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# Dimming, brightening, and runoff: Studying the impacts of radiative forcing on the water cycle during the second half of the 20th century using CLM

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Variations in incident solar radiation at the land surface have been noticed in observation records mostly from Europe, where a dimming trend from about 1960 to 1985 was followed by an ongoing period of widespread brightening. This may have affected the global water budget, in particular evapotranspiration and runoff, in ways that are not entirely understood. Thus, it is important to investigate trends in hydrological variables and identify their possible drivers. But many observations and reconstructed data are too scarce or do not agree on the sign of trends in runoff and evapotranspiration. Indeed, analyzing the impacts of radiative forcing on the global water balance from observations is no trivial task. Therefore, land surface modeling may be useful as a realistic approach to simulate surface exchanges and the hydrological cycle.

Here, we use the NCAR Community Land Model (version 3.5) to perform offline simulations of land-surface processes, to explain the trends in the hydrological cycle and analyze the potential direct and indirect effects of the solar radiation forcings on those trends. We use the Qian et al. atmospheric forcing dataset (2006), additionally applying a trend to the solar radiation at the surface similar to what was observed (Wild et al. 2005). We perform global simulations for the period between 1960 and 2004 forced with an artificial reduction in solar radiation of 1.3% per decade (1960-1985), followed by an increase of equal magnitude for the subsequent period of 1985-2004. Observed trends and variations in the hydrological cycle are investigated with the help of such pertinent datasets as that from the Global Runoff Data Centre (Fekete et al. 2008). Anomalies in evapotranspiration and runoff at the global and regional (Europe) levels as a result of the simulated dimming and brightening are studied in detail, along with the partitioning of the solar radiation between direct and diffuse.