Forest Monitoring, Reporting and Verification: Update on Google Initiatives

Rebecca Moore, Google

Current Initiatives

1. *Group on Earth Observations* Demonstration Portal
   - For the GEO Forest Carbon Tracking Task in 2009-2010

2. Web-integrated mobile devices for forest monitoring
   - Android phones and *Open Data Kit* for in situ measurements
   - For professionals and/or communities

3. *"Earth Engine, powered by Google"*
   - Web-based global forest MRV platform
   - Prototype demonstrated at COP15
   - Launch expected in 2010

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"Earth Engine"

Forest Monitoring

COP15 Demo/prototype

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Motivation

UNEP: "Atlas of our Changing Environment"

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Forest Monitoring Challenges

Access to Remote Sensing Data

- Optical and Radar data
- Historical, current, into the future
- Various spatial and temporal resolutions
- Issues:
  - Cost and availability
  - Data access is challenging
  - Data storage is burdensome – terabytes or petabytes
  - Raw data not usable - requires preprocessing, ortho-rectification, atmospheric correction

Should each country have to solve this on their own?

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Forest Monitoring Challenges *(cont'd)*

Access to Forest MRV Software Algorithms

- What is available and where to find it?
- What will operationally support REDD requirements?
- Algorithms are time-consuming to run
- Hardware and software requirements
  - Expensive and complicated
- Many countries lack technology infrastructure
  - *"Our computers are twelve years old!"*

UNFCCC requirement to be open, transparent, verifiable

- How to operationalize this?

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User Categories

1. Scientists / Developers:

- Scientists, university students, and others developing new algorithms
- Examples: *forest change detection, biomass estimation*

2. National Governments, NGOs, Indigenous peoples

- Run “canned” algorithms, specifying source data and parameters.
- Example uses: REDD implementation, decision support, law-enforcement
- Seek sharing and collaboration with stakeholder communities & general public

3. Stakeholders and interested public:

- Donors, policymakers, media, civil society
- Primarily viewing pre-generated results.
- Example: Globo Amazonia, a Brazilian deforestation tracking website

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Simple Goals

- Improve access and use of data and algorithms
  - Make these readily available, more easy to use by developing countries
  - Lower the technology barriers, cost and complexity
- Respect and Partner with others
  - Respect national and subnational sovereignty and concerns
  - Partner with NGOs, IGOs, Indigenous people, academic institutions...
  - No need to reinvent the wheel!
- Demonstrate that REDD is technically-feasible at global scale
  - To support policy goals at COP15
- Ultimate goals:
  - Climate change mitigation
  - Rainforest conservation
  - New sustainable income sources in developing world

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Conceptual user interface (early)

1. Point your web browser to the Google forest monitoring portal, and log in.
2. **"What do you want to do?"**
   - Forest Cover analysis *(land cover classification - forest, cropland, savannah...)*
   - Forest Change detection *(e.g. look for deforestation or reforestation)*
   - Burnt area detection
   - Carbon Emissions Calculation
   - ...
3. **"Where do you want to do it?"**
   - Select by administrative region (global, country, state/province, biome...)
   - Or draw free-form area.
4. We display: **Here are the Remote Sensing datasets for your area:**
   - LANDSAT (with dates)
   - CBERS
   - SPOT
   - ALOS
   - ESA
   - ....
5. **"Please select the remote sensing data you want to use"**
6. We display: **Here are the software tools available for your selected task, area and remote sensing dataset:"**
   - PRODES
   - DETER
   - TREES
   - ALU
   - FAO FRA
   - ...
7. **"Please select the tool you want to use"**
8. We display: **"OK, thank you. We will email you when your results are ready".**

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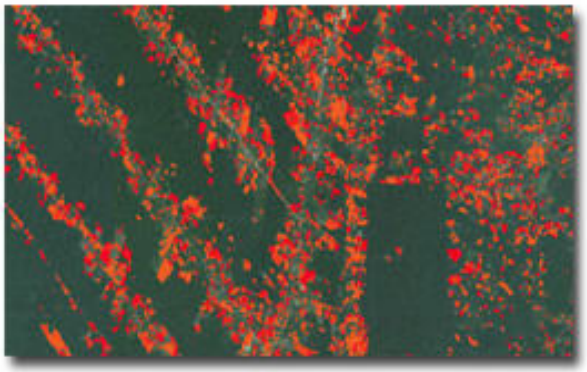
COP15 Demos

Carnegie Landsat Analysis System Lite (CLASlite)



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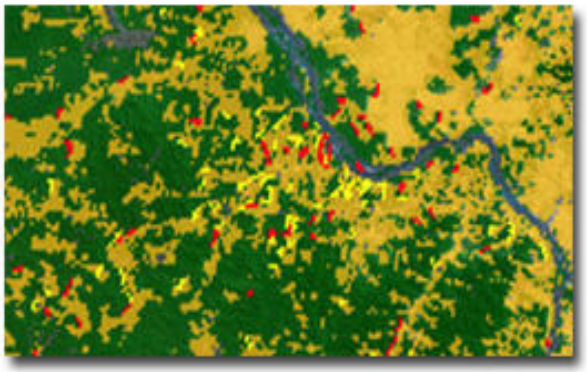
Imazon Sistema de Alerta de Desmatamento (SAD)



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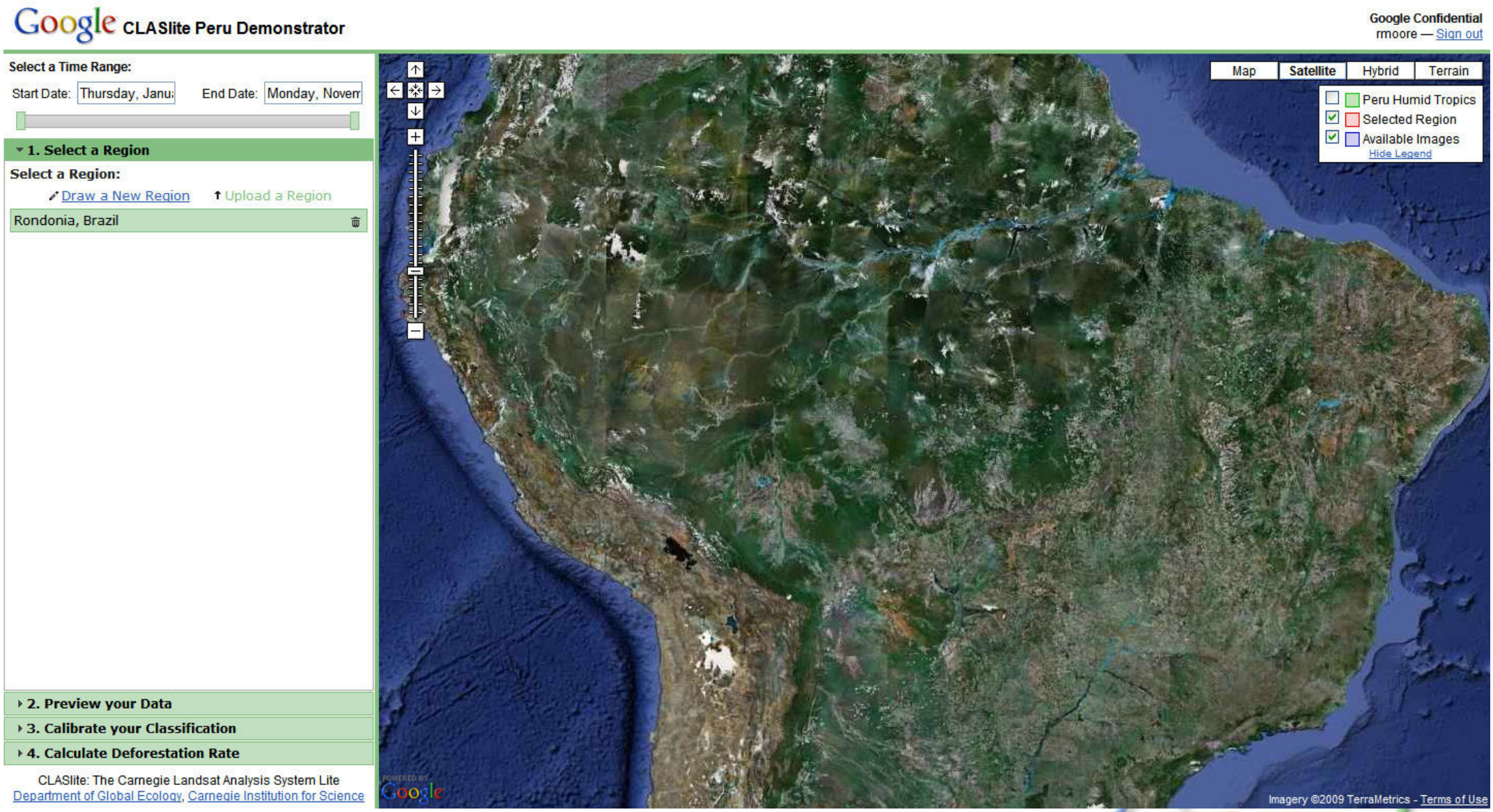
Forest MRV Prototype Demonstration



Forest MRV Prototype Demo *(cont'd)*

Google **CLASlite Peru Demonstrator**

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Select a Time Range:

Start Date: Thursday, Janu: End Date: Monday, Novem

1. Select a Region

Select a Region:

Draw a New Region Upload a Region

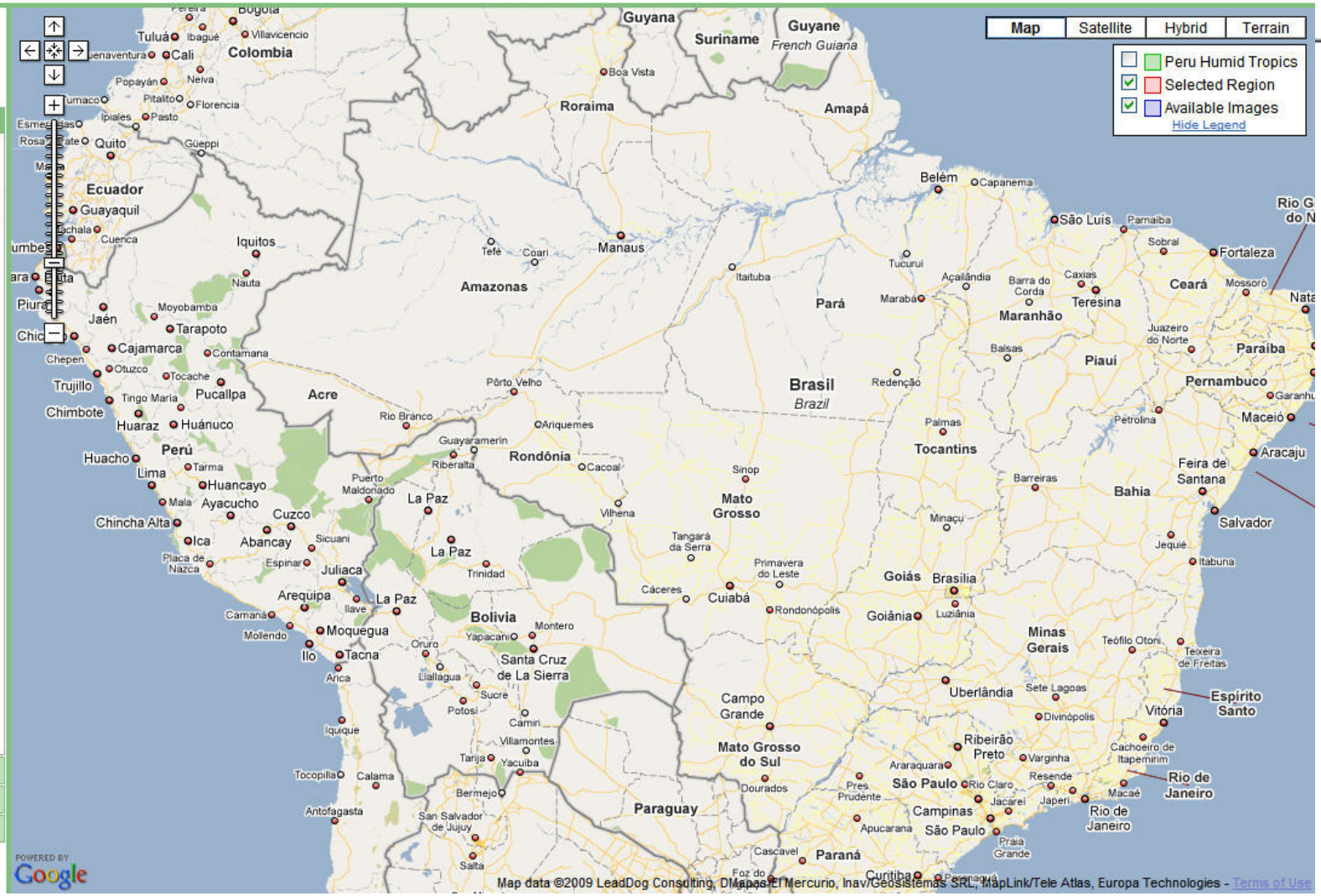
Rondonia, Brazil

2. Preview your Data

3. Calibrate your Classification

4. Calculate Deforestation Rate

CLASlite: The Carnegie Landsat Analysis System Lite
Department of Global Ecology, Carnegie Institution for Science



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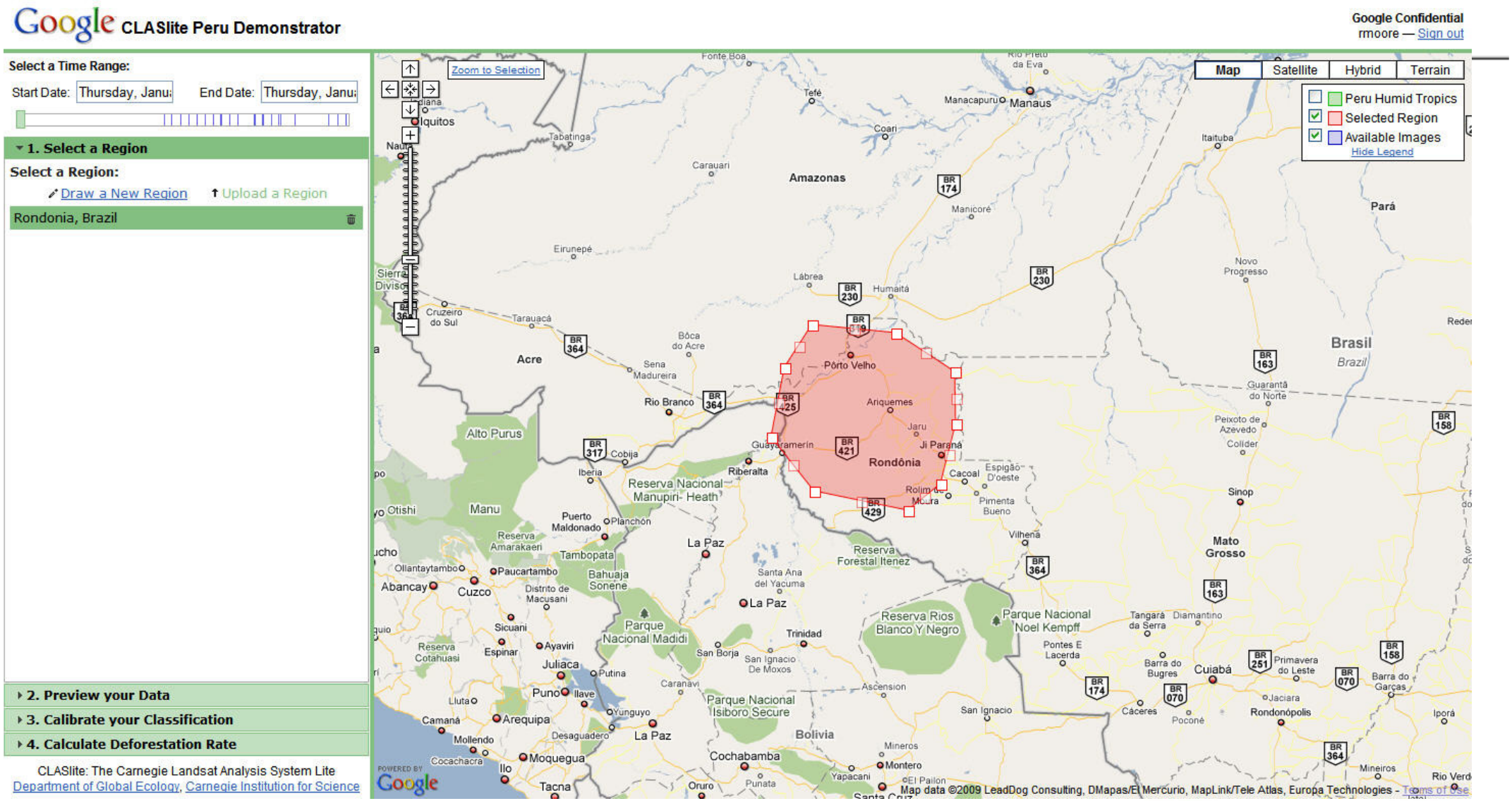
Demo: Select area to analyze



