Validation of a new soil bulk density sensor

Karin Pepers[1], **Ronald Koomans**[2], **Fenny van Egmond**[3], **Gijs Staats**[1], **Kees Teuling**[3], and **Gera van Os**[1]

[1]Aeres University, [2]Medusa Explorations, [3]Wageningen University and Research

Abstract

Soil compaction and bulk density are key soil properties, affecting the contribution of soil health to soil services like crop production, water retention and purification, and carbon sequestration. However, the standard measurement with rings is labor-intensive and expensive. To overcome classic limitations of soil density measurements we propose the use of a portable gamma sensor to measure bulk density in situ. A validation was performed in two locations, on sandy clay loam and sand soil in the Netherlands, both with large within field variation in subsoil compaction. In both fields ten soil pits were dug, where in every soil pit 3 profiles with the RhoC soil density meter were sampled. In addition, 3 profiles with undisturbed soil cores in rings were taken at every 10 cm depth, up until 60 cm depth. In total, 180 rings and 180 RhoC samples were taken per field. We will discuss the uncertainty of the RhoC method with respect to the uncertainty due to heterogeneity in the field. This novel technique allows the quantitative assessment of bulk density in the field at various depths. This measurement is essential for rapid and accurate soil compaction assessment and soil organic carbon stocks calculation. The acquisition of this data for land managers, advisors, and (national) soil monitoring is indispensable for the sustainable management of soils for the provision of ecosystem services, such as requested in the proposal EU Directive on Soil Monitoring and Resilience.

Keywords gamma-ray, soil compaction, bulk density, sensor development

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Correspondence to
Karin Pepers
k.pepers@aeres.nl