# 6. Experiments with 3-D model

The proposed modifications and new formulations of the mixing lengths were tested with ALARO -3MT on four cases, which were supposed to be sensitive on the parameterization fluxes. A brief description of cases is given by table 4.

| Nr. | Date and hour (UTC) of the run | Range (h) | Grid (km) | Domain | Synapsis |
|---|---|---|---|---|---|
| 1 | 2005-12-15_00 | +12 | 8.997 | CHMI | Strong NW-SE jet in northern Germany, erosion and too much TKE at tropopause |
| 2 | 2004-11-19_00 | +15 | 2.501 | SK25 | Downslope windstorm at High Tatras, problem with forecasting wind gusts in higher cycles than cy25 |
| 3 | 2006-05-16_00 | +36<br>+39 | 8.997 | CHMI | Passage of cold front and wind gusts in Hungary (Bakony mountains), false cyclogenesis and wind gusts in ALADIN SLOVAKIA |
| 4 | 1998-12-16_12 | +24<br>+84 | 32.369 | ATLA | Rapid cyclogenesis in Northern Atlantic, high sensitivity on turbulent transport of enthalpy |

Tab. 4: Short description of the cases evaluated with ALARO -3MT physical parameterization

Case nr.1: Strong jet over northern Germany

The case was used mainly for the evaluation of the TKE distribution in area close to strong upper level jet-stream. The vertical cross-section is zonal, along the 212 row of the model domain (Fig. 26). The main distribution of the TKE in the reference run with GC05 mixing length is within the PBL (Fig. 27) and the values are reasonable. However, there are also smaller amounts of TKE connected with strong mechanical turbulence below and above the jet axis (Fig. 28). Remarkable is also the “penetration” of the PBL values of TKE to the upper troposphere approximately over the point 165 of the cross-section. With application of the GCS06 modifications of the mixing length the TKE field inside the PBL does not change significantly. The TKE just above the PBL is suppressed, however, there is no sign of turbulence in the upper troposphere in the jet region, where the CAT occurrence is quite usual (Figure 29).

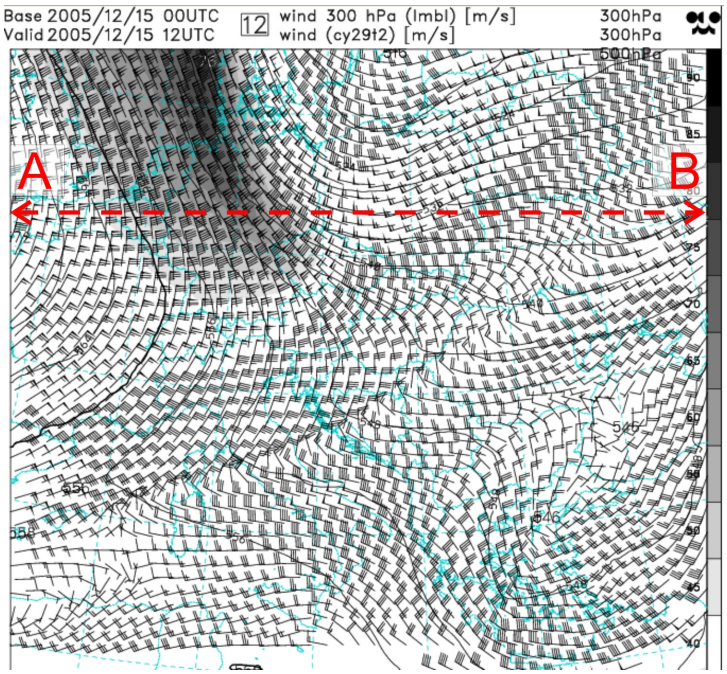


Fig. 26: 500 hPa geopotential and 300 hPa wind with the sense of the cross-section in Figures 27-31 for the situation of 15 December 2005

