World Data Center for Human Interactions in the Environment

UN Conference on Climate Change and Official Statistics
Oslo, Norway, 14-16 April 2008

Why Demographic Data are not Up to the Challenge of Measuring Climate Risks, and What to do about it

CIESIN
Columbia University

Introduction

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- AR4 (Schneider *et al.* 2007: 782):
  - An *impact* describes a specific change in a system caused by its exposure to climate change. Impacts may be judged to be either harmful or beneficial.
  - *Vulnerability to climate change* is the degree to which these systems are susceptible to, and unable to cope with, the adverse impacts.
  - The concept of *risk*, which combines the magnitude of the impact with the probability of its occurrence, captures uncertainty in the underlying processes of climate change, exposure, sensitivity and adaptation

Introduction (cont.)

- Layers of vulnerability
  - Everyone is vulnerable to climate change to some extent, it is an issue that cuts across socioeconomic status, settlement type or degree of development. *Someone or something is vulnerable just by virtue of being present at the place and time of occurrence of the particular hazard.* This is the external dimension of vulnerability, that of exposure.
  - However, not everyone in a specific situation shows the same *degree of vulnerability*, and this is related to the internal dimension, that of defenselessness. Multiple layers of vulnerability may be added because of the influence of group, household and individual characteristics such as age, gender, race or ethnicity, education, household composition, life cycle, etc.

IPCC AR4 Observed Effects

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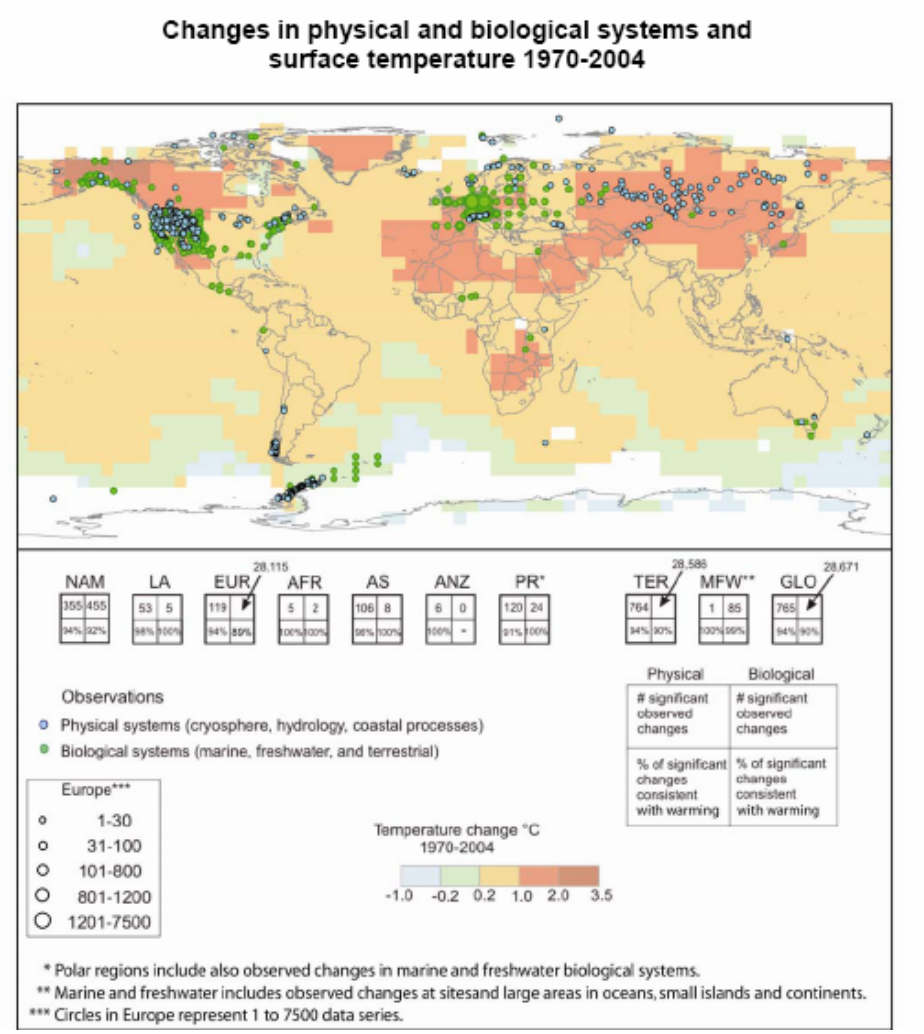

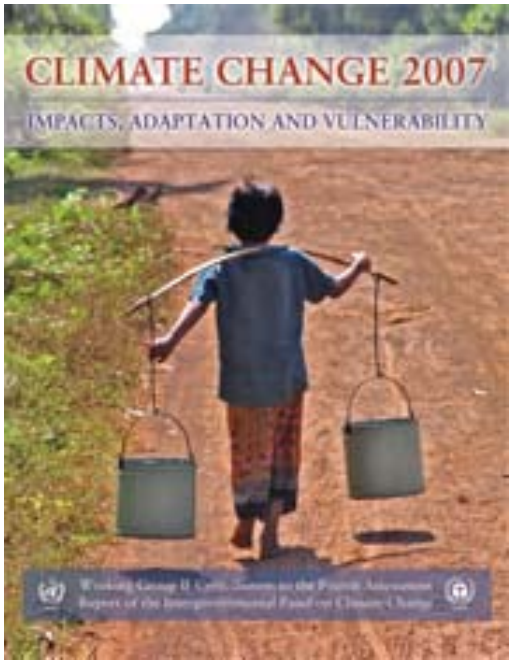

Climate Changes Are Under Way

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Changes in temperature, sea level and Northern Hemisphere snow cover

