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Long-Range Predictability of the Length of Day and Extratropical Climate.

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Angular momentum is fundamental to the structure and variability of the atmosphere and hence regional weather and climate. Total atmospheric angular momentum (AAM) is also directly related to the rotation rate of the Earth and hence the length of day. However, the long-range predictability of fluctuations in the length of day, atmospheric angular momentum and the implications for climate prediction are unknown. Here we show that fluctuations in AAM and the length of day are predictable out to more than a year ahead and that this provides an atmospheric source of long-range predictability of surface climate. Using ensemble forecasts from a dynamical climate model we demonstrate predictable signals in the atmospheric angular momentum field that propagate slowly and coherently polewards into the northern and southern hemisphere due to wave-mean flow interaction within the atmosphere. These predictable signals are also shown to precede changes in extratropical surface climate via the North Atlantic Oscillation. These results provide a novel source of long-range predictability of climate from within the atmosphere, greatly extend the lead time for length of day predictions and link geodesy with climate variability.