Authors Response to Interactive comment by I. Katsev (Referee) on “Development and validation of satellite based estimates of surface visibility” by J. Brunner et al.

The authors would like to thank I. Katsev (Referee) for their valuable comments to this manuscript.

1) General comments

The paper presents a method to estimate the visibility at the ground level using an atmosphere AOD and cloud optical thickness measured by a satellite spectral sensor. The method is developed using MODIS measurements as a proxy for the GOES-R ABI instrument. The method is validated using large volume of data received in the independent ASOS surface visibility measurements. Authors consider feasibility and accuracy of this technique for estimations of the surface visibility depending on various parameters, particularly on the accuracy of the AOD measurements. The presented method is based mainly on the regression relations. However from the reviewed manuscript it is difficult to understand how to implement this method and how the aerosol multiple regressions are taken into account in its implementation. This is especially important regarding that "the ABI aerosol visibility blended retrieval uses a 20/80% weighting of the first guess and multiple regression aerosol visibility estimates".

Authors Response: The multiple linear regression visibility estimate includes additional meteorological predictors for both aerosol and fog/low cloud visibilities. These additional meteorological predictors are included to account for the fact that the aerosol extinction is generally not uniform over the depth of the PBL as assumed in Eq. (3) and each regression term accounts for potential variability of the aerosol extinction profile through the PBL. Added to the sentence on p. 9 lines 204-207 to clarify this point and also added additional tables (Tables 1 and 2) that summarize the multiple regression coefficients for both aerosol and fog/low cloud multiple regression visibility estimates.

2) Specific comments

1. The GOES-R ABI visibility algorithm assumes that the aerosols reside within the planetary boundary layer and the extinction coefficient is constant, i.e. doesn’t depend on altitude. And why the authors did not try to use a different, more realistic model of the aerosol distribution in the boundary layer, for example, exponential one?

Authors Response: Added in discussion on p. 7 lines 151-154 that visibility most often refers to horizontal visibility when it is based on an observer. However, it is measured or inferred using local extinction. If the extinction is locally both horizontally and vertically homogeneous then the vertical extinction is representative of the horizontal extinction. Please see Authors Response to General comments by Anonymous Referee #2 with regards to comment on using exponential model for aerosol distribution in the boundary layer.

2. On pp. 11258 and 11259 authors note that the extinction (and visibility) depends on scattering and absorption by aerosol particles. But the extinction coefficient (and visibility) depends on molecular scattering and gas absorption as well.

Authors Response: Added molecular scattering and gas absorption to sentence on p. 6 lines 127-129 since extinction coefficient (and visibility) depends on those as well.

3. The statement that the Koschmieder method is based on scattering of light by a black object (p.11259) is incorrect. A black object does not scatter light at all.

Authors Response: Added discussion on p. 6 lines 130-132 that the Koschmieder method is based on scattering and absorption of light by aerosol particles in the air between the object that is being observed and the observer. Removed black object wording since that was incorrect.

4. Pp.11259 - 11260. The Koschmieder method was developed for observation along a horizontal track, the length of which can be considered infinite. It is why the theoretical basis for the GOES-R ABI visibility algorithm is Equation (1b) and not Equation (3), where is AOD of a vertical layer. It should be clearly formulated that the transition from the formula (1b) to (3) is made only in order to determine in the surface layer assuming that the extinction coefficient is a constant over the thickness (x).

Authors Response: Added discussion on p. 7 lines 140-143 and lines 150-155 that the Koschmieder method was developed for observation along a horizontal track in which the length can be considered infinite and therefore Equation (1b) forms the theoretical basis for the GOES-R ABI visibility algorithm where AOD is of a vertical layer. Visibility most often refers to horizontal visibility when it is based on an observer. However, it is measured or inferred using local extinction. If the extinction is locally both horizontally and vertically homogeneous then the vertical extinction is representative of the horizontal extinction. Equation (3) is used for the GOES-R ABI visibility algorithm in order to determine the visibility in the surface layer and it shows that visibility is inversely proportional to optical depth divided by the thickness of the material layer where the aerosol resides.

5. What is the difference between at the p.11264 and at p.11259? Just is it that is measured in inverse mega-meters? But the value of can also be measured in the same units.

Authors Response: Addressed this on p. 13 lines 291-292 by adding in description of what the light-extinction coefficient is in the dV equation, which is the inverse of $\sigma(\lambda)$ expressed in inverse mega-meters (Mm^{-1}) of ambient air.