



INFORMATION SYSTEMS

# Deforestation Monitoring Using RADARSAT-2 Extra-Fine Mode

*presented by Flavio Wasniewski*

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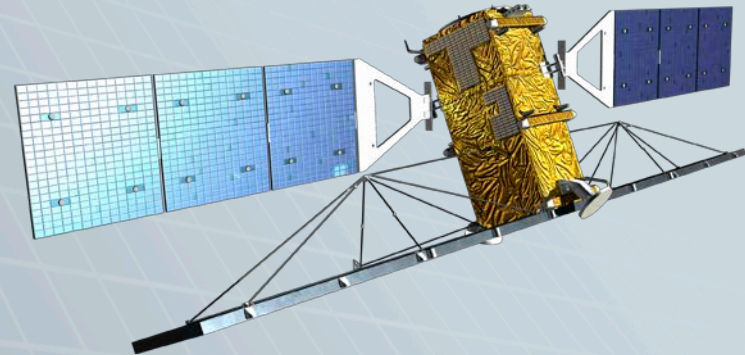
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# Summary

- About MDA
- RADARSAT-2 New Beam Mode
- Forest Management Challenges
- MDA ForestWatch for Deforestation Monitoring
- Stack-based Change Detection
- Case Studies



# MDA – A History in Space

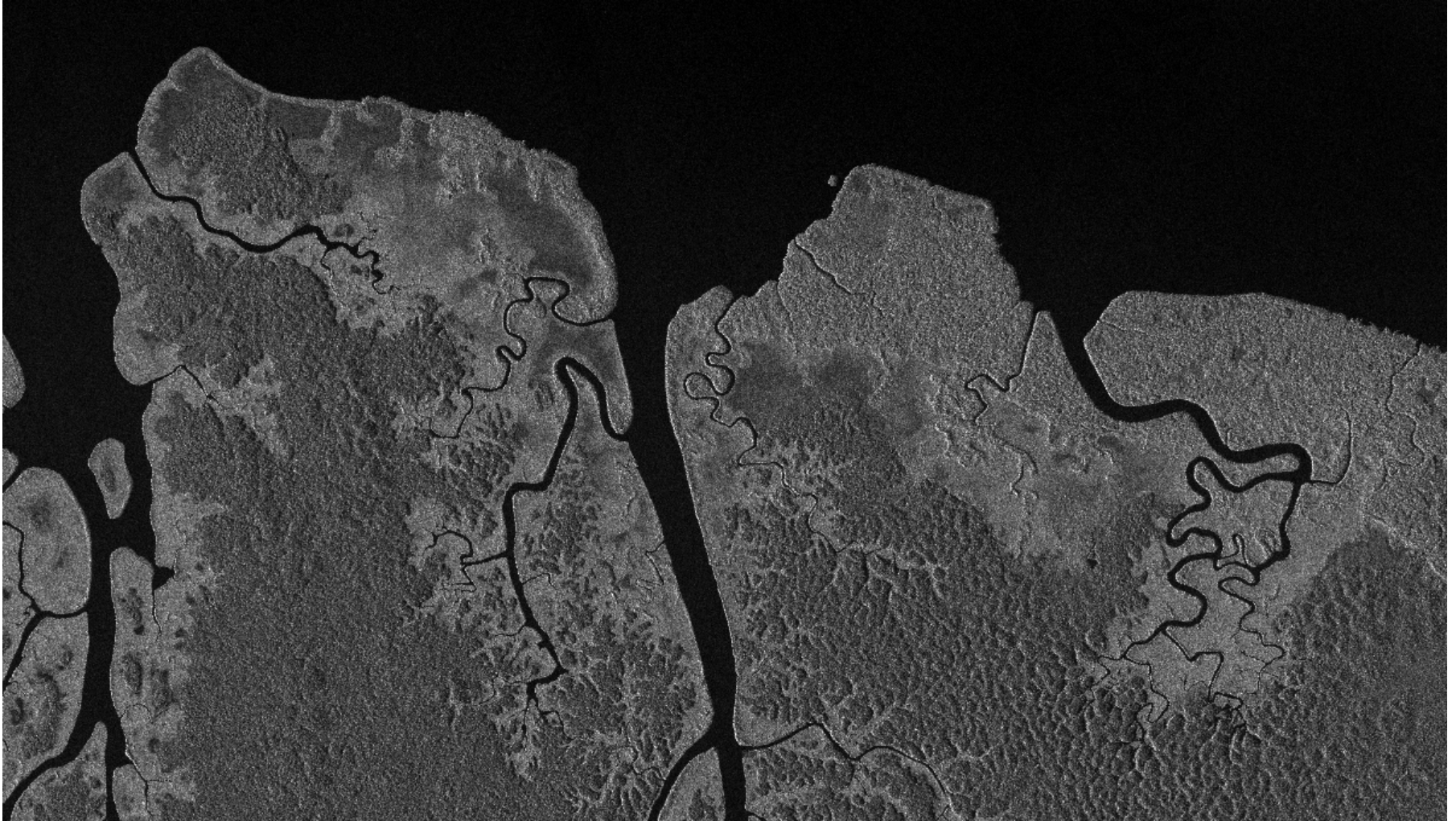
- **A history of building and operating systems designed for operationally-focused customers**
- **MDA Geospatial Services benefits from MDA's 50-year space legacy**
  - Launched RADARSAT-1 in 1995; RADARSAT-2 in 2007
  - Future: RADARSAT Constellation Mission (RCM) in 2018
- **Strong partnership with the Canadian Space Agency**
  - Canadarm, ISS Robotics, RADARSAT-1, RADARSAT-2 , RCM



