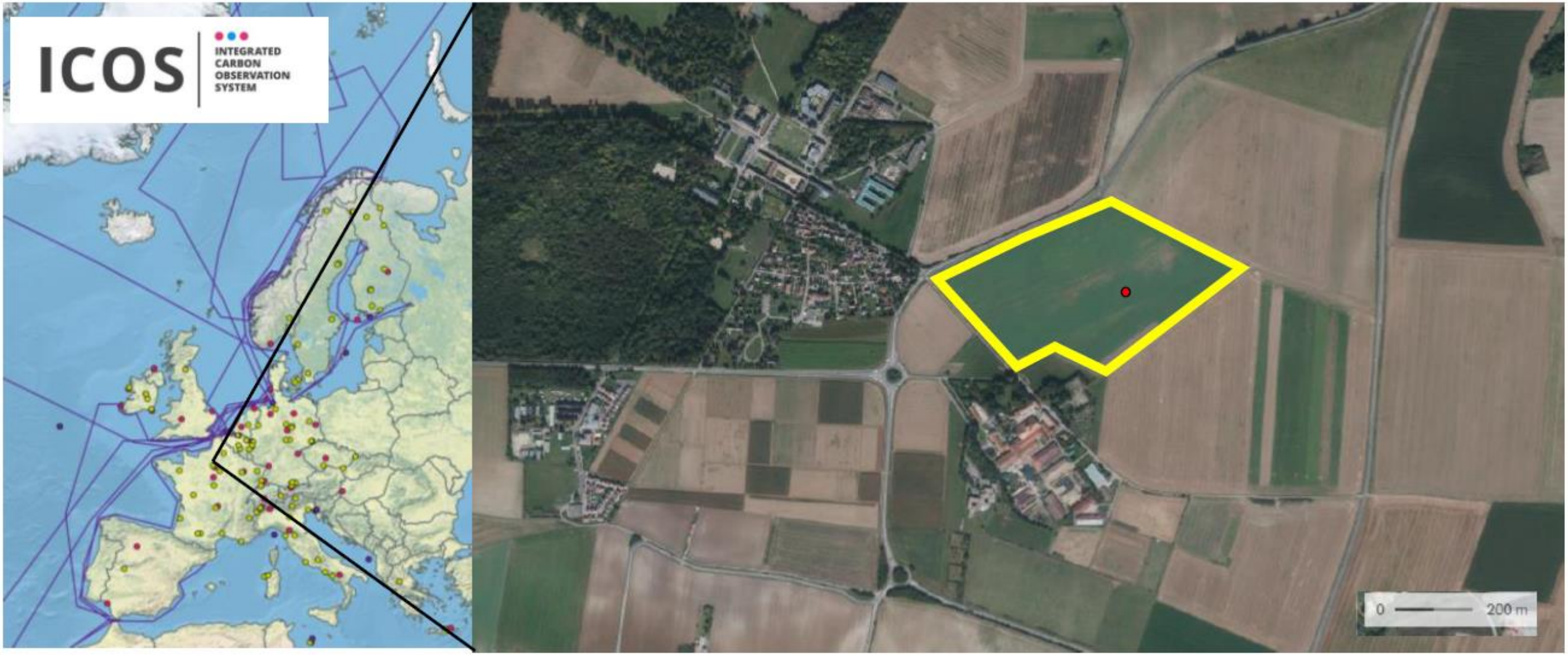

Figure 1. (left) The ICOS station network. (right) FR-Gri 19 ha field site highlighted in yellow. The CO_2 flux mast is shown in red. The farm is mixed farm with cows and sheep in the buildings visible on the south of the site. The site was cultivated for over 100 years, with no clear record of when cultivation started. It was highly fertilised in the 1980s with sewage sludge. On the left, the image is taken from the ICOS web site © ICOS RI. On the right the image was taken from the French GeoPortal © IGN 2023. The image was taken in 2021.

