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Vegetation Mapping in Mexico:

A Longitudinal Perspective on Data Generation and Utilization

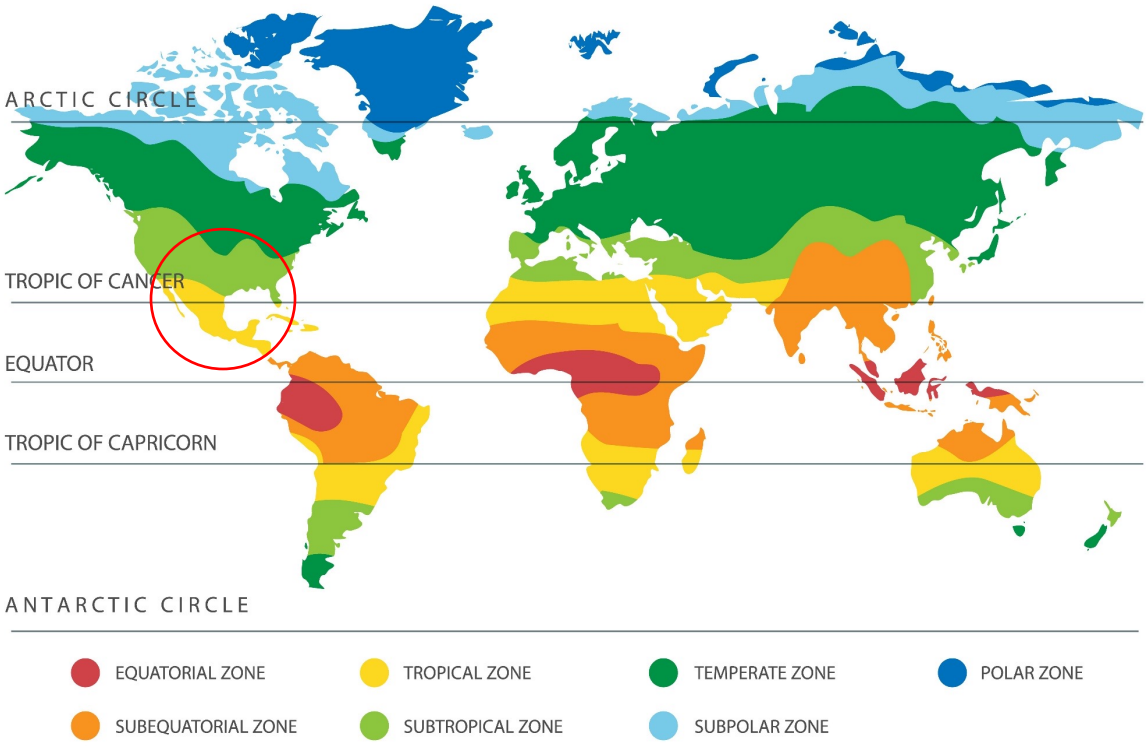
May 2024

AIM

The session aims to highlight the ongoing efforts of the ***National Institute of Statistics and Geography*** (**INEGI**) in **Mexico** regarding **Vegetation Mapping** along with exploring some impacts of **Climate Change** on vegetation distribution

Location of Mexico

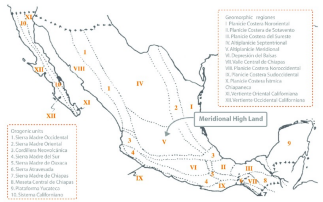
Between Tropical and Subtropical zones



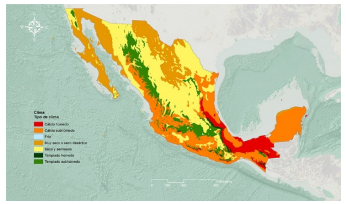
Elevation

0 – 5,636 m AMSL

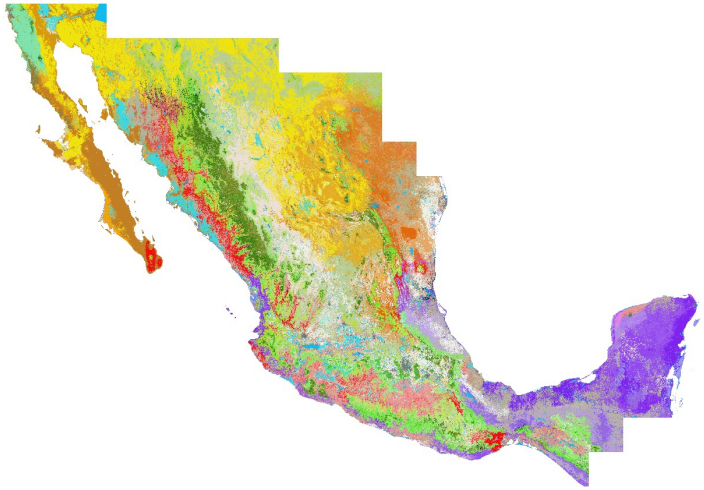
Orography



Climate



Soil Forming Factors



Almost **30 thousand** plant species: 10 - 12% of the world.

Biodiversity and ecological complexity

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Longitudinal efforts: over 150 years studying vegetation

1842 •Hartweg

1844 •Liebman

1852-1857 •Seeman

1857 •Berlandier

Mid 19th century

1858 •Parry

1909 •Ochoterena

1909 •Rovirosa

1914 •Reiche

1924-1926 •Johnston •Shreve

1934-1942 •Shreve

1941-1958 •Miranda

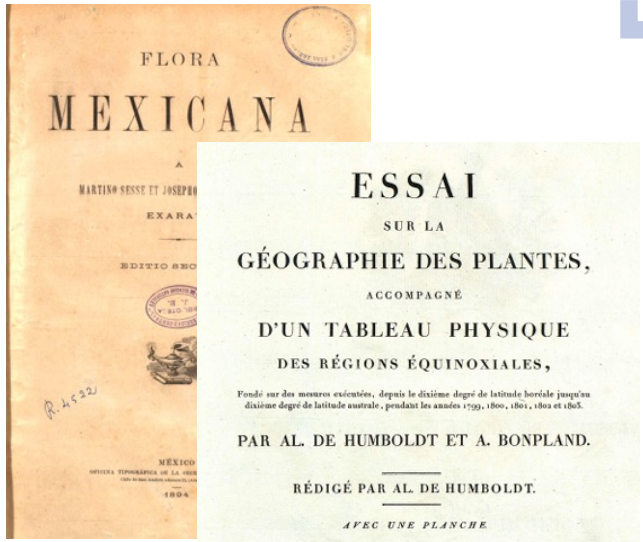
1953 •Hernández

1957 – 1966 •Rzedowski

After 1930

20th century

Codex



https://rjb.csic.es/

Geographic heterogeneity

Natural resources mapping, based on remote sensing images, nowadays demands:

