

3-2009

CHARTS data fusion: Multi-sensor imagery co-registration


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Recommended Citation

Pe'eri, Shachak and Rzhanov, Yuri, "CHARTS data fusion: Multi-sensor imagery co-registration" (2009). *Coastal Geotools* 2009. 493.
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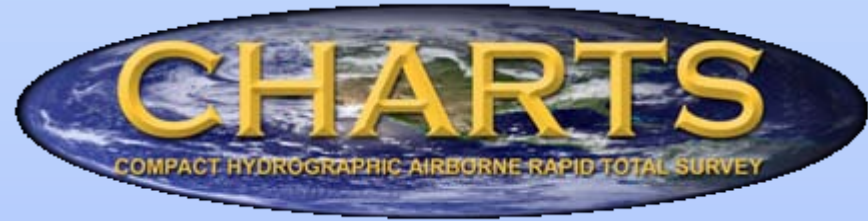


CHARTS Data Fusion: Multi-sensor Imagery Co-registration

Shachak Pe'eri and Yuri Rzhanov

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University of New Hampshire

CHARTS sensor suite

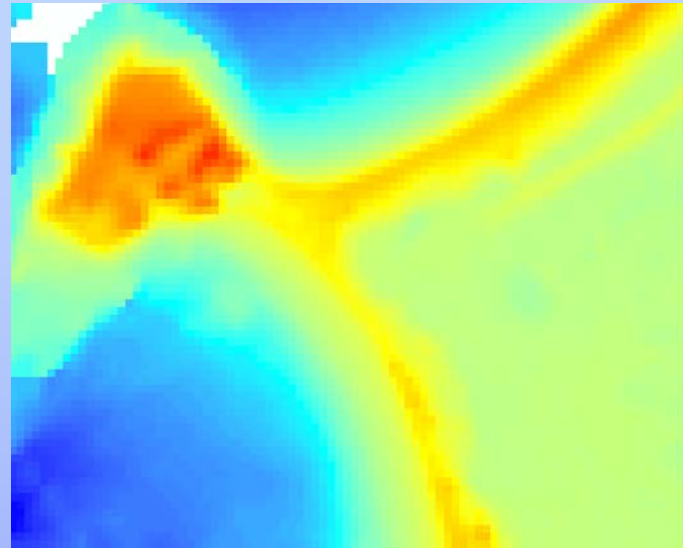
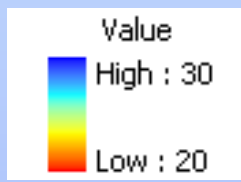


Duncan Tech-400
RGB Camera



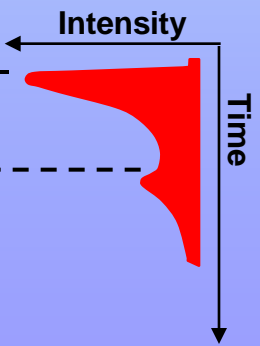
Image acquisition

Airborne lidar bathymetry



Sea surface

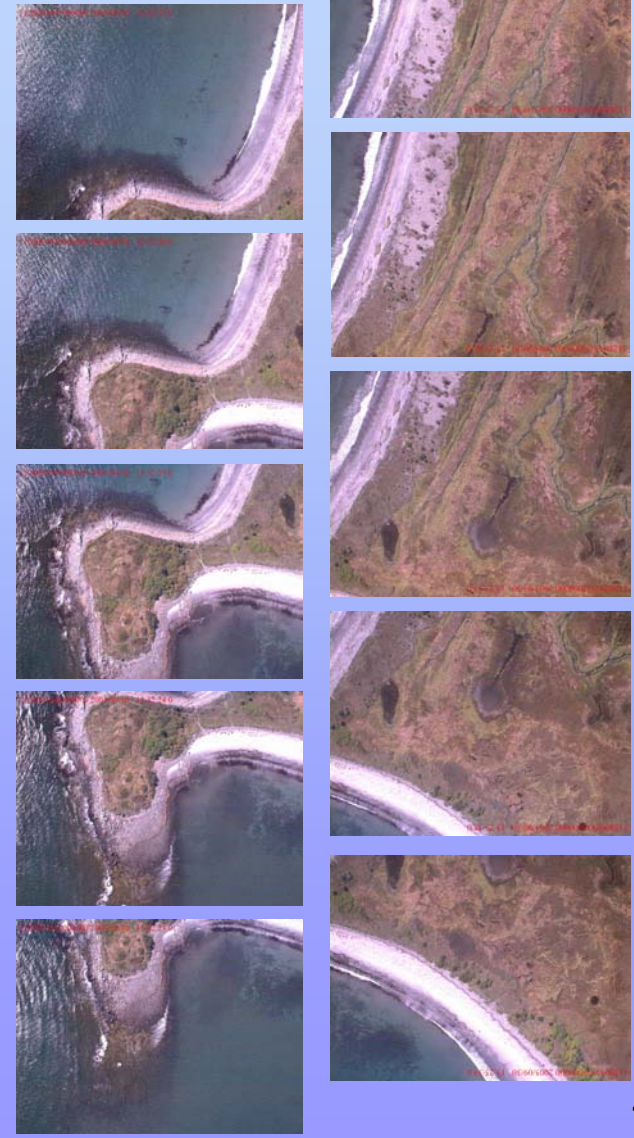
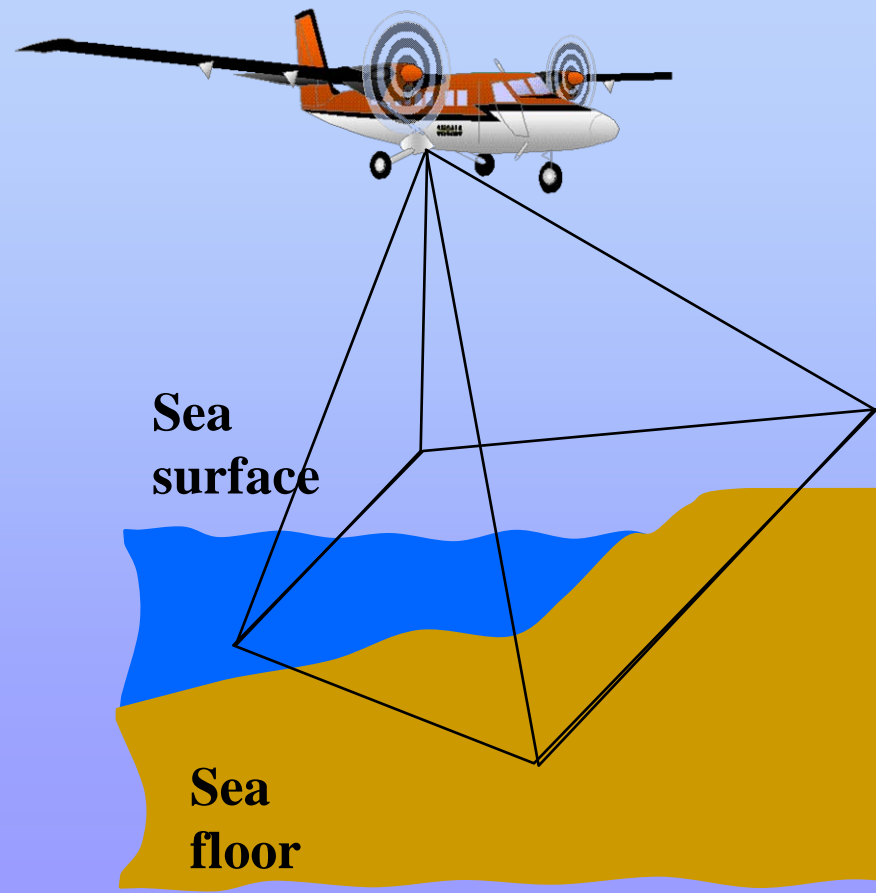
Sea floor



