

Instituto Nacional
de Salud Pública

Geographic Information Systems in Public Health: Mapping Maternal Mortality

Generating evidence for better
decision making

Geographic Information Systems in Public Health

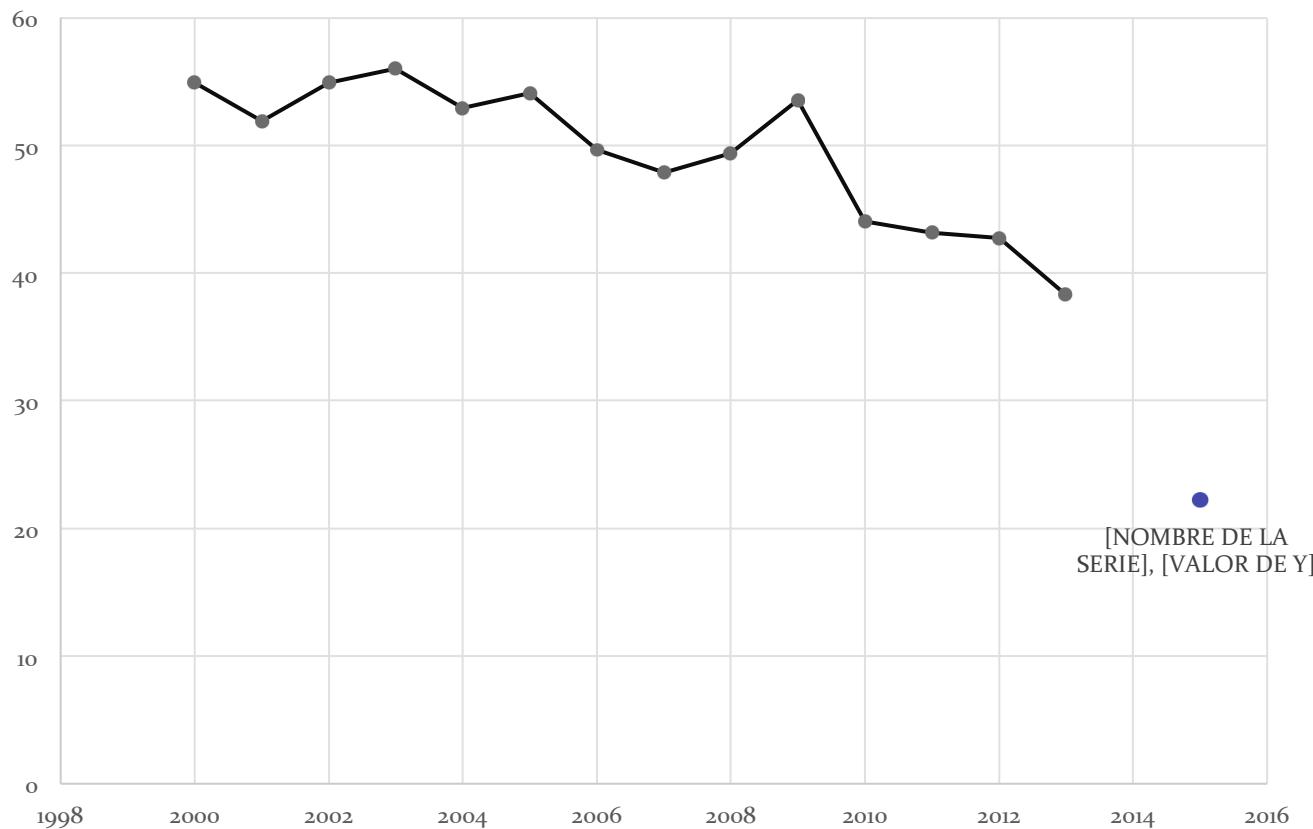
- Geographic Information Systems (GIS) have been used in public health since the nineteenth century
 - John Snow used a rudimentary system to investigate the source of cholera in England during an epidemic outbreak in 1854
- Modern informatics technology and satellite data facilitate the use of GIS in public health
 - Federal, state and local government health agencies in many countries use GIS in the planning, operation and evaluation of public health programs and policies

Information needed to Improve Population's health

- Data generation and integration
 - Accurate, timely, complete and consistent
 - Relevant / useful /accessible
 - Inter-departmental / Inter-institutional / Inter-sector
- Use of information
 - Better decision making
 - Monitoring & Impact evaluation
 - Accountability

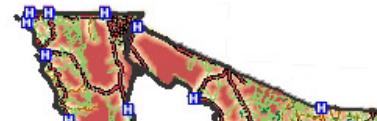
Maternal mortality in Mexico has not declined enough to meet MDG-5.1

Maternal Mortality Ratio, Mexico 2000 - 2014



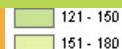
- Mapping maternal mortality in Mexico
 - Use of health administrative records
 - Hospital discharge data
 - Civil registry data
 - Mortality data
 - Infrastructure and resources geographic distribution
 - Census data
 - Topographic maps
 - Hydrology maps
 - Roads

Data Integration in GIS



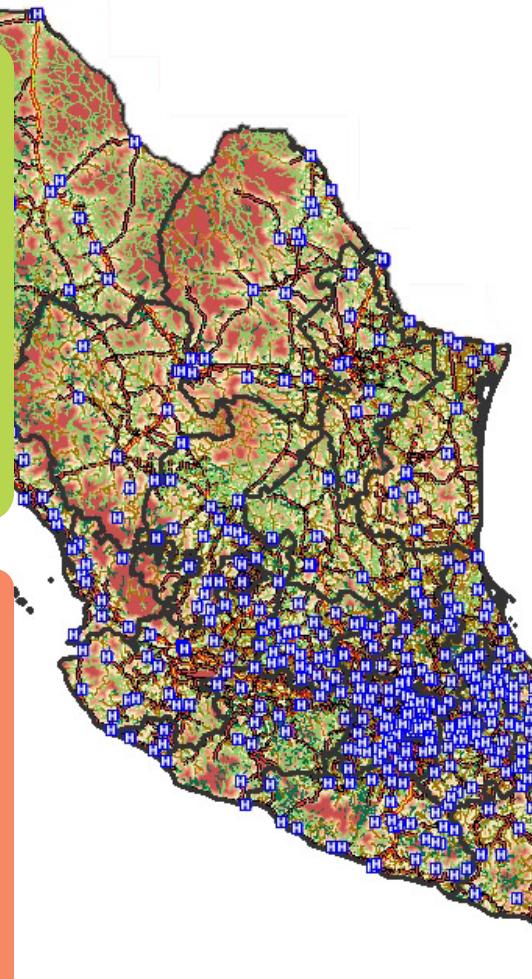
Health related data

- ✓ Healthcare Infrastructure
- ✓ Hospital discharges
- ✓ Service demand
- ✓ Epidemiological Surveillance)
 - Morbidity and Mortality



Demographics

- ✓ Population and population growth projections
- ✓ Vital statistics
- ✓ Socio-demographic Indicators
 - Deprivation
 - Human development

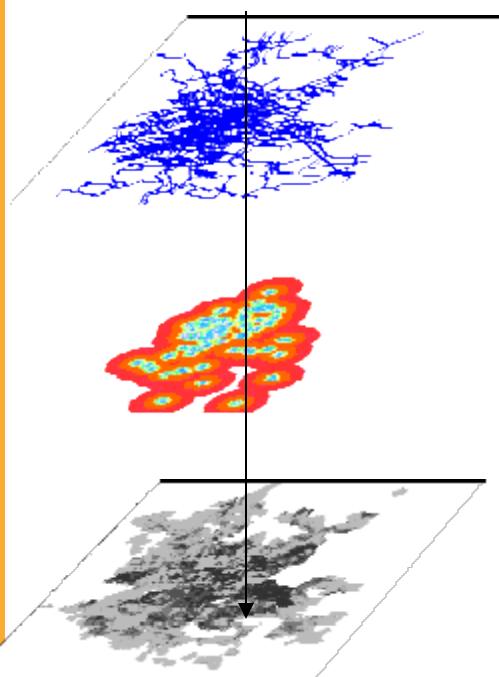


Geographic data

- ✓ Accessibility to healthcare infrastructure
 - Roads
 - Terrain and hydrology
- ✓ Health risk distribution
 - Natural
 - Related to human activities |

