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SPATIAL LAYOUT OF FORECASTED EXTREME TEMPERATURES IN THE CITY OF MURCIA (SPAIN)

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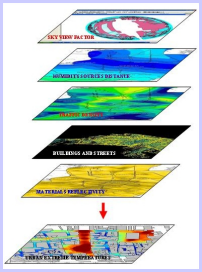
ABSTRACT

The extremely warm summer of 2003 encouraged the development of a "Heat wave Warning System". The health authorities issued extreme temperature warnings to the population using extreme temperatures that were forecasted for the provincial capitals. The forecast of extreme temperatures is elaborated by the post-process of EPS from ECMWF. For the Murcia Region, the heat wave warnings are generated using extreme temperatures from the Murcia/Guadalupe Observatory, which is located in the suburbs of the city of Murcia. However, under this warning system, some uncertainties were noticed regarding the difference between temperatures in the city and in rural areas. Therefore we designed a thermometric network in the city of Murcia as well as those rural areas. We have developed some tools for forecasting extreme temperatures in the city of Murcia. The development of this tool is expected to allow the forecast of extreme temperatures in summer for each part of the city of Murcia, based on the Sky View Factor (SVF) and meteorological parameters.The final objective will be to design an automatic process that incorporates forecasted meteorological variables and SVF values. It will generate a thermometric map, which will show the spatial layout of extreme temperatures in the city of Murcia.

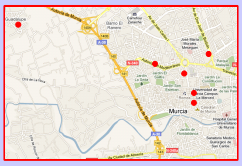
THERMOMETRIC NETWORK

We designed a first thermometric network in the city of Murcia as well as in rural areas, during the summer of 2009. Sensors were installed in points of the city with different urban parameters, like traffic density, distance to sources of humidity and urban layout (Sky View Factor), following the WMO assessments.

In the first thermometric network, we learnt that the Sky View Factor was the most important urban parameter. Therefore we designed a second thermometric network during the summer of 2010, where sensors were installed in points of the city with different Sky View Factors and the same condition for the rest of the urban parameters. Our aim is to check forecasted extreme temperatures.



GIS layers

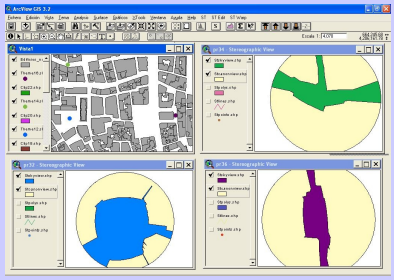


Thermometric network 2010

SKY VIEW FACTOR

Sky View Factor (SVF) is a parameter that indicates the relationship between the visible area of the sky and the area covered by urban structures.

A method of SVF estimation for urban analysis was developed and implemented in a Geographical Information System (GIS). A tool that allows an easy and quick way of calculating and representing SVF has been described by Souza et al.(2003). This tool, called ·3DSkyView Extension, is mainly an algorithm written in *Avenue* to work with *ArcView GIS 3.2* and its *3D Analyst* extension switched on. The tool transforms coordinates of polygons into stereographic and orthographic coordinates to allow SVF estimation.



SVF values obtained in the streets of the city of Murcia using this tool

FORECASTING EXTREME TEMPERATURES

We have developed some tools based on Model Output Statistic (MOS) for forecasting extreme temperatures in the city of Murcia.
The development of this tool expects to allow the forecast of extreme temperatures in summer for each part of the city of Murcia, based on the Sky View Factor (SVF) and meteorological parameters. The method will require values of forecasted extreme temperatures and meteorological parameters, obtained from the post-process of EPS from ECMWF, and SVF values in the city of Murcia.

