Solar Activity Variation and Its Effect on Ionospheric Ion Density

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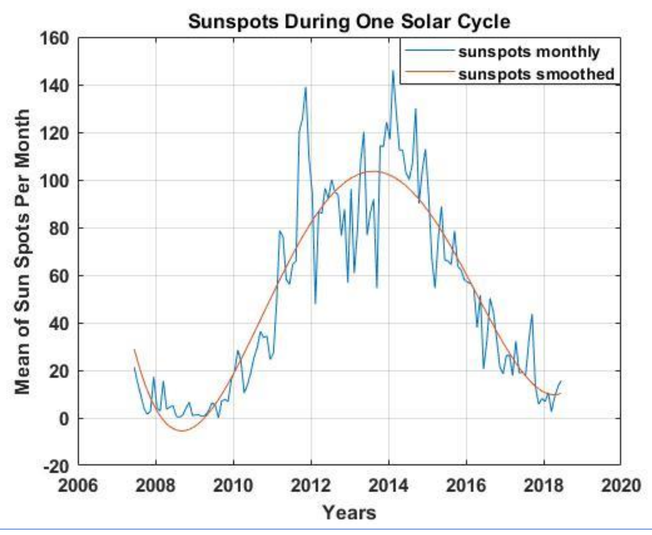
As the Sun progresses through its solar cycle and its activity increases, more number of sunspots occur and solar fluxes become more intense. The change in solar activity is related to the change in electron density of the ionosphere. Studying this relation is very important in terms of space plasma studies and space weather predictions, which play a significant role in radio and satellite communication as well as GPS navigation. In this poster we are presenting the sunspot and solar flux data for solar cycle 24 (year 2008-2018). We are using C/NOFS satellite data to understand the variation of ion densities of the upper atmosphere with solar cycle 24. Our analysis shows decrease of H+ density by a factor of 10 and increase of O+ density by a factor of 10 during solar maxima. This data set can be used as a framework for future advancement in empirical modelling of regional and global ion density of the ionosphere.

Space weather

- The sun is a hot ball of plasma which emits electromagnetic radiation and charged particles.
- The activity of Sun varies over a period of eleven years and is called solar activity.
- High energetic solar radiation ionizes the earths upper atmosphere creating ions and electrons that constitutes the ionosphere.
- The suns has a significant impact on the earth, has a heavy influence on satellites and astronauts.
- Charged particles and high energy radiation from the Sun can damage technologies and harm astronauts.

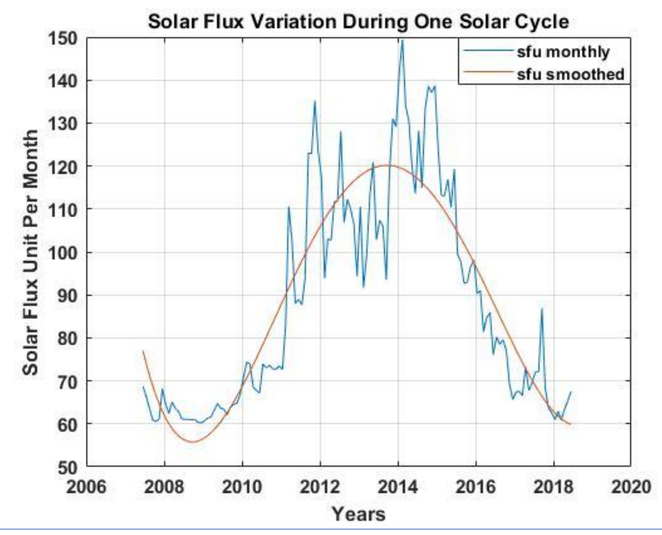
Research Objectives

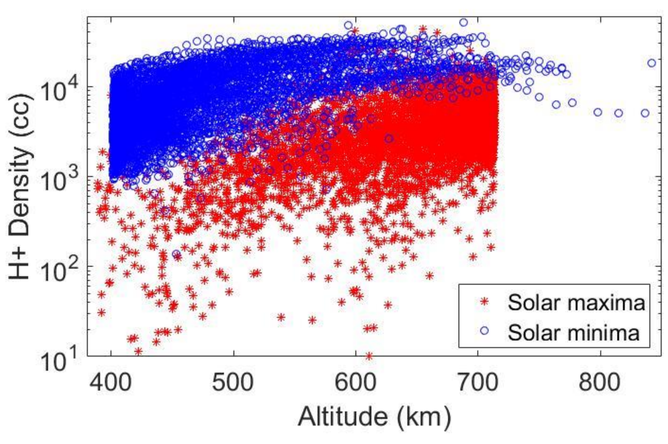
- The research goals are to study the effects of the Sun on our atmosphere during the solar maximum and solar minimum.
- We will be looking at the variations of the effects of the Sun on ionospheric electron and ion densities.
- We plan to design a framework for future advancement in empirical modelling of regional and global ion density of the ionosphere.
- Further understanding of the Sun's activity will allow us to better predict the effects the sun, and will help us better prepare for any harmful effects.

