Modelling European Agriculture with Climate Change for Food Security

Soil carbon sequestration under old and new, grazed grassland in the Netherlands

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Introduction

- Soil carbon sequestration mentioned as mitigation measure.
- C sequestration in soils might buy us time to develop mitigation strategies

the 4/1000 Initiative

Climate Change 2014
Mitigation of Climate Change

Working Group III Contribution to the
Assessment Report of the
mental Panel on Climate Change

Sequestration: Increasing the size of existing carbon pools, thereby extracting CO_2 from the atmosphere (e.g., afforestation, reforestation, integrated systems, carbon sequestration in soils)

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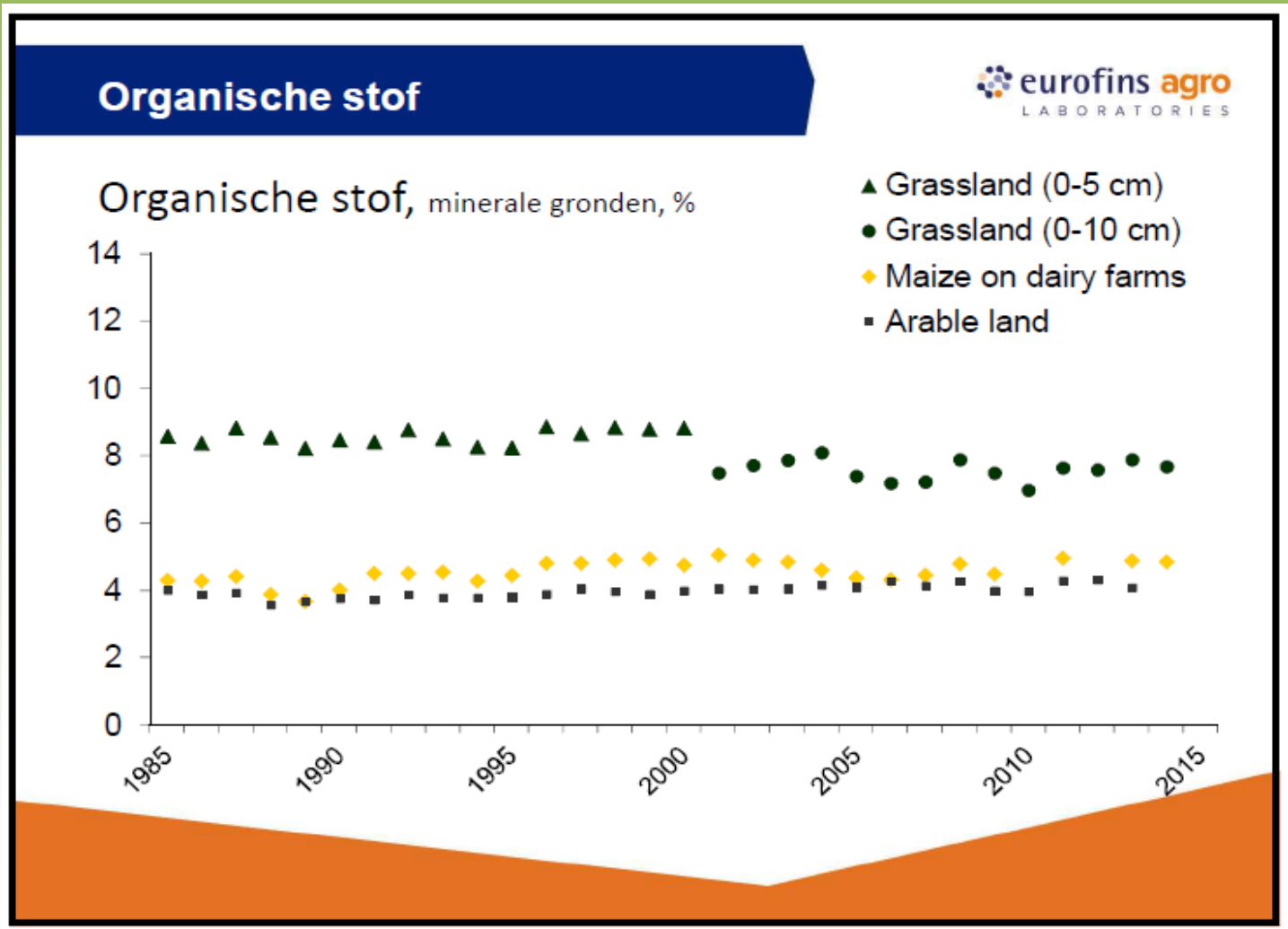
Soils in the Netherlands