Geographic Information Systems

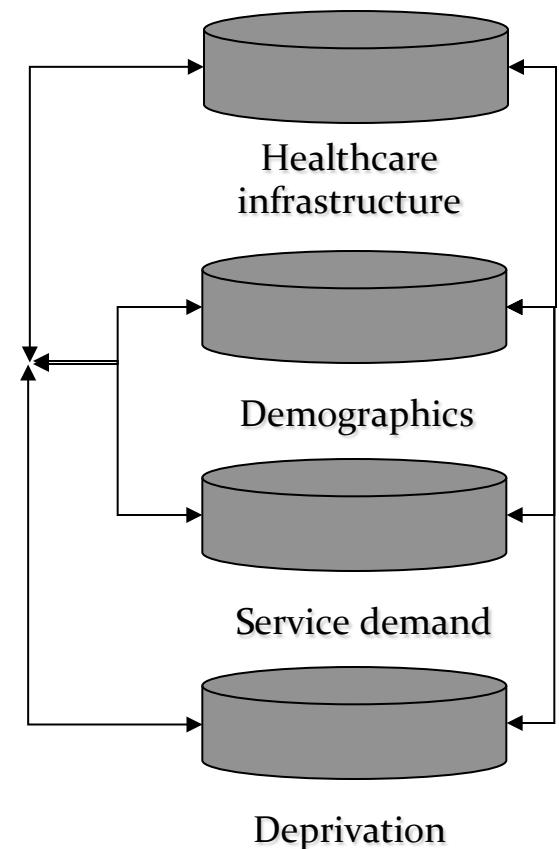
**Geo-referenced data
organized in map layers**



