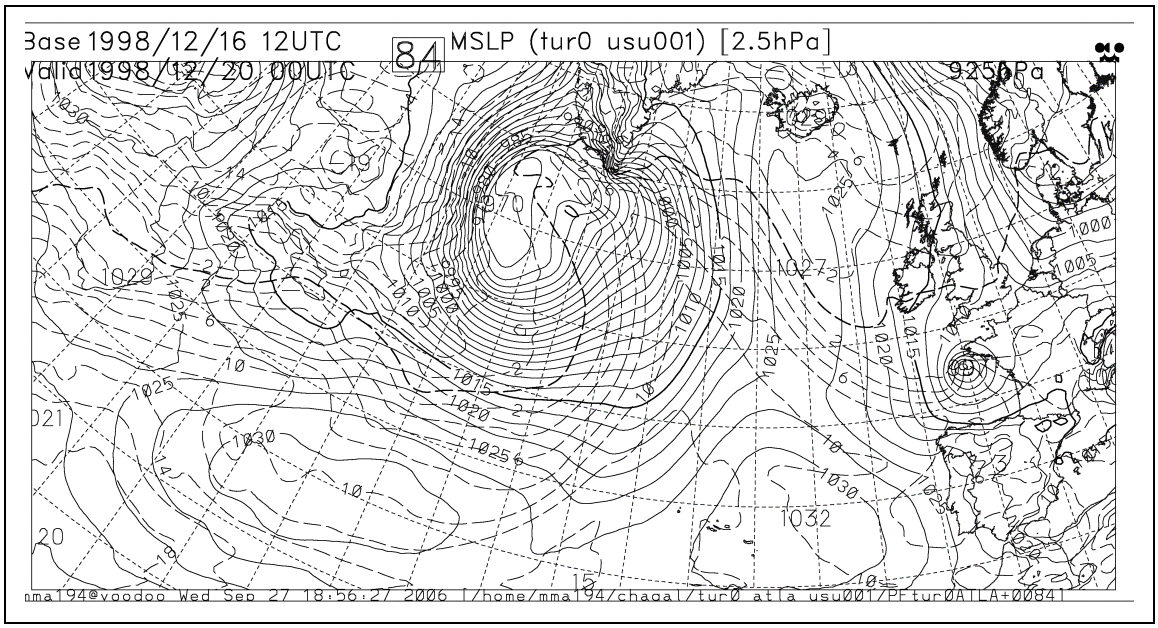

Fig. 40: ALARO -3MT and setup with constant (Z- type) mixing length and setup of cycle 24 (supporting cyclogenesis).

Surprisingly, the only ALARO -3MT forecast that was successful in deepening of the cyclone, used the former parameterization with constant mixing length profile and setup for enhanced turbulent fluxes at the top of the PBL in stable situations as with USURIC=1, USURICL=4, USURICE=0.5, USURID=0.01 etc. (Fig. 40).

Further evaluation of the case showed considerable differences in the TKE structure inside the cyclone already at early stage of its evolution. TKE profiles were observed in strong baroclinic zone in the middle of the vertical cross-section (Fig. 41).

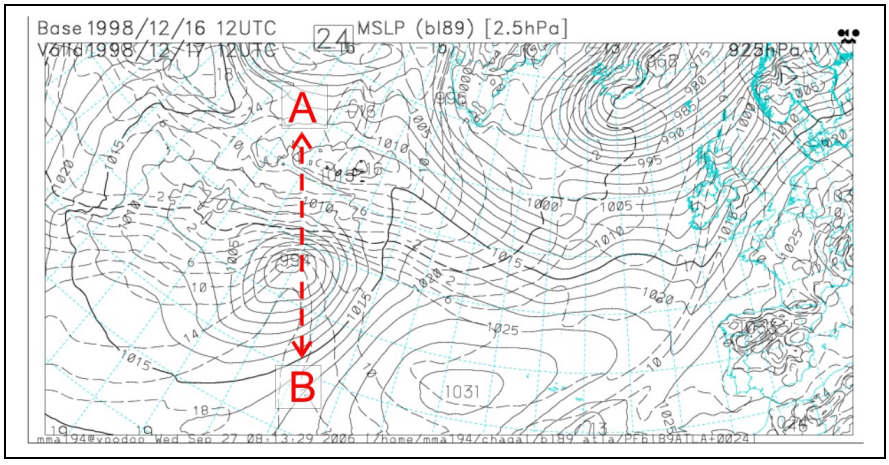

Fig. 41: Sense of the vertical cross-section used to evaluate the TKE distribution inside of the 20 December 1998 cyclone during its early stage after 24 hours of integration (17 December 1998 12 UTC).