- Agricultural land:
- 2 million ha of agricultural land
- 1 million ha of grassland
- 1 million ha of arable land of which 0.2 million ha maize

National trend OM



Grassland experiment

- Long term measurements of SOM in experiment,
- Experiment was set up to measure and understand mid/long term P response (in cooperation with WER: Ehlert&Regelink)
- SOM was measured, P has no effect
- No grassland renewal (no tillage)

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Grassland experiment

- Experiment started in 1997: close to actual practice in The Netherlands
  - Manure application at balanced P level (input = output), N (close to) application standard
  - Alternately grazed and mowed (ca. 50-50 in DM)
  - 1) Sandy soil, 2) Dry sandy soil, 3) Young marine clay (reclaimed in 1957, grassl since 1973), 4) Peat soil
  - Swards established in 1) 1994 2) 1989 3&4) <1989
  - 1)&2) finished, 3)&4) on-going till ???

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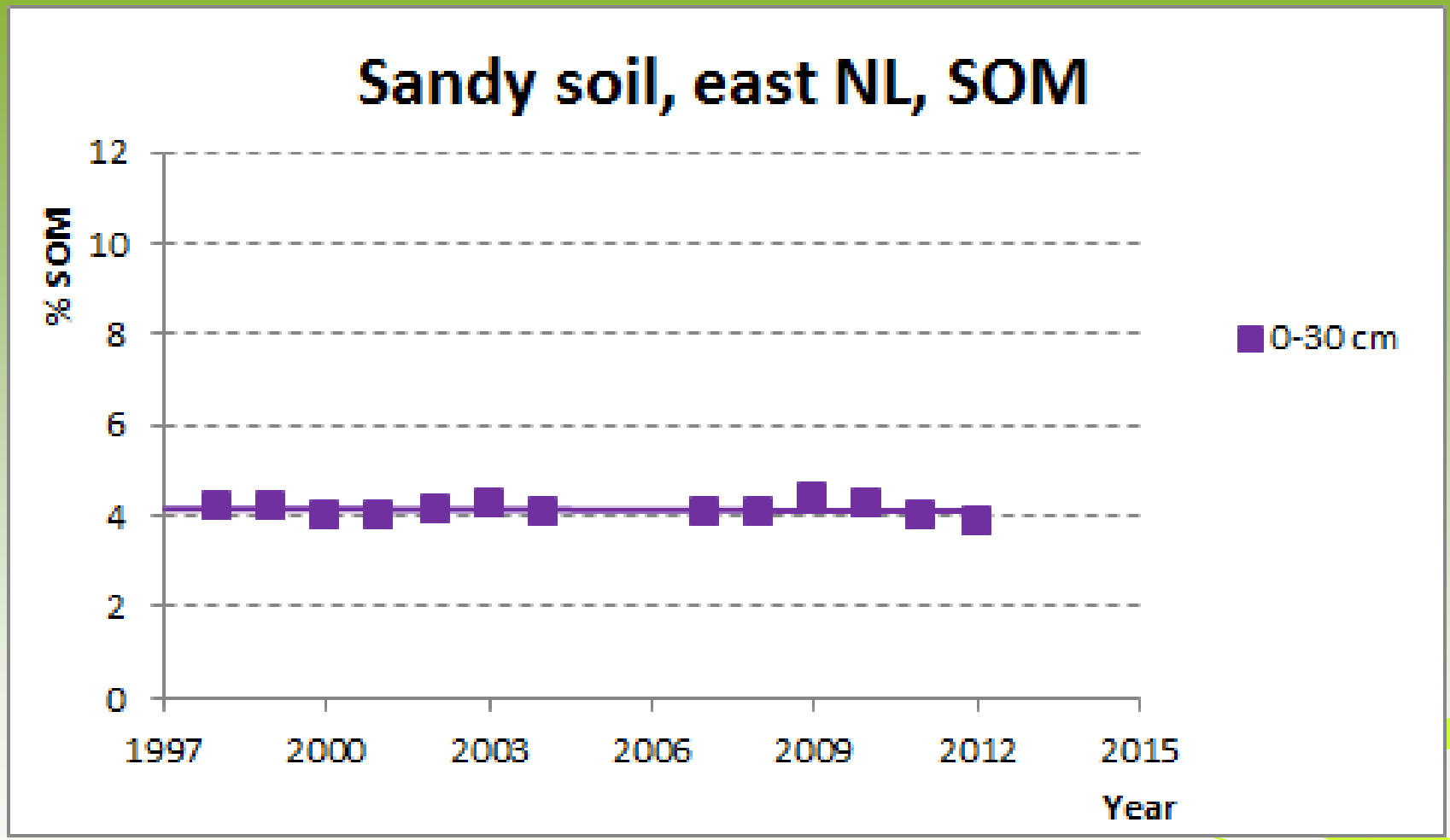

