Activity Data (AD) Monitoring in the frame of REDD+ MRV

NORWEGIAN MINISTRY OF FOREIGN AFFAIRS

CONAFOR
COMISIÓN NACIONAL FORESTAL

PNUD
Al servicio de las personas y las naciones

CONABIO
GOBIERNO FEDERAL

FAO
FIAT PANIS

Preliminary comments

REDD+ is sustainable "low emissions, high carbon" rural development

Monitoring efforts should support this effort

Challenges

- Diversity
- Scale
- Contribute to other monitoring efforts
- Institutional arrangements
- Nature of changes (degradation)

Uses

- International community
- Various levels of government
- Communities & other land owners

Technical Requirements for REDD+ MRV AD

Extend of Surface: **1.972.550 km²**

Frequency of LULCC: **Annual**

Forest Patch size: **0,5 hectare**

Spatial resolution: **MMU of 0.125 hectare**

Quantitative change and **Qualitative** Change

Multidirectional change over a 4 year reporting period

Method: **combined** automatic and visual interpretation

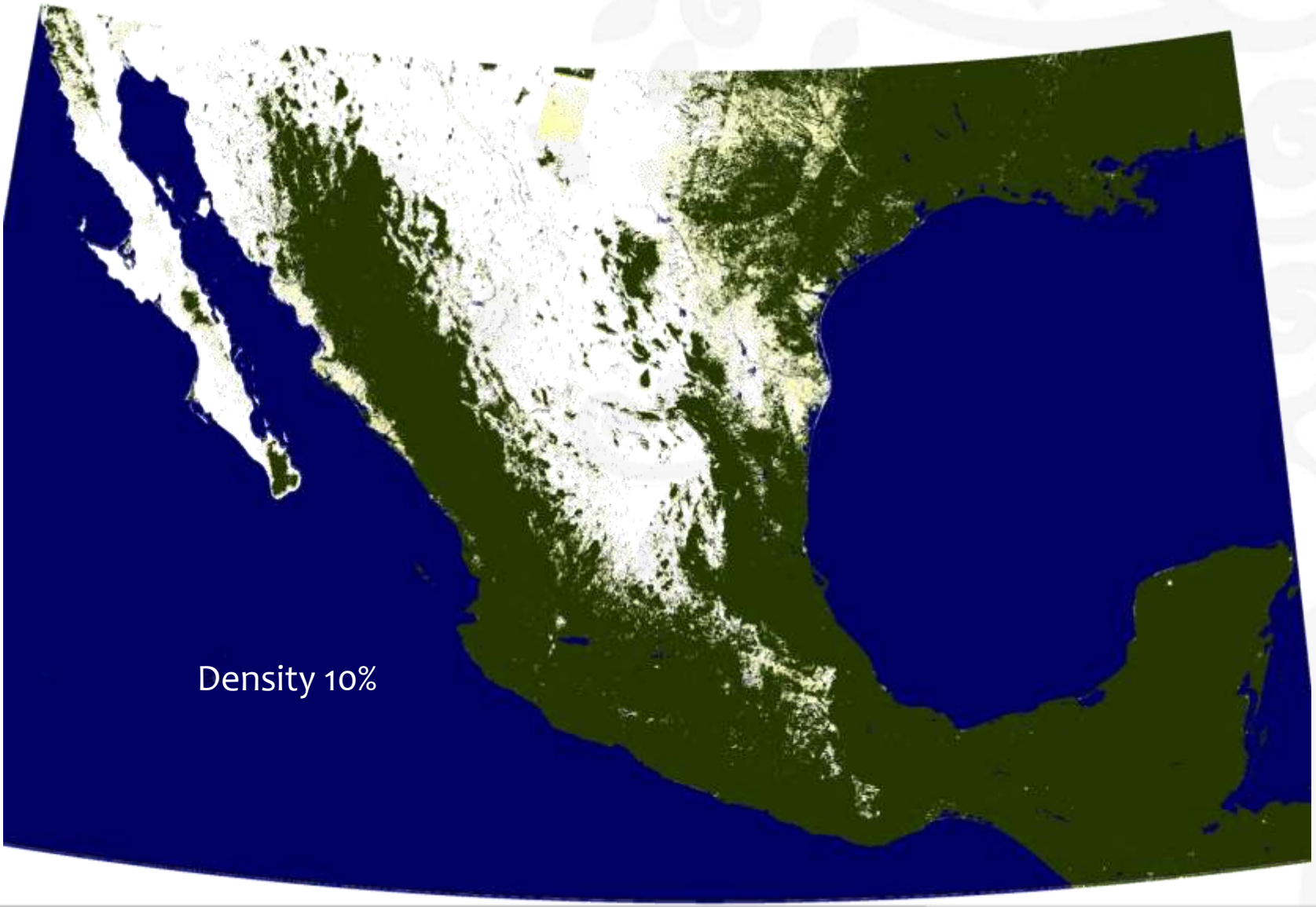
Forest Land Evergreen Lowland Rainforests

Initial / Final	FL *Managed* Evergreen Lowland Rainforests	FL *Managed* Dry Andean Forests	FL *Managed* Evergreen Andean Montane Forests	FL *Unmanaged* Evergreen Lowland Rainforests	FL *Unmanaged* Dry Andean Forests	FL *Unmanaged* Evergreen Andean Montane Forests	Crop Land	Wet Land	Settlement Land	Other Land	Final Area (T1)
FL *Managed* Evergreen Lowland Rainforests	51										61
FL *Managed* Dry Andean Forests		42									54
FL *Managed* Evergreen Andean Montane Forests			60								60
FL *Unmanaged* Evergreen Lowland Rainforests											123
FL *Unmanaged* Dry Andean Forests											26
FL *Unmanaged* Evergreen Andean Montane Forests											35
Crop Land											29
Wet Land											0
Settlement Land									15		20
Other Land										5	5
Initial Area (T0)									15	5	460
Net change (Δ = T0-T1)									5	0	5

Initial / Final	Degraded Burning	Degraded Selective logging	Degraded Insect infestation	SMF	ECS (restoration)	ECS (afforestation/ reforestation)	Conservation	Final Area
Degraded Burning	4							4
Degraded Selective logging		5	6					11
Degraded Insect infestation			2		4			6
SMF				1				1
ECS (restoration)					12			12
ECS (afforestation/ reforestation)						15		15
Conservation							0	0
...								...
Initial Area	4	5	8	5	16	15	9	47
Net Change	0	6	-2	-4	-4	0	0	-4

Approximate Extend of Forest Ecosystems in Mexico

Canopy Density Based:



Details:

Automated Product Generation

Target: 12-22 classes

Model: NALCMS and SERENA as region wide known and accepted schemes

Acceptable Accuracy: 80% Minimum

Base Line: Landsat System, L5 and L7

Future Monitoring: Tests using SPOT5 and possibly 6 and 7, 2011-2013: RapidEye

Work plan 2012, objectives until December 2012

Prototype in Conabio set up and running, DONE

Testing on selected L5/L/ and RapidEye tiles, DONE

Set-up of Satellite Images QA/QC system with CONAFOR and INEGI, DONE

Implementation in Google Cloud, IN PROGRESS

Adding Functionalities to EarthEngine (EE) and MapEngine (ME) tools w/ Google, IN PROGRESS

Processing of minimum 1 Mosaic over México, PENDING: EE and ME implementation

Information for Base Line Processing:

Land Cover / Land Use Base Maps

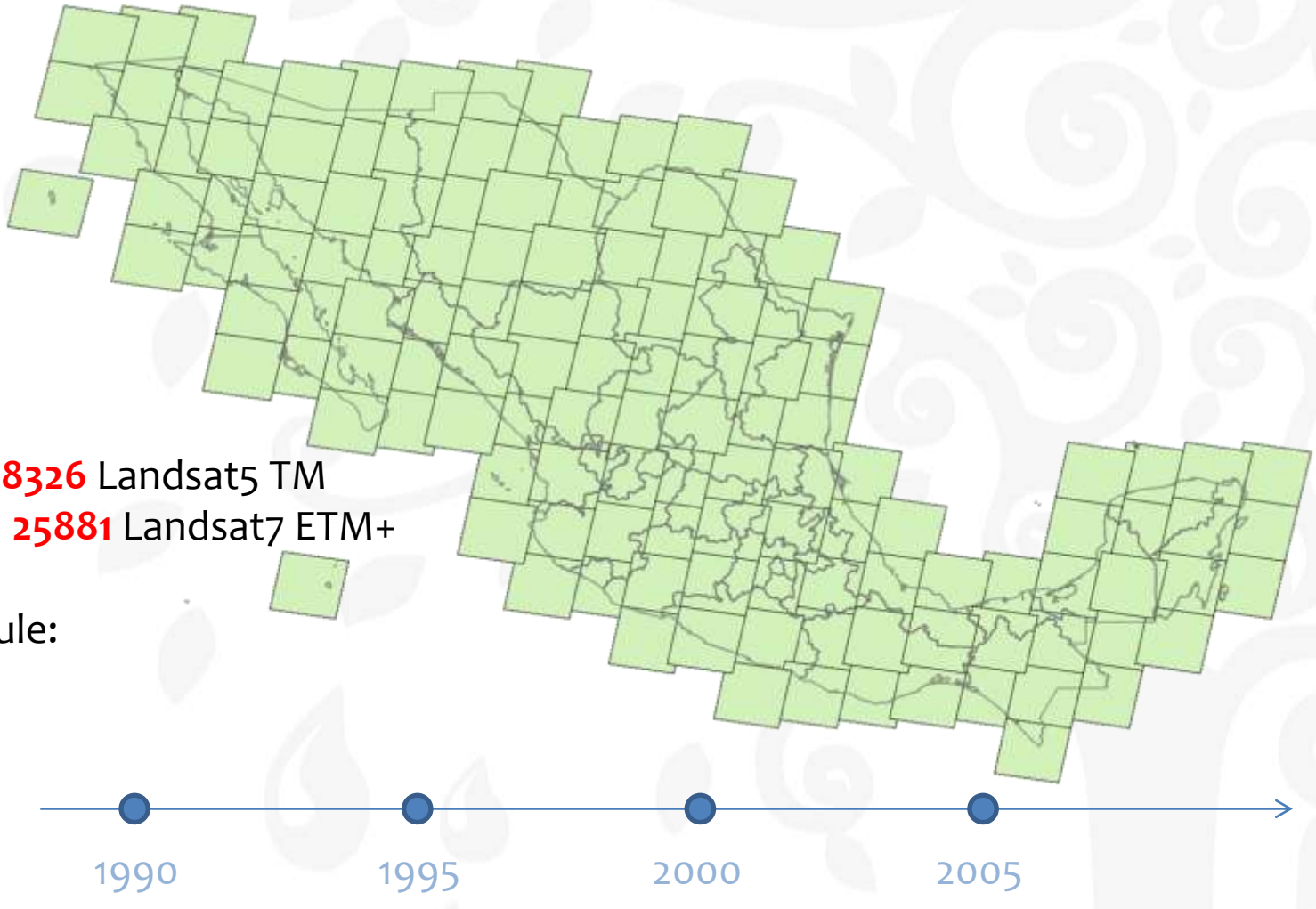
INEGI Land Use / Land Cover Products (LULC)

I (1979 – 1991)	1:250,000 scale
II (1993 – 1999)	1:250,000 scale
III (2002 – 2005)	1:250,000 scale
IV (2005 – 2007)	1:250,000 scale
INF (1992,2000) Forest Inventory actually a LULC map	1:250,000 scale
NALCMS (2005), 250 m, 19 clases (INEGI)	1:1,000,000 scale
SERENA (2008), 500 m, 23 clases (INEGI)	1:2,000,000 scale
Distribución de los manglares (2005)	1:50,000 scale

Training!!

