

MULTIPLE APPLICATIONS FOR AIRBORNE HYPERSPECTRAL SENSORS

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ABSTRACT



Airborne hyperspectral systems that span the visible near-infrared to short wave-infrared (VNIR-SWIR) wavelength range acquire a rich data cube that can be used for many applications. A VNIR-SWIR data cube can be effectively used for evaluating environment, facilities, land use/land cover and geology. The distribution of spectrally-unique soils, minerals, plant communities, manmade materials, and water conditions can be derived from the data cube. Integration of enhanced images with DEM's improves mapping for natural hazards and structural geology.

Recently we completed a new VNIR-SWIR spectral library for detecting oil-impacted surfaces (including onshore oil seeps). With this library, VNIR-SWIR hyperspectral technology can be more effectively applied to detect oil-impacted soils and surfaces within industrial sites and brownfields.

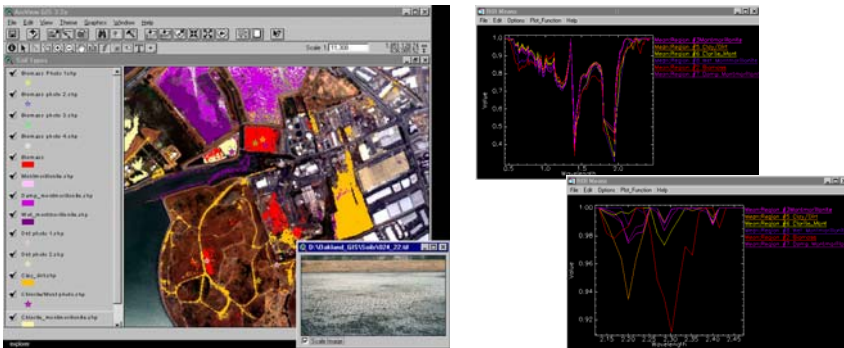
The most significant issue facing broader use of the technology and integration of images and derived products with GIS is the cartographic error associated with line-scanner technology. Orthophotographs help minimize the error. Acquiring VNIR-SWIR hyperspectral datacubes reduces the risk for management because the data can be effectively used to achieve several different business objectives.

128 BAND HYPERSPECTRAL FLIGHT STRIP

A flight strip collecting reflected visible-near IR to Shortwave IR wavelengths (VNIR-SWIR) over the Oakland airport was processed for multiple applications, including soils, plant communities, paved surfaces, vegetation vigor, and land use/land cover. It is most cost effective to use the data-rich VNIR-SWIR datacubes to support a broad range of applications.

