Characteristics of daytime medium scale traveling ionospheric disturbances (MSTIDs) as observed by SWARM

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ESA's SWARM Mission

- Constellation of 3 satellites with nearly polar orbits.
- Two of them Swarm-A and Swarm-C fly alongside each other with a separation of 1.5 degrees at an altitude of ~470 km.
- Swarm-B flies at an altitude of ~520 km.
- However, in the initial stages, the satellites flew close to each other.
- Electron density data obtained from onboard **Langmuir Probe (LP)** is used to study the TIDs along with magnetic field field data.
- All the data can be obtained via ftp from "***ftp://swarm-diss.eo.esa.int***"

Traveling Ionospheric Disturbances (TIDs)

- In simple words, the TIDs are horizontally propagating wave-like structures in the electron density, observed in the F-layer.
- Medium scale traveling ionospheric disturbances (MSTIDs) are features of milatitude ionosphere with typical wavelengths of the order of ~100-500 km.
- The nighttime TIDS are mostly attributed to the Perkins instability whereas the daytime TIDs are understood to be mostly due to effects of gravity waves.
- However, the magnetically conjugate nature of the TIDs during both night- and day-time suggests there deep rooted relationship to the ionospheric electrodynamics.

Day-time TID (~ 10.5 LT):Simultaneous SWARM Vs TEC Observations

Night-time TID (~ 22.5 LT)Simultaneous SWARM Vs TEC Observations

[Kil et.al., 2017]

Density vs Magnetic fluctuations : Examples

TID without magnetic fluctuations

TID with magnetic fluctuations

Electron density in log scale as a function of magnetic latitude

Percentage density fluctuation a function of magnetic latitude

Magnetic fluctuation perpendicular to the ambient filed direction as function of magnetic latitude

Magnetic fluctuation parallel to the ambient filed direction as function of magnetic latitude

Field aligned current as a function of magnetic latitude

Cases with/without Magnetic Fluctuations (2014)

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Density vs Magnetic fluctuations: Anti-Correlated ?

ΔNe and Δ B are multiplied by factors to fit into same scale for better visualization

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Conclusions

- Not all TIDs (as seen as density fluctuations) are associated with magnetic fluctions.
- ΔNe and $\Delta B_{\perp}$ are mostly anti-correlated.
- Needs more investigation.