Planbureau voor de Leefomgeving

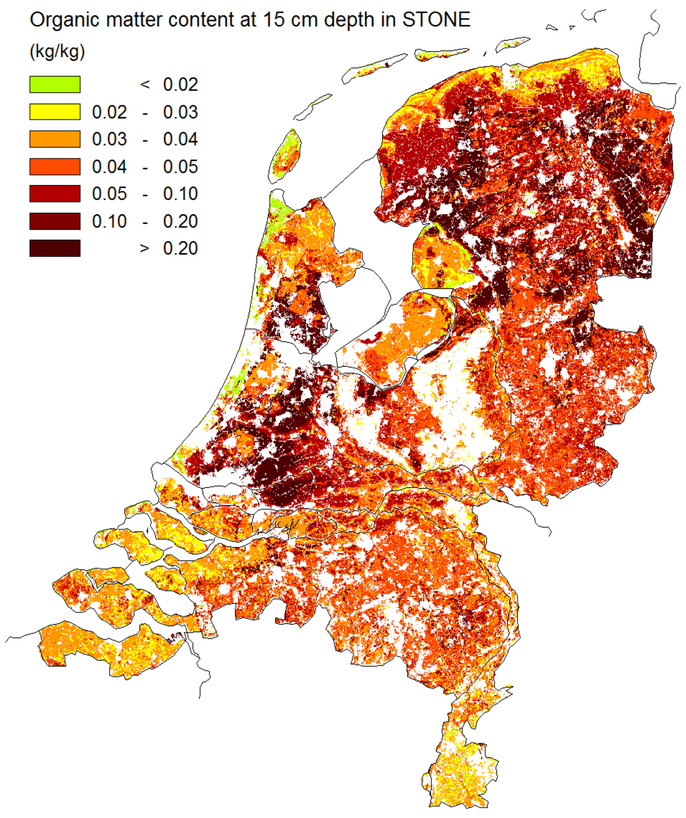
3D-digital soil mapping of soil organic matter for pesticide leaching models

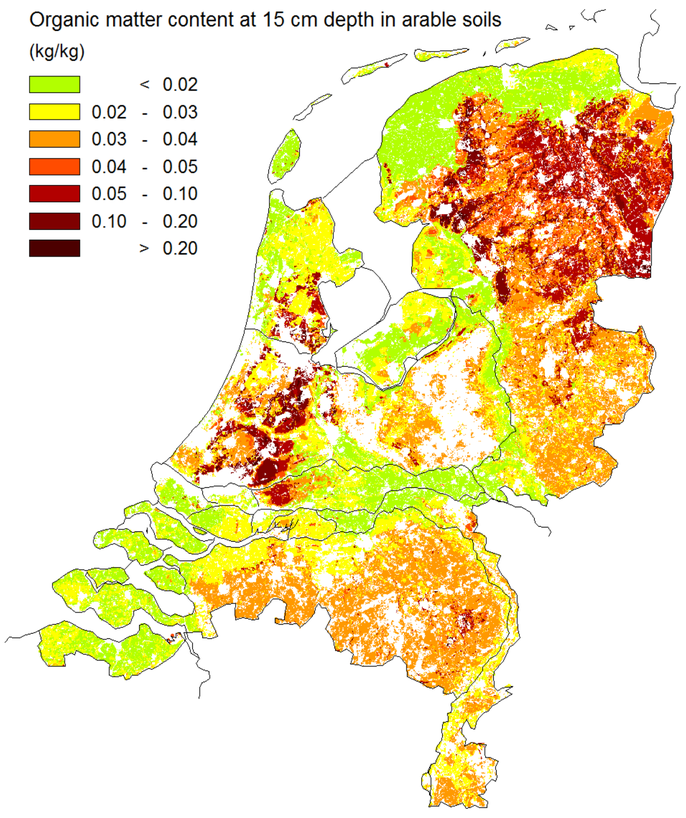
The spatially distributed pesticide leaching model GeoPEARL is used in higher tiers of the leaching assessment. GeoPEARL contains a map of organic matter that is based on a mixture of arable and grassland soils and therefore overestimates organic matter in arable soils. Digital soil mapping techniques were used to generate high resolution maps for arable soils. With the new maps, the 90th percentile of the leaching concentration increased by a factor of 2-10, depending on the crop.

