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Hydrology and Earth System Sciences Discussions

Interactive comment on "Biotic pump of atmospheric moisture as driver of the hydrological cycle on land" *by* A. M. Makarieva and V. G. Gorshkov

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The paper on the biotic pump indeed raises a very intriguing concept of active involvement of terrestrial vegetation in the water transport from ocean to land. Being not an expert in thermodynamics I have asked a few colleagues to comment on the physical mechanism involving the saturated lapse rate introduced in the paper, and the general comment is that the idea is indeed interesting, but the rationale of the proposed mechanism is difficult to follow without considerable time spent. In particular the statement that "the saturated lapse rate (1.2 K/km) is a fundamental parameter dictating the char-

acter of atmospheric processes" (P 2635) is difficult to appreciate, as is already raised by Henrique de Melo Jorge Barbosa and other review comments received earlier on this manuscript. We have planned a group seminar devoted to this paper to take place later this year, to stimulate the discussion on this intriguing issue. It would be very much appreciated if the paper would become easier to comprehend on this issue. However, we realize that fundamental new insights are difficult to explain in an easy way.

There are, however, two other issues I would like to raise. The first is that the extend to which "passive geophysical fluxes" are able to transport water onto the continents is calibrated using (arid) zones where the absence of forest is well explainable from the lack of precipitation originating from general atmospheric circulation that acts to move water away from the area. In other words: the "forest-free" horizontal water transport is calibrated in areas where other mechanisms than the absence of forest can explain the relatively short travel distance of water vapor. It is not clear to me that one can interpret this as a generally applicable value of the passive geophysical transport capacity, since at higher and lower latitudes the actual atmospheric circulation may be associated with much larger transport capacities.

An other issue that is not fully clear is what vegetation properties are actually needed to promote the evaporation force. To my perception it is not necessarily the high leaf area index or the vertical layer structure that makes forest so different from low but equally well-watered vegetation types: one can also argue that low vegetation types have a smaller aerodynamic coupling to the atmosphere and therefore need less control of evaporation loss by stomatal closure, which gives rise to higher evaporative fraction (LE divided by available energy) than for forests. The basic difference between low and tall vegetation is, I think, the higher albedo of surfaces with low vegetation, thereby reducing the available energy for evaporation. The biotic pump (if it is really existing) may find its origin in having a dark surface.

The paper is, again, very intriguing and deserves to receive wide attention. It is, however, very long and raises many (indeed related) topics within a single manuscript,

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of which some of them are still not fully comprehended by most of the readers. It is maybe an option to discuss the treatment of the evaporation force in a separate paper, for instance for J.Atmos.Sci.

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