Hydrol. Earth Syst. Sci. Discuss., 12, C4846–C4852, 2015
www.hydrol-earth-syst-sci-discuss.net/12/C4846/2015/

Hydrology and Earth System Sciences
Open Access
Discussions

Interactive comment on "Experimental evidence of condensation-driven airflow" *by* P. Bunyard et al.

P. Bunyard et al.

pbecologist@gn.apc.org

Received and published: 13 November 2015

We are indebted to the reviewer for revealing a mistake in eqn. 5 as printed in the paper. It should read

q=((0.622*p_wv))/(p_atmos)

When we take the corrected eqn. 5 into account, eqns. 4 & 6 are correctly formulated. In fact, q is the specific humidity in kg per kg moist air and r is the humidity in kg per kg dry air (McIlveen, R. 2010).

However, we must make it clear that the correct formulation of eqn. 5 as shown above was used in the analysis of the data, and consequently the results of the experiments are correct as presented.

The reviewer argues that the experiments and their consistent results, showing a strong

correlation between the rate of condensation and airflow, neither verify nor falsify the BPT. The basis for that view, the reviewer argues, lies in the difference between the air enclosed in the experimental set-up, and the air in the external atmosphere in which pressures and temperatures change with altitude.

In our experiments, seasonal surface temperature changes affect the temperature of the enclosed air. In some experiments, the artificial refrigeration of the small parcel of air in proximity to the cooling coils, does little more than nudge the temperature down to the dew point, with the refrigeration switching itself off for substantial periods of 5 minutes or more. For instance, the results for February 8th, 2015, when the temperature on starting the experiment was -1.16°C, show a series of pulses of airflow, varying between peak and valley from 0.09 and 0.02m/s, all of which coincided with pulses of increases and reductions in the rate of condensation as determined by changes in the partial pressure of water vapour, varying between 0.30 to 0.04 hPa/s.

That experiment should be compared with the results from March 3rd, 2015, when the initial temperature was 10.06°C. Again pulses of airflow varying between peak and valley 0.16 to 0.11 m/s, were coincident with changes in water vapour partial pressure of 1.1 to 0.5 hPa/s.

Prior to switching on the refrigeration in those two experiments, the airflow and the rate of condensation were zero. The warmer air of the March experiment contained more moisture and therefore the rate of forced condensation increased compared to the cooler air of February, (close to dewpoint as registered by the frost on the ground outside), and that increase in condensation led inexorably to a higher airflow. In effect, the latent heat release in the February experiment went to warm the air. But, whether it warmed the air or was annulled by the refrigeration made little difference to the overall airflow or indeed to the rate of condensation.

In the atmosphere at large, if air with sufficient moisture reaches dewpoint at a certain altitude, then condensation will take place and if CCNs (cloud condensation nuclei) are present, clouds will form. Prior to rainfall the total mass of the air column will be the same before and after condensation, as pointed out by the reviewer. However, if rain precipitates to the ground at a rate faster than the injection of water vapour via evapotranspiration, then the mass of the air column must reduce until such time as the air is recharged with water vapour.

In the atmosphere that process of rainfall versus evapotranspiration is dynamically changing during the course of the day. At the same time, condensation, as shown in the experiments, must cause an implosive pressure change (22.4 litres per gram molecule). Once that sharp reduction in pressure becomes focused in one direction air must inevitably flow. The experiments show this flow to be 100% consistent, and variations in the air velocity appear dependent on the rate of condensation. With no evidence to the contrary, we may at least assume that the same applies in the atmosphere when clouds form.

Some evidence of the relationship between surface humidity and airflow can be obtained from ground-based meteorological data from La Selva Biological Station in Costa Rica. Consistently there, throughout the year, we have shown the presence of approximately 10 distinct pulses in surface humidity (absolute humidity) during daylight hours, which are followed (up to 30 minutes later) with pulses in the surface airflow (Bunyard, P. P. (2014). How the Biotic Pump links the hydrological cycle and the rainforest to climate: Is it for real? How can we prove it?).

As to surface barometric pressure, in the equatorial tropics, it shows a double sinusoidal peak over 24 hours – the barometric 'tidal' wave. It is a moot question as to how much of that pressure change is caused by changes in surface humidity as well as insolation. Interestingly, the only time when a similar diphasic peak is seen over a boreal forest in Finland is during the September equinox when length of day and insolation plus evapotranspiration are comparable to that found over La Selva (Bunyard, P., Netchev, P., Peña, C., & Redondo, J. (2012). The Barometric Tidal Wave, What is it? STAHY 3rd International Conference on Hydrology. Tunis).

Finally, the reviewer states: ". . . {T}hat condensation causes airflow . . . is a well known phenomenon in Engineering Thermodynamics". If this is the case, why the resistance to the biotic pump theory? We have not found any reference in the literature to experimentation on 'normal air' under normal conditions to show the impact of condensation on airflow, and we suggest that our paper may fill this gap.

We therefore respectfully disagree with the reviewer that the experimentation bears no relevance to the atmospheric physics underlying the biotic pump theory.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 10921, 2015.

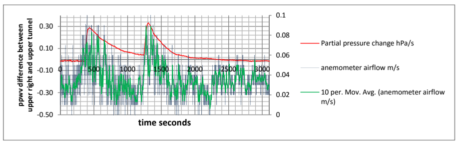

Figure 1 Experiment 8 February, 2015.

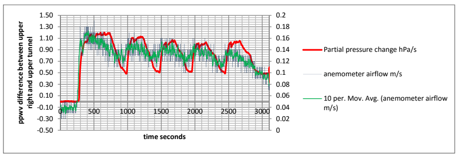

Figure 2 Airflow versus condensation. Experiment March 3, 2015

Fig. 1.

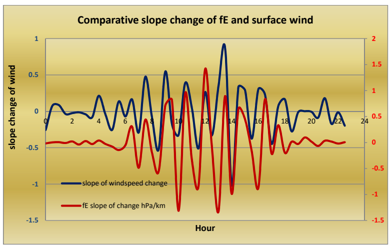

Figure 1.La Selva, Costa Rica, October 4th, 2015. Meteorological data showing airflow change m/s over 24 hours and change in the condensation/evaporation force f_E in hPa/km

Fig. 2.

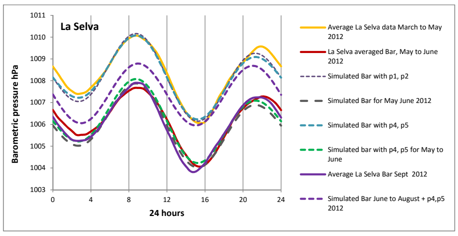

Figure 1. Barometric tidal wave, La Selva, Costa Rica

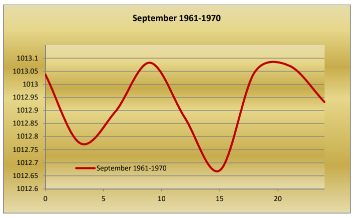

Figure 2. Average Barometric Pressure for Boreal Forest in Finland during time of September Equinox. Location Jokioinen

Fig. 3.