PO446

EVALUATION OF 50 YEARS SUBSIDENCE MONITORING OF A PEAT MEADOW PARCEL TO COMPARE SEVERAL METHODS TO DETERMINE CO_2-EMISSIONS

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Introduction

Subsidence of drained peat soils in agricultural use is a well-known problem in the Netherlands. After 1965 a modernization of dairy farming started including lowering of ditch water levels to improve the bearing capacity of peat meadow parcels. Among others to monitor the expected increase of subsidence the experimental farm Zegveld was founded in 1966. A major part of the subsidence of peat land is caused by biological degradation (peat oxidation). The associated CO_2-emission of drained peat soils in The Netherlands is about 4.2 Mton per year. More-over the mineralized N causes an extra N_2O-emission of 0.5 CO_2-eq. per year. The aim of the Dutch Government is to reduce the CO_2-emission by peat oxidation with 1 Mton per year in 2030. Therefore in 2019 a national research programme commenced to determine the effectiveness of measures to reduce CO_2-emissions and subsidence of peat soils (*see PICO-presentation PI035*). Part of this programme is the determination of the subsidence and CO_2-emissions in the past of the experimental farm Zegveld.

Subsidence Zegveld experimental farm

The altitude of the experimental farm Zegveld is measured with a water level instrument in vertical and horizontal cross sections in 1966, 1992, 2003 and in 2020 (fig.1). In 1966 the area of the experimental farm presented in figure 1 was divided in a Northwestern and a Southeastern part with a high ditch water level (20/25 cm –surface) and a Southwestern and a Northeastern part with a low ditchwater level ((55/60 cm –surface).

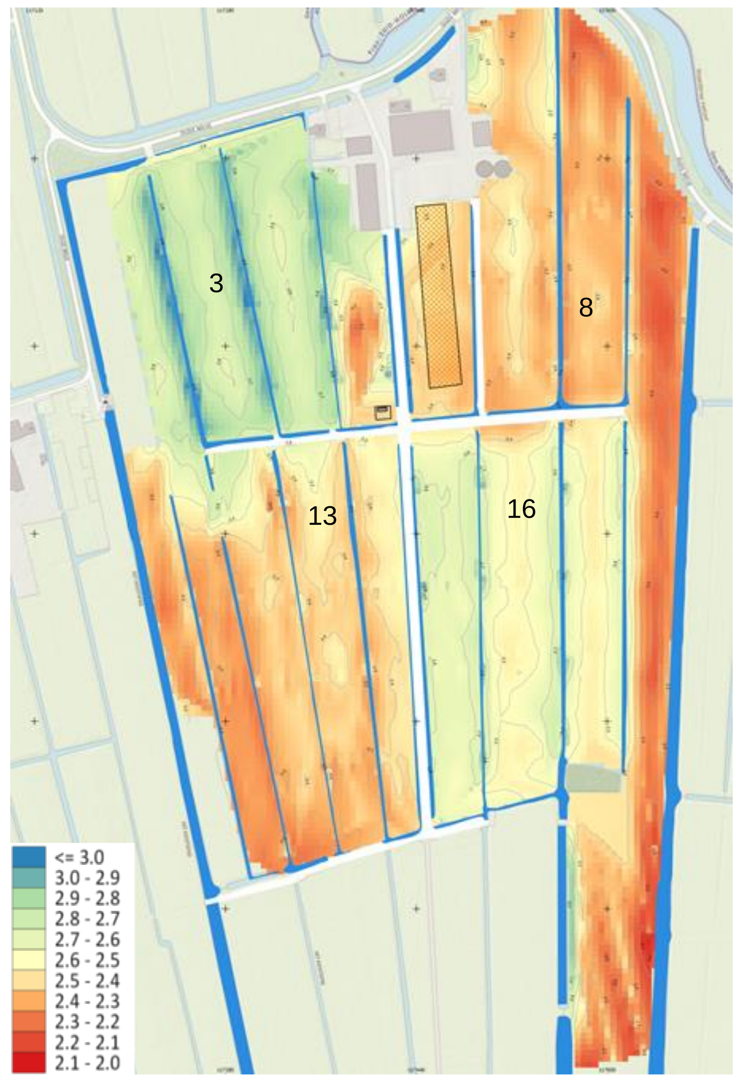

Figure 1. Altitude in 2020 experimental farm Zegveld in meters minus average see level. 3, 8, 13 and 16 are parcel numbers

