

# Preparing for climate change in the urban century: a demographer's perspective

Deborah Balk\*



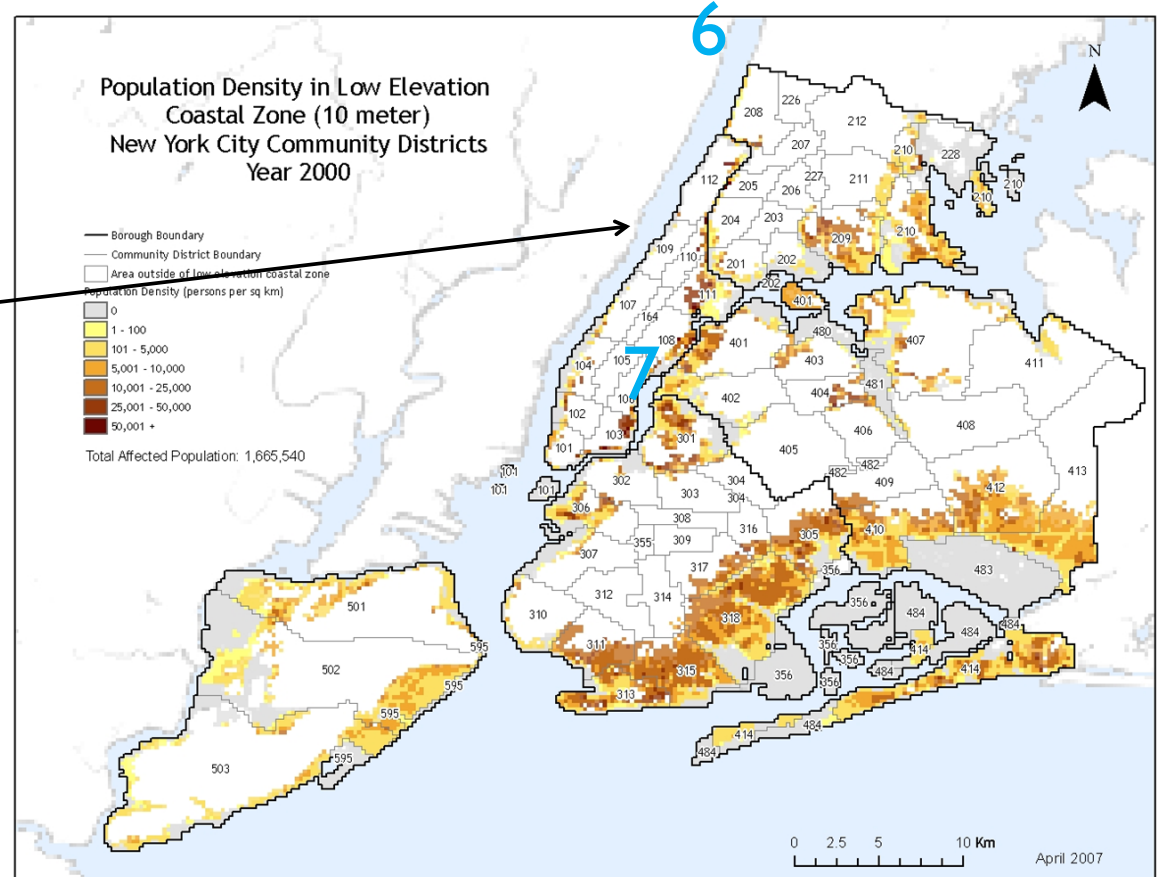
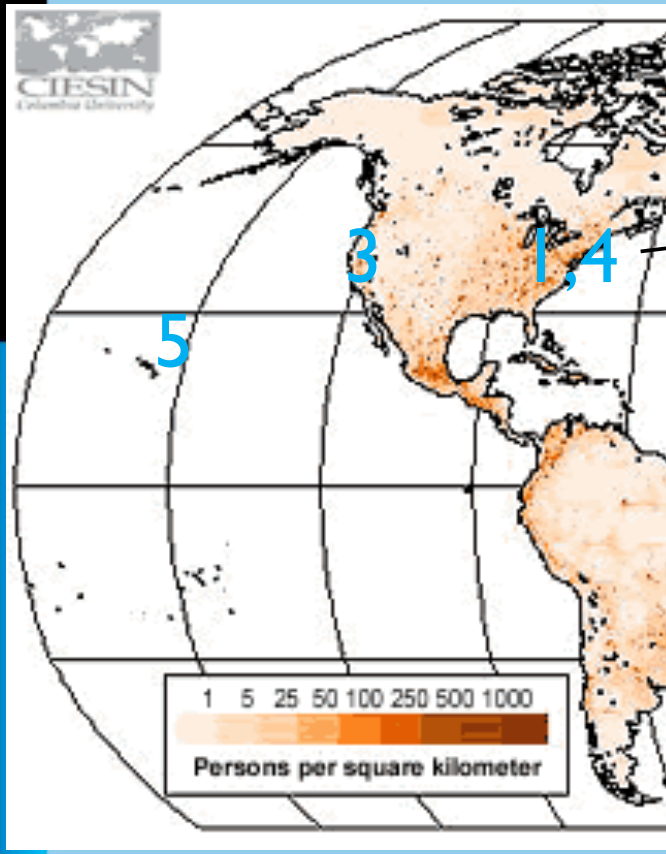
**CUNY INSTITUTE FOR  
DEMOGRAPHIC RESEARCH**

Remarks prepared for  
Aspen Climate Change  
Institute  
**21 Aug 2014**

\* CUNY Institute for Demographic Research, and Baruch College, City University of New York

# How did I get here?

1. BA/MPP (U-Mich)
2. Bangladesh (ICDDR,B)
3. PhD, Berkeley, Demography
4. Post-doc (U-Mich)
5. CIESIN, Columbia
6. CUNY
7. CUNY

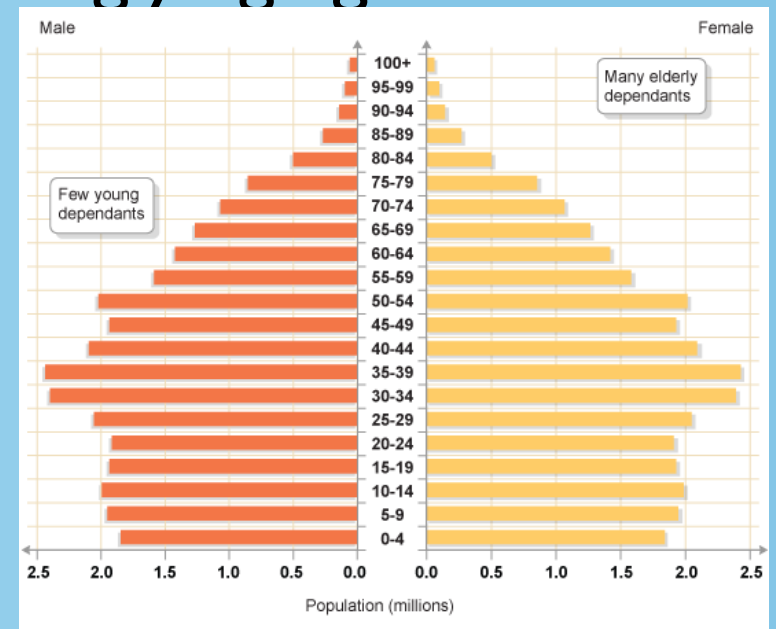


# Priors

- ❑ Population growth is not “the problem”, or at least it is a gross oversimplification
  - ❑ However, wealth and industrial economies are problematic
  - ❑ That said, economic development (growth) is important
- ❑ Link from science to society is not just science to collective action. Interaction with social scientist will be academic.
  - ❑ In fact, most social scientists study the behavior of individuals, agency, or institutions not decision-making per se
  - ❑ Policy is a rich and complicated process
  - ❑ Governance institutions and regulatory processes matter
- ❑ If the climate community needs demographic data and the demographic community can't supply it, it will create it.
- ❑ Global & local.

