Cities and Climate Change - Resilience Modelling

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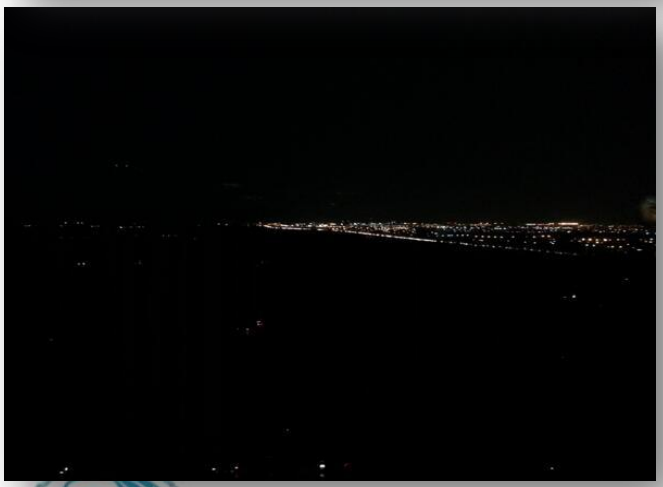
2 | CONCLUSIONS

- There are practical links between climate change adaptation, disaster risk management, and sustainable development leading to:
  - reduction of disaster risk and re-enforcing resilience as a new development paradigm
- Systems approach to quantification of resilience allows:
  - capturing temporal and spatial dynamics of climate change adaptation
  - better understanding of factors contributing to resilience
  - more systematic assessment of various measures to increase resilience
- Understanding of local context of vulnerability and exposure is fundamental for increasing resilience

3 | CALGARY
June 2013

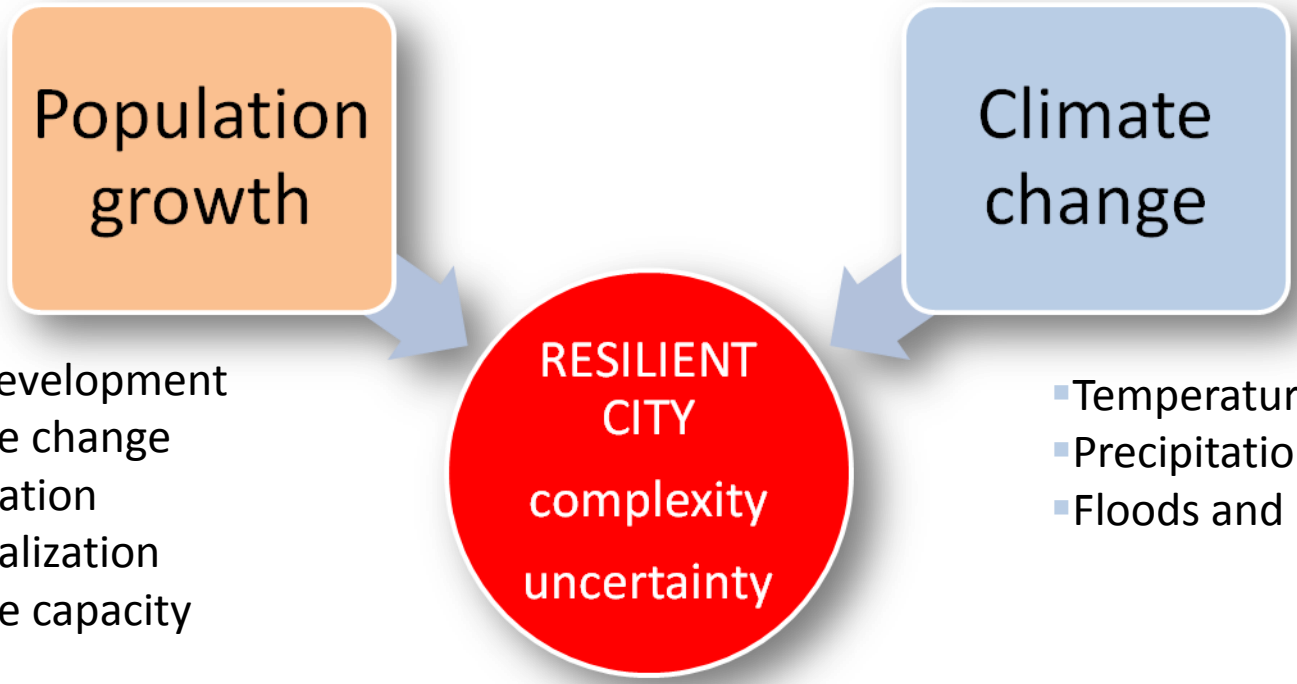
- Bow River
  - Peak flow 2,400 m^3/sec
  - 8 x the regular flow
  - 3 x 2005 flood
- Elbow River
  - Peak flow 1,240 m^3/sec
  - 12 x the regular flow
  - 3 x 2005 flood
- Outflow below Glenmore dam
  - 700 m^3/sec
  - 7 x the normal
  - 2.5 x 2005 flood
- 26 communities evacuated
- 100,000 people affected
- 20 bridges closed
- 34,000 people without power