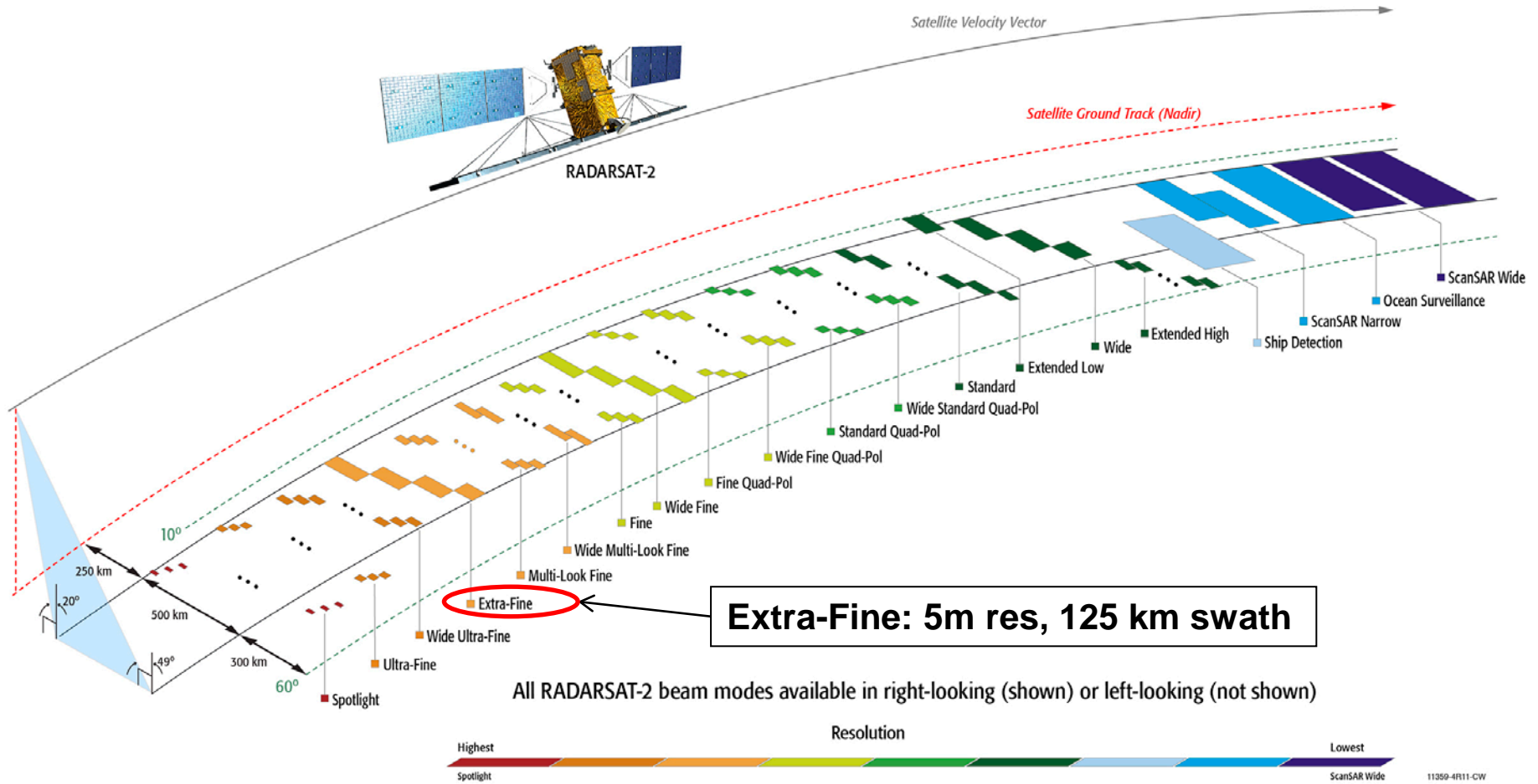
# New RADARSAT-2 Mode: Extra-Fine

- Widest coverage (125 x 125 km) per scene available from any SAR satellite at high resolution
- 2013 – New Extra-Fine beam developed to address high resolution, wide area applications.
- 2014 – Extra-Fine images available commercially; Canadian Space Agency awards MDA a RADARSAT-2 forest change application development project.
- Three versions of the same image available, processed from the same data source
  - 5 m, 1 look
    - Benefit: enables high resolution detection
  - 8 m, 4 looks
  - 21 m, 28 looks
    - Benefit: less speckle; easier visual analysis of low res features
- High resolution provides flexibility for other applications

# Extra-Fine Beam Mode Sample



# RADARSAT-2 Extra-Fine combines high resolution and wide swath



# MDA ForestWatch



Space-based, automated forest change detection solution that provides a cost-effective option for routine, reliable, high resolution monitoring of large forest areas



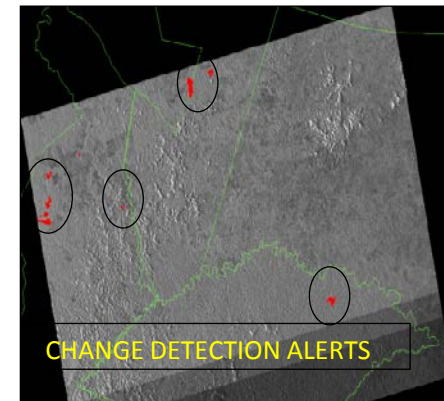
# Key Challenges for Forest Management

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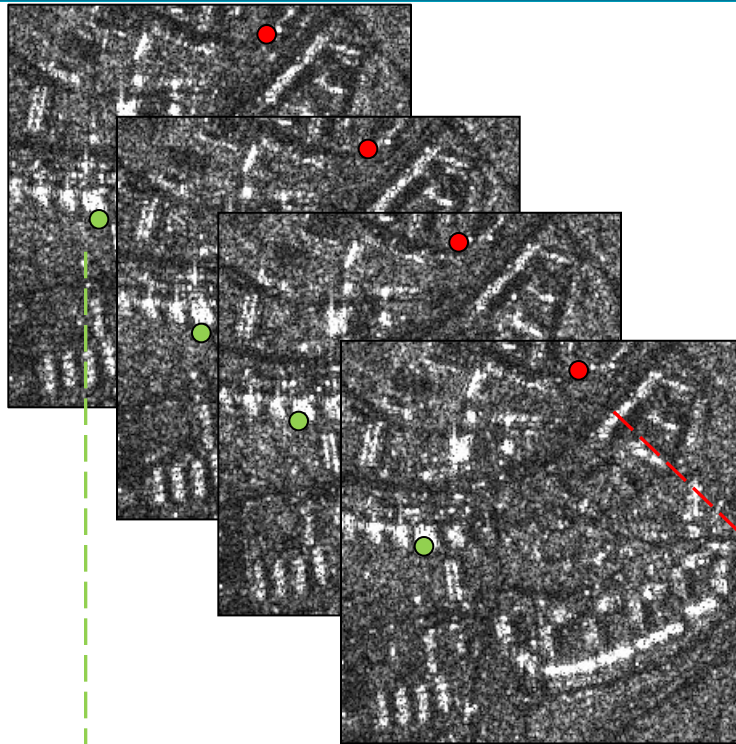
- Forest areas are large and often difficult to access
- Current methods for monitoring are time consuming and expensive
  - Aerial solutions are expensive and have limited range
  - Optical Satellite solutions are affected by cloud cover and weather
- Monitoring doesn't happen frequently enough
- Forest degradation and illegal selective logging difficult to detect using conventional methods

# MDA ForestWatch Characteristics

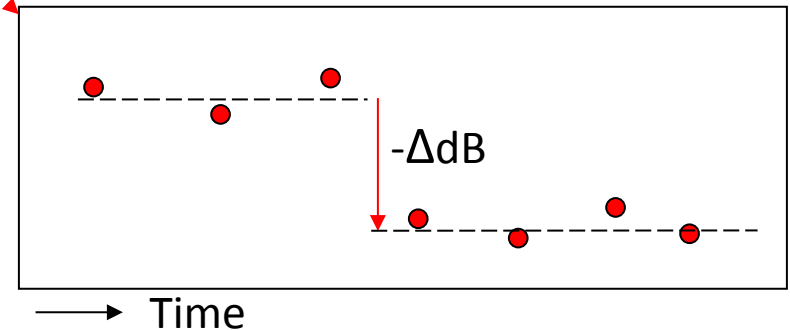
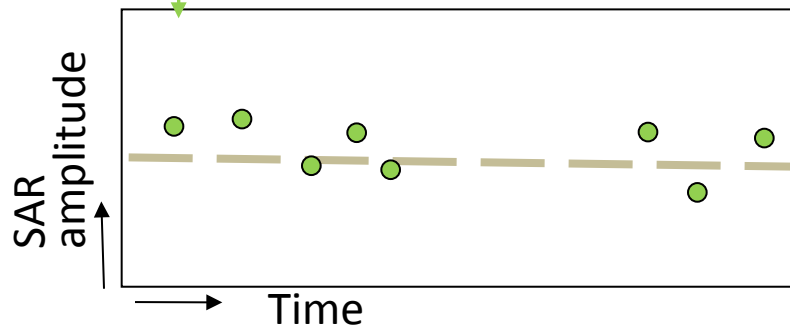
- Reliable, High Resolution Forest Change Detection
  - Unique RADARSAT-2 beam modes provide coverage of vast areas at high resolution
  - MDA ForestWatch change map products deliver information quickly
  - Operationally-focused, responsive production and customer support teams
    - 24x7 availability
  - Detection of small features including selective logging
  - Weather independent



