Causal relationship between multiple stressors and ecosystem sensitivity in urban landscape of the southwestern United States

Netra Chhetri, CSPO/SPARC, ASU

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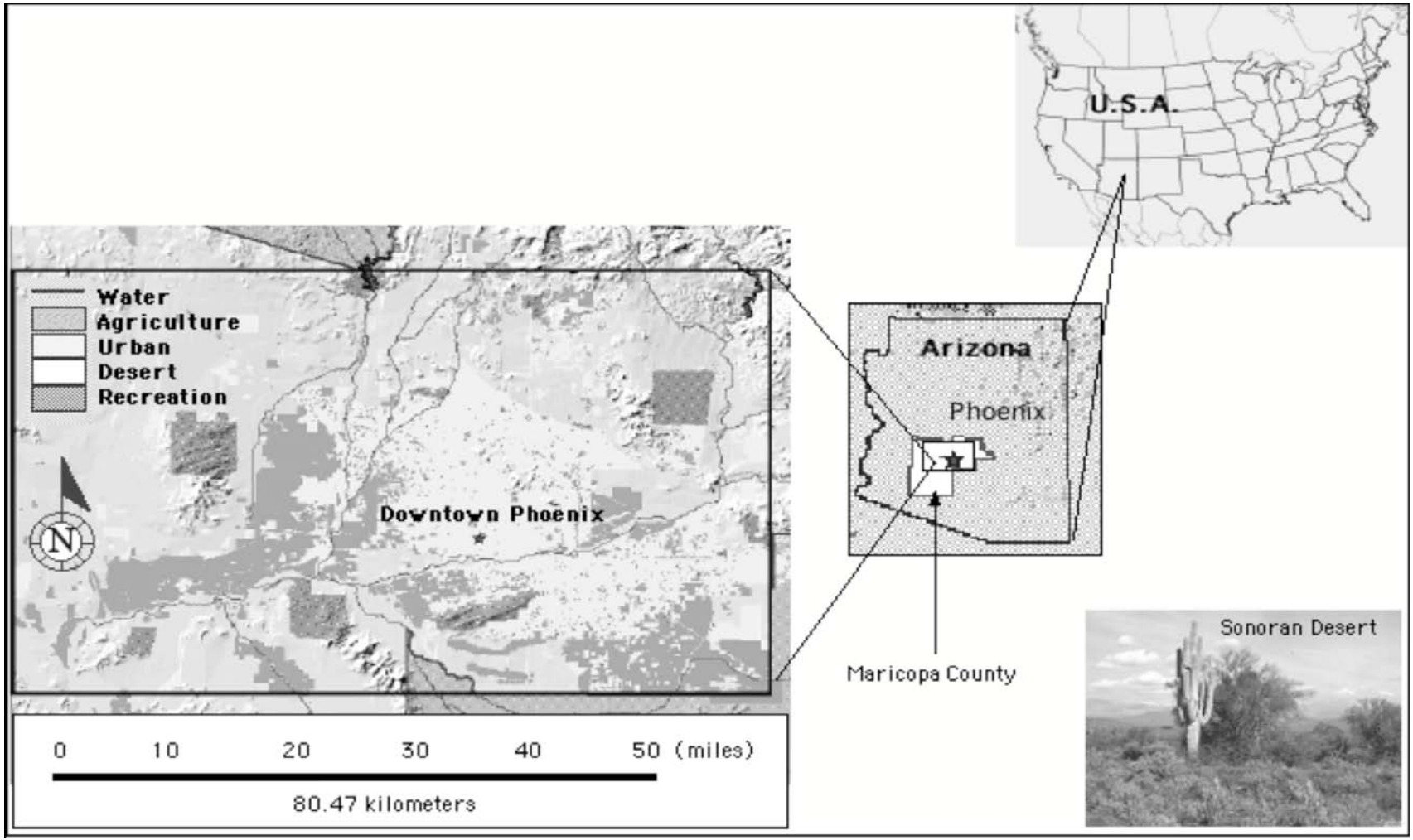
