

## Leverage of Geospatial and other information sources in Mexico: an institutional perspective on urban resilience

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Kunming Forum on UN-GGIM  
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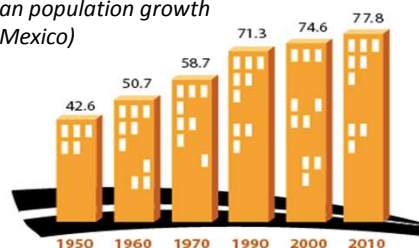


**“Cities are where the battle for sustainable development will be won — or lost, if we fail.”** *Ban ki Moon – June, 2012*

- Cities are where economic, social, cultural, political and environmental aspects of human activity come together in a dynamic way
- In 2050, around 70% of the world’s population will live in urban areas



Urban population growth  
(%, Mexico)



## Contents

- **INEGI as producer and coordinator of national information**
- **Information sources and tools**
- **Uses and applications**
  - National/ inter-institutional
  - International uses and collaborations



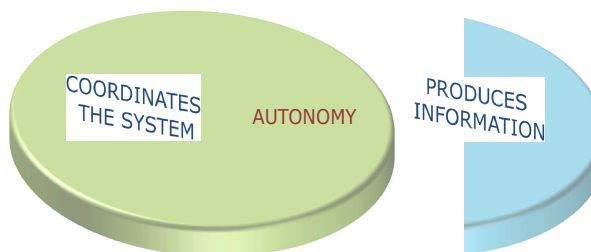
## National Institute of Statistics and Geography INEGI

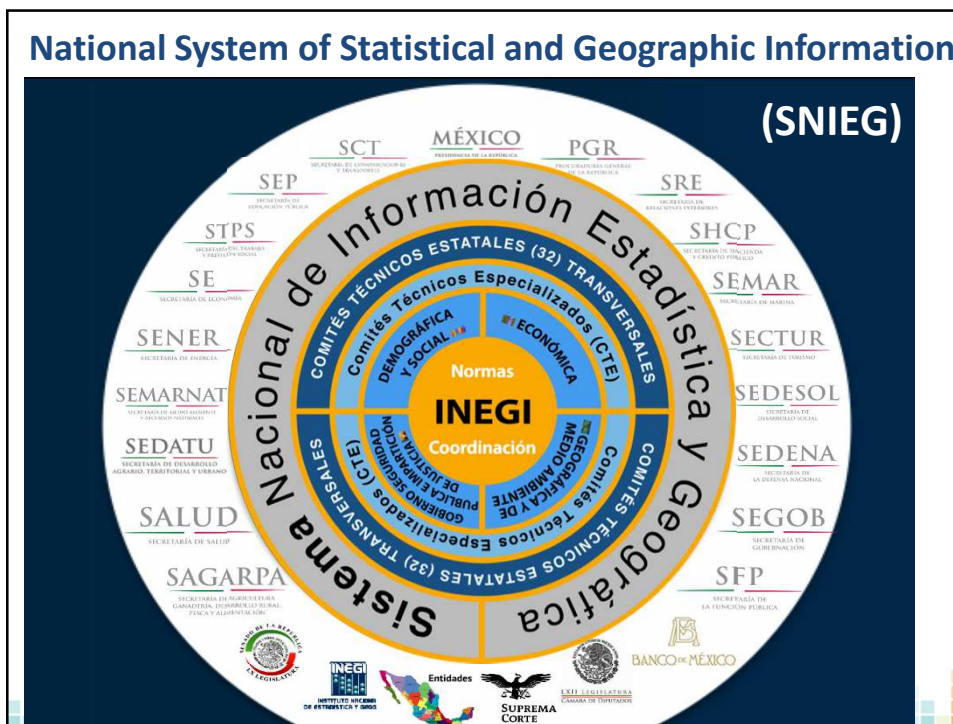
### 3 Key Elements

Geospatial and Statistical Information in a single Institution since 1983

Autonomous since 2008

Coordinates National System of Statistical and Geographic Information (SNIEG)





## National Housing Inventory

INSTITUTO NACIONAL DE ESTADÍSTICA Y GEOGRAFÍA

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**INVENTARIO NACIONAL DE VIVIENDAS (Actualización 2012)**

Buscar:  Búsqueda avanzada

**Capas**

- Etapas de actualización
  - Censo 2010
  - Censo 2010, actualizado a 2012
  - Crecimientos 2010 a 2012
- Inventario de viviendas
  - Total de viviendas
  - Total de viviendas particulares
  - Total de viviendas habitadas
  - Viviendas particulares habitadas
  - Viviendas particulares no habitadas
- Características de las viviendas particulares habitadas
  - Con recubrimiento en piso
  - Con energía eléctrica
  - Con agua entubada
  - Con drenaje
  - Con servicio sanitario
  - Con 3 o más ocupantes por cuarto
  - Promedio de ocupantes por vivienda
- Características de la población
  - Población total
  - Población de 0 a 14 años
  - Población de 15 a 29 años
  - Población de 30 a 59 años
  - Población de 60 y más años
  - Población con discapacidad
  - Promedio de escolaridad
- Características del entorno urbano

Nombre del indicador	Viviendas	Porcentaje
Total de viviendas:	2	
Total de viviendas particulares:	+	100
Total de viviendas habitadas:	2	
Viviendas particulares habitadas:	+	
Viviendas particulares no habitadas:	+	

