The paper by Li et al. analyzes the multi-decadal 1/Vis changes over the US, Europe and Eastern Asia and their correlations with SO2 emissions. Building on previous works, the paper makes important efforts to ensure data consistency over the long term, which leads to important findings on the 1/vis trends that are largely consistent with historical SO2 emissions. The paper is well written and could be published with minor revisions.

RESPONSE: Thanks very much for the positive review of the manuscript. The comments and suggestions below improve the quality of the manuscript. We have taken them into full consideration during the revision. Reponses to these comments are provided below. All the page and line numbers refer to the revised manuscript.

It would be interesting to compare the 1/Vis trends with satellite AOD data. For example, is the 1/Vis trend in the recent decade consistent with MODIS AOD trend? The comparison would be interesting especially for regions with fewer ground-based aerosol (optical) measurements.

RESPONSE: Good suggestion. We have added a summary of discussion of AOD trends in Section 5.4 (Page 20, Line 20-31):

"Reliable AOD data over land are limited to the recent two decades, but exhibit even greater consistency with 1/Vis trends. The recent decrease in 1/Vis after late-1990s over the US and Western Europe in this study is consistent with previous studies on AOD trends based on both ground based (e.g. Li et al., 2014; Yoon et al., 2012) and satellite (e.g. Chin et al., 2014; Hsu et al., 2012; Pozzer et al., 2015) observations. Over China, several studies on AOD trends in the 2000s showed notable increasing tendency (e.g. Hsu et al., 2012; Pozzer et al., 2015; Yoon et al., 2012), while some recent studies also discovered that separating AOD time series could reflect the plateauing and reversal of trends in recent years due to emission control strategies (Che et al., 2015; He et al., 2016; Lu et al., 2011). $PM_{2.5}$ trends derived from satellite AOD over 1998-2012 have decreasing tendencies over North America and Europe, and increasing tendencies over Eastern Asia (Boys et al., 2014; Van Donkelaar et al., 2015), similar to the 1/Vis trends found here."

In the abstract, please clarify 'change point detection'.

RESPONSE: We have expressed this term as in the following text "to identify and separate methodological discontinuities such as the introduction of instrumentation".

The nighttime and daytime visibility measurement methods and meanings are very different. Does the monthly 1/vis calculation take into account this difference?

RESPONSE: Thanks very much to point out this issue. We made a sensitivity test by applying the same screening procedure to the daytime and nighttime data based on local time. The change points detected using the combined data were applied since these should be consistent in both daytime and nighttime datasets. Relative trends of 1/Vis over all remained stations and the 8 time periods were calculated and compared to the trends calculated in the paper (from the combined data) as presented in the figure below. It could be observed that after representing the data into a monthly resolution and normalizing the changes in 1/Vis into relative trends, the difference between daytime and nighttime data is negligible. In other words, the daytime and nighttime data show consistent trends in haze level with the combined data.

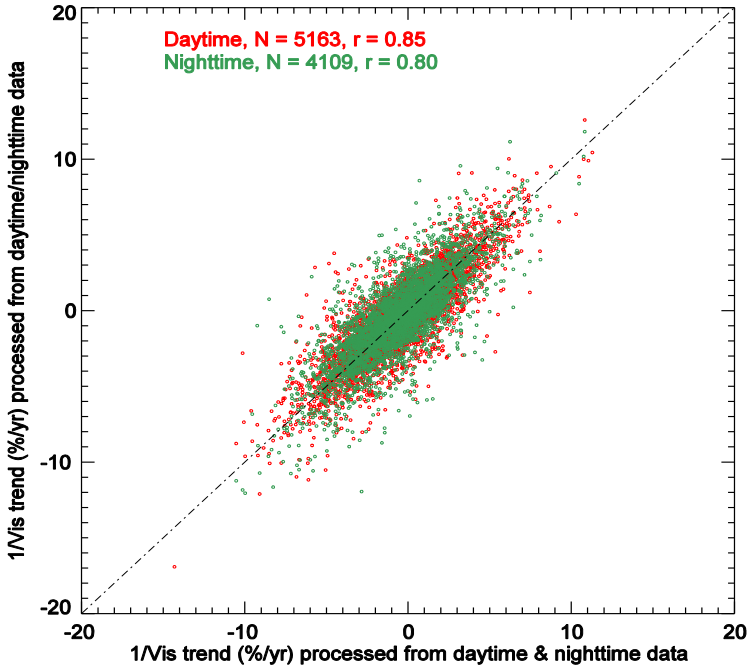

Figure 1. Scatter plot of relative trends calculated for the 8 periods using monthly 1/Vis derived from only daytime or nighttime data V.S. those calculated from monthly 1/Vis derived from both day time and nighttime data.

