We would like to thank the referees, Dr. V. Zakharov and Anonymous referee for their review. Their comments and suggestions allow to submit an improved version of the manuscript. In particular we include now 2 additional figures that better illustrate the collocation of TES and IASI measurements and spatial distributions of δD as seen by IASI and by TES.

Please find below our detailed answers (in blue) to the referee's comments (in gray). The modifications done in the manuscript appear in magenta.

Referee # 1, Dr. V. Zakharov

Comment 1:
It is necessary to show in the chapter of the article a picture (color map) of collocation the observation spots of IASI and TES and discuss estimation error of the inter-comparison due to spatial (up to 1 degree) mismatches and temporal (not less than 4 hours) differences.

→ We added the New Figure 1 in the revised manuscript which illustrates the different sampling capabilities of the two instruments as well as the collocation of their measurements. In section 4.1 (Datasets description and collocation criterion) we added:

> "The figure 2 illustrates the spatial collocation of TES (squares) with IASI (ellipses) measurements for the descending orbit (PM) on 18 January 2011 above the maritime continent. Only IASI pixels that are within the red circles (right panel of Figure 2) are considered for the comparison."

Concerning the error due to spatial and temporal mismatches we added the following paragraph at the end of section 4.1:

> "Despite the strict collocation criterion used, some mismatch due to the natural variability of δD could arise. The spatial mismatch within circles of 0.5 to 1° is assumed to be inferior to the error on IASI retrieval and is thus unlikely to control the total difference expected between TES and IASI. For example, the 1 sigma standard deviation at 4.5 km on IASI retrieved profiles within cell of 1°×1° is about 22‰. In Wiegele et al. 2014, the authors estimated the error due to spatial mismatch for similar distances of about 18‰. The impact of a temporal mismatch is more difficult to estimate and might affect the total difference budget to some extent especially above the maritime continent where convection has a pronounced diurnal cycle."

Comment 2:
It would be useful to add scatter plots of IASI-dD vs. TES-dD in the atmosphere (at different height) above ocean and above land separately and discuss impact of uncertainty of land surface emissivity on retrieval error and on the inter-comparison error.

→ Scatter plot is a different way to present the information presented in Table 1. We choose to present the agreement between TES and IASI this way to limit the number of figures shown in the paper. Since there are numerous figures and considering the two additional ones that we added after the corrections we feel that the Table suffices for presenting the agreement between TES and IASI. In the revised manuscript we provide however a more complete view on the vertical differences between TES and IASI giving the statistical parameters at several altitudes both for the direct comparison and the smoothed one. The new table is given below.

The uncertainty on emissivity is small above most land surfaces and does not affect significantly the total error budget on retrieved δD profile. Emissivity is a problem mainly above deserts and ice where spectral structures of emissivity vary strongly as function of the surface temperature and degree of humidity and thus vary in function of the seasons. These regions are not part of the study and we do not think that adding this in the error budget is necessary.

Comment 3:
Data of inter-comparison between TES-dD and IASI-dD obtained at large scale is one of main results of the article. To illustrate the result elegant, it would be useful to add a color map of the difference between IASI-dD and TES-dD data obtained above the Atlantic (from 60S to 60N and from 30 to 25W) and above the Indian and Pacific Oceans (from 15S to 10N and from 65 to 155E) both before bias correction and after the bias correction.

→ This is true TES and IASI are both capable to map spatial variations of δD and that we do not show any spatial distributions of δD. This is because the intercomparison study is oriented one versus one observation and showing map of δD require averaging over time and space due to TES sampling.