# Demographic truths

- ❑ The future world is (irreversibly) urban
  - ❑ The bulk of future population growth will take place in the cities and town of Asia, Africa, and LAC
- ❑ The future world is increasingly aging
  - ❑ Greater % old people
- ❑ Implications for climate change



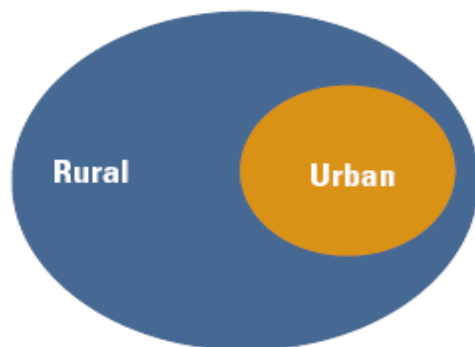


# Today's urbanization

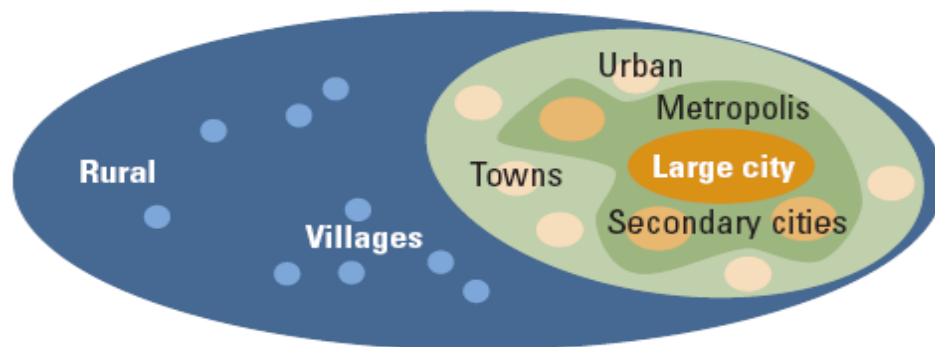
- ❑ Differs from the past. Now:
  - ❑ Urban “giganticism”
  - ❑ Urban agglomerations & a “continuum of urban”

Figure 1.1 From dichotomy to continuum: a portfolio of places

The simplified area economy



and a more realistic representation

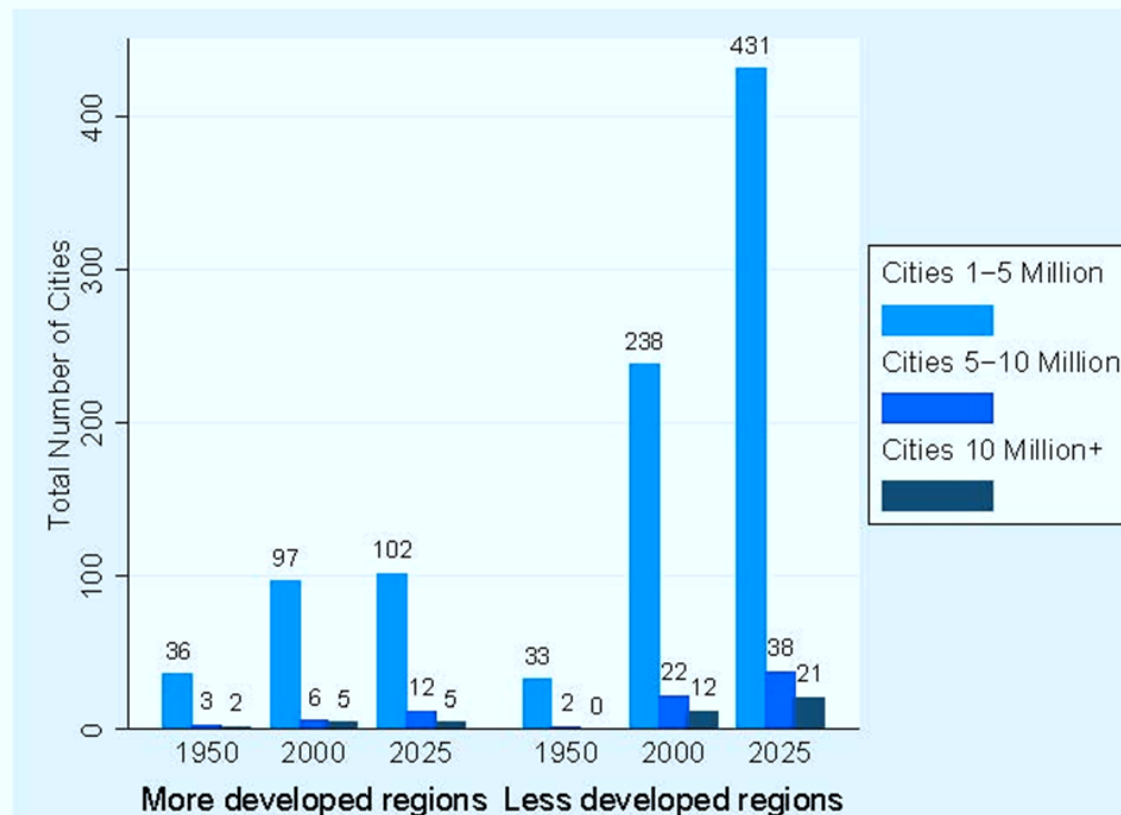


Source: WDR 2009 team.

- ❑ Migration to cities is largely from other cities and towns, not predominantly from rural areas
- ❑ Much variation in the urban demographic profile