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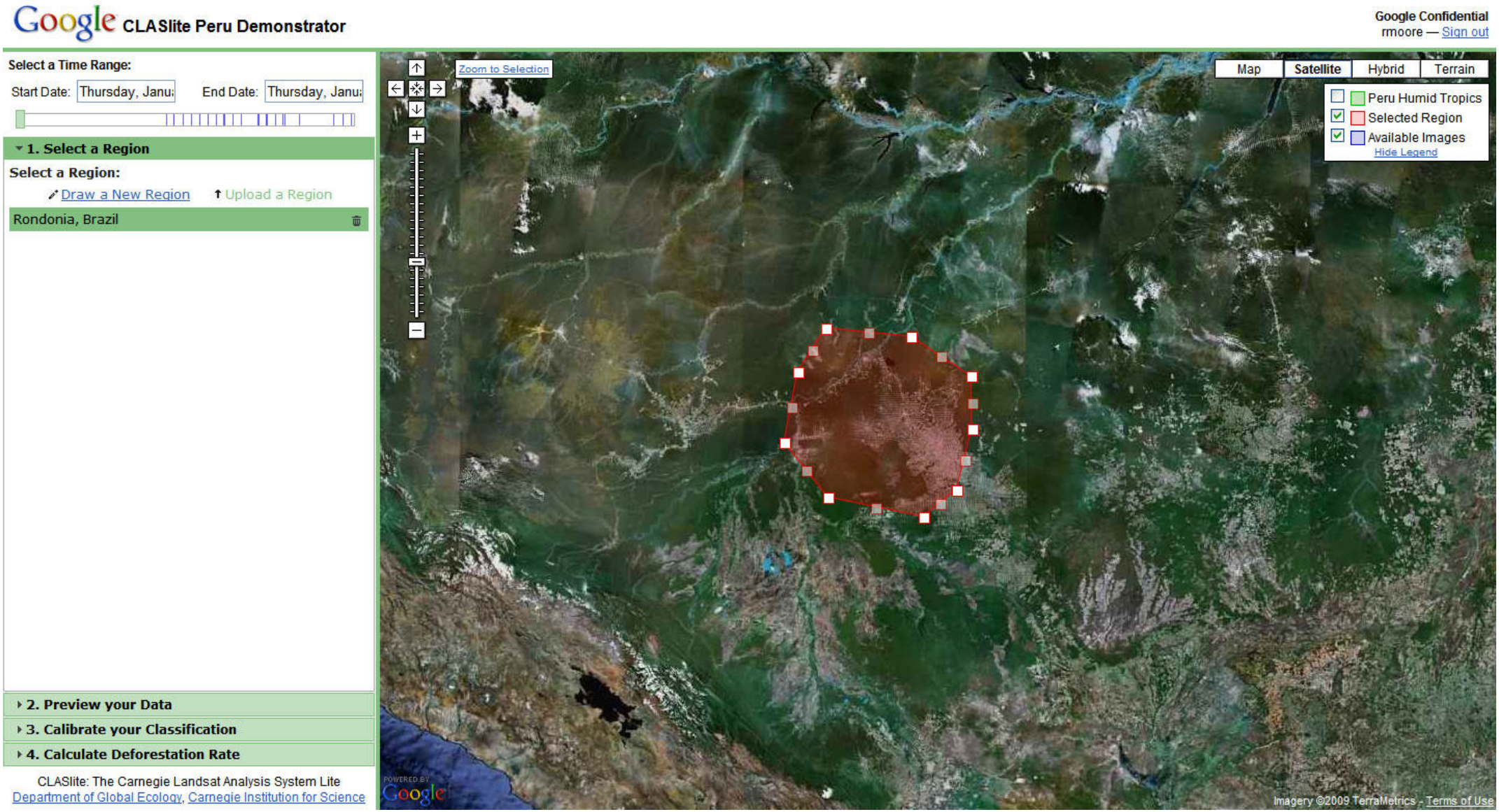
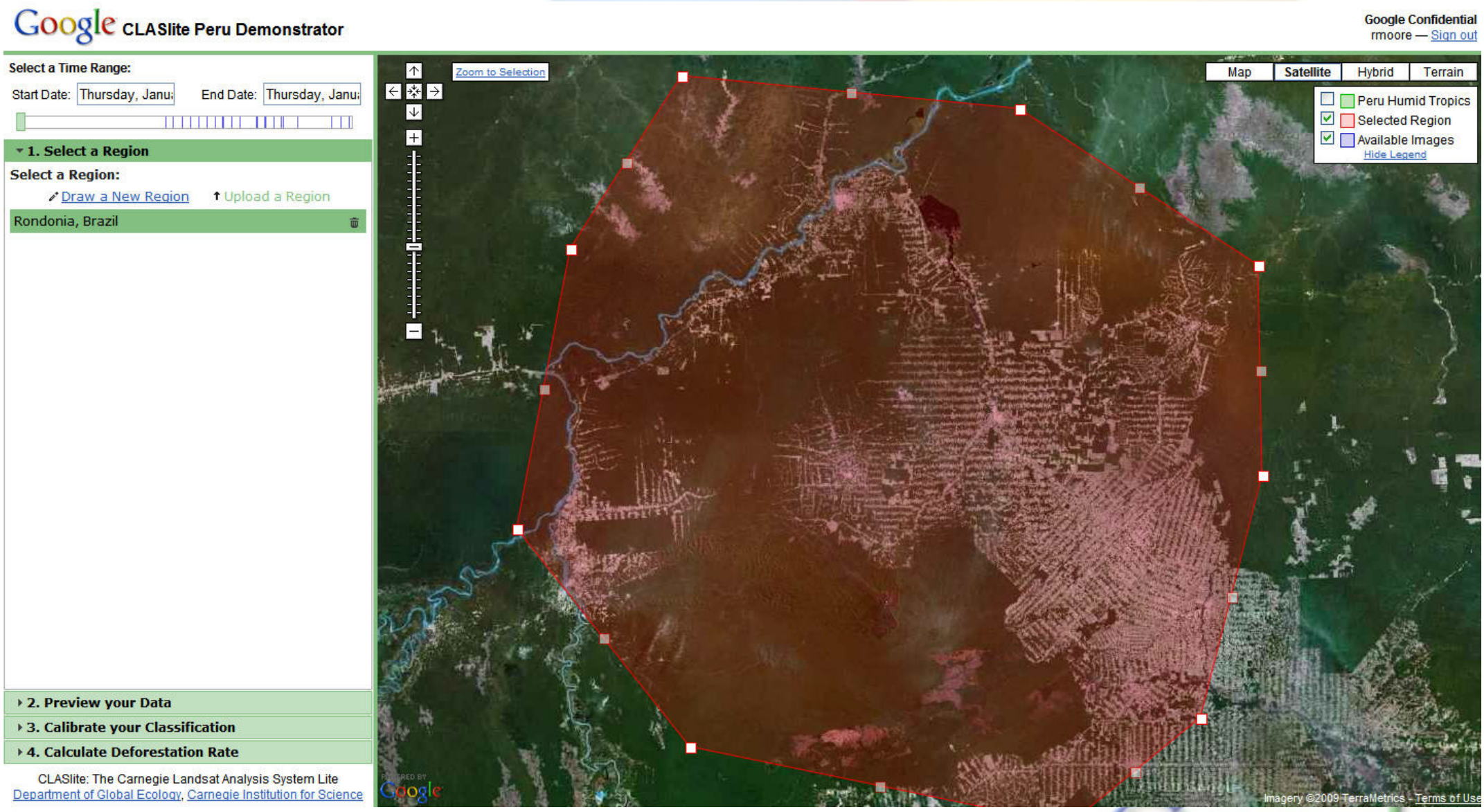
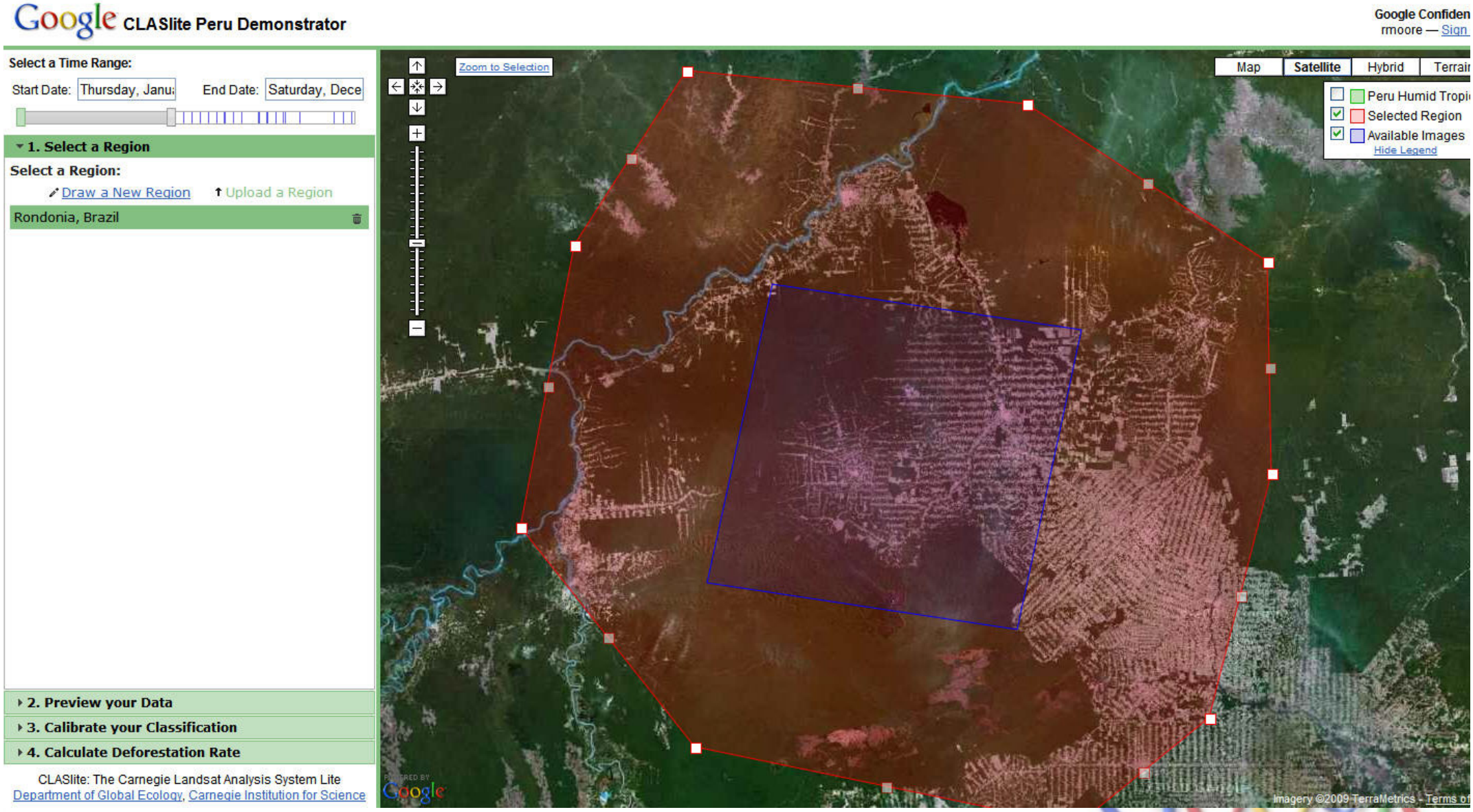
Demo: Select area to analyze *(cont'd)*



