# Spectral Properties of Kilometer-scale Equatorial Irregularities as Seen by the Swarm Satellites

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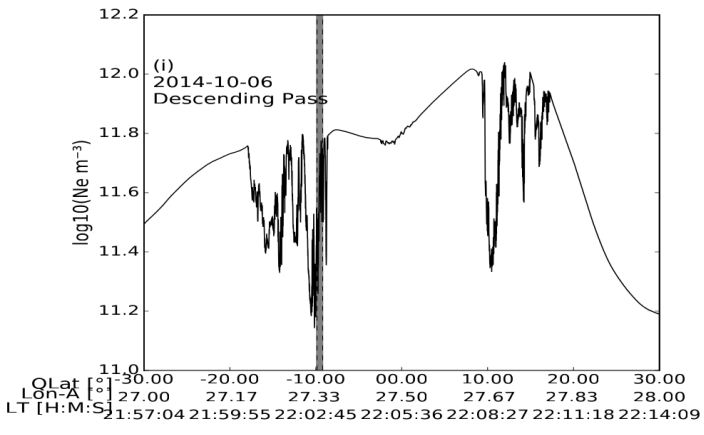
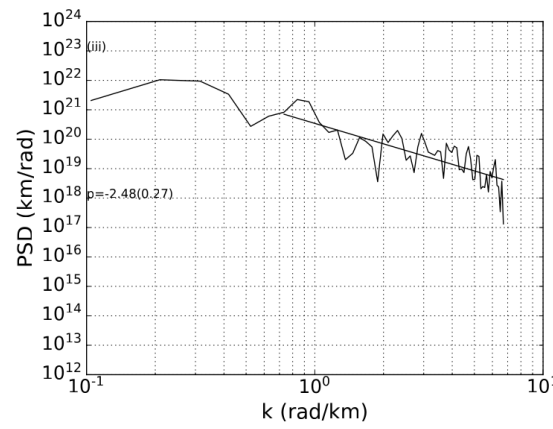
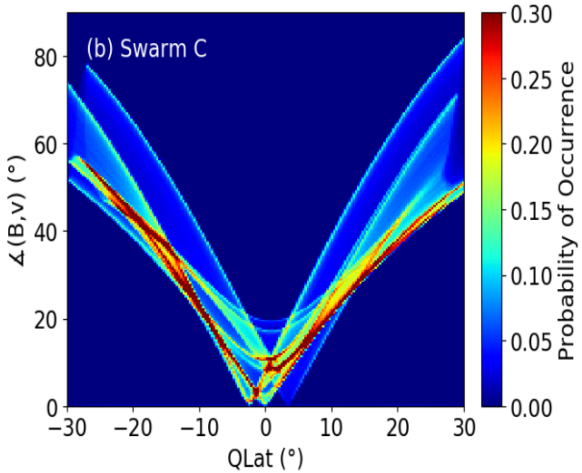
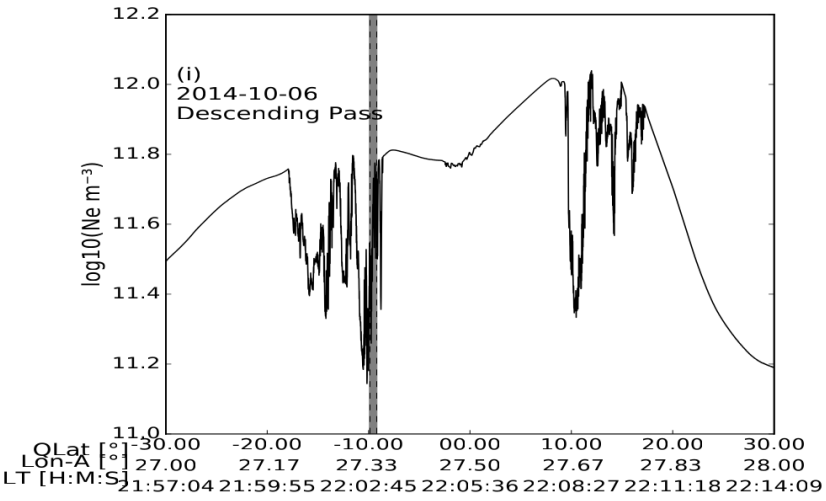


