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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Effects of ship wakes on ocean brightness and radiative forcing over ocean" *by* C. K. Gatebe et al.

Anonymous Referee #2

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The authors present a study of the potential impact of ship wakes on the Earth radiation budget. From estimates of the albedo change due to ship wakes, the dimensions of the wake, and the number of ships operating at a given time, they compute the average change (global, annual) in reflected solar flux at the top of the atmosphere.

Ship wakes are bright and therefore they might affect the reflected solar flux. This is an issue that deserves attention, all the more as ship traffic is expected to grow in the future. The radiative forcing calculation, unfortunately, is too simplified. It does not account for important elements, as detailed in the following.

First, the BRDF observations apparently used in the calculation (Figure 3 and end of Section 2) indicate a spectral albedo change of 0 to about 4% from the visible to the shortwave infrared. The change, when integrated over the entire solar spectrum, is

closer to 1% than 3%, since spectral solar irradiance exhibits a sharp maximum around 0.5-0.6 microns. This suggests an overestimation of the radiative forcing estimate by a factor of 3. The 3% figure needs explanation.

Second, estimating the change in reflected flux at the top of the atmosphere requires taking into account the atmospheric transmittance along the double path sun-to-surface and surface-to-space. In clear sky conditions, i.e., when ship wakes have the largest effect, this transmittance is about 0.6. In other words, due to atmospheric transmittance, the radiative forcing value should be smaller by 40%.

Third, ship routes are unevenly distributed over the oceans. They are mostly located in Northern mid-latitudes, where cloudiness is relatively high. Since the effect of ship wakes is substantially reduced or insignificant in the presence of clouds, the relative distribution of ship routes and cloudiness (including optical thickness) should be taken into account in the radiative forcing calculation.

To sum up, the value of 0.003 W/m2 obtained by the authors may be too high by a factor of 5 or more. It is highly desirable, in any case, to provide uncertainties, not only on the formula used in the calculation, but also on the various terms in the formula, i.e., albedo change, number of ships, area affected by the wake, and this is not provided in the study.

In view of the above, I do not recommend publication of the manuscript in Journal of Atmospheric Chemistry and Physics.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 21683, 2010.