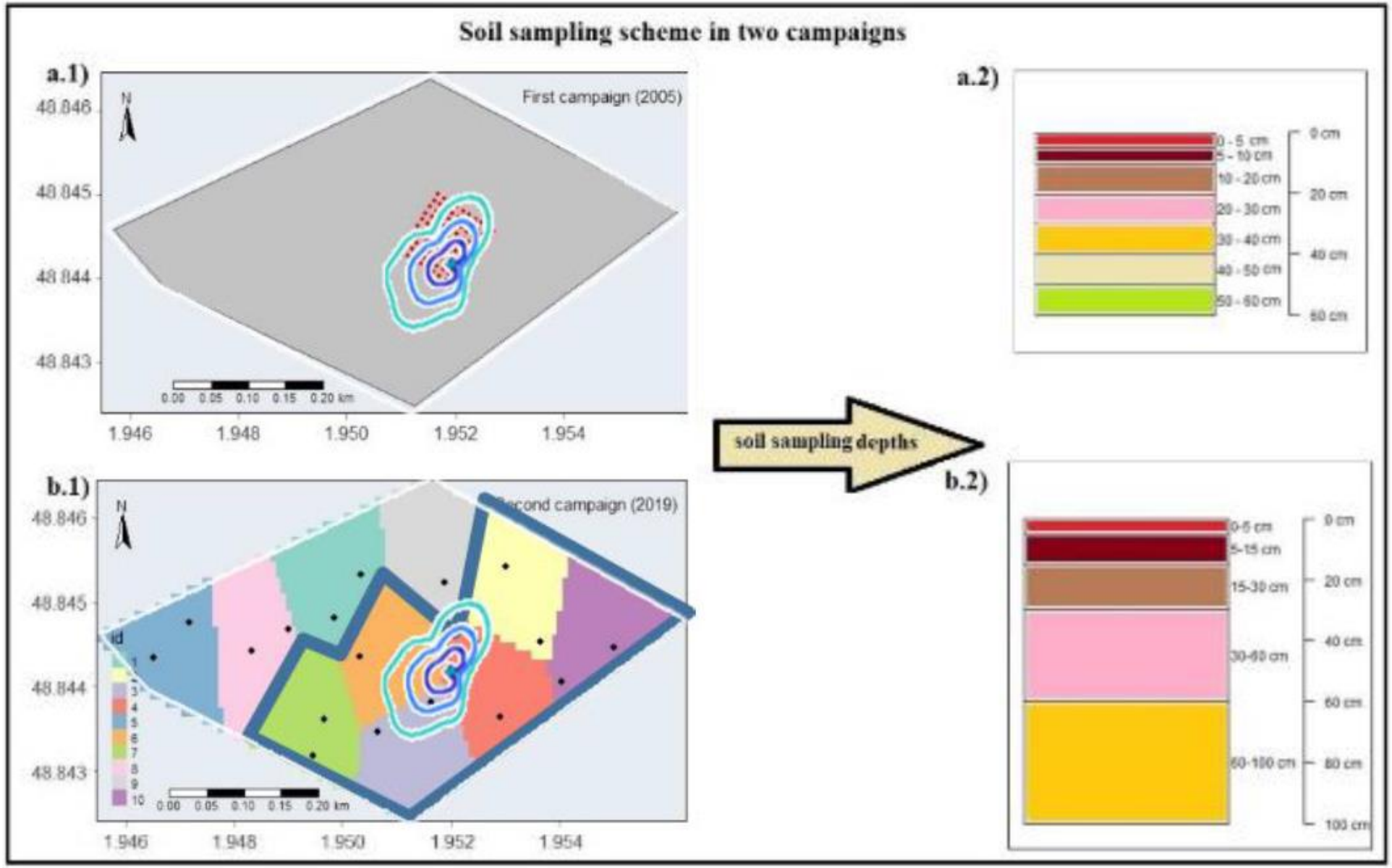

Figure 2. a. The sampling points and depths used in the 2005 campaign. The grey area represents the FR-Gri field. b. In 2019 the location of the aggregated SP-I samples in the 10 strata are shown. The bold blue line on the 2019 campaign shows the reduced sampling area used for comparison with the 2005 campaign. The blue lines show the 50, 70 and 80% footprint from the Eddy covariance mast.

