Panel Discussion on Urban Sustainability 10:45-12:15

- Jerri-Anne Garl, Director, Office of Science, Ecosystems and Communities, EPA Region V, Chicago
- Eric Ponthieu, Head of Section, Urban Sustainability and Cultural Heritage, Directorate General for Research, European Commission
- Volker Hartkopf, Professor of Architecture, Carnegie Mellon University
- Donna N. Myers, Chief, National Water-Quality Assessment Program, U.S. Geological Survey
- Chaired by John Crittenden, Richard Snell Presidential Chair of Civil and Environmental Engineering, Arizona State University; and Member, EPA Science Advisory Board, National Academy of Engineering

Questions to the Panel:

How can integrated urban planning decisions lead to the greatest long-term benefit, ensuring social inclusion, accessibility, public amenities, urban transparency, and environmental sustainability?

What advances in science and technology can best support integrated urban planning for sustainability?

What are the grand research challenges for understanding the links between urban development and human health?

How does sustainability enhance the economic and social well-being and quality of life of communities, their organizations and cultures?

More than 100 Faculty: Business, Law, Engineering, Behavioral Sciences, Policy, Urban Planning, Architecture, Construction

15 Million Dollar Endowment from Julie Wrigley

ECONOMY
ECOLOGY
SOCIETY

International Institute for Sustainability

- Ag Trans
- CAP LTER
- CSRUR
- Decision Center for a Desert City
- Down-to-Earth Science
- Ecology Explorers
- GP 2100
- IGERT in Urban Ecology
- SCERP
- Sustainable Materials and Technologies
- MUSES
- Urban Biogeochemistry
- Urban Heat Island Initiative
- 100 Cities

International Institute for Sustainability: Consortium Of Rapidly Developing Regions

Greater Phoenix 2100

John C. Crittenden, Ph.D., N.A.E., P.E.

Director of Consortium

Of Rapidly Developing Regions

Richard Snell Presidential Chair of Civil and Environmental Engineering,
ASU Main Campus
Ira A. Fulton School of Engineering
Department of Civil and Environmental Engineering

Email: j.crittenden@asu.edu

URL: http://ces.asu.edu/
http://sustainability.asu.edu/iishome/index.jsp

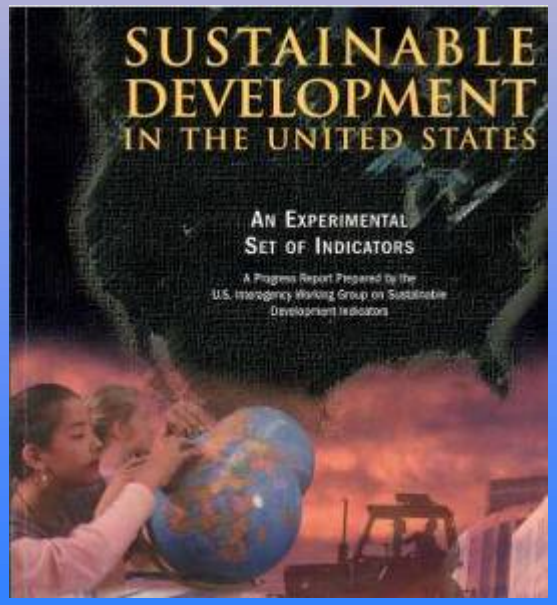
ASU Arizona State University

Sustainability Metrics: What gets measured, gets managed, and what gets managed can be improved

<u>Economic Sustainability</u>
Productivity,
Technological Growth,
Profit and Employment

<u>Environmental Sustainability</u>
Human Health,
Ecosystem Health,
Biodiversity,
Natural Resources:
Protection and Restoration

Sustainability Issues



<u>Societal Sustainability</u>
Informed Citizenry,
Stakeholder Participation,
Social Justice and Equity,
Consumer Choices,
Provide Opportunity for
Useful And
Productive Lives

Vibrant, Economically Sound and Livable Communities have realized the benefit of promoting all three attributes.

Engineered Quality of Life Issues

Goal - Develop long term endowments (renewable supplies, etc.) and Decrease environmental liabilities

- **Regional/ Local Issues**
  - Urban Heat Island, Dust, Noise
  - Social Justice
  - Reduce Ozone Concentration
  - Impact on local ecology
  - Open Space/ Access to Recreational Activities
  - Fish Toxicity
  - Green Algae Toxicity
  - Reduce Human Acute and Chronic Disease (e.g. asthmas and cancers)
  - Acid Deposition
  - Hydrologically Impermeable Surface Area
  - Reduce Resource Use and Waste Generation
  - Economic well being
- **Global Issues**
  - Impoverishment of Plants and Animals in order to supply societal resource needs
  - Stratospheric Ozone Depletion
  - Global Warming

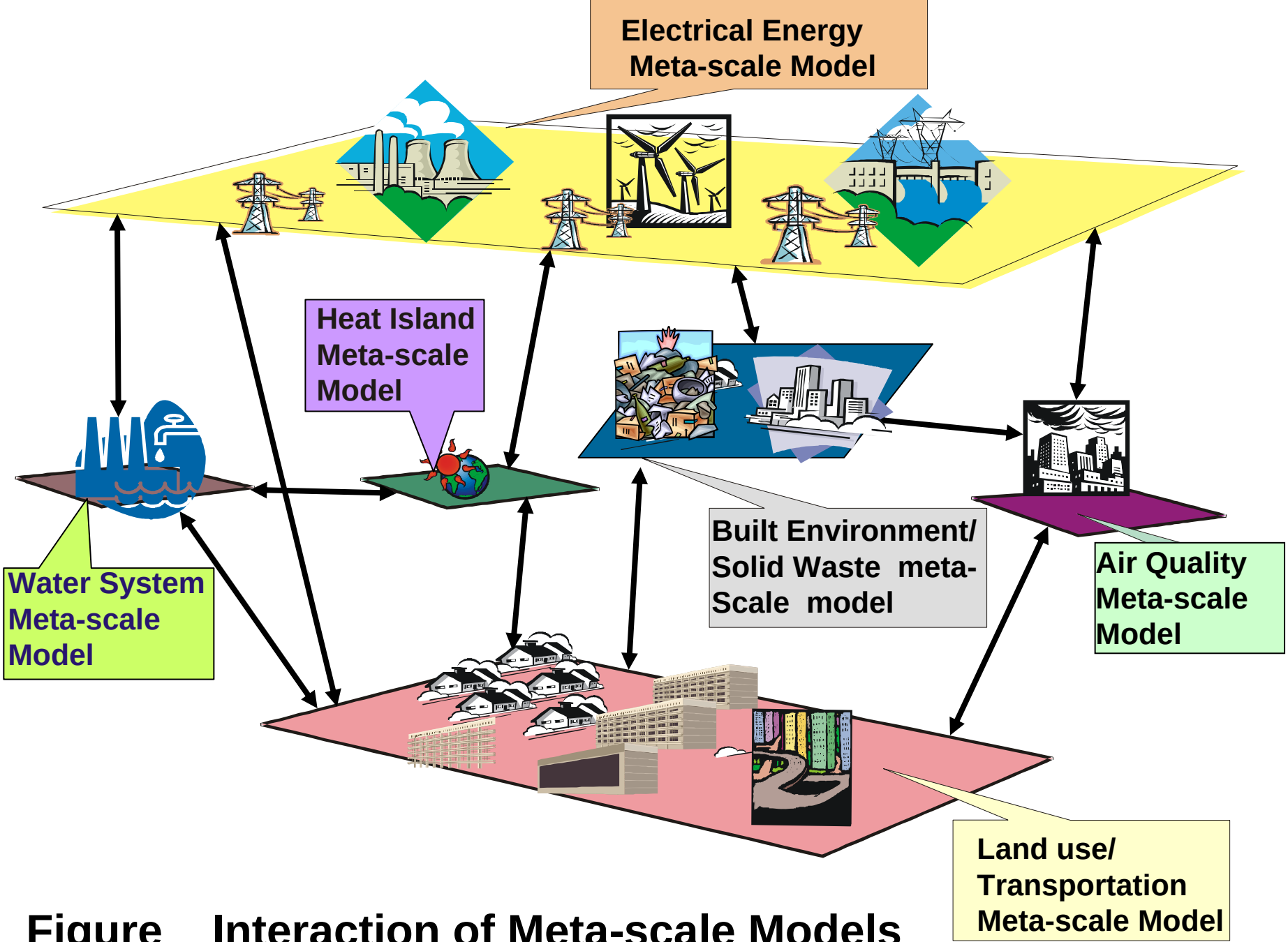
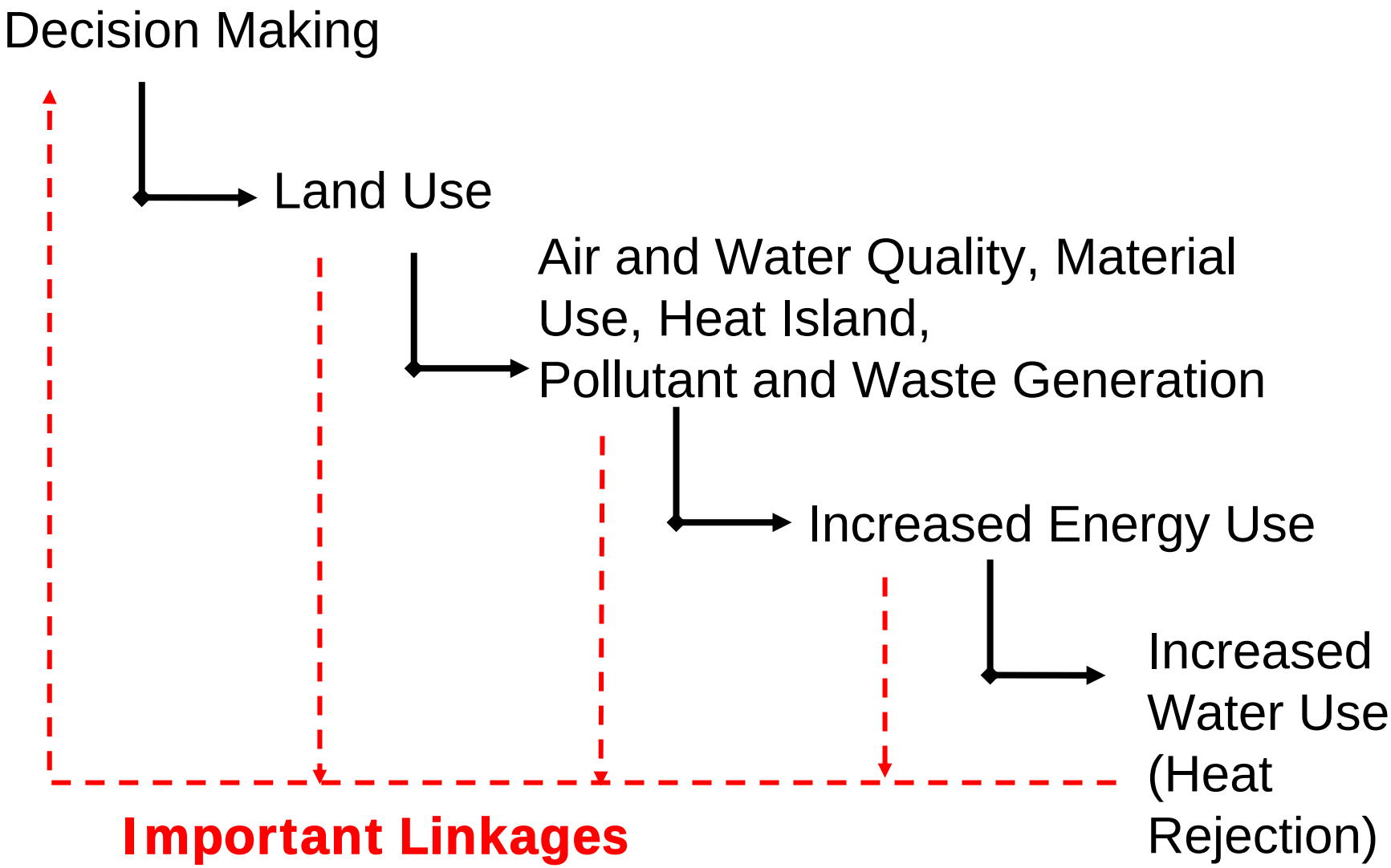
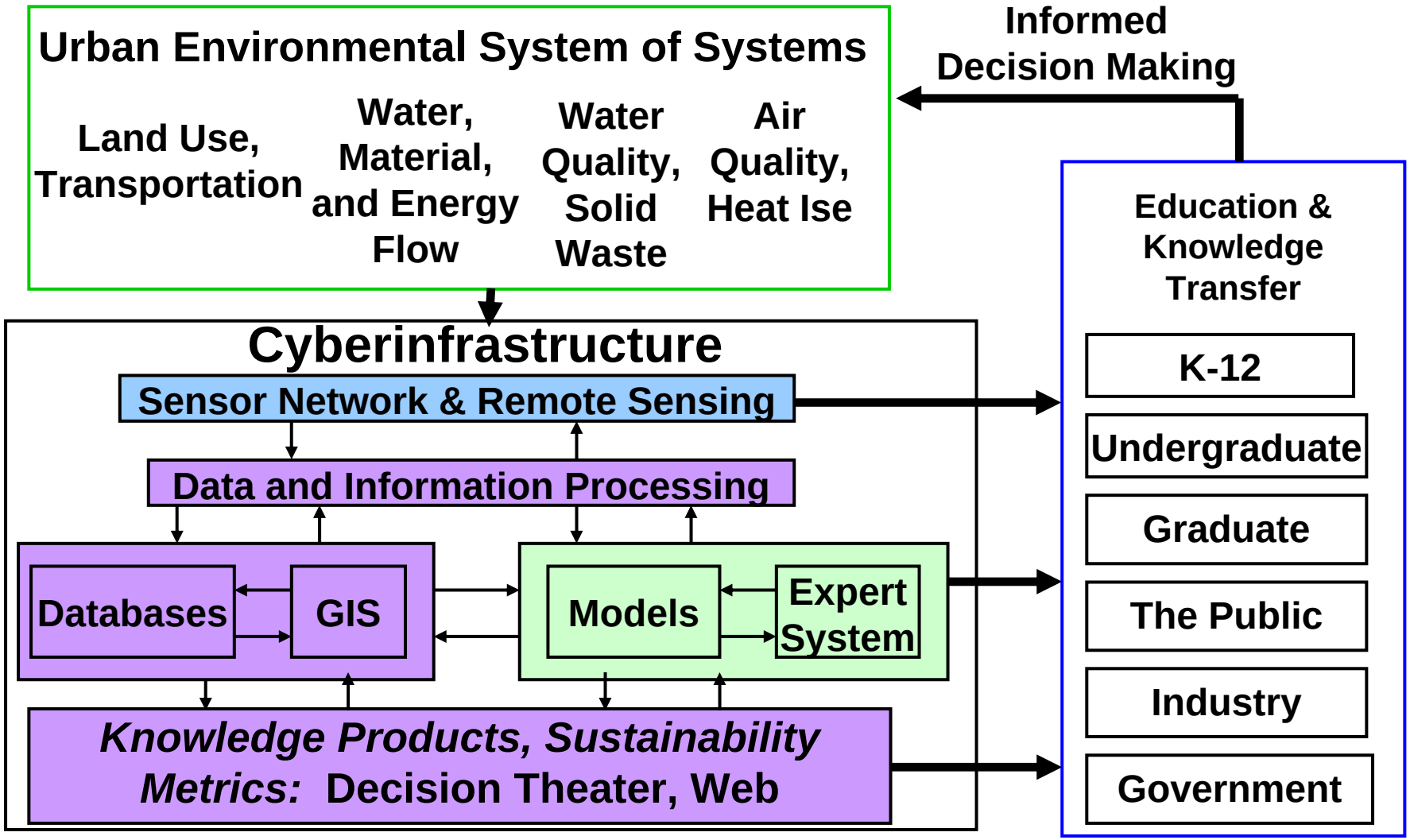


