

Forecast of the solar wind velocity and the interplanetary magnetic field radial component polarity for the September 2005 CAWSES Campaign

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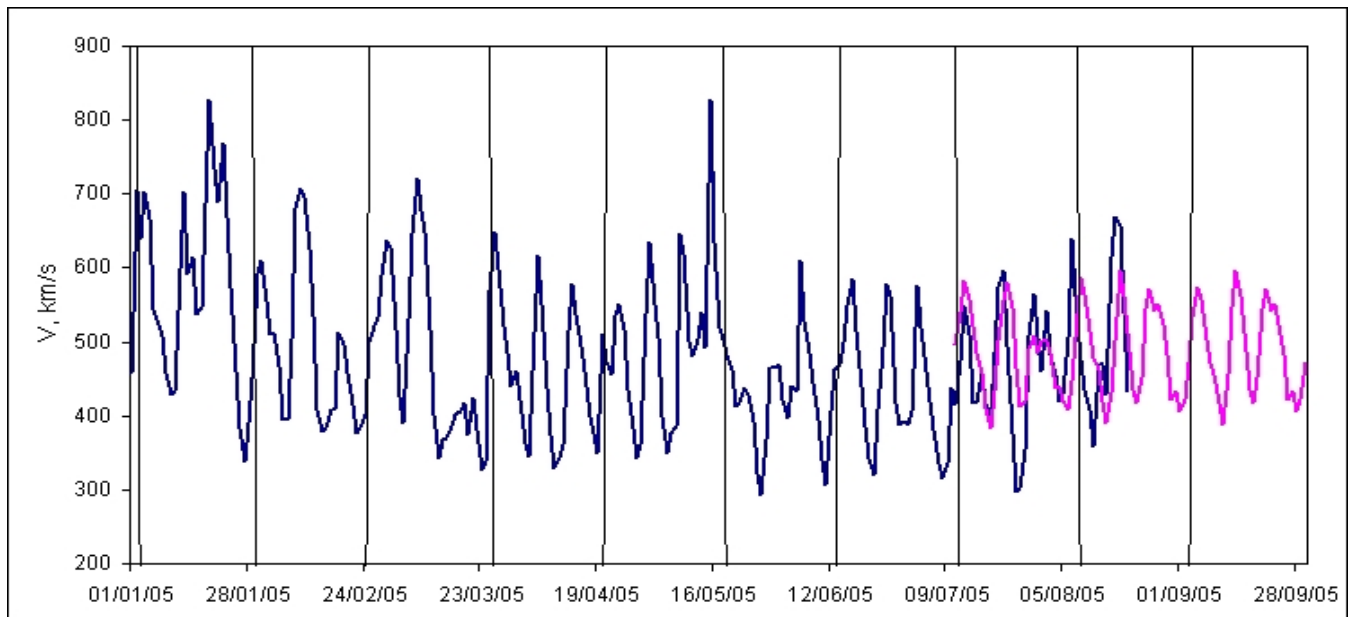


Fig1. Predicted solar wind speed at the Earth's orbit for the period of the CAWSES September 2005 Campaign. Blue curve – actual hourly averaged values measured during January 1, 2005 – August 19, 2005 on board ACE satellite (<http://www.srl.caltech.edu/ACE/>). Magenta curve – predicted values of the solar wind speed for the totally independent examination period of time from August 20, 2005 to September 30, 2005 together with the previous test period of July 11 up to August 19.

Short description

The forecast of the solar wind speed and IMF polarity was generated for the period covering the CAWSES Campaign (September 2005, practically CR 2034). The work was done in the D.V.Skobel'syn Institute of Nuclear Physics, Moscow State University by I.S.Veselovsky (veselov@dec1.sinp.msu.ru) and Yu.S.Shugai (JShugai@srd.sinp.msu.ru). The method used is just a continuation of the measured data sets according to the simplest principle: the next period of interest (one or two solar rotations ahead) is some averaged repetition of several number of previous rotations measured on board ACE satellite. This method was selected because of simplicity and taking also into account our experience of more complicated and recent 'recipes' and data analysis. A rather good and stable corotating character of variations due to big coronal holes prevailing during the declining phase of the current 23-rd solar cycle was documented (Veselovsky et al, 2005). Mainly it results in a simple rule of this kind of an inertial method: "the next Carrington rotation (CR) is just as an average of several previous CRs".

Test sets for the solar wind velocity were constructed as follows: for CR 2032 as the average of seven CRs 2025-2031; for CR 2033 as the average of eight CRs 2025-2032. The mean square root deviation between predicted and measured solar wind velocity values is equal to 69.3 km/s for the test period July 11-August 19 (CR 2032-part of CR 2033). The forecast for September is the average of nine CRs: eight measured CRs 2025-2032 and one partially measured/partially forecasted (CR2033) period. See Fig.1 for the velocity prediction.

Fig.2 shows the correspondence of observed solar wind velocity and radial magnetic field polarity signals for eight CRs. We expect that this pattern will be persistent also during CR 2034.

