

# National Forest Monitoring System México

"Reinforcing REDD+ Readiness in Mexico and enabling South-South cooperation"

CONAFOR-PNUD-FAO

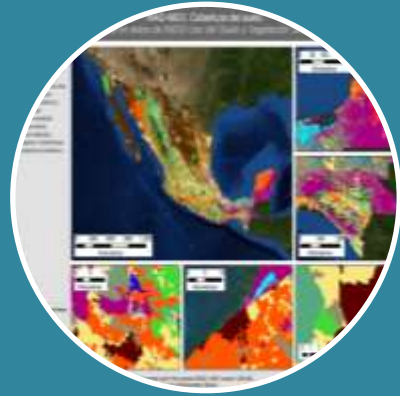
MRV is central element in the REDD+ following the UNFCCC and the IPCC guidelines.



Cooperation between Norway and Mexico governments to the project "Reinforcing REDD+ Readiness in Mexico and enabling South-South Cooperation"



# Project Results



## Outcome 1: MRV System desing and implemented

- Measure and moritoning
- Report and verification



## Outcome 2: South-South cooperation and capacity building

- Strenght national capacities for MRV
- South-South strategy
- Virtual Excellence Center for Forest monitoring



## Outcome 3: Linkage and Synergies for Public Policies Follow-Up



**Tool** to generate information to quantify **GHG** emissions and absorptions from deforestation and forest degradation at national scale.



1. Monitor REDD+ implementation.
2. Assess performance of mitigation actions in forest sector.
3. Provide relevant information for design, implementation and evaluation of public policies.

# COMPONENTS OF NFMS

Context

Emissions and removals from forests IPCC stock change method

IPCC

Activity Data  
Land Representation

Emission Factor C stock change

Emissions and removals e (GHG)

NFMS

Remote Sensing Monitoring

National Forest Inventory

National GHG Inventory

Mexico

Land Cover Series  
1:250,000

MAD-Mex  
Landsat  
1:100,000  
RapidEye  
1:20,000

NFI (2004-2014)

SFI (2013-2014)

