REDD+ MRV – MONITORING USING HR OPTICAL DATA - RAPIDEYE

Clemens Stromeyer
Regional Manager – Middle East & Africa
TOPICS OF THE PRESENTATION

- Who and what is BlackBridge/RapidEye
- Applicability for REDD+ MRV
- Examples of usage
- Availability of data over a country – example Ethiopia
ETHIOPIA’S CLIMATE RESILIENT GREEN ECONOMY

Combining economic growth with low GHG emissions, e.g.
- Sustainable land use via efficient agriculture
- Sequestration in forests
- Expansion of renewable energy
- Resource efficient advanced technologies

Green economy can help to avoid lock-in in old technologies, unsustainable growth and land use

Source: Ethiopia CRGE Strategy paper
THE MAIN FOCUS SECTORS

Source: Ethiopia CRGE Strategy paper
WHAT IS BLACKBRIDGE/RAPIDEYE

Providing end-to-end solutions across the geospatial value chain

RAPIDEYE

VISIT

GEOMATICS CANADA

VISIT

NETWORKS

VISIT
THE RAPIDEYE SATELLITE SYSTEM

- 5 satellite constellation
- 5 m imagery
- 5 bands (red edge)
RAPID/EYE CAPACITY OVERVIEW

**Five-Satellite Constellation**
Enables daily target revisit

**Broad Area Collection**
77 km wide sensor swath ideal for large area monitoring and mapping

**Superior Revisit**
Frequent revisit enables large area change detection and monitoring

**High Resolution Imaging**
5 meter resolution imagery

**Multi-Spectral Imaging**
5 spectral bands for improved feature discrimination

**Extensive Image Archive**
5 Billion km² of archived imagery
OUR STRENGTH IS RAPID COVERAGE OF LARGE AREAS

- Reliable coverage
- Best imaging chance in cloudy areas
- Same season coverage
- Multi-temporal coverage
WHAT RAPIDEYE BRINGS TO THE REDD+ TABLE
WHAT IS REDD+

**REDD** stands for countries' efforts to **R**educe **E**missions from **D**eforestation and forest **D**egradation

MRV (Monitoring, Reporting and Verification):
“... use a combination of **remote sensing** and ground-based forest carbon inventory to obtain estimates of forest related emissions ...“. UNFCCC
KEY POINTS OF RAPIDEYE COVERAGE

- High Resolution Imagery (Five Meter Pixel Size)
- Largest High Resolution Collection Capacity From a Constellation of Five Identical Satellites allowing Multi-temporal coverages
- Multi-spectral Sensor With Five Bands (including Red Edge)
- Multiple Country Coverages Already Available
- Proven Track Record in Global REDD efforts
- Guaranteed data continuity
RAPID EYE MOSAICS™ EXAMPLES

Somalia

Mozambique
THE RED EDGE BAND

The Red-Edge band is used to monitor vegetation health, improve species separation and measure chlorophyll, protein and Nitrogen content.
HUGE IMAGERY ARCHIVE INCL. MULTITEMPORAL COVERAGES
CASE STUDIES RAPIDEYE FOR REDD

- Mexico
- Guyana
- Indonesia/Brazil
- Laos
- Honduras
MEXICO

▪ CONABIO/CONAFOR/INECC/INEGI
▪ 2 coverages over the 2 Million km² per year
▪ Multiple usage (not just REDD)
▪ MMU of 0.125 ha

▪ Monitoring
  ▪ Baseline Landsat 1990 – 2020
  ▪ HR RapidEye 2010 - 2020
AUTOMATED PRODUCT GENERATION

Target: 13 classes Maximum aggregated from 66 vegetation and land use classes

- **CONIFEROUS TEMPERATE FOREST** - Needleleaf Forests - 7 Types in Mexico
- **MIXED TEMPERATE FOREST** – Pine/Oak – Oak/Pine Forests – Mixed Forests, 9 Types
- **DECIDUOUS TEMPERATE FORESTS** – Oak Forests – Broadleaf Forests – 5 Types in Mexico
- **EVERGREEN TROPICAL FORESTS** – Evergreen Tropical Forest (6 Types) + Mangroves
- **DECIDUOUS TROPICAL FORESTS** – Deciduous Tropical Forests (6 Types in Mexico)
- **SHRUBLAND** – Dry Forests and Shrubland  14 Types in Mexico
- **GRASSLAND** – 5 Types of Natural Grasslands, Pastures
- **Agriculture** – Non Cattle / Non Pasture
- **BARE SOIL** – without apparent vegetation
- **WETLAND** - Wetland, Meadows, mostly herbaceous vegetation
- **SNOW / ICE** – Winter period in Northern parts, mountain peaks
- **URBAN** – Cities and other settlements
- **WATER BODIES** – Open Water, no apparent vegetation cover
COMPARISON LANDSAT - RAPIDEYE

Left: ETM+: 01/06/2000
Right: RapidEye: 01/01/2011

MMU = 0.125 ha
COMPARISON LANDSAT – RAPIDEYE
SCALES 1:250.000, 1:100.000, 1:25.000
COMPARISON LANDSAT - RAPIDEYE
COMPARISON LANDSAT - RAPIDEYE
RAPID EYE CHANGE DETECTION