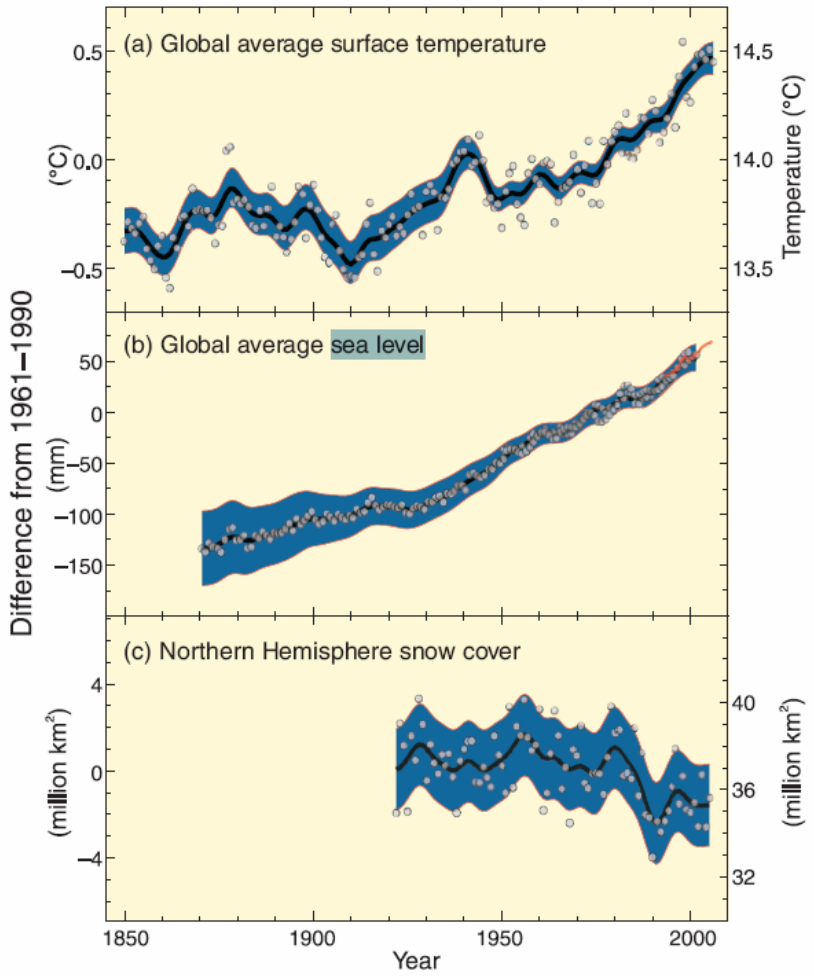

Figure SPM.1. Observed changes in (a) global average surface temperature; (b) global average sea level from tide gauge (blue) and satellite (red) data and (c) Northern Hemisphere snow cover for March-April. All differences are relative to corresponding averages for the period 1961-1990. Smoothed curves represent decadal averaged values while circles show yearly values. The shaded areas are the uncertainty intervals estimated from a comprehensive analysis of known uncertainties (a and b) and from the time series (c). {Figure 1.1}

From IPCC AR4 Summary for Policymakers

Rapid Deglaciation of Greenland Ice Sheet?

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- Greenland ice could raise sea levels up to 7 m

Melt descending into a moulin, a vertical shaft carrying water to ice sheet base

Source: Roger Braithwaite, University of Manchester (UK). Slide courtesy James Hansen

Jakobshavn Ice Stream in Greenland. Discharge from major Greenland ice streams is accelerating markedly.

Source: Prof. Konrad Steffen, Univ. of Colorado. Slide courtesy James Hansen

Collapse of the West Antarctic Ice Sheet?

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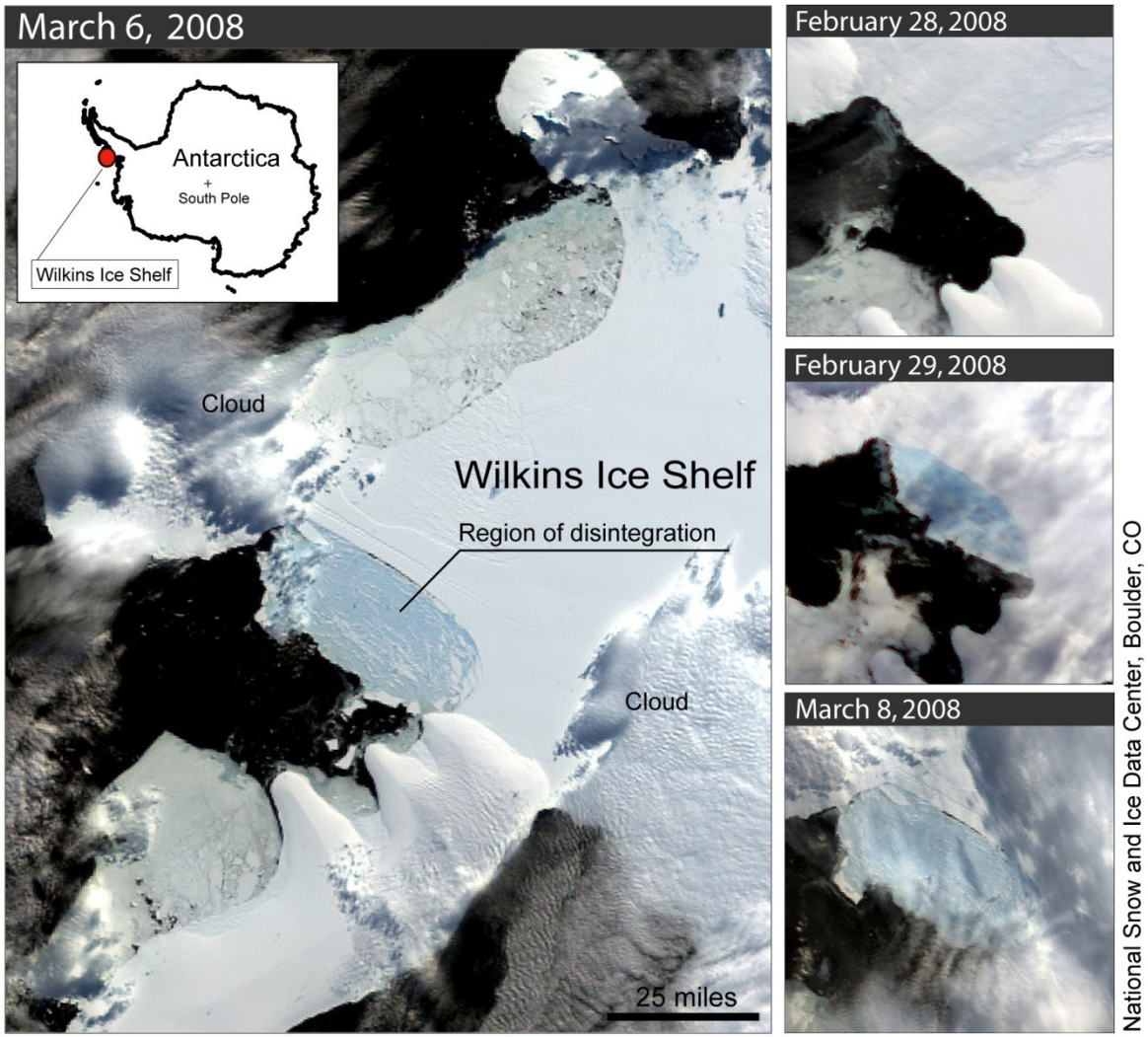
- Wilkins Ice Shelf disintegrated recently
- One of a string of ice shelves that have collapsed in the West Antarctic Peninsula in the past thirty years.
  - Larsen B in 2002
- West Antarctic ice could add 5 meters to sea level rise
- Remainder of Antarctic ice ~50 m



Impacts of Climate Change, Examples

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On Ecosystems:

Over the course of this century, net carbon uptake by terrestrial ecosystems is likely to peak before mid century and then weaken or even reverse, thus amplifying climate change

On Industry, Settlements, and Society:

The most vulnerable industries, settlements and societies are generally located in coastal and river flood plains, with economies closely linked to climate-sensitive resources and in areas prone to extreme weather events, esp. where rapid urbanization is occurring

Poor communities can be especially vulnerable, particularly those concentrated in high-risk areas

(AR4 Synthesis Report, p. 48)

In view of the fact that climate change impact and resulting vulnerability is inherently spatial, we now look at three challenges faced by national statistical offices in integrating data from a variety of sources to assess vulnerability

Challenge 1

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- 1) National census units are not well-delineated in geographic space, making it very difficult to locate human populations with respect to climate risks; this is especially problematic concerning coastlines and sea-level rise risks.