Allometric model DB  
National EFDB

BUR  
NFREL

REDD+ Report

6th NATCOM

# INTERINSTITUTIONAL ARRANGEMENTS



AD

x



EF

=



GHG



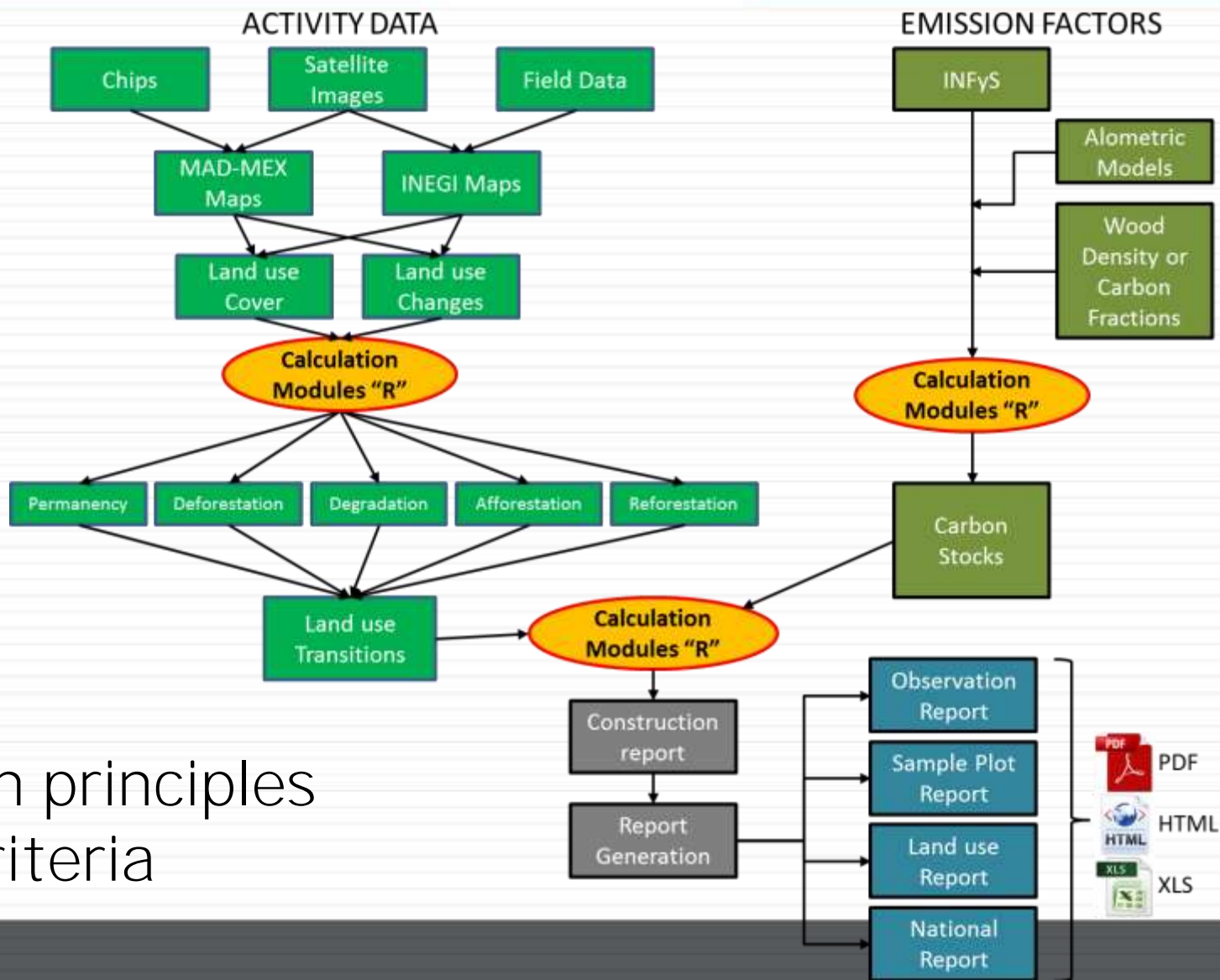
Land Use Series



National Forest  
Inventory



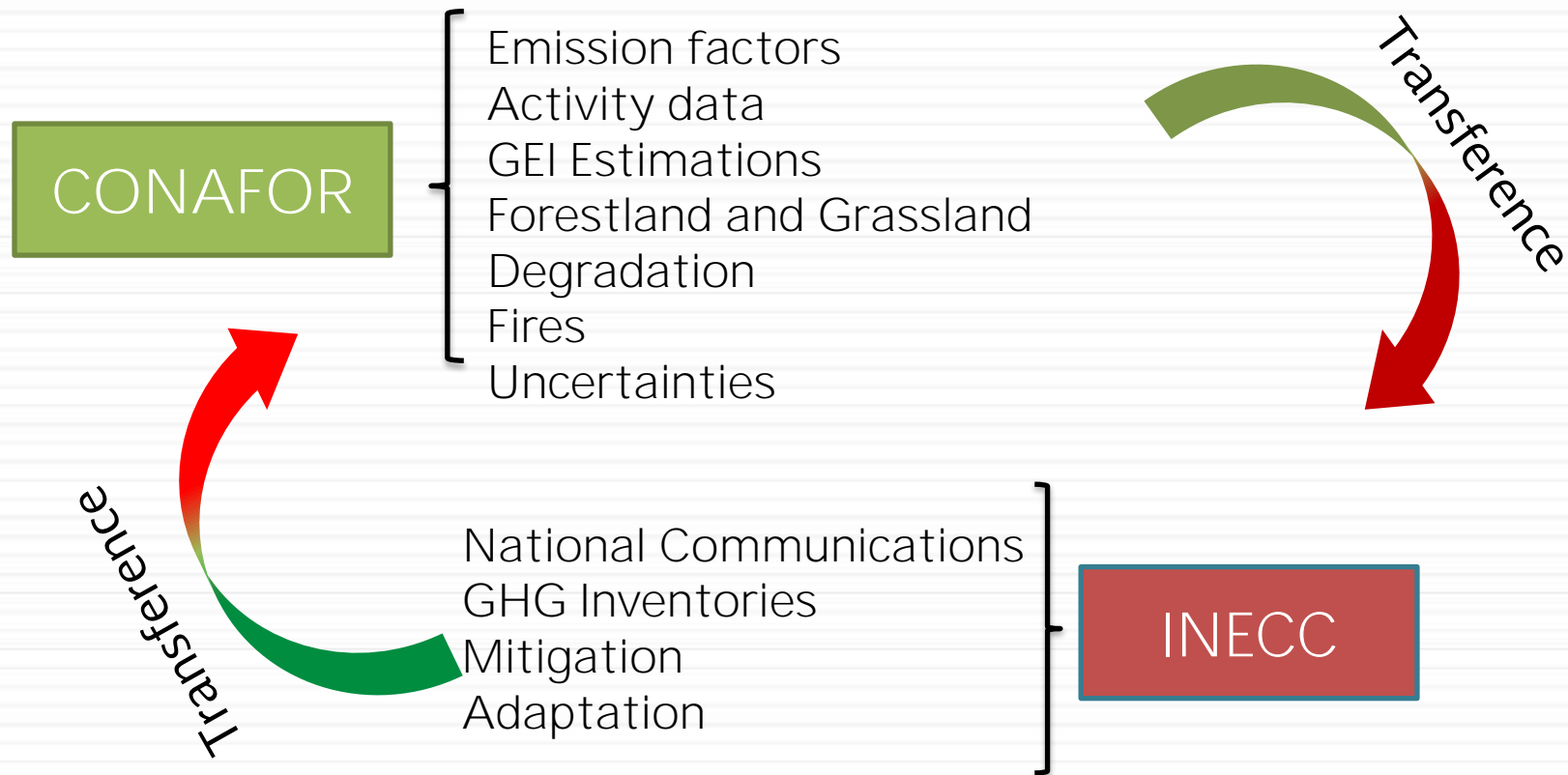
GHG Inventory



NFMS  
Design principles  
and criteria

# System Institutionalization

## Current capabilities





# ACTIVITY DATA



# CHANGE MATRIX

2003

Land Use Change Matrix SII - SIII	PRIMARY FOREST LAND											SECONDARY FOREST LAND								GRASSLAND				WETLAND				CROPLAND		SETTLEMENTS	OTHER LANDS					
	BC	BCO/P	BE/P	BM/P	EOTL/P	MXL/P	SC/P	SP/P	SSC/P	VHL/P	BCO/S	BE/S	BM/S	EOTL/S	MXL/S	SC/S	SP/S	SSC/S	VHL/S	EOTnL/P	MXnL/P	MKnL/S	P	VHnL/P	VHnL/S	Acuicola	HUM	AGR-AN	AGR-PER	AH	OT					
	8,901																																			
<b>PRIMARY FOREST LAND</b>	BCO/P	75	12,560,938	90,437	65,257	205	389	11,420	5,261	6,425	43	912,414	28,906	4,113		124	11,912	273	1,671				697								1055					
	BE/P	70	170,880	10,280,128	15,020	92	1,173	49,833	14,473	38,044	280	59,611	785,350	1,544	6,726	1,128	44,875	1,983	11,635		67		144664								216322	11621	906		41	
	BM/P																				471		144288		90						108925	1153	607		466	
	EOTL/P																						12794								22115	3978	58			
	MXL/P																						49217		1074						14938	323			396	
	SC/P																				5931	535	49217								174761	3044			1817	
	SP/P																				153	62215	4155	265577		1		2028				14938	3044			1817
	SSC/P																				165	228	1	197203		1853		390				275916	17809			1613
	VHL/P																				10			405662								68069	6296			577
<b>SECONDARY FOREST LAND</b>	BCO/S	8	224,619	18,758	8,380		738	2,400	362	1,299	161	2,532,269	13,903	9,859		50	11,322	117	1,972				96910								82298	1688			550	
	BE/S	368	36,590	121,546	1,388	8	698	19,629	1,037	6,299	115	25,277	3,508,386	234	787	45	38,669	437	6,124		209		205948								78139	902			1482	
	BM/S																						24775								27398	1250			34	
	EOTL/S																						49217								14938	323			396	
	MXL/S																						49217								174761	3044			1817	
	SC/S																				254		7498								9226	45			10	
	SP/S																				606	25	60741		74		478				65564	794			74	
	SSC/S																				549	341		443443		804		309				354855	26795			1618
	VHL/S																				11			378332		2927						94866	11148			452
<b>GRASSLAND</b>	EOTnL/P																																			
	MXnL/P																																			
	MKnL/S																																			
	P																																			
<b>WETLAND</b>	VHnL/P																																			
	VHnL/S																																			
	Acuicola																																			
	HUM																																			
<b>CROPLAND</b>	AGR-AN																																			
	AGR-PER																																			
<b>SETTLEMENT</b>	AH																																			
<b>OTHER LANDS</b>	OT																																			

1993

PRIMARY PERMANENCY

FOREST DEGRADATION

FOREST RECOVERY

SECONDARY PERMANENCY

AFFORESTATION

GRASSLAND PERMANENCY

WETLAND PERMANENCY

LAND USE CHANGE

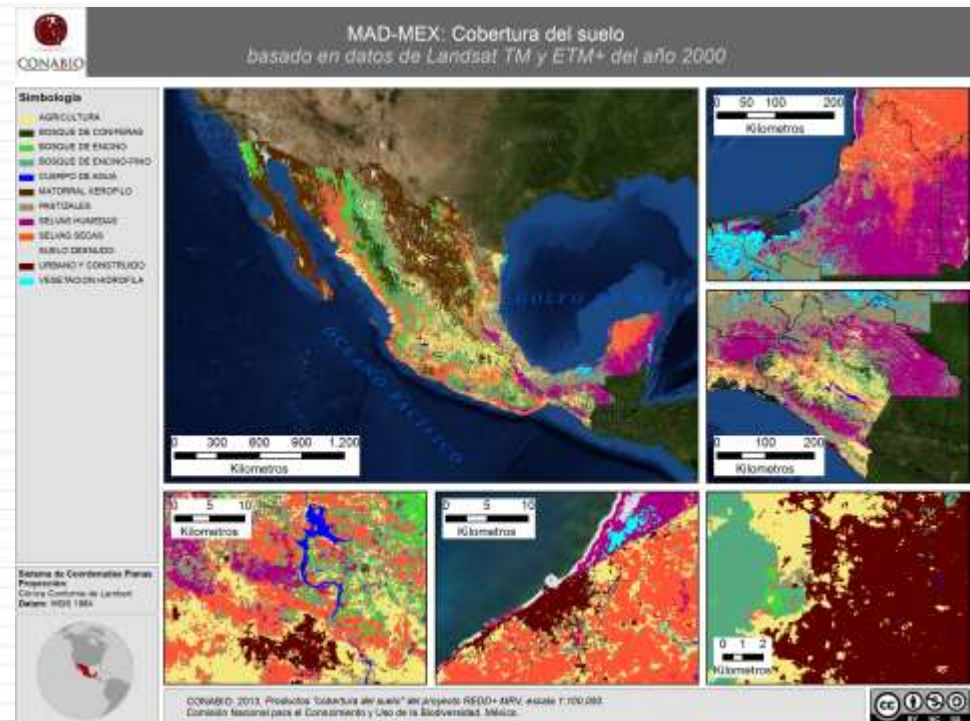
SIN CAMBIO

- **Land Cover 1:100,000 y 1:20,000**

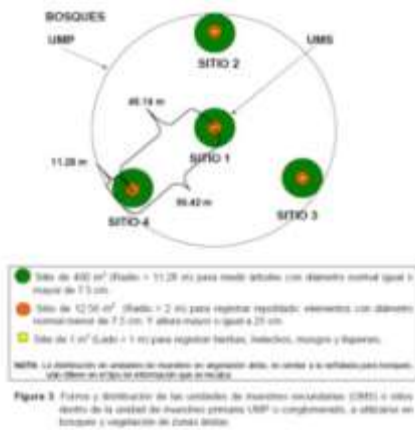
- Landsat– 12-20-32 clases, 1993,1995,2000,2005 y 2010
- RapidEye -12-20-35 clases, años 2011,2012 y 2013

- **Cover Change**

- Landsat 1995-2000, 2000-2005 y 2005-2010,
- Cambios RapidEye 2011-2012, 2012-2013.