Figure Interaction of Meta-scale Models

Importance of Considering the Big Picture and Informed Decision Making – Urban / Regional Systems are a System of Systems Interactions



Regional Environmental System Management



Regional/ Urban Metabolism

- Just as materials and energy are required for human metabolism and work, cities rely on a continuous supply of energy, resources and information to function.
- Inputs
  - Transformed inputs: food, fuel, water, construction materials
  - Passive Inputs: air, water (precipitation and surface flow), heat
- Outputs
  - Atmospheric outputs: pollutant air emissions
  - Aquatic and marine outputs: sewage
  - Earth system linkages: air pollutants derived from fossil fuels, pollutants derived from nitrogen fertilizers, and etc.
- Stored Materials
  - Durable Infrastructure: Built Environment
  - Solid Waste

Future Work – Urban Agenda

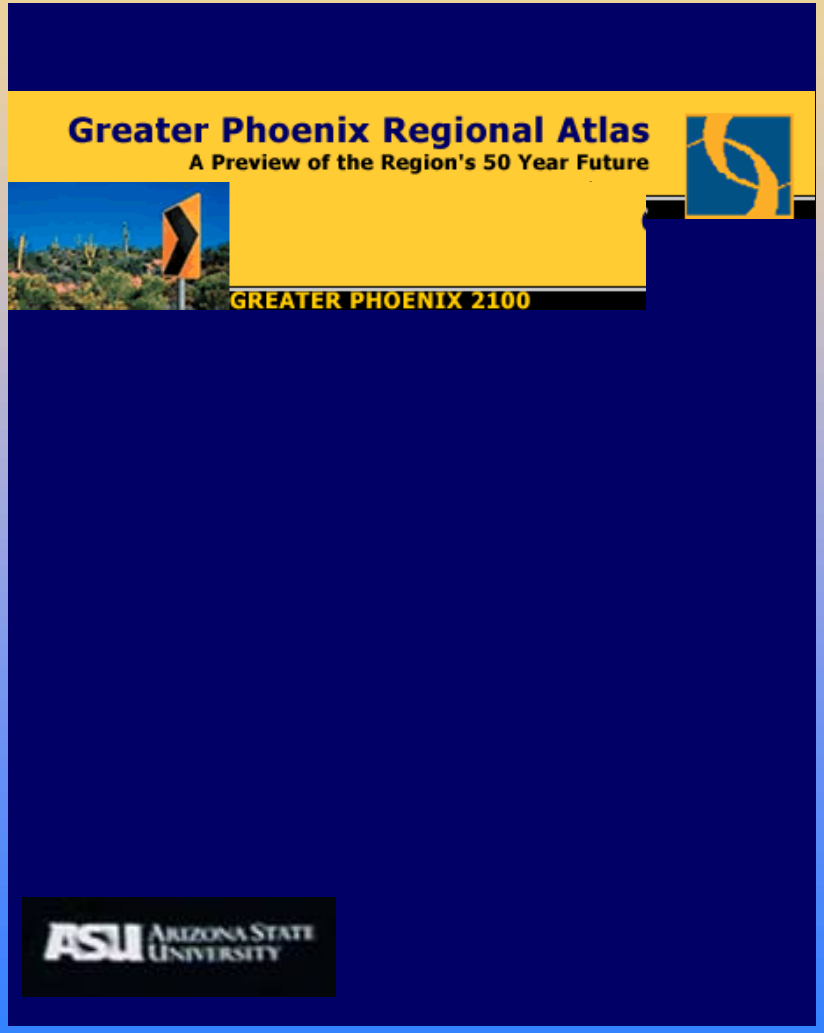
- Predict Urban Metabolism Metrics.
  - Stored Inputs: Construction and Solid Waste
  - Transform Inputs: Food, Fuel and Water
  - Passive Inputs: Air, Water and Heat
- What is the influence of demographics (race, education level etc.) on reducing metabolism
- Estimate the risk of Urban Activities on Human Health and the Environment
- Develop Educational Tools for Society to make more sustainable choices (K-to-Gray Education)
- What technologies and/or technological improvements would be required to achieve 10, 20, 30 % reductions in Urban Metabolism Metrics *and their environmental impacts*?
- Where should one invest strategically in technologies to reap the greatest benefit.

Greater Phoenix 2100 – Goals - http://ces.asu.edu/

- Develop visualization tools to help policy-makers better understand implications of their decisions
- Make science and engineering results more accessible
- Promote regional and long-term perspectives
- Partner with businesses and state agencies

Greater Phoenix 2100 – Atlas
http://ces.asu.edu/

- Air and Water Quality
- Water Availability
- Housing Affordability
- Population Growth
- Education of Diverse Groups
- Open space preservation
- Urban Heat Island
- Regional Transportation



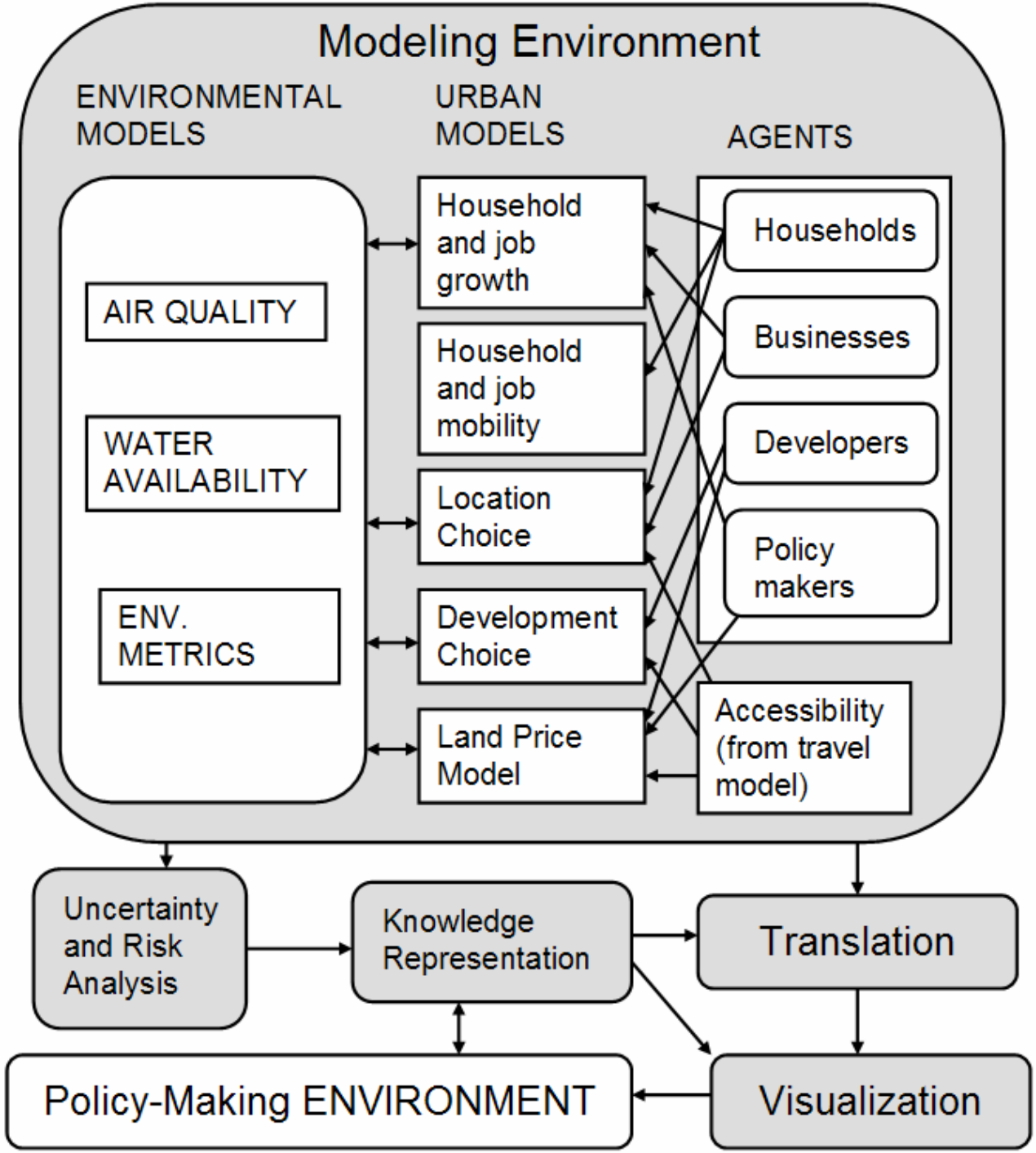
Greater Phoenix 2100

Visualization tools

- Regional e-Atlas
- SIM Phoenix
- Decision Theater for a Future Arizona – 3 Million Dollar Endowment from Ira Fulton
- Urban-SAT(s)

