The Global Roads Open Access Data Set (gROADS): Pilot Efforts to Develop Improved Roads Data

Global Roads Open Access Data Set (gROADS), a project of the CODATA Global Roads Data Development Working Group

Alex de Sherbinin, Greg Yetman, and Robert S. Chen, CIESIN, Columbia University
Matthew Steil, World Resources Institute

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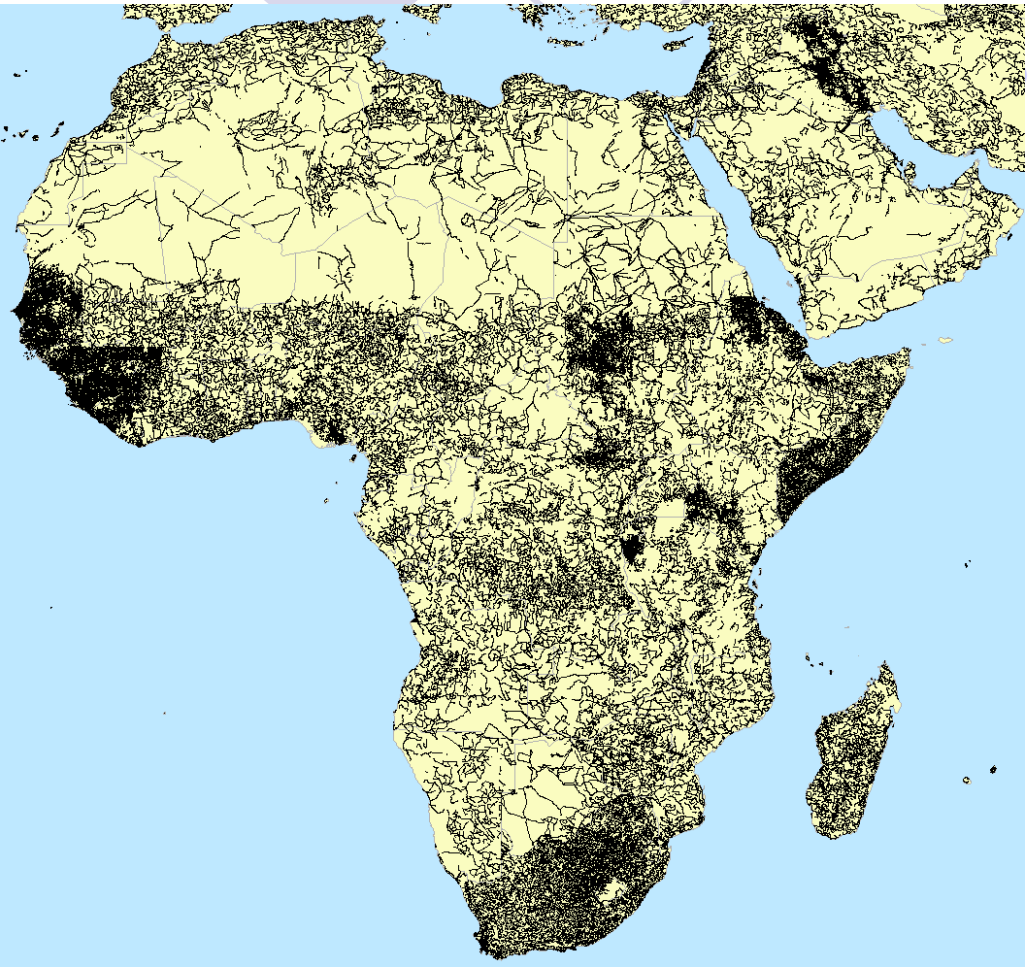
Outline

- Goals of Global Roads Open Access Data Set (gROADS) goal and releases
- Methods to develop roads data
  - Compiling best available public domain data, merging data where possible
  - Pilot testing semi-automated road extraction using ASTER imagery (Ethiopia)
  - Pilot testing PDA roads data development (Ethiopia)
  - Passive roads data collection using GPS (Africa)
  - Digitizing from moderate resolution imagery (Central Africa)
  - Crowd sourcing (global)
  - Other methods

gROADS Goal



To develop a global roads open access data set (gROADS) that is:

