General comments: Overall the paper reads very well. However, as discussed below, additional discussion is needed on how temperature related errors affect the retrievals and comparisons to the LMDZ model.

The authors would like to thank John Worden for his reading of the manuscript and for his constructive and detailed comments related on temperature errors affecting the retrieval. We tried to improve the content as recommended. A detailed point by point reply (in blue) is provided hereafter.
Please note that we do not simultaneously retrieve the temperature profiles since we rely on the L2 profiles retrieved independently by EUMETSAT processor. Thus in the following we studied the impact of the errors due to the temperature uncertainties by perturbing the T profile and retrieving the data.
To clarify this point, we added this sentence (in bold) in the section 3 (former line 2 page 11061):
"As compared to Lacour et al. (2012), the retrieval settings have been optimized for the specificity of the high-latitude region analyzed here. **We also do not simultaneously retrieve the temperature profiles and we use the EUMETSAT L2 retrieved temperature profiles for each IASI field of view.**"

Comments:
1) Page 11063 Line 18: Also state the percentage error into approximate per mil values so that the reader can relate the delta-d values to its uncertainties.

It is a good comment. We added this information in the text (hereafter in bold) and in the figure 3, as well for h2o as for deltaD.

"As can be seen in Figure 3 (**panels c & d**), the δD a priori variability reaches up to 18% **(80‰)** and varies from 8% to 14% **(15‰ - 50‰)** from the surface to 5km. The H_2O variability introduced in our retrieval is about 90% **(up to 1.5 g/kg)** from the surface to the free troposphere. In comparison with IASI retrievals used in Lacour et al. (2012), our variability is more constraint."

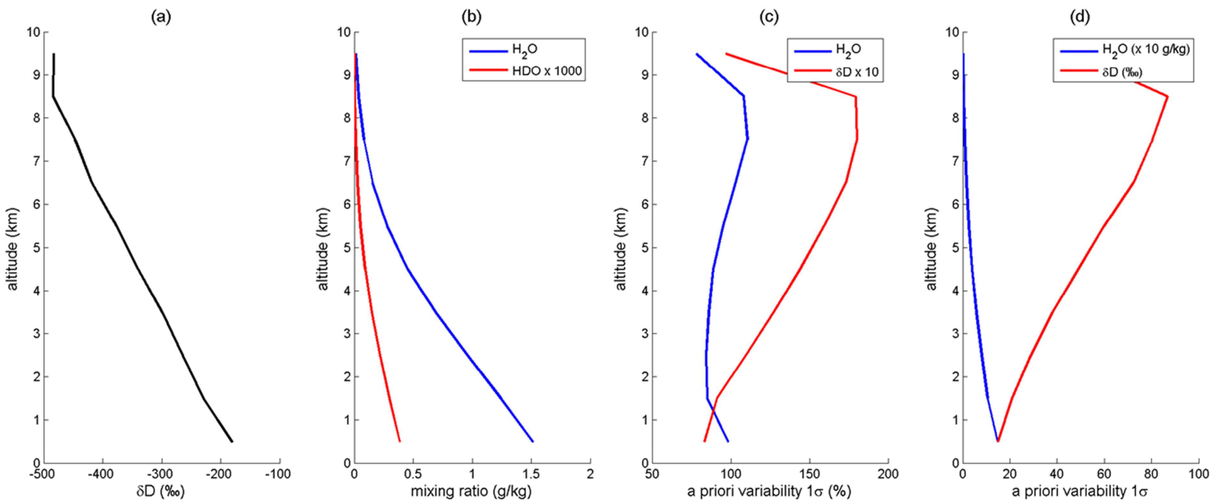


Fig. 3 A priori profiles used in the retrieval for δD in ‰ (a), for H_2O and HDO (in g/kg), plotted in blue and red curves, respectively (b). The a priori variability 1σ for H_2O and δD are expressed in % (c) and in their respective unit – in g/kg for H_2O and in ‰ for δD (d).

Page 11063 Line 22: The measurement covariance usually only includes the measurement error as the temperature error is not necessarily known a priori whereas the measurement error is typically known. It looks like your adding an ad hoc error to the measurement covariance presumably because your using the IASI temperature profiles instead of re-retrieving temperature? If so some additional discussion on this issue is needed in this section.