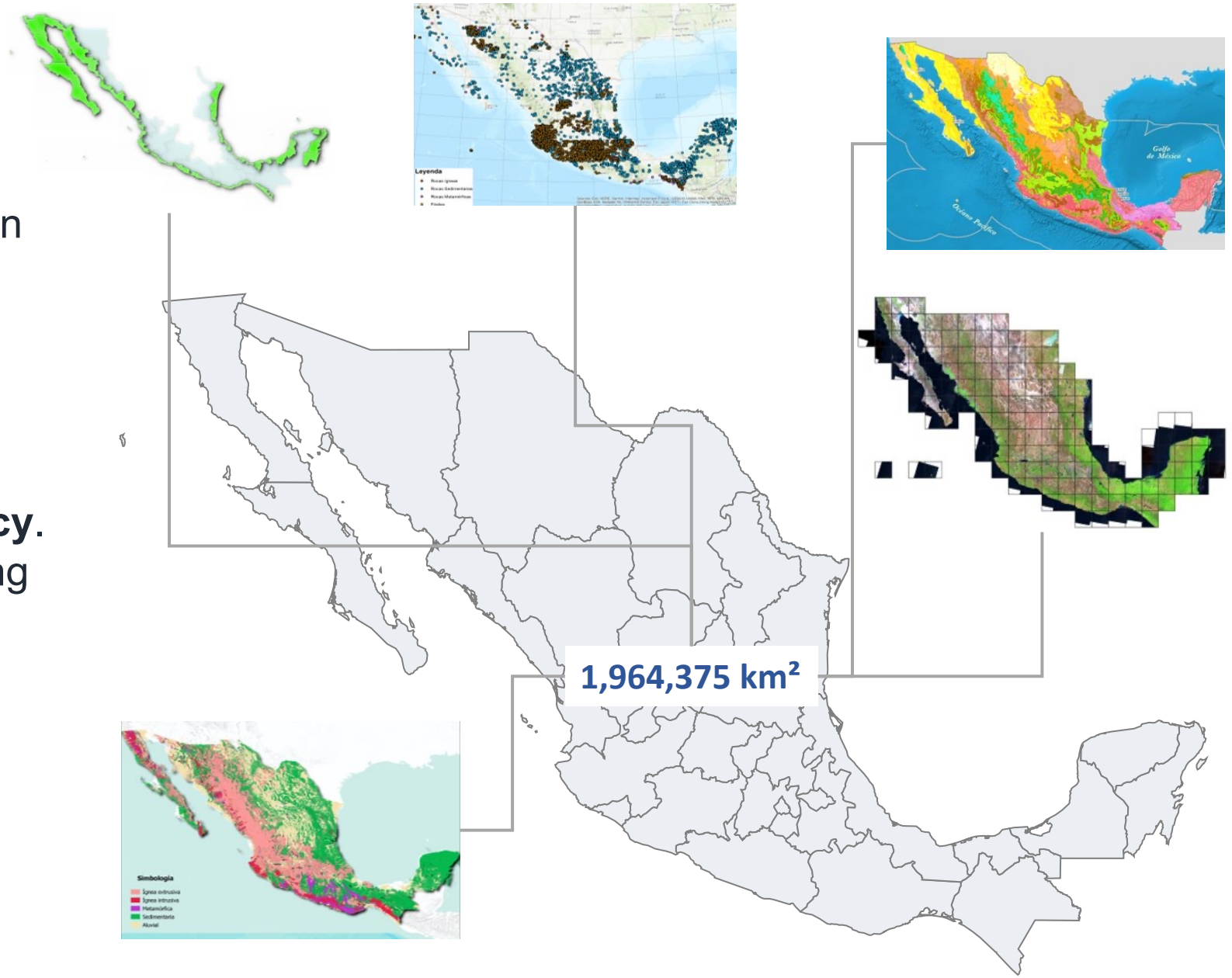
- More **spatial detail**.
- More **frequency**.
- Recent **reference data**.
- Final products high grade **accuracy**.
- More intensity **observations** during analysis period.

For that reason, we need to be capables of:

Manage → Process → Analyse

Big data

from imagery in an effective way.



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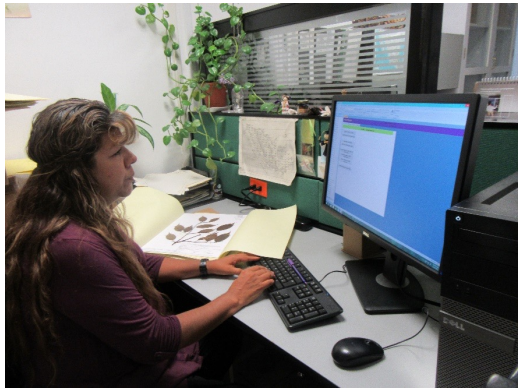
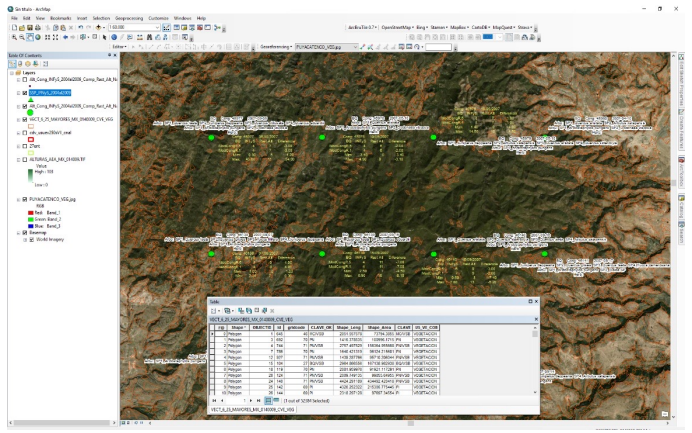
Vegetation mapping