Visualization



Relational database system

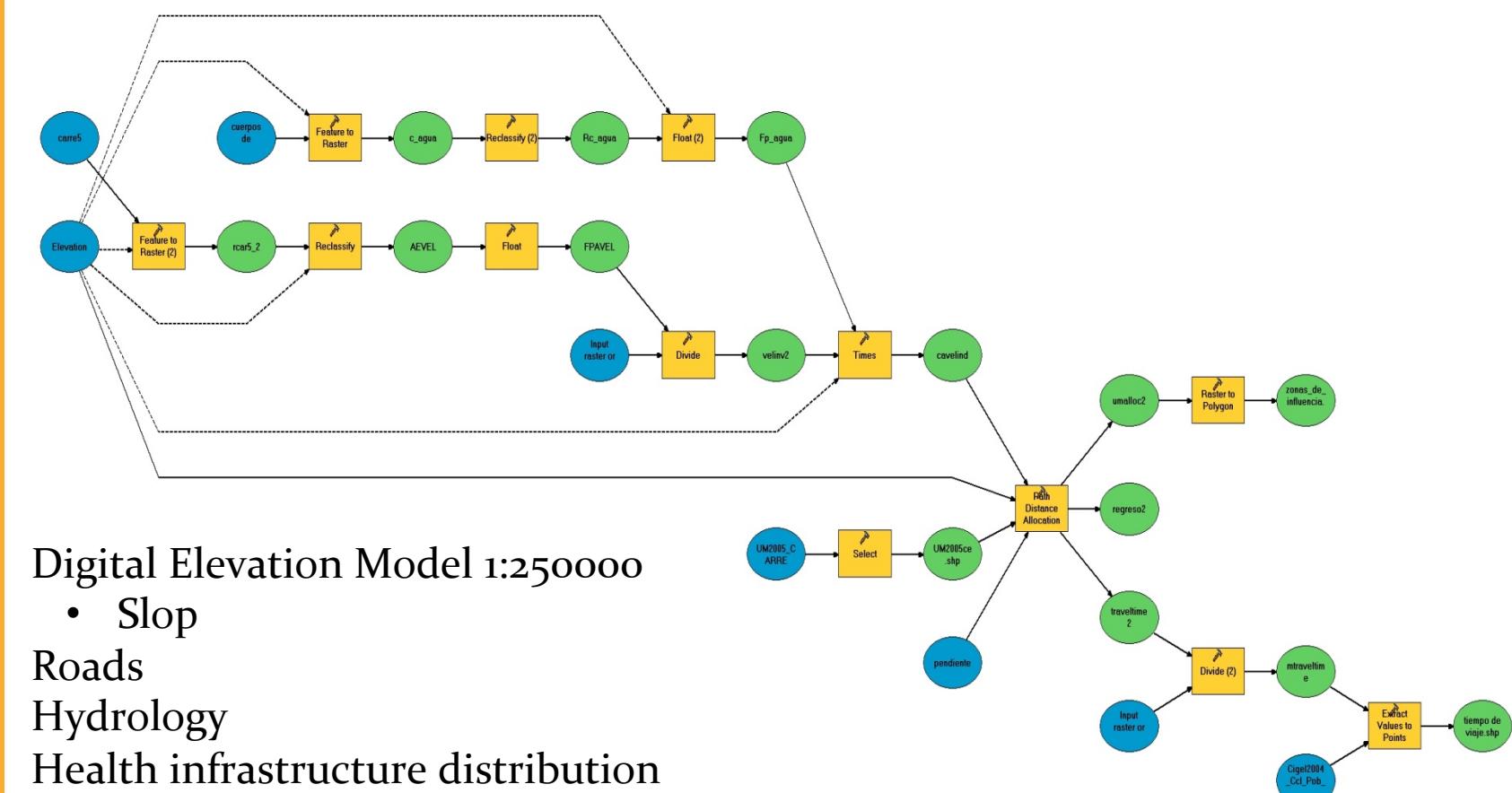


Spatial queries and analyses of data

Spatial visualization of database queries

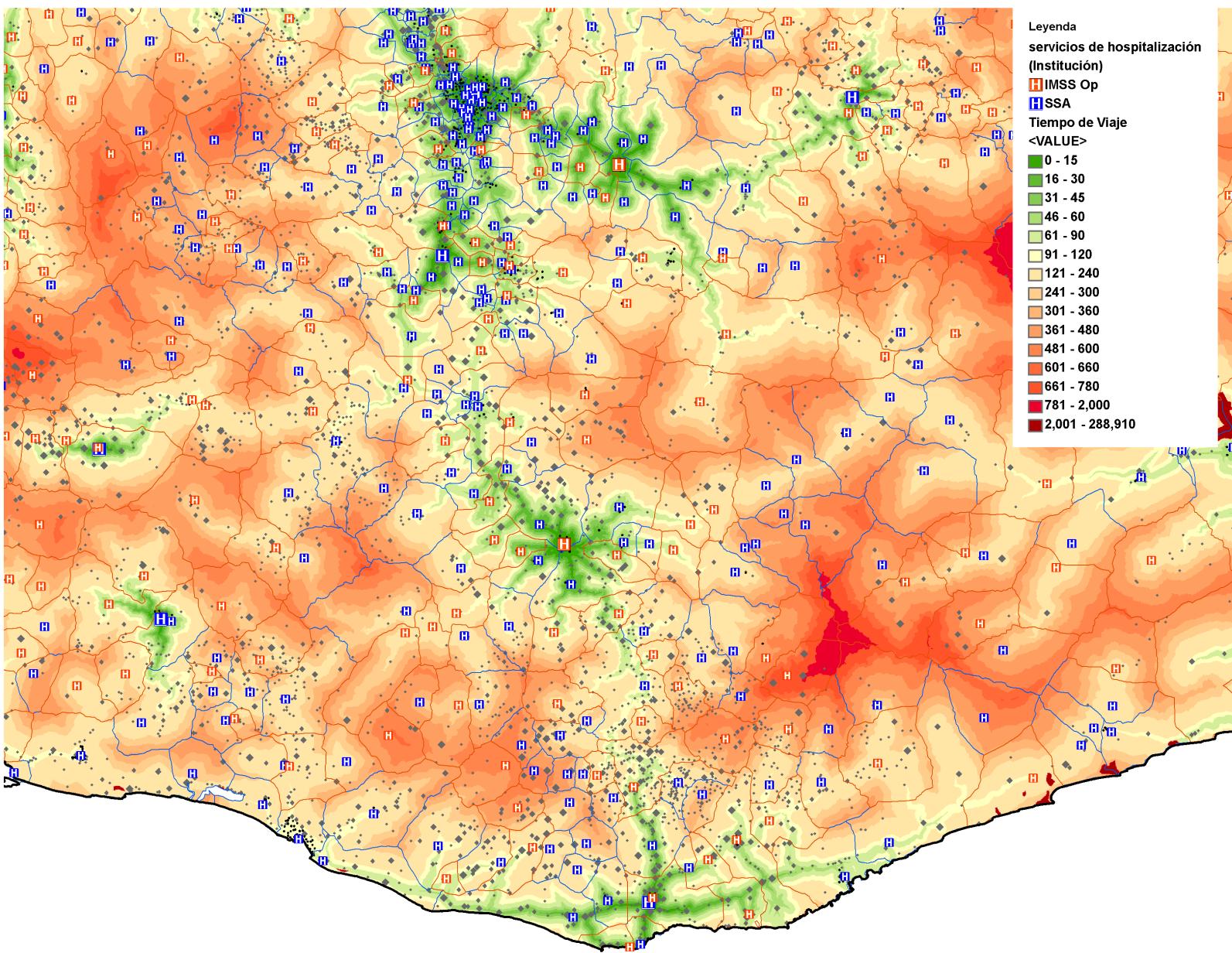
Database management and analyses through common index key variables

Spatial Model for travel time estimation

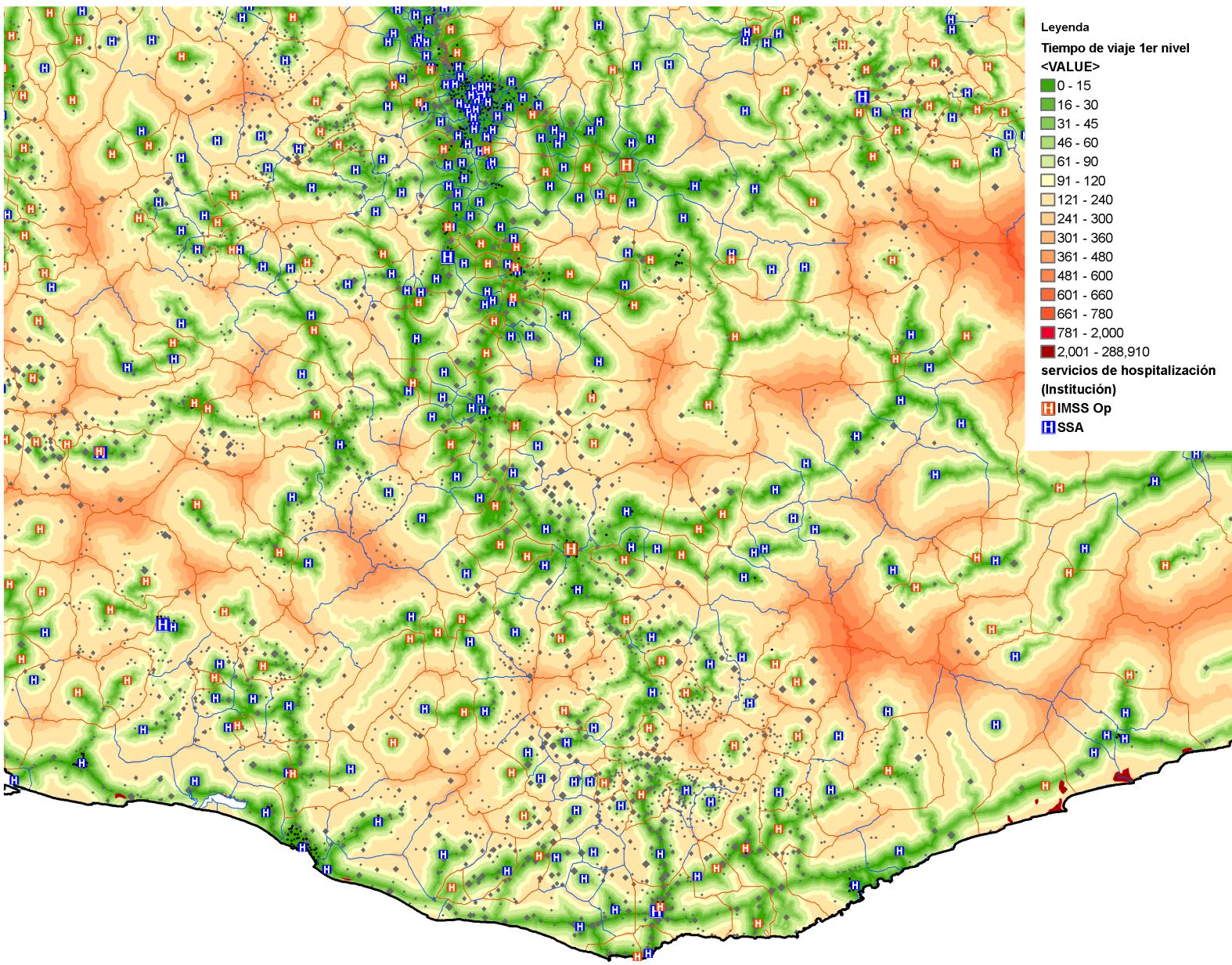


- Digital Elevation Model 1:250000
 - Slope
- Roads
- Hydrology
- Health infrastructure distribution
 - By type of service
 - By Institution
- Population distribution
- Cost surface based on the difficulty to transit through each 90m x 90m cell