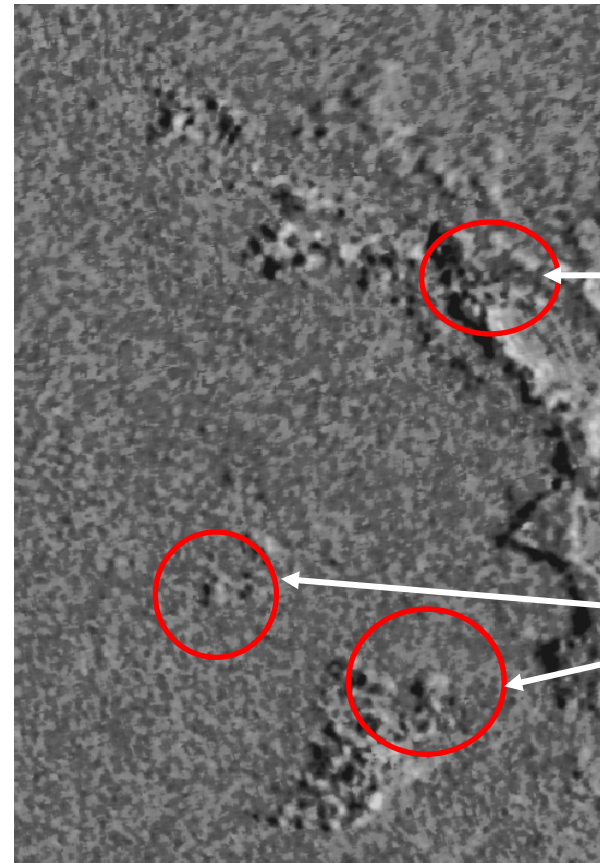
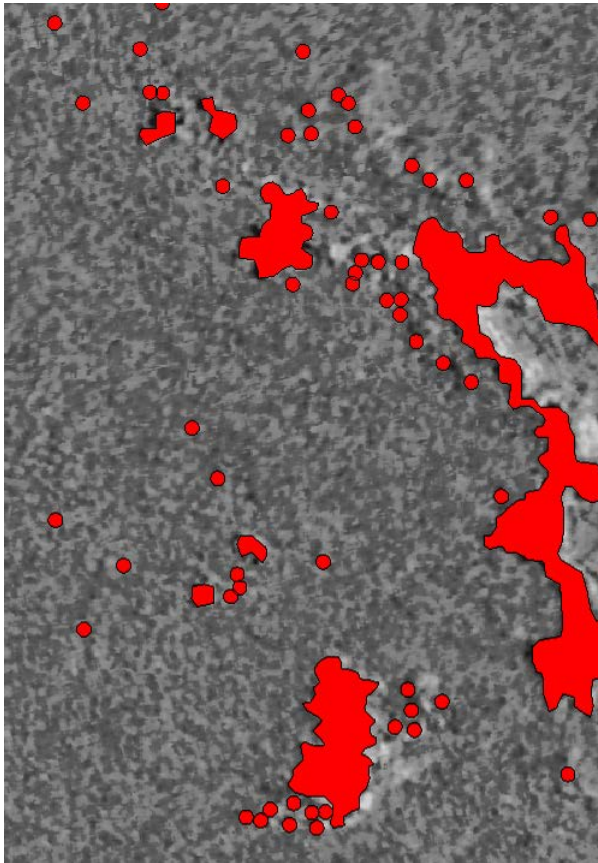
# Stack-based Change Detection in Detail



- A Stack is a set of images having identical geometry
- Stack-based approach allows
  - Filtering of speckle noise from individual acquisitions
  - Improvements in accuracy



# Spotlight Change Image Example



New cuts in  
plantation

Removal of  
trees

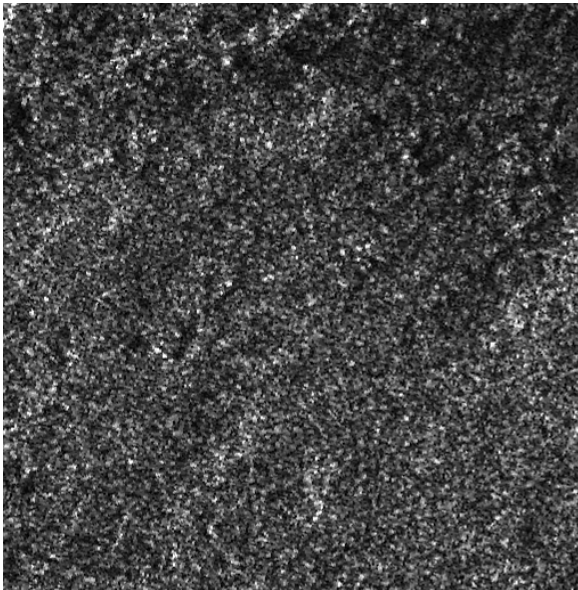
# Temporal Filtering

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- Employs co-registered images from different dates and same geometry to improve the image quality
- Change detection information is more reliable when preceded by temporal filtering
- Temporal filtering employs SLC data for sub-pixel co-registration accuracy

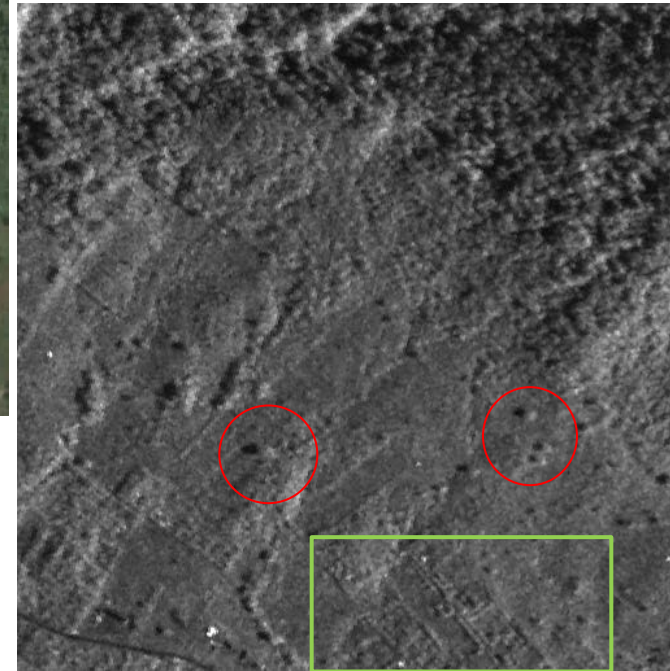
# SpeckleTemporal Filtering Using a Stack