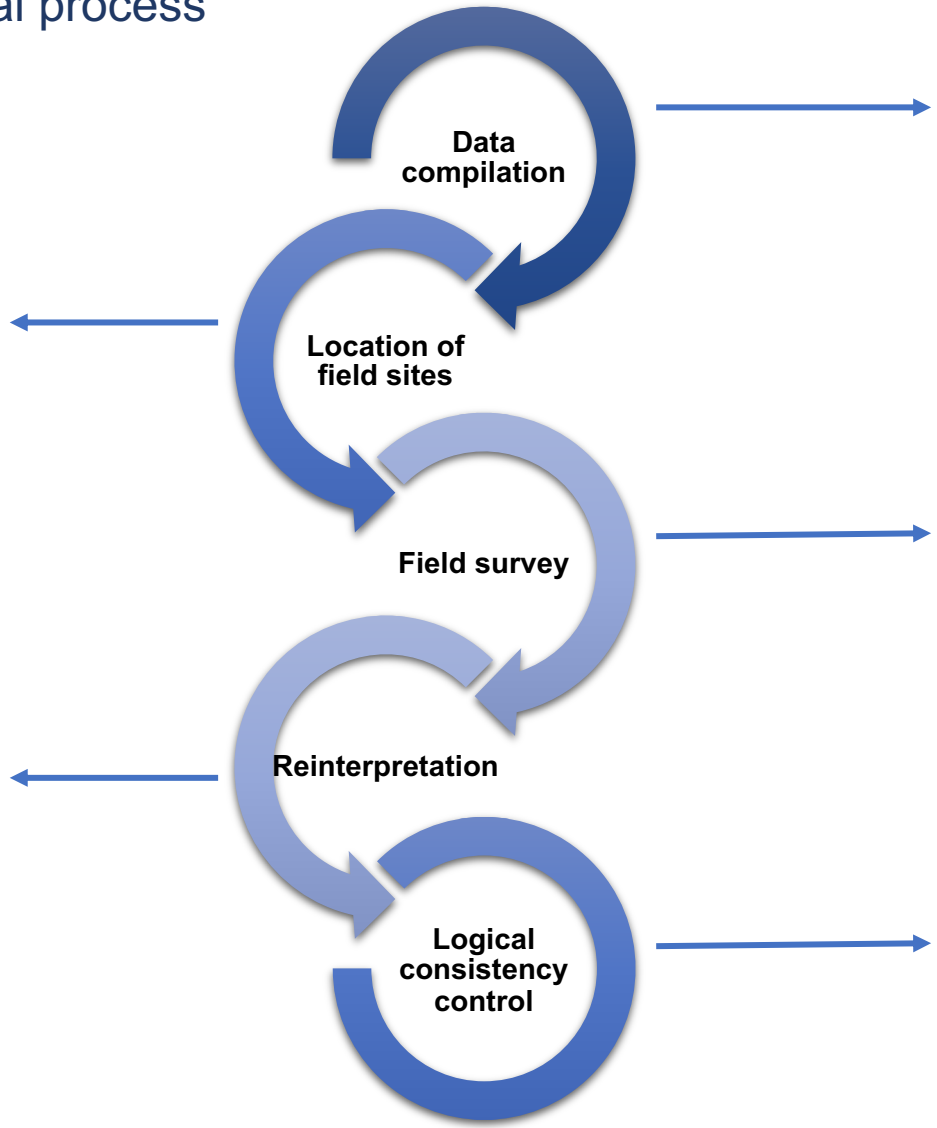
Efforts

Land Use and Vegetation Information

General methodological process

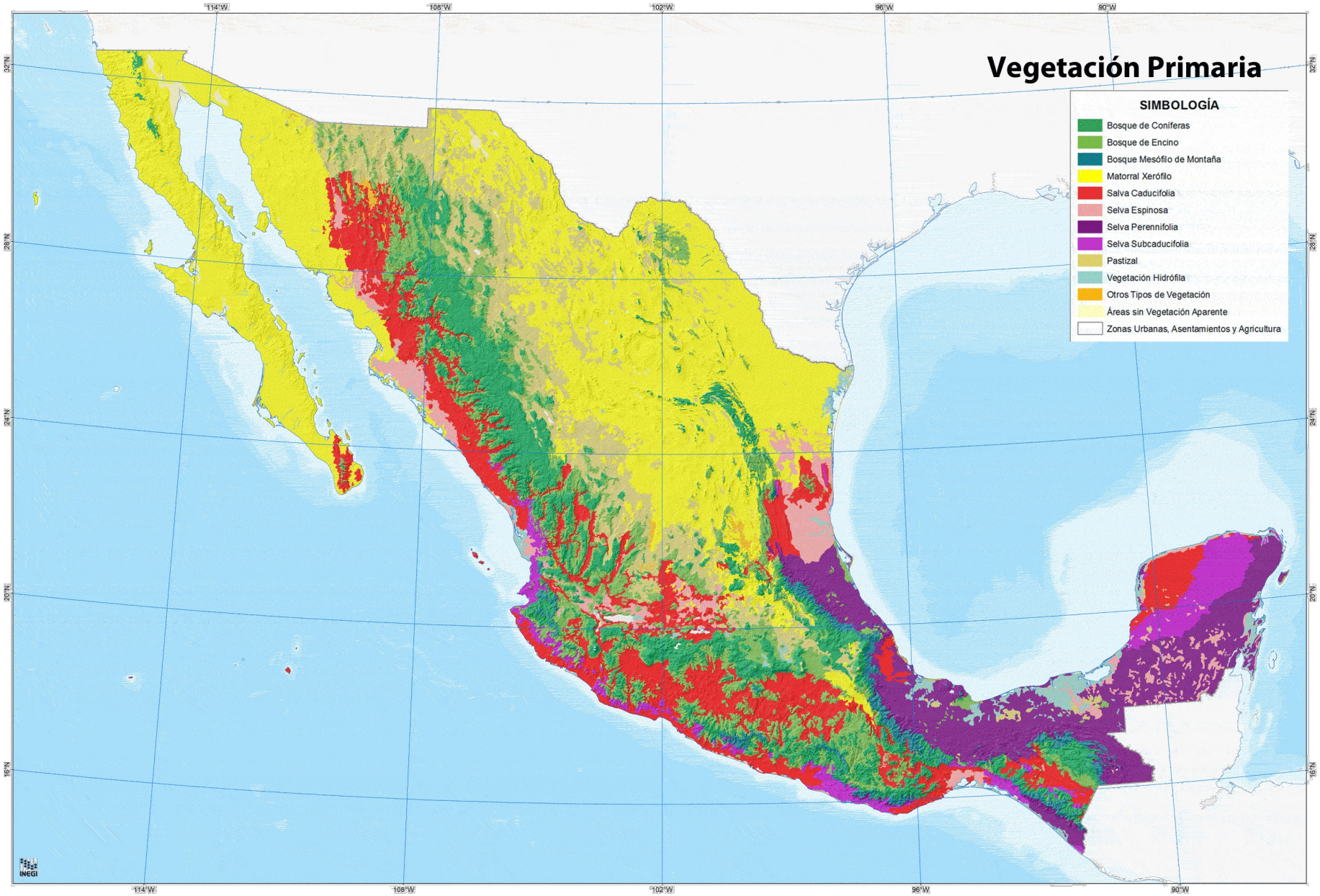






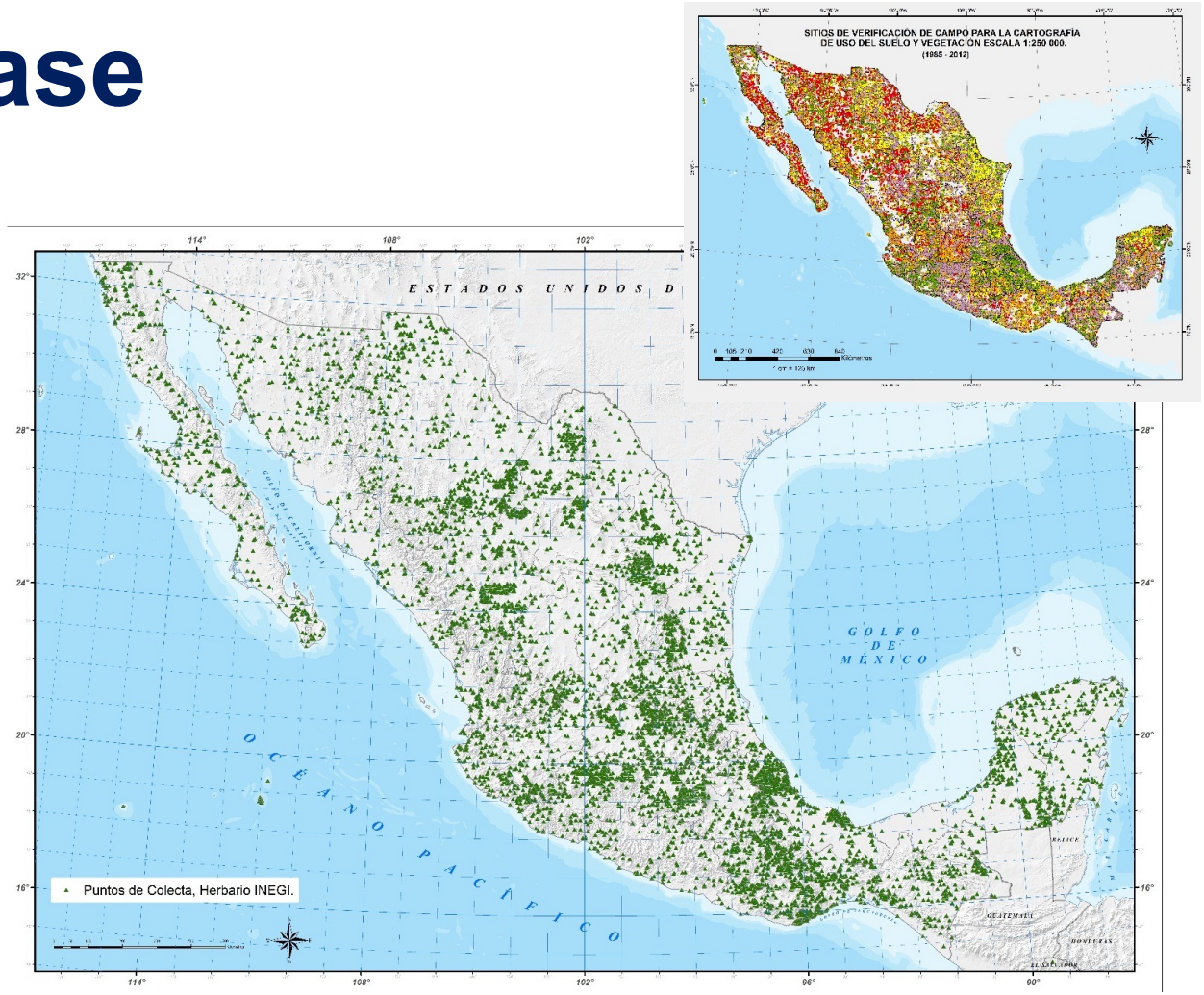
Land Use and Vegetation Charts

(1985 – 2018)



