Better Land Use Planning with NASA Earth Science Data and Models

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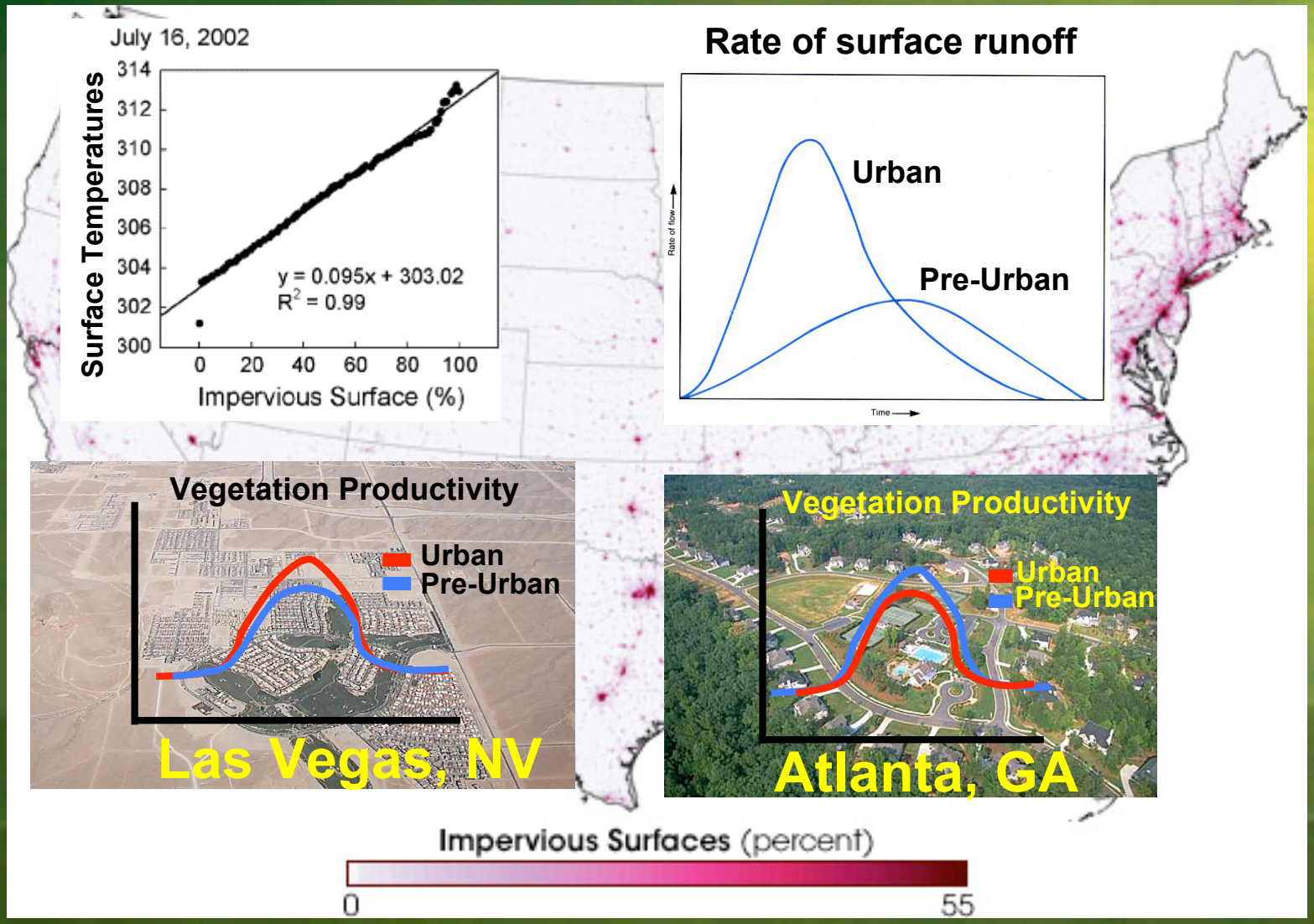
US Built-up area in the year 2000 is the size of Ohio

