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Solar wind forecasting: a method based on data assimilation with Kalman filters

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Data Assimilation through Kalman filtering [1,2] is a powerful statistical tool which allows to combine modeling and observations to increase the degree of knowledge of a given system. We apply this technique to the forecast of solar wind parameters (proton speed, proton temperature, absolute value of the magnetic field and proton density) at 1 AU, using the model described in [3] and ACE data as observations. The model, which relies on GOES 12 observations of the percentage of the meridional slice of the sun covered by coronal holes, grants 1-day and 6-hours in advance forecasts of the aforementioned quantities in quiet times (CMEs are not taken into account) during the declining phase of the solar cycle and is tailored for specific time intervals. We show that the application of data assimilation generally improves the quality of the forecasts during quiet times and, more notably, extends the periods of applicability of the model, which can now provide reliable forecasts also in presence of CMEs and for periods other than the ones it was designed for. Acknowledgement: The research leading to these results has received funding from the European Commission's Seventh Framework Programme (FP7/2007−2013) under the grant agreement N. 218816 (SOTERIA project: http://www.soteria-space.eu). References: [1] R. Kalman, J. Basic Eng. 82, 35 (1960); [2] G. Welch and G. Bishop, Technical Report TR 95-041, University of North Carolina, Department of Computer Science (2001); [3] B. Vrsnak, M. Temmer, and A. Veronig, Solar Phys. 240, 315 (2007).