# NATIONAL FOREST AND SOIL INVENTORY



- Spatial
- Systematic
- Temporal



PSU = 26, 220  
Sites = 81, 665

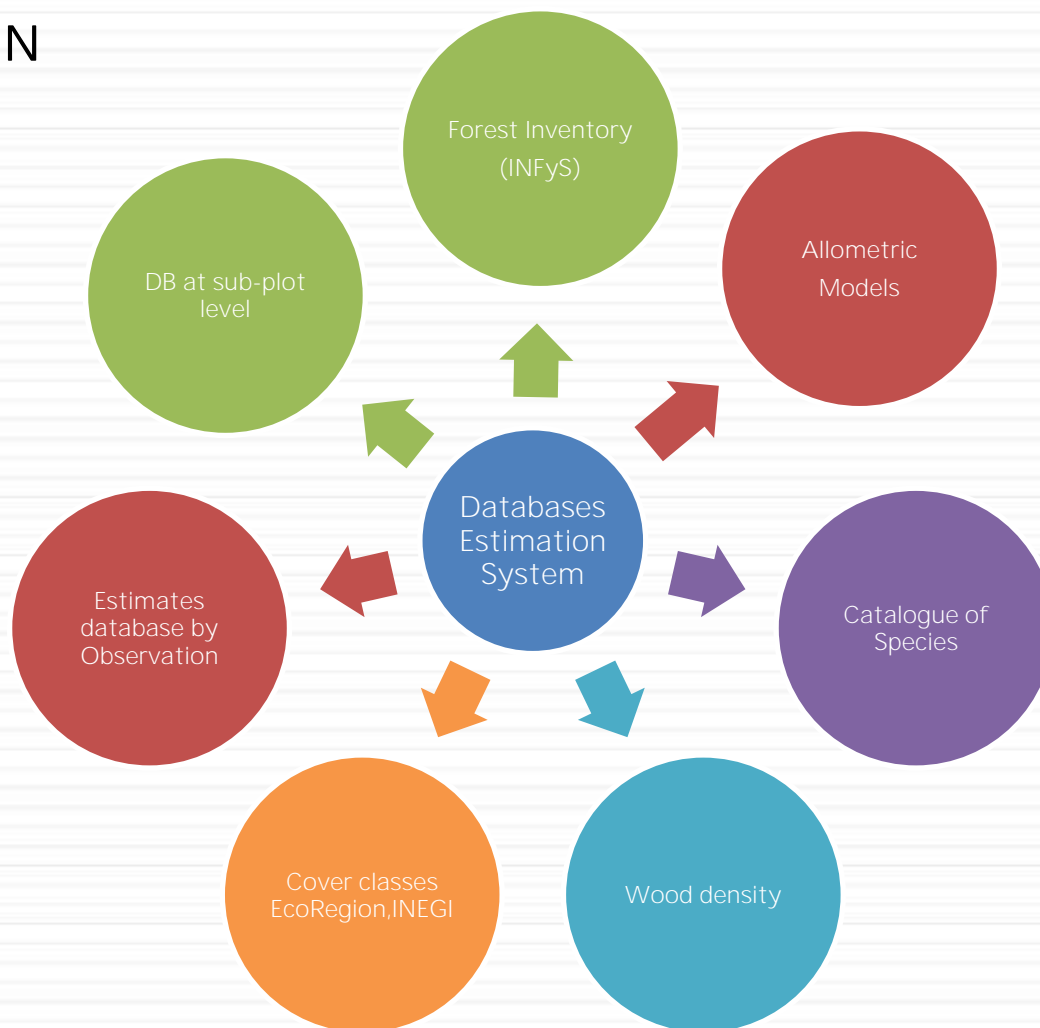
Sampling: 2004-2007  
Re sampling: 2009 -2014

Grid of km | 5x5 | 10x10 |  
20x20 |

**2' 365, 644 trees >7.5 cm (2004-2012)**

Additional data bases  
<http://www.mrv.mx/modelosalometricos>

## EF ESTIMATION



## DATABASE ANALYSIS- Quality Control

Forest  
Inventory  
(INFyS)

QA

- *Dbh and height wrong data*
- *Used a unique id for species*



QC

- Normalization by species. 
$$Z = \frac{(x - X_{sp})}{\sqrt{\sigma^2}}$$
- Where  $|Z| \geq 4.5$  sigma

From 2'899,270 individuals (2004-2013)

41,324 < 1.4% with error

Allometric  
Models

QA

Errors ~ 30%:

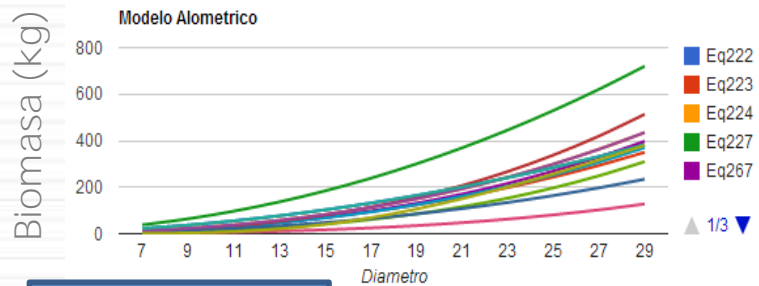
- Typo errors
  - Wrong unities
  - Environmental condition
  - Sampling information
- ( $n, r^2, d, \text{min-max, etc.}$ )

QC

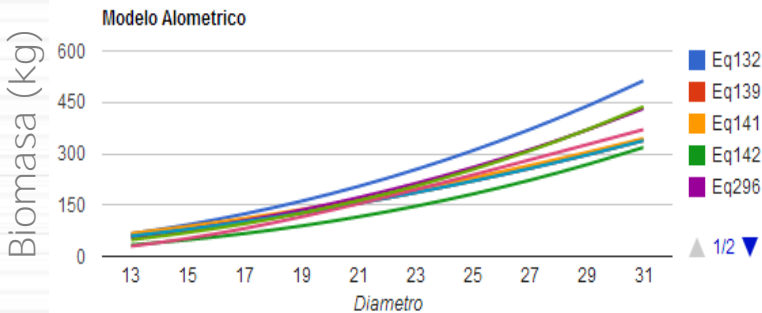
- *Negative estimates*
- *Decreasing estimates*
- *Degrees of divergence compared to other equations*
- *Homogenized species*

# Allometric Models database-Decision tree algorithm

## Supplies and characteristics

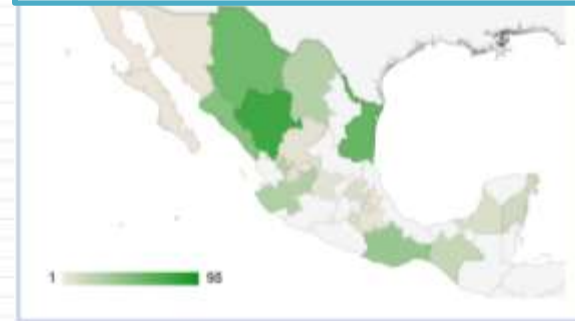


Quercus sp.



Pinus pseudostrobus

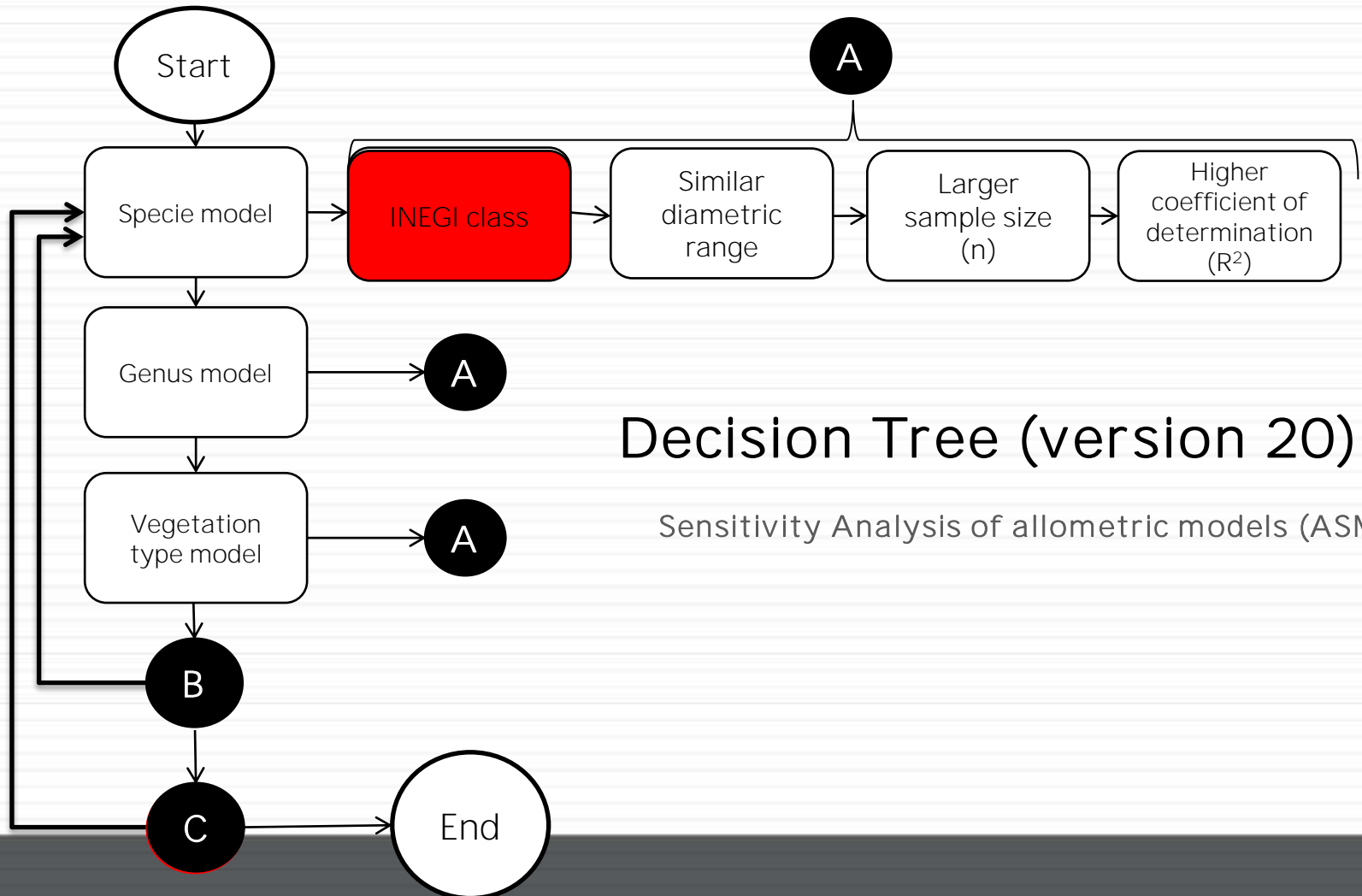
## State distribution of allometric models