That is true, there was an error and our sentence was confusing. To clarify this point we modified this information as below:

"The measurement variance-covariance matrix includes the instrumental noise. Hereafter, it is assumed to be diagonal, $\mathbf{S}_\varepsilon = \sigma_\epsilon^2\ \mathbf{I}$, where σ_ε is a constraint representing the noise equivalent spectral radiance and estimated at 5×10^{-9}W/(cm^2 sr cm^{-1}). This value is slightly higher than the IASI spectral noise estimated in the selected spectral range, for a temperature at 280 K (~3.5×10^{-9}W/(cm^2 sr cm^{-1})) (Clerbaux et al., 2009). Note also interestingly that the value of σ_ε used here is smaller than the one used in Lacour et al.(2012) (8×10^{-9}W/(cm^2 sr cm^{-1})). This reflects the better spectral fits obtained with IASI in regions with lower humidity, such as those analyzed here."

Hence we decided to fix the value of σ_ε somewhere between the IASI noise (3.5×10^{-9}W/(cm^2 sr cm^{-1})) and the value used in Lacour al. (2012) (8×10^{-9}W/(cm^2 sr cm^{-1})), mostly studying low and mid-latitudes scenes.

This lower value reflects our better spectral fit over Siberia compared to the area studied in Lacour et al (2012).

2) Page 11066: Fix grammar in this sentence "HDO AKs can usually be been interpreting"

We modified the sentence as below:

"HDO AKs are often used as a proxy for δD AKs"

3) Section 3.6.2: Temperature error is asserted even though its one of the larger errors. What are the uncertainties on the temperature profile and how are these generated? Also, presumably error in the surface temperature also greatly impacts the error in delta-d..is this uncertainty from surface temperature calculated or assumed? For example, we are finding with ozone retrievals generated from IASI radiances that the surface temperature at least needs to be re-retrieved in order to get consistent calculated and actual error characteristics (as evaluated using ozone-sondes).

- In our work, we do not retrieve temperature profile thus we cannot compute systematically the derivatives. Thus this error is assumed. The temperature covariance matrix was assumed to be diagonal. It was based on the Schneider et al. (AMT 2012) procedure, as done in Lacour et al. (ACP, 2012). The temperature covariance matrix is calculated by:

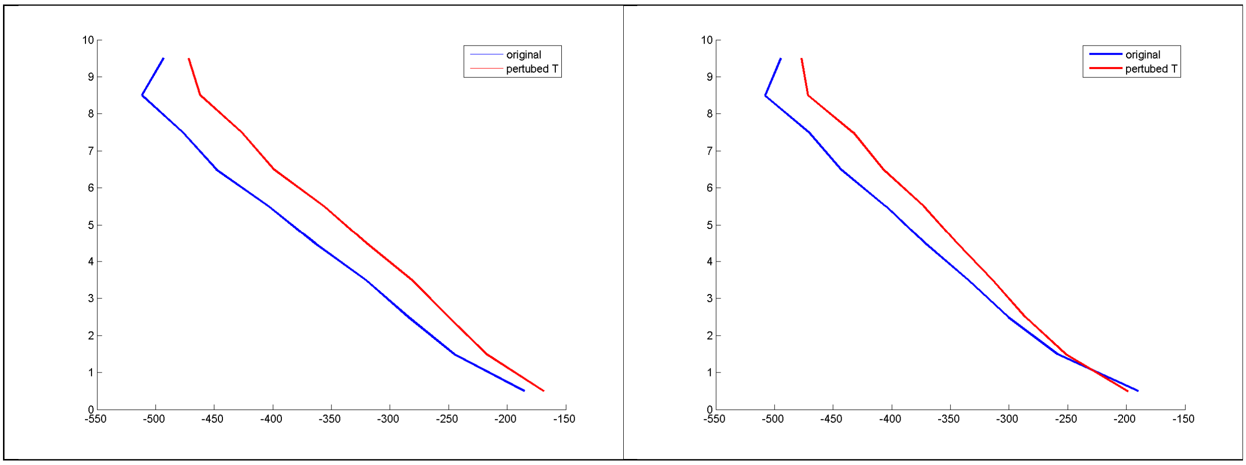
$$\mathbf{S''_T} = \mathbf{C\ P\ G\ K\ S_T\ K^T\ G^T\ P^T\ C^T}$$

