MULTIPLE APPLICATIONS FOR AIRBORNE HYPERSPECTRAL SENSORS

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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.

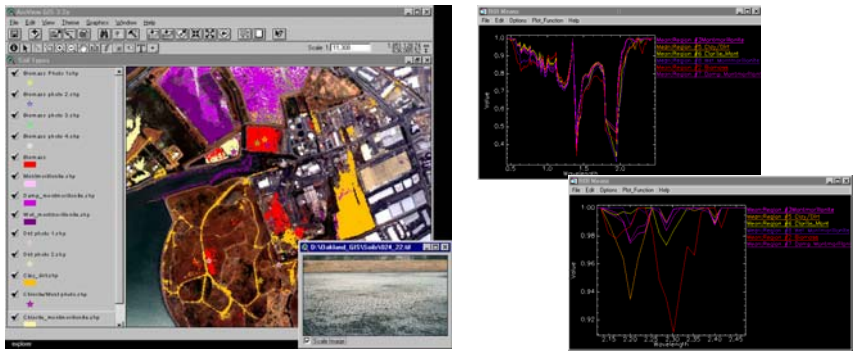
ABSTRACT

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.

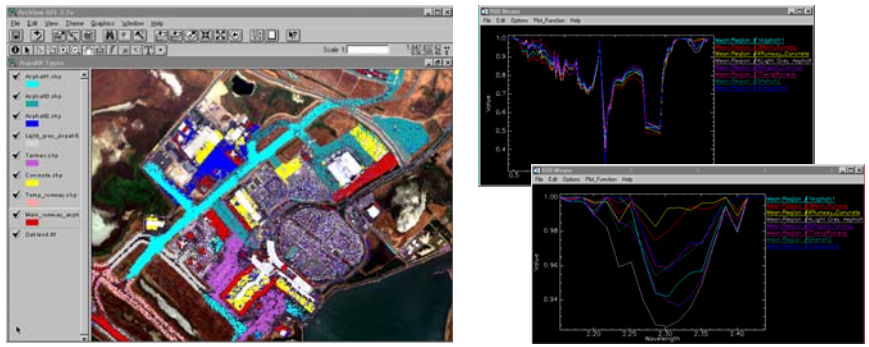
The most significant issue facing broader use of the technology and integration of images and derived products with GIS is the cartographic error associated with line-scanner technology. Orthophotographs help minimize the error. Acquiring VNIR-SWIR hyperspectral datacubes reduces the risk for management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

SOILS



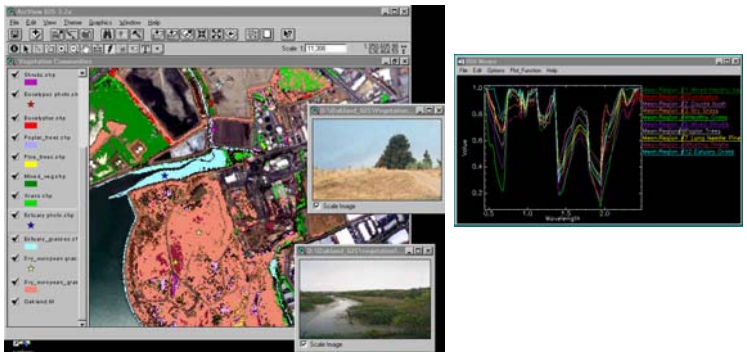
Mapping the spatial distribution and type of different soils may enable better understanding of a feature's engineering performance

PAVED SURFACES



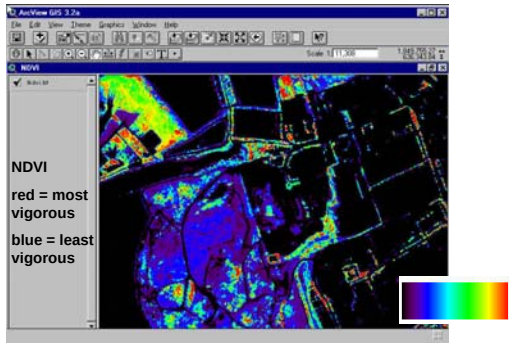
VNIR-SWIR imagery can differentiate paved surfaces based on composition and perhaps condition - improving monitoring the engineering performance of paved surfaces

PLANT COMMUNITIES



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

VEGETATION VIGOR



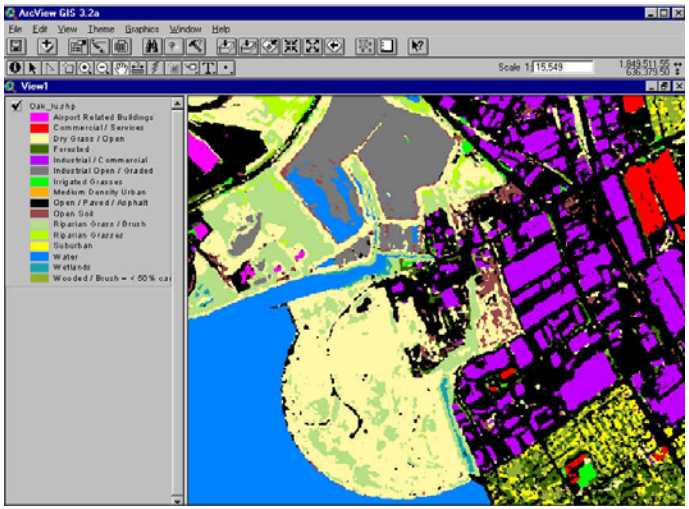
Red Edge shift, chlorophyll absorption or NDVI for mapping vegetation vigor