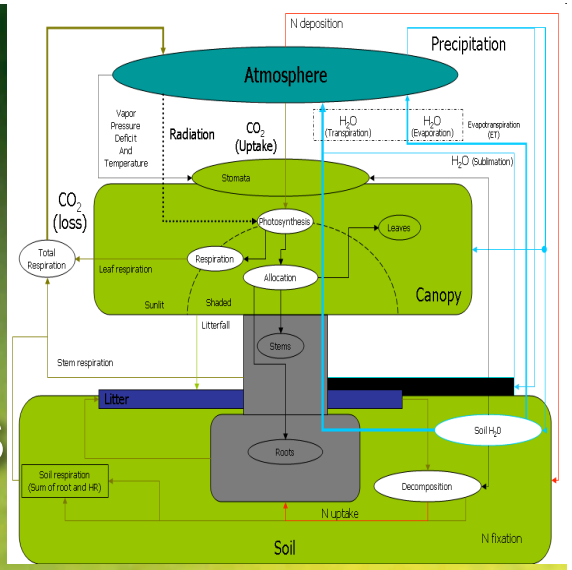


A number of options exist for mitigating the impacts of urbanization

- urban reforestation
- restoration of abandoned lands and riparian corridors
- green roofing/low impact development (LID) techniques
- replacement of asphalt and concrete with permeable surfaces

How to quantify the broad-extent, regional potential cumulative benefits of coordinated state- and region-wide implementation of the mitigation options?

NASA Earth Science Data and Models



- Carbon sequestration/emissions
- Nitrogen emissions/pollution
- Water cycle (runoff, evapotranspiration, water consumption, water quality)
- Coupled with climate models: future projections and feedbacks on climate

Useful tools for improved decision making when integrated with socio-economic components