With $\mathbf{S_T} = \boldsymbol{\sigma}_\mathbf{T}^2\ \mathbf{I}$ and $\boldsymbol{\sigma}_\mathbf{T}$ = 1K.

$$\mathbf{P} = \begin{bmatrix} \frac{1}{2}\mathbf{I} & \frac{1}{2}\mathbf{I} \\ -\mathbf{I} & \mathbf{I} \end{bmatrix}.$$

$$\mathbf{C} = \begin{bmatrix} \mathbf{A'_{dd}} & \mathbf{0} \\ -\mathbf{A'_{dh}} & \mathbf{I} \end{bmatrix}.$$

As suggested, to evaluate the error due to uncertainties in the temperature, we performed retrieval using a perturbed T profile. We used the forward simulation approach as performed in Lacour et al (ACP, 2012). We modified the temperature profile of 0.5% at each level (*e.g.* a temperature of 283.4K at the first layer of the atmosphere becomes a temperature of 284.8 K). This modification is larger than uncertainties found in the study by Pougatchev et al. (2009 ACP) (0.6 K between 800–300 mb with an increase to ~1.5 K in tropopause and ~2 K at the surface). Differences between the original and these new retrieved profiles allow estimating the error from the temperature profile.
For this test, we retrieved data for Feb, May, Aug and Dec 2011. This represents 5983 spectra and these 4 months are representative of different seasons.
Hereafter we present both δD profiles, when |ΔT| < 4 K (left) and when |ΔT| > 8 K (right).



With |ΔT| < 4 K, the difference between both profiles is below 48‰ in the [1-5km] altitude range. With |ΔT| > 8 K, this difference is lower than 15‰ between 0 and 3km. This shows the importance of uncertainties in the temperature on the δD retrieved values, compared to the annual difference with LMDZiso (32.6‰ between 1 and 5km and 22.8‰ between 0 and 3km).

Thus we added these sentences in the paper:
"To better evaluate the error due to uncertainties in the temperature, we used the forward simulation approach as performed in Lacour et al. (2012) since we do not retrieve the temperature profile. We modified the temperature profiles of 0.5% at each level. This perturbation is larger than the uncertainties found in Pougatchev et al. (2009). Differences between the original and these new retrieved profiles allow to estimate the error from the temperature profile. With |ΔT| < 4 K, the difference between both profiles is below 48‰ in the [1-5km] altitude range. With |ΔT| > 8 K, this difference is lower than 15‰ between 0 and 3km."

- The error from the Surface Temperature is negligible but as asked we plotted this error. We present hereafter the uncertainties from the surface temperature depending on the thermal contrast as done for the Fig 7 in the paper.

