9TH IMF Statistical Forum

MEASURING CLIMATE CHANGE
THE ECONOMIC AND FINANCIAL DIMENSIONS

The Importance of Geospatial Information Measuring Climate Change: Mexico’s Experience

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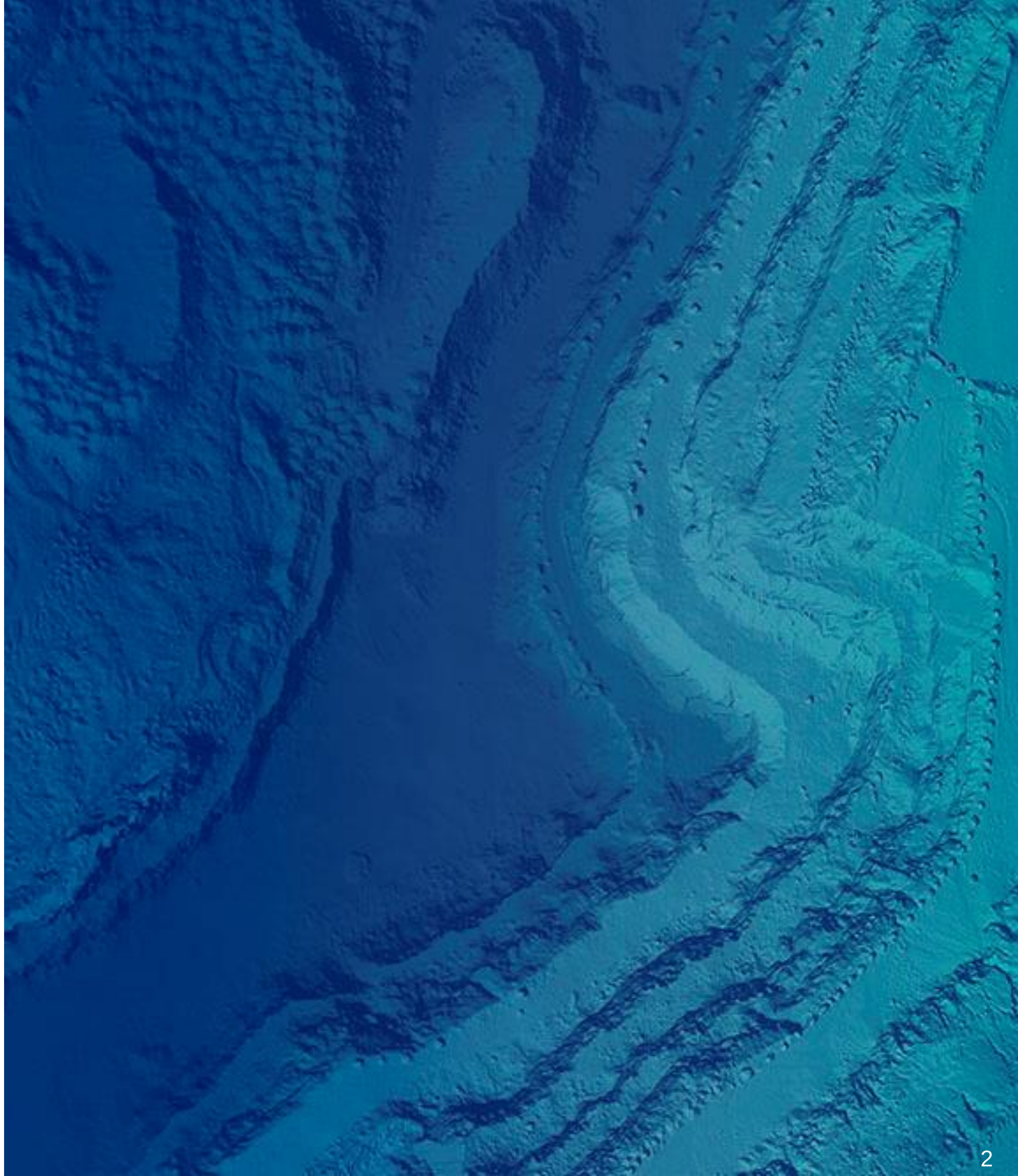
Julio Santaella
President of INEGI
Mexico