The subsidence per year is presented in figure 2. The subsidence per parcel is subdivided in the period 1966-1992 and 1992-2020. Note that in an experiment parcel 5 is covered with an organic clay layer and parcel 6 is used in an experiment with paludiculture. This results in an apparent strong reduction in subsidence in parcels 5 and 6 in the second period.

In the first period 1966-1992 the subsidence is significantly larger than in the second period 1992-2020 because the major part of the consolidation and compaction of the deeper peat and soft clay layers happens directly after lowering of the ditchwater level in the first period.

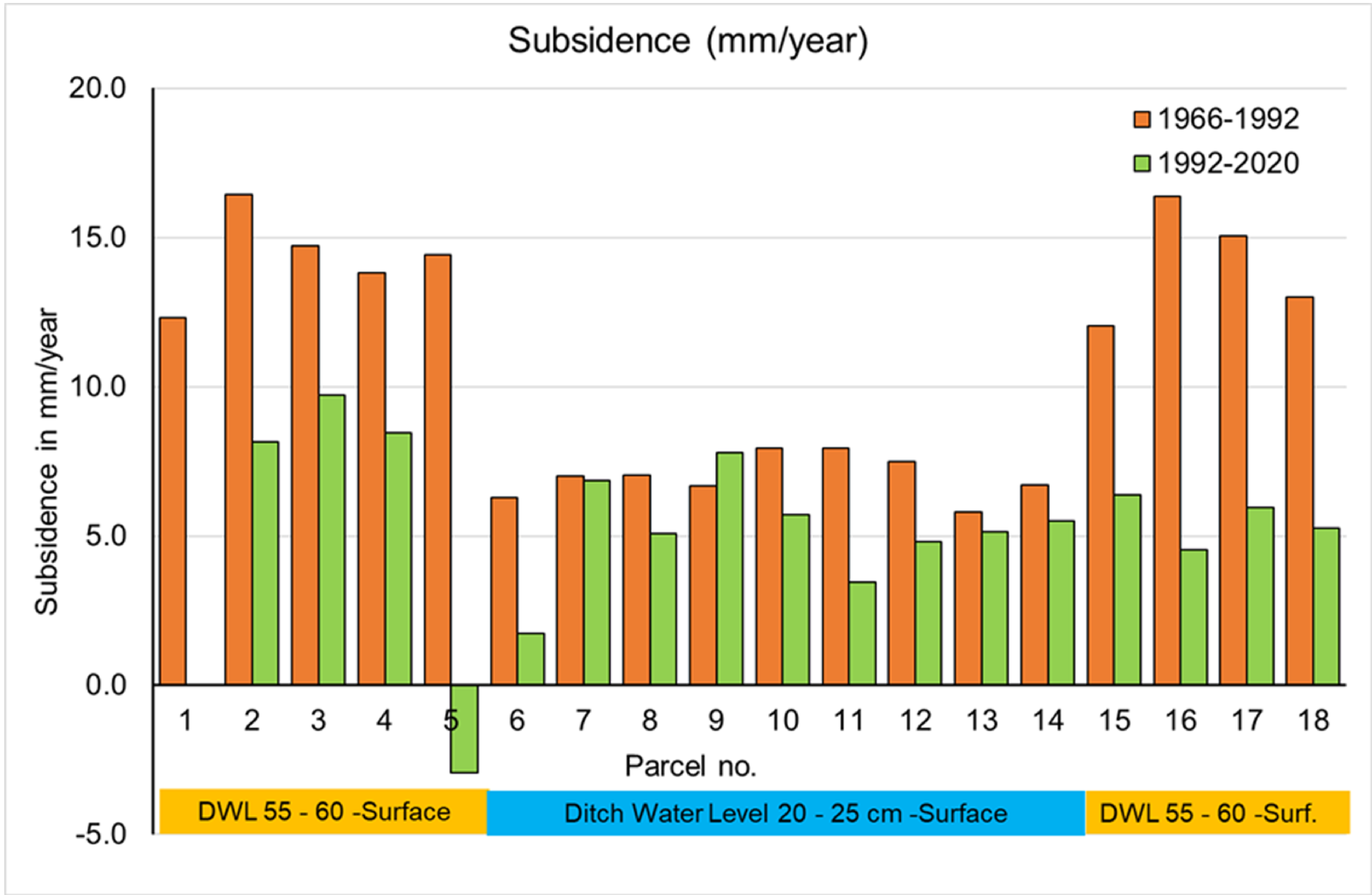

Figure 2. Subsidence in mm per year of the parcels 1-18 of the experimental farm Zegveld in the periods 1966-1992 and 1992-2020. DWL = Ditch Water Level

However, the main cause of the decrease in subsidence in mm per year in the second period is probably the ongoing increase of bulk density due to peat oxidation and degradation and associated loss of organic matter in the upper 40 to 60 cm of the soil profile. In the second period the subsidence of parcels 15-18 may be lower than of parcels 2-4 because of the substantial higher mineral part content of the eastern half of the experimental farm Zegveld.

Loss of soil organic matter and CO2-emission

In 1970 platens were installed in parcels 3 and 16 at targeted depths of 20, 40, 60, ... 140 cm (figure 3). In 1973 and 1978 also platens were installed in respectively parcel 13 and 8. Also the bulk density and organic matter content were determined in steps of 10 cm up to 80 cm depth. Every year in early spring when the soil is soaked and swollen the altitude of the soil surface and the platens are measured. In 1995 bulk density and organic matter was determined nearby the installed platens in parcel 13 up to a depth of 330 cm. In 2021 we did the same in parcels 13 and 16 nearby the installed platens in steps of 10 cm to a depth of 120 cm. In this way we could determine the total amount of SOM up to the depths of the platens in the start and in 1995 and 2021 (figure 4). This is the basis for calculation of the average yearly CO_2-emissions in these periods.

