

Solar dimming & brightening as related to airborne particulate matter.

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Global trends show dimming of solar radiation between 1960 and 1990 due to the increased water-holding capacity and resultant increase in atmospheric moisture of the globally warmer atmosphere. However, a subsequent increase in solar radiation since 1990 has occurred in many locations. The often reported explanation for brightening is a decrease in particulate matter. Several studies have shown a correlation between emissions of precursors to particulate matter and solar radiation, but none has shown the relationship between particulate matter and solar radiation measured simultaneously at the same site. In the rural northeastern US, particulate matter is dominated by sulfate particles that are a result of SO₂ emissions, which have decreased since 1990 with a resultant decrease in sulfate particles. This decrease in sulfate particles should result in a decrease in diffuse solar radiation, which should result in an increase in direct solar radiation, i.e., brightening. A decrease in diffuse radiation could also be the result of decreased cloudiness or a decrease in airborne water vapor (i.e. humidity). Here we describe changes in solar radiation, particulate matter, cloudiness and humidity at the Cary Institute and the relationships among those variables. We compare this site with two CASTNET sites for which solar radiation data are available from nearby NOAA, Surface Radiation Budget Network (SURFRAD) stations.

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