DAGIK: A DATA-SHOWCASE SYSTEM FOR THE GEOSPACE

***A Saito*[1*] *and D Yoshida*[2]**

[*1]*Department of Geopysics, Kyoto University, Kyoto 606-8502, Japan.*
Email:saitoua@kugi.kyoto-u.ac.jp
[2]*Data Analysis Center for Geomagnetism and Space magnetism, Kyoto University, Kyoto 606-8502, Japan. Email: daiki@kugi.kyoto-u.ac.jp*

ABSTRACT

We propose to establish "data-showcase" system to display the various geophysical data in one frame. Data-showcase is a system not to provide data but to show various types of the geophysical data in intuitable way. The newly developed Dagik, Daily geospace data in kml, is the first data-showcase system for the geospace data. It contains several types of data by ground-based and satellite measurements in addition to numerical models. We expect Dagik would make the combination and comparison of the geospace data easier, and foster new inter-disciplinary scientific researches.

Keywords: Virtual globe, Geo-browser, Geospace, Data-showcase, Google Earth

1 INTORODUCTION

Combination of various data is crucial for geophysical researches because geophysical phenomena are essentially related with multi-parameters. Especially for the geospace research, the combination of data is important because the observation in this field is sparse in space while the spatial extent of phenomena is varied from meter-scale to the Earth-radius (Re) scale. Several satellite projects such as the THEMIS satellite, and the ERG satellite, have been designed for coordinated observations with ground-based observations to fill the gap of geospace observation by combining various types of data. Combination of inter-disciplinary data also gets more important recently because it is now widely recognized that geophysical phenomena in different disciplines are more tightly connected with each other than that has been expected. The ionospheric perturbation excited by earthquakes is a good example of such an inter-disciplinary phenomena (e.g., Iyemori et al., 2005).

WWW-based databases of the geophysical data have been developed since the middle of 1990s, and made the data sharing much easier than the previous databases, which were mainly character-based. The graphical interface of WWW-based database has enhanced the data exchange in the geophysics community significantly. A large number of geophysical data is now available through WWW. Although the WWW-based databases are good at providing the data to users who are familiar with the data, it is not easy for the users who are not good at finding data, making plots, and comparing with other geophysical data. Meta-databases and clearing houses of data are newly developed systems to make the data usage easier than the simple WWW-based databases. Even with these systems, it is still difficult for users to find, plot and compare the various types of data.

To lower the barrier of the geophysical data usage by casual users, a system to display various data in an intuitable way is necessary. We call this system "data-showcase" to distinguish it from database. While database intends to provide the data, data-showcase system intends to display and compare the data.

2 DATA-SHOWCASE SYSTEM

We propose to establish data-showcase system to enhance the data sharing of the geophysics. The data-showcase system is designed to display plots of various geophysical data in one frame to show their outline. Location and time are the essential information of the geophysical data. Therefore, the data-showcase system should present the data in four dimensions, three dimensions in space and one dimension in time. In the data-showcase system, various data can be plotted in one frame to compare each other. The plots contain the information of the data. It can allow users to access the database of the data to download and study in detail. Thus, the data-showcase system can play a role as a portal of the geophysical data. Users can browse various data with the data-showcase system. If they are interested in a certain data, they can access the data following the information in the data-showcase system through WWW.

The data-showcase system is a system to browse the geophysical data plots to compare each other. The required

functions for the data-showcase system are as follows:

1) Four-dimensional data presentation capability.

2) Scalability in time and space.

3) Network capability.

The uniqueness of the geophysical data is that they are closely connected with time and space. To combine data that were observed in various locations and time, four-dimensional plot capability is necessary for the intuitable data presentation. The temporal and spatial scales of the data are also variable. Some data have higher sampling rates than 1Hz, and some data consist of daily values. To plot various geophysical data, the data-showcase system should be scalable in time and space. Finally, to display various types of data, network capability is necessary. It is impossible to store all the data in a local computer, and it is efficient to download the data through fast networks.

3 DAGIK

We developed a data-showcase system for the geospace data. That is called Dagik (Daily Geospace data in Kml) (http://www-step.kugi.kyoto-u.ac.jp/dagik/). Dagik data plots are written in KML (Keynote Markup Language), and browsed with Google Earth. The reason to use KML as its plot format and Google Earth as its browser is that they satisfy the required three functions for the data-showcase system discussed above. Making four-dimensional plots of various types of geophysical data on Google Earth with KML is simple and easy. One of the current problems of Google Earth as a data-showcase browser is that its plot area is limited from the Earth's surface to 11 Re.