No (provable) change of SOM

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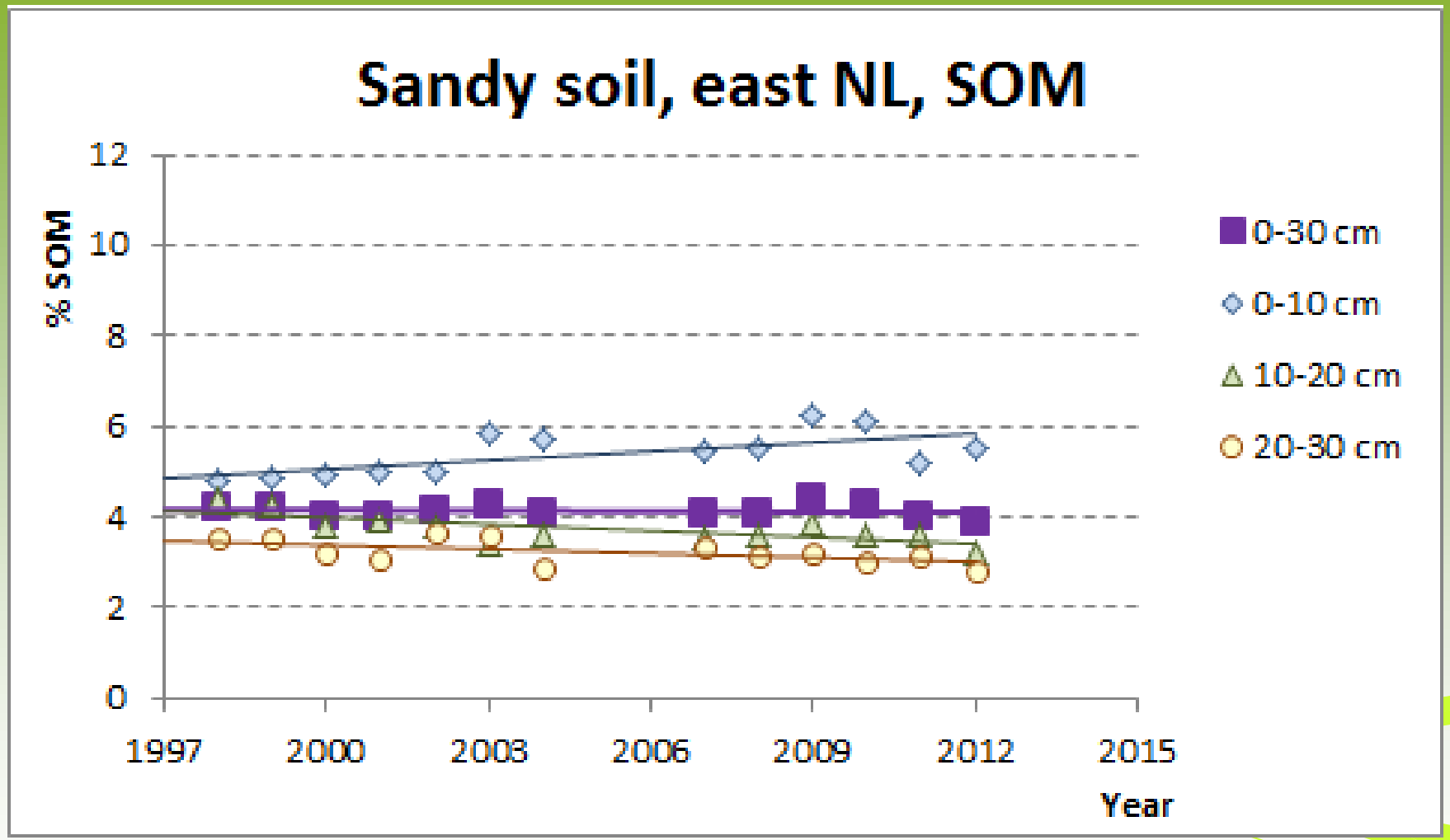

