Atmospheric changes during the Total Solar Eclipses on July 22 2009 and March 9 2016: NRLMSISE-00 Atmospheric Model Measurement

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Abstract

This study analyses the atmospheric changes associated with two total solar eclipses on July 22 2009 andMa rch 9 2016. The atmospheric parameters of atomic Oxygen (O), Hydrogen (H), Nitrogen (N), Helium (He), Argon (Ar), Oxygen (O_2), Nitrogen (N_2), total mass density (Tmd), neutral temperature (Tn) and Exospheric temperature (Tex) are used for analyzing during the two total solar eclipses. The Naval Research Laboratory Mass Spectrometer Incoherent Scatter Extension 2000 (NRLMSISE-00) model data is used in this study to analyses the atmospheric changes of total solar eclipses on July 22 2009 and March 9 2016. To compare the atmospheric changes of total solar eclipses one day before and after the total solar eclipses are considered. The results show that the maximum increment of atmospheric parameters during total solar eclipse on July 22 2009 are O (74.3 %, 64.1%), H (-26.5%, -20.0%), N (73.4% 63.1%), He (31.0% 23.7%), Ar (97.1% 93.1%), O_2 (93.5% 87.3%), N_2 (90.5% 83.2%), Tmd (17.2% 13.1%), Tn (6.4% 4.9%) and Tex (6.4% 4.9 %) on the days before (July 21 2009) and after (July 23 2009) respectively. For total solar eclipse on March 9 2016, the maximum increment of atmospheric parameters are O (2.5%, -16.7%), H (-0.41%, 1.8%), N (3.60%, -14.9%), He (0.44%, -4.60%), Ar (6.53%, -47.7%), O_2 (5.23%, -35.4%), N_2 (4.70%, -30.4%), Tmd (0.62%, -3.81%), Tn (0.23%, -0.85%) and Tex (0.31%, -0.97 %) on the days before (March 8 2016) and after (March 10 2016) respectively. Most atmospheric parameters during total solar eclipse on July 22 2009 are increased in the eclipse day July 22 2009, but during total solar eclipse on March 9 2016 most atmospheric parameters are increased after eclipse day on March 10 2016. The NRLMSISE-00 model can capture the effects of the total solar eclipses well.

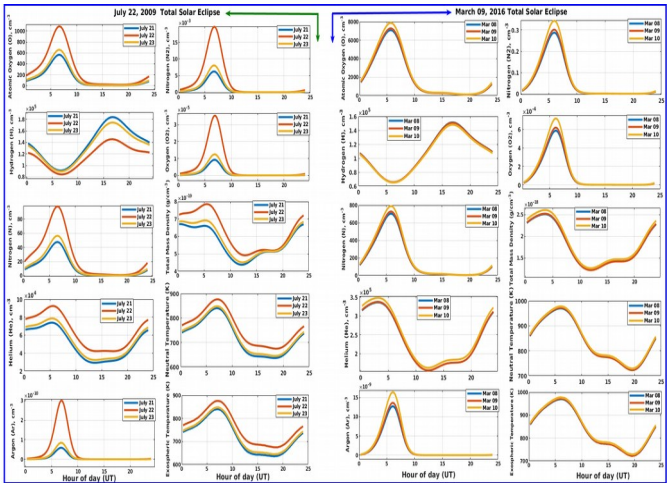

Figure 1. The NRLMSISE-00 model measurement of atmospheric parameters of the two total solar eclipses on July 22 2009 (left side) and March 9 2016 (right side) and comparison with the days before and after the total solar eclipses

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