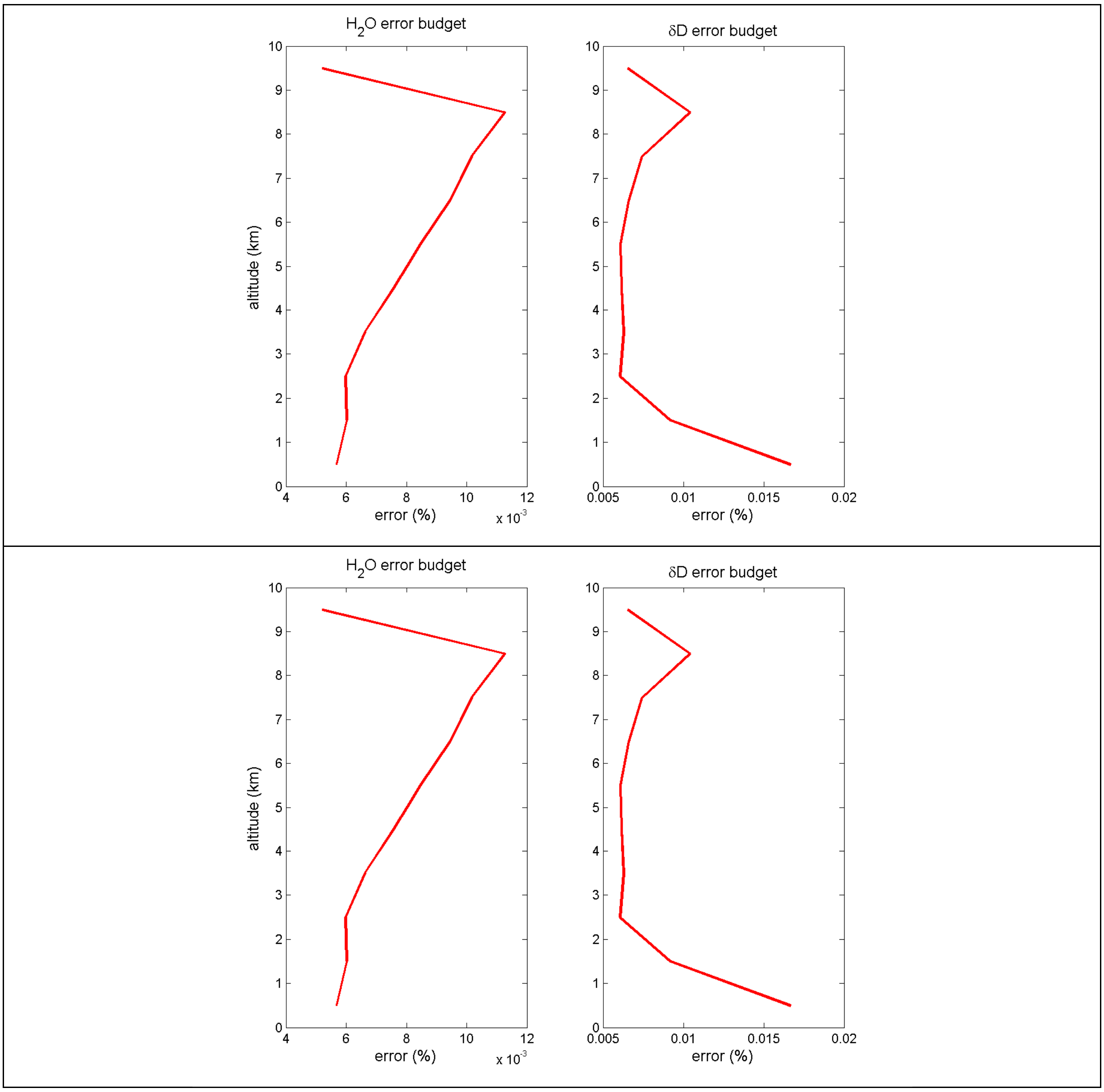


Fig. Error from the surface temperature with |ΔT| < 4 K (top) and with |ΔT| > 8 K (bottom).

This error was also calculated based on the Schneider et al. (AMT 2012) procedure, as below: $\mathbf{S''_{surfT} = C\ P\ A\ S_{surfT}\ A^T\ P^T\ C^T}$

Section 4.2: Additional discussion on the error characteristics are necessary here for the IASI and LMD comparisons. The best case uncertainty for the IASI mean values results from assuming a Gaussian error distribution, in which case the error on the mean is the (sqrt) of the sum of the error covariances divided by the number of samples. You should calculate this uncertainty for comparisons with the IASI data as this residual error could explain why the observed and modeled variations are different, for example, perhaps the data and model are consistent within the error.

The worst case uncertainty for the IASI mean values are that the temperature errors are all correlated.

The likely scenario is that the errors are some combination of bias and random as the temperature error has both a bias and random component. For example, the temperature errors could be biased in the same direction on one day but randomly vary from day-to-day (Kuai et al., AMT, 2012). Bounds on the errors from these scenarios should be estimated in order to provide some attribution to the observed random and bias differences between LMD and the IASI data.

Firstly, we would like to mention that we found a small error in our gain matrix and thus in our measurement noise and temperature errors calculation. Thus we updated the fig 7 in the paper and the text in the paper (page 11068 lines 18-21) but these changes (on the values) were negligible.