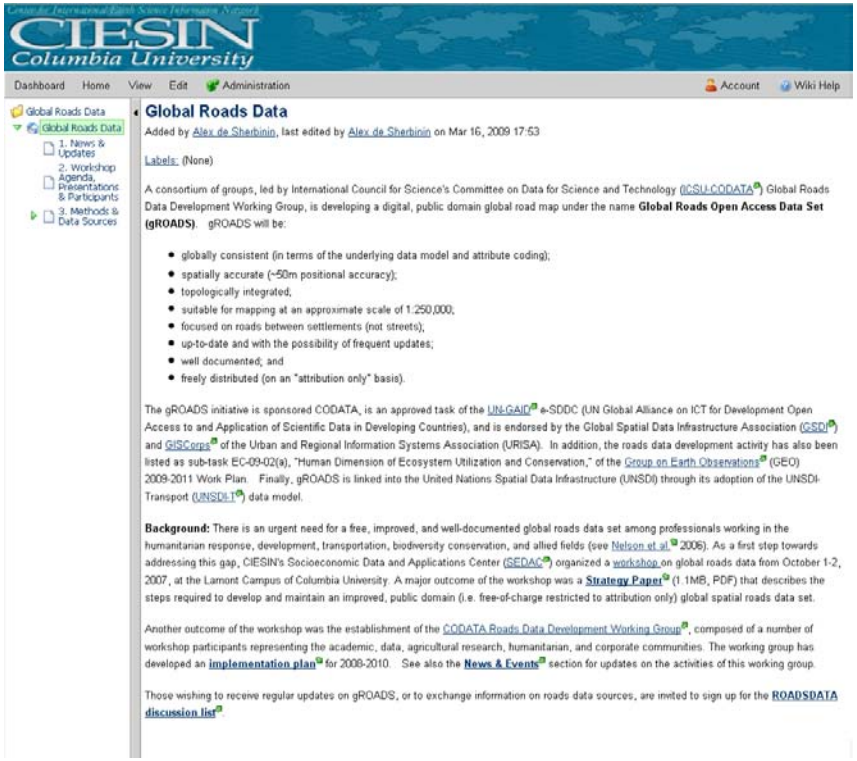
1. globally consistent model (UNSDI-T v.2)
2. spatially accurate (~50m positional accuracy)
3. topologically integrated
4. focused on roads between settlements (not streets)
5. up-to-date and with the possibility of frequent updates
6. well documented
7. freely distributed (on attribution only basis)

CODATA working group members

Name	Organization & Address	Email & Telephone Number
Olivier Cottray (co-chair)	IMMAP	ocottray@immap.org
Alex de Sherbinin (co-chair)	CIESIN, Columbia University	adesherbinin@ciesin.columbia.edu +1-845-365-8936
Nicolas Chavent	GIS/SDI Consultant	nicolas.chavent@gmail.com + 39 06 77 59 19 47
John Dann	Georigin, Ltd.	jdann@georigin.com +27 (0)12-345-6701
Johann Groenewald	Tracks4Africa	johann@tracks4africa.co.za +27(0)21-883-9212
Timothy Haithcoat	Geographic Resources Center University of Missouri	haithcoatt@missouri.edu +1-573-882-2324
Glenn Hyman	CGIAR-International Center for Tropical Agriculture (CIAT)	g.hyman@cgiar.org +57-2-4450000 ext 3731
Koki Iwao	AIST Japan, seconded to the GEOSS Secretariat in Geneva	iwao.koki@aist.go.jp
Mikel Maron	Open Streetmap Foundation	mikel@osmfoundation.org
Andrew Nelson	Independent consultant	dr.andy.nelson@gmail.com +39-0332-786744
Harlan Onsrud	Dept of Spatial Information Science University of Maine	onsrud@spatial.maine.edu +1-207-581-2175
Karen Payne	Information Technology Outreach Services (ITOS), University of Georgia	kpayne@itos.uga.edu +1-706-542-6535
Jinnian Wang	Institute of Remote Sensing Applications (IRSA), Chinese Academy of Sciences(CAS)	jwang@irsa.ac.cn + 86 -10-64859301

gROADS releases

Visit www.groads.org



gROADS Catalog v.1

1. Catalog of 360+ national and regional data sets

gROADS v.1 roads data set release in 2010 with data from:

1. University of Georgia's Information Technology Outreach Services (ITOS), compiled for the UN's Geographic Information Support Team (GIST)
2. Netherland's PBL Global Roads Inventory Project (GRIP)
3. Open Street Map
4. CIESIN data development activities

METHODS TO DEVELOP ROADS DATA

Assembling Best Available Data

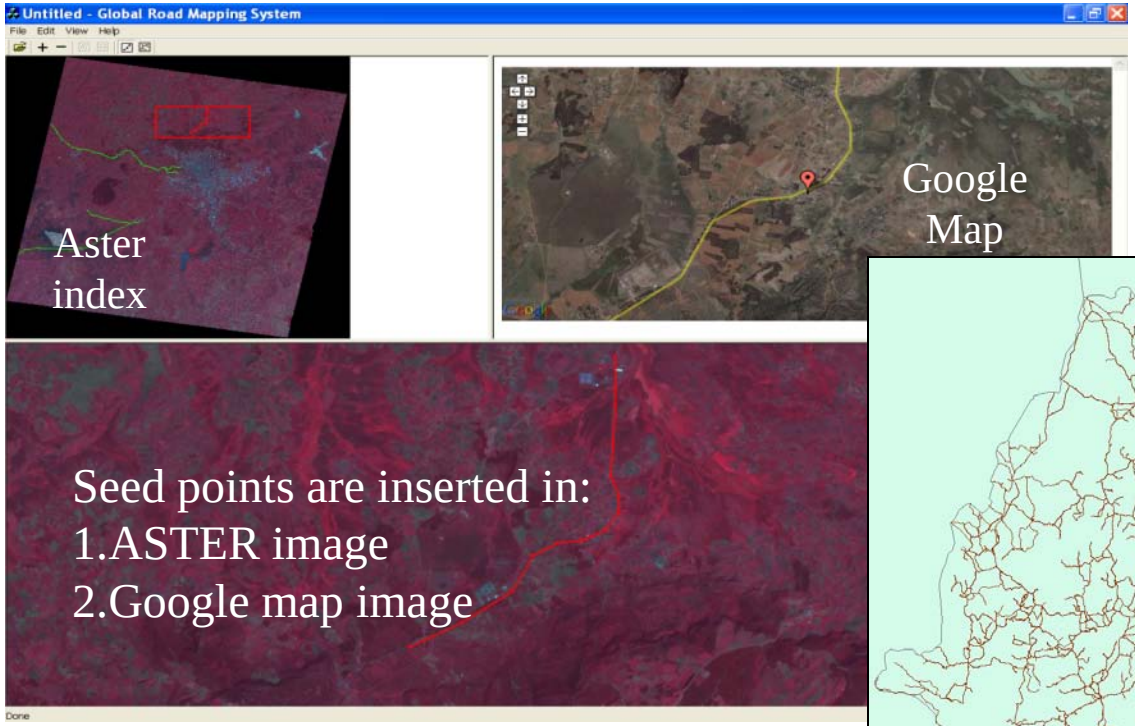
- Starting with University of Georgia/ITOS GIST data: A combination of VMAP1, DCW and national sources
- CIESIN is:
  - editing topology
  - contributing new data by cleaning GPS derived data (e.g. Kenya), Landsat derived data (e.g. Nigeria), and Global Map (ISCGM) data
  - combining data from multiple sources (e.g., DCW and Africover for Tanzania)
  - conducting pilot projects that will provide new data for Ethiopia