4 | TORONTO
July 2013



- Rain storm
  - 126 mm in two hours (74.4 mm July average)
- At least 300,000 people affected
- 1,400 train passengers stranded for hours
- More than 300,000 people without power
- Major traffic arteries flooded
- Insured damage $850 M
  - 2005 storm $671 M
  - 2009 storm $228 M

INTRODUCTION
Setting the stage



- Rapid development
- Land use change
- Urbanization
- Industrialization
- Adaptive capacity

- Temperature
- Precipitation
- Floods and droughts

- Systems approach
- Resilience modelling

6 | INTRODUCTION
Project

- Project: Coastal Cities at Risk (CCaR) - Building Adaptive Capacity for Managing Climate Change in Coastal Megacities
  - International research initiative on adaptation to climate change
  - International Development Research Centre - NSERC, SSHRC, CIHR
  - Five years - $2.5 M
  - Vancouver – Canada
  - Manila – Philippines
  - Lagos – Nigeria
  - Bangkok - Thailand

Manila

Bangkok

Lagos

INTRODUCTION
Project

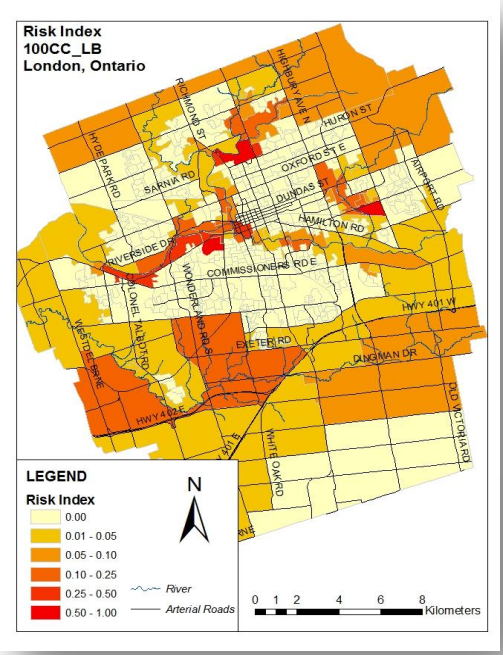
- Vancouver – Canada (OECD rating)
  - 16th for exposed assets – USD $55 billion at risk
  - 32nd in terms of population at risk – 320,000 people exposed