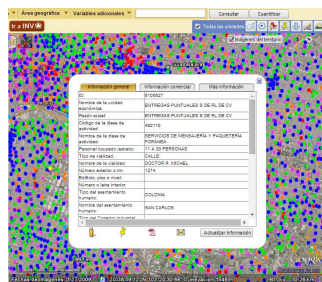
Entidad federativa: 09 Distrito Federal  
 Municipio: 015 Cuauhtémoc  
 Localidad: 0001 Cuauhtémoc  
 AGEB: 0930  
 Manzana: 007  
 Etapa de actualización: Censo 2010

Total de viviendas particulares :	35,617,724
Total de viviendas habitadas :	28,807,568
Total de viviendas deshabitadas :	4,997,806
Total de viviendas de uso temporal :	2,012,350

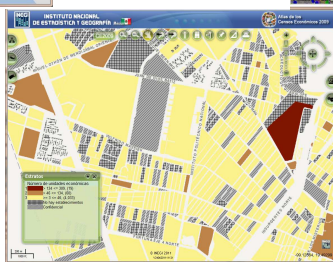
## Economic Census Atlas National Directory of Economic Units (DENUE)



Total economic units by state

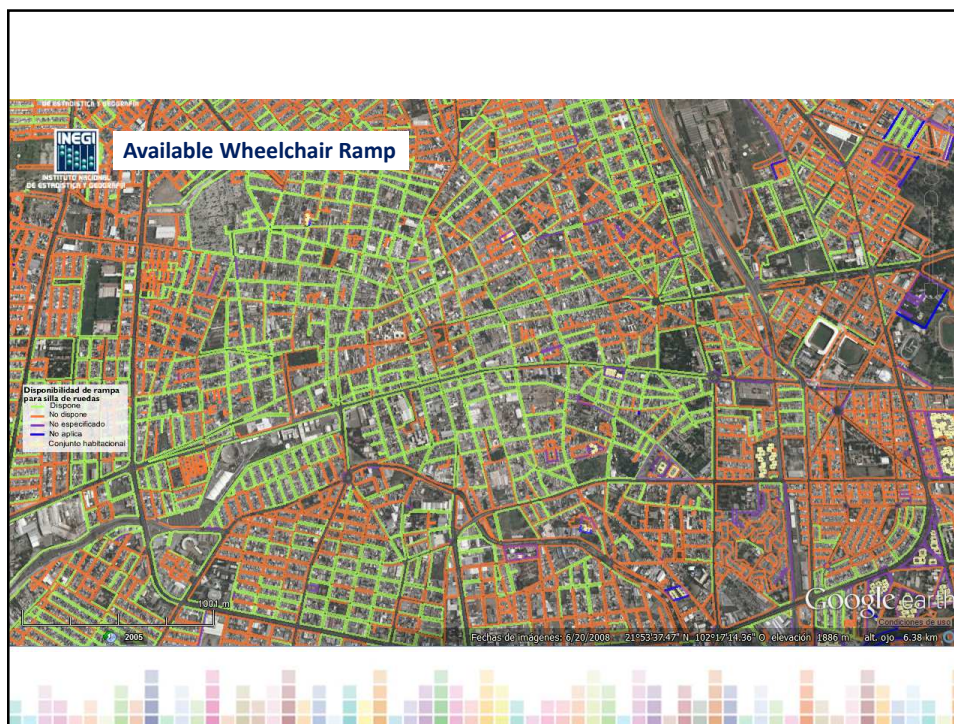


Data from economic units  
(commercial establishments)



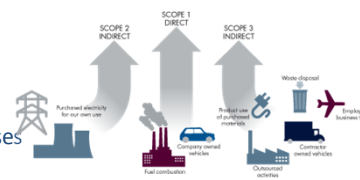
Total economic units, by block (Mexico City)





## ANNUAL OPERATION CERTIFICATE (COA Web)

- An online tool for the official reporting of emissions and pollutant transfers to air, water, soil, land and hazardous materials and waste, from industries and establishments from all productive sector:
  - Chemical, petroleum, automotive, pulp & paper, metal, glass, electric power generation, asbestos, cement, hazardous waste treatment, etc;
  - Waste management providers,
  - Those discharging wastewater into national water bodies, or
  - Those emitting 25,000 tonnes or more of CO2 or equivalent compounds
  - Greenhouse Gases (GHG) (transport, agricultural, trade & services, etc).
- Reporting is compulsory and free of charge;
- Information is validated and updated in real time
- Reporting fields include standardized physical addresses



## ANNUAL OPERATION CERTIFICATE (COA Web)

- All information about the location of the industries is geo-referenced, considering Technical Geographic Standards (Geographic Addresses)

