Analysis of ionospheric parameters using graphical models

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The influence of geomagnetic disturbances and solar activity on ionosphere is the main topic of this presentation. We employ multivariate statistic methods applied to daily observational data within the period 1994 – 2009, which were obtained using mid-latitude ionosondes. For the investigation of relationships between time variations of critical frequency (foF2) and solar radiation flux at 10.7 cm wavelength (F10.7 index), we use graphical models which describe and transparently represent the structure of dependence relationships in the time series. A specific problem is to determine, which variables interact and how strongly, and to decide if the data can be condensed without any loss of information. The theoretical basis of the technique is the concept of conditional independence and the prime tool is the conditional independence graph. We consider the structure of pairwise dependence of its individual components, looking for the maximum likelihood estimate of the variance matrix under the conditions given by the graphical model. The data best fit model was computed.

We compare this method with cross-correlation analysis results and we use it to search for any time delays between foF2 and F10.7. We found out that the method is also suitable for the analysis of the dependence between foF2 and shifted F10.7 time series. The conditional independence graphs method can be applied even in the case when classical parametric methods are not convenient, e.g. when the data are not normally distributed.