

# Evaluation of PBL schemes (report)

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*László Kullmann*

In surfex there exists 3 methods to calculate PBL parameters (temperature and humidity at 2m and wind at 10m):

**Paulson scheme (Paulson '70)** The scheme diagnoses PBL values by extrapolating from lowest atmospheric level. The extrapolation is done with prescribed stability functions.

**ACNTCLS scheme (Geleyn '88)** In contrary to the Paulson scheme this scheme interpolates between the lowest atmospheric level and the surface. The stability functions are not explicitly given, the profile is calculated with the help of surface exchange coefficients.

**Canopy scheme (Masson '07)** This scheme uses prognostic equations (in 1D, because only vertical interaction is assumed) in the Surface Boundary Layer (SBL) to calculate the tendency of meteorological fields taking into account LS forcing, turbulence and canopy drag. Using this scheme has also an impact on the surface temperature and water content since the forcing of surface will be the lowest level in the SBL and not that of the upper air model.

The drawback of ACNTCLS is that in stable cases it gives too cold 2m temperature value. In order to avoid this the  $C_V$  coefficient was modified in ALADIN but in this case we get too warm surface value. The problem with Paulson scheme is that since it is an extrapolator it is not suitable for data assimilation. The Canopy scheme seems to give the best forecast in case of direct model (except perhaps for wind) but since it has no tangent linear and adjoint version it can not be used either for data assimilation.

The purpose of my stay was to discuss the work that should be carried out to validate in detail the three methods both in direct model calculation and in assimilation.

The outcome of the discussion can be summarized in the following points

- The 3 method should be compared on cases of unstable and strongly stable situations.
- One should also consider the combination of the ACNTCLS and Canopy scheme as a possible method. The diagnosis itself is done by the ACNTCLS scheme but the surface exchange coefficients will be determined with the help of the Canopy scheme.
- In stable case new stability function should be tested (for all the 3 schemes).
- It should be tested whether the tangent linear of the ACNTCLS scheme is a good approximation for the Canopy scheme.
- If the previous point doesn't hold or if it is difficult to carry out then try to use ACNTCLS for the direct obs operator. In this case one has to check if the Canopy and ACNTCLS method give similar result in the direct model calculation.

During my stay I was getting familiar with the code and learned the technical details how to run the different schemes. We also found a minor bug related to the computation of relative humidity at 2m in case of ACNTCLS scheme. This bug was corrected.