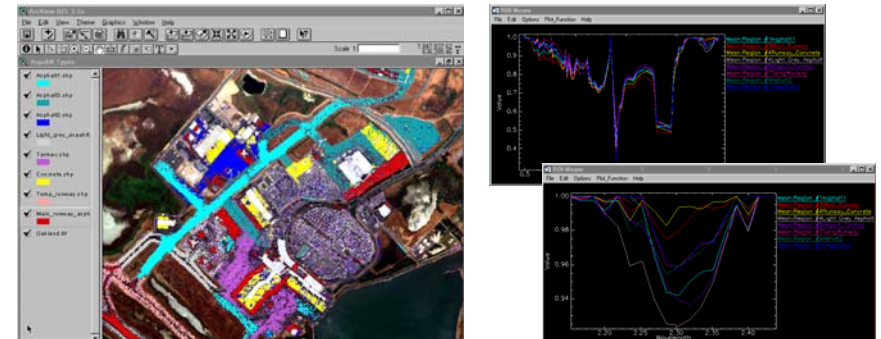


SOILS



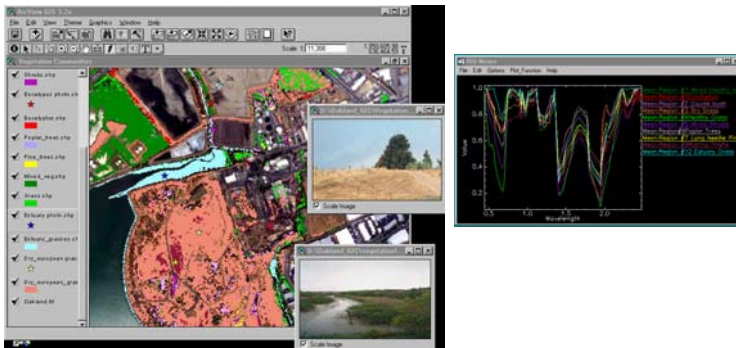
Mapping the spatial distribution and type of different soils may enable better understanding of a feature's engineering performance

PAVED SURFACES



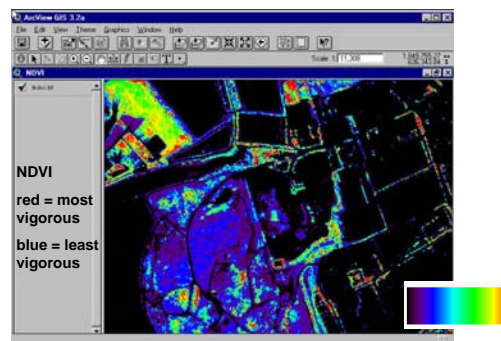
VNIR-SWIR imagery can differentiate paved surfaces based on composition and perhaps condition - improving monitoring the engineering performance of paved surfaces

PLANT COMMUNITIES



Spectrally-unique maps of plant communities for a baseline & monitoring

VEGETATION VIGOR



Red Edge shift, chlorophyll absorption or NDVI for mapping vegetation vigor

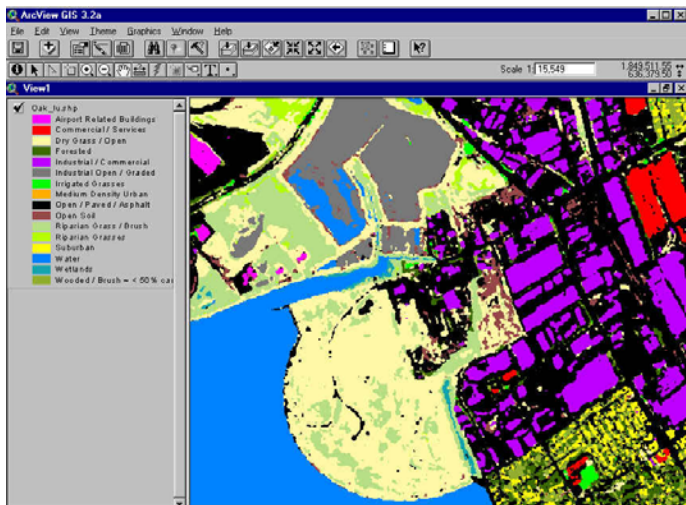
ORTHO BASE



Orthophotography provides a high resolution base with engineering-level x,y accuracy

