SOIL ORGANIC CARBON QUANTIFICATION IN PODZOL SUBSOIL

AN ATTEMPT TO REFINE SOIL CARBON INVETORY IN THE CZECH REPUBLIC

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MOTIVATION

As far as we know that soil are important sink of carbon, an attempt to quantify the carbon stock and fluxes exists. Organic horizons are homogenous in terms of carbon content (Dégórski 2007; Liski and Westman 1997), however, the carbon density is often underestimated by exclusion of subsoil (subsurface mineral horizons) which can be rich in carbon as well.

Chernozems and fluvisols are well known to have high carbon stock in subsoil. According to Rumpel et al. (2002) the soil organic carbon stock in mineral subsoil can be up to 47% in some cambisol, in podzols up to 75%, or 66% (Batjes 2002). Podzols are significant of having high soil carbon stock in their subsoil but this stock has high spatial variability; the variation coefficient can be up to 146% (Batjes 2002).

In the Czech Republic (CZ) an attempt to quantify soil carbon in forest soil have been done. But the quantification was done for only upper 30 cm of soil. The aim of this work was to point out that that exclusion of subsoil from soil carbon quantification should be revised. For this purpose, a profile of Carbic Podzol (IUSS WRB, 2007) was chosen for soil organic carbon quantification a and its spatial variability visualisation.

METHODS AND STUDY AREA

Ralsko region in the CZ is known as locality with well-developed Carbic Podzols (Fig. 1). The underlying bedrock is thick-bedded sandstone. Studied pedon (visualised in Fig. 2) was chosen as representative of Carbic Podzol both in Ralsko and CZ. Tonguing of Bhs horizon is frequent in the locality.

Calculation of soil organic carbon density was taken according to Cienciala et al. (2006) for each horizon:

$$SOC = C_{ox} \times BD \times T \times CF \times 10$$

where SOC is the final soil carbon density (kg. m^{-2}) in horizon, C_{ox} is the soil carbon content (%), BD is the bulk density (g.cm^{-3}), T is the thickness of the horizon (m) and CF is the coefficient for estimation of coarse fragments (absent coarse fragments, CF = 1). Similarly, see Batjes (1996) and Schwartz and Namri (2002).

Dataset of soil carbon densities for each horizon was put into a grid by kriging. The courses of the carbon density in individual soil profiles in the studied pedon were visualised as a diagram of soil carbon density in individual horizons (Fig. 3 and 4). Additionally, the spatial variability of all horizon courses (Fig. 2) was visualised.