We added additional discussion in the text (Page 11, Line 21-32) to address this issue:

"The meaning and observing methods of daytime and nighttime data differ. According to WMO (2008), Vis at night, as determined using illuminated objects, also depends on the light source intensity, the adaptation of the observer's eyes to darkness and the observer's illuminance threshold. We compare the relative trends calculated using daytime and nighttime data to the combined trends adopted in this paper, over all remaining sites and the 8 periods. The 5183 daytime trends have a correlation of 0.85 with the combined trends, in which 84% of the differences between significant trends ($p < 0.1$) are within 50%. For the comparison between 4109 nighttime and combined trends, the correlation is 0.80 and 78% of the differences between significant trends are within 50%. Therefore, after representing the data into a monthly resolution and normalizing the changes in 1/Vis into relative trends, the daytime and nighttime data show generally consistent trends in haze level compared to the combined data, and do not meaningfully alter our results and conclusions."

Page 7, Line 20-27: How exactly to determine the changes manually?

RESPONSE: As discussed in the text, we figured the automatically detected change points are too fragmentary, thus decided to visually check the time series superimposed with the candidate change points (as in Figure 1), and only select those points that are obvious structural breaking points in the time series.

We added several sentences (Page 7, Line 22-24) to modify the description: "By visually inspecting each remaining station from Section 3.1.3, we retain only obvious structural discontinuities in the time series of 50th or 75th monthly percentiles from the candidate change points provided by the RHtest results."

Page 8, Line 11-13: Is it possible to test the importance of change point detection for the long-term analysis, since this is a major contribution of the present study?

RESPONSE: Thanks very much for this suggestion. We similarly tested our trend calculation on the data before change point detection and separation. Interestingly, we found negligible differences in the calculated regional time series and trends compared to the results in the paper, thus similar results and conclusions could be drawn without the change point detection and separation. After re-examining the data archive, we discovered that in the remained 3930 stations after all the screening, 856 stations (22%) are actually reported with change points and separated after the last step. This small fraction of stations with change points does not alter the results greatly. Therefore, we suggest that the whole data screening processes, including the threshold filtering, the requirements on the temporal and spatial representativeness, all contribute to the reliability of the results. But the discontinuities are still a major issue if studies were to be conducted on independent sites or small regions, and data after separation are favored. Significant differences are expected due to the structural discontinuities in the original time series.

We added in the text (Page 8, Line 15-21) to address this issue:

"A total of 3,930 stations (5,320 time series) remain after this processing step, in which 856 sites (22%) are diagnosed as containing change points and thus separated. This small fraction of structural discontinuities generally has minor impacts on the large-scale trend features and regional trends in Section 5 according to our sensitivity test using data without separation. But the separated data reduce spatial incoherency in the derived trend maps, and are more reliable for studies over small areas or independent stations, as shown in Fig. 1."

Page 17, last paragraph: the discussion on Chinese pollution transport is relatively subjective. Could you provide more analyses or references on how Chinese pollution transport would change/reverse the pollution trend in Korea, since this has important implications for regional pollution control and collaboration?

RESPONSE: We have added discussion of two articles about air quality trends in Korea (Page 18, Line 25-30):

"Lee et al. (2015) also discovered insignificant improvement of Vis over urban areas of Korea after late 1990s despite the national emission reduction policy launched in early 2000s, which was attribued to the regional transport from upwind continental areas. Long-term aerosol measurement over Gosan Island, Korea showed rapid increase of sulfate and nitrate concentrations from early 2000s to ~2006, which were closely related with the trends of China's emission (Kim et al., 2011)."

We also reemphasize the importance of regional collaboration (Page 19, Line 11-13). Thanks for this good point.

" This analysis highlights the sensitivity of 1/Vis to long range transport, and the value of international collaboration for air quality improvement over Eastern Asia."

Especially in recent decades, the importance of other aerosols or precursors has increased relative to SO2, such as NOx, NH3, SOA, and BC. The paper mainly compares the 1/vis trend with SO2 trend. It will be interesting to discuss if other species have affected the 1/vis trends in recent years. For example, Lin et al. (2010) and Zhao et al. (2009) both showed the offset of SO2 reduction over China by rapidly increasing NOx.

Lin, J.-T. et al. Recent Changes in Particulate Air Pollution over China Observed from Space and the Ground: Effectiveness of Emission Control. Environmental Science & Technology 44, 7771- 7776, (2010).

Zhao, Y. et al. Soil Acidification in China: Is Controlling SO2 Emissions Enough? Environmental Science & Technology 43, 8021-8026, (2009).

RESPONSE: Yes. As discussed in the last paragraph, "SO_2 emission inventories cannot fully explain the trends in ambient haze due to the influence of other emissions and meteorological factors." We extended this discussion by adding the following text in the last paragraph (Page 22, Line 19-26). Thanks for this recommendation.

"Notable reductions in emissions of nitrogen oxides and black carbon have been reported over North America and Western Europe (Bond et al., 2007; Lu et al., 2015; US EPA, 2012; Vestreng et al., 2009), while steady increase in emissions of nitrogen oxides, organic carbon and black carbon were identified over China (Lu et al., 2011; Zhao et al., 2013). Observed (Leibensperger et al., 2012; Murphy et al., 2011) and simulated (Lin et al., 2010; Wang et al., 2013) changes in various aerosol chemical species suggest increasing importance of emissions other than SO_2 on air quality trends in recent years."