Observed and modelled influences of the 11-yr solar cycle on the Walker Circulation

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The Walker circulation (WC) fluctuates on multi-decadal and inter-annual time scales under the influence of internal variability and external forcings. We provide observational evidence showing that the 11-yr solar cycle (SC) affects WC variability on decadal time scales. We observe a robust reduction of West-East sea-level pressure gradients in the Indo-Pacific during solar maxima and the following 1-2 years. This reduction is associated with westerly wind anomalies at the surface and throughout the equatorial troposphere in the western/central Pacific paired with an eastward shift of convective precipitation that brings more rainfall to the east. The observed weakening of the WC results from a thermodynamical response of global hydrology to surface warming, which is further amplified by atmosphere-ocean coupling. The observed solar modulation of the WC is supported by a set of climate-model simulations forced explicitly by the SC forcing. These findings give confidence in predictions of a weaker WC under global warming, given that the response of the WC to the SC heating is constrained by the same mechanism that weakens the WC owing to increasing greenhouse gas concentrations.