Meta-analysis on different land management impacts on soil organic carbon stocks

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4PER1000 SOILS FOR FOOD SECURITY AND CLIMATE

Many studies on management effects on soil carbon but little overview

There are several management options in agriculture that aim at recovering the lost carbon and aim to sequester additional carbon. We reviewed several of these options performing quantitative meta-analysis in order to compile existing knowledge on their impact on soil organic carbon stock.

Cover crops effectively increase soil C

The potential has not been fully explored

Cover crops increase the carbon input to the soil without compromising external biomass resources. With 320 kg C ha^{-1} a^{-1} cover crops are a very effective measure to increase soil carbon on croplands (Fig. 1).

Legend:
RothC average scenario
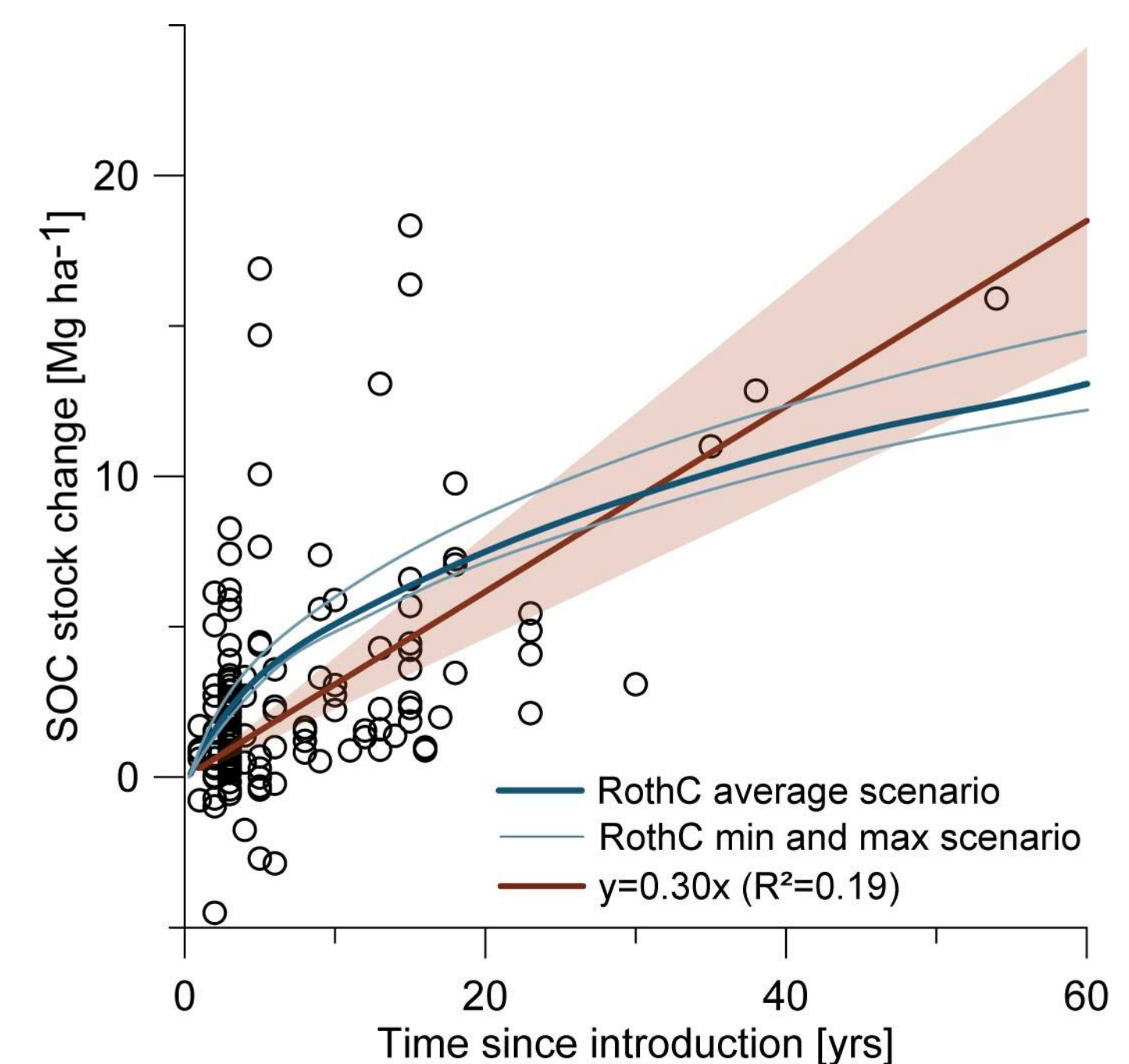RothC min and max scenario
y=0.30x (R²=0.19)