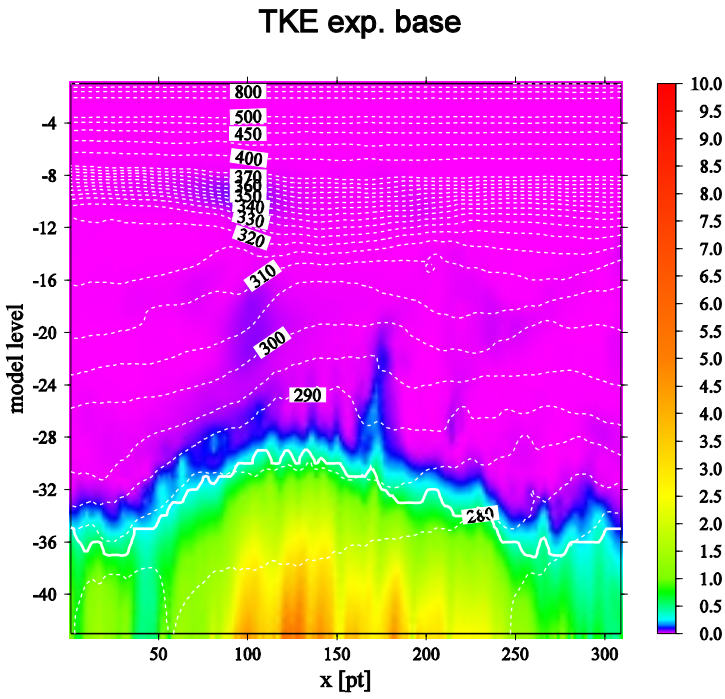


Fig.27: TKE (in colour), in $m^2s^{-2}$ , potential temperature (dashed), in K, and PBL height (solid line) in the reference run with GC05 type of mixing length. Valid for the vertical cross-section shown in Fig. 26. Note that the dark blue colour represent small TKE values, from 0.05 to 0.1 $m^2s^{-2}$.

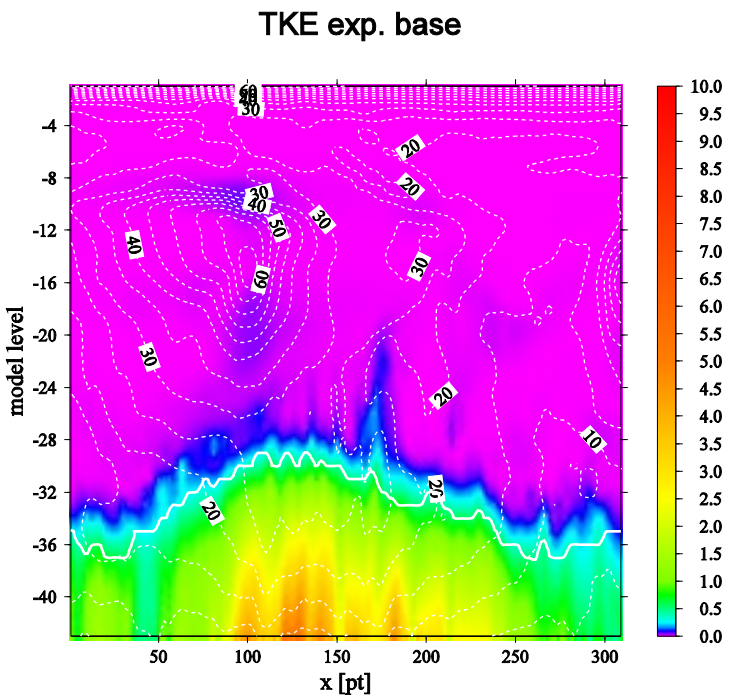


Fig.28: TKE (in color), $m^2s^{-2}$, isotachs (dashed), in $m.s^{-1}$ , and PBL height (solid lines) in the vertical cross-section shown in Fig. 26. and for the experiment with GC05 type of mixing length.