## Integration of statistical and geographic data sources

GEO-STATISTICAL INTEGRATION to MONITOR NATIONAL PRIORITIES & SDGs			
Satellite Imagery	Other sources	National Uses	SDG / other applications
High resolution (2.5 m) <b>SPOT</b> <b>ERMEX</b>	<b>Population Census</b> <b>National Housing Inventory</b> <b>Economic Census</b> <b>Technical Standard on addresses</b> <b>COA-Web</b> <b>In situ validation</b>	<b>Geo-statistical framework</b> <b>Updating of:</b> Topographic charts <b>Visualization of:</b> Population, Economic, Housing, Gender, Health, Education & public services Urban & rural development Water and sanitation Infrastructure GHG emissions/hzd waste	<ol style="list-style-type: none"> <li>1. No poverty</li> <li>2. Zero hunger</li> <li>3. Health and well-being</li> <li>4. Quality education</li> <li>5. Gender equality</li> <li>6. Water and sanitation</li> <li>7. Affordable &amp; clean energy</li> <li>8. Decent work &amp; economic growth</li> <li>9. Industry &amp; infrastructure</li> <li>10. Reduced Inequalities</li> <li>11. Sustainable cities &amp; communities</li> <li>12. Life on land</li> </ol>
Very high resolution (0.5 m) <b>GEOEYE</b> <b>EVISMAR</b>			
Medium resolution (5-30m) <b>RAPIDEYE</b> <b>LANDSAT</b>	<b>Natural resources &amp; topographic charts</b> <b>Forestry &amp; water data</b> <b>In situ validation</b>	<b>Land Use &amp; Vegetation map series</b> Deforestation, land use changes <b>Monitoring crops</b>	<ol style="list-style-type: none"> <li>2. Zero hunger</li> <li>16. Clean water and sanitation</li> <li>13. Climate action</li> <li>14. Life below water</li> <li>15. Life on land</li> </ol>
Low resolution (250 m) <b>MODIS</b>	<b>Topographic maps</b> <b>Land use &amp; vegetation</b>	<b>Disaster monitoring</b> Fires, large flooding	<b>Sendai Framework</b> <b>Climate action</b>
Radar <b>RADARSAT</b>	<b>Population</b> <b>Economic units</b> <b>Topography</b> <b>Land use/ vegetation</b>	<b>Disaster monitoring</b> Flooding, digital models in foggy areas	<b>Sendai Framework</b> <b>Climate action</b>

## Single Cartographic Base – Urban localities

### AIM:

To update Mexico's urban cartography, through the use of institutional inputs\*, administrative records, and other sources of geo-referenced data which, through a dynamic processing, allows for the maintenance of a single cartographic basis for the geo-statistic framework, topographic charts and all cartographic products required for census and surveys, thus consolidating the National System of Statistical and Geographic Information (SNIEG)

### Working universe:

**783** formats (scale 1:20,000)

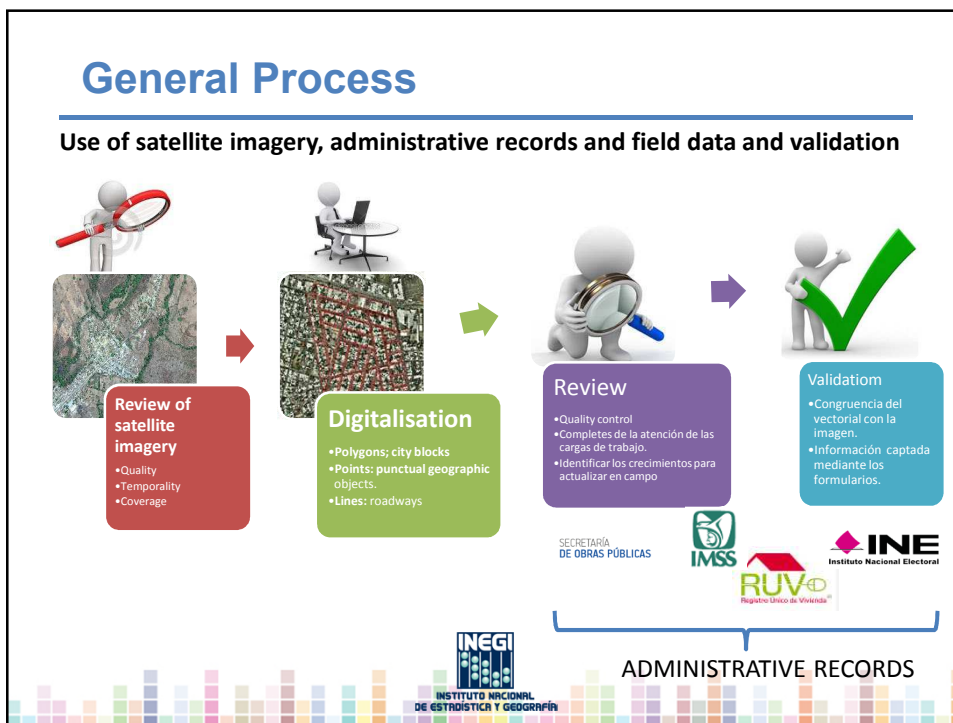
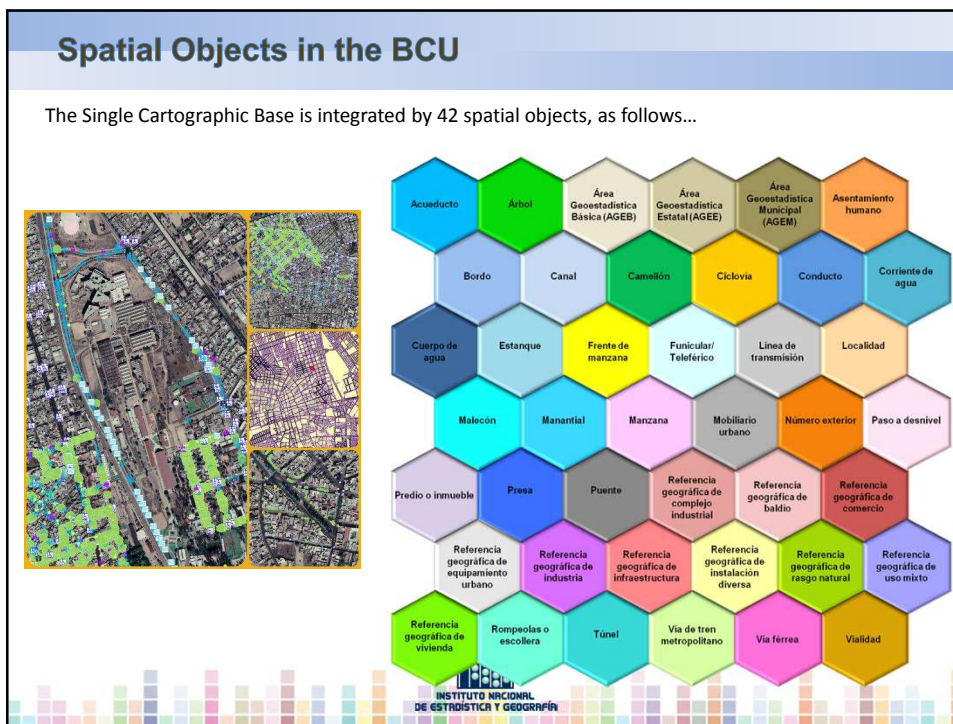
78% of total national population

