# Colorimetric Detection Of Moisture Change In Rhizotron Studies Using a Flatbed Scanner

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**Introduction:**

The relationship between soil color and moisture is intuitive and well documented. Several attempts to build a generalized model for the relationship between color and moisture have been attempted using spectrophotometers and digital cameras (Persson 2005 and Sanchez et al. 2007). A useful application of being able to model the color/moisture relationship is for being able to detect soil moisture change in rhizotron studies. High resolution rhizotrons (9600DPI ) offer the additional challenge of color heterogeneity due to pore space and colloid structure.

**Objectives**

- Assess the influence of field capacity and texture on moisture color calibration curves
- Assess the fraction of soil which undergoes the greatest color change due to moisture change in a high resolution rhizotron experiment.

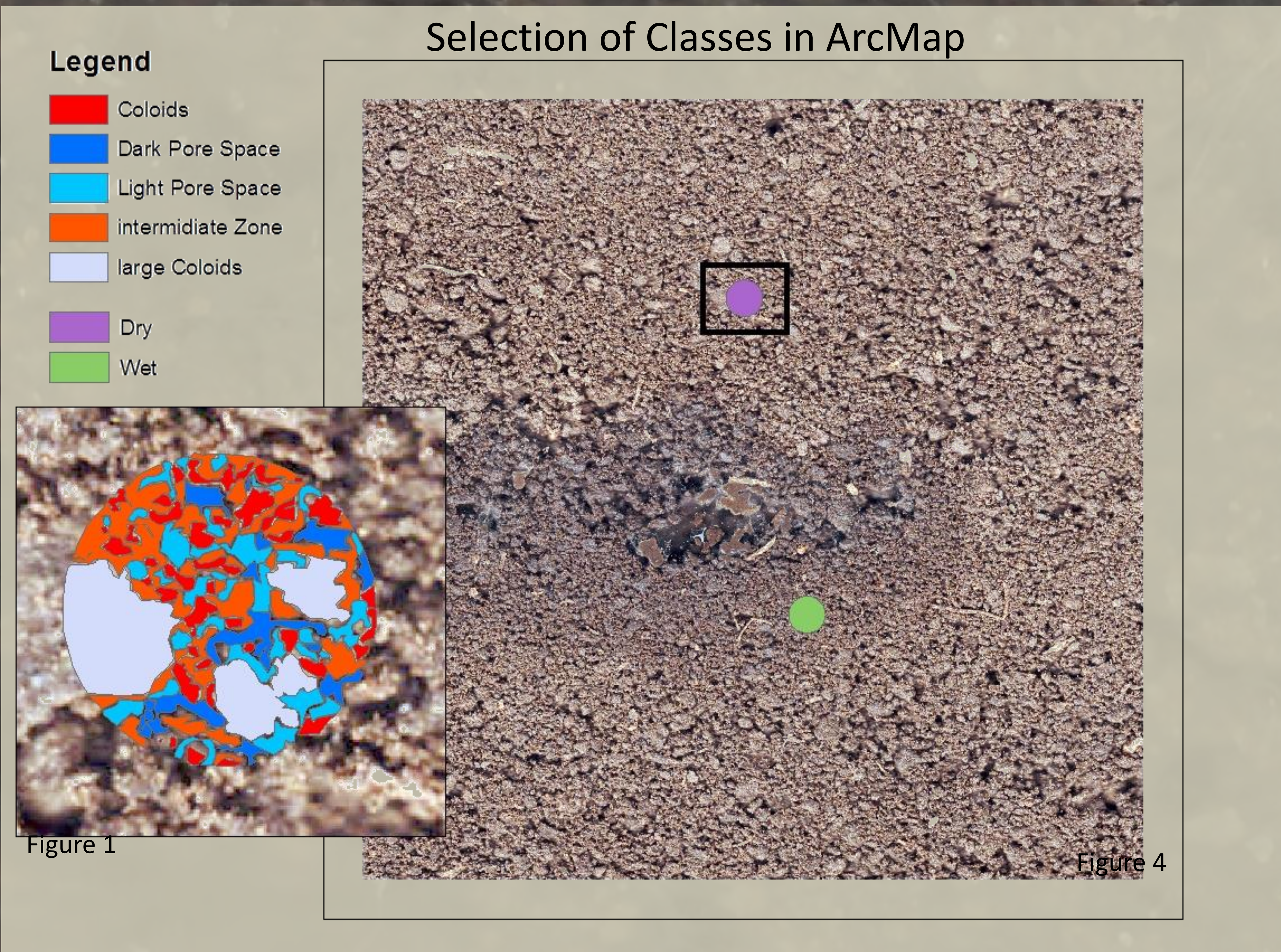


Figure 1

Figure 4

**Color Calibration Methods**

- 13 soils from Washington State were selected ranging in texture from a Sandy to Clayey Loam.
- Soils were sieved, dried at 105 C for 24 hours, and re-wetted to field capacity.
- Homogenized samples were placed on the scanner face and an image captured (300dpi).
- Samples were repeatedly air dried, scanned, weighed until moisture loss became negligible.
- The average red value was taken from the images and correlated to the moisture content.

**Spatial Fraction Methods**

- An image(4800 dpi) collected during a rhizotron study with a visible color change presumably due to moisture was used to demonstrate the difficulties with spatial heterogeneity.
- Sample circles in the 'dry' and 'wet' regions of the image were selected ArcMap (Fig 1&2)
- The 'dry' circle was broken down into 5 categories Coloids, Dark Pore Space, Light Pore Space, Intermediate Zone, and Large Coloids (Fig 1&2). (classification tool ArcMap)
- These 5 classifications were then used to classify the whole image using the maximum likely hood classification (Fig 3).

