Testing the Densiometer method with the PARIO device: Accuracy of results and influence of homogenization technique and sand removal

Magdalena Huber[1*], Georg von Unold[2] , Thomas Pertassek[2], Andreas Steins[2] und Wolfgang Durner[1*]

[1] Institut für Geoökologie | Technische Universität Braunschweig | 38106 Braunschweig | Deutschland

[2] UMS AG, München

* w.durner@tu-braunschweig.de | Telefon +49 (0) 531 391-1234

Introduction

- The particle-size distribution (PSD) is one of the main properties of soils. To determine the proportions of the fine fractions silt and clay, sedimentation experiments are used. Most common are the Pipette and Hydrometer method. Both need manual sampling at specific times. Both are thus time-demanding and rely on experienced operators.
- Durner et al. (2016; Poster 21) recently developed the Densiometer method which is implemented in the UMS device PARIO. This new method estimates continuous PSD's from sedimentation experiments. It requires no manual interaction after start and thus no specialized training of the lab personnel.
- The aim of this study was to test the precision and accuracy of new method with three soil materials, to answer the following research questions:
  - Are the results obtained by PARIO reliable and stable?
  - Are the results affected by the initial mixing technique to homogenize the suspension, or by the presence of sand in the experiment?
  - Are the results identical to the one that are obtained with the Pipette method as reference method?

Materials and Experiments

- Three soil materials: Groß Gleidingen (GG), Bundesanstalt für Wasserwirtschaft (BAW), and Julius-Kühn-Institut (JKI)
- Two replicates for each soil material
- Precision was checked by doing each PARIO measurement in three sequential repetitions
- For the BAW and JKI soils, the PARIO measurements were performed with and without removal of sand fractions, to see whether the initial settling of the sand affects the overall result.

Effect of the mixing method: Sequence of measurements (GG and BAW)

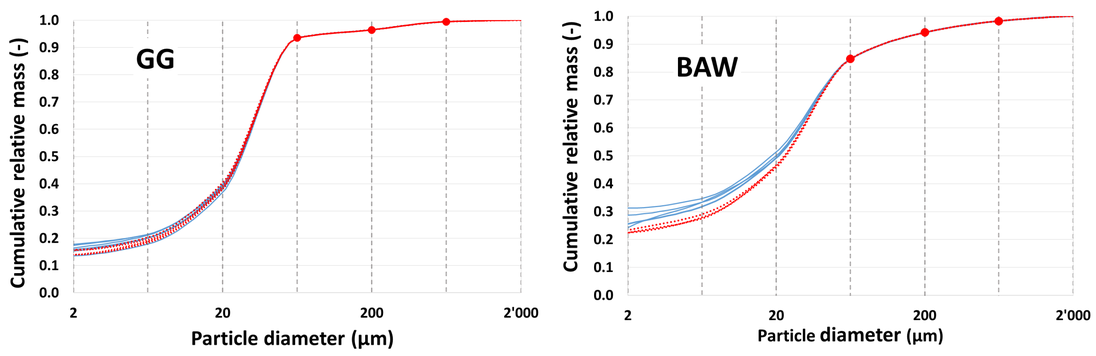
Device	Mixing method	Repetitions
PARIO	Overhead shaking	3
PARIO	Vertical stirring	3
Pipette	Vertical stirring	1

Effect of the sand removal: Sequence of measurements (BAW and JKI)

Series	Particle sizes in susp.	Repetitions
Series 1	< 2000 µm	3
Series 2	< 200 µm	3
Series 3	< 63 µm	3

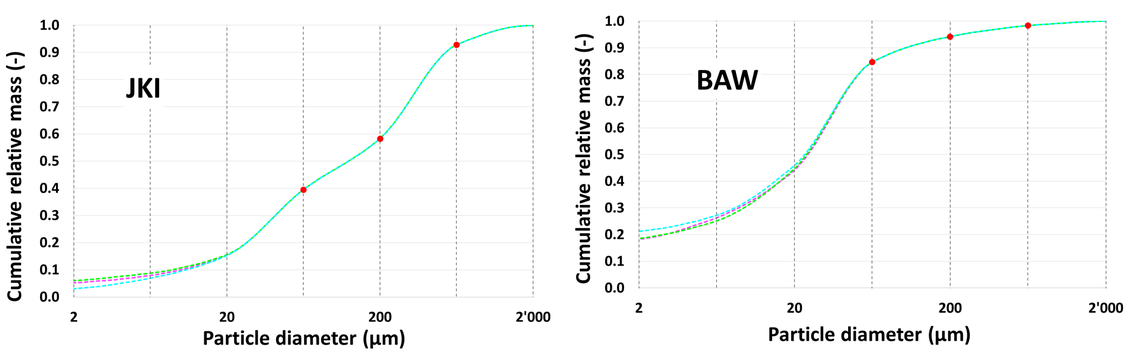
Results

Influence of mixing technique (GG and BAW)