Integrating data to assess vulnerability

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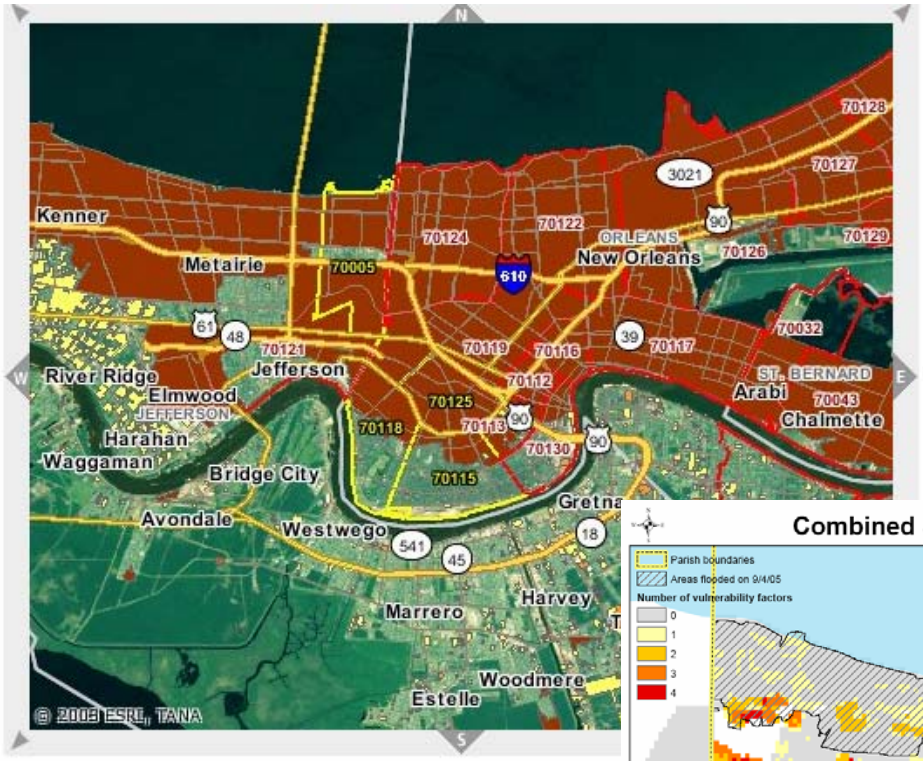
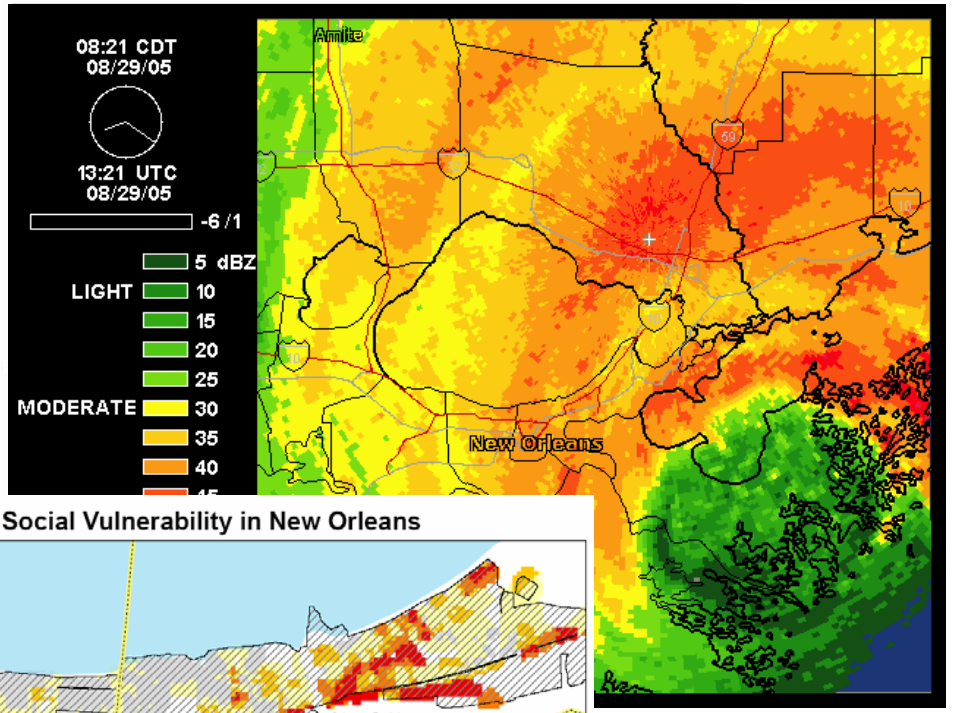