Workflow showing the interface between the model and policy-making environment

(2 Million lines of code)

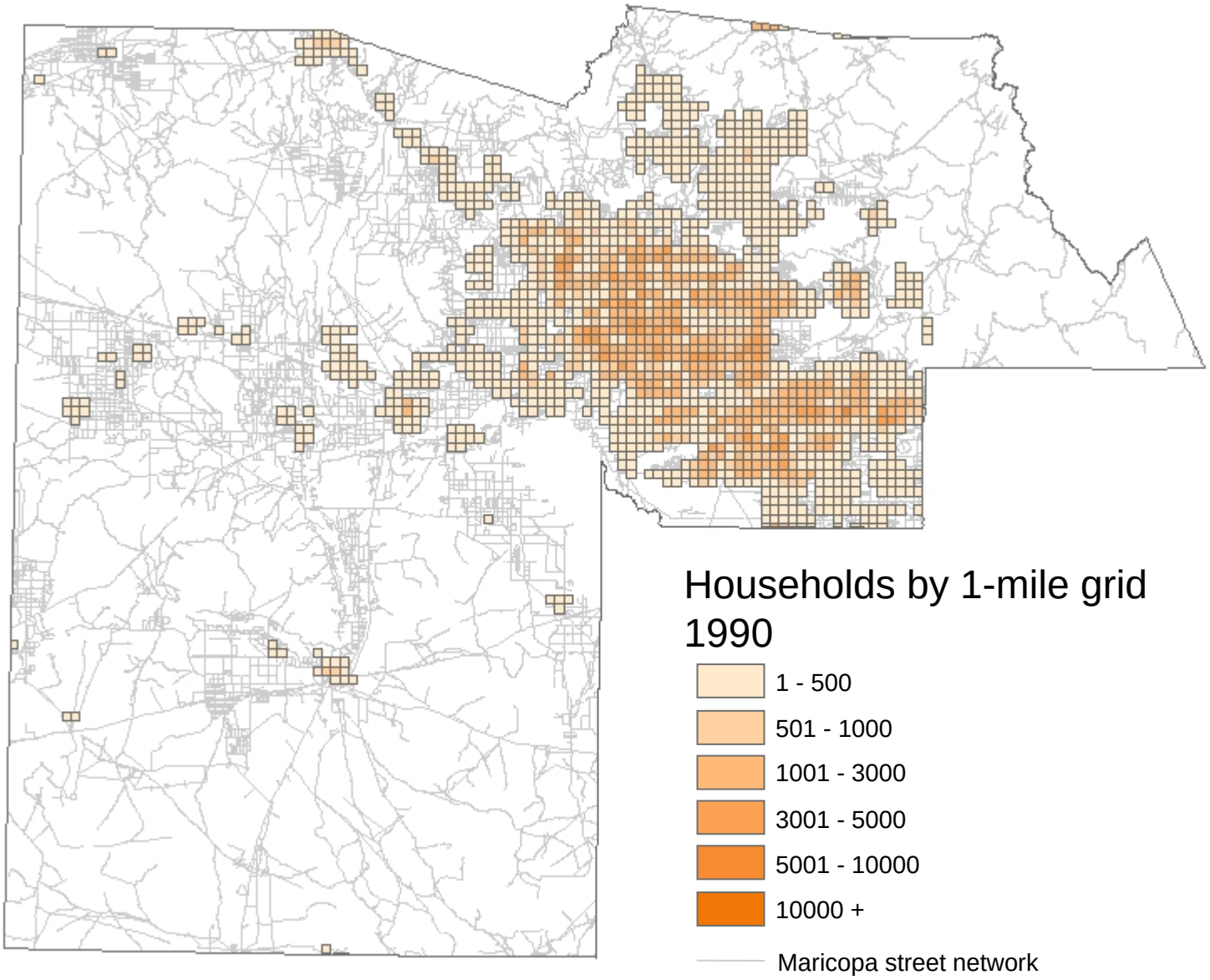


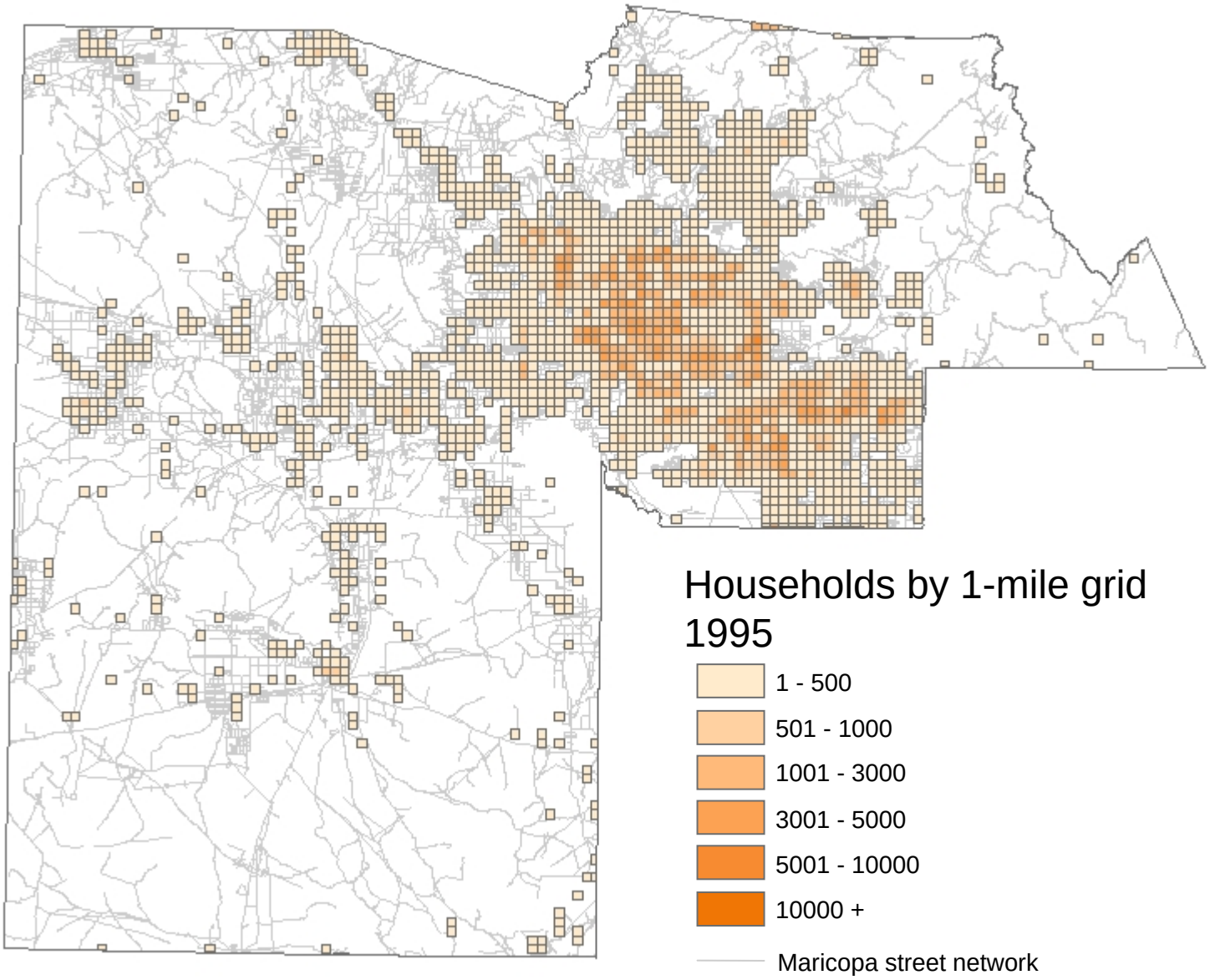
Output Tables

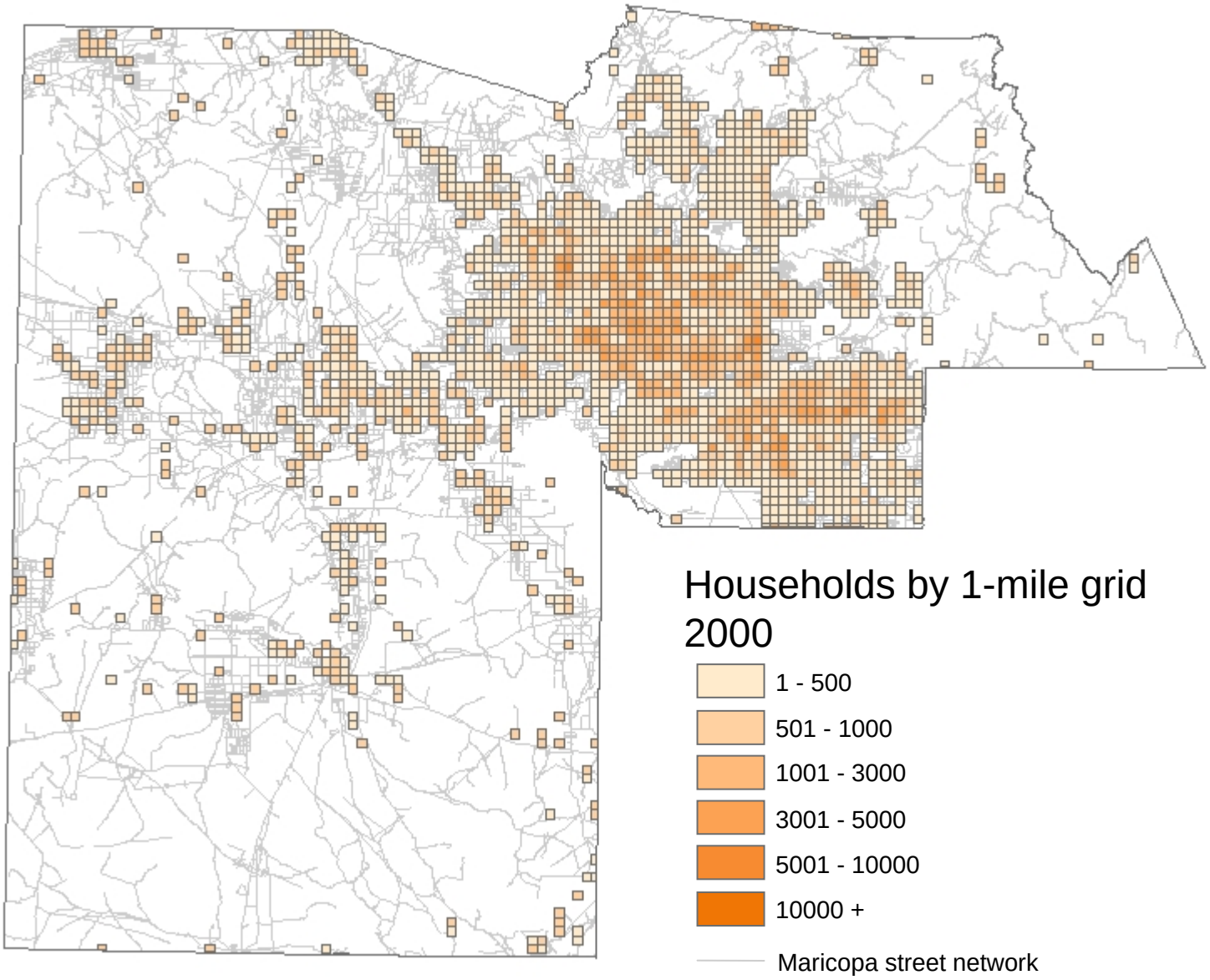
- Population and Households by Type
  - Income
  - Age
  - Household Size
  - Children
  - Workers
- Employment by Industry Sector
- Land Use and Density
- Housing Units, Commercial Square Feet, Prices by Type

