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Discussions

Interactive comment on "Comparative heat and gas exchange measurements in the Heidelberg Aeolotron, a large annular wind-wave tank" *by* L. Nagel et al.

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The authors would like to thank the reviewer for his detailed and useful comments, which help to improve the quality of the paper.

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.

Response: We will add the following references: (Krall, 2014, chapter 4.1): Krall, K.E., Phdthesis: Laboratory Investigations of Air-Sea Gas Transfer under a Wide Range of Water Surface Conditions, Institut für Umweltphysik, Fakultät für Physik und As-

tronomie, Univ. Heidelberg, 2013 , Url: http://www.ub.uni-heidelberg.de/archiv/14392

and (Jähne, 2001): Jähne, Bernd: Aeolotron: the Heidelberg air sea interaction facility, DOI: 10.5281/zenodo.10281

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.

Response: We think that the sentence "The annular shape results in a quasi-stationary wave field with a virtually unlimited fetch." expresses this fact correctly.

3. Why are the chosen wind speeds log separated ? Please justify this choice.

Response: Along with the comparison of heat and gas transfer, the investigation of the transition of the Schmidt number exponent from n=2/3 to n=1/2 was a goal of the measurements. As this transition is expected at low wind speeds, a higher resolution at lower wind speed was necessary. That is given by the log separated wind speeds.

4. Why did you choose N2O and CH4F5 gases ? Please explain and justify this.

Response: To determine Schmidt number exponents, the choice of two gases with significantly different Schmidt numbers and therefore significantly different diffusivities was necessary. These specific gases fulfill this condition and are additionally easy to detect with our measurement devices (FT-IR spectrometers).

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'.

Response: To clarify the sentence we will add the reference to section 3, where the system theoretical approach is described.

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?

Response: A description of the possibilities and challenges of the active thermography under field conditions is not the aim of this paper. An additional paper including these topics as well as the results of field measurements is in preparation.

7. RE: 'relative scaling error', p1702, line 10. Where did this come from ? Please explain the source of this value.

Response: We will clarify this sentence by adding 'relative scaling factor for k' to make clear, that an error propagation of the given values is done.

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.

Response: We did already explain the error analysis in the response to the other reviewer. We agree, that the sentence 'Secondly, the accuracy of the absolute value of the Schmidt number is assumed to be 5%.' needs a reference. Therefore, we will add (Jähne, 1987), where the accuracy of 5% is derived.

9. p 1702, this sentence 'Figure 7 shows the good agreement between the scaled heat and the scaled gas transfer velocities.' Please some statistics to back up your statement. stddev or RMSE (preferably both).

Response: Figure 7 does only show the measured data points over the friction velocity. The statistics is following in figure 8, where die k600 values for heat and gas are

correlated.

10. Section 5.3 would benefit from being reordered. 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.

Response: We would prefer to keep this order, as the comparison of heat and gas transfer velocities is the main topic of the paper. The most important finding is, that with this method the measured heat and gas transfer velocities agree within the range of the errors. Of course, the detailed description of the error budget, is also of interest. Nevertheless we would like to begin the chapter with our main statement.

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.

Response: The k600 values calculated from the heat as well as from the N2O transfer velocities will be added in two additional columns.

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* ∼0.6 has a much greater variance than all of the other datapoints).

Response: We did already explain the necessity of heating an area with is larger than the horizontal length scales for that wind condition in Sec. 5.1. A detailed determination of the horizontal length scales is given in the response to the first reviewer. For the value at about u*∼0.6 this conditions is hardly fulfilled and the fit gets inaccurate, resulting in a large error. See also the last paragraph of section 5.1.

Specific comments: 1. p1694, line 16, please replace '2 times as large' with 'twice as large'.

Response: We will make the suggested correction replacing '2 times as large' with

'twice as large'.

2. The introductory paragraph doesn't really make much sense. This needs rewriting 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 reword 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....'

Response: To clarify the introduction we will reorder the paragraph by moving the sentence 'Diffusion of heat is about one hundred times faster than diffusion of mass in water' (page 692 line 21) between the sentences '... and the Prandl number Pr= nu/D_heat' and 'By performing simultaneous gas and heat transfer measurements in the Karlsruhe linear air-sea interaction facility...' (page 1693 line 9).

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.

Response: We are not native speakers of English. Therefore, we rely on grammar and general writing guides, for instance: http://dictionary.cambridge.org/grammar/british-grammar/as-because-or-since http://blog.oxforddictionaries.com/2012/01/can-i-start-a-sentence-with-a-conjunction/ http://www.write.com/writing-guides/general-writing/miscellaneous/can-you-start-a-sentence-with-because/ Those are only some examples explicitly allowing the use of the word 'because' at the start of the sentence, as long as the dependent clause (starting with 'because') is followed by a main clause. All of the sentences we started with 'because' fulfill this requirement. Actually, both the Cambridge dictionary and write.com clearly recommend using 'because' at the beginning of a sentence, when special focus on the reason is to be given. This was exactly our intention when we wrote the sentences in question. Therefore, we would like to keep the sentences starting with 'because' as they are.

4. Please remove the word 'lower' from the first sentence on p.1695 as it is not needed.

Response: As much as we looked, we could not find the word 'lower' in the first sentence on p.1695.

5. p1701, line 28. Please replace 'however' with something like 'As previously discussed above and in section?'.

Response: We will make the suggested correction replacing 'however' with 'as discussed above'

6. Please avoid the use of the word 'about', 'as this is a scientific paper. (this occurs three times in the paper)

Response: We will replace the word about with the word approximately to indicate that the numbers given are rounded up to the nearest whole number.

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