Geophysical Research Abstracts
Vol. 15, EGU2013-3362, 2013
EGU General Assembly 2013

Natural variability of moisture recycling through a precipitationshed lens

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Moisture recycling, whereby evaporation from Earth's surface flows through the atmosphere and falls out as precipitation on land downwind, is increasingly being acknowledged as an important feature of the global Earth system. There is still substantial uncertainty of how the large-scale patterns of moisture recycling (moisture recycling regimes) vary with the background flow, and how the natural variability of the atmosphere can cause transitions between these regimes. Understanding the natural variability of moisture recycling in the absence of outside factors is critical for quantifying and determining the relative importance of external drivers such as land-use change or increasing greenhouse gases. This research explores this topic by quantifying the natural variability of moisture recycling for five regions globally, using the precipitationshed as the unit of analysis. We employ the Water Accounting Model (WAM 2.0), a numerical water transport model that vertically integrates atmospheric water vapour, to track how moisture flows through the atmosphere. Using reanalysis datasets, and multiple global indices of climatic variability (such as the El Nino Southern Oscillation and the North Atlantic Oscillation), natural variations in moisture recycling relationships are identified. The results suggest that some changes in the variability of moisture recycling relationships (and by extension, precipitationsheds) are related to global and regional climatic variability. Given that many large-scale features of climatic variability are expected to shift in varying ways with anthropogenic climate change, it may become possible to forecast how moisture recycling regimes may be expected to change. This has particular implications for ecosystem services that are dependent on the reliable delivery of precipitation, and the societies dependent on such services.