

Understanding Urban Systems in the Context of Global Change

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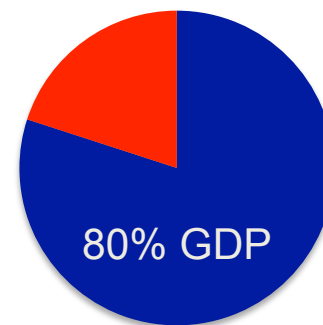
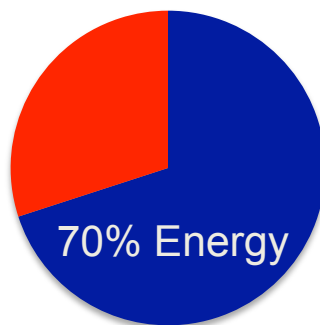
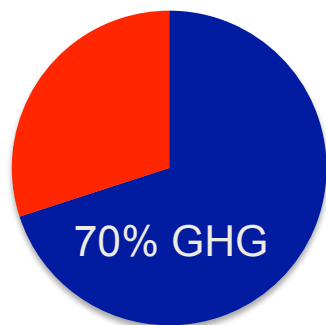
karen.seto@yale.edu



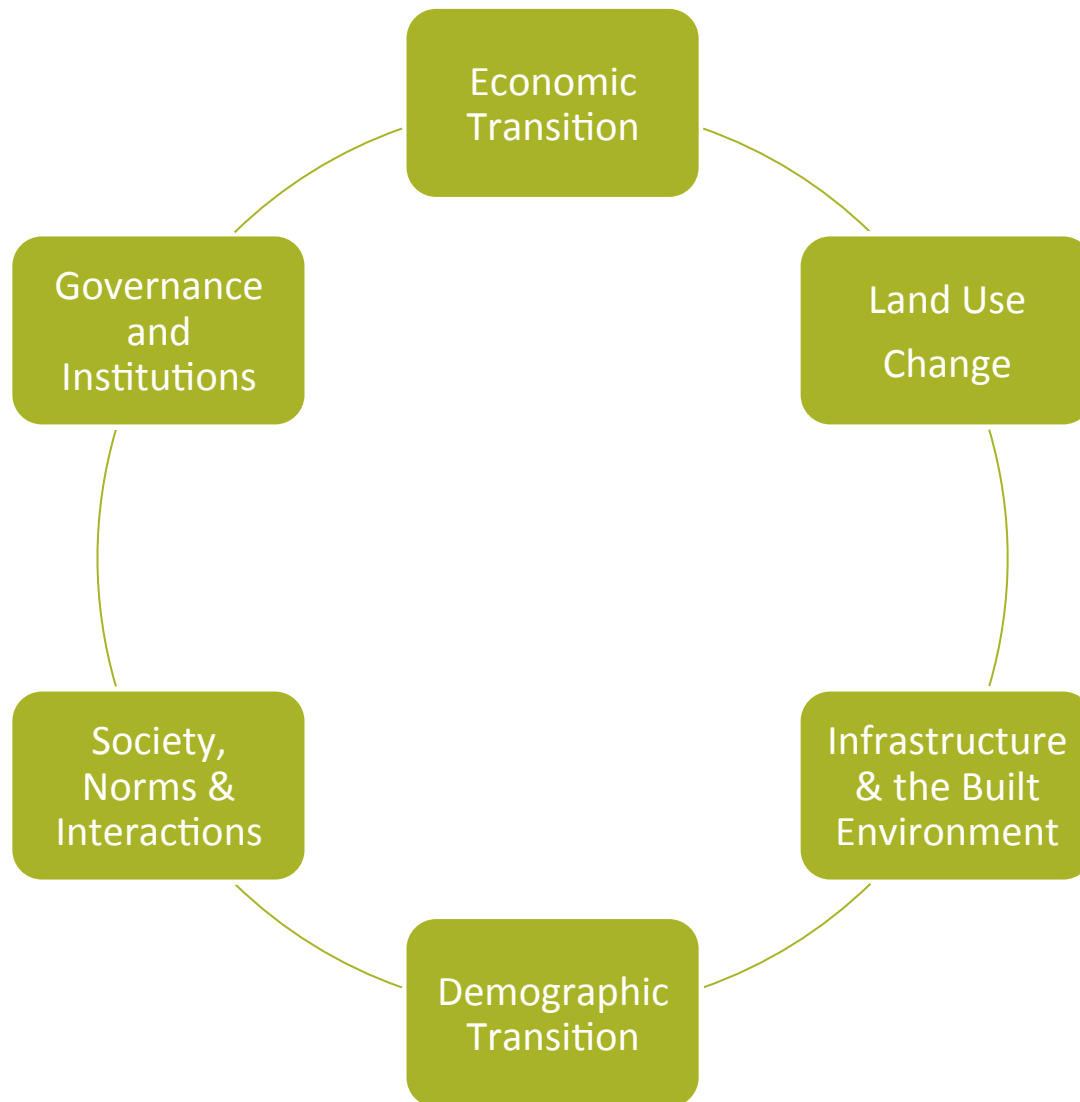
YALE UNIVERSITY

School of Forestry
& Environmental Studies

Urban areas are key drivers of global GHG emissions, energy use and productivity



Urbanization is a process of simultaneous change across multiple dimensions

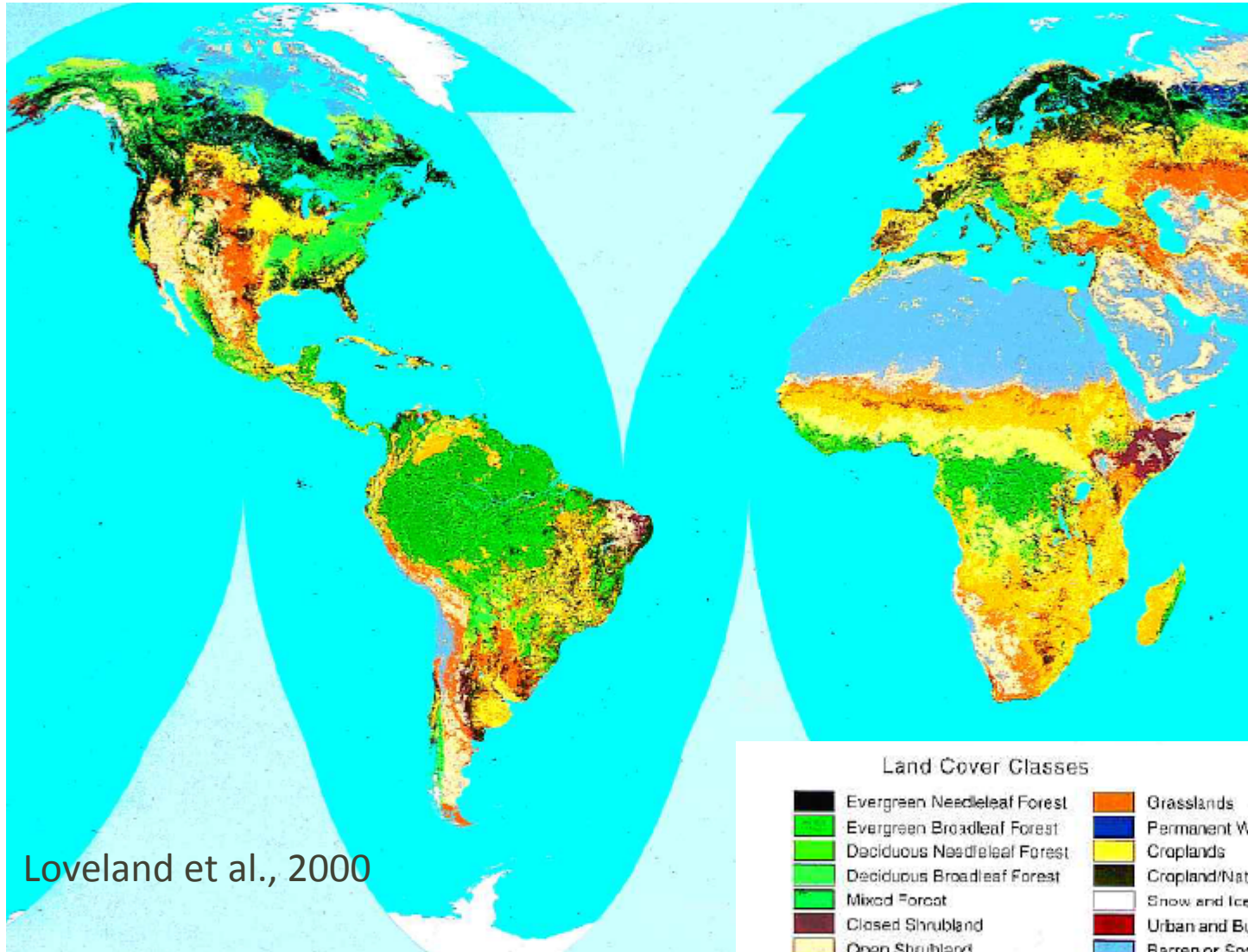


Dominant perspective on the impacts of cities and urbanization



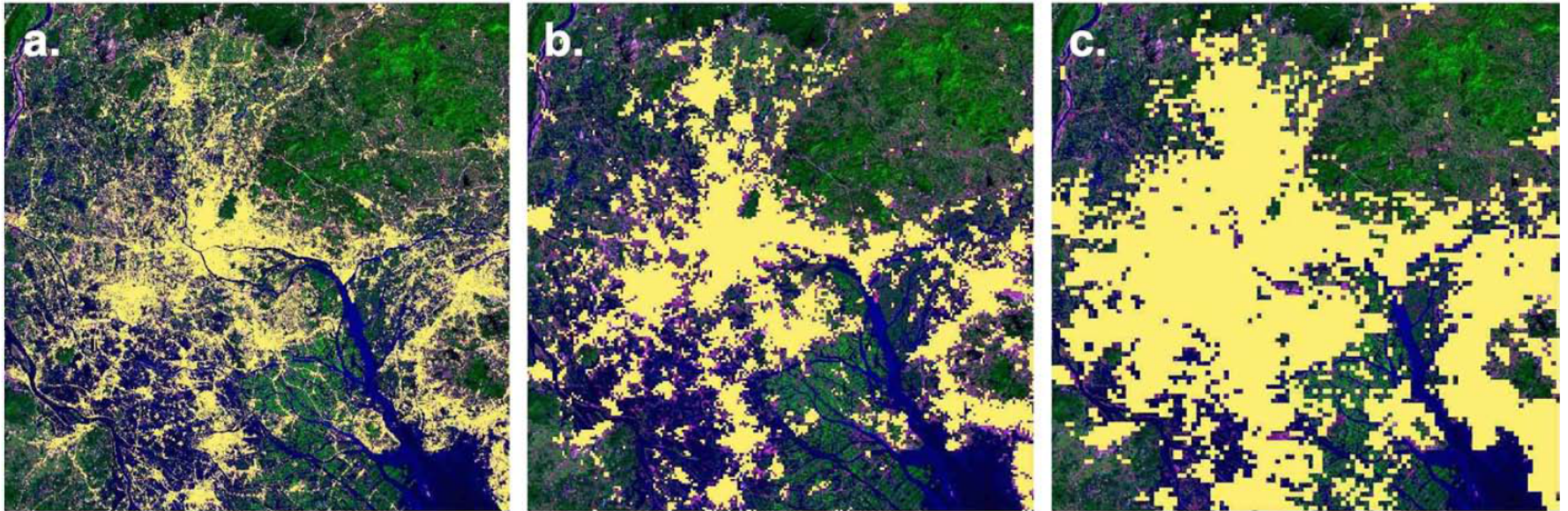
3. Classical Athens seen from the northwest. (Watercolor by Peter Connolly)

