

Differentiating Ash Contaminated by Trace Metals Using Field Spectroscopy and Remote Sensing

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Wildfires increasingly encroach on human habitation. The aftereffects of fires in populated areas pose unique threats to human health and the environment. In particular, ash from wildfires in inhabited areas may be contaminated with trace metals from electronics, construction, and industrial materials. Trace metals can cause health problems for returning survivors, as well as contribute to health issues for people living nearby. Accepted methods for identifying and monitoring trace metal contaminated ash require entering burned areas, collecting ash samples, and conducting laboratory analyses. Continuous monitoring using these techniques is prohibitively expensive. Differentiation of contaminated ash from uncontaminated ash by spectroscopy and remote sensing can help to provide real-time detections of contamination as well as continuous monitoring. We present results for the detection of trace metal contaminated ash using comparative field spectroscopy and remote sensing.

The goals of this work are: 1) To identify spectral differences between ash contaminated with trace metals and uncontaminated ash and; 2) To use any unique spectral features to identify contaminated ash by remote sensing and differentiate it from uncontaminated ash.

We collected field spectra between 350 – 2500 nm using an ASD FieldSpec 3 spectroradiometer in areas with high trace metal contaminant concentrations (e-waste recycling sites) and in areas with uncontaminated ash (brush fires). We identified meaningful spectral differences, resampled the spectra to 8-band spectral resolution, and used them to linearly unmix a WorldView-2 image containing both contaminated and uncontaminated ash. Future work will involve target detection of field spectra within images collected by the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) over California during severe wildfires.

Ash contaminated by trace metals can be differentiated from uncontaminated ash by two spectral features: 1) In the 2200 – 2300 nm region, ash containing high concentrations of trace metals displays a broad feature with a band center at 2240 nm, while uncontaminated ash displays a sharper feature with a band center at 2290 nm. 2) Contaminated ash also displays a broad feature centered at ~800 nm that is absent from the spectrum of uncontaminated ash. At 8-band resolution, regions of contaminated and uncontaminated ash are qualitatively distinguished by spectral linear unmixing. However, 3 of the 8 bands are not well captured ($RMSE \gg 1$). Future work will involve hyperspectral target detection of contaminated and uncontaminated ash.