TOPS

Terrestrial Observation and Prediction System

Ground-based

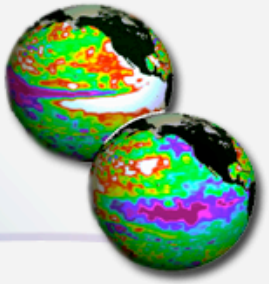
Space-based

Air-based

Observations

Ancillary Data

Ecosystem Simulation Models

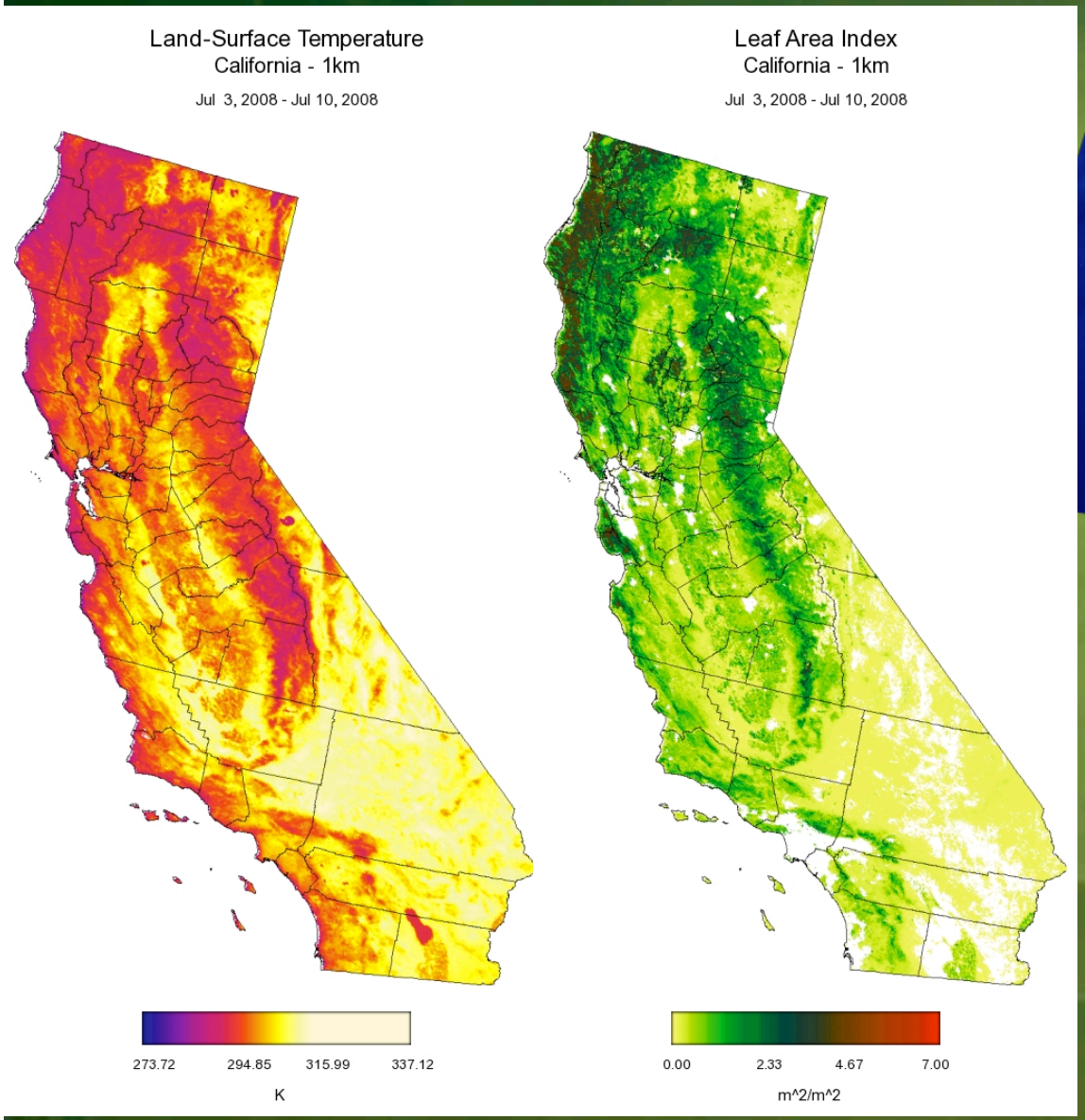


Weather/Cllimate Forecasts

Applications

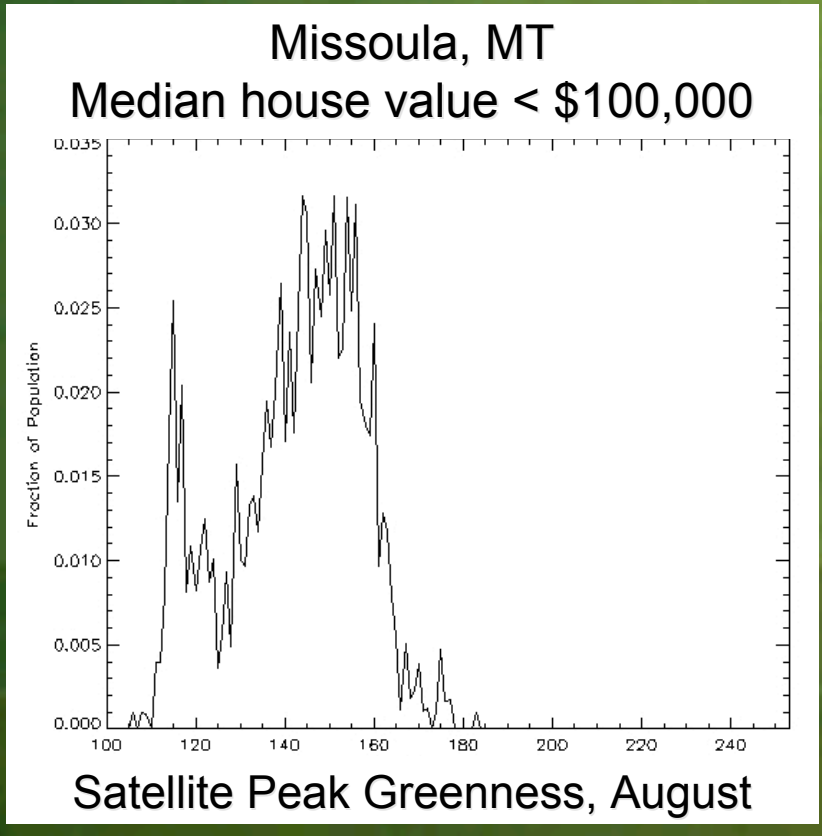
Water | Natural Hazards | Biomass | Agriculture | Public Health | Urban

