General comments:

The paper by Wiegele et al. documents an intercomparison of δD (and H_2O) retrieval products between two different observing systems: IASI and GB FTIRs. Such observations have been demonstrated to be of great interest to investigate the processes controlling humidity distributions. δD observations from remote sounders are however complex retrieval products and need special care. The authors apply a methodology they previously developed to fully consider that and show that the 2 observing systems exhibit very coherent datasets. It is the first time such intercomparison/cross validation study is realized for δD retrievals. Moreover the authors also introduce for the first time an original and necessary approach to assess the added value of this special retrieval product by analyzing the q-δD relation. The manuscript is concise despite the complexity of the retrieval products and generally reads well.

In particular, I think the effort to intercompare the "added value" of δD together with H_2O is really interesting and as explained by the authors necessary for this research topic. However it is not clear what the authors call the "added value", or typical correlation between δD and ln(H_2O), and thus I am not convinced the added value is demonstrated here. This part could be improved with more concrete explanations on the q-δD relation.

Therefore I recommend publication for AMT after considering the main comment above and the specific ones here after.

Specific comments:

P3921,L13: "each location is passed by each IASI instrument twice a day"

This is true to a first order but there can be relatively large area not sampled by IASI (until 50*50 km^2). - → IASI samples the atmosphere almost everywhere on the globe twice a day.

P3922,L20: Could you also state the variability for δD in approximate permil.

P3923,L14: Have the cross-kernels in the {humidity, δD }-proxy state have been multiplied by 12.5/0.08 like in Schneider et al., 2012? Maybe state that in the legends of the figures.

P3925, L10->15: This value of $2x10^{-2}$ µW/(cm² sr cm-1) corresponds to the IASI radiometric noise for the 645 – 1175 cm^{-1} region. Beyond this region the radiometric noise is significantly reduced, you should state the IASI radiometric noise in the spectral range you use. And if it higher you could comment on that.

P3934->3935, section "delta d correlation":

This section was a bit difficult to follow. I believe there is a problem in the related figure. First, the panel "Kiruna" appears twice. I suppose "Kalsruhe" is missing. And second, the figures document a scatter estimated lower than the scatter observed but in the text it reads that the observed scatter is in excellent agreement with the estimations.

P3933, L15: "A part of this scatter is expected to be due to the differences between the IASI and FTIR averaging kernels.."

It I surprising that even after the smoothing you still expect significant contributions from the smoothing error. Especially if there is a big difference between the averaging kernels.

"… and much of this scatter is due to errors in the IASI and FTIR data."

After that you assume negligible error in the FTIR to assess a conservative estimate of the IASI δD random error. So finally the scatter is only due to error in IASI? I guess the total expected error between the two instruments is dominated by the error on IASI and thus yes the scatter between the two can be used as an estimate of the IASI error. It may be useful to precise how the different error sources (FTIR observational, IASI observational, smoothing and spatio-temporal mismatch) propagate into the total scatter between the 2 instruments. From that you can then say that FTIR error and spatio temporal mismatch are negligible compared to the IASI error.

P3934, L1->L5: "However, in the lower and middle troposphere there is a strong correlation between the observed δD and ln(H2O). This means that most of the δD variations can easily be predicted from H2O measurements.

I think it would make more sense to state that the other way around. It is because δD can generally be predicted from q that there is a strong correlation between the two.

The δD data add scientific value to H2O measurements if we can measure the part of the deltad variations that do not follow the typical correlation between deltad and ln(h2o)"

You need to define what you mean by the typical correlation between deltad and ln(h2O). To my understanding you speak about the correlation found in Rayleigh distillation curves and I will assume so for the following. It might be useful for the readers to be a bit more explicit on this relationship between log(q) and δD. To a first order δD variations in the atmosphere can be interpreted in terms of a Rayleigh distillation. Rayleigh distillation predicts a progressive depletion of deuterium with a decrease of q. δD decreasing linearly with log(q) and thus the correlation is 1 between the 2 variables. However this typical correlation or relation varies spatially and temporally since it depends on the source term. This source term is characterized by a delta d value and q value in equilibrium with the surface temperature of the ocean. So in winter the Rayleigh distillation curve will be very different than in summer.

P3934->3935, section "the added value of deltad":

This section needs more explanations to assess the added value of the observations or more prudence in the wording used. Now it is not clear on the figures that the unusual isotopologues observations highlighted demonstrate an "added value" (deviations from Rayleigh distillation curve). They show the same behavior in the deltad-q space and that demonstrates that the delta d signal captured by both instruments is not coming from H2O. But the unusual isotopologues observations you highlighted could correspond to unusual Rayleigh distillation curves. And probably varies seasonally. For example the green points could correspond to a Rayleigh distillation curve for which the source term is specific humidity in equilibrium with a surface temperature of 300K while the red points might follow a Rayleigh distillation curve characterized by a source term in equilibrium with surface temperature of 285K. This is very nice to observe and that demonstrates that your delta d retrievals are actually dependent than H2O retrieval in the same way but the "added value" is not clear since it is not defined what you meant by that. If it is Rayleigh, you should plot the distillation curves and a mixing line. Mixing processes will give more enriched δD value than Rayleigh distillation for a same q, in that case the "added value" is straightforward.

It might be useful also to give the correlation between ln(H2O) and delta d.

P3935,L26: "(…) detects almost the same middle tropospheric (…)"

I agree with that statement in the case of the Izana comparison, but in the cases of Kiruna and Kalsruhe you compared δD at 2.4 km, that doesn't correspond to the middle troposphere.

P3936, L1: "Furthermore, the scatter we observe between the two datasets excellently confirms our error estimations."

Please check the consistency of that statement with the related figure (Fig.8). If I understand it correctly, for Izana, the scatter estimated is 23.62 permil and the scatter observed is 11.85 permil. That would indeed confirm your error estimation. But it also indicates a significant error overestimation?

P3936,L10-L14: "Our study is made for three rather different geophysical locations: the subtropics, the mid-latitudes, and the polar regions. Therefore, we conclude that the results are globally valid and provide a first clear theoretical (…)"

The conclusion on "globally valid" might be too precipitate, from a global perspective, a tropical site is missing. You should state that with more prudence.

<u>Technical corrections:</u>

P3916,L26: clear instead of cleared

P3918,L22: characteristic

P3921,L7: Izana instead of Izan

P3925,L12: µW/(cm² sr cm-1) (the slash is missing)

P3931,L13: kernels (kernals written)

P3932,L9: The here observed ?

Figure 8: There is twice the same plot in this figure (Izana, Kiruna and Kiruna again) I guess Kalsruhe is missing. (and the y axes are not in the same units as x axes)