INEGI´s Herbal collection and database

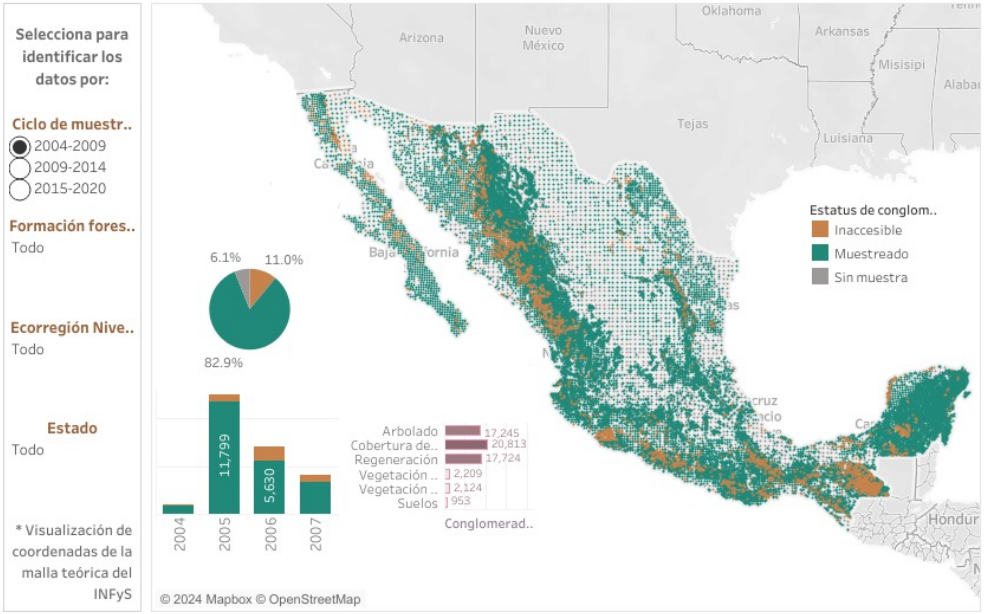
Data from the INEGI's Herbarium	
	Numbers
Records	**64 571**
Families	286
Genus	2 035
Species	9 500
Sampling Sites	**29 000**
Digitized Specimens	21 782
New Species	**67**