No (provable) change of SOM, “redistribution” to upper layer

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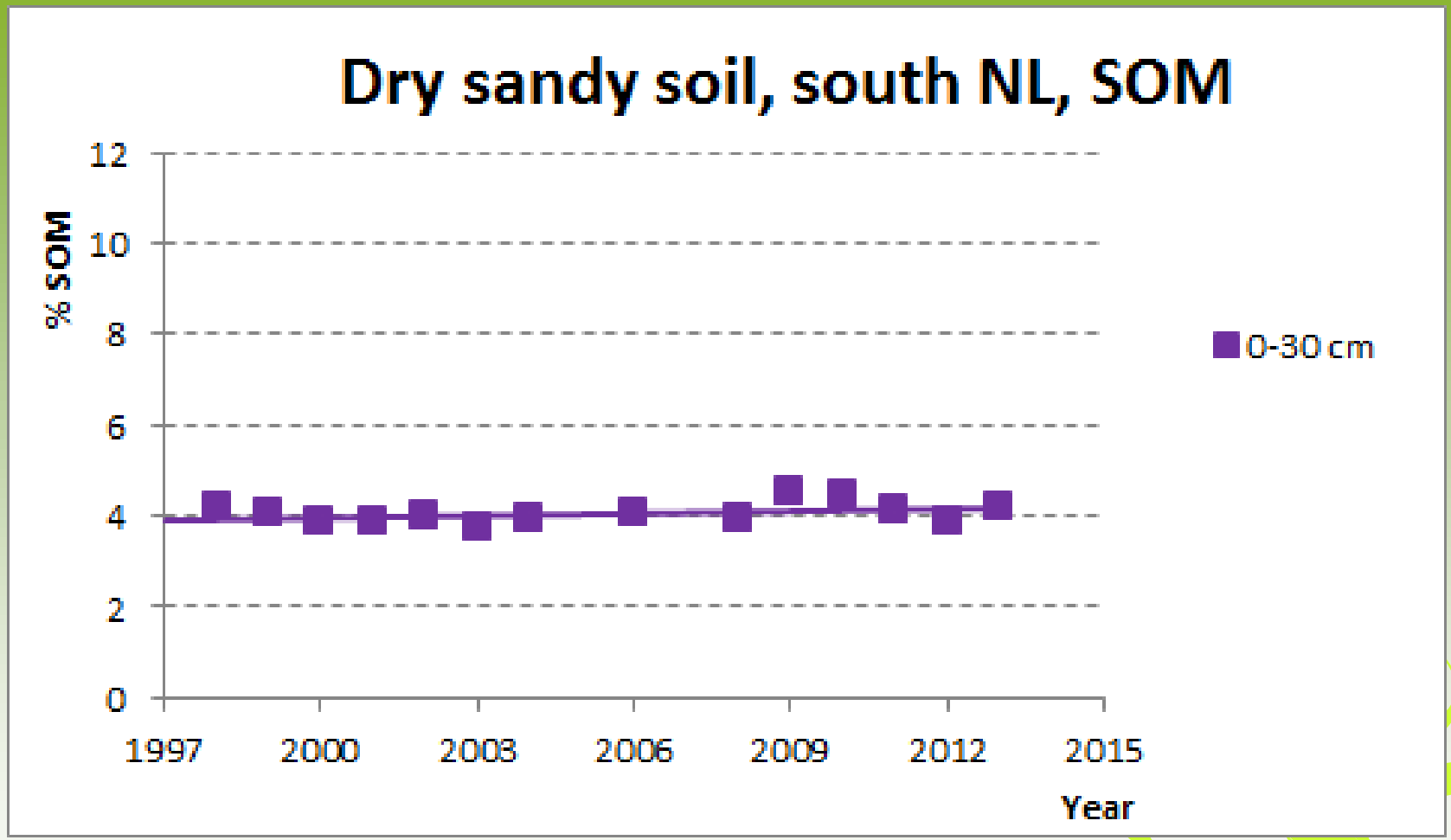
Dry sandy soil, south NL



