Geophysical Research Abstracts
Vol. 17, EGU2015-2542, 2015
EGU General Assembly 2015

Scaling in the climate, non-universality and climate states

Peter Ditlevsen (1) and Zhi-gang Shao (2)

(1) University of Copenhagen, Niels Bohr Institute, Centre for Ice and Climate, Copenhagen O, Denmark (pditlev@nbi.ku.dk), (2) South China Normal University, Guangzhou 510006, China

The scaling properties in climatological time series contains important information on persistence times and the complex underlying dynamics. Since non-trivial scaling was first observed in hydrological data series it has been a long standing discussion to which extent the fractal nature of the climate dynamics is universal, or if it is more specific to the processes and range of scales observed.
Here we compare the scaling behavior of the temperature record with paleoclimatic reconstructions. The scaling exponents of the Holocene – and the glacial records are fundamentally different. The Holocene record is weakly multi-fractal, with a scaling exponent around 0.7, significantly different at the 3σ level from the trivial value 0.5. This is in complete agreement with the scaling properties of the instrumental temperature records. On the contrary, the glacial climate record is more multi-fractal, with a significantly higher scaling exponent around 1.2 indicating a much longer persistence time and stronger non-linearities in the glacial climate. The glacial climate is dominated by the strong multi-millennial scale instability represented by the Dansgaard-Oeschger (DO) events, which would influence the long-time correlation. However, by analysing the last glacial maximum period (27-15 kyr), where the DO-events are absent, we find that the same scaling is present that climatic period as well. The unbroken scaling over the time scales of the DO-events thus indicates that these are part of the natural variability and not triggered by causes outside the climate system. At glacial time scales there is a scale break to a trivial scaling showing that the DO-events are indeed different from the apparently similarly saw-tooth shaped glacial cycles, which are externally forced.