Global land cover mapping with AVHRR



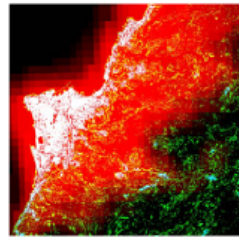
Loveland et al., 2000

Urban land cover mapping with MODIS

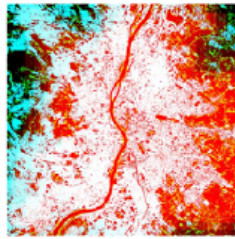


Friedl et al., 2010

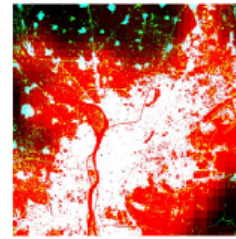
Global urban mapping with DMSP



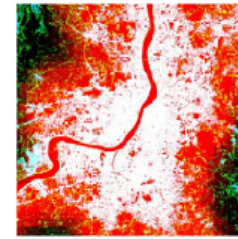
Beirut (9)



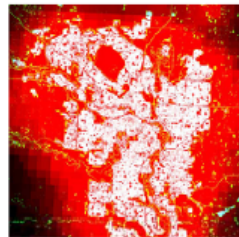
Budapest (2)



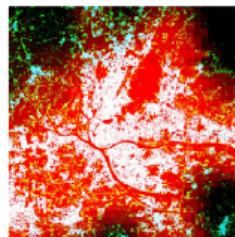
Cairo (7)



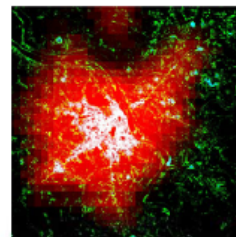
Calcutta (5)



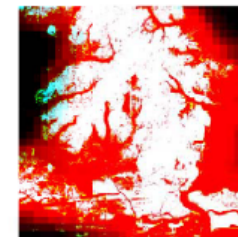
Calgary (6)



Guangzhou (4)



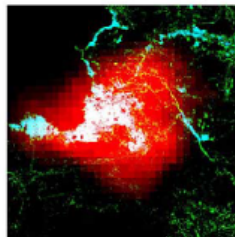
Hanoi (8)



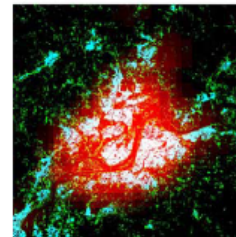
Lagos (10)



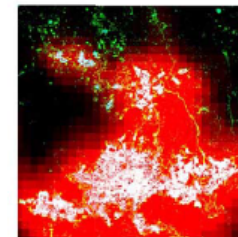
Miami (11)



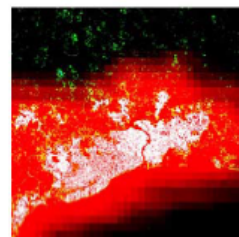
Port au Prince (12)



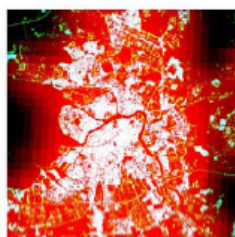
Pyongyang (13)



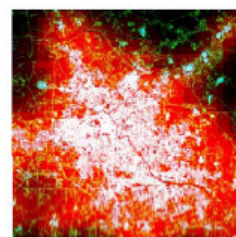
San Salvador (14)



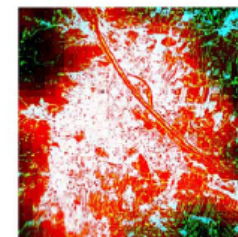
Santo Domingo (16)



St Petersburg (17)



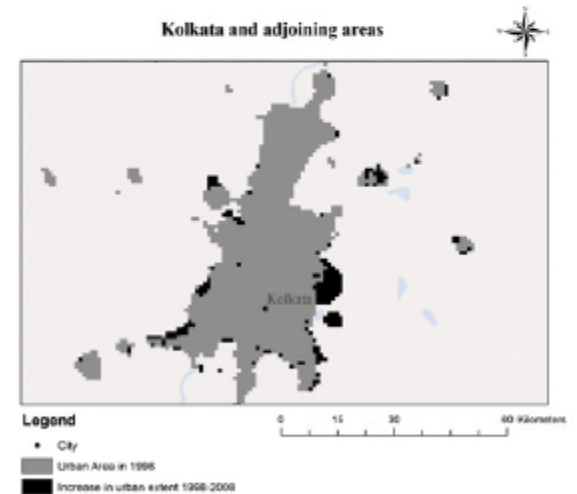
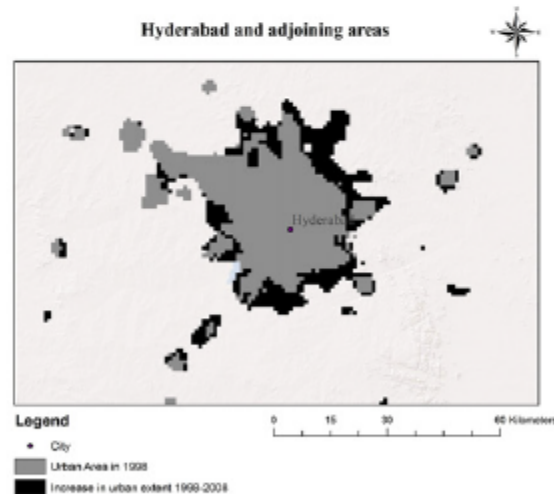
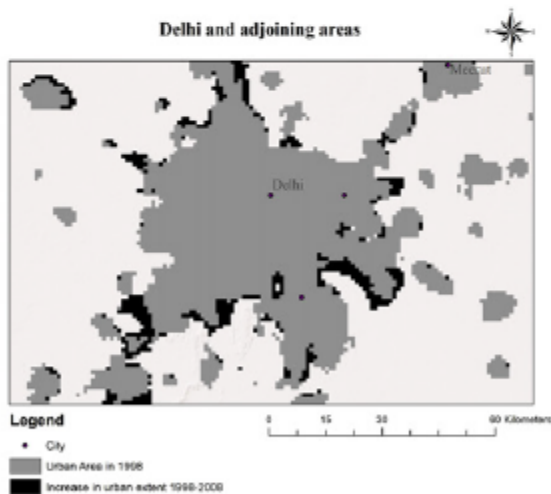
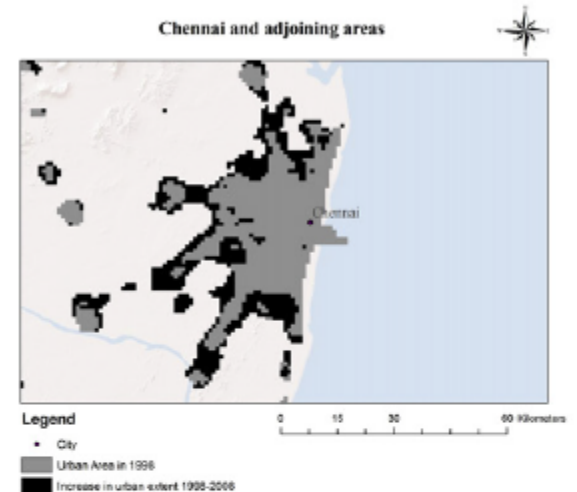
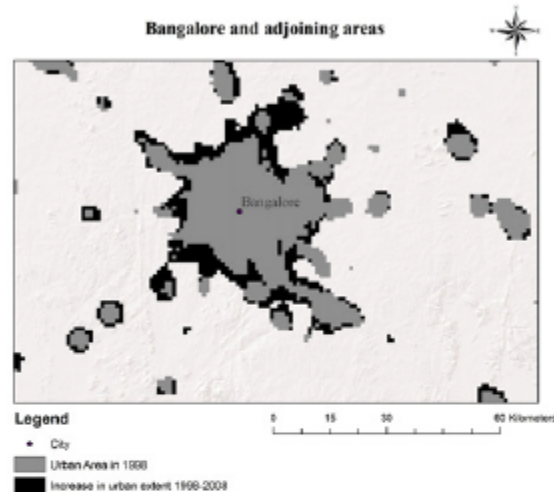
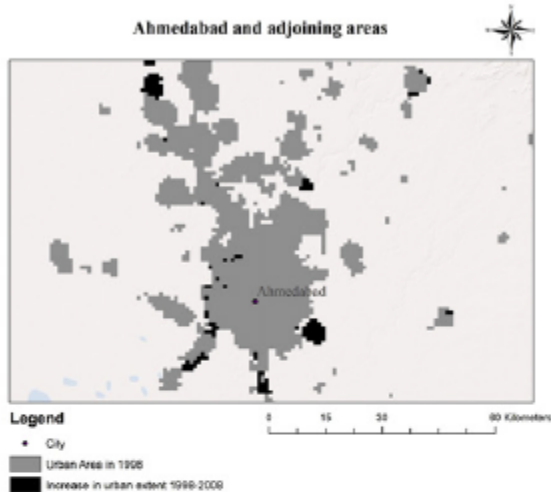
Tianjin (3)



