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Transport of radon-222 and methyl iodide by deep convection in GFDL AM2

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Distributions of radon-222 and methyl iodide are analyzed in the Geophysical Fluid Dynamics Laboratory (GFDL) Atmospheric Model 2 (AM2) using two parameterizations for deep convection. One of these parameterizations represents deep convection as an ensemble of entraining plumes whose intensity is governed by the rate at which cloud work function (convective available potential energy or CAPE, in the case of non-entraining plumes) relaxes to a threshold. The other parameterization represents deep convection as an ensemble of entraining plumes and a related mesoscale circulation, whose intensity varies such that CAPE variations are controlled by variations in the temperature and humidity of the planetary boundary layer. Although precipitation patterns are generally similar in AM2 with both parameterizations, the deep convective mass fluxes are quite different, with larger mass fluxes in the middle-to-upper troposphere for the parameterization consisting only of entraining plumes without a mesoscale circulation. The distributions of both methyl iodide and radon-222 reflect the different mass fluxes. The profiles of methyl iodide and radon-222 are more C-shaped in AM2 without mesoscale circulations. Observations, especially for methyl iodide, suggest that the smaller transport obtained when mesoscale circulations are included is more realistic. Differences in transport in the tropopause region are in contrast to those in the middle-to-upper troposphere, with more transport in the tropoause region when mesoscale circulations are present.