# Urban Gigantism

## Number of Cities of 1 Million or More

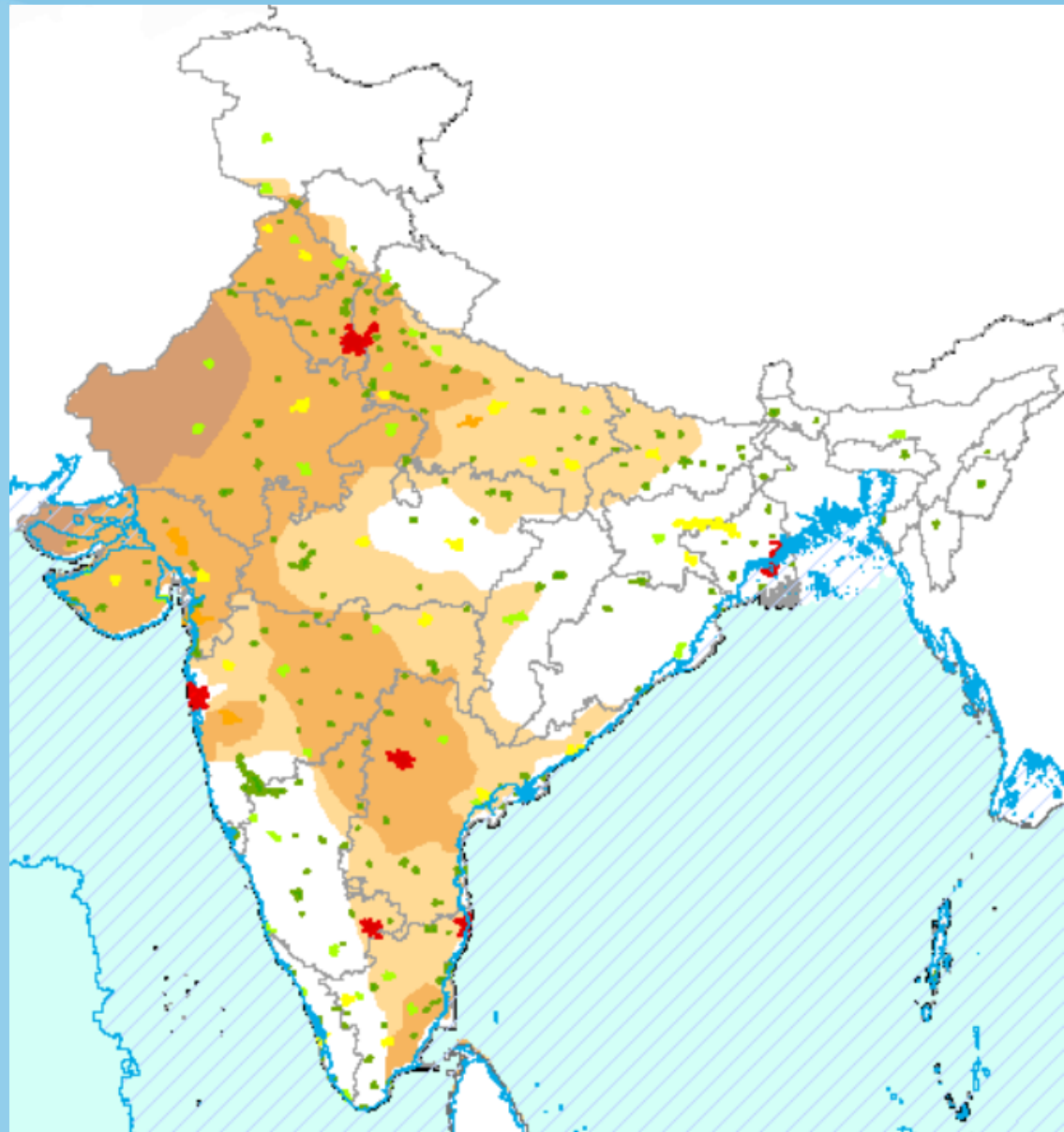


Now *this* is unprecedented! Preston (1980) termed it "urban gigantism".

Source: Montgomery, 2008

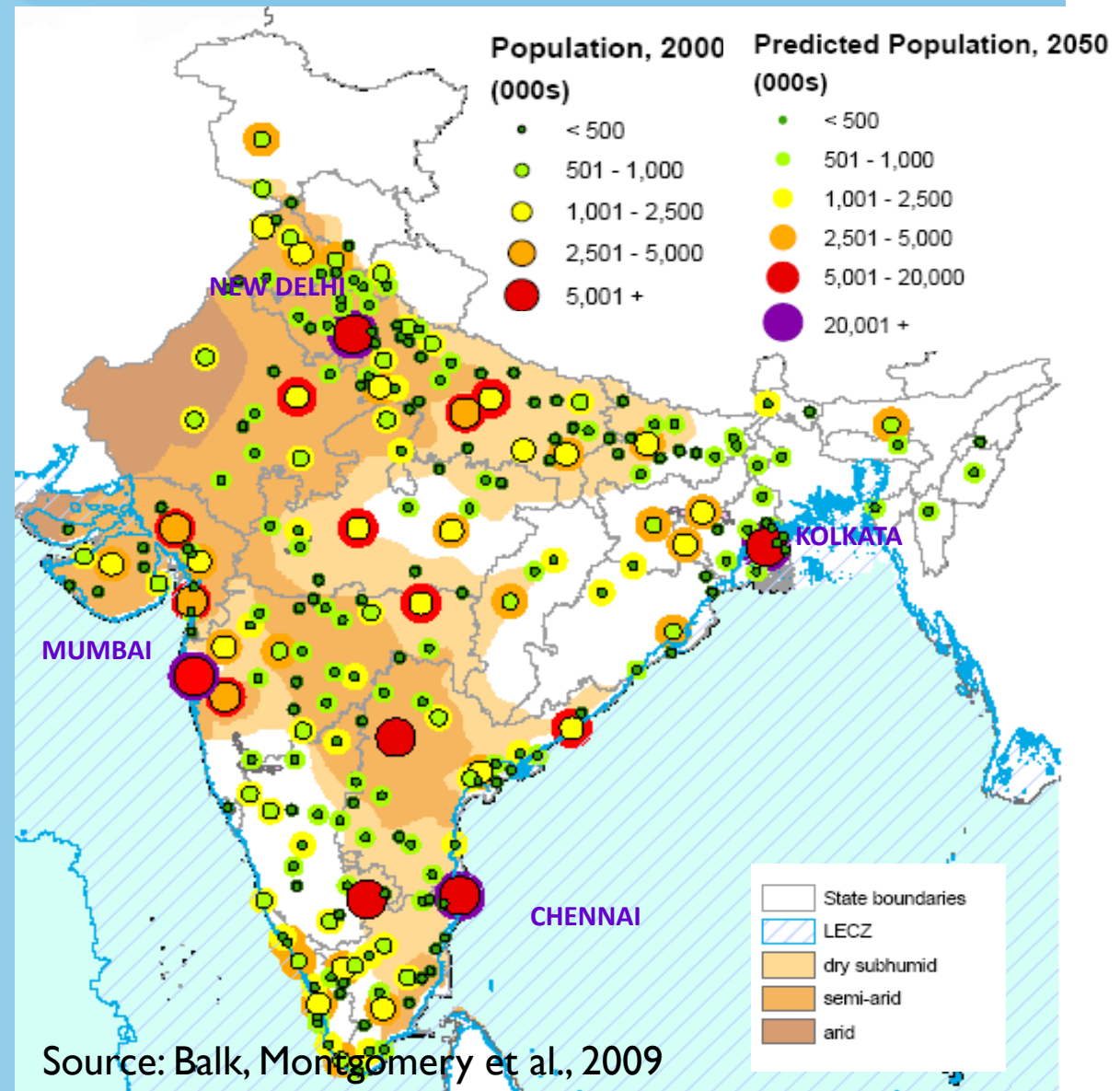
# Where are those giants?