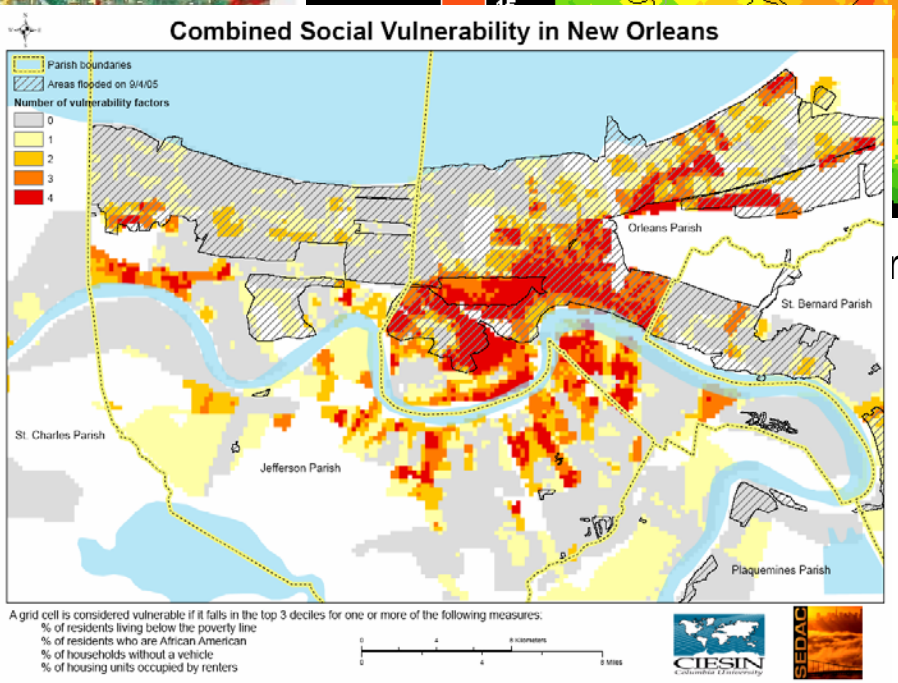
Hazard

rd

Powered by ArcWeb Services

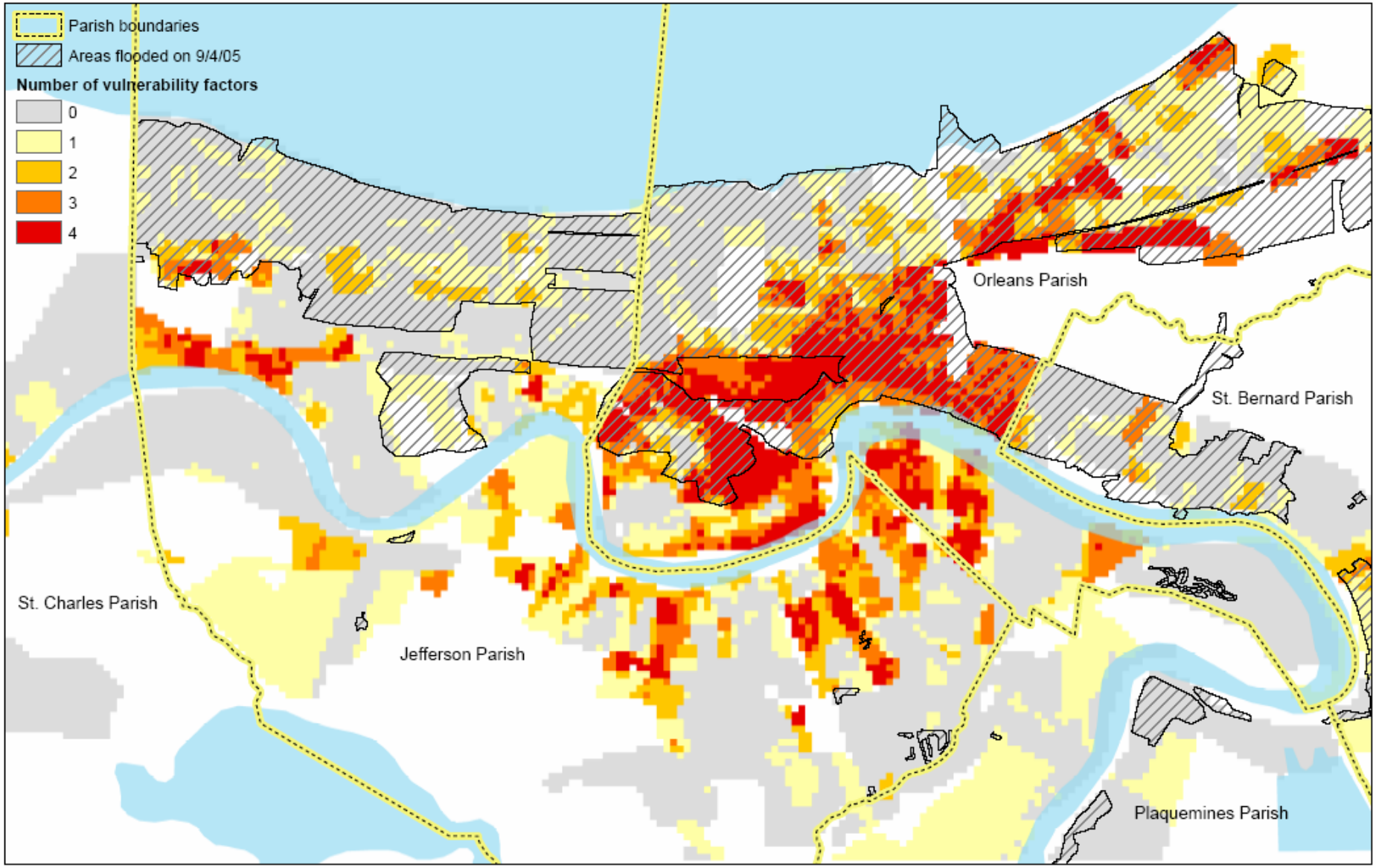
GlobeXplorer

Exposure (location) + defenselessness (individual, household and community characteristics)



= RISK!

Combined Social Vulnerability in New Orleans



A grid cell is considered vulnerable if it falls in the top 3 deciles for one or more of the following measures:

- % of residents living below the poverty line
- % of residents who are African American
- % of households without a vehicle
- % of housing units occupied by renters

0 4 8 Kilometers

0 4 8 Miles

CIESIN Columbia University

SEDAC

Early studies assessed potential impacts of sea level rise

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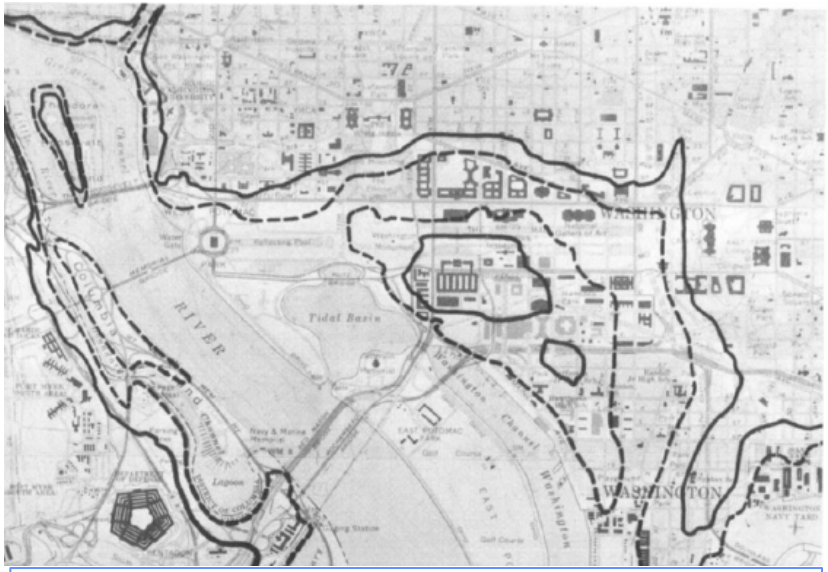


Ann. Rev. Energy. 1980. 5:107-40

CARBON DIOXIDE WARMING AND COASTLINE FLOODING: Physical Factors and Climatic Impact

◆11078

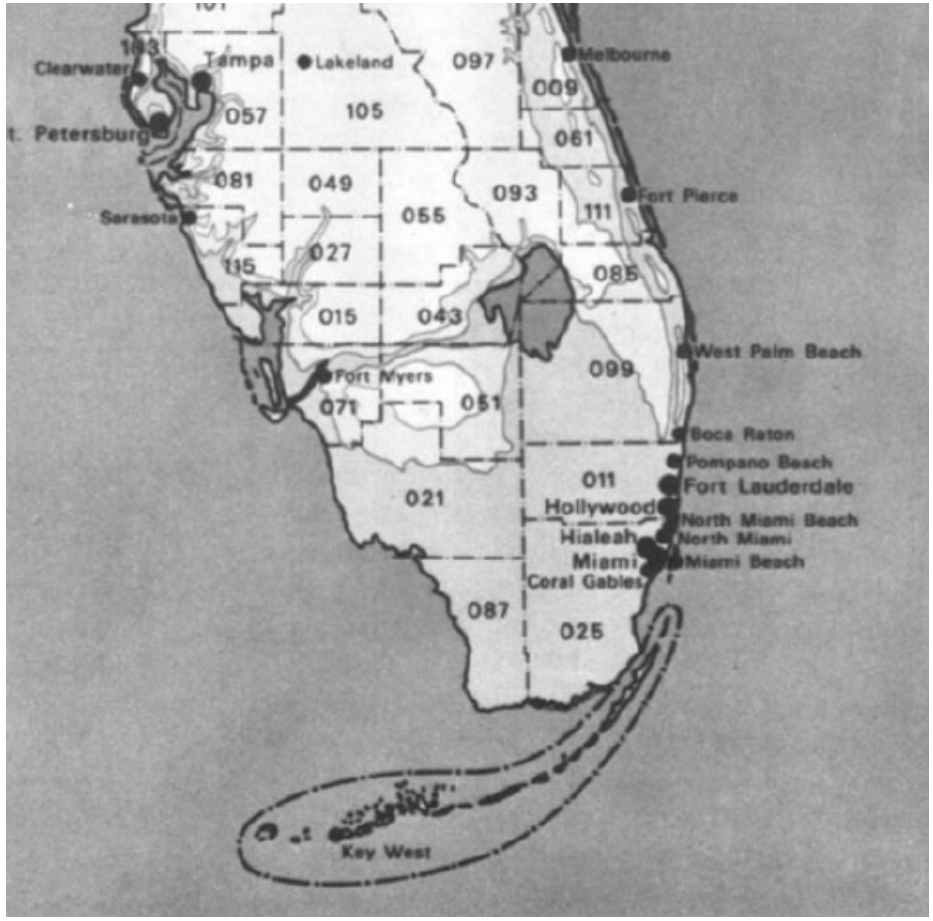
Stephen H. Schneider and Robert S. Chen[1]