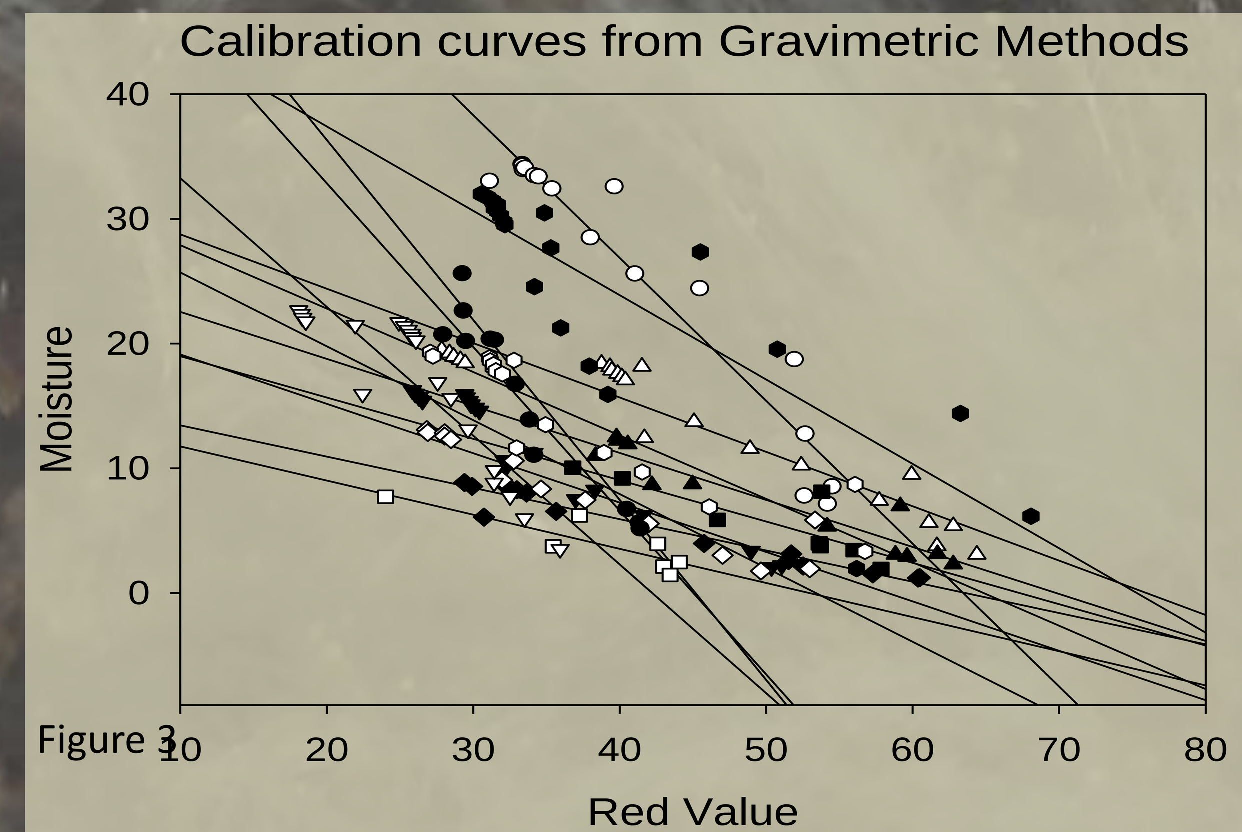


Figure 3

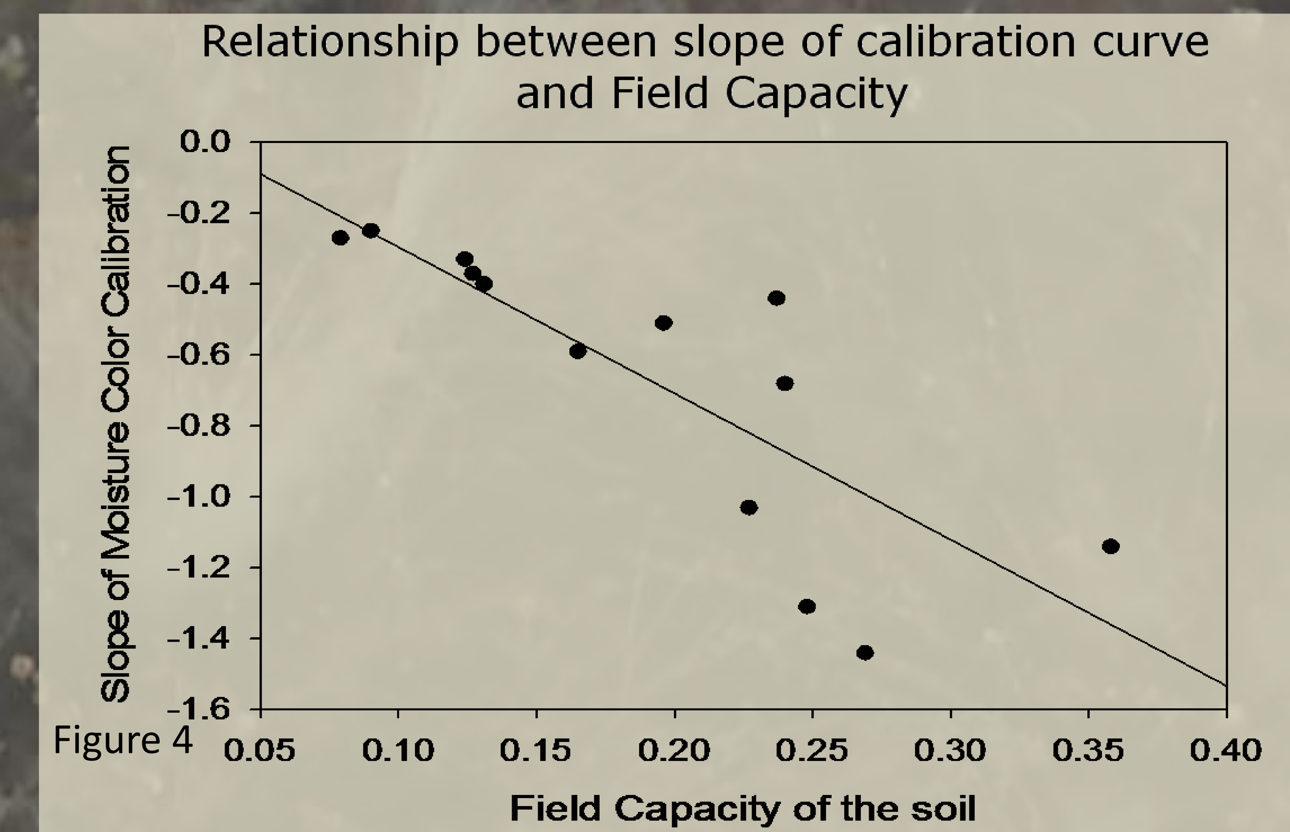


Figure 4

**Color Calibration Results**

- Individual soils had high correlations between soil moisture and color. ($R^2$ ranging from 0.94-0.74)
- Fitting a general model was not possible (Fig 4).
- When the slopes of the individual calibrations were plotted against the field capacity there appeared to be a trend towards higher field capacities having steeper slopes (Fig 5).

**Spatial Fraction Results**

- The 'colloids' classification best approximated the outline of the moisture front (Fig 3) suggesting the fraction of the soil which forms small colloids in immediate contact with the scanner face is the most influential fraction of the soil when considering the detection of moisture change in a heterogeneous soil matrix.

