SPECTRAL EVOLUTION

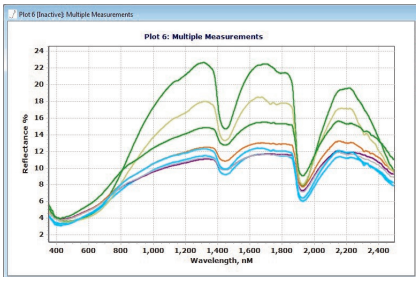
Soil Analysis is Key for Implementing Precision Agriculture

Soil analysis informs accurate precision agriculture decisions. It can influence everything from seed selection, selection of cover crops, crop rotation, application of fungicides, irrigation, and fertilization. Reflectance spectroscopy in the VIS/NIR range has been used for years as a nondestructive tool for evaluating soil properties. The measurement of water, carbon, nitrogen, and organic matter using a UV/VIS/NIR field spectroradiometer can provide critical information on soil health and help farmers make better precision agriculture decisions.

Soil analysis using NIR spectroscopy can measure water, carbon, nitrogen, clay, pH, and organic matter.

Traditional soil sampling processes are slow and expensive: gathering soil samples, preparing them for analysis, sending them to the lab, and waiting for the data. As a result, very few farmers have access to fast and accurate soil data. As concerns grow about more efficient agricultural practices, the effects of climate change, over-fertilization with chemicals, erosion, and pollution, the availability of field spectrometry for soil science becomes increasingly popular. A field spectroradiometer offers the possibility of accurately categorizing soil/land changes over a large area quickly.

For example, taking in situ measurements rapidly and without preparing or in any way affecting the sample, spectral information related to the main nitrogen absorption features near 1450, 1850, 2250, 2330, and 2430nm provide not only indications of nitrogen content but also can be used to derive quantitative information on total nitrogen using chemometrics programs like R or Camo's Unbscrambler.



DARWin SP Data Acquisition software is included with every SPECTRAL EVOLUTION spectroradiometer. The software includes access to the USGS spectral library via a simple pull-down menu as well as to 19 Vegetation Indices.

NIR reflectance spectroscopy performed in the field offers a relatively simple, non-destructive, reliable, inexpensive, fast, and accurate method for characterizing soil. Soil analysis doesn't change or affect the sample in any way, no chemicals or hazardous materials are used, measurements are very fast, and several different soil characteristics can be gleaned from a single scan. Testing can be performed in a lab, or more effectively, *in situ*.

Spectral signatures of materials are defined by reflectance or absorption as a function of wavelength. NIR spectroscopy measures the reflectance of infrared light wavelengths for samples and the shapes of the soil spectra correspond to mineral composition, organic matter, clay content, water, iron (form and amount), salinity, and particle size distribution. Depending on what's in the soil, individual molecular bonds vibrate and absorb light with a specific energy quantum related to the difference between two energy levels. The resulting absorption spectrum produces a characteristic shape that can be used for analysis. The data collected can provide a picture of soil health and fertility for food source management and security, as well as natural resource management and land conservation/development.

Spectral libraries can be built based on known samples and then applied in the rapid analysis of large numbers of samples. The spectra collected can be analyzed using a range of third party analysis and chemometric packages, including R and Unscrambler.

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Typical Soil Applications:

- Topsoil fertility
- Erosion risk
- Hydraulic properties
- Soil degradation
- Soil mapping and monitoring
- Crop monitoring during growth cycle
- Total carbon and inorganic carbon
- Organic matter in soil
- Total nitrogen and mineralized nitrogen
- Clay, silt, and sand
- Cation exchange capacity (CEC) measurement as an indication of soil fertility and nutrient retention capacity
- Moisture content

A field spectroradiometer, such as the SPECTRAL EVOLUTION PSR+, SR-6500, RS-5400 or RS-3500, allows a researcher to apply hyperspectral and multi-spectral data from satellite and airborne flyovers with field measurements. The PSR+ is ideal for soil analysis and mapping applications because it delivers:

- Fast, full spectrum UV/VIS/NIR measurements with a spectral range from 350-2500nm with just one scan
- Ultra-fast operation with autoshutter, autoexposure and auto-dark correction before each new scan – no optimization step
- Small and lightweight with rechargeable Li-ion batteries for field operation—half the weight of competitive instruments
- Superior signal to noise ratio with faster scan times and better reflectance measurement
- Reliable field performance with an all photodiode array platform and no moving gratings
- Detachable, field replaceable fiber optic and field swappable optics for varying target sizes and different measurement modes
- Single user operation with optional rugged tablet that provides a sunlight readable screen plus the ability to tag spectra with GPS, digital camera images, and audio notes

All SPECTRAL EVOLUTION spectroradiometers come equipped with DARWin Data Acquisition software that collects data and saves it to a compatible ASCII format for use with 3rd party chemometric analysis software without requiring post-collection processing.

The PSR+, SR-6500, RS-5400 and RS-3500 spectroradiometers are ideal for soil analysis in the field or in the lab whewn cobined with our 10mm contact probe, 3mm Miniprobe or benchtop probe with compactor.

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