- ❑ Many are in India and China.
- ❑ In 2000, India had more than 40 IM+ cities and 6 cities of 5M+
- ❑ Shown: Urban areas depicted with GRUMP Night-Lights based satellite data, along with dryland ecosystem and LECZ layers



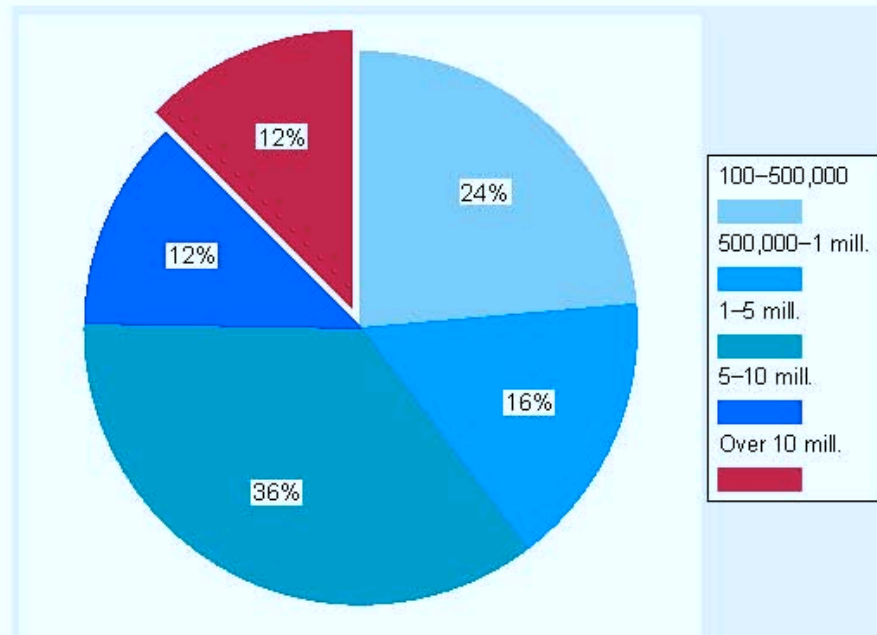
# How will they grow?

- ❑ Econometric model (using bayesian estimators), multi-level
- ❑ Findings:
  - ❑ By 2050, India will have 4 20M+ cities, 3 of which are coastal
  - ❑ And, another 11 cities of over 5M persons, all of which are either in arid or coastal zones!
  - ❑ Fertility → City Growth
- ❑ Satellite and other spatial information will add a lot to understanding which cities will grow and how.



# Small cities are important!

## Distribution of LDC Urban Population by City Size

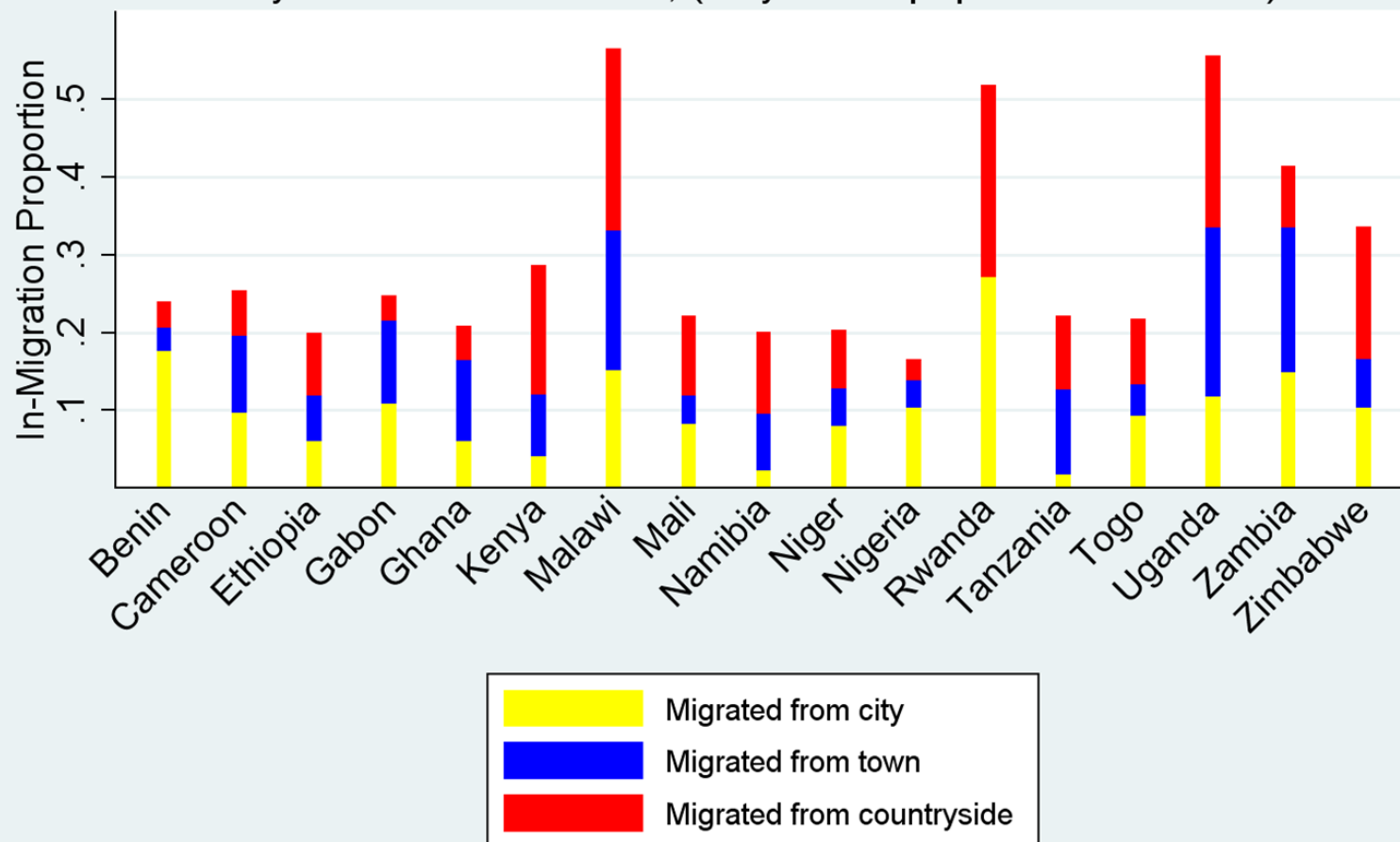


Still, among urban dwellers in cities of 100,000 and above, only 12 percent live in “mega-cities”. Far larger percentages in smaller cities.

Source: Montgomery, 2008

# Migration to cities from where?

5-Year Urban Total In-Migration Proportions for African Countries  
by Previous Residence, (only 15-49 population included)



\*Migration rates are calculated based on DHS 1998-2001 surveys

Source: Balk, Montgomery and Liu, 2012

# Basic knowledge about urbanization that we do not know

- ❑ Where growth will occur
  - ❑ Forecasts of city growth are currently non-spatial
    - ❑ Will growth occur on the periphery of cities? in new ones? Vertically? In slums?
- ❑ The causes of city growth
  - ❑ Natural increase or migration?
  - ❑ The composition of city growth—particularly of the poor
- ❑ Where precisely climate change impacts will occur

