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Measurement of particle size distribution of soil and selected aggregate sizes using the hydrometer method and laser diffractometry

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Soil particle size distribution has been traditionally determined by the hydrometer or the sieve-pipette methods, both of them time consuming and requiring a relatively large soil sample. This might be a limitation in situations, such as for instance analysis of suspended sediment, when the sample is small. A possible alternative to these methods are the optical techniques such as laser diffractometry. However the literature indicates that the use of this technique as an alternative to traditional methods is still limited, because the difficulty in replicating the results obtained with the standard methods.

In this study we present the percentages of soil grain size determined using laser diffractometry within ranges set between 0.04 – 2000 µm. A Beckman-Coulter ® LS-230 with a 750 nm laser beam and software version 3.2 in five soils, representative of southern Spain: Alameda, Benacazón, Conchuela, Lanjarón and Pedrera. In three of the studied soils (Alameda, Benacazón and Conchuela) the particle size distribution of each aggregate size class was also determined. Aggregate size classes were obtained by dry sieve analysis using a Retsch AS 200 basic ®. Two hundred grams of air dried soil were sieved during 150 s, at amplitude 2 mm, getting nine different sizes between 2000 µm and 10 µm. Analyses were performed by triplicate.

The soil sample preparation was also adapted to our conditions. A small amount each soil sample (less than 1 g) was transferred to the fluid module full of running water and disaggregated by ultrasonication at energy level 4 and 80 ml of sodium hexametaphosphate solution during 580 seconds. Two replicates of each sample were performed. Each measurement was made for a 90 second reading at a pump speed of 62.

After the laser diffractometry analysis, each soil and its aggregate classes were processed calibrating its own optical model fitting the optical parameters that mainly depends on the color and the shape of the analyzed particle. As a second alternative a unique optical model valid for a broad range of soils developed by the Department of Soil, Water, and Environmental Science of the University of Arizona (personal communication, already submitted) was tested.

The results were compared with the particle size distribution measured in the same soils and aggregate classes using the hydrometer method.

Preliminary results indicate a better calibration of the technique using the optical model of the Department of Soil, Water, and Environmental Science of the University of Arizona, which obtained a good correlations ($r^2>0.85$). This result suggests that with an appropriate calibration of the optical model laser diffractometry might provide a reliable soil particle characterization.