Mixing weather types and daily precipitation modelling as an approach to obtain climatic precipitation regions in mountain areas

Marc Lemus-Canovas (1,2), Joan-Albert Lopez-Bustins (1), Laura Trapero (2), and Javier Martin-Vide (1)

(1) Climatology Group, Department of Geography, University of Barcelona, c/ Montalegre, 6, Barcelona, PO: E08001, (2) Snow and Mountain Research Center of Andorra (CENMA-IEA), Institut d'Estudis Andorrans, Av. Rocafort,21-23, Sant Julià de Lòria, PO: AD600

Usually mountain areas present a very broad range of climatic diversity, as well as a multitude of geographical factors conditioning the distribution of precipitation amounts. The amount and variability of the precipitation over mountain areas is critically important to manage the impact of natural hazards such as avalanches or floods. Therefore, we combine the synoptic scale with regional-local scale, being our study area the Pyrenees. The interpolation of the mean daily precipitation (MDP) based upon a classification of weather types at the synoptic scale was carried out by means of the General Linear Models (GLM), Generalized Additive Models (GAM) and Regression Kriging (RK) methods. This combination of scales makes it possible to perform a spatial precipitation regionalization of the Pyrenees by means of the work flow proposed in the present research. The result is a catalogue of 20 atmospheric circulation types. For each of these circulation types, we obtained MDP maps for each of the aforementioned interpolation methods. The most satisfactory fit of the models was provided by the GAM and the RK methods, with an average R^2 of all models of 0.58 and 0.61, respectively. GAM models provided a regionalization of the Pyrenees involving eight differentiated precipitation regions.

In addition, we provided an Open Source R package called synoptReg (https://cran.r-project.org/web/packages/synoptReg/index.html) in order to make this research reproducible anywhere on Earth, as well as to explore the relationship between weather types and other environmental variables. The synoptReg package contains a set of functions used (1) to perform a PCA-based synoptic classification using an atmospheric variable; (2) to create maps showing the spatial distribution of the precipitation amounts based on the weather types of the synoptic classification; and (3) to develop a spatial precipitation regionalization based on the previous maps.

Keywords: synoptic classification, spatial interpolation, clustering, regionalization, precipitation, synoptReg, R package.