Nevertheless, since one of the purpose of our study is to document what differences are expected from the utilization of TES δD retrievals or IASI δD retrievals we agree with the referee that a map of δD would nicely illustrate that. We thus include one additional figure (New Figure 2) on spatial distributions of δD and H_2O observed by IASI and TES above the Pacific and Indian Oceans. H_2O distributions are mainly there to show again that δD estimates differ significantly from H_2O. The following text has been added at the end of section concerning the TES-IASI comparison:

> "To conclude this section we show in Figure 2 how the two instruments map δD and H_2O variations above the Pacific and Indian oceans. Since TES sampling is relatively sparse, collocated retrieved values of δD at 5.5 km are averaged on three months periods on cells of $2.5° \times 2.5°$. In that figure, TES retrieved values are not smoothed with IASI averaging kernel in order to ensure that TES retrieved profiles are not degraded to a lower sensitivity. δD variations are represented in relative values with respect to the mean of the dataset to avoid the impact of the bias on the comparison. One can see on Figure 2 that seasonal distributions of δD (panels a) and b)) are very similar for both instruments with the spatial structures of enriched and depleted zones being quasi identical. The same comparison with water vapour shows that humid and dry structures are also very similar in the TES and IASI retrievals and that the spatial structures of δD and H_2O exhibit very different patterns."

TES data used here are provided in a format where the correction for the bias is already applied which makes it difficult to address the referee comment with regard to the bias. Moreover in this study, we cannot assess the bias on IASI δD retrieval which includes a cross validation exercise. A proper validation exercise would be needed for this (see also answer to anonymous referee's comment 2). Spatial variations are therefore represented in relative values.

Fig. 6, it is necessary to add numbers on abscissa axis for g-i and j-l figures.
Fig. 11, JJA should be change to DJF at the blue box on the bottom, probably.

→ Done. Thank you.

Referee # 2, Anonymous referee

Comment 1:
Lines 713-718: In this chapter the different sensitivities are discussed. TES and IASI both work in emission, and the ground-based instrument work in absorption. The emission instruments are looking down. For the ground-based instrument the viewing direction is much less important, because its solar absorption. The sensitivities are therefore different, and I would like to see a larger discussion of this topic.

→ In general (but this can differ significantly) for water vapour retrievals, nadir infrared sounders have more sensitivity in the free troposphere because of the opacity of the boundary layer due to high water vapour content while ground-based instruments are more sensitive to the first layers of the atmosphere, but this also depends of the spectral resolution of the instrument, for example TES has a higher spectral resolution than IASI and has more sensitivity in the boundary layer while IASI sensitivity seems more affected by water vapour content. This instrumental sensitivity is implicitly included in the retrieval sensitivity discussion. A specific discussion on the individual instrumental sensitivities is not provided here as it is documented thoroughly in previous papers by the various groups.

Comment 2:
Lines 285-295: Here two retrieval schemes are discussed, the ULB one, and the KIT one. The wording in that chapter sounds a bit as if the KIT algorithm is much better. And then they state that they use the ULB algorithm for the IASI retrieval. This needs to be clarified and rewritten.

→ It was not intended to compare the two algorithms. The sentence

> " At KIT, a much wider spectral range is used (1190→1400 cm^{-1}) than at ULB (1195→1253 cm^{-1}). Another difference lies in the fact that the ULB retrieval only considers ten layers in the troposphere and does not retrieve temperature profiles simultaneously. At KIT the number of layers is larger and the temperature profiles are retrieved together with δD."

Is now:

> "The main differences are the spectral range used and the strength of the statistical constraint used: at KIT, a wide range of the IASI spectra is used in the retrieval (1190→1400 cm^{-1}) with a strong statistical constraint while at ULB the retrieval uses a shorter spectral range (1195→1253 cm^{-1}) and a moderate statistical constraint."

Comment 3:
Lines 318 ? 323: The authors mention in this chapter that the TES V005 data are bias corrected, due to a suspected problem in the HDO spectroscopy. Lateron, when studying literature results for a comparison with aircraft data a remaining bias of 37 permille is mentioned. Here it would be interesting whether the bias correction decreases the remaining bias to 37 permille, or increases it. When studying fractionation processes, potential biases cause a large problem, and need to be discussed sufficiently. Therefore I would like to see here a few more sentences on this topic.