Organic matter in arable soils currently overestimated

The soil organic matter map included in the current GeoPEARL schematisation contains organic matter contents for arable areas in the Netherlands that are a factor 1.5 to 2 higher than those measured in top soils. The reason is that the map of organic matter in GeoPEARL was generated using soils from both arable fields and grassland. Therefore, separate organic matter maps for grassland and arable fields were made.

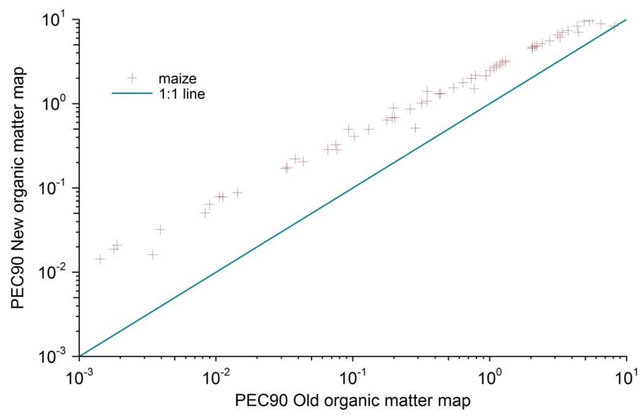
Figure below: Soil organic matter content in the topsoil of arable land is lower in the new map (right) than in the map included in earlier versions of GeoPEARL (left)

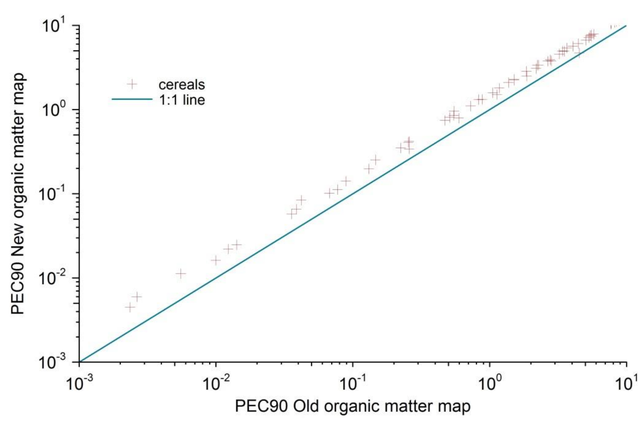




Leaching increases by a factor of 2-10, depending on crop type

To assess the consequences for the leaching assessment, we calculated the 90th percentile leaching concentration for 120 substances. Application time was 26 May. The examples shown below show that the differences between the new and the old version of GeoPEARL were crop dependent.



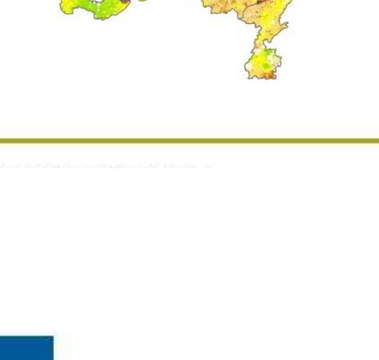


Combination of a trend model and 3D-geostatistical interpolation

The new maps of organic matter were made using digital soil mapping techniques. Firstly, a trend model was calibrated using the mapped soil type and land-use (arable or grassland) as a predictor. This step used the data from the Netherlands Soil Sampling Scheme, which consisted of samples from 1210 locations that were selected using a well-defined stratified random sampling scheme. The next step consisted of a 3D-geostatistical interpolation procedure of the residuals using 700 000 observations of soil organic matter. The advantage of this procedure is that regional differences within mapping units are accounted for.