National Center for Atmospheric Research,[2] Boulder, Colorado 80307

INTRODUCTION

Carbon dioxide concentration is known to be increasing in the atmosphere, and some calculations project about a 20% increase over present levels by 2000 AD and a doubling by the middle of the next century (1–9). CO_2 increases are associated with increasing use of fossil fuels (10, 11) and

- Potential impacts of 5- to 8-m rise on Washington DC and southern Florida



10-m LECZ: New York City

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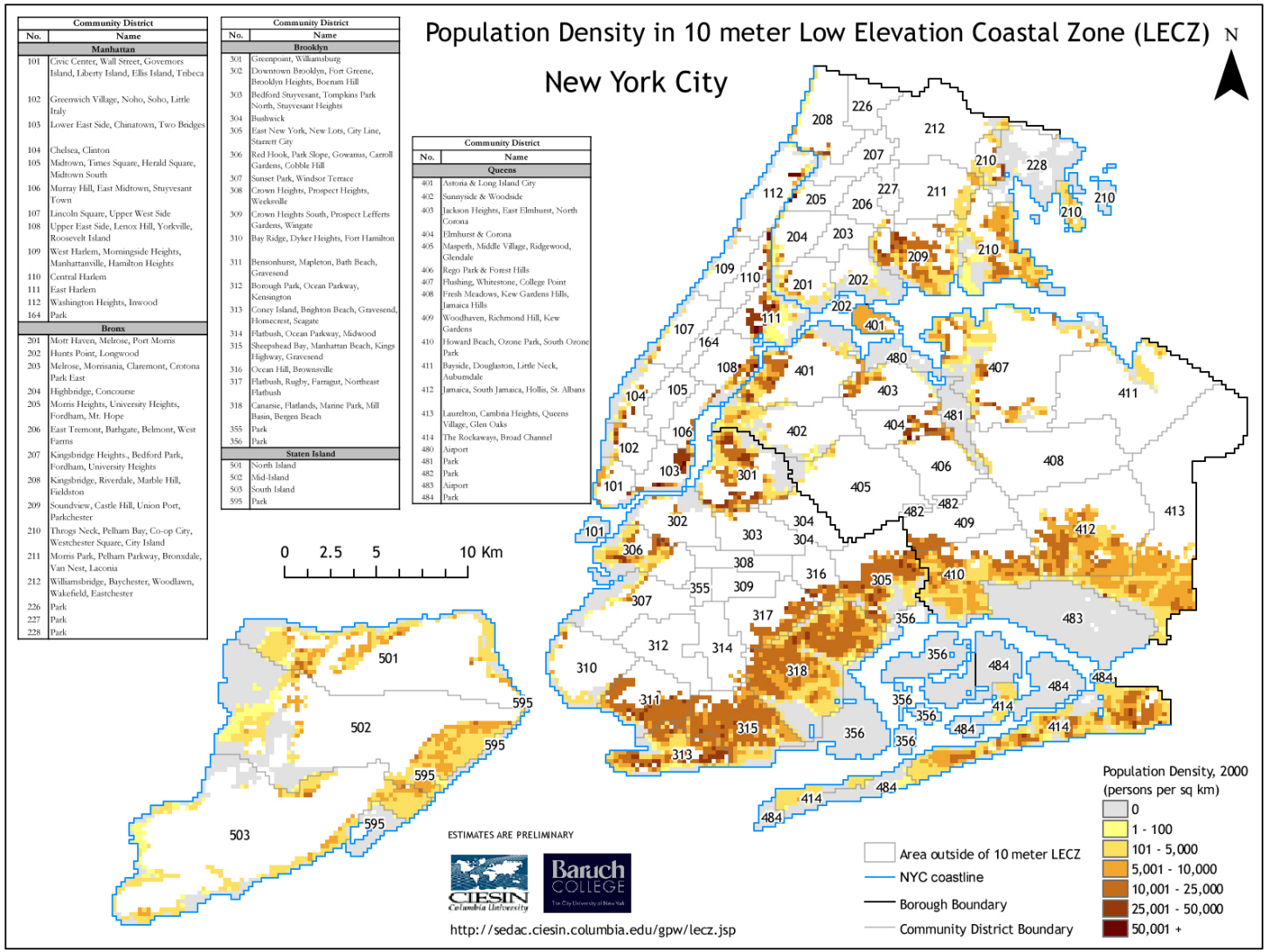

Community District	
No.	Name
Manhattan	
101	Civic Center, Wall Street, Governors Island, Liberty Island, Ellis Island, Tribeca
102	Greenwich Village, Noho, Soho, Little Italy
103	Lower East Side, Chinatown, Two Bridges
104	Chelsea, Clinton
105	Midtown, Times Square, Herald Square, Midtown South
106	Murray Hill, East Midtown, Stuyvesant Town
107	Lincoln Square, Upper West Side
108	Upper East Side, Lenox Hill, Yorkville, Roosevelt Island
109	West Harlem, Morningside Heights, Manhattanville, Hamilton Heights
110	Central Harlem
111	East Harlem
112	Washington Heights, Inwood
164	Park
Bronx	
201	Mott Haven, Melrose, Port Morris
202	Hunts Point, Longwood
203	Melrose, Morrisania, Claremont, Crotona Park East
204	Highbridge, Concourse
205	Morris Heights, University Heights, Fordham, Mt. Hope
206	East Tremont, Bathgate, Belmont, West Farms
207	Kingsbridge Heights., Bedford Park, Fordham, University Heights
208	Kingsbridge, Riverdale, Marble Hill, Fieldston
209	Soundview, Castle Hill, Union Port, Parkchester
210	Throgs Neck, Pelham Bay, Co-op City, Westchester Square, City Island
211	Morris Park, Pelham Parkway, Bronxdale, Van Nest, Laconia
212	Williamsbridge, Baychester, Woodlawn, Wakefield, Eastchester
226	Park
227	Park
228	Park