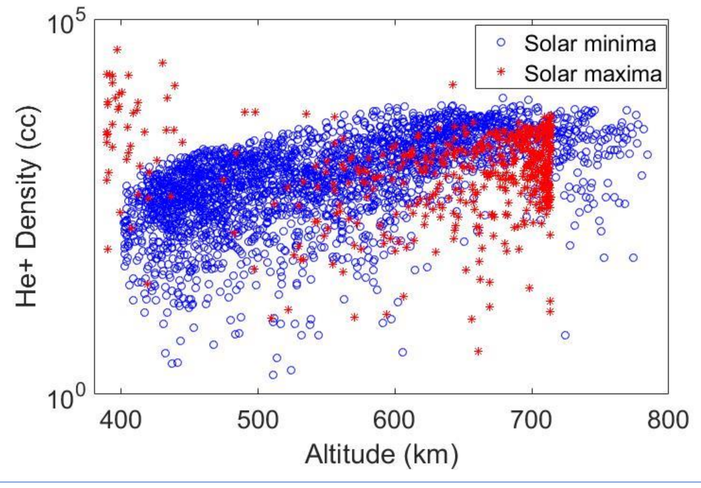


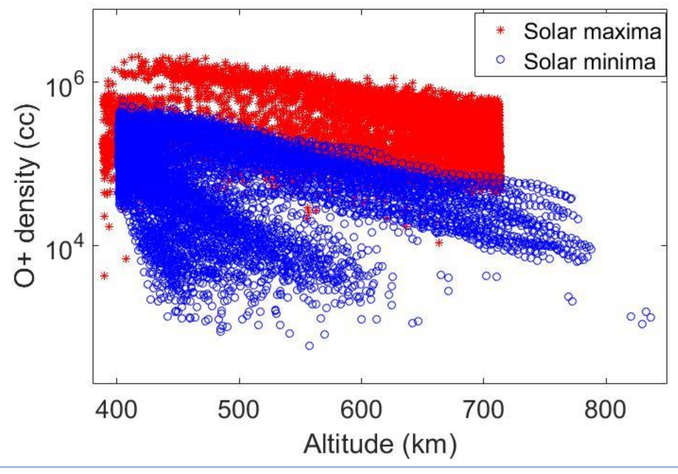
Results:

- These plots show the variation of solar flux density and sunspots in the 24th solar cycle.
- During the solar minimum, the early and later stages of the solar cycle, the SFU ranged from 60-28 and sunspots range from 0-20.
- During the solar maximum, the middle stages of the solar cycle, the SFU ranges from 90-150 and the sunspots range from 60-140.
- During the middle of the solar cycle the fluctuation of the solar flux density and sunspots is at its highest.
- The solar flux increases and decreases with the number of sunspots.









H+ Density:

- This plot shows the H+ ion density during the solar maximum (May, 2013) and minimum (May, 2009) of the 24th solar cycle. The density during the solar maxima decreases by a factor of 10.

He+ Density:

- This plot shows the He+ ion density during the solar maximum (May, 2013) and minimum (May, 2009) during the 24th solar cycle. The He+ density does not show much variation throughout the solar cycle as compared to O+ and H+.

O+ Density:

- This plot shows the O+ ion density during the solar maximum (May, 2013) and minimum (May, 2009) during the 24th solar cycle. During the solar maximum the density of O+ ions increases by almost a factor of 10.

Conclusion:

-Higher solar activity causes more EUV (Extreme Ultra Violet) and X-rays reaching the ionosphere and that causes higher density of O+ ions.

-He+ is a minor constituent of the ionosphere, therefore does not show much variation with solar activity

- This is an ongoing research work; we plan to study O+/H+ transition height of ions during solar minima and maxima period

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