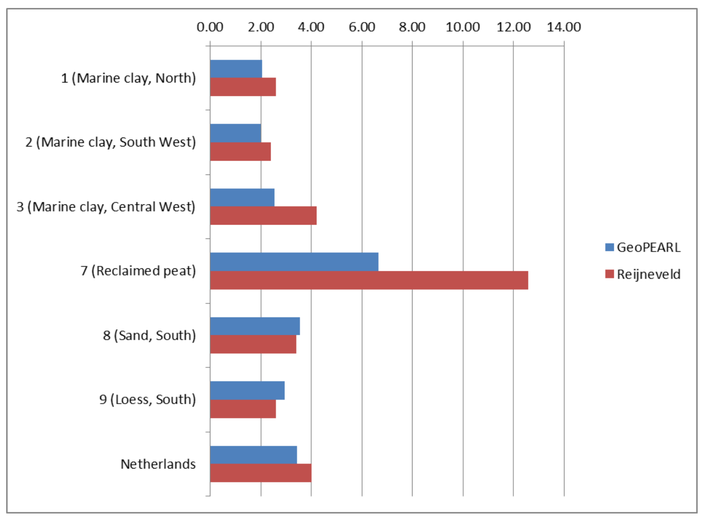
Accuracy of the map varies throughout the country

For the construction of the trend model, a stratified random sampling scheme with locations evenly distributed across the country was used (red dots). For the interpolation procedure many more observations were used, which were, however, not evenly distributed. The consequence is that the accuracy of the organic matter map differs between regions. To assess the accuracy of the map, a series of 100 simulations was done by means of sequential Gaussian simulation. This resulted in 100 realisations of the organic matter map, which were used to calculate the 10-90 percentile of each grid cell. Differences are 0.03-0.08 kg/kg in regions with sandy soils and 0.02-0.05 kg/kg in polder areas. This uncertainty should be dealt with in future GeoPEARL assessments.



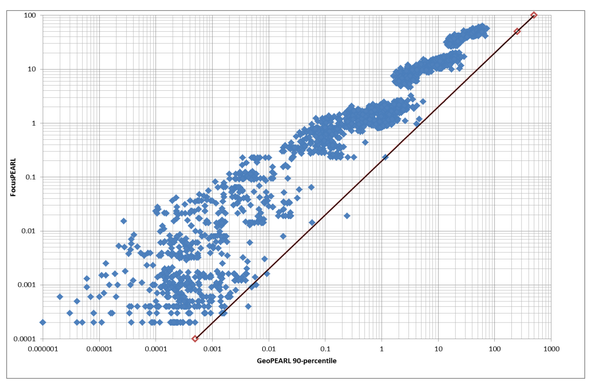
Good agreement with independent dataset

The new organic matter map was compared to the dataset of Reijneveld (2009), which contains some 2 million samples from agricultural fields. This comparison revealed that the agreement between the new map and the measurements is generally good except for peat areas. The difference for the peaty soils can be partly explained by the fact that the Reijneveld samples have been collected in the period 1994 – 2004, so the effect of the peat oxidation since then is not taken into account in the comparison. This, however, is not considered a problem for the leaching assessment, because the location where the 90th percentile occurs will not be in peat areas.



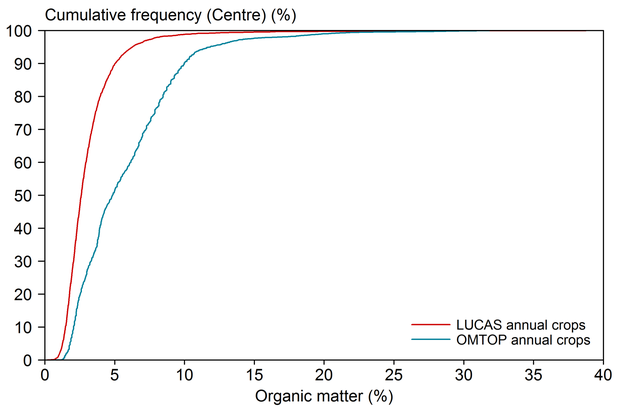
Calibration of the first tier needed to ensure consistency of the tiered approach

In the Netherlands, the FOCUS Kremsmünster scenario is used as the first tier of the leaching assessment. This first tier is not conservative enough when the new organic matter map is used. Therefore a calibration factor is needed to ensure consistency of the tiered approach.



Methodology applicable for improvement of leaching assessments at the European level

For assessments at the European level, the OMTOP map is currently used. Like the map that is currently used in GeoPEARL_NL, the OMTOP map was created using both arable and grassland soils. This will lead to an overestimation of organic matter in arable soils. This is confirmed by a comparison of the OMTOP map with the LUCAS dataset, which consists of some 20 000 point observations of organic matter throughout Europe. Using the LUCAS dataset and the methodology presented at this poster, models operating at the European scale could be improved.



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