Suggested IEAS research effort: Sustainable urban environments in changing climates

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Introduction

- My interests: 50 years of studies of polluted urban environments in changing climates, e.g., NYC, Beijing, L A, Mexico City, S. Paulo, Jerusalem, Athens, Venice, San Jose, San Juan, Atlanta, Houston
- Why should/could IEAS focus on cities in changing climates
  - More and more people live in larger & larger cities globally
  - Increased man-made & natural hazards exist in cities
  - Planning for sustainable urban environments requires interdisciplinary approaches with input from geoscientists, engineers, social scientists, government agencies (local to global), end users, diverse communities, planners, and communicators
  - Next two slides provide talking points (from $20m proposed NSF urban center)

Specific hazards in urban areas that will alter with changing climates

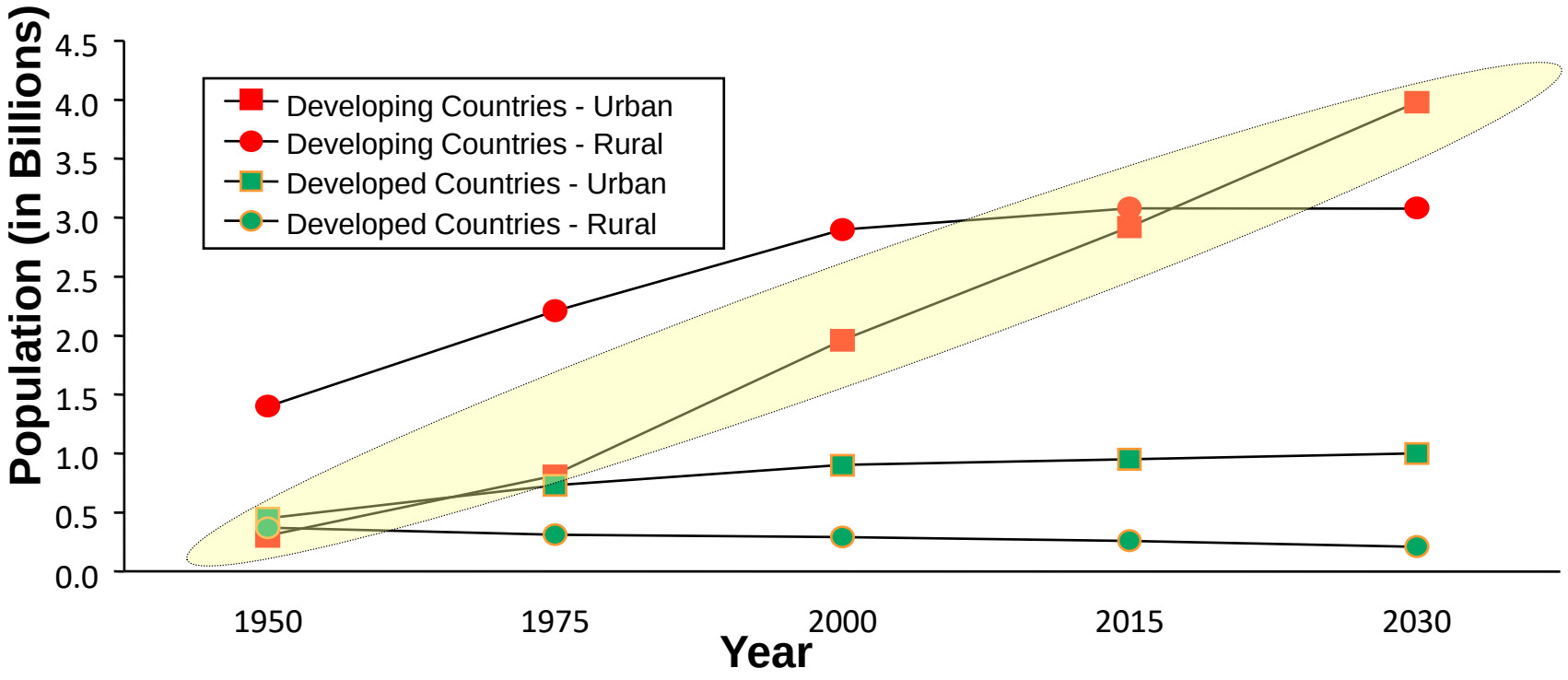
- Extreme temperatures: low temperatures mitigated by UHIs and regional warming
- Extreme winds from local Mt. systems & northward moving hurricanes/typhoons
- Flooding from mid-latitude & tropical storms
- Regional sea-level rise and river flooding
- Poor air quality & peak pollution episodes
- Wildfires and sand/dust storms
- Infectious disease spread