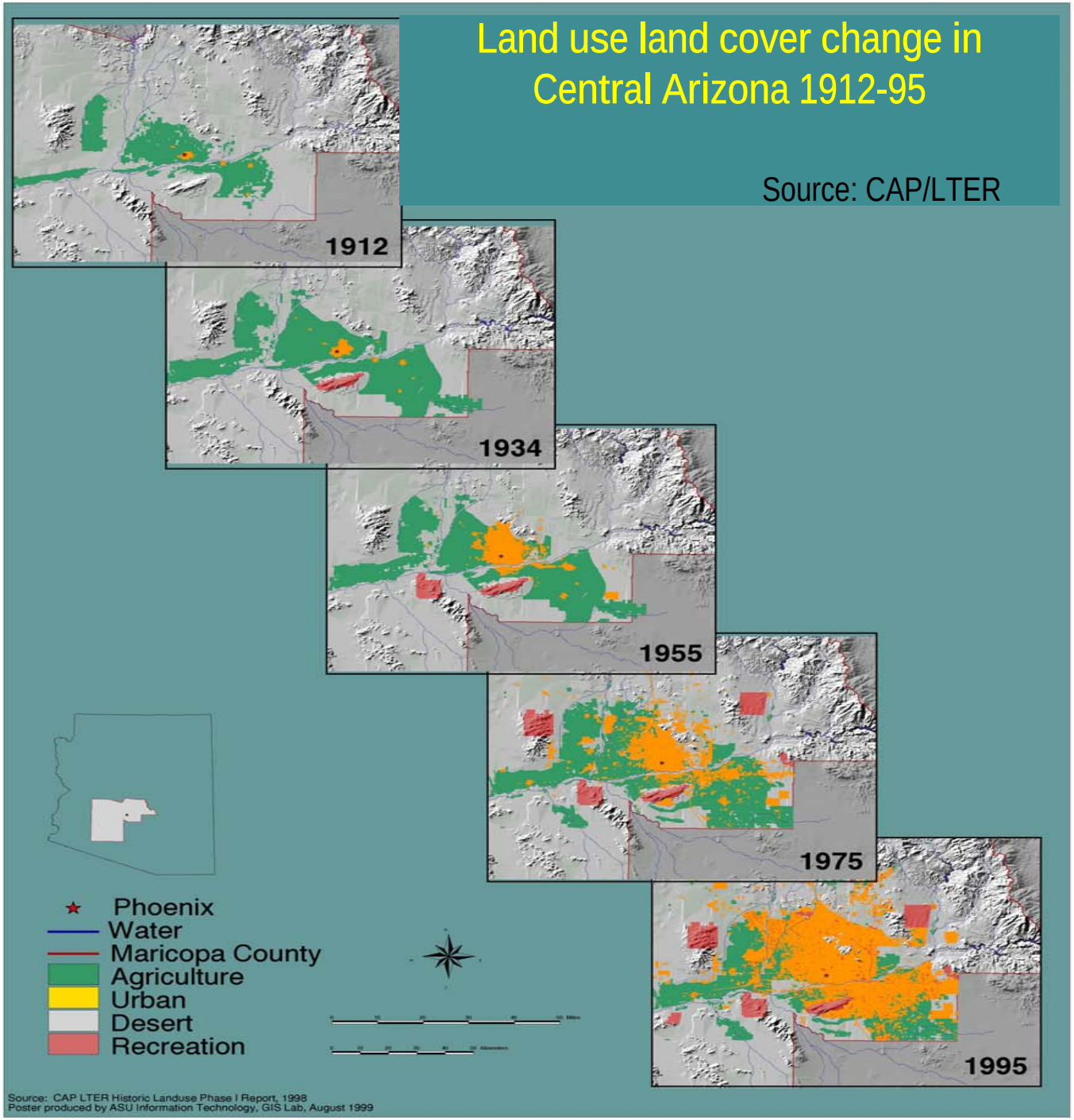
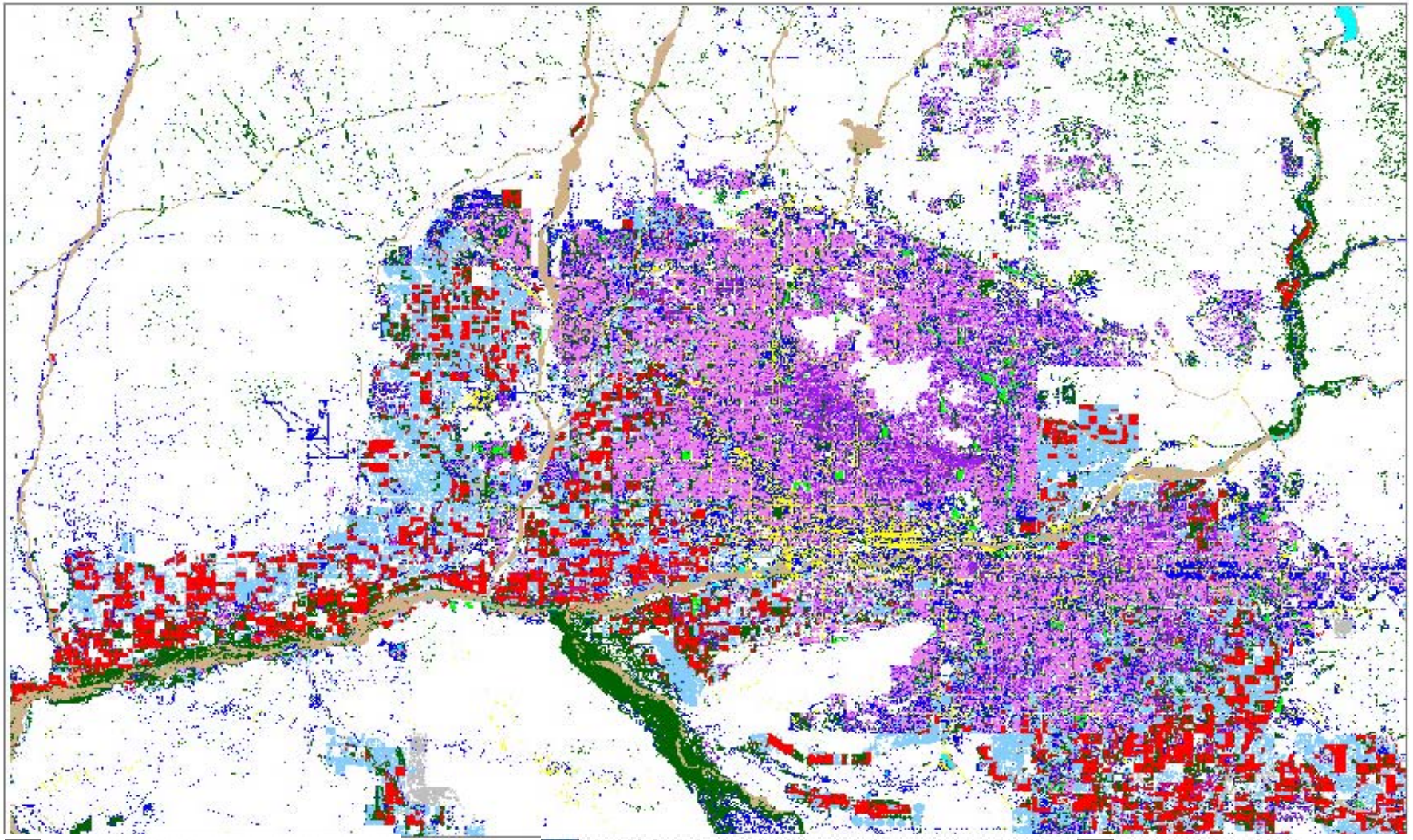
Proposed project site



