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Information transfer across the scales of climate variability: The effect of the 7–8 year cycle on the annual and interannual scales

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Complexity of the climate system stems not only from the fact that it is variable over a huge range of spatial and temporal scales, but also from the nonlinear character of the climate system that leads to interactions of dynamics across scales. The dynamical processes on large time scales influence variability on shorter time scales. This nonlinear phenomenon of cross-scale causal interactions can be observed due to the recently introduced methodology [1] which starts with a wavelet decomposition of a multi-scale signal into quasi-oscillatory modes of a limited bandwidth, described using their instantaneous phases and amplitudes. Then their statistical associations are tested in order to search for interactions across time scales. An information-theoretic formulation of the generalized, nonlinear Granger causality [2] uncovers causal influence and information transfer from large-scale modes of climate variability with characteristic time scales from years to almost a decade to regional temperature variability on short time scales. In analyses of air temperature records from various European locations, a quasioscillatory phenomenon with the period around 7–8 years has been identified as the factor influencing variability of surface air temperature (SAT) on shorter time scales. Its influence on the amplitude of the SAT annual cycle was estimated in the range 0.7–1.4 °C and the effect on the overall variability of the SAT anomalies (SATA) leads to the changes 1.5–1.7 °C in the annual SATA means. The strongest effect of the 7–8 year cycle was observed in the winter SATA means where it reaches 4–5 °C in central European station and reanalysis data [3].

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[1] M. Palus, Phys. Rev. Lett. 112 078702 (2014)

[2] M. Palus, M. Vejmelka, Phys. Rev. E 75, 056211 (2007)

[3] N. Jajcay, J. Hlinka, S. Kravtsov, A. A. Tsonis, M. Palus, Time-scales of the European surface air temperature variability: The role of the 7–8 year cycle. Geophys. Res. Lett., in press, DOI: 10.1002/2015GL067325