Introduction

- The **natural resources of a nation are essential to its economy**, providing:
  - Renewable and non-renewable assets
  - Employment
  - Food and commodities
  - Produce energy, etc.
- Due to the **increase in population**, **CO2 emissions** and other factors, these resources **are often over stretched**, leading to their depletion
- So, for humanity **it is of paramount importance to learn how to use these resources in a sustainable manner**, to ensure that their benefits can be enjoyed both by present and future generations



Introduction

Integrating economic and environmental data with geospatial information provides a comprehensive multi-thematic view of the interrelationships in the nexus economy-environment-territory, in order to measure the full impact of economic activities on the environment and territory (externalities)

TRADITIONALLY, NATIONAL ACCOUNTS DO NOT MEASURE THE EXTERNALITIES THAT AFFECT THE ENVIRONMENT AND THOSE THAT CAN PRESERVE IT

The importance of Geospatial Information

Climate change (CC) is a process that involves multiple facets, causes, and effects on different features; either natural, or anthropogenic

Everything related with it happens also in some place

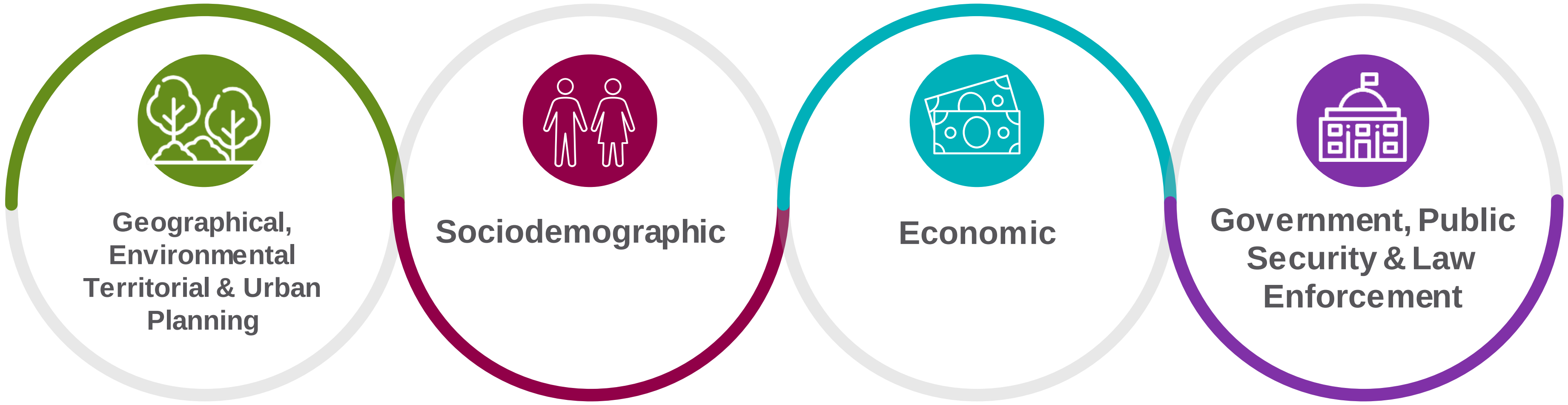
So, it is unthinkable to approach CC without the spatial dimension, that is, without maps or geospatial information about everything, even for the economic and financial issues, to achieve a holistic vision of CC

Mexico's Institutional framework

How is this integration done in Mexico?