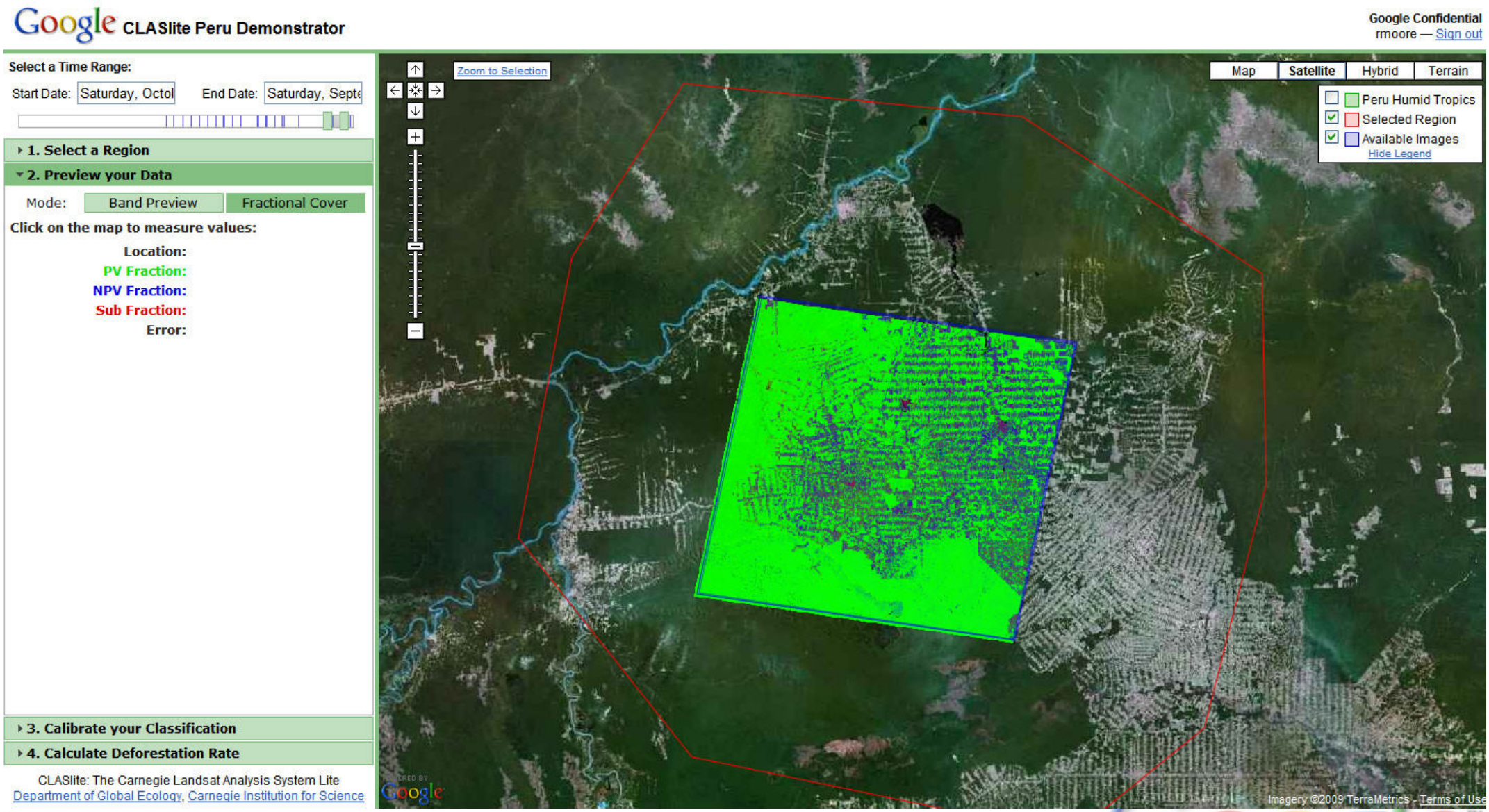
Demo: Select area to analyze *(cont'd)*



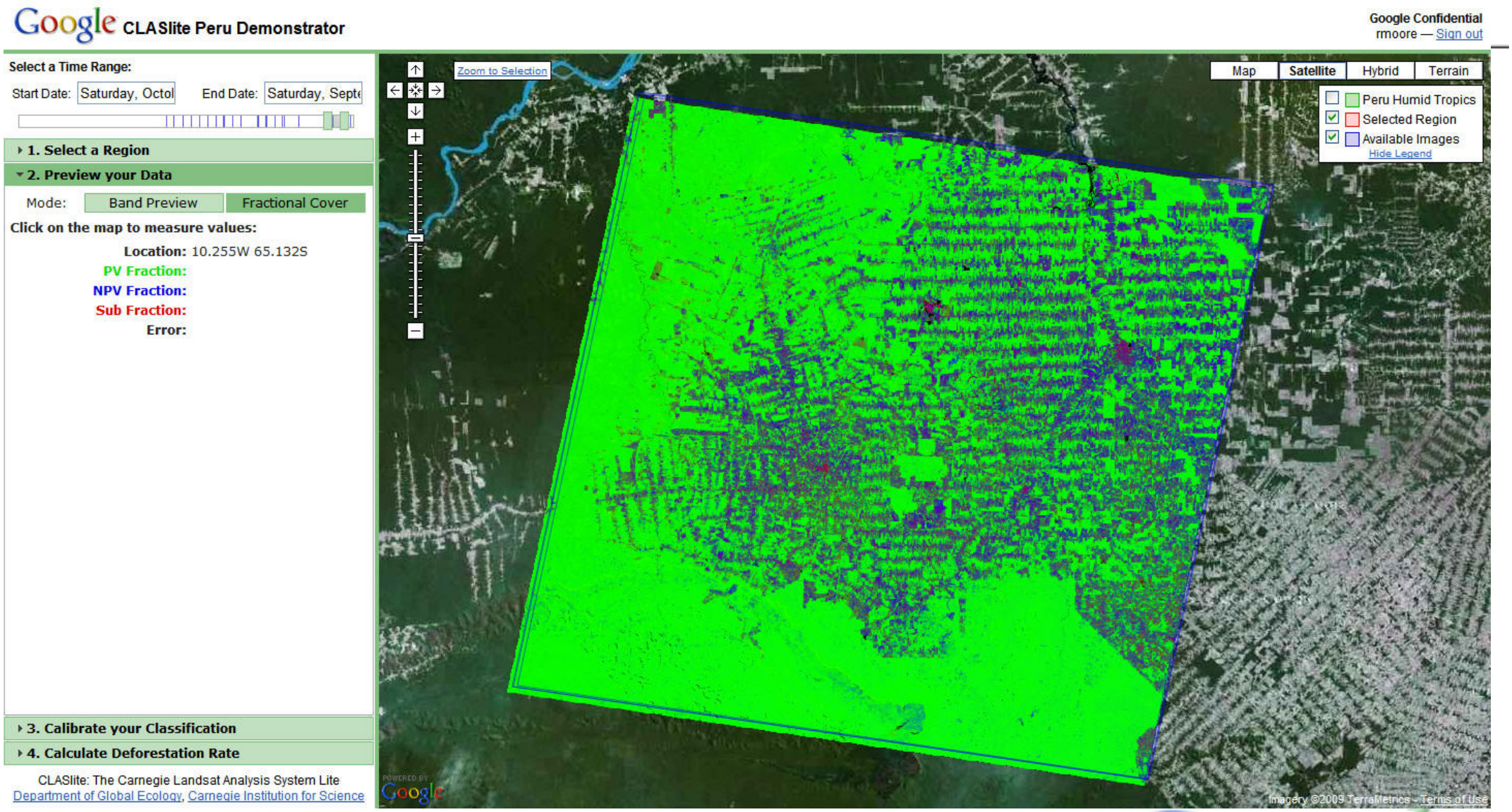
Demo: Available Imagery (Landsat)



Demo: CLASlite Fractional Cover Analysis



Demo: CLASlite Fractional Cover *(cont'd)*



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COP15 Demo: CLASlite

Select a Time Range:

Start Date: Sunday, Januar End Date: Tuesday, Decer

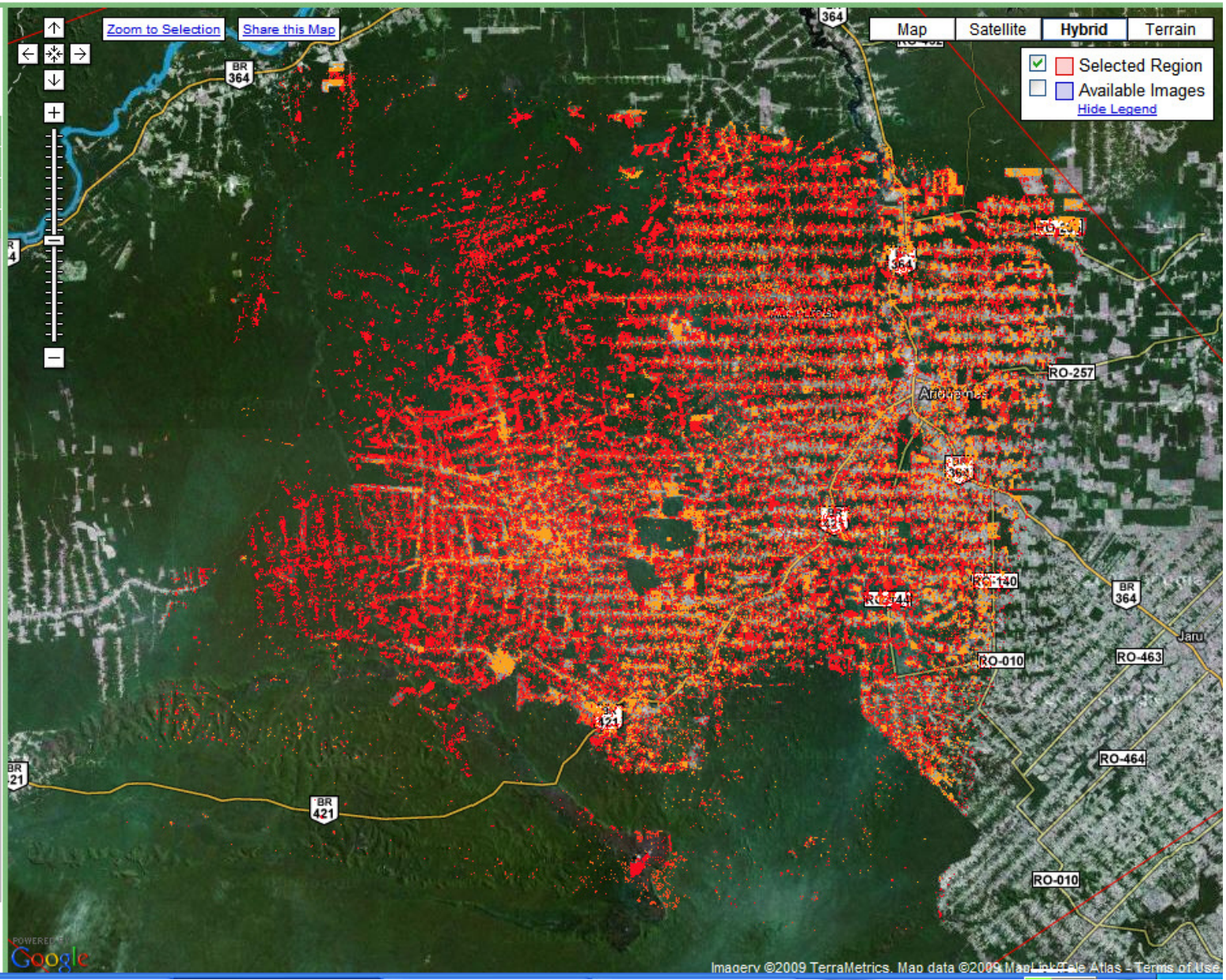
- 1. Select a Region
- 2. Preview your Data
- 3. Display Forest Cover
- 4. Display Deforestation over Time

Shows deforestation and forest degradation events over time. Wide-area images show preview data; for more accurate results, zoom in.

