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Study of wave and turbulent activities in the foreshock region using the FGM magnetic record of the Cluster space mission

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In this paper we study the turbulent and intermittent nature of the terrestrial foreshock region using the FGM magnetic records of the Cluster mission. The investigation of the turbulent dynamics is based on probability density function (PDF), spectral and structure function (SF) analyses of the magnetic signals. It is shown that the level of intermittency in the different parts of the foreshock can be monitored in terms of space and time by the fourth statistical moment of the temporal differences of the time-series, i.e. by their flatness. In the analyses, the multi-spacecraft observations have a key role, since with them the intermittency in the plasma fluctuations can be revealed not only in temporal but also in spatial scales. However, in the analyses, it must be taken into account that the dynamics of the foreshock region is governed not only by turbulent fluctuations but also by regular wave phenomena occurring in certain frequencies. From the point of view of the turbulence studies, the wave activities can strongly complicate the interpretation of the results of the analyses, since they can e.g. distort the power-law behavior of the turbulent spectra and influence the shapes of the PDF-s and structure functions of the magnetic records in certain time scales. For this reason, a special method based on dynamic wavelet filtering is intended to be introduced to discriminate between wave and turbulent components of the analyzed time records. The method is tested in hot-flow anomalies (HFA) that are transient plasma disturbances occurring along the interaction line of the bow shock and a tangential discontinuity plane embedded in the solar wind. The HF anomalies are typical regions where the wave and turbulent phenomena are mutually apparent.