ReCover

for REDD and sustainable forest management

Monitoring forest cover in Chiapas, Mexico to support REDD – Results of the ReCover project

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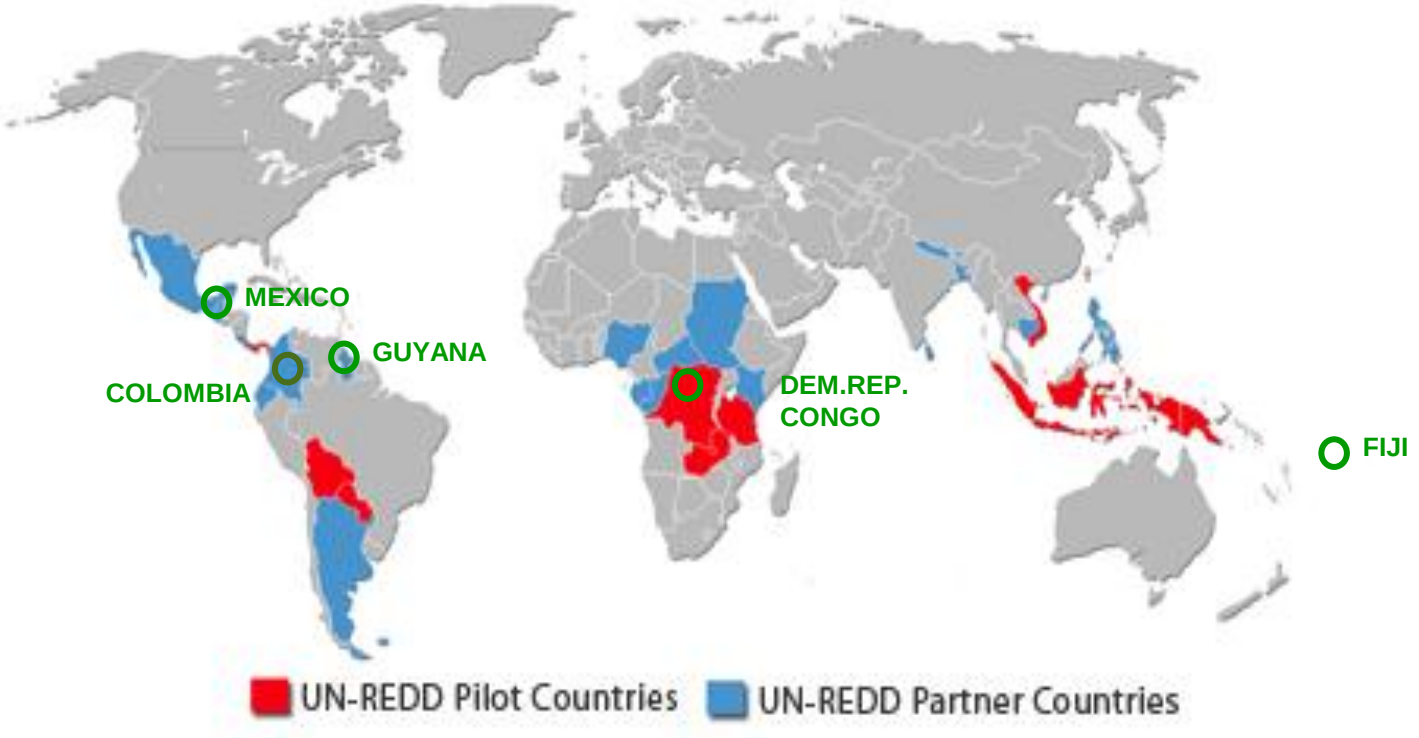
ReCover

Full title:

Science based remote sensing services to support REDD and sustainable forest management in the ***tropical region***

ReCover study sites, users and partners



Partners:

- VTT Technical Research Centre of Finland – Coordinator, Finland
- Albert-Ludwigs-Universität Freiburg ALU-FR FeLis, Germany
- Arbonaut, Finland
- Colegio de Postgraduados, Colpos, Mexico
- El Colegio de de la Frontera Sur, Ecosur, Mexico
- GMV, Spain
- Norut - Northern Research Institute Tromsø AS, Norway
- Wageningen Universiteit (WU), The Netherlands
- IDEAM (Instituto de Hidrologia, Meteorologia y Estudios Ambientales), Colombia

Users

- CONAFOR, Mexico
- SEMANH, Mexico
- CONABIO, Mexico
- CONANP-RFSIPS, Mexico
- OSFAC, Congo
- Guyana Forestry Commission, Guyana
- Department of Forestry in Fiji, Fiji
- IDEAM/Ministry of Environment, Colombia

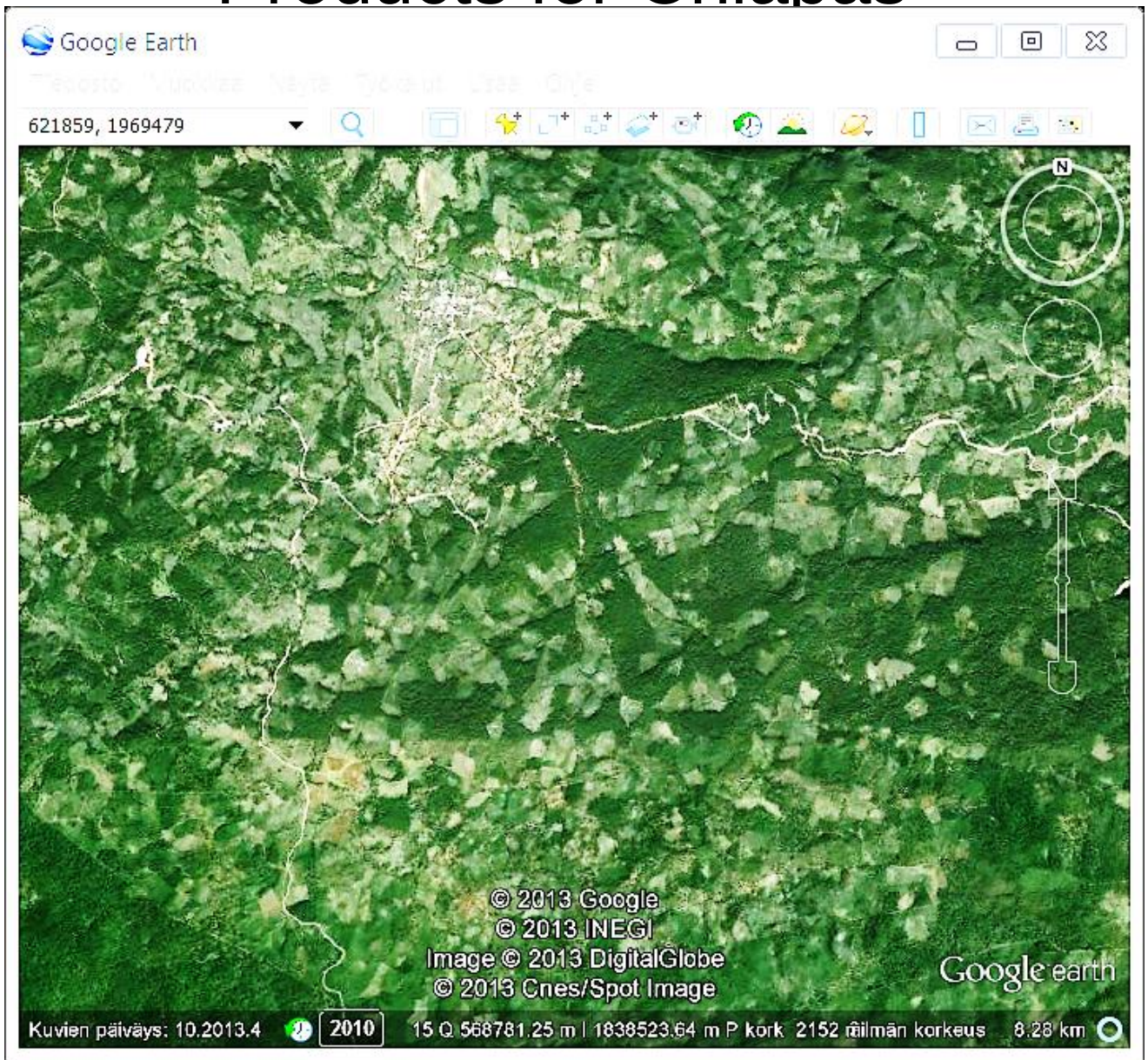
Overview of the ReCover products

- ReCover services produce wall-to-wall maps and statistical data according to the user needs (SLAs)