Footprint diameter: ~2.0 m

Image acquisition

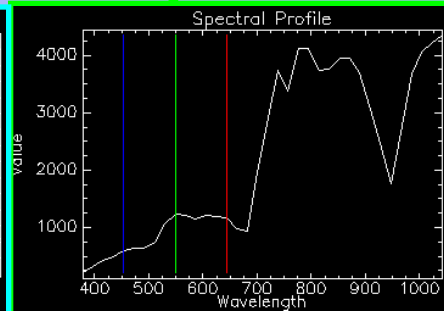
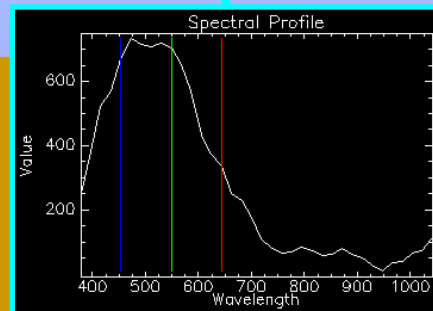
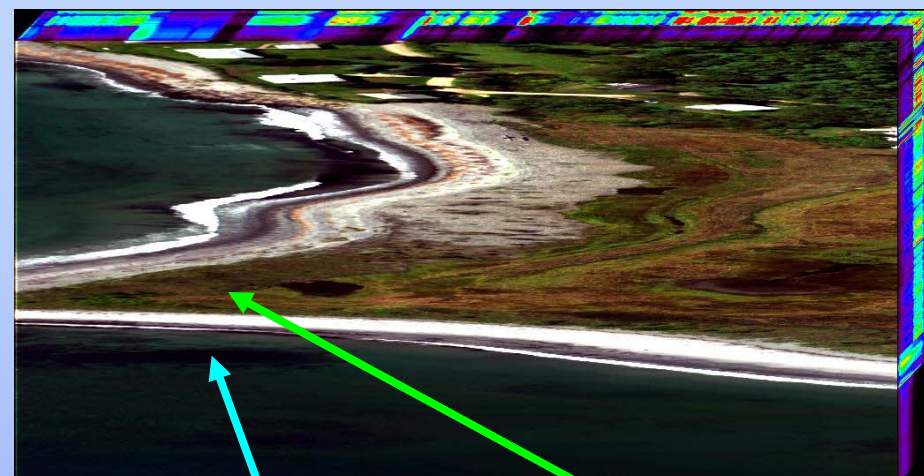
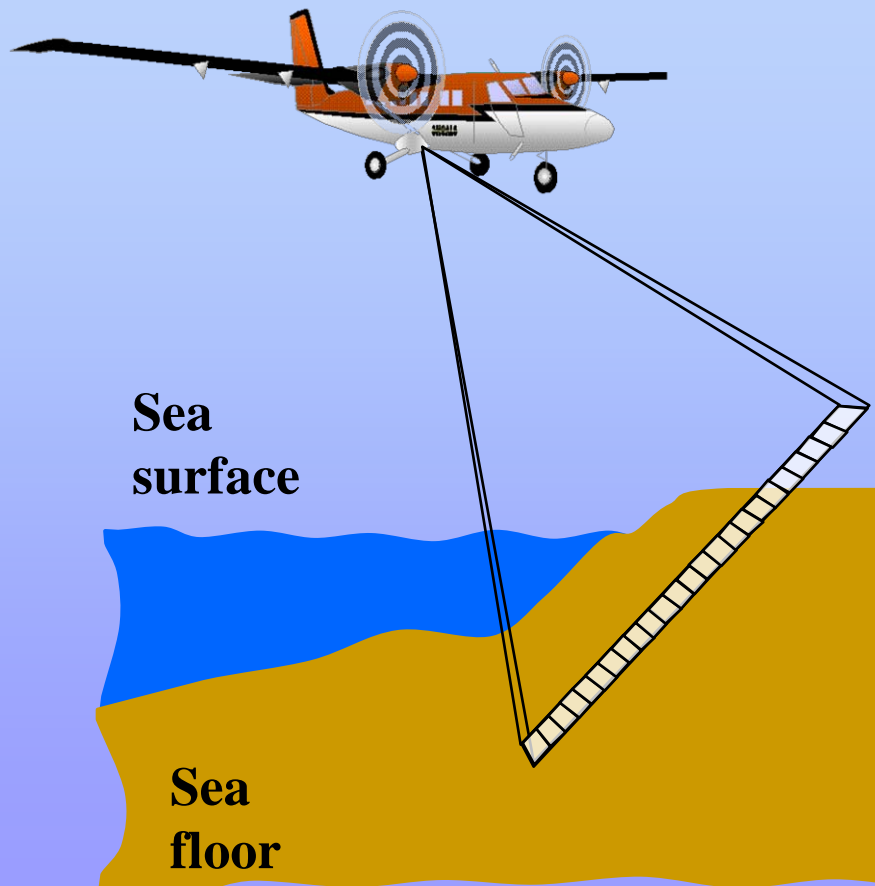
RGB camera