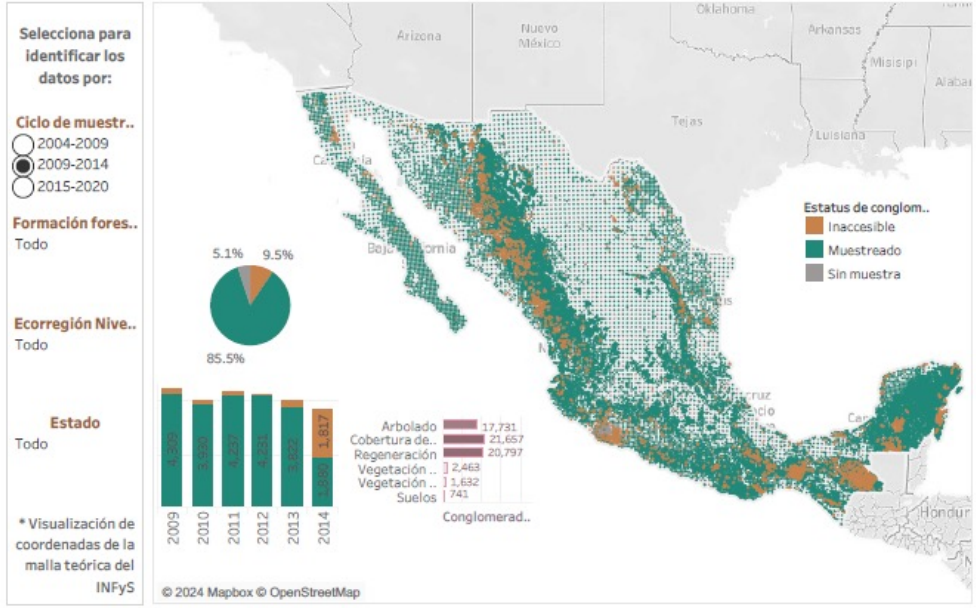


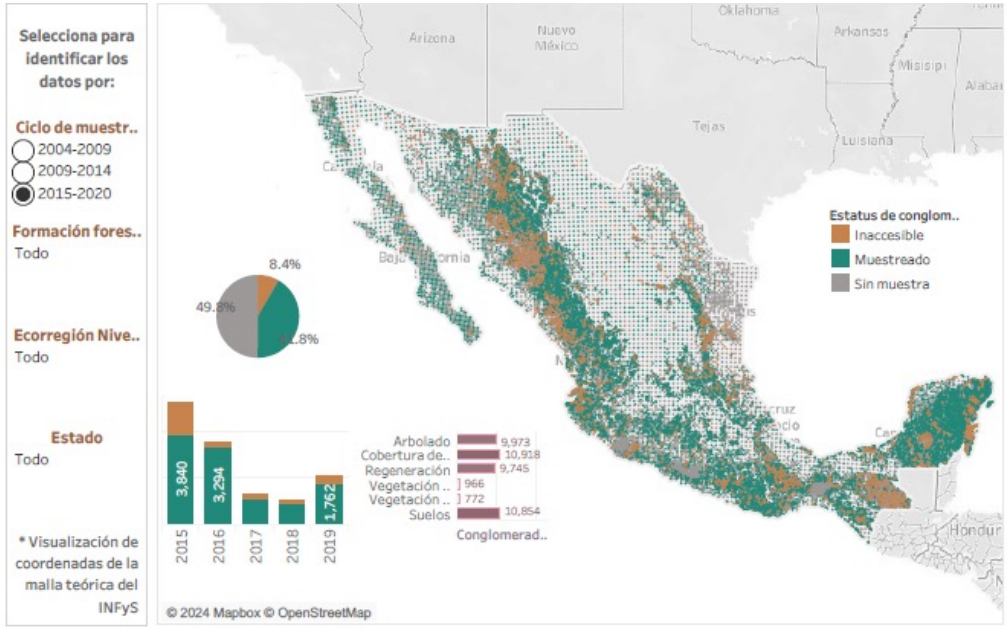
Collected points introduced to INEGI´s Herbarium.

National Forest and Soil Inventory

By National Forest Commission







https://snmf.cnf.gob.mx/principaleindicadoresforestalesciclo-2015-2020/

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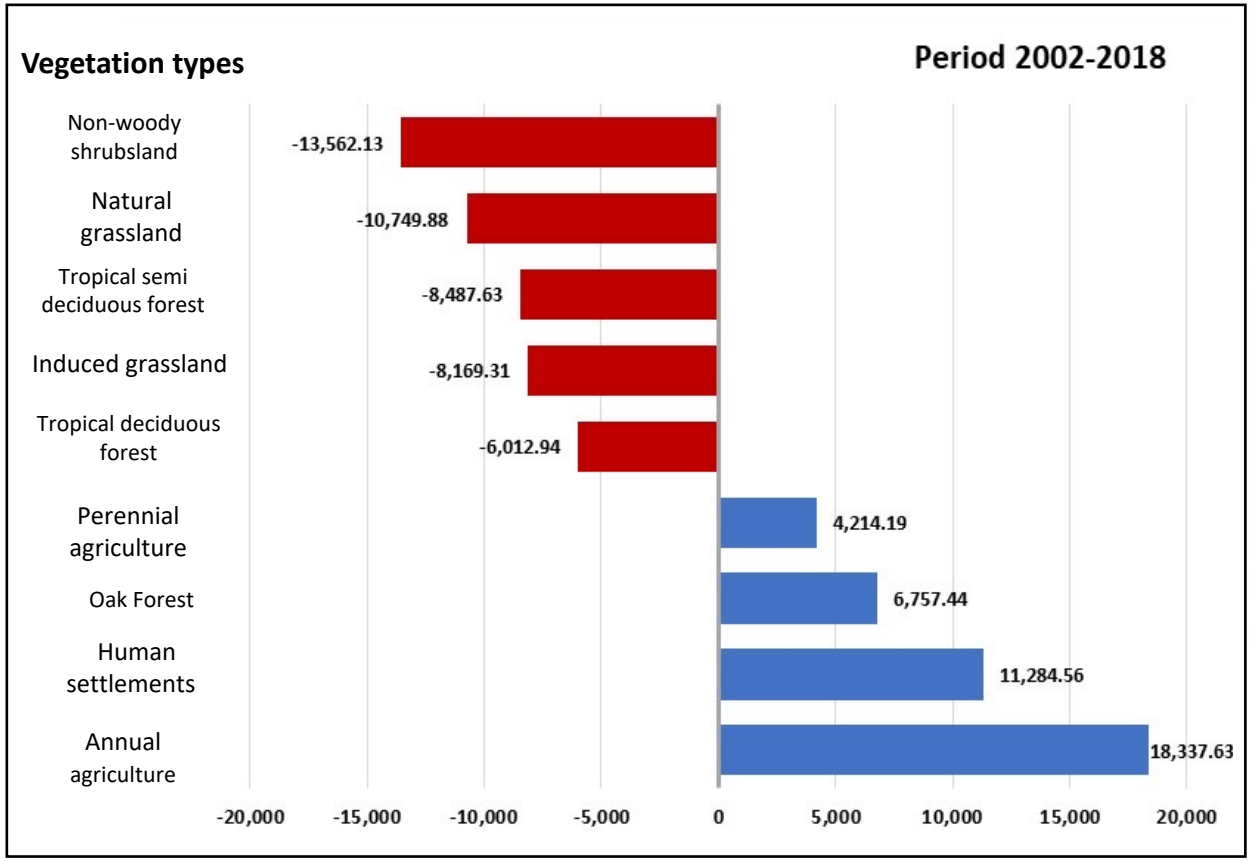
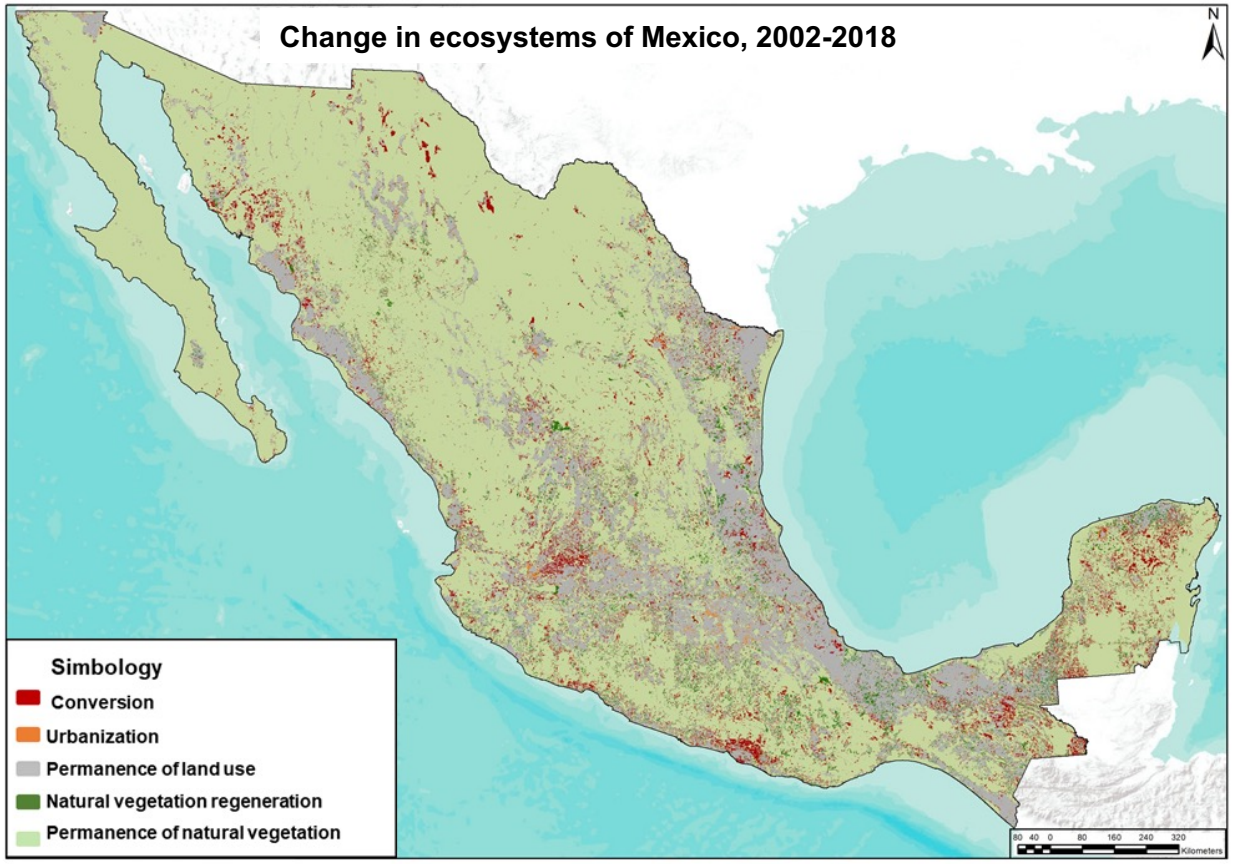
Climate Change