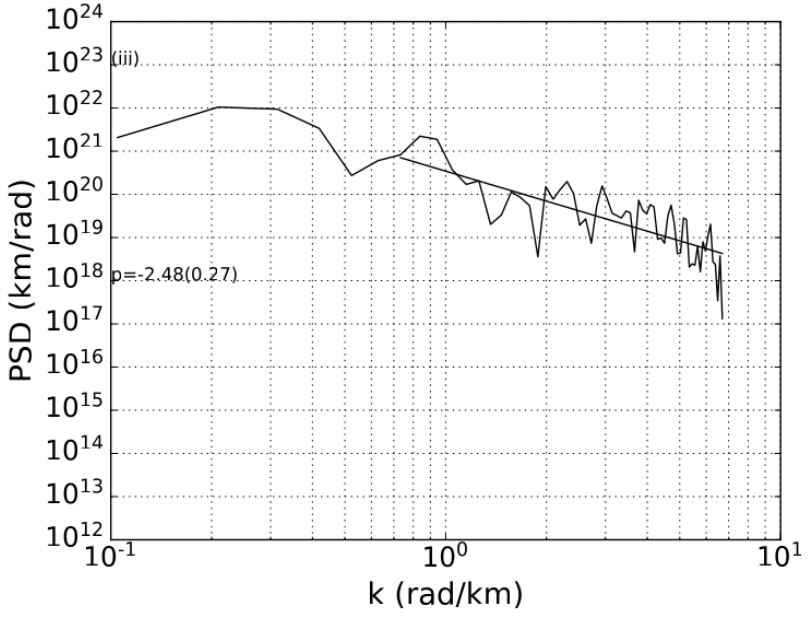



- ESA Swarm satellites, $\lesssim 100,000$ equator crossings per s/c;
- detect well-known plasma bubbles and irregularities
- with the Langmuir Probes, partially at 16 Hz time resolution,
- which corresponds to $\sim 1$ km spatial scale;
- the power spectral properties of $N_e$ are important,
- e.g. for phase screen models of scintillations (Rino, 1979).
- previously studied with C/NOFS, e.g. Rodrigues et al. (2009);
- this study:
  - polar orbits,
  - angle between $\vec{B}$ and s/c track between $\approx 0$ and $40^\circ$