Source: CAP/LTER

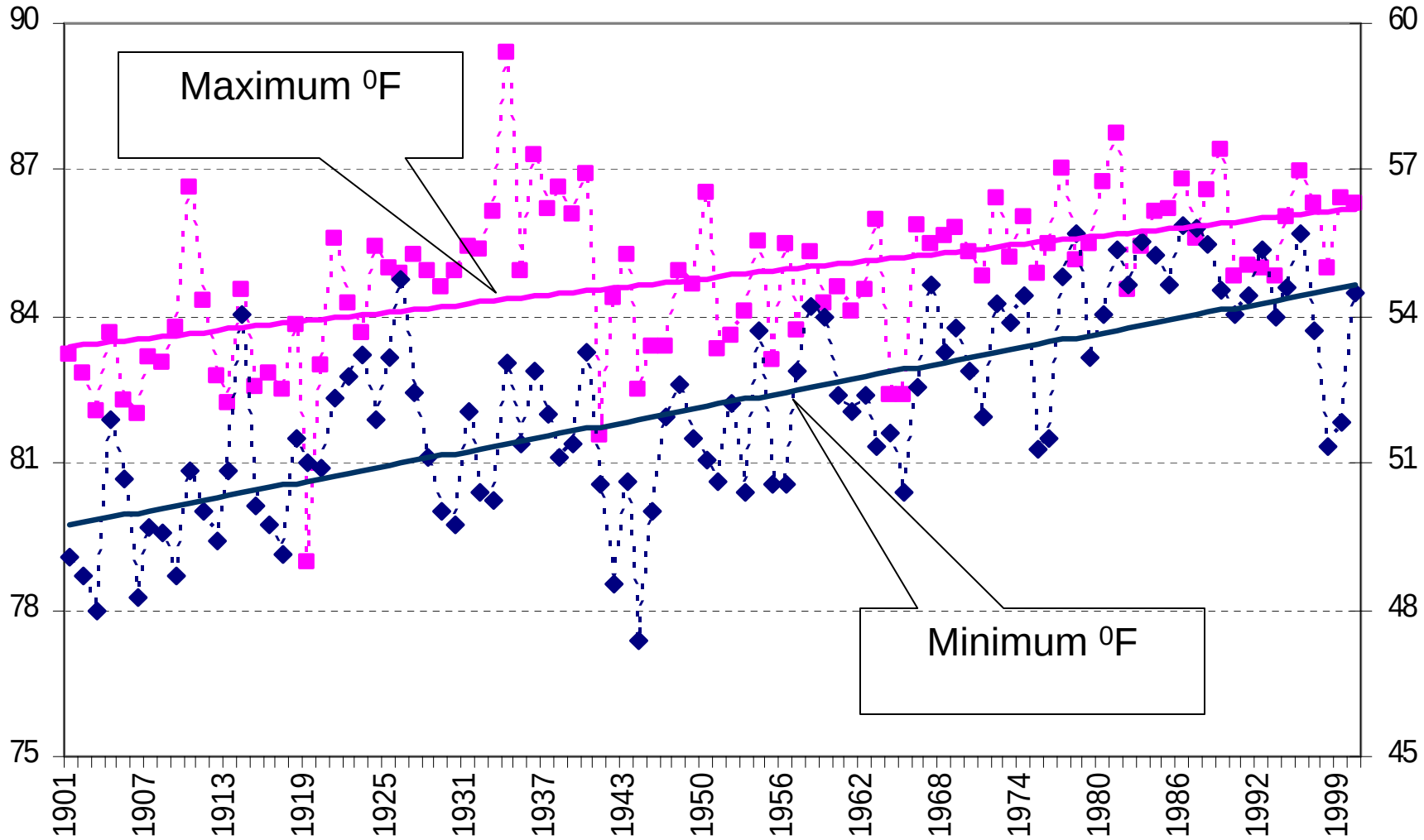
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
1880
1895
1910
1925
1940
1955
1970
1985
2000
2,861,395
(1999)
5,689 (1880)
10,986 (1890)
P = 5689 exp(0.0559(T-1880))
R2 = 0.9705
Source: CAP/LTER


Land use land cover change in
Central Arizona 1912-95
Source: CAP/LTER
1912
1934
1955
1975
1995
Phoenix
Water
Maricopa County
Agriculture
Urban
Desert
Recreation
Source: CAP LTER Historic Landuse Phase I Report, 1998
Poster produced by ASU Information Technology, GIS Lab, August 1999

