Geophysical Research Abstracts, Vol. 8, 03634, 2006
SRef-ID: 1607-7962/gra/EGU06-A-03634

The OASIS4 multi-grid search for data interpolation

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The focus in this presentation is on the search algorithm as it is implemented in the OASIS4 coupler software.

In order to perform an interpolation the first task is to identity the correct neighbour points that are needed to calculate the particular weight matrix for a given interpolation scheme. The second step is to calculate the elements of the weight matrix which is applied to the physical fields in a third step. In this whole process the search of neighbour points is the most complex and time consuming task and it is here where efficient and parallel algorithms are mostly needed that scale reasonably well with the number of grid points that have to be treated.

Following the basic initialisation phase each physical component provides required grid information to the OASIS4 library routines. This information includes the geographical locations of the vertices that form a particular grid cell, the geographical locations of the physical fields and information about masked points.

In order to reduce the overhead caused by the coupling, i.e. the actual exchange of coupling fields, it is required to establish the communication only between those pairs of processes that have to exchange data based in a given configuration. To achieve this the parallel neighbourhood search is performed at the end of the definition phase and the communication pattern is generated. For this search a multi-grid hierarchy is established. By construction this algorithm scales linearly with the number of grid points and is sufficiently fast to be employed at runtime at the beginning of each model run.

The OASIS4 library and in particular the search is designed to work in parallel in order to save communication time, to decrease the memory consumptions and to reduce time spent in the search. In order to achieve this goal, the OASIS4 library routines work on the local application grids as much as possible.