INEGI. type of vegetation AND Ecoregions



# Decision tree version 20 at Observation Level

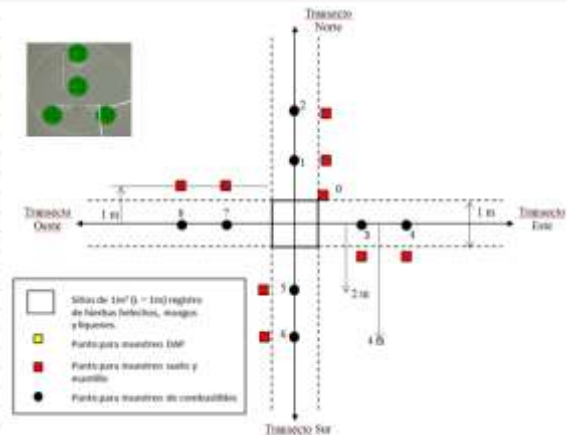
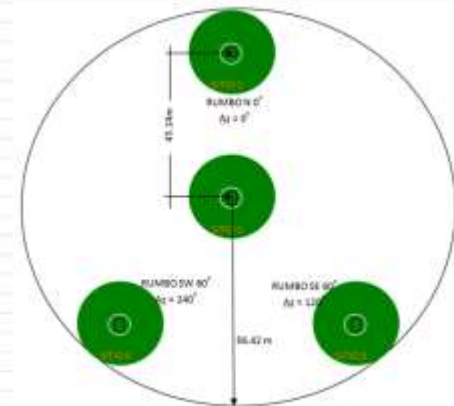




# Emission Factors

## Methods

Pool of Carbon	Components
Above ground biomass	Live tree
Underground biomass	Roots
Dead wood	Dead trees
	Stumps
	Coarse Woody Debris
Forest litter	Forest litter and Humus
Soils	Soil profile



# Emissions and absorptions in the forest sector

## Método



$$E_{TF-TF} = EF_{TF-TF} \times AD_{TF-TF}$$



$$E_{TF-TFd} = EF_{TF-TFd} \times AD_{TF-TFd}$$



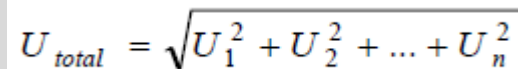
$$E_{TFd-TF} = EF_{TFd-TF} \times AD_{TFd-TF}$$



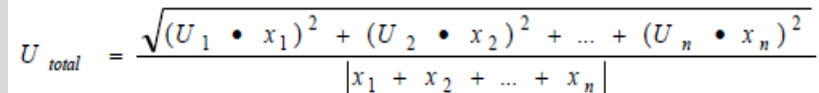
$$E_{OU-TF} = EF_{OU-TF} \times AD_{OU-TF}$$



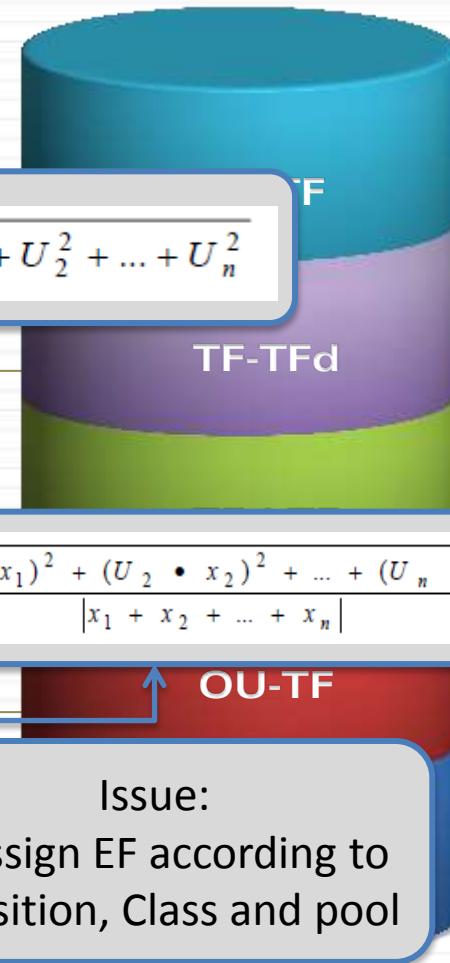
$$E_{TOT} = E_{TF-TF} + E_{TF-TFd} + E_{TFd-TF} + EF_{OU-TF}$$



$$U_{total} = \sqrt{U_1^2 + U_2^2 + \dots + U_n^2}$$



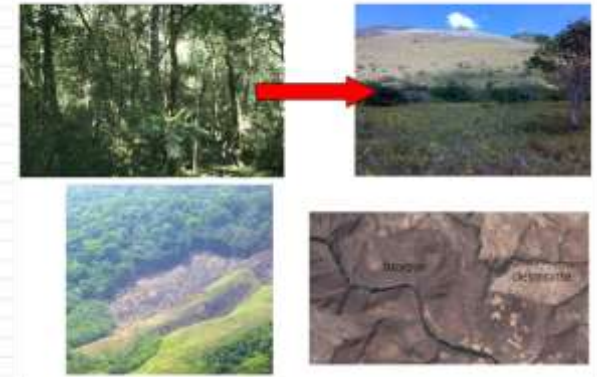
$$U_{total} = \frac{\sqrt{(U_1 \cdot x_1)^2 + (U_2 \cdot x_2)^2 + \dots + (U_n \cdot x_n)^2}}{|x_1 + x_2 + \dots + x_n|}$$