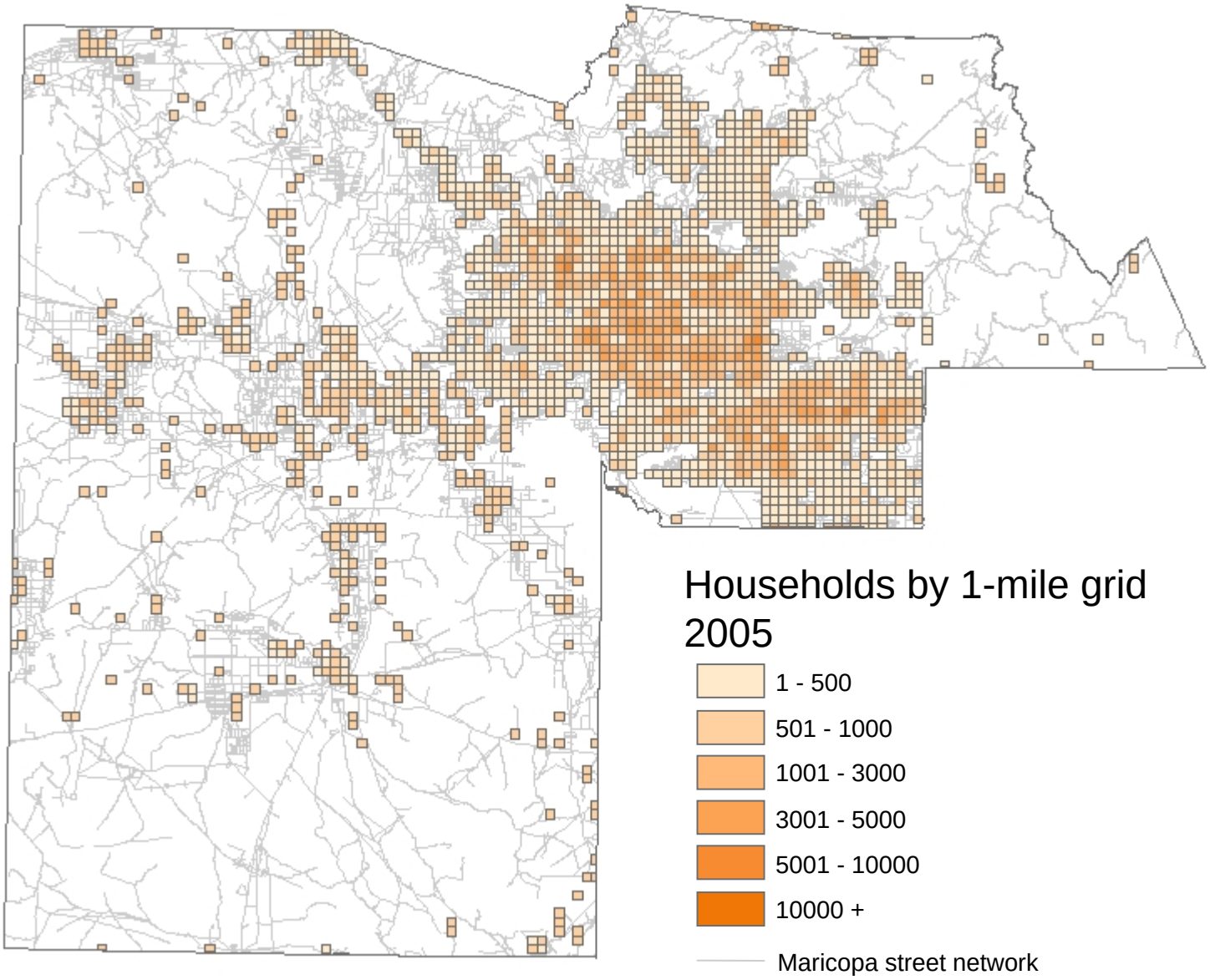
Simulating Household Location from **1990 to 2040** In Maricopa County

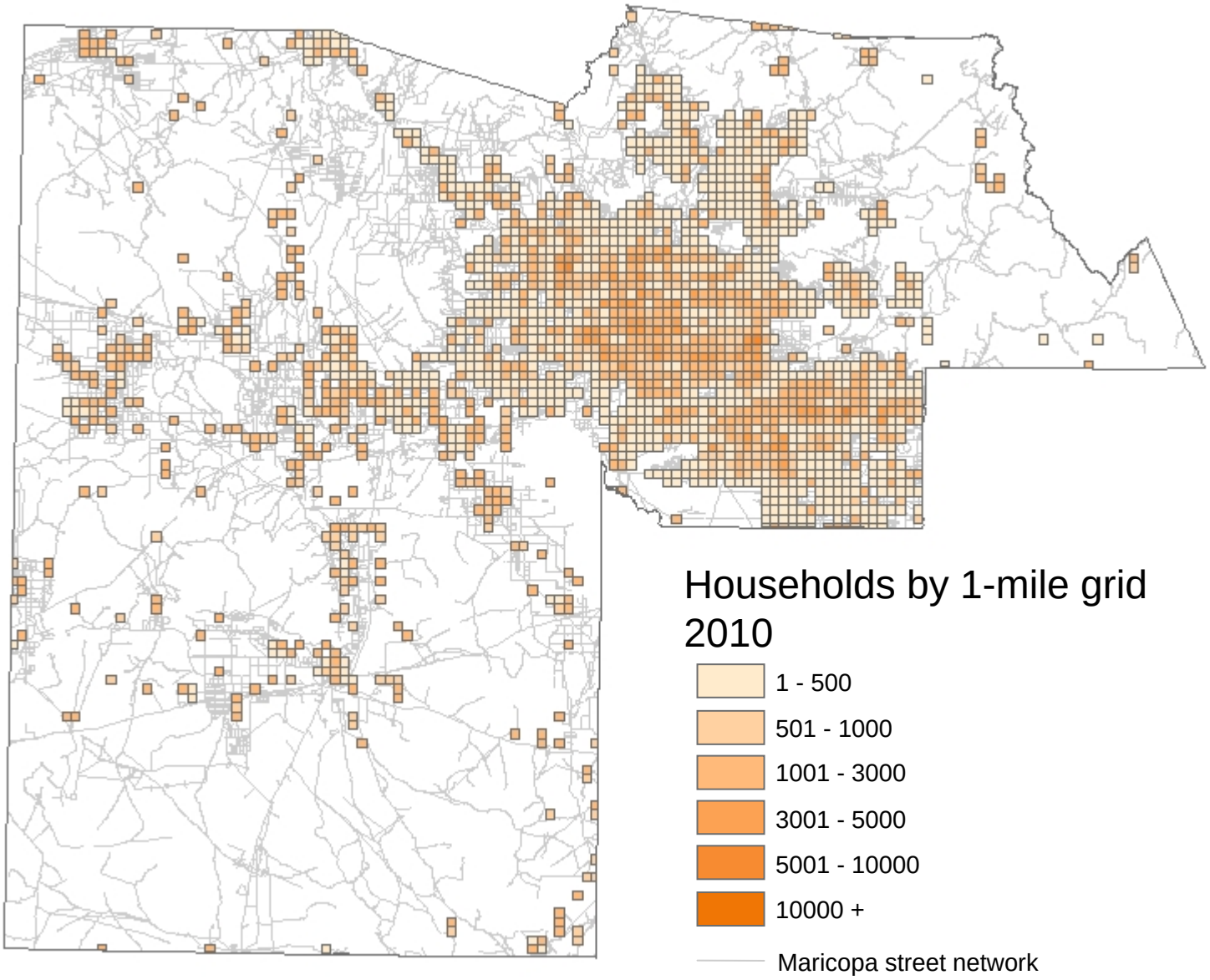
Business as usual scenario

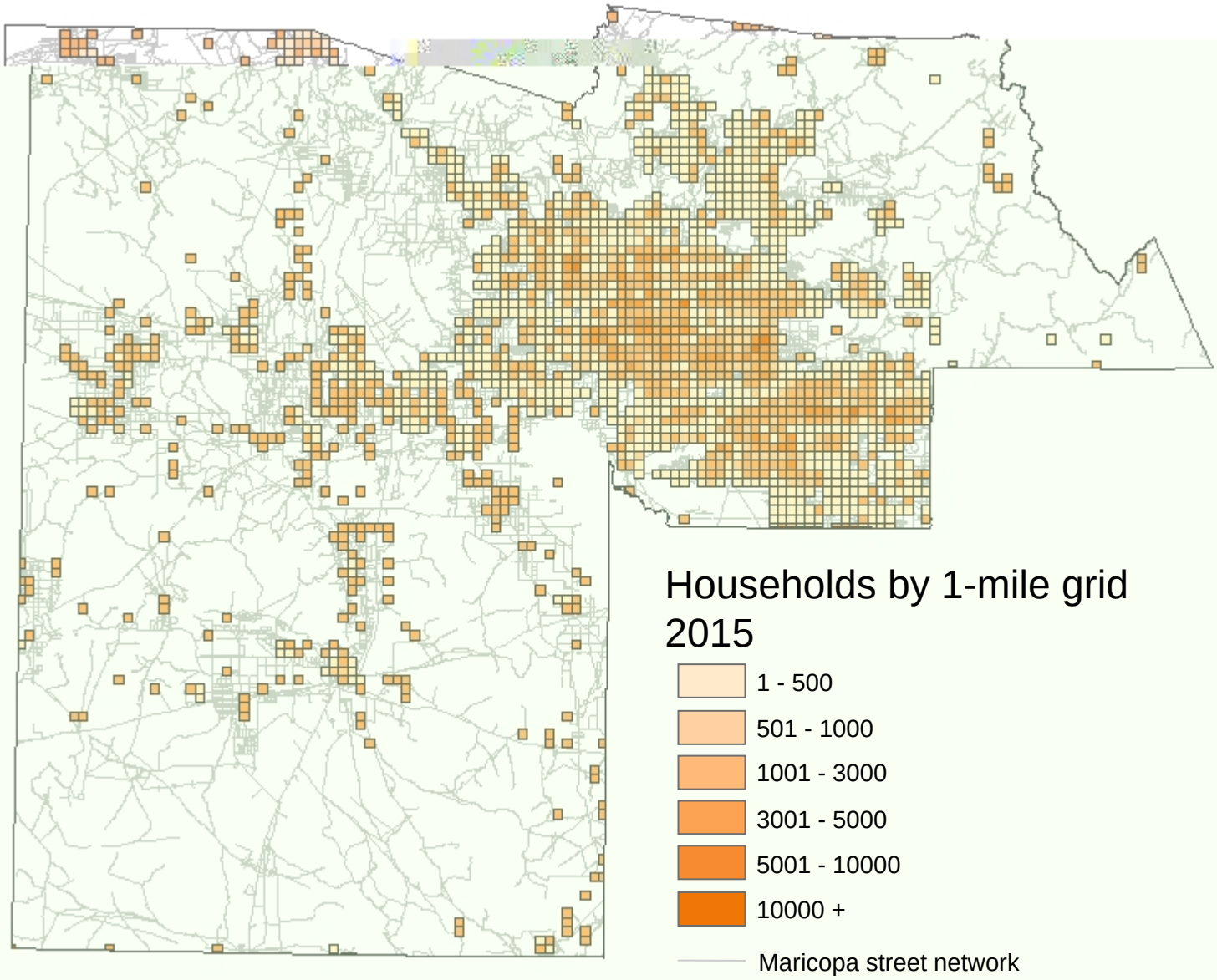

Households by 1-mile grid
1990
1 - 500
501 - 1000
1001 - 3000
3001 - 5000
5001 - 10000
10000 +
Maricopa street network

