

How will the occurrence of extreme weather events in Emilia-Romagna change by the end of the 21st century?

This information sheet is one in a series describing how the frequency and intensity of extreme weather events may change by the end of the 21st century in response to global warming. The regional information presented here was obtained using state-of-the-art climate modeling and regional downscaling techniques developed during the STARDEX European Union-funded research project. These methods and the STARDEX approach are described in an accompanying overview information sheet.

Extremes in the Emilia-Romagna region

Emilia-Romagna is a region situated in Northern Italy, in the Po valley, bounded by the Apennines mountains to the South and the Adriatic Sea to the East. The climatic conditions of the region are mostly influenced by the mountains and the sea, leading to high spatial variability in mean and extremes. In the last decade, Italy, as many parts of central Europe, has been characterized by anomalous years on the climatological point of view. For example, summer 2003 (June to August) was “very hot”, with high anomalies in both maximum and minimum temperatures. Figure 1 presents the time series of summer maximum temperature anomalies averaged over 24 stations from Emilia-Romagna. The average Emilia-Romagna maximum temperature in summer 2003 was 4°C greater than its 1961-90 average value, while record anomalies of 8°C were recorded at Reggio Emilia (in the plain) and of 6°C at Sestola (over the mountains). The 2003 minimum temperature was also characterized by high anomalies reaching a maximum of 6°C in the plain (Codigoro) and of 5°C in the mountains (Sestola). Summer 2003 was also a very dry summer with a longest dry period of 32 days at Reggio Emilia. Figure 2 presents the distribution of the anomalies of the index of longest dry period for 2003 (shading) with respect to the average for the reference period 1960-90 reported on the Figure at each station.

Past changes in extremes

During the period 1958-2000 in Emilia-Romagna changes in the mean minimum, maximum temperature and precipitation were accompanied by changes in frequency of temperature extreme events. In particular, seasonal minimum and maximum temperatures extremes (10th and 90th percentile) show positive trends, the increase being more pronounced in maximum temperature than in minimum temperature. These changes are accompanied by a reduction in the number of frost days and by an increase in the heat wave duration index. Concerning the precipitation, the period 1958-2000 was characterised by a decreasing trend

during winter and increasing during summer and autumn. During winter the longest dry period increased. Decreasing and significant trends were detected in the number of heavy rainfall days during winter and spring while summer presents an increasing trend, significant especially over the Apennine area.

Future changes in extremes

The future climate of Emilia-Romagna, 2070-2100, as results from the downscaling based on HadAM3P model output (A2 and B2 scenarios) seems to be warmer, in all seasons, with increases in both minima and maximum temperature. Significant increase is predicted to take place

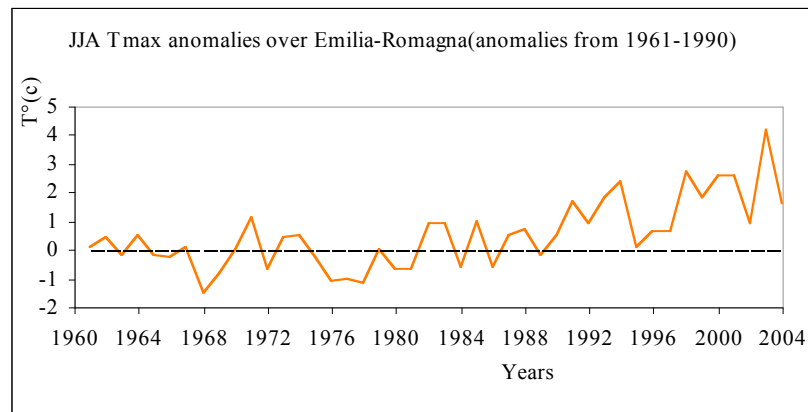


Figure 1: Time series of summer maximum temperature anomalies for the period 1961-2003, averaged over 23 stations from Emilia-Romagna

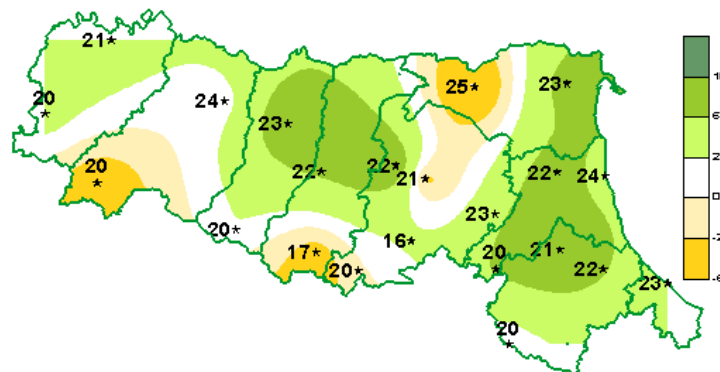


Figure 2: The spatial distribution of the anomalies (shaded area) of the longest dry days - summer 2003. The values reported at each station represent the index computed for the reference period (1960-1990)

during winter and autumn, when the minimum temperature will increase more than maximum temperature. On the contrary, during spring maximum temperature will increase more than minimum temperature, while during summer both minimum and maximum will increase in the same way. As a consequence, the number of frost days will decrease and the heat wave duration index will increase in all seasons (high signal in summer).