Pixel resolution: ~0.2 m

Image acquisition

Hyperspectral

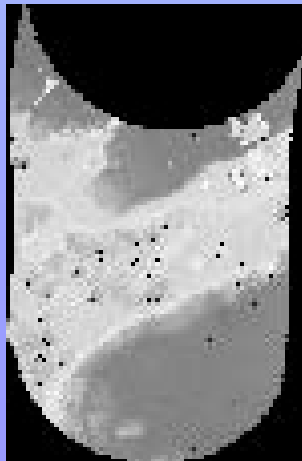
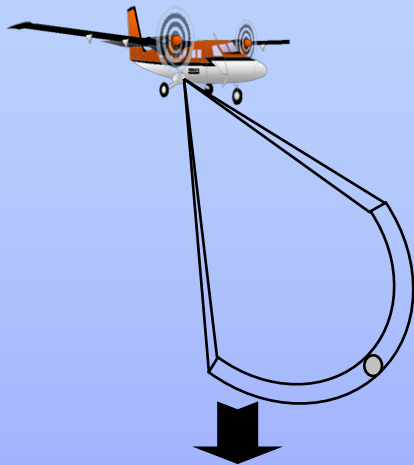


Footprint diameter: ~0.2 m X 1.0 m

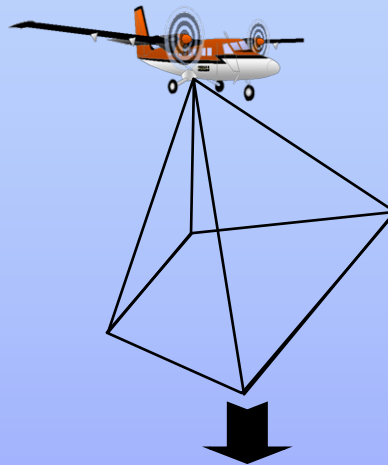
Registration approach



**ALB: SHOALS-3000
(whiskbroom)**

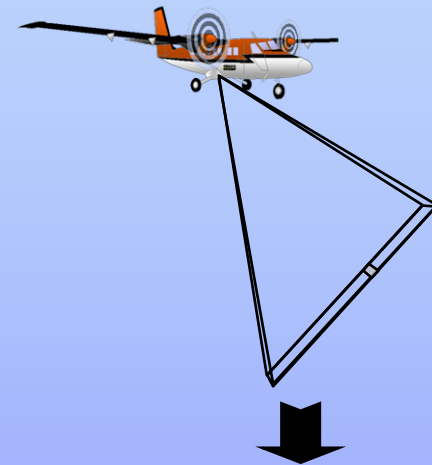


**Still camera: DT-4000
(Frame)**



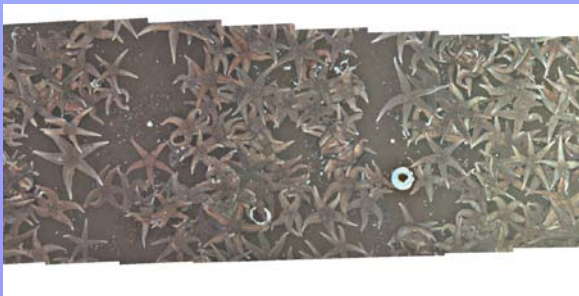
Coastal Geotools 2009

**Hyperspectral: CASI-1500
(pushbroom)**



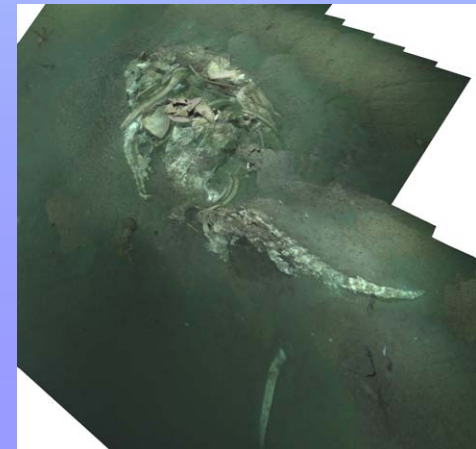
Motivation

- **Need to register the all available data to the same plane of reference.**
- **Potential decoupling between the hyperspectral sensor and the GPS/INS system.**
- **Available tools (from underwater imagery projects)**

