Shallow Convection Parameterizations in AROME

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1 Introduction

In the week of July 3-7 2006 I have made a short working visit to Meteo-France in Toulouse, France. In short there were 3 objectives:

1) To have a short workshop in which French, Portuguese and Dutch institutes could exchange their experience with respect to new parameterizations of shallow cumulus convection in numerical weather prediction and climate models.
2) To make agreements how to set up collaboration in developing parameterions of transport in the cloudy boundary layer between KNMI and Meteo-France for the use in the non-hydrostatic AROME/Meso-NH high-resolution forecasting system.
3) To get acquainted with the 1d/2d/3d IFS version of the ARPEGE/ALADIN/AROME/HIRLAM version (the socalled SCUM model) for the use of parameterization development and evaluations.

The outcome of each of these 3 topics will be reported in the next 3 sections.

2 Workshop on shallow cumulus convection parameterisations.

On July 3-4 a short workshop on shallow cumulus convection parameterizations has been held. One of the main reasons for this workshop was to exchange experience about a new unified approach for parameterization of the cloudy boundary layer through a combined eddy-diffusivity/mass flux (EDMF) approach. This approach has been introduced some years ago in the operational ECMWF model for the dry convective boundary layer (Siebesma and Teixeira 2000, Siebesma et al. 2006). The EDMF approach is simply based on the simple concept of a scale separation between large-scale organised strong updrafts and a remaining small-scale turbulent part. The organised, strongly skewed and non-local updraft part (M) is described by an advective mass flux approach whereas the remaining symmetric small-scale turbulent part is described by a diffusive approach (K), see Fig. 1. Since then it has been implemented in the French mesoscale model Meso-NH (Soares et al 2003). Parallel to this development the same concept has been generalized for the stratocumulus topped boundary layer in the operational ECMWF model (Koehler 2004) and a major update that includes the shallow cumulus topped boundary layer for use in the ECMWF model (Neggers et al 2006) is now ready for operational implementation. has been implemented in the French mesoscale model Meso-NH. A different flavour of this concept has now also been implemented in the French LMD climate model.
As the AROME model will adopt the Meso-NH physics, one of the objectives of this workshop was to discuss which flavour of the EDMF-scheme is most suitable for implementation in AROME.
It was encouraging to see that so much positive effort has been put in successfully implementing different flavours of the EDMF principle. It also demands careful analysis and discussion to decide which version is the most suitable to use.
The program and all presentations of this workshop have been put on the web and can be found at http://mesonh.aero.obs-mip.fr/mesonh/dir_meetings/SHAL05/ .

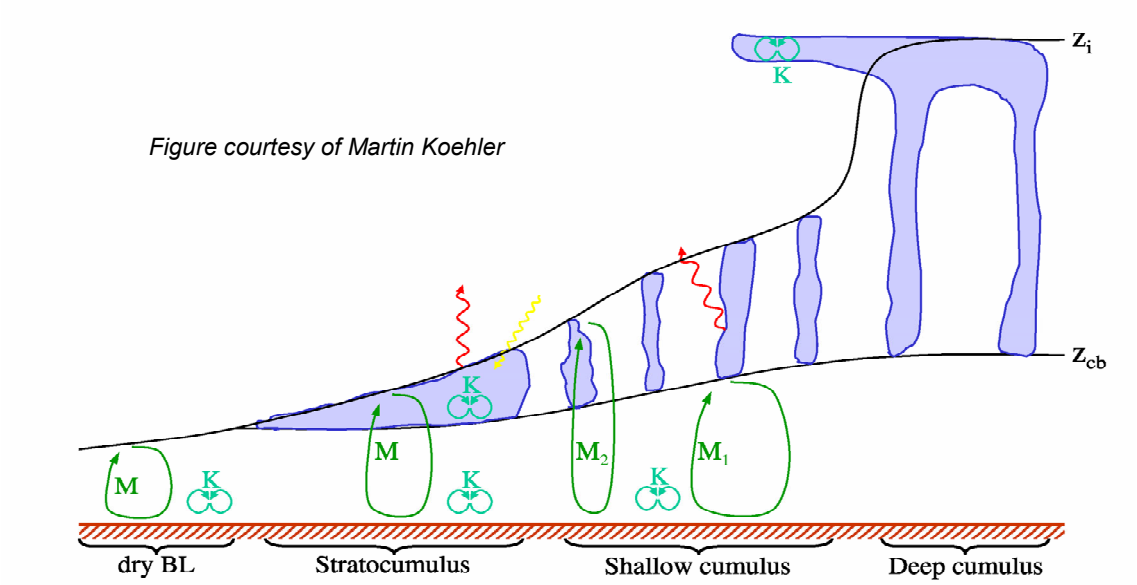

Figure 1: Schematics of the principle of the EDMF scheme. Note that the mass flux part, that is representing the thermals, is active in both the clear and the cloudy boundary layer. Therefore a trigger function for moist convection is not necessary anymore.

3 Agreements on future developments

It has been agreed that the IFS parameterisation for the EDMF such as developed by ECMWF/KNMI will be ported in the AROME system.. In practice this will imply that dual massflux updraft module (Neggers 2006) that has been developed for use in the upcoming cycle of the ECMWF model will be implemented in the AROME system along with new detrainment formulation (de Rooy and Siebesma 2006). Also the length scale formulation of Lenderink (Lenderink and Holtslag 2006) will be tested out in the TKE CBR-scheme of the AROME system. As these parts are easily portable within the IFS system this is technically the most appropriate way to proceed. The agreement is to have this ready in November 2006 since some 3d testing is planned from this month onwards. The updraft code from ECMWF will be made available in September 2006 and implementation and 1D-testing in the SCUM environment will start from September onwards. It was encouraging to see that all partners are positive and enthousiastic about this collaboration. Furthermore there will be a follow-up meeting in NY September 22 directly after the GCSS Boundary Clouds meeting since all the EDMF developers will be present at that meeting.

4 A Portable Testing and Evaluation 1D-Tool for AROME

Sylvie Malardel (Mete0-France) has recently developed a 1D version of the IFS system called Single Column Unified Model (SCUM). With this model ideal single column cases can be run with any IFS model configuration such as ECMWF, ARPEGE, ALADIN, AROME and (in near future hopefully) HIRLAM. There is also the possibility to run ideal cases in 2D and 3D. Essentially it is a stripped stand alone version of the whole IFS system. In the remainder of the working visit this model has been successfully installed and made running on a laptop. The only requirements are a recent Portland Fortran90 compiler and tools to run Perl scripts. Also the necessary software to set up cases and to generate output has been successfully implemented. The plan is now to implement the system on the LINUX platforms at KNMI and possibly other institutes for evaluations studies, especially to evaluate the Meso-NH microphysics that will be used in AROME. Before the end of the year the EDMF concept should be available within this testing environment. In a next Newsletter there will be a presentation with a more detailed formulation and evaluation of the EDMF scheme.

References

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