Urban Systems Research: Federal/USGS opportunities

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Outline of today’s talk

- Need for coordinated federal urban research/policy agenda
- USGS urban research opportunities
- Phoenix as a natural urban research laboratory
- ASU’s urban research portfolio
- Global relevance of “100 Cities” project
- Proposed USGS urban research center at ASU
Why have an urban research agenda?

• More than half of world’s population now lives in cities
• In next 35 years, society will need to replicate all existing and past urban infrastructure
• Urban socio-political problems will affect whole world
• Much global climate change driven by urban activities
• Cities have growing impact on undeveloped lands
What are some key urban system science questions?

- How does the growth of cities affect global climate?
- Can microbes evolve to mitigate groundwater pollution?
- How does land cover change affect geomorphologic cycles?
- Do socioeconomic factors control urban “ecological footprints”?
- How do spatial variations in pollution affect public health?
- Can the flow of energy in cities be accurately modeled?
USGS urban research programs/opportunities

• The National Map / Urban Dynamics
• Urban water supply and quality
• Biological Information on the web
• Emerging infectious diseases / Invasive species
• Geologic hazards in cities
• Coastal urban development
• Urban impacts on global climate
• Geoscience data use in regional decision-making
How can the study of urban systems be coordinated?
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Why do pilot studies in Phoenix?

• Several large federally-funded environmental research projects
• 5th largest, 2nd fastest-growing urban center in USA
• Geography, hydrology, climate, history relatively easy to model
• Ongoing collaborations of state agencies, industry, universities
• Greater Phoenix 2100 program working to make Phoenix a wired, modeled natural lab to study rapid urbanization
Greater Phoenix 2100 - Goals

• 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
Visualization tools

• Regional e-Atlas
• SIM Phoenix
• Decision Theater
• Urban-SAT(s)
Greater Phoenix 2100

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GREATER PHOENIX REGIONAL ATLAS
A Preview of the Region's 50-Year Future
A Regional Atlas for Greater Phoenix

Prototype data synthesis for decision making
Where/What will “Greater Phoenix” be?
Phoenix type-locality for rapid urbanization

Figure 2: National Urban Regions with Populations of Over One Million in 2000

Source: 2000 U.S. Census
Atlas addresses diverse topical issues

**Table 2: Scenarios For Future Growth of Greater Phoenix**

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>Land Area</th>
<th>Population</th>
<th>Land Area</th>
<th>Population</th>
<th>Land Area</th>
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<td>2000</td>
<td>3,251,876</td>
<td>1,207</td>
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<td>3,251,876</td>
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<td>2010</td>
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<td>1,859</td>
<td>4,549,622</td>
<td>1,688</td>
<td>4,040,797</td>
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<td>2020</td>
<td>7,716,016</td>
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<td>6,365,269</td>
<td>2,362</td>
<td>5,021,113</td>
<td>1,863</td>
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<tr>
<td>2030</td>
<td>11,885,644</td>
<td>4,411</td>
<td>8,905,496</td>
<td>3,305</td>
<td>6,239,259</td>
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<td>2040</td>
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<td>2050</td>
<td>28,202,126</td>
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<td>17,431,745</td>
<td>6,469</td>
<td>9,633,832</td>
<td>3,575</td>
</tr>
</tbody>
</table>

*How fast will Metro Phoenix grow?*
Maps combine data from multiple sources

Who owns most desirable lands?
Maps address politically charged issues

How to preserve most desirable areas?
Maps help frame emerging policy issues

How real is the urban heat island effect?
What are other relevant ASU assets?

- Greater Phoenix 2100 (NSF-ITR)
- CAP-LTER, 1 of 2 urban LTERs (NSF)
- 100 Cities Project (NASA EOS)
- Urban Ecology IGERT (NSF)
- Agrarian-urban transitions grant (NSF)
- Urban Fluid Dynamics (NSF, DOE)
- GEON, SEEK (NSF-ITR)
- Morrison Institute; CSPO
- Consortium for the Study of Rapidly Urbanizing Regions
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CAP is one of only two Urban LTERs

Network allows cross-site comparisons

Phoenix
- young city
- rapid growth
- arid climate
- rugged topography

Baltimore
- old city
- slower growth
- humid climate
- flat terrain
Cities directly link to nearby wilderness

Water-use ecological footprints of 20 largest U.S. cities
Cities directly link to nearby wilderness

University-based LTERs could add urban emphases
Proposed Urban LTER network

Leverage existing infrastructure
Proposed Urban LTER network

Link to international partnerships
100 Cities Project:
Standardized, repeated urban remote sensing
Different sensors = different information

Las Vegas, NV, 17-Oct-2000

Visible to near-infrared
15 m/pixel

- Major land cover classes
- Vegetation health
- Soil properties
- Soil contamination

Shortwave infrared
30 m/pixel

- Urban surface materials
- Rooftop materials
- Energy use
- Fugitive dust production
- Metal contamination
- Ecological communities

Thermal infrared bands
90 m/pixel

- Surface energy balances
- Regional climate models
- Anthropogenic heat sources
- Heat island development
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?
- What do cities contribute to global atmosphere?
- How can technologies promote sustainability?
How to monitor an urban laboratory?

• Automated collection of air, water, land cover, biologic, social, traffic data
• Link new and existing data streams
• Put all data in common formats
• Use a variety of models for forecasting
• Convert and translate the results for policy makers and the public
• Expand global relevance through collaborations with other regions

*National Map and ASU urban approaches similar*
How might USGS expand its urban research activities?

- Highlight urban aspects of existing programs
- Coordinate urban components
- Centralize staffing of urban researchers
- Co-locate with academic and federal researchers
- Emphasize interdisciplinary studies