Satellite Data Availability: Base Line

Images needed for 1 full coverage: 135



Images available in USGS:

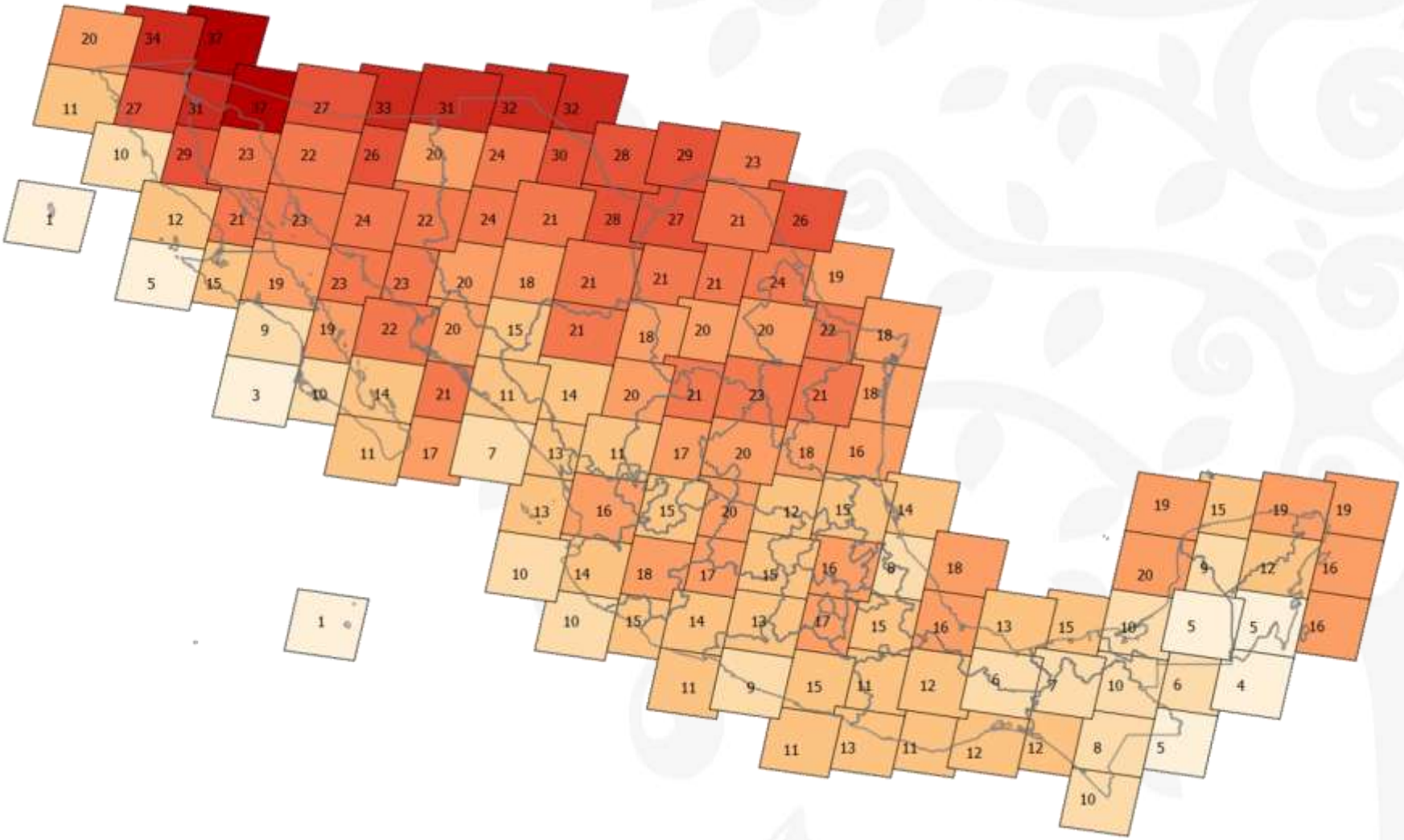
1982-11-13 - 2011-11-15: **48326** Landsat5 TM
1999-06-30 - 2011-12-13: **25881** Landsat7 ETM+

2012/2013 processing schedule:

1990:	784
1995:	3012
2000:	4206
2005:	4068
8 TB	

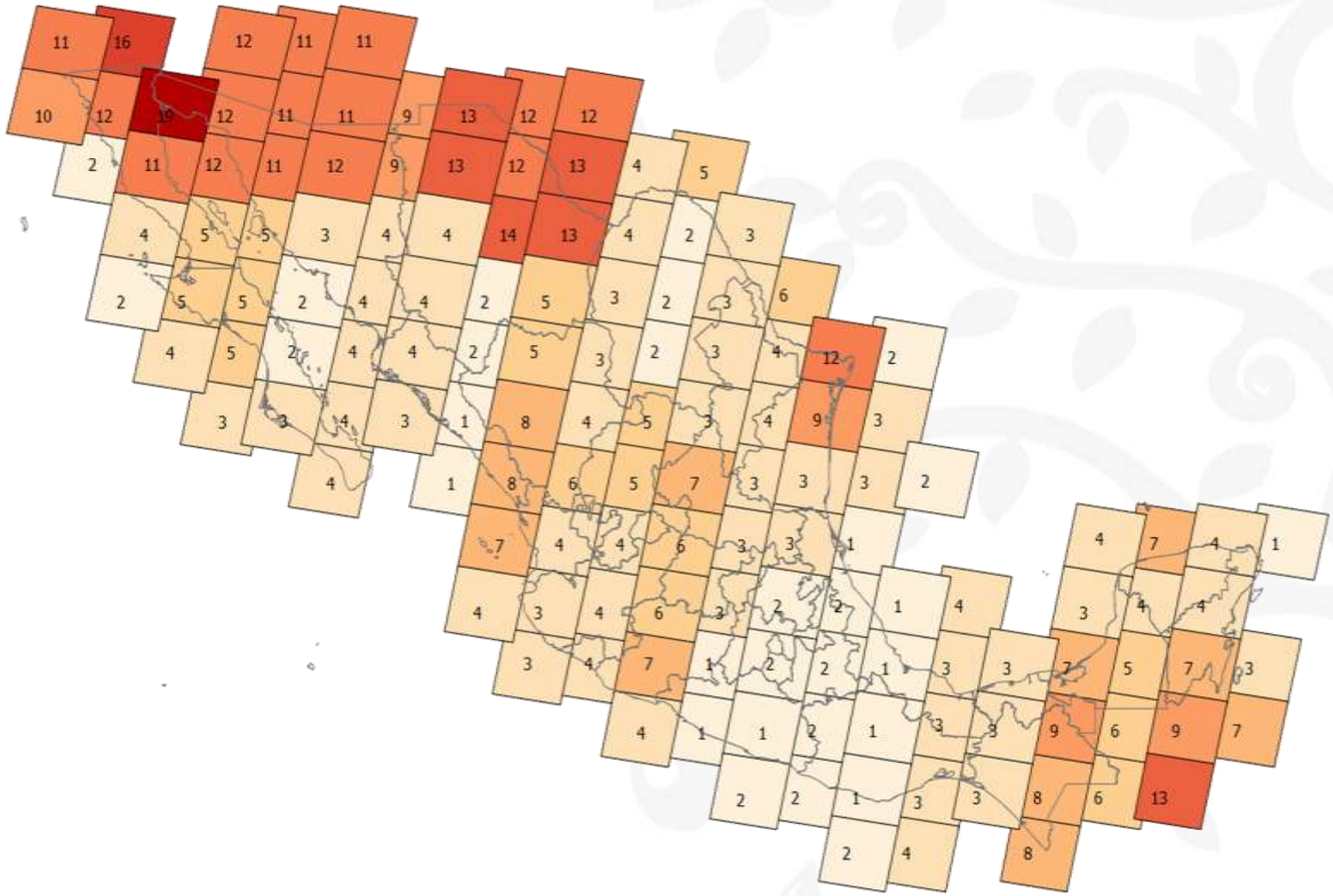
Satellite Data Availability: Base Line, Landsat 5/7

Available Temporal Resolution, selected year: 2000 (< 10% cloud cover only)



Satellite Data Availability: Base Line, Landsat 5/7

Available Temporal Resolution, selected year: 1990(< 10% cloud cover only)



Data Availability: Monitoring 2011-2013, RapidEye

2 coverages / year, rainy and dry season

Maximum 10 % cloud cover

Co-registration accuracy: min. 2 pixels

Geo-location accuracy: 25 m

No. of tiles:

2011:	3988+3988
2012:	3988+3988
2013:	3988+3988

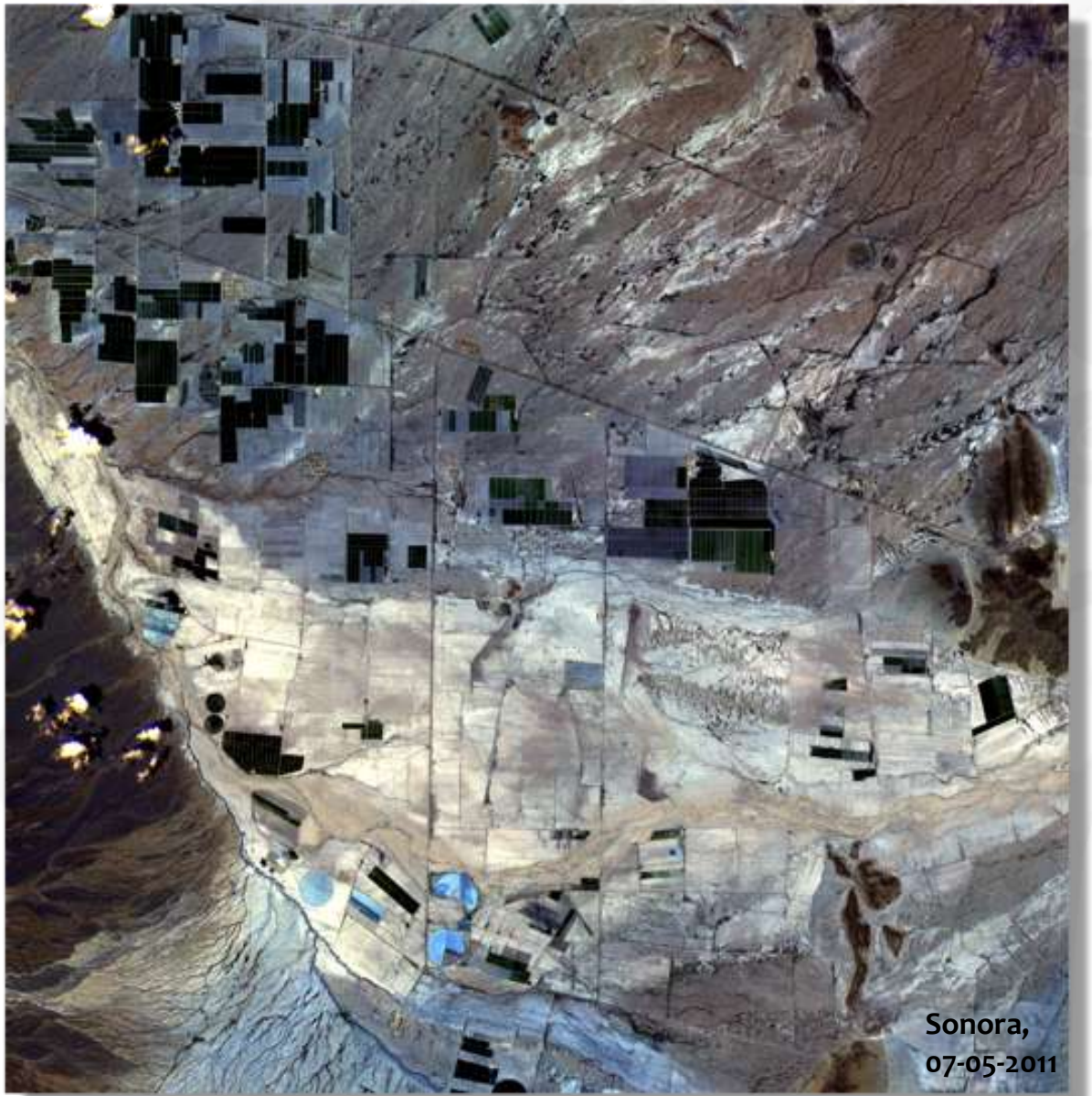
6 TB

Available Satellite Data: RapidEye

Caracteristics

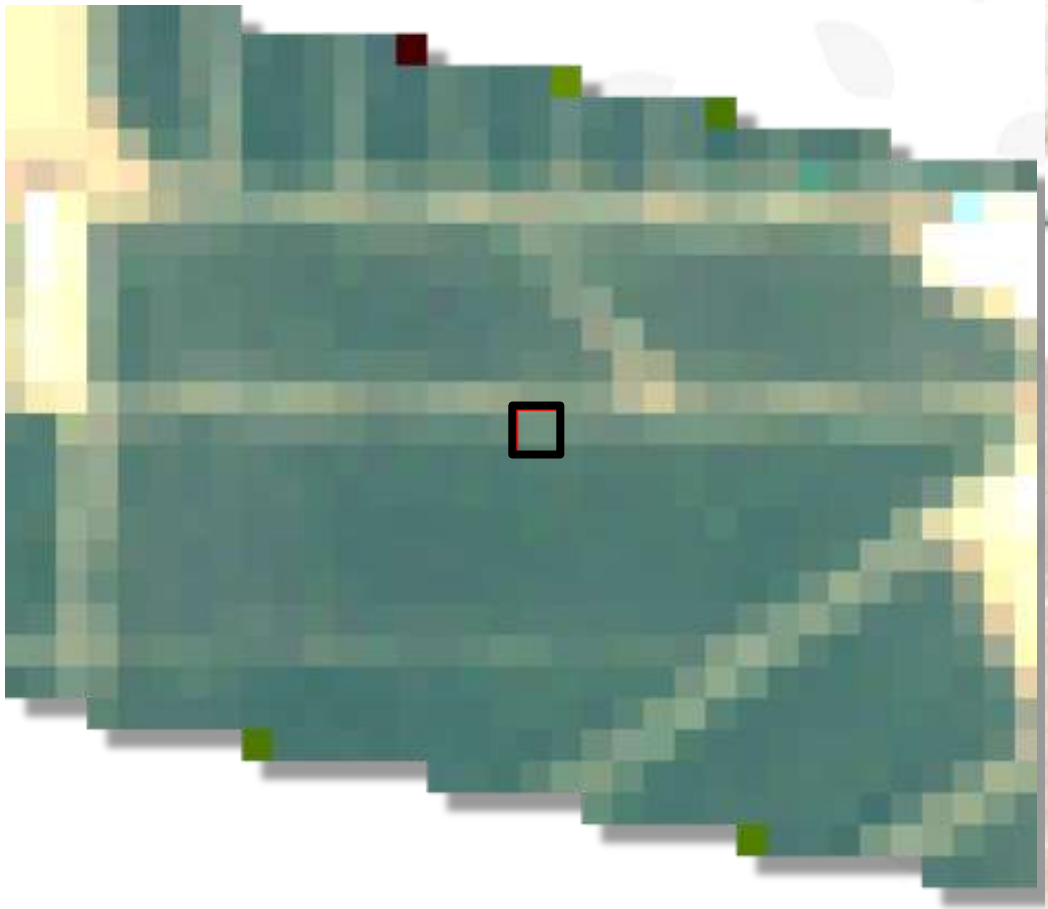
- Level 3A
  - Geo-rectified, ortho-rectified (2 pixels = 10 m)
- Spatial resolution: 6,5m, ortho product: 5m
- Spectral Resolution: 5 bands
  - RGB, NIR, RedEdge
- Acquired temporal coverage:
  - Dry season: January. – April
  - Rainy season: May – Oct.

  for 2011 / 2012 / 2013



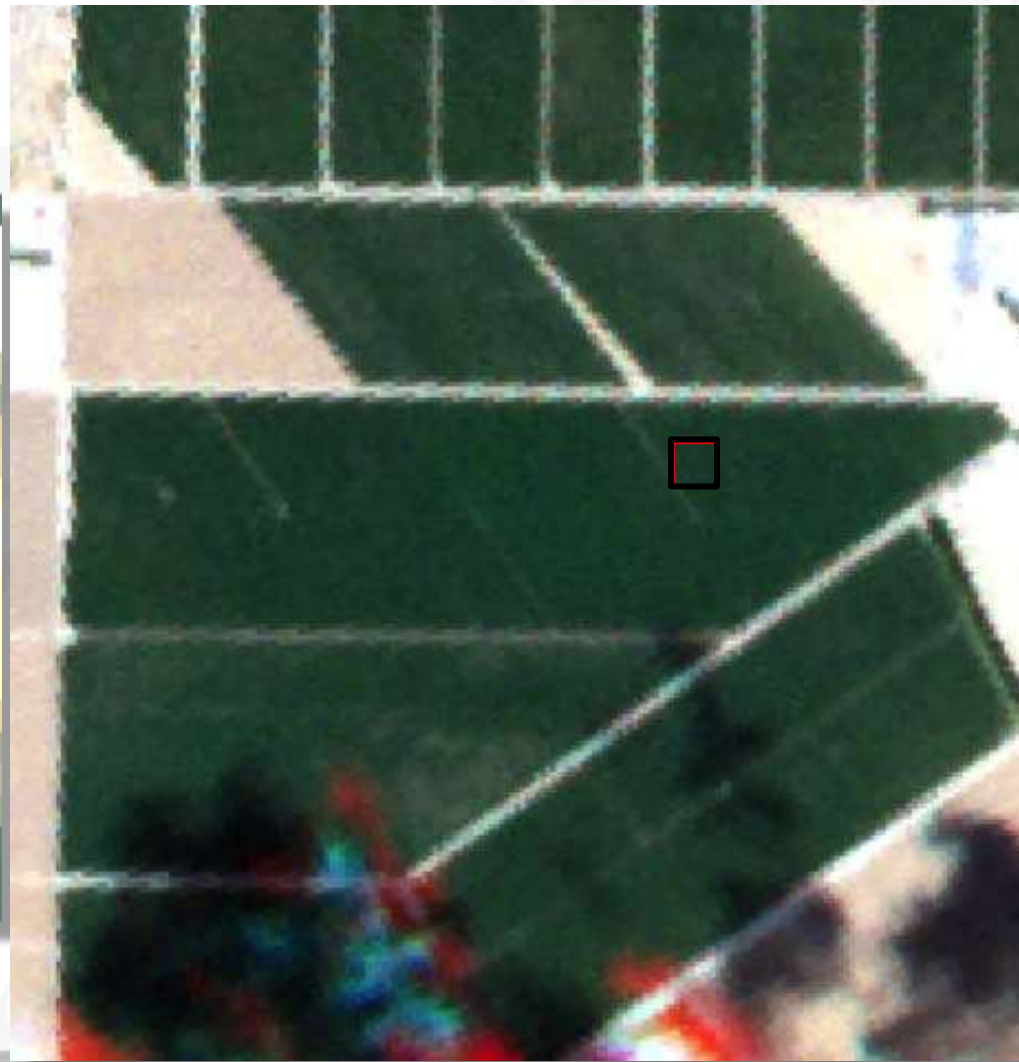
Available Satellite Data: RapidEye

- Landsat

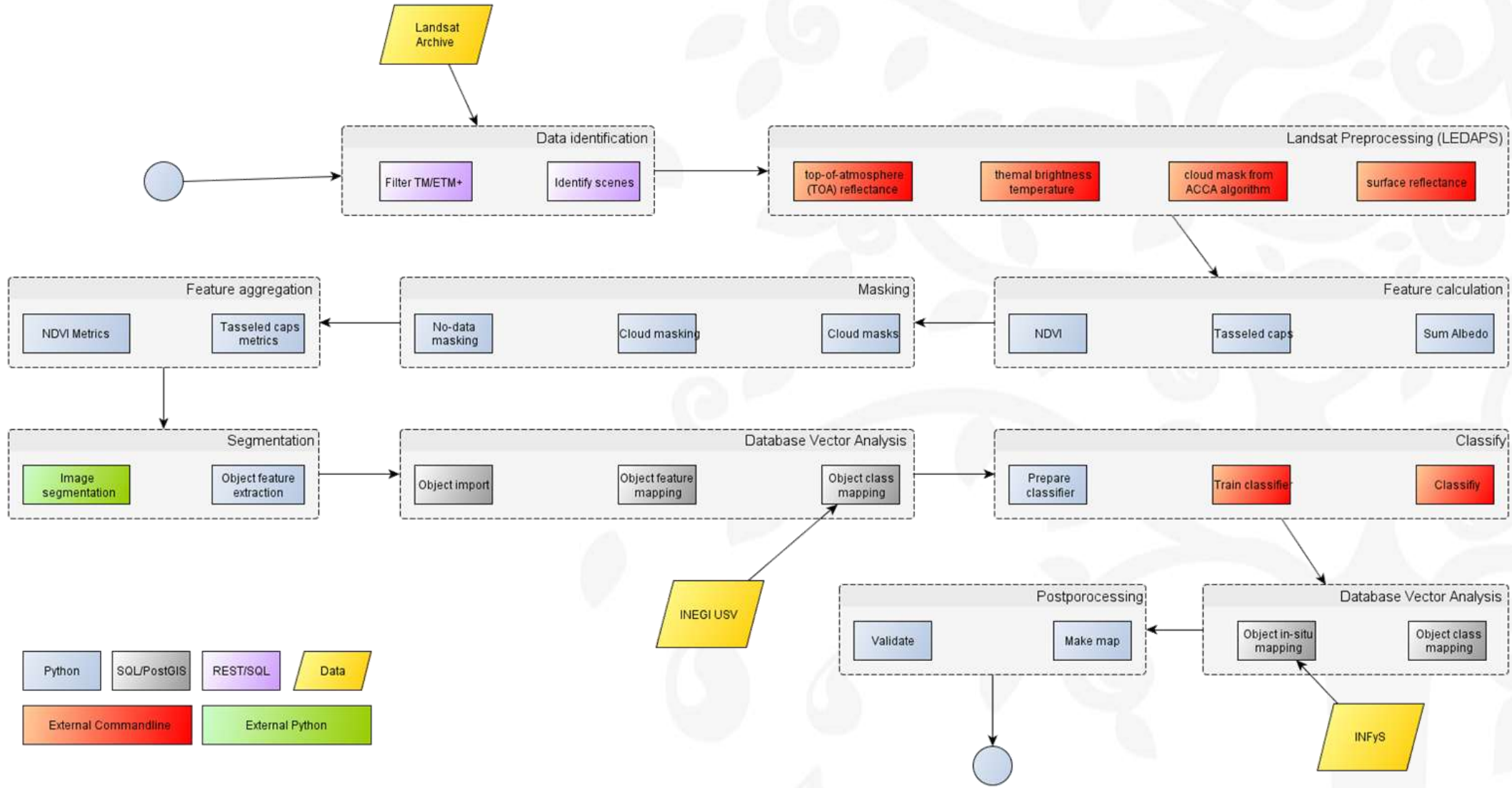


Minimum Mapping Unit (0,125 ha o 12.5*12,5m)

