Atmos. Chem. Phys. Discuss., 12, C12439–C12441, 2013
www.atmos-chem-phys-discuss.net/12/C12439/2013/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Relationship between snow microstructure and physical and chemical processes" *by* T. Bartels-Rausch et al.

Anonymous Referee #1

Received and published: 8 February 2013

The authors are to be congratulated for attempting to put together a comprehensive review of the ways in which snow and ice structures may influence contaminant behavior in snowpack environments. This provides a very valuable collection of the relevant experimental, modeling and field studies, and will be a useful start point for the next 5 years of work.

That said, I do have one significant issue with the manuscript as written (and several smaller points, listed below). To summarize – it lacks coherence, or a clear vision of where it want to go. The "physical" and "chemical" sections are quite distinct, with the latter much more focused, in my opinion. The "physical" section reads in a scattered way, more alike a series of short encyclopedia articles than an overall review. As well, and importantly, the level of synthesis is low – there is not really an overall picture

of how snow *microstructure* affects uptake and chemistry (as promised by the title). The discussion keeps returning to the issue of distinguishing the observables for the "disordered surface layer" vs. "brine", vs. "internal-to-ice" systems – a laudable goal, but different than the title's promise. I would suggest perhaps renaming the article, and trying harder to connect the physical and chemical aspects, perhaps removing some of the sections in the first part which are not connected to the second.

Minor comments:

Page 30414 line 3: "Adsorbed species may react . . ." line 20: " reflected by" should be "reflective of" line 21: define "riming"

Page 30416 Lines 25-28: are the insights from this previous work limited to the polar cryosphere only?

Page 30418 Line 3: 5-40 microns is hardly "sub micron"!

Page 30419 Line 12: what does "difference in the liquid-solid absorption contrast" mean?

Page 30420 Line 7-8: What does this sentence mean? Line 24-25: presumably the meaning is sulfuric acid solution?

Page 30421 Line 4-6: Is there a reference for this effect? Line 13: what are "grain boundary triple points"?

Page 30425 Line 17: "element-specific"

Page 30428 Line 7: surely not 1 mm!!

Discussion on pp 30438-30440 I think the hydrolysis of acids at the disordered surface should be discussed here. Papers by Kahan et al and Wren et al have reported on pH changes due to acid uptake – this must be due to hydrolysis taking place to some extent.

Page 30463 Line 10-14: Wren and coworkers have measured pH changes on freezing sea ice which suggest the buffering is maintained in the brine layer in contact with the atmosphere

Page 30465 Line 8: “expectedly” is awkward here; perhaps “expected to be”

Page 30485 Line 23-25: re the absorption spectra – immediately above, you state that it is not general for the spectra to be different; perhaps “similarly” is too strong here.

Page 30486 Line 2: I disagree. The presence of brine accelerates reactions in which either the availability of halide ions, or the increased concentration in the excluded liquid are important. But that is not all reactions, as is stated elsewhere (ie Kahan et al 2010a)

Page 30487 Line 1-10: You have pointed out already that it is often a poo approximation to consider liquid phase rate constants as being applicable here.

Page 30489 Lines 15-18 seem to contradict lines 1-5 somehow

Page 30495 Line 18 ff: This is certainly the elephant in the closet! How relevant are the studies of the surface vs. bulk; disordered layer vs. excluded brine, if the actual snow sample is cycling in temperature and humidity constantly?

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 30409, 2012.