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Evidence for biomass burning-forced dimming in southern Africa

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Decadal trends in Surface solar radiation (SSR) have gained attention in the last few decades after several studies identified the non stable behaviour of such measurements. Also referred to as Global Dimming and Global Brightening, these decadal trends are known to be spatially heterogeneous, meaning that different regions might experience different trends, associated with different causes. While measurements have allowed the identification of trends around the world, the understanding of the causes of those trends is limited to a few regional studies mostly focusing on developed countries. The lack of data in developing countries leads to an underrepresentation of those regions in what regards to global dimming and brightening research. In this work, we use around 39 years (1967-2005) of daily SSR measurements of two stations in Zimbabwe, and apply a new method for clear-sky derivation, using satellite cloud fraction to identify optimal daily transmittance thresholds for clear-sky identification. The all-sky and clear-sky time series of SSR are then compared to cloud fraction and water vapor data from ERA5 reanalysis and to aerosol emissions from the EDGAR database. The SSR time series show a persistent dimming of similar magnitude both in all-sky and clear-sky. The cloud fraction does not show any significant trends, reinforcing the hypothesis that the dimming was caused by cloud-free radiative processes in the atmosphere. The water vapour time series also does not show any significant trend which could justify the negative trends in SSR. However, the monthly interannual variability show that the dimming is stronger between July and September, months with higher emission of biomass burning aerosols in that region. This might also indicate an anthropogenic related cause of the dimming observed in southern Africa. This study intends to contribute to the understanding of the global dimming and brightening phenomena in southern Africa, but also to highlight the importance of studies focusing in underrepresented regions of the world.