Issue:  
To assign EF according to  
Transition, Class and pool

# EMISSION FACTOR DATA BASE

Deforestación = pérdida neta de cobertura forestal



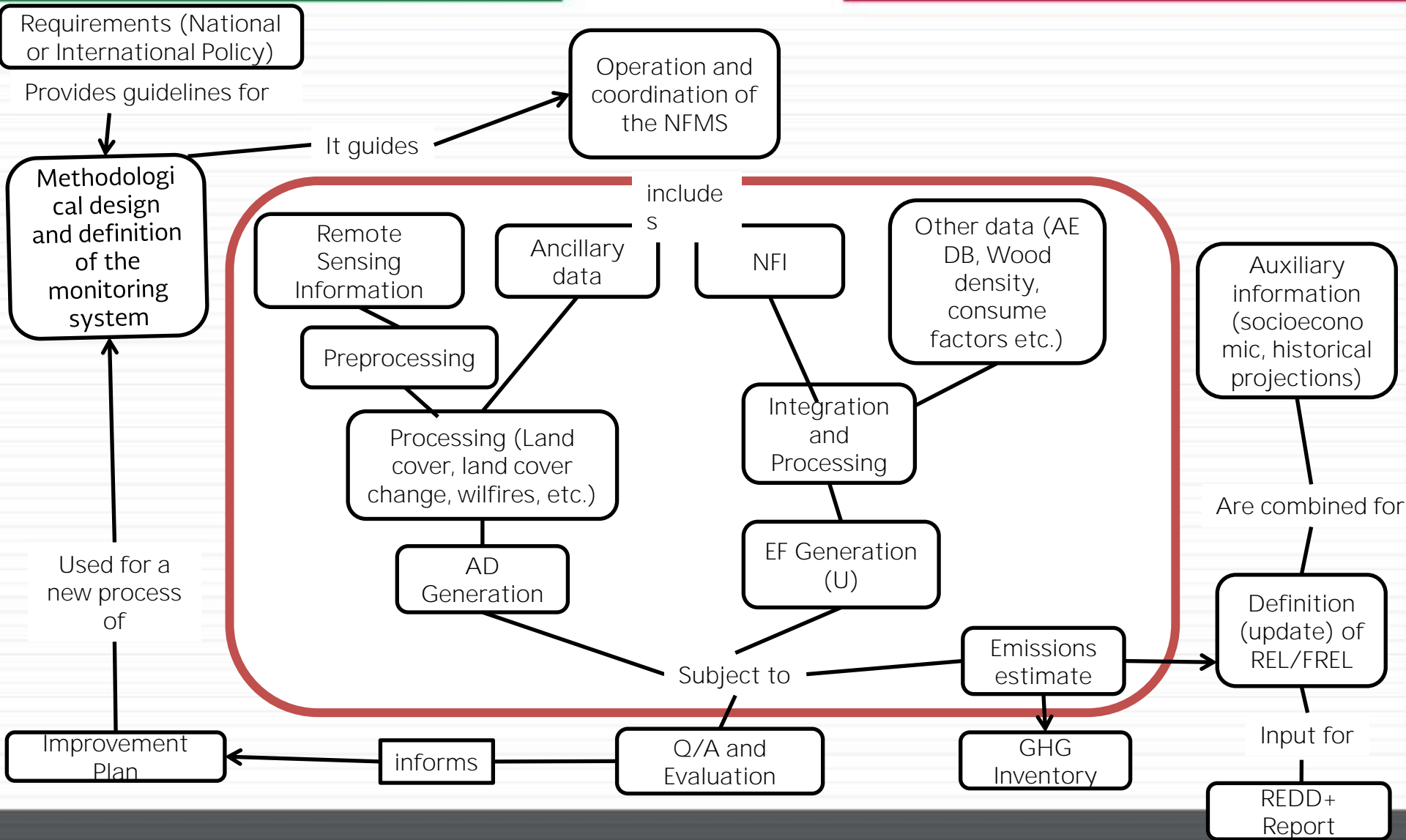
Forest Land – Other Land				Forest Land Remaining		
Strata	n	(ton C/ha)	U (%)	n	(ton C/ha/year)	U (%)
BCO/P	4404	33.6	2.1	3190	0.43	25
BCO/S	1137	22.1	4.8	780	0.30	57
BE/P	3365	20.7	2.7	2330	0.46	19
BE/S	1466	14.7	4.9	1037	0.48	24
BM/P	357	37.7	9.9	245	1.46	52
BM/S	160	18.1	19.0	102	0.30	228
EOTL/P	32	3.5	95.1	22	-0.41	-311
EOTL/S	31	4.6	55.8	28	0.09	193
MXL/S	198	3.2	28.8	129	0.04	324
SC/P	939	17.4	5.3	660	0.41	48
SC/S	613	12.6	7.6	413	0.66	35
SP/P	2375	40.4	2.9	1436	0.48	51
SP/S	585	19.7	9.1	280	0.63	63
SSC/P	993	30.2	4.8	680	1.36	18
SSC/S	491	16.1	8.9	187	0.63	63
VHL/P	246	13.3	22.4	142	1.03	56

Factores de Emision (BO)  
Base de Datos de Factores de Emision

Transition Pool	FL-FL (Permanence)	FL-FLd (Degradation)	FLd –FL (Recuperation)	FL-OL (Deforestation)	OL-FL (Reforestation)
Above ground biomass	Yes	Yes	Yes	Yes	Yes
Under ground biomass	Yes	Yes	Yes	Yes	Yes
Dead trees	Yes	--	--	Yes	--
Stumps	--	--	--	Yes	--
CWD	Yes	--	--	Yes	--
DOM (litter and duff)	--	--	--	Yes	--
Soils	--	--	--	Yes	--

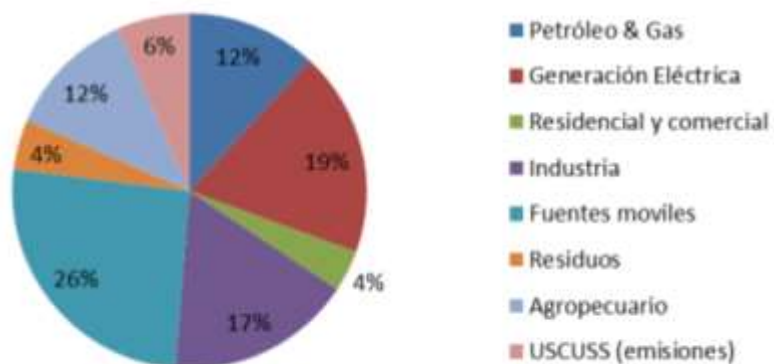
1. The number of EF depends on the classification system
2. **374** total EF for 5 pools and 5 transitions
3. **17** algorithms for EF estimation programmed in R

# NFMS Implementation



# Results

## Emisiones GEI Gg CO<sub>2</sub> eq.

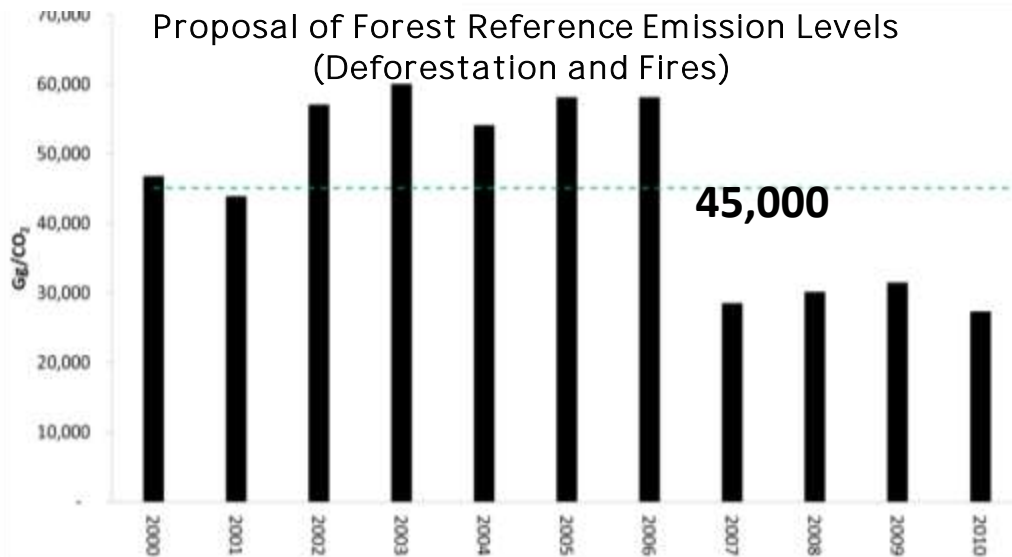


Absorción USCUISS 27.38%

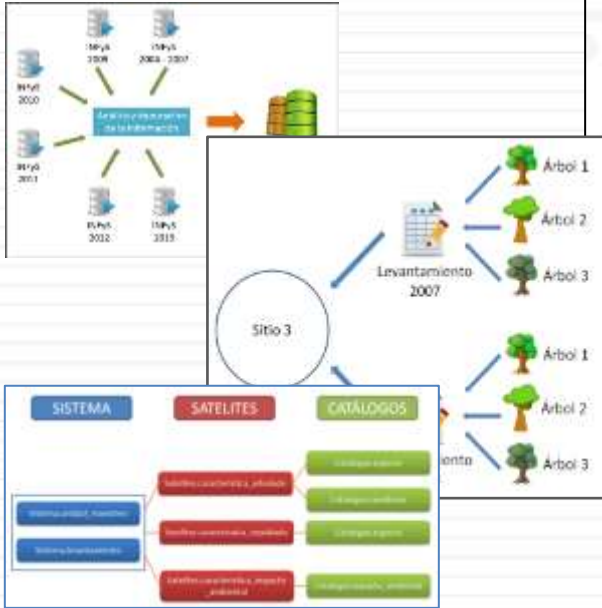
## FOREST SECTOR (USCUISS)

- Net Sink CO<sub>2</sub><sub>eq</sub>
- Sixth Emitter CO<sub>2</sub><sub>eq</sub>
- 27% of the CO<sub>2</sub><sub>eq</sub> total balance

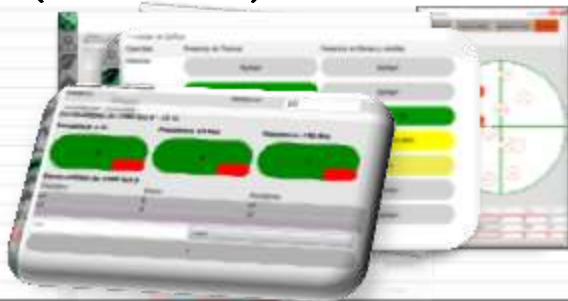
## Proposal of Forest Reference Emission Levels (Deforestation and Fires)



