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Solar variability and changes in the Indian summer monsoon during the Holocene

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The Indian monsoon system, influencing the large areas of the Asian-African region, is critical in understanding the global climate and hydrological budget. The large changes in seasonal insolation that have occurred in the past have a well-documented influence on the Indian summer monsoon. However, the effect of the small (<1%) decade to century scale solar variability is less clear. Evidence is emerging that Earth's climate is sensitive to small changes in solar output on decadal to centennial time scale during the Holocene. Comparison of a recently published proxy record for solar variability with our newly-revised higher-resolution record of the Indian summer monsoon winds from rapidly accumulating and minimally bioturbated sediments of northwest Arabian Sea reveals multiple intervals of weak summer monsoon during the Holocene at decadal to centennial scales. Weak summer monsoon winds correlate with reduced solar output as measured by the proxies for solar variability. Our results suggest that small changes in solar irradiance can bring significant changes in the tropical monsoon. The decade-century scale variations in the monsoon winds were much larger in the early Holocene and in the last few centuries, coincident with increased sunspot numbers. The monsoon-solar connection suggests significant external forcing of a large-scale aspect of the climate on the multi-decade to century scale.