

Solar system plasma Turbulence: Observations, inteRmittency and Multifractals

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The FP7 project STORM is funded by the European Commission to “add value to existing data bases through a more comprehensive interpretation”. STORM targets plasma and magnetic field databases collected in the solar wind (Ulysses and also some planetary missions), planetary magnetospheres (Venus Express, Cluster, a few orbits from Cassini), cometary magnetosheaths (e.g. Haley from Giotto observations). The project applies the same package of analysis methods on geomagnetic field observations from ground and on derived indices (e.g. AE, AL, AU, SYM-H). The analysis strategy adopted in STORM is built on the principle of increasing complexity, from lower (like, e.g., the Power Spectral Density - PSD) to higher order analyses (the Probability Distribution Functions – PDFs, Structure Functions - SFs, Fractals and Multifractals - MFs). Therefore STORM targets not only the spectral behavior of turbulent fluctuations but also their topology and scale behavior inferred from advanced mathematical algorithms and geometrical-like analogs. STORM started in January 2013 and ended in December 2015. We will report on a selection of scientific and technical achievements and will highlight: (1) the radial evolution of solar wind turbulence and intermittency based on Ulysses data with some contributions from Venus Express and Cluster; (2) comparative study of fast and slow wind turbulence and intermittency at solar minimum; (3) comparative study of the planetary response (Venus and Earth magnetosheaths) to turbulent solar wind; (4) the critical behavior of geomagnetic fluctuations and indices; (5) an integrated library for non-linear analysis of time series that includes all the approaches adopted in STORM to investigate solar system plasma turbulence. STORM delivers an unprecedented volume of analysed data for turbulence. The project made indeed a systematic survey, orbit by orbit, of data available from ESA repositories and Principal Investigators and provides results ordered as a function of the targeted system (solar wind/magnetospheres/geomagnetic indices), solar cycle phase (minimum versus maximum), type of result (PSDs, PDFs, Multifractals). The results catalogues, available online from <http://www.storm-fp7.eu>, include 4094 PSD spectra, 9566 PDFs and 15633 multifractal spectra (from partition function and respectively Rank Ordered (ROMA) formalisms). These results are obtained at solar maximum (2001-2002, both in the solar wind and the terrestrial magnetosheath) and solar minimum (1997-1998 in the solar wind, 2007-2008 in the solar wind, Venus and Earth magnetosheath and selected regions of the magnetosphere).

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