RADIO-SOUNDING OF THE NEUTRAL MARTIAN ATMOSPHERE WITH MARS EXPRESS: OVERVIEW OF THE OBSERVATIONS

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The Mars Express Radio Science Experiment onboard the Mars Express spacecraft started regular operations in April 2004. The experiment employed the radio occultation method during three occultation seasons from April to August 2004, December 2004 and since July 2005 to sound the neutral Martian atmosphere in order to derive vertical density, pressure and temperature profiles as a function of height, and to sound the ionosphere to derive vertical ionospheric electron density profiles. Both types of profiles have been monitored as a function of time to determine diurnal variations and, in the case of the ionosphere, its dependence on solar wind conditions.

The atmosphere and ionosphere can only be sounded when the spacecraft is going into occultation as seen from the Earth. Prior to occultation, the radio signals, uplink to the spacecraft and downlink from the spacecraft, are propagating through the atmosphere. The observations start typically 20 minutes before the predicted occultation time and stop three to five minutes into occultation. The frequency and AGC of the received radio signals at X-band and S-band are recorded at the ground station complexes of the Deep Space Network or at the ESA ground station in New Norcia (NNO), West-Australia.

The MaRS experiment retrieved about 100 vertical profiles of pressure, temperature, neutral number density from the neutral atmosphere from near the surface to about 50 km altitude during the first occultation season from April to mid August 2004. Thirty-two profiles have been obtained during the second occultation season and approximately another 200 profiles from the third season.

The data set from the first occultation season may be divided in two parts: 13 profiles obtained in April 2004 (solar Longitude L_s= 13° to 21°) covering solar zenith angles from 108° to 85° at local morning times of about 04:30 to 05:15 and a second part of about 86 profiles (L_s= 32° to 74°) covering solar zenith angles from 70° to 84° at local late afternoon times at about 17:00.

Thirty-two profiles of the second occultation season have been observed from 8th December 2004 to 4th January 2005 in the southern hemisphere in local winter at various local times.

The third occultation season started in July 2005 and covers the Northern mid to polar latitudes in local fall to winter at local times from the late morning at 11:00 to the early evening at 20:00. The latitude exceeds 67° North well into the polar night.

MEX occultations reach other latitudes and areas than Mars Global Surveyor and provides valuable input for general circulation models of the Martian atmosphere.

This paper gives an overview of the observations from April 2004 to end of 2005 and presents examples, results and interpretations and comparisons with the GCM from LMD.