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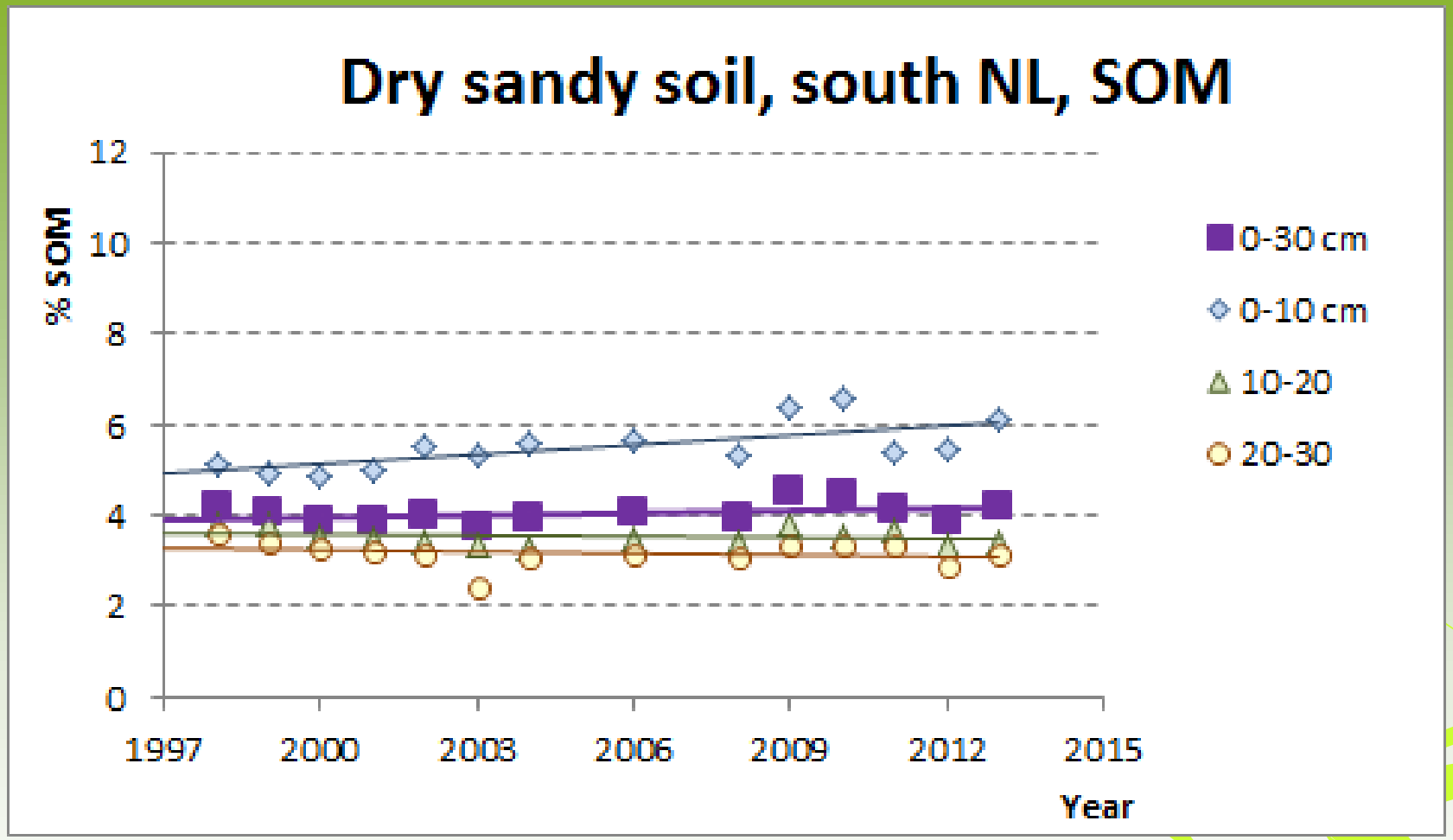