Recent

Oldest

☐ Enable Spatial Filtering



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CLASlite: The Carnegie Landsat Analysis System Lite

Carnegie Institution for Science

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COP15 Demo: Sistema de Alerta de Desmatamento (SAD)

rmoore@google.com | SAD ▾ | Sign out

Select a Time Range:

Start Date: 8/17/2009 End Date: 9/15/2009

- ▸ 1. Select a Region
- ▸ 2. Preview your Data
- ▾ 3. Display Deforestation

Shows new deforestation events against a map of old deforestation. Works best when both the start and end images are cloud-free.

- Forest
- New Deforestation
- New Degradation
- Old Deforestation
- Baseline Deforestation
- Unclassified, e.g. clouds

MODIS data: NASA / USGS, PRODES data: INPE

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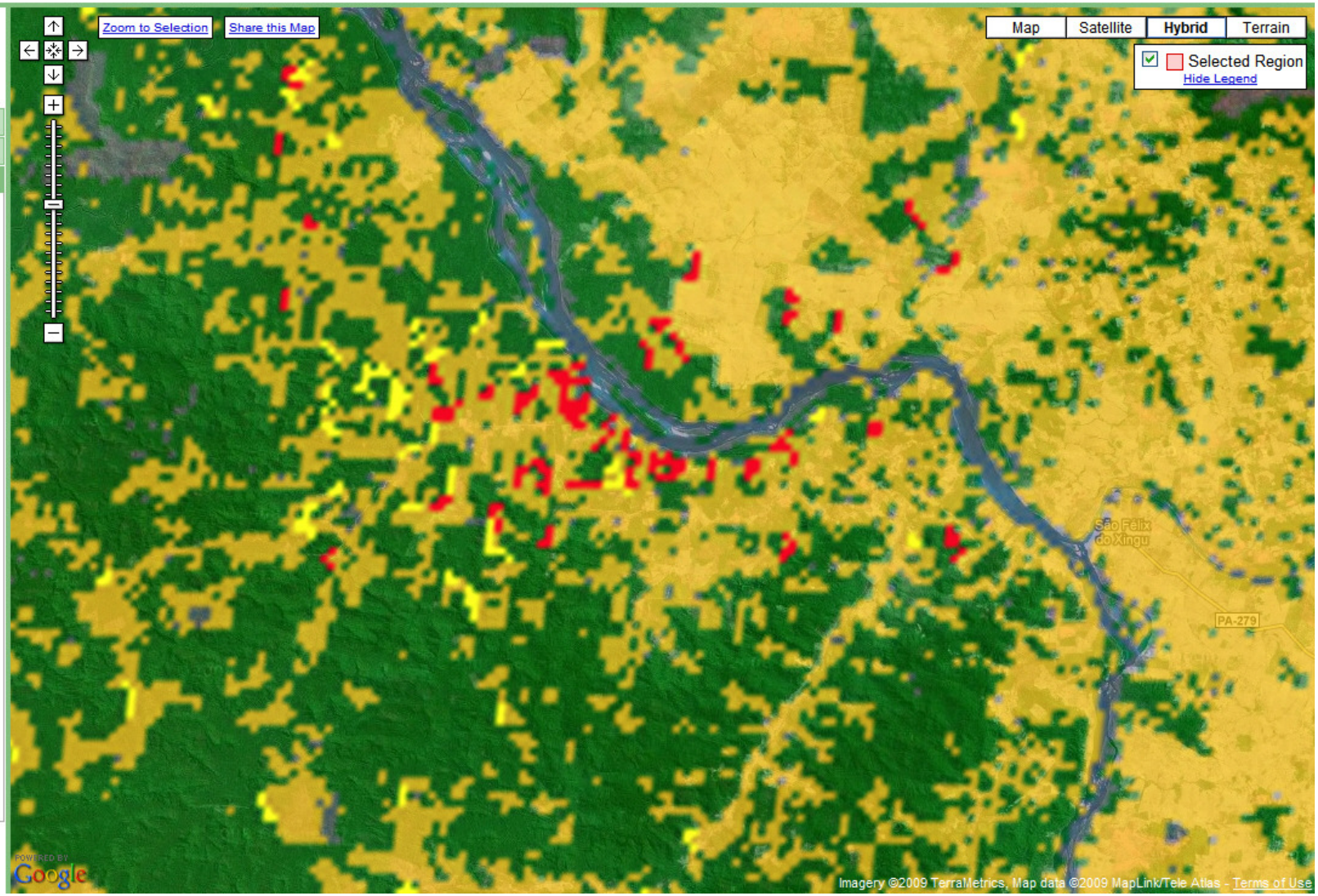
SAD: Sistema de Alerta de Desmatamento
Imazon Geo



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Science/Institutional partners *(so far)*

- Greg Asner, Carnegie Institute: *CLASLite*
  - Peru, Colombia, Bolivia, Ecuador, Madagascar
- Carlos Souza, IMAZON*: NDFI, SAD*
  - Brazil, Pan-Amazonia nations
- Dirk Hoekman, SARVision
  - Borneo, Guyana, …
- Josef Kellndorfer, WHRC
  - Pan-tropical nations
- Ron Eastman, Clark Labs: *Land Cover Modeler*
  - Brazil, Tanzania, more
- Gilberto Camara, INPE: *PRODES, DETER, DEGRAD*
  - Brazil (data services), other nations (INPE algorithms)

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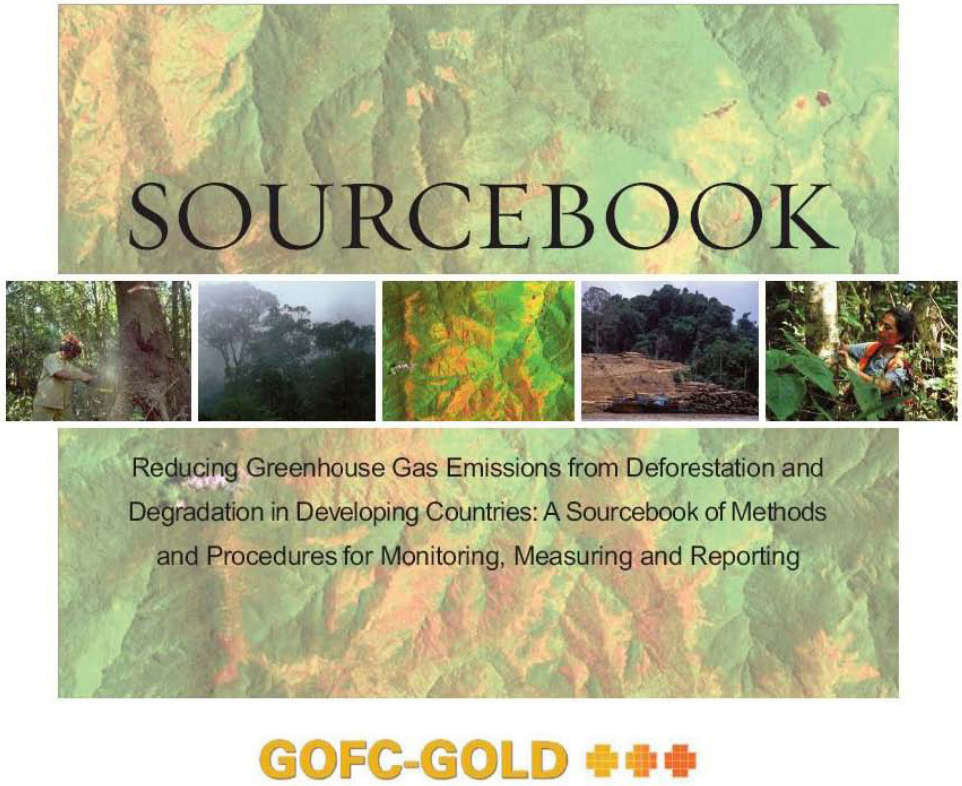
Potential



- All contributors to GOFC-GOLD Sourcebook
- All referenced algorithms
- All referenced data sources
- Use cases outside of forest/land

