Geophysical Research Abstracts
Vol. 16, EGU2014-638-3, 2014
EGU General Assembly 2014

Potential soil organic carbon stocks in semi arid areas under climate change scenarios: an application of CarboSOIL model in northern Egypt

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1. INTRODUCTION

Climate change is predicted to have a large impact on semi arid areas which are often degraded and vulnerable to environmental changes (Muñoz-Rojas et al., 2012a; 2012b; 2013). However, these areas might play a key role in mitigation of climate change effects through sequestration of carbon in soils (United Nations, 2011). At the same time, increasing organic carbon in these environments could be beneficial for soil erosion control, soil fertility and, ultimately, food production (Lal, 2004). Several approaches have been carried out to evaluate climate change impacts on soil organic carbon (SOC) stocks, but soil carbon models are amongst the most effective tools to assess C stocks, dynamics and distribution and to predict trends under climate change scenarios (Jones et al., 2005). CarboSOIL is an empirical model based on regression techniques and developed to predict SOC contents at standard soil depths of 0 to 25, 25 to 50 and 50-75 cm (Muñoz-Rojas et al., 2013). CarboSOIL model has been designed as a GIS-integrated tool and is a new component of the agroecological decision support system for land evaluation MicroLEIS DSS (De la Rosa et al., 2004).

2. GENERAL METHODS

In this research, CarboSOIL was applied in El-Fayoum depression, a semi arid region located in northern Egypt with a large potential for agriculture (Abd-Elmabod et al, 2012). The model was applied in a total of six soil-units classified according the USDA Soil Taxonomy system within the orders Entisols and Aridisols under different climate climate change scenarios. Global climate models based on the Organisation for Economic Co-operation and Development (Agrawala at al., 2004) and the Intergovernmental Panel on Climate Change (IPCC, 2007) were applied to predict short-, medium- and long-term trends (2030, 2050 and 2100) of SOC dynamics and sequestration at different soil depths (0-25, 25-50 and 50-75) and land use types (irrigated areas, olive groves, wheat, cotton and other annual crops, and fruit trees and berries).

3. RESULTS AND CONCLUSIONS

According to results, considerable decreases of SOC stocks are expected in the 25-50 cm soil section under all considered land use types and all projected scenarios, in particular in Vertic Torrifluvents and Typic Torrifluvents under wheat, cotton and other annual crops. Oppositely, SOC stocks tend to increase in the deeper soil section (50-75 cm), mostly in Typic Haplocalcids under permanently irrigated areas and olive groves in the 2100 scenario. In the upper layer (0-25 cm), slight increases have been predicted under all considered land use types. The methodology used in this research could be applied to other semi arid areas with available soil, land use and climate data. Moreover, the information developed in this study might support decision-making for land use planning, agricultural management and climate adaptation strategies in semi arid regions.

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