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Overall tuning of HIRLAM with the focus on the stable boundary layer

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Under stable conditions reference Hirlam versions have a large positive bias in the wind speed and direction. Moreover the diurnal cycle of atmospheric boundary layer parameters is not well enough represented in the model.

To improve the model in stable conditions the model needs an overall tuning. This tuning comprises a better choice of coefficients for the turbulence scheme in combination with the omission of the turning of the wind stress vector. In stable conditions heat and momentum exchange coefficients are tuned in order to increase the vertical mixing. The wind stress vector is turned in the geostrophic direction in stable conditions, increasing the ageostrophic flow, in order to get the cyclone behaviour right and to reduce the bias in the wind direction. This fix reduces the activity of cyclones, but a physical background for this approach is lacking. The over activity of the model most probably has a different reason like the energy fluxes over sea which may not be appropriate.

We present some interesting cases that have been selected to check the Hirlam performance. The GABLS experiment offers data that contains a diurnal cycle as well a pronounced low-level jet (LLJ) and we also study other data coming from the Cabauw tower in which LLJ's occur.

At first a 1D-model of HIRLAM was run to get a better tuning of the model. When there is dynamical forcing, it is not trivial to compare a 1D-model against observations instead of results from LES. Cases were selected in which the geostrophic wind remains almost constant during the integration period. In the GABLS case the varying geowind was prescribed to get realistic forecasts of the wind profile.

Secondly 3D-model runs were conducted over a relatively small area close to the

Netherlands for the Cabauw case with offshore flow. In this way we create a relatively clean experiment for the turbulence scheme without the effect of possible erroneous fluxes over sea.

From this study we conclude that a successful 1D-run needs appropriate wind forcing for useful testing of the turbulence scheme, especially if the focus is on the tuning of the vertical mixing. Tuning of exchange coefficients for heat and momentum cannot be carried out with a 1D-model sufficiently. We show that a dedicated 3D simulation over a small area has more potential.