



## **Heat waves and large deviations of spatially averaged temperature**

Vera Melinda Galfi (1,2), Valerio Lucarini (1,3,4), Jeroen Wouters (3,5)

(1) Meteorological Institute, University of Hamburg, Germany (vera.melinda.galfi@uni-hamburg.de), (2) IMPRS-ESM, Max Planck Institute for Meteorology, Hamburg, Germany, (3) Department of Mathematics and Statistics, University of Reading, Reading, UK, (4) Center for the Mathematics of Planet Earth, University of Reading, Reading, UK, (5) Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark

We study persistent extreme events of temperature, i.e. heat waves and cold spells, using large deviation theory. We consider the mid-latitudes of a simplified yet Earth-like general circulation model of the atmosphere and numerically estimate large deviation rate functions of near-surface temperature averages over different spatial scales. The rate functions indicate substantially different statistical properties of temperature averages over intermediate spatial scales (larger, but still of the order of the typical scale), as compared to the ones related to any other scale. According to this point of view, heat waves (or cold spells) can be interpreted as large deviations of temperature averaged over intermediate scales. This is a new way to assess the existence of specific dynamical mechanisms, which lead to the presence of organised structures in the form of persistent weather patterns.