1,130 Municipalities

2,411 Urban settlements

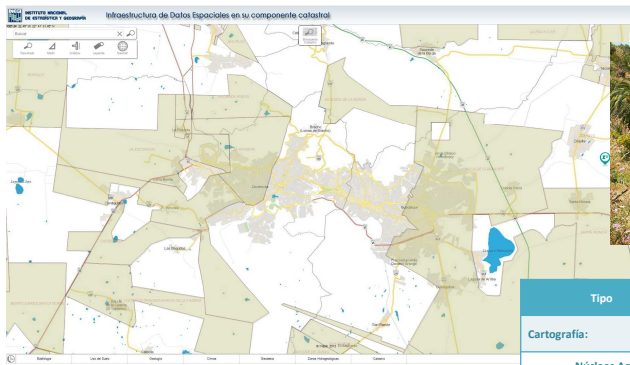
11,918 Rural settlements









## Use of Administrative records in Urban Cartographic database





Tipo	Registros	Periodo de operación
<b>Cartografía:</b>		
Núcleos Agrarios	30,250	1992 a 2017
Parcelas	6.2 Millones	
Dominio pleno	180,937	
Áreas de Uso Común	70,479	
Solares	2.1 Millones	

Source: Registro Agrario Nacional



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## Use of Administrative records in Urban Cartographic database

### Sources

**Cadastral cartography**  
**Public property registry**

¿De dónde se obtiene la información?

Programas modernización catastral

**SEDESOL** **BANCOBRAS**

Registros Administrativos (RA)

**CONAVI** **INE**



**CFE** **RUV**

### Processing

**Production of a harmonized and geo-referenced data layer of land properties**

¿Qué se hace con la información?

Se construye una capa de predios homologada y georreferenciada, coincidente con la imagen de satélite y el IMG con que cuenta el INEGI.


### Use

**Geo-statistical framework**  
**Single Cartographic Database**  
**SNIEG**  
**Sectoral projects**  
**Academia and civil society**

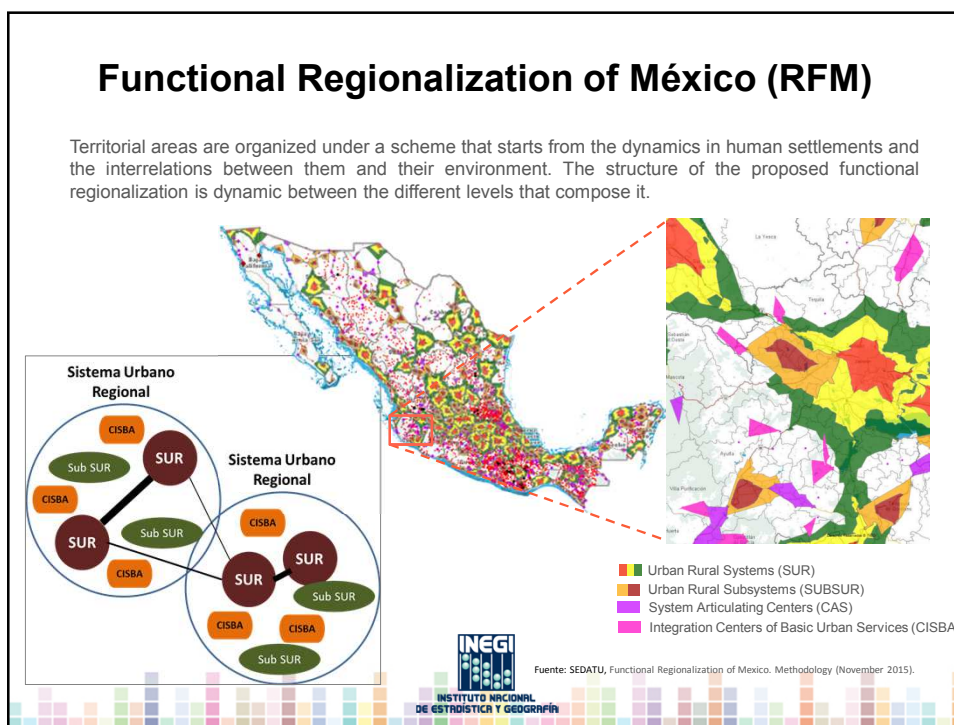
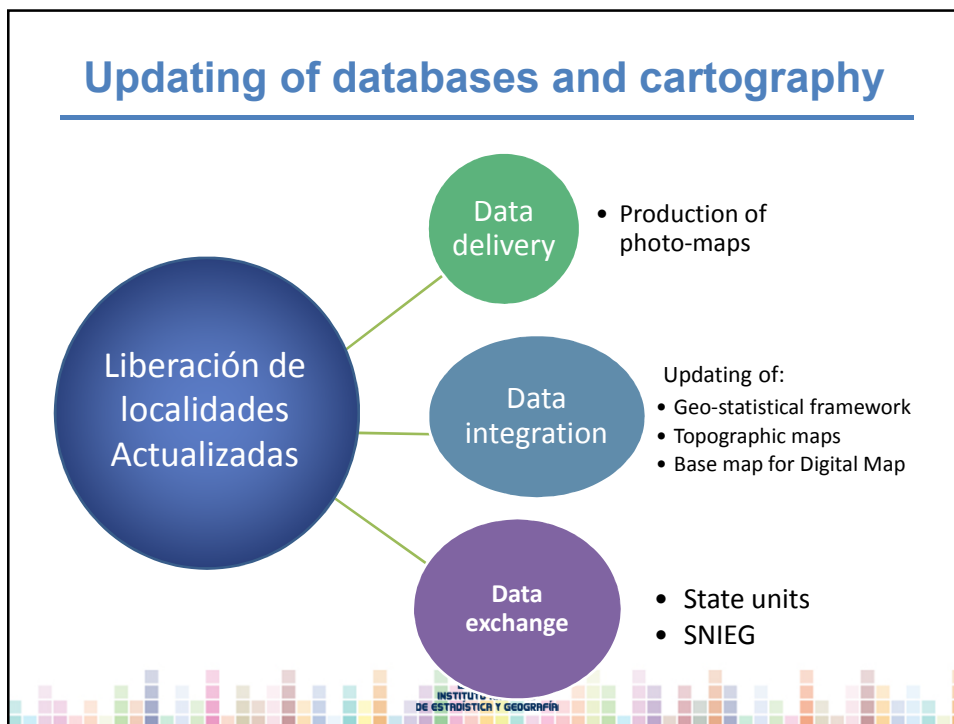
¿En dónde se aprovecha la información?

