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Trends, noise and re-entrant long-term persistence in Arctic sea ice

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We examine the long-term correlations and multi-fractal properties of daily satellite retrievals of Arctic sea ice albedo and extent, for periods of approximately 23 years and 32 years, respectively. The approach harnesses a recent development called multi-fractal temporally weighted detrended fluctuation analysis, which exploits the intuition that points closer in time are more likely to be related than distant points. In both datasets, we extract multiple crossover times, as characterized by generalized Hurst exponents, ranging from synoptic to decadal. The method goes beyond treatments that assume a single decay scale process, such as a first-order autoregression, which cannot be justifiably fitted to these observations. Importantly, the strength of the seasonal cycle 'masks' long-term correlations on time scales beyond seasonal. When removing the seasonal cycle from the original record, the ice extent data exhibit white noise behaviour from seasonal to bi-seasonal time scales, whereas the clear fingerprints of the short (weather) and long (approx. 7 and 9 year) time scales remain, the latter associated with the recent decay in the ice cover. Therefore, long-term persistence is re-entrant beyond the seasonal scale and it is not possible to distinguish whether a given ice extent minimum/maximum will be followed by a minimum/maximum that is larger or smaller in magnitude.