Answers to Santtu Mikkonen:

The authors thank Santtu Mikkonen for his comments and suggestions about the statistical treatment of the trend analysis.

During the review process, the routines for MK trend analysis were translated into R and an error was found in the selection of data for north hemispheric winter season. This error was corrected in the original matlab routines leading to minor changes in slope absolute values for most of the stations, but also sometimes to modification of the statistical significance. The more important changes are:

- ALT was the only station with ss trend in absorption coefficient and this was the only case where there is a strong discrepancy among the analysing methods, MK being ss positive, LMS/log not ss and GLS/day ss negative. The correction leads to MK not ss trend in absorption coefficient at ALT and remove therefore the solely strong discrepancy between the methods.
- MLO has a ss negative trend in scattering coefficient for the last 10 y, leading to a better agreement between scattering and absorption trends. The evolution from positive to negative ss trends is now well established.
- Some other not ss present-day trends are now ss negative (RMN scattering coefficient, CPR absorption coefficient, THD single scattering albedo) or ss positive (PUY single scattering albedo, MSY scattering Ångström exponent, LLN absorption Ångström exponent).
- Some ss trends are now not ss: IZO absorption coefficient,
- One trend (JFJ scattering Ångström exponent for the 20y period) change from ss negative to ss positive trend.
- The statistical significance of some of the 10 y trends of the time evolution analysis (Sect. 3.2) is also modified, but these changes do not impact the results.

The revised manuscript and all tables and figures were corrected in order to take into account the new results.

Answers to specific comments:

1. Using a pre-whitening method always loses information from the data and because there is no information on the applied method (Collaud Coen et al., in preparation), it is impossible to see how much information is lost. Thus, results of this work cannot be evaluated before the method is available for inspection.

   The referee is absolutely right. The applied methodology should have been available at the same time than this paper. Anyhow, this paper results from an international initiative in order to published this trend analysis of all in-situ aerosol optical parameters over the world so that it can be taken into account for the next release of the IPCC report. The paper on the applied methodology was then written thereafter but is submitted since three

weeks to Atmos. Meas. Techn. Discussion and I hope that it will be published there before the acceptation of this paper describing the results of the trend analysis.

2. There exists time series analysis methods which do not require pre-whitening, why the authors are not considering them? For example, dynamic linear models (DLM) have been shown to be good tools for atmospheric data e.g. in Laine et al. (2014), Dunne et al. (2015) and Mikkonen et al. (2015). with DLM, it is possible to model timevarying trends in measured time series and at the same time take account structural dependencies, e.g. seasonality and autocorrelation, in the data. In addition, it shows from Figure 3 that the trends in the data cannot be described with one linear slope. With DLM the shape of the trend is not limited to straight line but the trend can change its value continuously and it can be analyzed directly if the time series contains changepoints and where they most likely are.

   This analysis not only presents the non-parametric Mann-Kendall method for long-term trend analysis but also LMS and GLS/ARB results that do not require prewhitening. As described in sect. 2.5 and particularly in subsect 2.5.1, the distribution of the aerosol parameter is strongly skewed resulting in not normally distributed residues after LMS or GLS/ARB tests, so that non-parametric long-term trend analyses are required. Due to the high autocorrelation in the time series, a prewhitening method is also necessary in order to decrease the rate of rejection of the null hypothesis of no trend in the absence of a trend. The authors are well aware of the detrimental effect of prewhitening methods (see submitted manuscript Collaud Coen et al., 2020) but tried to apply the most adequate methodology.

   The authors are also aware of the DLM method: DLM is however a parametric method and should, thus, not be used if the residues of the fit are not normally distributed. The applied Mann-Kendall test was instead chosen and their results were compared to the LMS and GLS/ARB parametric methods. In order to have an insight into the change of the trend with time, all possible 10 y trends in the time series were computed and the results are described in Sect. 3.2. This procedure allows maintaining the rule of applying long-term trend analysis on periods of at least 10 y and can be considered, to some extent, as a differential non-parametric trend analysis method.