

Visitor Research Report

Visitor Name: Dr. Valery G. Petrov
Institute of Terrestrial Magnetism, Ionosphere, and Radio Wave
Propagation, Russia

Area of Research: Space Weather Research

Period of Visit: October 6, 2008 – October 31, 2008

Aim:

Since 2006 Magnetosphere-Ionosphere Research Team (MIST) at Virginia Tech uses software complex (Flat File database manager) to handle and create big data base of ground based magnetometer measurements and other time series used in Space Weather research. Last years support and further development of the software complex for Win32 operation system was carried out in IZMIRAN (Russia). Basic computers for research used by MIST in VT and NIA are MAC PC with MAC OS X. The main aim of my current visit here was to implement new version of the software for Intel MAC PC and update data base itself with new data.

Strategy:

One of the problems when using spacecraft measurements in the earth magnetosphere is a separation time and spatial variations. It is very difficult to say based only on spacecraft data are observed variations arise due to temporal variations or due to spacecraft moving to another position. But due to the fact that points in the magnetosphere are connected to Earth surface by geomagnetic field lines, changing in the magnetosphere are reflected in ground base magnetometer data. Taking into account, that ground base magnetometer observation much cheaper, dense network of magnetometers were developed over the world.

Global magnetometer network data are essential for understanding of the Sun-Earth connections and are used widely in different studies. The total list of magnetometers includes more then 350 stations, 150-200 of which are operated continuously. Unfortunately, in spite of all efforts to create common data base of all magnetometer datasets (WDC, Intermagnet), only about half of the stations are presented data in common format to Intermagnet data base. Most of other data sets are available online, but are stored in project data bases in internal project formats. Current data collecting system use so called “push data” concept, i.e. data providers (observatories) send data to data centers and users apply to data centers for data but it dos not work properly. MIST group introduced a Virtual Global Magnetic Observatory concept for “pulling” geomagnetic data distributed worldwide. The VGMO moves information exchange from simple file transfers to a higher level of abstraction, forming the distributed databases through establishment of self-organizing data nodes. The first working VGMO prototype is an Internet application that is transparent in its internal data management to the external users/clients. The VGMO server continuously builds data-objects only from client requests by going through a pre-set list of Web-based data nodes (including WDCs). As the retrieved data are added to the server (or node) database, future requests of the same interval would not force a new Web search. Furthermore, new nodes can be made available to others through the VGMO network, building the worldwide geomagnetic data “fabric” in a platform-independent and

location-neutral environment of newly “webbed” digital data. VGMO server was installed in NIA in 2007 and updated now.

Accomplishments:

Last years experience with VGMO server shows, that due to constantly increasing level of network safety protection, the usage of such distributed system became more and more unreliable. Another drawback of such system – author rules for data using, most data providers allow using data for research, but do not allow redistributing them. The easiest way to overcome problems – to have essentially the same VGMO server running locally on every user computer, we called it stand alone VGMO version and most effort was devoted to development of stand alone version. Win32 and OS X have different sets of internal function (calls), so to recompile Win32 program on OS X one should find and replace all system function calls, some times even high level program language (like fortran) use different manner of function calls. During my visit here all that was done and programs were successfully compiled on Intel MAC OS X.

The data base itself was updated, commonly used geomagnetic activity indices (Ap, Dst, Kp, Pc, Ae, PC, ASY, Ap and some others), interplanetary parameter data catalog –King IMF data, and some satellite data (mainly with solar wind parameter data: IMP, WIND, ACE) was added to data base. There are two ways to get full access to data: through VGMO server and through standalone version of VGMO installed on user computer. Both ways provide option to search for new geomagnetic data and automatically add them to database.

As was mentioned above, now became evident one disadvantage of approach used for VGMO server development: using direct socket connection between VGMO server and user. This give much more flexibility in development user interface (in comparison with HTML protocol), but often this sockets are blocked by firewalls or routers and VGMO server dos not work. It is not the case for standalone version – usually it works fine through firewall.

Future Work:

There a few directions of future work. First of all – support software (patch possible bugs, add new feature) and extend data base itself. Software itself is based on Fortran code, so there is difficulty with using modern graphics tools and adjusting to different operational system (Fortran does not have its own interface to system and we should use system calls, which are system dependant). The second direction – rewrite (create new) software based on Python program language. Python has modern graphic features and practically system independent. Another serious task – add scientific processing tools. Some most common tasks (like quit level calculation and removing or spike removing) already included in standalone version, but there exist a lot of other method of analyses applied to geomagnetic data. And the last direction – using software for geomagnetic variation study in Arctic and Antarctic, partial ring current and substorm study.

Pending Publications:

Updated web site <http://mist.nianet.org>

Seminar Presented:

October 31, 2008 at NIA