Daytime Climatology of Ionospheric $N_m F_2$ and $h_m F_2$ from COSMIC data

A. G. Burns$^1$, S. C. Solomon$^1$, W. Wang$^1$, L. Qian$^1$, Y. Zhang$^2$, and L. J. Paxton$^2$

$^1$ HAO/NCAR
$^2$ APL
Introduction

Instead of being dominated by the solar zenith angle, $F_2$ region ionospheric climatology is dominated by a series of anomalies in the $F_2$ peak electron densities ($N_{mF_2}$):

- The winter (or seasonal) anomaly
- The equatorial (Appleton) anomalies
- the annual anomaly (or asymmetry)
- The equinoctial anomalies (or peaks)

What do COSMIC Abel inversions say about the climatology of $N_{mF_2}$ and $h_{mF_2}$?
Methodology

- Calculate the height of the $F_2$ peak and the electron density at the $F_2$ peak for each Abel inversion
- Calculate the geomagnetic latitude using APEX coordinates
- Calculate the solar local time in geographic coordinates to exclude points when dark (0900 - 1500 solar local time)
- Bin the resulting $N_m F_2$ and $h_m F_2$ data for all longitudes and each 10 degree increment of latitudes for each day
- Apply a 30 day running median
Geophysical Conditions from 2007-2011

The graph shows the variation of SEE EUV (W/m²) and Ap (with a peak in 2008) over the years 2007 to 2011. The SEE EUV values are integrated EUV (5-105nm) and F10.7, which is a measure of solar activity.
hmF2 for 2007-2010

median hmF2 9-15 Lt

Latitude

Year
Conclusions

• Low-latitude $N_mF_2$ was dominated by the semi-annual anomaly, the equatorial anomaly and the annual asymmetry

• Semi-annual and annual anomalies extended into the middle latitudes

• There is no winter anomaly and maximum $N_mF_2$ at mid latitudes always occurs in the summer hemisphere

• The highest values of $h_mF_2$ at low latitudes occur on the summer side of the magnetic equator, probably as a result of winds blowing from summer to winter

• Minimum values of $h_mF_2$ at middle latitudes occur in winter, when $h_mF_2$ is typically 30 to 50 km lower than summer;