and vegetation distribution

Dynamics of Change

Losses and increase in extension, km^2.





Conversion: any transformation of natural vegetation into other land use categories

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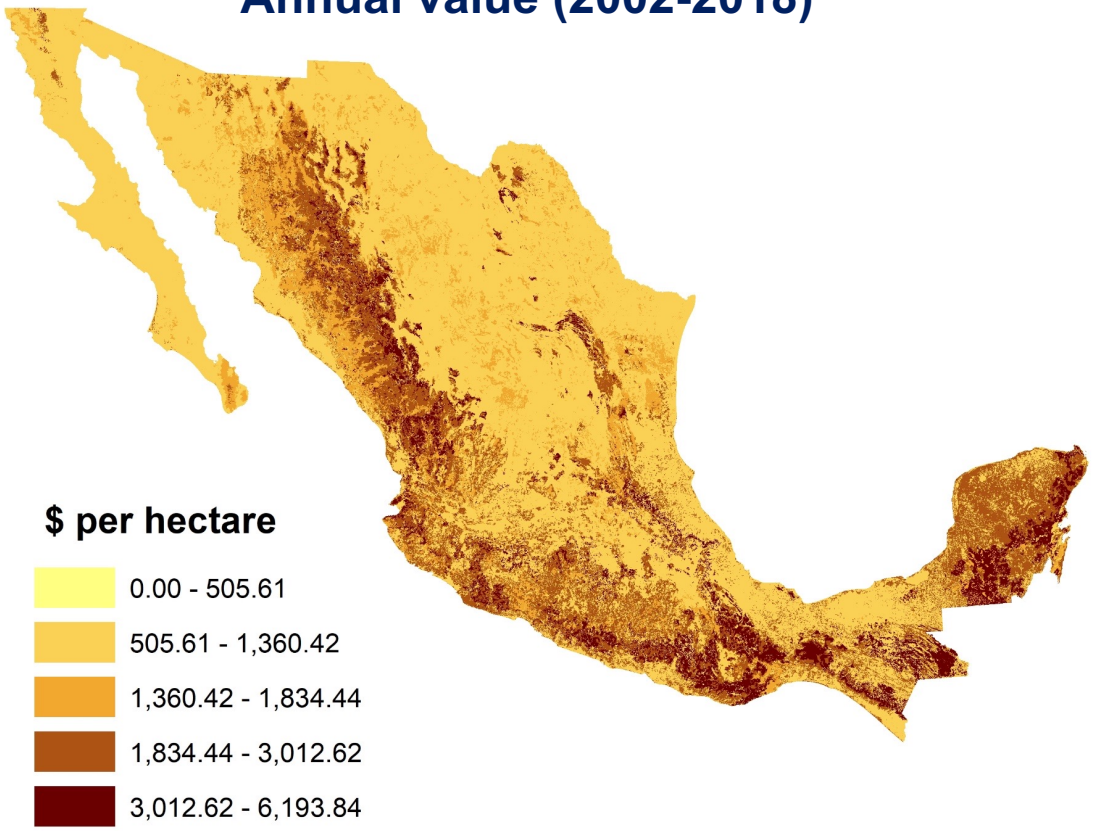
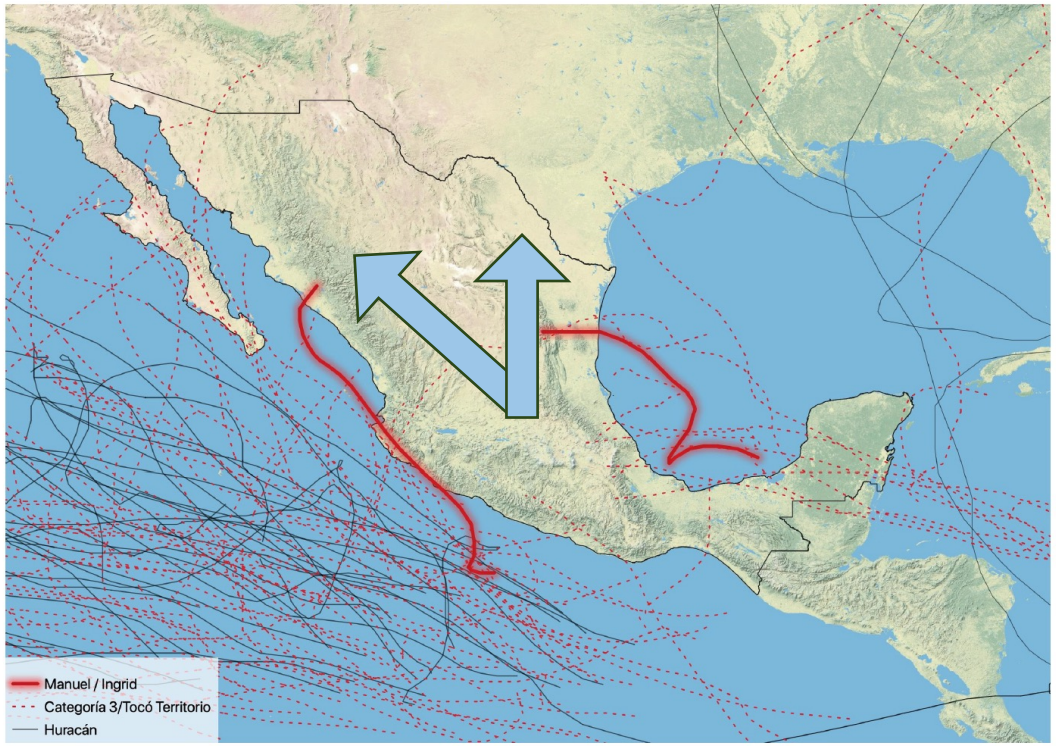
C sequestration and displacement of vegetation

