Experience of the short-term space weather forecast based on the real-time solar wind data

A.A. Petrukovich

Space Research Institute, Russian Academy of Science
Moscow, (apetruko@iki.rssi.ru)

An automated Web-based system of generic space weather forecast is developed in Space Research Institute, and is operating in real-time for more than 3 years at

http://www.iki.rssi.ru/forecast

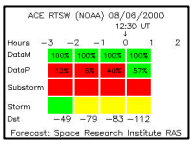
It uses ACE RTSW solar wind and interplanetary magnetic field data and provides short-term qualitative predictions, estimates of geomagnetic indices and verbal forecasts.

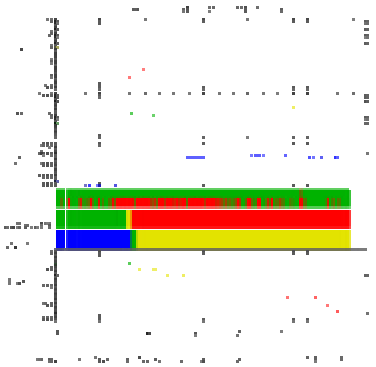
The output of this system is used by a number of consumers as a general warning and as an input to more special models.

The goal of this pilot project is to develop reliable and practically useful algorithms for translation of solar wind measurements into meaningful geomagnetic predictions.

Reliability of system components is illustrated on statistics and examples.

Example of Forecast output: http://www.iki.rssi.ru/forecast





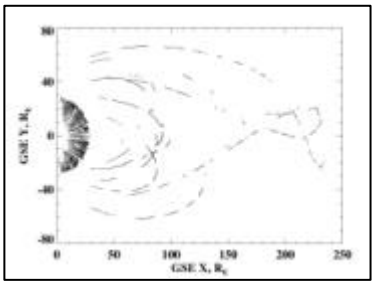
Forecast stages: quality aspect

- **Measurement reliability (physics)**
- **Measurement error (technical)**
- **Data flow stability & coding errors**
- **Internet connection quality**
- **Algorithm stability**
- **Quality of prediction**
- **Internet connection quality**

Measurement reliability (1)

Reliability of the L1 monitor due to natural spatial and temporal variability of solar wind and IMF

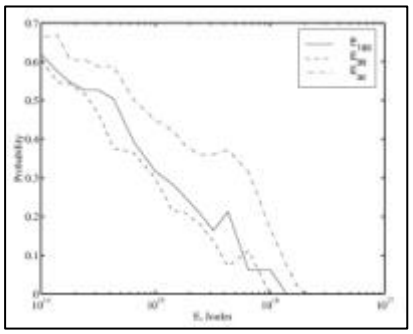
Measurements of solar wind and IMF (1996-1999) by Wind (distant monitor) and Interball (near-Earth) are compared:



Wind and Interball orbital positions

Measurement reliability (2)

Probability of different (by 15%) measurements with respect to Akasofu epsilon ~VB^2 input to the magnetosphere

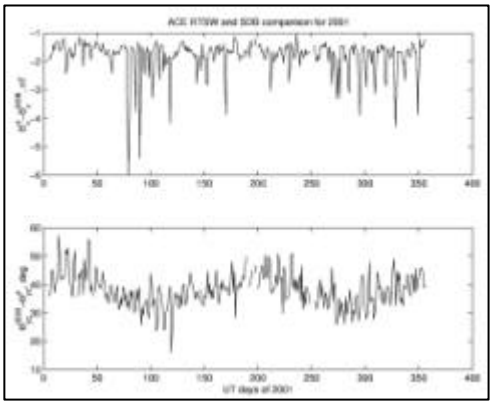


Magnetic storms (> 10^{16} J) predictions are quite reliable, while substorm predictions are uncertain

A.A.Petrukovich, A.Lazarus, R.P.Lepping, S.I.Klimov, Comparison of the solar wind energy input to the magnetosphere measured by Wind and Interball-1, JASTP, 63/15, 1643-1647, 2001.

Measurement errors in real time

Statistics of ACE IMF data quality:
RTSW and final scientific data compared: some errors are in real-time data!



Upper panel – small difference in Bx GSE
Lower panel – significant difference in IMF clock angle (30°-50°)

Data flow stability and error codes

unreliable RTSW data are marked by flags even if visually good

error codes ACE in 2001

IMF	**5.5%**
SW	**20%**

intervals > 20 min long

IMF	**3.9%**
SW	**3.9%**
IMF & SW	**2.1%**

Major reserve:
to accept good data even if it is flagged

Internet connection stability

simple UNIX cron and ftp are usually suggested for the data transfer management

experience of 1999-2002 operation on a good connection in the Space Research Institute shows for the data input segment:

5-10 (1.3-2.7%) erorrs (lost connections) per year for daily transfers (cataloguing, forecasts)

50-150 (1.7-5.2%) errors per month for real-time transfers (every 15 min)

after changing to a more clever software

1 error (0.07%) in last 15 days !