7. Conclusion

Experiences with both 1-D and 3-D model show that the choice of the mixing length parameterization became in the pseudo-TKE scheme even more important than it was in the former 1st order closure scheme. By definition, mixing length represents a distance, on which the parcel transported by turbulent eddy does not change it physical properties. However, this parameter represents rather a kind of ideal “concept” than a real physical quantity. This explains why simple and robust empirical schemes were quite successfully used in former parameterizations and why they provide sometimes better forecasts than model runs with more sophisticated formulations of mixing length. However, it is advantageous (and in smaller scales probably even necessary) to have parameterization of mixing length that is dependent on meteorological parameters. The mixing length parameterization of Bougeault and Lacarrère (BL89) seems to be the closest one to the above mentioned definition. However, its direct use in the computation of the exchange coefficients was unsatisfying for both 1-D and 3-D model. The overall production of TKE has increased; violating amounts of TKE could appear close to the tropopause, near the axis of strong jets, etc. This problem is probably connected also to the dimensions of the BL89 mixing length, which can be several times bigger than the empirical mixing length used for the computation of the K-coefficients. Hence, direct usage of the BL89 mixing length would require retuning or different formulation of the stability functions and of the computation of the exchange coefficients.

From this point of view, a merger of the empirical mixing length and of “more physical” BL89 formulation could be an acceptable compromise for both K- and TKE part of the computation. This is supported also by the results obtained with the proposed GCS06-BL89 mixing length that provide reasonable TKE amounts both in the PBL and in the upper troposphere. The performance of the scheme in forecasting surface parameters (10m wind, wind gusts, mean sea level pressure) is not worse (rather neutral) in comparison with the empirical scheme, even in extreme meteorological situations. However, further tests should be done on cases, which are sensitive on the mixing length parameterization.

The e/N type of the mixing length showed also some interesting results which were close to the forecasts with BL89 parameterization. Nevertheless, the scheme would require further development and careful tuning, above all in situation with small static stability (because in the original formula there are no limits for the TKE and Brunt-Väisälä ratio). Unlike the BL89 scheme, this parameterization is probably suitable only for local assessment of turbulence in statically stable environments.

Future development of the merged empirical – BL89 scheme should concentrate on the rate of the BL89 influence that could be probably also dependent on meteorological situation (this could be for instance different for statically stable and unstable part of the computation). The tuning of the scheme would require more information, comparisons and tests with empirical, BL89 and merged parameterizations in 1-D model on several types of situations (convective or very stable PBL). The same can be addressed to the parameterization of the PBL height which is particularly important for correct formulation of the mixing length.

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