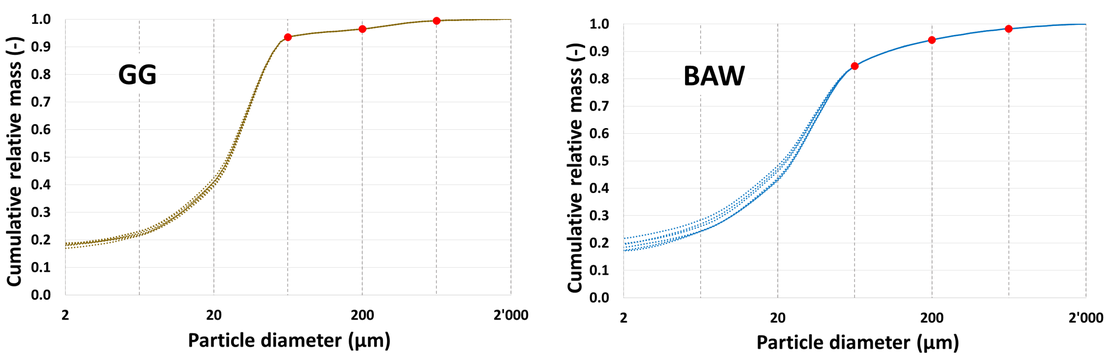
PARIO analysis for GG and BAW gave less variation for vertical stirring (red dotted lines) than for overhead shaking (blue lines). Overhead shaking lead to a slightly smaller estimation of the silt fraction (72.1 % vs. 75.2 %).

Influence of removal of sand fractions (JKI and BAW)



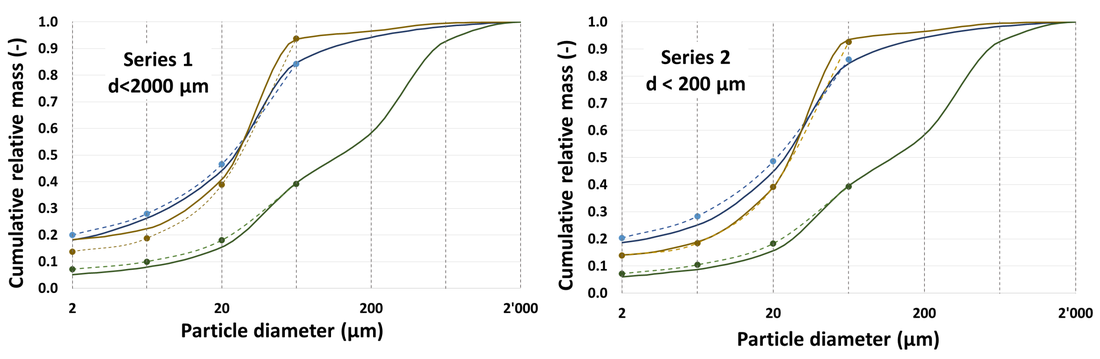
The presence of sand had no specific effect on the analysis. PARIO results with all material (pink: <2000 µm), and with sieved material (green: < 200 µm) agreed completely. Removal of the fine sand fraction (blue: < 64 µm) showed a slight tendency to less silt detection by PARIO.

Reproducibility (vertical stirring)



Two replicates with three repetitions gave almost identical PSD's for GG. For BAW, variability was slightly higher (SD of silt fraction 1.5 %, range about 5 %).

Accuracy (BAW, GG, JKI)



PARIO measurements agreed well with the Pipette method.
Blue: BAW, Brown: GG, Green: JKI.

Conclusions

- The PSD's obtained with the PARIO correspond well with the result of the Pipette method.
- The statistical error from replicate and repetitive measurements was in the range of 1 % to 2 % standard deviation for the silt fraction.
- Homogenization of the suspension by overhead shaking gave lower reproducibility and smaller silt fractions than vertical stirring.
- Analysis of material sieved to < 2000 µm and to < 200 µm gave equal results. Complete removal of the sand fraction, i.e. sieving to < 63 µm lead to less silt, probably due to a loss of fine material by the sieving process.