

# LEICA ADS40 SENSOR FOR COASTAL MULTISPECTRAL IMAGING

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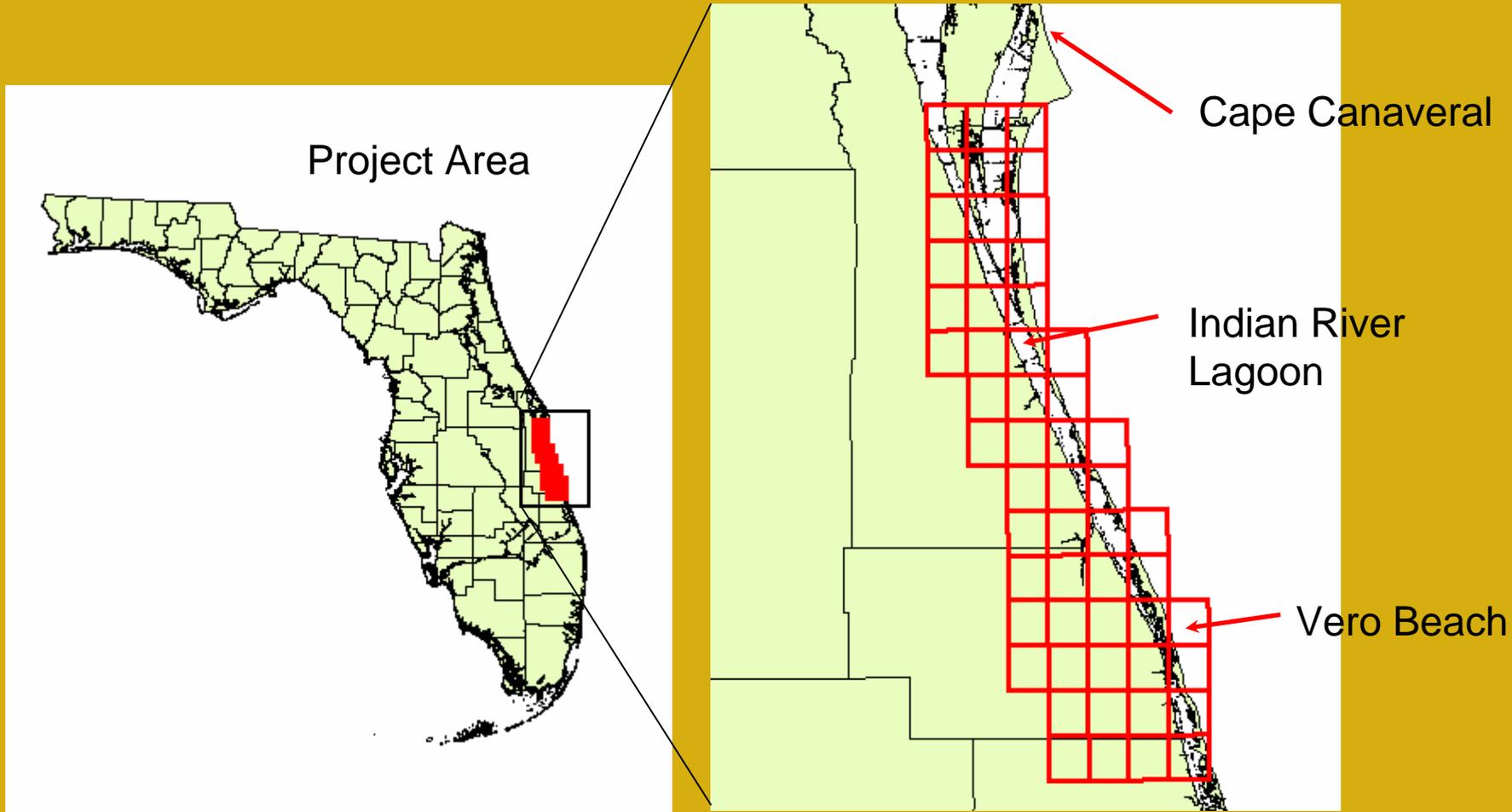
# Introduction

- *Impervious surface is the total area of ground covered by pavement or other surfaces that prevent water infiltration.*
- *It is an important indicator of urbanization or development.*
- *It is used as a parameter for hydrological models that estimate storm water runoff.*