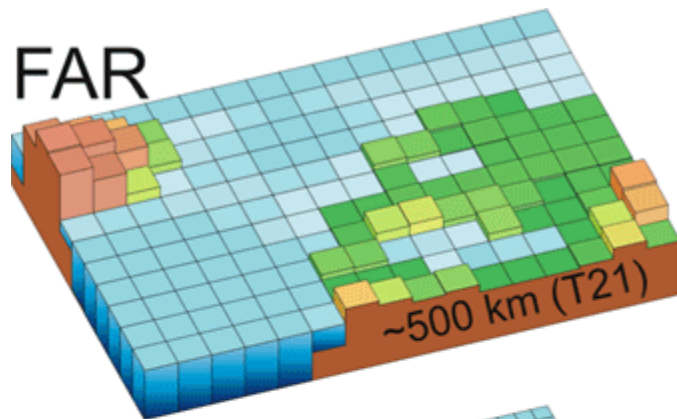
Vienna (1)

Small et al., 2005

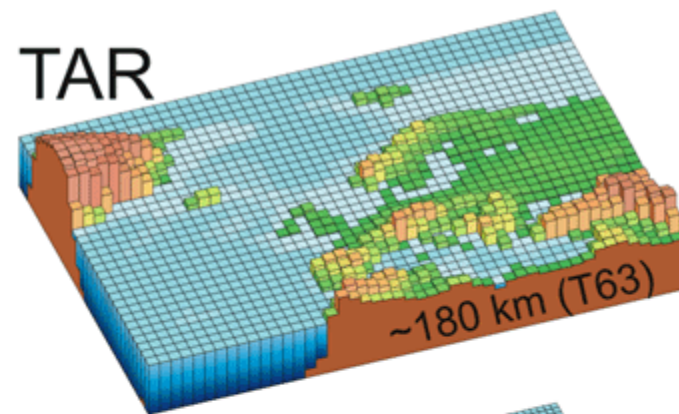
Urban mapping with DMSP + SPOT-VGT



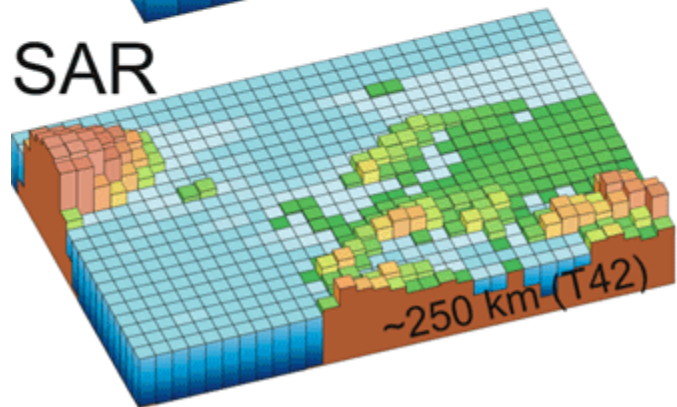
FAR



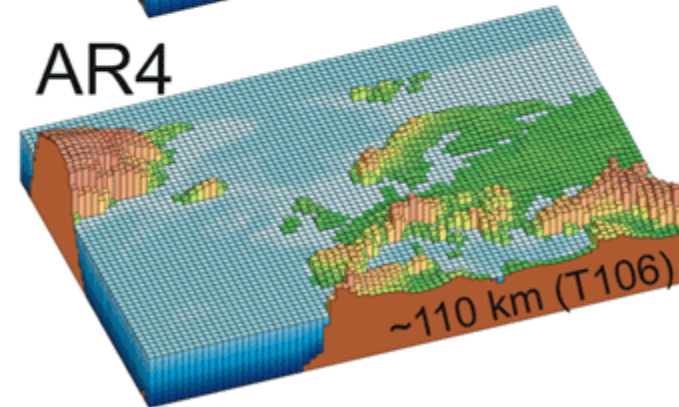
TAR



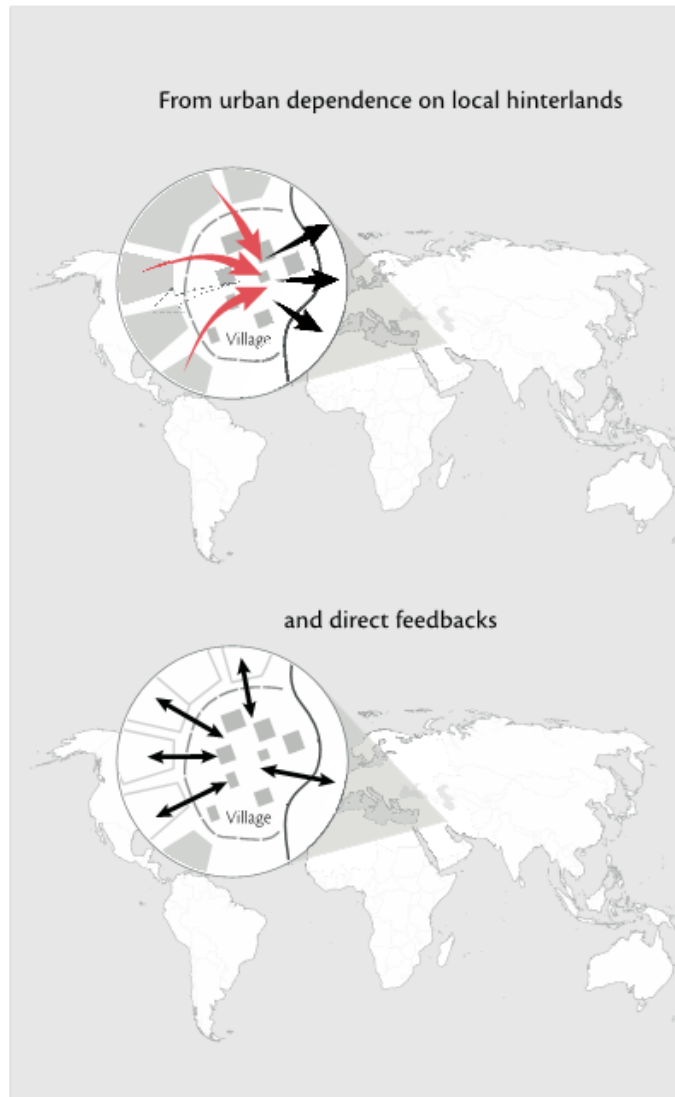
SAR



AR4



Planetary urbanization requires rethinking urban impacts and sustainability



(Elmqvist et al. 2013)

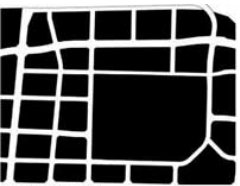
→ Resources

→ Waste

→ Incentives, regulations, subsidies etc.

↔ Feedbacks

We need to understand urban structure, function, activity, flows, and linkages



MISSISSAUGA



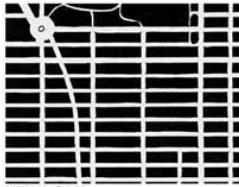
BARCELONA



COPENHAGEN



LONDON

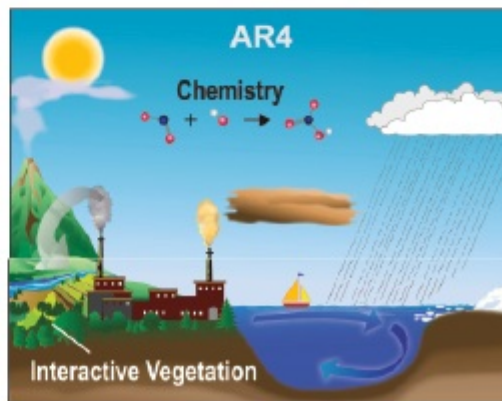
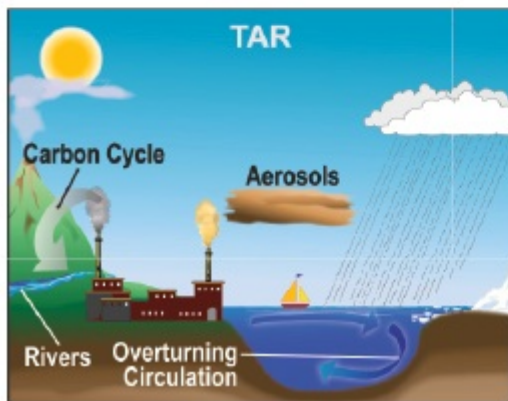
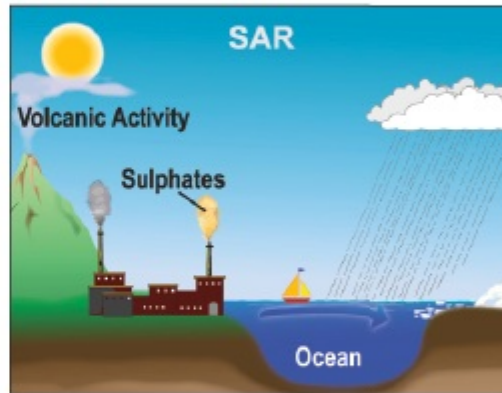
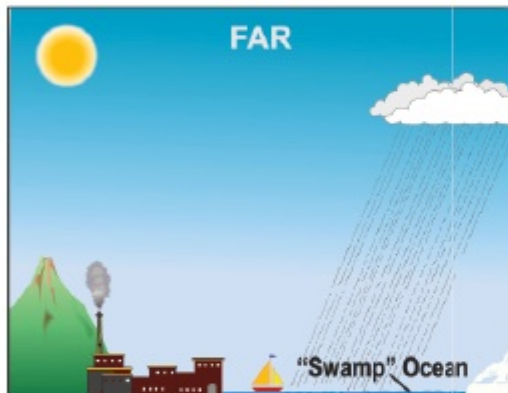
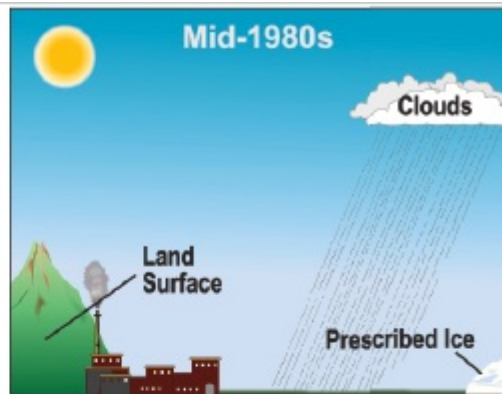
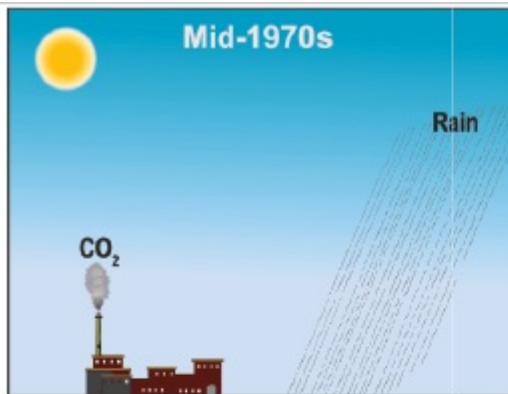