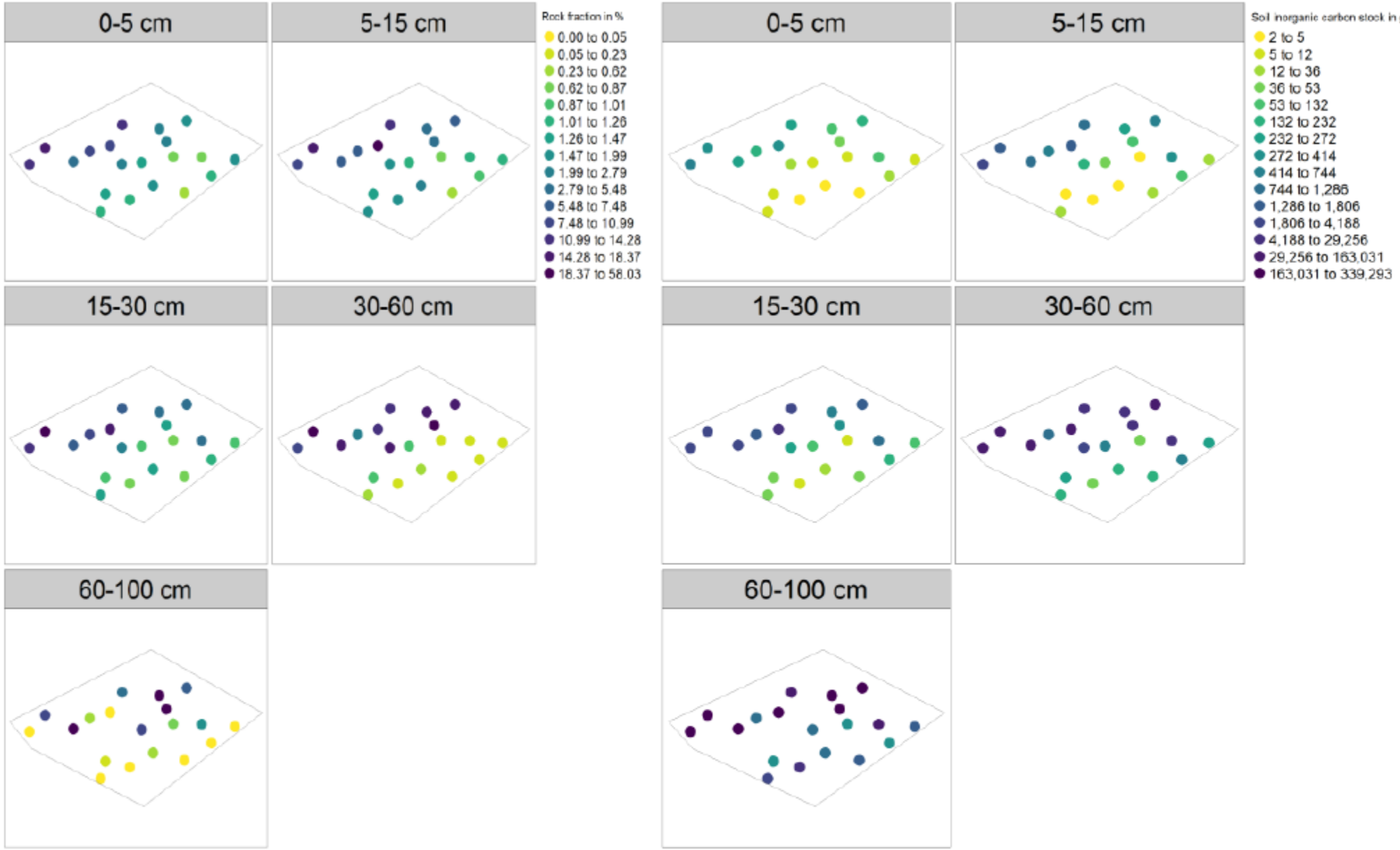

Figure 3. Rock fraction (left) and carbonates (right) spatial variability was measured in 2019 at the 20 spatial sampling points at several layers. In the 60-100 cm layer the SP-15 is missing as it was too stony to sample.

