Decadal Variations In Net Downward Shortwave Radiation Over South Asia - Solar Dimming

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The amount of solar radiation reaching the Earth's surface has gone through decadal changes of decreasing and increasing. These phenomena called solar dimming and brightening, respectively have been attracted the scientific interest in view of the climate change. Multi-decadal variations in cloud cover, cloud optical depth, and microphysical properties accompanied with changes in aerosol load and properties are the main factors controlling the solar dimming/ brightening. Despite the interest in the solar dimming/ brightening phenomenon the south Asia has not been critically examined so far. The present work uses the net downward shortwave radiation (NDSWR) values derived from satellites (Modern Era Retrospective-analysis for Research and Applications, MERRA 2D) in order to examine the multi-decadal variations in the incoming solar radiation over south Asia in the period 1979-2004. The study area covers the whole Indian subcontinent, Bay of Bengal, Arabian Sea and tropical Indian Ocean (north from equator). The results show that, despite other areas around the world, the solar dimming over south Asia is continuing with a mean value of -0.54 Wm⁻² yr⁻¹. Assuming clear skies the decrease in NDSWR is, on average, -0.05 Wm⁻² yr⁻¹, which is attributed to increased aerosol emissions. There is evidence that the variations (increase) in cloud optical depth play the major role for the solar dimming over the area. During the period 1979-2004 the cloud optical depth (MERRA retrievals) is increased for 10.7%, with the largest increase to be detected on the optical depth of the high-level (>400 hPa) clouds (31.2%). These large changes in the high-level cirrus clouds may be also attributed to the cloud-aerosol interactions over south Asia. Nevertheless, the decrease in solar radiation and the role of aerosols and clouds exhibit large monthly and seasonal variations directly affected by the local monsoons and the anthropogenic and natural aerosol emissions. All these aspects are examined in detail aiming at shed light onto the solar dimming phenomenon over a densely populated and climatic sensitive area.