REVIEW – REFEREE#3

As the first two reviewers already raised the main concerns of the manuscript for which I totally agree, I will only focus on a general comment. Throughout of the manuscript the authors take granted that the enrichment of Br above sea water has only one explanation, namely the first-year sea ice extension. The discussion that follows never question this hypothesis and only interprets enriched Br as the first-year sea ice extension. Such concordance is so strong in the paper that enriched Br and first-year sea ice extension are used indifferently, like synonyms.

The use in ice core/snow of Br-excess as a proxy of sea ice extent was initiated in 2013 by the present author's team. Since then, this team has published around 10 papers with most of them using the same adequacy Br-excess = FYSI to reconstruct sea ice in Russian & Canada Arctic, East Antarctica, in East Greenland.

However, quoting their own conclusion in their 2013 original paper: "Although further investigation is required to characterize potential depositional and post-depositional processes, these preliminary findings suggest that I and Br can be linked to variability in the spring maximum sea ice extension and seasonal sea ice surface area (Spolaor et al., The Cryosphere, 2013)". Requirement and suggesting are the two most important terms in their conclusions. With time "suggest" has become a certitude and "require" has turned into still awaiting. I could not find in ISI database any papers treating this hypothesis at the process level as originally suggested the authors.

In J Abbath's Nat Geos comment of Pratt et al. 2013 paper (which results are at the heart of their hypothesis), I quote "Whether the rising fraction of young sea ice will enhance snowpack bromine production and release, and concomitant changes in atmospheric chemistry, remains to be seen (J. Abbath, Nat Geo, 2013)". Interestingly, Pratt's paper argues that acidity of snow is a prerequisite for Br activation as well as internal snow pack air chemistry, e.g OH snow pack production, nitrate/nitrite concentration etc. As the relative scavenging efficiency between ssNa and gaseous Br seems to be the main driver of the Br-excess, change in precipitation regime can potentially greatly influence the Br/Na ratio. A transect study from coast the inland along a strong accumulation gradient will be very informative in this view. The speciation of Bry species, air snow transfer are also important parameters to consider. In summary, the current literature gives little concrete elements to definitely link Br-excess and FYSI extension. Increase production efficiency at constant extension is for instance never considering, neither change in scavenging precipitation, etc. A correct scientific approach should be: 1- Establish the hypothesis 2- Test it against observations, determine the sensitivity to parameters 3- And use it within its limits It seems to me that the step 2 is currently missing for Br-excess. There is a long list of acclaimed proxies in the ice core community that after a throughout investigation turned out to have been interpreted too simply (just few of them MSA, MSA/sulfate ratio, water isotopes, levoglucosan, nitrate concentration).

In conclusion, the authors should clearly state that their hypothesis is not yet fully demonstrated and their conclusions are only hypothetical. Currently, other interpretations are possibles.

We thank Reviewer#3 for her/his comment. We agree on the general point that the uncertainties related to the Brenr have to be clearly stated. The manuscript introduction now focuses on Brenr as a potential indicator of past sea ice conditions (*1. Introduction: Brenr as a potential indicator for past sea ice conditions*). The uncertainties and the key aspects that require future studies and investigations are

discussed. This paragraph includes both aspects that Reviewer#3 and Reviewer#1 pointed out, as well as other few aspects. This section is structured into three general aspects related to Brenr: activation, transport and deposition/postdeposition. The reader can find this section attached in the answer file to Reviewer#1 (pp2,3).