SNIEG: Mexico's coordination framework to produce statistical & geographical information

Coordinated by INEGI, Public Entities are organized in **4 Subsystems of Information** that interact with each other



INEGI & geospatial information

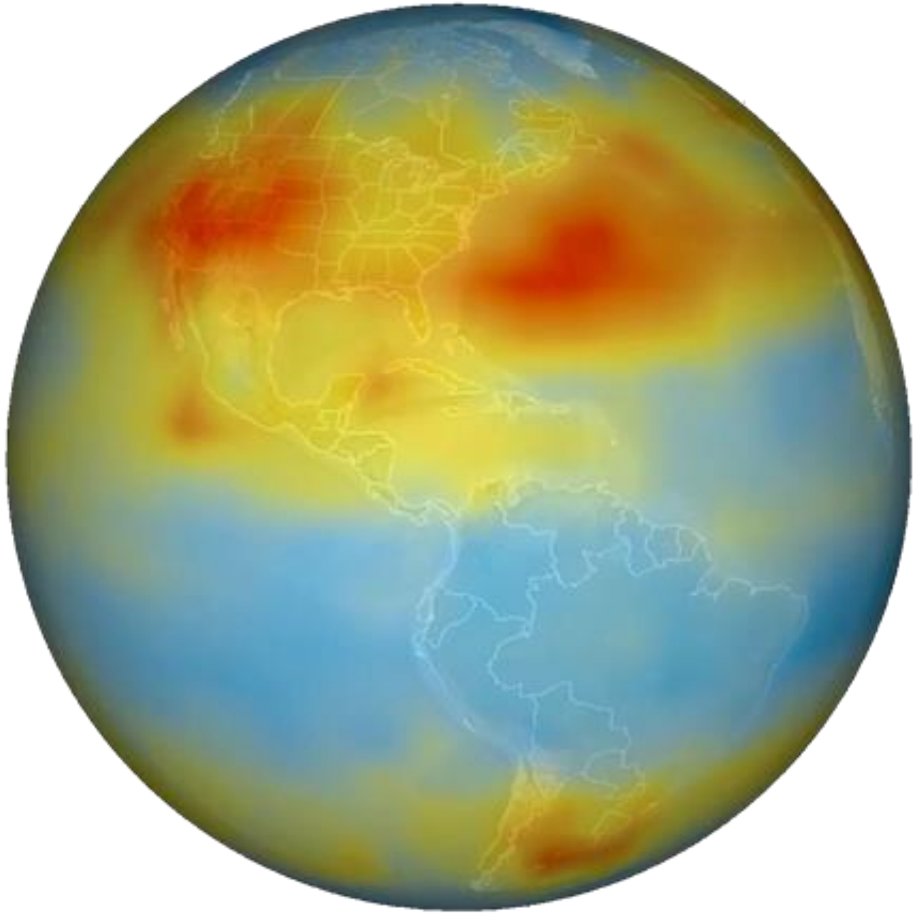
INEGI is in charge of the generation and dissemination of diverse geospatial information:

Geospatial information	Use
National Geodetic Service (Vertical, Horizontal and Gravimetric Networks)	Supports the spatial reference system for all the geospatial information
National Aerial Photography System. (After 2010 it was replaced with high resolution satellite imagery)	Imagery is the base for all the mapping.
Orthoimagery and Digital Elevation Model Production	Representation of the relief, elevation, slope, and others.
Topographic maps	Portrays relief, hydrography, urban areas, infrastructure, places names, among others
Natural resources maps	Map series for climate, geology, water (surface and ground), soils, vegetation and land use.
Geostatistical framework	Spatial Framework for censuses and surveys
Cadastral, land registration	Detailed and accurate spatial data for land tenure-ownership, from land rural land parcels to houses.