Digitizing from ASTER imagery (Ethiopia)

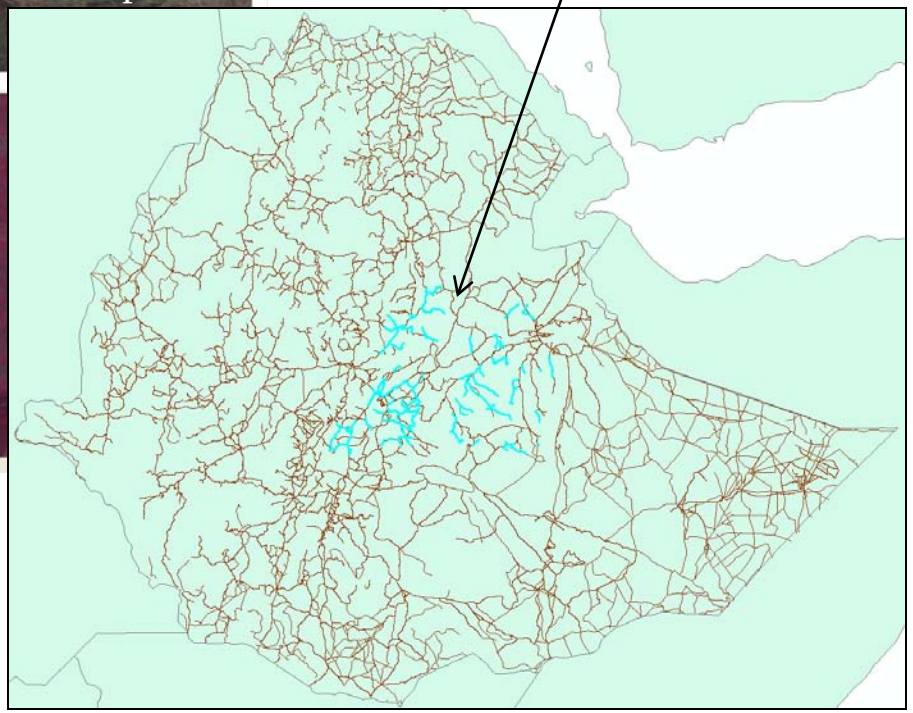
Funded by NASA-SERVIR

- Pilot tested a semi-automated road extraction tool (GRMT) developed by the Center for Spatial Information Science (CSIS) at University of Tokyo
- Used ASTER imagery (15m resolution, 60x60km footprint)
- The alpha version of the software was comparable to manual digitizing
  - line following algorithm underperforms due to similar spectral signature for roads and surrounding land covers
- Average time per scene ~8hrs (depending on rural vs. urban and number of roads)

Global Road Mapping Tool details



ASTER derived roads digitized in aqua-blue



"Snake Algorithm" then uses the seed points and the image spectral signature to place the line.

