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TRACER TRANSPORT BY PARAMETERIZED CONVECTION

L. Donner

GFDL/NOAA, Princeton University [ljd@gfdl.noaa.gov 1 609 987 5063]

In large-scale circulation and transport models, significant effects of cumulus convection on heat, moisture, momentum, cloud condensate, and tracers must be parameterized, since they are largely unrepresented by explicitly resolved motions. In general, the unresolved effects can arise from in-cloud sources and sinks and eddy transports associated with cumulus-system updrafts and downdrafts and compensating subsidence. In part, it is possible to represent the aggregate effects of the in-cloud sources and sinks and eddy transports in terms of the net convective mass fluxes. This approach has been extensively used in cumulus parameterizations in general circulation and chemical transport models in a wide variety of mass-flux cumulus parameterizations.

As new demands are placed on cumulus parameterizations to treat tracer transport and transformation and cloud-convection-radiation interactions, limitations of the mass-flux approach as currently employed have become evident. This presentation will summarize the basis for the mass-flux parameterizations, emphasizing the simplifications it permits in cumulus parameterizations but also noting its limitations for non-thermodynamic applications like tracer transport. A more general approach to cumulus parameterization will be presented, which both predicts significantly different tracer transport (and mass fluxes) and also includes mesoscale components of cumulus systems.