Geophysical Research Abstracts
Vol. 17, EGU2015-9925, 2015
EGU General Assembly 2015

Information transfer across the scales of climate data variability

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Multitude of scales characteristic of the climate system variability requires innovative approaches in analysis of instrumental time series. We present a methodology which starts with a wavelet decomposition of a multi-scale signal into quasi-oscillatory modes of a limited band-with, described using their instantaneous phases and amplitudes. Then their statistical associations are tested in order to search for interactions across time scales. In particular, an information-theoretic formulation of the generalized, nonlinear Granger causality is applied together with surrogate data testing methods [1]. The method [2] uncovers causal influence (in the Granger sense) 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 daily mean surface air temperature from various European locations an information transfer from larger to smaller scales has been observed as the influence of the phase of slow oscillatory phenomena with periods around 7-8 years on amplitudes of the variability characterized by smaller temporal scales from a few months to annual and quasi-biennial scales [3]. In sea surface temperature data from the tropical Pacific area an influence of quasi-oscillatory phenomena with periods around 4-6 years on the variability on and near the annual scale has been observed.
This study is supported by the Ministry of Education, Youth and Sports of the Czech Republic within the Program KONTAKT II, Project No. LH14001.
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