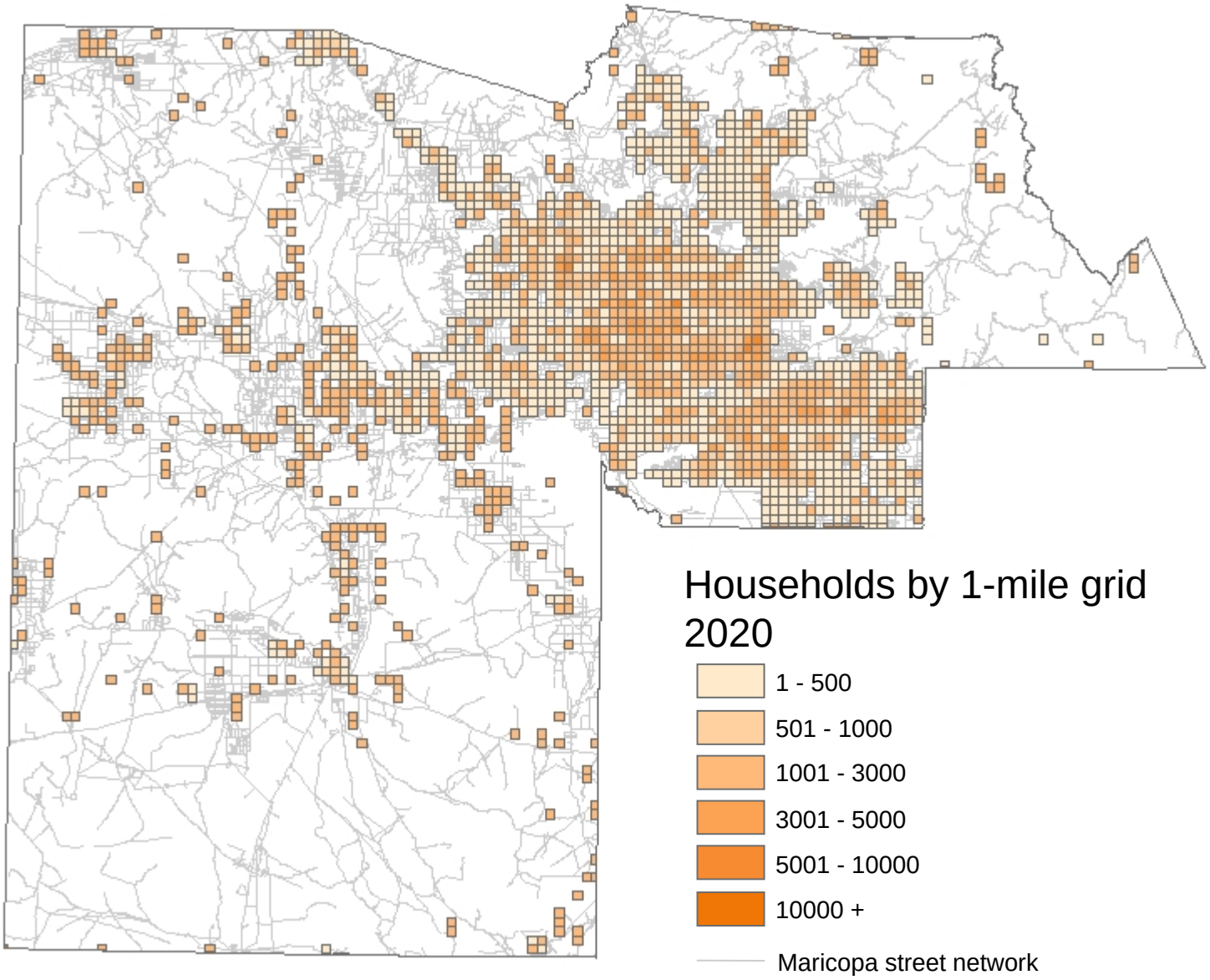

Households by 1-mile grid
1995
1 - 500
501 - 1000
1001 - 3000
3001 - 5000
5001 - 10000
10000 +
Maricopa street network

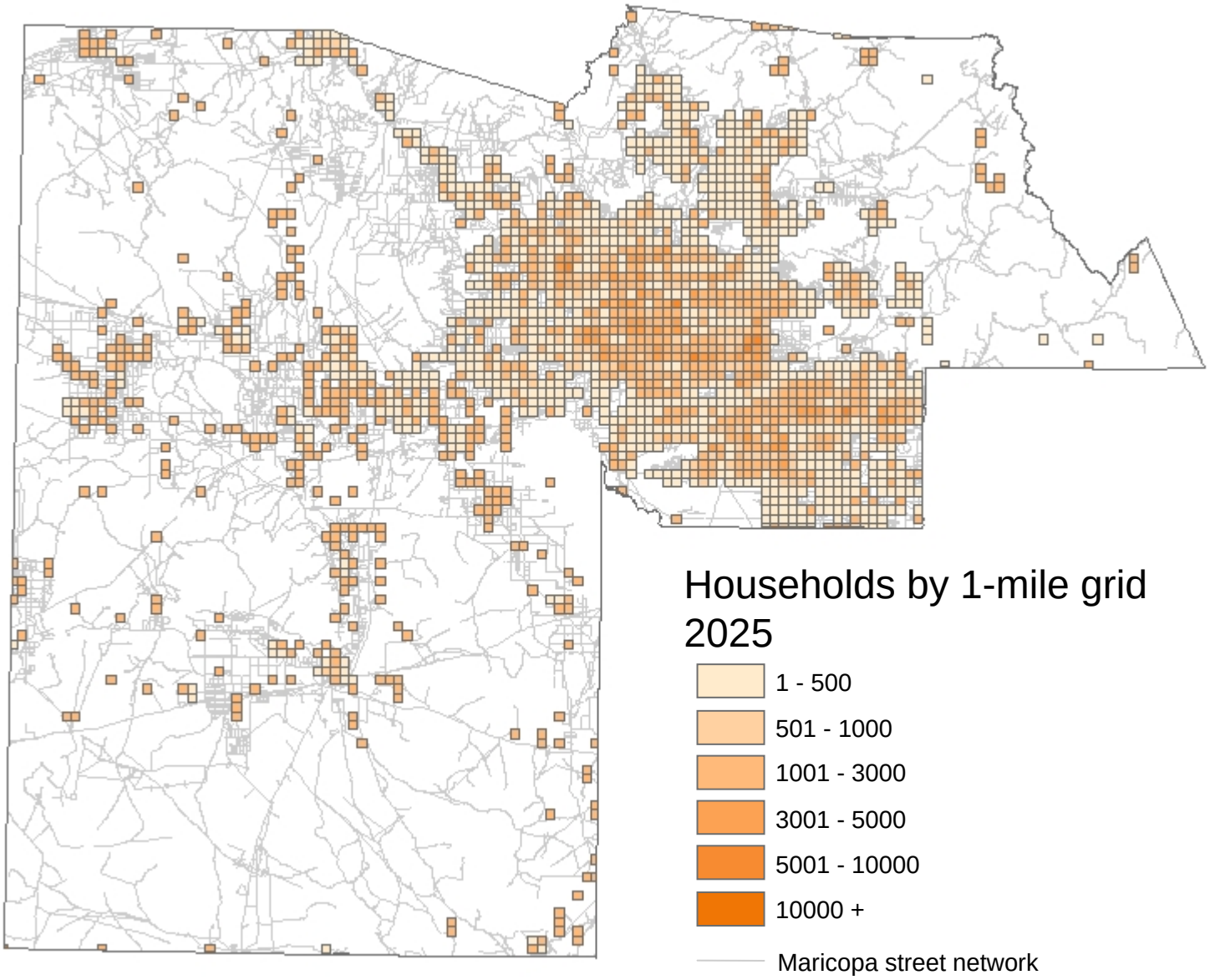

Households by 1-mile grid
2000
1 - 500
501 - 1000
1001 - 3000
3001 - 5000
5001 - 10000
10000 +
Maricopa street network

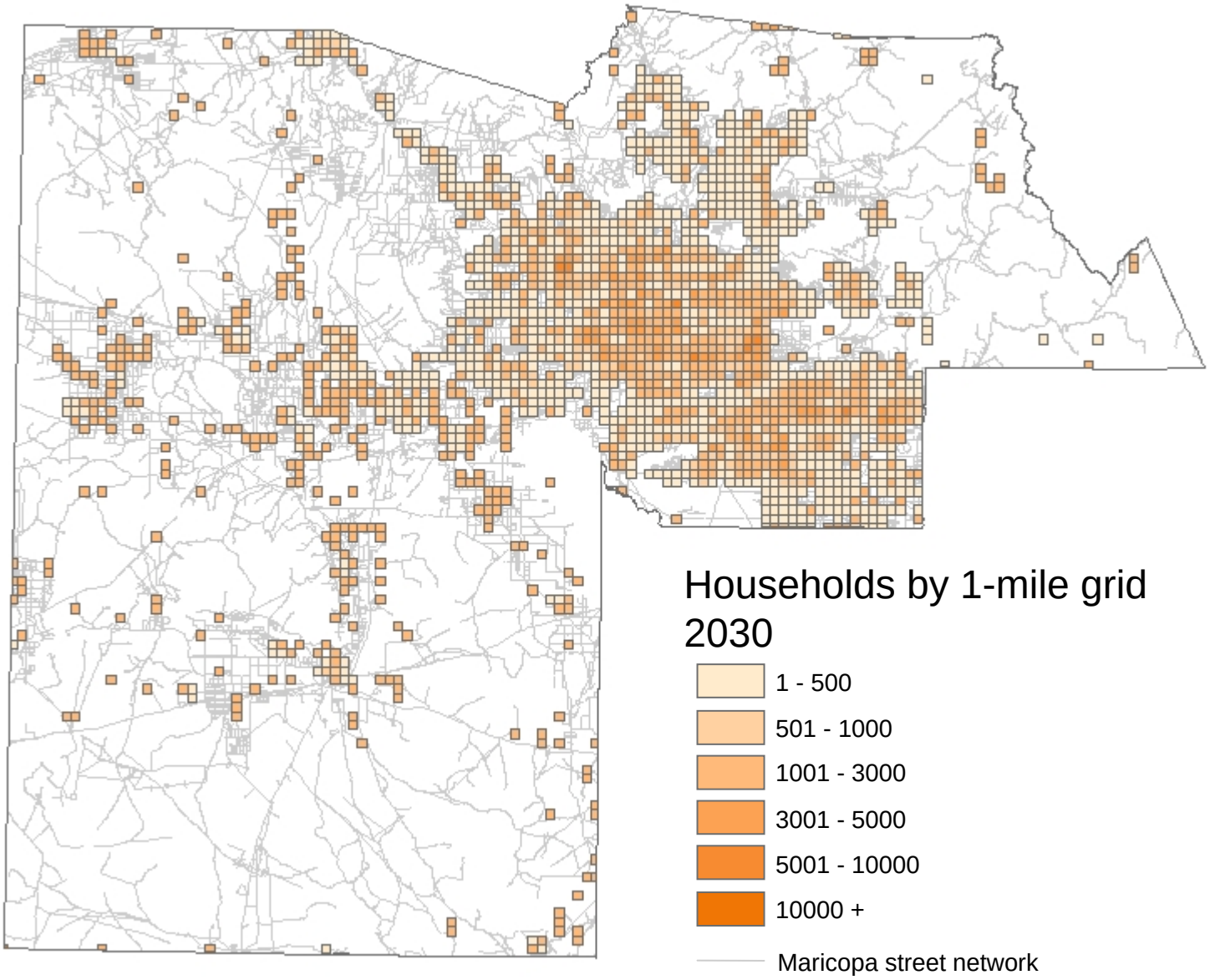

Households by 1-mile grid
2005
1 - 500
501 - 1000
1001 - 3000
3001 - 5000
5001 - 10000
10000 +
Maricopa street network

