

Interactive comment on “What controls the isotopic composition of Greenland surface snow?” by H. C. Steen-Larsen et al.

Anonymous Referee #2

Received and published: 12 December 2013

The study compares stable isotope ratios of water vapor, precipitation and surface snow samples from the NEEM site, NW-Greenland, in order to study the influence of post-depositional processes and the exchange between atmosphere and snowpack between snowfall events. The methods are sound, the results interesting and not yet fully explained, which shows that a lot more is to be done in this field before it is really possible to interpret stable isotope ratios from ice cores quantitatively. The paper is generally well written, the English is mostly ok; however, the usage of definite and indefinite articles (or better the non-usage) seems a bit arbitrary and sg./pl. are not always correct either. Generally, many sentences are very long and should/could be divided into two for better understanding. Sometimes the logic of a sentence or the logical connection of two (sub)sentences is not clear/exact or not quite suitable expressions are used. Thus I have quite a few, but mostly minor comments. The paper

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is highly interesting, contains new data and concepts, original work and therefore is definitely suitable for publication in CP after minor revision.

Specific comments: (format changed after submission for unknown reasons, sorry about that)

6037: L4: amongst glaciologist the term post-depositionAL processes is more common
17: the top L8/9: “measurements”: repetition L21: the phase transition from vapor to solid is called deposition (according to the AMS Meteor. Glossary) If you want to use different terms, please define them. I22: “synoptic weather”: weather is always synoptic. I26: 606038 L4: directly provide 6038/39: please rewrite the explanation of (i), this can be expressed more clearly 6039: L6: atmospheric general circulation models (GCM) L22: not always anti-correlation, especially at upper levels of snow/ice (Schlosser et al., 2008?) ..impact of changes in condensation temperature on...Not very clearly formulated, please rewrite 6040: L23: “whether”? I think we know that post-depositional processes (not “post-deposition”) have detectable impacts, the question rather is how they impact the T-stable isotope relationship. (iii): the structue of the sentence is not logical here. The processes have no impact on the processes L25: “in-between”: between would be enough, also in the following

6041: How do you define “high d-excess events”? L15: originating from the Arctic: Greenland is part of the Arctic, please specify L18: delta rather than d L20: delete “altogether” at least once 6042: L.13: automatic weather station (AWS) L15. Using a Campbell... L16: using an RM... L21: estimated to L22: 2.5 and 4.5 are not fractions, but factors, if I understand S-L2011 correctly. L25: what are extra sensors? At additional layers? 6043: L4: at the edge L5: from the nearest.. L10: were placed.. L16: calibrated in the beginning... L21,22: delete “of” L24: was discarded L25: was measured continously except for 15min every hour when the 20cm level was measured. 6044: L4: when L20: delete “off” L23: previously, by taking surface snow L28: until the measurements 6045: L12: because the results... L20: Calculation 6046: L3: “the reason.. due to “ is not logical (double expression), please, reformulate L6: GCM

C2930

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9, C2929–C2932, 2013

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L12: with a resolution L17: frost= deposition? What is calving in this context? This paragraph is a bit hard to understand for people not familiar with the model. 6047: L3: delete “exchanged” L5: forcing was. . . . L9: explain GC-NET L10: linear correlation: how about a correlation coefficient and a significance level? L21: “reliably calculate the vapor fluxes”: it surprises me that the vapor fluxes should be correct if precipitation rates already have an error of 1006048: L4: the use of “respectively” seems a bit unusual, also at other places L6: delete “probably”, due to an increase in downwelling long-wave radiation Many “dues” anyway, maybe better: because the clouds lead to an increase in downwelling long-wave radiation (rather than “greenhouse effect”). You could also refer to the long-wave radiation balance, because the upwelling long-wave radiation changes, too, of course. L8: changes in the large-scale L13: delete “to occur” Grey band: melt or precip? Figure caption says precip. Contradictory, please clarify. L14: do you mean: “melt had occurred before (so far) only in summer 2005” L15: delete “been L16: by rather than from L17: how do you define “spring-summer transition”? L20: the difference of minimum and maximum temperature during the warming is not a good measure for the amount of warming, better compare minima or maxima before and after what you call spring-summer transition 6049: Fig.1: it would be easier for the reader if you used the real date rather than Julian days and you refer to real dates in the text. Like ref.1 I miss the precip data in 2012. L4: are representative. . . . L5: strongly rather than very depleted L8: clear-sky conditions L12: explain synoptic variations L17: delta rather than d, changes in the.. L20. In preparation L21: event is a strange expression here, explain L22: replace “if” by “with” L23,. Spring-summer: see above L23: fastest event, expr. L25. Atmospheric river: does not mean much, better describe the synoptic situation that led to the warm air advection L29: ..of variations is observed General: tenses: past or present? Be consistent. I do not agree with referee 1 concerning removal of the results from LMDZiso, since you do need them for your argumentation. So, please, keep them in the figure. 6050: L2: are comparable L4: all show L5. Synoptic events, see above Anti-correlation only for synoptic events? Any explanation of this? L6: why do you isolate this period? L18: the range of values is

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Interactive
Comment

smaller than for vapor 21: A similar..over the same L23: the summer L24: value rather than level 6051: L1: averaging over the same... yields.. L3: delete “we observe that” L6: this is not logical L25: delete “in” Fig.2 and 3: some of the regressions look kind of “daring”, esp. precip and surface snow 2011 and . Are those statistically significant?? 6052: Fig.4: explain the shaded areas in the fig. caption General: surface snow, not snow surface when you talk about samples L10: the daily... What do you mean, daily mean? L24: in table.. L25: delete “appear to” 6053: L1: while between precipitation events a better agreement is found for calcul... L16: For different years a comparable.. is found L19: exist for vapor and ... 6054: L4: at play Can you specify those processes? l12: move “for one period” to the end of the sentence l.15: decreases by.. l.17: damped: better dampened or attenuated, in this case you could also simply say “lower magnitude” 6055: L1: but not in d-excess. L2: predominantly does not make sense here L3: ambiguous? Do you mean “less uniform”? L6: From this co-evolution the following question arises: L11: delete “resort to” L13: delete “isotopes” L16: if this were the case L18: the majority is decreasing, so why “however”? L23. Delete able 24: any mechanism that could... 6056: It would be good to define the sign of the fluxes here, too. And see above: why should sublimation be largest during precip events? L9: what is the top layer exactly? L11: this is not exactly true. Please distinguish between physics and model assumptions. 6057: L1: we therefore do... 7: condensation: see above L11: please explain self-diffusion 19: synoptic changes, see above 6058: L1ff: this is not understandable without reading (Pinzer et al 2012). 6059: L1: logic: show much weaker relationships between GL delta 18 O and temp. in summer than in winter. Any explanation for this? L24: Tape recorder: not really scientific language, also not too good a comparison anyway 6060: L14: an excellent site for a case study 27: damp, better: attenuate References: Neumann and Washington: volume number missing (169)

Interactive comment on Clim. Past Discuss., 9, 6035, 2013.

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