Threshold climatic changes for SOM variations in different Mediterranean crop systems

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Introduction. Soil organic matter content (SOM) variations observed along climatic gradients (climosequence ClSe) can provide information about potential fluctuations in past or future climatic scenarios. This work aimed at studying a set of ClSe to establish threshold climatic changes for SOM variations in different crop systems.

Materials and methods. Four typical Mediterranean crop systems were selected in Italy: crop rotation for animal husbandry in the Po plain (AH), specialized olive grove in Campania (OT), permanent meadows in Sardinia (PM), and cereal crops in Sicily (CE). 148 sites with similar soil type, morphology, geology and LUM were investigated along 4 different ClSe. A set of climatic parameters were spatialized with a resolution of 1 km. All sites in the ClSe were associated with different climatic parameters and correlated with SOM content in the first 30 cm. We used the De Martonne aridity index as indicator for describing climate changes (ΔAI) affecting SOM variations (ΔSOM). AI values of the sites in each ClSe were clustered and SOM values of the clusters were submitted to analysis of variance to find statistical differences. Three climatic maps were produced, about i) long-term and ii) mean values of the periods 1961-1990 and iii) 1981-2010. The ΔSOM were validated in 65 legacy sites, surveyed in the years 1960-2000 and resampled and analyzed in 2012.

Results and discussion. Significant ΔSOM in the ClSe were 0.56 ± 0.12 g dag^{-1} in AH, 1.81 ± 0.46 in OT, 0.28 ± 0.11 in PM, and 0.33 ± 0.14 in CE, corresponding to ΔAI of 6.88 ± 0.71 in AH, 3.04 ± 0.54 in OT, 2.00 ± 0.15 in PM, and 3.21 ± 0.39 in CE. Thus the most sensitive environment was OT (SOM changed 0.6 g dag^{-1} per unit of AI), followed by PM (0.14 g dag^{-1}), CE (0.10 g dag^{-1}) and AH (0.08 g dag^{-1}). The sensitivity of OT could be related to the andic properties of the soil type. Although the SOM of legacy and recent sampling were never statistically different, the maps of the AI of the two periods indicated that a climatic change potentially able to induce a significant ΔSOM was reached in many areas of OT, but also in parts of all the other crop systems.

Conclusions. The overall increase of aridity occurred in the last 50 years in the Mediterranean area caused a significant potential SOM decrease, especially in the andic soils of the OT crop system. In the other crop systems under investigation, the observed climate change was not strong enough to cause significant and generalized SOM variations during the considered time frame.

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