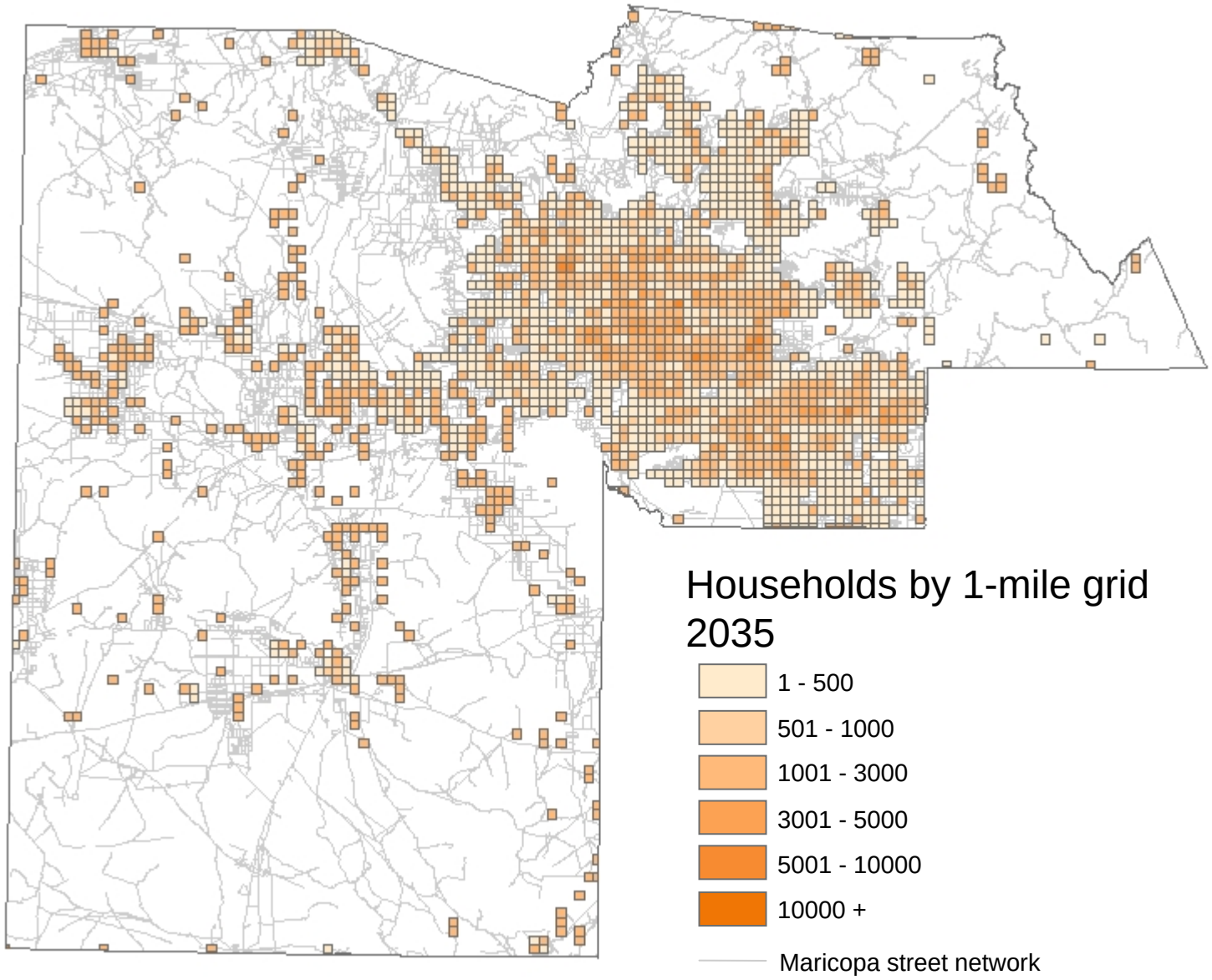

Households by 1-mile grid
2010
1 - 500
501 - 1000
1001 - 3000
3001 - 5000
5001 - 10000
10000 +
Maricopa street network

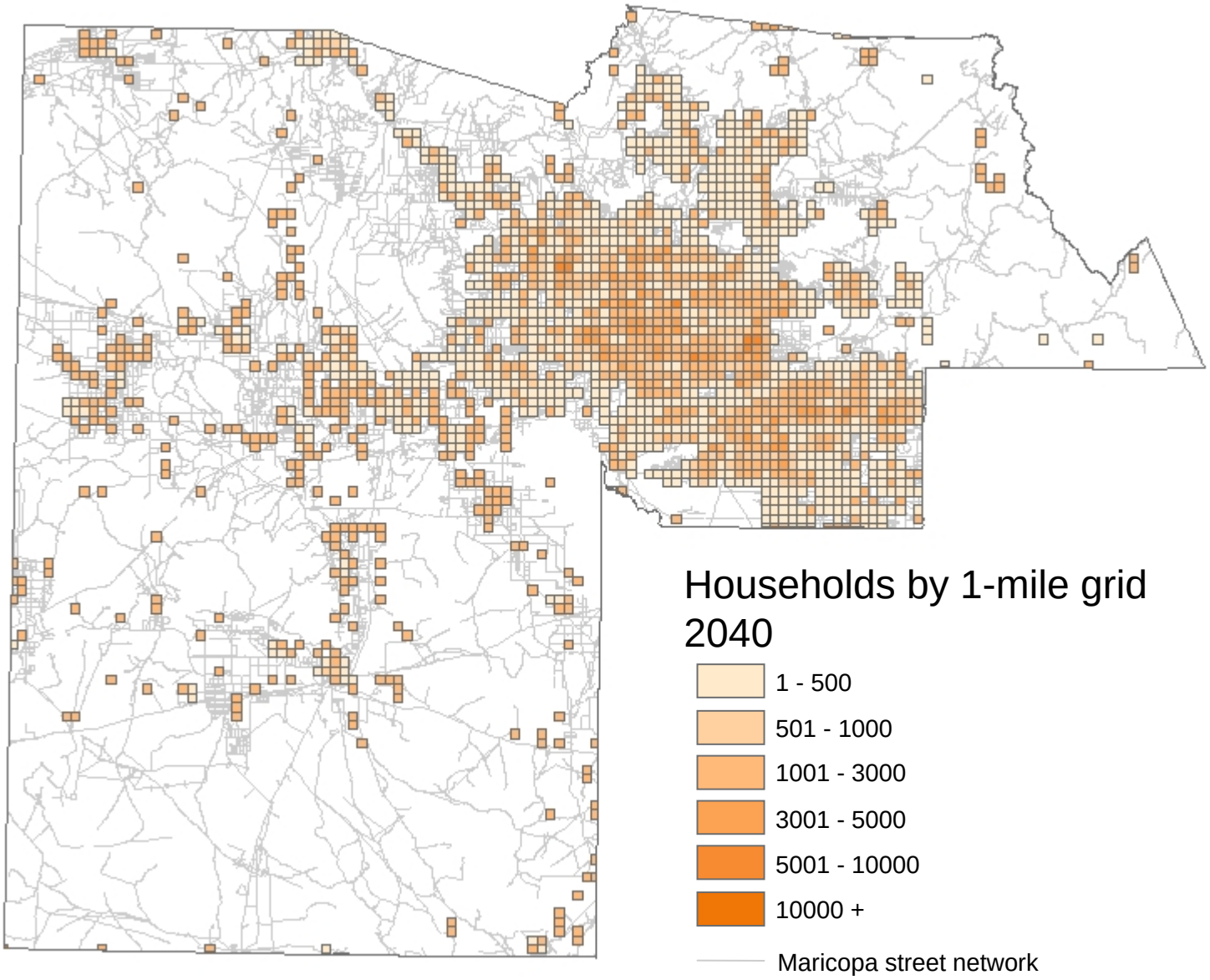

Households by 1-mile grid
2015
1 - 500
501 - 1000
1001 - 3000
3001 - 5000
5001 - 10000
10000 +
Maricopa street network


Households by 1-mile grid
2020
1 - 500
501 - 1000
1001 - 3000
3001 - 5000
5001 - 10000
10000 +
Maricopa street network


Households by 1-mile grid
2025
1 - 500
501 - 1000
1001 - 3000
3001 - 5000
5001 - 10000
10000 +
Maricopa street network


Households by 1-mile grid
2030
1 - 500
501 - 1000
1001 - 3000
3001 - 5000
5001 - 10000
10000 +
Maricopa street network


Households by 1-mile grid
2035
1 - 500
501 - 1000
1001 - 3000
3001 - 5000
5001 - 10000
10000 +
Maricopa street network


Households by 1-mile grid
2040
1 - 500
501 - 1000
1001 - 3000
3001 - 5000
5001 - 10000
10000 +
Maricopa street network

