Royal Netherlands
Meteorological Institute
Ministry of Infrastructure and the Environment

Evaluation of HARMONIE using a Single Column Model in the KNMI Parameterisation Testbed

Cisco de Bruijn (bruijnde@knmi.nl) and Wim de Rooy*

A Single Column Model (SCM) of HARMONIE is run daily in the KNMI Parameterisation Testbed (KPT). The initial conditions and dynamic forcings are obtained from RACMO. The HARMONIE SCM is run with different options from which the output can be compared with observations and other participating SCMs as well as with the corresponding columns from 3D models. Supersite Cabauw in the Netherlands offers a wide variety of quality observations to do that comparison.

1. Introduction

Like most of the NWP models, HARMONIE has a corresponding single column version dedicated to the validation of physical parameterisations. This single column model (SCM) is run on a daily basis in the KNMI Parameterisation Testbed (KPT) see[1].

2. Setup of the system

In the KPT so-called driverfiles are constructed for various locations of interest like Cabauw, Chilbolton and Lindenberg. These driver files contain all input fields required to run a SCM. The driverfiles are based upon the most recent RACMO forecast. RACMO is initialized with the ECMWF analysis and forced by boundaries from the same model. The surface scheme (SURFEX) is run in force-restore mode with soil layers at 0.13,0.72,1.89 m which is almost similar to the RACMO soil layers. Two HARMONIE model flavours are evaluated namely the default EDKF and the new EDMFm scheme including a modification of the cloudscheme. The HARMONIE SCM is based on a rather old version cycle 33t1. The EDMFm scheme and the cloud scheme update however, are the same as in cycle 36r1.3. Nevertheless an update of the SCM in the near future is advisible.

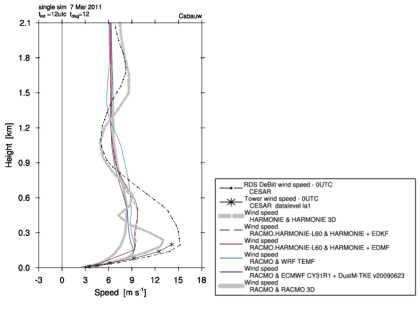

Figure 1: Windprofile in stable conditions at 8 March 2011 00 UTC at Cabauw represented by SCMs and 3D models

3. Results

In the KPT especially fast processes like turbulent and convective transport can be well investigated. Apart from a wealth of observations also LES runs can be used for validation. With an user-interface all kind of diagnostics can be made interactively. In Fig. 1 a multi-model windprofile in stable conditions is depicted. All SCMs are driven by RACMO. It is striking to see that 3D HARMONIE shows the best gradient in the windspeed profile. Probably this is caused by a superior analysis scheme which uses more detailed observations. In Fig. 2 we show the development of winterly precipitation. At 17 December 2010 the freezing level comes down resulting in snow on the ground.

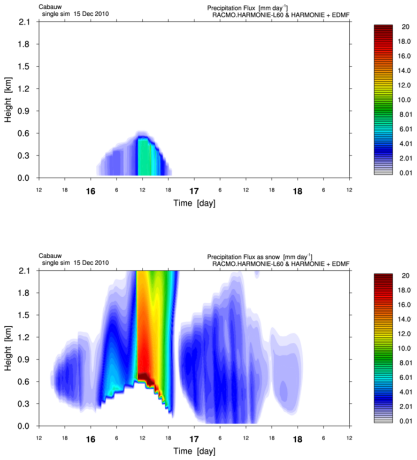

Figure 2: Predicted rain(top) and snow(bottom) with a SCM of HARMONIE during +72h forecast starting at 15 Dec 2012 00 UTC at Cabauw

Now we present in Figs 3 and 4 an example of a model improvement on the basis of a low visibility case of 15 February 2011. The EDKF model was not able to capture the mist while EDMFm with a modified cloud scheme was able to simulate the fog. The improved fog forecast is probably related to the modification in the statistical cloud scheme. In typical fog conditions there is almost no turbulent activity. Consequently the variance of the moisture deficit used in the statistical cloud scheme can be too low. The update in the cloud scheme adds the characteristics of a relative humidity scheme to the statistical cloud scheme which explains larger cloud fraction and liquid water content in certain fog conditions.

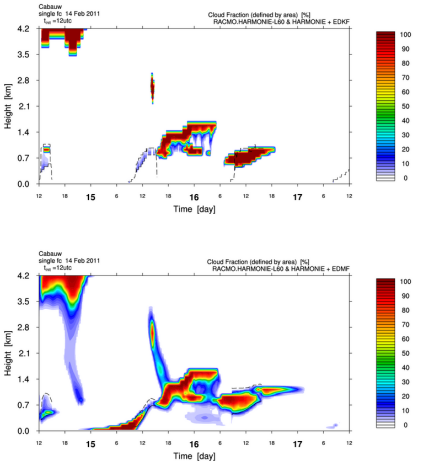

Figure 3: Cloud cover predicted with a SCM of HARMONIE with EDKF (top) and EDMFm(bottom) during 15 Feb 2011 at Cabauw

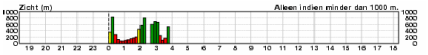

Figure 4: Visibility at surface level during 15 February 2011 at Cabauw. Note the formation of fog in the first 6 hours.

4. Conclusions and recommendations

KPT has been succesfully used for evaluating HARMONIE model performances for fast processes, like shallow convection, turbulence and surface processes. Numerous bugs have been fixed and parameterisations have been evaluated to advanced observations. It is recommended to upgrade the SCM version of HARMONIE. Plans are being made to obtain the initial profile and the dynamic tendencies from the 3D HARMONIE.

5. References

[1] R.A.J. Neggers, Siebesma, A.P., Heus, T., 2010: Continuous single-column model evaluation at a permanent observational supersite *Bull. Amer. Meteor. Soc.* **xx**, 1-16.

* Royal Netherlands Meteorological Institute (KNMI), P.O. Box 201, 3730 AE De Bilt, The Netherlands.