Abstract

The present study deals with the nature of the coupling of low latitude thermosphere ionosphere system (TIS) under varying geophysical conditions. The thermospheric parameters studied were temperature and meridional winds obtained by using nighttime high resolution central aperture scanning Fabry-Perot spectrometers for the Optical Aeronomy Laboratory at Mt.Abu (24.6° N, 72.7° E). Ionospheric parameters such as F-layer equilibrium height and electron density at 250 km were obtained by means of ground based ionosonde at Ahmedabad (23° N, 72.1° E). Data from the satellite Dynamics Explorer - 2 (DE-2) was also made use of in order to overcome the limitations imposed by the ground based spectroscopic measurements, in the present investigation. The work carried out towards the completion of this thesis is presented as follows.

• A brief introduction of the earth's upper atmosphere is provided in chapter 1. Different, basic energetic and dynamic, aspects of the low latitude thermosphere and the ionosphere in terms of their coupling are described. The less understood prominent low latitude, large scale processes like equatorial spread F and Midnight Temperature Maximum (MTM) are discussed.

• Chapter 2 describes the selection of various suitable instrument parameters of our instrument i.e. high resolution central aperture scanning Fabry-Perot spectrometer. The data analysis techniques adopted is also described in appropriate details.

• Chapter 3 provides the results of the study of low latitude TIS coupling during low solar activity epoch and geomagnetically quiet periods. Rishbeth's servo model was used to study the nature and the extent of the coupling in low latitude TIS. The observed temperatures and winds were used as an input to the model. This study brought out the dominant role played by the thermospheric parameters over ionosphere during geomagnetically quiet and low solar activity phases. This study also confirmed the existence of enhanced observed temperatures with its prominent day to day and short temporal variabilities.
• In chapter 4, we discuss the behaviour of the low latitude TIS during geomagnetically perturbed periods. We studied the changes in low latitude TIS in terms of its energetics and dynamics during disturbed periods. These changes are a result of the high latitude-low latitude coupling. We concluded that the temperatures at low latitudes undergo severe modulations under the influence of storm time meridional circulation, ring current, and traveling atmospheric disturbances. In this chapter we also show that the servo model is equally applicable for the magnetically disturbed periods as well.

• Chapter 5 comprises of the discussions and results on the detailed investigation done in order to account for the differences observed between the measured and MSIS model predicted thermospheric temperatures. This was done for both geomagnetically quiet and disturbed periods. These results show that geomagnetic index D$_{st}$ in the form of $\frac{d}{dt}D_{st}$ is a better index than $A_p$ to represent low latitude TIS. This index has also been successfully used to improve the MSIS model. The limitations involved in the use of spectroscopically observed temperatures for the augmentation of the model has also been discussed in this chapter.

• In chapter 6 we give the details of the estimation of contributions from local processes like ETWA. To estimate the extent of heating due to ETWA, DE-2 data on composition and temperature were used. Contribution from both the processes i.e. chemical heating and ion-drag which are supposed to be responsible for the generation of ETWA, was estimated. Finally, the results dealing with all the three namely, ring current, ion-drag and chemical heating, are presented in this chapter.

The results presented and discussed in this thesis bring out the importance of the various local and non local processes which contribute significantly to the low latitude energetics. However it was realised that more quantitative information on these processes is needed to improve the existing thermospheric models to make them represent the low latitude temperatures more realistically.