Single SAR Image



~ 1 x 1 km of typical forested terrain

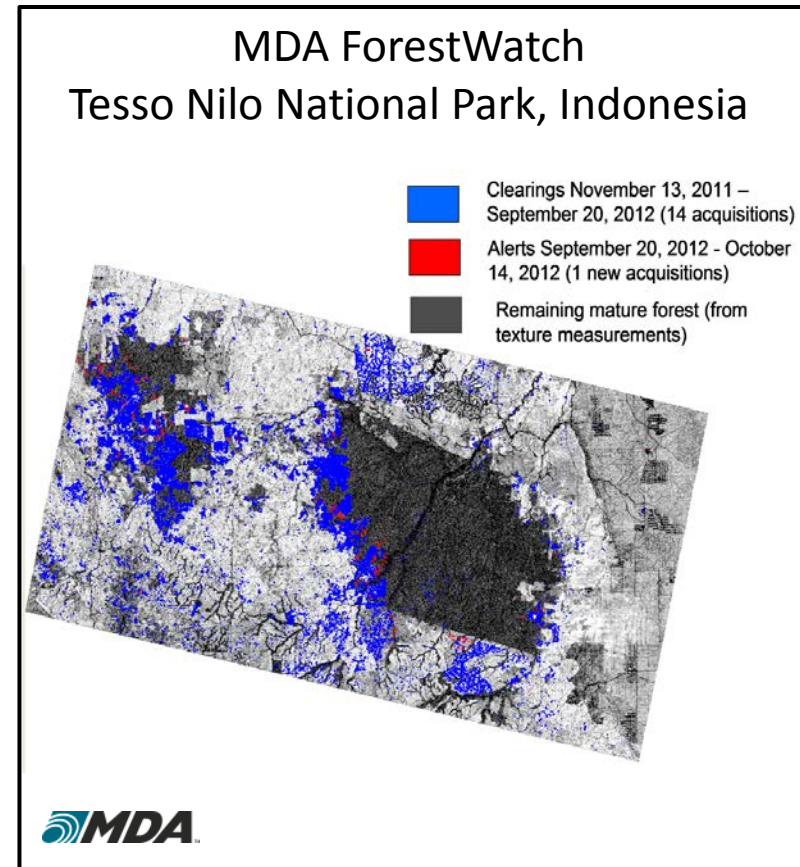
Stack-Based SAR Image  
(20 MF Scenes, 5-m resolution)



Individual trees, agricultural fields, and variations in the texture of the vegetation can be identified in stack-based SAR Images

# MDA ForestWatch Deliverables

- Forest Change Vectors
  - Standard ESRI shape file
  - With associated attribute table
    - Latitude/Longitude
    - Area
- Forest Change Report
  - PDF or JPG
  - Graphical representation of the SAR image and change results
  - Overlaid on a basemap image of the area of interest

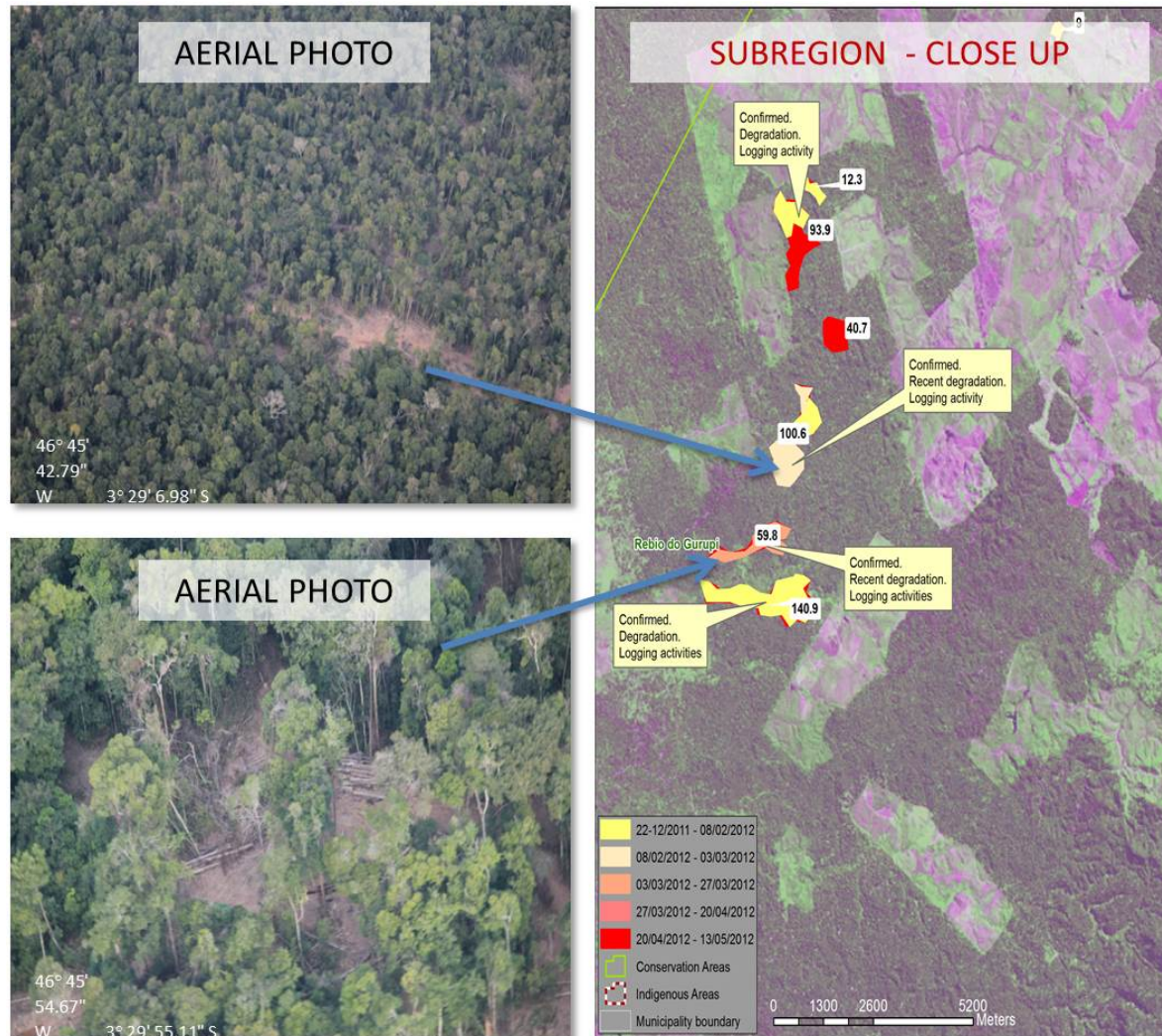




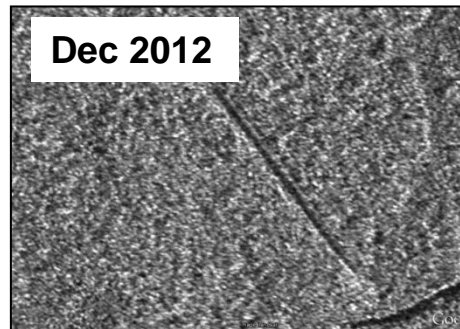
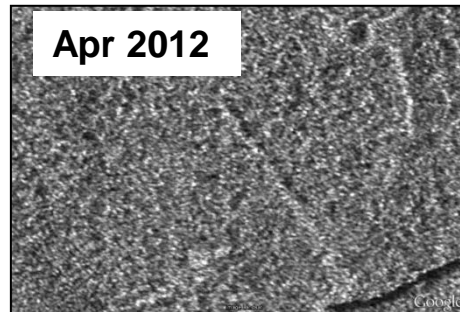
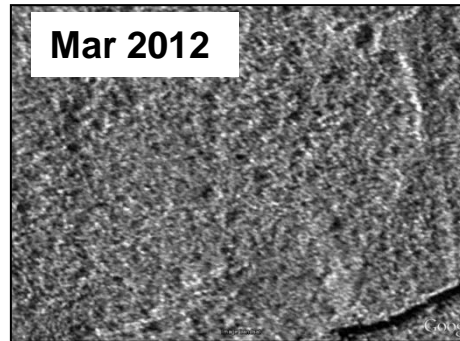
# EXAMPLES