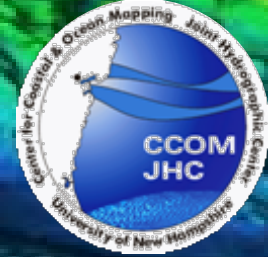


HabCam,
Woods Hole, MA

Whale carcass,
Monterey Bay CA



Imagery co-registration algorithm



CHARTS reference frame

..... Under development

CASI-1500

DT-4000

SHOALS-3000

Initial line estimate

Attitude correction

Arc calculation

Line matching

Pair-wise registration

Initial arc estimation

Line relocation

Global alignment

Arc Matching

Image construction

Blending

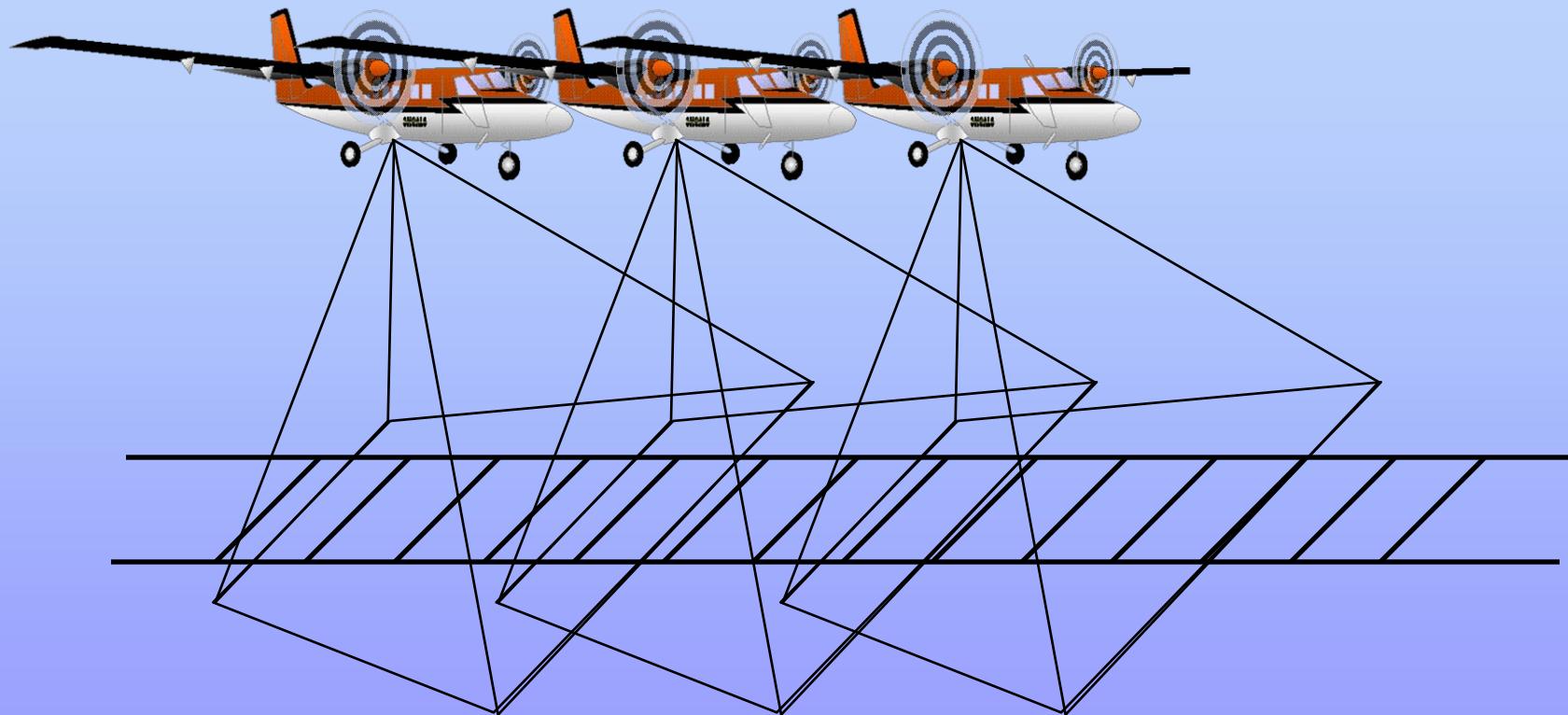
Arc relocation

Mosaic

Image reconstruction

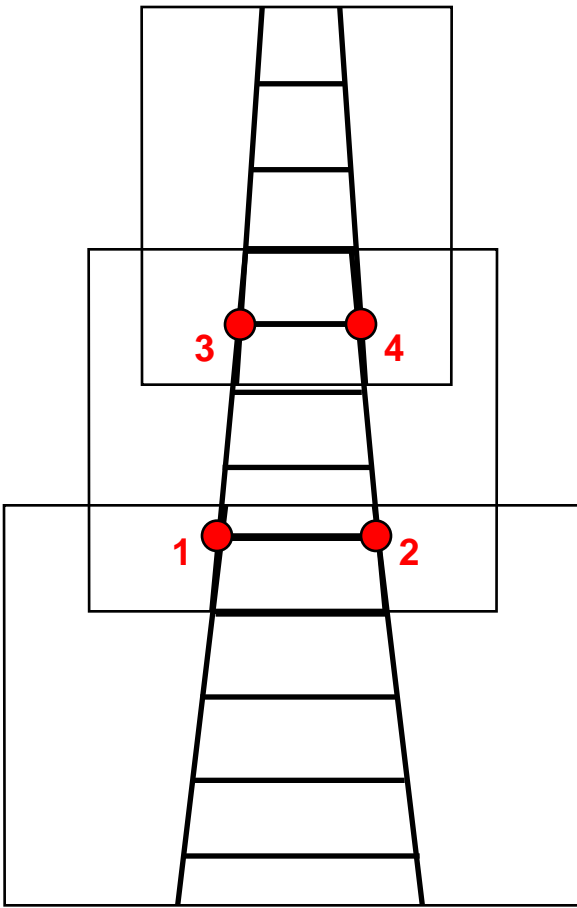
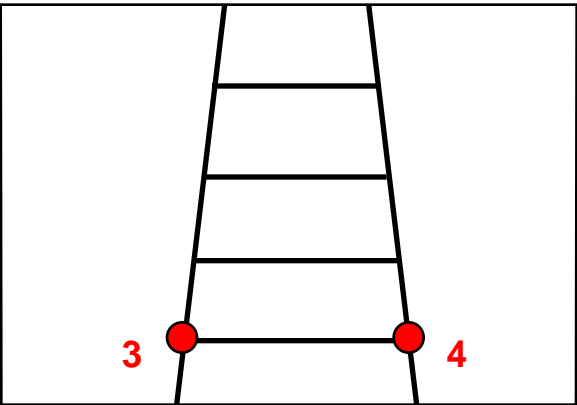
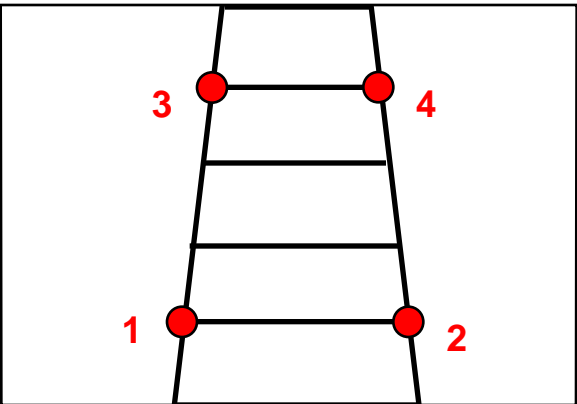
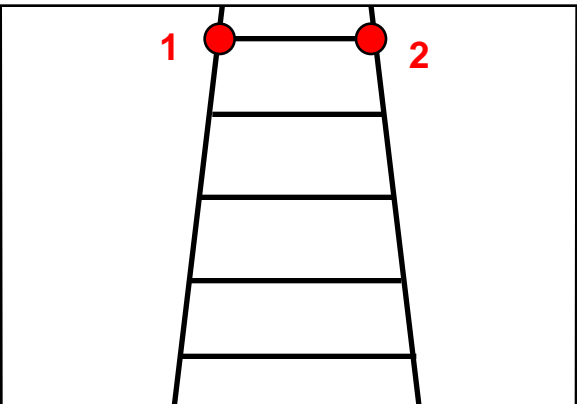
Image registration: DT-4000