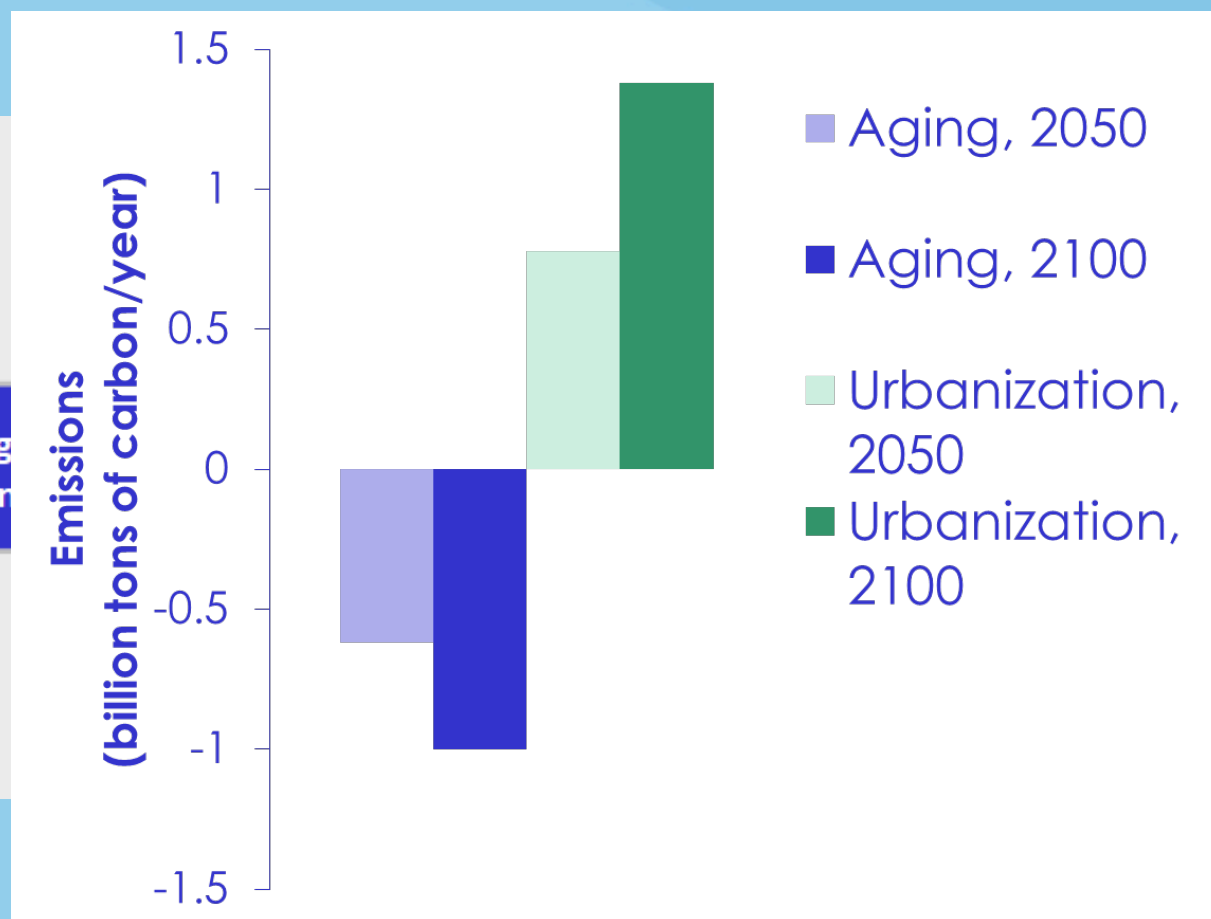


# Demographic contributions to climate change research

- ❑ Global scale studies:
  - ❑ Emissions scenarios and mitigation
  - ❑ Adaptation, populations-at-risks, and vulnerability studies
- ❑ Local-scale studies:
  - ❑ Land-use change (and demography, both as cause and consequence)



# Demographic effects on carbon emissions



- Work of NCAR. Brian O'Neill, Leiwen Jiang et al. (O'Neill et al., 2010, *PNAS*)

# Downscaling

National Projection

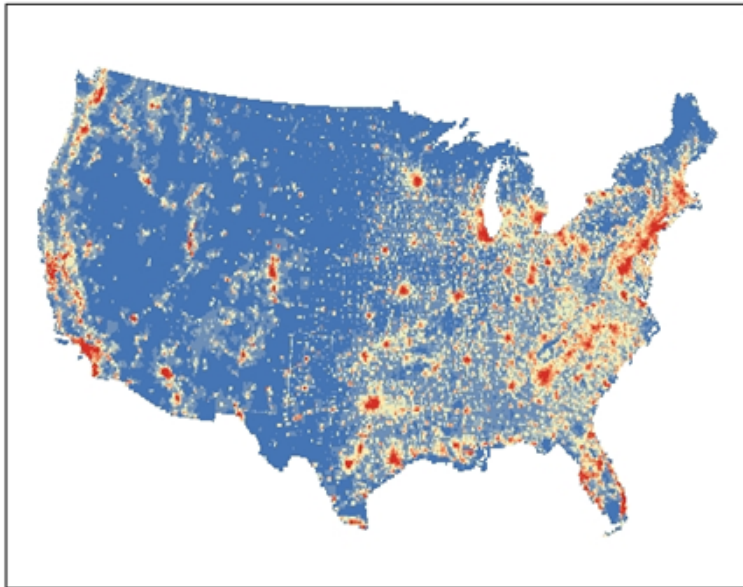


Regional Projection

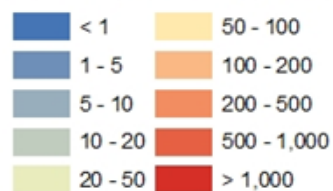


Gridded Projection

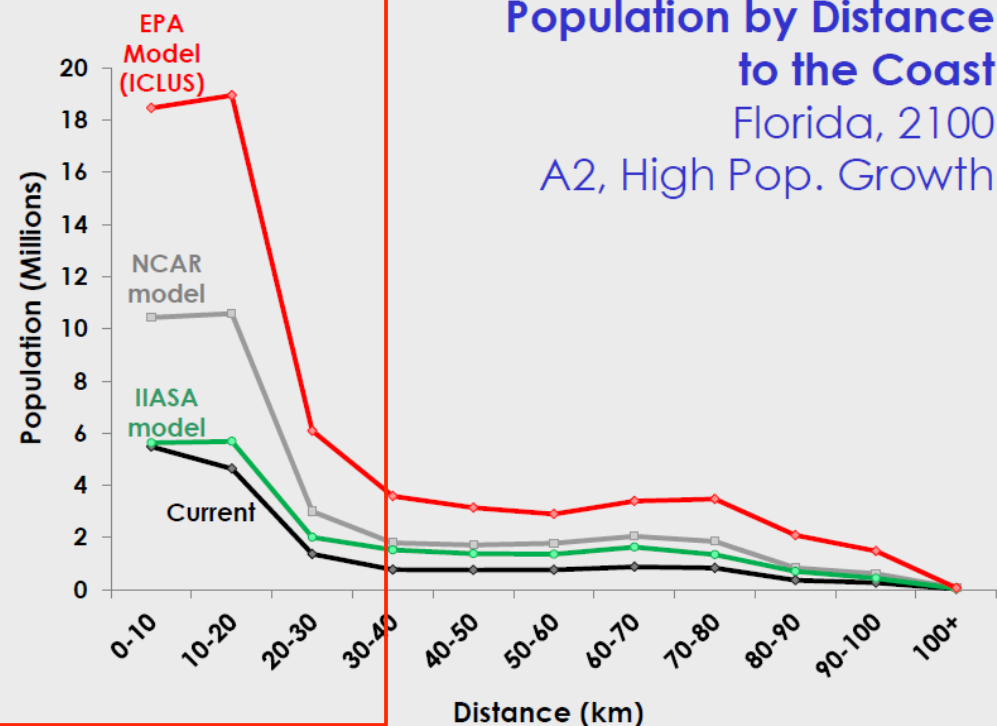
Projected Population Density  
Divisional Redistribution Scenario, 2100



