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The Potential Influence of River CO2 Effluxes on Regional Carbon Balance in the Tapajos Region, Para, Brazil

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The Simple Biosphere Model Version 2 (SiB2) is coupled with the CSU Regional Atmospheric Modeling System (RAMS) to study the two-way interactions between the land surface and atmosphere. SiB2 treats the vegetation explicitly and realistically (Baker et al. 2006), thereby incorporating the biophysical controls on the exchange of momentum, energy, water, and carbon between the two systems. The coupled SiBRAMS is able to reproduce the observed meteorology and CO2 concentration, as well as surface fluxes of CO2, H, and LE, for the 15-day simulation time period during 2001 Santarem mesoscale field campaign. The mechanically forced low-level convergence (LLC) proves to have significant impact on observed ecosystem carbon fluxes, and should be taken into account if tower fluxes are to be generalized to a large region. The impact of CO2 evasion from the Tapajos River has also been evaluated by performing numerical sensitivity experiments with and without river CO2 effluxes. The results show that the river CO2 effluxes increase carbon uptake over vegetated land due to short-term CO2 fertilization effects. The Amazon Basin stays a carbon sink regardless of the river CO2 evasion. However, to study the long-term effects of atmospheric CO2 enrichment, a more sophisticated ecosystem model that can account for nutrient limitation may be needed.

In addition, the mechanisms for the formation of LLC line are further explored. When the background winds turn southeasterly, the channeling effect from the Amazon River to the Tapajos River is reduced and the blocking effects of elevated topography start to take over, resulting in wind speed decreases downwind, and the initiation of the convergence line. Contrary to the channeling effect, in this case, the LLC line does not form exactly along the east bank of Tapajos River; it moves in the eastwest direction,

depending on the relative strength of the background winds and the physical blocking of elevated topography. This explains why the LLC line moves eastward after sunset when easterly winds gradually die down.