ACPD Manuscript Evaluation for MS No.: acp-2010-972

Principal Criteria	Excellent (1)	Good (2)	Fair (3)	Poor (4)
Scientific Significance: Does the manuscript represent a substantial contribution to scientific progress within the scope of Atmospheric Chemistry and Physics (substantial new concepts, ideas, methods, or data)?			←X	
Scientific Quality: Are the scientific approach and applied methods valid? Are the results discussed in an appropriate and balanced way (consideration of related work, including appropriate references)?				←X
Presentation Quality: Are the scientific results and conclusions presented in a clear, concise, and well-structured way (number and quality of figures/tables, appropriate use of English language)?				X

In the full review and interactive discussion the referees and other interested members of the scientific community are asked to take into account all of the following aspects:

1) Does the paper address relevant scientific questions within the scope of ACP?
   a) maybe
2) Does the paper present novel concepts, ideas, tools, or data?
   a) Only so far as Frisbee, but it is in context of previous work not well compared or discussed.
3) Are substantial conclusions reached?
   a) Maybe, but not ones that acknowledge the context of this work.
4) Are the scientific methods and assumptions valid and clearly outlined?
   a) Yes, except the model FRISBEE is a black box for this journal.
5) Are the results sufficient to support the interpretations and conclusions?
   a) No.
6) Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)?
   a) No. Data not made available, and no inter-comparison to allow adjustments to publicly available data.
7) Do the authors give proper credit to related work and clearly indicate their own new/original contribution?
   a) No. It could seem that the authors intentionally leave out discussion with work published in ACP in 2010, misrepresenting it in supplemental as still in ACPD, and with no clear inter-comparison of results, similar strengths, common weaknesses, or particular differences.
8) Does the title clearly reflect the contents of the paper?
   a) Perhaps, but it appears to be a Norwegian-focused subset of arctic shipping. The transit discussion in abstract and paper seems beyond the title.
9) Does the abstract provide a concise and complete summary?

a) The travel time information is incomplete and seems unclear.

10) Is the overall presentation well structured and clear?
    a) Not enough, without good maps and access to the data product for this work.
11) Is the language fluent and precise?
    a) Satisfactory.
12) Are mathematical formulae, symbols, abbreviations, and units correctly defined and used?
13) Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated?
14) Yes, see comments
15) Are the number and quality of references appropriate?
    a) Maybe.
16) Is the amount and quality of supplementary material appropriate?
    a) No, see comments

Peer-Review Comments (ACPD)

General comment: This paper should not be accepted for ACP, and in current form this manuscript should be revised for presentation in ACPD to address major concerns in analysis, organization, and clarity of presentation. To enable the journal to continue to aspire to these important philosophical and scientific objectives, the clarity of presentation must include a) transparent presentation of inputs; b) sensitivity analysis of alternate results under reasonable alternate assumptions; and c) self-critical inter-comparison with existing work already meeting a) and b), above. This manuscript does not yet provide this standard of presentation. Lastly, the open source nature of this journal and the standard practice within the community, suggest to me that these data be findable and reviewed as part of the manuscript. My sense is plurality is a good, and that the two Arctic inventories may represent that well. I will also expect that ACP require an open-access link to the data; some of these inventories have in the past been published on but not released.

Detailed comments:

1) One main area of concern in reviewing this manuscript is the FRISBEE model. Readers of ACPD should note that the application of the partial equilibrium model of international energy markets is a) an economic model, not an atmospheric or chemistry model; and b) that this model was not intended to directly estimate shipping activity; and c) inputs and assumptions for the FRISBEE model are not transparent in this work and variable. This means that this work may require a different journal publication than ACPD (or ACP), despite the authors' intention to derive an emissions inventory. This is critical to a paper like this because the resulting estimates of emissions appear to be far and away different than prior work; if the FRISBEE model is the source of this difference then this needs to be transparent for critical (skeptical) review of that and preceding estimates. There is insufficient description (supplemental material notwithstanding) to know that the FRISBEE model is predicting Arctic energy use with sufficient accuracy; this may be the case for many scenarios, but the authors do not engage the effort to perform comparison with other studies in sufficient detail, and they do not present any sensitivity analyses under alternate reasonable FRIBEE model settings. Certainly, this would merit an energy model paper (peer reviewed in Energy Policy or such) to stand upon, and a thorough analysis of sensitivity with regard to the scenario inputs to the shipping activity and emissions estimation derivations. This appears to be a case of black boxes being coupled and referenced without any good way to understand the claims and results.

