World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:12, No:10, 2018

Spatial Climate Changes in the Province of Macerata, Central Italy, Analyzed by GIS Software

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Abstract : Climate change is an increasingly central issue in the world, because it affects many of human activities. In this context regional studies are of great importance because they sometimes differ from the general trend. This research focuses on a small area of central Italy which overlooks the Adriatic Sea, the province of Macerata. The aim is to analyze space-based climate changes, for precipitation and temperatures, in the last 3 climatological standard normals (1961-1990; 1971-2000; 1981-2010) through GIS software. The data collected from 30 weather stations for temperature and 61 rain gauges for precipitation were subject to quality controls: validation and homogenization. These data were fundamental for the spatialization of the variables (temperature and precipitation) through geostatistical techniques. To assess the best geostatistical technique for interpolation, the results of cross correlation were used. The co-kriging method with altitude as independent variable produced the best cross validation results for all time periods, among the methods analysed, with 'root mean square error standardized' close to 1, 'mean standardized error' close to 0, 'average standard error' and 'root mean square error' with similar values. The maps resulting from the analysis were compared by subtraction between rasters, producing 3 maps of annual variation and three other maps for each month of the year (1961/1990-1971/2000; 1971/2000-1981/2010; 1961/1990-1981/2010). The results show an increase in average annual temperature of about 0.1°C between 1961-1990 and 1971-2000 and 0.6 °C between 1961-1990 and 1981-2010. Instead annual precipitation shows an opposite trend, with an average difference from 1961-1990 to 1971-2000 of about 35 mm and from 1961-1990 to 1981-2010 of about 60 mm. Furthermore, the differences in the areas have been highlighted with area graphs and summarized in several tables as descriptive analysis. In fact for temperature between 1961-1990 and 1971-2000 the most areally represented frequency is 0.08°C (77.04 Km² on a total of about 2800 km²) with a kurtosis of 3.95 and a skewness of 2.19. Instead, the differences for temperatures from 1961-1990 to 1981-2010 show a most areally represented frequency of 0.83 °C, with -0.45 as kurtosis and 0.92 as skewness (36.9 km²). Therefore it can be said that distribution is more pointed for 1961/1990-1971/2000 and smoother but more intense in the growth for 1961/1990-1981/2010. In contrast, precipitation shows a very similar shape of distribution, although with different intensities, for both variations periods (first period 1961/1990-1971/2000 and second one 1961/1990-1981/2010) with similar values of kurtosis (1st = 1.93; 2nd = 1.34), skewness (1st = 1.81; 2nd = 1.62 for the second) and area of the most represented frequency (1st = 60.72 km²; 2nd = 52.80 km²). In conclusion, this methodology of analysis allows the assessment of small scale climate change for each month of the year and could be further investigated in relation to regional atmospheric dynamics.

Keywords : climate change, GIS, interpolation, co-kriging
Conference Title : ICCCGW 2018 : International Conference on Climate Change and Global Warming
Conference Location : Paris, France
Conference Dates : October 29-30, 2018