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Global dimming and brightening - evidence and agricultural implications

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There is growing observational evidence that sunlight received at the Earth surface is not stable over the years but undergoes substantial decadal changes, These changes, known popularly as global dimming and brightening, are caused by anthropogenic air pollution as well as changes in cloudiness. Here we summarize the evidence and discuss the implications of these variations for biospheric growth in general and agricultural applications in particular. Emphasis is placed on implications for forest canopies, grassland and agricultural crop production. Important thereby is not only the total amount of sunlight that the biosphere receives, but also the relative portion of the direct and diffuse light therein. Increasing air pollution and cloudiness can alter this partitioning towards a higher relative portion of diffuse light, in addition to a reduction of the total amount of sunlight. This diffuse light can enhance photosynthesis particularly in tall and dense vegetation canopies, as it is distributed more effectively within the canopy compared to direct solar radiation, which is only accessible for the outermost (sunlit) layers. Here we conclude that the growth of tall canopies like forests or crop fields may be favoured under global dimming conditions due to the enhanced diffuse light, despite the overall reduction in the total amount of sunlight. Under the same dimming conditions, grassland, on the other hand, with its shallow open canopy may reduce its yield, as it has little benefits from the enhanced diffuse fraction, while suffering from the loss in total amount of sunlight for photosynthesis. Variations in solar radiation therefore may have largely varying effects on agricultural production depending of the structure of the crop canopy.