IDENTIFICATION OF IONOSPHERIC SIGNATURES OF MAGNETOSPHERIC BOUNDARIES BY CLASSIFICATION

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The SuperDARN radar network provides continuous access to the Doppler spectra in the auroral regions. It has been reported that the characteristics of backscatter spectra allow to locate the ionospheric projection of the magnetospheric cusp [1]. Recent investigations lend further support to a relationship between the spectral characteristics and the projection of magnetospheric regions [2]. The identification of these regions, however, has essentially relied so far on ad hoc criteria, involving mostly visual inspection.

This need for a more quantitative approach has led us to perform a statistical analysis based on techniques such as unsupervised classification and principal component analysis. These techniques are applied to the autocorrelation functions of the radar data. The first result is that the salient characteristics of the autocorrelation functions show very few degrees of freedom, i.e. most of the observations can be explained in terms of a combination of a limited number of "modes". When plotting these modes in an adequate coordinate system (magnetic local time vs magnetic latitude), it appears that some of them almost exactly match the footprint of magnetospheric regions such as the cusp, the auroral oval, the low-latitude boundary layer, etc.

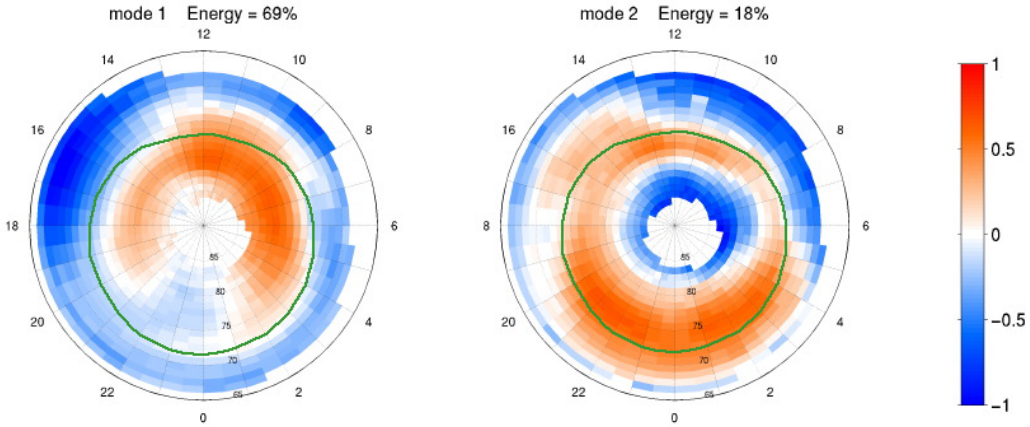

Figure 1: The amplitude of two strongest principal components, shown vs magnetic local time (the Sun is at noon) and vs magnetic latitude (ranging from 65 to 90 deg). The green oval-like curve represents the average position of the poleward boundary of the auroral oval.

We conclude that a statistical analysis of the SuperDARN data succeeds in identifying different types of characteristics, which in turn correspond to specific magnetospheric regions. It must be stressed that these regions are identified blindly, i.e. without ever specifying their number or their location. This approach can be used to systematically explore the location of these regions vs different solar wind conditions and for different seasons. It also opens the interesting perspective of identifying magnetospheric regions in real time.

REFERENCES

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