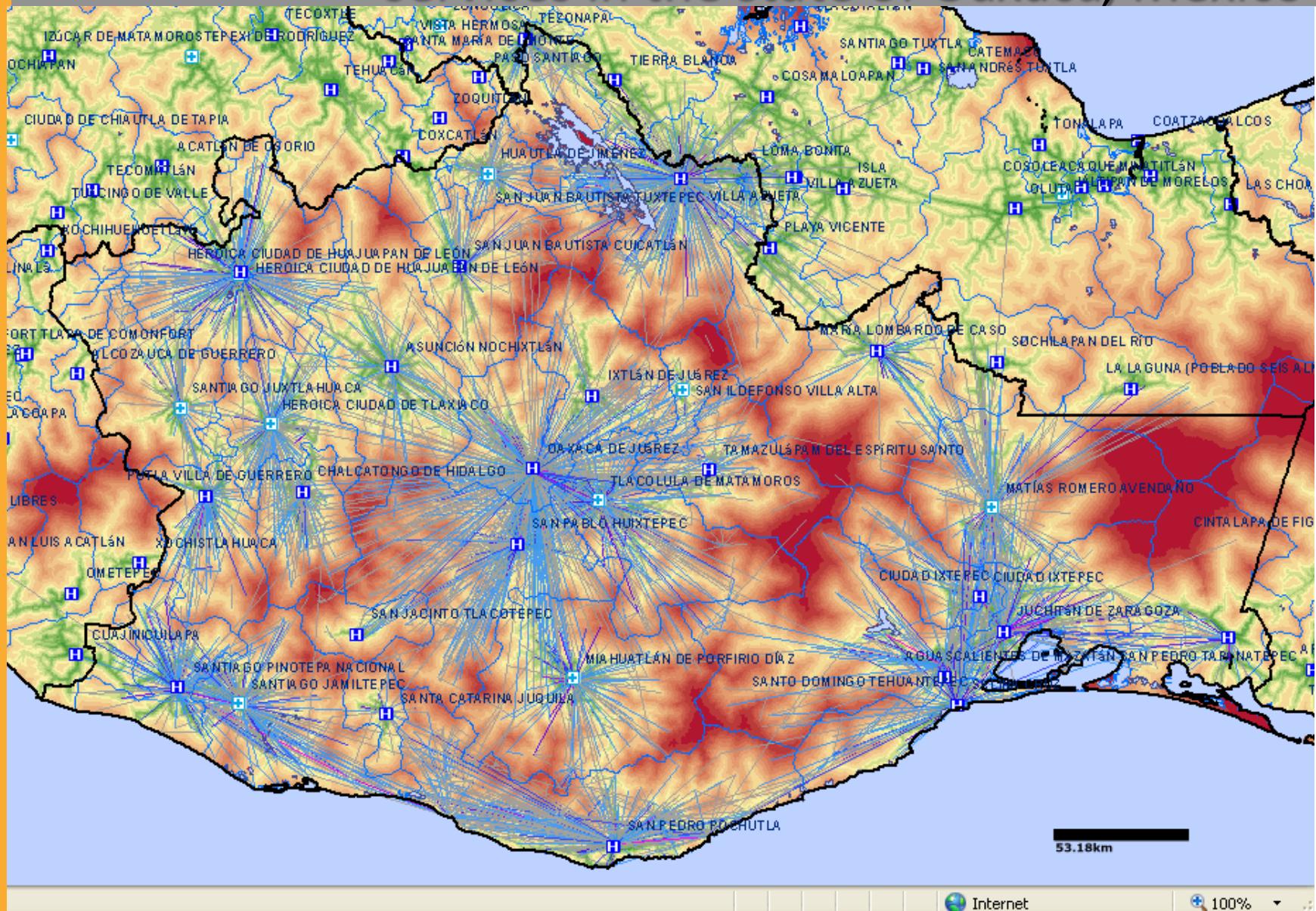
Spatial Model Results



Spatial Model Results



Movement patterns in seek of birth care health services in the state of Oaxaca, Mexico



SHARING RESULTS THROUGH WEB MAPPING APPLICATIONS

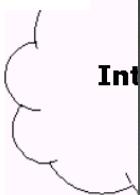
- Web Based GIS applications allow data integration and use of information in all governmental levels (local, state, national)
 - They provide a common frame to gather and share information
 - Data input can be done over the Internet to a common database or use distributed databases
 - Data is accessible to all who need it as soon as it is entered
 - Training curve is less steep

Web Based GIS Schematic Architecture

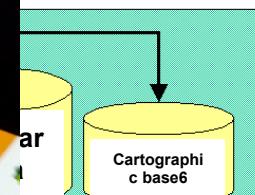
Users:
Public health workers
Scientific Committee
General population



Data input
Statistical or geographic queries



Windows Enterprise Server



OLE DB / ADO

Map generator

Web Based Mapping Application

WebServer
IIS

Main causes of hospital discharges

Sistema de Información Geográfica en Salud - Windows Internet Explorer

<https://geosalud.insp.mx/planeacion3/default.aspx>

Plan Maestro Sectorial de Recursos para la Salud

Tareas

- Demanda de servicios
 - Nacimientos 2005 (Desplazar)
 - Principales causas de Egreso
 - Ocupación Hospitalaria
 - Menos de 40.0%
 - De 40.1 a 60.0%

Contenido de Mapa

- Nacimientos 2005 (Desplazar)
- Principales causas de Egreso
- Ocupación Hospitalaria

Resultados

- Unidades Médicas
- PMI 2008 por Nivel y Estatus
- Ocupación Hospitalaria por Institución
- Egresos Hospitalarios Zonas de Captación por Municipio
- Egresos Hospitalarios por Localidad

Por Residencia Habitual

AÑO: 2005

CLUES: MNSSA002591

Ver Lineas

Limpiar Lineas

Nacimientos 2005 (INEGI)

Selección

Mapa

JUCHIPILA HUICALTICHE HUONISTEN DE MEJIA SAN JUAN YAHUALICA DE GONZALEZ GALLO TEPATITLÁN DEMORELOS ATOTONILCO EL CHAL LOS REYES DE SALGADO ZINAPECUARO DE MIGUEL ORELLANA TANGATO ALDAMBRA Copyright

Egresos Hospitalarios

Total de casos

Tot_Egresos

Ver Principales Causas
Ver Principales Causas Sin Obstetricas
Ver por grupo de Edad
Ver por tipo de Servicio

Egresos 2006

Ver Principales Causas
Ver Principales Causas Sin Obstetricas
Ver por grupo de Edad
Ver Por tipo de Servicio

Egresos 2007

Ver Grupos de edad
Ver Servicios

Legend

- Parto único espontáneo, sin otra especificación
- Aborto no especificado incompleto, sin complicación
- Atención materna por desproporción de origen no especificado
- Oligohidramnios
- Cálculo de la vesícula biliar con otra coleocistitis
- Hernia inguinal unilateral o no especificada, sin obstrucción ni gangrena
- Hemorragia gastrointestinal, no especificada
- Apendicitis aguda, no especificada
- Esterilización



Met need index for

obstetric emergency care

PMS Plan Maestro Sectorial

de Recursos para la Atención de la Salud

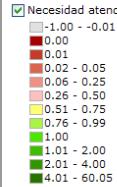
Descripción Sistema Manual Salir del Sistema

Tareas

- Buscar por Municipio y/o Localidad
- Unidad Médica por Clave
- Unidad Médica por Nombre
- Unidad Médica por Localidad
- Imprimir Mapa

Contenido de Mapa

- atendida
- ud materna
- Mortalidad materna por residencia h
- Mortalidad materna por lugar de la
- Zonas de influencia UM Obstet.
- Urgencias Obstétricas por Municipio
- Urgencias Obstétricas por Estado
- Necesidad atendida por zona de inf



- Necesidad atendida por municipio
- Necesidad atendida por estado

dicional

general

nño

Resultados

Unidades Médicas

PMS 2008 por Nivel y Estatus

Ocupación Hospitalaria por Institución

Egresos Hospitalarios Zonas de Captación por Municipio

Egresos Hospitalarios por Localidad

Nacimientos 2005 (INEGI)

(Desplazamientos)