- Marco Geoestadístico (MG)
- BCU
- SNIEG
- Proyectos que hacen uso de la información de BCU

Tipo	Registros	Periodo de operación
<b>Cartografía:</b>		
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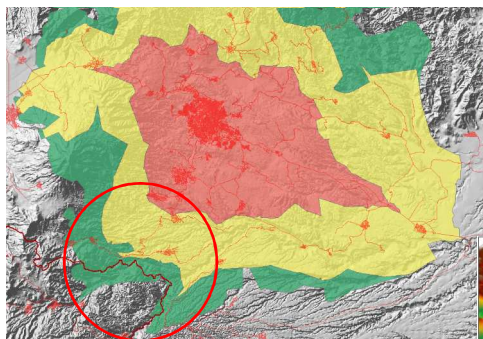


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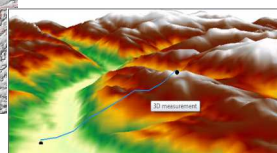
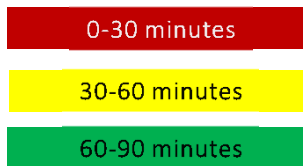


## Rural Urban Systems (SUR)

Urban Rural Systems (SUR) are strategic centers in the urban areas with the largest population and in state capitals that make territorial cohesion, decision-making, among others.



Polygons with time travel distances:



Optimization of travel polygons considering:

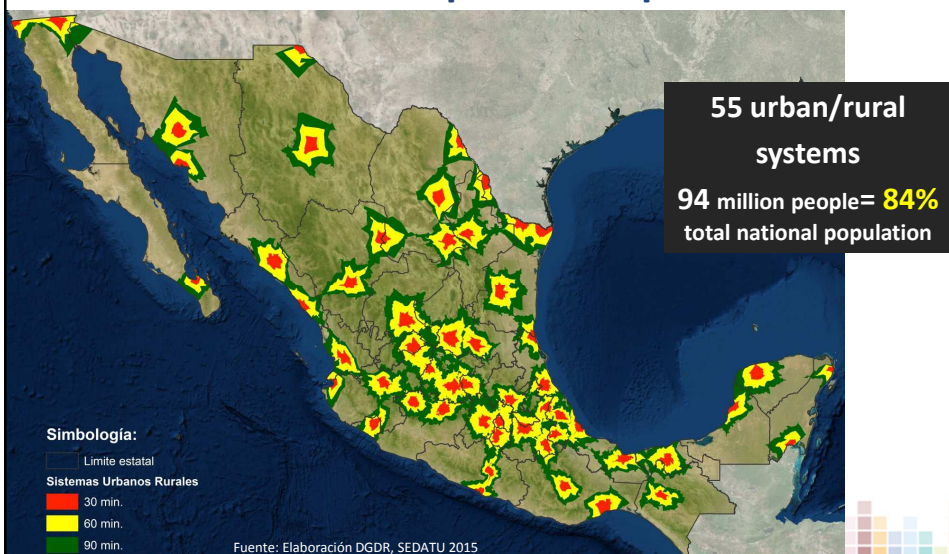
- The National Road Network, and
- The Digital Elevation Model



Re: SEDATU, Política Nacional y Programas de Desarrollo Regional 2014-2018, lámina 15.

