EGU24-7095, updated on 20 May 2024
https://doi.org/10.5194/egusphere-egu24-7095
EGU General Assembly 2024

Two-level GLM approach for detection of spatio-temporal interactions in daily maximum temperature record-breaking in Spain 1960-2022

Zeus Gracia-Tabuenca, Elsa Barrio-Torres, Jorge Castillo-Mateo, Jesus Asin, Ana Carmen Cebrian, and Jesus Abaurrea
University of Zaragoza, Faculty of Science, Statistical Methods, Zaragoza, Spain (zeus@unizar.es)

Recent findings showed that extreme events such as daily maximum temperature record-breaking are not following a stationary pattern, with trends associated to global warming [1]. But there are spatial variability identifying the change-point when this pattern is dated and, most interesting, there is not evidence of non-stationarity in North stations of Spain in spring and autumn. To this regard, it is essential to develop novel tools and models that represent the seasonal and spatial variability, and effectively capture the spatio-temporal dependence of covariates of interest. Effective detection will enable us to more accurately describe and predict which regions may be affected by stronger trends.
In this framework, the utility of spatio-temporal models including relevant covariates for the occurrence of records is evident. However, achieving this objective requires the preliminary identification of the covariates and interaction terms that influence the occurrence of records. Thus, we propose a two-level generalized linear models (GLM) approach to detect spatio-temporal dependence of covariates of interest in daily maximum temperature record-breaking. To do so, we took daily maximum temperatures in the 1960-2022 period in 36 stations distributed over the peninsular Spain with low level of missing values (below 0.5%). We computed the calendar day record-breaking by binarizing the temporal series assigning a one only if a particular daily maximum on year 't' is above all its previous years on the same date [2]. First, for each station a local logistic regression was applied setting the trend term as log(t-1); note that the trend term in the probability of a record, on the logit scale, is -log(t-1) under a stationary climate. Finally, all the estimated beta coefficients for the trend were gathered and correlated with spatial covariates such as latitude, longitude, altitude, and distance to the coast. We found that only log-altitude and log-distance showed a significant positive correlation with the trend coefficients, being the latter the one with a higher effect (r=0.59). Although preliminary, these results showed a straightforward approach to model the relationship between spatial covariates and the temporal trend in extreme events, in particular, record of maximum temperatures. In addition, we anticipate that this tool will be potentially useful to build models based on atmospheric covariates.

References:
[1] Castillo-Mateo, J., Cebrián, A. C., and Asín, J. (2023). Statistical analysis of extreme and record-breaking daily maximum temperatures in peninsular Spain during 1960–2021. Atmospheric

Research, 106934. https://doi.org/10.1016/j.atmosres.2023.106934
[2] Castillo-Mateo, J., Cebrián, A. C., and Asín, J. (2023). RecordTest: An R Package to Analyze Non-Stationarity in the Extremes Based on Record-Breaking Events. Journal of Statistical Software, 106, 1-28. https://doi.org/10.18637/jss.v106.i05