

Gtool5: Fortran 90/95 data I/O library for hierarchical models for geophysical fluid

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In studies of geophysical fluid dynamics using numerical models, an intercomparison of results of several models that differ in governing equations is often needed for discussions about a result of a calculation. We think that hierarchical models for geophysical fluid dynamics, that is to say, a series of models with a systematic programming style are useful in order to perform the intercomparison efficiently. Therefore, we have been designing programming styles and developing software infrastructures. In this talk, we introduce a development of Fortran 90/95 library Gtool5 that provides data I/O interfaces contributing to develop various models representing geophysical fluid phenomena with a systematic programming style.

Data I/O interfaces must be designed systematically in order to use the systematic programming style. Therefore, a method of similarly structuring several models about I/O must be found out. Large-scale models like atmospheric general circulation models which are parallelized and calculate many physical quantities and small-scale models which need not be parallelized and calculate a few physical quantities should be considered. Therefore, following 3 requirements should be satisfied. (1) Various data with arbitrary dimensions can be output. (2) Parallel processings about I/O do not depend on individual models. (3) As a support for large-scale models, it is possible that dynamic changes in output settings (selection of output variable, precision of data, etc.) of variables for analysis are available, and output settings of variables for restart are fixed. Dynamic changes mean changes without re-generation of an executable file here.

As a previous work with a similar viewpoint, by Gtool4 Fortran 90 tools/library and the successor, I/O library Gt4f90io, data with arbitrary dimensions can be output, and the number of subroutines necessary for the output is reduced to 4. In Flexible Modeling System that is a framework of climate models developed in Geophysical Fluid Dynamics Laboratory, systematic I/O interfaces are prepared by separating processings of the I/O and the parallelization as an infrastructure of several models. In AGCM5 that is an atmospheric general circulation model, dynamic changes in output settings are available by using NAMELIST that is a function of Fortran. However, Gt4f90io does not support parallel processings and dynamic changes in output settings. In FMS and AGCM5, the number of dimensions of output variables is restricted to 3.

In this study, Gtool5 Fortran 90/95 library has been developed as a successor of Gt4f90io aiming to provide systematic I/O interfaces for large-scale and small-scale models. In Gtool5, a new subroutine which receives coordinate data on CPU cores as information of a domain decomposition has been added. As a result, Gtool5 can undertake integrations and outputs of data on CPU cores, and parallel processings about I/O in each model become unnecessary. For dynamic changes, an interface in which dynamic changes by NAMELIST are available and one in which the changes are not available are prepared respectively for output of variables for analysis or variables for restart. For small-scale models in which output variables need not be selected since few variables are treated, the I/O part can be described by using only the latter. On the other hand, for large-scale models in which it is necessary to select output variables from among a lot of variables, both interfaces can be used together. In addition, since subroutine names and arguments of both interfaces are similar, one usage can be easily applied to the other, and the systematic I/O interfaces can be used in both models. By using Gtool5, the systematic I/O interfaces are available in both models. Now, Gtool5 is being introduced to several models, and a series of models with the systematic programming style is being developed. In this talk, a demonstration result about validity of Gtool5 will be introduced too.