The reference run with GC05 parameterization shows maximum TKE values in the PBL in the northern part of the cross-section (Fig. 42). In the southern part of the cross-section the PBL shows only small TKE, despite of small static stability and strong surface winds.

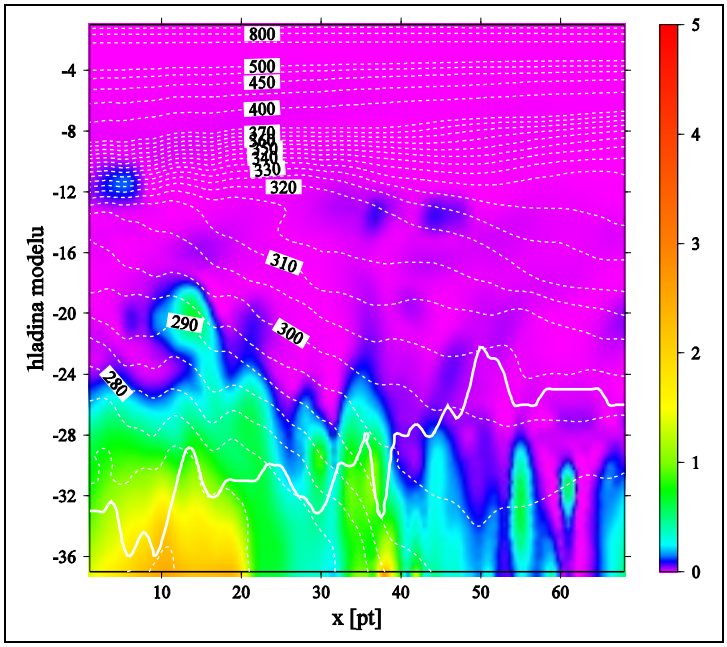

Fig. 42 : Meridional cross-section through the cyclone in Fig. 39. TKE (m^2 s^{-2}) is in colour, isolines of potential temperature are dashed and the PBL height is marked with solid line. The run used the ALARO-3MT GC05 mixing length parameterization.

The fully applied BL89 mixing length shows a tendency to increase TKE. The increase is significant in the upper troposphere, again in regions with strong wind shear and near tropopause (Fig. 43). This maxima can be suppressed by the use of the merged GCS06-BL89 parameterization (Fig. 44).