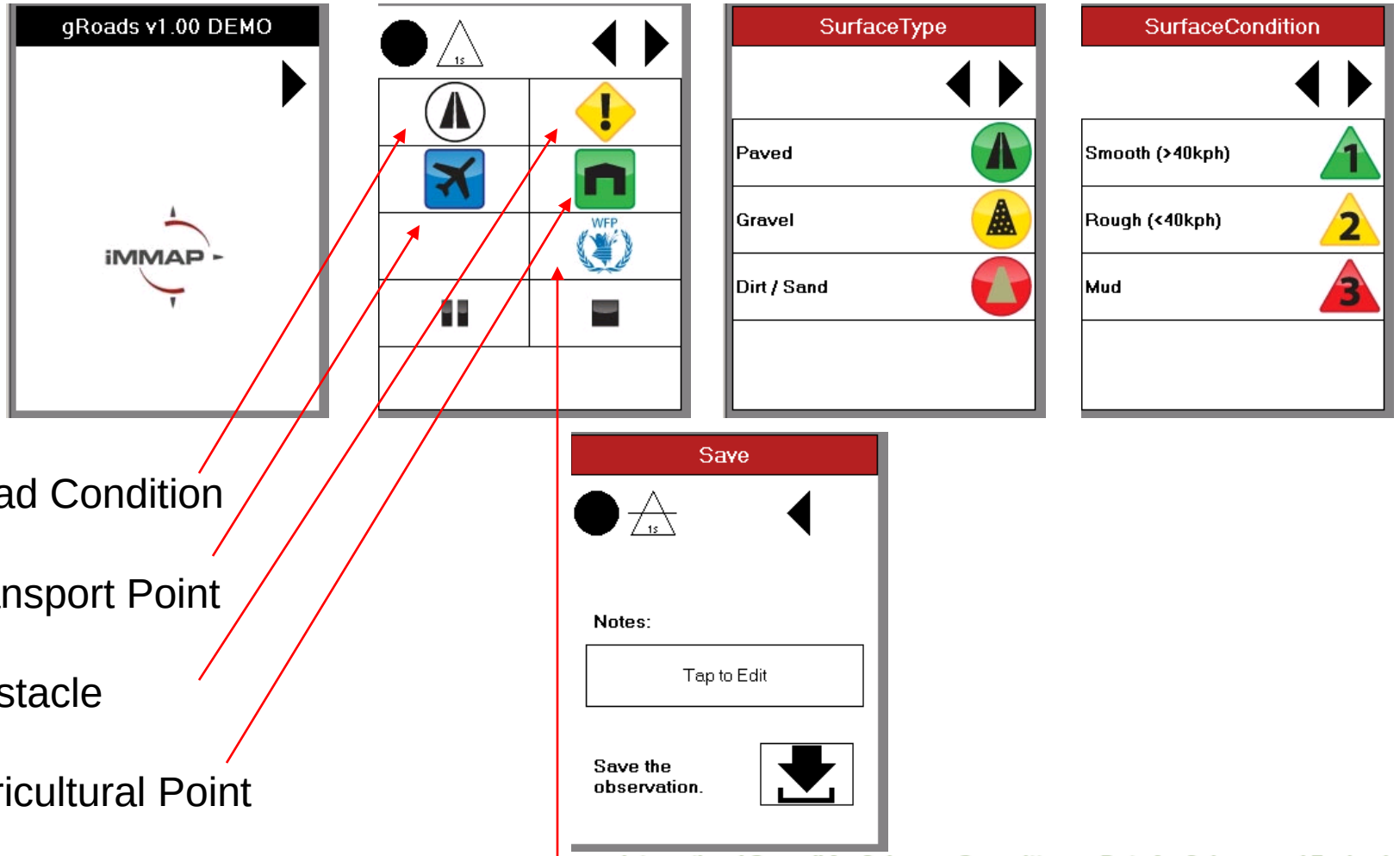
Similar to RoadTracker Commercial software
See: www.**youtube**.com/watch?v=azq0ZIIr6hI

Using GPS enabled PDAs (Ethiopia)

Funded by Gates Foundation/AGCommons

- Output 1: A UNSDI-T compliant roads data set from GPS tracks, along with agricultural features of interest
- Output 2: Software for a PDA tool that includes all fields of the UNSDI-T data model (based on *Cybertracker*) ⟶
- Approach:
  - Incidental data collection: Engage third parties (WFP field teams) who are conducting missions to hard-to-reach places to collect data
  - Active data collection: Pay truck drivers or higher cars to collect data for regions that are missing (not done)
  - Incorporate data from third party sources where possible
- IMMAP hired a local representative to train WFP staff and manage data collection
- RCMRD collaborated on field campaigns
- CIESIN completed data cleaning and compilation