Geospatial information, climate change and its economic and financial dimensions

With **geospatial data** we can **infer and measure natural causes and effects of CC**, and from them, economic and financial issues, so that mitigation and adaptation measures for CC are adopted and financed, for example:

- Mapping of climatic variables (temperature, precipitation)
- Emissions of GHG from land use change – deforestation
- Carbon storage and sequestration
- Habitat and Biodiversity loss
- Risks (floods, drought, hurricanes) for human activities and infrastructure
- Towns, cities
- Agriculture
- Infrastructure: roads, buildings, ducts, transmission lines, etc



Natural Capital Accounting and Valuation of Ecosystem Services Project (NCAVES) and the System of Environmental Economic Accounting - Ecosystem Accounting (SEEA EA)

SEEA EA is a spatially-based, integrated statistical framework for organizing biophysical information about ecosystems, measuring ecosystem **services**, **tracking changes** in ecosystem extent and condition, valuing ecosystem services and assets and **linking this information to measures of economic and human activity**

The **NCAVES project seeks to improve the measurement of ecosystems and their services**, in **physical and monetary terms**, at the national or sub-national level. It incorporates, in a transversal way, biodiversity and ecosystems as foundations for the formulation and implementation of public policies

The results obtained **are presented in accounting tables as well as in georeferenced biophysical and monetary data**, such as:

1)**Transition matrices** that represent changes in land use and vegetation
2) An **Ecosystem Integrity Index** that allows knowing the integrity degree of the different ecosystems
3) **Distribution maps** of the carbon value in soil and biomass

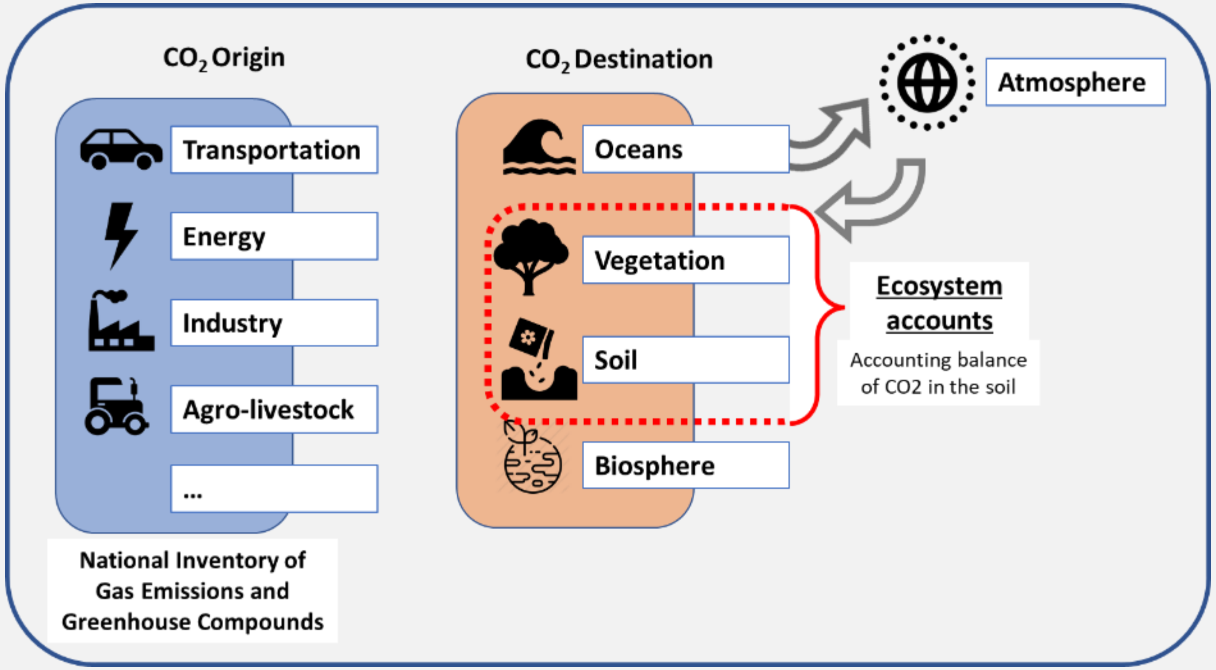
Carbon sequestration and storage in the SEEA EA