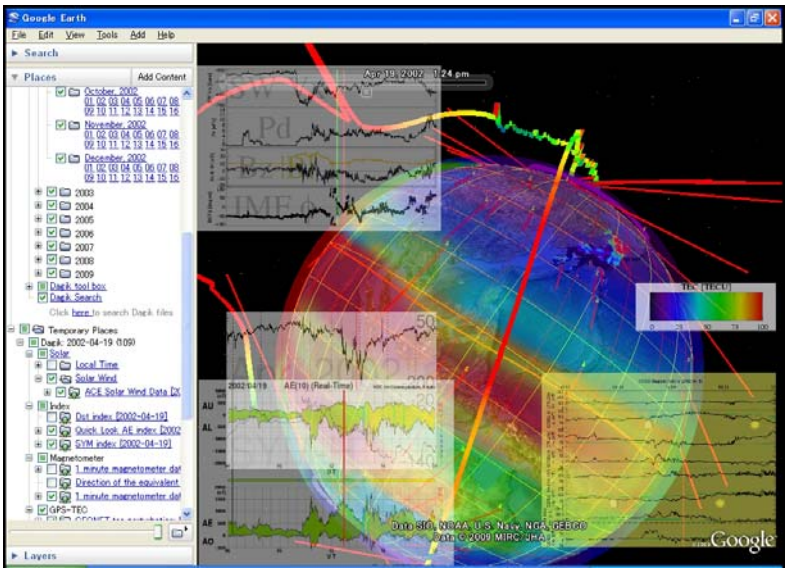

Figure 1. Example of data display by Dagik. Data list is displayed in the "side bar" window on the left. Data displayed in the right panel for 13:24UT on April 19, 2002 are solar wind, geomagnetic indices, EISCAT radar, GPS total electron content, geomagnetic field variations, ion density by the DMSP satellite, and so on.

Figure 1 shows an example of the data display by Dagik. Data shown in the right panel is the solar wind data, the geomagnetic indices Dst and AE, the EISCAT radar data, GPS total electron content, geomagnetic field variations by ground-based magnetometers, the ion density by the DMSP satellite, the geomagnetic field by the GOES satellite, and the geographic and geomagnetic coordinates. The time of the data was at 13:24UT on April 19, 2002. Data list is displayed in the "side bar" window on the left hand side. Users can select the date and data type from the "side bar" window to display the data plot. The data plots written in KML are superimposed to compare the location and time of the data. The data that does not have location information such as indices are displayed as a two-dimensional plot on the panel. The various types of data are plotted in one frame, and make themselves easy to compare with each other.

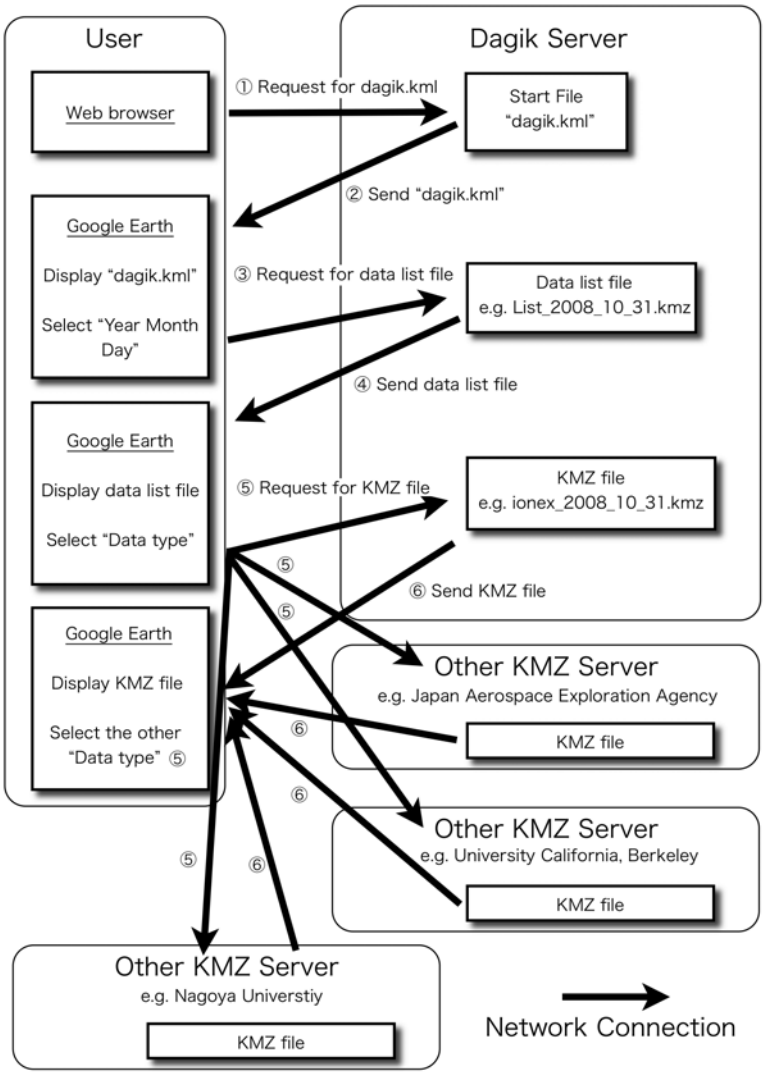

Figure 2. Procedure of the data display by Dagik. User downloads the start up file, dagik.kml, and opens it with Google Earth. For the selected date, the data list file will be sent from the Dagik server. User can select the data type from the data list, and the KML/KMZ plot files will be downloaded from the Dagik server or the other KML/KMZ server to display the data on Google Earth.