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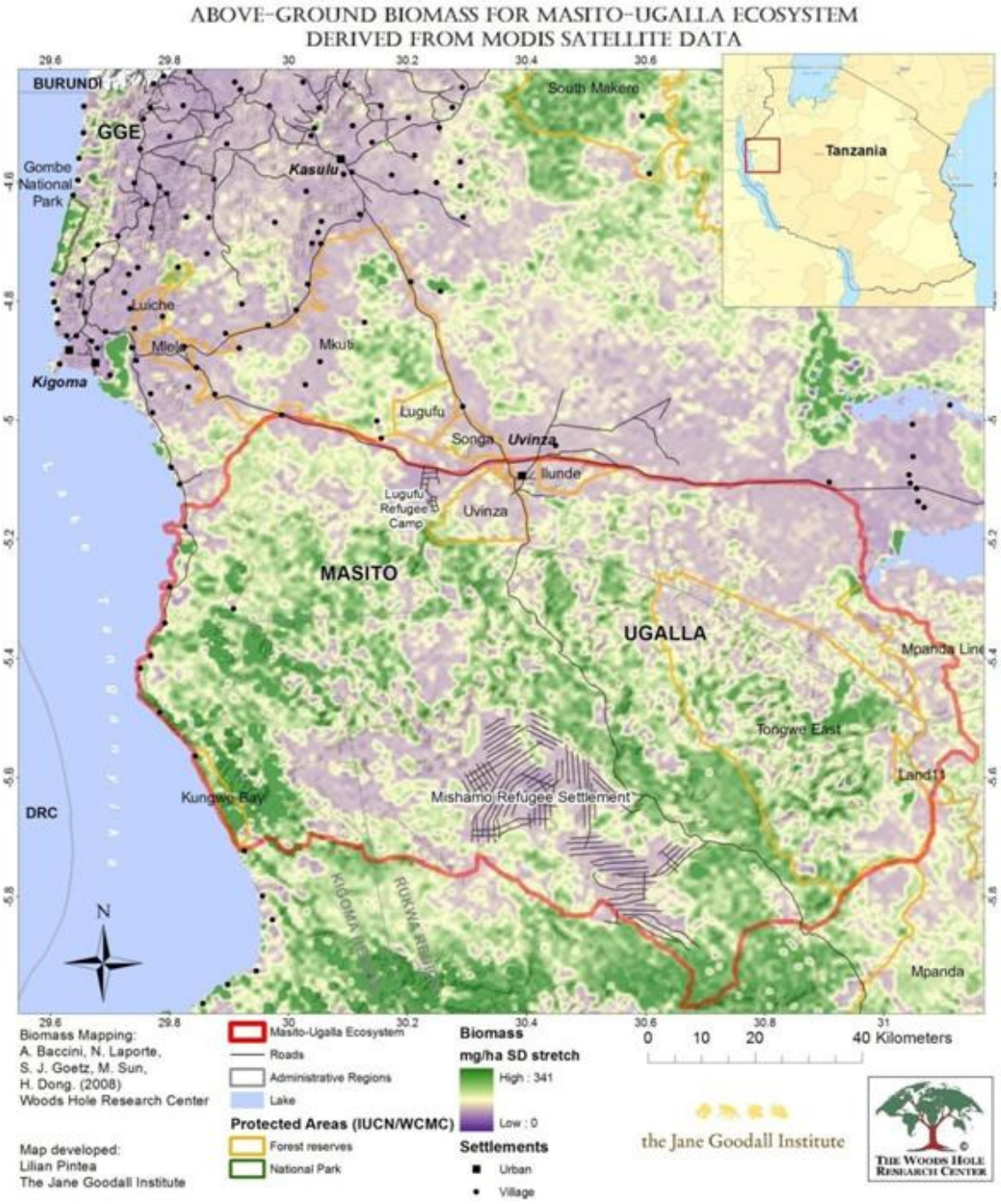

Courtesy of Dr. Lilian Pintea, Jane Goodall Institute

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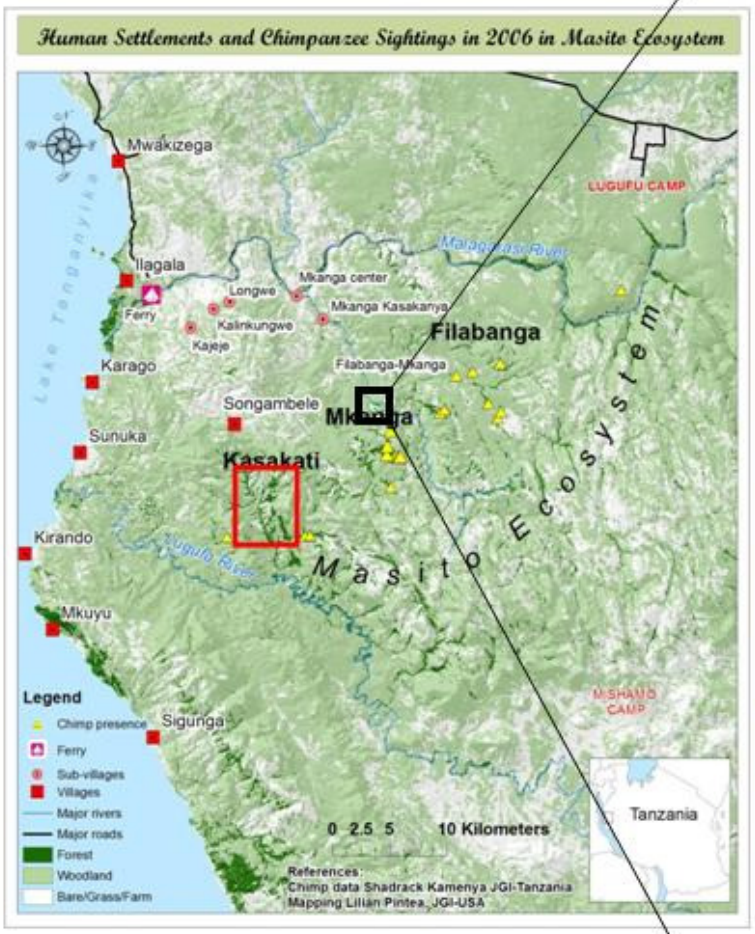
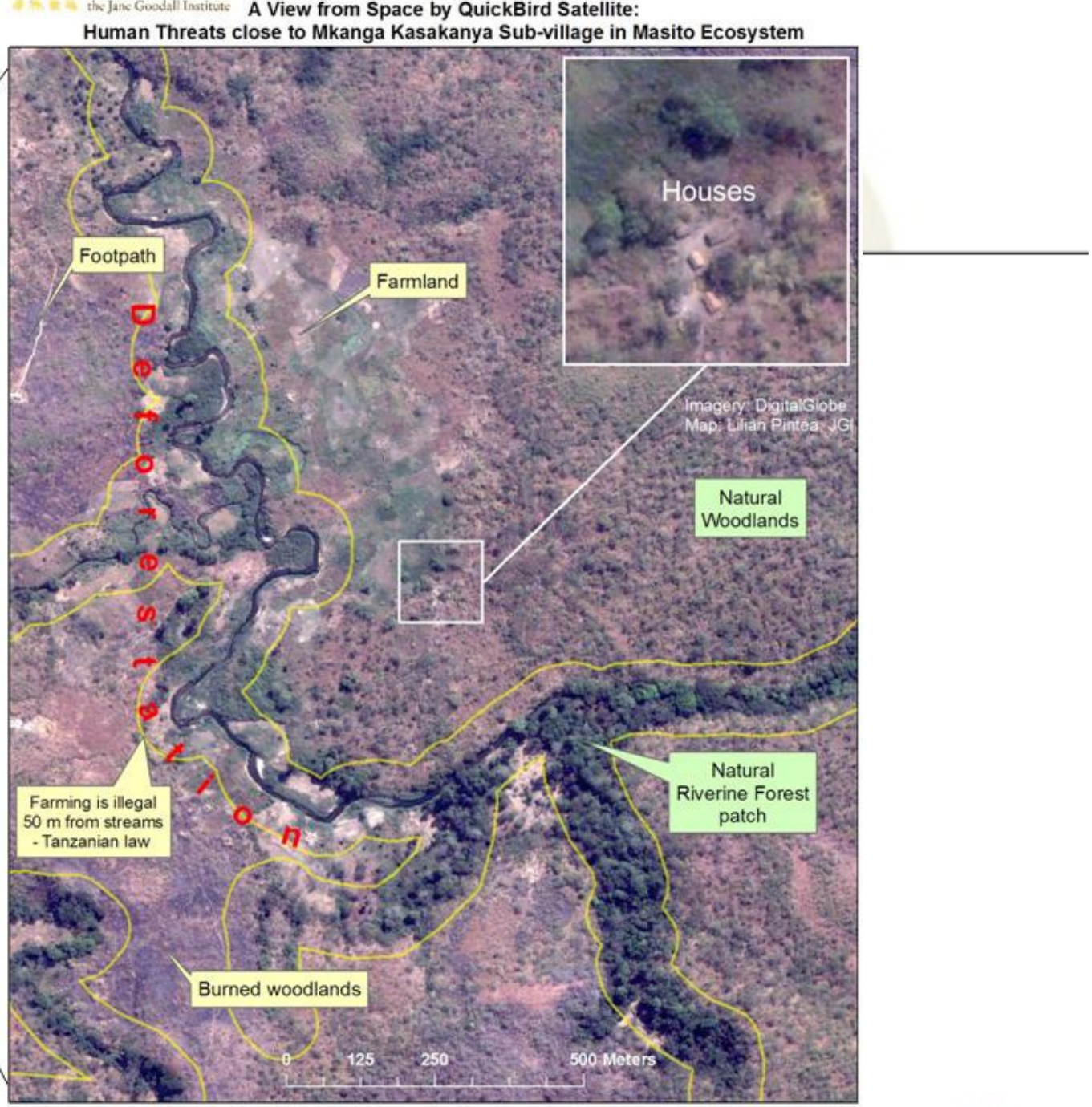
Masito-Ugalla Ecosystem