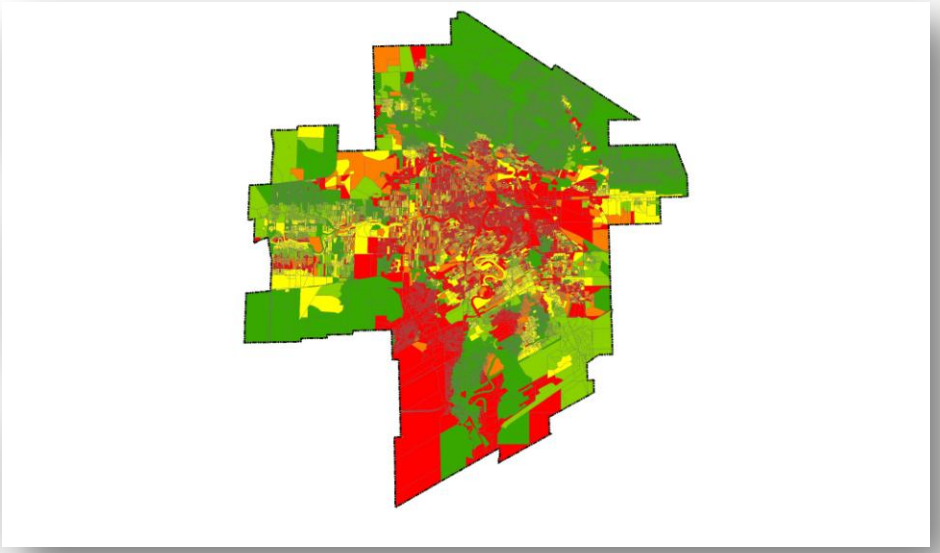
STARTING POINT
Basic definitions

- Embrace the broad definition of risk

  Risk = Hazard x Consequence
- Consider paradigm change

  Risk -> Resilience



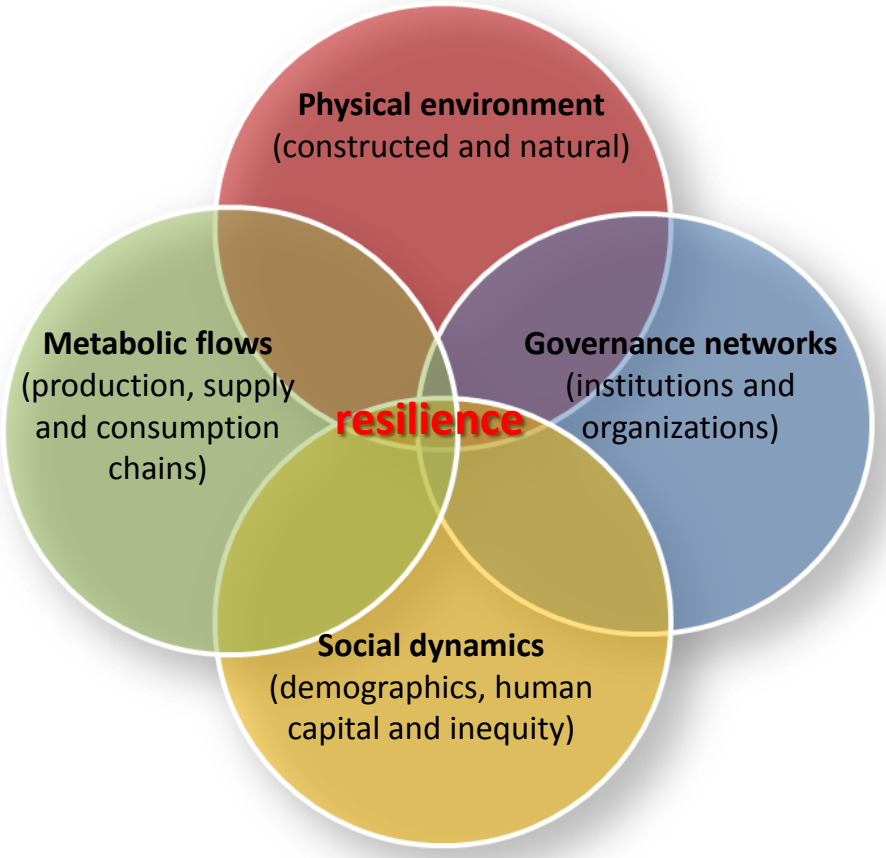


9| MODELING RESILIENCE
Basics

- Broader concept of resilience
  - The ability of the system to reduce the chance of shock, to absorb a shock if it occurs and to recover quickly after a shock
- Resilient system is one that
  - Reduces failure probability
  - Reduces consequences from failures in terms of live lost, damage, and negative economic and social consequences
  - Reduces time to recovery (restoration of a specific system or set of systems to their 'normal' level of performance)
- Resilient city
  - A resilient city is a sustainable network of physical (constructed and natural) systems and human communities (social and institutional) .

