The authors would like to thank the two anonymous reviewers for their helpful comments. Both reviewers raised concerns regarding the use of correlated variables in the multiple regression. We agree that this should be discussed in the manuscript and have included a brief discussion and a table below; these will be added to the revised manuscript for publication.

> Ref #1: I have one major comment however. The paper hinges on a multiple regression between a TES ozone product with two other fields - upper tropospheric humidity from GOES and potential vorticity from GFS. On p. 30066 l. 11 these are described as 'independent variables' - but whereas they are certainly derived from different sources these two datasets are themselves highly correlated and so are not statistically independent. At no point in the paper is this point discussed.

Some of these issues were addressed in the thesis of Mr. Felker, but were edited out of the final paper. While the GOES Layer Average Specific Humidity (GLASH) brightness values and the Global Forecast System potential vorticity (PV) are inversely correlated (r=-0.707 in the training dataset), we believe they each add content which is unique in explaining the variability in ozone. The variables were considered separately to evaluate their capacity to explain variability in TES observed ozone. The authors recognize that while PV has traditionally been used as an effective tracer, when operating over data sparse regions like the North Pacific, the model may have errors of magnitude or displacement of features. Furthermore, it was the original goal of this project to try to define an empirical and independent method for extrapolating the information that TES provides to a larger domain, based on a correlation of remotely sensed information from two satellite platforms. However, it was found that individually GLASH could only explain 60% of the variance in TES, with a standard error of 22ppb. So a purely satellite-based product was not that effective. In fact, the residuals of this regression indicate that the largest errors in estimating TES ozone occur for high ozone values. Similarly, variability in PV alone could explain 63% of the variance in TES ozone, with a standard error of 21ppb. The use of both variables together in a multiple regression was able to increase the explained variance and reduce the residual error. In regions favored for tropopause folding, we know that ozone is enhanced and specific humidity is low, but the ability to resolve differences in ozone at the high ozone end of the distribution is compromised. It is our understanding that while the GOES water vapor imagery is very useful at delineating the location of the tropopause break, and the step change in ozone across this boundary, the inclusion of PV enhances the ability to resolve variations in TES retrieved ozone on the poleward side of the tropopause break or the polar front, when the upper tropospheric humidity is very low and loses power; thus these two parameters clearly provide some complementary or independent information. We regret we did not include this information previously. A short discussion of these additional results will be included without showing all of the figures from the thesis.

> Ref # 2: In equations 2-4 a simple regression model is invoked involving three derived constants (a, b, c). It would be important to include values (in main text or maybe in a table) for the computed one-sigma or two-sigma statistical uncertainties for these derived constant coefficients which one can get from the three diagonal elements of the derived covariance matrix. The off-diagonal elements of the covariance matrix would also provide information of covariance/correlation between H_2O and PV which may be substantial especially in NH spring within the analyzed region. Equations 3 and 4 list the coefficients to four or five significant digits, but their actual uncertainties could possibly be as large in magnitude as the derived coefficient numbers themselves.

The table below further addresses the concerns of collinearity, which has the potential to cause instability in the regression coefficients, as noted by reviewer #2. We have added the statistical uncertainties in the regression coefficients; these are all on the order of 3% error, so the results do not seem unstable. We will limit the significant figures reported. The collinearity tests further indicate that the variables are not so strongly correlated as to be redundant in the regression. The tolerance ($1-r^2$) is a common measure and should not be a problem unless the value is small (some statistics books suggest 0.1 or less); in this case it is 0.5. Furthermore, the variance inflation factor, which is the inverse of tolerance, will clearly indicate collinearity for values greater than 10, and could be a problem for values between 2.5 and 10, which implies correlations between 0.78 and 0.95. As noted previously, the correlation between GLASH and PV was -0.707 (the covariance between them is -8.8).

Multiple Regression of GLASH and PV against TES Ozone					
				Collinearity	
Model Parameters	Coefficient	Standard Error of Estimate	Significance	Tolerance	Variance Inflation
Constant	281.40	7.99	.00		
a *GLASH	-1.21	.04	.00	0.5	2.0
B *PV	17.05	.54	.00	0.5	2.0
R^2	0.72	18.47	.00		

> Ref #2: The conclusions section 6 mentions a future plan to evaluate the method over a longer record than the one month of INTEX-B in this study. As the authors point out, STE effects are greatest in the NH in spring months and the constant coefficients could be very different over the analyzed GOES West region during other times of the year. It is possible that for the one month of measurements in this study that the regression coefficients would have a significant spatial

variability over the analyzed region. Have the authors tried partitioning the analyzed region, perhaps into two or three sub-regional latitude bands to improve the regression results?