# Introduction

- *The project area covered 55 3.75 minute quarter quad image tiles along the coast of Brevard, Indian River and St Lucie counties in Florida (over 2000 sq. Km.)*
- *Surface water features include Atlantic Ocean, Indian River Lagoon, canals, ponds, marshes and drainage ditches.*
- *Impervious surface features include paved areas (roads and parking lots) and building roofs.*

# Introduction



# Project Area Overview

IR, R, G  
Mosaic



R, G, B  
Mosaic

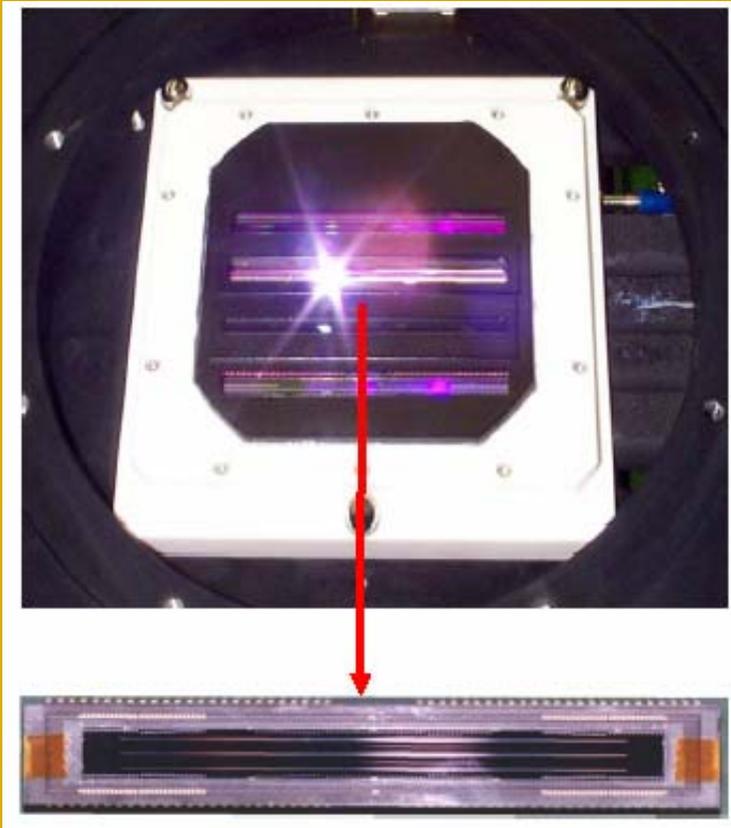


# Leica ADS40 Sensor

- *Panchromatic lines oriented 28° forward, nadir and 14° back for 200% stereo overlap*
- *R,G,B lines optically co-registered*
- *Infrared line co-registered by ortho-rectification*

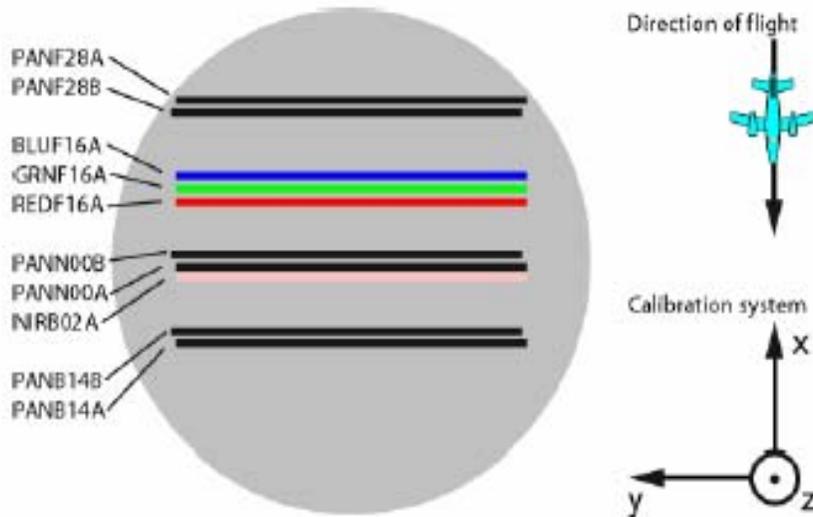


# Focal Plate Arrangements



- *Image size – 12,000 pixels by the length of the flight line*
- *Alternating readout of the A and B lines allows a 24,000 pixel swath in PAN bands*
- *Linear CCDs contain no dead pixels.*

