

TRANSMIT

TRAINING RESEARCH AND APPLICATION NETWORK TO SUPPORT THE MITIGATION OF IONOSPHERIC THREATS



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Morphology of shape of the ionospheric irregularities and GPS scintillation statistics

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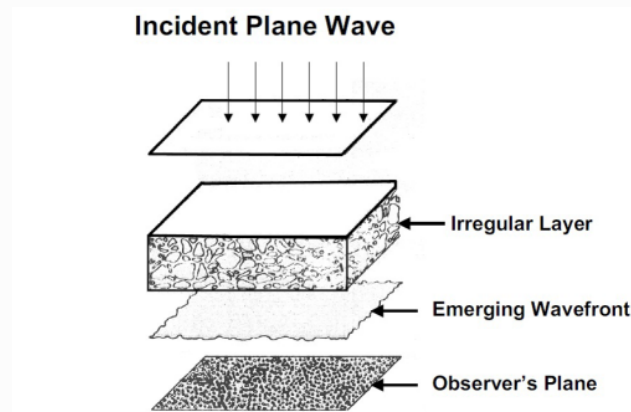
11th ESWW, Liege, Belgium 18.11.2014.





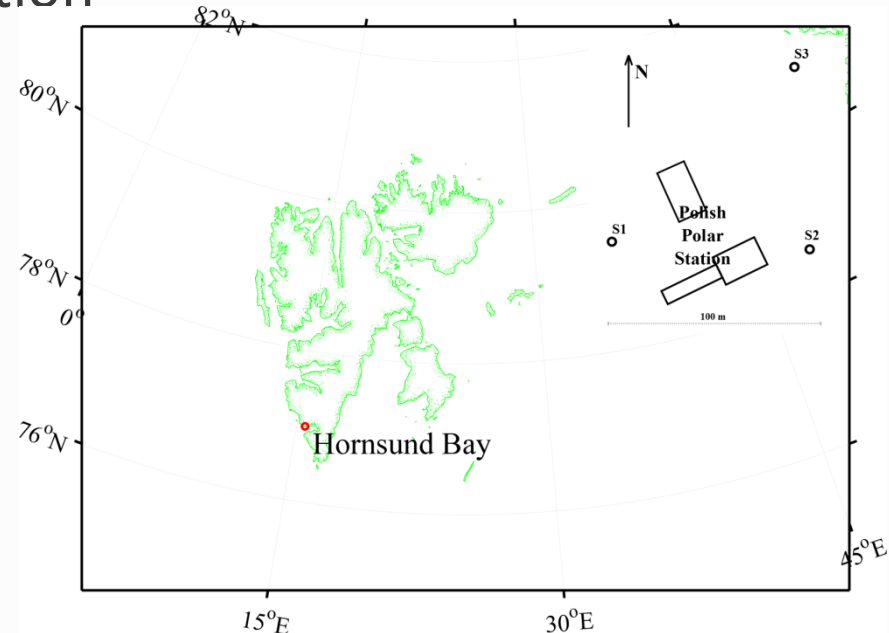
Introduction

- Ionospheric irregularities – random electron density fluctuations within the ionosphere
- Variability of the ionospheric drifting irregularity shape and scintillation statistics, reflects the ionospheric behavior influencing the signal propagation



Pictorial illustration of the phase fluctuations imposed on a wavefront traveling away from an irregular layer for a vertical radio path.

