Geophysical Research Abstracts
Vol. 16, EGU2014-842, 2014
EGU General Assembly 2014

Spectroscopy as a diagnostic tool for urban soil contaminants

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Urbanization has become one of the major forces of change around the globe. Land use transformation, especially urbanization has the most profound influences of human activities because it affects so many of the planet's physical and biological systems. Land use changes directly impact the ability of the earth to continue to provide ecological services to human society and the other occupants of the ecosystems. The urban process gradually degrades and transforms agricultural and natural ecosystems into built environments.

The urban environment includes cities, suburbs, peri–urban areas and towns. Urban ecosystems are highly heterogeneous due to the variety of land covers and land purposes. Thus, the choices on managing the extent and arranging the land cover patches (e.g., lawns) assist to shape the emergent structure and function of the urban ecosystems.

As a result of ecological conditions and current management status the urban soils show substantial spatial heterogeneity. Whereas, adverse effects of pollutants on ecosystems have been demonstrated, one important need for environmental impact assessment have been defined as maintenance of long-term monitoring systems, which can enable to improve monitoring, modelling and assessment of various stressors in agriculture environment. Diffuse reflectance spectroscopy and diffuse reflectance Fourier-transform infrared (FTIR) spectroscopy across visible–near- short- mid- and long- wave infrared (0.4-14μm) has the potential to meet this demand. Relationships between spectral reflectance and soil properties, such as grain size distribution, moisture, iron oxides, carbonate content, and organic matter, have already been established in many studies (Krishnan et al. 1980, Ben-Dor and Banin 1995, Jarmer et al. 2008, Richter et al. 2009). The aims of this study are to develop diagnostic tool for heavy metals, polycyclic aromatic hydrocarbons, asbestos and other anthropogenic contaminants in urban soil using spectroscopy across 0.4-14μm spectral range. To examine the potential of the above-mentioned technique on contaminated and uncontaminated urban areas in Northern Israel, we propose to use both portable field spectrometers across 0.4-2.5μm and laboratory FTIR system across 3-14μm testing selected bare soil samples and integrate the obtained knowledge into the expert prototype system. The significances and contributions of the proposed work are expected in: 1) estimate morphological and biochemical characteristics of urban soils, 2) examine the possibility to detect early soil response to stress before damage occurs, 3) study the concentration of pollution on urban soils, 4) design and develop the methodology for a near real-time expert monitoring system. The present research will focus on spectral identification and characterization of urban soils toward quality assessment of the urban ecosystem.