## Database Management (Quality - Systematization)



## Enhancements INFyS field (variables)



## Protocols



## Uncertainty estimations (Transparency)

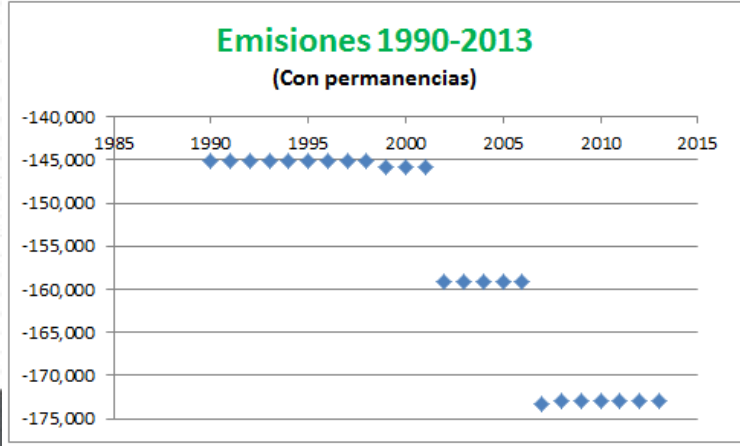
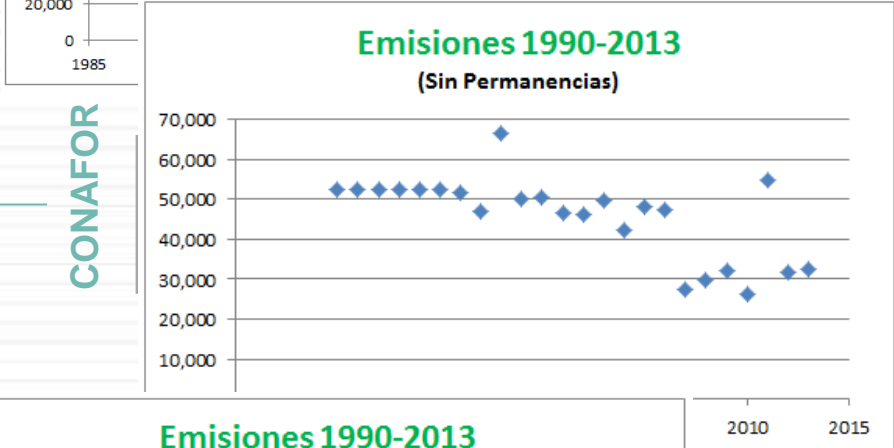
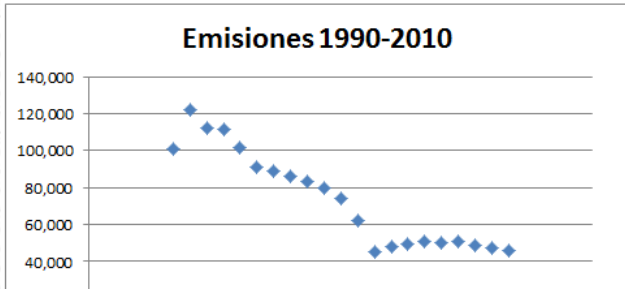
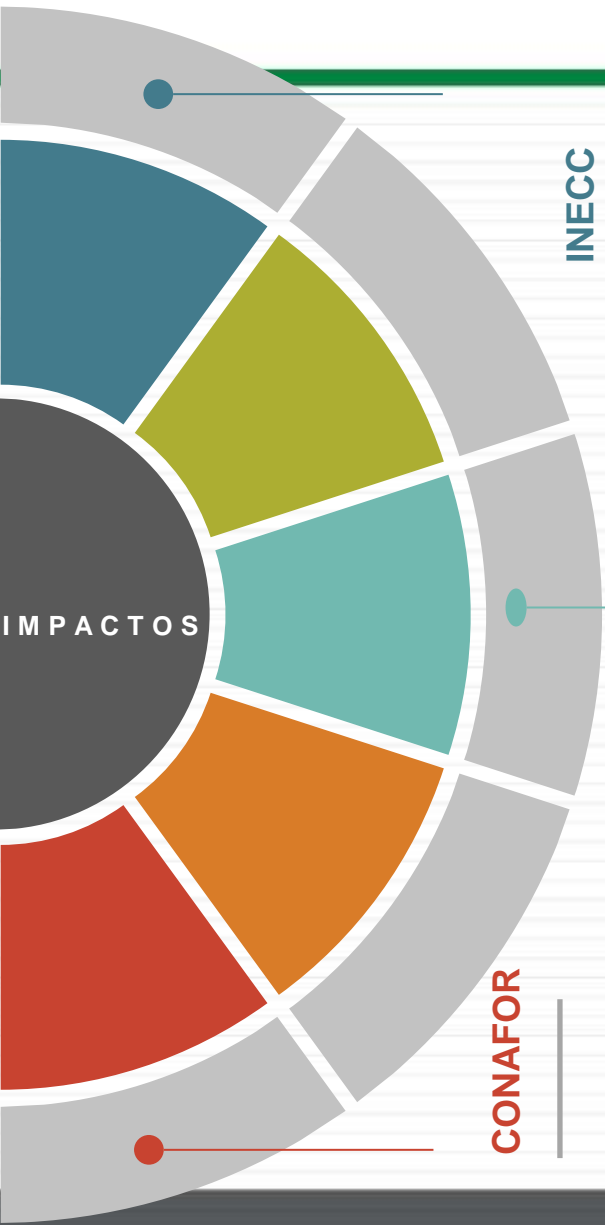
Estrato	Número de UMS	Número de UMP	Area (Has)	Densidad de Carbono (tonC/ha)	Incertidumbre (%)
	24	9	37,350.7	50.3	38
		4,539	12,916,771.5	32.6	2
		1,189	3,920,676.8	21.6	5
		3,478	10,708,651.8	20.0	3
		1,522	4,920,073.4	14.4	5
		367	1,300,704	38.0	10
		160	541,573.1	18.1	21
		28	270,230.5	8.3	70
		31	157,748.2	5.7	43
		4	154,700	2.9	219
		1,497	18,501,770.3	1.7	11
		184	2,437,423.9	1.4	30
		889	34,105,690.3	0.2	22
		89	2,660,600.2	0.5	85
		2,067	31,116,487	4.7	10
		984	10,896,213.7	12.1	6
		629	6,799,071.2	8.3	8
		2,512	8,162,564.8	34.4	3
		482	2,122,608.4	14.1	11
		1,175	2,990,571.9	21.8	5
		305	1,451,458.9	15.2	11
		263	1,097,953.5	10.2	22
		18	78,105.8	6.1	68
		171	1,428,189.4	1.6	50

## Communication



## Capacity Building







# Emission Estimation Plataforma

Observación

Unidad de Muestreo

Estrato

Nacional

Período

2004-2007 (ciclo 1)

▲ INEGI-BUR (USCUSS)

▲ Reporte REDD+

▲ Reporte FRA

▲ Reporte NREF



National BUR

Cambio de Uso de Suelo	Superficie (ha)	Emisiones de C (tonC)	Incertidumbre (%)
OU-PRAD	556652	-118636.85	0
OU-TF	678780	-627275.09	0
PRAD-OU	225469.25	796472.785	5.445
PRAD-PRAD	67826854	0	
TF-OU	155562.25	1938158.571	1.128
TF-PRA	192668	2805288.599	1.073
TF-TF	86073201	0	
TF-TFd	238116	401245.16	0
TFd-TF	1147570	-1246859.36	0

Showing 1 to 9 of 9 entries

📄 Exportar como Excel archivo

<http://pref.cnf.gob.mx/pref/>

# IMPACT

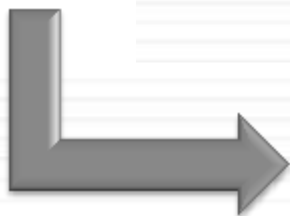
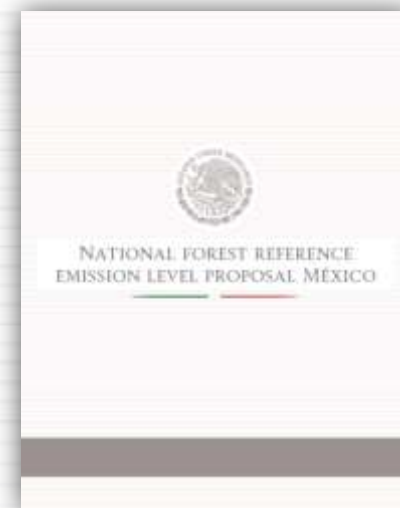