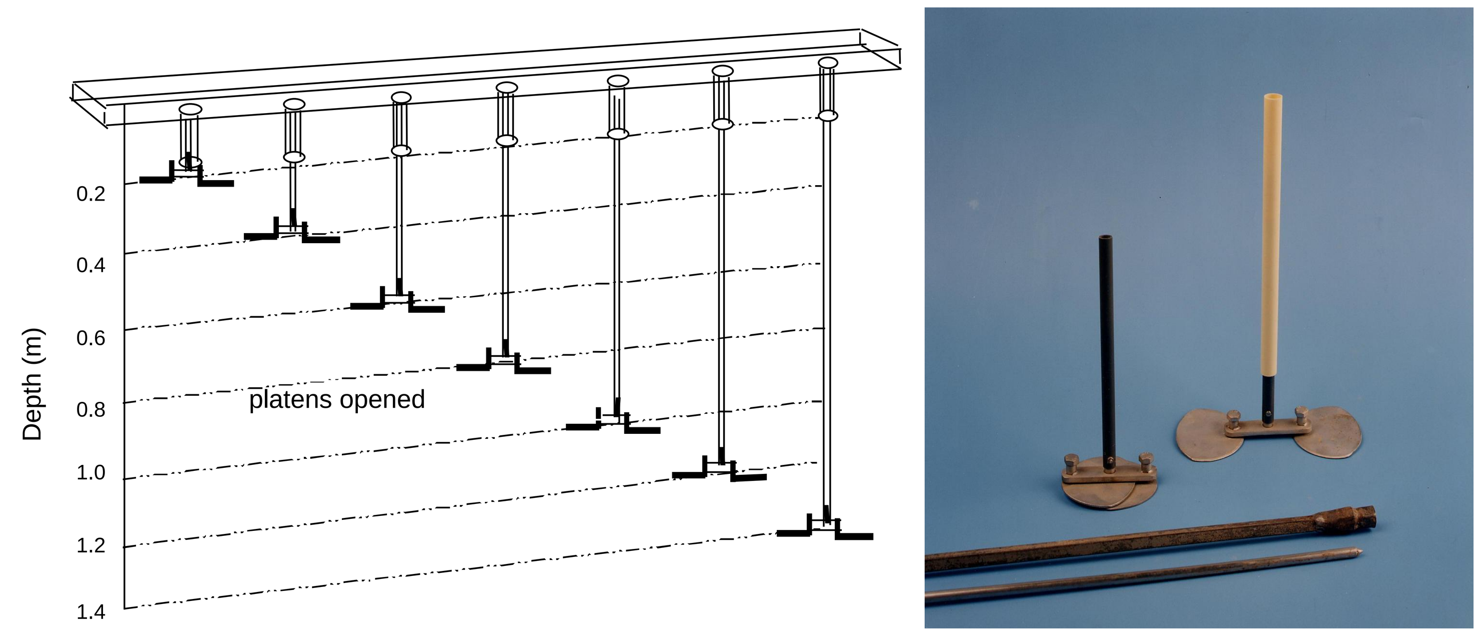

Figure 3. Platens installed in a bore hole at targeted depths of 20, 40, 60, ... 140 cm, opened and connected to the surface with two telescopic plastic tubes. The altitude is measured with aid of a steel rod lowered in the plastic tubes.