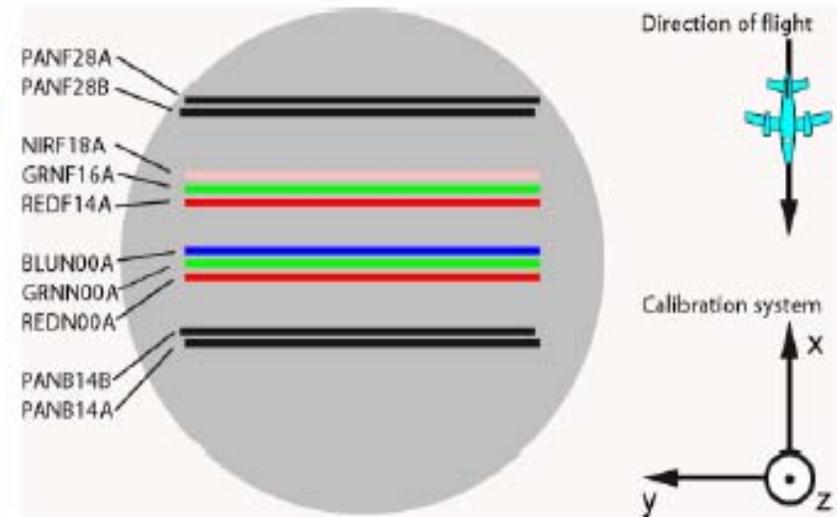
# Focal Plate Arrangements



Staggered panchromatic line in Nadir

Excellent digital surface models

Most sold solution

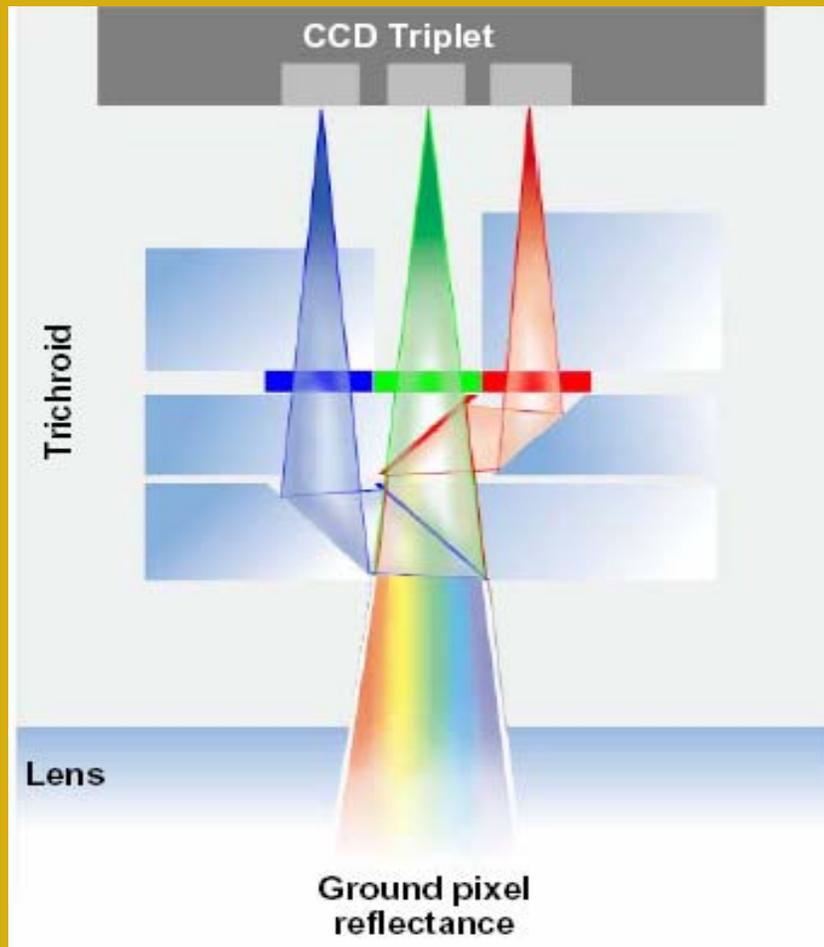


Panchromatic Nadir line is substituted by Green line

RGB in Nadir is perfect for true orthos

Co-registered false color bands

# Trichroid Filter



- *Optical RGB co-registration device*
- *Cascaded dichroitic beam splitters*
- *Energy conserved due to spectral light splitting*
- *Metal interference filters between prisms and CCDs*