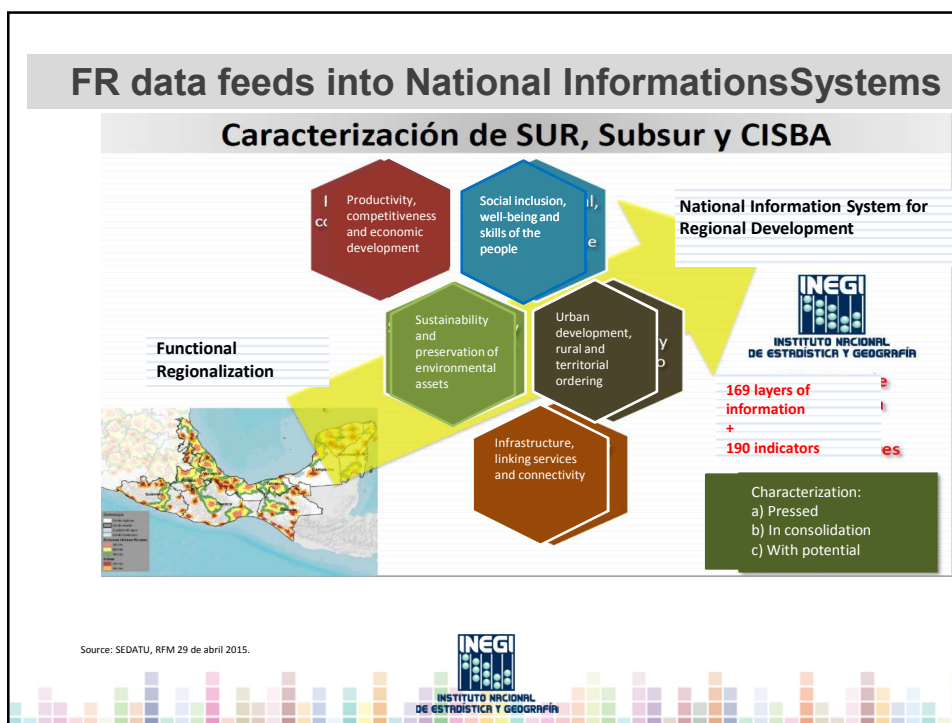
## Use of BiG DATA

geo-referenced tweets to identify Urban-rural dependence patterns



**Simbología:**  
 Limite estatal  
 Sistemas Urbanos Rurales  
 30 min.  
 60 min.  
 90 min.

Fuente: Elaboración DGDR, SEDATU 2015



## Participatory Cartography

- An interactive, dynamic crowd-sourcing process to channel citizen input for territorial information used to permanently update and improve official cartography.
- Discrepancies or updates in addresses and roadways (numbering, nomenclature, senses, services and status updates during emergencies)
- Inputs: comments, pictures and other formats
- Input is validated by INEGI specialists and uploaded to the Digital Map of Mexico or the Collaborative Disaster Platform.



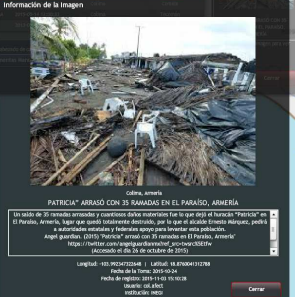
## Damages after Hurricane Patricia (Oct 2015)

[http://antares.inegi.org.mx/analisis/red\\_hidro/siatl/#](http://antares.inegi.org.mx/analisis/red_hidro/siatl/#)

Fotografías registradas por colaboradores

Título	Fecha	Estado	Municipio
PUNTO DE VISTA DEL SAN JUAN O'BARRO	2015-10-26 08:15:15	Coahuila de Zaragoza	San Juan O'Barro
LAMPARA DEL PUEBLO GARIBATO PARACUATLES Y ALLE	2015-10-27 02:28:28	Coahuila de Zaragoza	San Juan O'Barro
CERCA DEL BOSQUE SAN JUAN O'BARRO	2015-10-27 02:28:28	Coahuila de Zaragoza	San Juan O'Barro
ANTARQUE ARRABADO CON TRAMADO DE LA SIERRA	2015-10-28 09:28:28	Coahuila	Antarique

Información de la imagen



**PATRICIA" ARRABADO CON TRAMADO EN EL PARAJISO, ARMERIA**  
 Coahuila, México  
 Un video de 30 segundos transmitido y compartido en YouTube tras que el huracán "Patricia" en El Paraiso, Armeria, dejó un saldo de cientos de fallecidos, por lo que el Estado Coahuila Mexicana, pidió a sus habitantes estatales y federales apoyo para brindar una publicación en redes sociales. (INEGI "Patricia" Armeria) en Twitter en El Paraiso, Armeria: [@inegiarmeria](https://twitter.com/inegiarmeria) (https://www.youtube.com/watch?v=9j0jwv4v00w) (https://www.facebook.com/inegiarmeria) (https://www.instagram.com/inegiarmeria) (https://www.linkedin.com/company/inegiarmeria) (https://www.pinterest.com/inegiarmeria) (https://www.tumblr.com/inegiarmeria) (https://www.vimeo.com/inegiarmeria) (https://www.youtube.com/watch?v=9j0jwv4v00w)

Longitud: -105.962020044 | Latitud: 18.890000000000004  
 Fecha de la toma: 2015-10-28  
 Fecha de registro: 2015-10-28  
 Usuario: COB/ANTARQUE  
 Modificación: none

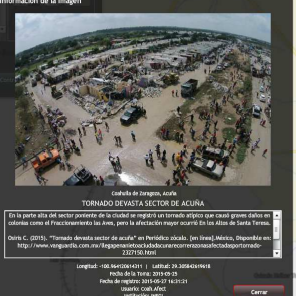
INEGI INSTITUTO NACIONAL DE ESTADÍSTICA Y GEOGRAFÍA

