Review report on “Technical note: An assessment of the relative contribution of the Soret effect to open water evaporation”

by Demetris Koutsoyiannis

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Recommendation:	Accept

Reviewer’s assertion: It is my opinion that a shift from anonymous to eponymous (signed) reviewing would help the scientific community to be more cooperative, democratic, equitable, ethical, productive and responsible. Therefore, it is my choice, consistent with my aesthetic attitude, to sign my reviews. Furthermore, I believe that the current trend in the review system to seek credit for anonymous transactions (by asking recognition for anonymous reviews through Web of Science, a practice also encouraged by journals) is problematic on ethical and aesthetic grounds. Only eponymous transactions can deserve recognition.
After the introduction of chatbots, which can produce automatic reviews superior that the typical average review, I believe that the peer-review system needs a major overhaul on the basis:

TEAR: Transparency, Eponymity, Accountability, Responsibility.

I am not an expert on thermodiffusion and the Soret effect. Rather, I accepted the review invitation to learn, as a student, about an issue that I did not know before. I am very satisfied as the authors, as well as the other reviewers, are indeed so very knowledgeable that I did learn a lot.

I see that the other reviewers have made several constructive suggestions, which the authors responded to, and I feel there is no need for me to make additional comments. One unaddressed issue is Kowalski’s point that the authors’ “specification of Fick’s 1st Law is incorrect” and that “Eq. (1) is dimensionally inhomogeneous unless the diffusive flux density (J) is specified in molar terms”. By the way, I enjoyed Kowalski’s examples, yet I do not see his contradiction of “Newtonian transport” vs “Fickian transport”. I believe the former needs to be complemented by the latter (which reflects the principle of maximum entropy) to explain the phenomenon fully. Otherwise, the motion of the molecules from one half of the container to the other half does not make sense.

Feeling like a student, I did my homework on this issue, which I include as an Appendix to my review. The results of my homework show that the mass description is precisely equivalent to the molar description and that the only change needed to the paper is to correct the phrase (above Eq. (1)) “diffusive flux J $(\mathrm{kg\ m^{-2}\ s^{-1}})$ ” to “diffusive flux

J (mol m^{-2} s^{-1}). Otherwise Eq. (1) would indeed be dimensionally inhomogeneous. I hope the authors and discussers find my homework correct.

Appendix

Fick's law (in mass units, as I used to teach it, in one dimensional form for simplicity) is:

$$J = -D\frac{\mathrm{d}\rho_v}{\mathrm{d}z}$$

with
J [$\mathrm{kg\,m^{-2}s^{-1}}$]: the water vapour flux,
D [$\mathrm{m^2s^{-1}}$]: the diffusion coefficient,
ρ_v [$\mathrm{kg\,m^{-3}}$]: the density of water vapour, and
z [m] : the vertical coordinate.

Now, the densities of water vapour and of the mixture are, respectively:

$$\rho_v = \frac{M_v}{V}, \qquad \rho = \frac{M_{\mathrm{TOT}}}{V}$$

where M_v [kg] and M_{TOT} [kg] are the masses of the water vapour and the mixture at a specified volume V [$\mathrm{m^3}$]. From these we get

$$\rho_v = \frac{M_v}{M_{\mathrm{TOT}}}\rho = \frac{m_v n_v}{m_{\mathrm{TOT}} n_{\mathrm{TOT}}}\rho = \frac{m_v}{m_{\mathrm{TOT}}} x\rho$$

where m_v [$\mathrm{kg\,mol^{-1}}$] and m_{TOT} [$\mathrm{kg\,mol^{-1}}$] are the respective molar masses, n_v [mol] and n_{TOT} [mol] the respective number of moles, and $x \coloneqq n_v/n_{\mathrm{TOT}}$ the mole fraction of water vapour in the mixture.

Hence

$$J = -\rho\frac{m_v}{m_{\mathrm{TOT}}} D\frac{\mathrm{d}x}{\mathrm{d}z}$$

Now, if we define the molar density of the mixture

$$\rho_{\mathrm{mol}} = \frac{\rho}{m_{\mathrm{TOT}}}, \qquad \rho_{\mathrm{mol}}\colon [\mathrm{mol\,m^{-3}}]$$

and the molar water vapour flux

$$J_{\mathrm{mol}} = \frac{J}{m_v}, \qquad J_{\mathrm{mol}}\colon \left[\frac{\mathrm{kg\,m^{-2}s^{-1}}}{\mathrm{kg\,mol^{-1}}} = \mathrm{mol\,m^{-2}s^{-1}}\right]$$

we get

$$J_{\mathrm{mol}} = -\rho_{\mathrm{mol}} D\frac{\mathrm{d}x}{\mathrm{d}z}$$

which is the first term in Equation (1) in Roderick and Shakespeare.