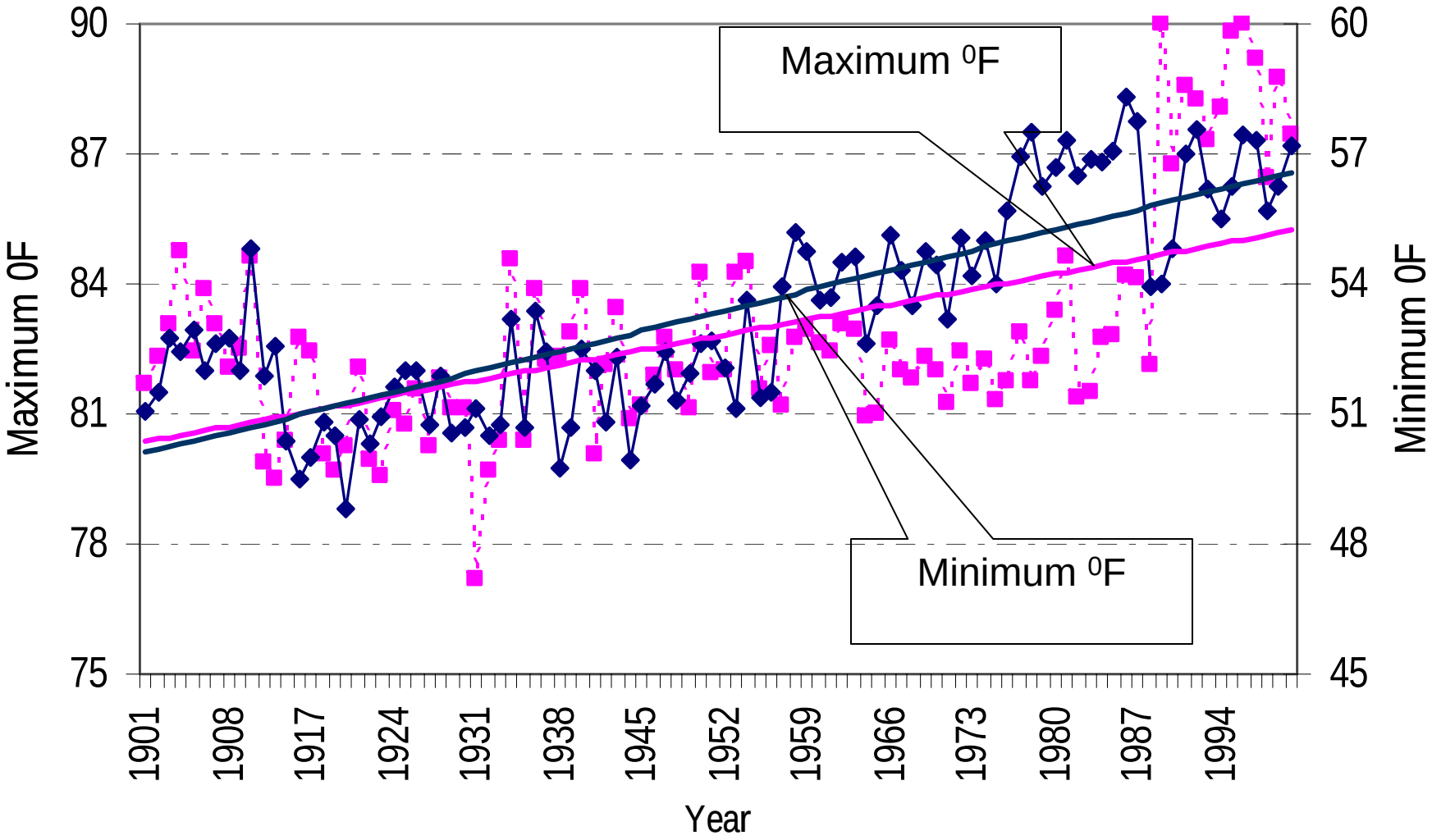

Undisturbed
Cultivated Vegetation (Active)
Cultivated Grass
Fluvial and Lacustrine Sediments (Canals)
Compacted Soil (Prior Agricultural Use)
Vegetation
Disturbed (Commercial/Industrial)
Disturbed (Asphalt and Concrete)
Compacted Soil
Disturbed (Mesic Residential)
Disturbed (Xeric Residential)
Water

Is climate changing?