Biomass carbon
Annual value (2002-2018)



Track of hurricanes and tropical cyclones in Mexico (2010-2020)



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Use of Artificial Intelligence (AI) for Vegetation and Land Use mapping

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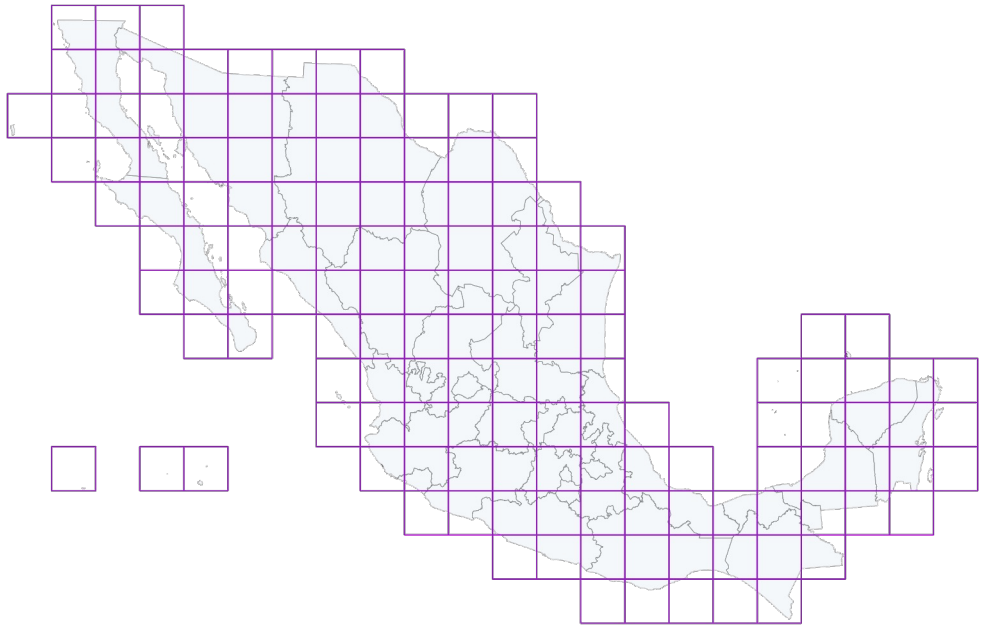
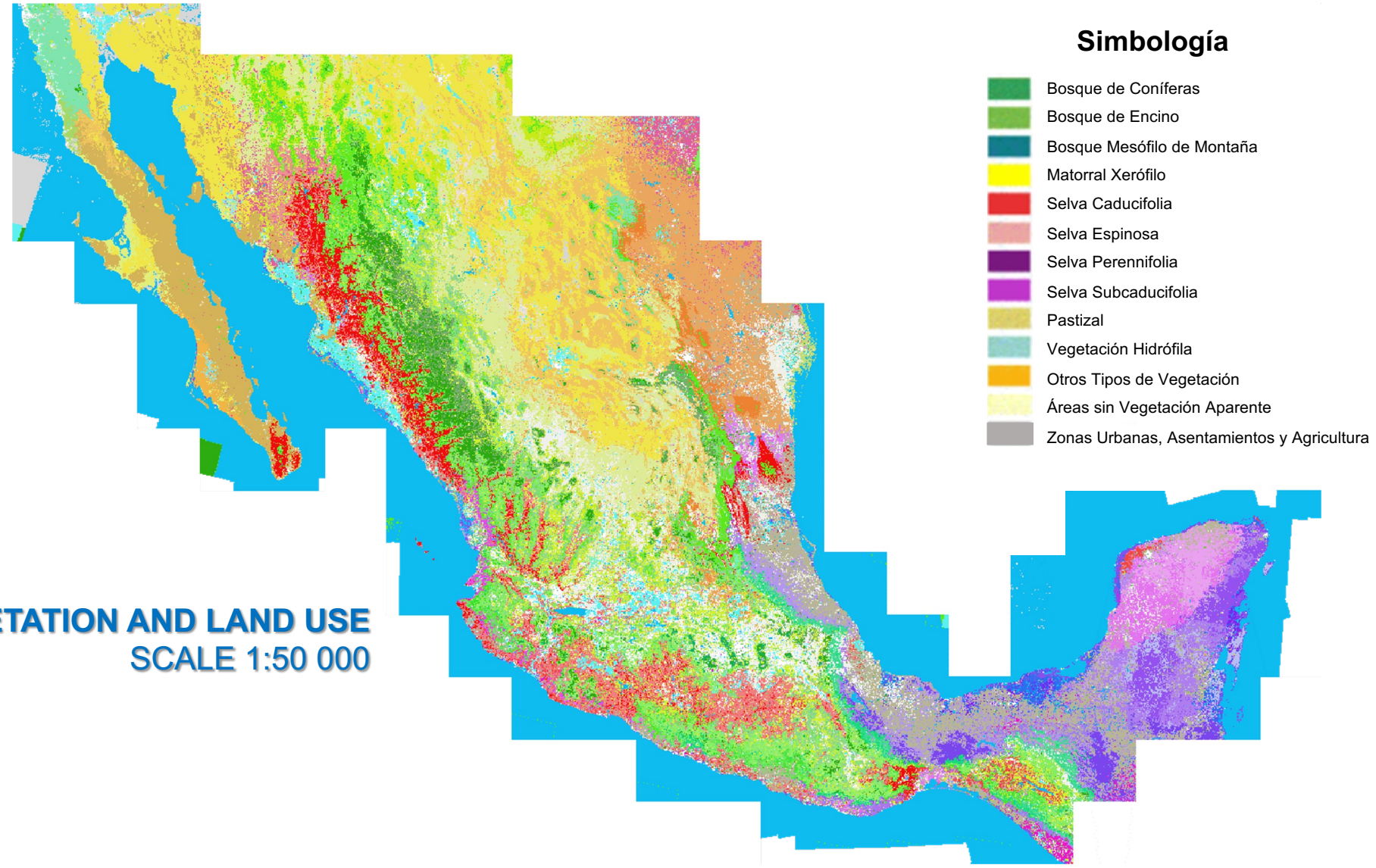
Mexico´s Geospatial Data Cube

