Review of
"Annual variation in precipitation δ^2H reflects vapour source region at Barrow, AK"

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The following are additional responses to the following questions that concern the utility of h2m,SST. Additional responses are marked in green.

12. p. 5, L. 12-16: The idea to use T_d as a summary variable for both relative humidity with respect to sea surface temperature ($h_{2m\ SST}$) and SST-effects seems not justified to me from a physical point of view. The influence of SST on T_d is only indirect and a strong coupling of the ocean surface conditions with near-surface air characteristics is not necessarily given particularly at the event timescale. From a theoretical perspective and for all isotope-enabled numerical modelling experiments it is the Craig-Gordon model and thus the other two variables that are used to determine *d* of the fresh evaporate. So I am not convinced that it is sensible to introduce a third variable that does not contain more information than the specific humidity at 2 m. Furthermore, it should be made clear in the manuscript that it is not the 2m relative humidity that is important for the non-equilibrium fractionation part during surface evaporation but the humidity gradient towards the surface which is represented by the relative humidity at 2m with respect to sea surface temperature ($h_{2m\ SST}$). The authors should make a stronger case for why they use T_d rather than the classical variables. Also the sentence "T_d depends on the specific humidity of saturated air at the sea surface and on the amount of dry air from aloft that has subsided and mixed into low altitude air" is a confusing statement.

The idea of using Td is to indicate the moisture condition PBL, the moisture that forms the first condensate. This is not the same as the evaporative flux predicted by the Craig-Gordon model. Our group has done a significant amount of work to model and understand isotopic variations in the marine boundary layer (manuscripts in preparation), and our understanding continues to improve. We realized that our discussion about Td in the earlier version was not clear, and it is valid for this reviewer to solicit further explanation. We have completely rewritten section 3.2 that pertains to Td (p. 9 l. 6-35, p. 10 l. 1-9). Basically, the Craig-Gordon model only predicts the evaporative flux, not the vapor properties in the PBL. In addition, the Craig-Gordon model does not consider effects of convection on vapor isotopic ratios in the PBL. However, convection is very important process that 1) transports PBL air to the free troposphere, and 2) brings dry air from aloft to the PBL. The boundary layer air is therefore a mixture of evaporated vapor from the ocean surface, and the dry air from aloft. The extent of this mixing within the PBL is reflected by (2m) dew point, Td. Td is also important for indicating the evaporation condition in that it is more directly related to relative humidity with respect to the sea surface temperature than is the 2 m relative humidity. When h2m, SST was used in the multiple regression instead of Td, it was a significant predictor of d2H. However, in both variance explained and AIC, the the multiple regression that incorporated Td performed better. Both because it performs better in the multiple regression, and because it is a measurable quantity, we prefer Td to h_2m,SST and have retained it in the paper. We hope the new discussion in the revised version is clearer.

27. p. 10, L. 17: I am surprised at the *d*–*h* slope which is not at all in agreement (opposite sign and different order of magnitude) with other literature values (*d*-0.6h%$^{-1}$ to -0.32h%$^{-1}$, though a difference with literature values is that h_{2m} is used and not $h_{2m\ SST}$). This mismatch should be explained and the relevant literature should be cited (Pfahl and Wernli, 2008; Steen-Larsen et al., 2014; Aemisegger et al., 2014). Also the *d*-SST regression slope is of opposite sign to what we would expect from the Craig-Gordon model.

We too were surprised at the outcome. Efforts were made in the text to explain it, focusing on the effect of the larger-scale humidity gradients and potential mix-phased cloud effects. However, considering that evaporative condition is only one process controlling the vapor properties in the PBL, as we explained earlier and also in the revised manuscript, this result is not entirely unreasonable. See our response for 28 below.

The statistics were performed with h2m,SST, and the results were significant ($p < 0.001$), and in the range of the values described above:- 0.39+/- 0.067 h%-1, with 34% variance explained. This has been added to the paper in this section. Note- because we updated the sea ice threshold to 96% (per specific comment on modeling by JL Bonne), some values of source variables have changed slightly. This is why there are updated numbers in the table.