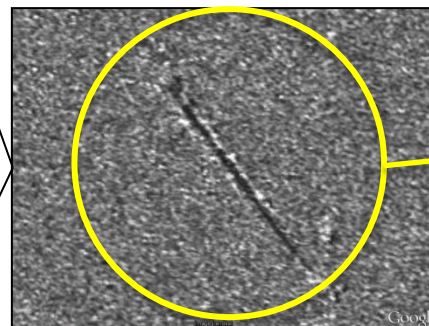
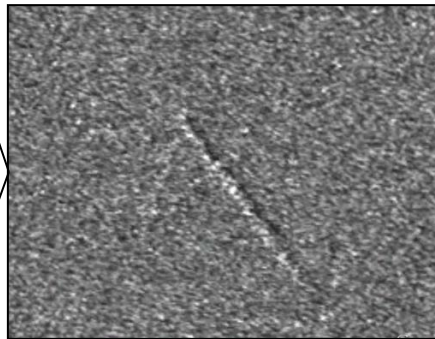
# Selective Logging in Maranhão, Brazil



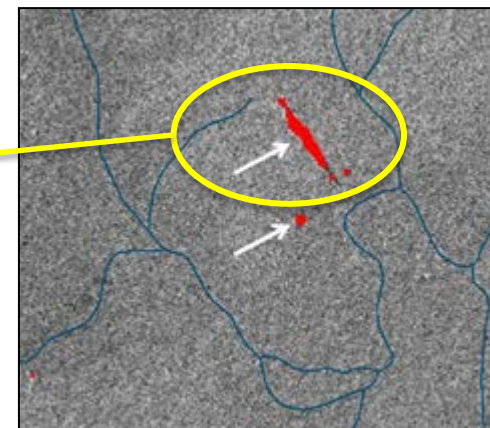
# Detection of Airstrips



*Change Images*



*Automated Detection*



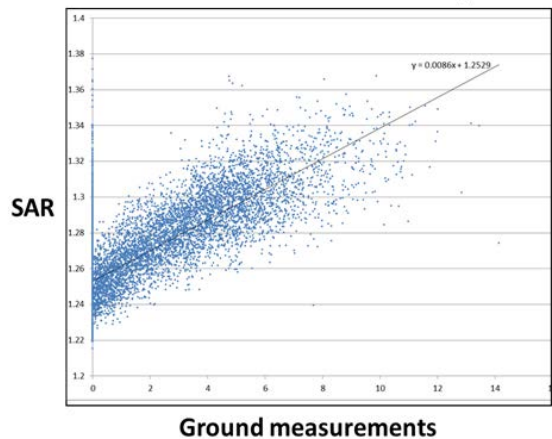
# Amazon Forest, Brazil



Flightlines, photos © ISA, 2014

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# Detailed Validation of Low Impact Logging



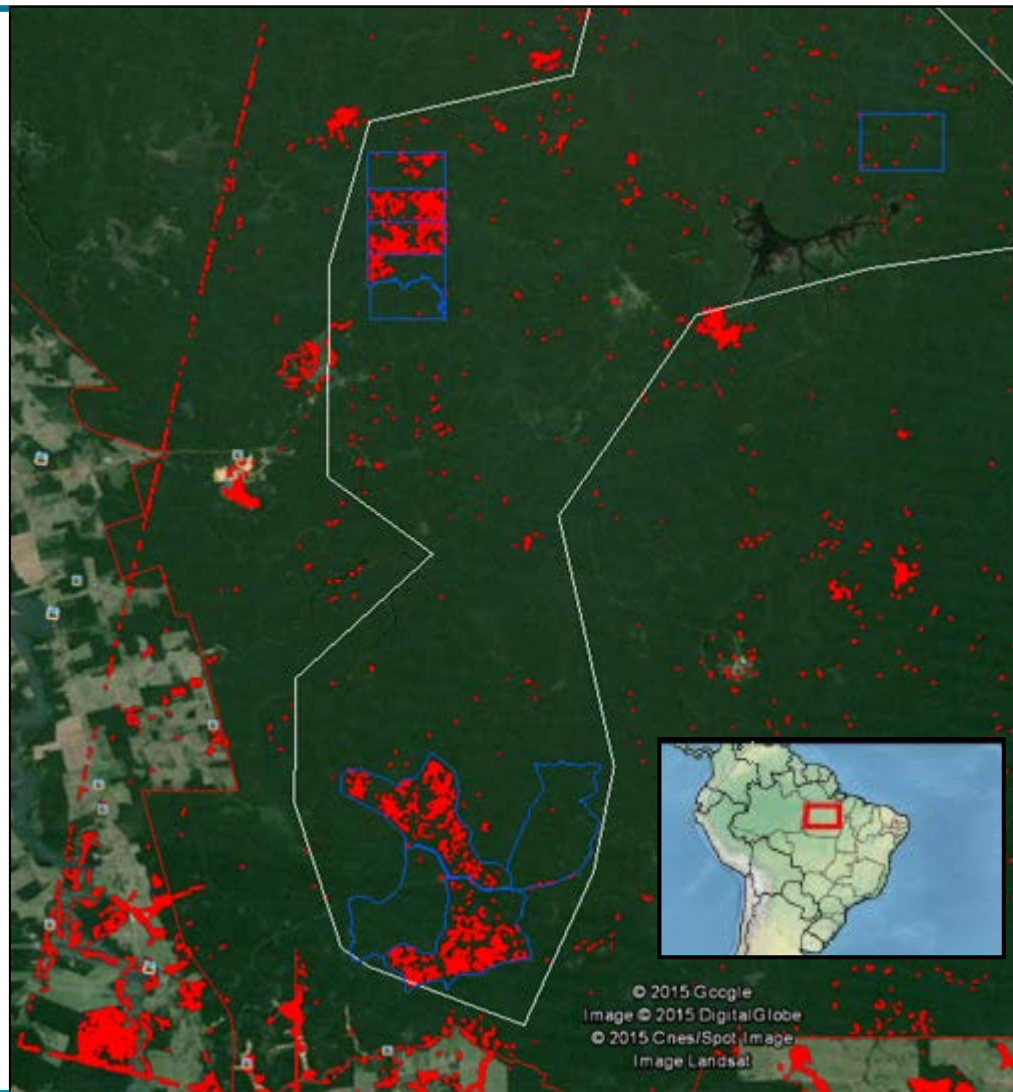
- Logging detected from SAR is well correlated to ground measurements (50 x 50m samples)

