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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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This article brings a new dimension to moist atmospheric processes for the development of horizontal pressure gradients, long recognized as a major driving of atmospheric motions. The authors main claim lies on the effect of partial pressure of the water vapor during condensation/evaporation on generating significant horizontal pressure gradients and winds.

Their argument is based on classical theory of gases, in which the total pressure of an air parcel at constant volume and temperature equals the summ of the partial pressures of the gases within the parcel. Therefore, in an arbitrary combination of gases, if one

of such gases is extinguished (e.g. during condensation of water vapor), the total pressure of the parcel shall be subtracted its parcial gas pressure. Common knowledge so far. However, common meteorological wisdom states that when water vapor condensates, its main effect on the air parcel in which it was diluted is the change of buoyancy due to the liberation of the equivalent laten heat of condensation, making the parcel relatively warmer, and therefore more buoyant, than the surrounding environment.

The authors go at length to demonstrate that the pressure gradient force associated with the extinction of the water vapor partial pressure within the parcel is the dominant effect to create sizable pressure gradients and winds. There have been lengthy discussions on the internet about this new proposition. The focus of such discussions, however, have been grid locked on the hydrostatic concept of (surface) pressure as the weight of the air column above, and "mass conservation" of the air parcel. I naturally do not dispute the hydrostatic concept as a whole, but at the same time confess myself surprised that general circulation models of the atmosphere do not take the effect of "pressure extinction" during water vapor condensation explicitly into consideration.

"Its not the weight of the water vapor mass, it is its partial pressure!"

As a meteorologist and climate modeler, I welcome the fact that this basic physical principle is now been challenged! Which, in my view, has profound consequences for the study and prediction of global climate change.

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