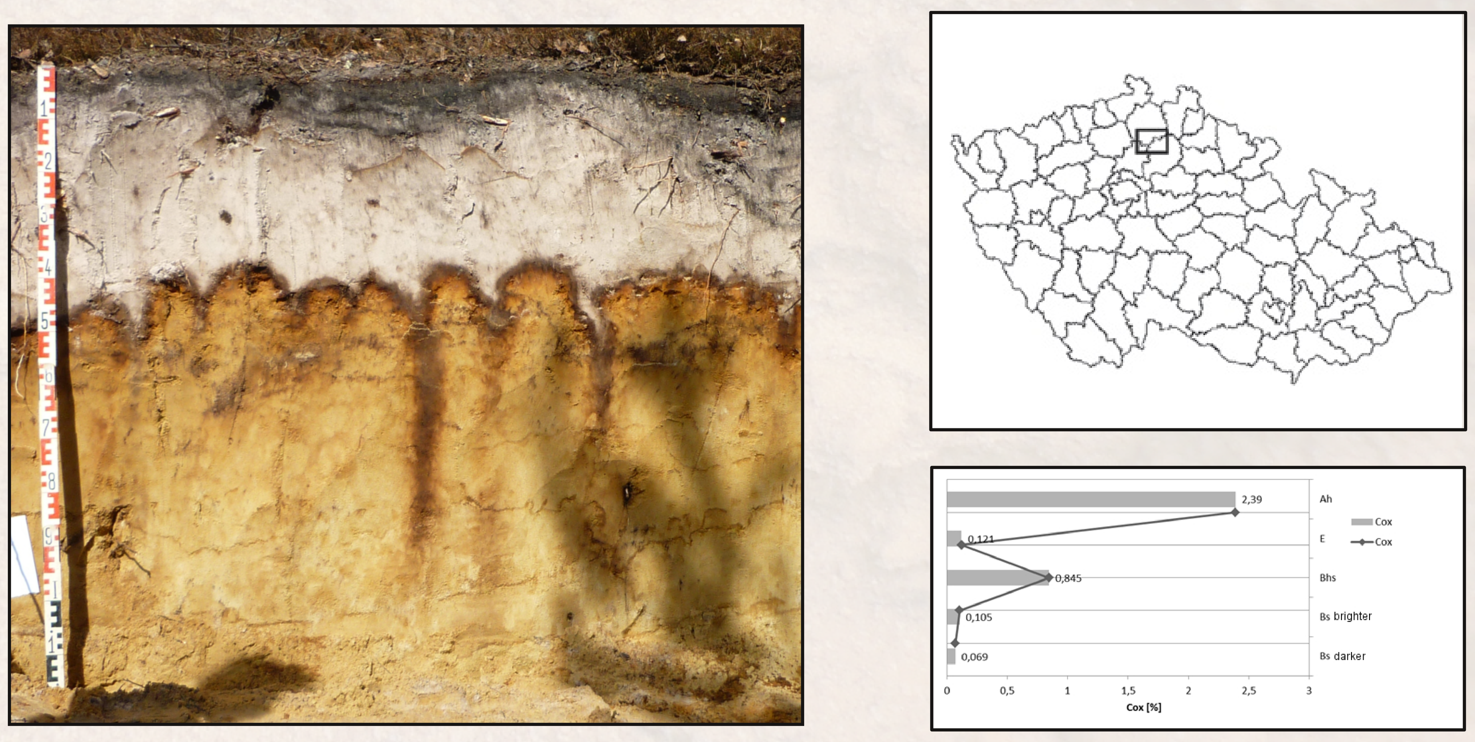

Fig 1 Localization of the Ralsko region in the CZ (upper right), typical course of the soil organic carbon content (%) in the podzol profile (bottom right), studied podzol (left).

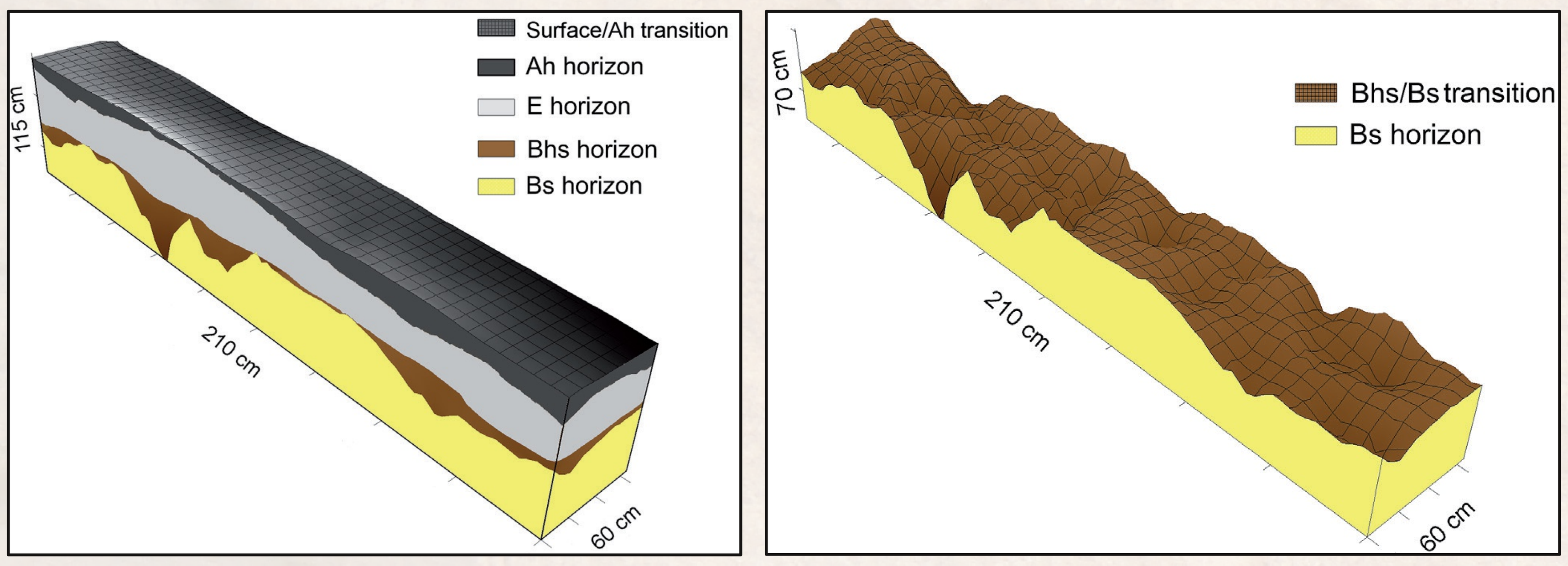

Fig 2 Studied soil pedon, complete soil profile (letf), tonguing course between Bhs and Bs horizon (right)

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The quantification of soil carbon in forest soils in CZ was carried out for the upper 30 cm, which is, considered by Marek et al. (2011), crucial for the soil carbon balance. The only currently available output on a national level with soil carbon data in CZ is the map with charts of the soil carbon stock in Marek et al. (2011). We consider this approach to be insufficient.

