Dear Editor,
Please find our responses to referee #1 embedded below in *blue italics.*

Anonymous Referee #1
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The study by Worden presents a comprehensive study of trends in CO concentrations observed in the last decade by multiple satellite instruments. At the same time the study presents useful information about the consistency and the validity of the 4 different sensors, which is crucial in order to start obtaining robust and coherent multidecadal datasets on CO. I think the paper would gain strength if the authors also inform us on the (quantitative) mean biases of the various CO products relative to one another. Such information is important to those intending to use the CO data for model evaluation or inverse modelling.

Thank you for reviewing our manuscript. Our confidence in these results relies heavily on previous intercomparison and validation studies. In particular, the intercomparison by George et al., 2009, provides details on the quantitative relative biases of the 4 instruments after accounting for different sampling, in 3 different months. For this study, accounting for sampling differences would add significant complexity to the analysis since we used gridded, monthly mean data in some cases. To address some of the reviewer's concern, we have included another reference (Ho, et al., 2009) with a reported TES-MOPITT total column bias in Sec. 2.3:

CO profiles and total column amounts have been validated with respect to in situ measurements (Luo et al., 2007a) and compared to MOPITT V3 data (Luo et al., 2007b) and to MOPITT data processed with the TES a priori profiles and covariances (Ho et al., 2009). When a priori profiles and covariances are the same for both TES and MOPITT retrievals, column differences are less than 6.5% globally, with MOPITT higher than TES.

We have also included more information as to the source of the AIRS bias in the southern hemisphere by adding the following sentence to section 3.2:

In particular, the high bias in SH AIRS V5 data is most likely due to the use of a single global first guess profile (Warner et al., 2010). The use of a single global a priori profile was the source of the high bias in SH MOPITT V3 data, which was removed in MOPITT V4 and V5 by the use of the MOZART climatology for a priori profiles (Deeter et al., 2010).

The observational evidence put forward by the authors is convincing, and clearly points in the direction of reducing CO throughout the world, with strongest reductions over the polluted areas of the world. It is striking that the satellite instruments witness a 'clean-up' in CO over China. As acknowledged by the authors, the reasons for the trends are not fully explained, which is somewhat of a missed opportunity, but fewer fires, environmental measures, and less incomplete combustion all point in the right direction. To complete that list, I think the authors should also point out that the steeper decreases in CO in 2008-2009 coincide with the economic recession (Fig. 6, Fig. 8 for China, U.S., and Europe), as suggested by Castellanos and Boersma [2012] for NO2 over Europe, and by Russell et al., 2012 over the US. Overall, the Worden-study is very interesting and it should be published in ACP. Besides the above two points I only have a few minor issues left.

We agree that the discussion of trends should include the global financial crisis. We now include the suggested references along with 2 others in the following new text:

There may also be some correlation of lower CO column to lower emissions due to the global financial crisis starting in late 2008. The observed minimum in CO in early 2009 overlaps with the recorded dip in manufacturing (Alcorta and Nixson, 2011) along with related transportation and shipping decreases (de Ruyter de Wildt et al., 2012). Declines due to the economic crisis are clearly observed for NO_2 in Europe (Castellanos and Boersma, 2012) and the U.S. (Russell et al., 2012), however, given the longer lifetime of CO, this would require further study (inverse modeling) for attribution.

Since our first submission, we have also identified another important reference for trends in surface CO in Beijing. We have added the following text and reference:

Li and Liu (2011) report a decreasing trend in surface CO in Beijing for 2000 to 2009 from in-situ measurements collected from 8 urban sites using commercial gas filter correlation analyzers. Using the values shown in Fig. 6 of Li and Liu, (2011), this trend appears to be similar to the U.S. EPA surface CO trends, ~ -6%/yr. Li and Liu (2011) also examined MOPITT V4 CO data over Beijing, which did not show a decreasing trend. As described in section 2.1 and shown in Fig. 1, the uncorrected instrument drift in MOPITT V4 data resulted in an increasing CO column trend that is large enough to obscure the decreasing trends we observe in this study.

Minor issues:
P25711, line 12: the text says ‘September, 2004’ but the Figure itself mentions ‘March 2005’. Please correct. *Figure was correct – fixed in text.*

P25713, line 3-4: please comment why routine sampling of the SH was limited to northward of 30 deg S for TES in 2010.
Reducing sampling in the SH was the decision of the TES science team in order to conserve instrument lifetime, (i.e., interferometer travel distance). This was instigated by increased interferometer currents in the diagnostics telemetry and the analysis of lifetime tests performed on the interferometer engineering model. Observational priority was given to continental and outflow regions. The text now states this reason.

P25714, line 9: I have some reservations about using the 12-month running average. Of course, using a 12-month smoothing filter removes much of the seasonal variation, but the implicit assumption is that every successive annual cycle lasts 12 months, whereas for some regions or periods, an annual cycle may actually take 11 or 14 months. Smoothing over a longer window will improve the chances of cutting off the higher frequencies that may still seep through with the current approach. This might be especially relevant for CO with a relatively long lifetime in winter.

This is a good point and we will consider this in our more detailed analysis of trends and trend errors in progress for MOPITT. For this study, our focus was to perform a simple calculation in the same way for all the instruments to find out if we were seeing consistent temporal behavior.

New References:

Castellanos, P., and K. F. Boersma, Reductions in nitrogen oxides over Europe driven by environmental policy and economic recession, Sci. Rep., 2, 265; DOI:10.1038/srep00265 (2012).

Russell et al., Trends in OMI NO2 observations over the US: effects of emission control technology and the economic recession, Atmos. Chem. Phys. Discuss., 12, 15419- 15452, 2012.

Alcorta, L. and F. Nixson: The Global Financial Crisis and the Developing World: Impact on and Implications for the Manufacturing Sector, United Nations Industrial Development Organization (UNIDO) Working Paper 06/2010, *www.unido.org,* Vienna, 2011.

de Ruyter de Wildt, M., H. Eskes, and K. F. Boersma: The global economic cycle and satellite-derived NO_2 trends over shipping lanes, *Geophys. Res. Lett.*, 39, L01802, doi:10.1029/2011GL049541, 2012.

Ho, S.-P., D. P. Edwards, J. C. Gille, M. Luo, G. B. Osterman, S. S. Kulawik, and H. Worden: A global comparison of carbon monoxide profiles and column amounts from Tropospheric Emission Spectrometer (TES) and Measurements of Pollution in the Troposphere (MOPITT), J. Geophys. Res., 114, D21307,doi:10.1029/2009JD012242. 2009.

Li, L. and Y. Liu: Space-borne and ground observations of the characteristics of CO pollution in Beijing, 2000-2010, Atmos. Env. 45, 2367, 2011.