Basu S., 2003. Ionospheric scintillation: A tutorial

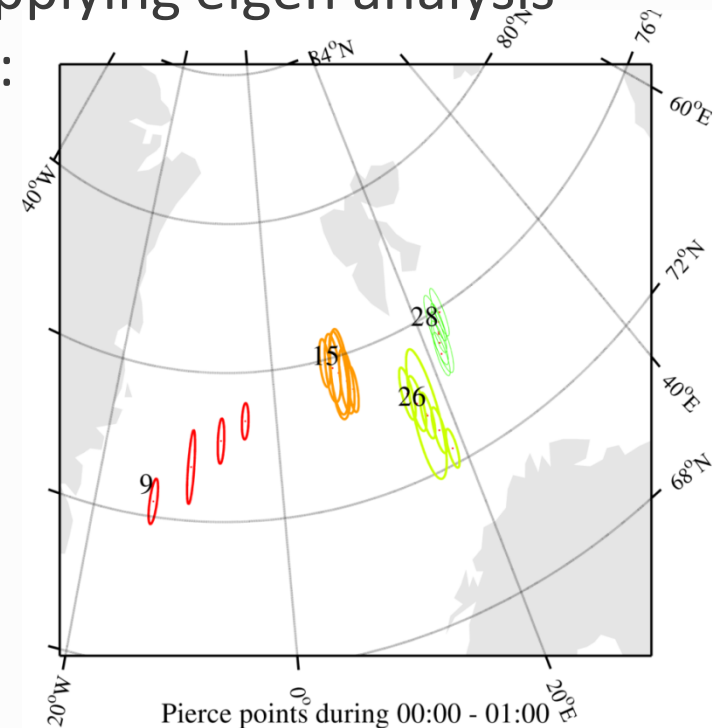
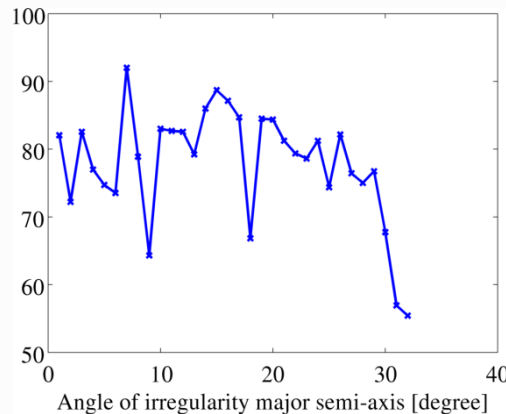
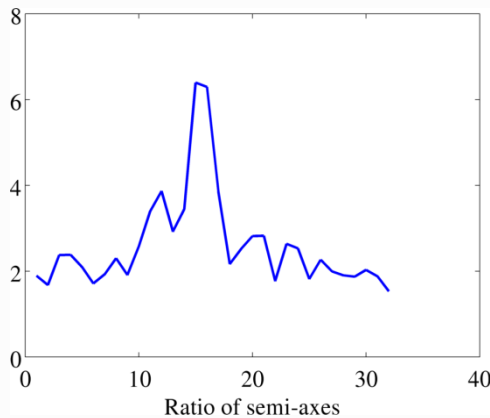




Eigen analysis

- Allows us to identify the principal directions in which the data varies
- Shapes of the irregularities defined by applying eigen analysis on covariance matrix of phase gradients:

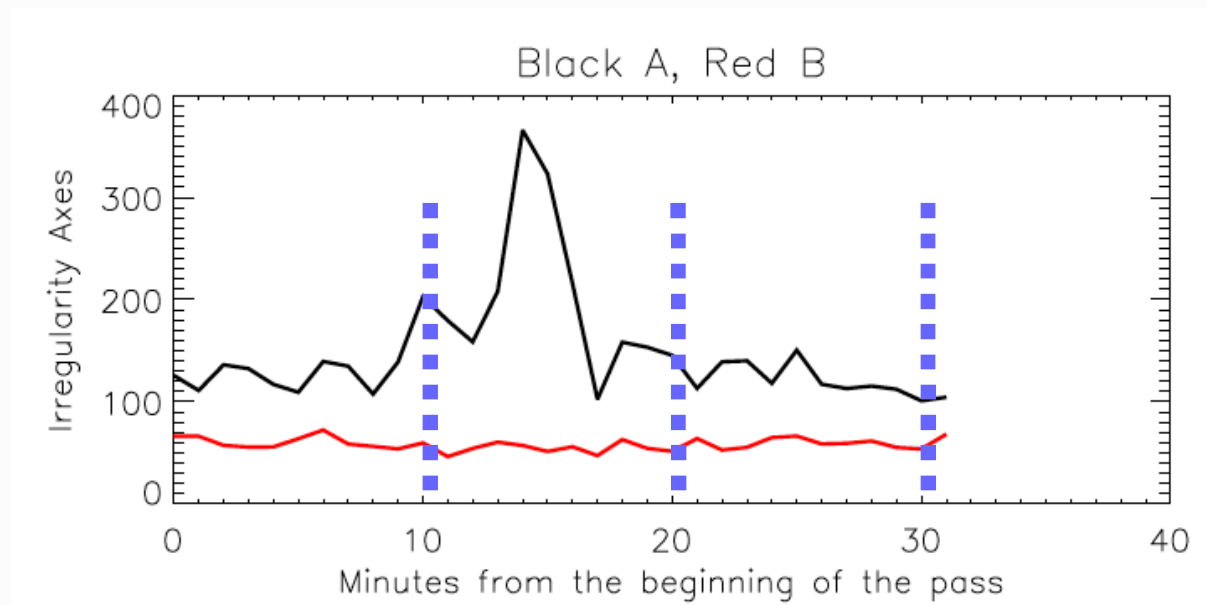
$$C = \begin{bmatrix} \left\langle \frac{d\varphi}{dx} \frac{d\varphi}{dx} \right\rangle & \left\langle \frac{d\varphi}{dx} \frac{d\varphi}{dy} \right\rangle \\ \left\langle \frac{d\varphi}{dy} \frac{d\varphi}{dx} \right\rangle & \left\langle \frac{d\varphi}{dy} \frac{d\varphi}{dy} \right\rangle \end{bmatrix}$$