## Damages after tornado through Acuña City, Coahuila (April 2015)

Fotografías registradas por colaboradores

Título	Fecha	Estado	Municipio
TORNADO DEBASTA SECTOR DE ACUÑA	2015-04-27 16:25:25	Coahuila de Zaragoza	Acuña
REGION DE EXPLOSIONES FUERTE	2015-04-28 16:14:12	Coahuila de Zaragoza	Ocampo
PROBLEMAS EN EL TORNADO	2015-04-28 16:14:12	Coahuila de Zaragoza	Ocampo
CAMAL PARA LA MONTAÑA PUEBLO	2015-04-28 16:14:12	Coahuila de Zaragoza	Ocampo
PUEBLO MACHO EL PRESIDENTE	2015-04-28 16:14:12	Coahuila de Zaragoza	Ocampo
LAPSO EN EL TORNADO	2015-04-28 16:14:12	Coahuila de Zaragoza	Ocampo
AMBITO DE MONTAÑA	2015-04-28 16:14:12	Coahuila de Zaragoza	Ocampo

Información de la imagen

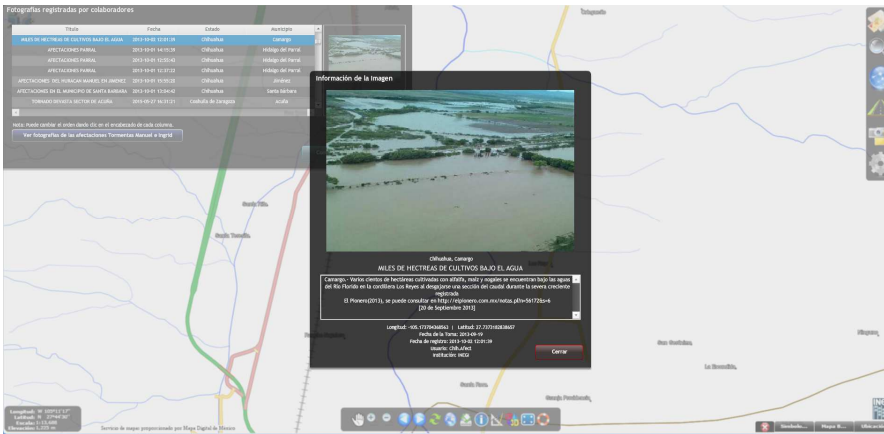


**TORNADO DEBASTA SECTOR DE ACUÑA**  
 Coahuila de Zaragoza, México  
 En la parte alta del sector presente de la ciudad se registró un tornado que causó graves daños en Acuña Coahuila al fracasar en su paso, pero la destrucción mayor ocurrió en los alrededores de Santa Teresa Coahuila. (INEGI "Tornado de Acuña" en Twitter) en Twitter México, República Mexicana: <http://www.vanguardia.com.mx/Reportajes/2015/04/27/tornado-de-acuna-coahuila-reconstruccion-coahuila-reportaje-2015-04-27>

Longitud: -105.862000000 | Latitud: 23.356000000000004  
 Fecha de la toma: 2015-04-27  
 Fecha de registro: 2015-04-27 16:25:25  
 Usuario: COB/ANTARQUE  
 Modificación: none

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## Flooded cropfields. Chihuahua, september 2013



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## Damages after strong winds and hail, Chiapas



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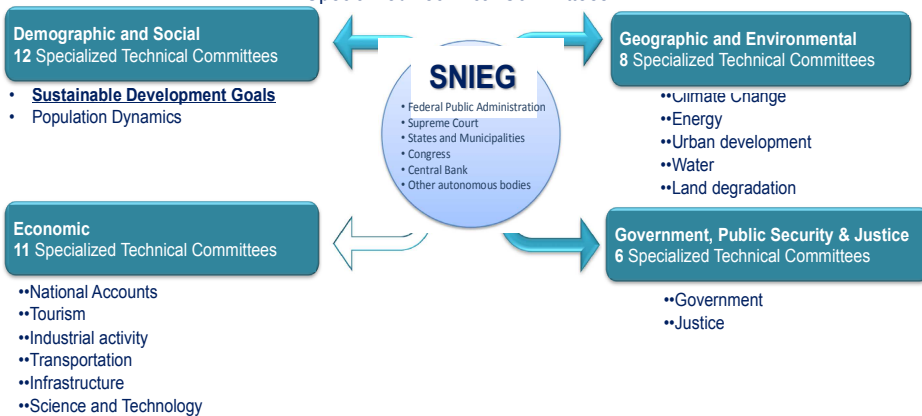
## Uses and applications of diverse and integrated information systems



### National System of Statistical and Geographical Information (SNI EG)

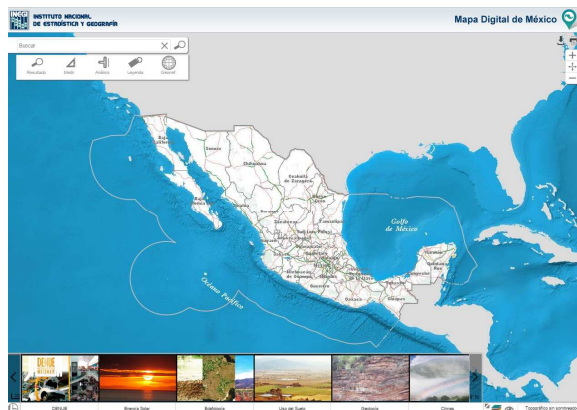
#### Thematic Information Subsystems

Specialized Technical Committees



## Digital Map of Mexico

Open-source geomatic platform that allows the visualization and analysis of geographic and geo-referenced statistical information. It contains 208 vector data layers, with more than 71 million geographic objects and 4 raster layers covering the entire country.



