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The investigation of arable soils with cross hole seismics.

M. Carizzoni

Department of Geography, Soil Science Section, University of Berne,

Hallerstrasse 12, 3012 Berne. Email: carizzon@giub.unibe.ch

The propagation of acoustic and seismic waves in lossy media like soil is hampered by its strong attenuation and has therefore rarely been investigated. With the development of a high voltage pulse generator and the construction of emitters and receivers, able to be mounted in boreholes at varying depths, it is now possible to examine the propagation of compression waves in situ. Our devices show good signal repeatability and are capable to generate and record automatically in short time 20-30 compressional waves within a distance of 1[m].

Measurements were performed at several locations with different land use in the Central Plateau of Switzerland. Differences in bulk densities and saturation degrees at the field scale strongly influenced the velocities and allowed to distinguish areas with different soil properties. While increasing bulk densities enhance wave speed, areas with higher water and clay content decrease velocities. Measurements with infiltration showed the influence of high water contents on wave properties, especially on travel times and amplitudes. The investigations in a trafficked field showed impacts on soil structure in the subsoil even under dry soil conditions. The analysis of constraint moduli determined from field and laboratory measurements showed an obvious distinction between the investigated sites. Therefore, acoustic and seismic methods together with adapted evaluations of the results of compression tests on undisturbed samples might be a promising alternative for the determination of soil strength.