

Requirement for comprehensive database for geosciences --- current product and prospect of gtool4 project

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<http://www.gfd-dennou.org/arch/gtool4/>

Introduction

As the authors reported in this meeting in 2001, the authors are developing a Fortran 90-based tools for analysis and visualization, keeping vast multi-dimensional geoscientific data in mind.

Now the completion of the minimal requirement of the project is in sight; the functionalities of GTOOL3 by Dr. Numaguti is re-implemented in netCDF environment, and many rules of the gtool4 netCDF convention are checked by the implementation.

Thus the authors report on the current product of the project, and on implicitly assumed data models of geosciences being enlightened through the experiment.

Regeneration and improvement of GTOOL3

GTOOL3 was built to provide extraction, arithmetic operation, averaging, and visualization of three-dimensional gridded data. The gtool4 product re-implemented the command interface of GTOOL3 on the software base of netCDF, that is portable, is able to keep unlimited number of metadata, and can contain array of any number of dimensions. Input/Output interface is abstracted not to depend on the number of dimensions, using derived types and generic procedures of Fortran 90. Time series writing is supported by especially simplified interface, with the numerical simulation model in mind. The analysis tool can perform subtraction of time average from time series; this operation could not done by GTOOL3, though it is frequently used.

Implementation test of Gtool4 netCDF conventions

The gtool4 netCDF convention is described before the programming work. Thus the implementation clarified the imperfection of the conventions, indicating difference between the explicit examination and the implicit expectation. First, visualization class design is simplified. Unification of classes with similar data dependency proved to make program simple, while the initial class list was identical to that of DCL packages. Contours and shading, or line graph and scatterd marks are unified. That is caused by lack of inheritance of Fortran 90. Next, the convention is found to have insufficient rules of giving attributes automatically. Data generating tools should have common rules of making attributes, and it should be implemented as standard library interface.

Prospect about data model

Like GTOOL3, current implementation of Gtool4 provides the data model of regular gridded data, that is array values are stored as netCDF variables directly and is visualized using coordinates associated with axes (variables associated with netCDF dimensions). However, the not all data in geosciences can be handled with regular grid. For example, the station observation data is well handled with relational table model. It is identified using station number, that is not associated with coordinate directly and is visualized using location indexed by station number. Relational indexed visualization is considered in the gtool4 netCDF conventions, but handling of them are not implemented yet.

The gtool4 experiment suggests that software is strongly binded to data model and that supporting multiple data models with one application is difficult. This leads to idea that a data is serviced in many form, instead of forcing application to read many form. Client server system like WWW will be strong help to this idea. Comprehensive database requires such flexibility that the user can select data with SQL (based on relational model) from apache-cached server (based on URL tree structure) and visualizes with gtool4 (based on regular grid).

References

Swamp project, GTOOL3.

<http://www.gfd-dennou.org/arch/gtool/>

GFD-Dennou Club Davis Project, Gtool4.

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