NEW YORK

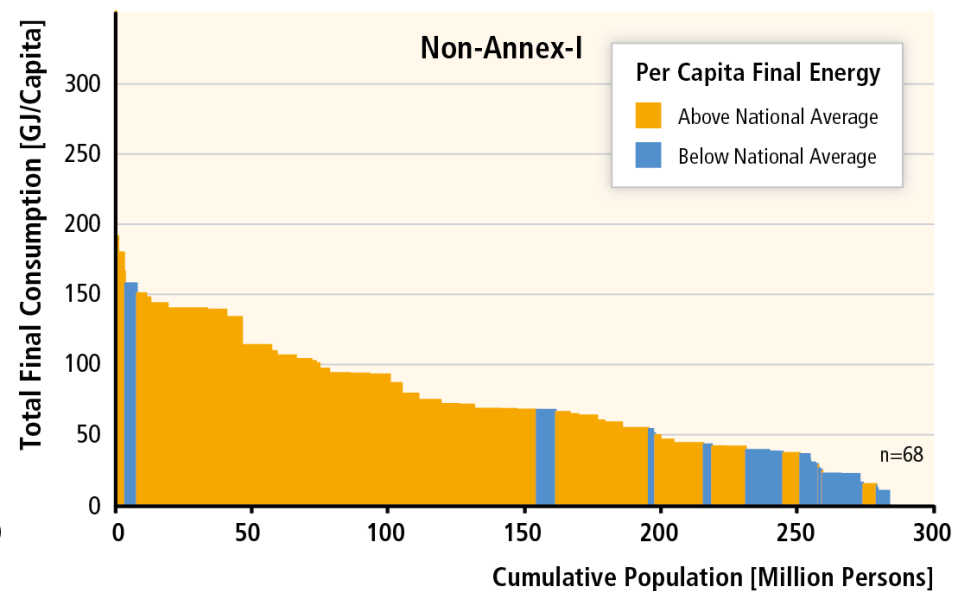
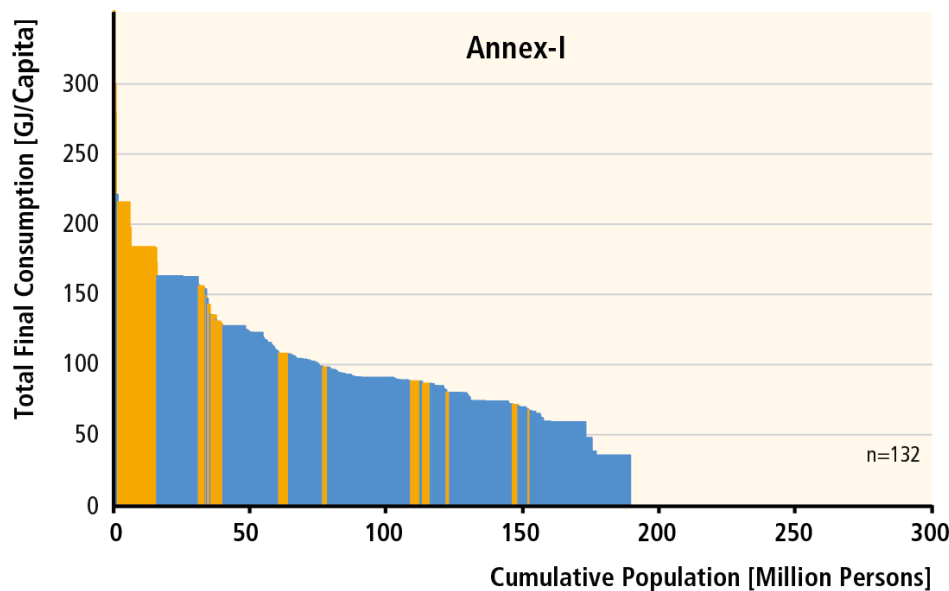


PARIS

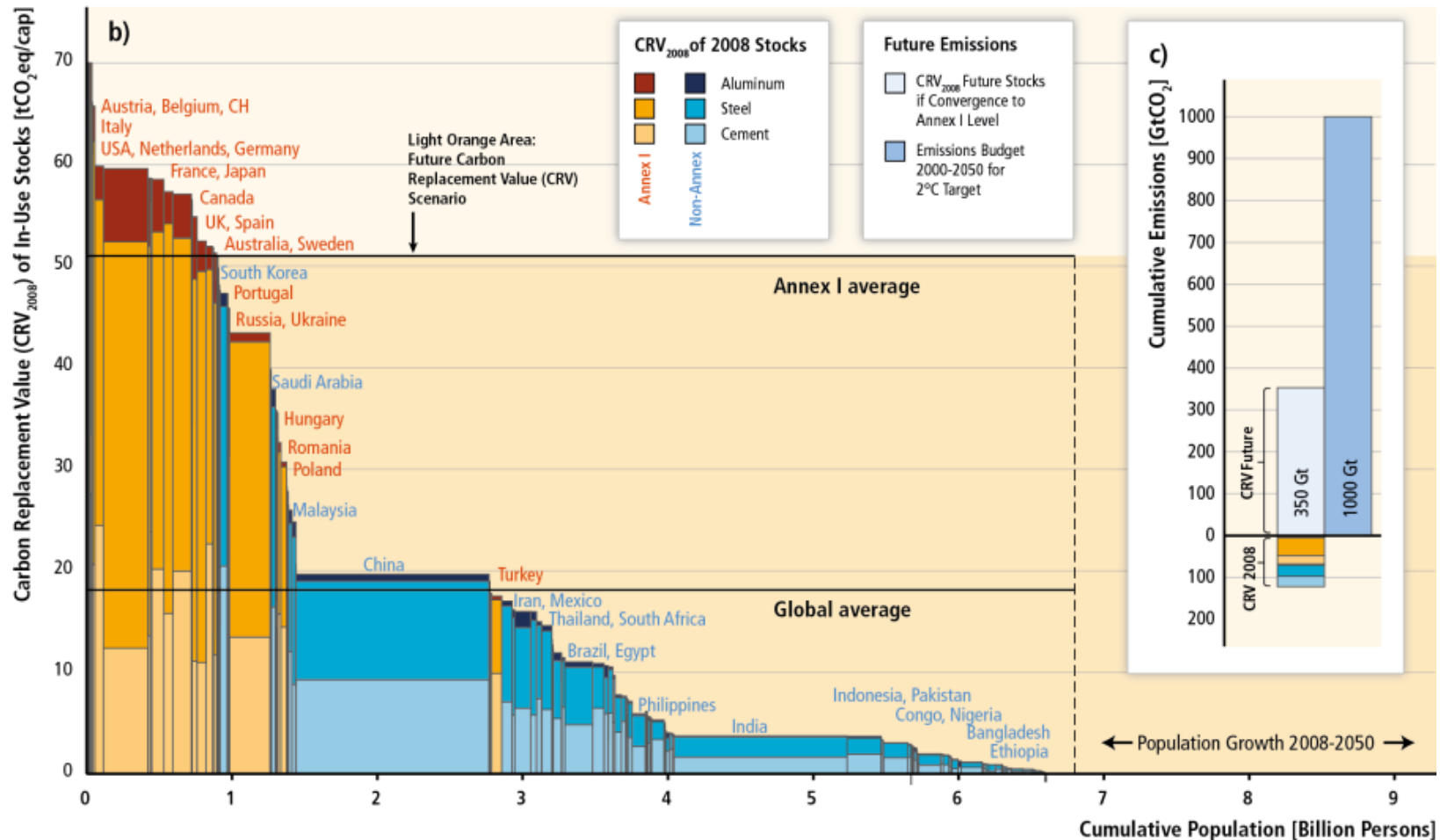




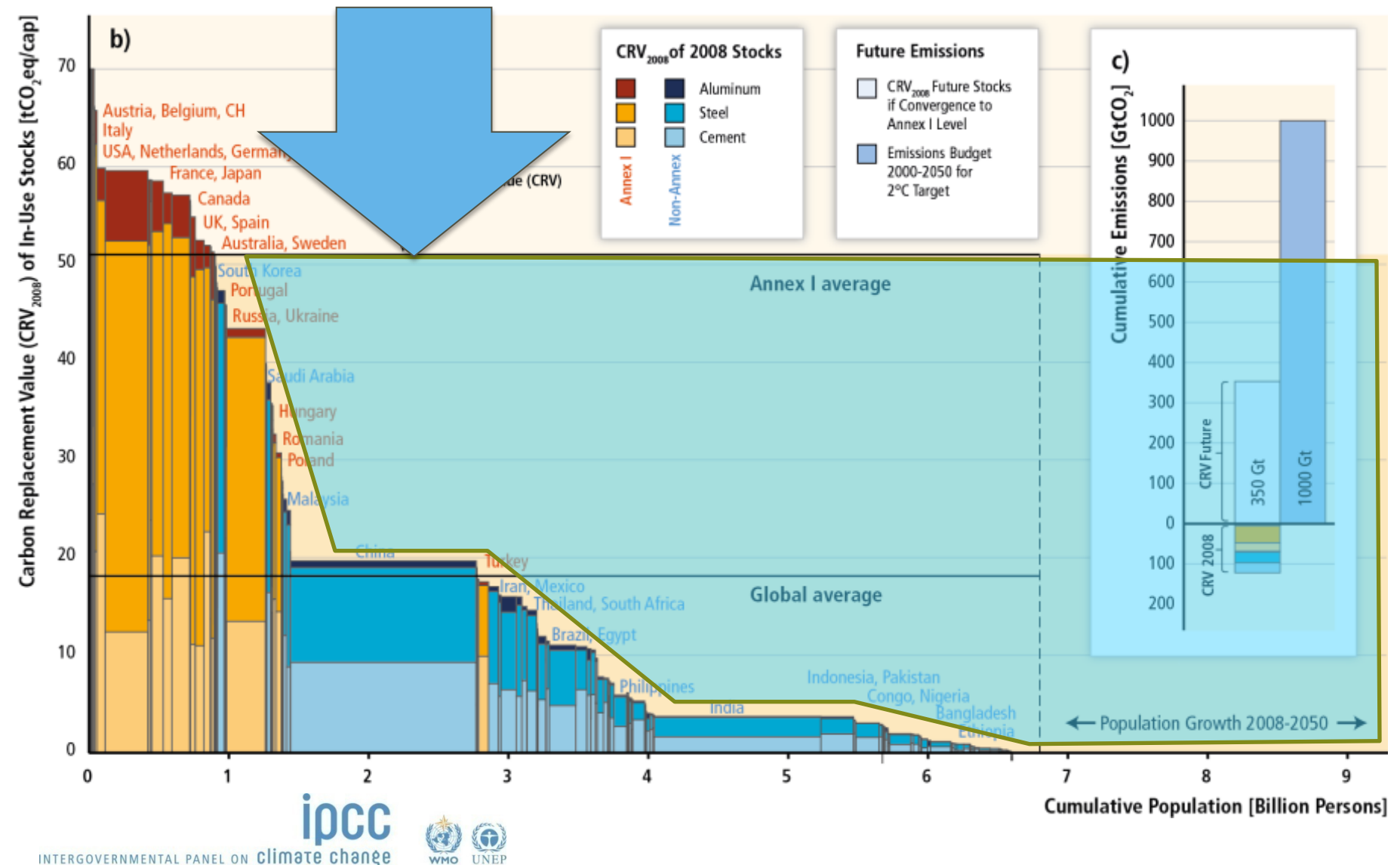
IPCC AR5: Significant variation in energy use across cities due to differences in economic structure and urban form