Community District	
No.	Name
Brooklyn	
301	Greenpoint, Williamsburg
302	Downtown Brooklyn, Fort Greene, Brooklyn Heights, Boerum Hill
303	Bedford Stuyvesant, Tompkins Park North, Stuyvesant Heights
304	Bushwick
305	East New York, New Lots, City Line, Starrett City
306	Red Hook, Park Slope, Gowanus, Carroll Gardens, Cobble Hill
307	Sunset Park, Windsor Terrace
308	Crown Heights, Prospect Heights, Weeksville
309	Crown Heights South, Prospect Lefferts Gardens, Wingate
310	Bay Ridge, Dyker Heights, Fort Hamilton
311	Bensonhurst, Mapleton, Bath Beach, Gravesend
312	Borough Park, Ocean Parkway, Kensington
313	Coney Island, Brighton Beach, Gravesend, Homecrest, Seagate
314	Flatbush, Ocean Parkway, Midwood
315	Sheepshead Bay, Manhattan Beach, Kings Highway, Gravesend
316	Ocean Hill, Brownsville
317	Flatbush, Rugby, Farragut, Northeast Flatbush
318	Canarsie, Flatlands, Marine Park, Mill Basin, Bergen Beach
355	Park
356	Park
Staten Island	
501	North Island
502	Mid-Island
503	South Island
595	Park

Community District	
No.	Name
Queens	
401	Astoria & Long Island City
402	Sunnyside & Woodside
403	Jackson Heights, East Elmhurst, North Corona
404	Elmhurst & Corona
405	Maspeth, Middle Village, Ridgewood, Glendale
406	Rego Park & Forest Hills
407	Flushing, Whitestone, College Point
408	Fresh Meadows, Kew Gardens Hills, Jamaica Hills
409	Woodhaven, Richmond Hill, Kew Gardens
410	Howard Beach, Ozone Park, South Ozone Park
411	Bayside, Douglaston, Little Neck, Auburndale
412	Jamaica, South Jamaica, Hollis, St. Albans
413	Laurelton, Cambria Heights, Queens Village, Glen Oaks
414	The Rockaways, Broad Channel
480	Airport
481	Park
482	Park
483	Airport
484	Park

Units of Analysis Differ

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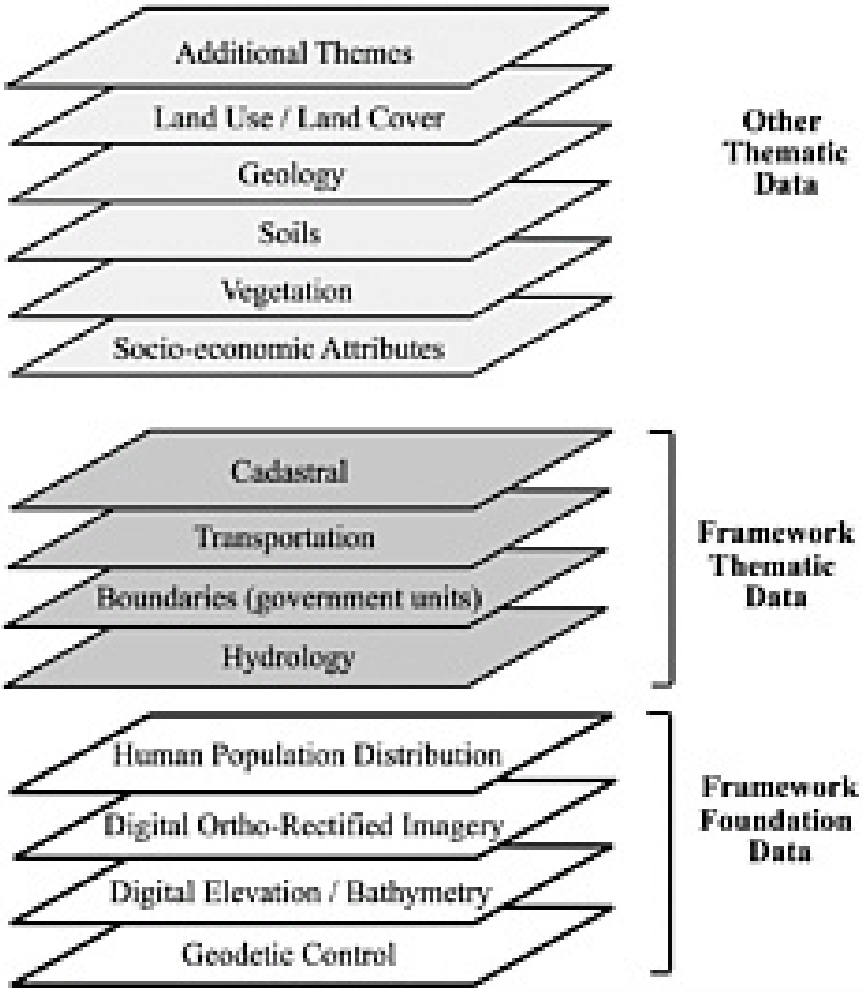
- Earth and social scientists use different units of analysis and have different ways of aggregating data
  - e.g., pixels vs. individuals, physical features vs. households, physiographic vs. administrative regions, grids vs. countries
- Linking such data requires conversion of data between geographies
  - e.g., grids to administrative units or vice versa



Converting Units of Analysis

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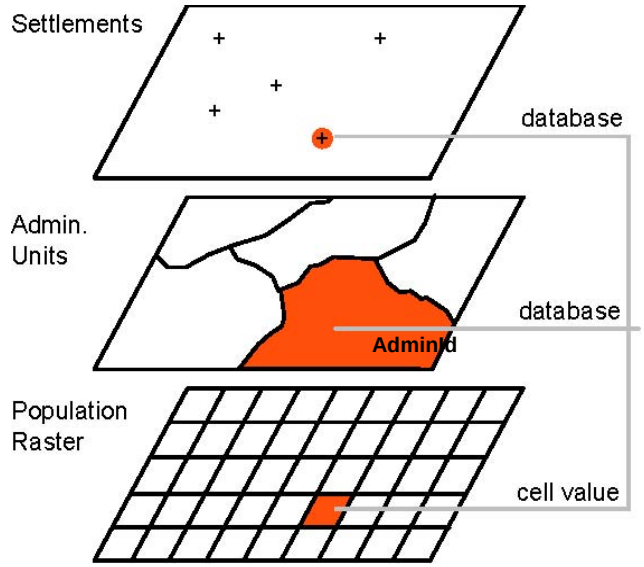
- Administrative boundaries and population information in raster format.
  - Physio-geographic variables (climate, vegetation, soils) are frequently stored in raster format (Deichmann 1996).



