Reflectance spectroscopy in the VIS/NIR range has been used for years as a non-destructive 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.

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 locations in the United States, let alone the rest of the world, have accurate soil maps. 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.

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 GRAMS. Software products such as GRAMS are used for geochemical analysis and interpretation of basic soil composition, especially organic matter, texture, clay mineralogy, nutrient availability, fertility, structure, and even microbial activity.

GRAMS is a product from Thermo Scientific.
SPECTRAL EVOLUTION is an authorized GRAMS reseller.
A field spectroradiometer, such as the SPECTRAL EVOLUTION PSR+, 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 PDA that provides a sunlight readable screen plus the ability to tag spectra with GPS, digital camera images, and audio notes
- Standalone operation with 1,000 scan storage

The PSR+ comes 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.

In addition to the PSR+ and other portable spectroradiometers, SPECTRAL EVOLUTION also offers a full range of portable spectroradiometers and lab spectrometers. For more information, visit: www.spectralevolution.com.

### 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
- Soil pH

The PSR-3500 spectroradiometer is ideal for soil analysis in the field or in the lab.