The sequence of the data display by Dagik is shown in Figure 2. Google Earth has a network capability. The files are downloaded over the Internet on the user's request. At first, 1) the user downloads the start up file, dagik.kml, from the Dagik server (http://www-step.kugi.kyoto-u.ac.jp/dagik/) with a WWW browser. 2) It can be opened with Google Earth. 3) The user can select preferred dates from the "side-bar" window of the Google Earth to display. 4) For the selected date, the data list file will be downloaded from the Dagik server, and displayed in the sidebar window. 5) User can select the data type from the data list, 6) and the KML/KMZ plot files will be downloaded from the Dagik server or the other KML/KMZ server to be displayed on Google Earth. KMZ is a compressed file format of KML. There are several databases that provide their data plots in KML/KMZ format for Dagik. Some of these databases will be introduced in the following section.

Dagik is a system using the distributed database system connected by the Internet. The plot files are stored and provided by several the KML/KMZ servers. Most of the KML/KMZ are operated on the WWW-based databases of the data holder. It, therefore, is relatively easy to increase the number of data on Dagik with the collaboration of the data holders who already operates the WWW-based databases. It is important to increase the number of data in Dagik.

Therefore, Dagik data center helps the data holders to make KML/KMZ following the plot rules of Dagik.

Following two rules are applied for the style of the Dagik plots to make combination and comparison of data easy:

1) One file contains the data for one day in UT.

2) The size of the plot panel on screen is fixed.

The first rule is to make the comparison of various data in the same time frame. Although Dagik now handles only daily data files, monthly and yearly data files will also be included. The second rule is to overlap the plot panels in the same size. The transparency function of Google Earth makes the comparison of overlapped plots easy.

Dagik itself is a data browsing system and does not have function to generate KML/KMZ files. The Dagik data center helps to data folders to make KML/KMZ files. To make Dagik files, there are three ways. The first one is that Dagik data center makes KML/KMZ files, and provide them by Dagik server. The second one is that Dagik data center helps data holders to make KML/KMZ files, and the data holders make and provide them. The last option is that the data holders make KML/KMZ, and provide them by their server. Dagik data center registers the KML/KMZ files to the Dagik data lists. Dagik data center provides miscellaneous tools to help to browse geophysical data. They are the files of the locations of observation sites, geomagnetic coordinates, and the keyword file.

4 DATABASES IN DAGIK

There are several databases that collaborate with Dagik and provide their KML/KMZ plot files. Solar-Terrestrial Environment Laboratory, Nagoya University shows their all-sky camera data whose URL is http://stdb2.stelab.nagoya-u.ac.jp/omti/, and their Super-DARN radar data at http://skdb1.stelab.nagoya-u.ac.jp/hokkaido/ in Dagik. University of Texas Dallas shows SSIES data of the DMSP satellite, http://cindispace.utdallas.edu/DMSP/, and University of California, Berkeley shows FUV data of the IMAGE satellite, http://sprg.ssl.berkeley.edu/image/. MIT Haystack observatory and Kyoto University display their GPS Total Electron Content data. Their databases are http://stegps.kugi.kyoto-u.ac.jp/ and http://madrigal.haystack.mit.edu/madrigal/, respectively. For the radio measurement data, National Institute of Polar Research displays the EISCAT radar data at http://polaris.nipr.ac.jp/~eiscat/eiscatdata/, and National Institute of Information and Communication displays ionosonde data in Japan at http://wdc.nict.go.jp/IONO/index_E.html. Magnetometer data and indices are displayed by WDC Kyoto for Geomagnetism via http://swdcwww.kugi.kyoto-u.ac.jp/.

5 CONCLUSION

To make the combination of the multiple geophysical data easier, we have proposed a data-showcase system to display various types of geophysical data in one frame. Dagik is the first data-showcase system for the geospace data. The four-dimensional data presentation and network links enable to display various types of data in an intuitable way of data presentation. Dagik is a distributed database system using the network connection. Thus, it can handle a large number of data. We expect Dagik will make the combination and comparison of the geospace data easier, and foster new inter-disciplinary scientific researches.

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7 REFERENCES

Iyemori, T., M. Nosé, D. Han, Y. Gao, M. Hashizume, N. Choosakul, H. Shinagawa, Y. Tanaka, M. Utsugi, A. Saito, H. McCreadie, Y. Odagi, and F. Yang, (2005) Geomagnetic pulsations caused by the Sumatra earthquake on December 26, 2004, Geophys. Res. Lett., 32, L20807, doi:10.1029/2005GL024083.