



## **Return Levels of Temperature Extremes in Southern Pakistan**

Maida Zahid (1), Valerio Lucarini (1,2), Richard Blender (1), and Maria Caterina Bramati (3)

(1) CEN, University of Hamburg, Hamburg, Germany, (2) Department of Mathematics and Statistics, University of Reading, Reading, UK, (3) Department of Statistical Science, Cornell University, Ithaca, USA

Southern Pakistan (Sindh) is one of the hottest regions in the world and is highly vulnerable to temperature extremes. In order to improve rural and urban planning, information about the recurrence of temperature extremes is required. In this work, return levels of the daily maximum temperature  $T_{max}$  are estimated, as well as the daily maximum wet-bulb temperature  $TW_{max}$  extremes. The method used is the Peak Over Threshold (POT) and it represents a novelty among the approaches previously used for similar studies in this region. Two main datasets are analyzed: temperatures observed in nine meteorological stations in southern Pakistan from 1980 to 2013, and the ERA Interim data for the nearest corresponding locations. The analysis provides the 2, 5, 10, 25, 50 and 100-year Return Levels (RLs) of temperature extremes. The 90% quantile is found to be a suitable threshold for all stations. We find that the RLs of the observed  $T_{max}$  are above  $50^{\circ}\text{C}$  in northern stations, and above  $45^{\circ}\text{C}$  in the southern stations. The RLs of the observed  $TW_{max}$  exceed  $35^{\circ}\text{C}$  in the region, which is considered as a limit of survivability. The RLs estimated from the ERA Interim data are lower by  $3^{\circ}\text{C}$  to  $5^{\circ}\text{C}$  than the RLs assessed for the nine meteorological stations. A simple bias correction applied to ERA Interim data improves the RLs remarkably, yet discrepancies are still present. The results have potential implications for the risk assessment of extreme temperatures in Sindh.