- RapidEye

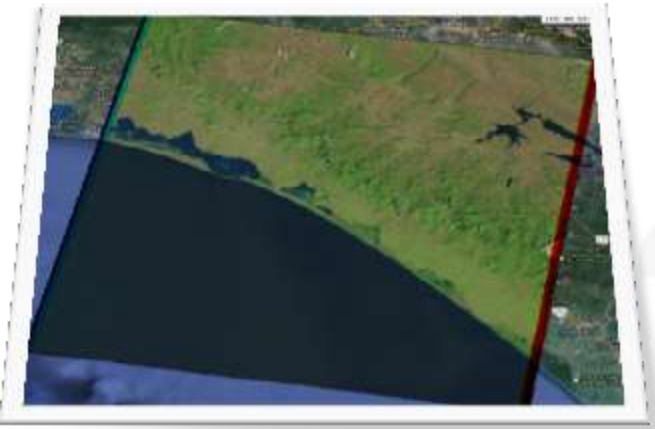


Work flow implemented in CONABIO

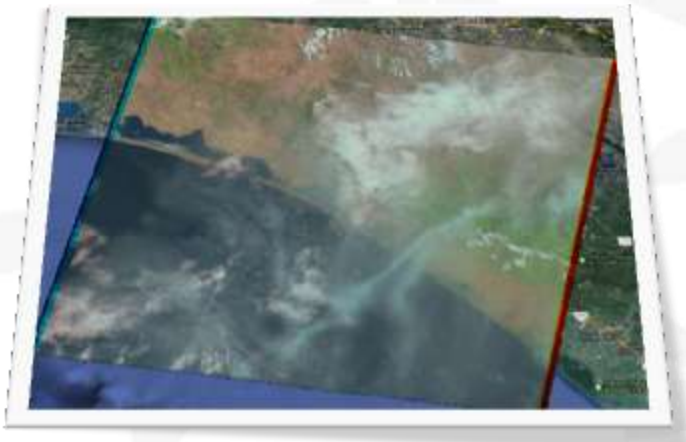


Data – Different Conditions

atmosphere



Blue skies



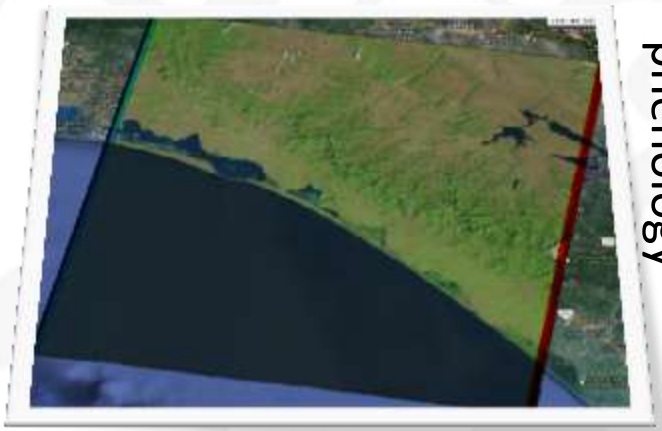
Cirrus cloud

Cumulonimbus

phenology

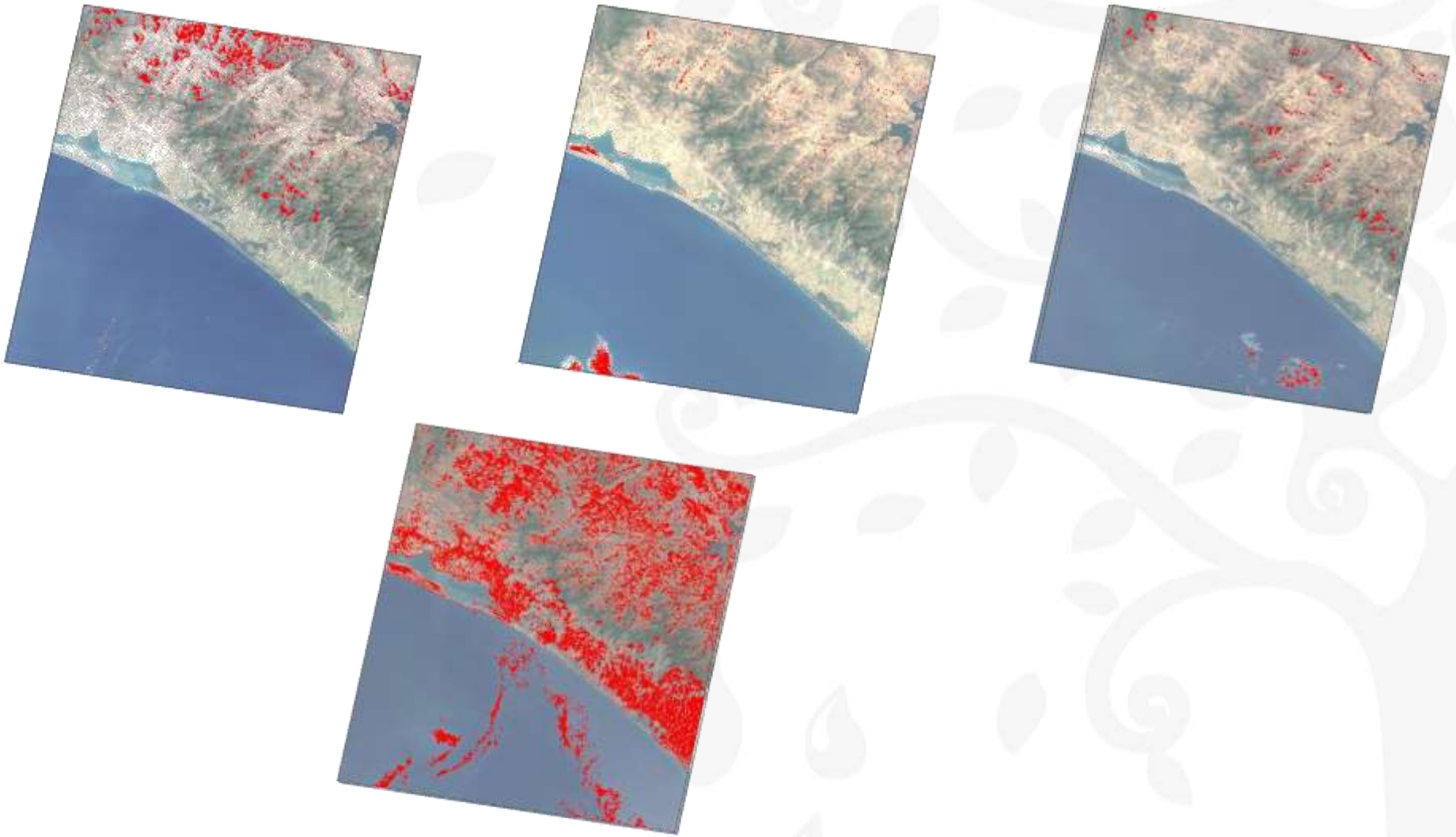
March 1993

July 1993

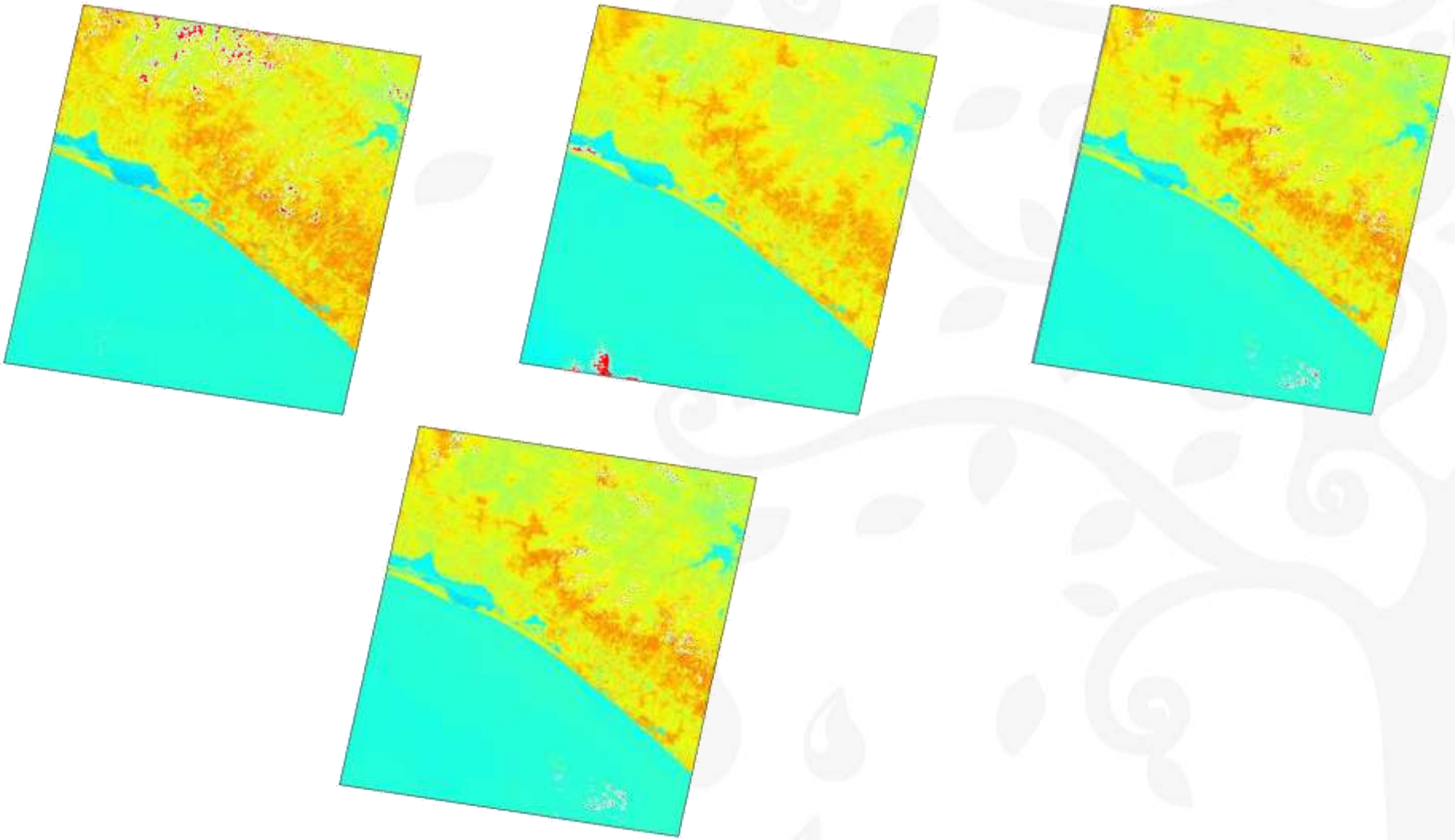


Dec. 1993

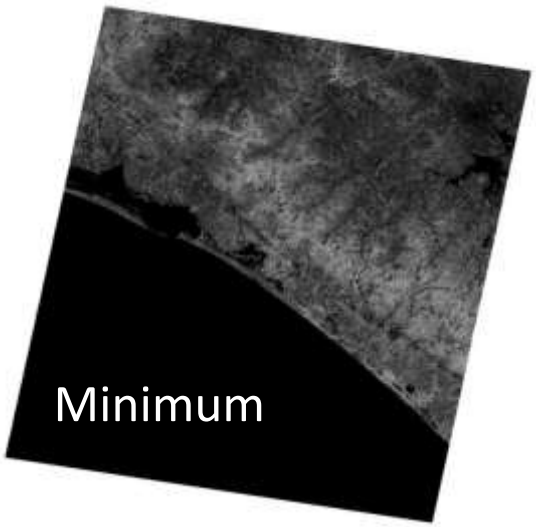
Data – Cloud Masking

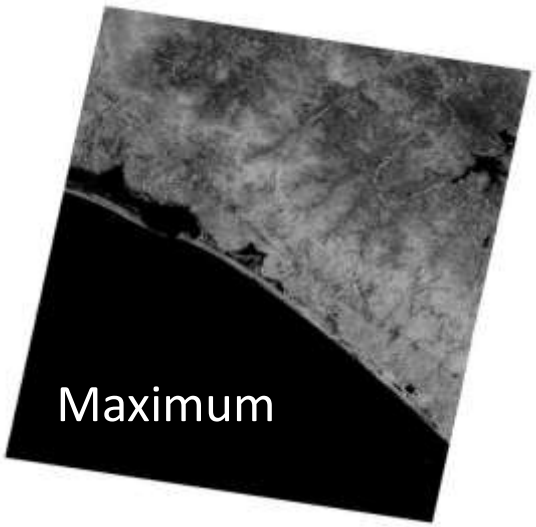


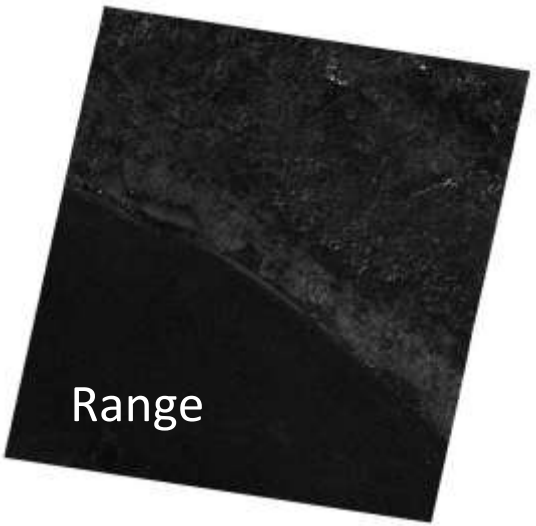
Vegetation Indices, here NDVI

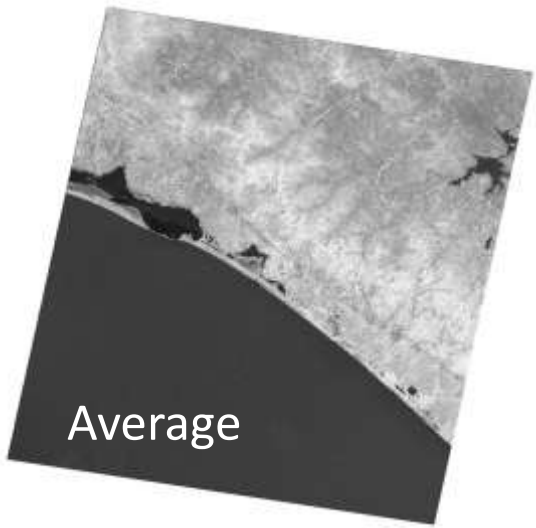


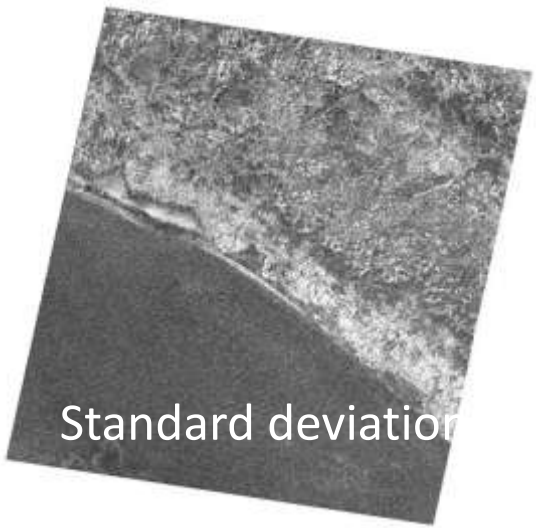
Multi-temporal features, descriptive stats





