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## Innovations in soil color characterization: From Munsell color charts to flatbed scanners and digital cameras

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**Statement of the Problem:** The physical characterization of soil horizons based on color is a key diagnostic method in the description of soil profiles, and has been integrated in to diagnostic keys such as the world reference base for soil resources. The Munsell color system has been the primary qualitative or semi-quantitative mean to describe soil color. The purpose of this study is to explore the feasibility of using flatbed scanners and digital cameras to derive colorimetrically accurate images and data of soil samples, and to replace semi-quantitative Munsell chart comparison, or more expensive spectrophotometers.

**Methodology & Theoretical Orientation:** Flatbed scanners have been used previously for colorimetric characterization of rocks and sediments. We undertook a series of calibration/characterization steps to optimize the colorimetric accuracy of two commercially available flatbed scanners and a digital camera. The basic principle underlying our approach is to characterise and calibrate digital devices using a variety of colour charts/targets. We tested the accuracy of these calibrations through analysis of a soil sample set containing 161 spectrophotometrically analyzed soils.

**Conclusion & Significance:** With careful calibration, scanners and digital cameras can be used to measure soil color with an accuracy close to that achievable with spectrophotometers, and hence to replace applying Munsell charts to evaluate soil color.

### Recent Publications

1. Kemp D B (2014) Colorimetric characterization of flatbed scanners for rock/sediment imaging. *Computers and Geosciences* 67:69–74.
2. Kirillova N P and Sileva T M (2017) Colorimetric analysis of soils using digital cameras. *Moscow University Soil Science Bulletin* 72:13–20.
3. Kirillova N P, Sileva T M, Ul'ynova T Yu and Savin I Yu (2014) Match method and its application for the development of a large-scale soil map. *Eurasian Soil Science* 47:995–1004.
4. Levin N, Ben-Dor E and Singer A (2005) A digital camera as a tool to measure colour indices and related properties of sandy soils in semiarid environments. *International Journal of Remote Sensing* 26(24)5475-5492.



Figure1: Schematic diagram of obtaining a colorimetrically accurate image using digital devices

### Biography

Nataliya P Kirillova has her expertise in developing digital soil maps and evaluation of soil horizons color. Her match method (MM) was developed to create a digital fine-scale soil map and uses the indicative soil–landscape relationships. Accurate soil mapping relates to the correct classification based on soil horizons description. The study of the database that contains information on 800 profiles of the soils from the southern taiga subzone shows that more than 70% of the soil horizons are identified by color. That was the reason to develop the rapid and effective approaches for quantitative soil color evaluation.

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