USING AIRBORNE DIGITAL CAMERAS FOR ENVIRONMENTAL APPLICATIONS

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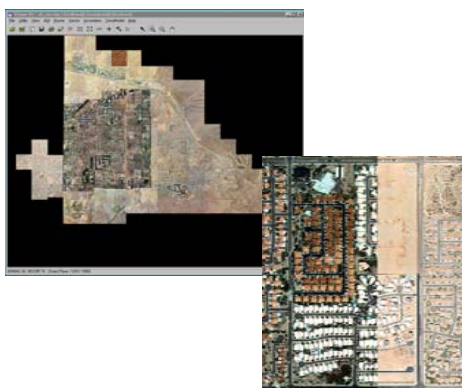
ABSTRACT

Airborne digital cameras are providing new information to support environmental planning and monitoring. A range of sensors, including single visible-near infrared (VNIR) cameras, multiple VNIR cameras, and single-band thermal IR cameras, provide cost effective and timely solutions. These systems are frame cameras that enable relatively accurate and consistent cartographic products to be derived for planning purposes.

The applications range from monitoring urban sprawl to determining the temperature of lakes. Single VNIR cameras enable the most accurate orthorectification and mosaicking. Multiple VNIR camera systems provide enough data to support unsupervised/supervised land use classifications that can be integrated with more regional satellite-based maps. These classifications are excellent for deriving permeable/impermeable statistics to support floodplain and runoff modelling.

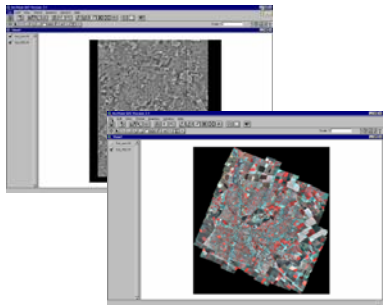
Inexpensive, single-band thermal cameras have many applications, including mapping the pattern of surface temperature across lakes and industrial ponds, detecting near surface groundwater and temperature anomalies within infrastructure, and smoke penetration in support of fire fighting.

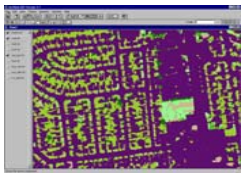
URBAN GROWTH

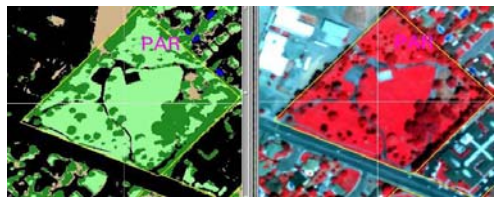


Rapid change detection is enabled by digital cameras. On the left, a digital camera mosaic is superimposed on a high-value orthophotograph two years older - note rapid growth within enlarged area. On the right suburbia sprawling into open space.

WATER CONSERVATION

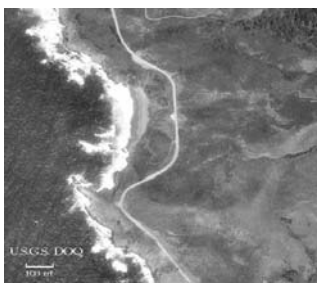


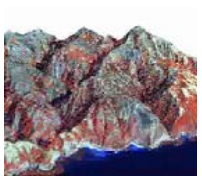




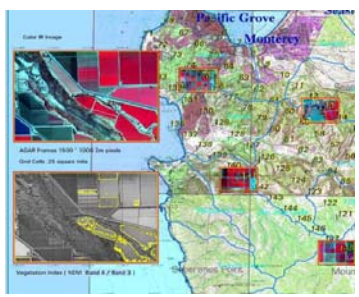
Orthophotograph base controlling 4-camera ADAR mosaic with classification of impermeable surfaces (black- purple), irrigated turf (light green), trees/shrubs (dark green) and open areas/other vegetation (tan)

COASTAL ZONE MANAGEMENT





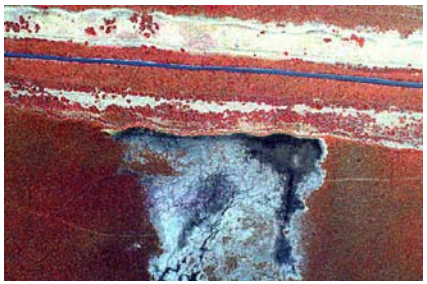
Digital mosaic of many CIR frames enlarged in middle image and compared with USGS digital orthophotograph. Kelp beds, beach, surf zone, and watersheds are more clearly depicted on the digital CIR imagery. Draping imagery or a land use classification on a DEM enables stereoscopic viewing (for improved understanding of land use and slope stability) and enhances modelling (see right).