The compiled knowledge in the Environmental Accounts of **ecosystems helps to understand the role of forests as a natural carbon sink on a large scale**, by capturing atmospheric carbon through photosynthesis and retaining it in trees as organic matter

Meanwhile**, the soil captures carbon through the respiration of the organisms that inhabit it**, particularly when it comes to fertile soils, rich in microorganisms

In addition, **the oceans are the main carbon collectors, mainly through phytoplankton and corals**. They absorb about 50% of the atmospheric carbon

The following diagram shows how an accounting scheme can be derived from the carbon cycle using the approach of origin and destination:



In this way, it is possible to observe how the amount of emissions captured and their imputed cost change to a great extent depending on when and where they are made

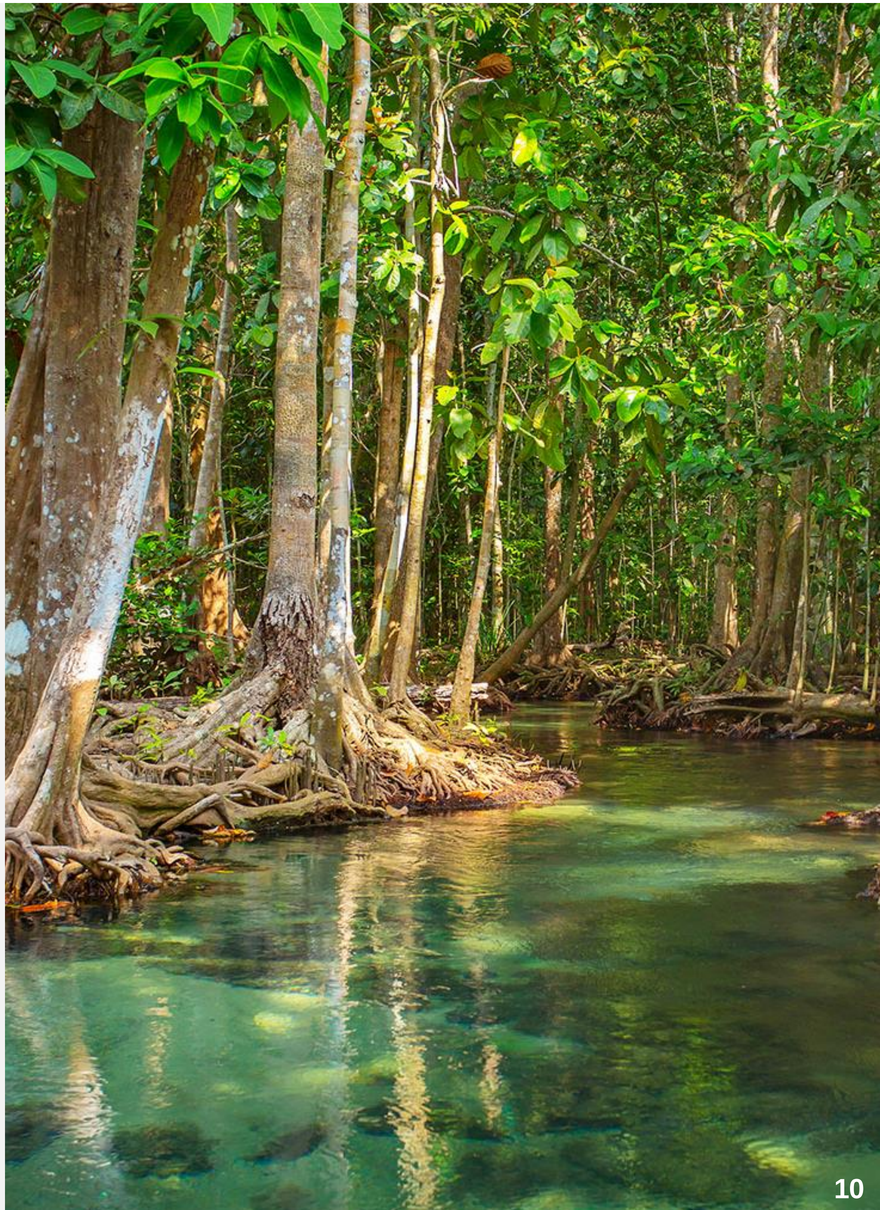
Mexico´s experience implementing the NCAVES project