Positive pitch



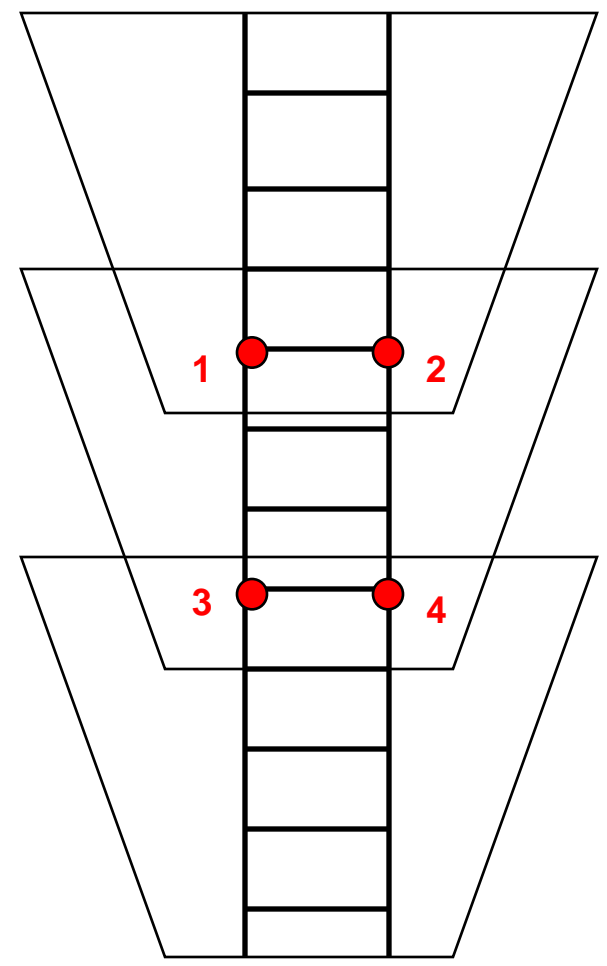
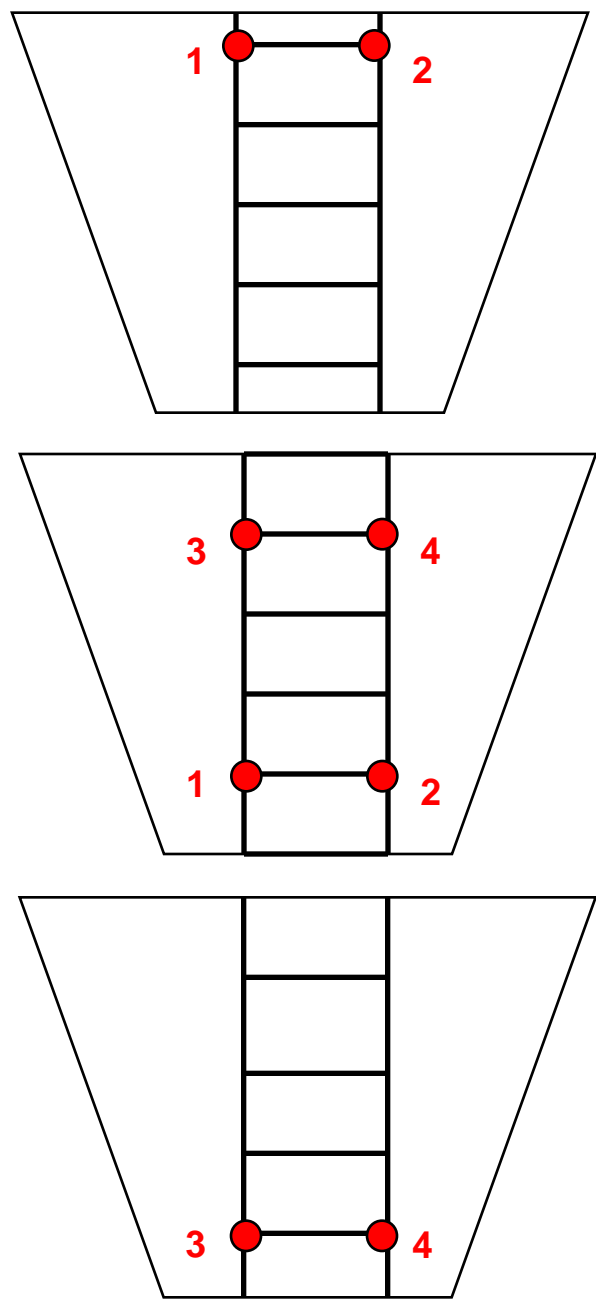
No pitch correction