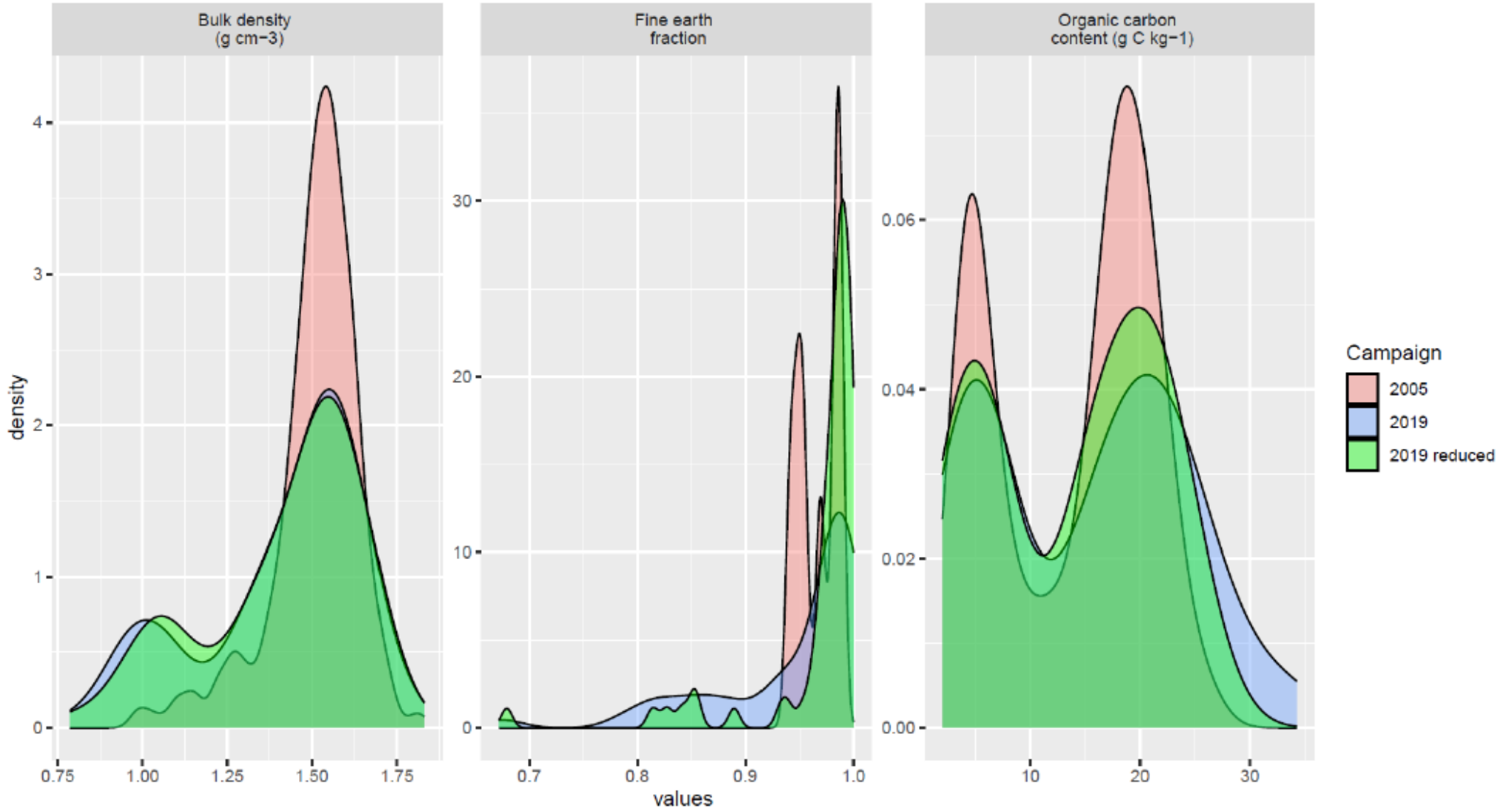

Figure 4. Density distribution of soil bulk density, fraction of fine earth in soil, and soil organic carbon content (named SOC_{fe} in the text) for all sampling depths considered together in the two campaigns (2005 and 2019) as well as for the reduced area in 2019 which was chosen so that the fine earth content was similar as in 2005.