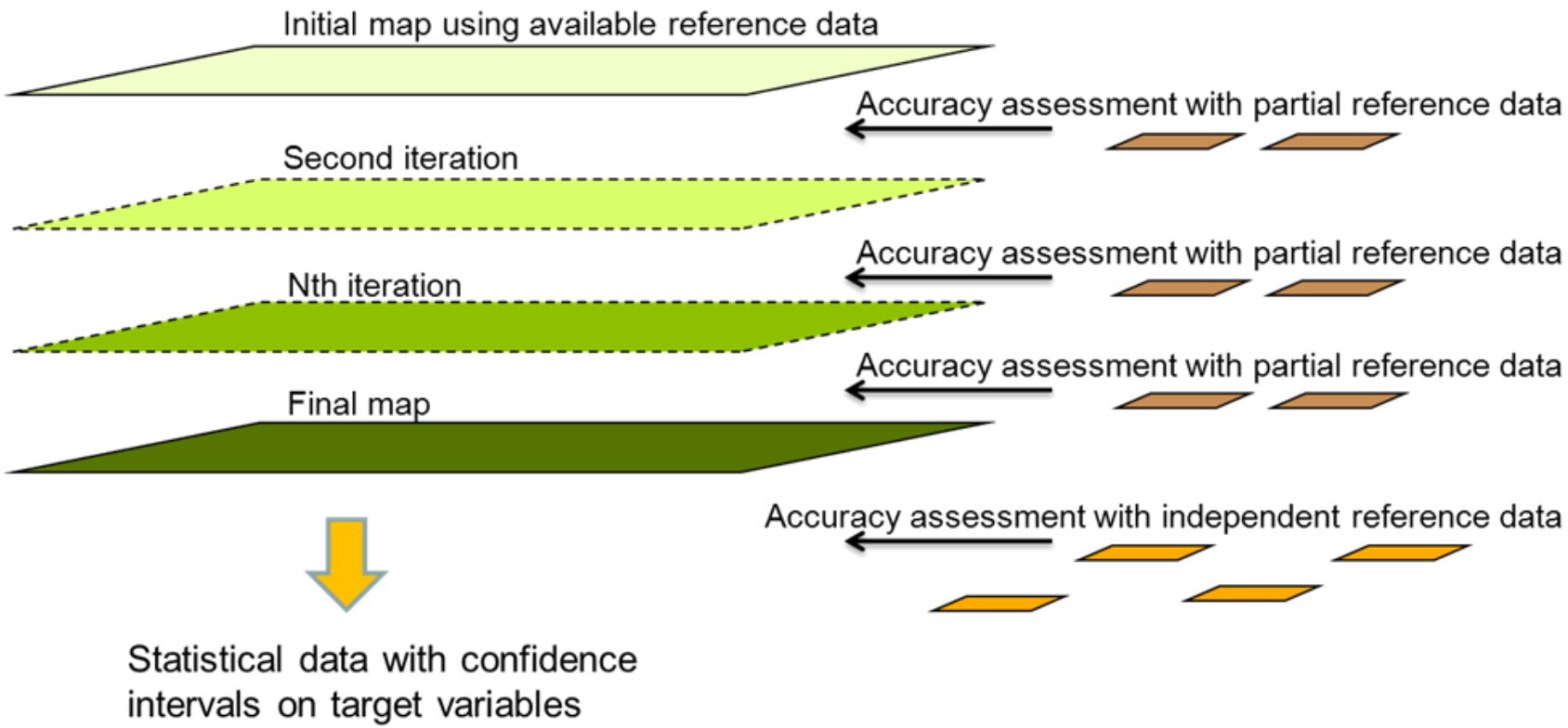
Land cover	• Six land use categories that are consistent with the IPCC Guidelines (IPCC, 2003): Forest land, cropland, grassland, wetlands, settlements and other land
Land cover change	• Same IPCC compliant classes as land cover products
Biomass	• Estimated as continuous variable • 'Direct remote sensing approach'
Forest degradation	• Measured by estimating carbon i.e. biomass loss using multitemporal data • If appropriate multitemporal data are not available forest disturbance grade is estimated

General concept

Products for Chiapas



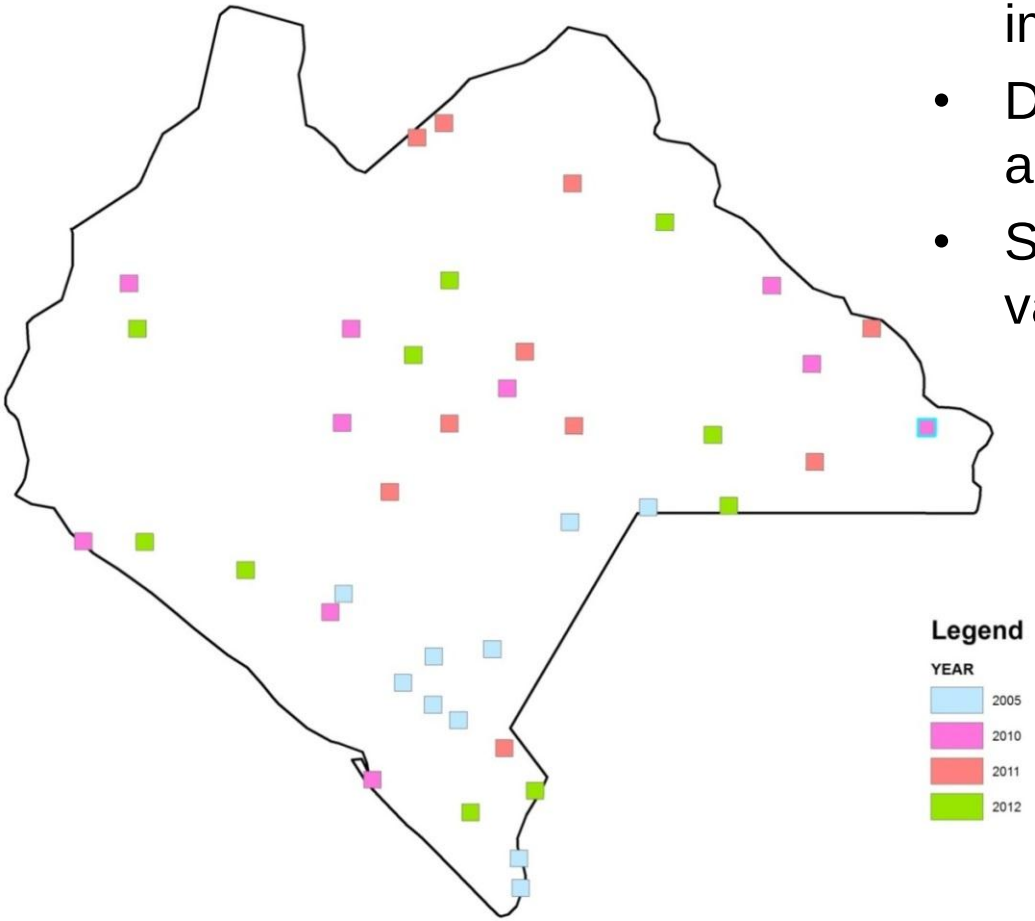
Iterative mapping process



Two-stage sampling

First stage:

- sample of VHR images

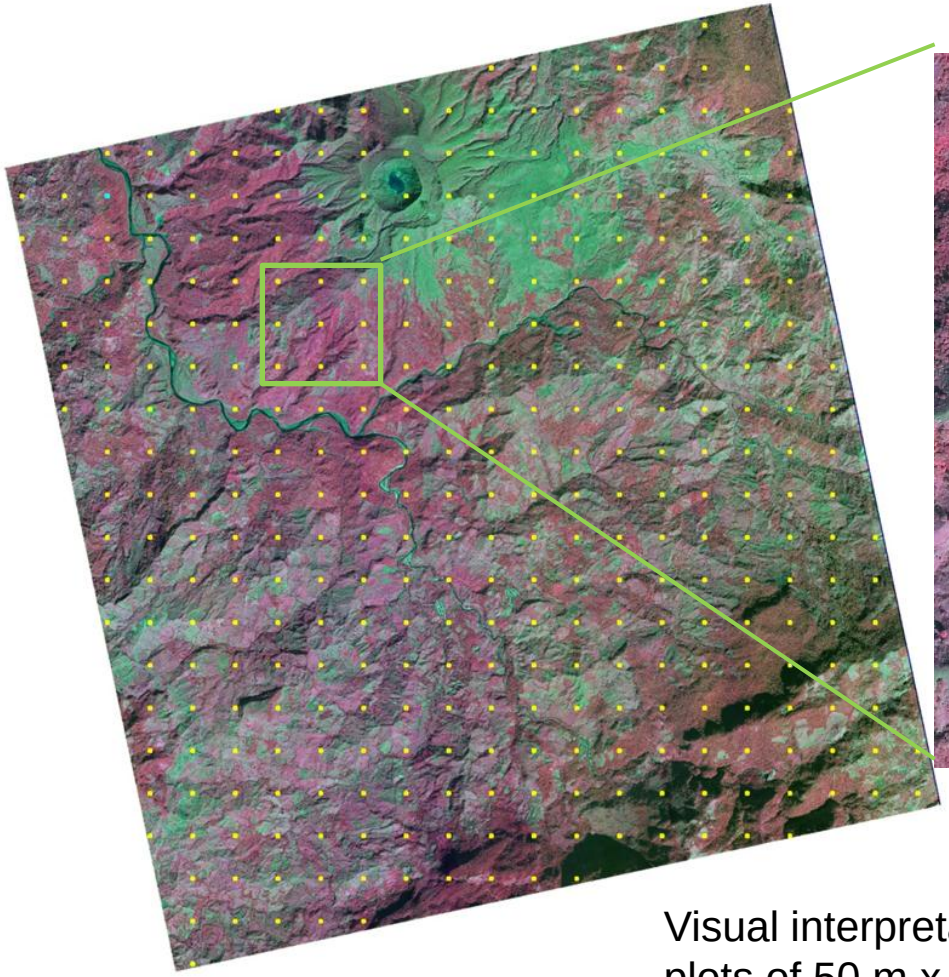


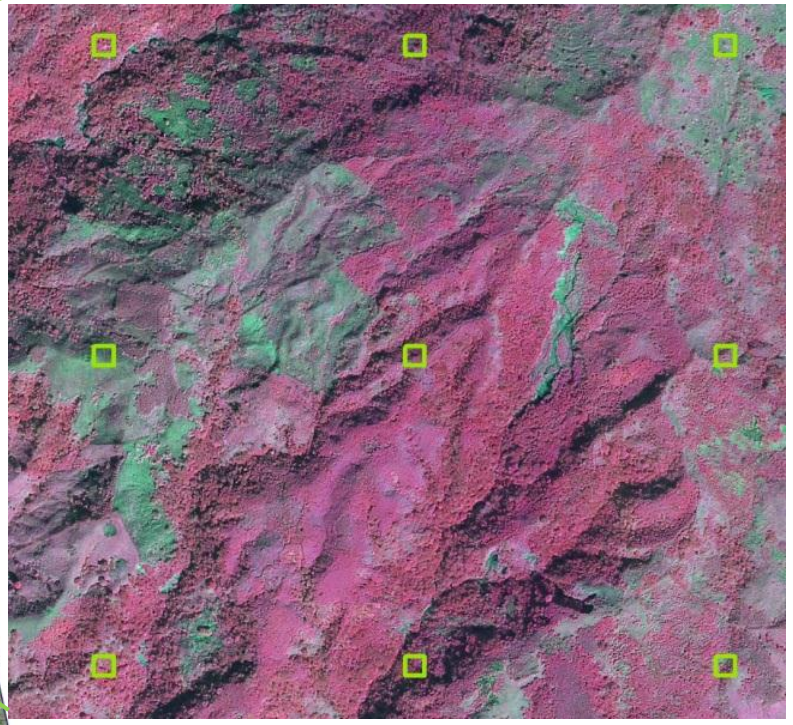
Second stage:

- Sample of plots within the VHR images
- Data for training and accuracy assessment
- Statistical information on variables of interest

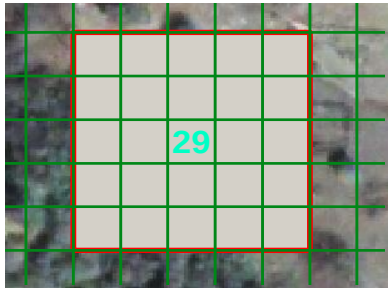
Häme et al. 2013. IEEE JSTARS

Sample plots of VHR data





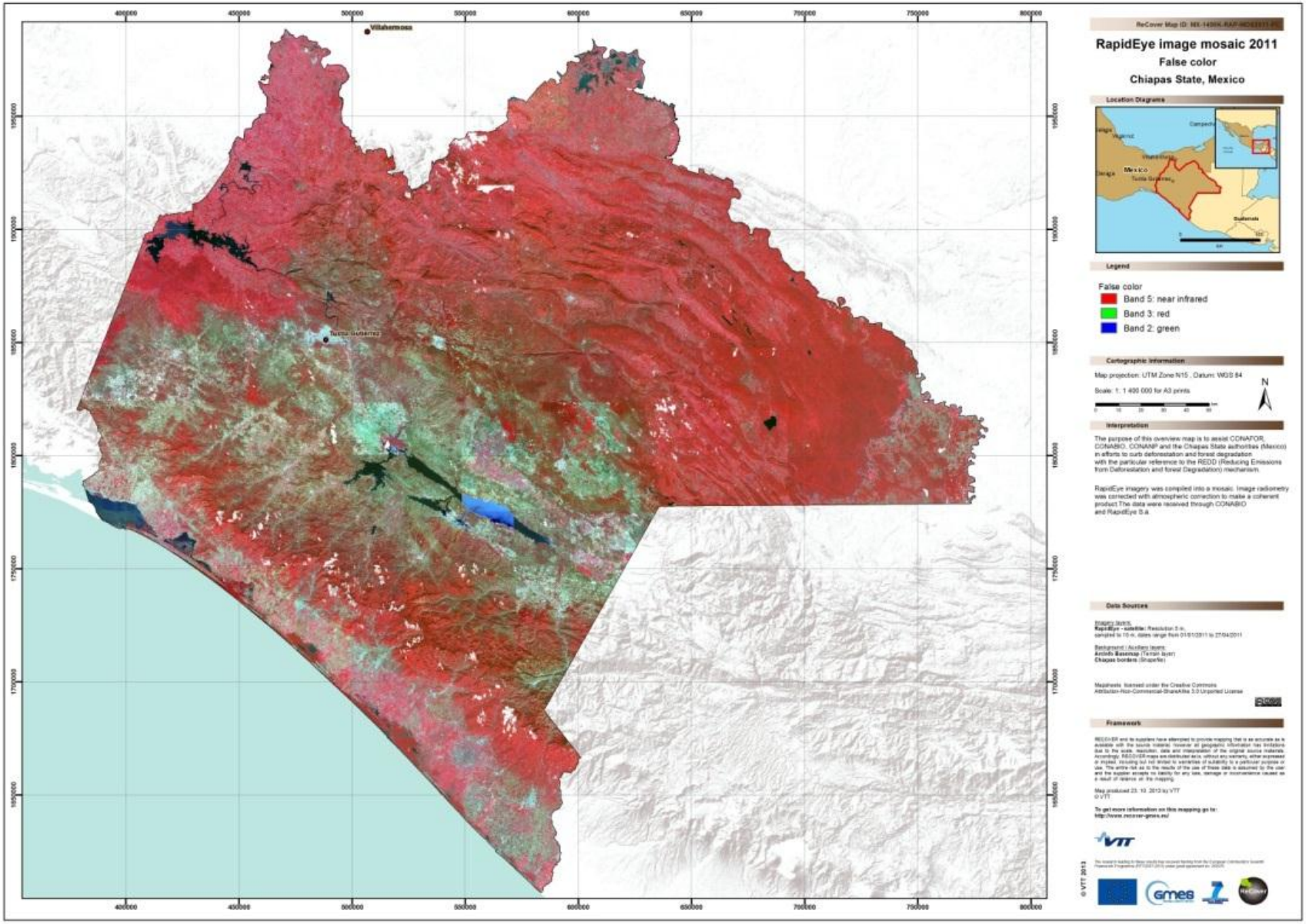
Visual interpretation of plots of 50 m x 50 m



