Geophysical Research Abstracts
Vol. 12, EGU2010-10466, 2010
EGU General Assembly 2010

Potential contribution of groundwater to dry-season ET in the Amazon

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Climate and land ecosystem models simulate vegetation stress in the Amazon forest in the dry season, but observations show enhanced growth in response to higher radiation under less cloudy skies indicating an adequate water supply. The question is: how does the vegetation obtain sufficient water, and what is missing in the models? Shallow model soil and rooting depth is a factor; the ability of roots to move water up and down (hydraulic redistribution) may be another, but another cause may lie in the buffering effect of the groundwater found in nature but absent in models. We present observational and modeling evidence that the vast groundwater store, consequence of high annual rainfall combined with poor drainage in the Amazon, may provide a stable source for dry-season photosynthesis. The water table beneath the Amazon is sufficiently shallow (38% area <5m and 63% area <10m deep) as to contribute >2mm/day to dry-season evapotranspiration, a non-negligible portion of tower-observed flux of 3-4mm/day, the latter including canopy-interception loss and open-water evaporation. This may have important implications to our understanding of Amazonia ecosystem response and feedback to climate change. Current models, lacking groundwater, predict a significant reduction in dry-season photosynthesis under current climate and large-scale dieback under projected future climate converting the Amazon from a net carbon sink to a net source and accelerating warming. If groundwater is considered in the models, the magnitude of the responses and feedbacks may be reduced.