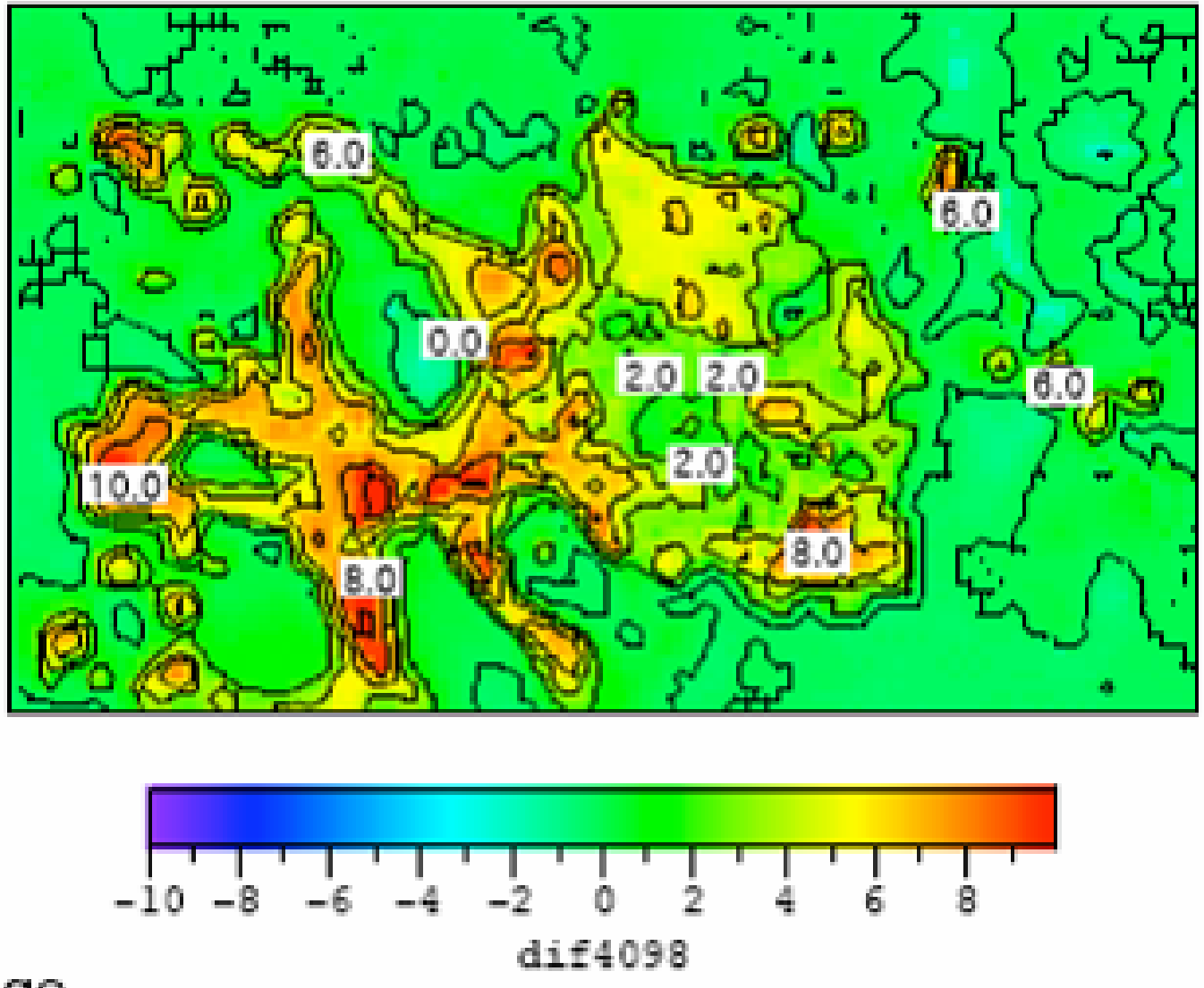
Land Use and Traffic Patterns Yield Allows Us to Calculate Ozone Levels

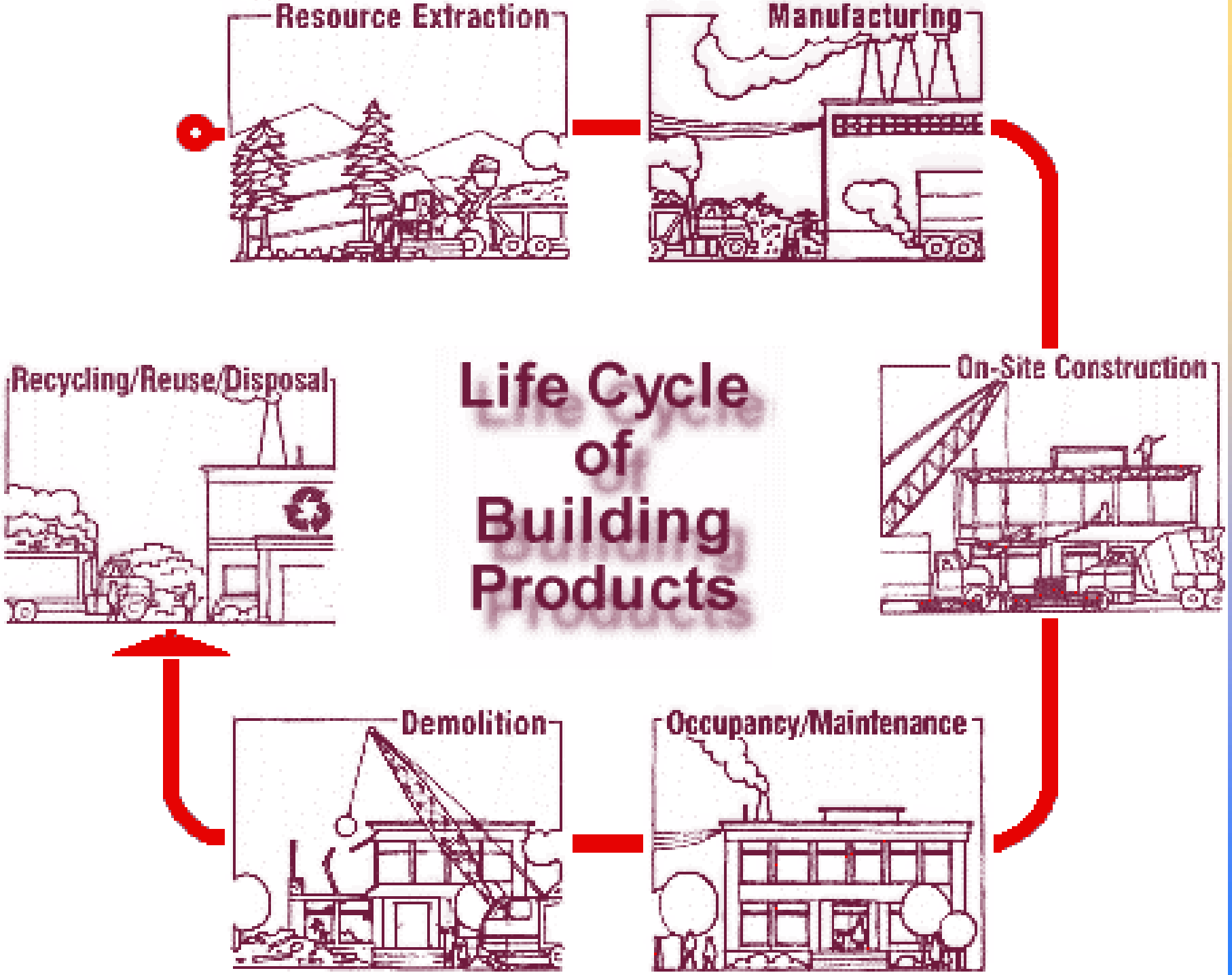
Ozone.avi

Groundwater Overdraft

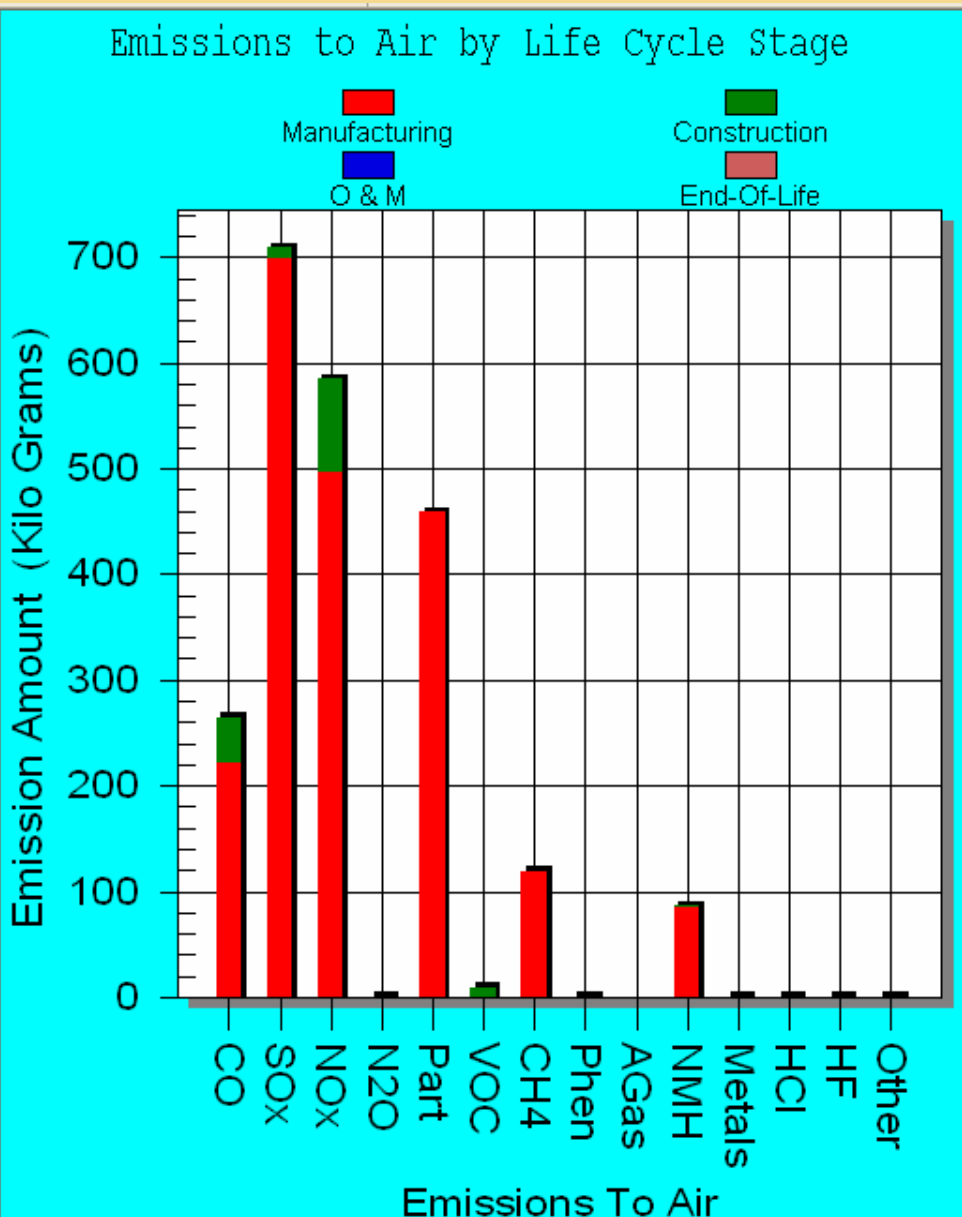
dt_wateranimation.mov

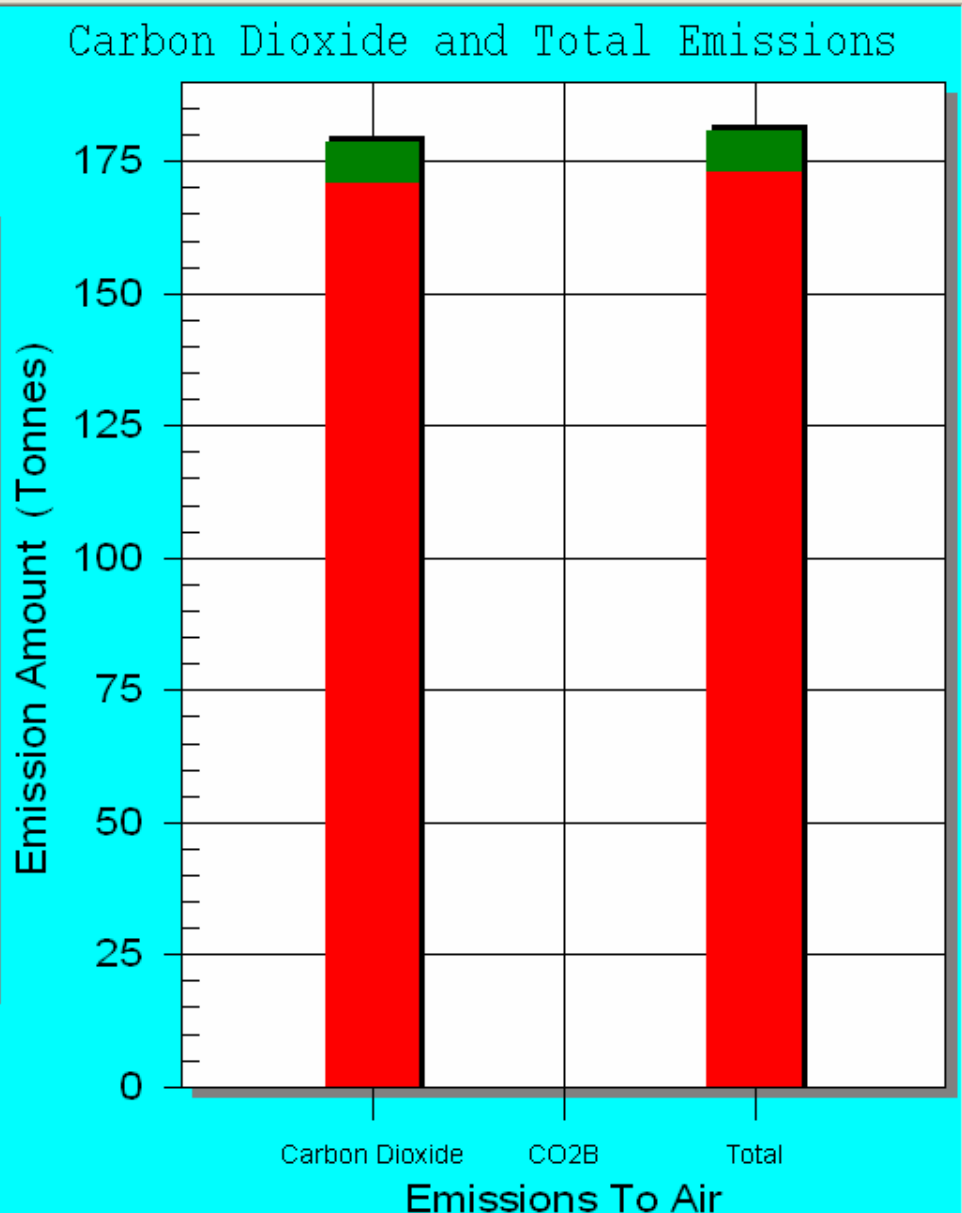
Difference in Temperature Contour in 1998 and 2040 (Predicted by UrbanSim)