→ TES profiles of δD have initially been evaluated against calibrated measurements in Worden et al., 2011. Based on this first validation exercise and in a new version of their product (the one we used), TES team provided a bias corrected dataset (TES HDO profiles are corrected downwards). This last product, bias corrected, has been re-evaluated against new profiles of δD measured by aircraft (Herman et al., 2014) and a remaining bias of +37‰ (in the free troposphere) has been identified.

It is true that the difficulty to determine an accurate bias for δD indirect measurements in the free troposphere places some limitations for using δD estimates as absolute values. Nevertheless, despite this lack of accuracy knowledge, the relative variations of δD offer plenty of possibilities to study various hydrological fractionation processes. Note moreover that recent efforts for measuring δD in the troposphere with in situ instruments provide first data that will allow assessing the bias on δD accurately (with the difficulty that the majority of these profiles are limited to 5 km height). This constitutes a validation by itself and is beyond the scope of our study. In the cross-validation study provided here we cannot assess an accurate bias because the profiles we use are all indirect measurements; we document however the different biases between the different indirect measurements.

At the end of section 4.1.2 we added the following:

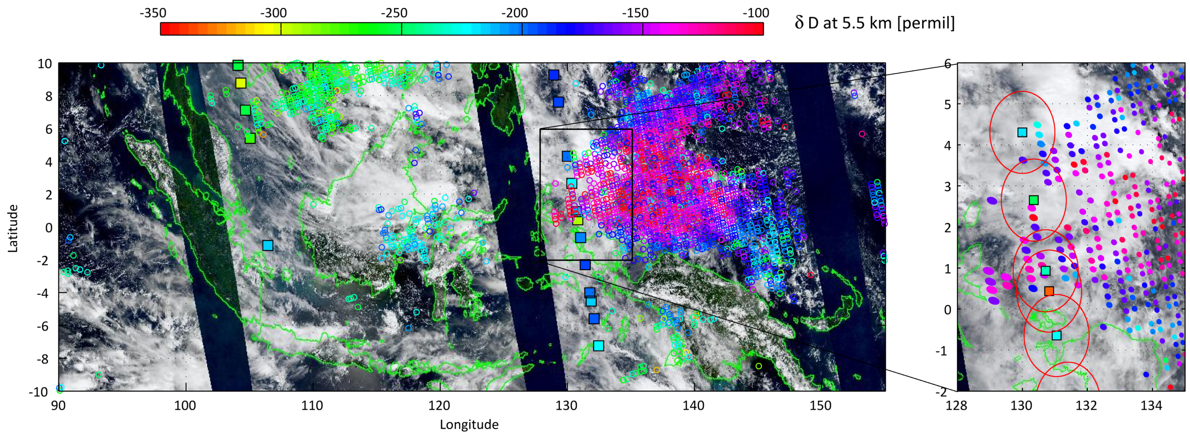
> "An accurate estimation of the bias on δD retrieved profiles from IASI would require further investigations including direct comparisons with available in situ profiles of δD in the troposphere (Herman, et al., 2014; Schneider et al., 2015). Here, the purpose is to qualitatively document the bias between the different δD products."

In the conclusions, the following sentence, which was confusing, has been deleted:

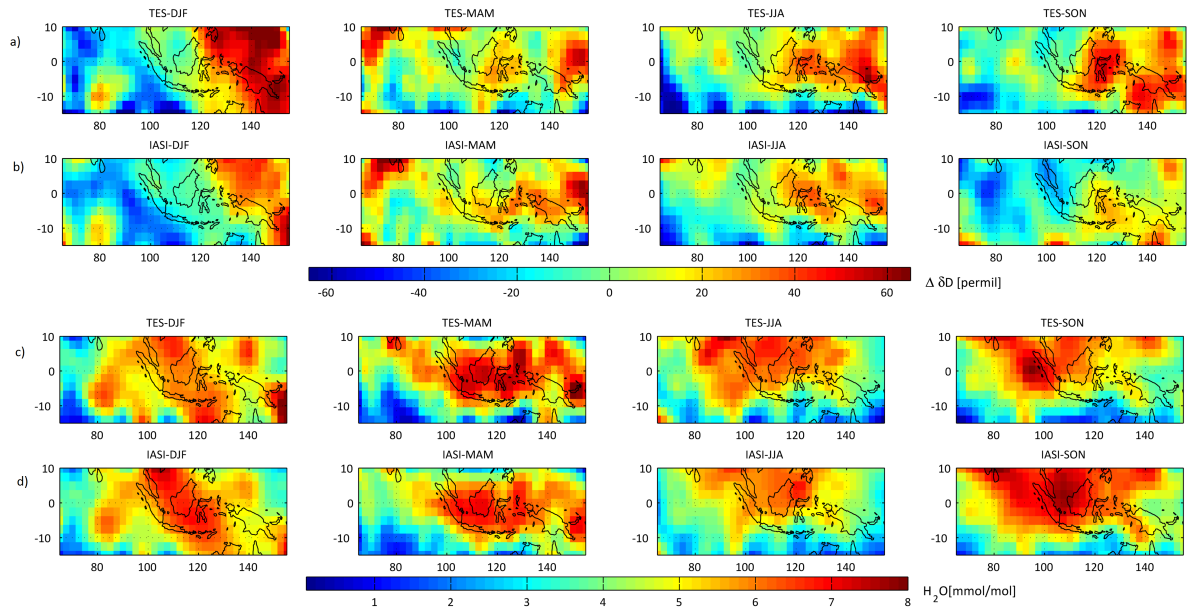
> "~~As TES data are bias-corrected, this suggest that the IASI retrieved profiles presented here are unbiased.~~"

Comment 3:
Figure 6: The figure captions on the x-axis are to small.

→ The size of the x-axis captions has been increased.



New Figure 1: Illustration of the collocation between TES and IASI measurements for the IASI descending orbit (PM) on 18 January 2011 above the Pacific and Indian Oceans. TES and IASI ground pixels are represented by square and ellipses respectively. The color scale indicate the retrieved values of δD at 5.5 km. The background is a MODIS picture taken the same day. On the right panel, IASI pixels are represented at their real sizes.



New Figure 2: Seasonal distributions of δD and H_2O for the PIO dataset at 5.5 km (2010) as seen by TES (a) and c)) and by IASI (b) and d)). Only collocated pairs are used to compute the seasonal averages. The values are relative differences with respect to the mean of each dataset.

Dataset	Altitude [km]	m		r		σ**(diff) [‰]**	
PIO		Direct	Smoothed	Direct	Smoothed	Direct	Smoothed
	0,5	0,09	6,24	0,13	0,30	91	72
	2,5	0,93	1,73	0,41	0,44	44	34
	3,5	1,18	1,12	0,50	0,55	41	30
	4,5	1,21	0,81	0,55	0,61	43	35
	5,5	1.27	0,79	0,57	0,39	42	41
	8,5	0,22	4,27	0,25	0,25	66	50
MD		Direct	Direct*	Direct	Direct*	Direct	Direct*
	0,5	0,38	0,37	0,28	0,27	71	72
	2,5	0,80	0,93	0,60	0,61	56	54
	3,5	0,98	1,18	0,67	0,73	49	35
	4,5	0,95	1,02	0,62	0,76	46	37
	5,5	1,04	1,12	0,47	0,59	68	50
	8,5	0,16	0,16	0,29	0,40	84	72

Table 1: Comparison between IASI and TES δD at different heights for the PIO and MD datasets. σ(diff) is the SD of the difference between TES and IASI, in ‰. r is the pearson correlation coefficient and m is the slope of the major axis regression TES vs. IASI (a value of m greater than one indicates that TES variability is greater than IASI variability). Direct comparison* is for the comparison restricted to the TES and IASI data having similar sensitivities (see text for details).