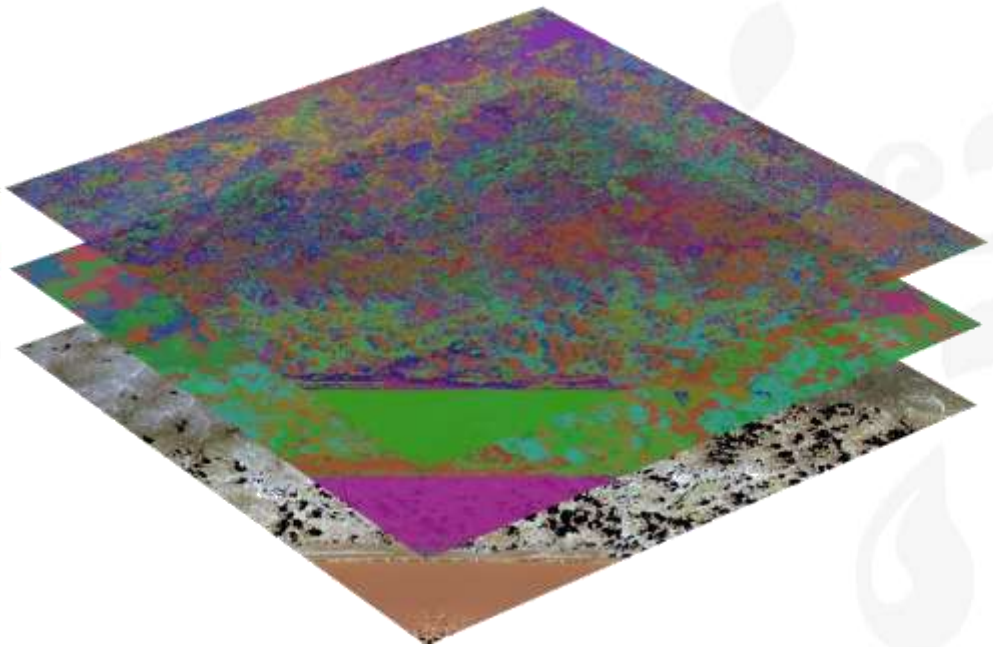


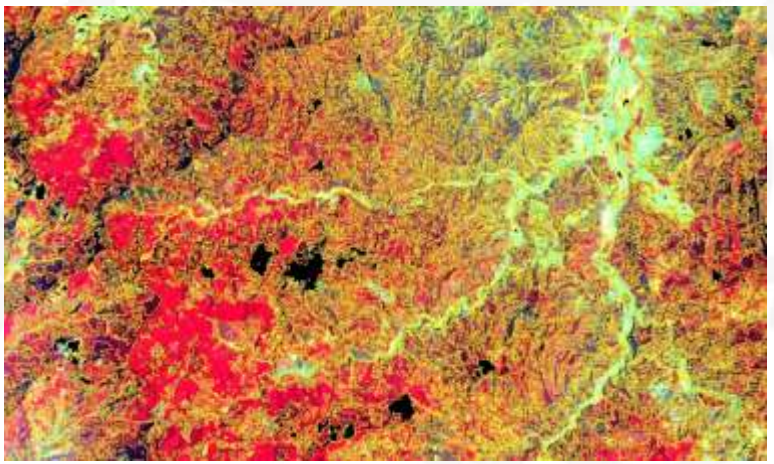


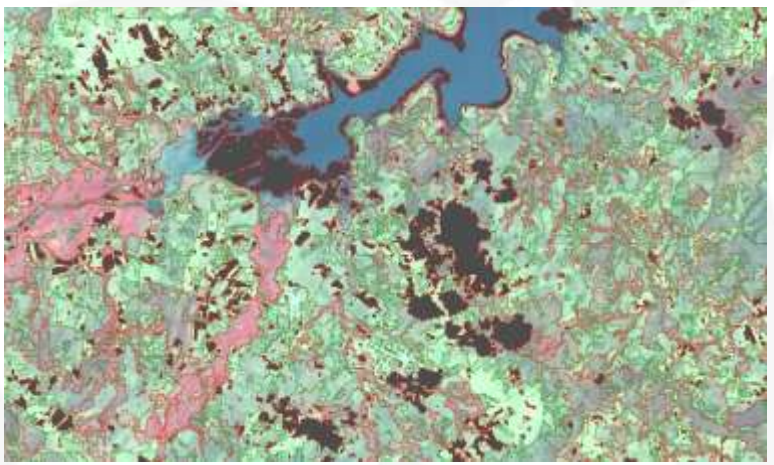


- NDVI
- Tasseled Cap

Image Objects – Segmentation of Images

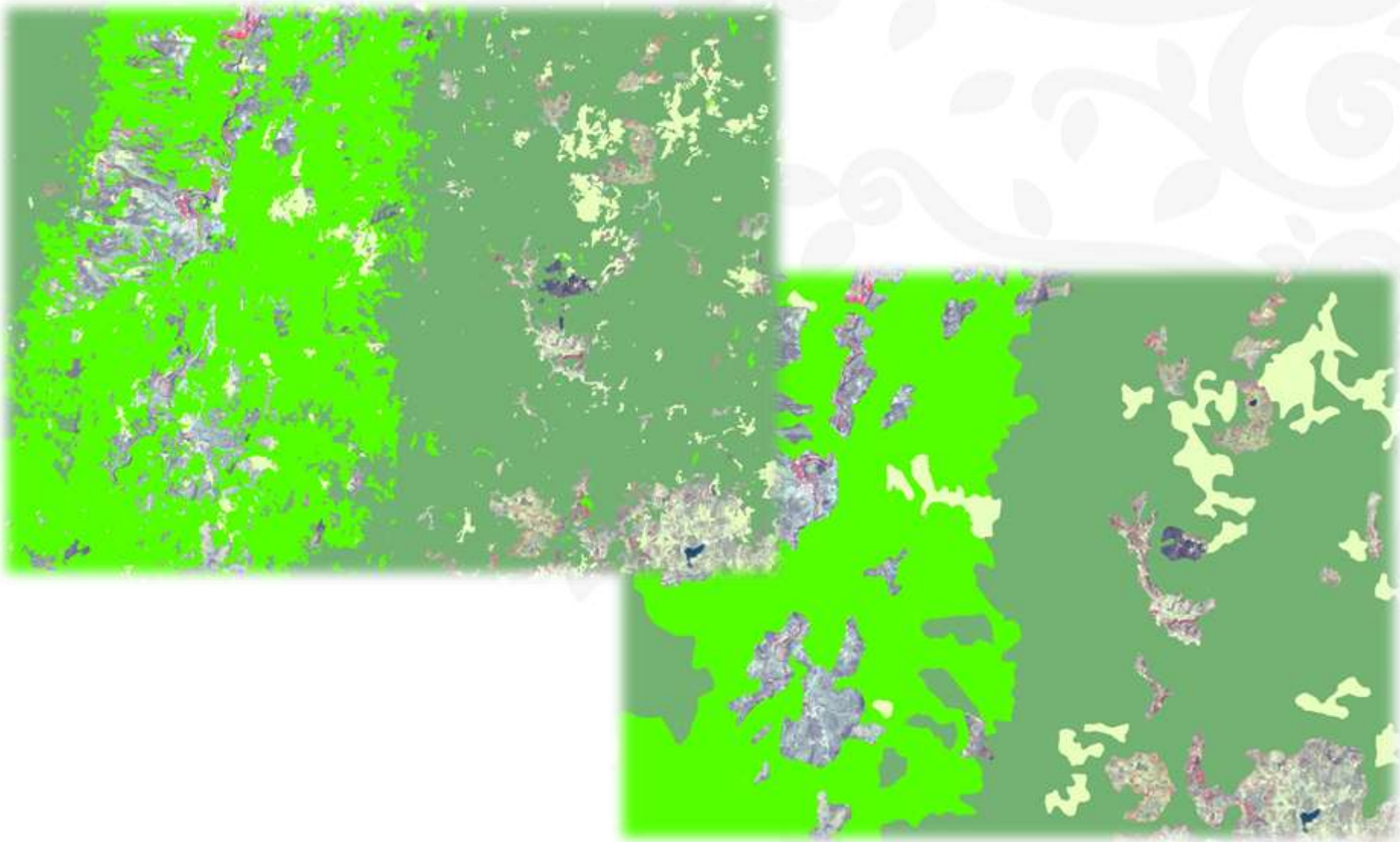






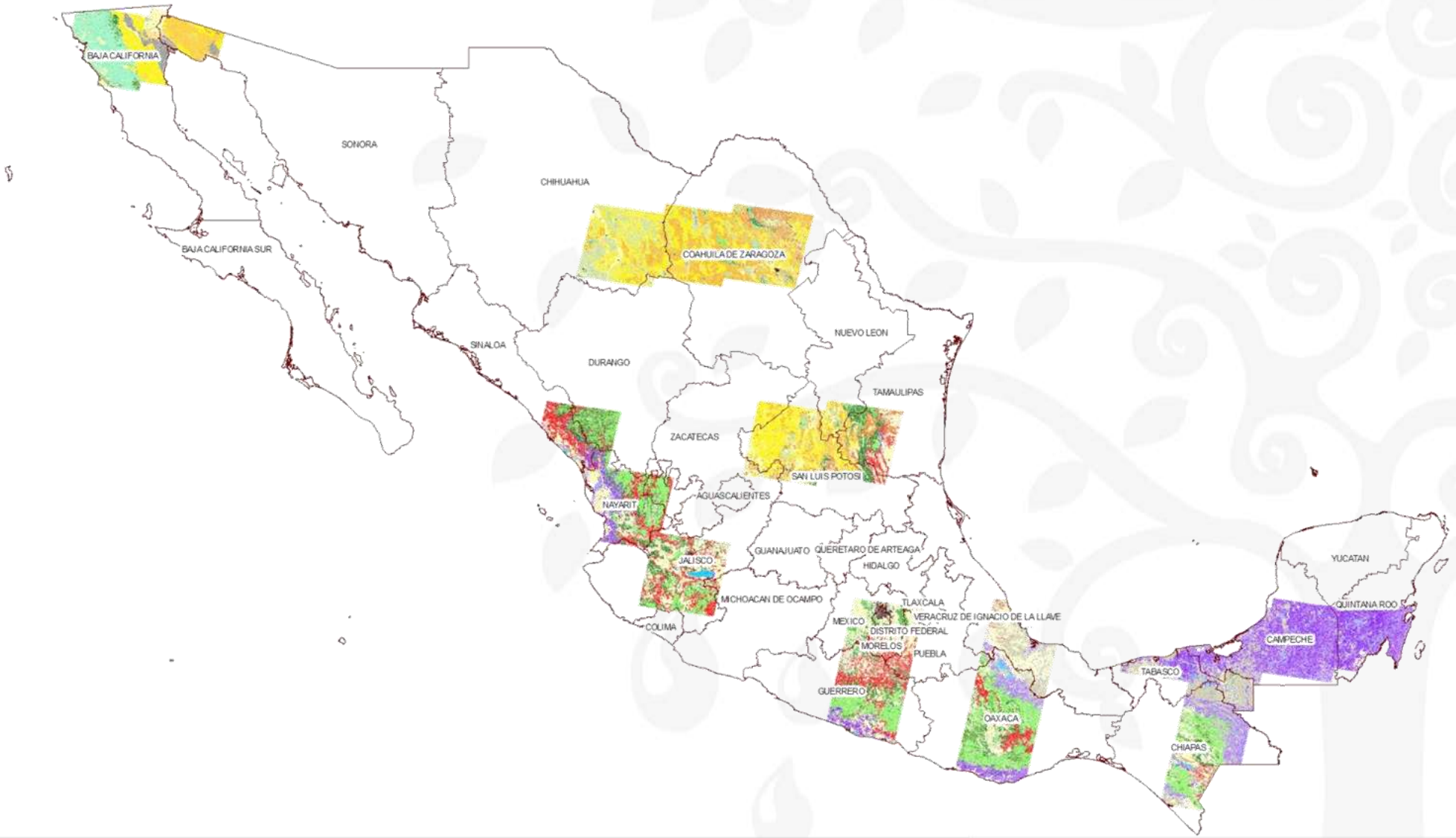
Results: e.g.: more detailed 1:100,000 vs. 1:250,000

System generates a much more detailed product, especially on edges:

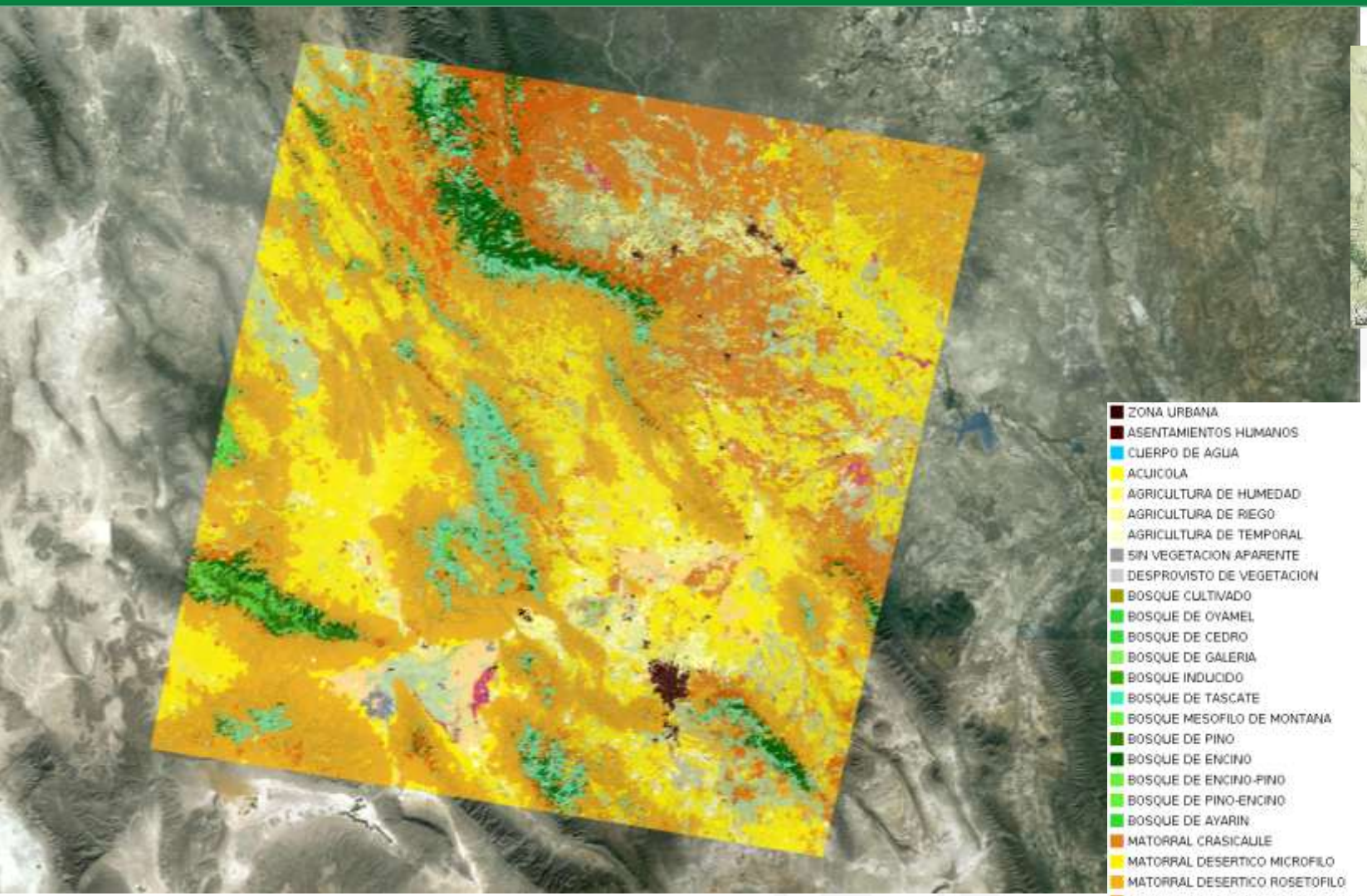


Results: processed data so far for testing

Separability analysis to discuss land cover classification scheme:

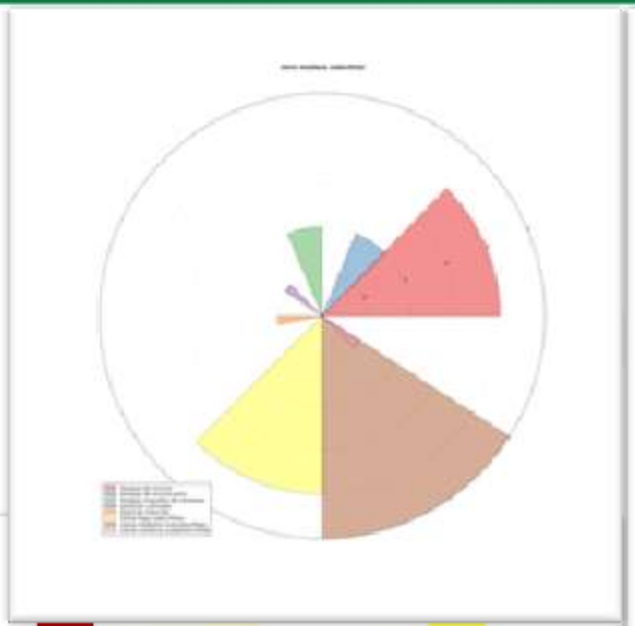


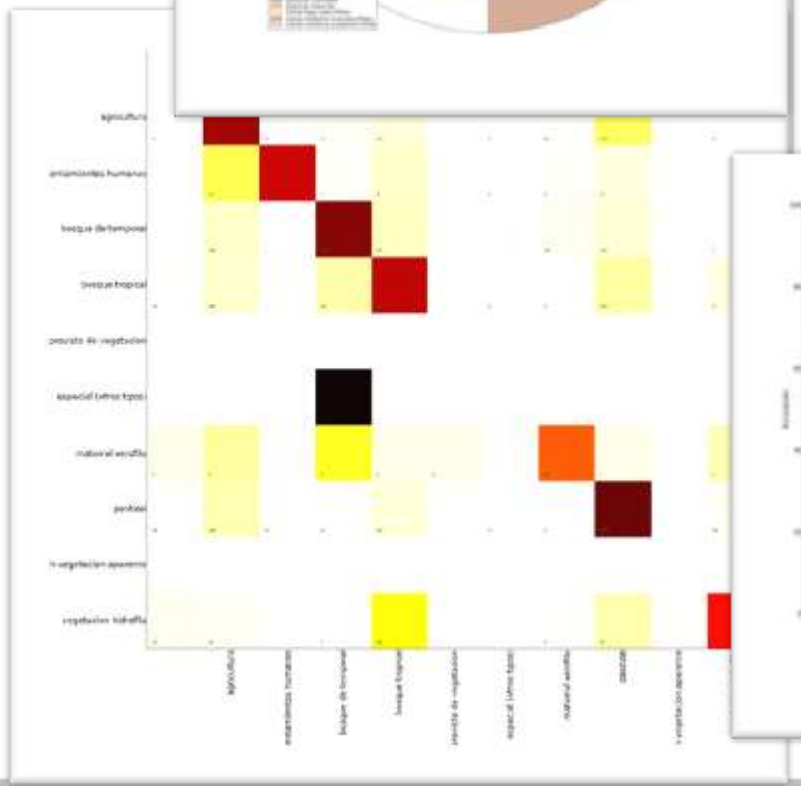
Results: samples

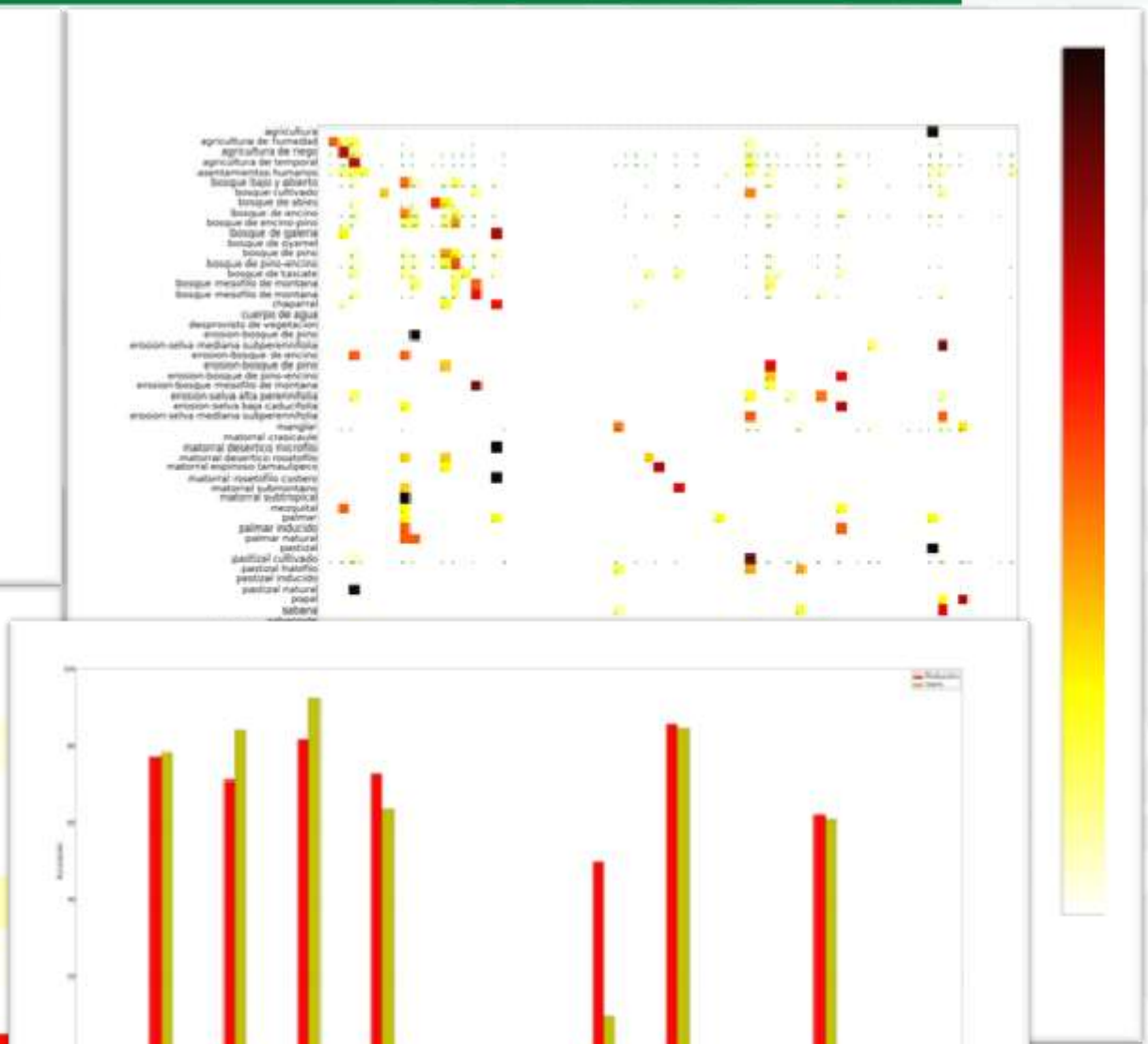


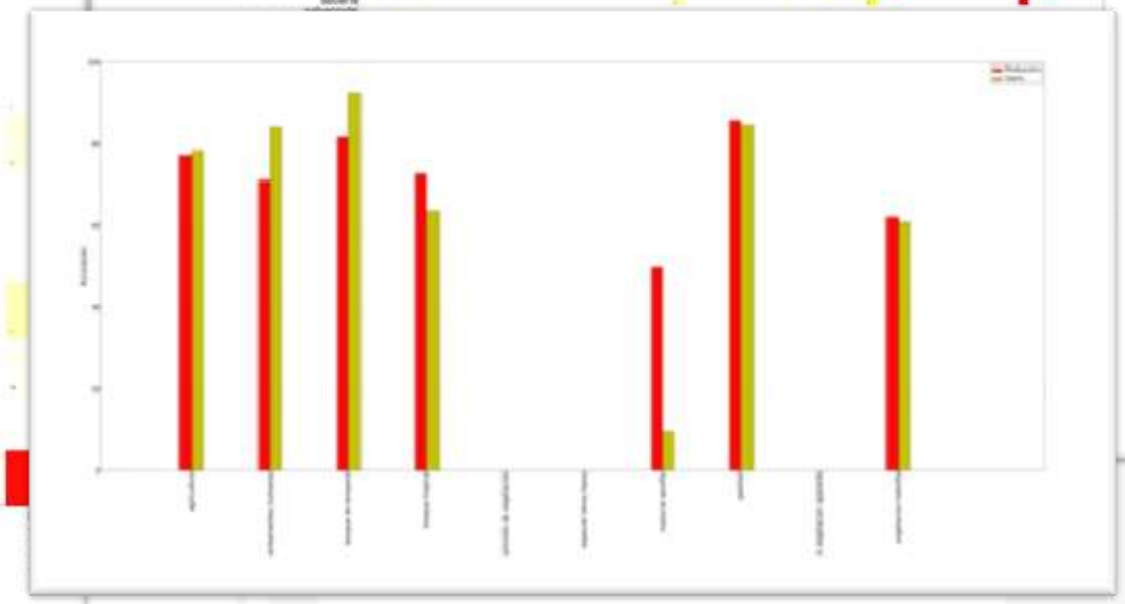
- ZONA URBANA
- ASENTAMIENTOS HUMANOS
- CUERPO DE AGUA
- ACUICOLA
- AGRICULTURA DE HUMEDAD
- AGRICULTURA DE RIEGO
- AGRICULTURA DE TEMPORAL
- SIN VEGETACION APARENTE
- DESPROVISTO DE VEGETACION
- BOSQUE CULTIVADO
- BOSQUE DE OYAMEL
- BOSQUE DE CEDRO
- BOSQUE DE GALERIA
- BOSQUE INDUCIDO
- BOSQUE DE TASCATE
- BOSQUE MESOFILO DE MONTANA
- BOSQUE DE PINO
- BOSQUE DE ENCINO
- BOSQUE DE ENCINO-PINO
- BOSQUE DE PINO-ENCINO
- BOSQUE DE AYARIN
- MATORRAL CRASICAULE
- MATORRAL DESERTICO MICROFILO
- MATORRAL DESERTICO ROSETOFILO
- MATORRAL ESPINOSO TAMAULIPECO
- MATORRAL DE CONIFERAS
- MEZQUITAL
- CHAPARRAL
- MATORRAL ROSETOFILO COSTERO
- MATORRAL SARCOCAULE
- MATORRAL SARCOCAULEC
- MATORRAL SUBMONTANO
- MATORRAL SARCO-CRASICAULE DE NEBLINA
- MATORRAL SUBTROPICAL
- PASTIZAL CULTIVADO
- PASTIZAL HALOFILO
- PASTIZAL INDUCIDO
- PASTIZAL NATURAL
- PASTIZAL GIPSOFILO
- SELVA ALTA PERENNIFOLIA
- SELVA ALTA SUBPERENNIFOLIA
- SELVA BAJA CADUCIFOLIA
- SELVA BAJA ESPINOSA CADUCIFOLIA
- SELVA BAJA PERENNIFOLIA
- SELVA BAJA ESPINOSA SUBPERENNIFOLIA
- SELVA BAJA SUBCADUCIFOLIA
- SELVA DE GALERIA
- SELVA MEDIANA CADUCIFOLIA
- SELVA MEDIANA PERENNIFOLIA
- SELVA MEDIANA SUBPERENNIFOLIA
- SELVA MEDIANA SUBCADUCIFOLIA
- VEGETACION DE DESIERTOS ARENOSOS
- VEGETACION DE GALERIA
- VEGETACION HALOFILA
- VEGETACION DE DUNAS COSTERAS
- PRADERA DE ALTA MONTANA
- VEGETACION GIPSOFILA
- VEGETACION DE PETEN
- MANGLAR
- PALMAR INDUCIDO
- PALMAR NATURAL
- SABANA
- TULAR
- POPAL

Validation and Calibration

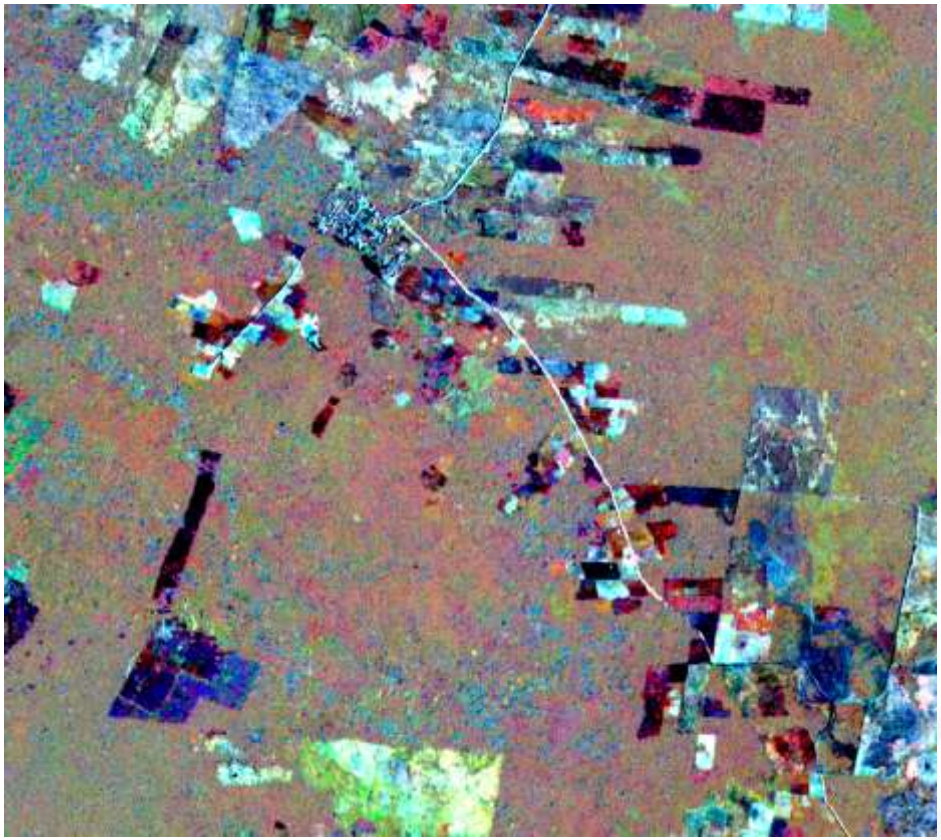








Change Detection



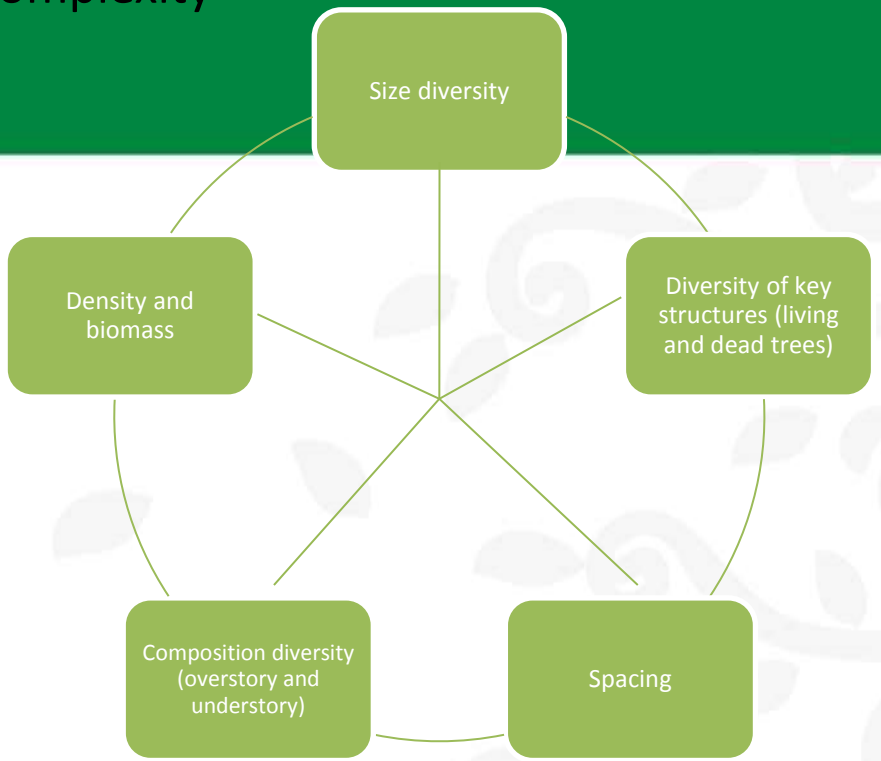
Definition: Degradation

- LGCC – Ley General de Cambio Climatico
  - Reduction of carbon content in natural vegetation, ecosystems and soils induced by human activity
- LGEEPA – Ley General de Equilibrio Ecologico y Protección ambiental
  - The process of reductions in the capacity to offer EES and products such as productivity

