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Revision of moist PV under the notion of the particle relabeling symmetry

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There are multiple versions of Ertel's potential vorticity (EPV) to be found in the literature. The scalar psi is either taken as the virtual potential temperature, or as the equivalent potential temperature. This poster motivates that both are not suitable. Rather, a potential temperature derived from the linear combination of the entropy potential and the total water content times a reference value is an appropriate choice. Both, the total water content and the entropy are Lagrangian invariants under ideal (reversible, adiabatic) conditions, so that particles can be relabelled on a psi surface. The derivation of the EPV equation with the new 'modified entropy' (or modified entropy potential temperature) contains further non-convective fluxes which are due to the mixing of constituents and have not yet been described in the literature.

The do-nothing-flux of EPV motivates the definition of the inactive wind, which is the most general wind balance in the atmosphere. A version of transformed atmospheric equations are given, which make the do-nothing-flux of EPV 'invisible'. In the horizontal momentum equation, one can thus distinguish baroclinic and barotropic forcing terms. The active wind (as the deviation from the inactive wind) and the entropy source term (see other poster) describe together, how isentropes are moved. In the time-mean, the vertical active wind resembles the vertical residual wind of the TEM framework.

The often used virtual potential temperature is not a Lagrangian invariant and must be ruled out as a choice of psi . The often investigated effect of latent heating on the evolution of the EPV is meaningless under the strict notion of a potential vorticity.

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