In 2017, **the UNSD and the UNEP**, in collaboration with the Convention on Biological Diversity Secretariat implemented the NCAVES project in **five strategic countries**: **Brazil, China, India, Mexico and South Africa**

Within the framework of this project, **the extent of ecosystems in Mexico and their state of condition were analyzed** taking advantage of the availability of information derived from INEGI´s Vegetation and Land Use Charts, Series III to VI, as well as the Forest and Soil Inventory of the National Forestry Commission

The **resulting maps integrate geospatial information** from INEGI and other Mexican institutions **with carbon sequestration and storage information**, serving as the **basis for the valuation** of environmental services **in monetary terms**

This valuation of ecosystem services **makes visible the contribution of nature to economic activities and human well-being**, assuming that all goods and services must be valued for their conservation and sustainable use, **to support evidenced-based public policies**



How to estimate the monetary value of the ecosystem services

1

Take the **tons of carbon stored and sequestered** in **biomass and soils** estimated in the SEEA EA - MX

2

Multiply them by a **conversion factor** to get the **CO_2 equivalent** (CO_2e)[1]

3a

Get the monetary value of the **Carbon Sequestration Services (MV_{csqs})** by multiplying the CO_2e flux in the period between t and t-1 by the SCC[2]

3b

Get the monetary value of the **Carbon Storage Services (MV_{cses})** by multiplying the CO_2e total by the SCC[2] and apply an interest rate of 2%[3] to obtain the value of the service in a year t

To obtain the **total monetary value of the ecosystem services**, add **MV_{csqs}** in t and **MV_{cses}** in t-1

1/ The conversion factor is 44/12 of the IPCC according to the Group of Experts on SEEA Ecosystem Accounting Guidelines by the United Nations Statistics Division (UNSD) in collaboration with the United Nations Environment Programme, and the World Bank.
2/ The 2% annual rate is taken according to international standards, which is consistent with sustainable development, since higher discount rates weigh the future to a lesser extent and vice versa.
3/ The SCC is the Social Cost of Carbon which corresponds to the economic cost generated by an additional ton of carbon equivalent in the atmosphere. A meta-analysis allows obtaining an "average value" of USD 25, taking advantage of the results of the study "The social cost of carbon: an aggregate view from Latin America", by Alatorre, Galindo, et al. 2019a.

Mexico’s results

The calculation of the monetary value of ecosystem services is key to the design and implementation of economically efficient public policies that contribute to the sustainable use and conservation of ecosystems:

Biomass living area and organic carbon in soils, 2014

Thousand tons, Billions of dollars* and as a percentage of the 2014 GDP

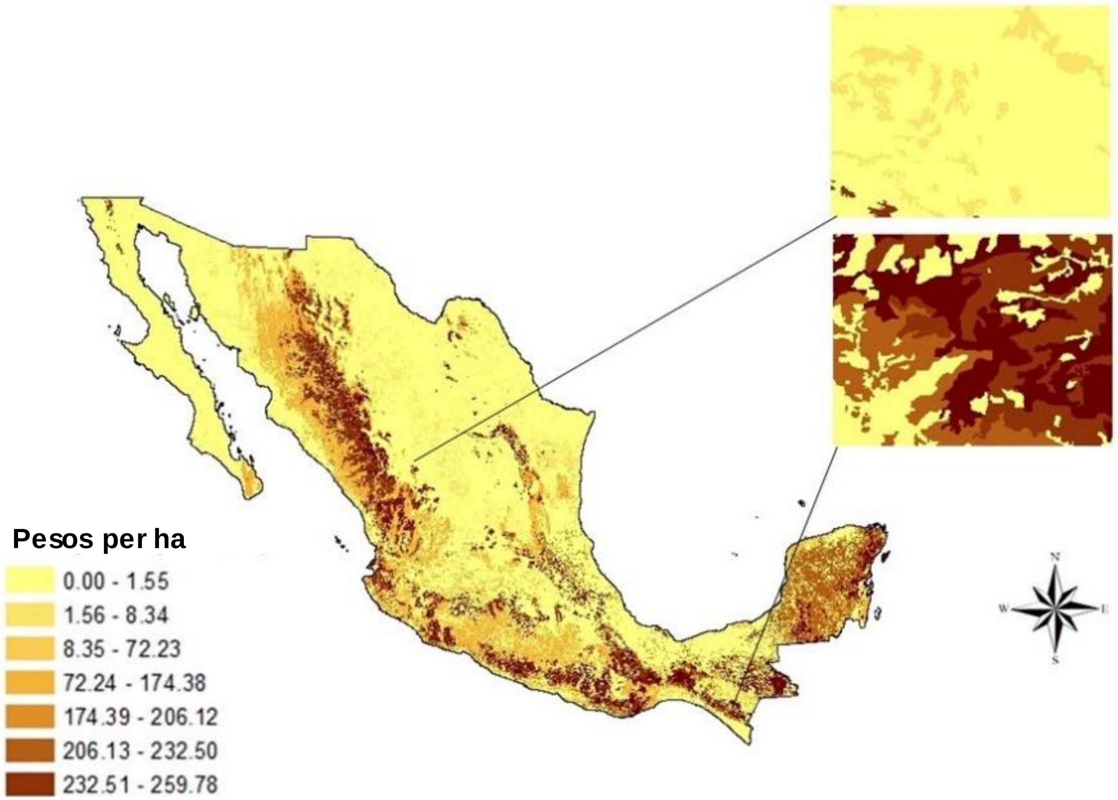
25 dollars SCC and 2% rate	Millions tons			Billions of dollars*			Percentage of GDP		
	Biomass	Soil	Total carbon	Biomass	Soil	Total carbon	Biomass	Soil	Total carbon
Storage	95.3	669.4	764.7	2.38	16.73	19.12	0.19	1.33	1.52
Sequestration	63.2	12.8	76.1	1.58	0.32	1.90	0.13	0.03	0.15
Storage + Sequestration	158.6	682.2	840.8	3.96	17.05	21.02	0.31	1.35	1.67

SCC: Social Cost of Carbon.