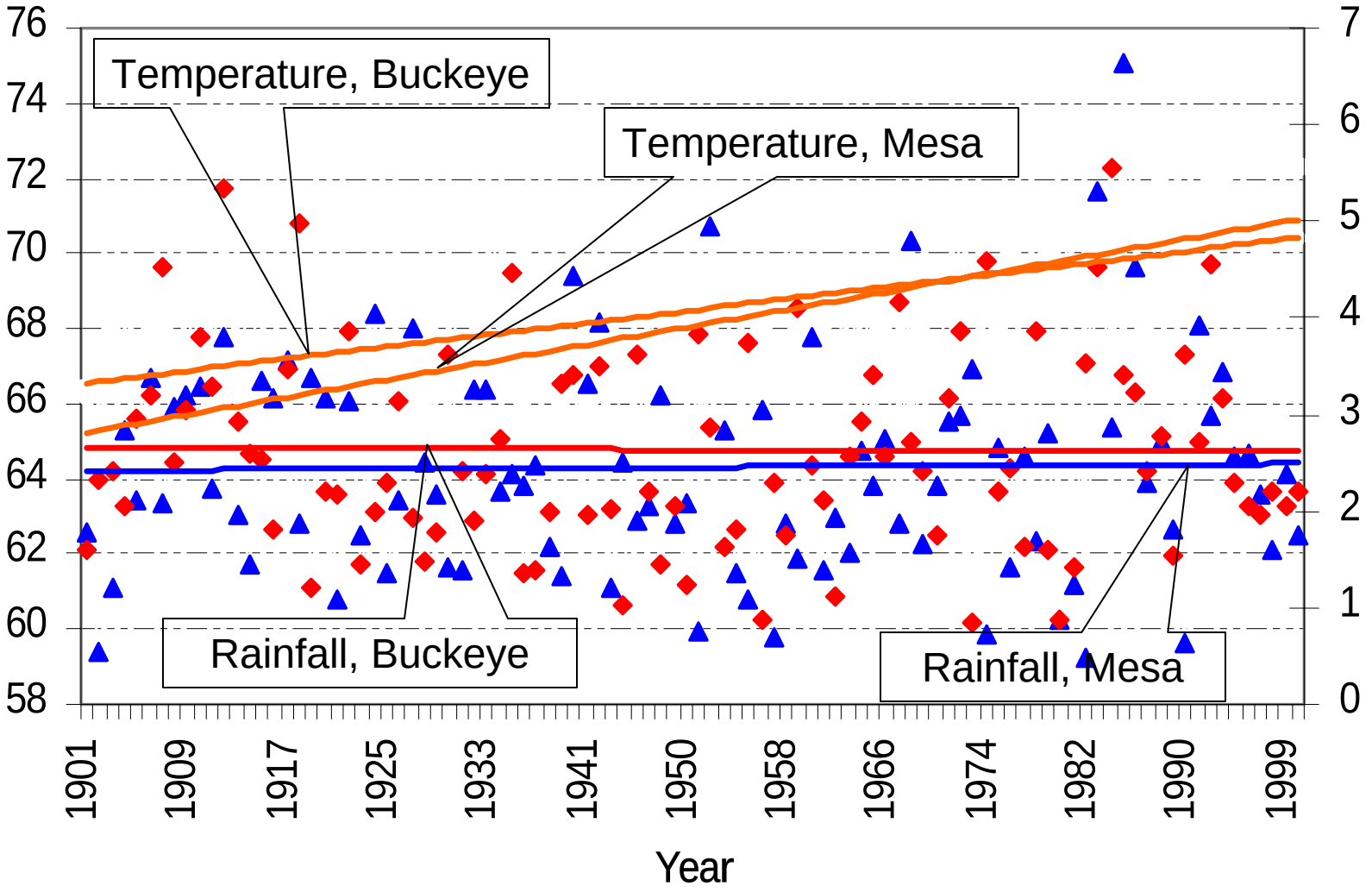
Change in annual average maximum and minimum temperatures in Buckeye, AZ, 1901-2000



Change in annual average maximum and minimum temperatures in Mesa, AZ, 1901-2000



Average Temperatures and Rainfall in two Meteorological Stations of Maricopa County, AZ