Figure 1: SOC stock change as a function of time since start of cover crop cultivation and the RothC simulated average SOC stock changes (Poeplau and Don, 2015 AGEE)

No tillage and minimum tillage are often promoted to sequester C

In the temperate zone effects on soil C are small

The effects of reduced or no-tillage on soil carbon stocks are less clear that often discussed. We did not detect any significant soil carbon sequestration rate with reduced or no tillage in temperate soils (Fig. 2) . Even the oldest field trials revealed inconsistent results. However, increased nitrous oxide emissions due to reduced tillage may turn greenhouse gas balance of no-tillage into negative (Fig 3).
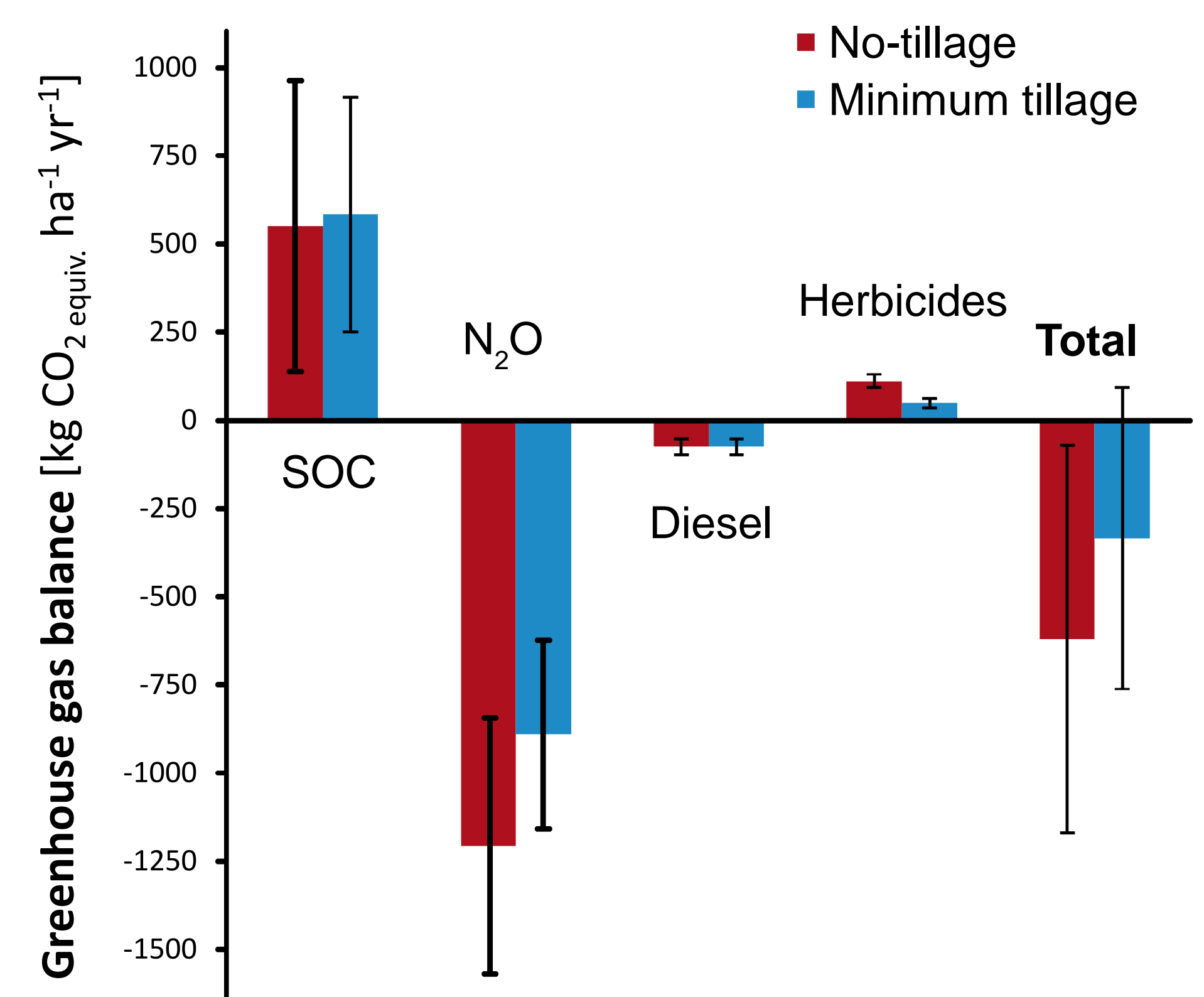

