



Cross-scale causal links from El Niño Southern Oscillation to precipitation in East China

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Possible interactions between the El Niño-Southern Oscillation (ENSO) and the precipitation variability in East Asia are subject of intensive research. Recently, Jajcay et al. [1] have identified an intricate network of causal interactions among three dynamical components of ENSO which differ in their time scales: (i) the annual cycle and near-annual variability (quasiannual - QA – component), (ii) quasibiennial (QB, periods around 2 years), and low-frequency (LF, period 3-7 years) component. The interactions of these components lead to intermittent synchronization episodes, coinciding with extreme El Niño or La Niña events [1]. Precipitation variability is also a complex process evolving on multiple time scales. Therefore we study cross-scale causal interactions and information transfer [2] between the ENSO (Niño3.4 index) and precipitation records from East China. We have identified the causal influence of the ENSO QB mode on the amplitude of the annual cycle and QA variability in the precipitation as well as the causal influence of the phase of the ENSO LF mode on the amplitude of the precipitation QB variability. In the analysis of the effect of these causal links we have found that the precipitation variability in the area between the Yellow River and the Yangtze River is influenced more by the phase of the ENSO LF mode than by the total ENSO variability (Niño3.4 index). On the other hand, in the area south of the Yangtze River, the effect of the total ENSO variability is dominant. The mechanisms of the observed causal links are yet to be understood, however, these results have potential to improve forecasts of precipitation variability in different areas of East China.

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[1] Jajcay, N., Kravtsov, S., Sugihara, G., Tsonis, A.A. and Paluš, M.: Synchronization and causality across time scales in El Niño Southern Oscillation. *npj Climate and Atmospheric Science* 1, 33 (2018). doi:10.1038/s41612-018-0043-7, <https://www.nature.com/articles/s41612-018-0043-7>

[2] Paluš, M.: Multiscale atmospheric dynamics: Cross-frequency phase-amplitude coupling in the air temperature. *Physical Review Letters* 112, 078702 (2014). doi: 10.1103/PhysRevLett.112.078702