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Interactive comment on "Deep-convective vertical transport: what is mass flux?" *by* J.-I. Yano

Anonymous Referee #2

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article

Review

Deep-convective vertical transport: what is mass flux? J.-I. Yano.

This premise of this paper is that there are conceptual problems regarding the use of mass flux as a characteristic of deep convection. In fact, the paper, though providing an interesting perspective on convection and convective mass fluxes, does not demonstrate any conceptual problem to exist. Convective mass fluxes as presented in the paper are well-defined. The paper concludes with a more technical issue as to how to

set convective transports to zero, but, even there, what is presented as an “alternate" solution to this problem yields an identical result to a procedure used by Lawrence and Salzmann (2008, Atmos. Chem. Phys.). That equivalence is not surprising, given that the relevant mass fluxes are, indeed, well-defined.

The paper touches tangentially on issues that are important to implementing mass-flux parameterizations, e.g., closure, which are quite difficult problems. However, the basic decomposition of fluxes, given adequate care in definition, is not a source of great difficulty.

About the only point where there is possible confusion regarding fluxes and their relationship to convection is in the discussion on p. 3547 about what is characterized as “associated residual environmental descent $M_e{}'$." It is noted that setting $(\partial\overline{Mr}/\partial z)_c$ to zero turns off not only convective transport associated with convective updrafts and downdrafts but also transport due to associated residual environmental descent. This statement is correct, but note that both procedures for setting convective transports to zero in this paper do so. Problems can be avoided here by defining clearly what is meant by deep convection. If one defines it as departures from the mean flow, it is appropriate to zero all transports. If the convective updrafts and downdrafts did not exist for a given mean flow, there would also be no associated residual environmental flow, and the procedures for eliminating convective transport are suitable. If one focuses instead only on the transports associated with convective updrafts and downdrafts, the concern raised is valid. Both perspectives have utility, but there is no fundamental ambiguity regarding the meaning of the various mass fluxes.

In light of the preceding comments, I would not agree with the assertion in the abstract that the “main point" of the convective mass flux formulation is to assume different profiles for transported quantities in updrafts, downdrafts, and environment." All aspects of

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the mass-flux formulation, both the decomposition into components and the differences in profiles in the different components, are important. A central concern in the paper's introduction is reducing confusion about the mass-flux formulation, but de-emphasizing the fundamental physical decomposition is problematic enough to increase confusion!

Regarding the moist entropy: On p. 3538, it is stated to be conserved for condensation. This is true in the absence of precipitation, and this is important in considering the tropical balance of moist entropy, discussed in Section 2.

The notation in Eq. (11) is not clear. The flux divergence is not a delta function; rather, it is constant above and below z_t and z_s, as depicted in Fig. 2.

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