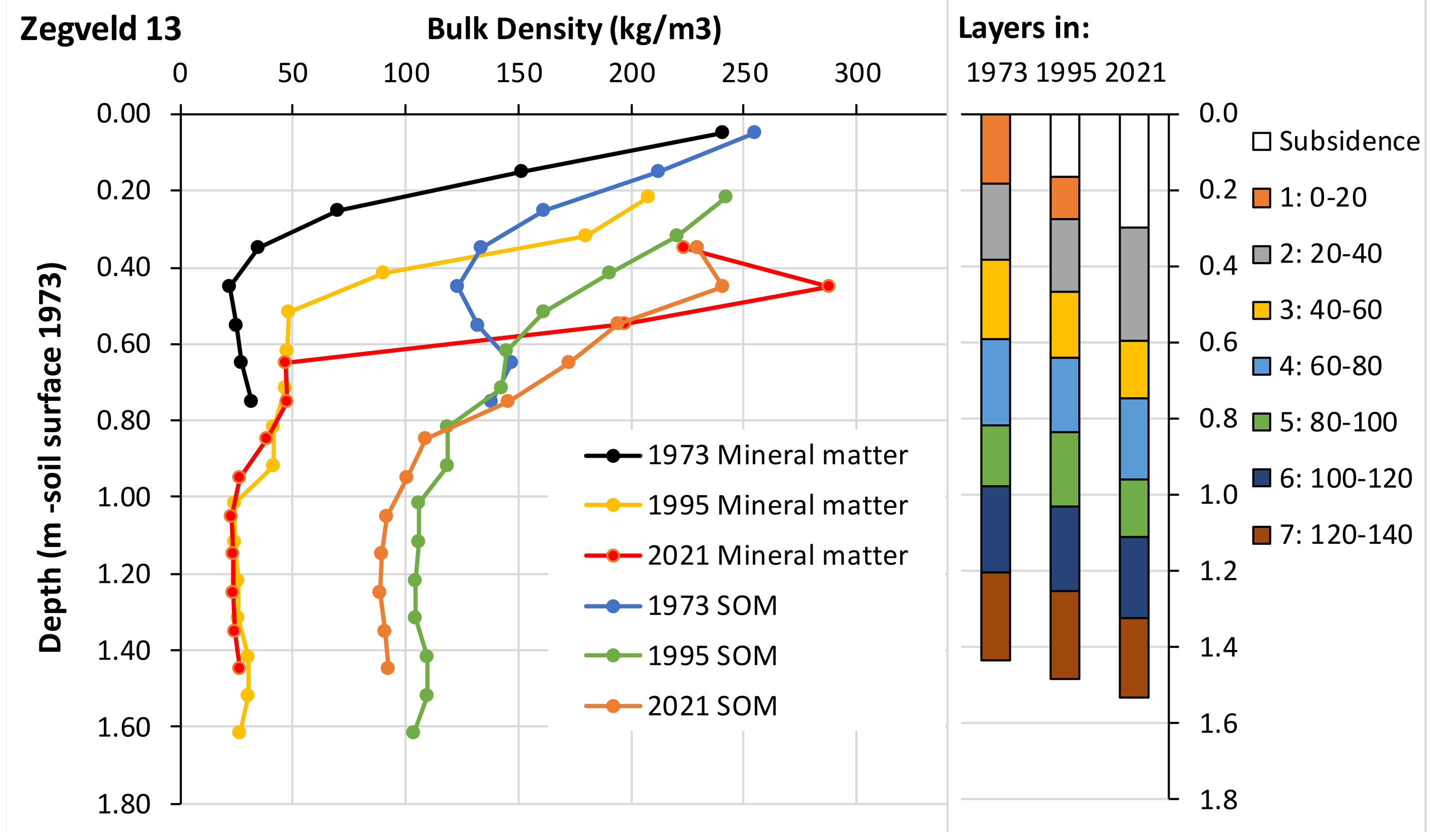

Figure 4. Bulk density SOM and Mineral matter and layers between the depts of the installed platens in 1973, 1995 and 2021. Zegveld 13, DWL 20-25 cm –surface.

Depending on the platen considered and the assumed bulk density of the SOM in 1970 below 80 cm depth, we calculated for Zegveld 13 an average yearly CO2-emission of 10.7 – 14.1 $ton.ha^{-1}$. The highest value is mainly caused by the unexpected low SOM density below 80 cm depth in 2021. For Zegveld 16 we calculated an average yearly CO_2-emission of 14.2-15.3 $ton.ha^{-1}$. These values were compared with literature (Table 1).

Table 1. Comparison with literature. Mean yearly groundwater table WTD = 19.5 cm (Zegveld 13) and WTD= 37.0 cm (Zegveld 16). Mean yearly lowest 3 biweekly measured groundwater tables in the period 2009-2015 is GLG = 44.1 cm (Zegveld 13) and GLG = 65.9 cm (Zegveld 16)

	CO_2-emission ($t.ha^{-1}.year^{-1}$)		
Reference	Zegveld 13	Zegveld 16	Comments
This poster	10.7 - 14.1	14.2 - 15.3	SOM loss in 50 years
Jacobs et al., 2003	15.0/19.2	25.3/25.4	Eddy covariance (EC) measurements Zegveld
Schothorst, 1982	8.1	14.5	Based on grass yield by N-mineralisation peat
Van den Akker et al., 2008	8.4	20.0	CO2 = 0.5319 GLG – 0.15 (based on Dutch subsidence measurements)
Fritz et al., 2017	8.9	16.7	CO2 = 0.45 WTD – 0.088 (based on literature study Dutch measurements)
Tiemeyer et al., 2020	18.7	34.5	CO2 = -3.41+40.33EXP(-7.52EXP(-0.1297 WTD)) (based on chamber measurements Germany)
Evans et al., 2021	3.2	11.8	CO2 = 0.4917 WTD–6.43 (based on EC measurements UK)

Conclusions

The determined CO_2-emissions based on loss of SOM fit well in the range found in literature, however, the CO_2-emission of Zegveld 13 is higher and of Zegveld 16 lower than expected based on literature. Measurement of loss of SOM nearby the platens in parcels 3 and 8 is needed to draw sound conclusions

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