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Copping with Uncertainties in Mapping Extreme and Mean Temperatures at the Regional Level for Risk Management in Agriculture: A Case Study in Galicia, NW Spain

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Temperature is one of the main factors regulating crop growth and duration of crop cycle. Climate risk can be identified by characteristics such us geographic area (areal extent), time of year it is most likely to occur and its severity. Knowledge of the geographic coverage of mean, maxima and minima temperatures as well as the spatial distribution of this variable above or below a given threshold is fundamental for designing viable practices in the agriculture sector. Thus, managing temperature effects in agriculture needs reliable regional maps from which information can be obtained by downscaling at the farm scale. Several techniques are currently employed to create discretized, continuous surfaces from point data through a set of spatial interpolation techniques. Geostatistics, based in the random function theory is commonly used in the assessment of uncertainty associated with a spatially correlated variable, such as most climatic parameters, including temperature. The aim of this study was to provide a comparative analysis of various methods used for mapping monthly maximum, minimum and mean air temperatures in Galicia, northwest Spain over a 0.5 x 0.5 km grid size. The air temperature datasets involved more than 140 meteorological stations irregularly distributed in the region. Methods, included statistical and of spatial dependence analysis and mapping by inverse distance weighting (IDW) and several kriging techniques, including residual kriging (RK), collocated cokriging (COK) and kriging with an external drift (KED). There was a significant relationship between temperature and altitude for the study data sets. Interpolated monthly air temperature maps, produced by IDW indicate that the general pattern of values varied from one month to another, and therefore it can not be assessed based on previous records. Mean maxima and minima temperatures showed spatial dependence, which was described by spherical and gaussian variograms. First, IDW was used to produce interpolated monthly air temperature maps, with the results indicating that the general pattern of values varied from one month to another. The geostatistical techniques used, i.e. RK, COK and KED roughly produced similar temperature maps, but several differences in refinement could be distinguished. So, RK slightly underestimated the maximum and overestimated minimum temperature values while COK produced maps which had been smoothed to a lesser degree due to the consideration of altitude in the interpolation. Maps produced using KED, which also accounted for the effect of altitude in temperature, were greatly influenced by topography, even more than those obtained by COK, and showed lower kriging interpolation errors than those obtained by other geostatistical methods. Therefore, the interpolated maps produced using kriging with external drift (KED) are the most plausible. Maps obtained by KED could be considered as the most suitable for delivering relevant information at the 0.5 x 0.5 km scale size to evaluate the potential effect of temperature on crop growth in the rural communities of Galicia