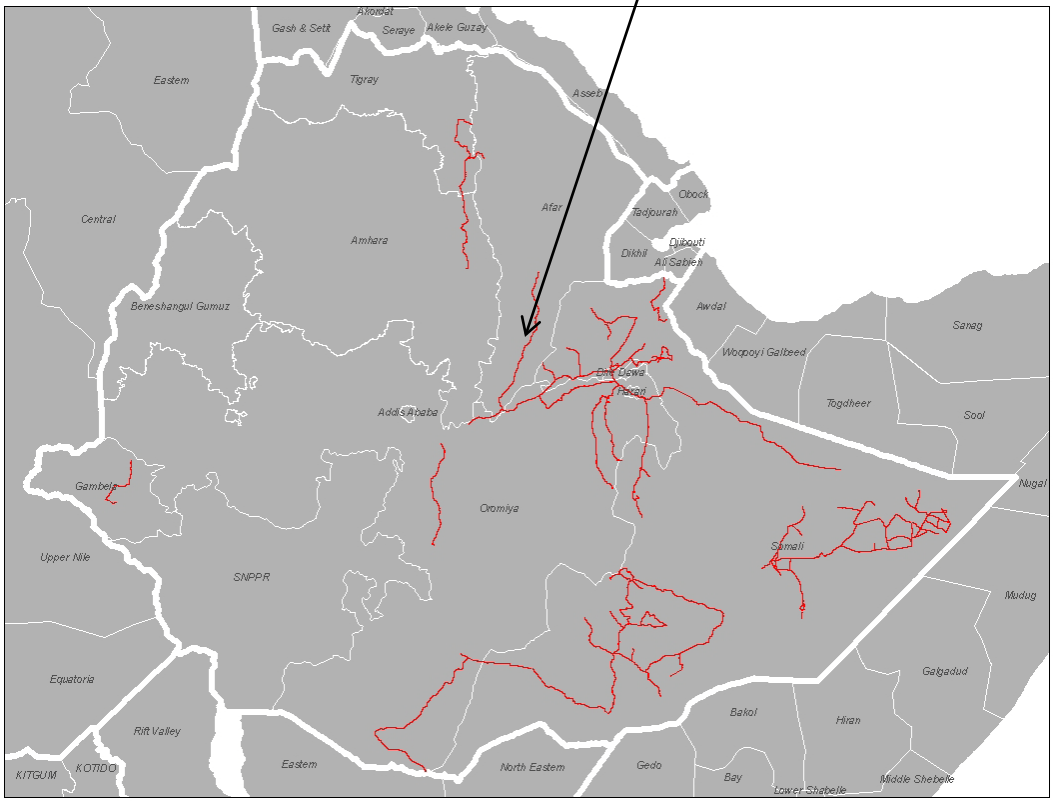
Customized Cybertracker Tool



Challenges ecountered

- Resistance on the part of WFP field teams to additional duties
- Redundancy in routes covered
  - no incentive to take longer and less secure routes in order to cover additional roads
- Coding of roads traveled more than once was sometimes inconsistent
- Assertive collection using truckers not possible because of illiteracy