Interdisciplinary approach produces the following inputs

- Geoscientists (meteorologists, oceanographers, ecologists, biologists) to explain current & future threats
- Social scientists to determine human/community impacts
- Engineers to evaluate risks to infrastructure & required upgrades
- End users (industry, energy, transportation, health delivery, food supply) to evaluate their own risks
- Planners to calculate cost-benefits of resiliency actions
- Government agencies (local to global) to regulate, fund, & coordinate
- Diverse communities should provide input at every step
- Communicators to develop a common language understood by diverse communities to scientists to planners

Why an urban focus: Global populations continue to move to cities

Estimated & Projected Total Urban (■) & Rural (●) Populations of Developing (red) and Developed (green) Countries, 1950-2030



Original source: United Nations (2002)

Adapted from Hinrichsen, Salem and Blackburn (2002)

VAISALA

Producing in 40 years, more (up from 5 to 23) mega-cities (> 10 M) with ever-larger populations (up to 26 M)

City-1975	Population
Tokyo	19.8
New York	15.9
Shanghai	11.4
Mexico City	11.2
Sao Paulo	10.0
	68.3 (5)

City-2000	Population
Tokyo	26.4
Mexico City	18.1
Mumbai	18.1
Sao Paulo	17.8
Shanghai	17.0
New York	16.6
Lagos	13.4
Los Angeles	13.1
Kolkata	12.9
Buenos Aires	12.6
Dhaka	12.3
Karachi	11.8
Delhi	11.7
Jakarta	11.0
Osaka	11.0
Metro Manila	10.9
Beijing	10.8
Rio de Janeiro	10.6
Cairo	10.6
	266.7 (19)

City-2015	Population
Tokyo	26.4
Mumbai	26.1
Lagos	23.2
Dhaka	21.1
Sao Paulo	20.4
Karachi	19.2
Mexico City	19.2
Shanghai	19.1
New York	17.4
Jakarta	17.3
Kolkata	17.3
Delhi	16.8
Metro Manila	14.8
Los Angeles	14.1
Buenos Aires	14.1
Cairo	13.8
Istanbul	12.5
Beijing	12.3
Rio de Janeiro	11.9
Osaka	11.0
Tianjin	10.7
Hyderabad	10.5
Bangkok	10.1
	379.3 (23)

Source: UN Population Division, March 2000

2015: (most) blue = mostly developing world coastal cities (18)