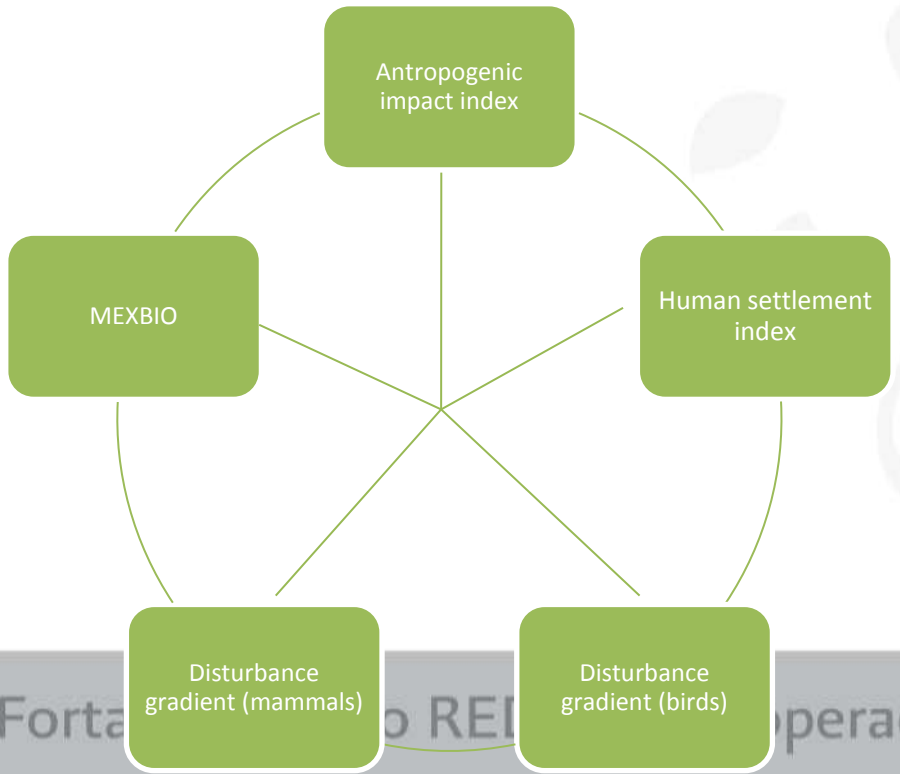
E.G.: Max. Tree Height

E.G.: Tree Density

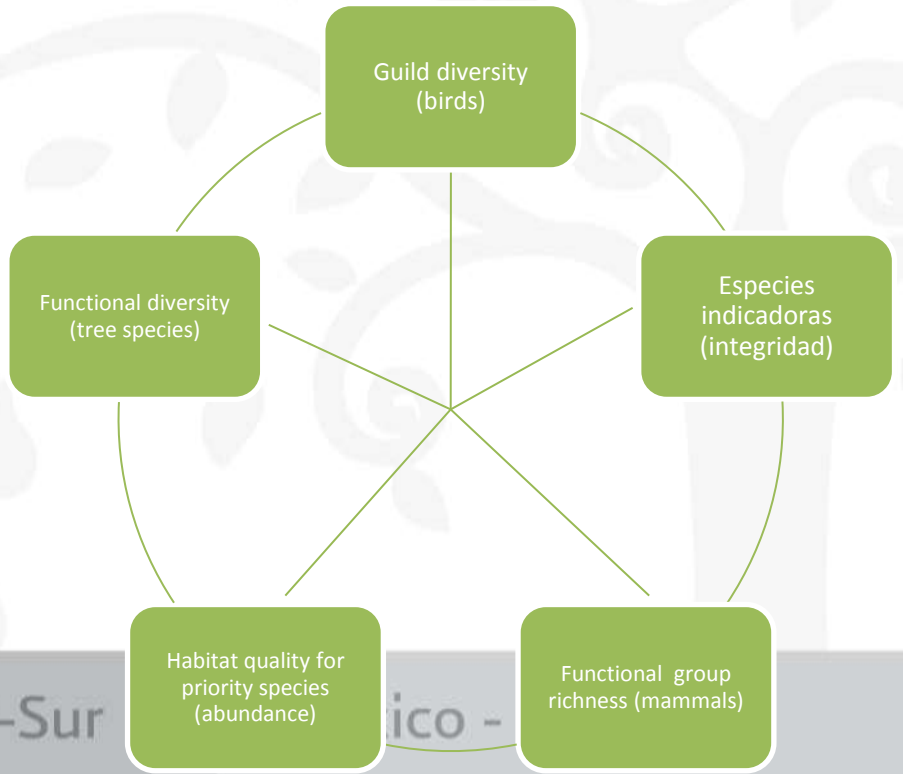
Structural complexity



Human impact



Functional diversity



Degradation in a national and a REDD + context

Index of ecosystem integity =

STRUTURAL DIVERSITY + FUNCTONAL DIVERSITY + RICHNESS

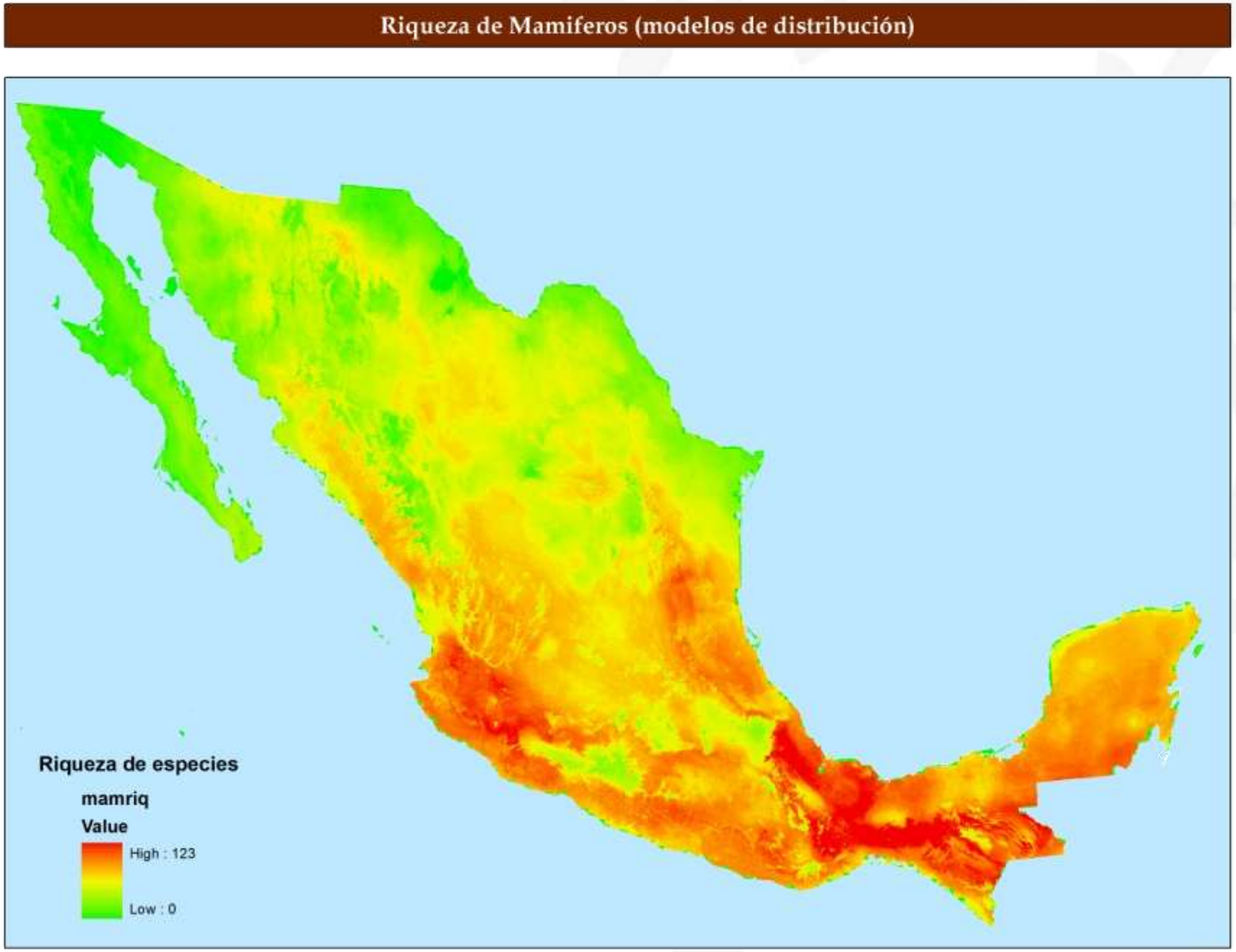
The Index will need to address:

Temporal component
Spatial component
Structural component
Flora componets
Fauna component

Have a benchmark!!!

Degradation and Monitoring of Env´tl Safeguards (incl. Biodiversity)

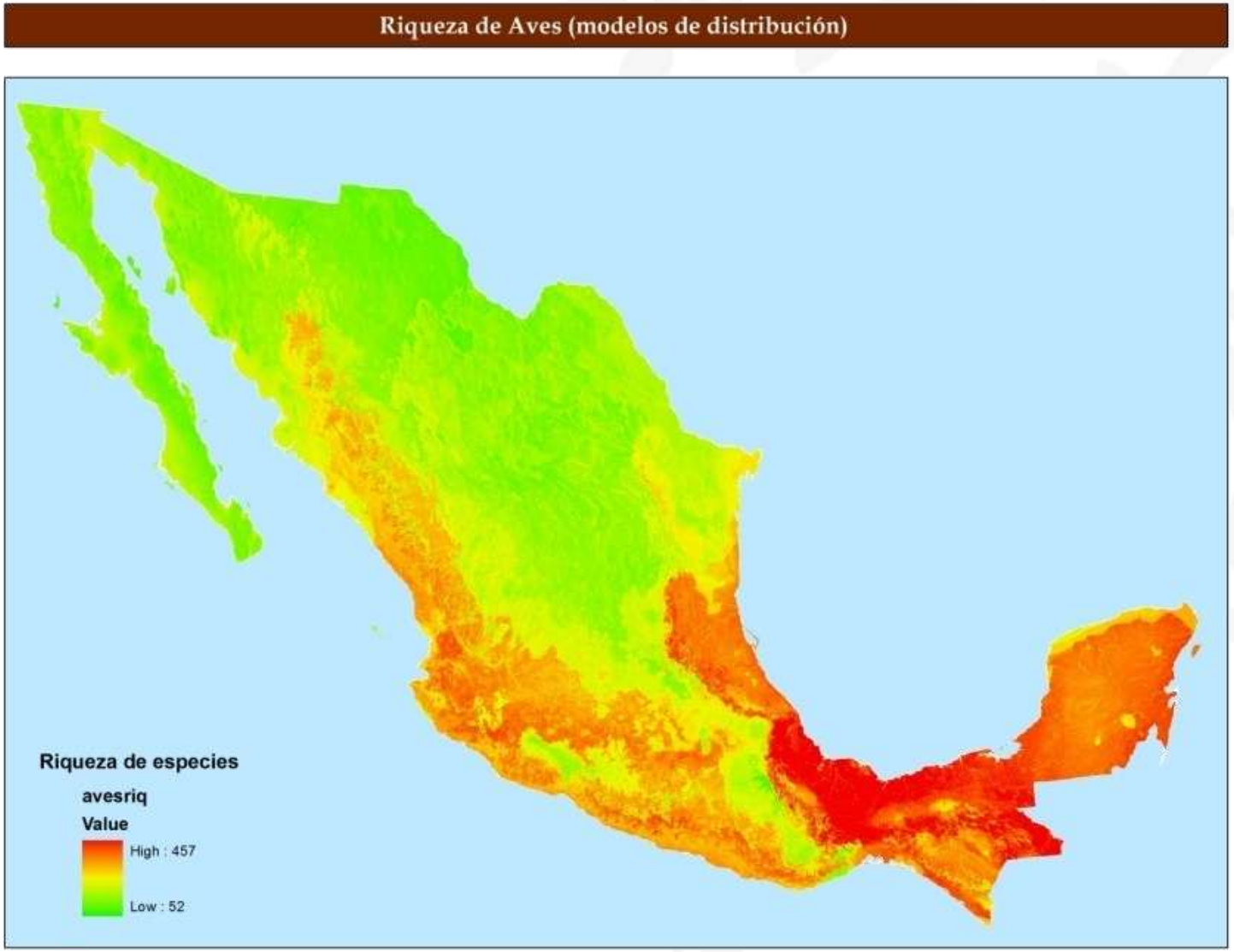
Modelled Distributions used for Size Estimation: Mammal Diversity



Based on SNIB data, Conabio

Degradation and Monitoring of Env´tl Safeguards (incl. Biodiversity)

Modelled Distributions used for Size Estimation: Bird Diversity

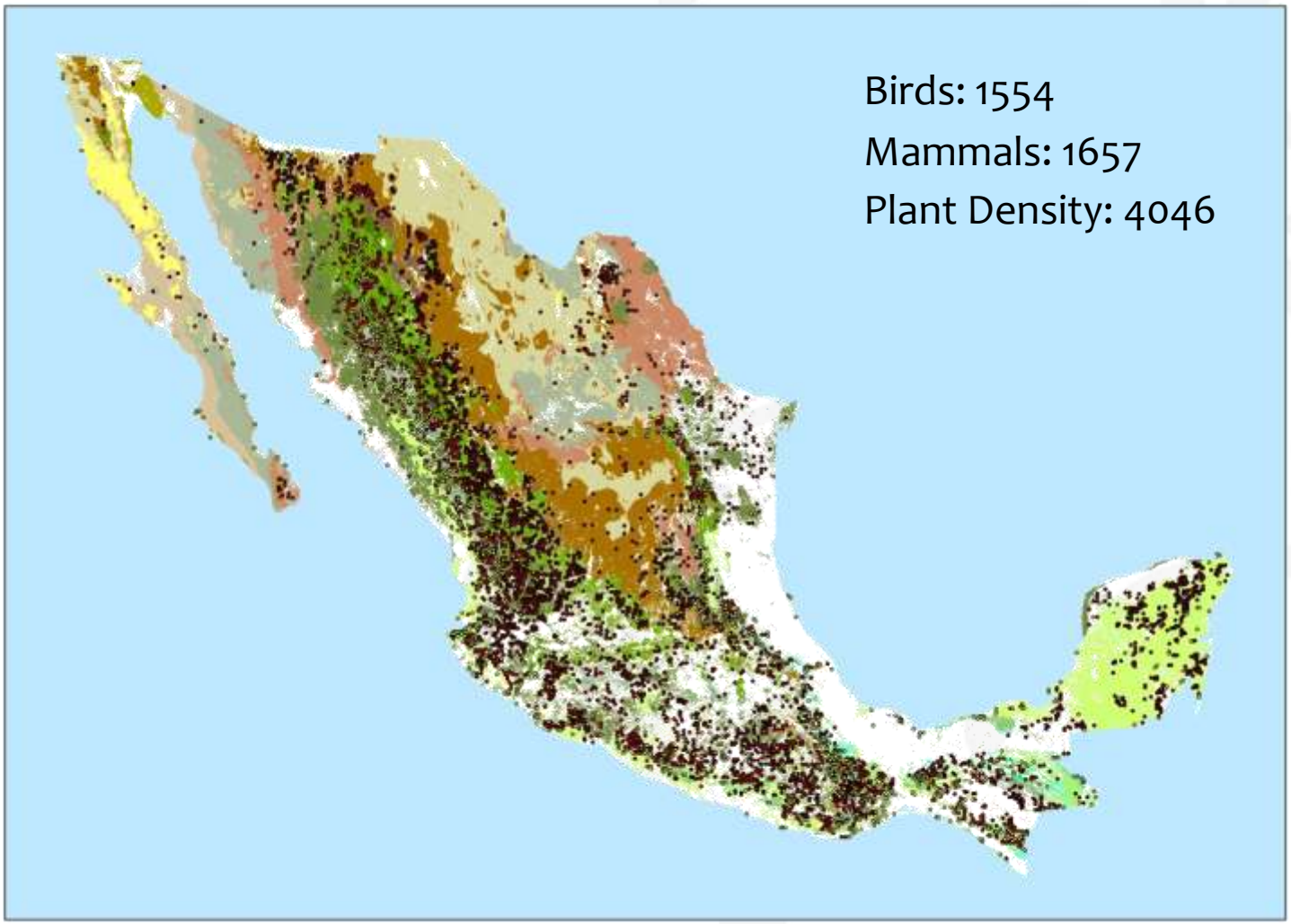


Based on eBird aVerAves

Degradation and Monitoring of Env´tl Safeguards (incl. Biodiversity)

Estimated Sampling Size:

Puntos de muestreo en Zonas de vida (Mamiferos, Aves y NDVI)



Next Steps and cooperation opportunities for further RS work for REDD

Degradation Mapping

Combine optical and SAR data to

- improve RL / Base Line
- support degradation monitoring

3 products relevant from SAR data:

- biomass (current and historic products, X, C, L-band data)
- change detection, hi-res X-band 3-1 m
- change in canopy density, hi-res, X-band

Capacity Building in SAR processing @ Conabio/Conafor