Vertical Earth: Databases and Interfaces for the Vertical Integration of Earth Science Data

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A big challenge on earth science data is the construction of information infrastructure in which the variety of earth science data can be used in an integrated manner. A large amount of earth science data has been observed and archived at many sites on the globe, but existing information infrastructure is still not satisfactory for the comparison and analysis of long-term and multi-disciplinary data. This paper focuses on the problem of multi-disciplinary nature of data, for which databases and interfaces for the integration of earth science data is a key solution.

This paper proposes a term 'Vertical Earth' to symbolize the multi-disciplinary nature of the data [1]. Earth science data is usually collected for each layer of the earth (such as X-sphere), so vertical integration across multiple layers of the earth is a key for earth science data integration. The goal of this paper is in the integration of earth science data that conventionally belong to different layers. This type of integration facilitates the analysis of multiple datasets across layers, and may lead scientists to explore into unexpected relationship across distant layers, which might be conceived by scientists as 'too vague an idea' or 'a thought of instinct.'

Vertical Earth focuses on two types of earth science data in the initial stage. The first type is the atmospheric data that have been compiled at National Institute of Informatics (NII). The largest part of this data is related to typhoons (or tropical cyclones in general), and is accessible at the Website 'Digital Typhoon' (http://www.digital-typhoon.org/). The large amounts of heterogeneous data are integrated into the typhoon database and can be used by anyone in the world. The second type is the Antarctic geographic data that have been compiled at National Institute of Polar Research (NIPR). The data collected here includes map data and aerial photographs of the Antarctic area, and those data are digitized and registered into the database. Antarctic Geographic Information System (GIS) will be opened to the public in the near future, and this will enable the integrated usage of earth science data about the Antarctic. An important mission of Vertical Earth is to provide Web services connecting multiple databases distributed across multiple organizations over the Internet, because Vertical Earth is collaboratively developed at multiple organizations as stated above.

Another important challenge of Vertical Earth is to study visualization, namely how to provide useful visual representation of data. To test the usefulness of interface for the vertical integration of data, we chose to use one of atmospheric data, GPV (Grid Point Values) data from Japan Meteorological Agency. The reason of choosing GPV data is their suitable structure for Vertical Earth in the sense that data is generated on selected pressure levels for vertical layers of the atmosphere. Our goal is to provide an interface that allows users to combine and overlay any kinds of data across any time, with any number of images.

The current interface is based on a model that all operations can be done on standard Web browsers. We use a Web technology called AJAX to communicate between servers and browsers to display any GPV data on request, and plan to develop this interface to allow the comparison of multiple data. We also plan to provide the conversion of data format for allowing the integrated browsing of earth science data on advanced browsers, such as Google Earth that is optimized for the sharing of earth science data on the Internet.

References: [1] Asanobu KITAMOTO, Vertical Earth: Databases for the Vertical Integration of the Layer Structure of the Earth System, Abstracts of Japan Geoscience Union Meeting 2006, No. J157-P002, 2006-05

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