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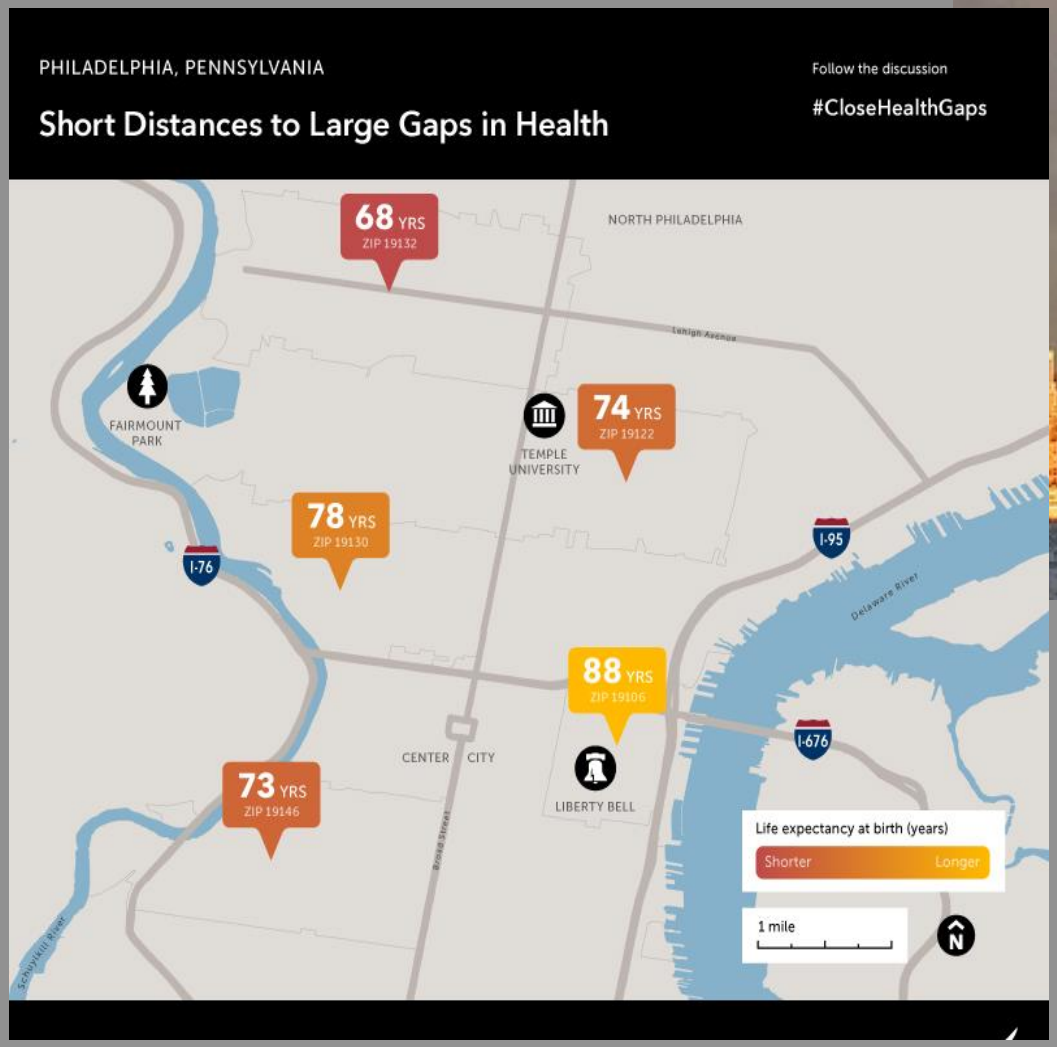
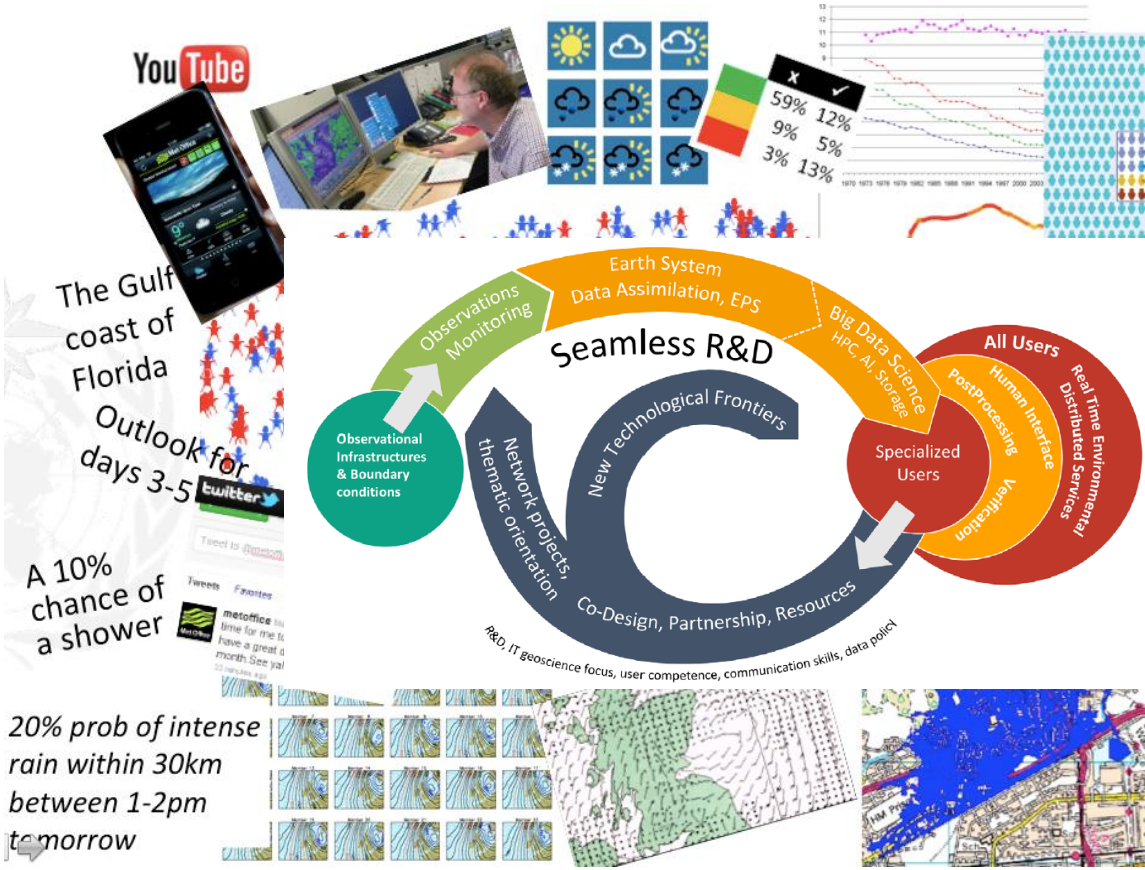