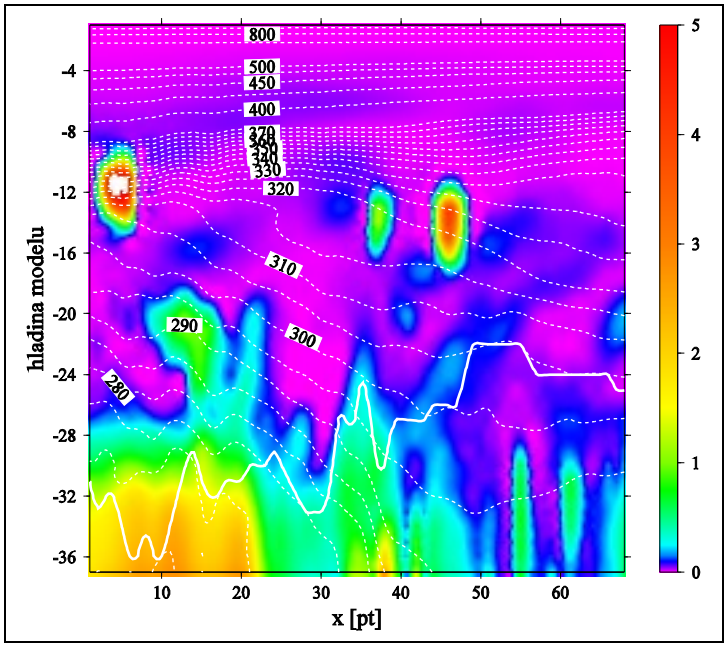

Fig. 43: The same as in Fig. 42, except for the fully applied BL89 mixing length

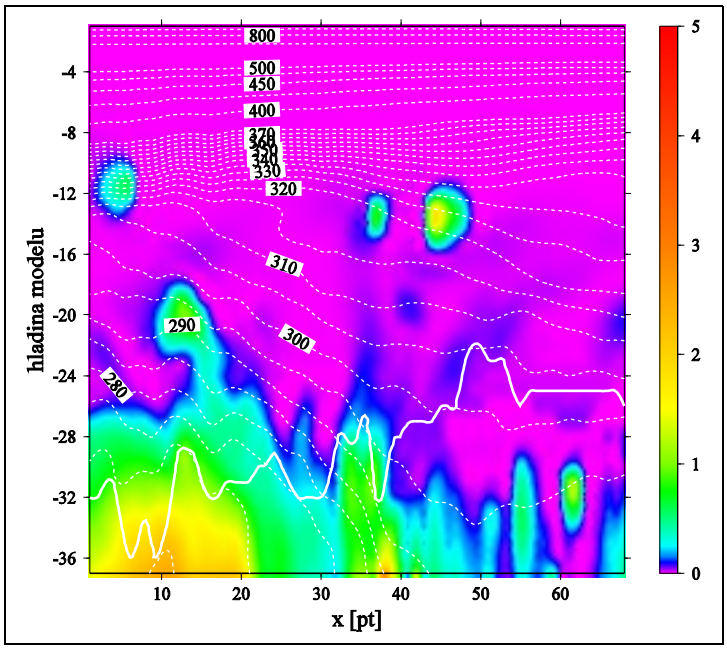

Fig. 44: The same, except for the merged GCS06-BL89 mixing length

Finally, the most interesting profile is given by the "old-fashion" parameterization of mixing length that does not depend on the height of the PBL and is everywhere constant (Fig. 45). The distribution of the TKE in the southern part of the cross-section is now better expressed. The maximum TKE is situated in the frontal zone in the middle of the cross-section, where the PBL height reaches a local maximum. Significant drop of the PBL is visible in the rear of the frontal zone.

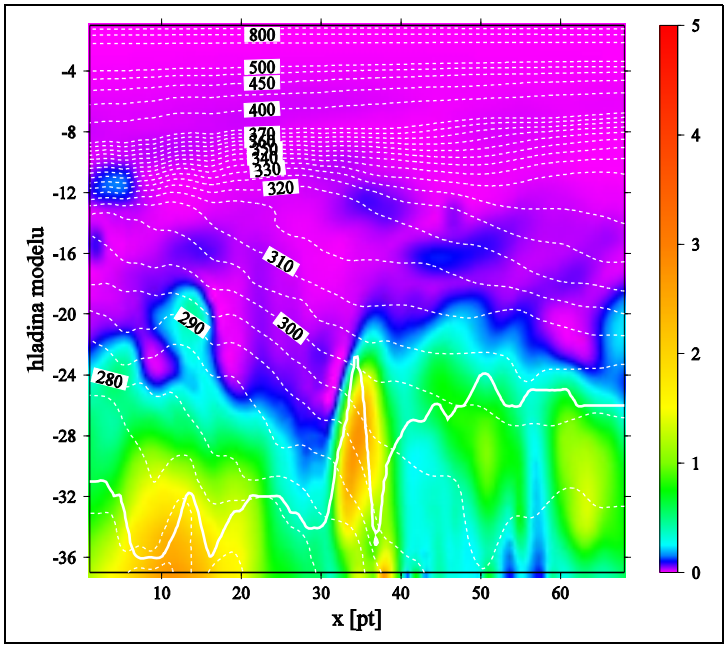

Fig. 45: The same as in Fig. 42, except for the constant mixing length and stronger limitation of the critical Richardson number.

However, the change of the cyclone structure should be not considered as a direct consequence of different parameterization of turbulent fluxes. The forecast of the 20 December 1998 cyclone depends on complicated relationships between the physical parameterization and the dynamics of the predicted cyclone, what was proved by several earlier studies. This should be kept in mind before stating premature conclusions. From this perspective, the latter simulation is perhaps not so “realistic” as it seems. The evolution of the cyclone is probably extremely sensitive on vertical diffusion at certain model levels (matched well by earlier, simpler parameterizations). Worse results of the PBL-height dependent scheme can be linked also with insufficiencies in the diagnostics of this parameter. On the other hand, constant mixing length profile and overall increase of turbulent fluxes in the PBL lead to unwanted erosion of inversions. Hence, more detailed study is needed to understand the links between the physical parameterization and dynamics and to find solution for optimal turbulence scheme in similar cases.