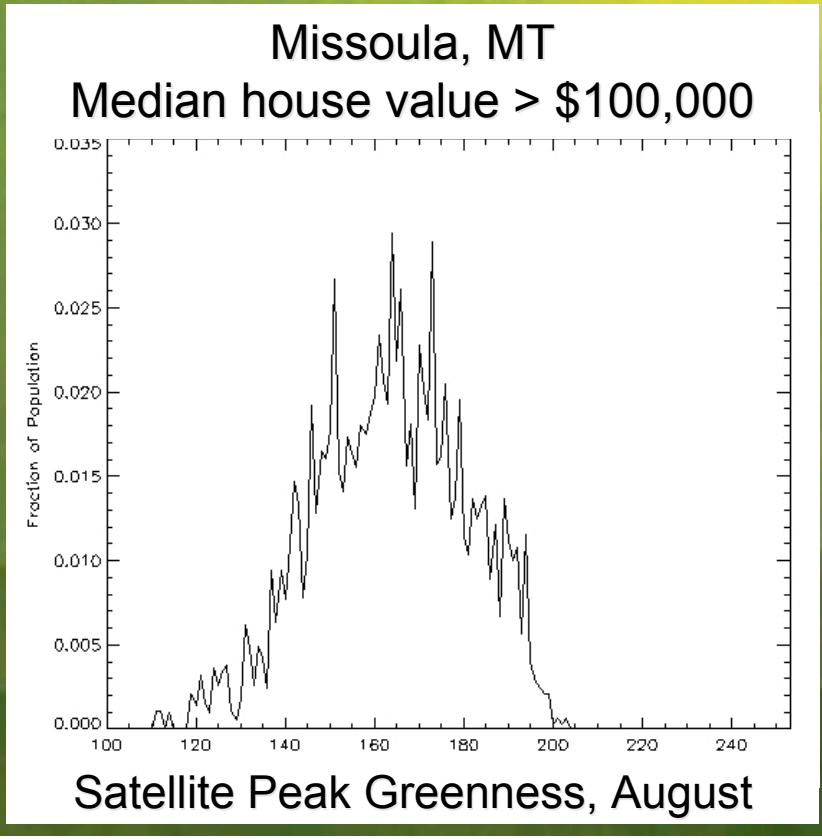
TOPS can integrate data from different sources at a variety of spatial and temporal scales



Vegetation Productivity is an important variable to monitor over urbanized landscapes