Source: Deichmann 1996: 24

Need access to data before it can be integrated

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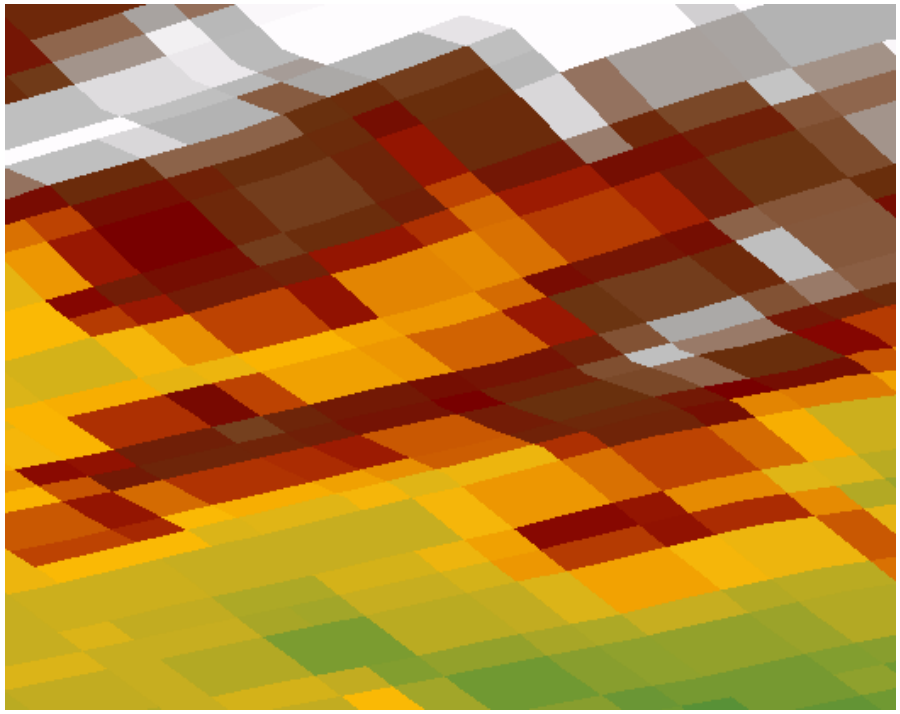
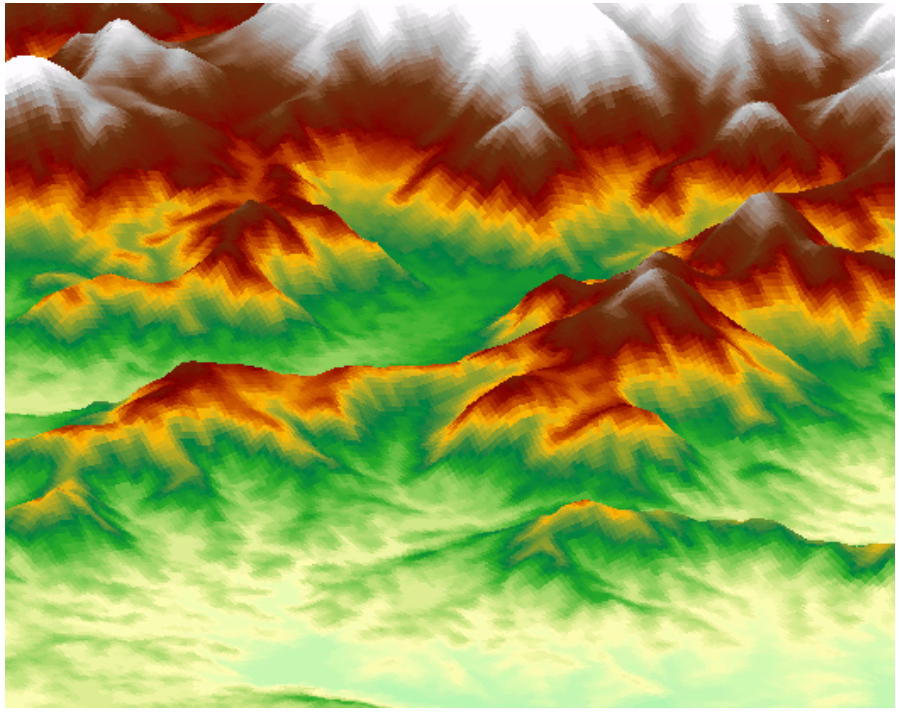
- Increased concerns about national security, intellectual property rights leading to reduced access to data
- Example: U.S. has not released 30-m SRTM for world, despite significant potential benefit for applications
  - Comparison of 30- and 90-m SRTM for Blue Ridge Mountains, VA:

90 m



30 m



Comparison courtesy of Y. Gorokhovich, CIESIN

Conflicting boundary data

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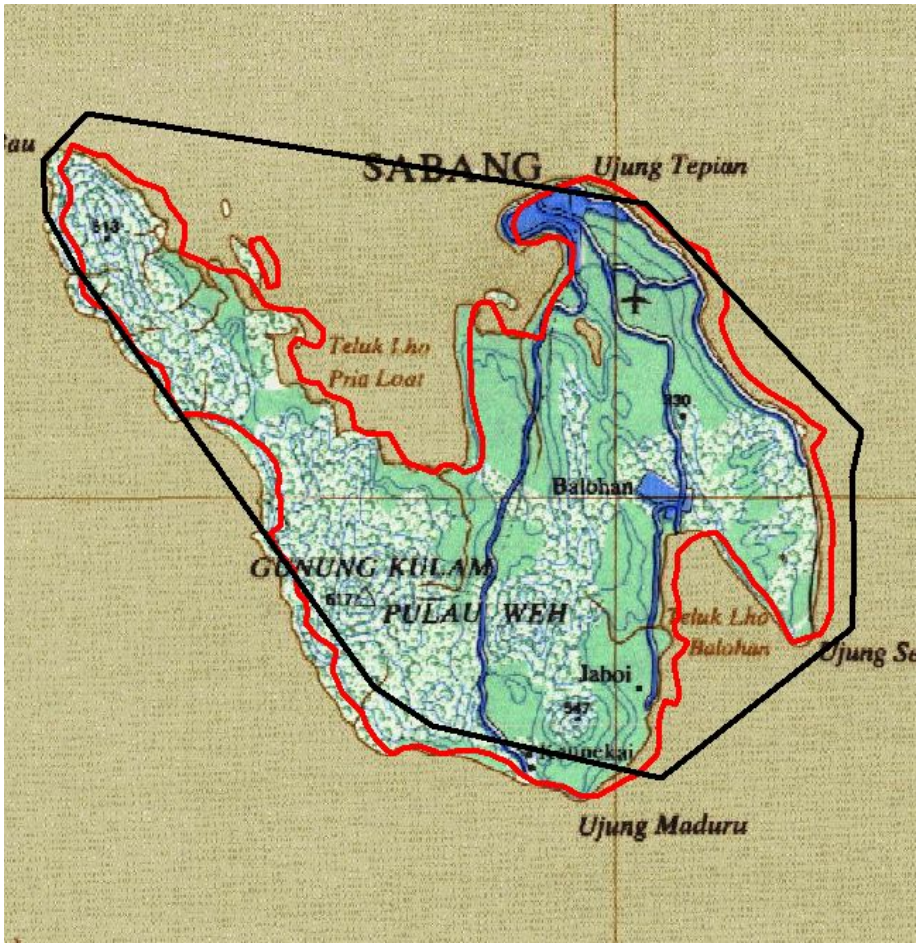

