Hydrol. Earth Syst. Sci. Discuss., 3, S1466–S1469, 2006
www.hydrol-earth-syst-sci-discuss.net/3/S1466/2006/

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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Received and published: 14 November 2006

The author's reply has cleared some of my doubts, but I still have some important points which I would like to discuss.

1) Latent Heat

It does not seem to me that the latent heat release during condensation is considered anywhere in the calculation. I think this is important since it warms the air, increasing the local pressure, and thus decreases the total pressure gradients and the effect of the evaporative force.

2) Precipitation before RH=100%

With the author's theory, precipitation occurs due to excessive moisture in the atmosphere. However, it is well known that condensation occurs at relative humidity well below 100% because all different kinds of aerosols act as cloud condensation nuclei. Therefore, well before the vertical profile is fully saturated, there will be precipitation, which reduces specific humidity, pressure gradients and lapse rate, etc...

3) And what about shallow cumulus parameterization?

An atmospheric model does not use only one parameterization for describing convection. Usually there are:

- Deep convection parameterization, which occurs, as the authors say, in unstable atmospheric columns ($\Gamma > 6.5K/km$)

- Shallow convection parameterization. This takes into account vertical motions of moisture and energy without precipitation and happens for $\Gamma < 6.5K/km$, as the evaporative forced does.

- Large scale condensation, which removes excessive water (if any, after deep and shallow cumulus parameterizations) from the column.

I would like to know what is the difference between a shallow cumulus parameterization and the authors evaporative force theory, as they both do the same: vertical transport of moisture and heat well before deep convection develops.

4) A matter of precision

I think that the 10% change in the temperature and the other 10% change in the value of Q_{H_2O} cannot be neglected. For instance, a 20% change in the author's estimates in sections 3.2 and 3.3 (either making f_{ev} larger or smaller) would bring their estimated values out of agreement with observations.

5) Downward diffusion

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Interactive Comment

After the authors answer to my first comments, I agree that the upward motion of the water vapor molecules will make the whole moist air moves upward.

However, this means that the nitrogen and oxygen will become into a state where their partial pressure at the surface are less than the weight of their masses. Therefore, as soon as the moist air start to move upwards, there will appear a partial pressure gradient pointing downwards. This difference of concentration will induce diffusion of unbalanced gases N_2 and O_2 from top to bottom, and the final equilibrium situation should be such that, for all constituents, partial pressures are in equilibrium with gravity at all heights. The downward diffusion of the initially hydrostatically balanced gases should reduce the evaporative force.

Question to the authors: what would be the velocity of the downward diffusion of N2 and O2 in the moist atmosphere case? Is it really much slower than the upward H20 velocity that it can be neglected?

— Specific comments on the authors answers to my first comment —

Example given by the authors in pages S1450:

The authors give an example of two different gases in two different compartments. I believe that in this case there is will be motion (contrary to what was stated by the authors) since different gases will have different molecular masses. Initially, the center of mass (CM) will not be at the center of the box, but closer to the heavier side. At equilibrium, the CM will be exactly at the center of the box. In fact, doing this experiment in vacuum, one would see the box oscillate with decreasing amplitudes before reaching its final position. If done on a workbench, the workbench would exert a force on the box that would be responsible for changing the position of the CM.

evaporation/condensation

The authors say: *"we do not state anywhere in the paper that it is the same molecules that evaporate into the atmosphere that immediately condense"*... but on page 2636, lines 1 to 3, it is written:

*"Solar radiation absorbed by the Earth's surface makes water evaporate from the oceanic and soil surface, **but the evaporated water undergoes condensation immediately** at a microscopic distance above the surface, which is of the order of one free path length of water vapor molecules."*

Archimedes

Since you say: *"We do not base our consideration on the Archimedes force and, hence, we do not need to prove this statement."* I think you should take "Archimedes paragraph" out of the paper.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 3, 2621, 2006.