The forecast can be of some interest for participants of the CAWSES September 2005 Campaign. Preparations can be done with this forecast in hands, which proved to be robust and accurate in phasing and amplitudes up to ten-twenty percent during the period of previous several solar rotations in the current phase of the solar cycle. Similar attempts were performed in summer of 2005 and proved to be rather successful. Naturally, short sporadic perturbations can occur occasionally and unexpected. In this case, they are superposed on these

expected variations. The good recurrent pattern also can brake due to the internal restructuring processes inside the Sun. They also can be not predicted in advance by this method.

Our important hypothesis is that the stable corotating pattern will be preserved. This pattern is documented in solar wind and the interplanetary magnetic field data. It consists of repeated high speed solar wind streams from coronal holes with a specific geometry configuration: one negative and two positive domains at the Earth's orbit per one rotation. The movie of the parent coronal hole patterns was constructed and analyzed with SOHO/EIT daily images in the line 28.4 nm (<http://sohowww.nascom.nasa.gov/data/realtime/gif/>). Several other interesting features of this period of time can be marked: 1) unusual existence of an active region situated like an "island" near the equator inside the big positive coronal hole lasting for several rotations; 2) the positive polarity high speed stream had two peaks in the velocity time profile during each solar rotation and lasting for the whole 2005 up to now; 3) usual for this phase of cycle long-lived prominences and very long and high prominence channels are seen, ready to erupt with the formation of big coronal mass ejections; 4) active regions are connected by magnetic loops and form big complexes evolving simultaneously on one side of the Sun; 5) global latitudinal asymmetry of the activity distribution on the Sun and recurrent patterns in the heliosphere are documented; 6) super long-duration energy releases and structures are seen as clusters lasting for months; 7) many features typical for this phase of the solar cycle were also documented during several similar previous episodes in declining cycles 20-22.

After these general comments we are turning the attention to the results of the forecast. They are shown in Figs.1, 2.

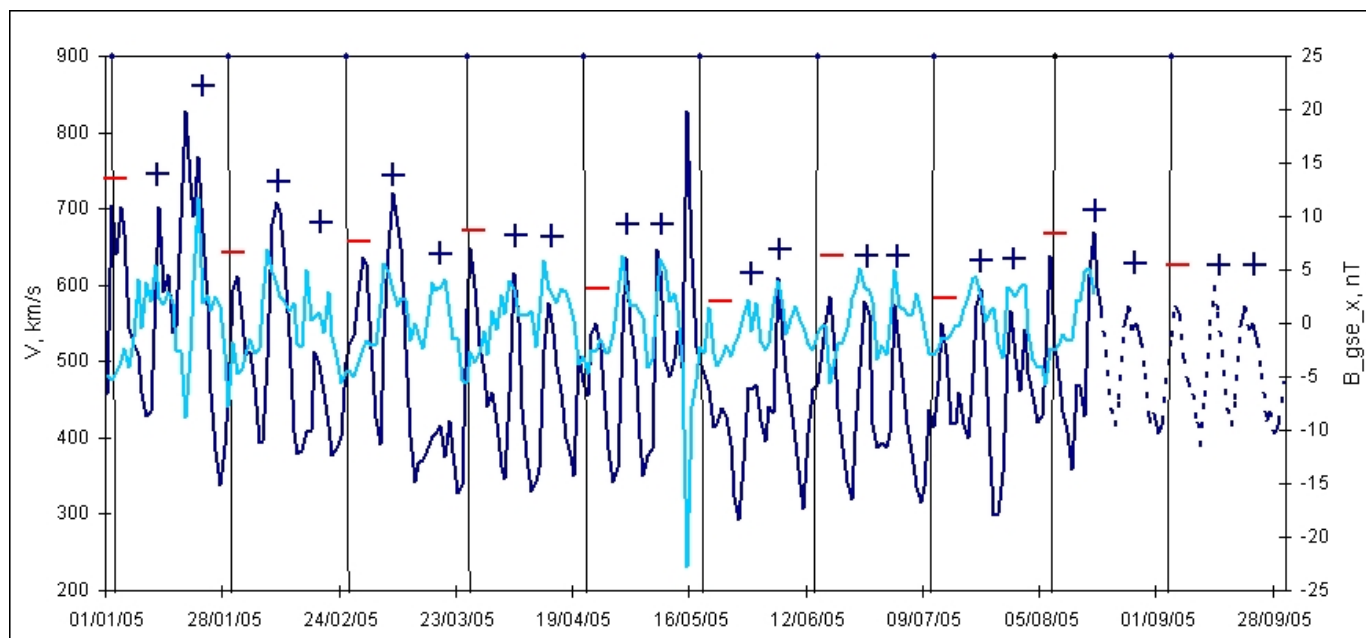


Fig. 2. Predicted solar wind speed and the sign of the Bx-component of the interplanetary magnetic field (IMF) at the Earth's orbit during August 20-September 30, 2005. Positive polarity (+ signs) means the field away from the Sun. Negative (- signs) –means towards the Sun. Solid blue curve – actual values of solar wind velocity, dashed blue curve – predicted values of solar wind velocity also shown in Fig.1; light blue curve – measured Bx-component of interplanetary magnetic field (<http://www.srl.caltech.edu/ACE/>).

Reference:

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