Thank you for your comments suggesting revisions to our manuscript. We made changes to the text as suggested by you.

The reviewers' suggestions are in italic.
All of the revisions, which were made by following the suggestions from reviewers, are in blue.

Reviewer #2's suggestions:

This paper presents a retrieval method able to derive ozone profiles using both TES and OMI data. The particularity of this article is to combine the TIR radiances and the UV radiances from TES and OMI, respectively. The authors also present a validation of this method by using coincident ozone sonde profiles for the period 2005-2008. The authors shows some improvements when using together OMI and TES data instead of TES or OMI data alone. I recommend the publication of this paper in ACP, even it will better fit in AMT, after the following recommendations:
1: The authors should present yearly ozone maps (or/and maps of DOFs) at global scale or regional scale for the three retrievals (together TES and OMI, TES only and OMI only) between surface and 700 hPa and for the free troposphere (even if the averaging kernels are different). This should qualitatively highlight the differences of each retrieval, in particular the differences from the joint OMI-TES retrievals between surface and 700 hPa.
Re: The data shown represent results from the TES/OMI prototype code that is now being implemented into a production code that will generate ozone estimates from all available OMI/TES radiance matchups. However, the ozone profile estimates using the prototype code is computationally expensive and therefore we cannot feasibly generate global data sets. We did however generate ozone profile estimates for August 2006 using the prototype code and this allows us to evaluate the sensitivity of the TES/OMI retrievals for a much larger data set. However, we prefer to show the results in a later manuscript.

2: Considering the weak number of ozone sondes used (which is only 22) during a period of about 3 years, the authors should be more cautious in their conclusions. A clear statement about the statistics should be added in the text.
Re: It is similar to the previous suggestion. We have added the following statement in the conclusion Page 27613 line 10: "Additional comparisons between OMI/TES profile estimates and ozone-sondes are desirable to gain more confidence in these statistics."

3: OMI and TES do not have the same ground pixel size at nadir and then do not represent the same scene. When combining the two types of data, how the authors take that into account? Some clarifications are necessary in the text.

Re: We added some discussions in section 4.3 to include the suggested topics.
The P27612 lines 3 to 13 were revised:
"Our joint retrieval algorithm utilizes spatiotemporally coincident measured spectral radiances to retrieve the vertical distribution of ozone concentration. The spectral radiances from 312 to 330 nm were coadded using measurements over two OMI UV-2 ground pixels prior to the spectral fitting yielding a group pixel size of 13 × 48 km^2 (along ground track × cross ground track of spacecraft) at Nadir. The co-addition approach, which has been used by Liu et al. (2010a) in OMI retrievals, helps in reducing

forward model computation time compared to simultaneously fitting UV-2 spectra that represent these ground pixels. It also ensures both OMI UV1 and UV2 measurements probing common air volume, despite of introducing minor spectral wavelength registration artifacts. A TES measurement at Nadir yields a ground pixel size of 8.5 × 5.3 km^2 (along ground track × cross ground track of spacecraft). We expect that the differences on the size of ground pixels between TES and OMI measurements do not significantly affect the retrieved ozone VMR since the measurements of using TIR spectral region show most sensitivities over/above free troposphere where the spatial gradient of ozone concentration are weak."

4: Sometimes the authors use the term boundary layer. This term is not appropriate because the boundary layer depth depends on many parameters. The authors should use throughout the text the "layer surface-700 hPa" which does not necessarily represent the ABL

Re: The term of boundary layer was used in both the citation of previous studies and the discussions of this work. We do not change those used in the citation of previous studies. The term of boundary layer in the discussions of this work were replaced by *"layer surface-700 hPa"* in the following places:
Page 27605 lines 11-12: "The combined TES and OMI measurement also shows an increased sensitivity to the layer surface-700 hPa."
Page 27609 lines 21-23: "We calculated the DOFS between the surface and 700 hPa (Figure 7, bottom panel) to estimate the sensitivity of the ozone estimate to ozone near surface."

Minor comments

1: Section 2.2 there is a difference between the period used. In this section it is 2004-2008, but the analysis starts in 2005 (see table 2). Please clarify or make consistent.
Re: The following sentence replaced the quoted sentence in P27595 lines 26 to 27: "For this reason, the TES and OMI joint retrievals shown in our study are for measurements from 2005 to 2008."

