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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Where do winds come from? A new theory on how water vapor condensation influences atmospheric pressure and dynamics" *by* A. M. Makarieva et al.

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General comments

I found the paper generally unclear, and the later stages of the mathematics seemed to involve, at least, very restrictive assumptions, so that I could not see how the results could be used.

Specific comments

My ability to follow the paper ended at Equation 34. This is introduced with no justification or derivation. It appears that it should follow from Eqs 32 and 33, but later in the paper it is explained that this is a false belief, and that the equation is independent. However, the equation is not derived, but a vague qualitative explanation is given.

I think Eqs 32 and 33 do correctly express conservation of mass. The argument for 34 also seems to be in terms of conservation of mass; no other physics seems to be introduced. But independent equations cannot be derived from the same physics.

In discussion at Judith Curry's website, it seems that Eq 34 was seen as valid for saturated adiabatic ascent. That is restrictive, and would limit 37 to the same conditions, which then makes the application to Hadley cells puzzling.

I could not see then how Eq 35 was derived, nor 36. It was surprising to see $\frac{\partial N}{\partial x}$ appear when $\frac{\partial N_v}{\partial x}$ has been assumed zero.

It is not clear how Eq 25 helps in deriving 37 from 36, but 37 does seem to require that T be constant.

My view is that Eq 34 is not independent of 32 and 33, and cannot be used as an extra equation. I also doubt the algebra leading from 34 to 37, and think that it should be written out in greater detail.

In fact it is clear something is wrong with the math. If you combine Eq 34 and Eq 36, you get

$$S = u\frac{\partial N}{\partial x}$$

This gives a finite value for condensation rate S even if the air is dry.

Math Issues

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An equation very like Eq 34 does follow from 32,33

It is possible to derive an equation like 34 from 32,33 thus, with $v = (u, 0, w)$:

$$\nabla.(vN_d) = N_d\nabla.v + v.\nabla N_d = 0 \tag{1}$$

$$\nabla.(vN_v) = N_v\nabla.v + v.\nabla N_v = S \tag{2}$$

Combine $N_d \times (2) - N_v \times (1)$:

$$N_d v.\nabla N_v - N_v v.\nabla N_d = N_d S$$

$$S = v.\nabla N_v - \frac{N_v}{N_d} v.\nabla N_d \tag{3}$$

or going back to components

$$S = u(\frac{\partial N_v}{\partial x} - \gamma_d \frac{\partial N_d}{\partial x}) + w(\frac{\partial N_v}{\partial z} - \gamma_d \frac{\partial N_d}{\partial z}), \quad \gamma_d = \frac{N_v}{N_d} \tag{4}$$

Assuming $\frac{\partial N_v}{\partial x} = 0$ and presumably on the same basis $\frac{\partial N_d}{\partial x} = 0$

$$S = w(\frac{\partial N_v}{\partial z} - \gamma_d \frac{\partial N_d}{\partial z}) \tag{5}$$

Trying to derive 35

It is said to be a result of Eq 32 and 34, with $\frac{\partial N_v}{\partial x} = 0$ But 34 comtains S and 32 does not, so I don't see how S can be eliminated, without bringing in 33.

Adding 32 and 33 gives

$$\frac{\partial(Nu)}{\partial x} + \frac{\partial(Nw)}{\partial z} = S$$

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In fact, with $\frac{\partial N_v}{\partial x} = 0$ this is

$$N\frac{\partial u}{\partial x} + u\frac{\partial N_d}{\partial x} + \frac{\partial (Nw)}{\partial z} = S$$

and Eq 35 says

$$N\frac{\partial u}{\partial x} + \frac{\partial (Nw)}{\partial z} = 0$$

So

$$S = u\frac{\partial N_d}{\partial x}$$

which gives S (condensation) depending on N_d only.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 24015, 2010.

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Interactive Comment