PDA derived roads in red

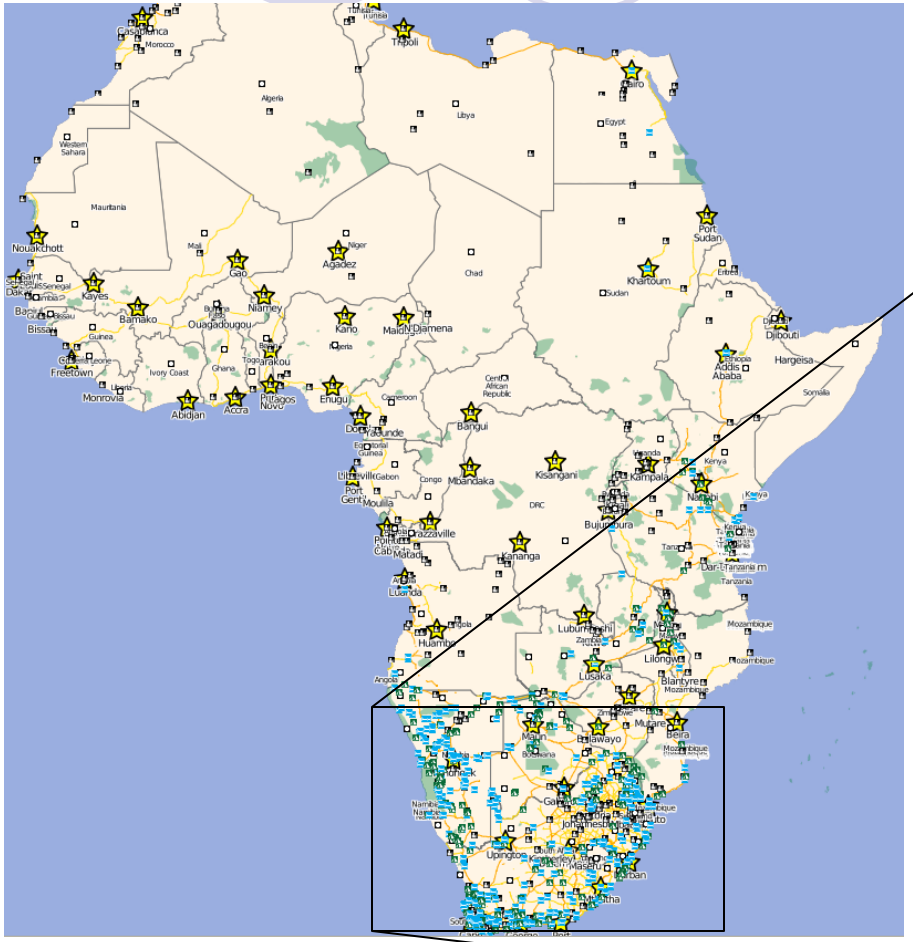


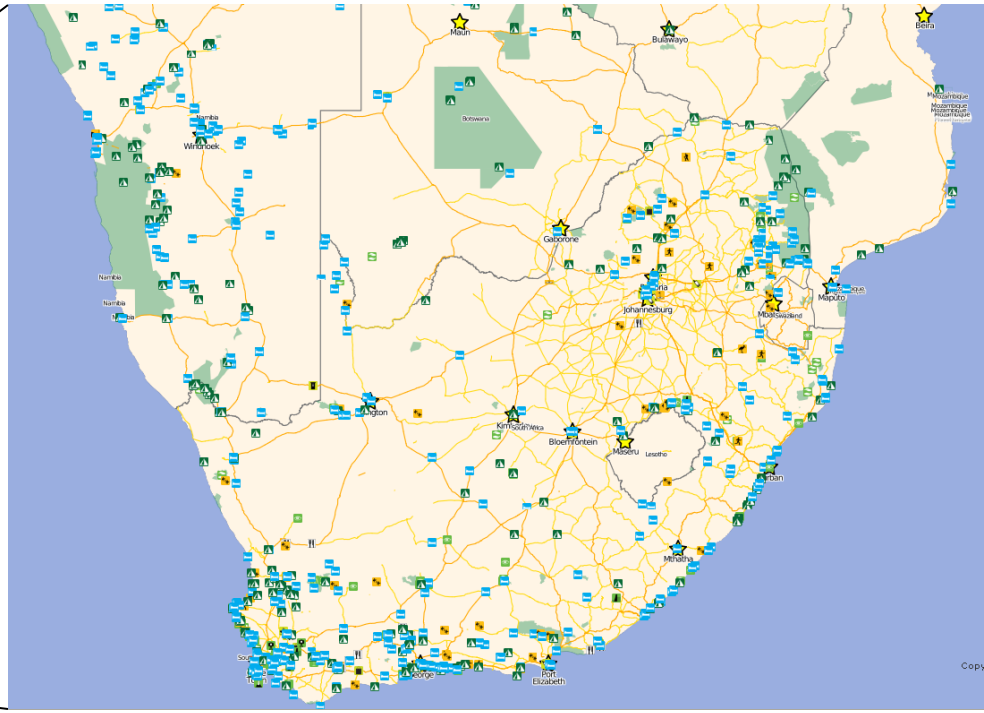
Passive Collection with GPS

- Approach pioneered by Tracks4Africa
- Method: Amass large quantities of GPS tracks from recreational travelers and assimilate these tracks to:
  - Create road centerlines by averaging tracks
  - Infer road quality from average travel speeds
- Advantages: low cost, spatially accurate data, with features of interest to recreational travelers
- Disadvantages: Additional attribute information (road name, road surface type, etc.) not generally collected

Tracks4Africa

In the year 2005 Tracks4Africa started to sell T4A GPS Maps to people outside the Tracks4Africa community of travelers who contributes the data. The company found a unique balance between crowd sourced data, community driven development of our products and a sustainable commercial model.





WRI road mapping in Central Africa: Methods overview

Digitization from satellite imagery

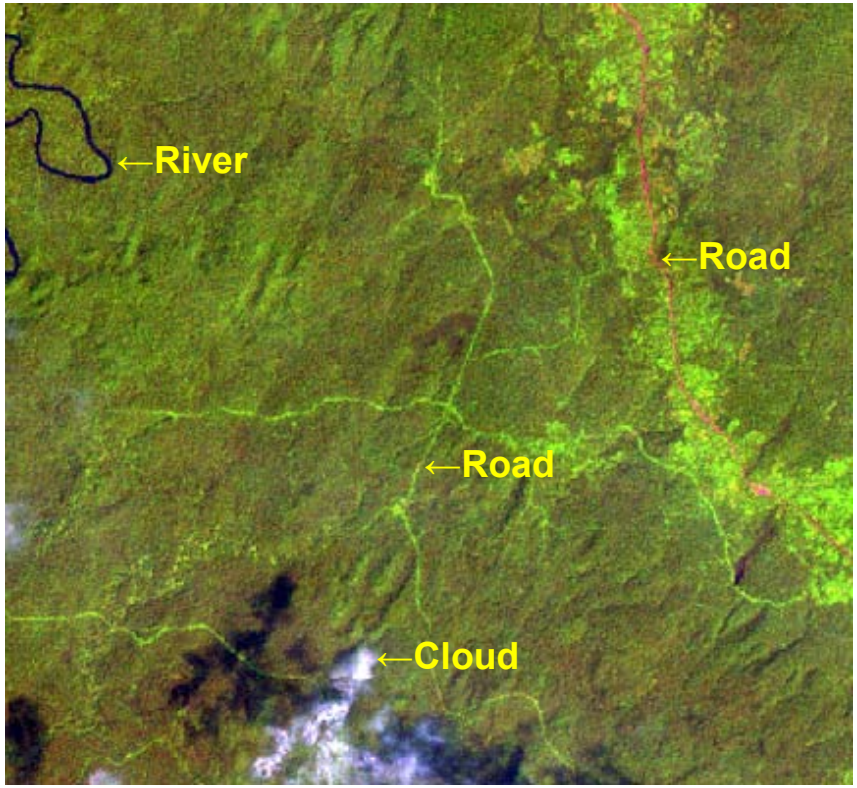
- Image types: Landsat ETM+, ASTER, ALOS-AVNIR, DMCii, SPOT 5
- Process imagery to enhance road distinction (e.g. Landsat 5-4-3 combination)
- Roads digitized manually using Erdas Imagine or ArcGIS software at 1:30,000 with 30m "snapping" tolerance
- Begin with oldest image of an area, in order to track progression
- Attributes applied to road segments from existing datsets using spatial join or according to standardized classification developed by WRI and collaborators
- Field verification of a select percentage of roads using GPS

  - Advantages: cover large areas relatively cheaply (if images area available) and using standard methods; can get acceptable accuracy considering scale
  - Disadvantages: many forested areas have heavy cloud cover and thus visible imagery difficult to acquire; misclassfication of road attributes if not field verified