Infrastructure build-up over the next few decades will result in significant emissions



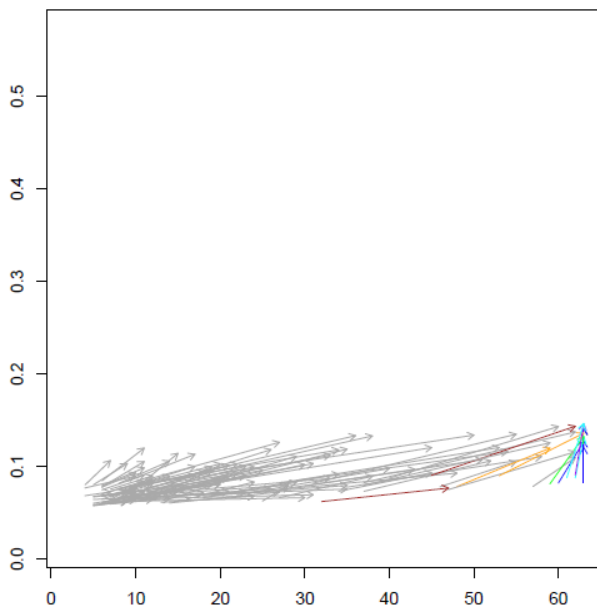
Future CO2 emissions if developing countries catch up to average developed country level



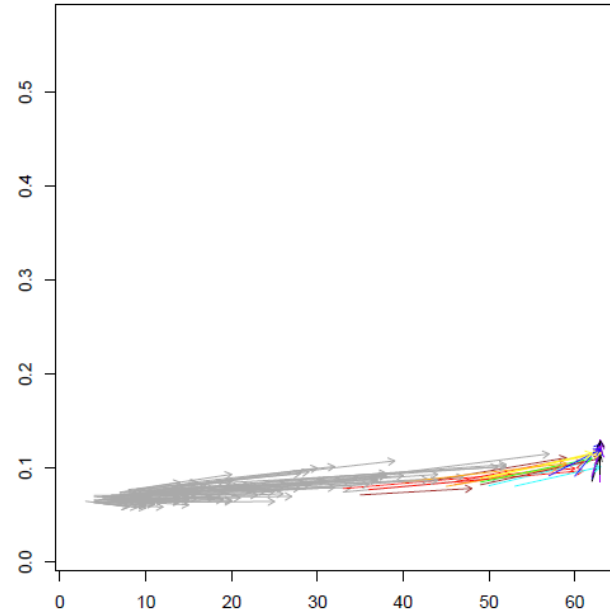
Example 1: SeaWinds & DMSP to characterize urban structure (S. Frolking, UNH)

- Differentiate urban structures
- Embodied energy
- Committed infrastructure
- GHG emissions pathways

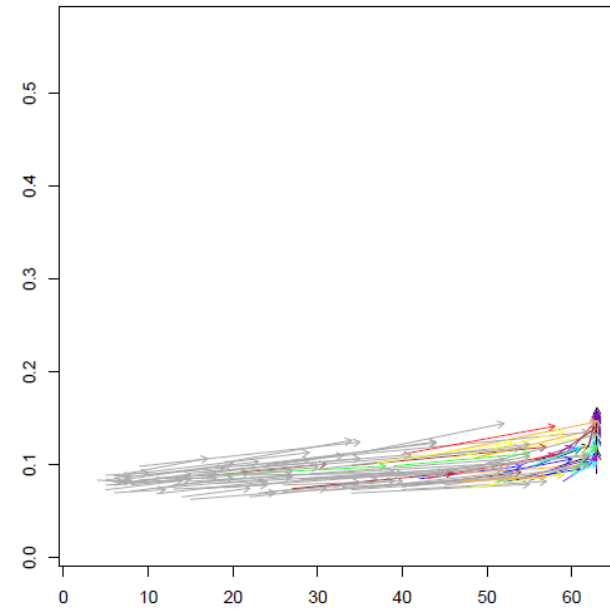
Bangalore



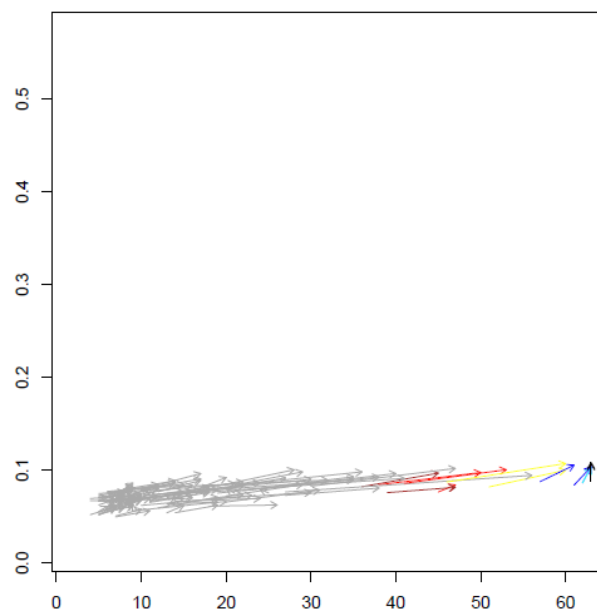
Hyderabad



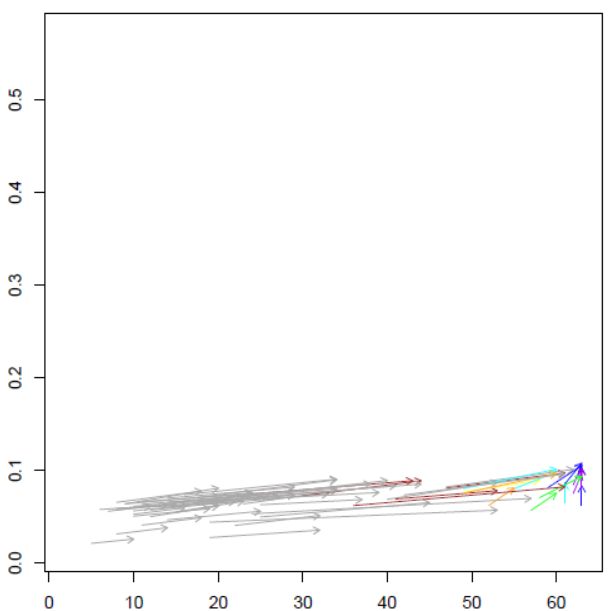
Delhi_(National_Capital_Region)