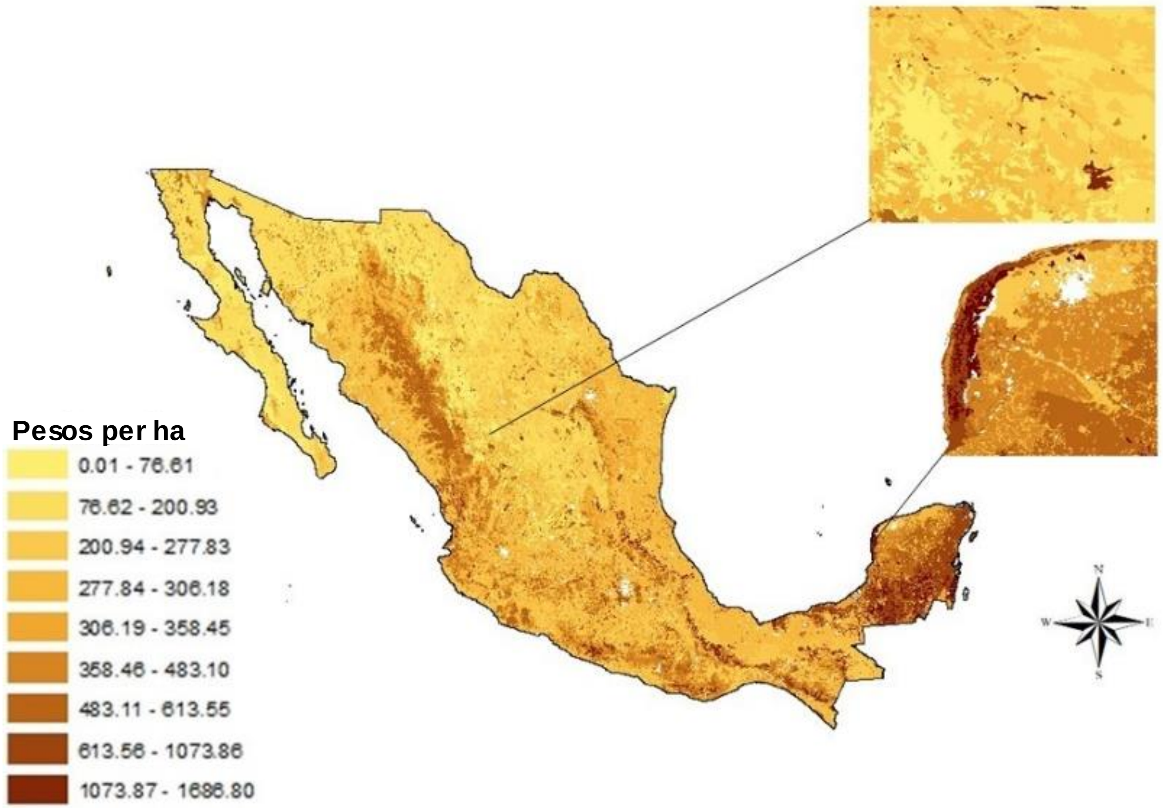
* Average FIX exchange rate 2014: 1USD = 13.30 MXN.

Mexico’s results

Annual value of the carbon sequestration and storage services in BIOMASS in Mexico, 2014
25 dollars SCC and 2% rate
(Pesos / hectare)



Annual value of the carbon sequestration and storage services in soils in Mexico, 2014
25 dollars SCC and 2% rate
(Pesos / hectare)



Examples of public policies to mitigate CC using the measurement of carbon sequestration and storage in SEEA EA

The **economic valuation** of natural capital has the advantage to express the value of, or damages of, **natural capital in the same terms as financial capital**

In this sense, **the economic valuation of carbon in SEEA EA,** should be used as an important element **for the determination of a carbon tax, which can provide general incentives to reduce energy use and switch to cleaner fuels used in economic activities**

1. Nationally Determined Contributions
2. Carbon taxes
3. Mexico´s National Strategy for the Reduction of Emissions from Deforestation and Forest Degradation
4. Payment Program for Environmental Services
5. Social Cost of Carbon

Final considerations

- The environmental, economic and financial sectors, as well as their interrelations, will face important challenges with CC; this represents both a challenge and an opportunity for the integration and generation of statistical and geospatial information that may be useful for these sectors

- The accounting scheme of the SEEA EA helps us to know part of the destination of these emissions (through the accounting balance of carbon in soil and biomass), with focus on carbon storage and sequestration ecosystem services

- But if we also assign an economic value to these services, it would allow us to measure more adequately their size and importance

- The results of projects such as the SEEA EA, where the ecological and economic visions are combined are expected to have a direct impact on the design and application of public policies or on the improvement of existing ones

- The georeferencing of the carbon sequestration and storage information at the national and local levels, and the assignment of an economic valuation for the services provided by the ecosystems, through the SEEA EA, demonstrates the importance of having geospatial information and its integration with statistics to support decision-making in matters of national and global policies which seek to mitigate the phenomenon of CC and promote a sustainable development

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