Some results:

- For Cameroon – 40,044 km mapped at an average accuracy of ±42m compared to GPS verification
- At first pass in 2003, nearly 10% of roads were considered to be potentially "illegal" – another pass in 2008 found suspect road building to be significantly reduced (remote monitoring and enforcement had a measurable effect?)
- Have produced roads datasets for Cameroon, CAR, Congo, DRC and Gabon

Landsat Imagery (5-4-3 band combination)



←10km→

Crowd sourcing

Open Street Map

- 5,000+ active volunteers
- Roads manually digitized from:
  - GPS tracks collected by volunteers
  - Base imagery from Yahoo
- Mobilized quick response for Haiti in Jan 2010

Google Map Maker

- Unknown number of active volunteers
- Roads manually digitized from Google Earth/Maps base imagery

Crowd sourcing challenges

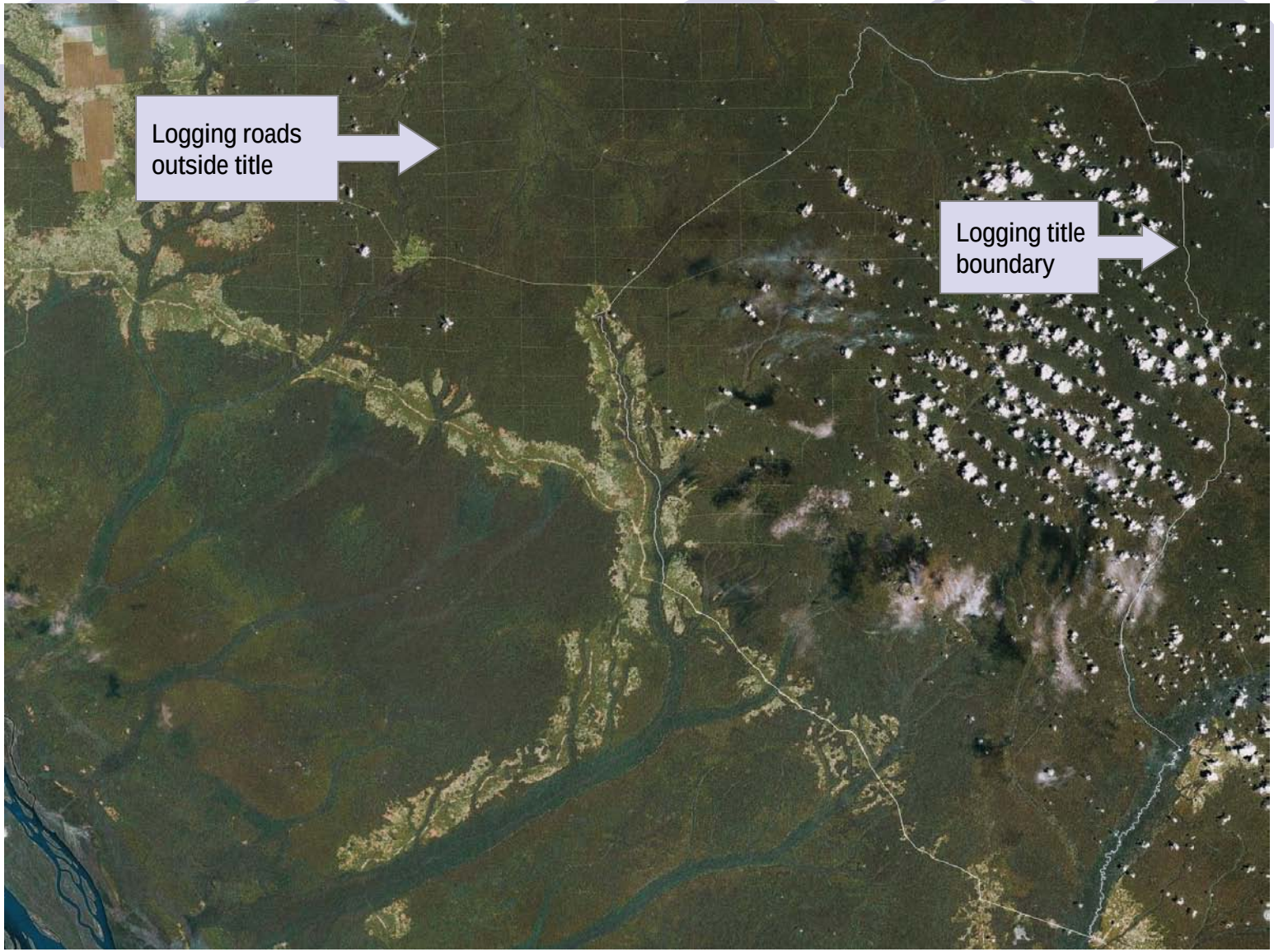
- Quality control
  - OSM has few controls, relies on community norms
    - In some cases, bulk additions have been “merged” with individual contributions without any reconciliation
  - Map Maker has volunteer moderators who review edits and provide feedback to other volunteers
    - One's "trust" within the program determines “weight” of moderation
- Licensing
  - OSM adopted the CC Share Alike license and is migrating to Open DB License (a viral license)
    - Extensive documentation on permitted and unpermitted uses (http://wiki.openstreetmap.org/wiki/OpenStreetMap_License)
  - Map Maker is for non-commercial use only
- Tends to favor more accessible/urbanized regions where high res imagery exist

Other approaches

- Data fusion by GeoOrigin (now TeleAtlas), using commercial GPS, Landsat, and Soviet era topo sheets
- Monitoring logging roads using RS imagery (Woods Hole)
  - Similar to WRI's approach
- Various image extraction methods from remote sensing imagery
  - Tend to work best in urban areas

Want to learn more or help out?