ESTADO: Michoacán

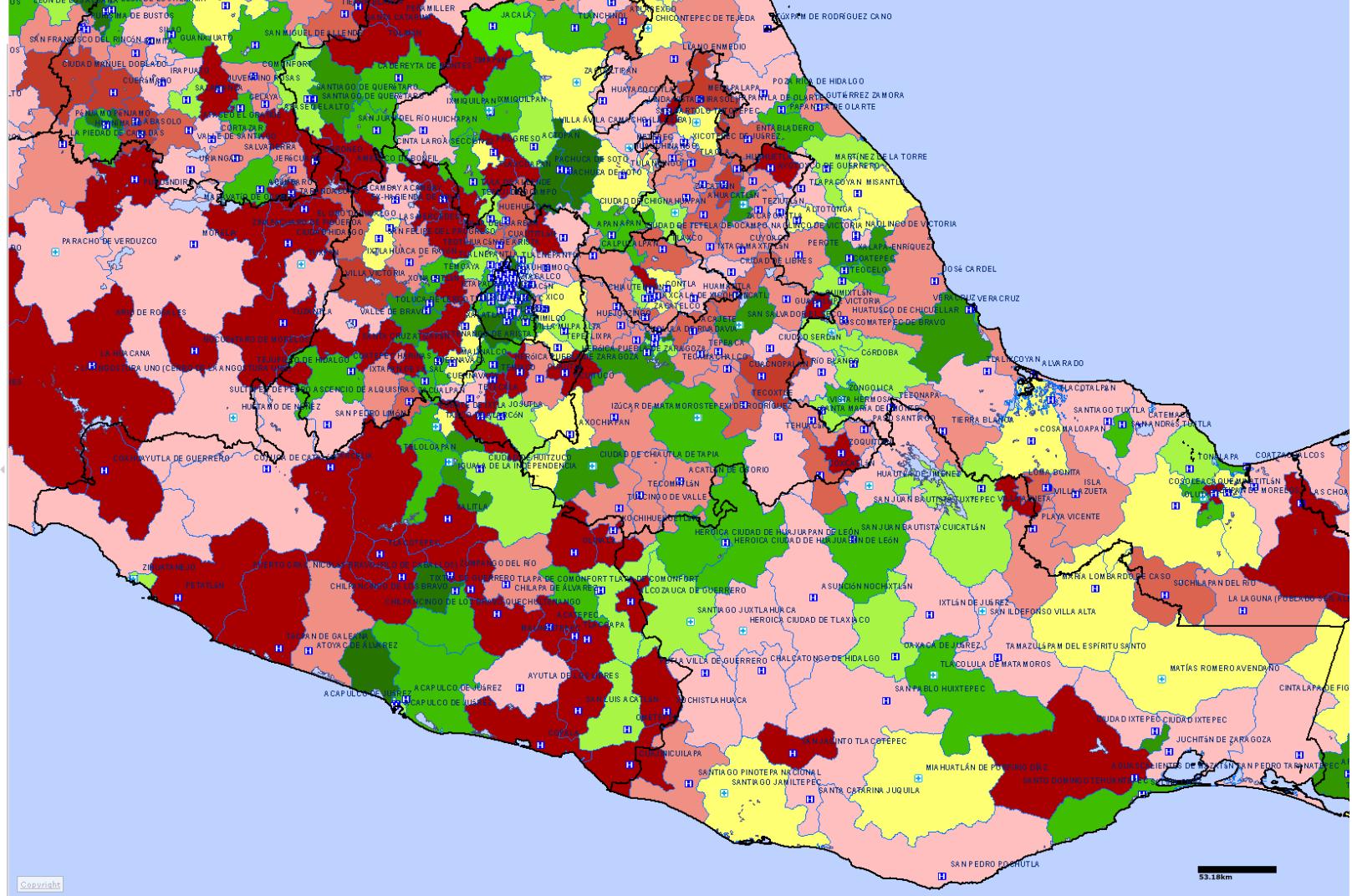
AÑO: 2007

Enviar

Limpiar

Mortalidad Materna 2004-2007

Descargar datos por Capa



Copyright

53.18km

Internet

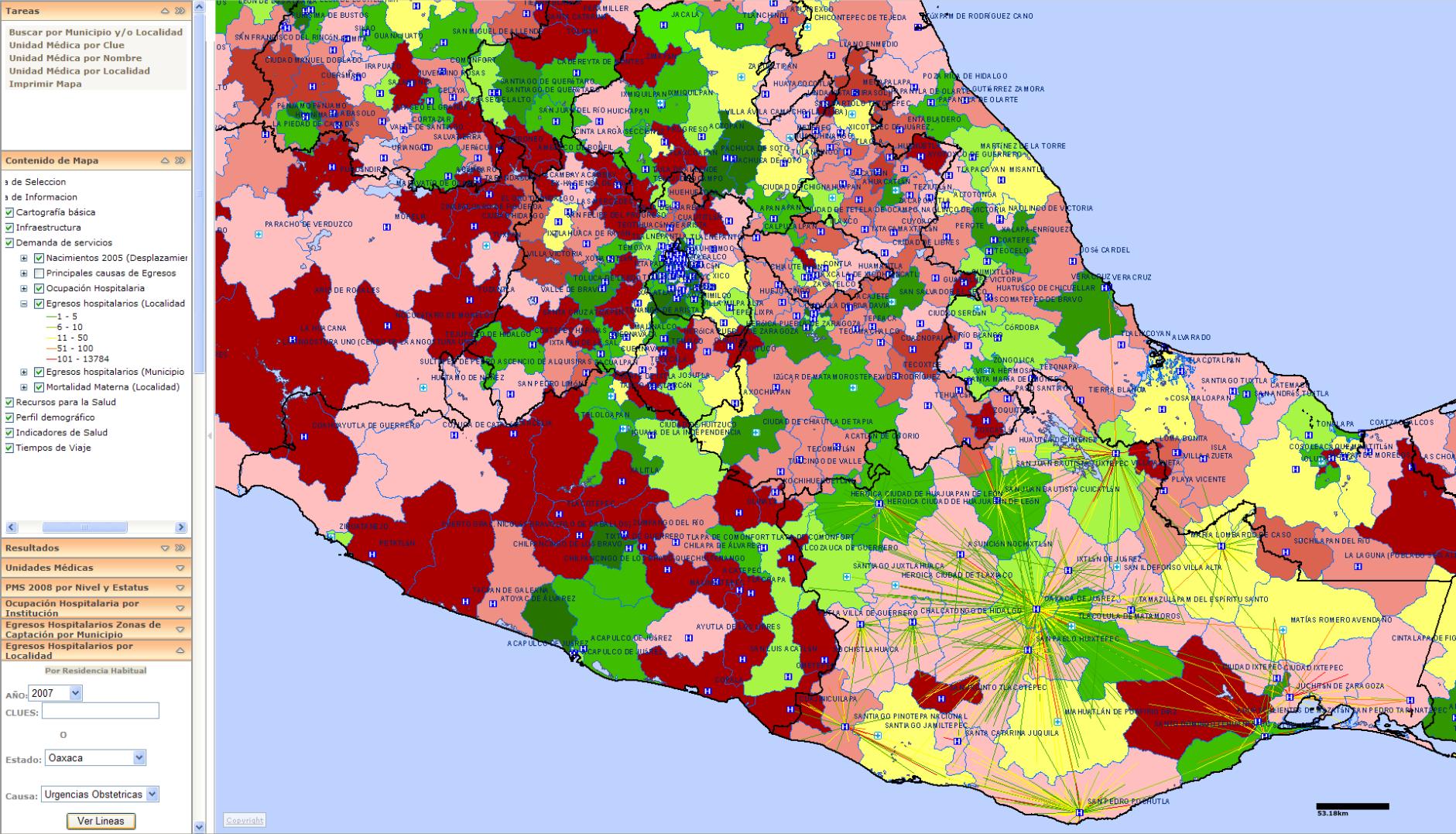
100%

Movement patterns in seek of obstetric emergency care in the state of Oaxaca

PMS Plan Maestro Sectorial

de Recursos para la Atención de la Salud

[Descripción Sistema](#) [Manual del Sistema](#)



Movement patterns in seek of obstetric emergency care in the state of Oaxaca

PMS Plan Maestro Sectorial
de Recursos para la Atención de la Salud

sica
a
ervicios
la Salud
fico
Salud
dad atendida
Salud materna

- Mortalidad materna por residencia
- 2004
- 2005
- 2006
- 2007
- Mortalidad materna por lugar de
- Zonas de influencia UM Obstet.
- Urgencias Obstétricas por Municipio
- Urgencias Obstétricas por Estado
- Necesidad atendida por zona de
- Necesidad atendida por municipio
- Necesidad atendida por estado

jurisdiccional

Resultados

Unidades Médicas

PMS 2008 por Nivel y Estatus

Ocupación Hospitalaria por Institución

Egresos Hospitalarios Zonas de Captación por Municipio

Egresos Hospitalarios por Localidad

Por Residencia Habitual

AÑO: 2007

CLUES:

O

Estado: Oaxaca

Causa: Urgencias Obstétricas

Ver Líneas

Limpiar Líneas

Nacimientos 2005 (INEGI)

Mortalidad Materna 2004-2007

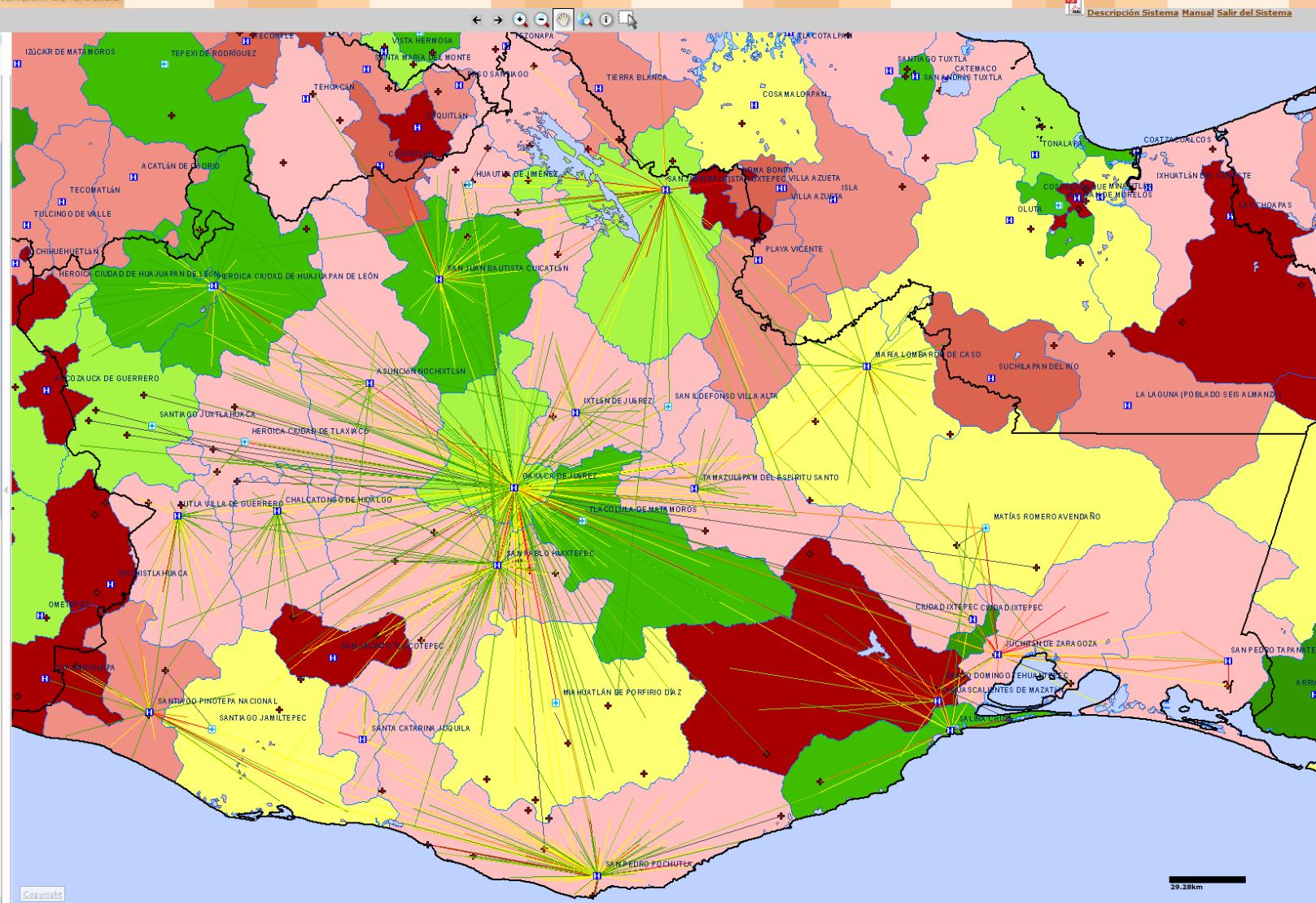
ESTADO: Oaxaca

AÑO: 2007

Enviar

Limpiar

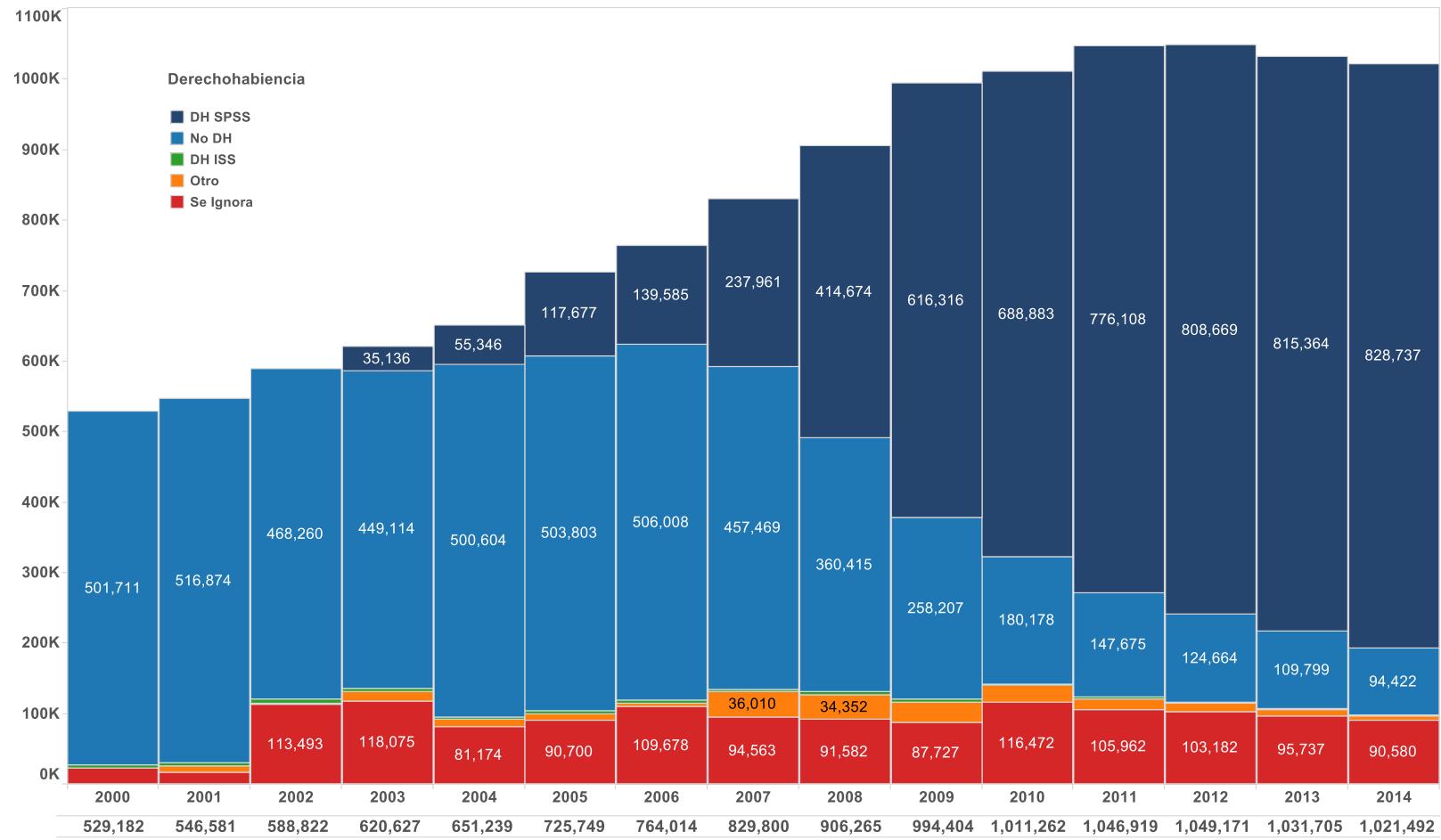
Descripción Sistema Manual Salir del Sistema