> Recall E.F. Schumacher's quote: "It is fashionable today to assume that any figures about the future are better than none. To produce figures about the unknown, the current method is to make a guess about something or other – called an "assumption" – and to derive an estimate from it by subtle calculation. The estimate is then presented as the result of scientific reasoning, something far superior than guesswork. This is a pernicious practice that can only lead to the most colossal planning errors, because it offers a bogus answer where, in fact, an entrepreneurial judgment is required.
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> The study here under review employs a vast array of arbitrary assumptions, which are then, as it were, put into a calculating machine to produce a "scientific" result. It would have been cheaper, and indeed more honest, simply to assume the result."– Schumacher, E.F. (1964) Review of EEC report on fuel and energy by the European Coal and Steel Community. The Economic Journal, March: 192

Questions that arise from the FRISBEE model, which includes exogenous price signals and other features that drive the model predictions, include generally: What inputs would be required to match existing shipping inventory estimates? Are these alternate inputs within a reasonable choice set for FRISBEE? Why or why not use alternate assumptions that conform to other expert opinion? Is the supplemental material estimating transpolar shipping coupled with or independent from the FRISBEE model and oil and gas inventory results? Clearly, these questions must not be unaddressed in this manuscript, even as a discussion paper that may not be ACP quality. The methods used to convert energy demand into the shipping activity presented here are not sufficiently described to recommend acceptance. My suspicion based on many efforts of this kind is that the extension is not direct and trivial, that this effort involves at least some assumptions or arbitrary judgments that need better explanation. Efforts like these are only as useful as they are transparent; there are many examples in the atmospheric literature where poorly constructed or black-box inventories lead to years of modeling and conclusions only to be proven wrong through the systemic bias of the inventories upon which they rely. These need to be included in an ACPD revision.

2) Another concern is the extrapolation of energy model data to shipping activity data. In this regard, the manuscript appears only passively aware of the prior work on Arctic shipping, in ACP. While reference is made to acknowledge this work, insufficient effort is made by the authors to preform inter-comparisons of baseline emissions estimates for a common year, nor is there effort to evaluate how the scenario offered compares with the bounding range of scenarios in the prior work. The abstract, for example implies that this is THE or ONLY inventory to be used "as input into chemical transport, radiative transfer, and climate models to quantify the role of Arctic activities in climate change compared to similar emissions occurring outside of the Arctic region". As I read this paper it is not reconciled with the much higher numbers reported in the earlier ACP publication describing ALL shipping activity, not just activity from "transpolar shipping and oil and gas-related shipping in the Arctic." It appears in Table 2, Table 3 and Table 5, that this study overestimates oil and gas activity in comparison with prior work; apparently these estimates are higher than the entire inventories of all in-Arctic shipping from the prior ACP-published study. Without any information from the authors, one is left to speculate whether this may be due to very different FRISBEE-derived growth assumptions, whether this is due to the authors' careful but vaguely presented inclusion of platform activity (not included in other Arctic shipping estimates), or some other reason(s). (Perhaps, part of the problem is that this study does not clarify the 2030 emissions due to oil and gas

activities from the transpolar shipping, which was done explicitly in other work not evaluated.) These are important gaps in the value of this paper's contribution, especially given that it will follow closely on Arctic work already published in ACP. The paper cannot be considered for more than discussion presentation without substantial work to make this work usable in comparison with other independent efforts.

3) Lastly, the gridded inventory is described but not provided. From description, its resolution is coarser than other available inventories, either global or specific to the Arctic; however, the figures (Figure 4a through e) reflect images with legends and icons, rather than geospatial presentations of the data expected from description. Whether it follows the same route information as the AMSA study or offers a variation or independent version of spatial allocation is unclear – and needed before readers can utilize the paper in the work intended for such inventories. In fact, I don't find that the geospatial domain is clearly described, only saying "we use a broader definition of the Arctic region to fully capture oil and gas activities that potentially requiring shipping in the Arctic Ocean." Readers of an open source journal, indeed most journals, would expect that the data presented was accessible. That data is not provided and/or sufficiently described bothers me as reader and reviewer.

In summary, this discussion paper is not adequate for revision and acceptance without redesigning its presentation of information, analysis, and results comparisons. If the authors do a good job in addressing these issues, and if the forecasting model can be well reviewed, then the contribution should complement the existing work we presented in ACP last year. Again, plural and independent inventories are good for the community, and two Arctic inventories may represent that well if readers can understand their respective agreement, contradictions, and methodological differences that may explain these. This manuscript does not yet meet these criteria.

Previous ACP Arctic Shipping Inventory, properly cited in the ACPD manuscript main paper and mis-referenced in this manuscript supplemental material:
Corbett, J. J.; Lack, D. A.; Winebrake, J. J.; Harder, S.; Silberman, J. A.; Gold, M., Arctic shipping emissions inventories and future scenarios. *Atmos. Chem. Phys.* **2010,** *10*, (19), 9689-9704.