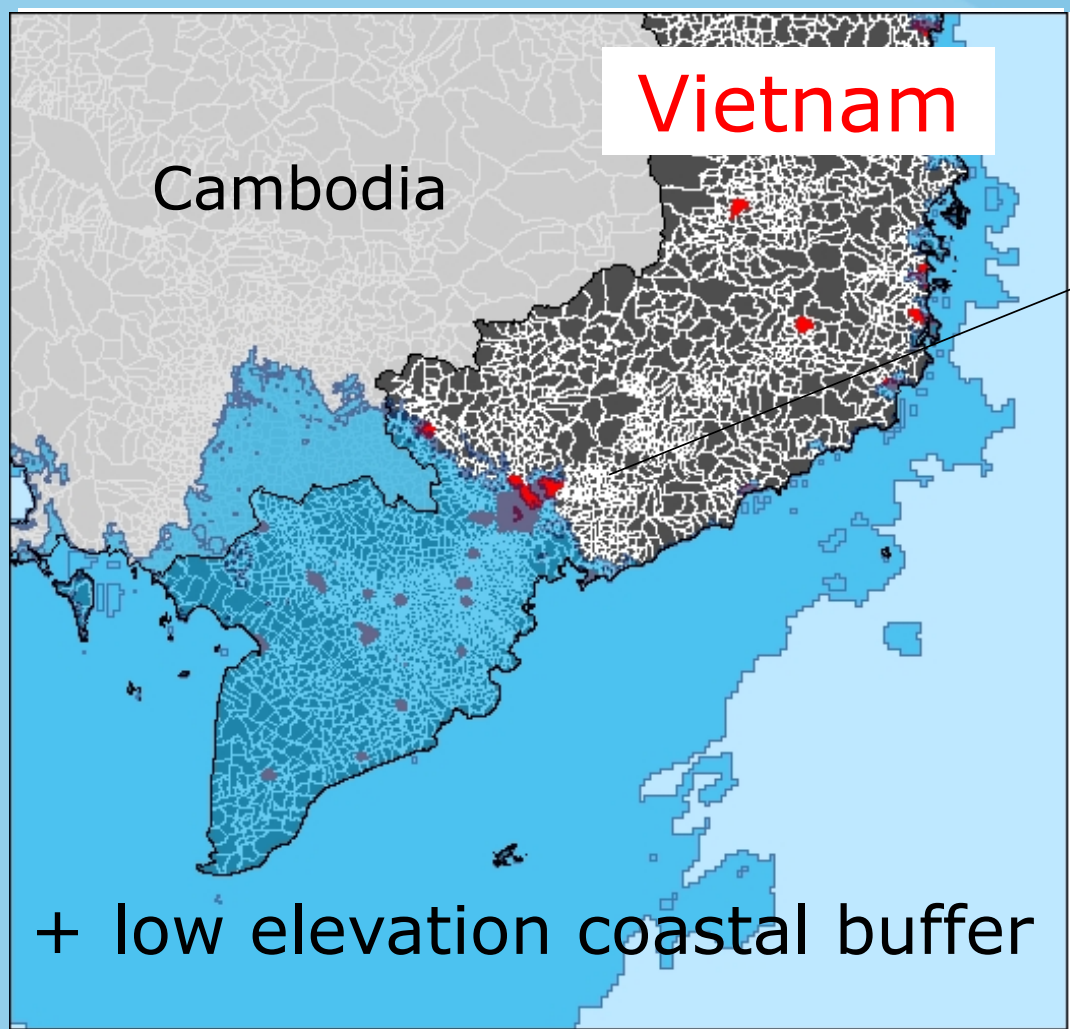
Population Density (km<sup>2</sup>)



Population by Distance  
to the Coast  
Florida, 2100  
A2, High Pop. Growth



# Estimating populations at risk of climate-related hazards: LECZ



- ❑ Calculations based on spatial overlays
- ❑ All data are gridded

# Estimating populations at risk of climate-related hazards

Persons living in the LECZ (millions), by continent

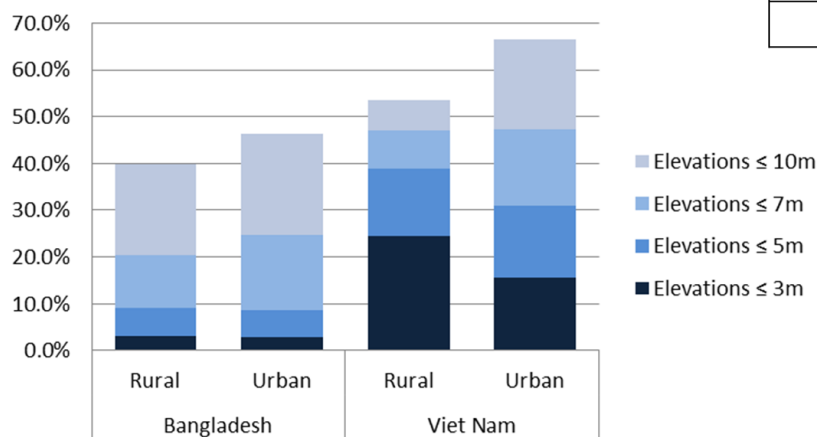


- Globally, more than 600 million persons (2000) — *1 out of every 10 persons* — live in the LECZ.
- 466 Million Asians
- Globally, 360 million urban persons (2000) — *1 out of every 8 city-dwellers* — live in the LECZ.
- 240 Million Asians

# Estimating populations at risk of climate-related hazards

- ❑ Produces tabular data of cities-populations at risk and country-urban/rural totals
- ❑ For LECZ, in-land flooding, dryland ecosystem, other ecosystems

