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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Organics in environmental ices: sources, chemistry, and impacts" *by* V. F. McNeill et al.

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We thank the reviewer for his or her insights and welcome the opportunity to improve the manuscript based on these comments and suggestions. Our response to the reviewer's comments is in bold type below.

This article evolved out of a workshop meeting held during the summer of 2011 in New York. The aim of the publication is to follow up on the Grannas et al. 2007 review and to present new measurements that have been made since. The manuscript summarizes new field observations, physical processes, chemical transformations, and biological sources. It concludes with a chapter on the impact of Ices on the local, regional, and global carbon cycle.

This article is ambitious, attempting to cover a wide range of topics relating to the role of organics in the cryosphere. It is also ambitious in the sense that it aims to go beyond the somewhat similar overview paper by Grannas et al., from only five years earlier. This new publication shines in the very extensive consideration of published literature on this topic, incorporating some 200 references. Despite the claim that the focus is meant to be a review of the last five years of research, there are numerous places where earlier work is included. In several places the article goes into topics beyond what would have been expected from reading the title. For instance, I would not have expected to find a review of QLL under this topic.

In my opinion the manuscript covers too many fields of research for one article. To a large part it is an enumeration of previously published work, which I do not find all that exciting. It has a bit of a textbook character rather than being tailored towards experts in this field. I would have been more enthusiastic about this paper if individual fields of this research would have been developed in more depth. I believe that it would benefit from following more of a synthesis approach rather than presenting a summary of the research that has been done.

The last sentence of the abstract set the stage for my expectation to learn something new about the role of organics in climate change and the carbon cycle. Even though the paper dedicates a full page to this topic, it does not provide much insight into this question. Instead, a few articles that touch this question are summarized without much synthesis of the published information.

In summary, I think these authors would be better off if they chose to go a different conceptual route, rather than repeating the route taken in the previous Grannas et al. publication. I would find an article presenting a more focused and in depth treatise of particular aspects of organics in snow more valuable instead of trying to squeeze this high number of topics into a single journal publication. There are many topics in the article that could be singled out for a valuable standalone article, such as a review of the QLL, chemical transformations, or the carbon cycle impacts, just to name a few. I

encourage the authors to revisit their work in light of this recommendation.

This is the first review to comprehensively present the chemical and physical issues that arise at the molecular level when organic species become associated with snow and ice. Grannas et al. (2007), provided a general overview of important topics in snow photochemistry, which included some material on organics in snow and ice. This article includes a wider range of topics, moving into the discussion of a number of non-reactive interactions with ice/snow, and reactions that are not primarily photochemically driven. Rather than being an update to that review, this manuscript is the first review in the literature dedicated to the topic of organics in ice from the perspective of air-ice chemical interactions, and is thus much more comprehensive than the Grannas et al. paper. The "textbook" quality that the reviewer mentions was achieved by design. Our goal was to provide a reference point for current and prospective researchers in a broad spectrum of related areas, as well as provide material of interest to experts in the field. A standalone review of snow microphysics/QLL and its influence on air-ice chemical interactions will be submitted to this special issue in the near future (Bartels-Rausch et al., 2012), and another review on the role of the cryosphere in the fate of organic contaminants, with a focus on persistent organic pollutants, (Grannas et al., 2012) has been published in ACPD. From those reviews it is evident that those topics are more complex than expressed in this review. Here, we focus on the main findings and feel that relating those is necessary to give a full picture of the molecular chemistry of organics. We refer the readers to these companion reviews for more detail on these topics.

We acknowledge that the original manuscript could be improved upon by adding depth in some places; in response to these comments and those of the other reviewer, we have revised the review with an eye to being more critical rather than simply summarizing, and thus offering more insight for the reader. Examples of changes made include: We have added more critical analysis in sections II

(discussion of BC absorption measurements in snow), III A (discussion of experimental studies of physical interactions between organic gases and ice, discussion of the correlation between $\triangle$Gads and $\triangle$G gas-liquid, H), III B (discussion of discrepancies between OH-organic studies from different groups, and cage effects studies from different groups) section IV (ice and the carbon cycle) and Section V (outlook). Our discussion of the QLL and other compartments in ice is also more critical now.

We have also made changes to the manuscript to further clarify the goals of the review (that is, to emphasize that this manuscript is not simply a follow-up to Grannas et al. (2007)). The final paragraph in the introduction has been amended to help distinguish this work from that of Grannas et al. (2007). The following sentence has been added: "This is the first review to comprehensively present the chemical and physical issues that arise at the molecular level when organic species become associated with snow and ice." Section II has been restructured to reduce the emphasis on photochemistry.

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