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Study of Cross-Correlation between Information Matrices of Observations of the URAGAN Muon Hodoscope and Dst Index

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Averaged intensity and anomaly functions

$$T_{s1}(i,j) = m_s(i,j) + \frac{\sigma_s(i,j)}{\sqrt{k}} c_{pd}, \quad T_{s2}(i,j) = m_s(i,j) - \frac{\sigma_s(i,j)}{\sqrt{k}} c_{pd}.$$

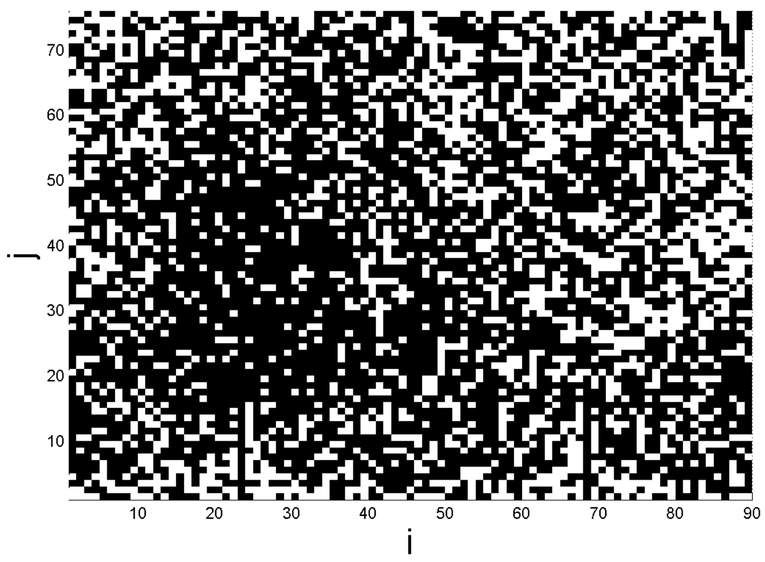
$$\rho_{s1}(i,j) = \frac{T_{e1}(i,j) + T_{e2}(i,j)}{T_{s1}(i,j) + T_{s2}(i,j)}, \quad \rho_{s2}(i,j) = \frac{T_{s1}(i,j) - T_{s2}(i,j)}{T_{e1}(i,j) - T_{e2}(i,j)},$$

$$\rho_s(i,j,\alpha) = \rho_{s1}(i,j) + \alpha\rho_{s2}(i,j).$$

$$\rho_s(i,j,\alpha) \geq \rho_0, \quad f_s(i,j) = 1, \quad \rho_s(i,j,\alpha) < \rho_0, \quad f_s(i,j) = 0.$$

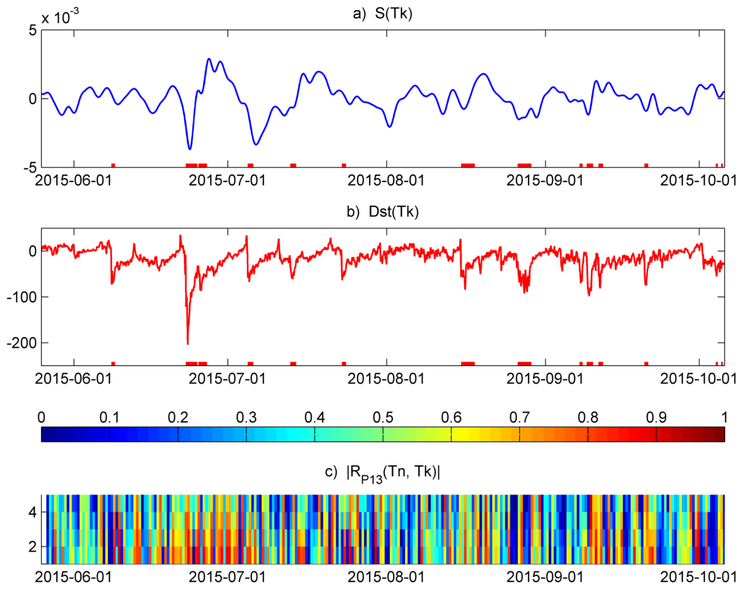
$$\varepsilon(Tk) = \frac{1}{N_1 N_2} \sum_{i=1}^{N_1} \sum_{j=1}^{N_2} f(i,j,Tk) \qquad S(Tk) = \frac{1}{N_1 N_2} \sum_{i=1}^{N_1} \sum_{j=1}^{N_2} M(i,j,Tk)$$