**Cumulative Percent of Population Living in LECZ, by Elevation (2010)**



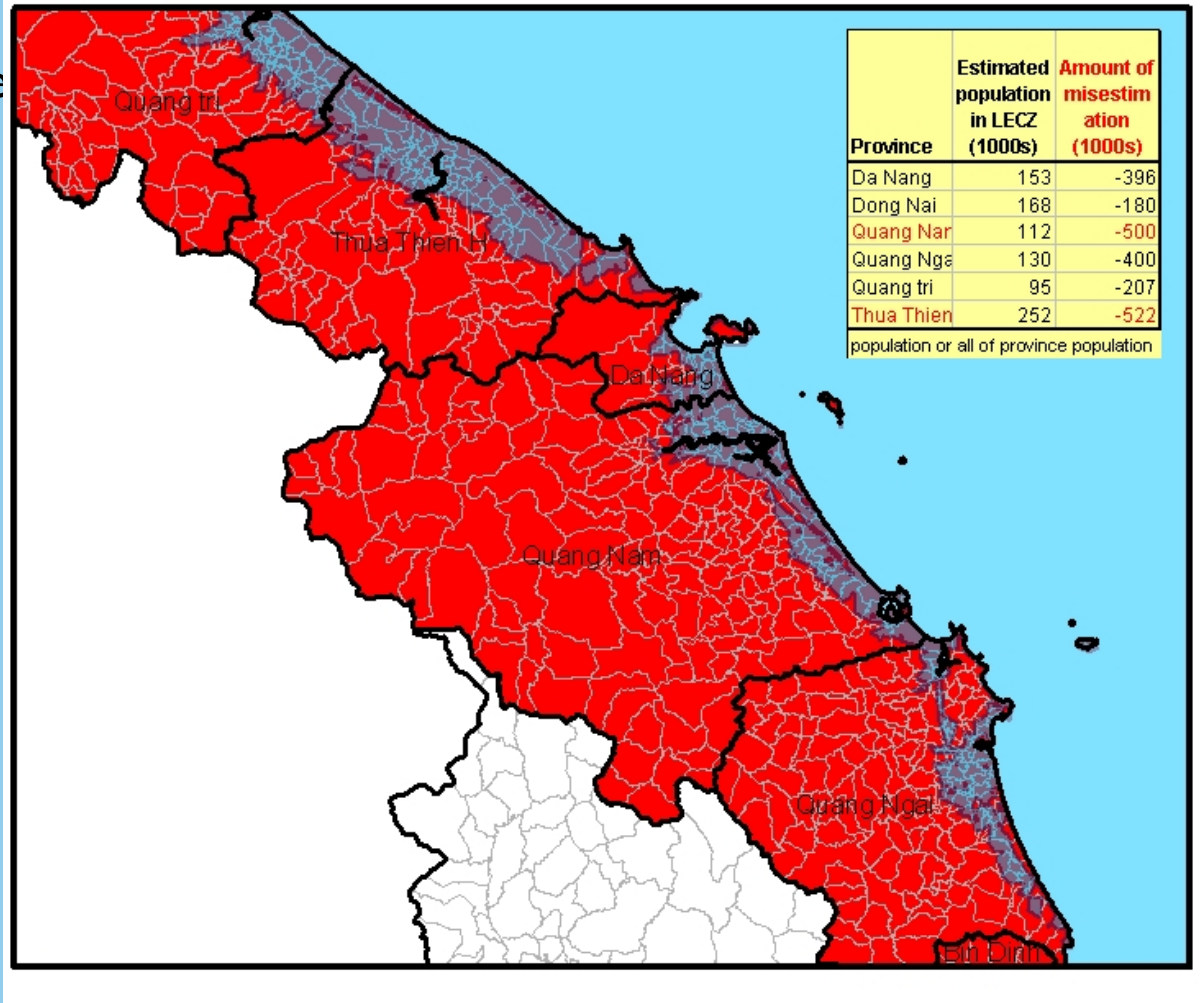
Countries ranked by total population in the LECZ				
Rank	Country	Pop Rank	Population in LECZ	% of Population in LECZ
1	China	1	143,879,600	11%
2	India	2	63,188,208	6%
3	Bangladesh	8	62,524,048	46%
4	Vietnam	13	43,050,593	55%
5	Indonesia	4	41,609,754	20%
6	Japan	9	30,477,106	24%
7	Egypt	16	25,655,481	38%
8	USA	3	22,859,359	8%
9	Thailand	19	16,478,448	26%
10	Philippines	14	13,329,191	18%

- ❑ Of the more than 180 countries with population in the LECZ, 130 of them — about 70% — have their largest urban area extending into that zone (McGranahan et al., 2007)



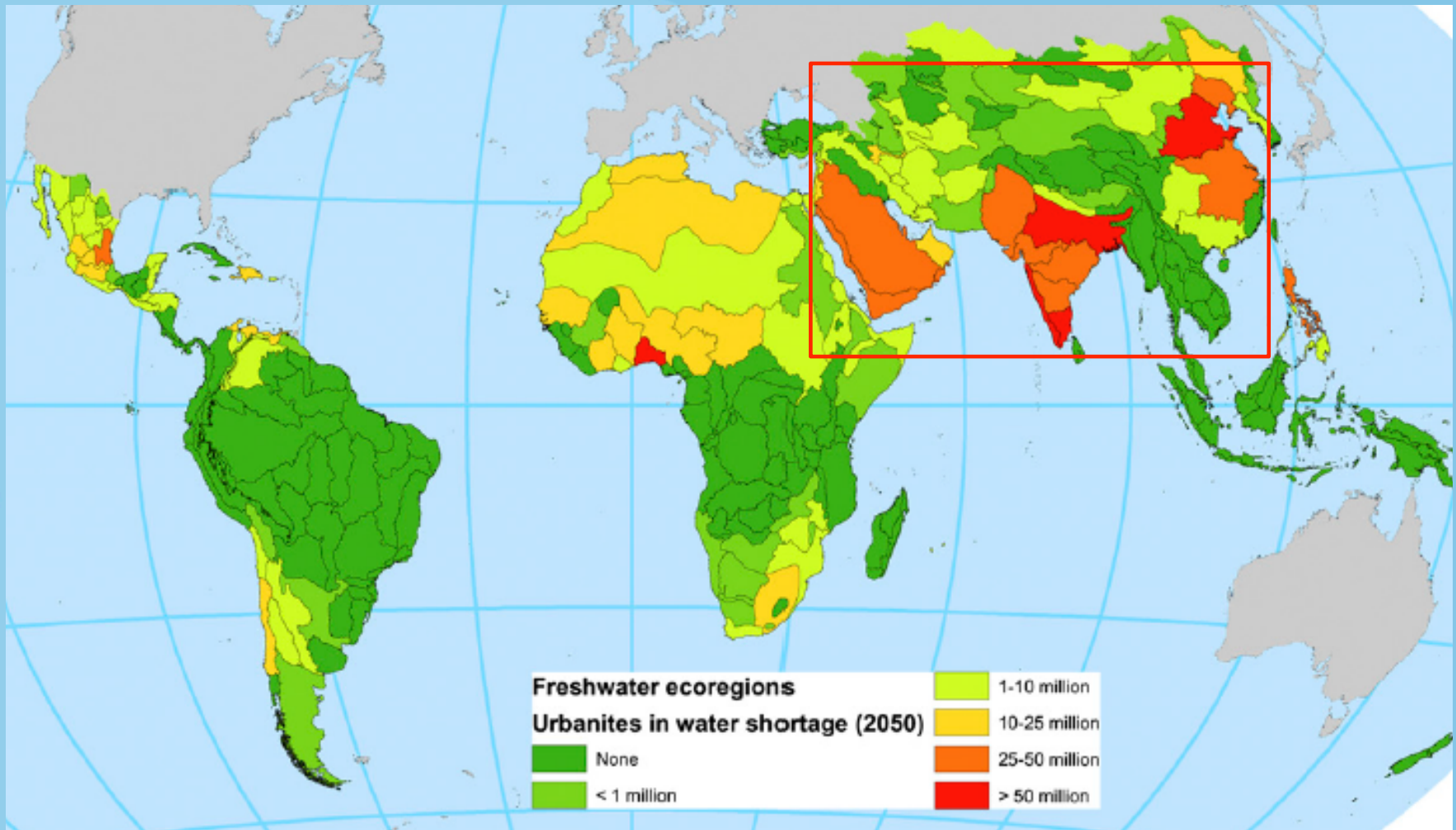
# Resolution and scale matter

- ❑ Province → Commune level administrative units
- ❑ Hundreds of small area units make estimation rigorous and accurate
- ❑ About 25% or 12 million persons too low in total.
- ❑ Localized effects are much greater.



