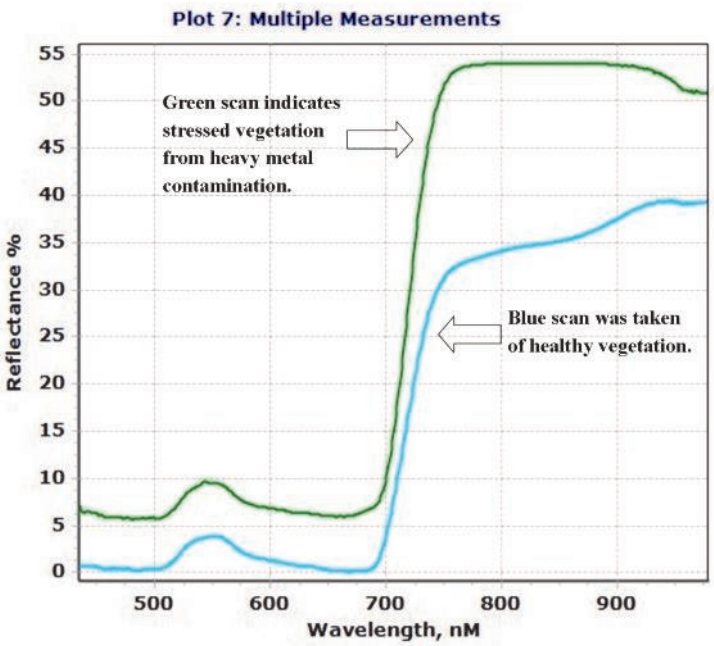
SPECTRAL EVOLUTION

Identifying Heavy Metal Stress in Vegetation

Increased industrialization as well as modern agricultural practices have resulted in increased heavy metal contamination of soil and vegetation. At elevated levels, heavy metals produce stress in vegetation that can lead to such problems as lower biomass, adverse effects on growth and photosynthesis, altered water uptake and nutrient assimilation, senescence, and plant death. Metals usually interfere with basic plant metabolism, and enzyme activity is often negatively affected. Heavy metal exposure negatively affects photosynthetic processes and generally induces stress in plants. In some cases, the absorbed metal ion replaces the central magnesium atom in the chlorophyll molecule. This substitution reduces or prevents light harvesting and results in a photosynthetic breakdown.

One of the most used indications of heavy metal stress in vegetation involves the red edge measurement in a spectra. As heavy metal negatively affects the production of chlorophyll, the red edge moves toward shorter wavelengths and reflectance increases at 680nm.



An example of the red edge shift and increased reflectance in a spectra displayed in DARWin SP Data Acquisition software.

Heavy metals that can be found in vegetation include copper, zinc, lead, chromium and cadmium. Using chemometrics software such as Unscrambler from Camo Analytics and the following absorption features heavy metal stress can be identified:

- Copper: 489, 616, 809, 2431nm
- Zinc: 437, 564, 665, 688, 883, 2032nm
- Lead: 356, 683, 692, 728, 1865nm
- Chromium: 415, 652, 713, 863, 1036, 2044nm
- Cadmium: 438, 631, 744, 1373nm

Build, optimize and test your model in Camo Analytics Unscrambler. The coefficients from your model are used in the prediction engine built into our DARWin SP Data Acquisition software to identify heavy metals in new samples. In analyzing heavy metals in vegetation, first and second derivatives can also supply useful information. DARWin software that runs on all SPECTRAL EVOLUTION instruments provides these derivatives.

SPECTRAL EVOLUTION spectroradiometers deliver the following capabilities:

- Rapid data/spectra collection in the field – take more scans in less time
- High resolution in a field instrument
- High signal-to-noise ratio for improved reflectance values
- Fast start-up and use with no optimization step required between scans
- Sturdy construction for harsh field environments
- Reliable operation with no moving optics and a robust fiber optic cable with quick-disconnect

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