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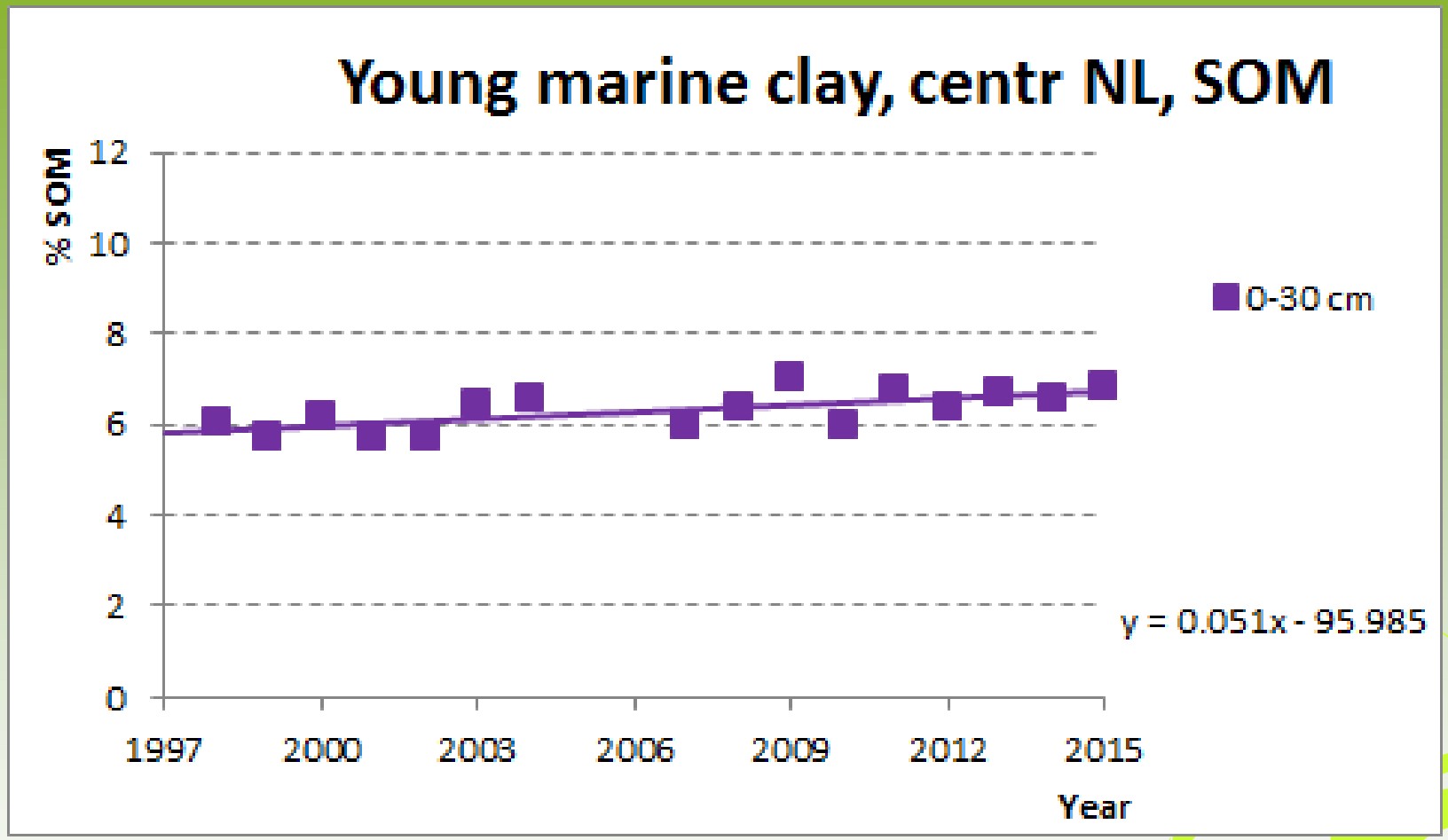