# Gradient Correction

- *The Gradient Correction algorithm as implemented in Leica GPro 2.1 software is a dark pixel subtraction method.*
- *Image statistics are calculated on segments of the flight line (default 100 pixels) and cross track variation is analyzed to determine correction parameters.*
- *Each band is analyzed independently, but generally only the blue and green bands are corrected.*

# Image Acquisition

- *Imagery was collected in Jan-March 2004 with the Leica ADS40 sensor.*
- *Flying height of 20,000 ft AGL, produced native pixels of approximately 0.62 meters*
- *Orthorectified, with 1 meter pixel output.*
- *12-bit dynamic range scaled to 16-bit, with “gradient correction” algorithm to reduce bidirectional reflectance and atmospheric effects.*

# Remote Sensing and ADS40

- *12-Bit Dynamic Range*
- *All Bands are Captured in Native Pixel Resolution*
- *Spectral Range (nanometers)*
  - Panchromatic      465 – 680
  - Red                    610 – 660
  - Green                 535 – 585
  - Blue                  430 – 490
  - Near IR              835 – 885

# Band Comparisons of Satellite and Airborne Sensors

UNITS=nm	Pan		Blue		Green		Red		NIR	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
<b><u>Airborne Sensors</u></b>										
Z/I Imaging DMC	400	900	400	580	500	650	590	675	675	850
DMC Alternate									740	850
Vexcel UltraCam	390	690	390	470	420	580	620	690	690	900
Space Imaging DAIS	n/a	n/a	450	530	520	610	640	720	770	880
Leica ADS40	465	680	430	490	535	585	610	660	835	885
<b><u>Satellite Sensors</u></b>										
QuickBird	450	900	450	520	520	600	630	690	760	900
Ikonos	450	900	445	516	506	595	632	698	757	853
OrbView-3	450	900	450	520	520	600	625	695	760	900

# Impervious Surface Extraction

## Data Pre-processing

- *Stack B, G, R, NIR images to create 4-band 16-bit images.*
- *Normalize Imagery brightness values per band to equalize across image swaths and ensure “typical” vegetation and water reflectance signatures*

# Impervious Surface Extraction

- *Extract Land/Water Interface (Surface Water) is extracted by using an normalized ratio of Blue to Near Infrared bands  $(B-NIR)/(B+NIR)$ ,*
- *Speckle caused by specular refraction from ripples or band misalignment where movement occurs is removed by morphological filtering (Erode/Dilate/Open/Close)*

# Impervious Surface Extraction

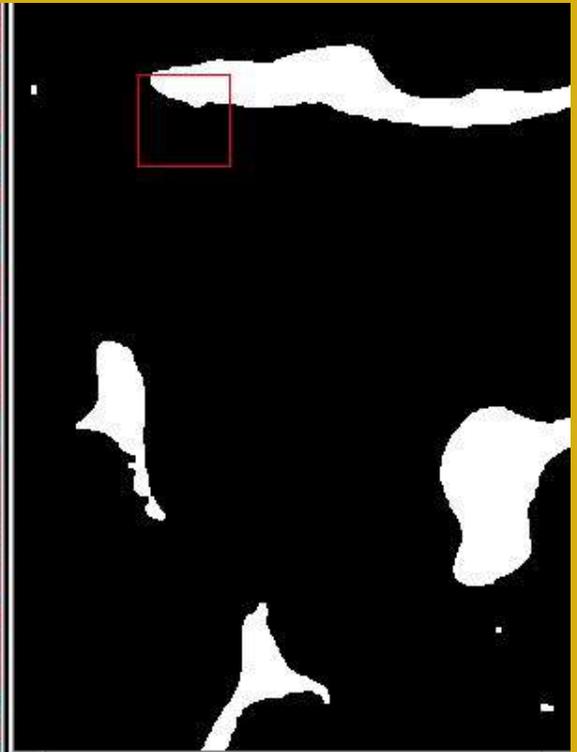
- *Extract vegetated areas by using NDVI  $(NIR-R)/(NIR+R)$ , and determining a threshold value to create vegetation mask.*
- *Areas that are not vegetated and not water may be impervious.*
- *Run multispectral supervised classification of these areas to distinguish land cover types and reduce error.*
- *Create Impervious Surface Layer.*