Resource Extraction
Manufacturing
On-Site Construction
Occupancy/Maintenance
Demolition
Recycling/Reuse/Disposal
Life Cycle of Building Products

Concrete Office Building

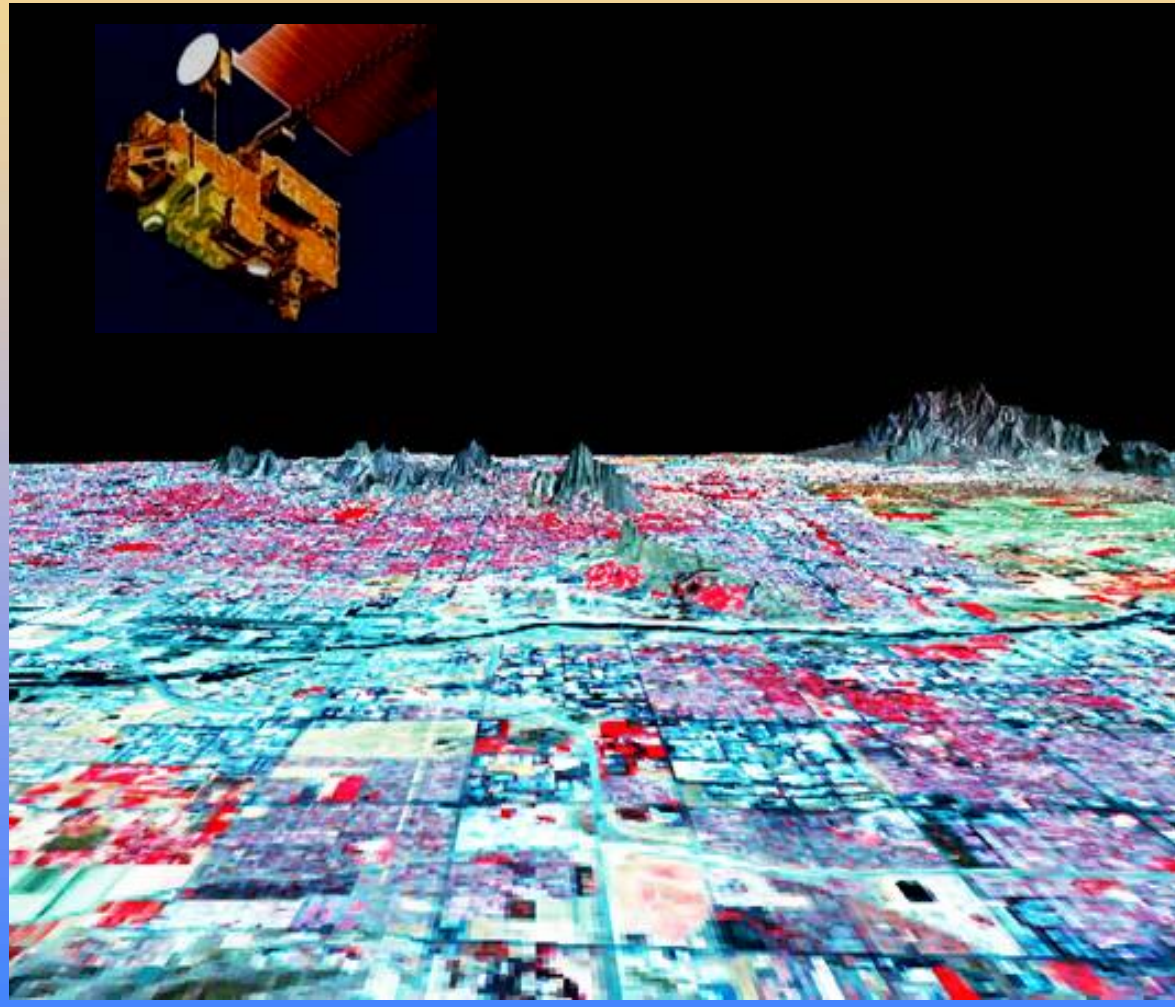




Greater Phoenix 2100 – Not Just about Rich Phoenix

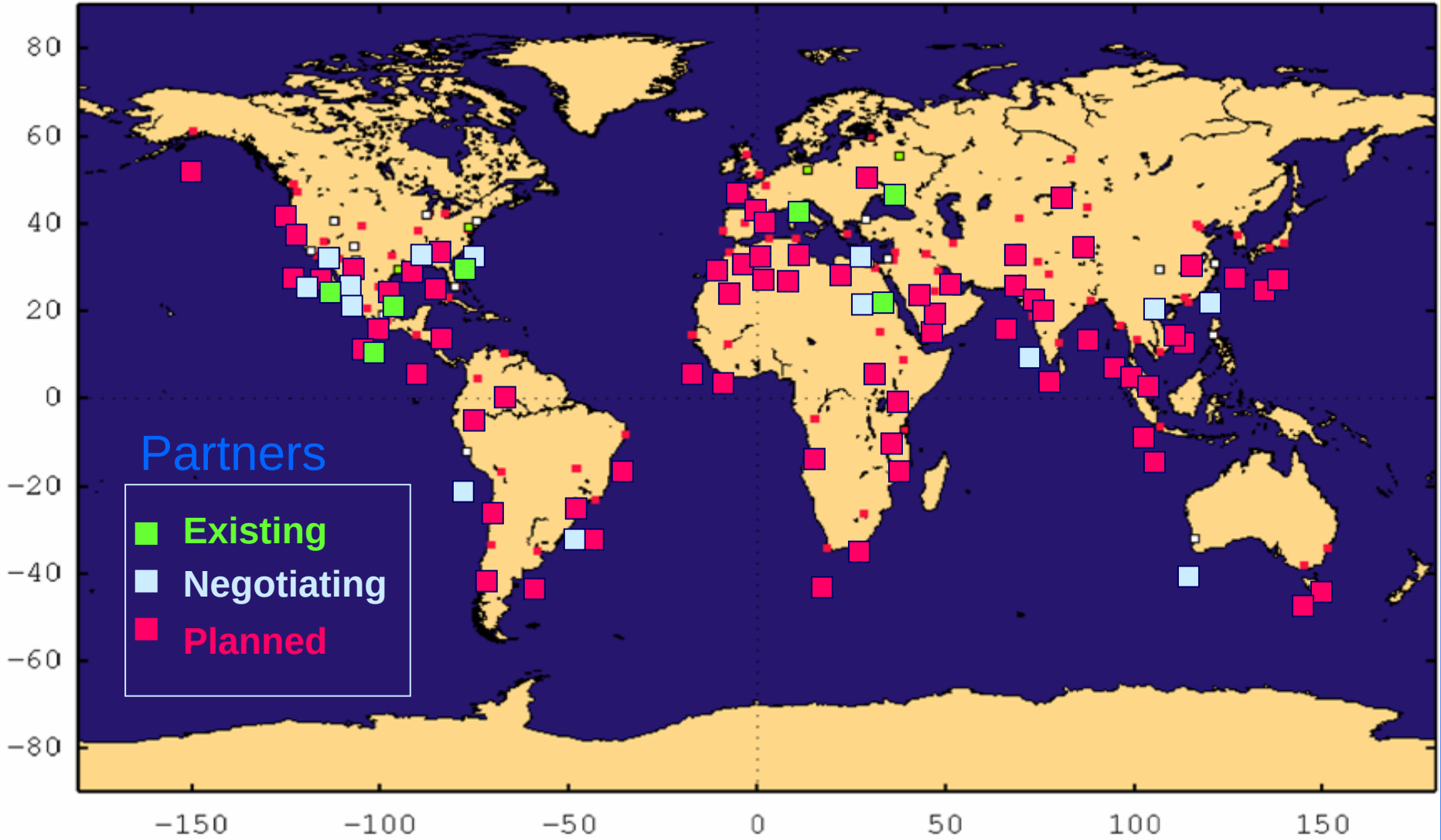
Visualization tools

- Regional e-Atlas
- SIM Phoenix
- Decision Theater
- Urban-SAT(s)

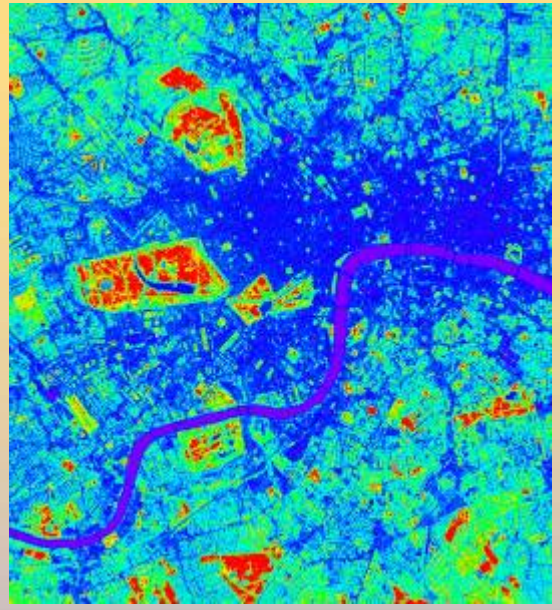


100 Cities Project:

Standardized, repeated urban remote sensing



100 Cities Project



- Annual day and night images collected for each
- Goal is to partner with local groups in all 100 cities
- Can we develop a taxonomy of growing cities?
- How can cities minimize their environmental impact?
- How can urban security threats be minimized?
- How can technologies promote sustainability?

Concluding Remarks

- Need to look at:
  - Past
  - Present
  - Future

- Examine past (mine the data and model it for understanding)
- Examine present situation to gain understanding that data from the past can not reveal
- Decide upon the type of cyber infrastructure to employ that can examine the present situation and verify our current understanding of regional / urban (re)development (rfid, heat isle, sensor networks, wireless communication, stress strain, air and water quality, noise, traffic)
- Engage stakeholders and explain the present situation and decide future directions / scenarios
- Predict future the impact of (re)development scenarios on sustainability metrics and educate the public and policy makers about those choices