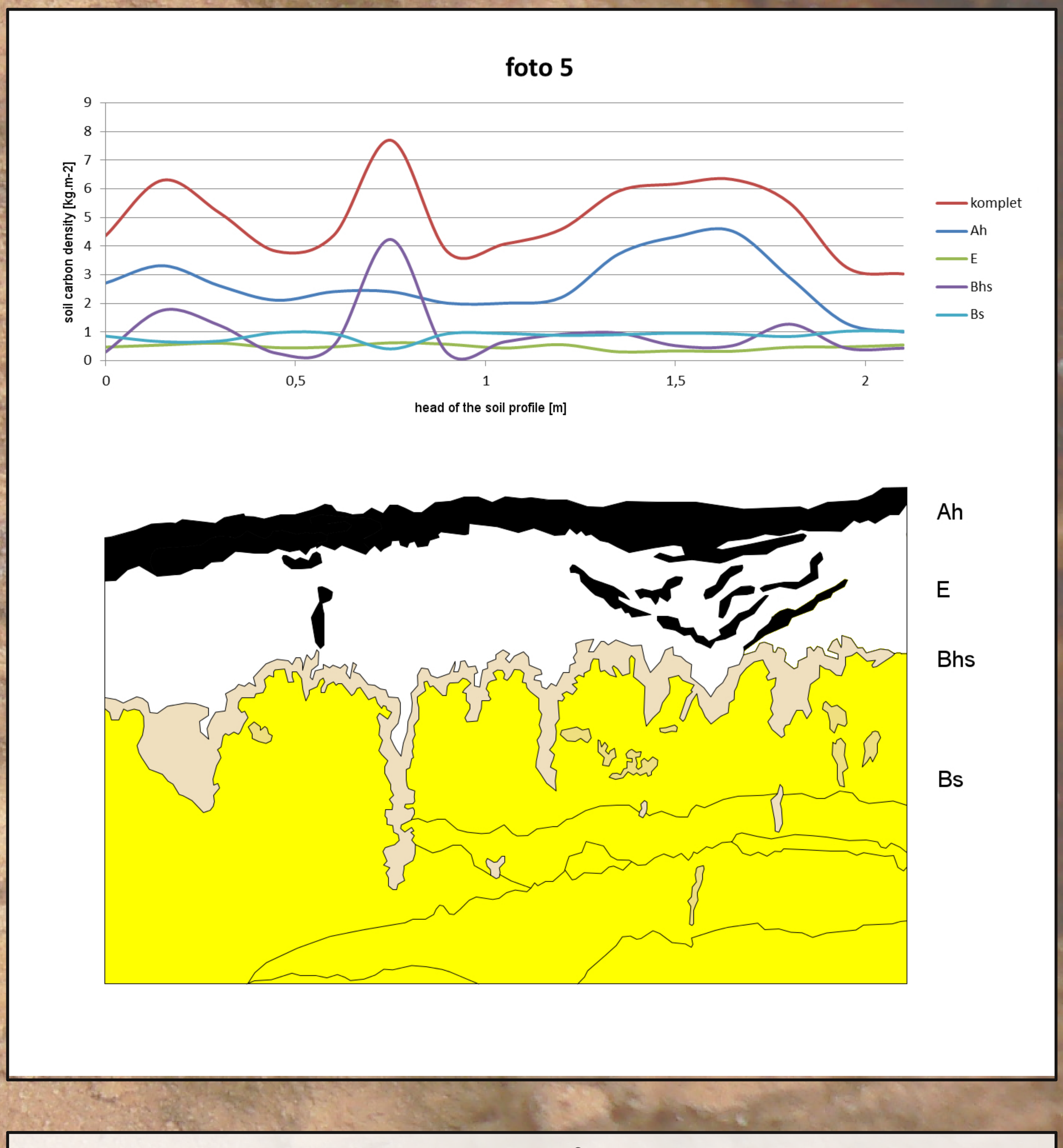

Fig. 4 Soil organic carbon densities (kg.m^{-2}) as a function of horizon thickness in indidual horizons ("Ah-Bs") and in complete soil profile ("komplet").

