Effects of soil heterogeneity on the uncertainty in modelling the fate of urinary nitrogen

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Wintering cows on high yielding forage crops during winter is commonly done on small blocks, where stocking densities can be as high as 300-600 cows/ha. This results in the return of large amounts of excreted nitrogen (N) to the soil during a period when treading damage and soil compaction is likely, all of which is contributing to high risk of N losses.

Identifying good management practices for wintering systems for different soils and climatic conditions is challenging, as such systems can vary in the forage crop used, the grazing management, fallow period, as well as the land use after grazing. Process-oriented modelling is a cost-effective way to understand the implications of such a variety of management options.

One of the key problems with process-orientated modelling is the difficulty to account for the effect of variability and uncertainty in input model parameter values. This variability can be due to imprecisions in sampling and laboratory or in situ measurements, but it can also come from the inherent natural soil heterogeneity.

To quantify how changes in the physical description of soil layers, used as model input, affect outputs of the biophysical APSIM model regarding the fate of urinary N following winter grazing a sensitivity analysis was performed. The model was set up with various descriptions of a poorly drained soil, with and without compacted soil surface layers due to treading. The analysis identified that the bottom layer (1.0 to 1.5 m depth) had the greatest impact on the N loss pathways. This is due to the effect of the bottom layer on water movement and storage within the soil profile. These results highlight the need for accurate soil physical descriptions for adequate model parameterisation, when such models are used for assessing management practices.