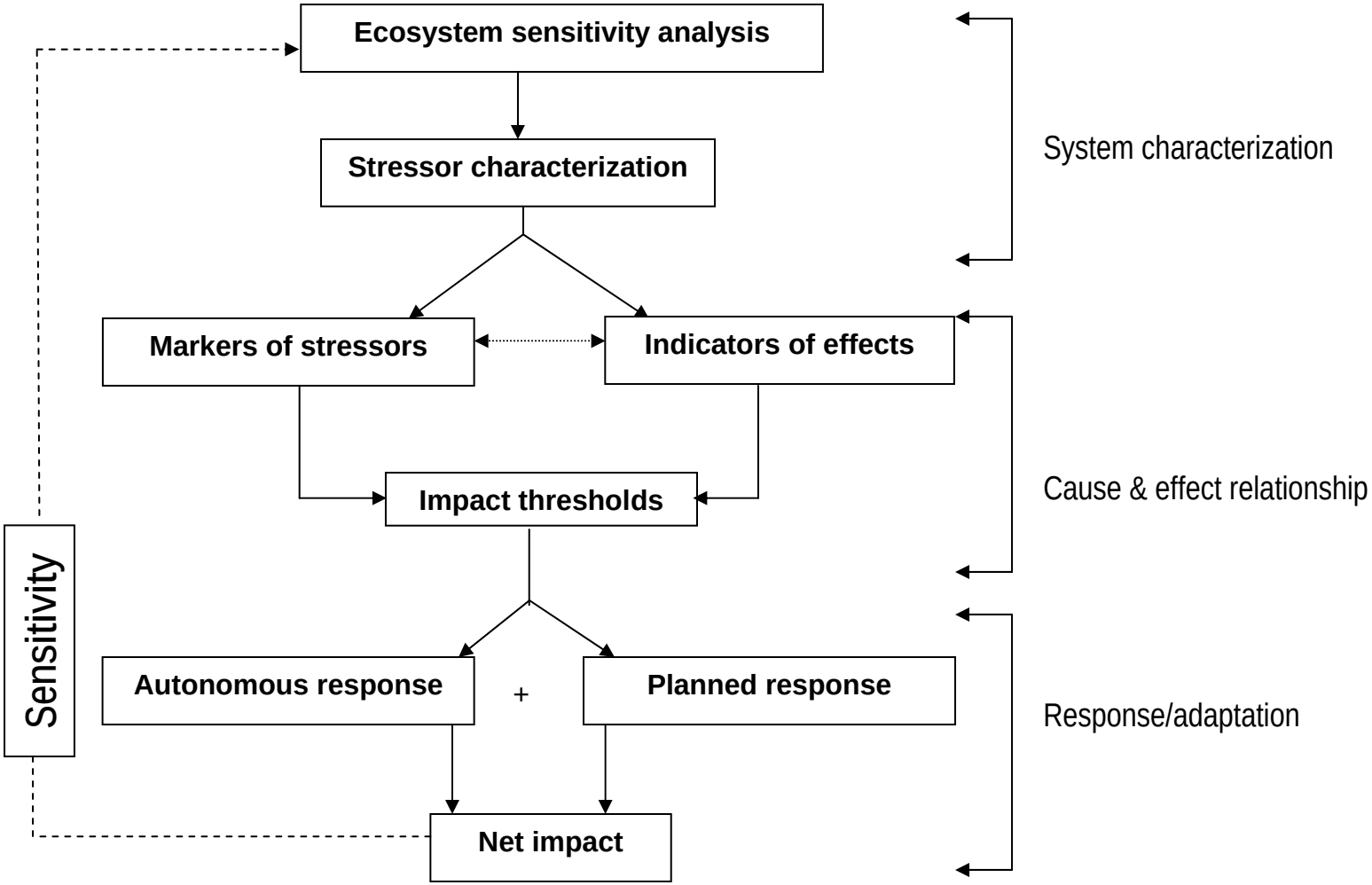
Questions

- What are the existing stresses in an urban ecosystem that form the backdrop for potential climate impacts?
- How might the functioning of urban ecosystem change in the future under various plausible scenarios, including climatic and non climatic?
- What are the research and information needs that can guide appropriate policy decisions in the future?
- What are the most important uncertainties regarding the abilities of urban ecosystem to cope with the anticipated change?

