The Weather and Climate
Emergent Laws and Multifractal Cascades

Shaun Lovejoy
McGill University, Montréal

Daniel Schertzer
Université de Paris-Est, École des Ponts Paris Tech

Advances in nonlinear dynamics, especially modern multifractal cascade models, allow us to investigate the weather and climate at unprecedented levels of accuracy. Using new stochastic modelling and data analysis techniques, this book provides an overview of the nonclassical, multifractal statistics. By generalizing the classical turbulence laws, emergent higher-level laws of atmospheric dynamics are obtained and are empirically validated over time-scales of seconds to decades and length-scales of millimetres to the size of the planet. In generalizing the notion of scale, atmospheric complexity is reduced to a manageable scale-invariant hierarchy of processes, thus providing a new perspective for modelling and understanding the atmosphere. This synthesis of state-of-the-art data and nonlinear dynamics is systematically compared with other analyses and global circulation model outputs. This is an important resource for atmospheric science researchers new to multifractal theory and is also valuable for graduate students in atmospheric dynamics and physics, meteorology, oceanography and climatology.


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