**Manuscript Number: egusphere-2022-986**

**Title: Evaluation of a wind tunnel designed to investigate the response of evaporation to changes in the incoming longwave radiation at a water surface**

**Response to second round of reviews**

*Original review comment in ITALICS.*
**Author Response in bold.**

*Associate Editor (Dr Daniela Famulari)*

***Public justification (visible to the public if the article is accepted and published)**:*
*I thank the authors for all the work they spent on synthesying two manuscripts into one, and for improving their initial contribution following the reviewers' inputs. I believe the work has improved considerably since the first submission, and the paper is in my opinion worth for publication, as it can provide useful discussion ground for this topic amongst the scientific community.*

**We thank the associate editor for the helpful and supportive comments. We agree it has been a long process but we also think the review process has improved the original submission/s and thank the reviewers for their contributions.**

*Reviewer 2*

*The authors have successfully integrated their two distinct manuscripts into a coherent single manuscript, the structure of which I find to be substantially improved to the point where I can evaluate it on its scientific merits. I won't rehash my description of the elements which existed in the two preceding manuscripts. However, I have some lingering "big picture" concerns:*

*The work is motivated by a desire to better describe the balance between evaporation and longwave irradiance at the air-water interface. In the discussion and conclusion sections of the manuscript, however, it remains unclear the specific research questions which are addressable via the setup described here. Zooming out even further- what is the impact of this work? I strongly recommend fleshing this out.*

*In support of those efforts, I make the following specific recommendations regarding the communication of quantitative results:*

*A fairly "low-cost" way of tying together the initial motivation and synthesis of results would be to plot curves associated with eq. 1 and then compute the size of the effect determined in your laboratory work due to radiative considerations.*

*Furthermore, I think the manuscript would greatly benefit from a comparison with the treatment of LW & SW radiative fluxes within the COARE parameterization. Whether or not the authors view COARE as the gold standard and the issue of parameterizing air-sea heat flux as settled, the inclusion of such a comparison will be of tremendous value to readers of this paper and help to place the results in a broader context.*

**We thank the reviewer for these helpful comments.**

**As noted by the reviewer below this is a "technique paper in a technique-focussed journal" and our aim was not to evaluate the science involved but rather the underlying techniques required before the big science questions could be addressed. The detailed analysis the reviewer refers to (i.e., an evaluation of the Dalton-type bulk formula) will appear in a future publication. Here we focus purely on the methods. Recall that we are not aware of any other study that has manipulated the longwave radiation**

**independently of other variables (air temperature, humidity and wind). Our paper actually shows how difficult this was to achieve.**

**With that in mind we have modified the introduction by adding a further sentence to the justification paragraph (see new lines 66-67) where we have directly spelled out what this means. The new sentence we have added reads as follows:**

"If the longwave fluxes were important for evaporation as we have inferred, but did not cancel, then the Dalton-type formulae in widespread use (e.g. Eqn 1) would not be a valid description of the evaporation process."

**We believe that this very direct statement should satisfy the philosophy that underlies the reviewer comment/s.**

*Minor stylistic/editorial comments:*

*Even though this is a technique paper in a technique-focused journal, I find that the overall course of the manuscript is bogged down by details which are ultimately not of central importance. For example, while the multiple depictions of radiative balances and corrections (Figures 4-7) exist to describe the considerations taken in designing the experimental setup, I believe that some of the figures corresponding to initial design iterations (e.g. single film) could be relegated to the appendices. This isn't a major sticking point, though.*

**We respect the authors viewpoint and we accept there is a lot of material. We included the single film treatment (Figs 4, 5, 6) because that was used directly in the manuscript to experimentally estimate the transmission coefficient of the film. We felt that this important step had to be included in the main text but relegated the less important determination of the absorption/reflection to the appendices as originally suggested by reviewer 2.**

*L52-54: it would be far more realistic (and not too onerous) to account for exponential decay of radiation: to first order, couldn't one assume that ~63% of the heat is absorbed between the interface and the e-folding depth? In a similar vein, I understand that this example exists solely to demonstrate the importance of evaporation, but the neglect of turbulence (even simple surface renewal) is striking. I recommend providing at least a rough order of magnitude estimate of the relative importance of the different heat transfer processes at play here.*

**Respectfully we are unable to do this at the moment but it is something we plan for future publication/s. As explained in the introduction, the objective of the work is to evaluate the underlying validity of the Dalton-type formulae (Eqn 1). In the introduction we would be forced to use the Dalton-type formulae to calculate the relative importance of the various heat transfer processes involved.**