2: Table 2, profile 8: Please correct the latitude, this is North not South.
Re: Corrected the latitude from 37.91°S to 37.91°N.

3: Section 4.1 This is still not clear to me why in the altitude range of 300-100 hPa the joint TESOMI retrievals show larger errors. Why two major systematic errors affect TES and OMI in this altitude range and not in the same way in lower layers? In addition the averaging kernels of joint TES-OMI seem to show more sensitivity than the others for OMI and TES alone at this altitude range. Please clarify this point.

Re: Page 27607 line 18 to Page 27608 line 7 provides the explanation on this topic. The altitude dependency of measurement errors likely arise from the inconsistency of spectroscopic parameters between UV and TIR spectral regions since the absorption cross sections show temperature dependency. We expected the improved spectroscopic parameters will reduce the error of retrieved ozone profiles.

4: Section 4.1 (p 27608). The ozone retrievals for joint TES-OMI is from a classical optimal estimation method whereas the TES only retrievals use Tikhonov constraints.

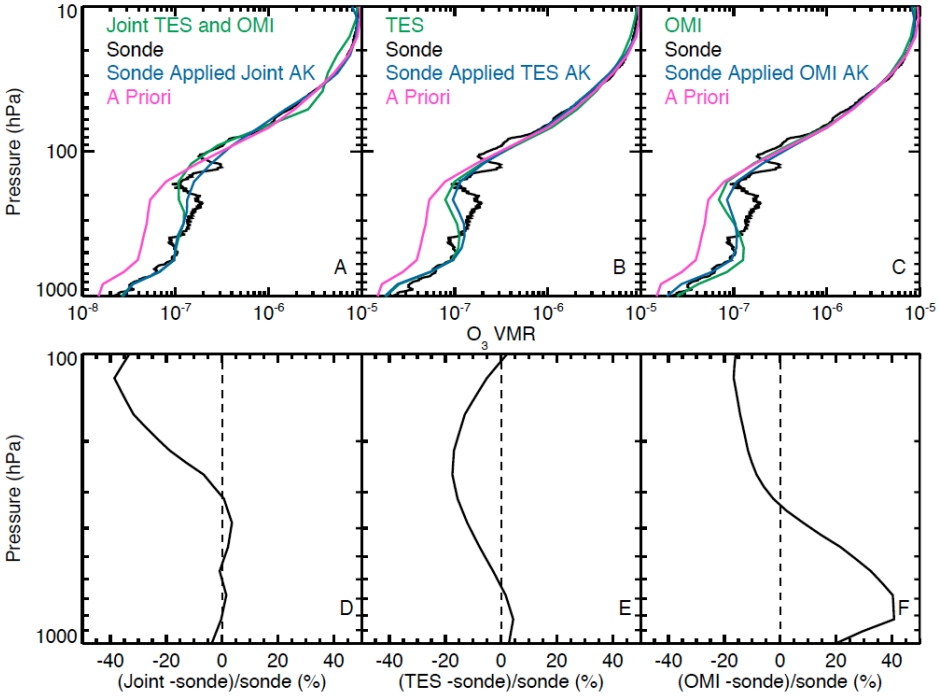
What is the impact of such methods in the lowermost layers? Please clarify this point in the text.

Re: We apologize for this confusion. In fact we do not use the classic Tikhonov constraint for TES retrievals. For TES only retrievals, we used the altitude-dependent constraint developed by Kulawik et al. (2006c). It is composed of combinations of the zeroth-, first-, and second-order Tikhonov constraints with altitude–dependent weights. The altitude-dependent Tikhonov constraints do not allow the ozone concentration near surface to vary much since previous TES retrievals with a relaxed constraint show un-physical oscillation near the surface. Because combining TIR and UV spectral regions enhances the sensitivity near surface, the constraints of surface ozone concentration can be relaxed. A discussion was given in the original manuscript in page 27602 line 18 to page 27603 line 15 for the impacts of such methods in the lowermost layers.

In addition, we added the following sentence in Page 27602 line 21:
"The altitude-dependent Tikhonov constraint, which is different from the classic Tikhonov constraints, is composed of combinations of the zeroth-, first-, and second-order Tikhonov constraints with altitude–dependent weights. (Kulawik et al., 2006c)."

