

Response to comment by reviewer 2:

We once again thank reviewer 2 very much for the added comments to the manuscript. We have answered the comments below using **green text**.

We believe that taking the comments into considerations have improved the manuscript.

6041 L15: Arctic origin could mean from the Arctic ocean, from the Canadian Arctic, whatever. It would be interesting to know where the moisture came from.

In Steen-Larsen et al. 2013 we carried out a water tagging experiment using the LMDZiso model to show that high d-excess vapor corresponded to moisture from the Arctic. We designed (as explained in Steen-Larsen et al. 2013) the tagging such that we defined the Arctic as being north of 70 deg N. This allowed for maximum ocean and limited land surface. We agree with the reviewer that we should specify the area in the text and have therefore added that we are referring to the area north of 70 deg. N.

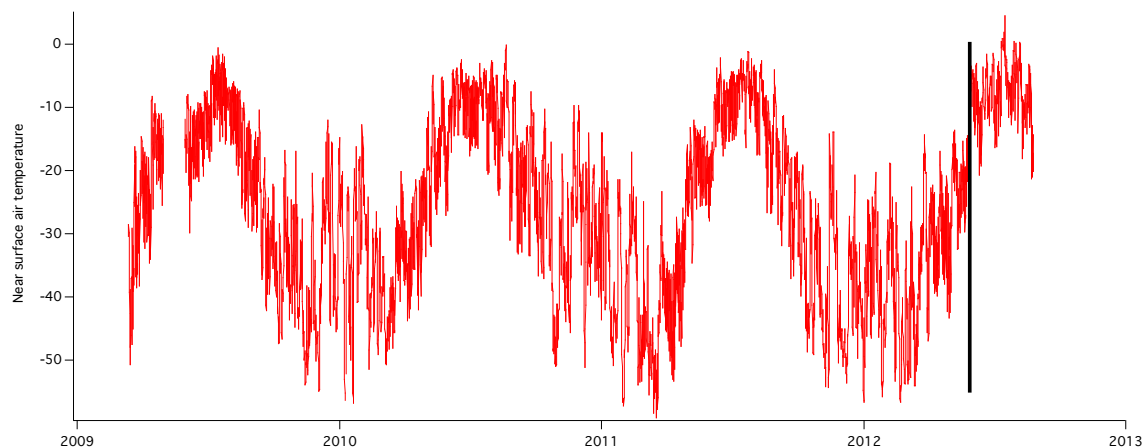
6042 I22: Fraction would be a percentage. 2.5 and 4.5 seem to be factors to me.

We have corrected the text such that we are not using the word “fraction” but instead “part” ... i.e. a large part of the precipitation

6048: I20: Since the NEEM temperature seems to be affected by the influence of changing weather systems it you can have relatively low temperatures in summer as well as relatively high temperatures in spring. Thus it sounds a bit strange to speak of a spring-summer transition.

We agree with the reviewer that the temperatures at NEEM are strongly affected by weather systems. We also agree that the temperatures during the summer can be as low as the temperatures before the “spring-summer” transition.

However we would like to still use the term “spring-summer” transition. We support the reason for this by showing below the temperature variability at NEEM during years 2009-2012. (Only since 2009 do we have complete coverage of temperature during the winter). It can be noticed that for 2009, 2011, and 2012 are indications of a sharp transition into summer temperatures. (We have highlighted the 2012 “spring-summer” transition using a black solid line). We hope that you agree that albeit the term “spring-summer” transition is not very strictly defined it is OK to use it as a tie point in the record when describing the variability.



6049 125: Atmospheric rivers: to my knowledge the term was introduced in the 90s by Newell and Young, better use the original reference. And still it would be interesting to know which synoptic situation caused the atmospheric river.

We thank the reviewer for bringing the paper to our attention. The reference has now been added.

6056: 111 From my understanding isotopic fractionation should occur during sublimation/ deposition for exactly the same reasons as during evaporation/condensation (mass dependent saturation vapor pressure, mass dependent diffusion). Model assumptions are not necessarily the same as physics. Unfortunately, I am not aware of a study with quantification of these processes that might justify their neglect in the corresponding models. Would be happy to read about this in your paper.

We are in the process of experimental investigation using water isotopes to understand the physical processes occurring during sublimation and deposition from / on snow grains. We notice that we in the text do not assume that sublimation does not change the isotopic composition but merely reference previous work, which assumes that sublimation, does not change the isotopic composition of the snow. We do however notice that we do not see any systematic relationship between sublimation simulated by CROCUS and trends in the surface snow $d_{18}O$. This could either imply that the sublimation simulated by CROCUS is not correct or the fact that sublimation does not change the isotopic composition of the snow grains.

In general, the assumption that sublimation from snow grains does not change the isotopic composition of the snow grain itself is based on the assumption that the “self-diffusion” (isotopic diffusion inside the ice lattice) is too slow for the “quasi-liquid” layer formed during evaporation to equilibrate with the solid-snow below. This means that the layers of the ice lattice is “peeled” of one-by one.

We agree that there is still a lot of research to be done on the subject.