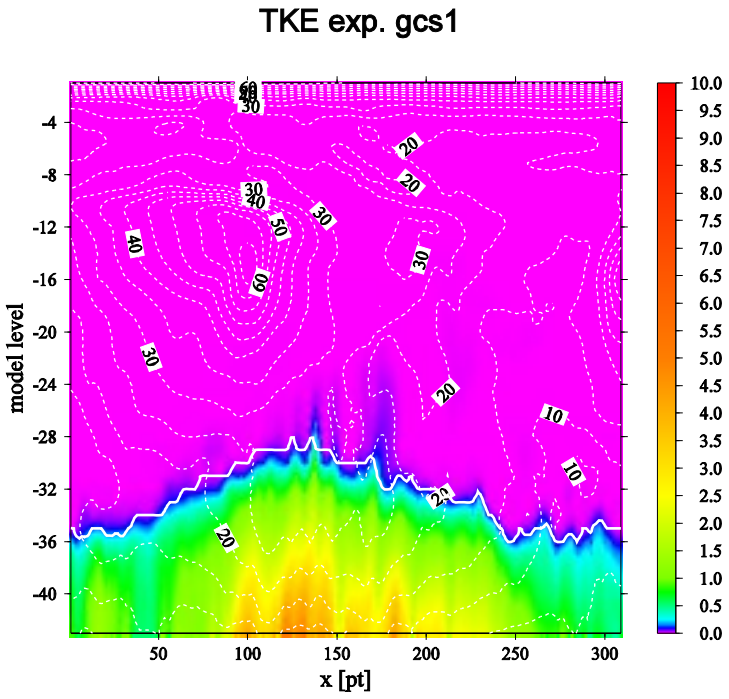


Fig. 29: As in Fig. 28, except for the experiment with GCS06 mixing length

Different view is obtained after full introduction of the BL89 mixing length in the parameterization of turbulence (Fig. 30). Regions of moderate turbulence are shown in the jet

area (but also in the region of tropopause). The TKE production in the PBL is also stronger than by the experiments with empirical mixing lengths.

The merger of the GCS06 and BL89 mixing lengths shows at least some weak turbulence in the jet region (Fig. 31) without exaggerating the TKE distribution in the upper troposphere. The e/N parameterization with "strong" setup (ALMKEN=5, BLMKEN=1) shows comparable values of the TKE below the jet stream axis but small values in the tropopause region (Fig. 32). However, TKE increased substantially in some other parts of the upper troposphere (eruption over the point 165). The "weaker" setup (ALMKEN=0.5, BLMKEN=0.1), which is closer to e/N parameterizations used in another models (e.g. also HIRLAM) showed only little changes comparing to GCS06 experiment.

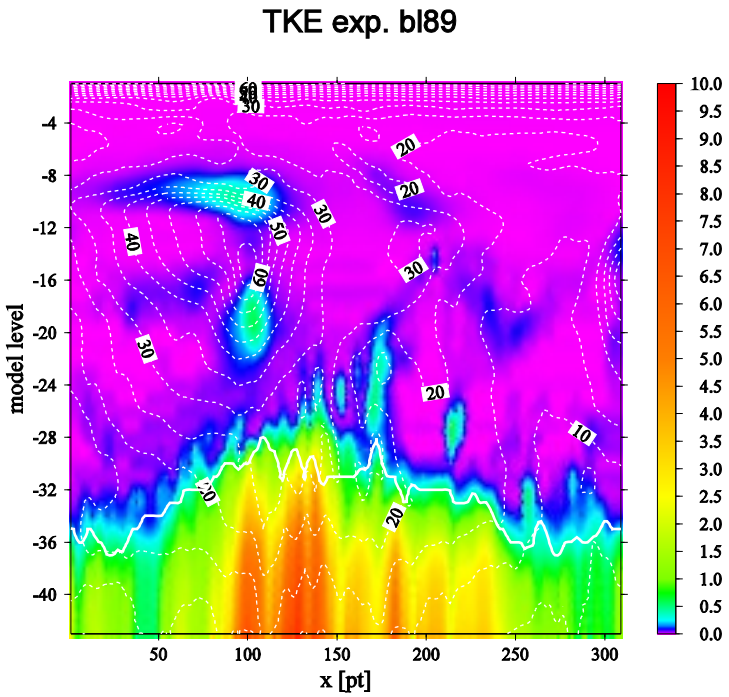


Fig. 30: As in Fig. 28, except for the experiment with fully applied BL89 mixing length

