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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Estimation of bubbled-mediated air/sea gas exchange from concurrent DMS and CO_2 transfer velocities at intermediate-high wind speeds" *by* Thomas G. Bell et al.

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I'm glad to see this analysis. We've been puzzling over significant differences between Knorr11 results and the 2013 HiWinGS cruise (also on the Knorr). The discussion is helpful.

One comment on section 2.2. I believe it's incorrect that air-side resistance is a function of gas solubility. It depends only on diffusivity in air (or Sc_air), and is about the same for all gases. The physics of air-side mass transfer are fairly well understood, and you are using COAREG to estimate ka for DMS. You should find computed ka (or ra) for

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Discussion paper

CO2 is almost identical to ka for DMS, and it could simply be subtracted from K to get kw. Although the correction is a much smaller fraction of Kco2.

The striking feature of these measurements are the low values for both kdms and kco2 at ST191 (the majority of high wind conditions sampled on this cruise). Compared to the 2013 HiWinGS observations, k660 for both DMS and CO2 on Knorr11 are ∼30 cm/hr lower in the highest wind speed bin (19 +/- 1 m/s). Sea state conditions conditions during ST191 may have contributed to a suppression of interfacial transfer for both gases via reduced tangential stress in the presence of large waves, as suggested by prior theoretical papers and wave tank studies. But the proper metric to quantify that effect remains elusive (to me). During HiWinGS we saw no suppression in k for either gas in wind speeds up to 25 m/s and wave heights up to 8m, and no obvious trends with wave age. So I'm wondering what significant difference existed between the two cruises? You might consider adding sea state parameters to Table S1 (Hs, Cp, wave age, whitecap fractions, etc.).

You might examine at how COAREG is computing whitecap fraction for the kb calculation. From the plotted curves, it looks like Wf is an ∼cubic function of wind speed. You could try replacing that with a whitecap model based on more recent measurements, or with an empirical fit to the Knorr11 observed Wf. You could also simply use your measured Wf in the computation of kb. Any of that would require retuning the B parameter for a best fit to both gases, especially if you use stage A Wf.

However, current versions of COAREG don't consider reduction in tangential stress with flow separation (related to, for example, wave age), so assuming flow separation is causing suppression of k at high winds, it's unlikely to cleanly fit this data set . . .

Last, it would be nice if the plots had gridlines. . .

Cheers, B. Blomquist

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