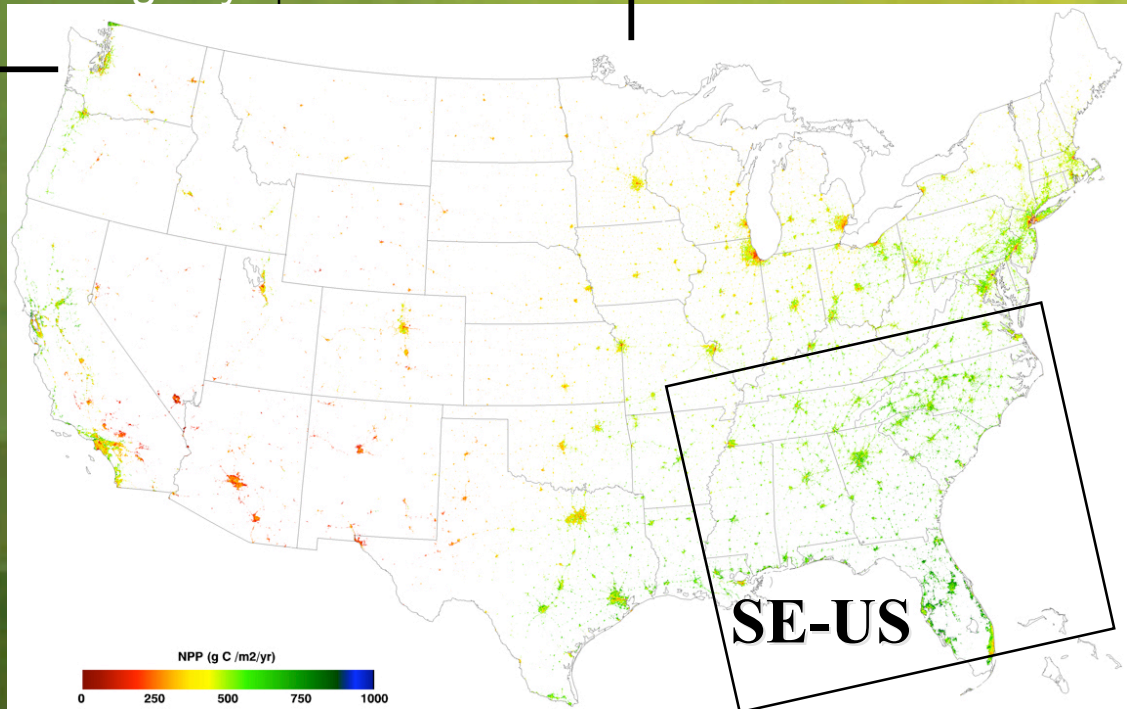
- Recreational/aesthetic value
- Carbon sequestration
- Emission reduction/removal of pollutants
- Stormwater control





Vegetation productivity of US urban ecosystems

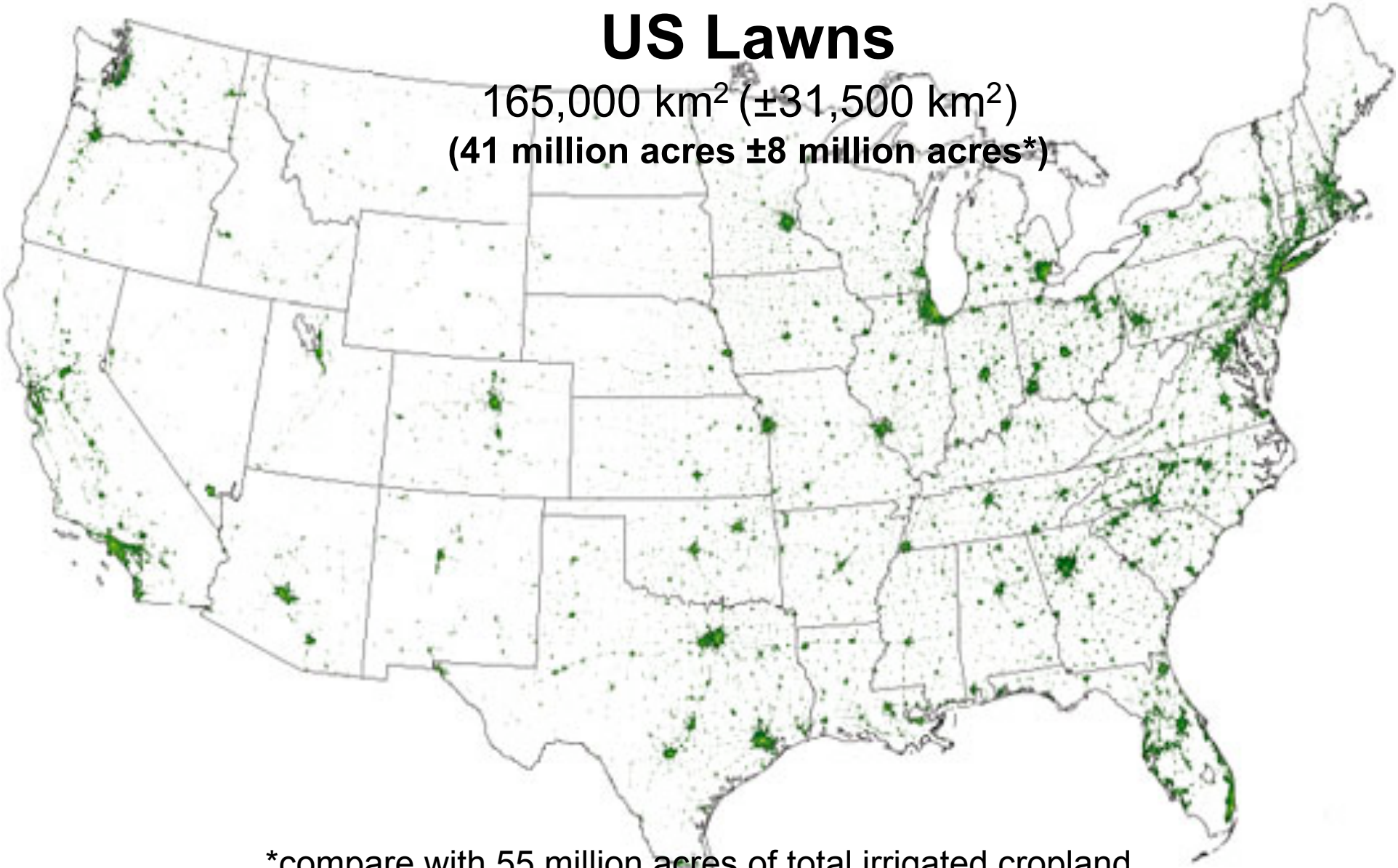
	Continental US	SE-US
NASA-CASA $NPP=PAR * FPAR * \varepsilon_{max} * T * W$ $NPP=PAR * FPAR * \varepsilon_{max} * T$	0.117 Pg C/yr 0.126 Pg C/yr	0.032 Pg C/yr 0.033 Pg C/yr
MOD17 $GPP=PAR * FPAR * \varepsilon_{max} * T * W$ $NPP=GPP – Rm - Rg$		0.030 Pg C/yr
BIOME-BGC Turf grasses only	0.007–0.110 Pg C/yr	