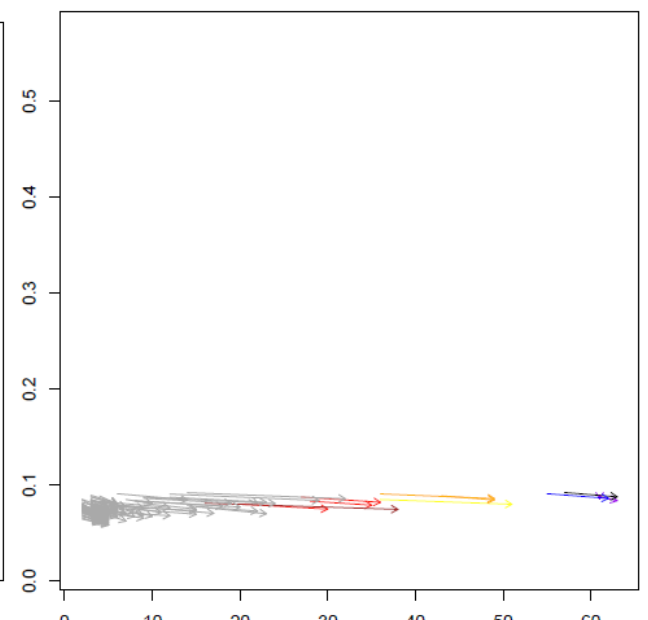
Ahmedabad

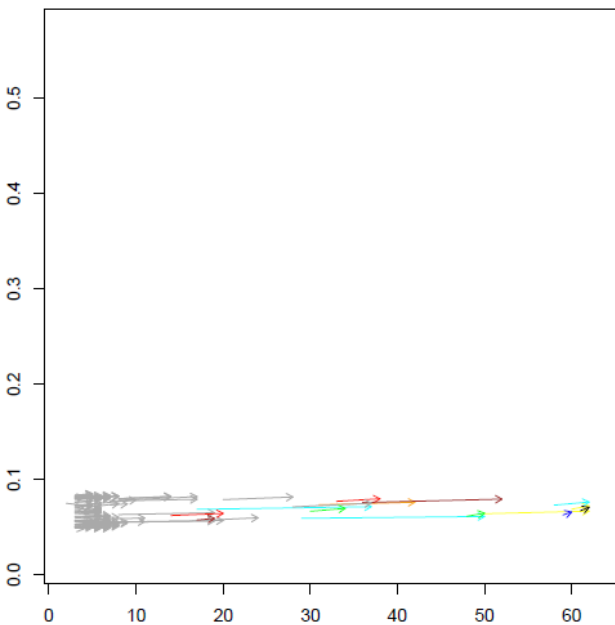
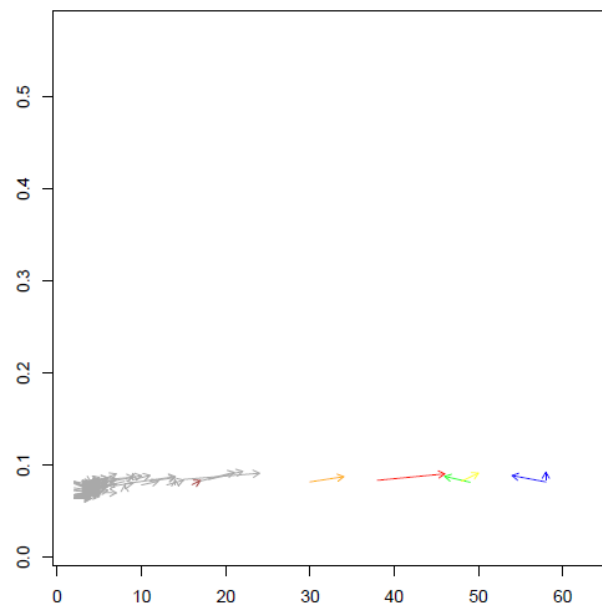
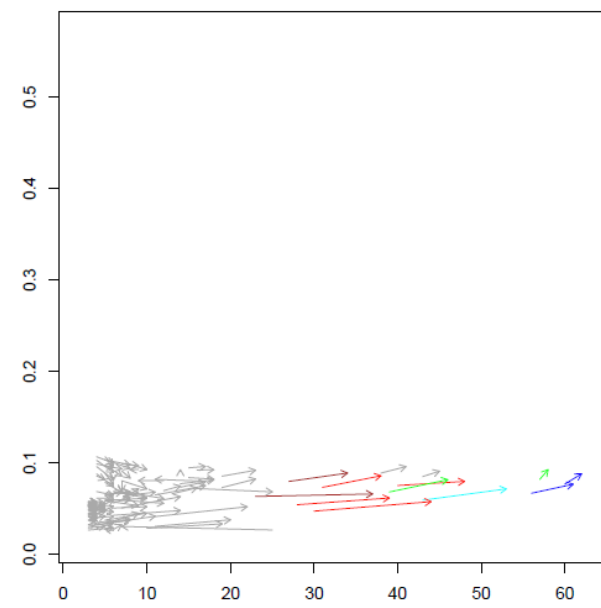
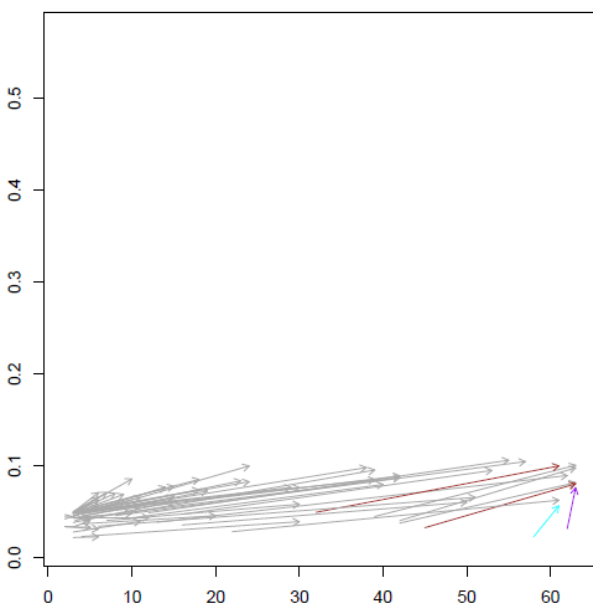
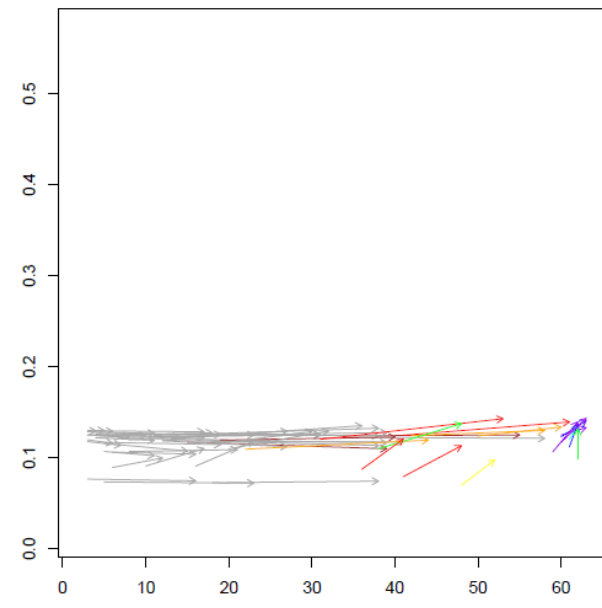
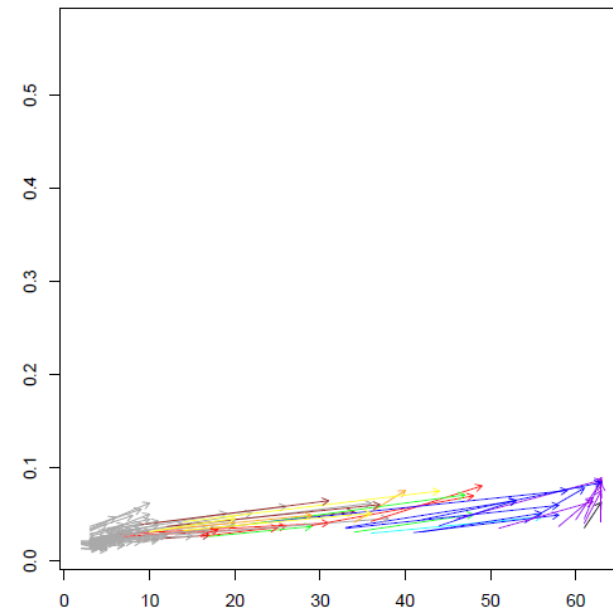


Chennai_(Madras)

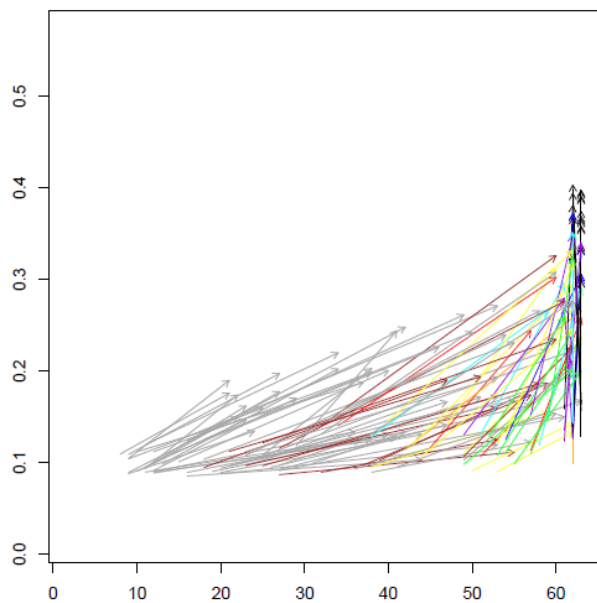


Kanpur_(Cawnpore)