*L623-624: parenthetical seems to be a relic from the two-manuscript organization*

**Thank you. We have removed the parenthetical statement.**

*Figure 15: I recommend that the ticks on the left and right axes are matched so that the gridlines are shared; an easy way to do this is to set limits of 1000-8000 Pa for e and 5-40 g/kg for q.*

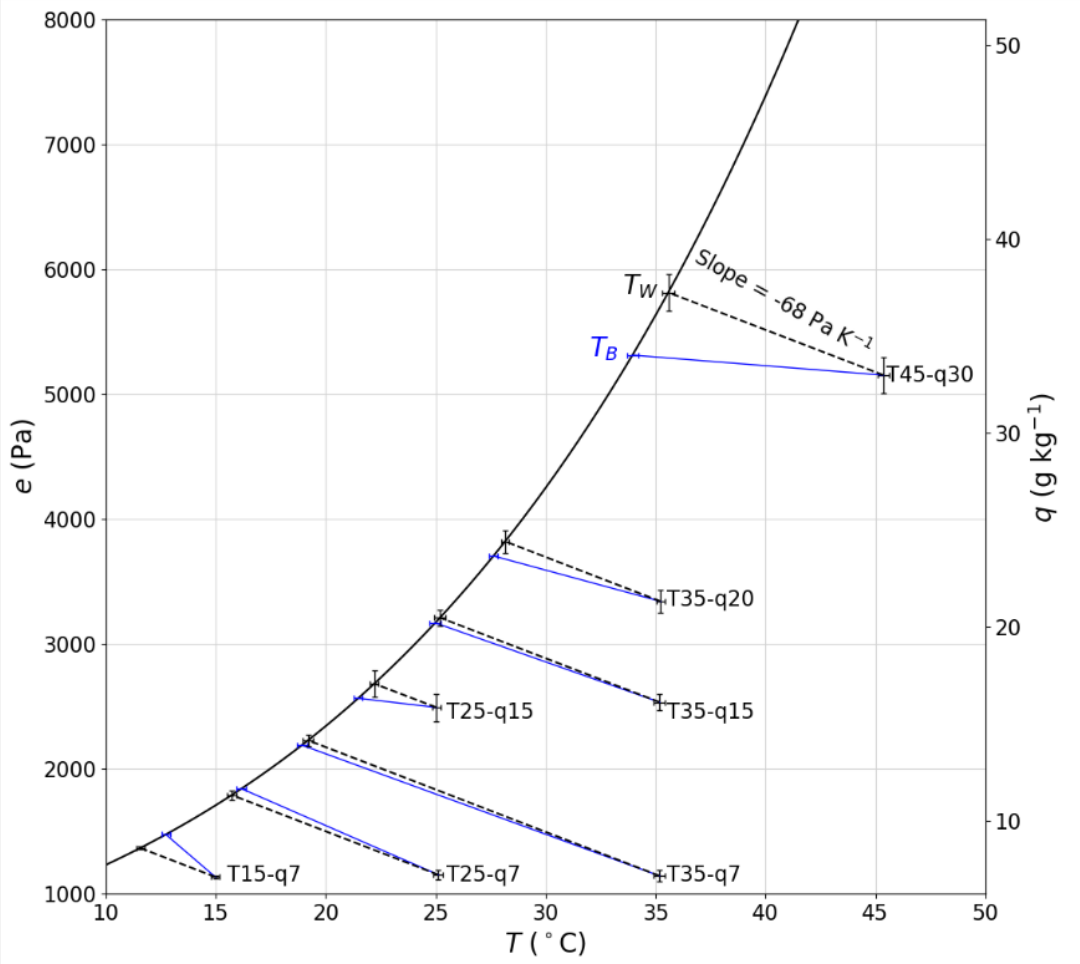
**We did not understand this point.**

**With the limits for *e* (left hand axes) currently defined as 1000 to 6000 Pa, then the axes on the right (for *q*) cannot be arbitrarily assigned but is instead set automatically by the underlying physics linking *e* and *q*. For example, at 1 bar total pressure the relation between *e* and *q* is:**

| ***e* (Pa)** | ***q* (g kg$^{-1}$)** |
|---|---|
| 1000 | 6.24 |
| 2000 | 12.54 |
| 3000 | 18.87 |

```
4000    25.26
...     ...
```

**By changing the left hand axes as proposed the plot would look like:**




**We have left the original plot (Fig. 15) as is.**

**Michael L. Roderick & Callum J. Shakespeare (on behalf of all authors)**

**31st August 2023**