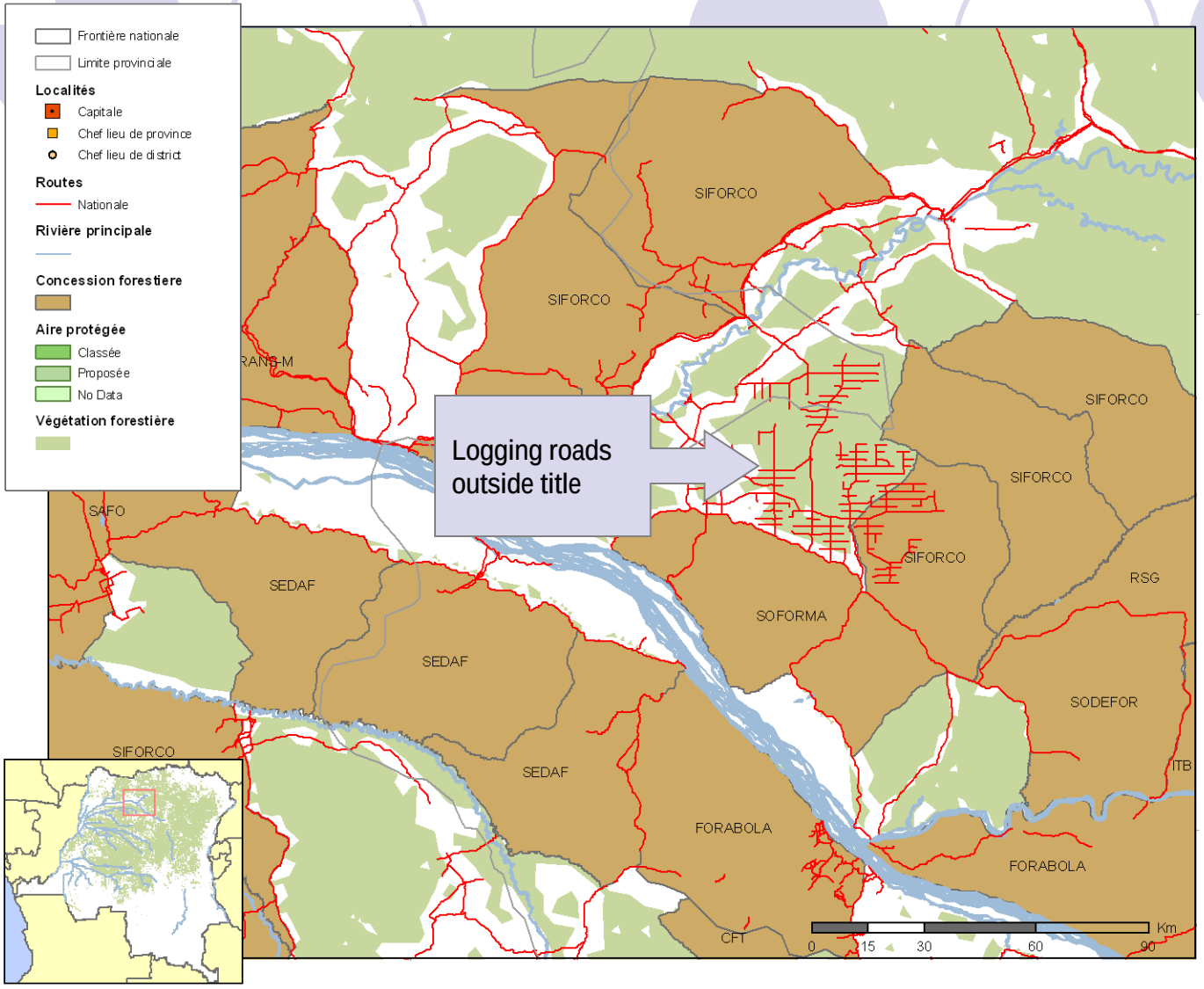
- Visit www.groads.org
- Sign up for the ROADSDATA discussion list to exchange information on data sets
- Send us your data!
  - Contact Alex de Sherbinin at amd155@columbia.edu


Logging roads outside title
Logging title boundary

Ministère de l'Environnement
Conservation de la Nature
et du Tourisme

Atlas Forestier Interactif de la République démocratique du Congo
Version de démonstration - Décembre 2007

WORLD RESOURCES INSTITUTE



International Council for Science : Committee on Data for Science and Technology

Applied sensor types

Satellite	Resolution	Swath width
Landsat 7 ETM+	30m / 15m	185 km
DMC ii	32m	Variable
ASTER	15m	60 km
ALOS	10m	70 km
SPOT 5	10m / 5m	60 km