Carbon and Biomass



United Nations  
Framework Convention on  
Climate Change

Forest Reference  
Emission Level  
Proposal



Biannual Update Report  
(BUR)  
NGHGI - LULUCF

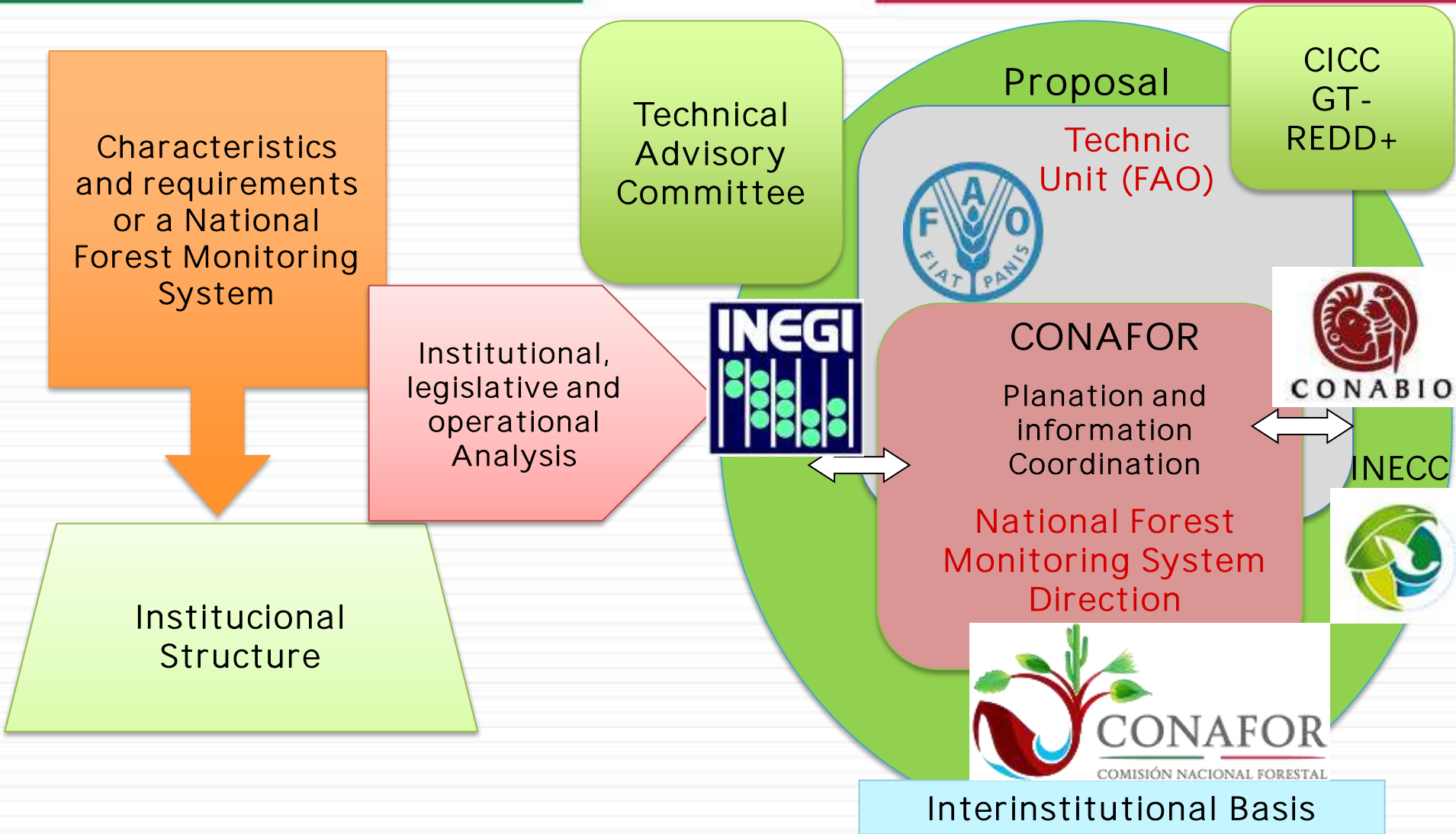
NFMS Useful  
for:

INDC

REDD+  
report

Conversion of natural  
forest, reversals,  
displacement

6<sup>a</sup> NATCOM



## IMPACT

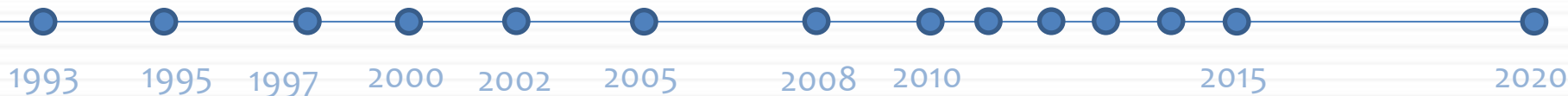
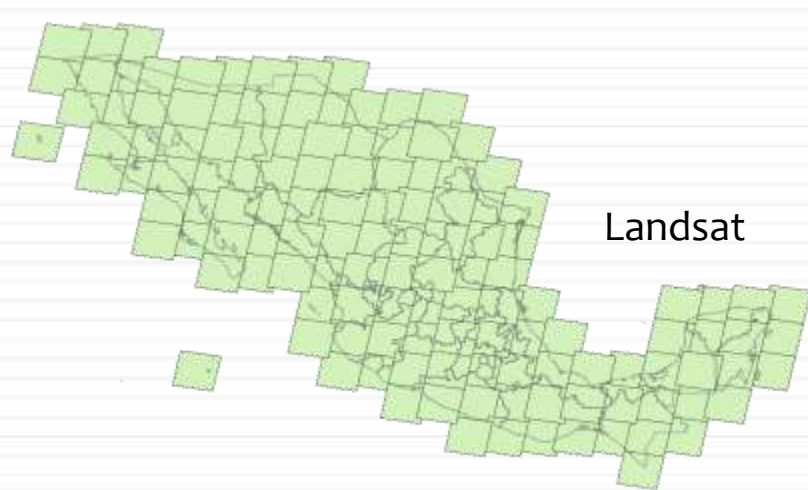
- Advance in REDD+ readiness
- Accomplishment of international commitments
- Improvement of monitoring of mitigation national targets
- Mexico is now a referent in Forest Monitoring in Latin America
- South South cooperation opportunities

## CHALLENGES... SOME IMPROVEMENTS

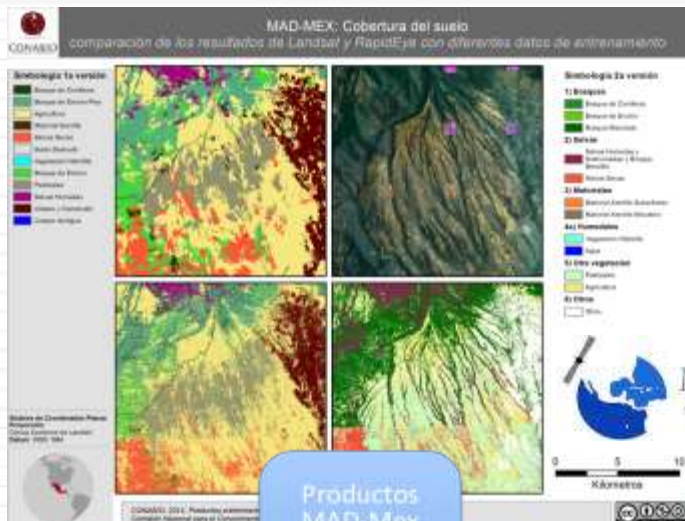


**MAD-MEX**  
SISTEMA PARA EL MONITOREO  
DE DATOS DE ACTIVIDAD

1. Land Cover (32 classes)
2. Change in land cover (deforestation / reforestation) (IMAD-Maf)
3. Canopy cover as a proxy for degradation / recovery (Matt Hansen)



## Land Cover Maps



Productos MAD-Mex producción automática: LC / LCC 1:20,000 & 1:100,000 Estatus: no validado, preliminar 35/16 clases 2-4 clases de cambio