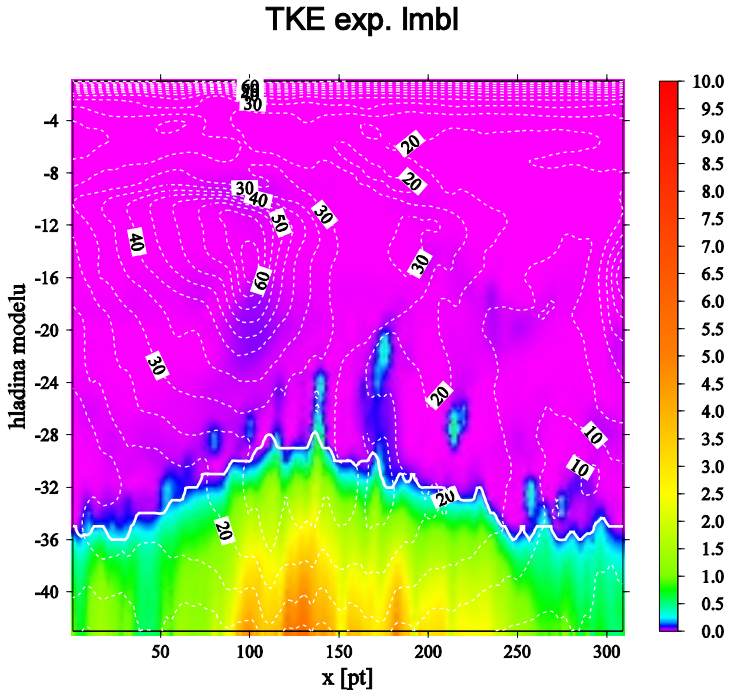


Fig. 31: As in Fig. 28, except for the experiment with merged GCS06-BL89 mixing length

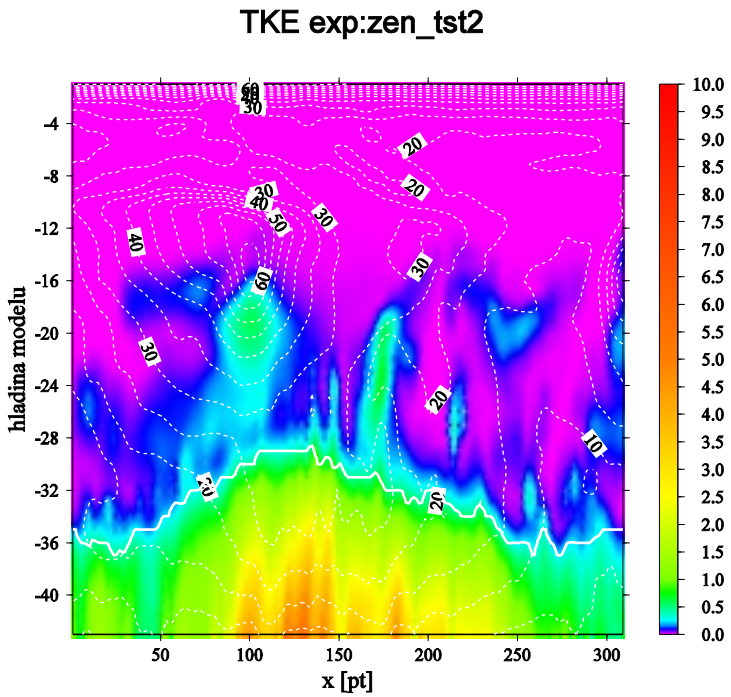


Fig. 32: As in Fig. 28, except for the experiment with 2nd setup of the e/N mixing length parameterization