ORTHO BASE

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

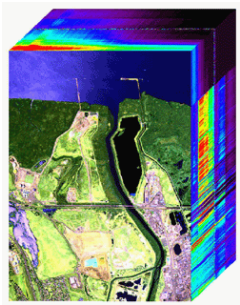
LAND USE/LAND COVER

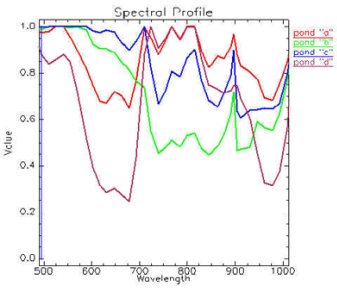
Land use/land cover classification of hyperspectral imagery provides a comprehensive background map that can improve understanding of the spatial distribution of spectrally unique materials ("biomass, montmorillinite, asphalt1, etc") . Statistics can be developed to determine areal extent of different land uses/land covers for use in modelling storm run-off, irrigation amounts, and degree of development.



WATER CONDITIONS

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

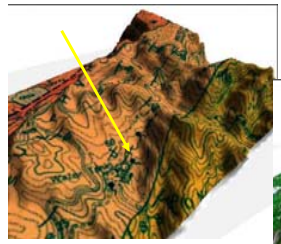


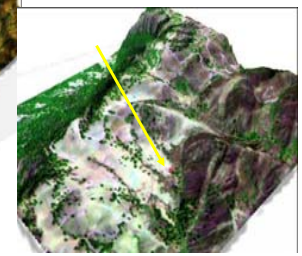


The spectral response of pond "a" and "d" are similar and show the 0.67 chlorophyll absorption feature (note depth and width of 550-700 nm curves). However, this chlorophyll absorption feature is missing within in ponds "b" and minimal in pond "c", perhaps indicating a lack of healthy biomass with chlorophyll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

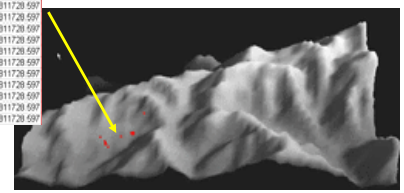
DETECTING OIL-IMPACTED SOILS

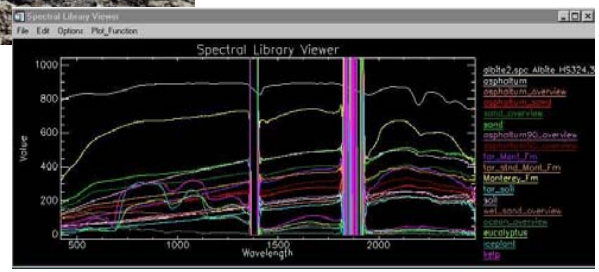
3 locations in S. California were evaluated for oil-impacted soils and onshore seeps. A Dibblee Geologic Foundation map were draped over a DEM, revealing the relationship of mapped oil seeps with geologic structure (see yellow arrows). Field measurements were made and used to calibrate VNIR-SWIR airborne 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.





	A	B	C	E	G	H
1	ID#	MATERIAL_WITH %	DESCRIPTION	ASD#	X_COORDINA	Y_COORDINA
2	401	Tar 100%	Large semi-smooth knob of seep above or at extent of	000-006	241693.905	3811728.597
3	402	Tar 50% Geo 50%	Overview of Tar/soil mix	040-045	241693.905	3811728.597
4	403	Tar 50% Geo 50%	Mixed pixels of Tar and dry sand	046-050	241693.905	3811728.597
5	404	Geo 100%	Overview of sand	051-054	241693.905	3811728.597
6	405	Geo 100%	Dry sand on beach adjacent to seep	076-080	241693.905	3811728.597
7	406	Tar 90% Geo 10%	Overview of tar/rock (90/10)	018-021	241693.905	3811728.597
8	407	Tar 50% Geo 50%	Overview of tar and rock mix (50/50)	022-025	241693.905	3811728.597
9	408	Tar 50% Geo 50%	Soil and weathered Monterey Formation with Tar	007-011	241693.905	3811728.597
10	409	Geo90% Tar 10%	Tar stained or discolored Monterey Formation	012-017	241693.905	3811728.597
11	410	Geo 100%	Exposed Monterey Formation at sea cliff (west of seep	081-085	241693.905	3811728.597
12	411	Tar 50% Geo 50%	Stratified layers of Tar and soil	026-028	241693.905	3811728.597
13	412	Geo 100%	Soil/sand on terrace adjacent to seep	059_061	241693.905	3811728.597
14	413	Geo 100%	Wet sand	062-064	241693.905	3811728.597
15	414	Geo 100%	Overview of ocean, beyond surf	037-039	241693.905	3811728.597
16	415	Veg 100%	Eucalyptus tree (adjacent to seep)	065-067	241693.905	3811728.597
17	416	Veg 100%	Iceplant	056-058	241693.905	3811728.597
18	417	Veg 100%	Kelp	073-075	241693.905	3811728.597





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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