Almost all provinces underestimate populations-at-risk except for densely settled areas at higher elevations such as Ha Noi!

# Urban Water Shortage, 2050



McDonald et al, 2011 *PNAS*

# Why engagement in the social sciences is limited

- ❑ Methods and materials of demography
  - ❑ Largely aspatial
- ❑ Climate science seen as outside the domain of most social scientists, even those interested in policy
- ❑ Demography itself is interdisciplinary within the social sciences
- ❑ But the times they are a changing...



# Method

- ❑ Empirical
  - ❑ Theory → Model → Analysis → Theory
  - ❑ Generalizability and representativeness
- ❑ Understanding causal pathways and mechanism
  - ❑ Description is seen by many as a lesser science
  - ❑ “Assessment” view with suspicion
  - ❑ Statistically representative surveys that can illuminate causal mechanisms are safest
- ❑ Modelling still has a place, but not on the scale seen in the natural sciences

# Material: Demographic data

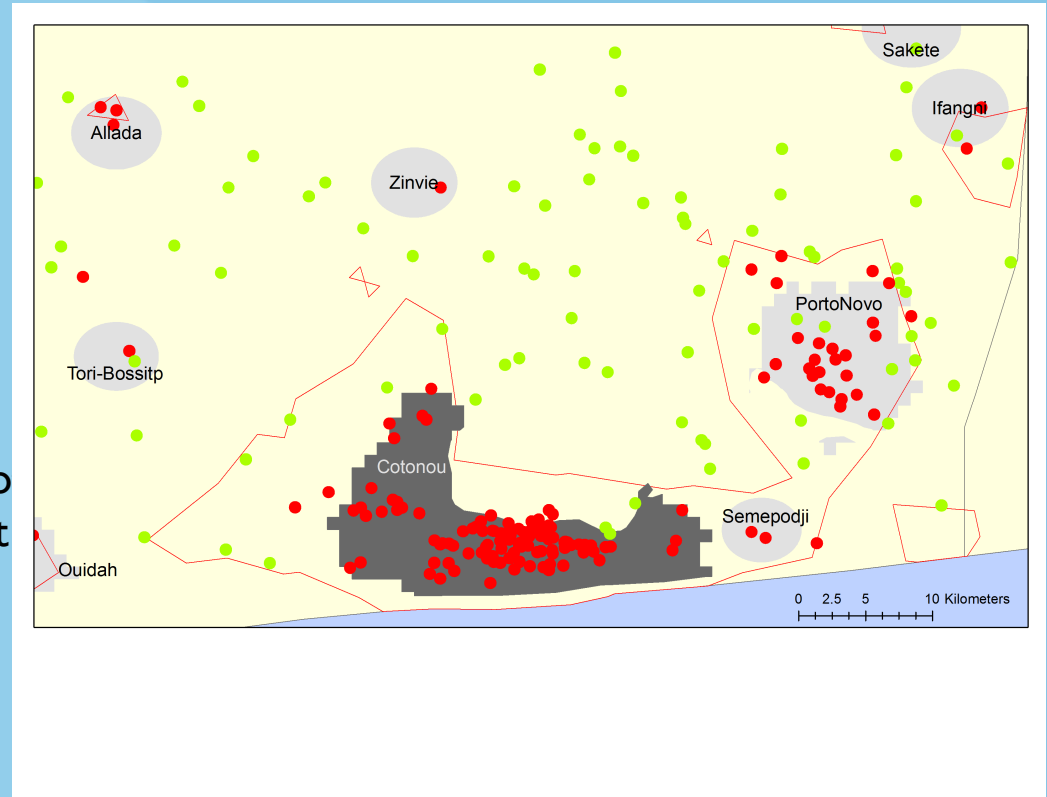
- ❑ National Censuses
  - ❑ Age-sex structure (all)
  - ❑ Education (most)
  - ❑ Race-ethnicity (many)
  - ❑ Housing (some)
  - ❑ Income/poverty (some)
- ❑ Coverage/universe
  - ❑ Most countries
  - ❑ Population-wide (usually)
  - ❑ Decadal intervals
- ❑ Reporting unit
  - ❑ Administrative units
    - ❑ Sometimes quite small
- ❑ International Demographic Surveys
  - ❑ Age-sex structure
  - ❑ Education
  - ❑ Births
  - ❑ Infant and child death
  - ❑ Housing
  - ❑ Poverty proxies
- ❑ Coverage/universe
  - ❑ Developing-world countries
  - ❑ Women of child-bearing age
  - ❑ Periodic (irregular intervals between survey rounds)
- ❑ Reporting unit
  - ❑ Coarse subnational region

What about migration??



# Compatibility with climate data

- ❑ Spatially explicit
  - ❑ Stations/points
  - ❑ Satellites
  - ❑ Models
- ❑ Linkages
  - ❑ Spatially
    - ❑ Satellite observations cannot confirm place or catchment
    - ❑ Social scientists don't work in grid-space
    - ❑ Representativeness
- ❑ Temporal scale
  - ❑ On-going vs. periodic
- ❑ These concerns are exacerbated for cities



# Evidence of progress

- ❑ Congressional briefing, April 2010
  - ❑ The Impact of Climate Change in an Increasingly Urban World, organized by Association of Population Centers
- ❑ *Nature Climate Change*
- ❑ PAA Presidential Address, 2010
  - ❑ Have we Survived the Population Bomb? Climate change given as the only example that perhaps we have not
- ❑ Doctoral student topics
- ❑ Translational data
  - ❑ SEDAC
  - ❑ TerraPopulus



# How to address inequalities?

- ❑ Costs of climate change “pollution” unfairly borne by non-“polluters”
  - ❑ Engagement with development agencies?  
Foundations?
- ❑ Balance efforts for mitigation, necessary for long-term sustainability, and adaptation, to avert short and medium-term disasters

# Reiteration of themes

- ❑ Scales matter, probably have need for all of them
  - ❑ We don't know much about the relationship between scales
- ❑ Need strong interdisciplinary work building on a strong disciplinary foundation
- ❑ The social sciences, including demography, needs to reorient themselves – data, methods, concepts – to contribute in a sustained way to climate change adaptation

# A New Urban Demography

- ❑ Reorientation from national-level urban trends  
→ cities in a systematic framework
- ❑ Place cities in a spatial context
  - ❑ Borrow strength from satellite and spatial data
- ❑ Fosters:
  - ❑ A much better understanding a full range of urban demographic behavior
  - ❑ Estimates of urban populations at risk beyond total counts. Cannot effectively prepare adaptation plans without this.

# What engagement do climate change researchers want from the social science community?

- ❑ Start with questions that we need answers to – this will be iterative
  - ❑ What does this imply for data collection, data integration and methods of analysis
- ❑ Translational issues to a wider audience still imperative.
  - ❑ The social sciences have just as much to learn here as climate scientists
  - ❑ But the reach will be far greater



# Thanks to AGCI