Mapping illegal logging and farming within 50 m from riverine forests





Courtesy of Dr. Lilian Pintea, Jane Goodall Institute

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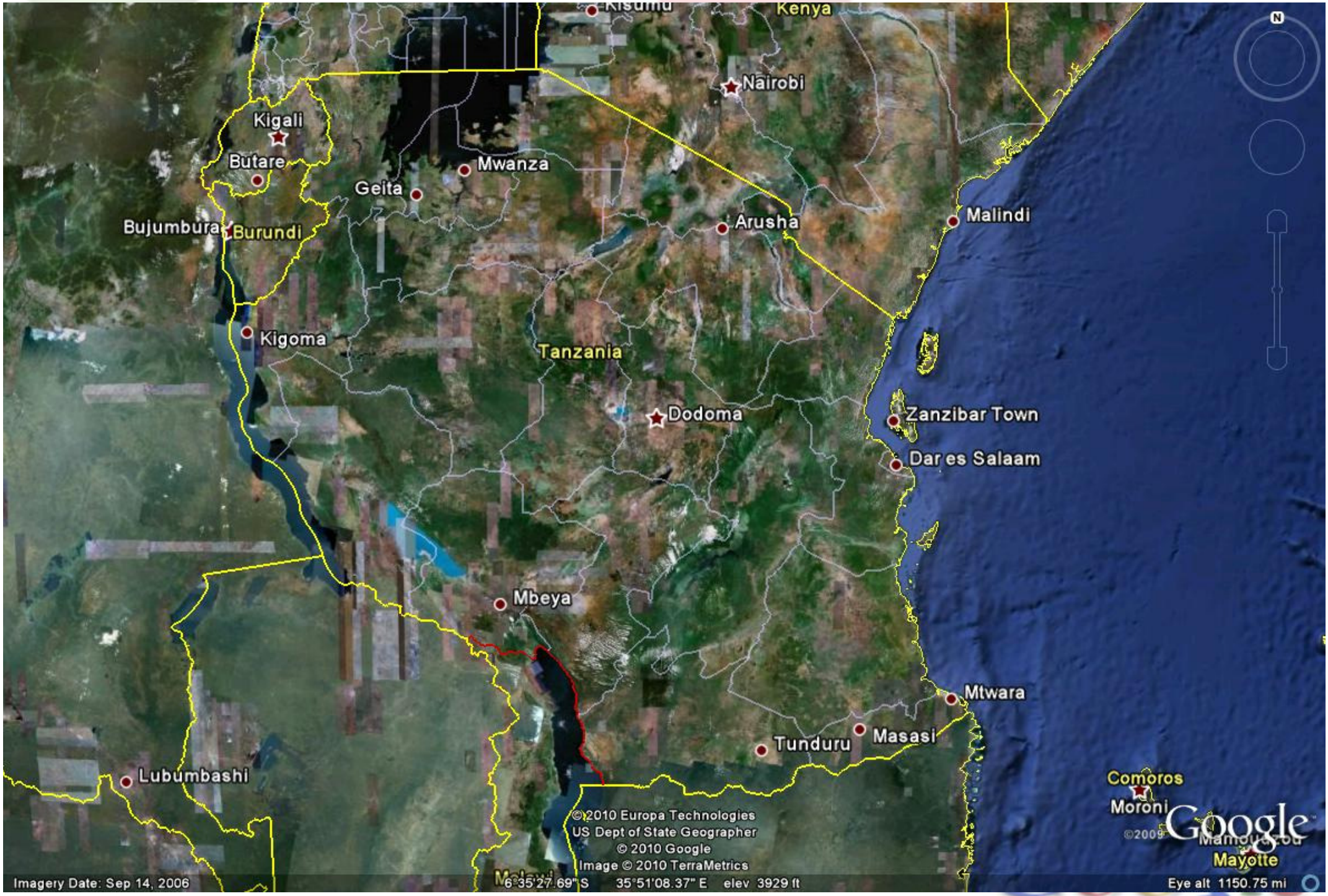
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Zanzibar Town
Dar es Salaam
Mbeya
Mtwara
Tunduru
Masasi
Lubumbashi
Comoros
Moroni
Mayotte
©2010 Europa Technologies
US Dept of State Geographer
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Eye alt 1150.75 mi
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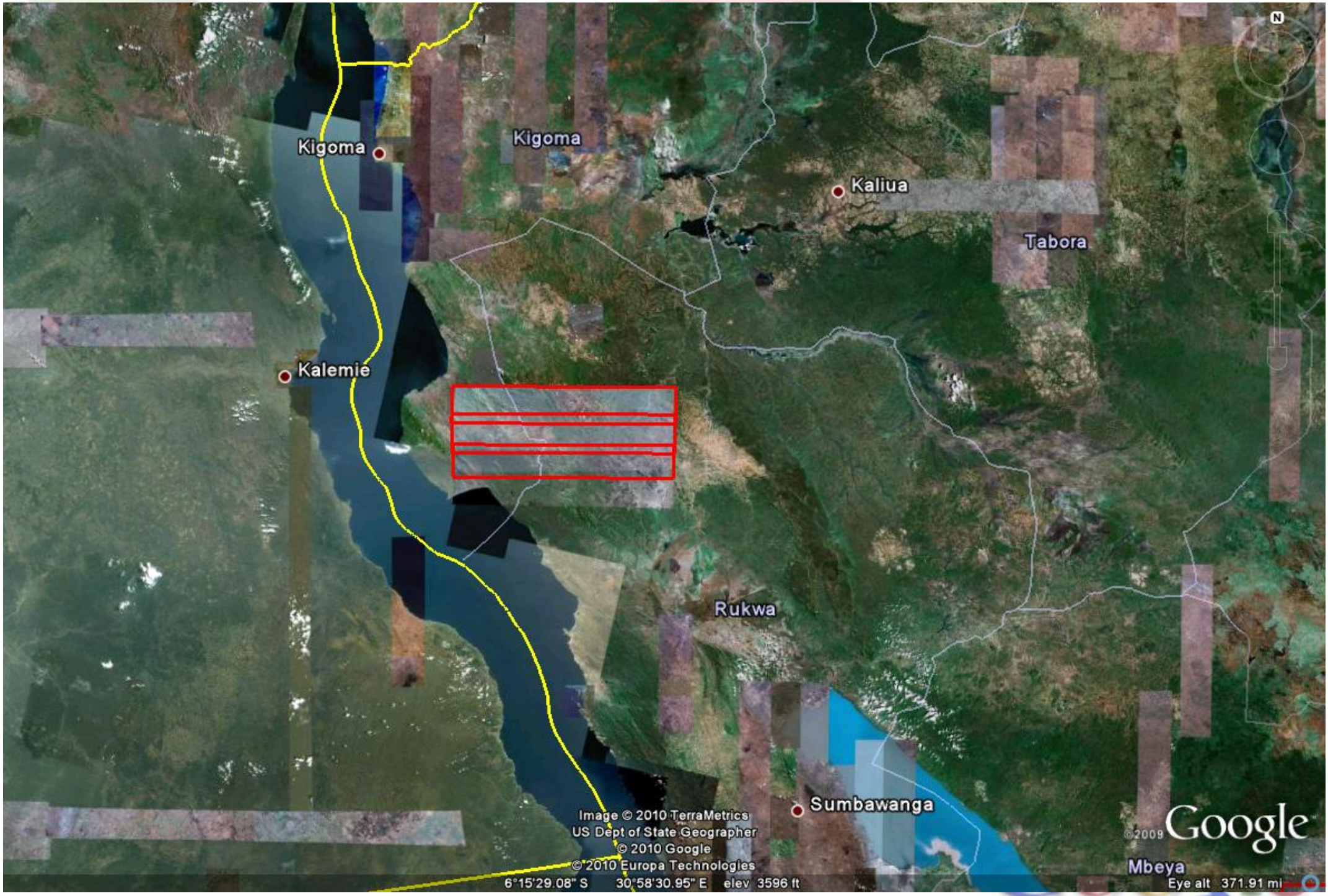
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Kigoma
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Tabora
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Rukwa
Sumbawanga
Mbeya
Image © 2010 TerraMetrics
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© 2010 Europa Technologies
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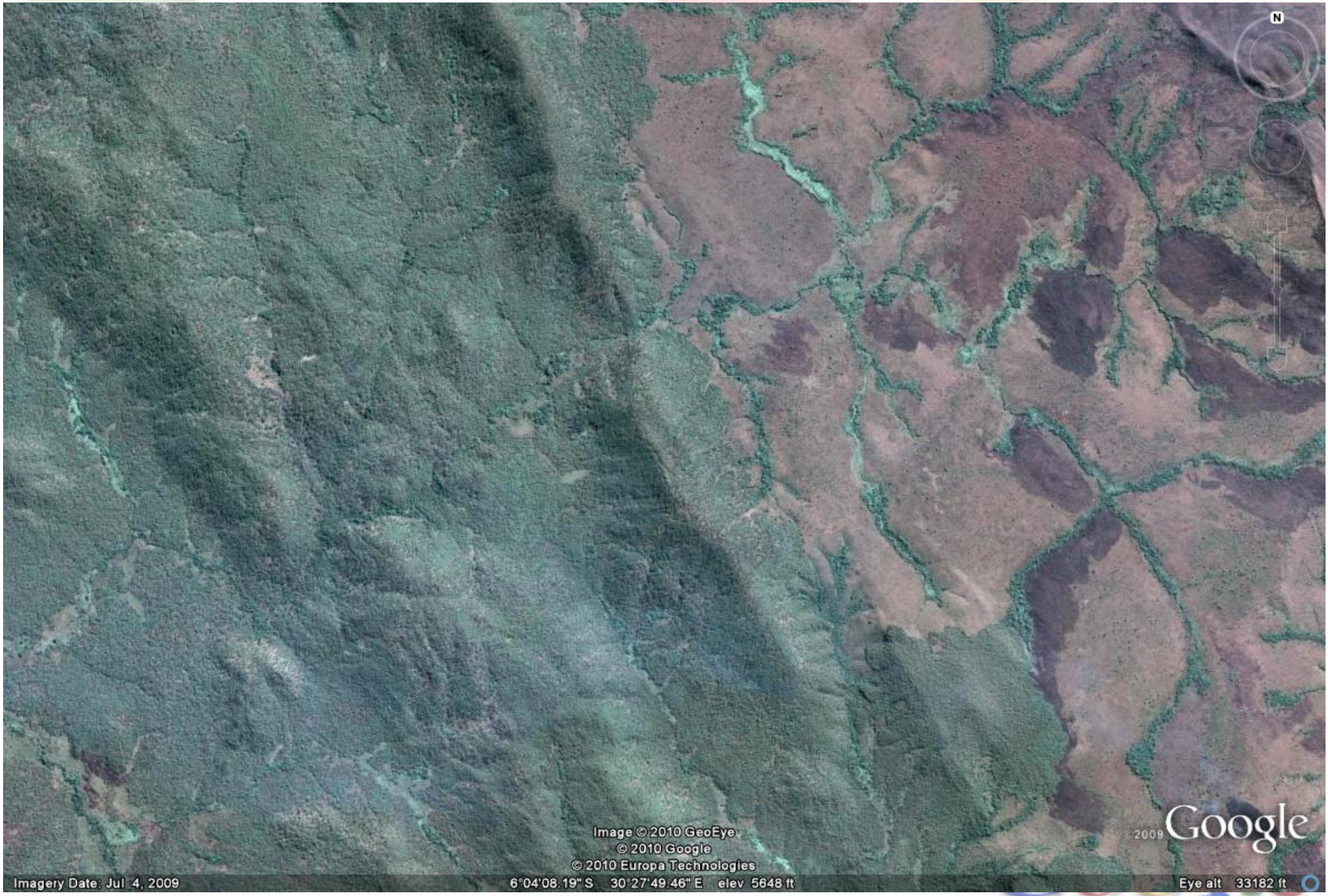
N
Image © 2010 GeoEye
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© 2009 Google
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Eye alt 33182 ft


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2009 Google
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Eye alt 7559 ft