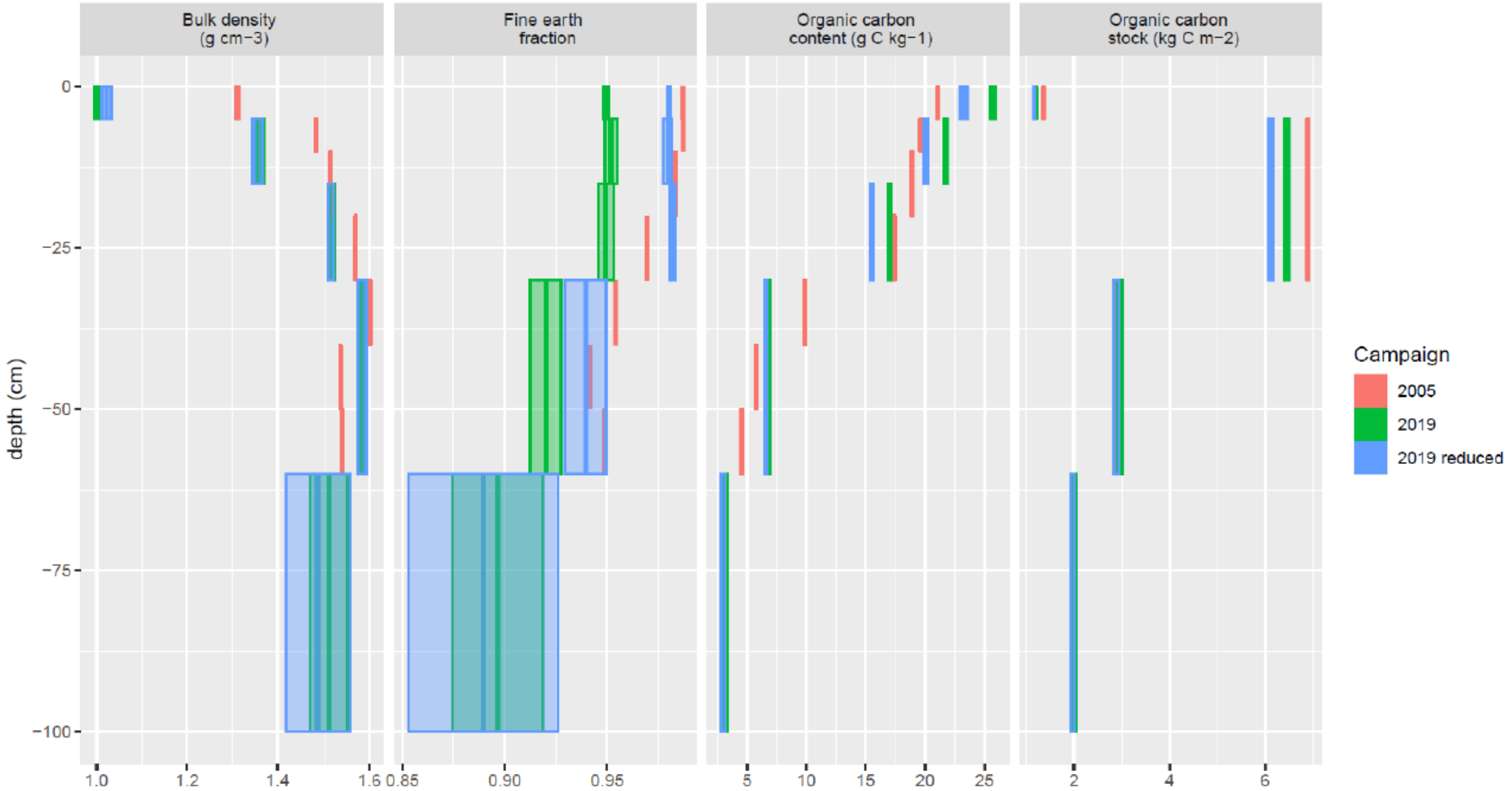

Figure 5. Profiles of bulk density (BD), fine earth fraction, soil organic carbon content (SOC_{fe}), and organic carbon stocks in the two campaigns. Ribbons show the 95% confidence interval calculated computed with eq. 9, and lines show means. A graph showing the organic, inorganic and total carbon stocks for 2019 is shown in Figure S1. Note that here, the carbon stocks are calculated at fixed depths.