Environmental Injustice:
Variations within a city, e.g., babies in Philadelphia (US) only 5 miles apart face 20-year difference in life expectancy (via G. Ellis)

Note: One-in-six people live in squatter cities globally

WMO-IUWECS Program: Translating Research to Improved Urban Environmental-Services (via S. Baklanov, + next slide)

- **Multi-purpose**: forecasting, research, planning, mitigation
- **Multi-threat**: severe weather, air quality, floods, climate change, natural hazards
- **Multi-scale:** urban, neighbourhood, street canyon, building
- **Multi-variable:** weather, chemicals, hydrological, biometeorological, ecological
- **Multi-tool/platform**: ground-based, airborne, satellite
- **Multi-links:** between all aspects, using big-data & models

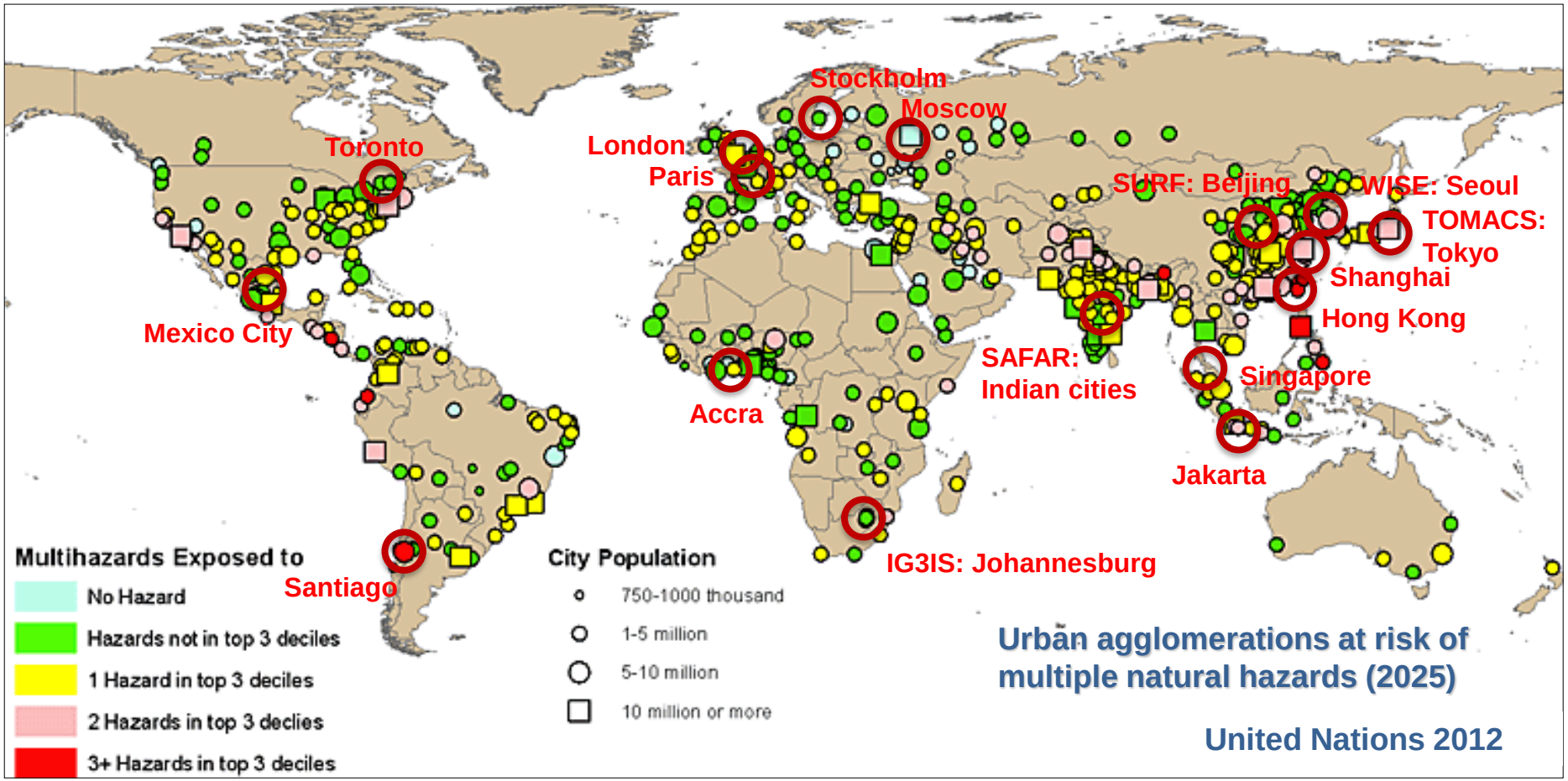


Tan et al., 2015

Better communications of impacts & risks

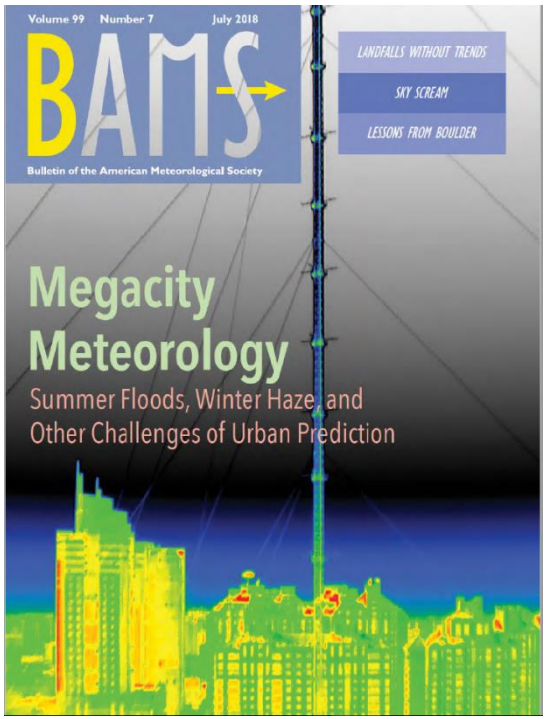
WMO OMM

IUWECS pilot projects & demonstration cities (in red), with the Beijing-SURF project as one I work on



WMO Messages: New cities and countries are welcome.
Bring Integrated Urban Services to your city!

WMO OMM



Study of Urban-impacts on Rainfall and Fog/haze (SURF)
IUM/CMA Project
July *BAMS,* Liang, et al. (2018)