29.28km

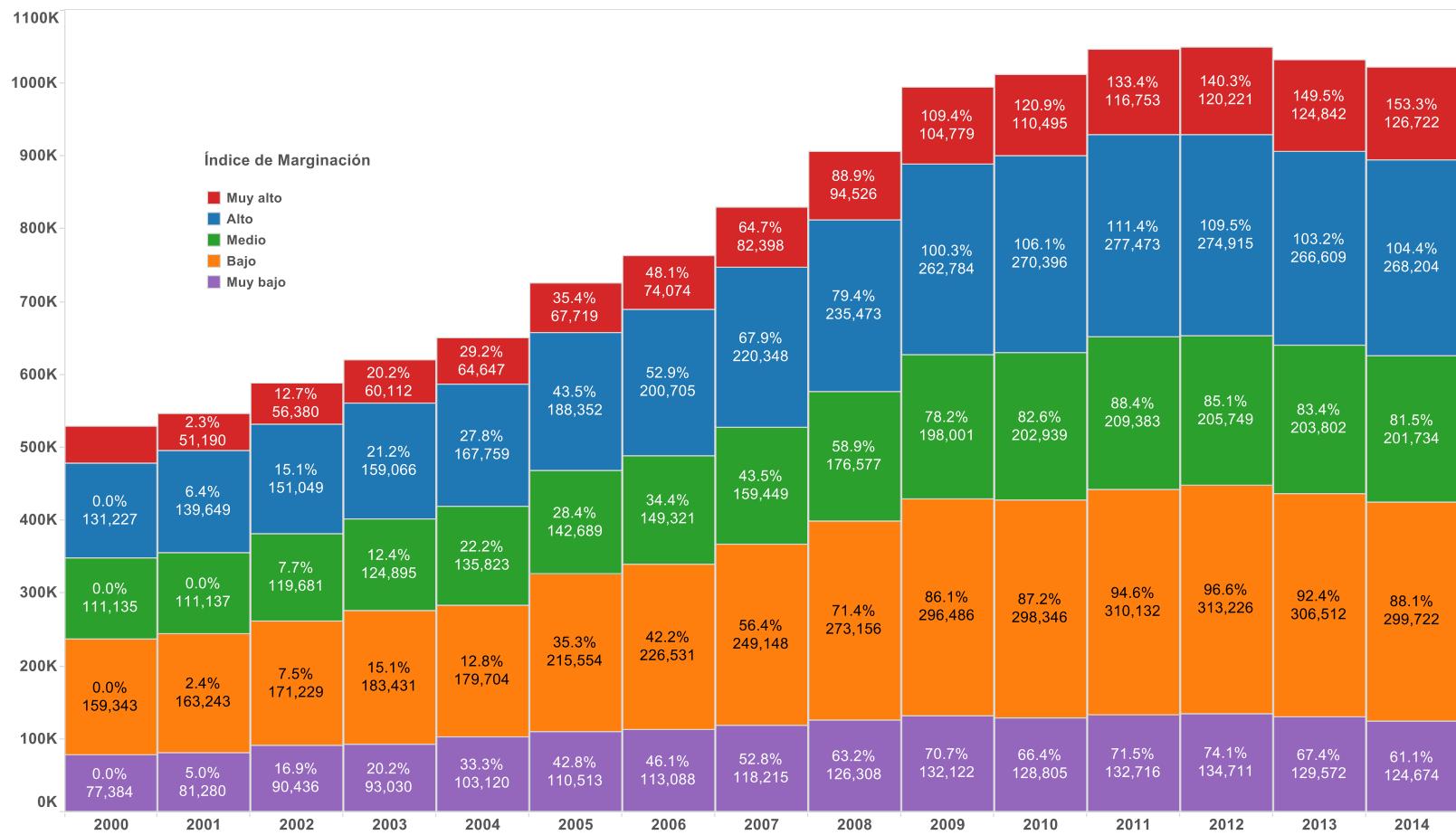
- Visualization of geographical and institutional barriers to access EmOC services aided in the development of a new maternal health policy in Mexico:
Regardless on health insurance status, any woman should receive free-of-charge EmOC services in any public hospital in Mexico; this was extended later to include also childbearing services.

Birth services provided by health insurance of the mother, México 2000 - 2014



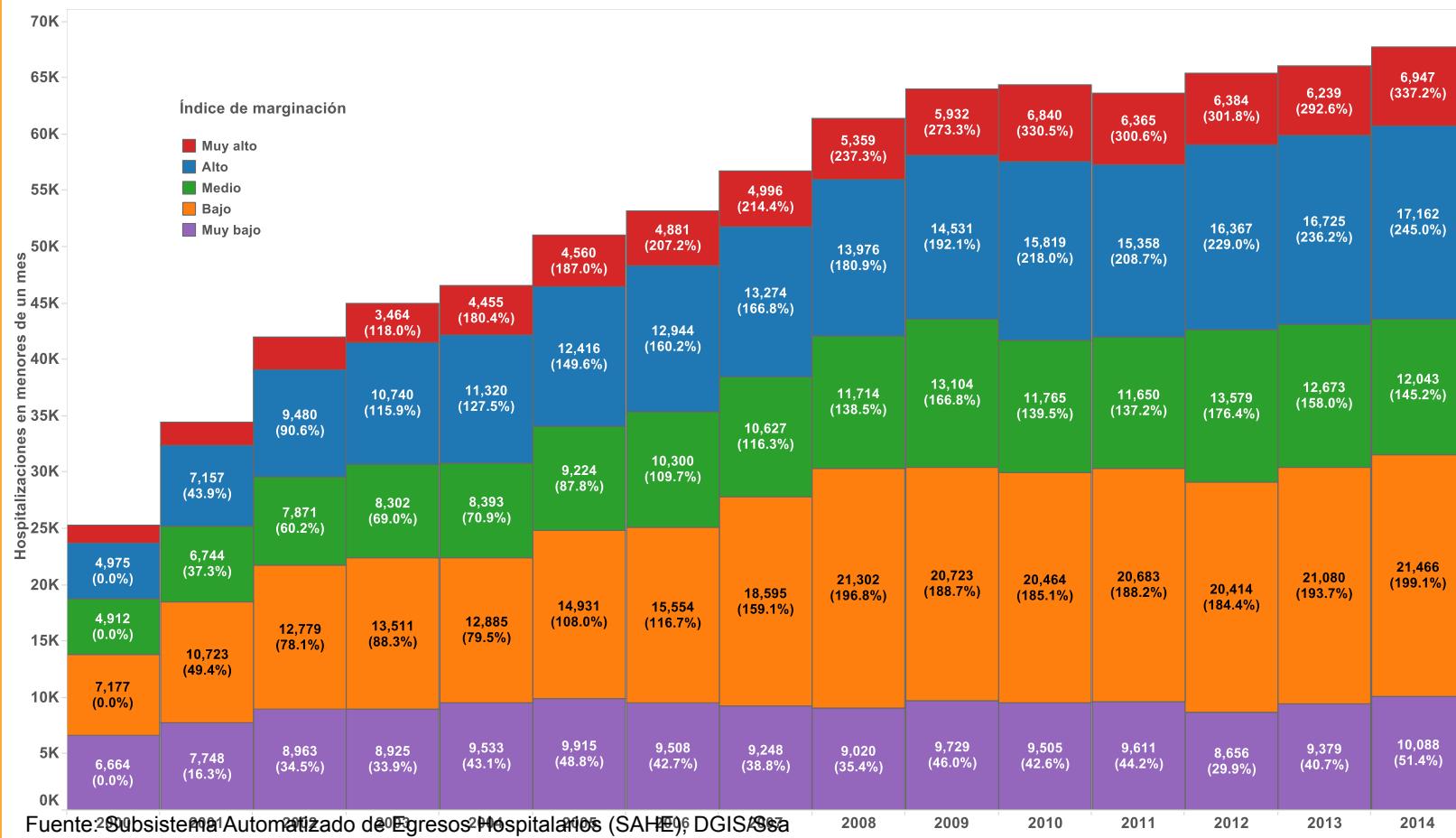
Fuente: Subsistema Automatizado de Egresos Hospitalarios (SAHE), DGIS/Ssa