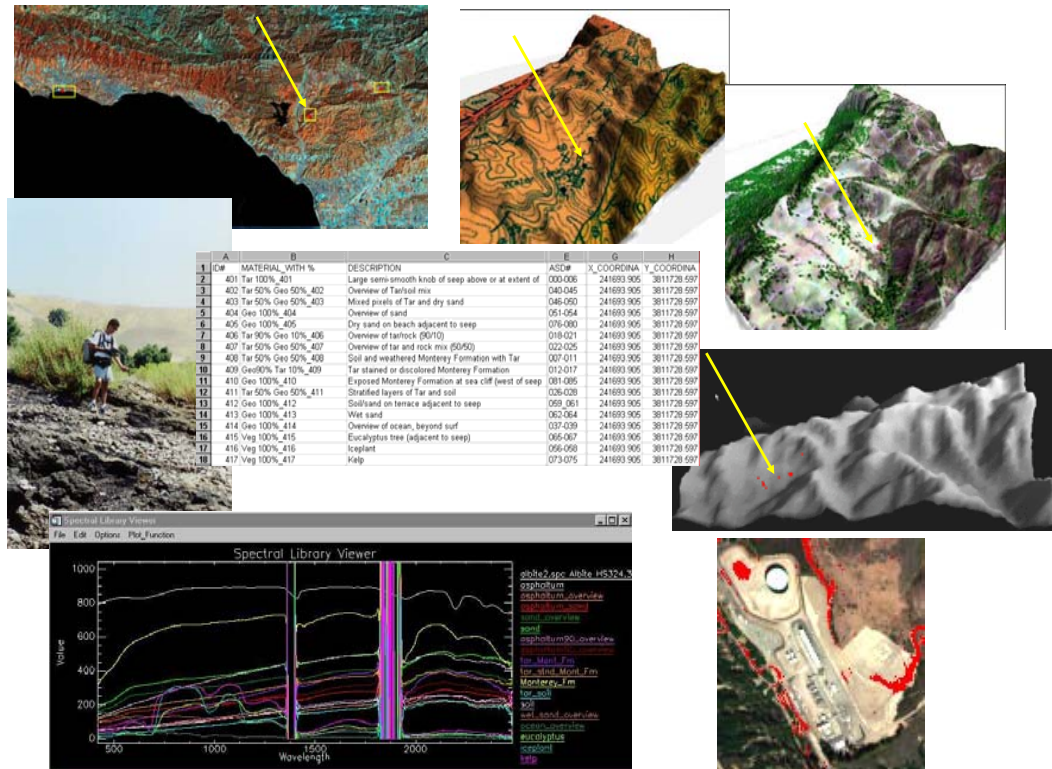
LAND USE/LAND COVER

Land use/land cover classification of hyperspectral imagery provides a comprehensive background map that can improve understanding of the spatial distribution of spectrally unique materials ("biomass, montmorillonite, asphalt, etc"). Statistics can be developed to determine areal extent of different land uses/land covers for use in modelling storm run-off, irrigation amounts, and degree of development.



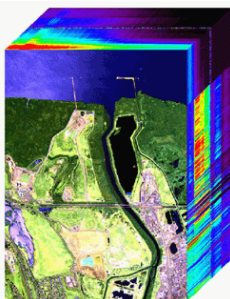
DETECTING OIL-IMPACTED SOILS

3 locations in S. California were evaluated for oil-impacted soils and onshore seeps. A Dibblee Geologic Foundation map were draped over a DEM, revealing the relationship of mapped oil seeps with geologic structure (see yellow arrows). Field measurements were made and used to calibrate VNIR-SWIR airborne detection of these oil seeps (red shapes on the illuminated DEM). The spectral library enables hyperspectral imaging to be used for exploration and environmental applications, especially for establishing baselines of brownfields and industrial property.

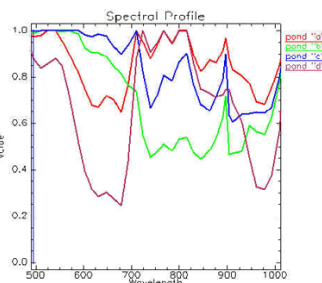


WATER CONDITIONS

A ESSI Probe-1 VNIR-SWIR datacube over an industrialized estuary north of the Oakland Airport provides insight about water bodies



The spectral response of pond "a" and "d" are similar and show the 0.67 chlorophyll absorption feature (note depth and width of 550-700 nm curves). However, this chlorophyll absorption feature is missing within in ponds "b" and minimal in pond "c", perhaps indicating a lack of healthy biomass with chlorophyll at the surface.



CONCLUSIONS

Airborne VNIR-SWIR hyperspectral datacubes can be processed and interpreted for multiple applications. Each application requires the image processing analyst and client to work together to ensure that training sites, ancillary information, and appropriate maps are integrated into the mapping effort. Management risks are reduced when a datacube is exploited for multiple applications.

ACKNOWLEDGEMENTS

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