TIME



With pitch correction

TIME



Attitude correction

Pitch



No pitch correction



5 pitch correction



10 pitch correction

Building mosaic

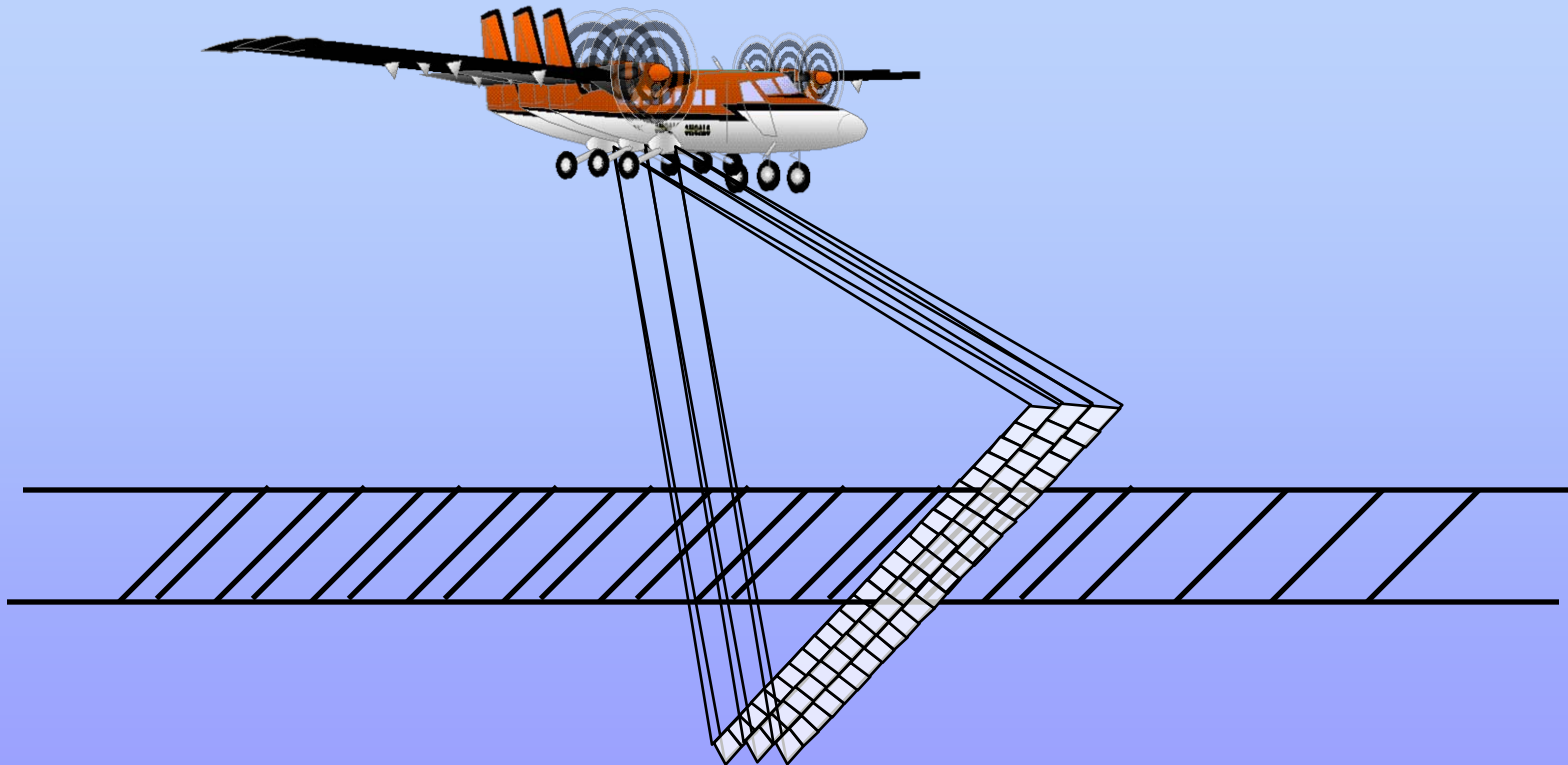


Without attitude correction (AC)

With AC



Image registration: CASI-1500



DuncanTeck Vs. CASI



DuncanTech-4000



CASI-1500 (532 nm)



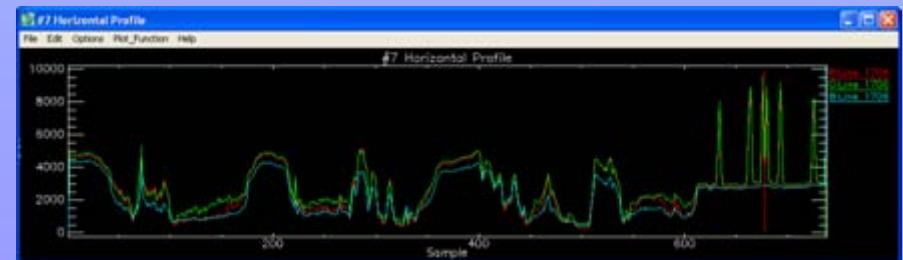
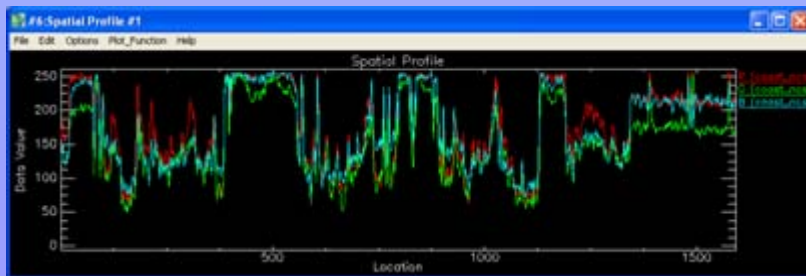
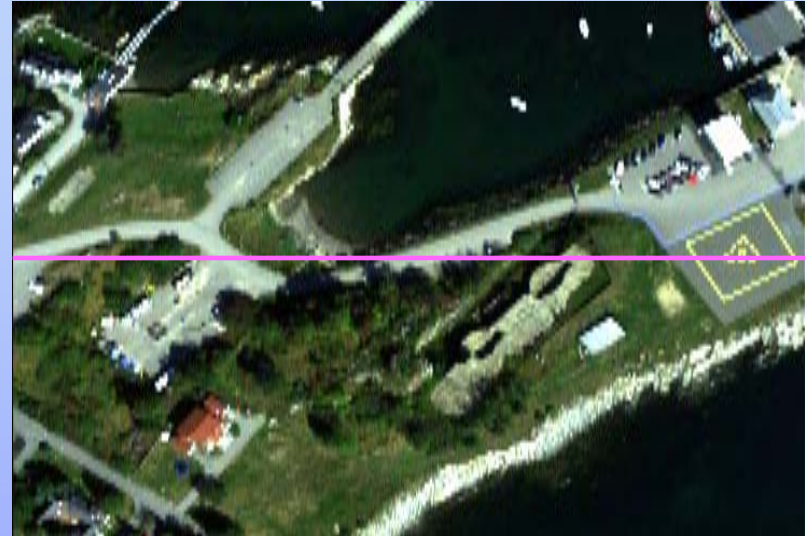
spectral correlation of the images



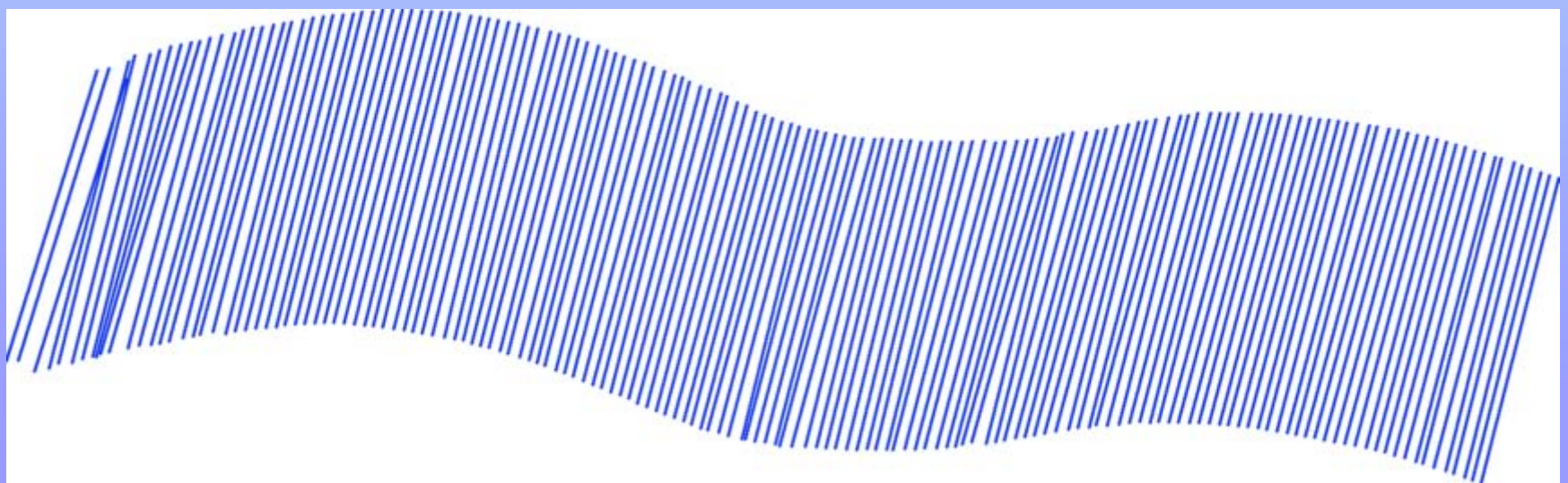
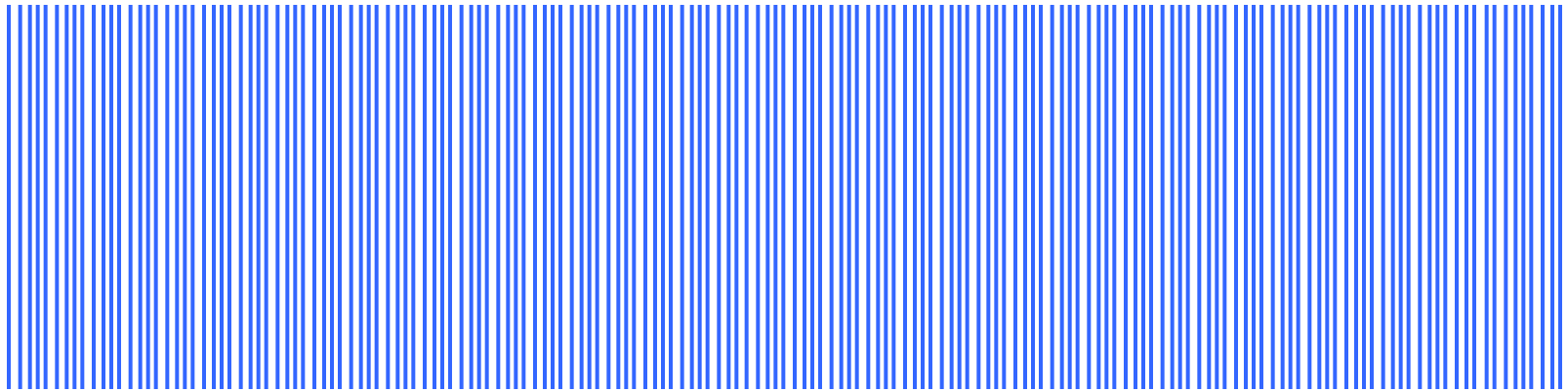
DuncanTech-4000



