Application of Thermospheric Temperature Measurements using Fabry - Perot Interferometry

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Ground based measurements using Fabry-Perot Interferometry have been carried out for the last thirty years for studying thermospheric F-region neutral temperature from Doppler broadening of O (^{1} D) Red Emission line at 630 nm produced by dissociative recombination reactions. The observations are carried out during moonless and clear nights preferable at a hill site. This is the most potent and popular system and has been extensively utilized in different parts of the globe ranging from low latitudes to Polar Regions including Antarctica. Line of sight neutral winds have also been observed from Doppler line shift of the source profile. Combination of these two parameters has been used to explain a host of natural phenomena including equatorial anomalies.

It has been found that there is a one to one correspondence between the neutral temperatures and the F-region base height showing a relation of 11+-4 km / 100 K. As the neutral gas pressure increases in the F-region due to enhanced temperatures, the F-layer height tends to increase. A sudden spurt in temperature has been seen to be associated with occurrence of equatorial spread F over dip equator. The ESF manifests itself in the form of intensity biteout in thermospheric airglow. The pressure gradients due to differential heating of the atmosphere drive horizontal winds to which the ionized gas offers a frictional force called ion drag due to their constrained movement along the geomagnetic field lines. In the lower thermosphere and E -region of ionosphere, these winds cause global scale dynamo action. During high solar activity periods, the measured neutral temperatures show high variability from model values (MSIS-86) and hence one must properly account for its effect on F-region heights (obtained from ionograms) before estimating meridional winds. The model values of temperature take care of changing values of solar radiation fairly well but fail to take care of short period changes due to joule heating, equatorial wind and temperature anomaly (ETWA) and factors like midnight temperature maximum (MTM) etc. It has been proposed that there is coupling of the troposphere mountain dynamics to the dynamics of thermosphere and such effects may occur over orographic regions of Himalayan Mountains and the American Rockies. That the gravity waves from the surface penetrate into the thermosphere where viscous dissipation causes the heating is another hypothesis to explain increased temperature variability in hilly regions. Neutral parameters like temperature and wind has also been used to infer plasma drift during magnetic storms and the results are comparable to incoherent scatter radar measurements.

Such ionospheric phenomena, which have bearing on the F-region neutral temperature measurements by Fabry - Perot Interferometry, will be presented and discussed .