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Impact of land use on carbon sequestration in young coastal soils determined by stable carbon isotope and carbon turnover measurements

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Soils are the largest carbon reservoir in the terrestrial environment containing four times more carbon than the terrestrial biosphere and three times more than the atmosphere. Their potential for additional carbon sequestration is still tremendous and considered in strategies for reducing the atmospheric CO_2 increase. Carbon sequestration in soils depends on the type and conditions of the ecosystem and on land use. We studied carbon sequestration in young coastal soils that developed from a tidal flat that was diked 35 years ago. The area (1,500 ha) was homogeneous in terms of basic soil properties and mainly used as agricultural land, grassland and forest land. Carbon sequestration under these three land use systems was measured by quantifying net primary production and heterotrophic soil respiration. Furthermore stable carbon isotope signatures of plant material and soil organic matter were determined. The forest and grassland sites accumulated organic carbon with annual rates between 0.2 and 1.5 t C ha^{-1} yr^{-1}. In contrast, soils of the arable land were a net carbon source with an annual carbon loss of -0.8 t C ha^{-1} yr^{-1}. Differences in carbon sequestration rates were also supported by stable carbon isotope signatures of soil organic matter. Grassland and forestland δ^{13}C signatures were lowest at the soil surface (-28 to -30 per mill PDB) indicating an accumulation of carbon from the terrestrial plant biomass (-28 to -31 per mill PDB) in the surface horizons. Stable carbon isotope values below 30cm were similar to those from the parent material, the marine tidal flat (-24 to -26 per mill PDB). In contrast, δ^{13}C values of the soil organic matter in the arable land (-24 to -26 per mill PDB) did not change with depth and resembled those of the parent ma-

terial (-24 to -26 per mill PDB) but not those of the current field crops (-29 to -31 per mill PDB) giving no evidence for an accumulation of organic matter from terrestrial plants. We conclude that the main reason for the observed differences in soil carbon sequestration is related to the type of land use.