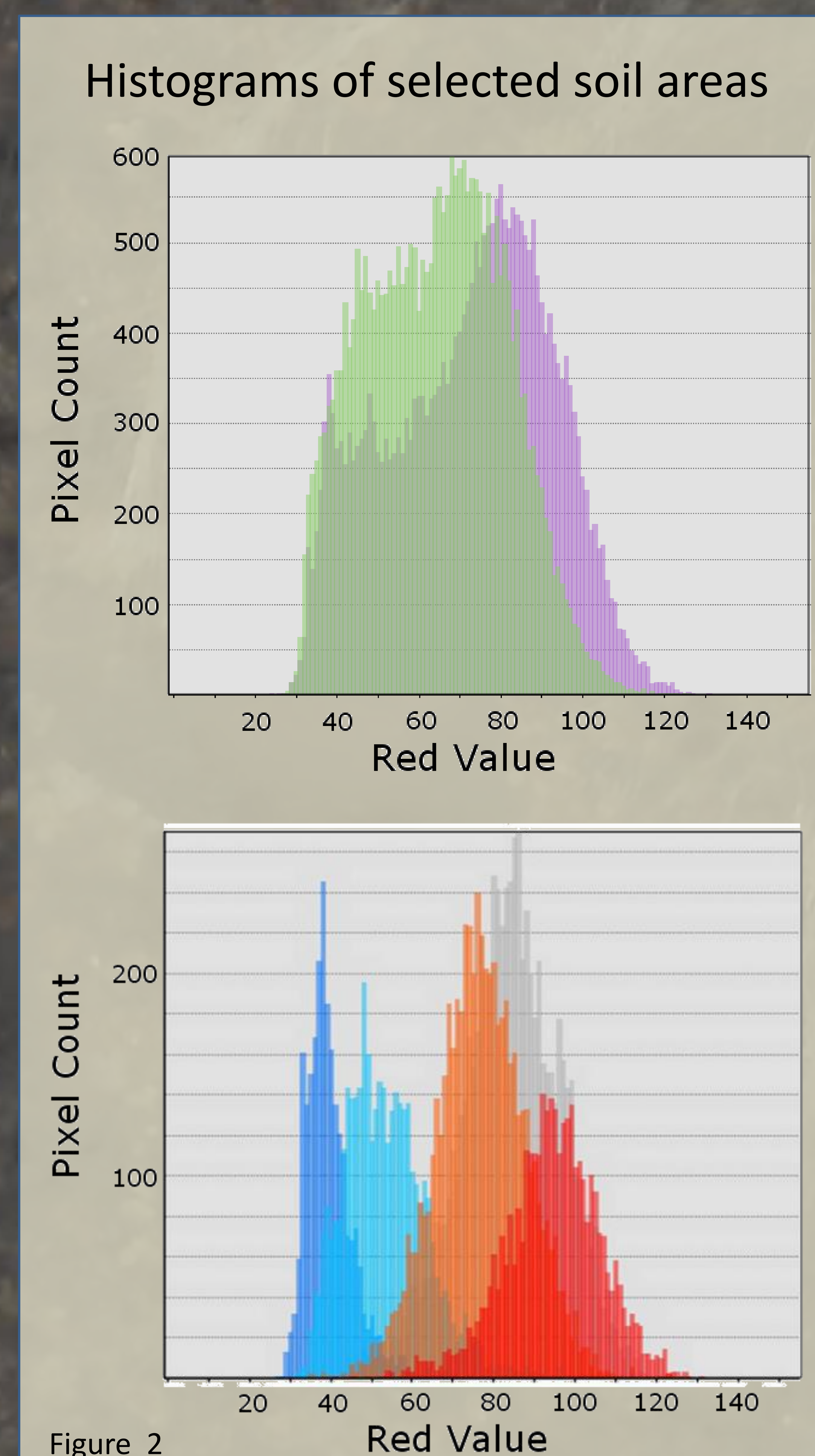


Figure 2

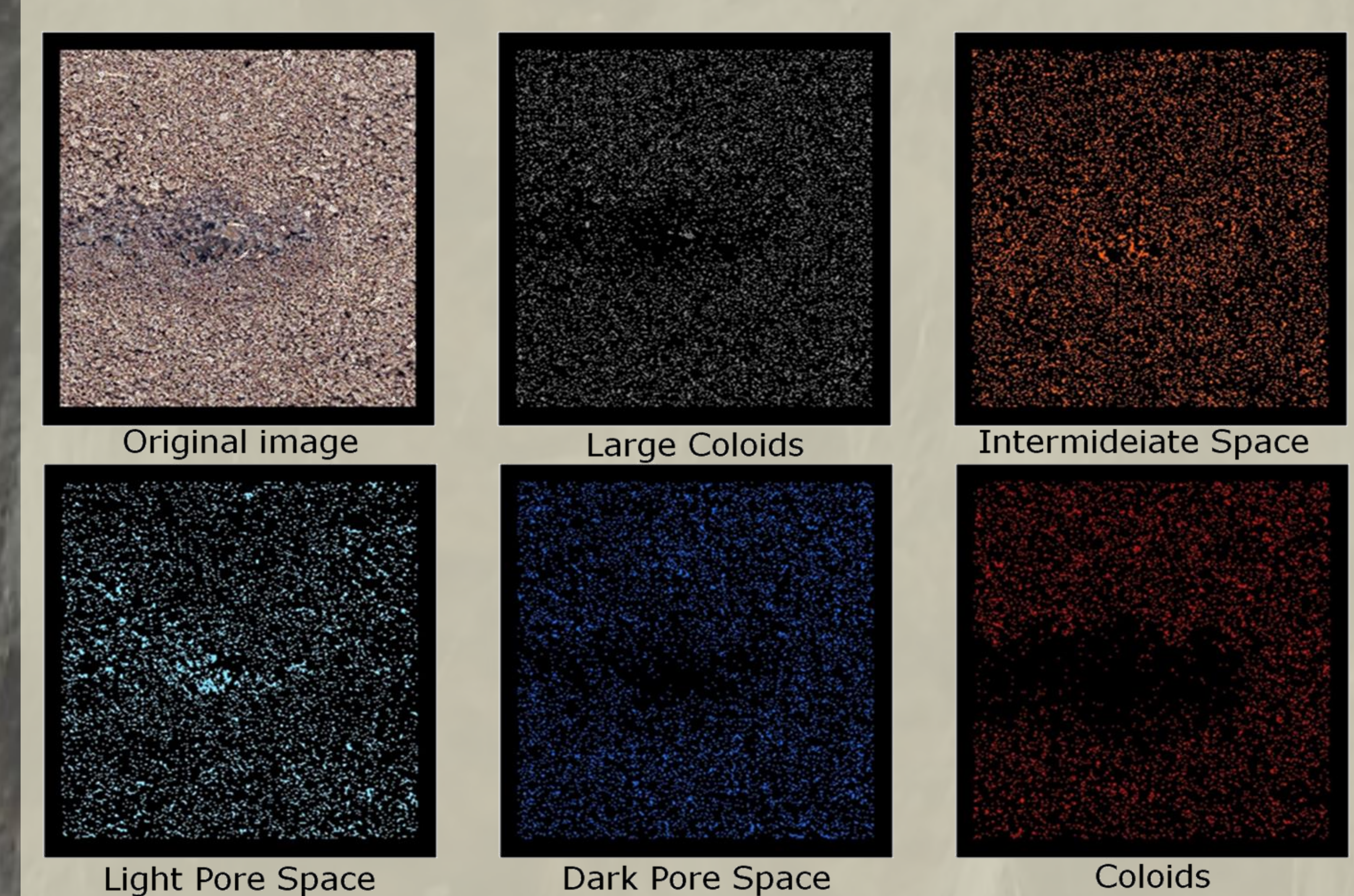


Figure 3

**Conclusions**

- Texture is an important factor to consider when calibrating soil moisture and soil color.
- There is potential for accurately determining the soil moisture of a heterogeneous soil based on the spatial selection of the correct fraction.

**Sources:**

Persson, Magnus. "Estimating Surface Soil Moisture from Soil Color Using Image Analysis." *Vadose Zone Journal* 4, no. 4 (November 1, 2005): 1119–1122. doi:10.2136/vzj2005.0023.

Sánchez-Marañón, M., R. Ortega, I. Miralles, and M. Soriano. "Estimating the Mass Wetness of Spanish Arid Soils from Lightness Measurements." *Geoderma* 141, no. 3–4 (October 15, 2007): 397–406. doi:10.1016/j.geoderma.2007.07.005.