 SAR Canopy Change detection

17/12/2011-30/12/2013

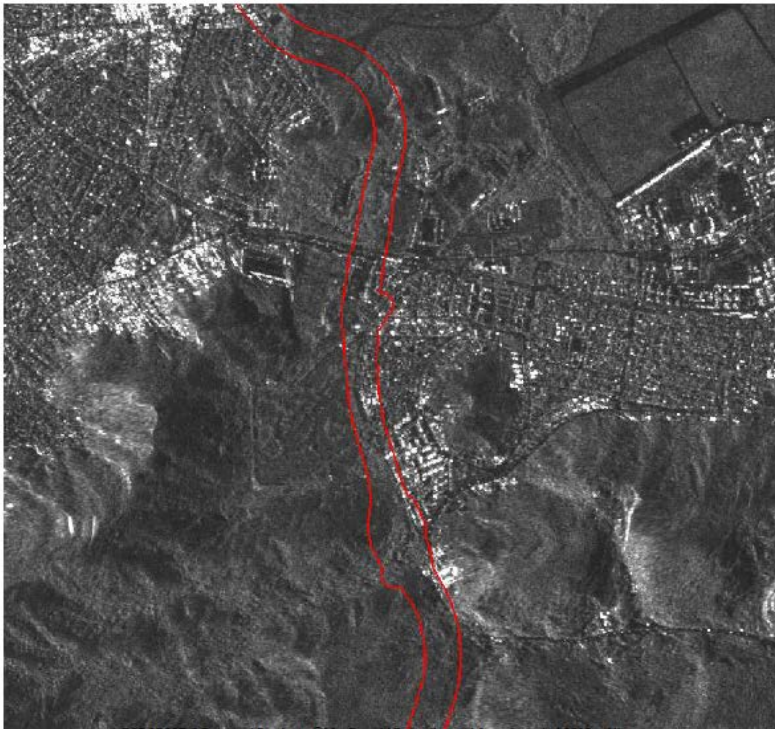
 Controlled logging areas

 Protected area

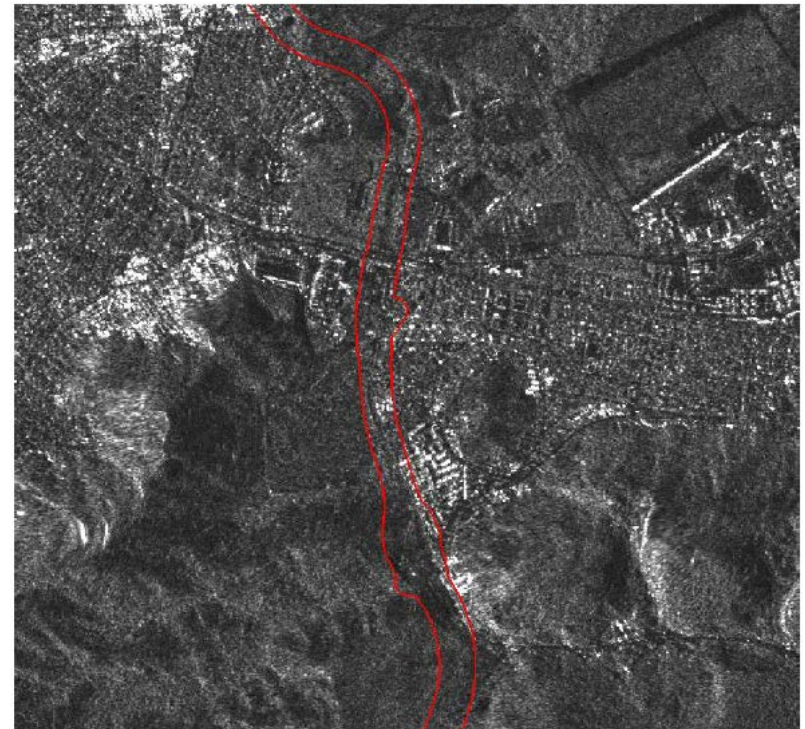


# Transolympic Highway, Rio, Brazil

Area A  
20130205



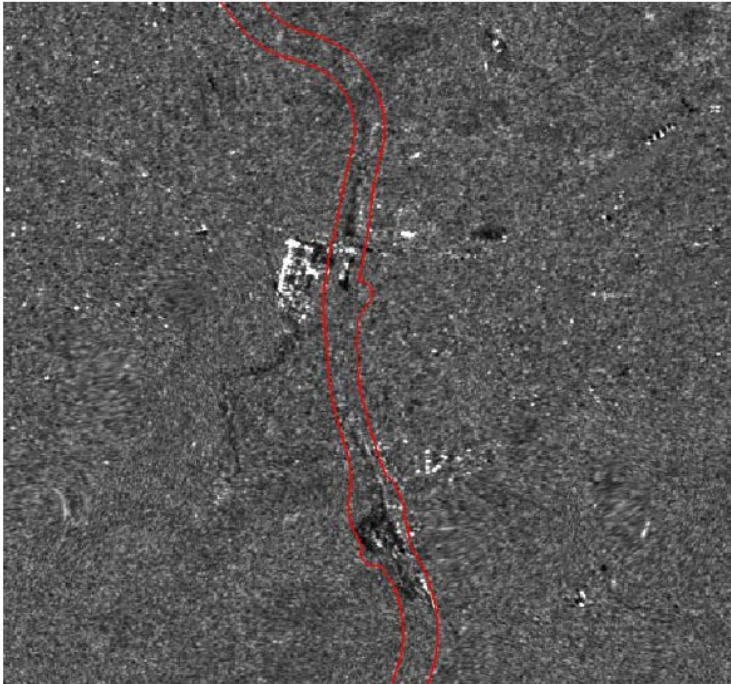
Area A  
20130816



# Transolympic Highway, Rio, Brazil

## Change detection area A

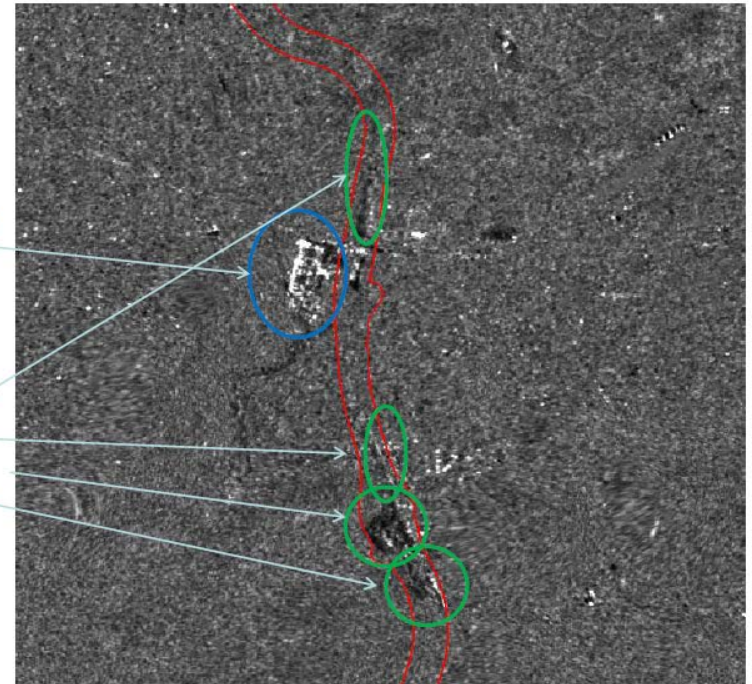
white = increased backscatter  
Black = reduced backscatter