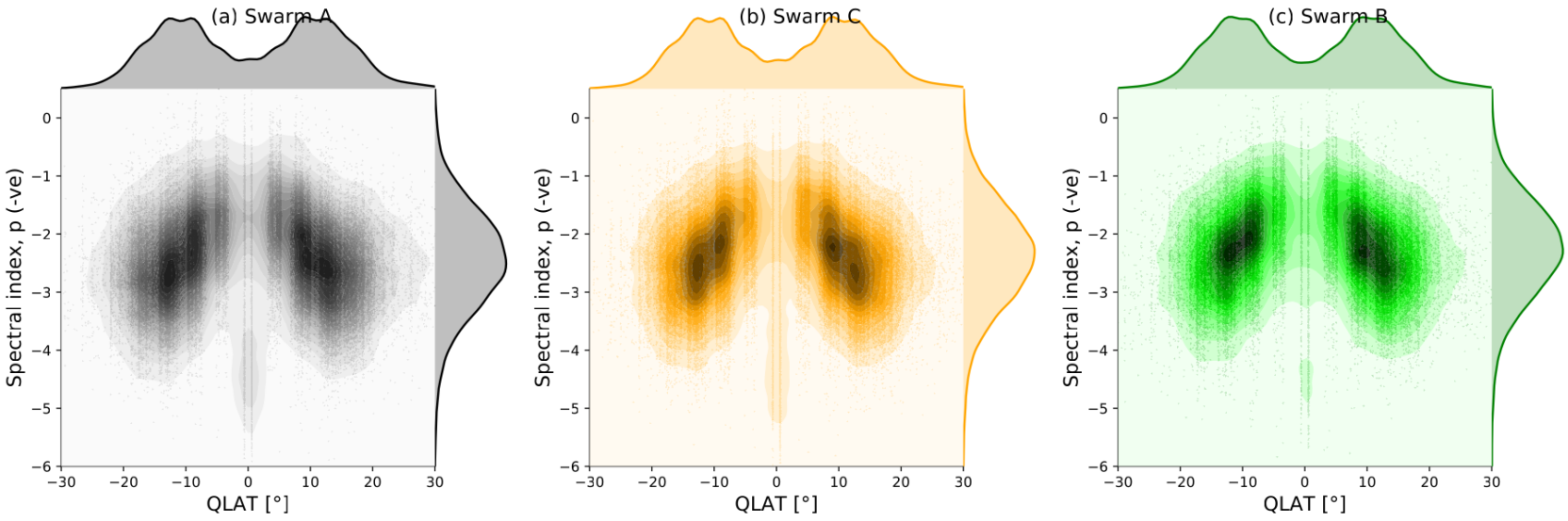
# Spectral Index



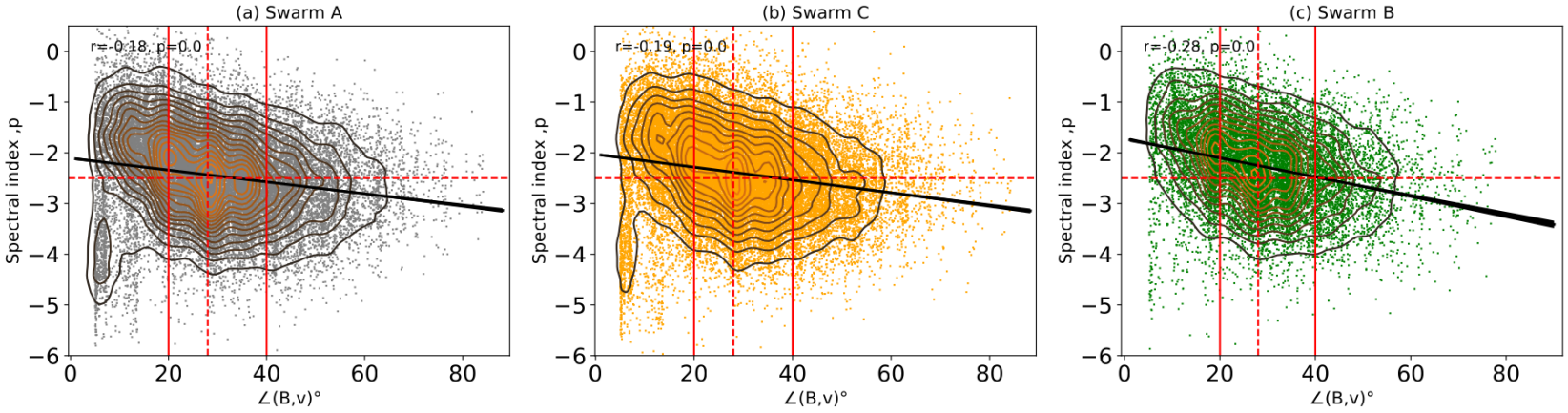

- FFT of the residual $\Delta N_e$ after linear detrending
- within a moving window of 8-s,
- when $std\,(\Delta N_e)$ is above a threshold;
- assume irregularities are frozen for 8 s, frequency $\rightarrow$ wave number $k$,
- straight line fit of $\log(k)$-$\log(P)$ gives
- the spectral index $p$

# Results




- the spectral index statistically varies with the magnetic latitude
- symmetrically around the equator
- from more “inertial” near the equator
- to more “dissipative” turbulence further away.

# Results




- the spectral index statistically weakly varies with the angle between $\vec{B}$ and $\vec{v}_{s/c}$
- this may be an effect of the latitude dependence
- rather than caused by the probing of the irregularities at different aspect angles?

# Conclusions

- the spectral index estimated from the 16 Hz Swarm density data 2014–2018 is with the ranges previously observed with other missions (C/NOFS, DE-2, . . . )
- the spectra vary with magnetic latitude, symmetrically around the equator,
- being more shallow near $0^\circ$ QDLat and steeper further away;
- there is also a weak dependence on the magnetic field aspect angle,
- which might be caused by anisotropic irregularities (at $\sim 1$ km scales),
- or be a consequence of the latitude dependence.