Geophysical Research Abstracts
Vol. 20, EGU2018-8685, 2018
EGU General Assembly 2018

Solar Wind Forecast based on Data Assimilation with an Adaptive Kalman Filter

Tatiana Podladchikova (1), Astrid M. Veronig (2), Manuela Temmer (2), and Stefan Hofmeister (2)

(1) Skolkovo Institute of Science and Technology, Moscow, Russian Federation (t.podladchikova@skoltech.ru), (2) Institute of Physics & Kanzelhöhe Observatory, University of Graz, Austria

Accurate solar wind modeling is important for predicting the arrival and geomagnetic response of high-speed solar wind streams as well as for modeling the transit of coronal mass ejections in interplanetary space and their impact at Earth. Data assimilation techniques combining the strength of models and observations provide a very useful tool for accurate solar wind forecasts. We develop a method to predict the solar wind speed at Earth 1-day ahead by using coronal hole areas derived from SDO AIA images in combination with in situ solar wind plasma and field data (speed, density, and magnetic field magnitude) from ACE and Wind spacecraft. To forecast the solar wind speed, we form a multidimensional linear regression model relating the solar wind speed one day ahead with the fractional coronal hole area observed three days before the current moment, as well as proton density, magnetic field magnitude, and solar wind speed at the current moment. One of the major concerns with such data assimilation scheme is that the regression coefficients do not remain constant and are time-varying. To avoid the fitting of regression coefficients to a particular situation, that can be changed in future, we develop an adaptive Kalman filter to create a dynamic linear regression for the 1-day ahead prediction of the solar wind speed. Testing the developed forecasting technique for the period 2010-2017, we obtain a correlation coefficient between the predicted and observed solar wind speed of 0.93, with an RMS error of prediction of 33 km/s. These results demonstrate that the proposed adaptive Kalman filter method significantly improves the quality of the solar wind forecasts and can be applied for reliable real-time warnings of the space weather conditions in the near-Earth environment.