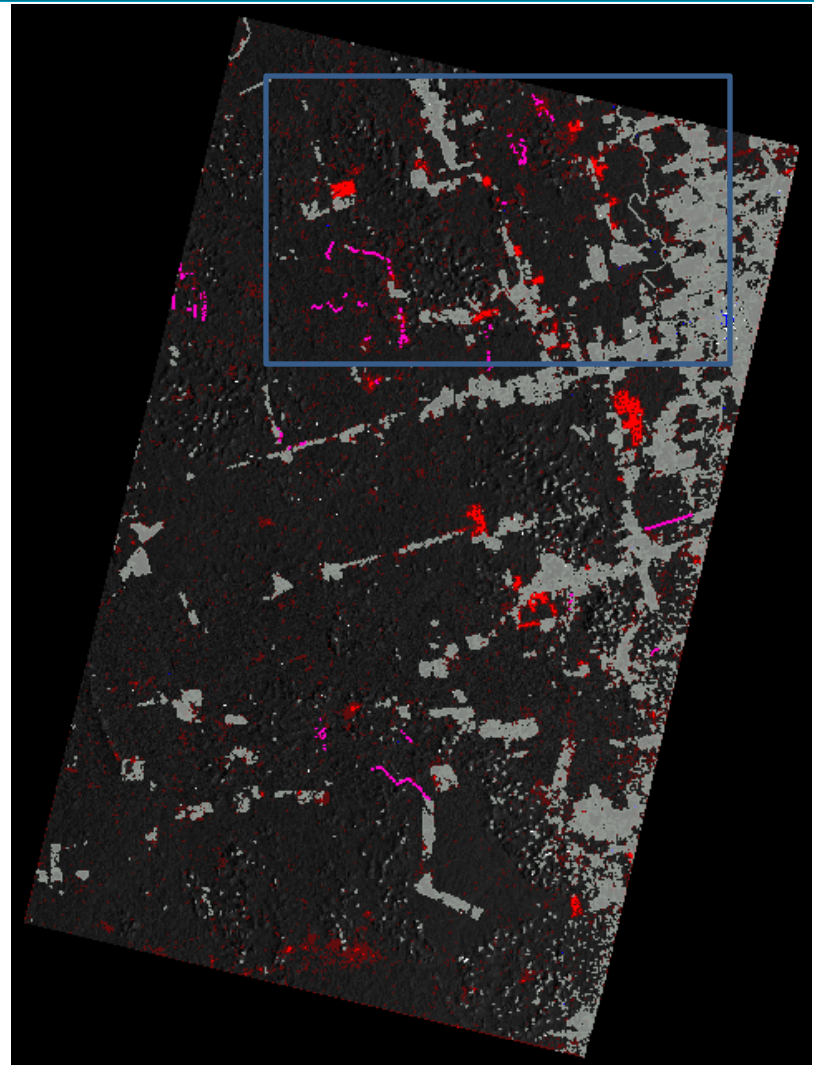
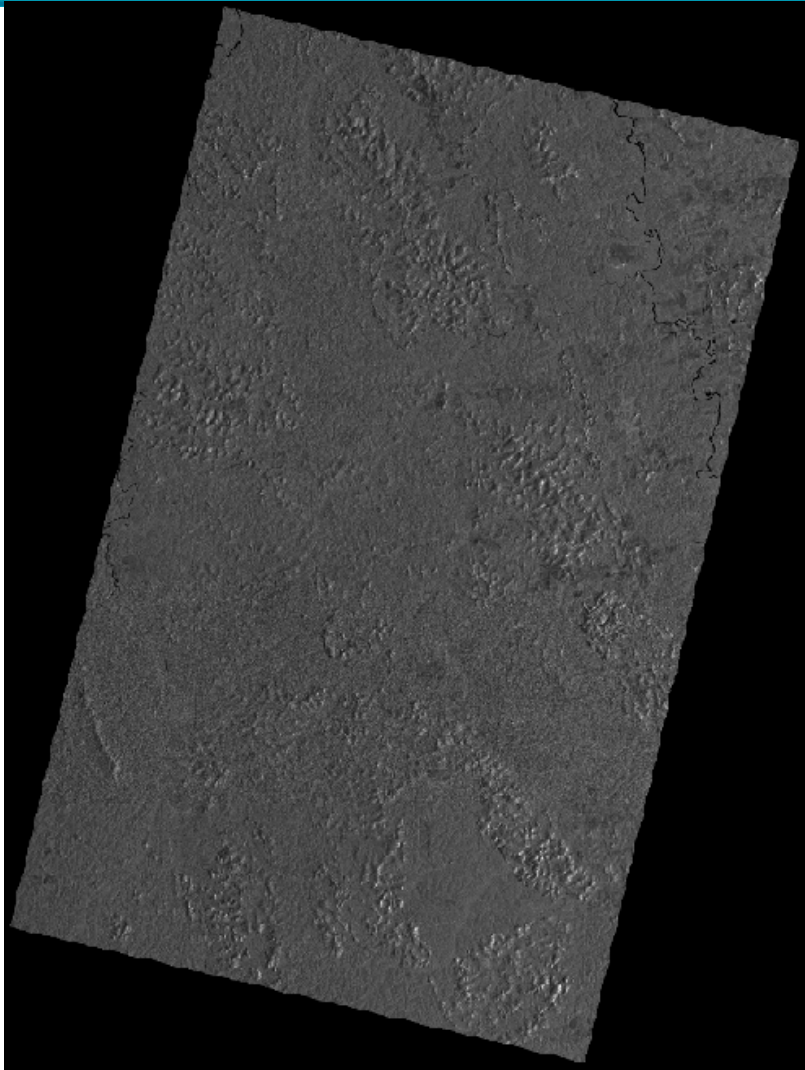
## Interpretation area A