Indicator Matrix F_s

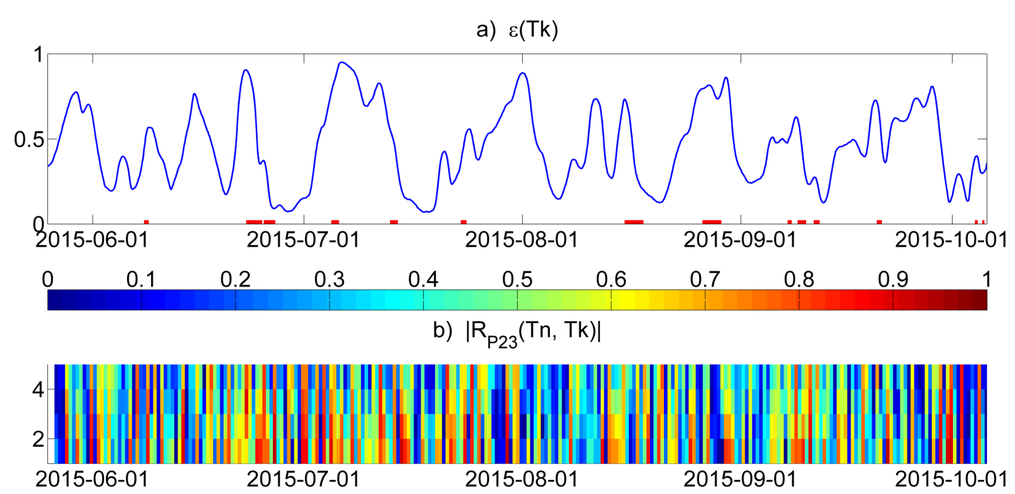


Indicator matrix for 28.06.2015 17:00 – 29.06.2015 17:00.

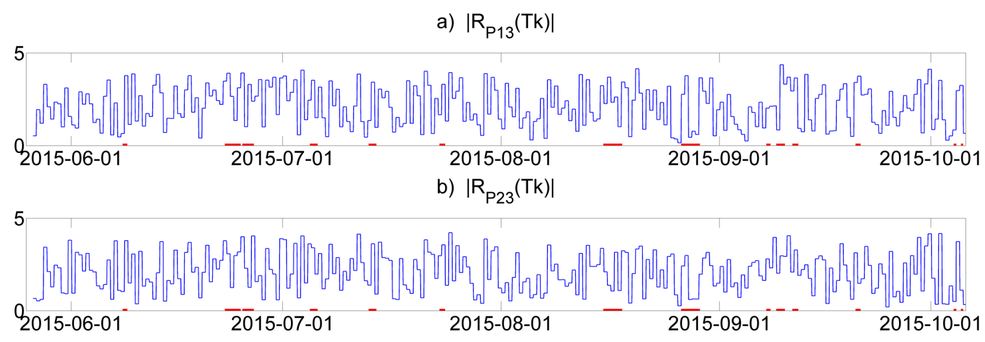
Cross-correlation between S(Tk) and Dst(Tk)



Cross-correlation between ε(Tk) and Dst(Tk)



Sums of cross-correlation



Conclusions

- Cross-correlations between functions of the averaged intensity and anomaly and Dst index may be the basis for precursors of geomagnetic storms.
- Time periods of increased geomagnetic activity are most likely to be preceded, on average, by 1-1.5 days, by time periods with elevated values of the cross-correlation.
- The developed approach allows for significant improvements.

Acknowledgements

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