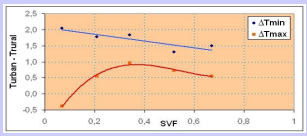
The difference in extreme temperatures between urban and rural areas depends on values of meteorological parameters, urban parameters and their interaction (1). The most important urban parameter has been SVF, so we considered the equation (2) as an acceptable approximation. The influence of F3 in temperatures, shown in the registered data, is an order of magnitude smaller than F1 and F2. This is mainly due to the fact that weather patterns show little variation in summer in the Southeast of Spain. For this reason, we changed the equation (2) to equation (3).

$$Text(urban) - Text(rural) \approx F1\ (meteorological\ parameters) + F2\ (urban\ parameters) + F3\ (meteorologial\ parameters : urban\ parameters) \quad (1)$$

$$Text(urban) - Text(rural) \approx F1\ (meteorological\ parameters) + F2\ (SVF) + F3\ (meteorologial\ parameters : SVF) \quad (2)$$

$$Text(urban) - Text(rural) \approx F1\ (meteorological\ parameters) + F2\ (SVF) \quad (3)$$

F2: We studied the relation between differences in extreme temperatures and SVF.



Functional relationship between differences in extreme temperatures and SVF

F1: Once we detected F2, we corrected SVF values in each point of the city to the value of SVF in the rural area (Murcia/Guadalupe Observatory). We calculated model F1 as a function of meteorological parameters for forecasting maximum and minimum temperatures. We obtained the following forecast models:

$$Tmax(urban) - Tmax(rural) = F2\ (SVF)$$

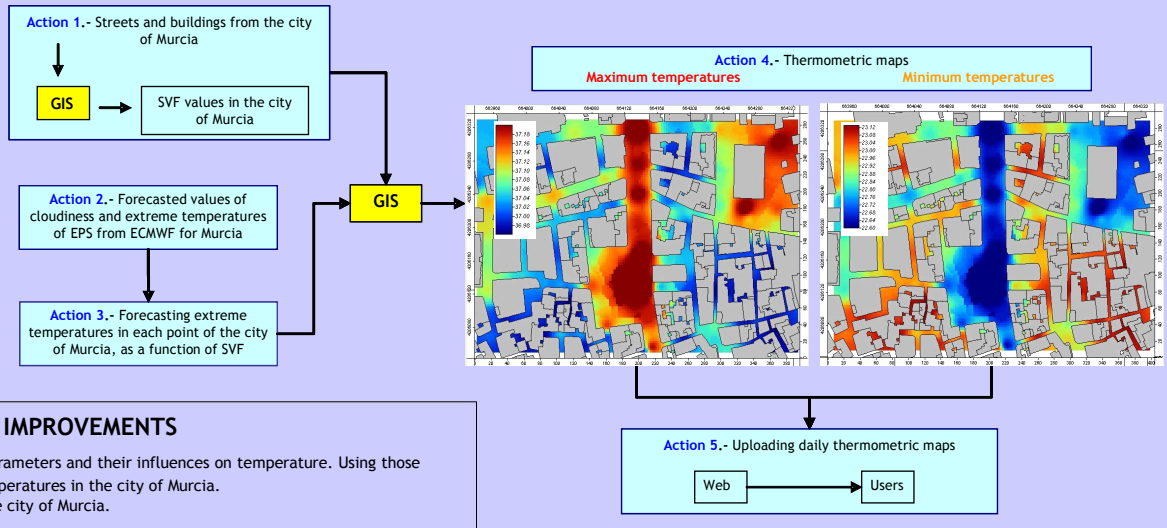
$$Tmin(urban) - Tmin(rural) = F1\ (cloudiness) + F2\ (SVF)$$

CONCLUSIONS

We have studied urban thermal singularities in the city of Murcia for the summer of 2009 and the summer of 2010.

We have developed a tool for forecasting extreme temperatures in each point of the city of Murcia, based on SVF values and forecasted meteorological parameters, such as cloudiness.

We have generated thermometric maps, which show the spatial layout of extreme temperature in the city of Murcia.



FUTURE IMPROVEMENTS

- Obtaining information about other urban parameters and their influences on temperature. Using those urban parameters for forecasting extreme temperatures in the city of Murcia.
- Improving the spatial resolution of SVF in the city of Murcia.
- Generating thermometric maps, using forecast models that includes every urban parameter.