'Dry case' target time-step organisation of TOUCANS

The resulting 'dry' scheme would then look like this:

1. computation of stability functions $\chi_3, \phi_3, T_h, F_{\overline{w'^2}}$, and F_ϵ from $\Pi^- = \frac{TPE^-}{e^-} [= \frac{C_p Ri_f}{1-Ri_f} \leftarrow$ cold start]
   [or at start for fast and dirty implementation: computation of Ri from Π^-]
2. computation of L, l_m from e^- and Π^-
3. computation of τ_ϵ, and K_E from l_m, e^-, and F_ϵ
4. computation of τ_{TTE}, and K_{TTE} from τ_ϵ, K_E, and Π^-
5. computation of $\tilde{e}$ from $\overline{w'\theta'}$, $\overline{w'u'}$, $\overline{w'v'}$, and τ_ϵ
6. computation of $\widetilde{TTE}$ from $\overline{w'u'}$, $\overline{w'v'}$, and τ_{TTE}
7. solver for prognostic TKE
8. solver for prognostic TTE **and prognostic L for next time step if not diagnostic**
9. computation of K_m, K'_h: $K_m = L_K C_K \sqrt{e^{(+)}} \chi_3(\Pi), \quad K'_h = L_K C_K C_3 \sqrt{e^{(+)}} \phi_Q(\Pi)$
10. local vertical diffusion solver with K_m, K'_h
11. non-local solver with additional TPE(=TTE-TKE) source term
12. no need anymore for a non local correction to the final value of TKE (and of TTE)

The main difference of TOUCANS with respect to other schemes is that the new TKE is computed first (with direct 'local' closure in the case of prognostic TKE only; with use of previous time step fluxes and present gradients in the case with prognostic TKE & TTE). The exchange coefficients follow (and they are used even in the fully prognostic scheme, because we want to differentiate SOMs from TOMs terms, the 'local' solving acting as preconditioning for the 'total' solving).

'Moist case' draft extension to the target time-step organisation of TOUCANS

The resulting 'moist' scheme would then look like this:

1. computation of $Ri_{f_m} = \frac{\Pi}{C_P+\Pi}$, and $Ri_{f_{s1}} = -g\,M\,(C)\,\frac{\tau_\epsilon\,C_p(1+\Pi)}{TTE'(C_P+\Pi)}\left\{\frac{\overline{w's'_{sL}}}{\overline{c_p}\,\overline{T}} + \left[\Lambda - \frac{c_{pd}-c_{pv}}{\overline{c_p}}\right]\overline{w'q'_t}\right\}^-$
2. computation of stability functions $\chi_3\left(Ri_{f_{s1}}\right), \phi_3\left(Ri_{f_{s1}}\right), T_h\left(Ri_{f_{s1}}\right), F_{\overline{w'^2}}\left(?Ri_{f_{s1}}\ or\ Ri_{f_m}\right)$, and $F_\epsilon\left(Ri_{f_m}\right)$
3. computation of L, l_m from e^- and Ri_{f_m}
4. computation of τ_ϵ, and K_E from l_m, e^-, and F_ϵ
5. computation of τ_{TTE}, and K_{TTE} from τ_ϵ, K_E, and Π^-
6. computation of $\tilde{e}$ from $\overline{w's'_{sL}}$, $\overline{w'q'_t}$, $\overline{w'u'}$, $\overline{w'v'}$, and τ_ϵ
7. computation of $\widetilde{TTE}$ from $\overline{w'u'}$, $\overline{w'v'}$, and τ_{TTE}
8. solver for prognostic TKE
9. solver for prognostic TTE **and prognostic L for next time step if not diagnostic**
   [Remark: Here is a possibility to compute $Ri_{f_{s1}}$ (and stability functions following) from resulting energies instead of computation in steps 1 and 2.]
10. computation of K_m, K'_h: $K_m = L_K C_K \sqrt{e^{(+)}}\chi_3\left(Ri_{f_{s1}}\right)$, $K'_h = L_K C_K C_3 \sqrt{e^{(+)}}\phi_Q\left(Ri_{f_{s1}}\right)$
11. local vertical diffusion solver with K_m, K'_h
12. non-local solver with additional TPE(=TTE-TKE) source term according to relations (60), and (61) **Difficulty associated with the 'resonance' when the <w'.q't> weight gets 0**
13. no need anymore for a non local correction to the final value of TKE (and of TTE)

Differentiation for simulating the 's-conservation' behaviour

Apart from the two (important) remarks, the structure is dictated by the 'dry' one and by entropy considerations