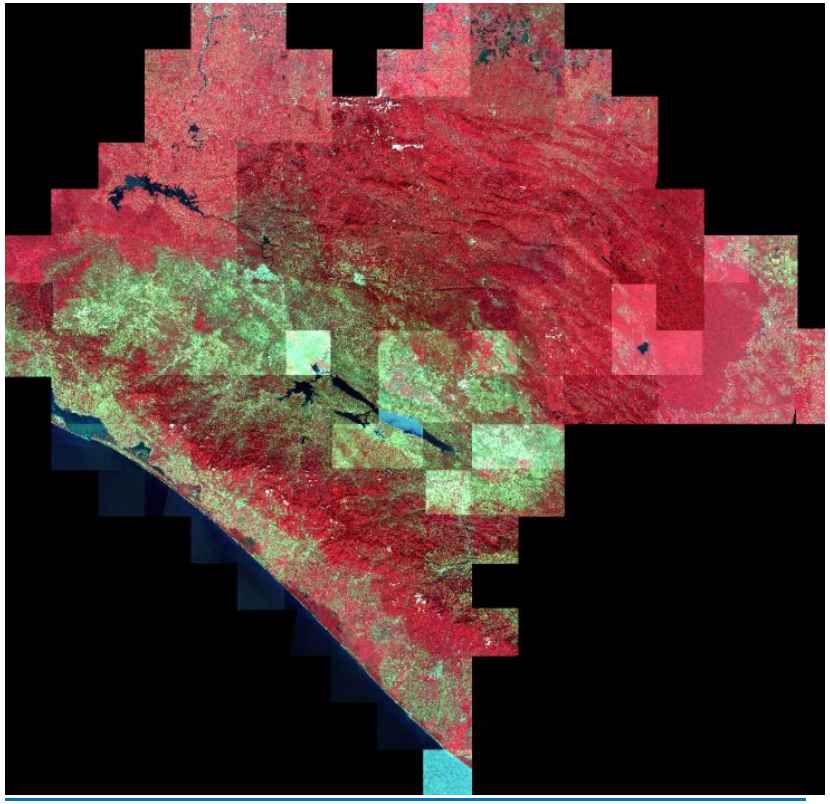
Overview of the map products

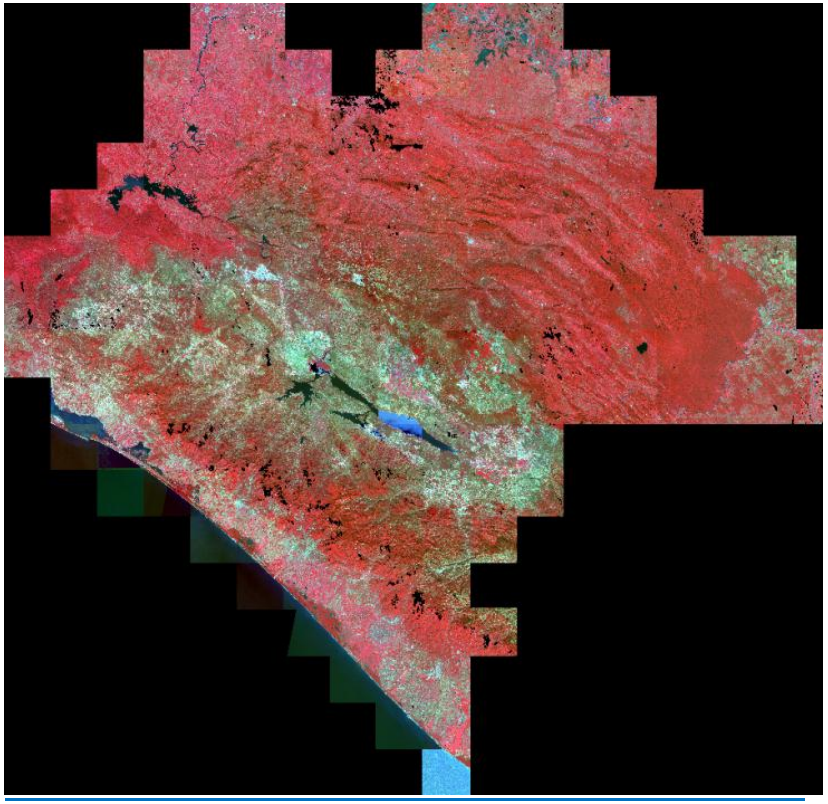
	1990 Landsat TM	1995 Landsat TM	2000 Landsat TM/ETM	2005 Landsat ETM	2008 ALOS PALSAR	2010 Landsat TM/ETM	2011 RapidEye	2012 RapidEye
Pixel size	25 m	25 m	25 m	25 m	25 m	25 m	10 m	10 m
Image mosaic	✓	✓	✓	✓	✓	✓	✓	✓
Land cover						✓	✓	✓
Forest- non-forest	✓	✓	✓	✓	✓	✓	✓	✓
Degradation	✓	✓	✓	✓		✓		
Biomass					✓			
Structural products	✓					✓		

