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Structure of the upper atmosphere of Mars based on the ACS solar occultation data from the ExoMars/TGO mission.

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This study investigates the altitudes of the middle and upper atmosphere of Mars, specifically the mesosphere, above ~50 km, and the thermosphere, above 100-120 km, up to the exobase for the CO2 molecule (180-220 km). Seasonal variations of the transitional regions of the upper atmosphere are considered: the mesopause, located at altitudes of about 80-120 km, where a temperature minimum is observed, as well as the homopause, located 10-20 km higher, where the turbulent diffusion changes to the molecular one that is individual for each gas component. Variations in the height and temperature of the mesopause/homopause, as well as the exobase, are influenced by seasonal variability, solar activity, including vertical energy transfer caused by global circulation and atmospheric waves [1, 2].

The paper presents vertical distributions of temperature and CO2 concentration measured by the Russian Atmospheric Chemistry Suite (ACS) spectrometer, operating aboard the Trace Gas Orbiter (TGO) of the ExoMars-2016 mission [3]. Since April 2018, the ACS mid-infrared channel (ACS-MIR, 2.2-4.3 μm) has been probing the Martian atmosphere during solar eclipses. Density and temperature are retrieved from atmospheric transmission spectra measured in CO2 absorption bands around 2.7 μm with high spectral resolution, covering altitudes from 10 to 180 km, the troposphere, mesosphere, and thermosphere of Mars [4]. The results of observations over 2.5 Martian years (MY), from mid-MY34 to the end of MY36, are shown, with seasonal and latitudinal variations in temperature and the altitudes of the mesopause, homopause, and exobase. The homopause region is defined by comparing the coefficients of molecular (CO2) and turbulent diffusion under the condition of saturation of atmospheric gravity waves around 80-120 km [5], which are recorded in vertical temperature profiles according to ACS data [2]. This study also presents validation of ACS data with solar eclipses from the EUVM spectrometer of the MAVEN mission [6] and with a global circulation model (GCM) [1].

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