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Cumulus Parameterization in the GFDL AR5 General Circulation Model

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Among the major goals for the AR5-generation atmospheric general circulation model (GCM) completing development at the U.S. National Oceanic and Atmospheric Administration (NOAA) Geophysical Fluid Dynamics Laboratory (GFDL) are inclusion of cloud-aerosol interactions, tropical land precipitation simulations accurate enough for coupling the GCM with a carbon-cycle model, and a stratospheric simulation capable of supporting realistic chemistry, including ozone-hole simulations. Through its roles in activating aerosols, dominating tropical precipitation, and troposphere-stratosphere exchange, cumulus parameterization has played an important role in realizing these goals.

The cumulus parameterization in the GFDL AR5-generation model includes vertical velocities, mass fluxes, single-moment microphysics, and mesoscale circulations. A mixture of entraining plumes and ascending parcels with stochastic mixing represent deep and shallow convection, with closures related to convective available potential energy and turbulence kinetic energy. The choice of closure exerts a strong influence on transient behavior in the tropics, as well as the magnitude of land precipitation. Convection also plays a key role in chemical transport and scavenging.