AGRICULTURE

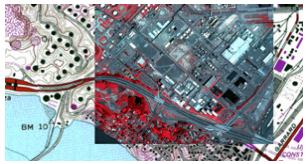
Four-camera systems enable NDVI calculations, interpretation of crop vigor, and land use/land cover classifications across agricultural districts.

WETLANDS

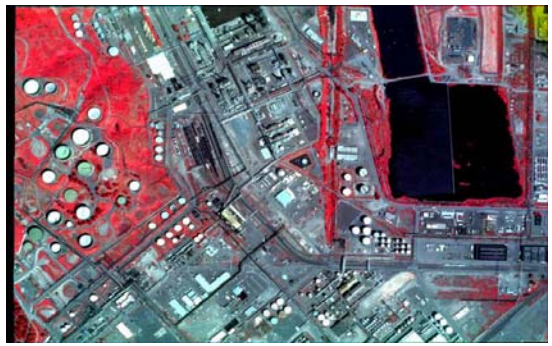


ColorIR and natural color imaging reveals details of dredged channels, embayments, vegetation cover, construction impact, and river channels.

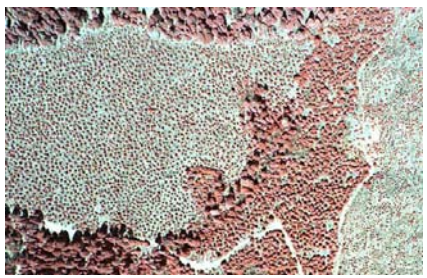
INDUSTRIAL SITES

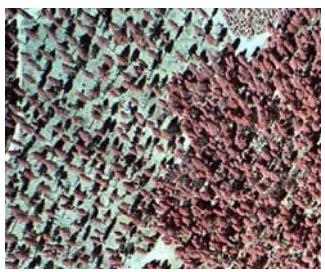


Change Detection and Establishing Low Cost Baseline using VNIR Digital Sensors.



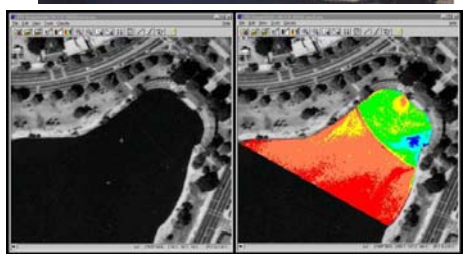
FORESTRY





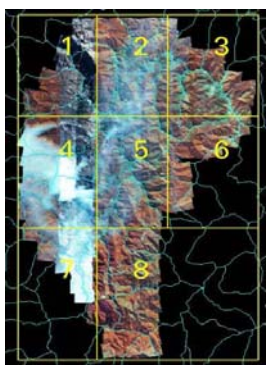
A flight program that has >50% overlap enables stereoscopic models to be created that enhance interpretation of natural hazards, canopy height, building elevation, and infrastructure. Leaning trees can be seen on the right image. Ground Sampling Distance (GSD) = 0.5 meters

THERMAL



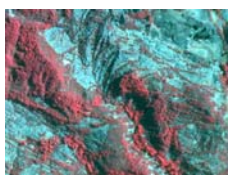
A thermal IR sensor (FLIR ThermalCam PM 595) that collects thermal radiation in the 7.5 – 13 micron range in a single 14-bit band. Ground photograph of Lake Merritt showing curtain and small white building on far shoreline with a thermal image mosaicked into an orthophotograph of Oakland. The cold to warm "thermometer" spans 7ºF. There is an abrupt temperature differential of 2-3ºF across the arc that is caused by the floating curtain. Cold water (dark blue feature) is imaged as it flows through drains beneath the small building on the far shoreline.

FOREST FIRES



These digital mosaics have >250 frames each - they are georeferenced to USGS 7.5' Quads for evaluating burn areas. 5 day turn-around needed.

GEOLOGY



Geologic structure and Stratigraphy can be interpreted through vegetation patterns. GSD = 2 meters.

CONCLUSIONS

Airborne digital cameras offer rapid turn-around and timely acquisition at resolutions that typically vary between 0.5 m to 2 m. Cameras are available that can record visible - near IR through SWIR and into the thermal wavelengths. The frame imagery can be orthorectified to varying degrees of accuracy, depending on level of system calibration, lens and array quality, and multi band-to-band registration.

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