1075–1092.
<https://doi.org/10.1109/TGRS.2006.873771>.

[61] Read, W. G., L. K. Tamppari, N. J. Livesey, R. T. Clancy, F. Forget, P. Hartogh, S. C. R. Rafkin, G. Chattopadhyay, 2018. Retrieval of wind, temperature, water vapor and other trace constituents in the Martian atmosphere, *Plan. and Sp. Sci.*, doi.org/10.1016/j.pss.2018.05.004..

[62] Gordley, L.L. and B.T. Marshall, "Doppler wind and temperature sounder: new approach using gas filter radiometry," *J. Appl. Rem. Sens.* 5(1) 053570 (1 January 2011)
<https://doi.org/10.1117/1.3666048>