Space Environment around the International Space Station

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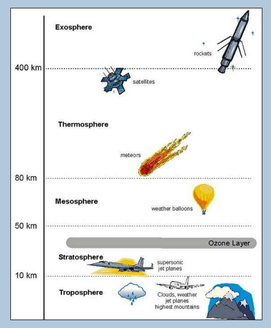
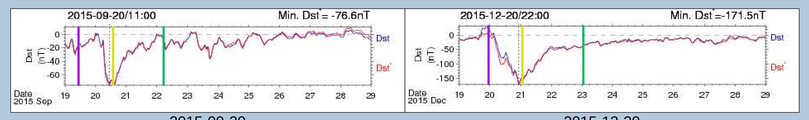
Introduction



The International Space Station (ISS) was launched in 1998 and is used to conduct space environment research. It orbits at about 410 km in the Ionosphere (80 to 1,000 km).

The Floating Potential Measurement Unit (FPMU) is one of the modules installed on the ISS. It is used to measure ion density, ion temperature, and electric potential of the surrounding environment.

For this research, two geomagnetic storms were chosen; one on 2015-09-20 and the second on 2015-12-20. Both storms were caused by Coronal Mass Ejections (CME). Ion density and temperature data from the FPMU was studied for both.



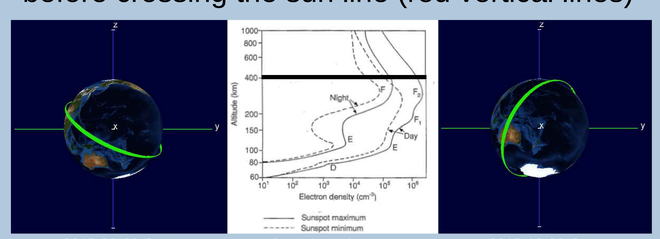
2015-09-20 2015-12-20

Figure 1 - Storm Overviews

Calm Conditions

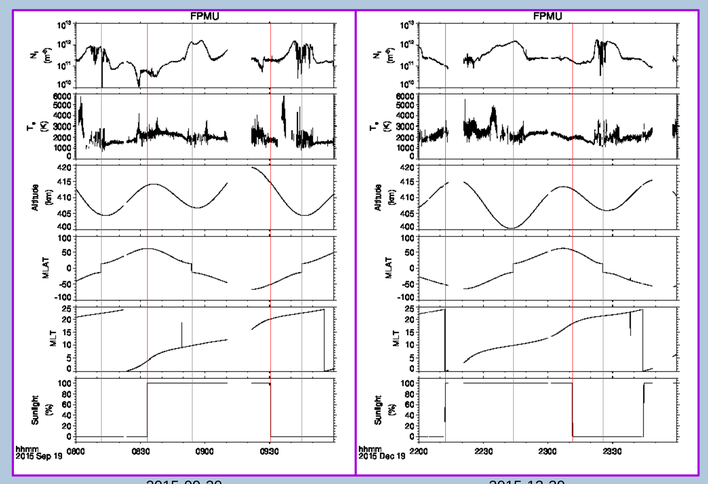
The calm periods showing normal space conditions are shown in Figure 3. There were a few patterns that stood out:

- Ion density (N) increased with lower altitudes. This matched known behavior of ion density as shown in Figure 2 below.
- Both density and temperature showed increased turbulence during an equatorial crossing (gray vertical lines) on the night side (night crossing)
- The September density plot had small depletions before crossing the sun line (red vertical lines)

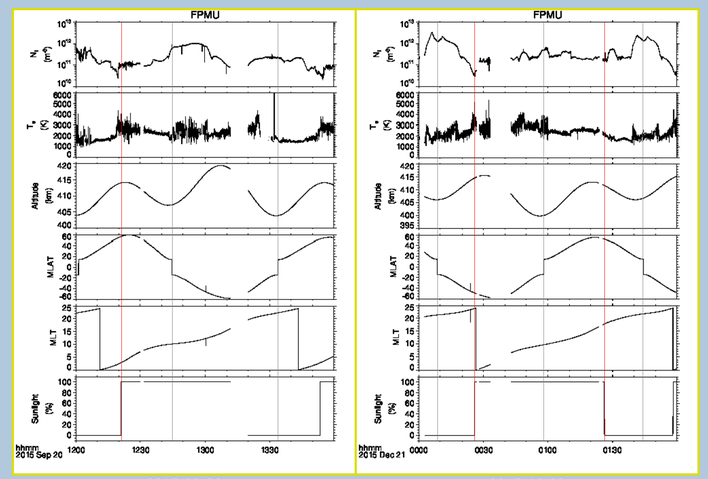


2015-09-20 Orbit Density vs Altitude 2015-12-20 Orbit

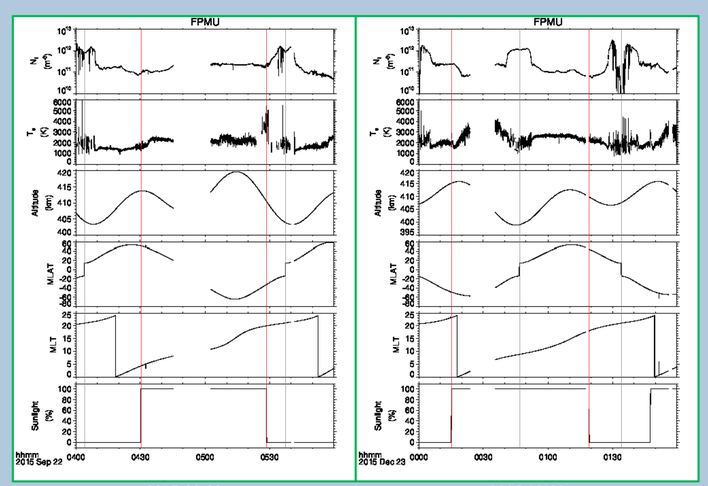
Figure 2



2015-09-20 Figure 3 - Calm 2015-12-20



2015-09-20 Figure 4 - Peak 2015-12-20

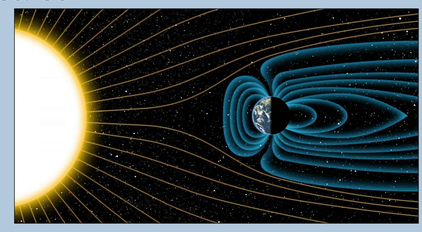


2015-09-20 Figure 5 - Recovery 2015-12-20

Peak of Storm

The peak of a storm occurs when the disturbance storm time index (DST) reaches a minimum. The peaks are shown in Figure 4. Two changes from normal conditions occurred at the peaks:

- Density's dependence on altitude weakened. In a couple places the density does not increase at all when altitude decreased
- The turbulence that occurred during night crossings disappeared.



Recovery Phase

During the recovery phase of the storms shown in Figure 5, the normal space conditions began to return:

- Density dependence on altitude returned to normal
- Turbulence at the night crossings for both density and temperature reappeared
- An interesting note is the depletions before sun line crossings disappeared while they were present during the storm itself.

Conclusion

Both CME's had a noticeable effect on the density and temperature, though the effect was less than that of normal space weather factors such as altitude, night crossings, and sun/shadow crossings. The effects were also short term. Differences that could be looked at in the future would be seasonal and orbital effects. The orbits for the two periods are shown in Figure 2. The September storm was at equinox and had a more equatorial orbit while the December storm was at solstice and had a more polar orbit.