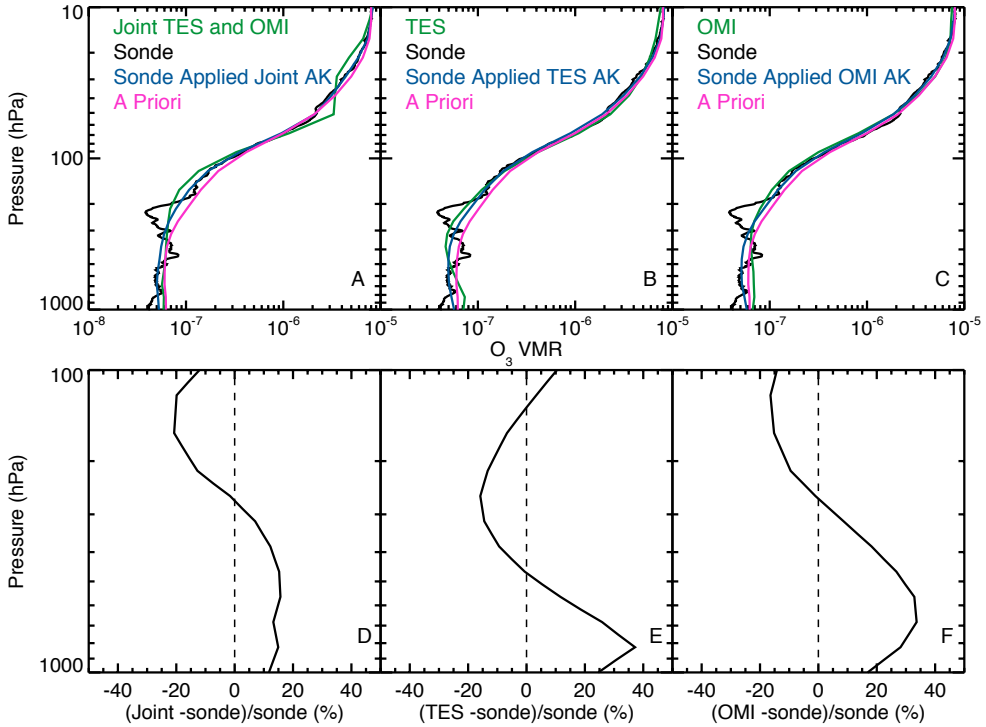
5: Fig 3 and Fig 4; In the caption there is "ozone measurements (black line)" and "ozonesonde profile (black curve)". I do not see the difference. Also please add the units of ozone in the caption. In the version I have, the figures are very small, please enlarge them. In addition, there is no legend for the relative difference. Please add it in the caption.

Re: We deleted the "ozonesonde profile (black curve)". Figures 3 and 4 were remade in order to enlarge the size and the captions were revised.



"**Figure 3**. Ozone volume mixing ratios measured by the instruments on Aura satellite and ozonesonde over Naha, Okinawa, Japan on August 1st, 2007. It is the same scenario as the one shown in Figure 1. (A) Joint TES and OMI vs. Ozonesonde; (B) TES only vs.

Ozonesonde; (C) OMI only vs. Ozonesonde; (D) Percentage differences between joint retrieval and co-located sonde measurements; (E) Percentage differences between TES retrieval and co-located sonde measurements (F) Percentage differences between OMI retrieval and co-located sonde measurements. In Panels A, B and C, retrieved profiles in green; ozonesonde measurements are in black; ozonesonde profiles smoothed by averaging kernels of TES or OMI in blue; A priori in magenta."



"**Figure 4**. Ozone volume mixing ratios measured by the instruments on Aura satellite and ozonesonde over Wallops Island, Virginia, USA on October 2nd, 2007. It is the same scenario as the one shown in Figure 2. (A) Joint TES and OMI vs. Ozonesonde; (B) TES only vs. Ozonesonde; (C) OMI only vs. Ozonesonde; (D) Percentage differences between joint retrieval and co-located sonde measurements; (E) Percentage differences between TES retrieval and co-located sonde measurements (F) Percentage differences between OMI retrieval and co-located sonde measurements. In Panels A, B and C, retrieved profiles in green; ozonesonde measurements are in black; ozonesonde profiles smoothed by averaging kernels of TES or OMI in blue; A priori in magenta."