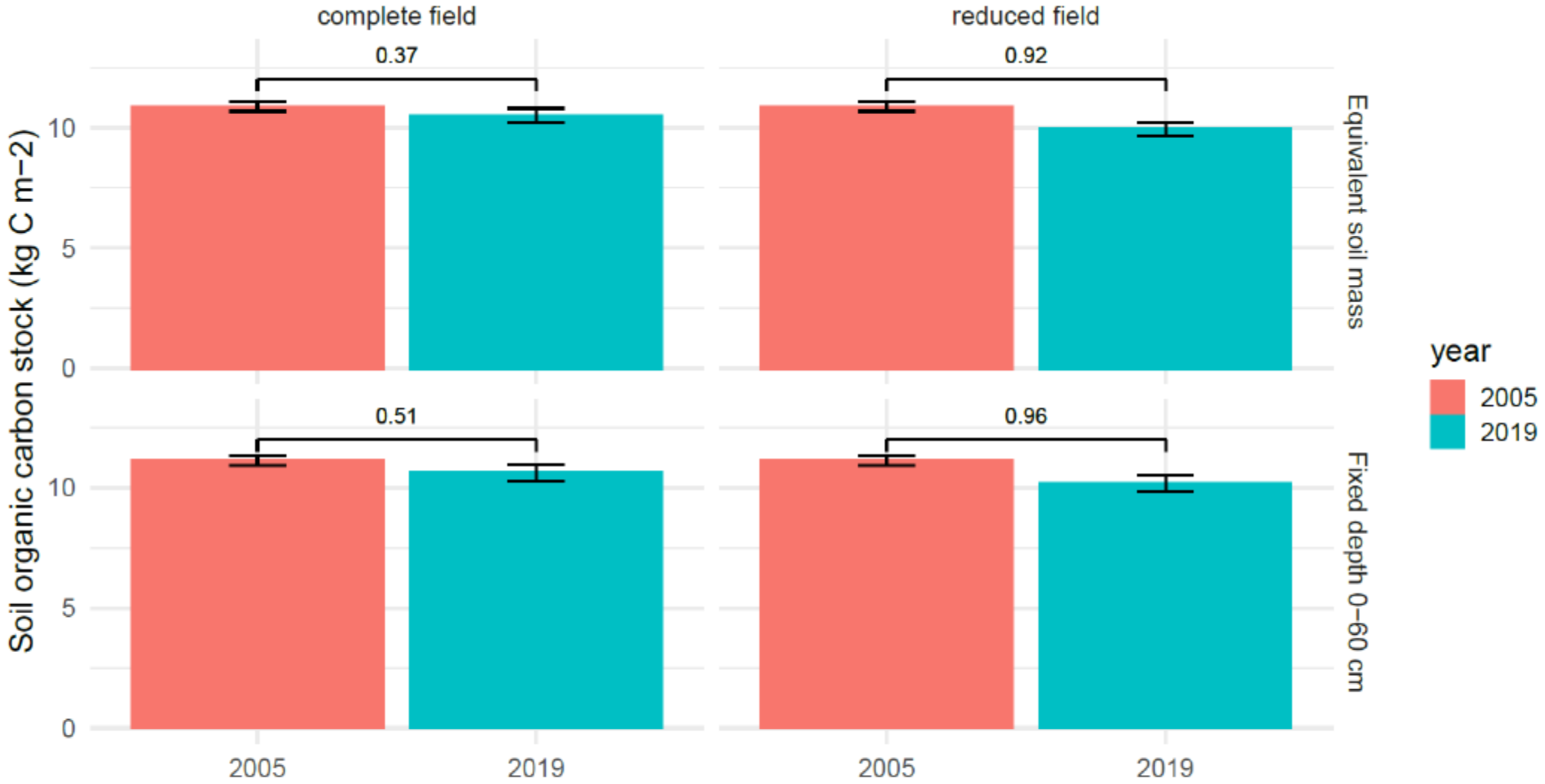

Figure 6. Organic carbon stock measured in 2005 and 2019 over the 0-60 cm layer with the fixed depth (lower panels) and equivalent soil mass (upper panels) methods. For 2019, the complete field or a reduced area most corresponding to the 2005 sampling area are considered. The error bars show the 95% confidence interval calculated according to eq. 9. Figure S3 shows the carbon stock over the 0-30 cm layer.