Figure 2: Compilation of SOC stocks effects of no-tillage and minimum tillage from 116 field studies from the temperate zone (Don et al. In prep)

Figure 3: Field greenhouse gas balance of no-tillage and minimum tillage in relation to conventional tillage. Diesel refers to the fossil fuel consomptions during tillage (Don et al. in prep).
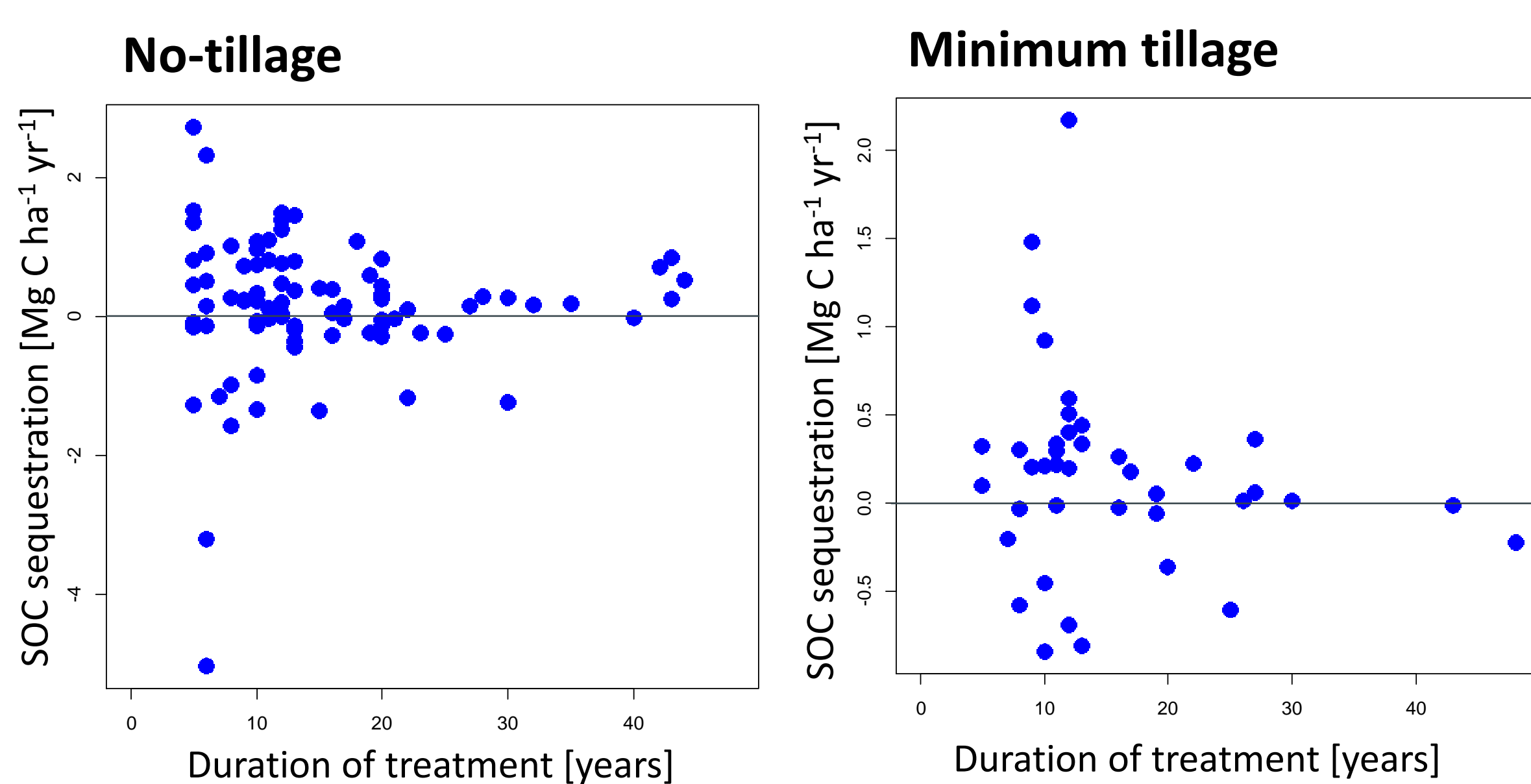
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With our extensive meta-analysis on different land management options we contributed to compile scattered knowledge into a more comprehensive picture.

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