CASI-1500 (532 nm)



Registration



Preliminary results (single frame)



DuncanTech-4000



CASI-1500 (532 nm)



Preliminary results (mosaic)



Unregistered
CASI-1500



Registered
CASI-1500



Mosaic
DT-4000



Preliminary results (mosaic)



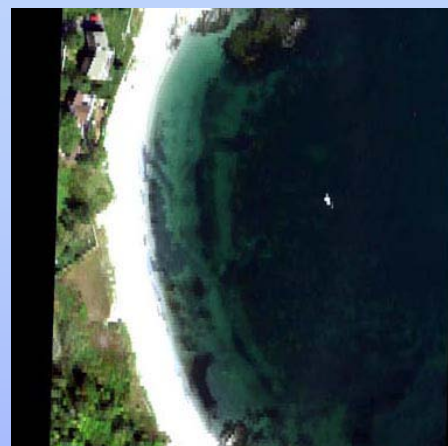
Coastal Geotools 2009

Algorithm robustness



Underwater registration

**CASI-1500
registration
lines overlaid
on a
DT-4000
background**

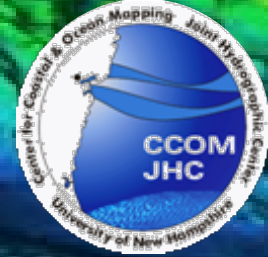


**CASI-1500
registered
image**

Surf



Imagery co-registration algorithm



CHARTS reference frame

..... Under development

CASI-1500

DT-4000

SHOALS-3000

Initial line estimate

Attitude correction

Arc calculation

Line matching

Pair-wise registration

Initial arc estimation

Line relocation

Global alignment

Arc Matching

Image construction

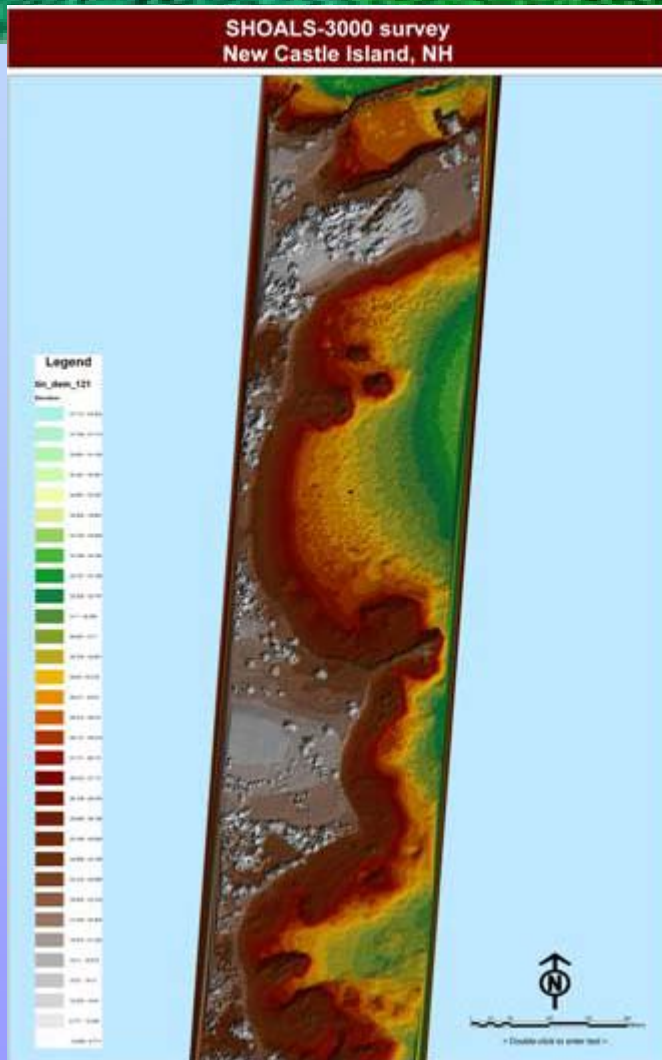
Blending

Arc relocation

Mosaic

Image reconstruction

What next? Applications...



