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The Hurst phenomenon and climate

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Hurst's observation in 1950 that Nile streamflows exhibit persistent excursions from their mean value has plagued, entertained and humbled hydrologists for over half a century. The "Hurst phenomenon," sometimes denoted "long-term persistence (LTP)", has subsequently been recognized in countless natural and artificial processes. While LTP initially presented an analytical challenge, the concern was mostly academic: In many practical situations, calibration datasets were insufficiently long to reveal LTP; planning horizons were sufficiently short that other sources of variability and uncertainty dominated the effect of LTP; and the Hurst phenomenon seemed relevant, if at all, only to very large water projects. However, things have changed: Statistical tools and stochastic theory have improved, more data are available, and research now suggests that LTP is nearly ubiquitous when dealing with complex natural systems. Moreover, many of the problems we face today occur over the large spatial and temporal scales where LTP tends to emerge as a dominant component of natural processes evolving in continuous time or space. Under such circumstances, LTP must be taken into account when conducting statistical analyses and predictions. In particular, physical arguments and data indicate that LTP is likely a fundamental characteristic of global climate processes, and thus, when studying climate data, it would seem prudent to employ statistical methods that are robust to the presence of LTP.