Large new building

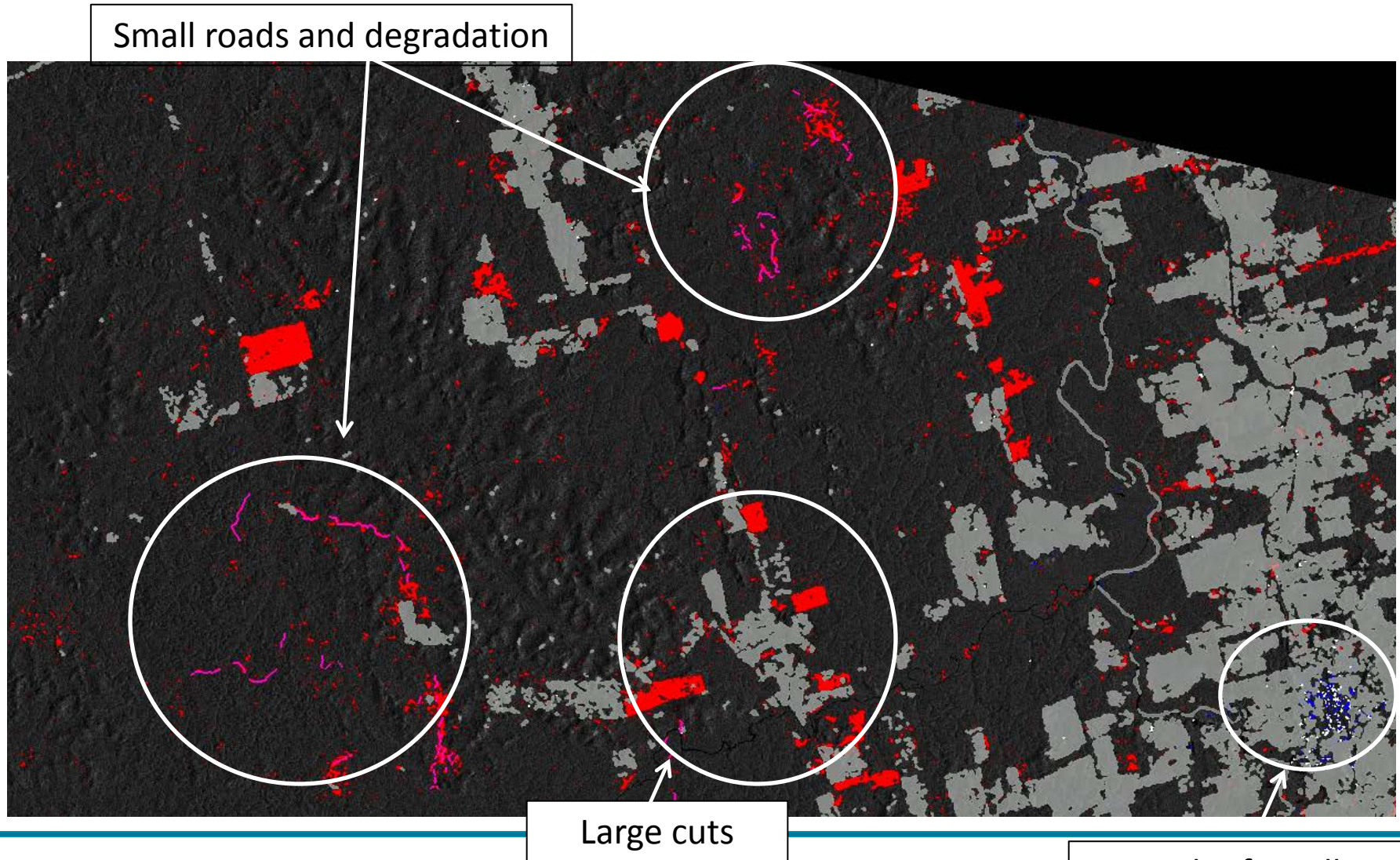
Tree removal, surface alteration



# Deforestation Monitoring in Pará, Brazil

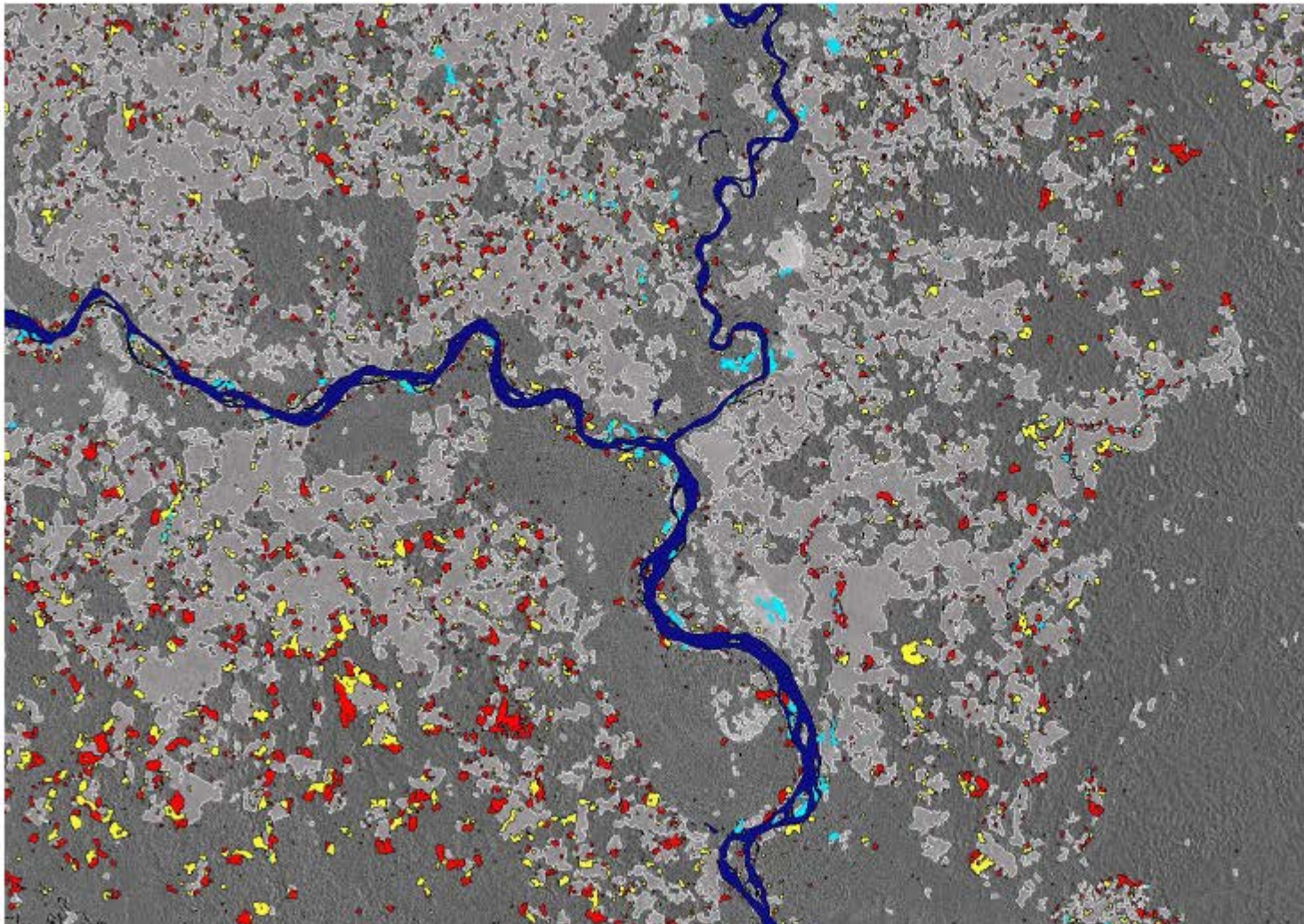








# Deforestation Monitoring in Pará, Brazil





# Tres Esquinas, Colombia



-  Non-forest 20120208
-  Forest cuts 20120627 - 20130222
-  Forest cuts 20130716 - 20140430
-  Permanent water
-  Temporary water
-  Unchanged forest

# Summary

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- RADARSAT-2's Extra Fine beam mode provides high resolution, wide area and weather independent coverage
- MDA ForestWatch change detection method allows for detection of deforestation in early stages
- Easy-to-use, customizable reports that clearly show the location and extent of deforestation
- Can quickly issue deforestation alerts over areas from thousands to hundreds of thousands of square kilometers in size

# Thank You

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MDA Geospatial Services Inc.