DT-4000 mosaic



CASI-1500

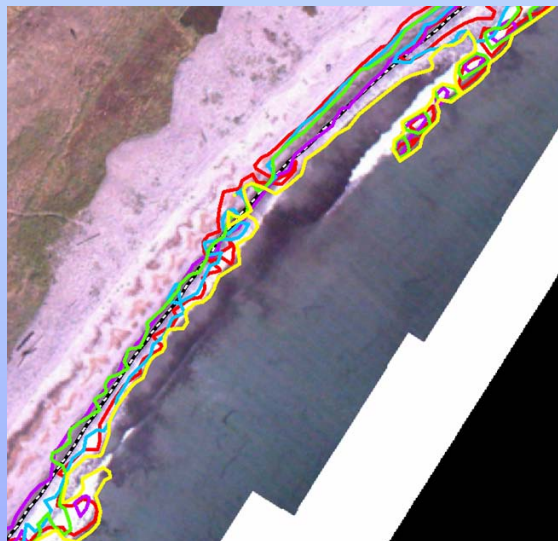
SHOALS-3000
Coastal Geotools 2009

Applications

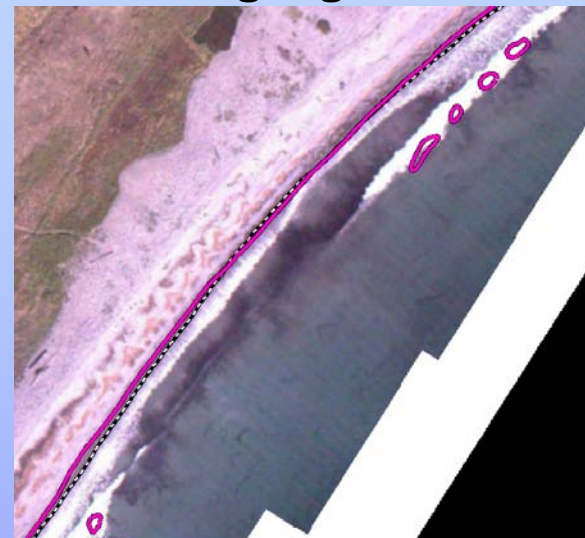
Shoreline mapping



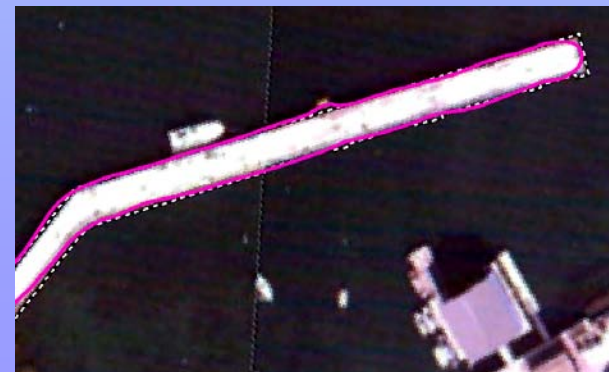
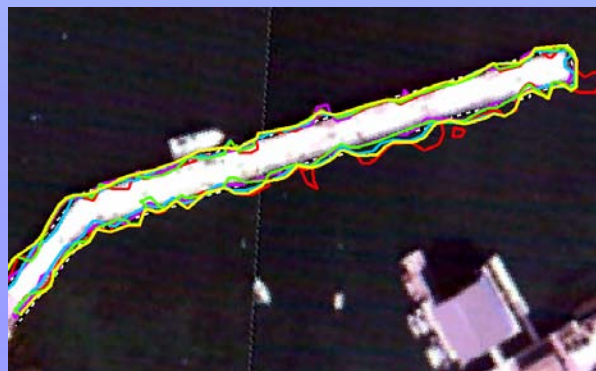
ALB shoreline algorithms



Smoothing algorithm



Shachak Pe'eri
Lynnette Morgan
Andrew Armstrong



Applications

Estuarine Water characterization



John Ru Morrison
Thomas K. Gregory
Shachak Pe'eri
William McDowell
Philip Trowbridge

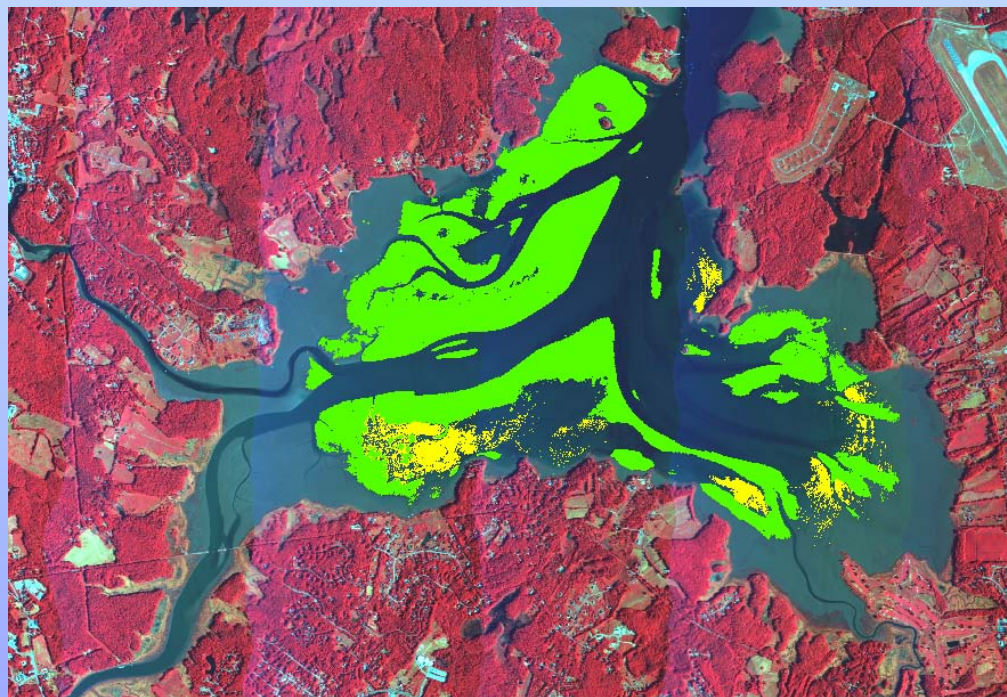


Applications

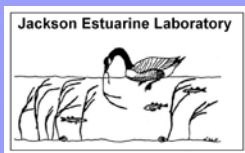
Eelgrass/macroalgae mapping



Shachak Pe'eri
John Ru Morrison
Fredrick Short
Arthur Mathieson
Philip Trowbridge

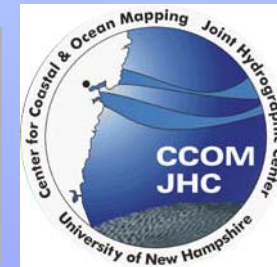


Eelgrass (green) and macroalgae (yellow) distribution overlaid on the hyperspectral survey project mosaic. (false color image with R: 814 nm, G: 670 nm B: 527 nm channels).





Thanks



Acknowledgment:

Tyco Fellowship for Ocean Mapping and UNH/NOAA Joint Hydrographic Center grant NA05NOS4001153.