## Gender Atlas

46 Gender-related indicators (geo-referenced)

10 main areas:

- General population
- Education
- Health
- Labor
- Decision making
- Use of time
- Poverty
- Entrepreneurship
- Violence
- % Indigenous population



[http://gaia.inegi.org.mx/atlas\\_genero/](http://gaia.inegi.org.mx/atlas_genero/)

## Urban Cartographic database

**Information sources**

- Administrative records
- Information from INEGI
- Satellite images and pictures

**Benefits**

- Update of the national geostatistical framework
- Provides support for censuses and surveys
- Update of the National cartographic database
- Support for the activities of State Units
- Strengthens the Public Information Service

Updated every three years  
2,234 localities - 80% of the country's population.

## Collaborative platform for disaster preparedness

**Multi-layer web platform**

Accessible to all relevant government agencies

Combines layers on Population, economic, and environmental data

With real-time news and satellite/radar imagery

Data available prior, during and post-emergencies

**Web Geo-services**

- Discovery
- Viewing and Consultation
- Downloading
- Direct Access

Employment of Standards OGC:

- WMS
- WCS
- WFS

*Permanent base layers and by phenomenon or event*

**geospatial information as a critical asset for disaster management**

## The National Council for Sustainable Development and Agenda 2030

- A cross-sectoral committee (18 ministries), coordinated by the Office of the President
- It includes state and local governments, Congress, the private sector, academia and civil society;
- Technical advice from INEGI and other autonomous institutions;
- Launch of the National Platform for SDG monitoring (<http://agenda2030.mx>)



### SDG preliminary indicators assessment



According to INEGI's experience in geospatial information, a number of SDG indicators can be spatially referenced, as follows:



## Measuring SDG indicators

SDG 1 - No poverty

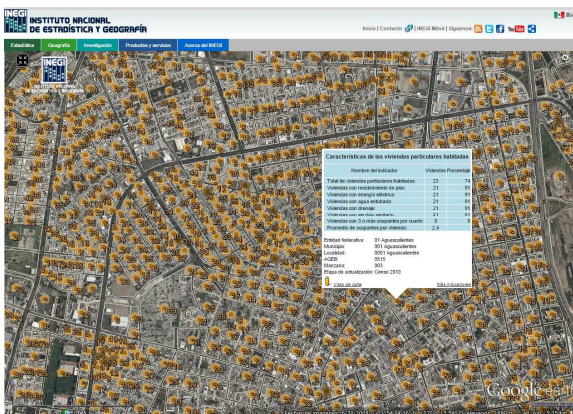
**Target 4:** By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance.

**Indicator 1.4.1** Proportion of the population living in households with access to basic services



Use of the geo-referenced National Housing Inventory

Visualized within the Digital Map of Mexico

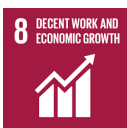


## Measuring SDG indicators

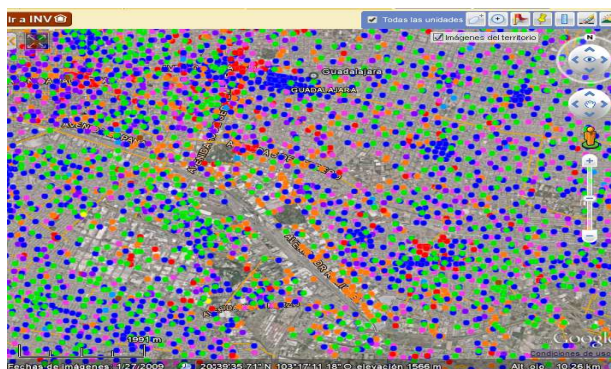
SDG 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

**Target 8.3 :** Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services

**Indicator 8.3.1** Share of informal employment in non-agriculture employment by gender



National Employment Survey visualized within the Digital Map of Mexico



## SDGs related to Disasters



There are **25 targets** related to disaster risk reduction in **10 of the 17 SDGs**, firmly establishing the role of disaster risk reduction as a core development strategy.



## Sustainable Urban Development (SDG 11)

### **Target 11.5 Disaster Preparedness**

By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations

- **Indicator 11.5.1** - Number of deaths, missing and persons affected by disaster per 100,000 people
- **Indicator 11.5.2** - Direct disaster economic loss in relation to global GDP, including disaster damage to critical infrastructure and disruption of basic services
  - Collaborative platform for disaster preparedness
  - Technical Committee on Urban and territorial development
  - IAEG-SDG
  - Sendai implementation



## Conclusions

- Diverse information sources (e.g. geospatial, Earth observations, *Big Data*, citizen data, and statistics) can and should be integrated in support of national priorities and global goals;
- Powerful synergies emerge in such integration; benefits are particularly evident in cities and during disasters, and can be instrumental in building *resilient, smart and sustainable* environments;
- Inter-institutional coordination (constant, expert & high-level) is key to generate, integrate, analyze and adequately use information for policy-making;
- This conversation benefits greatly from inputs by civil society, the private sector, and academia, as well as participation in international forums.




**Conociendo México**  
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