# Impervious Surface Details

Impervious

Color Infrared Image

Surface Water



# Impervious Surface Details

Impervious

Color Infrared Image

Surface Water

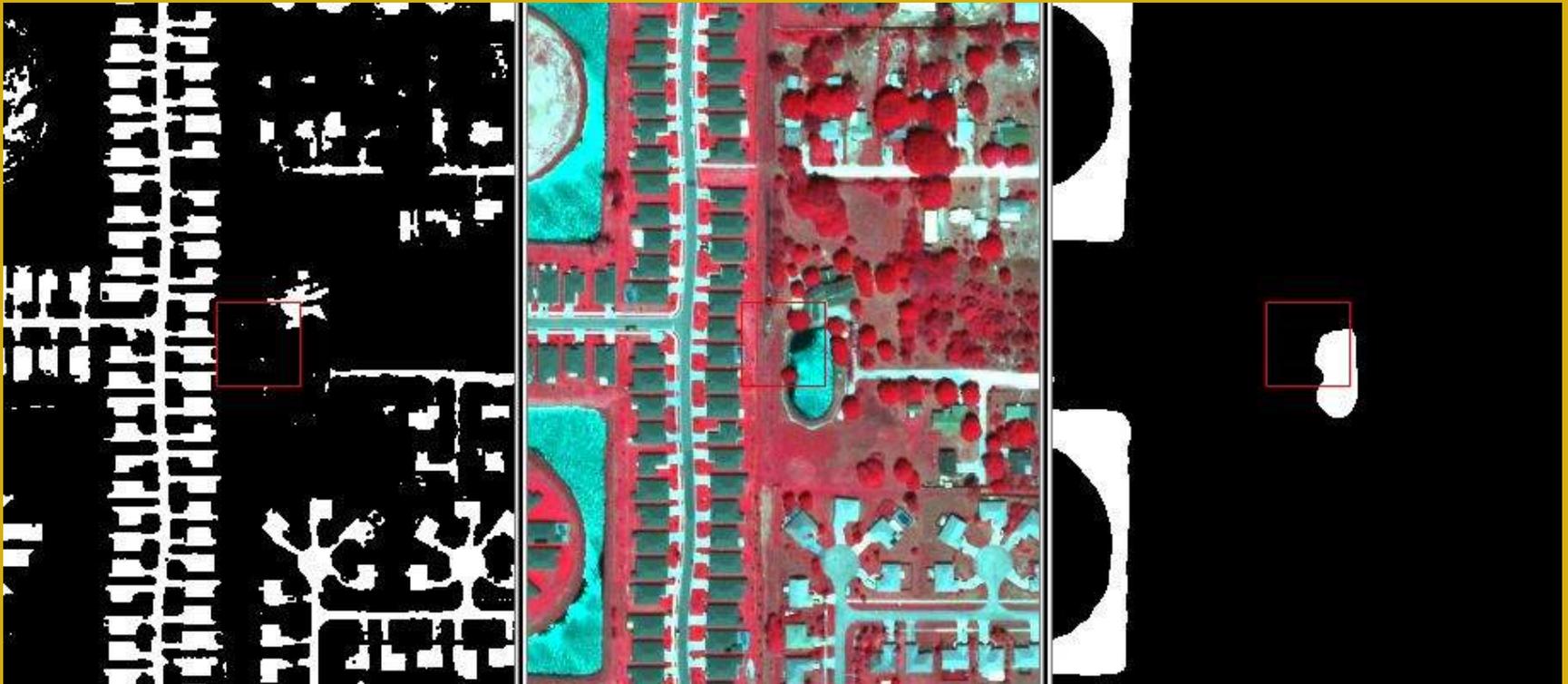


# Impervious Surface Details

Impervious

Color Infrared Image

Surface Water



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Impervious

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# Impervious Surface Details

Impervious

Color Infrared Image

Surface Water



# Conclusions

- *Visual inspection of the impervious surface layer and the source imagery indicates that over 90% of asphalt and concrete surfaces were correctly identified as impervious.*
- *Exeptions include freshly layed asphalt (very black).*

# Conclusions

- *Building roofs are more difficult to uniformly identify, as they are made of many different materials, but at least 80% of roof area is correctly identified.*
- *Most areas of open sand are classified as impervious, due to their similarity to concrete.*
- *This can lead to a substantial of error of commission, unless the sand can be masked out by overlaying previously identified areas of sand*

# Conclusions

- *This study has shown the feasibility of performing automated classification of surface water, vegetated surface, and non-vegetated land area.*
- *To the extent that open sand can be excluded from the non-vegetated land by using a priori land cover or land use information, a successful impervious surface layer can be efficiently extracted.*

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