



Evaporation tagging and atmospheric water budget analysis with WRF: A regional precipitation recycling study for West

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Regional precipitation recycling is the measure of the contribution of local evaporation E to local precipitation. This study provides a set of two methods developed in the Weather Research and Forecasting WRF model system for investigating regional precipitation recycling mechanisms: (1) tracking of tagged atmospheric water species originating from evaporation in a source region, ie E-tagging, and (2) three-dimensional budgets of total and tagged atmospheric water species. These methods are used to quantify the effect of return flow and non-well vertical mixing neglected in the computation of the bulk precipitation recycling ratio. The developed algorithms are applied to a WRF simulation of the West African Monsoon 2003. The simulated region is characterized by vertical wind shear condition, i.e. southwesterlies in the low levels and easterlies in the mid-levels, which favours return flow and non-well vertical mixing. Regional precipitation recycling is investigated in 100×100 and 1000×1000 km² areas. A prerequisite condition for evaporated water to contribute to the precipitation process in both areas is that it is lifted to the mid-levels where hydrometeors are produced. In the 100×100 (1000×1000) km² area the bulk precipitation recycling ratio is 0.9 (7.3) %. Our budget analysis reveals that return flow and non-well vertically mixed outflow increase this value by about +0.2 (2.9) and +0.2 (1.6) %, respectively, thus strengthening the well-known scale-dependency of regional precipitation recycling.