gt4f90io: Fortran90 netCDF I/O library with gtool4 conventions

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In this talk, we introduce gt4f90io, a Fortran 90 I/O library for numerical models of geophysical fluids, and exemplify its implementation into a numerical model.

Gt4f90io has been developed and maintained as a part of the gtool4 Project. The objectives of the gtool4 Project are, to design a data format suitable for geophysical fluid research, and to develop an I/O library and analysis and visualization tools to manipulate data of the proposed format. Products of the project are presented on the network as open and free resources to anyone who wishes to use them for the purpose of research and education. As for the data format, netCDF is adopted, since netCDF enables us to keep data self-descriptive and network transparent. In order to have a multi-dimensional numerical data representation which is suitable for geophysical fluid phenomena, we have proposed ``gtool4 netCDF Conventions'' as a set of conventions on netCDF format, and continue to refine it. By the sharing use of network transparent and self-descriptive data format, we can expect to reduce data management costs and and to enlarge data exchange efficiency within cooperative research members. Gt4f90io is an I/O library for data based on ``gtool4 netCDF Conventions'' (gtool4 netCDF data). Analysis and visualization tools are now being developed separately as the ``Dennou Ruby Project'' by using object-oriented scripting language Ruby.

Gt4f90io is a data I/O library for numerical models written in Fortran90. The library consists of modules and subroutines for data output in the form of gtool4 netCDF format from numerical models and input of gtool4 netCDF data to numerical models. Gt4f90io is a rebuilt package only of the I/O library for numerical models extracted and refined from ``gtool4 Fortran90 Tools and Library'' which has been developed by our group. Internal structure of gt4f90io is characterized by complete layering of modules. Modules and subroutines are divided broadly into three layers; lower layer for accessing netCDF data (an_generic module), middle layer for handling multi-dimensional features numerical data (gtdata_generic module), and upper layer for providing user interface (gt4_history module). This layered structure is realized by the functions of Fortran90 module. The layered structure also enables us to realize drastic information hiding. Object-oriented coding in Fortran90 is tried in the implementation of gt4f90io; ``class'', ``method'', and ``polymorphism'' are emulated by the use of derived types, subroutines, and generic subroutines, respectively.

These characteristics of gt4f90io present a simple and intuitive interface of data I/O to those who develop and use numerical models. Model developers can output gtool4 netCDF data with only four subroutines of ``gt4_history'' module: (1) ``HistoryCreate'' that defines a output file name, dimensions, and so on. (2) ``HistoryAddVariable'' that defines descriptions of variables, for example velocity or temperature. (3) ``HistoryPut'' that output numerical value of variables. (4) ``HistoryClose'' that closes output file.

Gt4f90io is already used in ``Hierarchical Spectral Models for GFD (SPMODEL)''. The simple interface of gt4f90io enables us to perform numerical experiments easily with various models such as a shallow-water system.

As the issues to be persuaded in future, interface routines for data input are to be developed and reference manuals and tutorials are to be provided. We are going to polish up gt4f90io by settling these issues.

References URL
gtool4 Project: http://www.gfd-dennou.org/arch/gtool4/ .
gtool4 netCDF Conventions: http://www.gfd-dennou.org/arch/gtool4/conventions/ .
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