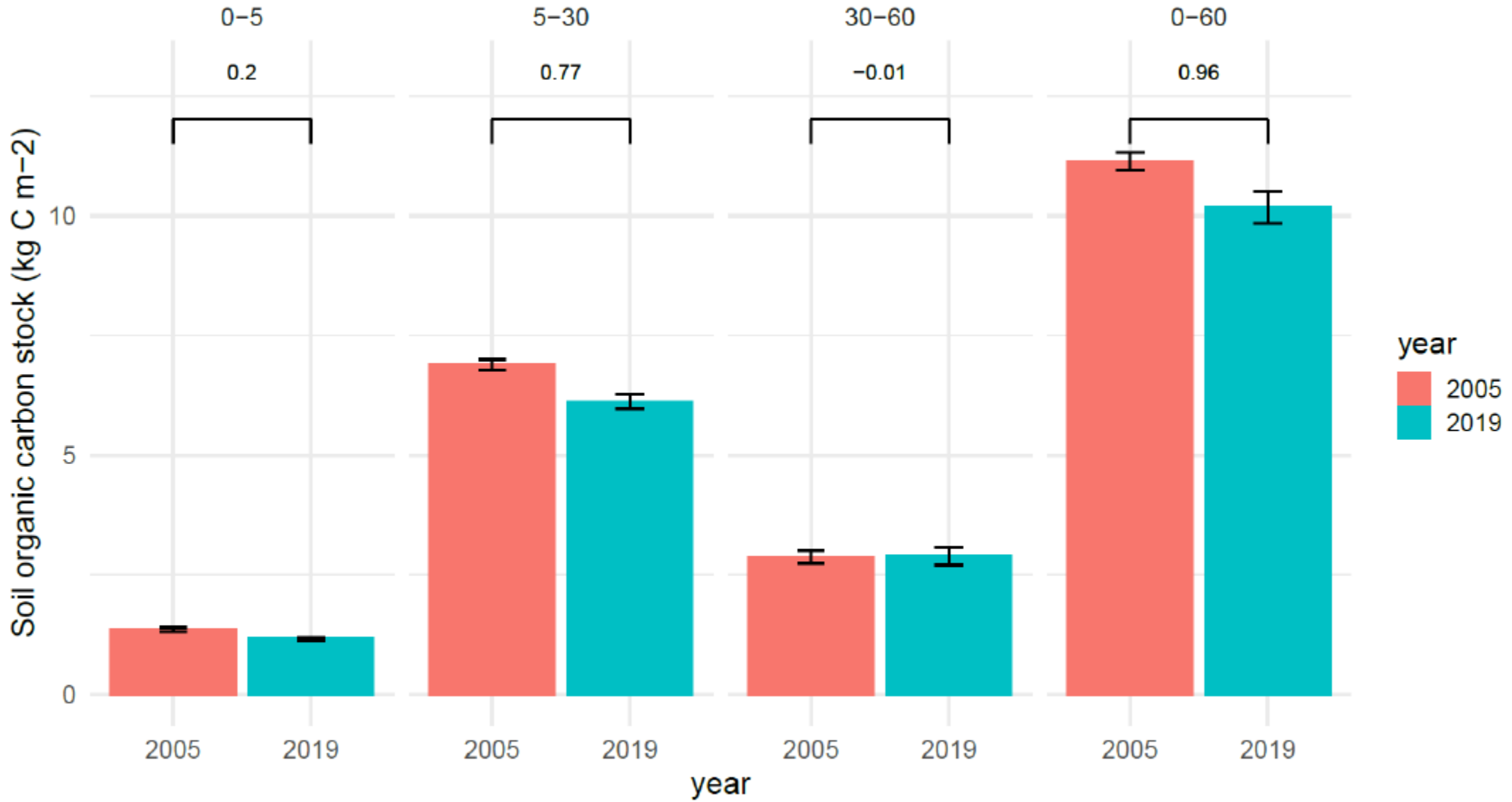

Figure 7. Carbon stock evolution between 2005 and 2019 over different layers with the fixed depth method (FD) over the reduced area. The error bars show the 95% confidence interval calculated according to eq. 9.

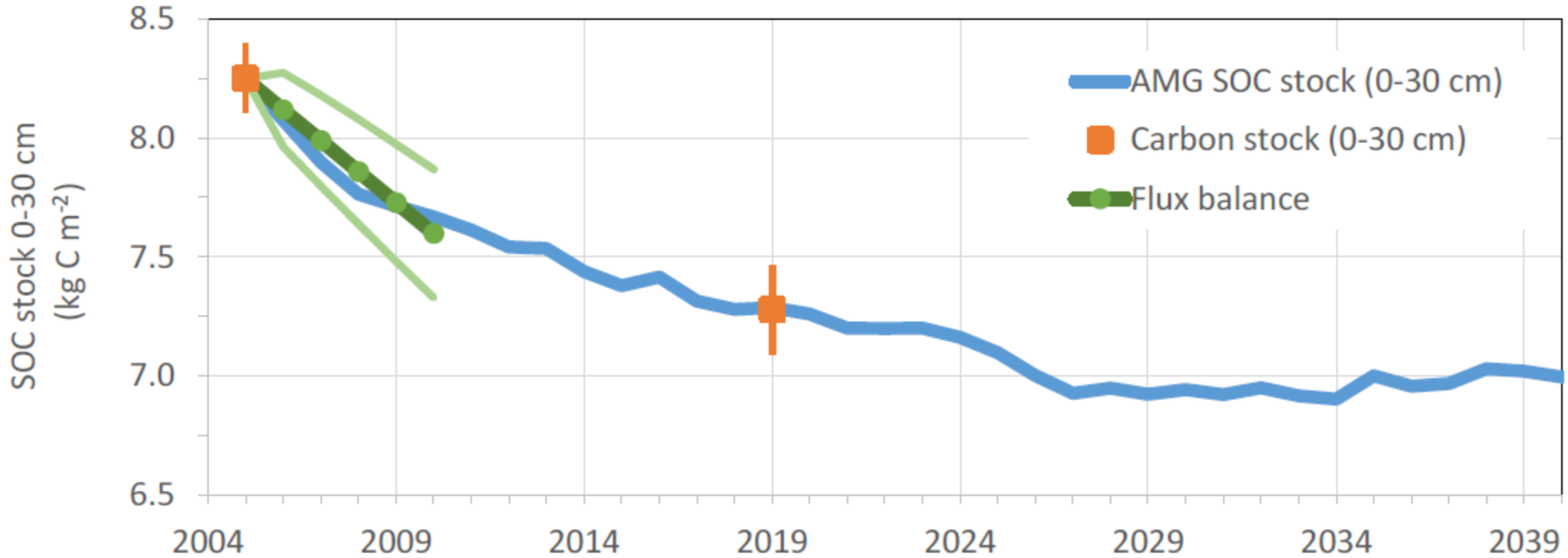

Figure 8. Soil organic carbon stock in the 0-30 cm depth as simulated by the AMG model (blue), measured by soil sampling in 2005 and 2019 with the fixed depth method (orange squares), and measured by flux balance over the 2006-2010 period (green points and light green line for error bars) as published in Loubet et al. (2011). The error bars show the sampling standard error. The 2019 soil stock is given for the reduced field only.