As recommended, the error on the mean was calculated for both distributions (δD & H2O) and for both altitude ranges, [0-3km] and [1-5km]. We calculated this error as:

$$\sqrt{(Err\ T^2 + \ Err\ Meas.^2\ )\ /\ N}$$

We did not take account the smoothing error in our calculation as we compared the IASI retrieval with the smoothed LMDZ-iso values (convolved with the IASI AKs).

The errors on the mean are presented below:

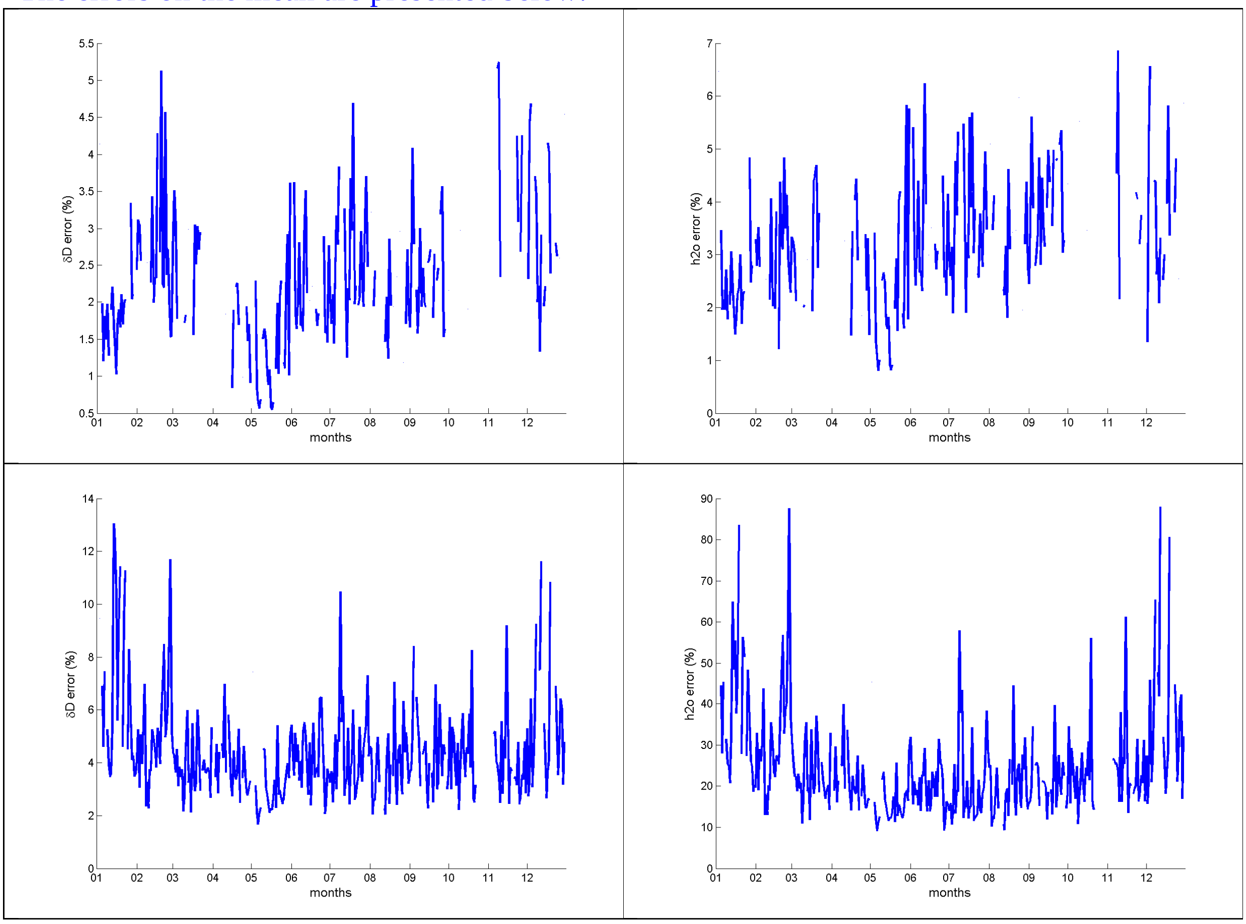
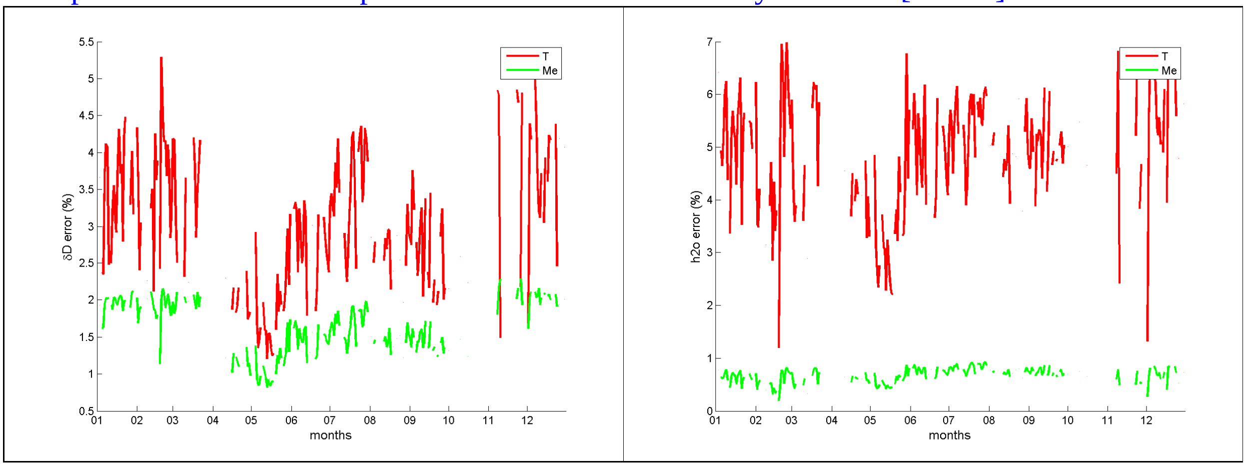