Change Intensities
- Strong negative
- Medium negative
- Light negative
- No change
- Light positive
- Medium positive
- Strong positive

2010-01-24

2011-03-10
RAPIDEYE CHANGE DETECTION
GUYANA

- Guyana National Forestry Commission + Indufor
- Usage of Landsat and RapidEye
- Low deforestation, more degradation
- Small scale degradation by illegal mining
- 2010 - 2012 – 121.500 km², half the country
- 2013 – full country coverage of RapidEye
GUYANA – NATIONAL MONITORING

2013 Program

• 215,000 km², or 100% of Guyana

• Limited acquisition period

• Integration of afforestation monitoring

• Target of reducing illegal mining / forestry activities
CHANGE DETECTION

Landsat EVI | RapidEye Classification | Mapped Change

Landsat change detection 2010-11 updating to RapidEye change detection 2011-12
INDONESIA/BRAZIL

- Various projects done by RSS
- Benefits of
  - Timeliness
  - Multitemporality
  - High resolution
DEFORESTATION BY ILLEGAL LOGGING

Landsat, 30 meters

RapidEye, 5 meters
LAND COVER CHANGE THROUGH DEFORESTATION

Rapid changes

22.05.2009

28.07.2009
MONITORING LOW INTENSITY LOGGING

RapidEye time series showing a peat swamp forest in Central-Kalimantan and the progress of selective logging
EXAMPLE DEFORESTATION
EXAMPLE DEFORESTATION/FOREST DEGRADATION

RapidEye 2012
EXAMPLE OF DEFORESTATION

RapidEye 2011
EXAMPLE OF DEGRADATION THROUGH FIRE
LAOS

- Forest Carbon and Aruna
- Usage of Landsat AND RapidEye for the REDD MRV
- Project in Khammouane province (16.315 km²) in Laos funded by GIZ
- Will be rolled out to all of Laos
RAPIDEYE COVERAGE KHAMMouANE PROVINCE (LAOS)
HISTORICAL REFERENCE (REL)
FOREST COVER CHANGE 2002 - 2012
ECOLOGICAL CLASSIFICATION
CARBON STRATIFICATION
THREAT MAPPING
HONDURAS

- Forest type maps based on Landsat are available for Central American countries
- These maps are suitable for **regional** analyses and monitoring
- However, for **national** level monitoring, higher accuracy (spatial resolution) is needed
BACKGROUND

RapidEye data can provide the right type of information...
BACKGROUND

... for higher resolution analyses

RapidEye

Landsat
BACKGROUND

- Rapideye-data can be used to build on previous data, adding value to them.
- Landsat-based maps can be kept for:
  - broader analyses and monitoring at the regional level
  - providing a baseline for higher detail maps for national and local monitoring
APPROACH

Original RapidEye image

Cloud masking

Reference map

Segmentation

Spectral signature assignment

Spectral signature extraction

Classification

Final map

Validation

Refinement

Final map

Validation

Refinement

Classification

Spectral signature extraction

Reference map

Segmentation

Cloud masking

Original RapidEye image

APPROACH

22 January 2015
APPROACH

Reference map

- Broadleaf forest
- Conifer forest, sparse
- Conifer forest, dense
- Dry forest/shrub
- Grassland
APPROACH

Original RapidEye image

Cloud masking

Masked RapidEye image
APPROACH

Segmentation
APPROACH

Reference map + Segmentation

- Broadleaf forest
- Conifer forest, sparse
- Conifer forest, dense
- Dry forest/shrub
- Grassland
Approach

Spectral signature assignment

Combination of all Landsat sources

- Broadleaf forest
- Conifer forest, sparse
- Conifer forest, dense
- Dry forest/shrub
- Grassland
APPROACH

Spectral signature extraction

- Broadleaf forest
- Conifer forest, sparse
- Conifer forest, dense
- Dry forest/shrub
- Grassland
APPROACH

Classification

- Broadleaf forest
- Conifer forest, sparse
- Conifer forest, dense
- Dry forest/shrub
- Grassland
APPROACH

- Refinement
  - Urban
  - River
  - Clouds

Legend:
- Red: Broadleaf forest
- Green: Conifer forest, sparse
- Light green: Conifer forest, dense
- Grey: Dry forest/shrub
- Yellow: Grassland
APPROACH

Validation

Ground surveys

Database

Classification model improvement

Validation

Ground surveys

Database

Classification model improvement
APPREACH

Accuracy goal: 85% accurate classification for each classified image
EXAMPLE
WHAT DO MOST OF THEM HAVE IN COMMON?

- **Usage of:**
  - High resolution
  - Medium resolution

  **Conclusion:** All scenarios are possible and there is not the ONE solution for remote sensing data for MRV.

- **Drivers:**
  - Project(s) requirements
    - Diversity of landscape (classes)
  - Availability of data
    - Clouds
    - Acquisition planning
  - Budget
EYEFIND – ONLINE ARCHIVE TOOL
COVERAGE ETHIOPIA
Clemens Stromeyer
Regional Manager – Middle East & Africa

Kurfürstendamm 22
10719 Berlin
Germany

Phone: +49 30 609 8300 546
Mobile: +49 151 16127129

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www.blackbridge.com