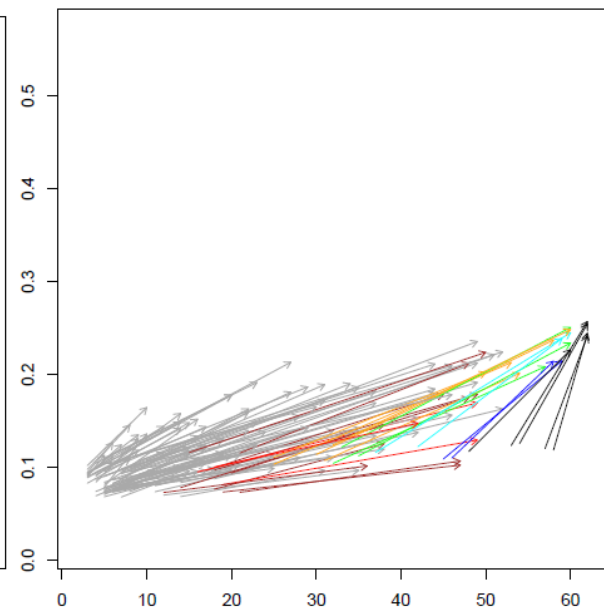


Kinshasa**Kano****Nairobi****Luanda****Lagos****Khartoum**

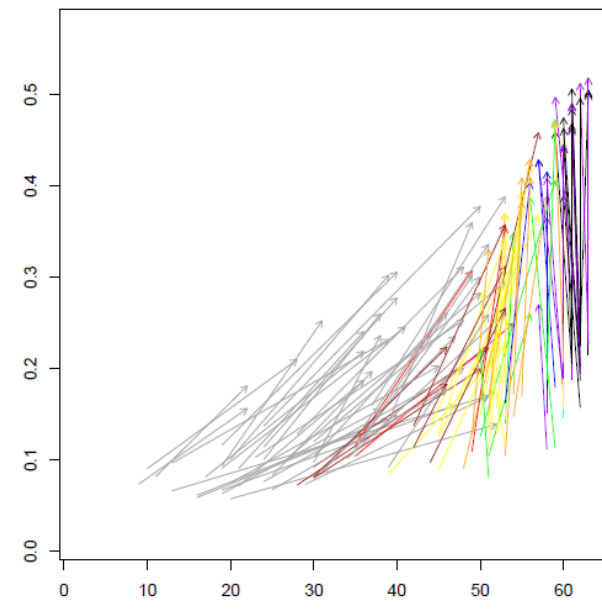
Beijing



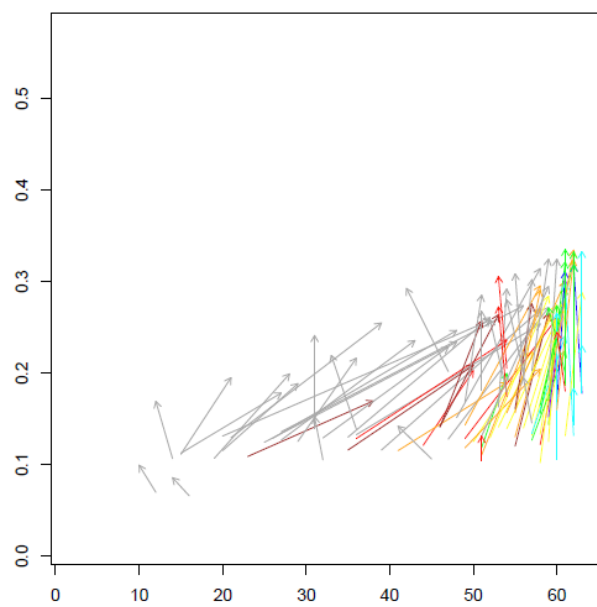
Chengdu



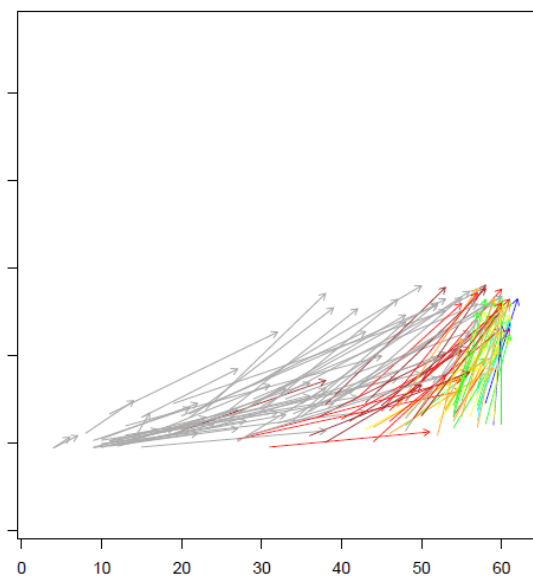
Shanghai



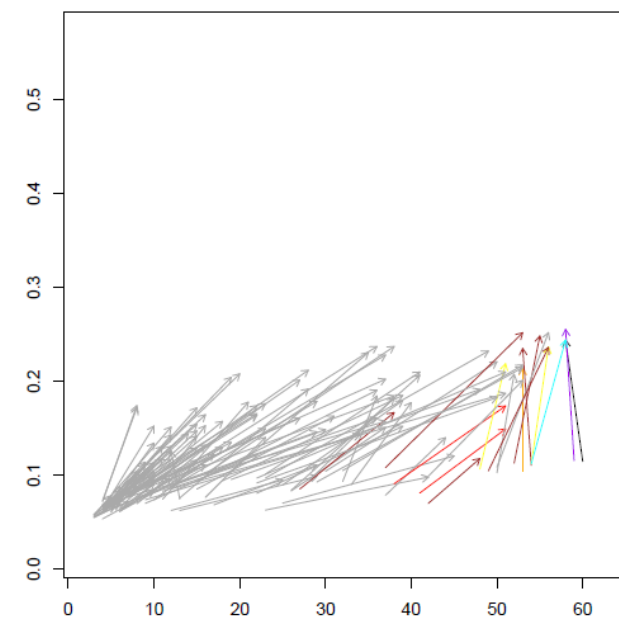
Shenzhen



Dongguan



Nanjing

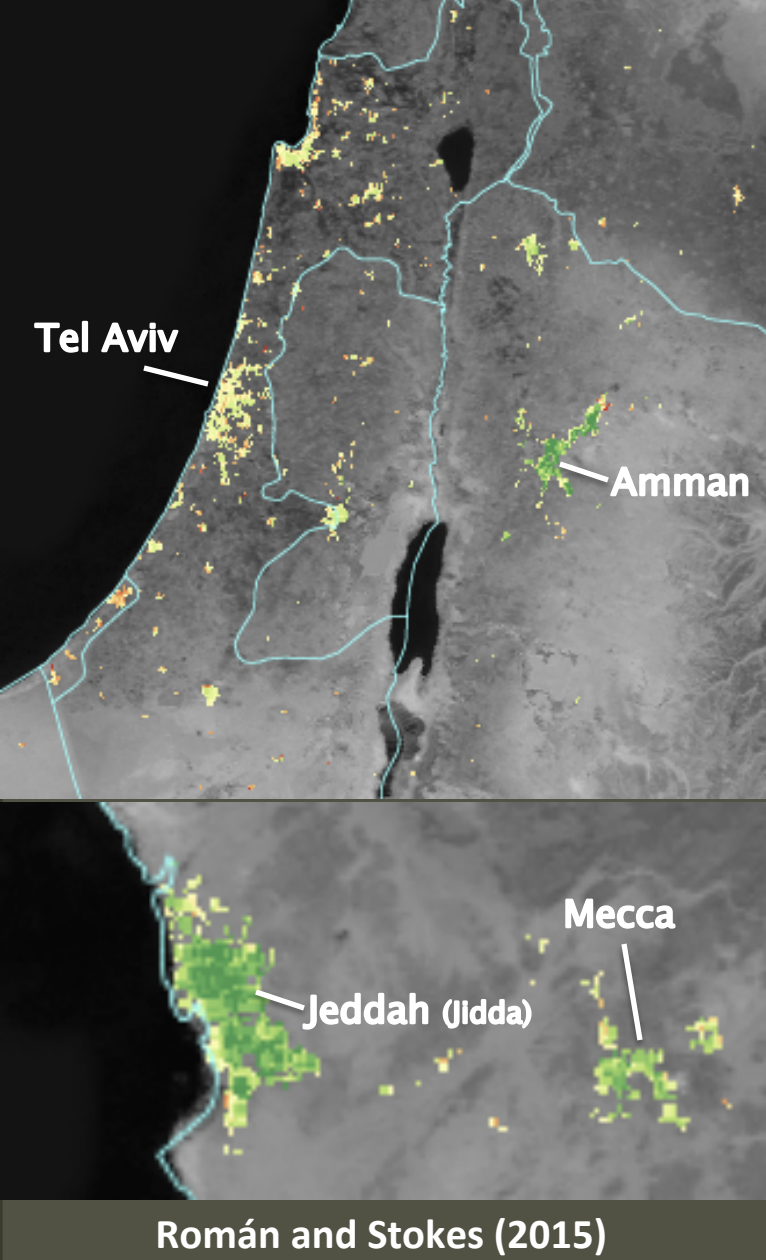


Example 2: VIIRS to characterize variation in urban activity (M. Roman, GSFC)

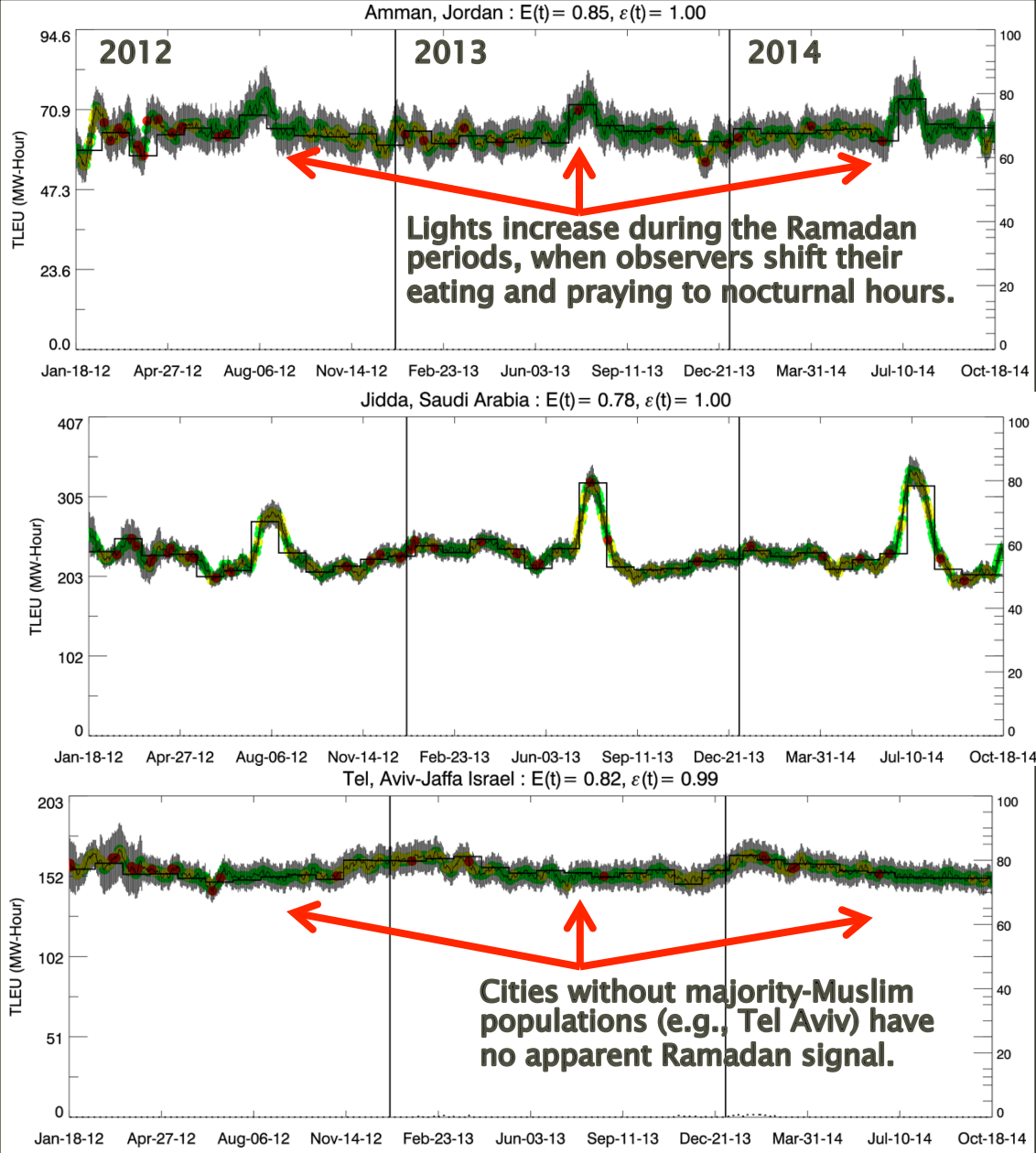
- Intensity of urban activity
- Inter-urban variation in energy use
- Socio-cultural affects on energy use



