

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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Review for “Comparative heat and gas exchange measurements in the Heidelberg Aeolotron, a large annular wind-wave tank” by Nagel et al. 2014

This paper describes an improved method for deriving the gas transfer velocity from the active thermography technique (CTF) in a wind-wave tank. By heating a large enough patch area and ensuring lateral homogeneity, assumptions of a 3D transport model (e.g. surface renewal, turbulent diffusion) that were necessary for previous point-based CFT measurements are now no longer needed. This makes the current method much more robust. The authors showed intercomparisons of gas transfer velocities derived

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from CFT and measured from the budgets of N₂O and C₂H₅F, which demonstrated fairly good agreement. In the outlook section, the authors appropriately listed the advantages and limitations of the improved CFT approach. A bit more discussion on the possible deployment of this approach in the field would be welcomed (for example, on a coastal tower if the platform needs to be free of motion?). Overall, I recommend the publishing of this paper.

Some minor specific questions/comments below.

p. 1693 line 9. To illustrate how large the adjustment in Eq. 2 is, it would be useful to provide the order of magnitude for Sc (e.g. for CO₂ or N₂O) and for Pr, at a temperature of for example 20 deg. C.

p. 1694, line 9. Rewrite sentence. For example "More recent experimental evidence suggest that extrapolating from heat transfer velocities to gas transfer velocities using a surface renewal model can result in biased results." p. 1697, Eq. (3). For the benefit of readers, can you provide another 1-2 sentence on why it is appropriate to compute k from the response time τ ? Approximately what temperature is the patch heated to? Do the ambient air/water temperatures (without heating) affect τ ? p. 1699, line 11. Why is there a cubic relationship between wind speed and u^*w ? Is that unique to the Heidelberg tank? The relationship between wind speed and u^*a is nearly linear. And u^*a and u^*w is typically related by the square root of their densities. p. 1700. line 1. Can the authors provide the approximate physical size of the patch (both required and actual) under the different wind speeds?

p. 1701, line 6. Does the quoted error for n include the uncertainties in the Schmidt numbers of N₂O and C₂H₅F? If not, it would be helpful to propagate the uncertainties in Sc (e.g. from a survey of literature values) for both gases to the derived n.

p. 1703. line 1 Why is a platform following the water surface required when the time scale τ under typical oceanic conditions is only on the order of a second? The dominant frequency for ship motion is about 0.1~0.2 Hz. Line 16. So at the highest

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wind speed of this experiment ($U_{10} > 12$ m/s), there was still no bubble formation in the wind-wave tank? Line 20. An ideal validation for active thermography in the field would be direct air-sea exchange measurements of a gas that does not have a large bubble-mediated transfer component (e.g. DMS transfer by eddy covariance. e.g. Yang et al. JGR 2011).

Fig. 3 and 4. Does amplitude damping taken on a normalized value between 0 and 1? Label the response time on these plots. Fig. 7 caption. "plotted against the friction velocity". Has u^*w for heat been adjusted for the 15% enhancement at the location of the heat transfer measurement? Please specify. Fig. 8. What would the slope be if forced through a y-intercept of zero? If the authors think this would be inappropriate, please explain why.

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