Birth services provided by marginality index of state of residence of the mother, México 2000 - 2014



Fuente: Subsistema Automatizado de Egresos Hospitalarios (SAHE), DGIS/Ssa

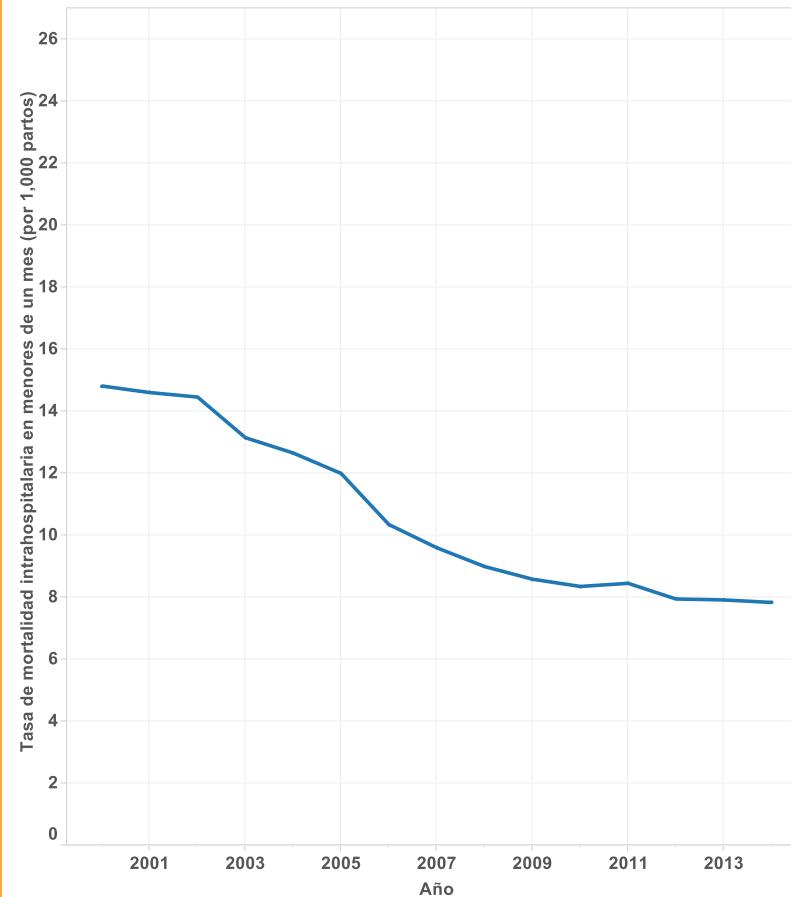
Hospital utilization in new bon infants by marginality index of the state o residence of the mother, México 2000 - 2014



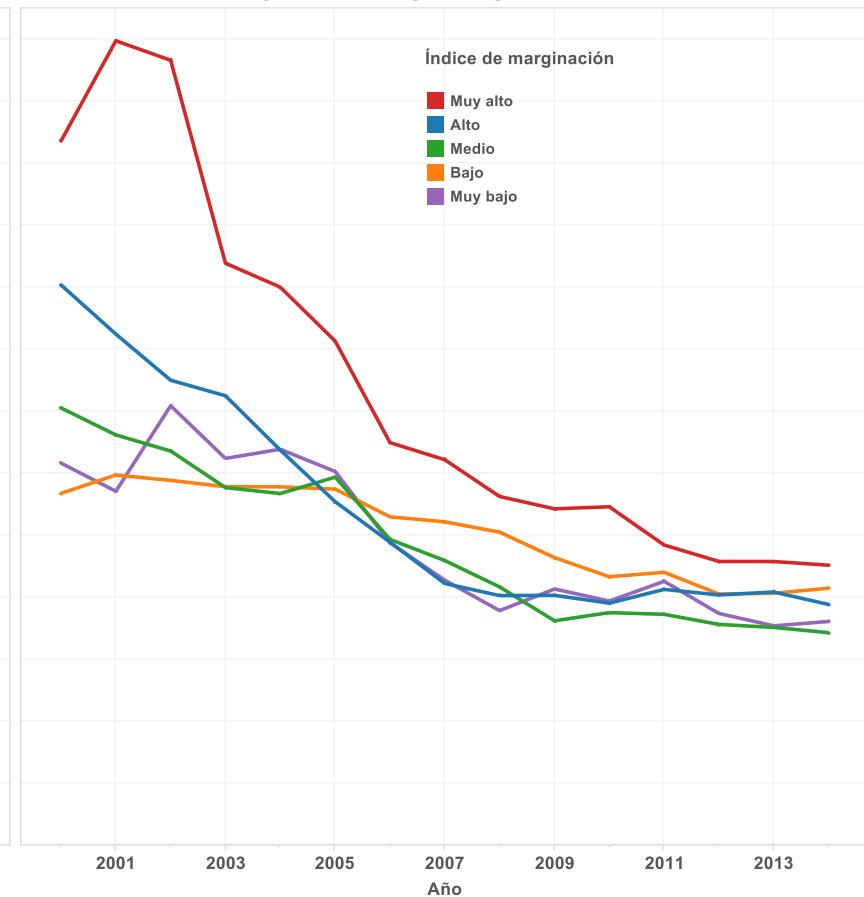
Hospital mortality in infants (27 days or less)

México 2000 - 2013

General



Por índice de marginación según lugar de residencia



Conclusion

- We are clearly reducing gaps in maternal and newborn health but we still need to focus our strengths to reach every mother and child
- Mapping geographical and institutional barriers was helpful as one of the pieces of evidence reviewed in the development of better public health policies
- Nationally, the impact of such policies benefited all the population but, mostly those in most need
- Web-based mapping applications to plan health infrastructure and to monitor access, utilization and quality of services may become a cornerstone in the reduction of maternal and newborn deaths
- We want to seek, detect and correct anomalies in the maternal and newborn services before we have to count another death

Collaborating team

- René Santos Luna
- Víctor Hugo Ríos Salgado
- Lina Sofía Palacio Mejía
- Rosa María Núñez Urquiza
- Evangelina Morales Carmona
- Lucino Ivan Espin Arellano
- Verónica Sánchez Castañeda
- Ana Lidia Salgado Salgado
- Susana Román Pérez
- Erika Hernández Deheza
- Lidia Evelina Valerio Dávila
- Alejandro de Jesús Rosas Jaimes
- Aracely Gutiérrez Rojas
- Lilian Ochoa Tello
- Leticia Emilia Salgado Jiménez
- Lorena Tejeda Canseco
- Miriam González Velasco
- Esperanza Muñoz Rangel
- Gabriel Núñez Urquiza
- Elías Arredondo Ortega
- Jorge Gomez Hernández
- Moisés López Castellanos

Juan Eugenio Hernández Ávila
Instituto Nacional de Salud Pública
juan_Eugenio@insp.mx

THANK YOU VERY MUCH!