1. OBJECTIVE

Characterize the solar radiation influence on the ionospheric neutral and electron densities during different phases of the solar cycle.

Science questions:
1. To what degree is solar EUV radiation reflected in the ionospheric neutral and plasma densities?
2. Is solar rotation evident in neutral/plasma densities?
3. Does neutral/plasma density correlate well with F10.7 and neutral density?
4. Is this correlation strongly dependent on the phase of the solar cycle?
5. What is the best proxy to describe the absorption of solar EUV radiation in the ionosphere?
6. What solar wavelengths describe neutral and plasma density variability?
7. Are there EUV irradiances showing a better correlation than the F10.7?

2. DATA & METHODOLOGY

- CHAMP neutral and plasma densities
  - Orbit: 87.3°
  - Precipitation rate: 1.3°/day (24 hrs. in 264 days)
  - Ap as proxy for geomagnetic activity, F10.7 and TIMED-SEE irradiances as proxy of solar radiation
  - Years analyzed: 2002/2003 (solar max) and 2006/2007 (solar min)
  - Time domain – correlation of “mean” residuals (27-day means shifted one day at the time are subtracted from raw data and a 5-day running mean is applied, similarly to Forbes et al., 2006)
  - Frequency domain – FFT and Morlet wavelet

3. CORRELATION DURING SOLAR MAXIMUM

- Good correlation is found between solar proxies (F10.7 and TIMED-SEE irradiances) and neutral densities at solar maximum (Table 1 and 2).
- Figure 1 and 2 (3 and 4) show significant correlation between F10.7 and neutral density for 2002 (2003) during solar maximum. The correlation drops during parts of the year due to decreased solar radiation variability. Ap is for the most part uncorrelated to neutral density.
- The bottom panel in Figure 1 and 3 shows Pearson correlation coefficients higher than 0.75 for most of the year, this means that over 56% in neutral density variability is captured by F10.7.
- No significant correlation is found between any solar or geomagnetic proxy and electron densities (Table 1 and 2).

4. CORRELATION DURING SOLAR MINIMUM

- As shown in Figure 5 and 6 (7 and 8), F10.7 and neutral density are quite uncorrelated during 2007 (2008) at solar minimum.
- We notice good correlation with Ap (coefficients ranging from 0.7 to 0.95 for most of the years), indicating that geomagnetic effects are dominating (see Table 3 and 4).
- Drops in correlation with Ap correspond to jumps in correlation with F10.7, their source is still being investigated.

5. PERIODOGRAMS AND WAVELETS

- The periodograms and wavelets for 2003 and 2007 are shown in Figure 9 and Figure 10 respectively. Results consistent with the previous ones are found. For 2003 we notice the 27-day peak in F10.7, present the neutral density well. For 2007 we observe the many similar structures between Ap and neutral density.

5. CONCLUSIONS

We gained a better understanding of the influence of solar radiation in neutral/electron density variability at 300-400 km and the processes driving satellite drag variability.

a. The phase of the solar cycle highly influence the best proxy for neutral density variability (F10.7 at solar max and Ap at solar min)

b. Far Ultra Violet (FUV) radiation seems more representative of solar energy input in the 300-400 Km region – especially 133.5 nm