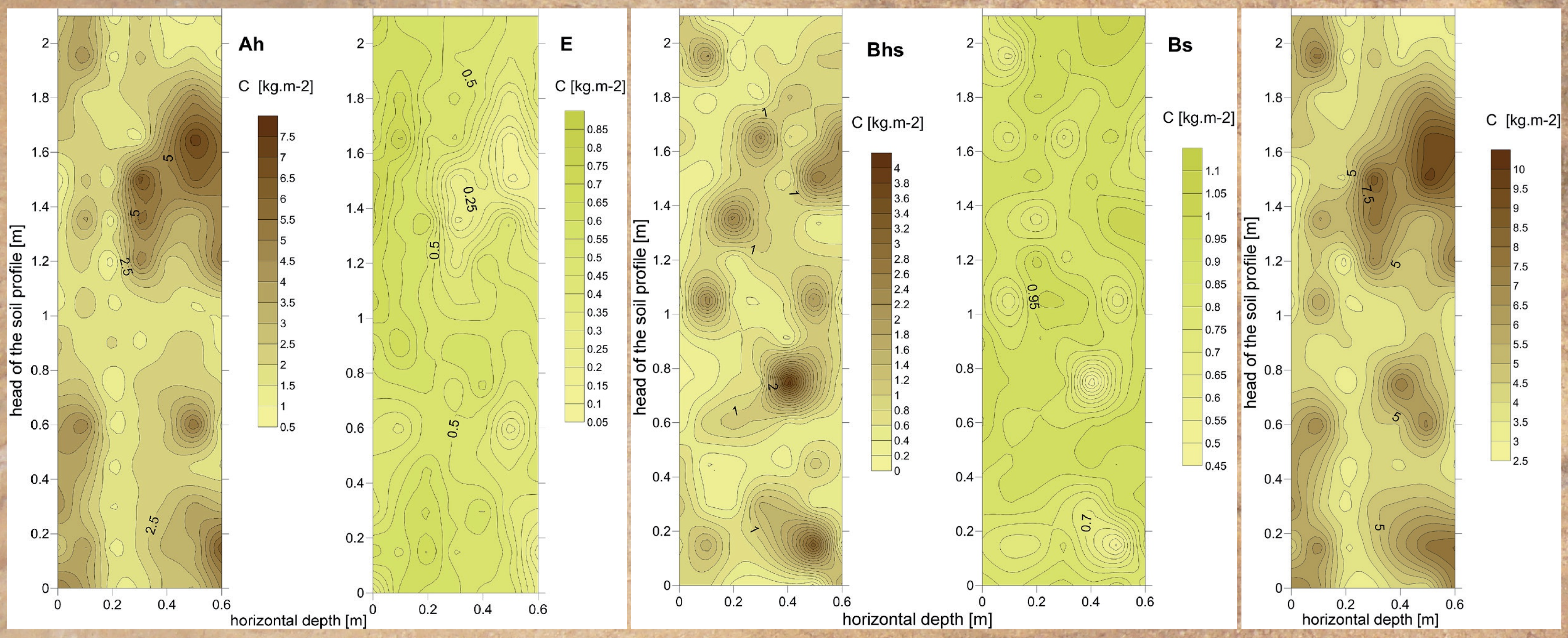

Fig. 3 Soil organic carbon densities (kg.m^{-2}) in the studied pedon in individual horizons (Ah - E - Bhs - Bs) and in complete soil profile (figure on the right).

RESULTS AND CONCLUSION

The course of the carbon densities in individual horizons and in the whole profile is depicted in Figure 3. The total carbon density depends on horizon thickness (Fig 4). First of all, carbon stock in the whole soil profile is determined mainly by carbon density in Ah horizon, because of the small thickness of Bhs horizon. But, where the tonguing is appearing, and as you can see from Fig 2 it is very frequent in the locality, the total carbon density is considerably affected by higher thickness of Bhs. Therefore the carbon density is higher in these positions.

The quantification of carbon densities below and above the level of 30 cm was done. The exclusion of the mineral or organic horizons below the 30 cm leads to shrinkage of the total carbon density up to 53 %. The total carbon density in whole soil profile is 4.997 kg m^{-2}. The average carbon density is the highest in Ah horizon, but a large amount can be found in Bhs horizons.

Soil organic carbon acculmulated in subsoil can influence the eventual soil carbon stock. To provide more accurate results in soil organic carbon estimation, inclusion of mineral horizons in subsoil is necessary.

ACKNOWLEDGEMENTS

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