We did not stratify the events by latitude, but by PV, which adds dynamic variation as well as some implicit latitude dependence. While the correlation coefficient of -0.707 between GOES GLASH and PV does indicate significant anticorrelation, in the events with PV greater than 1.5 pvu, which accounted for 25% of the data points, the mean O_3 was 128, and PV and GLASH were less strongly anticorrelated (r=-0.234).

The results of the regression analysis of PV and GLASH versus TES ozone was used to generate all of the figures in the paper. We will drop the two parameter regression analysis of the ¼ of the data used for testing the model from the text (equation 4), as it was never used, and was provided only for completeness. Instead we will include the equation that compares the predicted ozone (equation 3) to the observed TES ozone (this is the MUTOP versus TES), as this represents the performance of the regression applied to the data that were held back for testing. We regret that in reassessing statistics, we have just discovered there were a few points in the testing set that were not unique from the training set. This problem has been remedied, and the testing data set error analysis included is now correct. We will need to update the paper with the new error statistics. However, nothing else will change, as the training regression was used to generate all images for the paper. The updated statistics for the testing or evaluation data are as follows: R = 0.73, MAE = 13.6 ppbv, RMSE = 18.1 ppbv, and these will be presented as a new Table (an improvement over the results reported in the paper in the second part of Table 1). This will make also slight change to the residuals reported in figure 5, which is a plot of the testing or evaluation data, this figure has been updated (although the differences are nearly indiscernable. While it is true that the overall magnitude of the regression error (RSME of 18ppb) is not small, it is in line with previous estimates of tropospheric residual ozone for extratropical spring locations (eg. Schoeberl, et al., 2007).

Regression of MUTOP (predicted) against TES Ozone (observed)			
Model Parameters	Coefficient	Standard Error of Estimate	Significance
Constant	-1.13	1.97	.567
a *MUTOP	1.016	.02	.00
R^2	0.73	18.14	.00

Ref #2: Does the Moody et al. paper (manuscript in preparation) on ozonesonde validation of this MUTOP product cover several years and with global extent? If so, does basic seasonal variability tend to agree between the MUTOP product and ozonesondes? It is difficult to properly evaluate a new data product with just one month of measurements over one sector of the globe – ideally the evaluation should cover many years with global extent to investigate basic features such as seasonal variability. There is also something somewhat circular in the validation of the MUTOP product in the current paper - a regression model is used which combines H2O and PV with TES ozone and then compares with TES ozone.

It is our understanding that it is common practice to make a radom selection of a dataset and use one part of the data for training (developing a regression) and the reserved data for evaluating the regression. The companion paper to this manuscript provides an independent validation of the MUTOP derived product imagery, based on a comparison to ozonesonde data collected during the INTEX/B field campaign. While it is a limited dataset, the results suggest that the MUTOP product extrapolation of TES reproduces ozonesonde estimates of upper tropospheric ozone with a mean absolute error of 12ppb and an RSME of 16ppb. The authors agree that while it would be very valuable to produce a larger dataset; the funding for this project was quite modest, and has expired. The availability or production of GOES specific humidity is not routine, and is not currently supported. It is the hope of the authors that the publication of this limited dataset may spur interest within the community on this approach, combining information from more than one satellite system, and in particular, demonstrating the application of GOES derived specific humidity as a method for using near real-time remotely sensed information to help characterize the dynamic behavior of ozone in the upper-troposphere.

Finally, upon reading the paper after some time away from it, we also agree with Referee #1 that some sections can be tightened up with critical editing. We will correct the misspelled names of references (we thank Ref#2 for catching this) and will attempt to enhance the scales on the multi-figure panels, though this is something of a challenge to keep the number of panels presented without reducing the size or spatial extent of the images further by expanding the font for axes. Finally, we will revise the discussion of potential vorticity, and address the other minor points raised by Ref#1.

Again, we greatly appreciate the helpful comments of the reviewers and look forward to the opportunity to complete the publication of this manuscript.