6: p27609, l 12 please correct the sentence.
Re: Changed to: "We found that the DOFS in the lower troposphere increases but the error in the retrieval increases as well."

7: section 4.2 p 27610, l 7. This is not clear that OMI averaging kernels peak a little below the ones of TES (we just have two figures of averaging kernels for this comparison). Is there a way to show better this effect by averaging the AK for example and show a zoom of this region in a additional figure.

Re: A "zoom-in" view of averaging kernels was added in the lower panel of Figures 1 and 2 to show the offset of averaging kernels between TES measurements and OMI measurements.

8: Fig 5 and Fig 6 shows two types of comparisons. Fig 5 shows data with the use of an altitude dependent Tikhonov constraint matrix for TES only whereas Fig 6 shows the same constraints for TES only and joint TES-OMI. But the best fit is for TES only in fig 5 from the surface to 100 hPa (and also between 700 to 100 hPa in Fig 6). Why using the joint TES-OMI retrievals when there is a possible existing TES product, which is better in this case? Please clarify this point in the text.

Re: Comparisons between Figures 5 and 6 show the measurement uncertainties arise from the measurement noise and interferences but not the capability of capturing the ozone variability. Figure 6 shows using the relaxed constraints increased the error of TES estimates for the near surface layer as expected. However, the joint TES and OMI retrievals show much less measurement errors than the TES only retrievals using the same constraint. Consequently, there is net information gain for the near surface ozone estimates using the joint retrievals. We did the same comparisons for Figure 8 but we saw negligible changes in the correlations between TES only and ozonesonde measurements. Hence, we did not show the comparison in the manuscript.

9: Fig 8: Why the averaging kernels are not applied? This is not consistent with fig 5 and 6. Please add a comment in the text. Please could you provide the same comparison using the different averaging kernels (joint TES-OMI, TES and OMI) in your answer. Please add also the units of ozone in the caption.

Re: We applied two approaches to evaluate the retrieved profiles using ozone sonde measurements.
Approach # 1 applied the averaging kernels (joint TES and OMI, TES only, and OMI only) to the ozonesonde profiles. This approach accounts for the vertical resolution and *a priori* constraint of the TES estimate in the comparison. The differences between retrieved profiles and the smoothed ozonesonde profiles therefore represent the observation errors shown in equation 11 (or Equation 3 in updated manuscript), The results of approach # 1 are shown in Figures 5 and 6.
Approach # 2 used a common priori profile for the retrievals and compared the retrieved profiles to the ozonesonde profiles without smoothing by the averaging kernels. Our goal here is not to evaluate the retrieval errors but to examine how well the different approaches capture the ozone variability. The results of approach # 2 are shown in Figures 8 and 9.

The following sentences replaced the caption of Figure 8:
"**Figure 8**. Correlations of Aura measured and ozonesonde measured ozone concentration (parts-per-billion) in the region from surface to 700 hPa: joint TES and OMI (left panel); TES only (middle panel); OMI only (right panel). The joint observations have improved the capability of capturing the variations of ozone concentration in the region from surface to 700 hPa, compared to TES or OMI observations alone. A common a priori ozone profile (horizontal dash line) was used in the retrievals for all of the scenes. The black dotted dash line indicates one to one correlation. The averaging kernels of the Aura measurements were not applied to the ozonesonde measurements."

10: Fig 9: same remark than fig 8. and please correct 700hPa to 200 hPa into 700 hPa to 100 hPa.

Re: The following sentences replaced the caption of Figure 9: "**Figure 9**. Correlations of Aura measured and ozonesonde measured ozone concentration (parts-per-billion) in the region from 700 hPa to 100 hPa: Joint OMI and TES (black plus); TES (green diamond); OMI (purple triangle). The discrepancy between joint observations and sonde measurements is larger (Mean: 1.24%; RMS: 0.75%) than that between TES only measurements and sonde measurements. Both Joint observations and TES only measurements show better agreement to sonde measurements than OMI only measurements. A common a priori ozone profile was used in the retrievals for all of the scenes. The averaging kernels of Aura measurements were not applied to the ozonesonde measurements."

In addition, we made numerous corrections on typo and grammar in the manuscript, which are also highlighted in blue.