Concerning the precipitation in Emilia-Romagna, the future scenarios show a slight increase during summer and autumn. A significant increase in the longest dry period will take place in autumn.

Impacts

Changes in extremes have a great impact on the environment, human activities and health. Many researchers have highlighted the influence of climate on mortality, showing a high increase in mortality in summertime especially during “heatwaves”. This relation seems to be stronger than those between mortality and other environmental factors, such as atmospheric pollution (Zauli Sajani et al., 2002). In the following, is presented a summary of some of the impacts of the summer 2003 heat wave on the population and the environment in Emilia-Romagna

a) Increased mortality

A preliminary study made by the “Agenzia Sanitaria Regionale” concerning the mortality in Emilia-Romagna during summer 2003, reveals an increase in the mortality with respect to the period 1998-2002 (http://www.regione.emiliaromagna.it/agenziasan/pubblicazioni/p_altro/mortal_estate2003.pdf). The months with great impact on the life of the people were August and June when an increase in the mortality of around 26.3% and 14.3% respectively was recorded. As can be seen from Figure 3, these increases were especially linked to the higher mortality of older people (over 75 years). A link between daily maximum temperature and the number of deaths was also found. In addition, the Thom’s discomfort index

of June and August, had values typically associated with states of discomfort in each day of the above months and during the same period it frequently reached values typically associated with states of discomfort and deterioration of psychophysical conditions.

(http://www.arpa.emr.it/calore/download/emilia_estate2003.pdf)

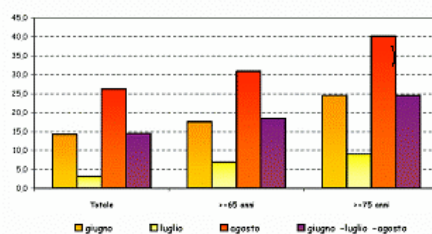


Figure 3: The percentage of the mortality during June-August 2003 in Emilia-Romagna

b) Anomalies in ozone concentration

Starting on the 5th of June 2003 the ozone concentration recorded at surface station in Emilia-Romagna gradually increased, so that between the 11th and the 15th of June the values of concentrations at most of the stations located in the region were well above the threshold of 180 µg/m³, with area averages between 210 and 240 µg/m³ and peak local values over 270 µg/m³. It is interesting to notice that the peak values were recorded at the stations located out of the main urban areas. During the same period peak values of concentration of PM10 were also recorded along the Adriatic coast. These data are made available by ARPA-SIM.

c) Fires in Emilia-Romagna

The anomalous summer 2003 was associated with large wildfires that caused the destruction of an important fraction of the forest resources. Official statistics of Italy (provided by the Dipartimento della Protezione Civile, Corpo Forestale dello Stato) for the fire season 2003 (up to 13 August 2003) reveal the occurrence of a total of 7,916 wildfires which affected 24,328 ha of forest land and 34,574 ha of non-forest land, totalling 58,902 ha (http://www.fire.uni-freiburg.de/GFMCnew/2003/0903/20030903_europe.htm).

On 17 September 2003 the surface affected by fires in Emilia-Romagna was 173ha, with a percentage of total area burnt equal to 0.5. The Italian region with largest damages was in fact Sardegna followed by Sicilia, Liguria, Toscana and Calabria.

b) Impacts on agriculture

The climatological anomaly of summer 2003 over Emilia-Romagna implied peak values in crop evapotranspiration and exceptionally negative water balances. The high temperatures not only increased crop water needs, but also negatively influenced their phenological growth, leading to a further possible reduction in yields. Greatest impacts were observed on crops with great water demands, with reductions up to 50% of the yield in the absence of proper irrigation. The very high temperatures recorded during that summer also implied a decrease in fruit sizes, and in fruit production in general, a decrease in the quality of tomatoes and apples, and in the acidity of grape-juices. At the same time, an increase in the number and in the impacts of plant parasites was recorded.

References and further reading

Zauli Sajani, S., Garaffoni, G., Goldoni, C., A., Ranzi, A., Tibaldi, S., Lauriola, P., 2002: Mortality and bioclimatic discomfort in Emilia-Romagna, Italy. *J Epidemiol Community Health*.56:536-537

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