Toronto , Fricke Friday, August 25, 2005

10 | MODELING RESILIENCE
Basics



Modified after Resilience Alliance, 2012 (www.resalliance.org)

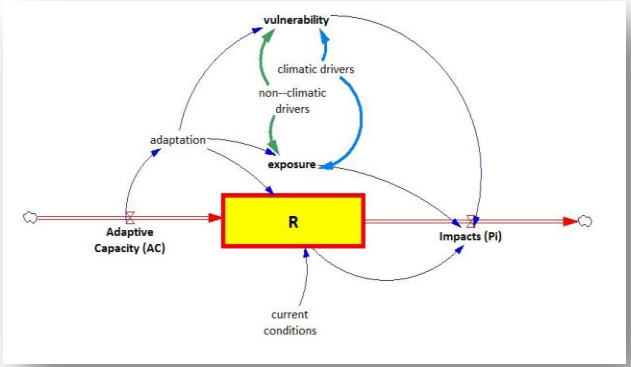
11 | MODELING RESILIENCE
Space-time dynamic resilience measure (ST-DRM)

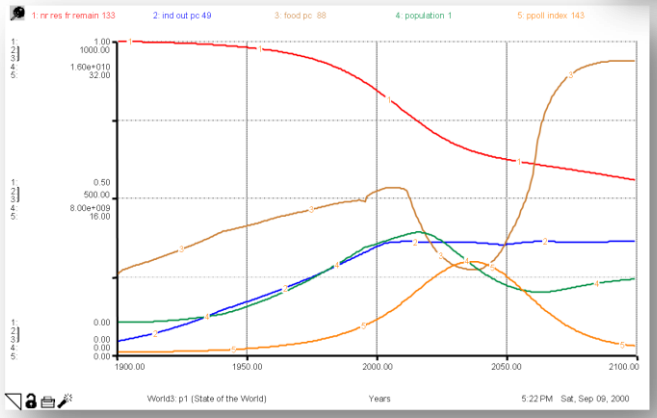
- Dimensions of resilience (t, s)
  - Time
  - Space
- Units of resilience - SP
  - Physical
  - Health
  - Economic
  - Organizational
  - Social
  - …..
- Properties of resilience (physical and social systems) – AC
  - Robustness
  - Redundancy
  - Resourcefulness
  - Rapidity
-