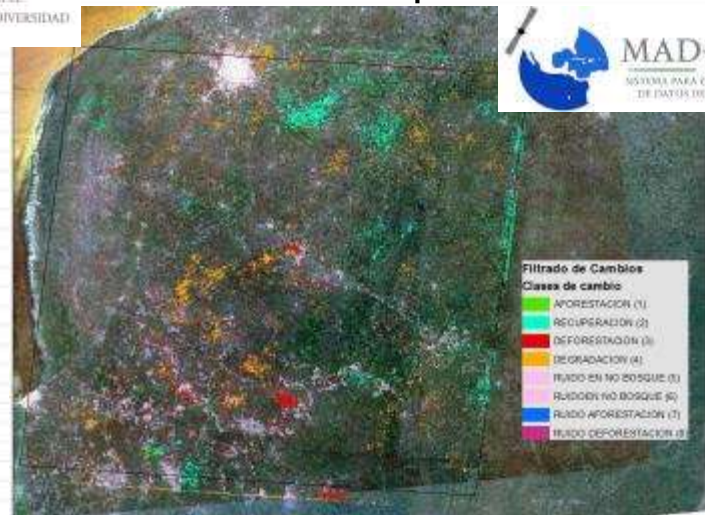
Productos LUCC 1:20,000 & 1:100,000 16/35 clases, revisado, control de calidad, dirección y tipo de cambio, incertidumbre preliminar calculada

revisión por expertos externos (academia, etc.), comentarios

edición final, publicación



## Land Cover Change Maps



## CHALLENGES

- Long Term Interinstitutional Coordination
- High level capacities
- **Generate and transfer of “new” knowledge**
- Field campaign for all pools and changes
- Tools to share results
- Long term sustainability (institutionalization of the NFMS)
- Used for other purposes

# South-South Cooperation Strategy

Reinforcing REDD+ and South-South Cooperation Project



# Mesoamerican Strategy for Environmental Sustainability

- Cooperation instrument: structured flexible and participatory to strengthen capacities in the region
- Promote sustainable development, identifying priorities in the region and including actions that were established in agreement with the countries.
- Climate change is one of the three strategic areas



May  
2013

- Second meeting of the Ministers Council of EMSA (may 2013), cooperation activities y monitoring systems and climate change analysis

July  
2013

- Workshop “*International cooperation opportunities to strengthen monitoring systems in Mesoamerica and REDD+ Readiness*”
- Identify needs and priorities on forest monitoring in order to identify collaboration priorities in the Mesoamerican Region.

Nov  
2013

- Draft “State of implementation of National Monitoring Systems in Mesoamerica”
- Warsaw meeting: Agreement to work in a Work Plan proposal to strengthen national forest monitoring systems.

Feb  
2014

- Draft for final feedback from countries. Proposal for three main activities: i) south-south cooperation early actions; ii) sources of finance for the activities, iii) Master plan for building capacities and institutionalizing monitoring systems.

Feb –  
Nov  
2014

- **Early cooperation actions:** Strengthening of technical capacities through six workshops (2014), with technical and financial support of the main initiatives working on monitoring systems for REDD+ in the region.

Oct  
2014

- Approval of regional needs assessment: **financial and technical support by the UN-REDD programme** to consolidate the Detailed Plan for Forest Monitoring within the EMSA

# GUIDING PRINCIPLES

1. Compatibility

2. Quality and neutrality

3. Sinergy promotion approach

4. Economies of scale

5. Network-based

6. Sustainability

## Coordination and execution of activities with initiatives operating in the region

**PROGRAMA  
ONU-REDD**



Organización de las Naciones  
Unidas para la Alimentación  
y la Agricultura



**cooperación  
alemana**

**DEUTSCHE ZUSAMMENARBEIT**

**giz**

Deutsche Gesellschaft  
für Internationale  
Zusammenarbeit (GIZ) GmbH



**CATIE**

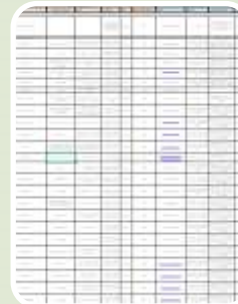
Solutions for environment and development  
Soluciones para el ambiente y desarrollo



**USAID**

DEL PUEBLO DE LOS ESTADOS  
UNIDOS DE AMÉRICA

# LINES OF ACTION



Diagnosis of technical capacities & the status of implementation of NFMS in the region

- Common framework of analysis: regional needs
- International Cooperation Opportunities Workshops

Technical and financial support for the execution of early actions of south-south cooperation

- Forest Monitoring Capacity Strengthening Package

Elaboration of a Long Term EMSA Work Plan on Forest Monitoring

- Workshop: Update of regional needs (march 2015)
- Country Needs Assessments
- Workshop: Elaboration of the Proposal for the EMSA Work Plan

Documentation of Mexico's lessons learned and publication of technical materials

Construction of a regional network of professionals in forest monitoring

Design and installment of a Virtual Center of Excellence in Forest Monitoring

- Strategic Workshop for the Strengthening of the Virtual Center of Excellence in Forests Monitoring

## CENTRO de EXCELENCIA VIRTUAL en MONITOREO FORESTAL

The Virtual Center of Excellence in Forest Monitoring (CEVMF, in Spanish) is an online **collaborative platform** that offers solutions of **knowledge management** to strengthen the sustainable management of forests, through robust and transparent **forest monitoring systems**.



## CENTRO de EXCELENCIA VIRTUAL en ■■■■ MONITOREO FORESTAL ■■■■



### Target Audiences

- People who depend on forest resources for their livelihood
- Owners and possessors of forests
- Decision makers at local, subnational, national and regional
- Specialized public and private initiatives
- Academic institutions and civil society
- Technical and professional forest monitoring



# Addressing Mesoameric an priorities



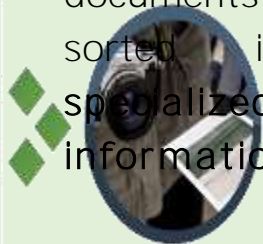
**Methodology:** In various sessions in which representatives of the EMSA actively participated, strategic lines of action were determined within the areas of collaboration of the CEVMF. These lines of action were prioritized as follows:



## CENTRO de EXCELENCIA VIRTUAL en MONITOREO FORESTAL

# Addressing Mesoamerican priorities

- Creation of an **online database** of permanent plots.
- Publishing links to **official information** of the countries of the region.
- Sharing of documents sorted into **specialized information**.



Information

- Making available **expert technicians** for specialized technical assistance in forest inventory methodologies
- Establishing a forum on **methodologies** for the calculation of forest growth rates, that links research centers and universities
- Establishing **thematic forums** according



Networking

- **Sharing experiences** of geographic information processing
- Systematizing and sharing experiences and **lessons learned** in the creation of protocols and methodologies to detect forest degradation through remote sensing
- Training on methodologies of estimation of emissions factors through **learning** forest



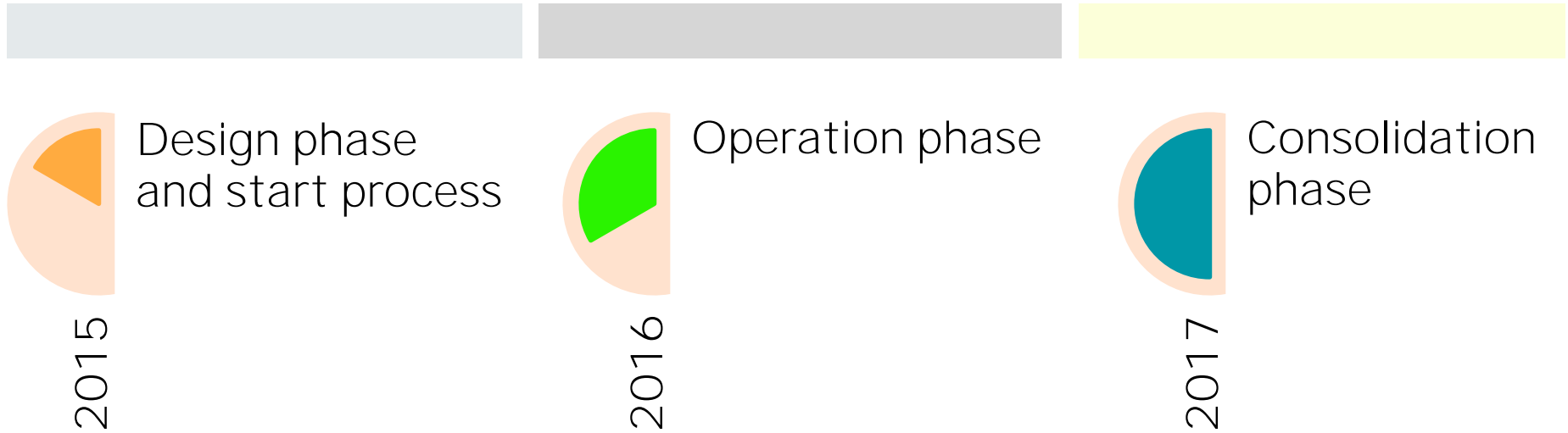
Learning

In addition to these activities, the CEVMF is committed to **developing and hosting** activities comprised within the Long Term EMSA Workplan on Forest Monitoring.



Change

# CENTRO de EXCELENCIA VIRTUAL en MONITOREO FORESTAL



## PHASES OF CEVMF

# SEMARNAT

SECRETARÍA DE  
MEDIO AMBIENTE  
Y RECURSOS NATURALES