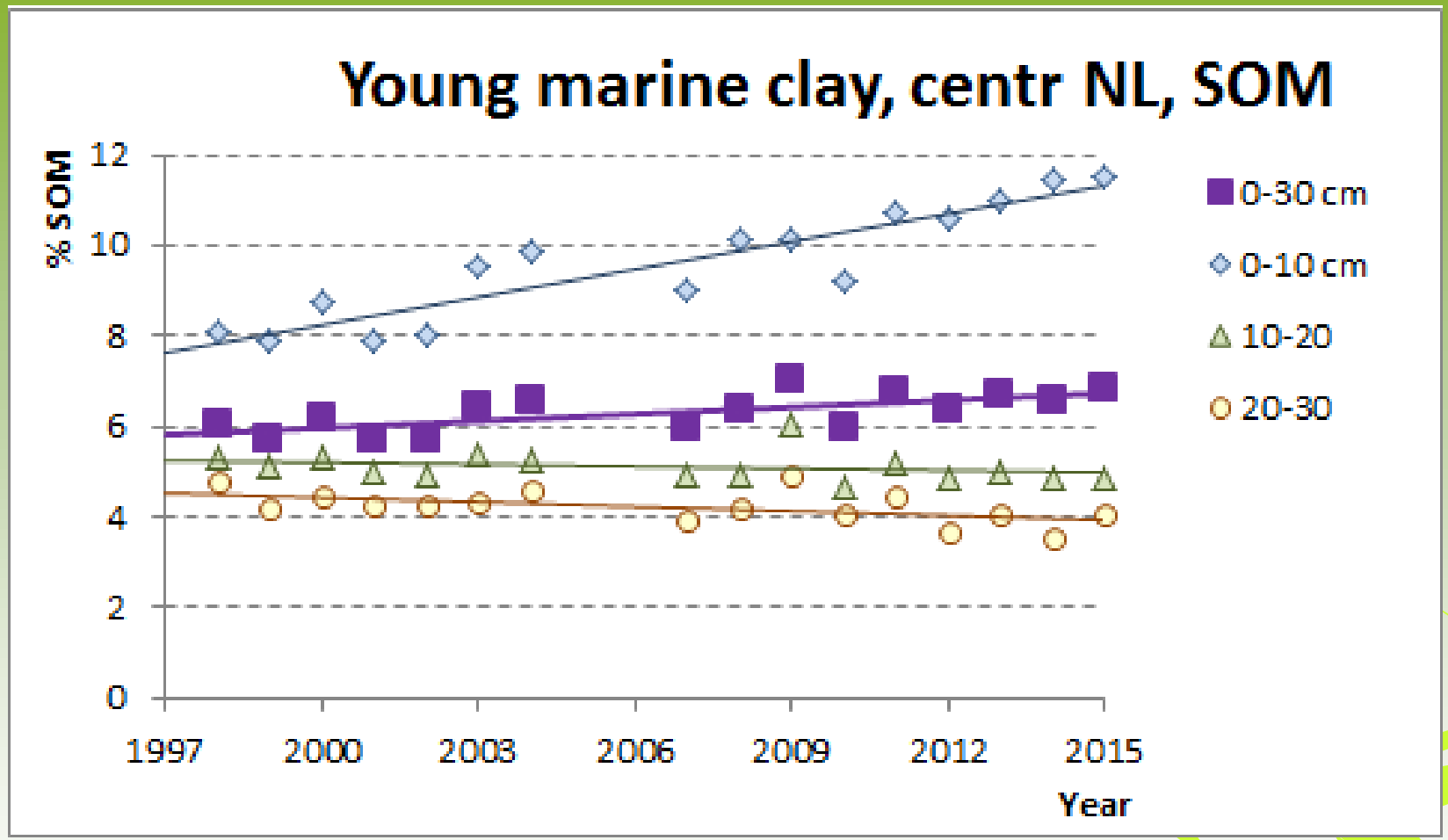
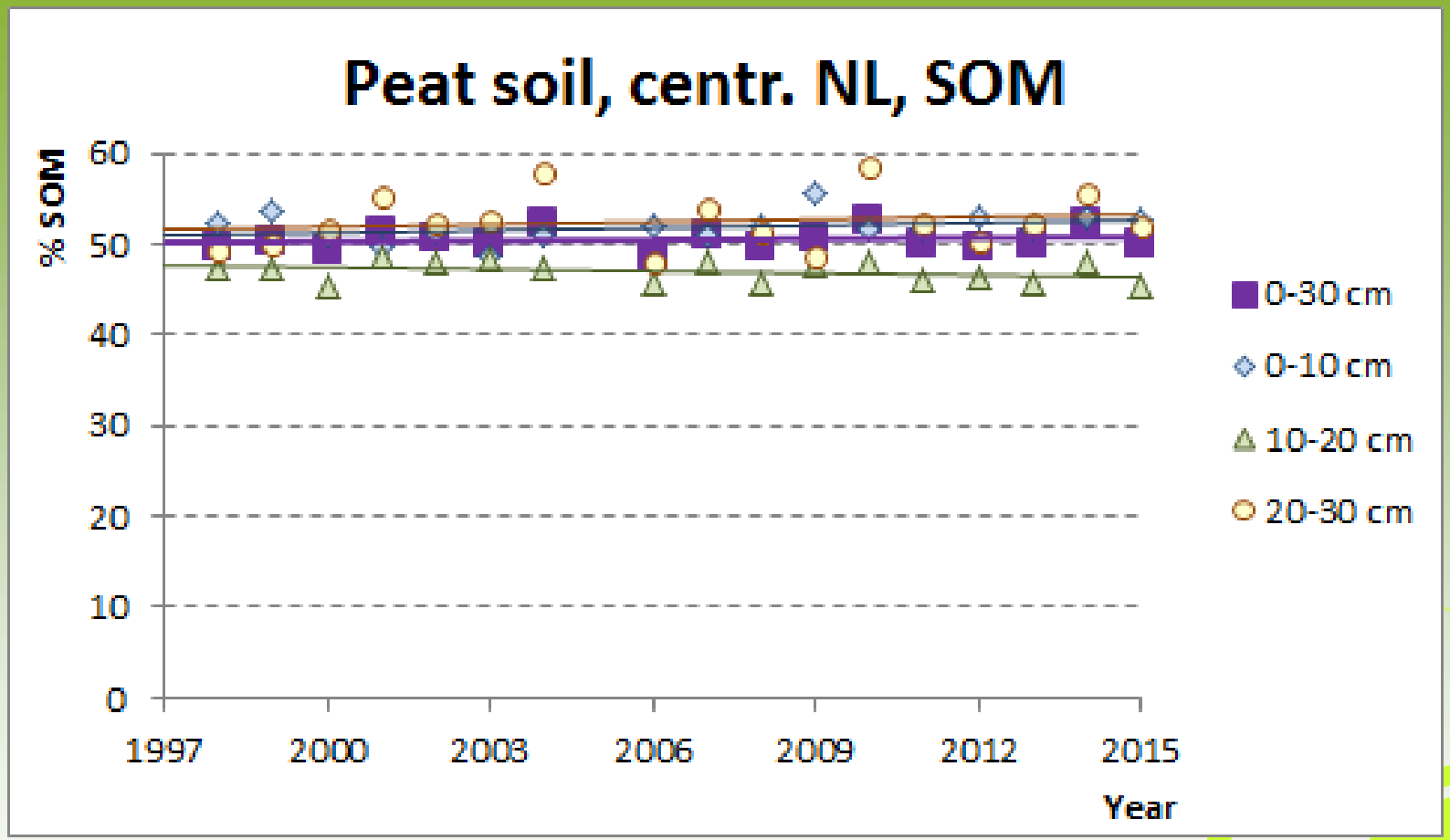