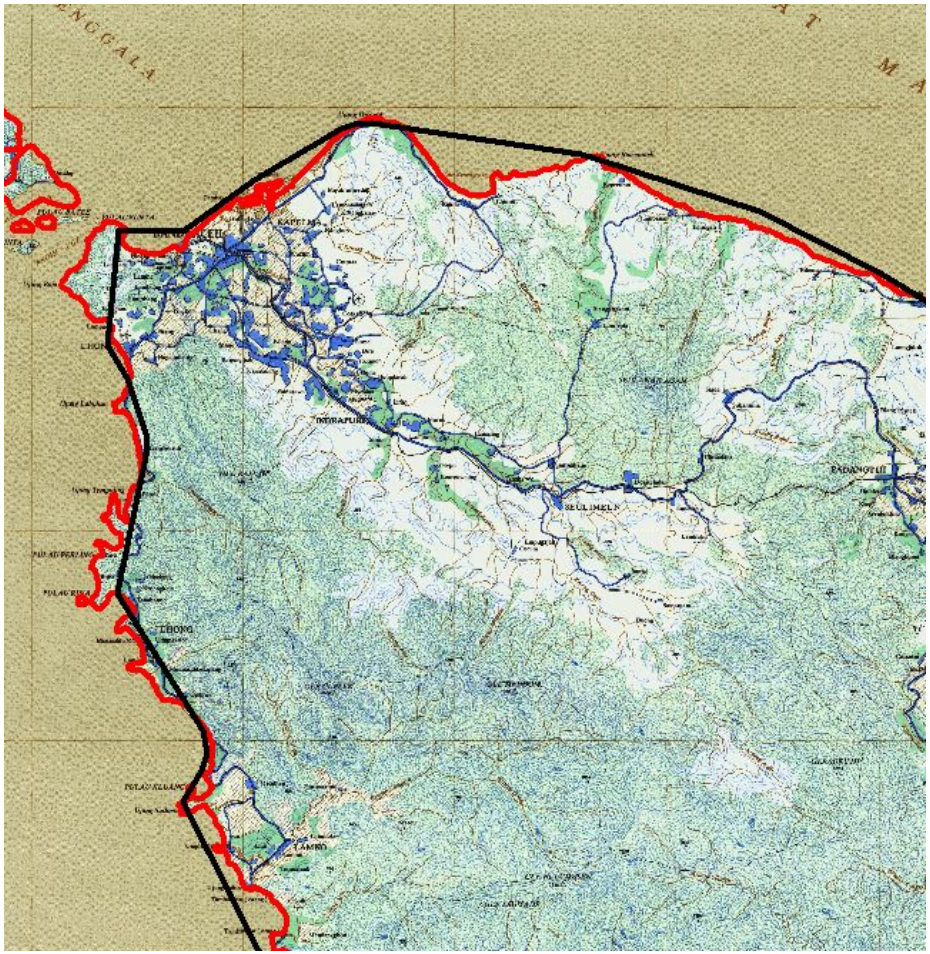

Black shoreline: ESRI

Red shoreline: Administrative Units, BPS

Challenge 2

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- Inter-annual change in the spatial distribution of population is almost impossible to characterize with precision, because of incommensurate administrative boundaries across censuses.

BOLIVIA: Change in boundaries between censuses

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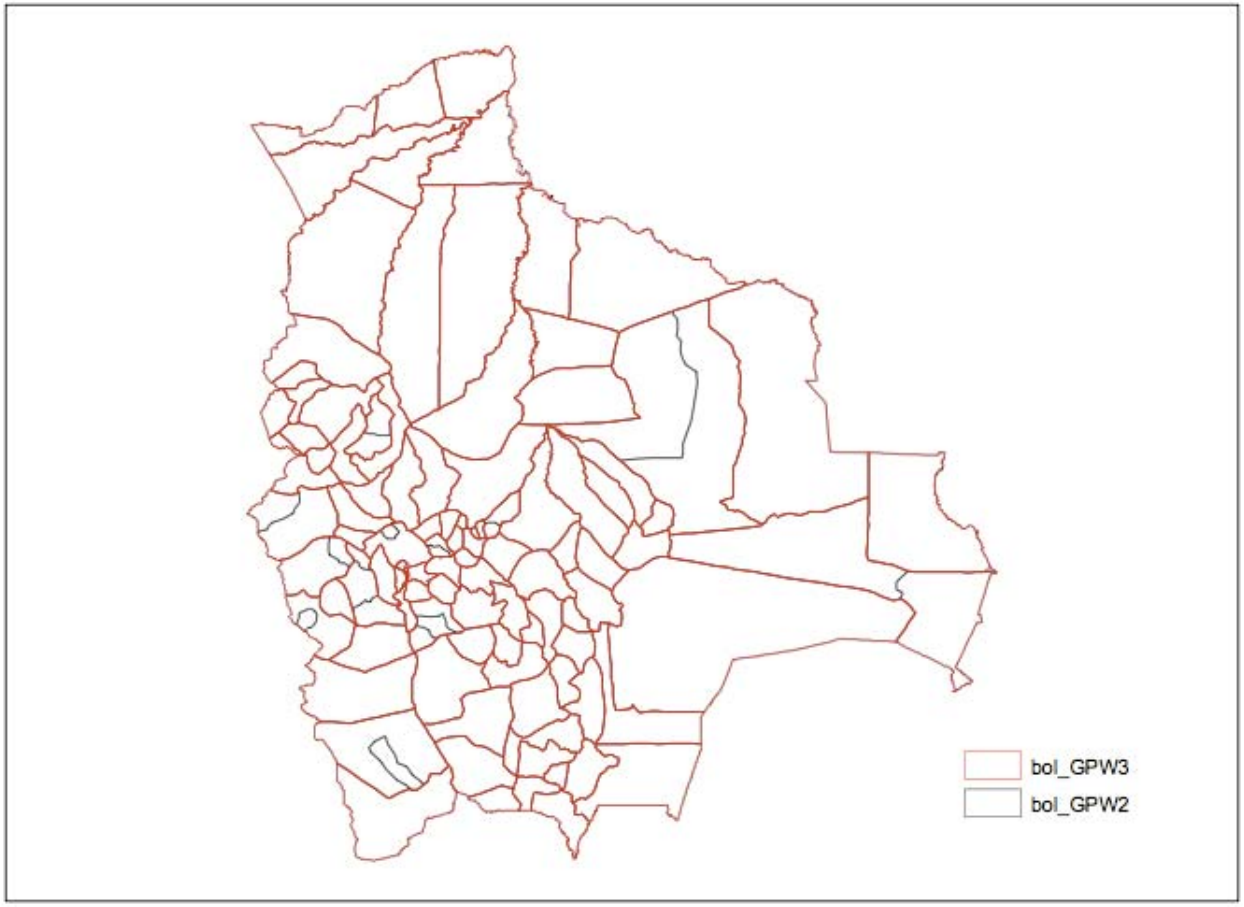

Challenge 2, cont.

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- Tracking changes in the spatial framework permits comparisons over time
- Changes in census spatial units are more common at higher resolution (census tract level and higher)
- These higher level resolutions are the ones needed for vulnerability assessment

Challenge 3

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- Intra-annual variation in population distribution is not systematically tracked, making it hard to characterize exposure to highly variable climate risks

Recommendations

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- Greater spatial precision in census units (boundary data)
- Commitment to "spatial backcasting" when census units are redrawn, to permit spatial census time series (which are now impossible)
- Discourage redrawing census units unless necessary
- Use of surveys to pinpoint inter- and intra-annual population movement

Recommendations, cont.

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- Capture information about place of work, daily displacements including shopping and schools, seasonal movements, etc. in surveys/other ways(?)
- More attention to spatial mobility, including migration