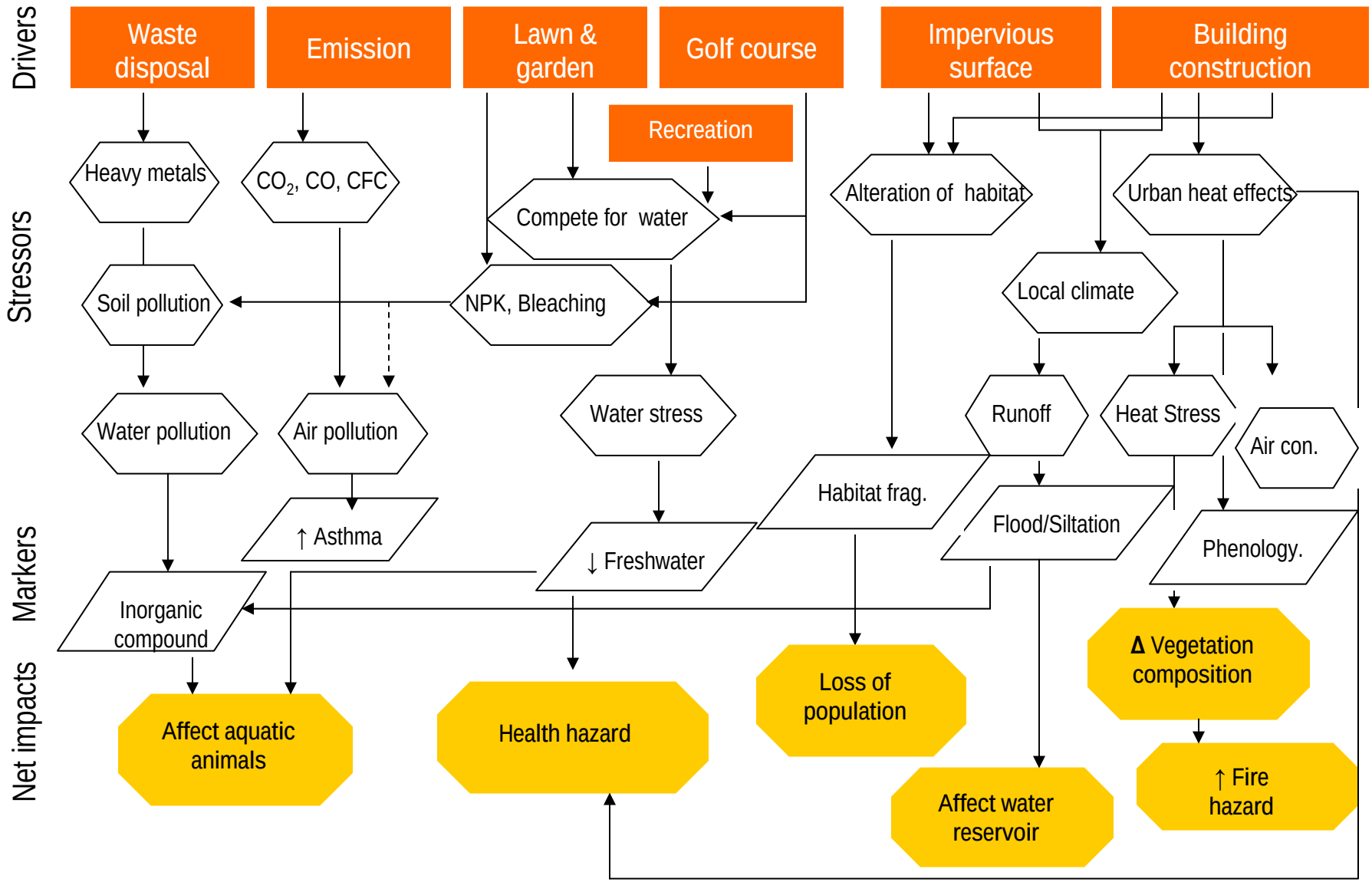
Steps for assessing ecosystem sensitivity

- Identify **key variables** exerting stress in ecosystems;
- Create **scenarios (projected ranges)** for key variables;
- Carry out a **sensitivity analysis** to assess the causal relationship between key variables and their impacts on ecosystem;
- Identify the **impact thresholds** to be analyzed for risk with stakeholders;
- Evaluate risk and identify feedbacks likely to result in **autonomous adaptations**;
- Consult with stakeholders, analyze proposed adaptations and recommend **planned adaptation** options;
- Assess **net** impacts to the ecosystem

General framework for establishing causal relationship between stressors and its consequences in an ecosystem



Conceptual model for ESA in an urban environment



Ecosystem Sensitivity: Response to Stressors

Response strategy	State of the ecosystem	
	Φ^0	Φ^1
$¥^0$	Present ecosystem and present response strategy	Changing state of ecosystem but present response strategy
$¥^1$	Present ecosystem condition and new response strategy	Changing state of ecosystem with new strategy to restore the ecosystem