Increase of SOM, 1% in 18 years, 0.051%/a



Increase of SOM, 1% in 18 years, 0.051%/a

☹ <15000 ha in NL, <1,5% of the grassland area



Peat soil: C loss by definition: 0-10cm in 1997 is not the same layer as in 2015

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Young Marine clay

Increase SOM: 1% in 18 years ≈ 0.051%/a in 0-30 cm
4 promille would be 0.024%/a

$1.4\ g/cm^3 \times 30\ cm \times 0.00051 \times (10^4 \times 10^4)/10^6$
$=2.1$ ton SOM/(ha × a) = 0.96 ton C/(ha × a)

→ $44/12 \times 0.96 = 3.5$ ton CO_2/(ha × a)

☹ <15000 ha in NL, <1,5% of the grassland area

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How much OM is roughly added?

Estimation per ha:

- 50 m^3 applied slurry = 1500 kg eff OM
- manure patches = 500 kg eff OM
- 2000 kg eff OM by grass (turnover)
- 4000 eff OM ≈ 1800 kg C
- ca. 50% is measured in SOM increase

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Hypotheses

- Under “old” grassland increasing C in soil is difficult at actual system and GAP, probably saturation occurs/has occurred
- Young marine clay can still sequester more C and saturation level is higher than on sandy soils
- For grassland on dairy farms in NL the opportunity for C sequestration seems limited at actual system under GAP

Plans

- Use the data for model evaluation (e.g. introductory carbon balance model ICBM, Andrén&Kätterer, 1997)
- Find strategies with models in which C under grassland is preserved and sequestered where possible
- Can we find different system (sylvo-pastoral systems?) to sequester C to a higher saturation level?

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