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Thermosphere structure and variability as inferred from the ExoMars Trace Gas Orbiter aerobraking campaign and in-situ MAVEN NGIMS observations

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Abstract

The aerobraking phase of the ExoMars TGO spacecraft was performed between March 2017 and February 2018, reaching pericentre altitudes down to approximately 105 km, sufficient for the on-board engineering accelerometers to obtain readings of total atmospheric mass densities. Since April 2018, the Science Phase of the mission, the orbital periapsis altitude is too high for accelerometer readings but daily mean densities (single value per orbit) can be inferred via precise orbit determination. Simultaneously, the MAVEN NGIMS mass spectrometer carried out in-situ gas density measurements above 150 km altitude and during several ‘deep dip' campaigns down to 120 km. The ExoMars and MAVEN dataset represent the first ever simultaneous two-spacecraft observations in the upper atmosphere of Mars.

In this paper we will present the combined measurements to infer the global horizontal density structure on Mars as well as atmospheric waves and smaller scale variability. With TGO sampling lower altitudes in the atmosphere, the vertical evolution of waves is studied, drawing comparisons with MAVEN data. TGO and MAVEN sampled similar concurrent local times and latitudes during the latter stages of the aforementioned aerobraking phase; vertical profiles during this period are presented and key results are highlighted.