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# An 'Integrating Model and Data Infrastructure' for Earth system modelling

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The Model and Data group at the Max-Planck-Institute for Meteorology (M&D) provides services to support Earth System (ES) data analysis and modelling activities of the German and European ES research community.

M&D has undertaken the development of an Integrating Model and Data Infrastructure (IMDI) in order to support most aspects of ES research activities, such as source code management, model development, compilation, experiment execution, and result archiving, retrieval, and analysis. The latter facets connect the modelling activities with the ICSU World Data Center for Climate (WDCC) which is maintained and run by M&D together with the DKRZ(German Climate Computing Centre).

The development of the built system, the Standard Compile Environment (SCE), and that of the Standard Running Environment which supports experiment execution (SRE), was started in the PRISM EU FP5 Project for Integrated Earth System Modelling. The high level design of the SCE and SRE is similar in that toolkits are provided which can be used to assemble scripts for compilation and execution of a specified coupled model on a specified platform from a common base of script code. The method guaranties that a user has a common look&feel with all models on all platforms interfaced with the SCE and SRE. The toolkits are designed in a way to allow an easy extension of the infrastructure to accommodate new models, platforms, and tasks. The system can be set up as a central installation where some components of the system are built initially and shared by different users (e.g. libraries and the coupler executable), or as a local installation, where each user builds all components locally.

The infrastructure IMDI supports modular design of ES models. Components of coupled models can not only be the traditional ocean, atmosphere, sea ice, land surface, marine or air chemistry models, as defined by PRISM, but any other software packages representing subsystems of the ES (e.g. cloud or runoff schemes). Whether or not a code base represents a component is decided by the model developer and depends on the source code organization and on its independence of other component code bases. A coupled ES model can be made up of more than one executable (each possibly containing more than one component) in which case the information exchange between the executables is by the PRISM coupling software, which was also developed in the PRISM project. Both versions of the PRISM coupling software, OASIS3 and OASIS4 are supported, as well as single-executable models.

IMDI is also modular in the sense that the individual facets of IMDI can be used independently from each other. They are, however, fully interoperable. In addition, when setting up an experiment, the user can select from a number of optional tasks, e.g. preprocessing of input data for regional models, model integration, model diagnostic output processing, experiment monitoring, data visualization, or data archiving into a file system or into a data base (e.g. Cera/WDCC).

Recent developments and plans for the future are the creation of meta data before and during the execution and/or automatic filling of model output and meta data into the WDCC or other data archives. The meta data should not only describe the data generated by the model, but also the model itself and its configuration used in the experiment. These meta data will be designed in cooperation with other international meta data initiatives, e.g. the Numerical Model Meta data (NMM) project.