Data Collection			
Sensor	**Start date**	**End date**	**Amount**
Landsat-4	1982-11-13	1993-07-14	1 288
Landsat-5	1984-03-5	2012-05-5	47 043
Landsat-7	1999-06-30	2021-12-31	55 071
Landsat-8	2013-03-18	Present	45 814
Landsat-9	2022-01-01	Present	7 321
		Total	**156 537**

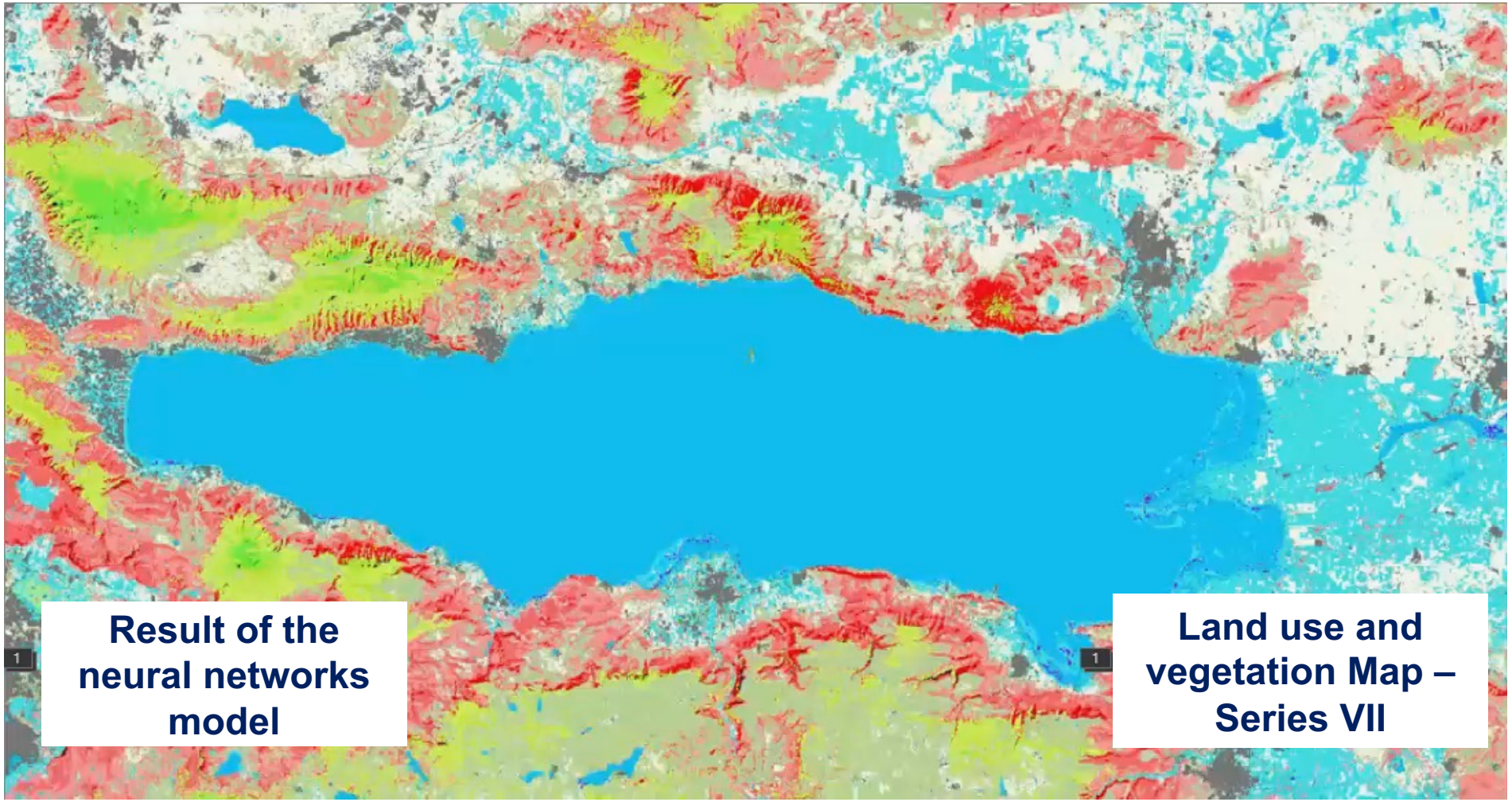


Data Tiling	
Distribution	Regular
Number of tiles	**144**
Dimensions	150 km x 150 km
Pixels per tile	25,000,000 pixels –Landsat– (5,000 x 5,000 pixels)
Resolution	**30 m**
Spatial Reference	Albers Equal Area
Goals	• “Fixed divisions” to nest **inputs** and **products.** • Input **nesting** of various **resolutions** (multiples and dividers of **30 m**)

Modeling with neural networks (AI)



Neural networks vs traditional mapping



In summary

Conclusions

- Mexico's **latitude**, ranging approximately from 14°N to 32°N, has a **significant impact** on its **climate and ecosystems**, leading to a variety of landscapes such as deserts, mountains, tropical rainforests, and coastal areas.
- Mexico boasts a rich biodiversity, hosting around **10-12% of the world's plant species**.
- The country has a history of over **150 years** of studying vegetation.
- **Vegetation mapping** has been achieved through the generation of **7 series** of periodic land use and vegetation maps, in addition to efforts made by **other institutions**.
- The persistent effort in **vegetation mapping** enables us to identify various **impacts** of **climate change**.
- Mexico is currently exploring **new possibilities**, such as utilizing the ***Geographic Data Cube***, employing **neural networks** techniques, and leveraging mass processing capabilities for mapping tasks.

Challenges

- **Field evaluation**, especially in countries as complex as Mexico, poses a significant challenge.
- Knowledge about vegetation is **heterogeneous** with some regions being better studied than others.
- There is a lack of studies conducted with **quantitative methods**.
- **Research** on the relationship between **vegetation** and **environmental** factors is **limited**.
- The interpretation of **vegetation type** varies among authors with **different approaches**, despite most contributions focusing on this aspect.
- Studies on **vegetation dynamics** and **secondary vegetation** are generally scarce.
- **Discrepancies** in **nomenclature** are accentuated at a chaotic level.

Conociendo
México

800 111 46 34
www.inegi.org.mx
atencion.usuarios@inegi.org.mx

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