Abstract paper

Impact of climate change on soil temperature in Croatia

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Abstract

The mean, maximal and minimal soil temperatures have been analyzed, at different depths 2, 5, 10, 20, 30, 50 and 100 cm, for selected meteorological stations in Croatia. The main goals were to study the impact of climate change on soil temperature by depth and identify vulnerable areas due to the high soil temperature.

At most stations mean annual soil temperatures have increased by approximately 1°C at all depths in the last three decades. The analysis of the linear trend and the Mann-Kendall test confirm the existence of a significant positive trend of mean annual soil temperature at the 0.05 significance level.

A significant increase in soil temperature is observed, at the depth of 2 cm in particular, at all meteorological stations in the period 1961–2010. In shallower soil layers, up to a depth of 10 cm, the positive trend is between 0.2 and 0.7°C/decade. In deeper layers, up to 100 cm, the trend is slightly less pronounced (0.3–0.6 °C/decade). Seasonal trends show the greatest contributor to the increase in mean annual soil temperature is their increase in the spring and summer. A more significant trend of temperature increase is in the upper layers because the surface layers are heated more quickly during the day and in the summer, and cooled more quickly during the night and in the winter.

In the period 1961-2010 for almost all stations in all seasons and depths there are positive trends of maximal soil temperature. Annual trends of maximal values at 2 cm of depth are 0.4–2.6 °C/decade and generally decrease with depth. However, there are not so many significant annual and seasonal trends of minimal soil temperature. In the continental part of the country, mainly positive significant summer trends are in deeper layer and some positive significant winter trends. In the upper layer, a couple of stations mark negative significant winter and autumn trends. In the coastal part of the country some positive significant spring and summer trends are through all depths. Thus, annual trends of minimal values at 2 cm of depth are -0.45–0.3°C/decade with variations of trend values with depth.

Analysis of consecutive days with daily maximal soil temperatures above 30°C shows the longest extremely warm periods in the wider Dubrovnik area. Soil temperatures above 45°C in the surface layer with duration above 10 days appeared only in Trsteno near Dubrovnik in the period 1961–1990. Since 2000 year such warm period has began to occur along the Adriatic coast and islands, and at the Đakovo area. Vulnerability of the high soil temperatures in agriculture is defined by warm period longer than 10 days which appeared in the six years out of the observed 30 years. Thus, the likelihood of the occurrence is above 20%. A soil

temperature above 30°C for depth of 2 cm affected the entire Croatia according to available data of soil temperature.

Vulnerability is greater on the Adriatic coast and islands than in the Croatian inland at a depth of 5 cm and 10 cm. With increasing the critical soil temperature and the depth, the size of vulnerable areas decreases.

Key words: climate change, soil temperature, Croatia