Image mosaic maps

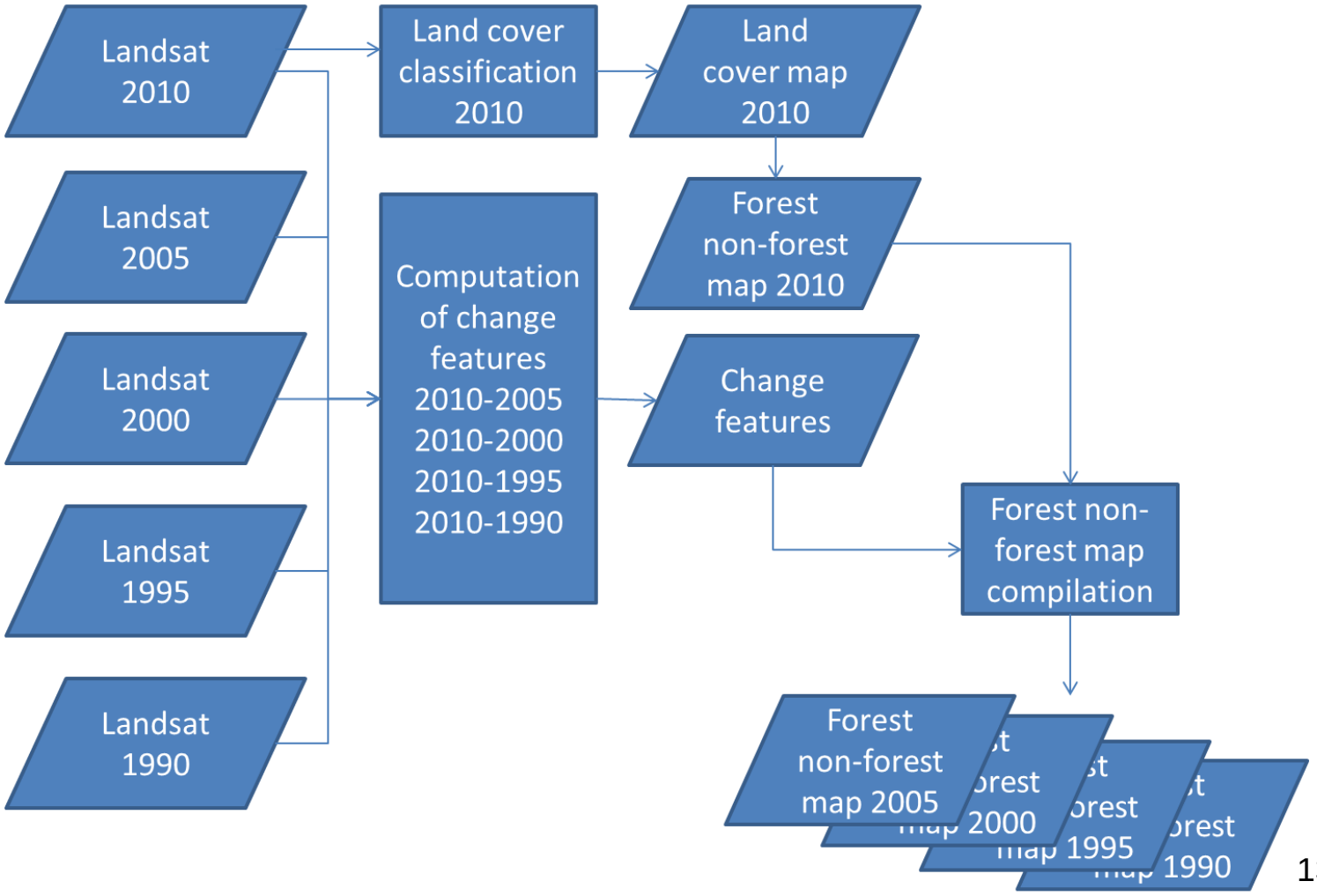


Making the RapidEye 2011 mosaic

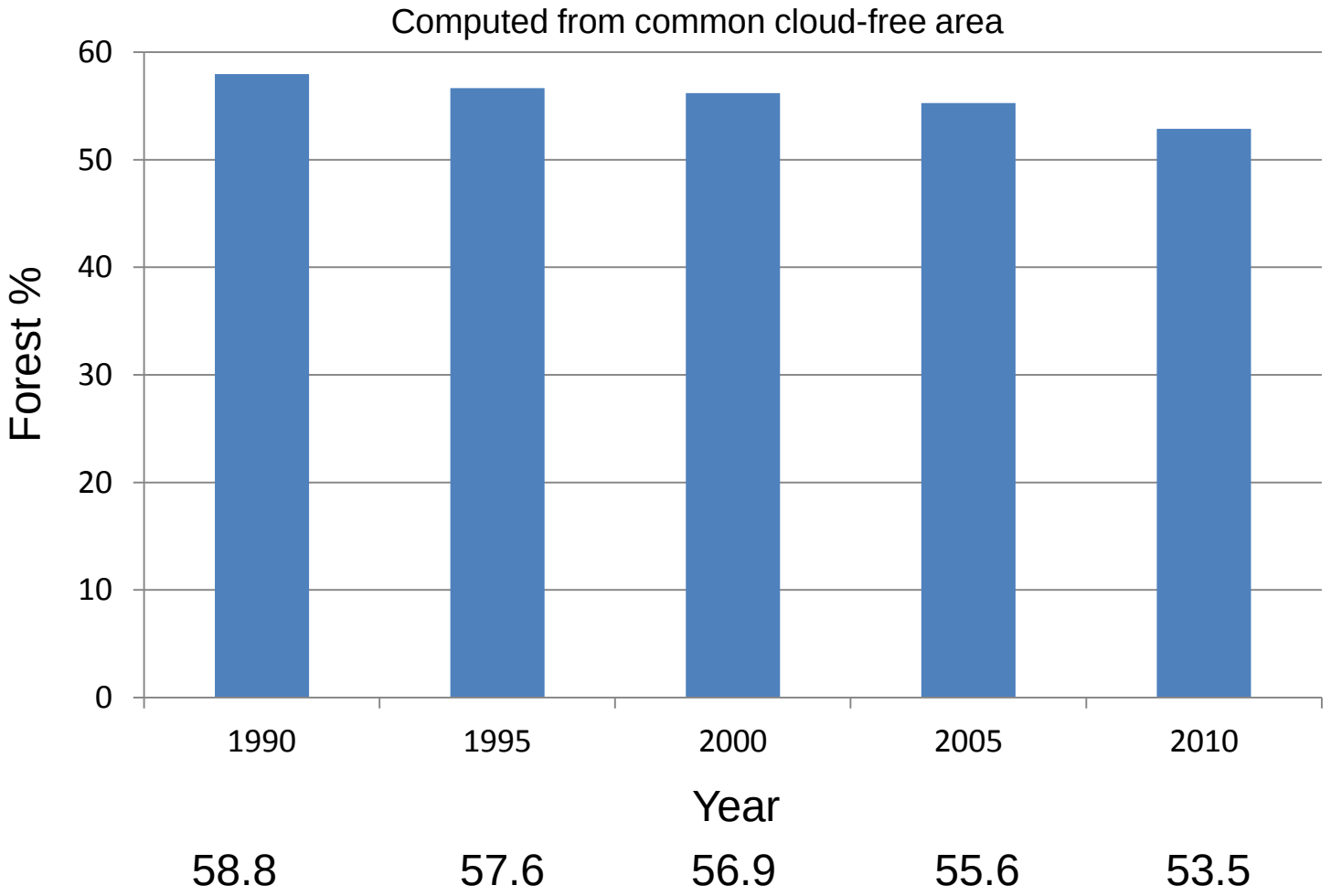




Computing historic maps through change



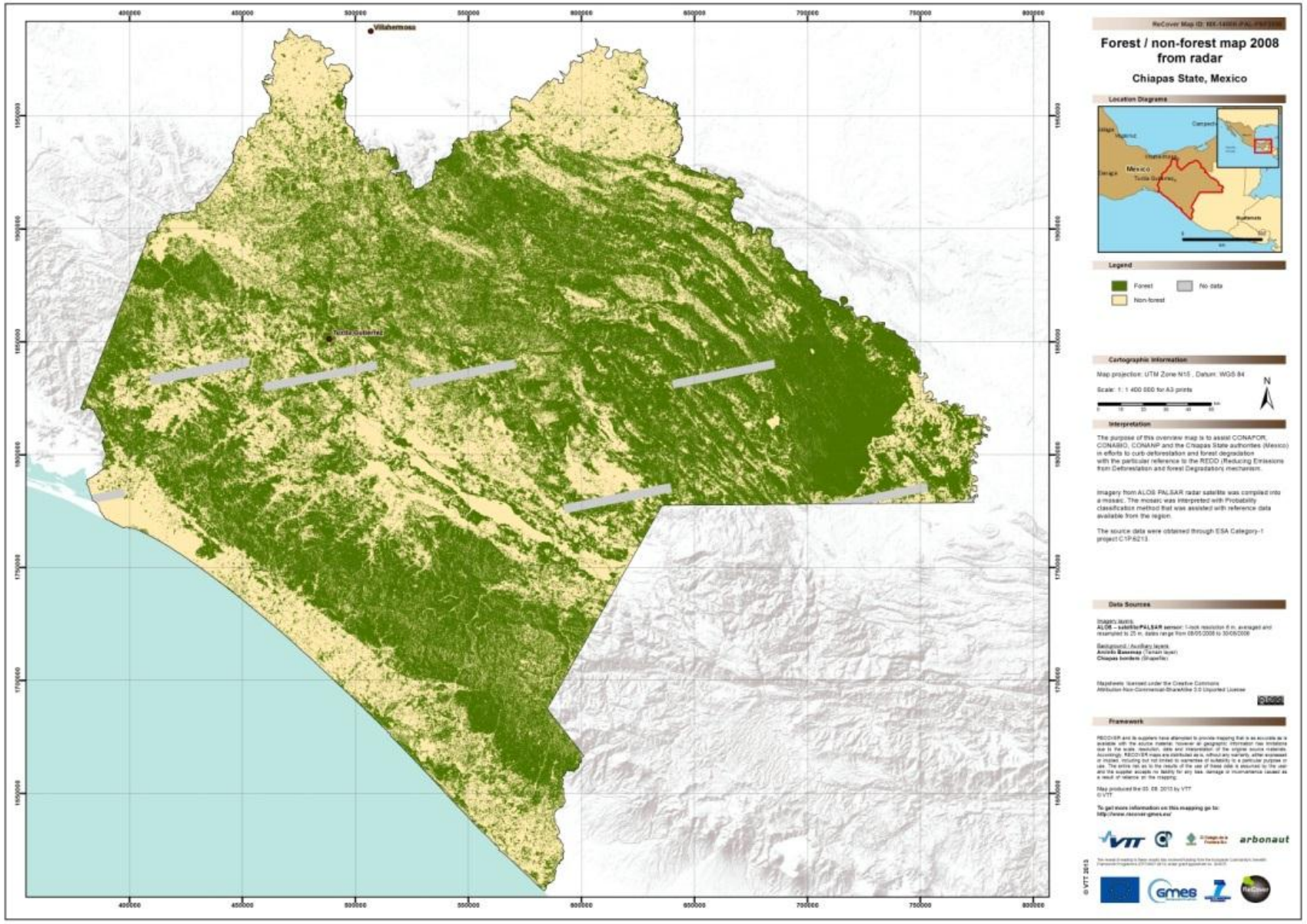
Forest area from Landsat 1990 - 2010



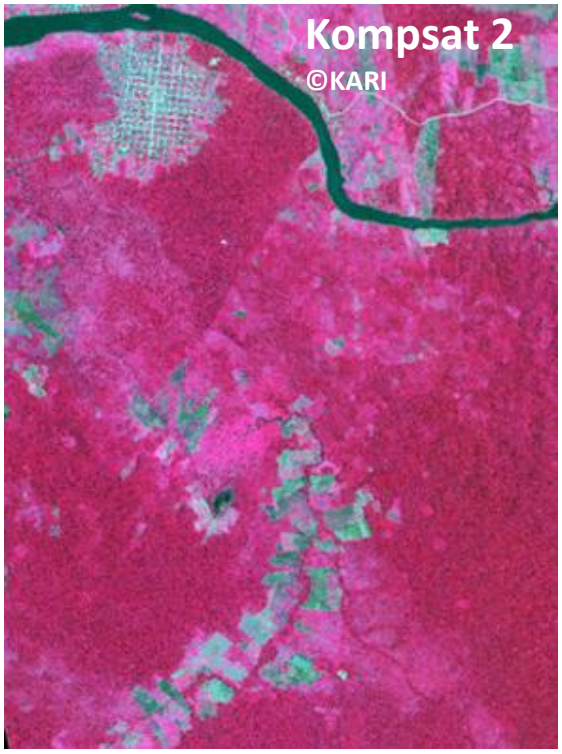
1990	1995	2000	2005	2010
58.8	57.6	56.9	55.6	53.5

Computed from cloud free area of each map (no difference to common cloud free area)

Forest - non-forest map from ALOS PALSAR radar



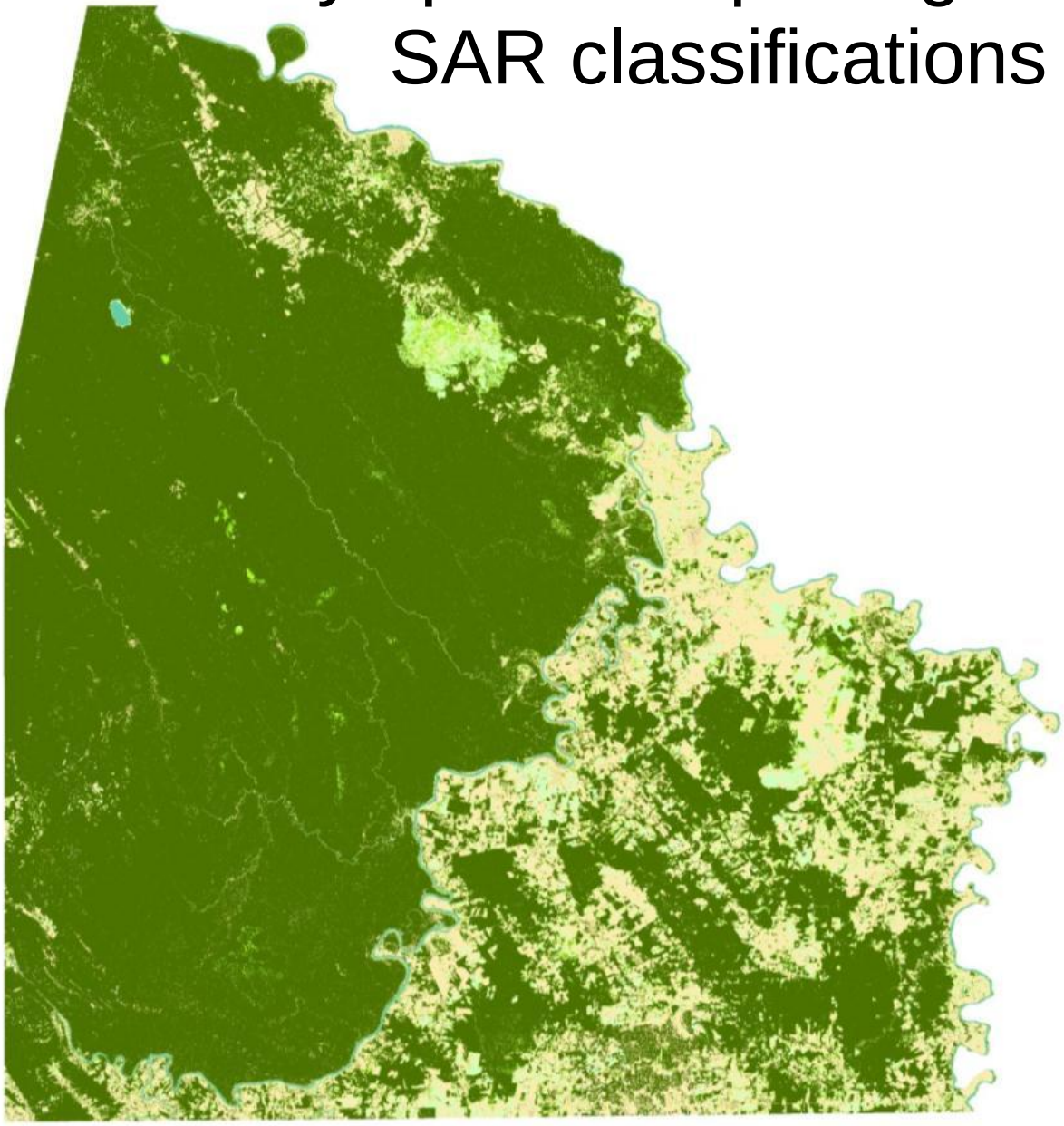
A map detail



	Forest land		Wetlands
	Shrub		Settlements
	Cropland		Other land
	Grassland		No data

Size of the area
~ 12 km x 8 km

Cloudy optical maps augmented by SAR classifications



Accuracy assessment results

Map	Reference data set	Overall accuracy (forest – non-forest)	Overall accuracy (five classes)	User's accuracy for forest class (forest – non-forest)	Producer's accuracy for forest class (forest – non-forest)	Number of obs. (forest – non-forest)	Number of obs. (land cover)
Forest cover 2005	VHR 2005	81.5	-	87.0	84.3	302	-
Forest cover 2008	VHR 2005	87.0	-	90.2	91.5	399	-
Land cover 2010	VHR 2010	87.9	83.6	92.2	92.0	1005	920
Land cover 2011	VHR 2011	87.5	72.6	86.7	94.7	481	438
Land cover 2012	VHR 2012	78.5	78.0	89.9	82.8	545	489

The accuracy figures for the land cover and forest maps with pure plots.