- System performance

- System adaptive capacity

12 | MODELING RESILIENCE
Implementation - resilience simulator





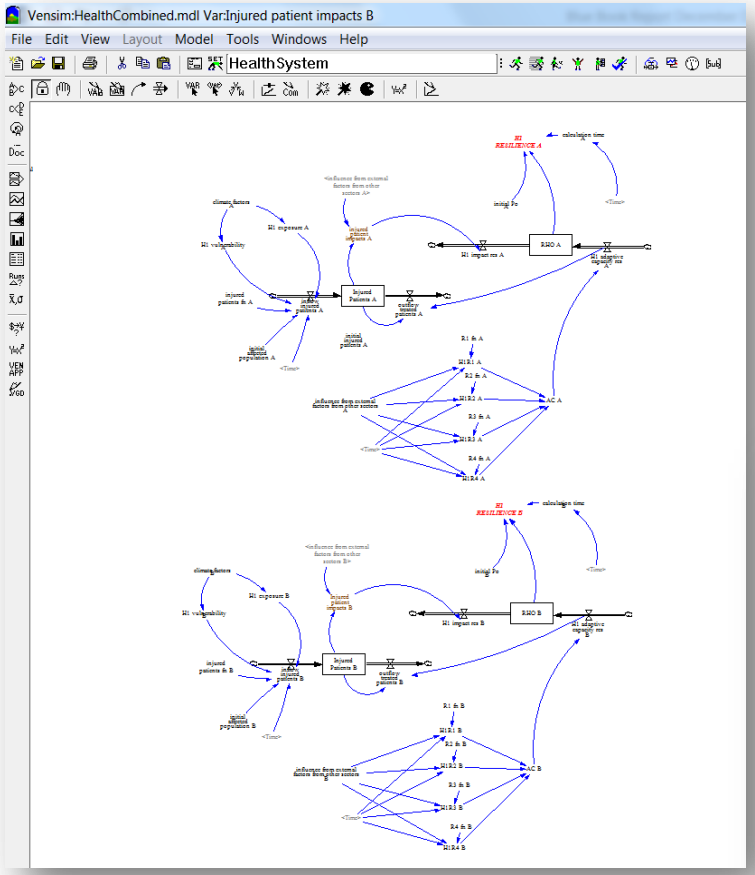
Temporal dynamics

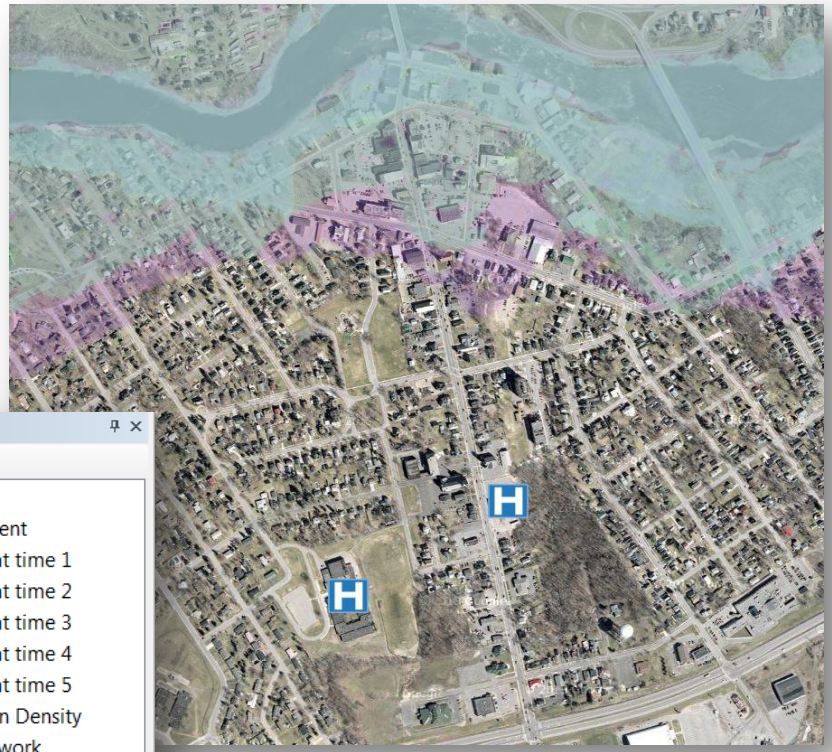
SD ⟺ GIS

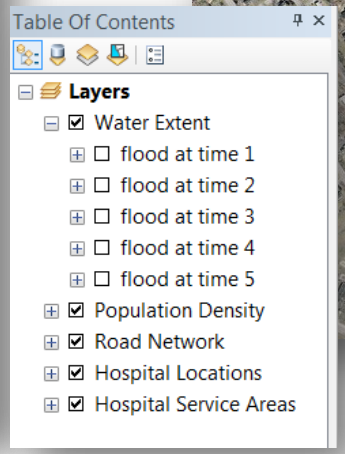
dynamic data exchange

Spatial dynamics

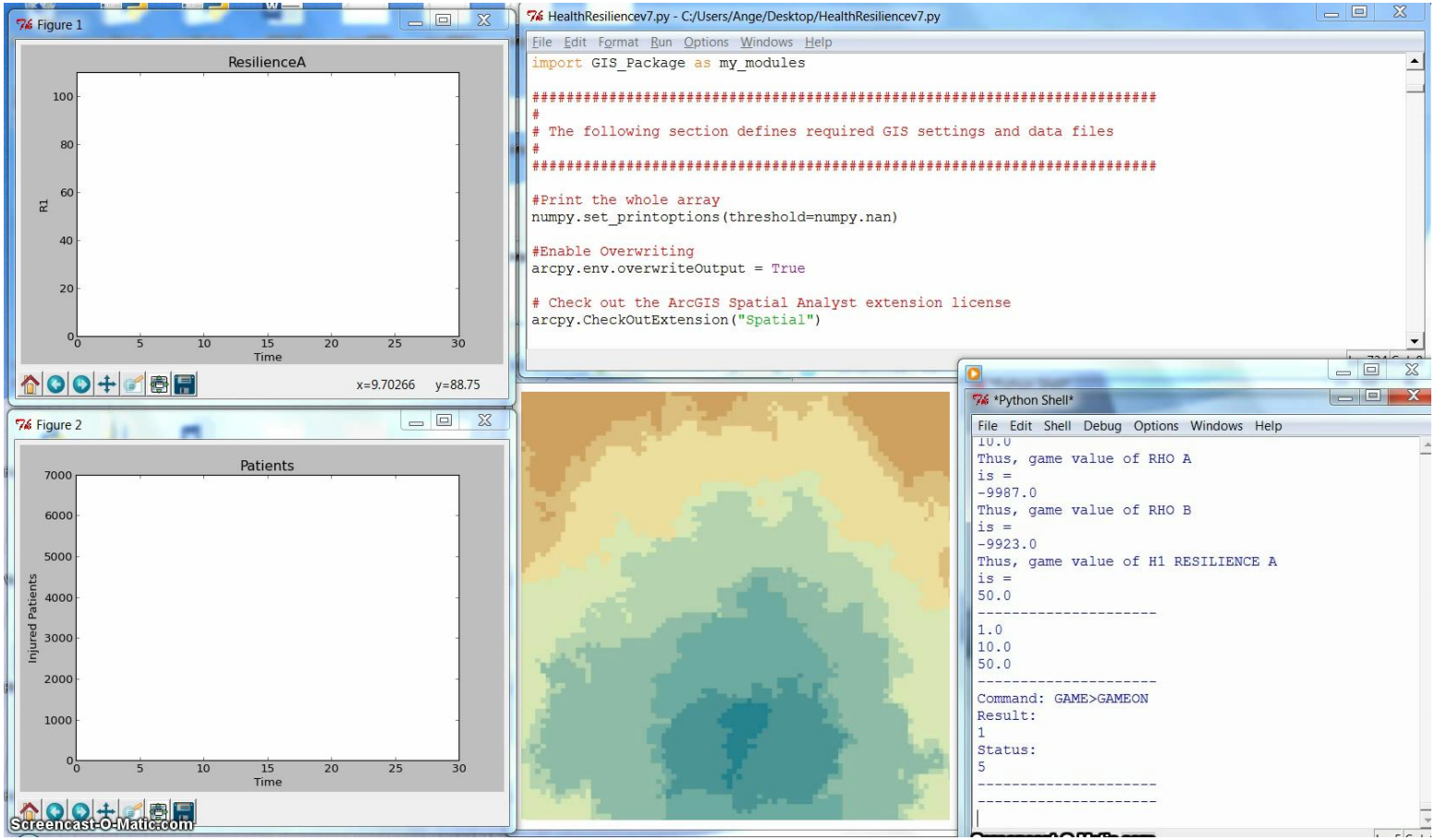
13 | MODELING RESILIENCE
Implementation - resilience simulator







14 | MODELING RESILIENCE
Implementation - resilience simulator



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16| RESOURCES

www.slobodansimonovic.com

Research -> FIDS -> Research projects

- Simonovic, S.P., and A. Peck, (2013) "Dynamic Resilience to Climate Change Caused Natural Disasters in Coastal Megacities - Quantification Framework", *British Journal of Environment and Climate Change*, 3(3): 378-401.