Instantaneous multiscale properties of solar wind dynamical regimes and their attractors

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The solar wind is characterized by a multiscale dynamics showing features of chaos, turbulence, intermittency, and recurring large-scale patterns, pointing towards the existence of an underlying attractor. However, magnetic field and plasma parameters usually show different scaling regimes with different physical and dynamical properties. Here by using a recent and novel approach developed in the framework of dynamical systems we investigate the multiscale instantaneous properties of solar wind magnetic field phase space by means of the evaluation of instantaneous dimension and stability. We show the existence of a break in the average attractor dimension occurring at the observed scaling break between the inertial and the dissipative regimes. We further show that sometimes the dynamics is higher dimensional (d>3) suggesting that the phase space is larger than that described by the system variables and invoking for an external forcing mechanism, together with the existence of at least one unstable fixed point that cannot be definitely associated with noise. Instantaneous properties of the attractor therefore provide an efficient way of evaluating dynamical properties and building up improved cascade models.