Forest or non forest?

Classified to forest and shrubland (forest)

Classified to shrubland (forest)

Classified to mixed shrubland and grassland

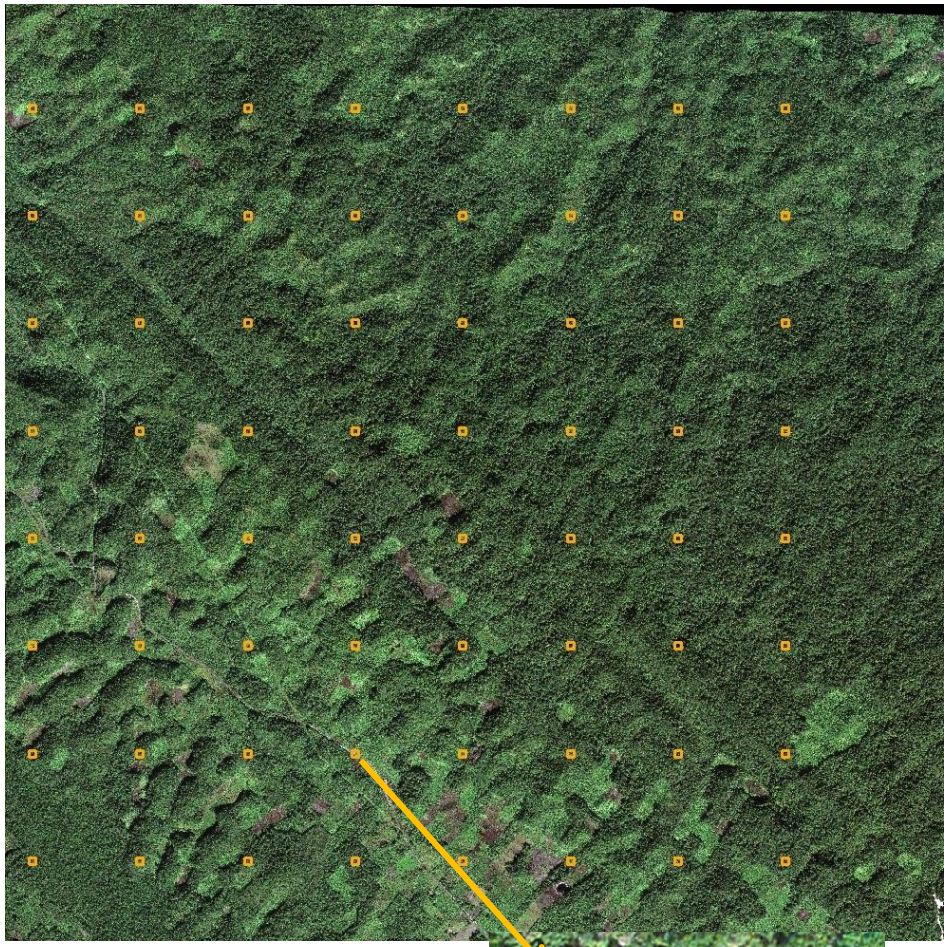
Some additional challenges

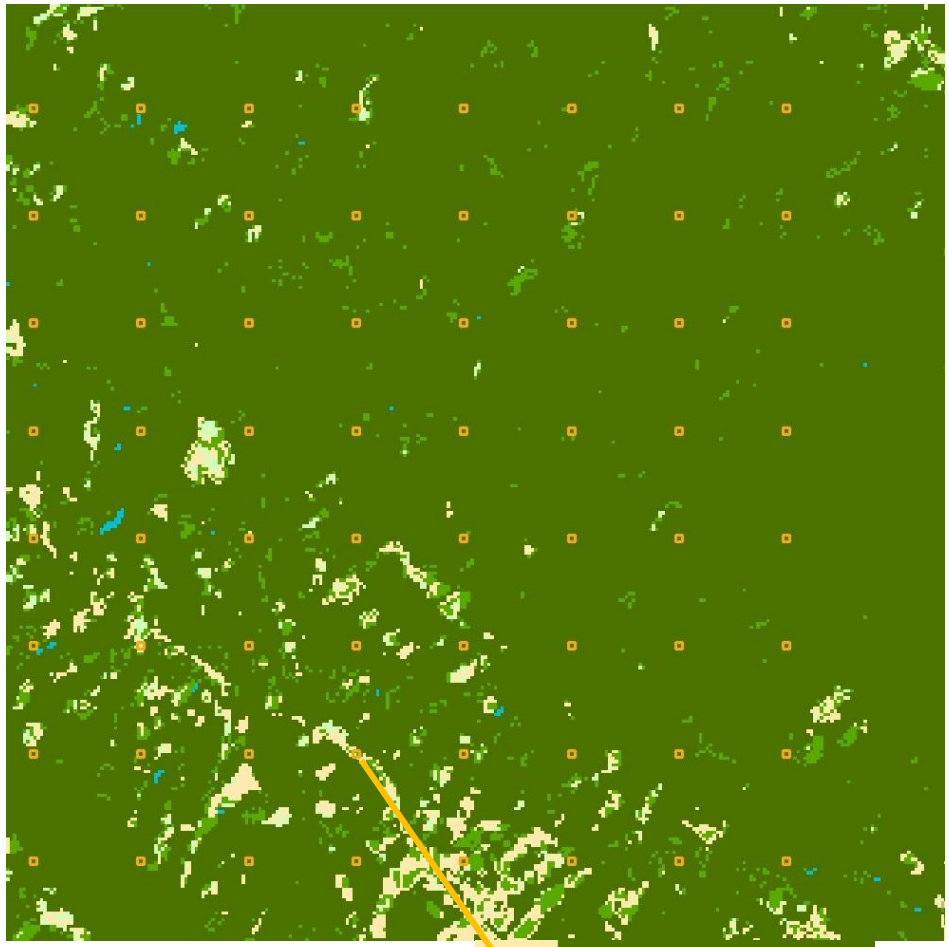
Classified to wetland
In reality dry but was burned

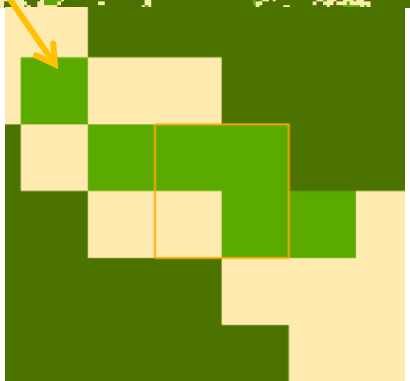
Classified to wetland
In reality was wetland

Classified to grassland but
low grass went to cropland

Classified partly to grassland
(semi-deciduous trees
increase reflectance)