US Lawns

165,000 km^2 (±31,500 km^2)

(41 million acres ±8 million acres*)



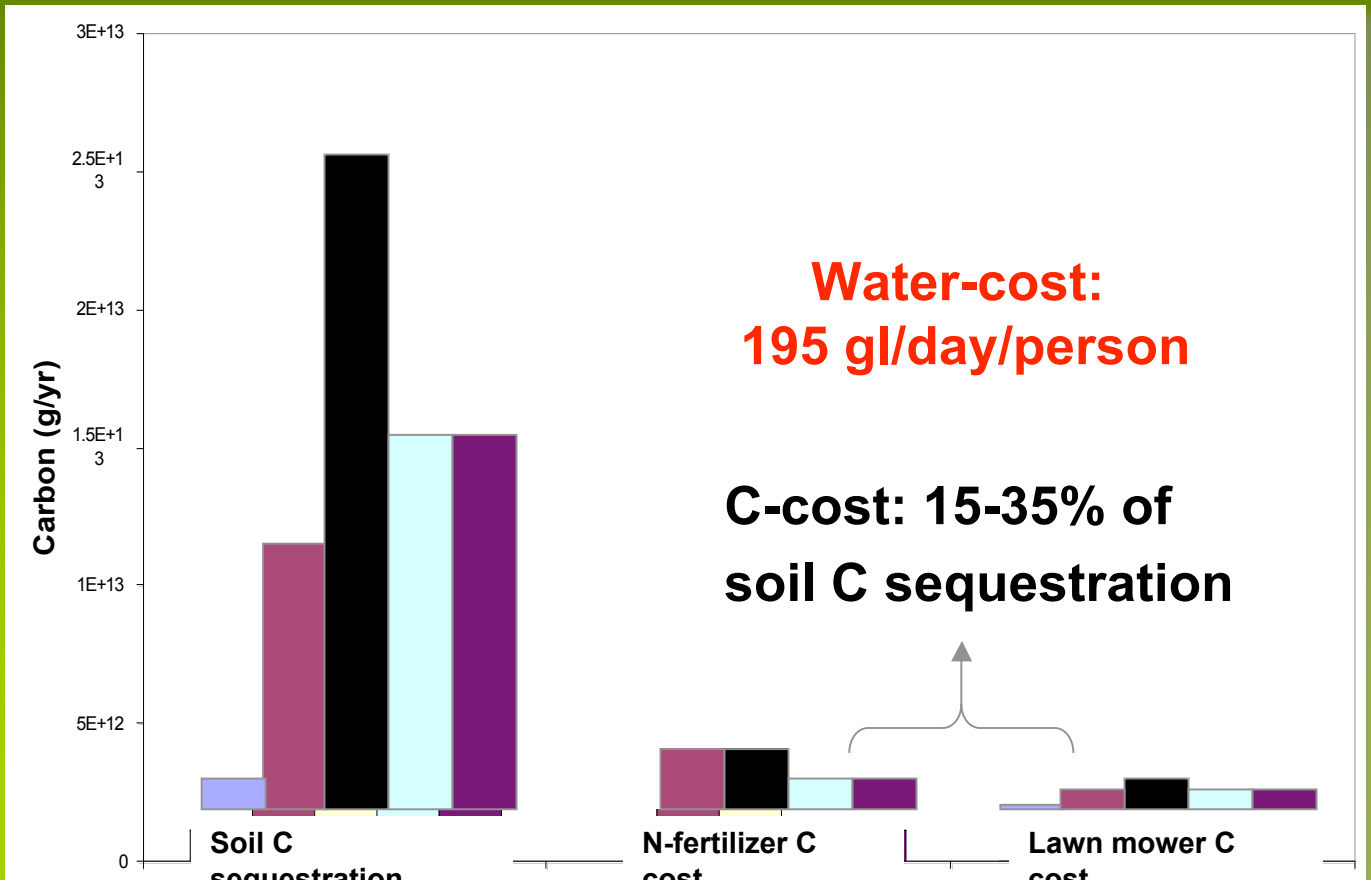
*compare with 55 million acres of total irrigated cropland

