1st TERRABITES Symposium
Hamburg, Germany, 9-11 February 2010
TERRABITES-83

Simulation of Continental Moisture Recycling and its Modification by Vegetation

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Continental moisture recycling is the process by which precipitation is returned to the atmosphere through evapotranspiration, supplying the atmosphere with moisture for repeated precipitation. In order to quantify continental moisture recycling, we apply a simplified water vapour tracing to global moisture and wind fields generated with a general circulation model (GCM). Instead of tagging water according to its source region, we treat moisture fractions as tracers according to the number of experienced continental recycling events (recycling count), i.e. precipitation/dew-evapotranspiration events. We run the GCM in two configurations, with present-day potential vegetation and without vegetation, to investigate the influence of vegetation on moisture recycling.

In accordance with expectation, we find that the mean recycling count increases from the continents' windward coast to their leeward coast. Over the Amazon region, due to the steady trade winds, the mean recycling count increases from 0 at the Atlantic coast (100% oceanic moisture) to $\sim$1 at the Pacific coast ($\sim$60% recycled moisture) throughout the year. The mid- and high-latitudes show pronounced seasonality with stronger recycling in summer (recycling count up to 2-3 in Eastern Central Asia, $\sim$90% recycled moisture) and weaker recycling in winter. However, although overall continental precipitation decreases considerably after global removal of vegetation, the spatial pattern of precipitation change is largely uncorrelated with the recycling pattern simulated with present-day vegetation. This suggests that vegetation influences precipitation through other mechanisms rather than through moisture recycling, for example large- and small-scale dynamical effects.