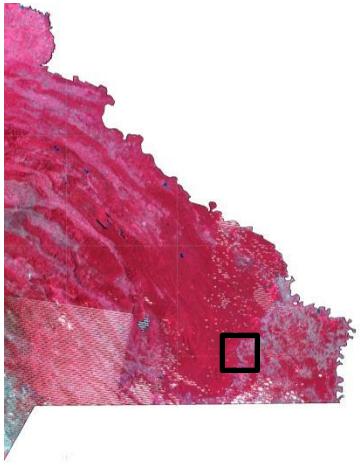


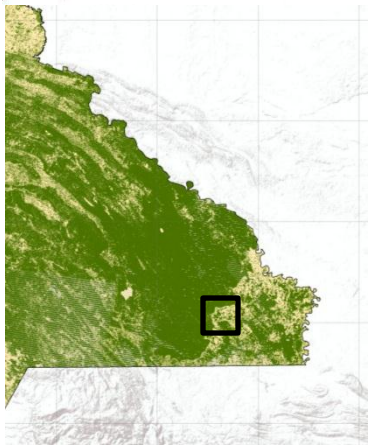


Disturbed
forest 85 %
Artificial 15 %

Land cover change products

Forest removal in Mexico between 1990 and 2010



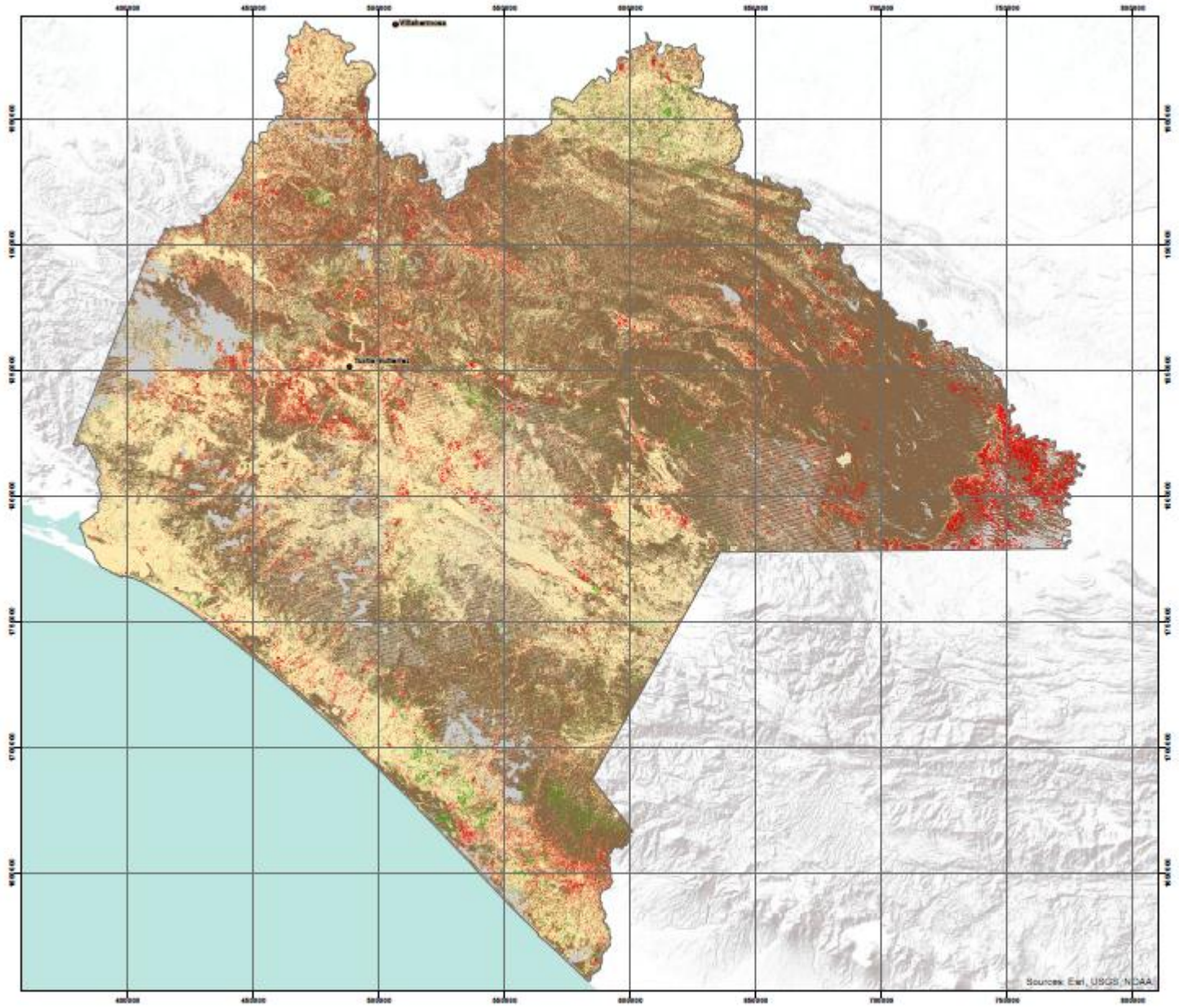


”False color” satellite images – vegetation is shown as red

1990 2000 2010

Maps – forest is shown as green

Area size ~ 11 km x 13 km



Forest change map 1990-2010

Chiapas State, Mexico

Location Diagram

Legend

- forest all years
- non-forest to forest
- non-forest all years
- no data
- forest to non-forest

Cartographic Information

Map projection: UTM Zone N15 , Datum: WGS84

Scale: 1: 1 400 000 for A3 plots

Interpretation

The purpose of this overview map is to support CONAFOR, CONABIO, CONANP and the Chiapas State authorities (Mexico) to support efforts to curb deforestation and forest degradation with the particular reference to the REDD (Reducing Emissions from Deforestation and forest Degradation) mechanism.

The maps shows forest cover change between years 1990 and 2010.

The change maps was compiled by applying change detection and land cover classification techniques to image mosaics that were produced from data of Landsat TM/ETM 4, 5 and 7 from years 1990, 1995, 2000, 2005, and 2010.

Data Sources

Processing Notes

Background / Auxiliary Data

Map Limits Licensed under the Creative Commons

Framework

Map produced the 04. 08. 2010 by VTT

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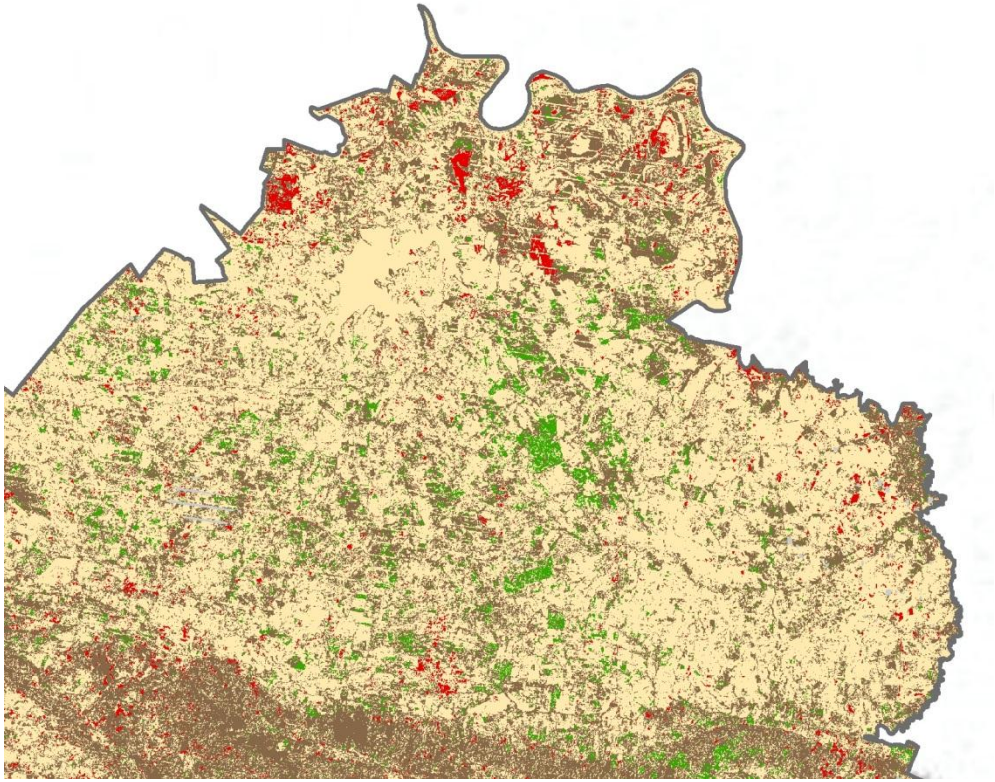
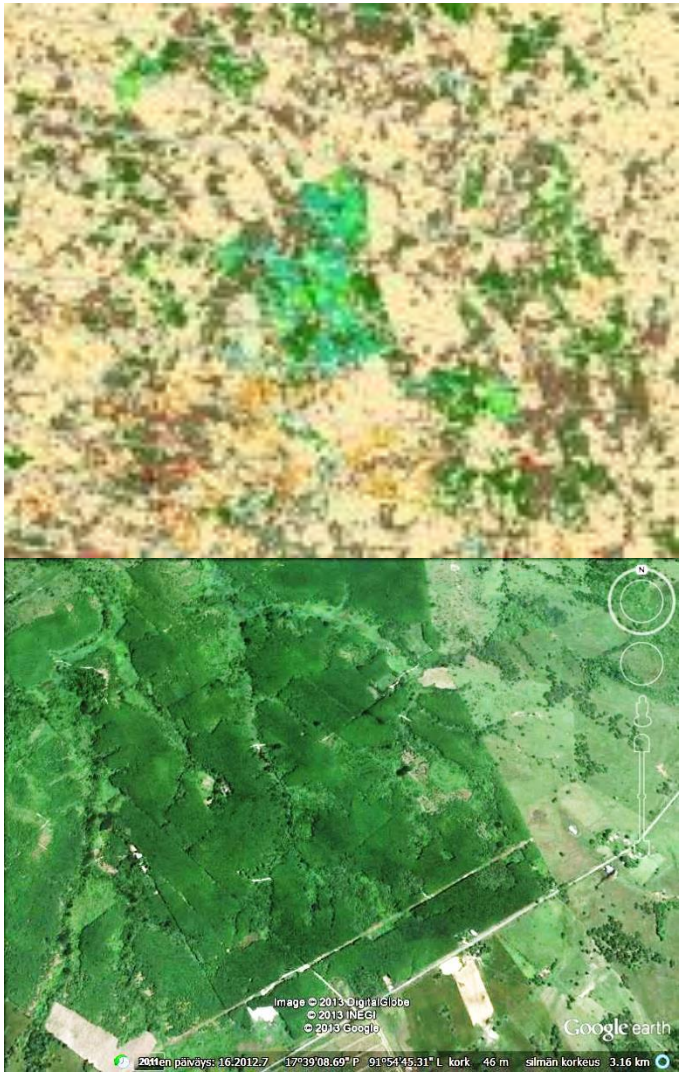
To get more information on this mapping go to:

VTT arbonaut

Gmes

Mexico, Northern Chiapas – reforestation 1990 - 2010

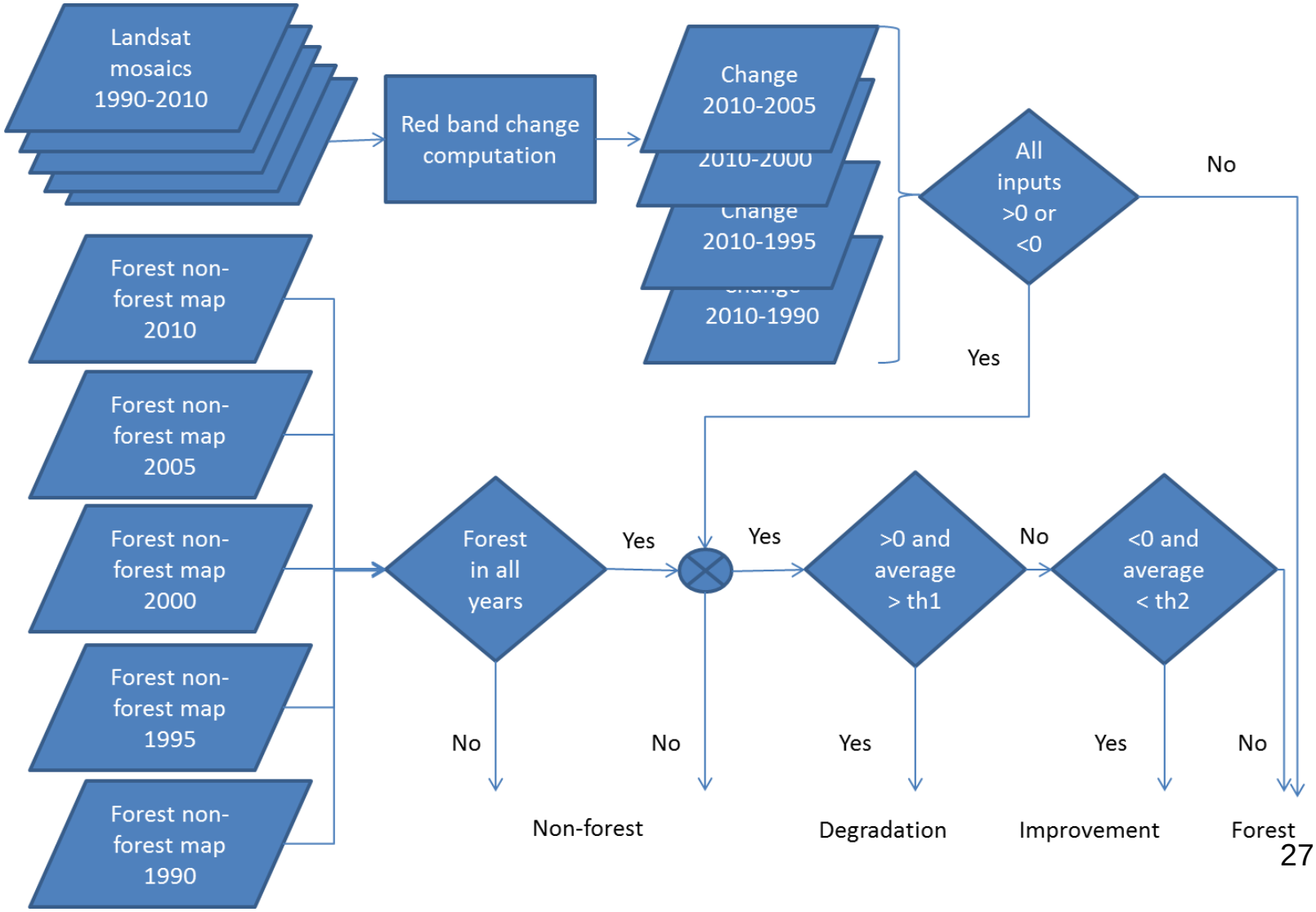




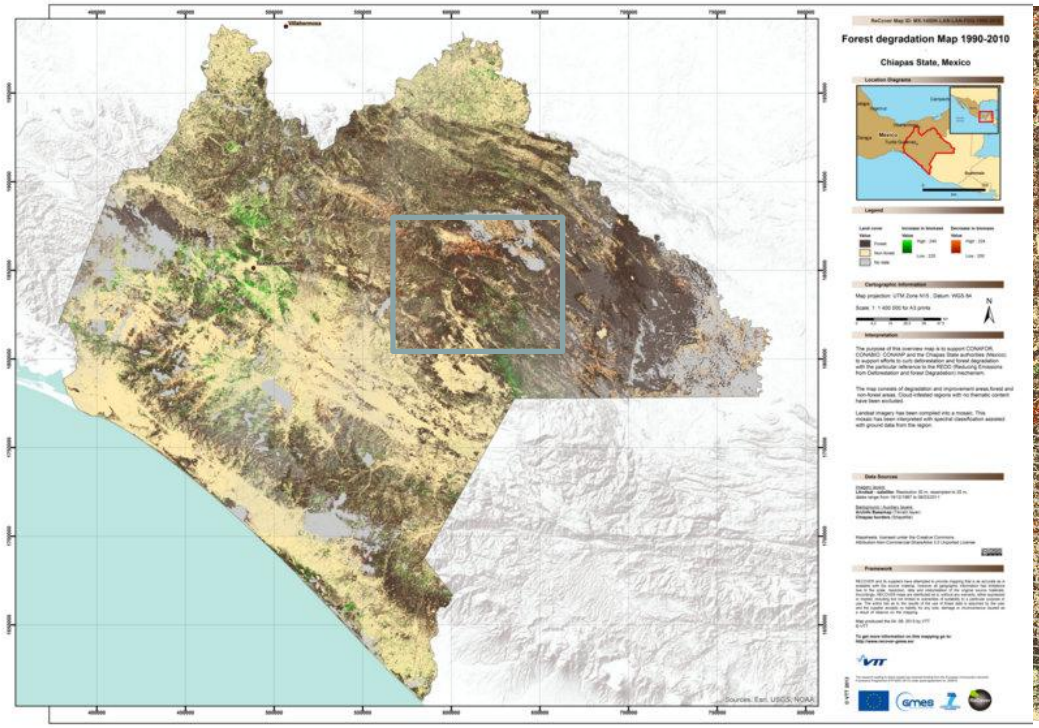
Changes within forest: degradation & recovery

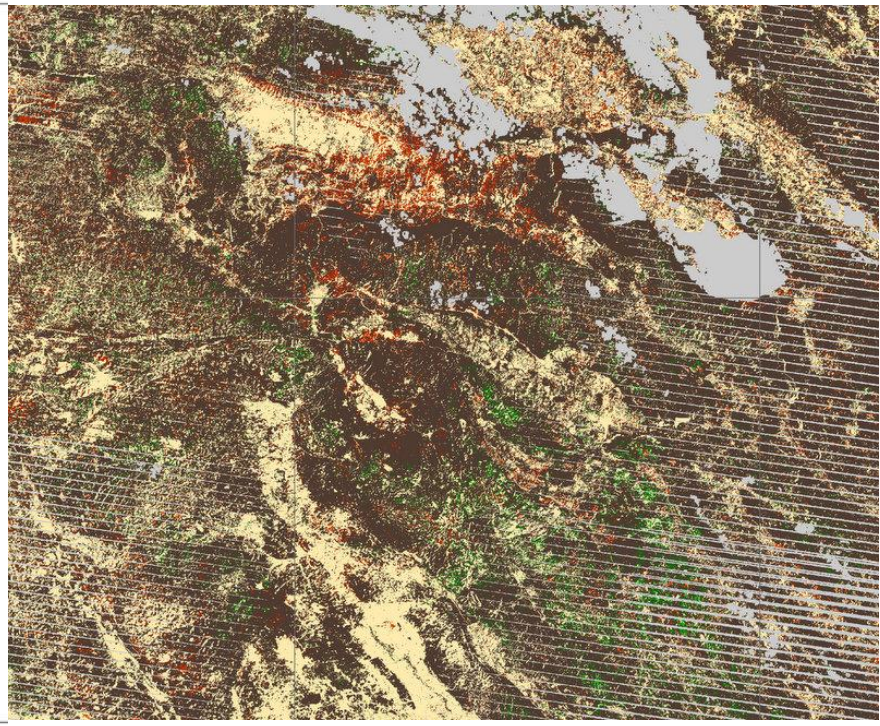
- Degradation: long term(?) forest biomass decrease *within forest class*
  - In ReCover range 1990 – 2010 was applied
- Disturbance: can be observed at one moment of time
  - Was evaluated in the interpretation of the VHR plots

Algorithm for degradation & recovery



Degradation & recovery 1990 - 2010





Chiapas, Mexico

Lessons learned open issues

Challenges on the way to operational services

- Data acquisition needs too much effort presently
- Cloud and haze masking very laborious
- Accuracy assessment for change still partly unresolved
- Forest and degradation definitions not clear
- Standards un-established (processes, product specifications)
- Ground reference data

Conclusions

- Service concepts for forest cover mapping that can be applied at an operational scale were developed
- Statistical sample of VHR data very important to have reliable reference for land cover classes – global sampling system should be implemented
- EO has to be considered in ground samples for biomass
- L-band radar results in forest and non-forest classification approximately as good as those with similar resolution optical data – further testing needed however
- Results with C-band radar variable
- Assessment of the accuracy of change needs attention
- Sentinel-2 with large image size, high acquisition interval, and good enough spatial resolution will be a working horse for REDD

www.**recover-redd.eu**