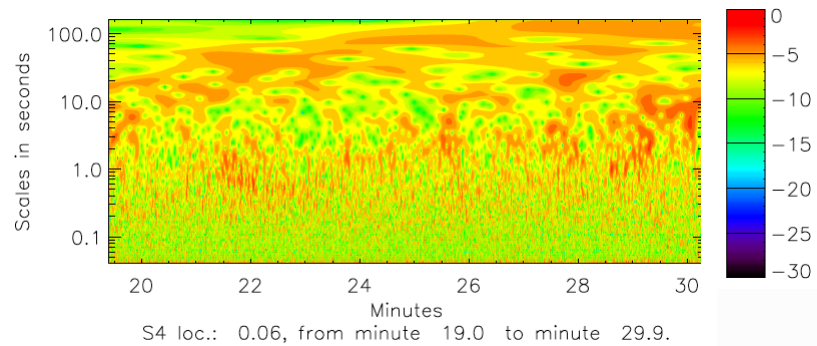
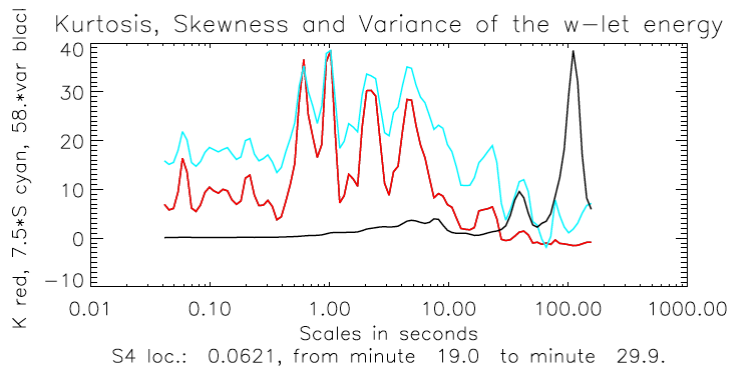
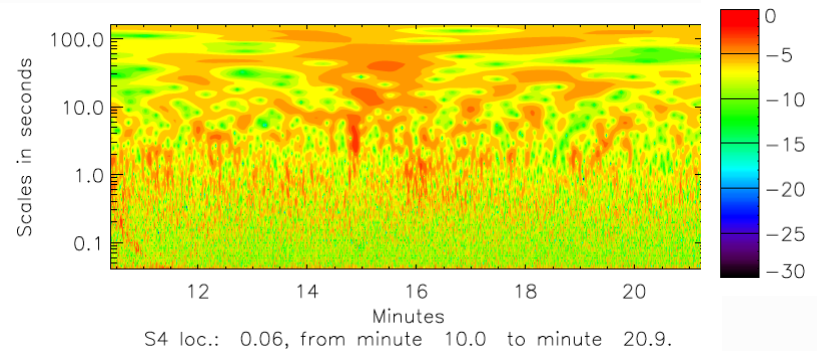
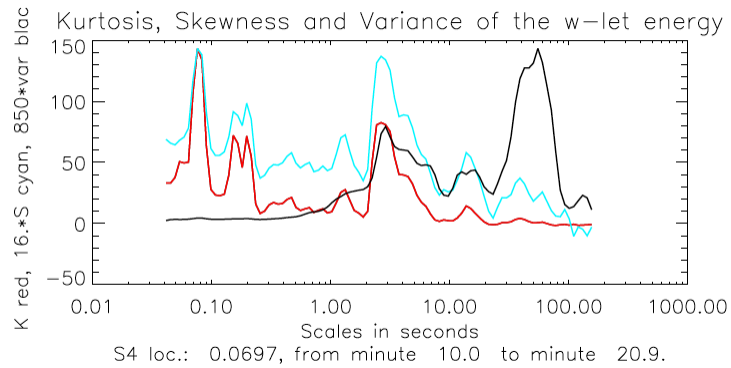
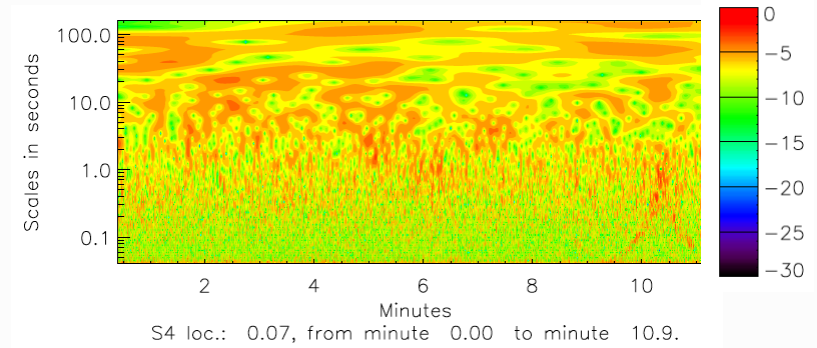
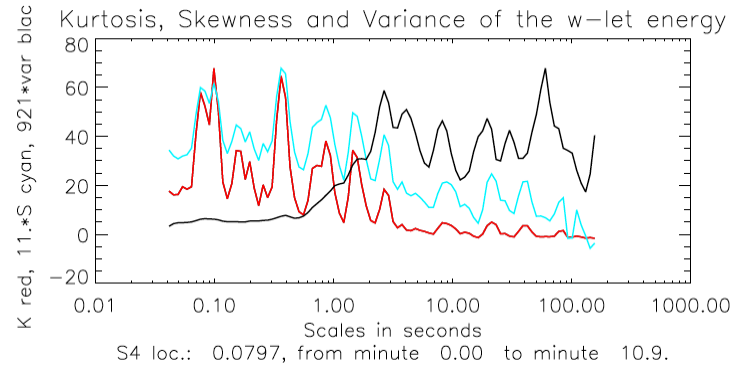




