

The paper describes a novel method to derive heat transfer velocity (without the need for a priori knowledge of the wave field) that can then be used to estimate gas transfer velocity. This is a valid and useful piece of research as it provides the potential to study gas transfer rates without the need to actually pump water through an analysis system (e.g. like eddy covariance and equilibrator based systems). The paper is an interesting and informative read and should be accepted for publication. Before this happens though the paper needs some updates and some of the English needs checking and correcting. For instance with respect to the latter issue, there are some sentence fragments and some sentences are missing key pieces of information. Please see my comments below.

#### Scientific comments:

1. Please add a reference for the Aeolotron facility. Is there a methods paper that describes the facility as the paper is missing a description. A short paragraph describing the facility and a reference will suffice.
2. RE: 'virtually unlimited fetch' – you need to explain that this is because of the circular nature of the flow around the facility. Currently the sentence is missing this key piece of information.
3. Why are the chosen wind speeds log separated? Please justify this choice.
4. Why did you choose N<sub>2</sub>O and CH<sub>4</sub>F<sub>5</sub> gases? Please explain and justify this.
5. line 20, p1699 - the beginning of the sentence 'To use the system theoretical approach for data analysis' doesn't make much sense. Please clarify this sentence. e.g. is this correct? 'Theoretically for the method to work, a water parcel needs to stay in the heated area long enough for it to reach thermal equilibrium'.
6. It would be helpful to have a discussion on how the approach and system could be used at a fixed site to illustrate the potential of the work beyond just a lab study (e.g. a coastal tower or on an offshore oil rig). It would also be helpful to include some discussion on the issues that may still need to be overcome to allow a fully automated system. e.g. how could the Schmidt number be derived?
7. RE: 'relative scaling error', p1702, line 10. Where did this come from? Please explain the source of this value.
8. The error analysis on p1702 (line 11) needs more detail. Please refer back to sections to provide the linkage between these values and/or provide references for the values in the error analysis. Currently it is hard to see where these values have been derived. E.g. Secondly, the accuracy of the absolute value of the Schmidt number (as derived in section??) is assumed to be 5%. Please avoid the use of the word 'about' as this is a scientific paper.
9. p 1702, this sentence 'Figure 7 shows the good agreement between the scaled heat and the scaled gas transfer velocities.' Please provide some statistics to back up your statement. stddev or RMSE (preferably both).
10. Section 5.3 would benefit from being re-ordered. For example, this sentence 'This is within the conservatively estimated error budget, which contains three different sources of errors' refers to the 'estimated error budget' that is calculated later (ie p1702, lines 4 onwards). Please put the calculation of the 'estimated error budget' first, then compare it with the experimental results.
11. It would be useful to the reader to add a k600 column into table A1. This would allow the table to be easily related to the values in Figures 2 and 7.
12. Can you please provide some comments and discussion the possible reasons for the high variance of the k600 value in fig 7 (value at about  $u^* \sim 0.6$  has a much greater variance than all of the other datapoints).

Specific comments:

1. p1694, line 16, please replace '2 times as large' with 'twice as large'.
2. The introductory paragraph doesn't really make much sense. This needs re-writing and clarifying. For example you make the statement 'However, using heat as a proxy for mass has one significant drawback. Diffusion of heat is about one hundred times faster than diffusion of mass in water. But you don't explain why this is a problem ? Please re-word this to something equivalent to "Using heat as a proxy for mass has one significant drawback which is that the diffusion of heat is about one hundred times faster than diffusion of mass in water. This causes a problem because....'
3. Beginning a sentence with the word 'because' is grammatically incorrect. This has been done at least twice in the manuscript. Please correct all instances of this.
4. Please remove the word 'lower' from the first sentence on p1695 as it is not needed.
5. p1701, line 28. Please replace 'however' with something like 'As previously discussed above and in section ?'.
6. Please avoid the use of the word 'about', 'as this is a scientific paper. (this occurs three times in the paper).