**When and how we use energy is shaped
by culture and routines of a society.
– Miguel Román and Eleanor Stokes**



Holiday Lighting

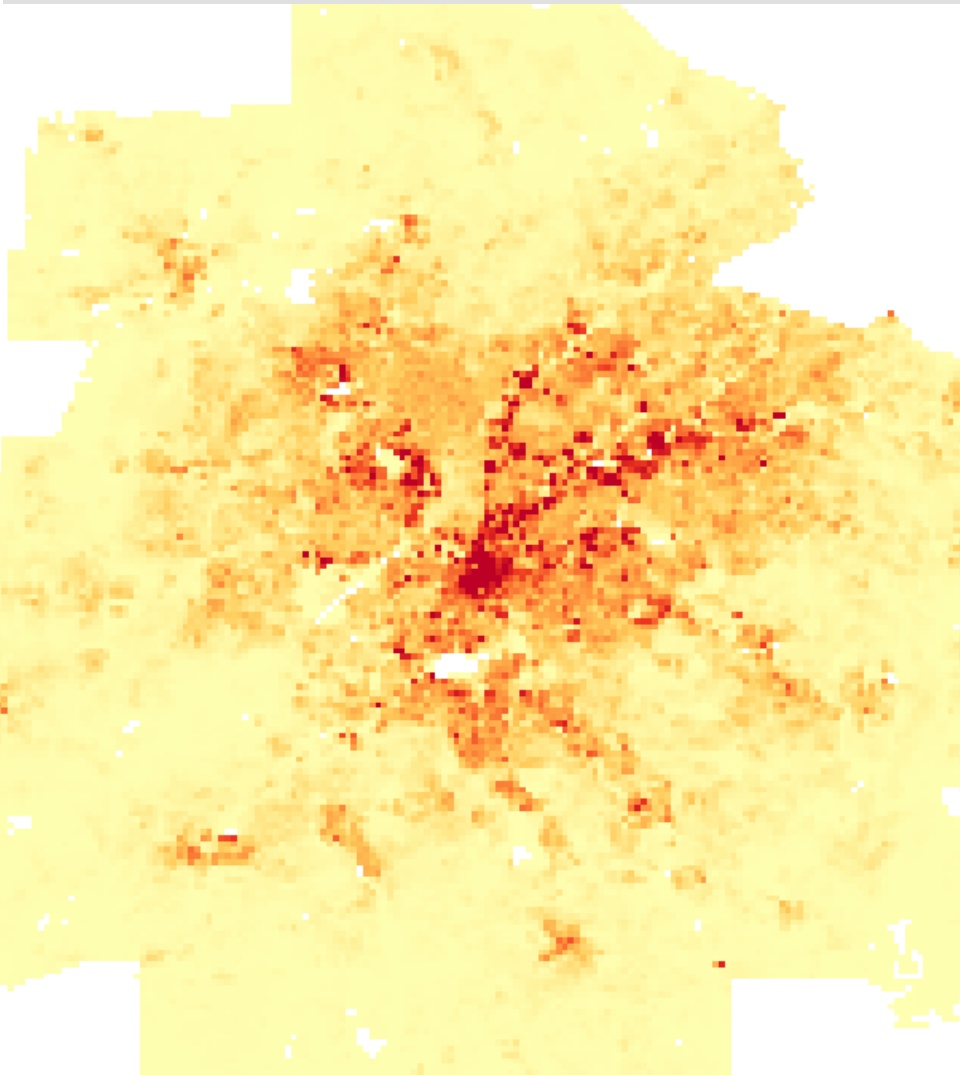


Energy use is shaped by social and cultural identities.

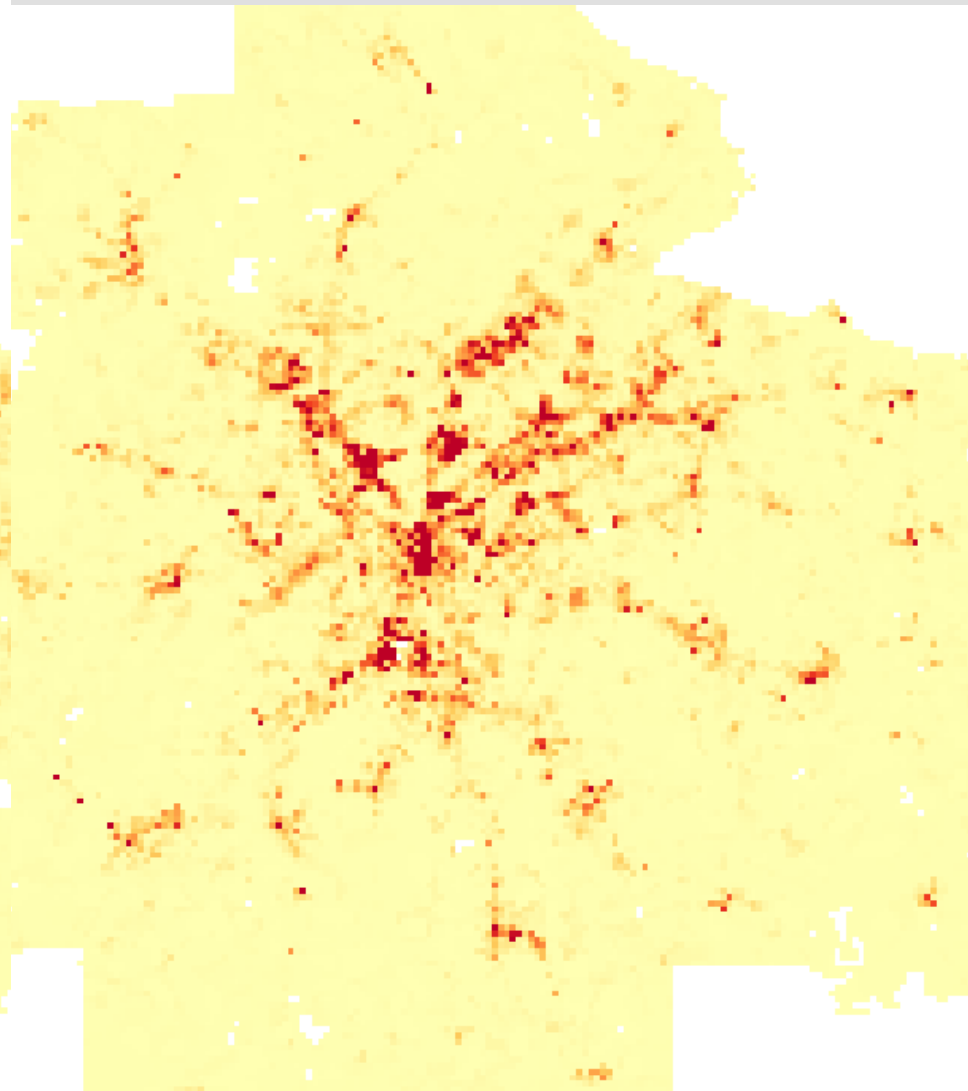
Example 3: VIIRS to explain urban structure and flows (E. Stokes, Yale)

- Locations of origins and destinations
- Intra-urban energy behavior
- Urban structure and function

Functional mechanics of Urban Areas

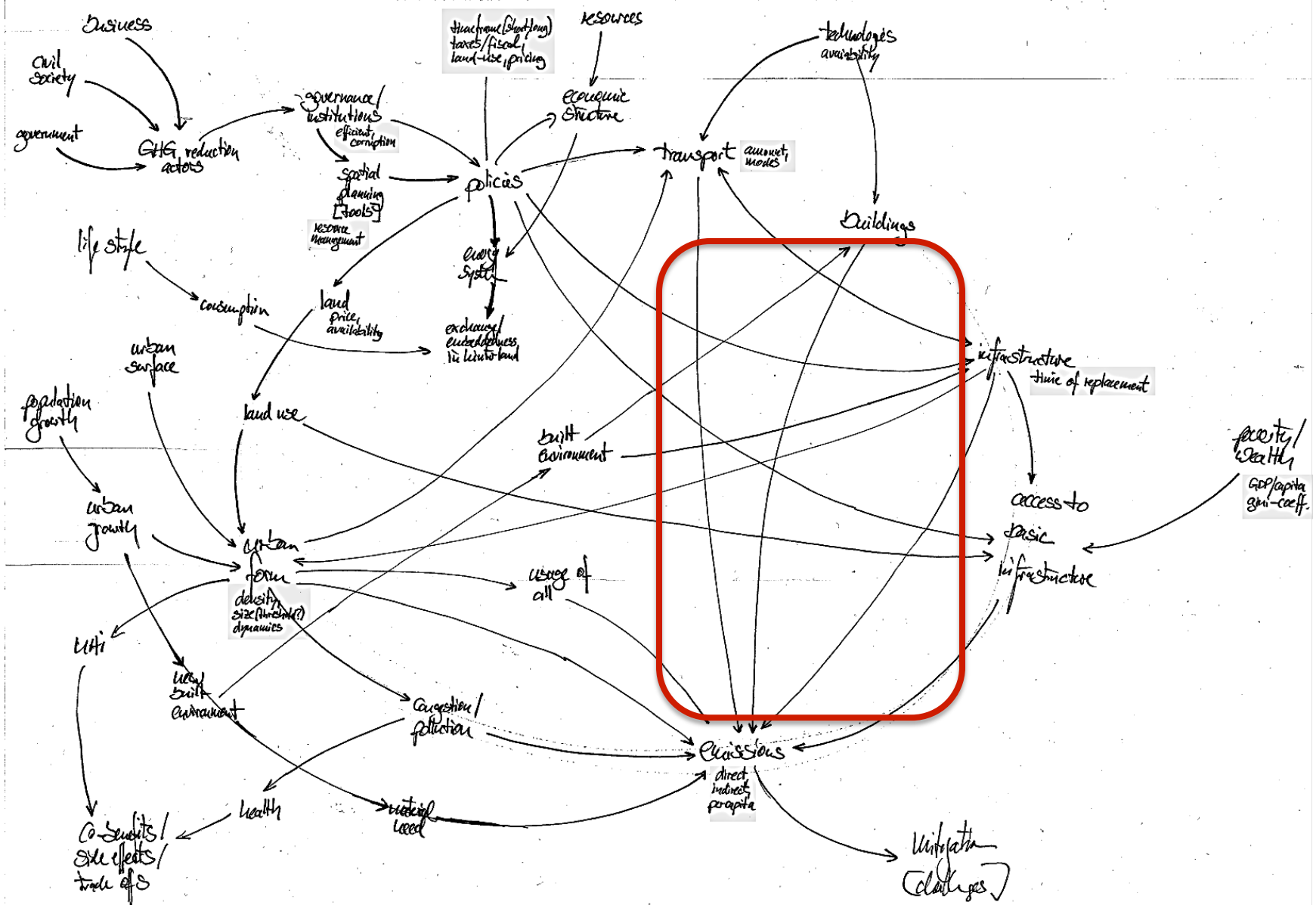


Atlanta Origins



Atlanta Destinations

Weak scientific knowledge of complexities, dynamics, and interdependencies among components



Planetary urbanization requires rethinking urban impacts and sustainability