Wavelet analysis

- Explore how scintillation statistics vary with time scale and relate this variability with the shape of irregularities producing the scintillation
- Wavelet decomposition used in performing such analysis

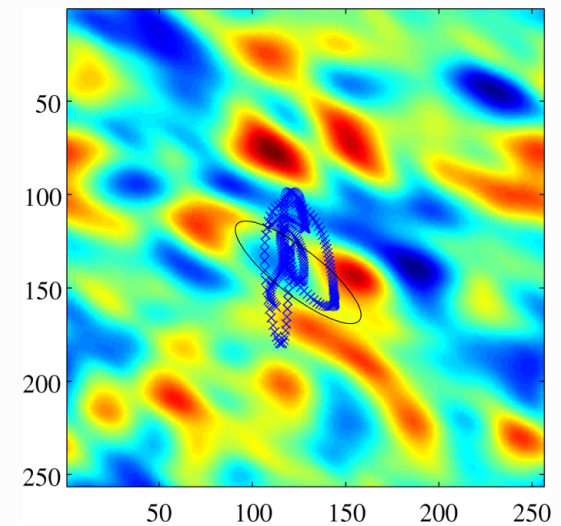
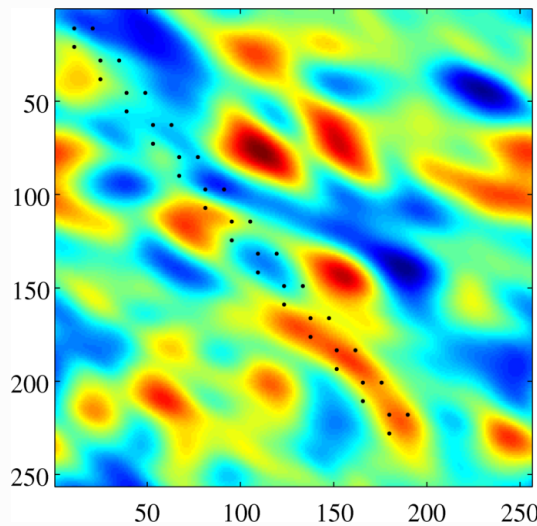
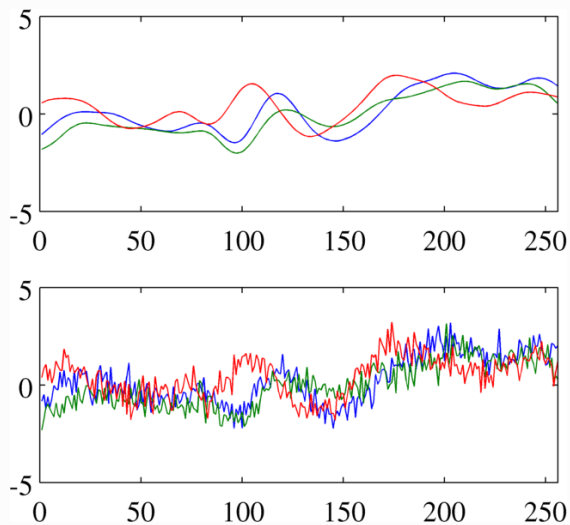






Conclusions

- Shape dynamics of irregularities could be related with the scale properties of radio scintillation
- Further work:
 - validate estimated properties using different measuring techniques, and observations;
 - potential development of the ionospheric model





Thank you

Please, feel(be) invited for more detail discussion on the topic at the poster session, right after oral presentations.