Fig. Daily error on the daily mean for δD (left) and H_2O (right) for the [0-3km] altitude range (top) and the [1-5km] altitude range (bottom).

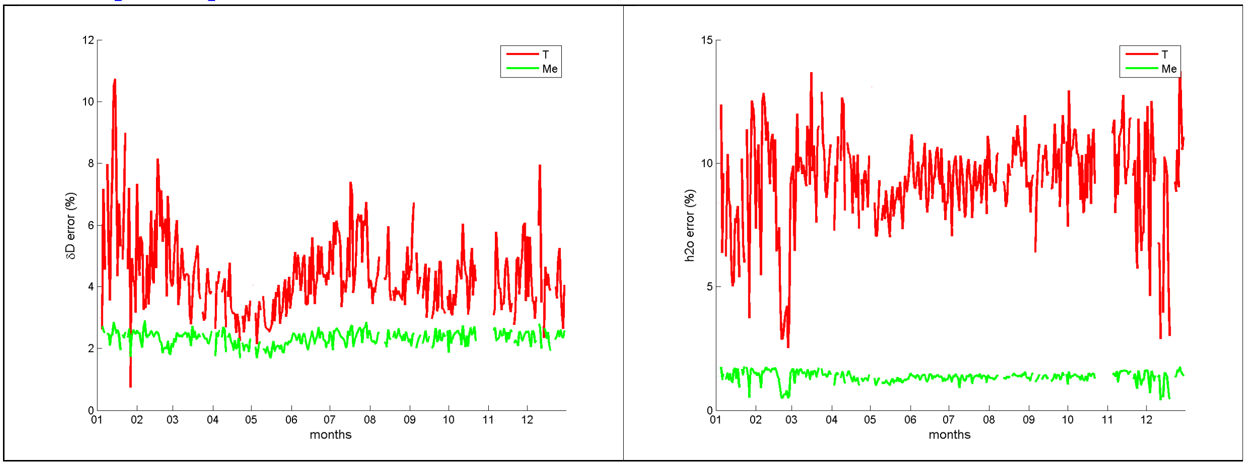
For both retrievals (δD and H_2O), it is tricky to distinguish a seasonal variation.