Shinyanga, Tanzania: 50 cm GeoEye

Web-integrated mobile phones for field data collection

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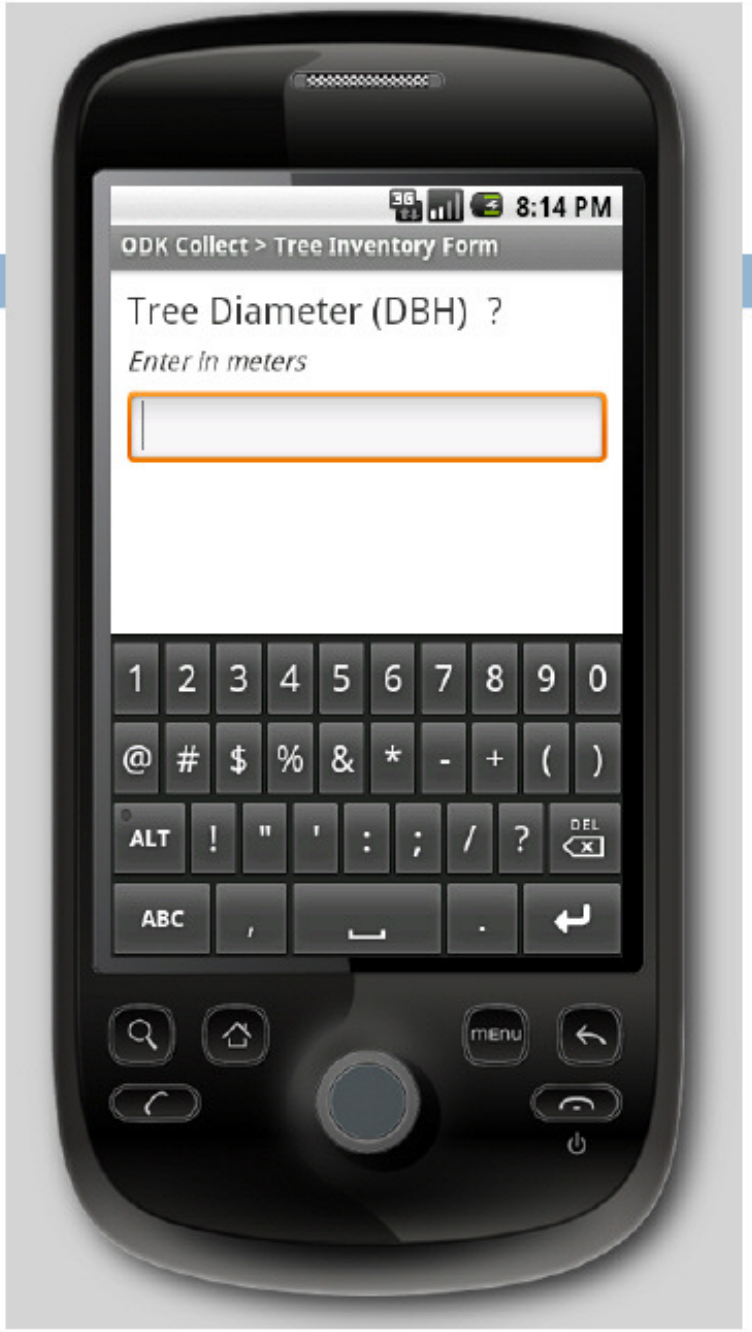
Open Data Kit

- Open-source data collection tool kit for community-based monitoring
- Enable resource-poor organizations to build scalable data collection/visualization systems
- Collaboration between Google & Univ. Washington
  - Forms + GPS + Picture + Barcode + Video + ...
- Initially targeted at public health applications
- Expanding to forestry and disaster response

http://code.google.com/p/open-data-kit/

Forms

- Users specify the questions and types of data to be collected by creating a Form (or survey)
- Xform web standard is used to describe the form
- Form definitions are the core of Open Data Kit




HIFADHI MISITU KWA
MAENDELEO YA JAMII YETU


N
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Image © 2010 DigitalGlobe
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Imagery Date: Jul 25, 2002
5°20'32.02" S 29°54'50.98" E elev 3180 ft
Eye alt 29513 ft


N
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Image © 2010 DigitalGlobe
©2009 Google
Imagery Date: Jul 25, 2002
5°20'09.35" S 29°54'37.30" E elev 3278 ft
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Tanu msekenyi

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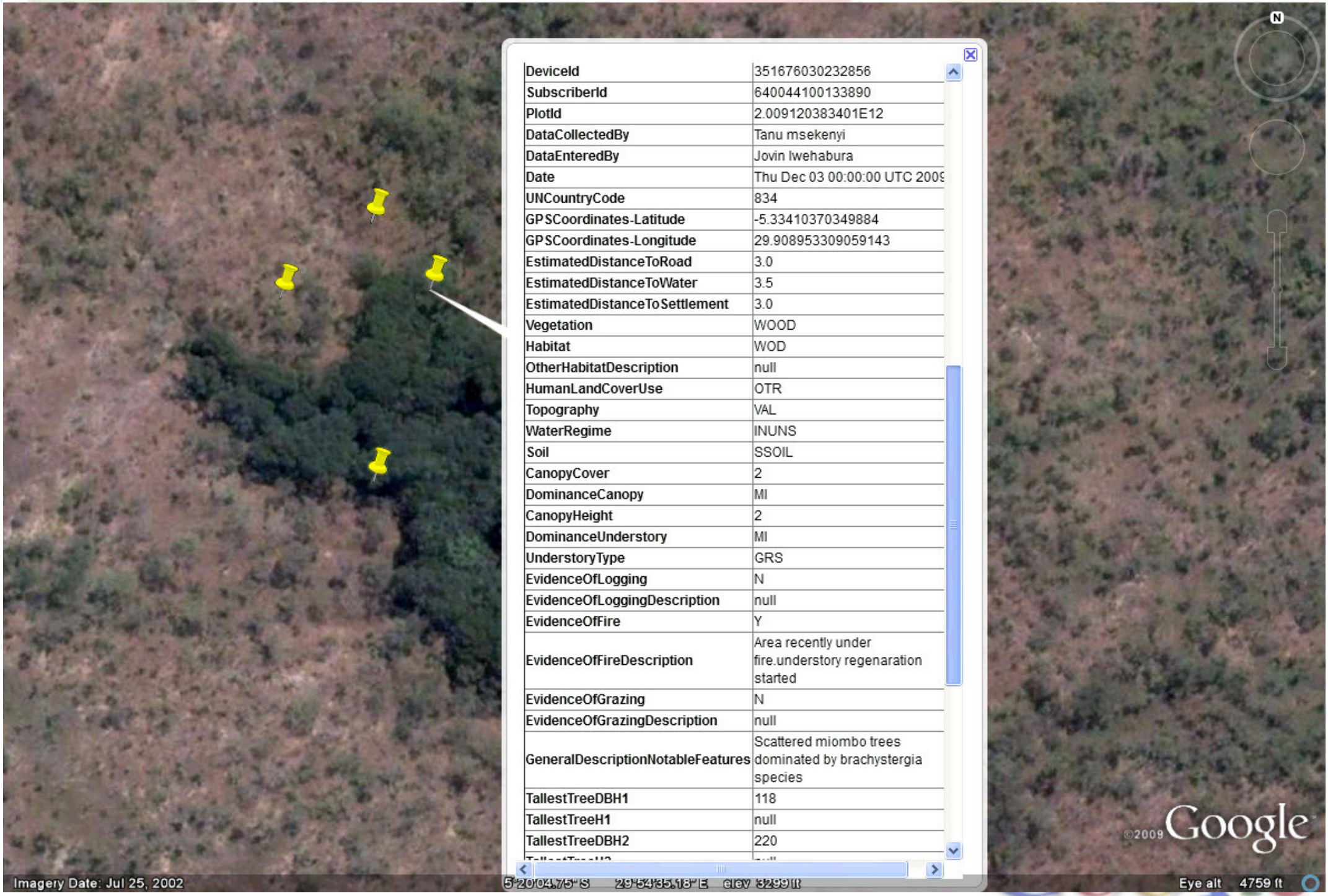
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GPSCoordinates-Longitude	29.908953309059143
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EstimatedDistanceToWater	3.5
EstimatedDistanceToSettlement	3.0
Vegetation	WOOD
Habitat	WOD
OtherHabitatDescription	null
HumanLandCoverUse	OTR
Topography	VAL
WaterRegime	INUNS
Soil	SSOIL
CanopyCover	2
DominanceCanopy	MI
CanopyHeight	2
DominanceUnderstory	MI
UnderstoryType	GRS
EvidenceOfLogging	N
EvidenceOfLoggingDescription	null
EvidenceOfFire	Y
EvidenceOfFireDescription	Area recently under fire.understory regenaration started
EvidenceOfGrazing	N
EvidenceOfGrazingDescription	null
GeneralDescriptionNotableFeatures	Scattered miombo trees dominated by brachystergia species
TallestTreeDBH1	118
TallestTreeH1	null
TallestTreeDBH2	220
©2009 Google
Imagery Date: Jul 25, 2002
5°20'04.75" S 29°54'35.18" E elev 3299 ft
Eye alt 4759 ft

Earth Engine: Data goals

- Continuous acquisition of free satellite data from space agencies and other institutions
- Pre-processing of the data to standards and quality that make them immediately useful for forest monitoring applications
- Serving the data for free download by users
- Hosting the data for high-performance analysis “in the cloud”

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Earth Engine: Algorithms

- Easy Access to published forest MRV algorithms
  - From Carnegie, IMAZON, SARVision, Woods Hole and more
  - For those regions and applications that they approve
- Access to Google's high-performance computational resources "in the cloud"
  - Countries can run their chosen algorithms on their own data
  - Keep their data and results private when then want
  - Share results when ready
- Earth Engine programming interface for easily creating new forest MRV applications
  - Make remote sensing much easier than it is today!

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Opportunities for Collaboration

- Tanzania national-scale REDD project
- NAFORMA Inventory
- Jane Goodall Institute Community-based Forest Carbon Project
- Bringing all three together in a collaborative platform that bridges community-based and national-scale forest monitoring

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Questions?

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