We present below the components of the error on the daily mean for [0-3km]:



Daily air temperature (red) and measurement noise (green) error for δD (left) and H2O (right).

And at [1-5km]:



Daily air temperature (blue) and measurement noise (green) error for δD (left) and H2O (right).

We summarize hereafter the mean |RD| with LMDZiso and the annual mean error.

	|RD| %	Error %
δD (0-3)	3.9	2.3
δD (1-5)	5.3	3.0
H_2O (0-3)	16.8	3.3
H_2O (1-5)	22.5	5.7

The difference between the retrieval and the smoothed LMDZiso values are higher than the error. This shows that this difference is not due to the error on the mean and it is representative to a difference of representation of the daily variation on the water cycle.

Larger amplitude on the variations is distinguishable on the air temperature errors (compared to the measurement noise) but these air temperature errors are theoretical.
Thus, based on our forward simulation approach, we compared the error due to uncertainties in the temperature profile comparing both retrievals (original and T perturbed) for the four tested months. The differences on δD are summarized below:

	Feb	May	Aug	Dec
Diff δD ‰ (0-3)	17	26	19	11
Diff δD ‰ (1-5)	51	38	26	58

This shows that the uncertainties on T profile have a larger impact in May and in Aug on the retrieval between 0 and 3 km; and in Feb and in Dec between 1 and 5 km.

In conclusion, we added a new Table 1 and a new section 4.2.3 as below:
"4.2.3 Error on the mean
The error on the mean was also calculated for H_2O and δD at both altitude ranges. This error is defined as the square root of the sum of squared error covariances (temperature and measurement noise) divided by the number of samples. The values are summarized in Tab. 1 and are lower than the mean annual RDs. This shows that the RDs are representative of a real difference between the values from IASI and from LMDZ-iso."

Tab. 1 Annual mean for the error on the mean for δD and H_2O and both altitude ranges (0-3km and 1-5km). The error is calculated as: $\sqrt{(Err\ T^2 + Err\ Meas\ noise^2)\ /\ N}$.

	δD (0-3km)	δD (1-5km)	H_2O (0-3km)	H_2O (1-5km)
Error on the mean (%)	2.3	3.0	3.3	5.7

4) Page 11069 Line 5: There are several general statements comparing LMD to "other GCMS'. These statements need references or alternatively the comparisons to other GCMS need to be removed.

The references are now added (hereafter in bold). The sentences are:
"There is no fractionation during the evapotranspiration over land, as done in most other GCMs due to the simplicity of the land surface parameterization **(e.g. Hoffmann et al., 1998; Lee et al., 2007)**. The representation of the reevaporation and diffusive exchanges as the rain falls is significantly different compared to other GCMs **(e.g. Hoffmann et al., 1998)**."

Hoffmann, G., Werner, M., and Heimann, M.: Water isotope module of the ECHAM atmospheric general circulation model: A study on timescales from days to several years, J. Geophys. Res., 103(D14), 16871–16896, doi:10.1029/98JD00423, 1998.

Lee, J.-E., Fung, I., DePaolo, D., and Fennig C. C. : Analysis of the global distribution of water isotopes using the NCAR atmospheric general circulation model, J. Geophys. Res., 112, D16306, doi:10.1029/2006JD007657, 2007.

5) Page 11073: Can you elaborate on the WSIBISO project so that the reader can understand how the measurements are related to the WSIBISO science objectives?

We added these sentences (in bold) in the introduction:

"…the new dataset from IASI retrievals allows us to evaluate the performance of isotopic General Circulation Models (GCMs) over Siberia. **This project aims to better document the water and the carbon cycle over peatlands and permafrost regions of Western Siberia and their projected changes under a warming climate, focusing on isotopic studies. WSIBISO is based on a combining approach with observations (using both surface measurements and satellite data), as well land surface and permafrost models as atmospheric models.** Here we use the isotopic version of the LMDZ model, LMDZ-iso (Risi et al., 2010)."

6) The word "his" needs to be replaced on page 11071 line 10 and 11073 Line 9

It was replaced by "its".