Fractional Turf Grass Area

0.0 1.0

Carbon sequestration on US lawns depends on high resource inputs

	Gross C sequestration
don't water, don't fertilize	1 Tg C / yr
water 1"/week, fertilize, bag the clippings	10 Tg C /yr
water 1"/week, fertilize, mulch the clippings	25 Tg C /yr
water 1"/week, half the fertilizer, mulch the clippings	15 Tg C /yr
follow PET to water, half the fertilizer, mulch the clippings	15 Tg C /yr



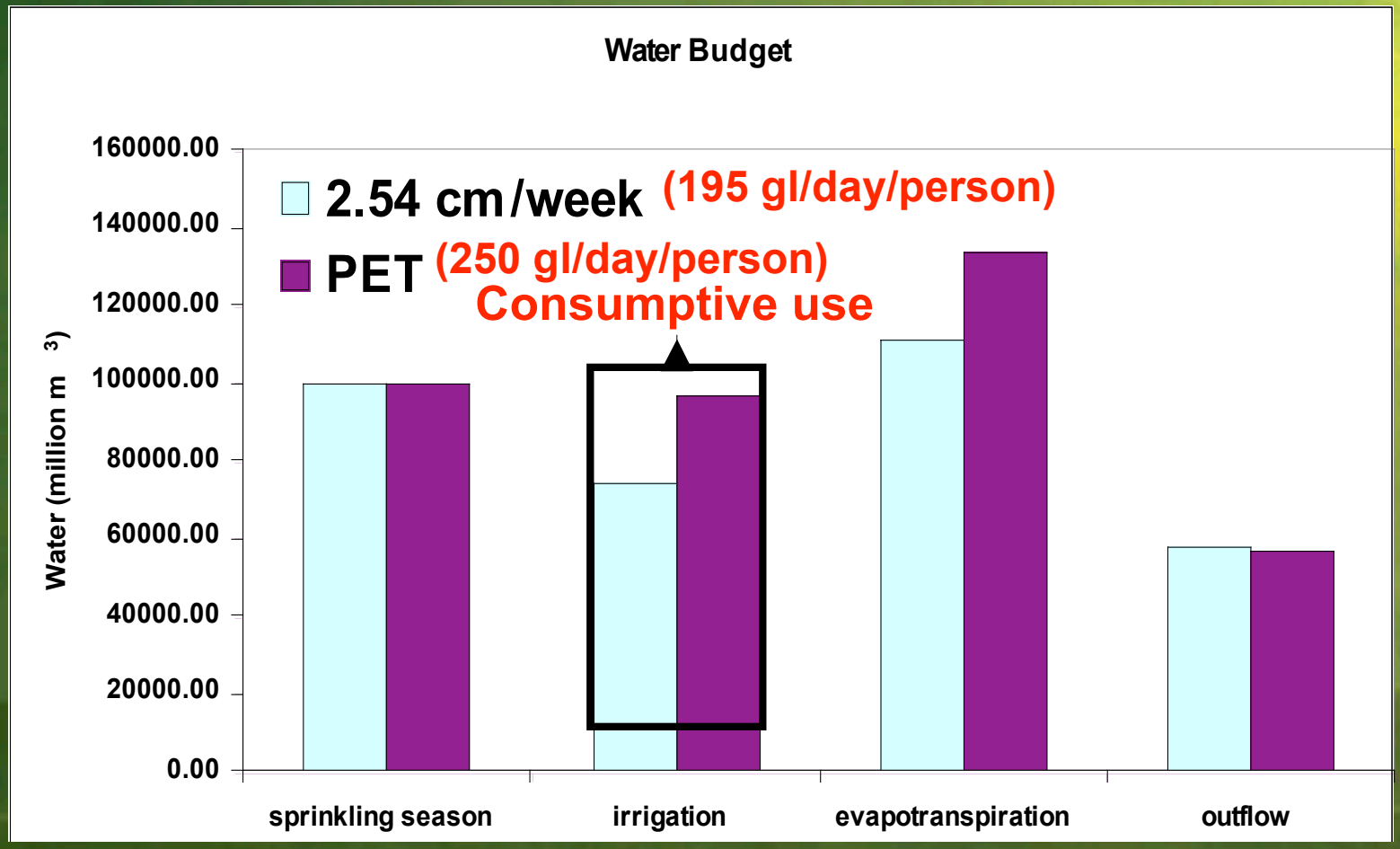
Total US C seq

300-580 Tg C/yr

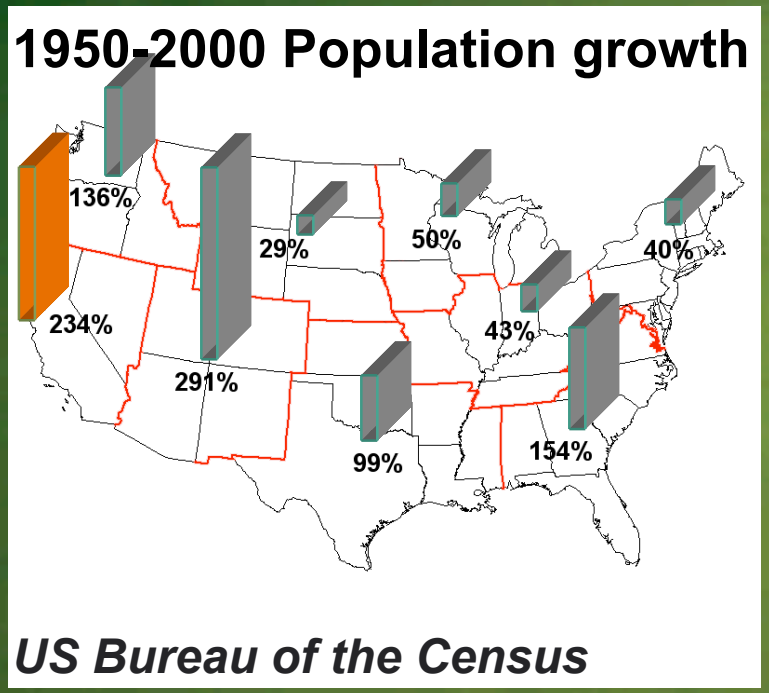
Pacala et al. 2001

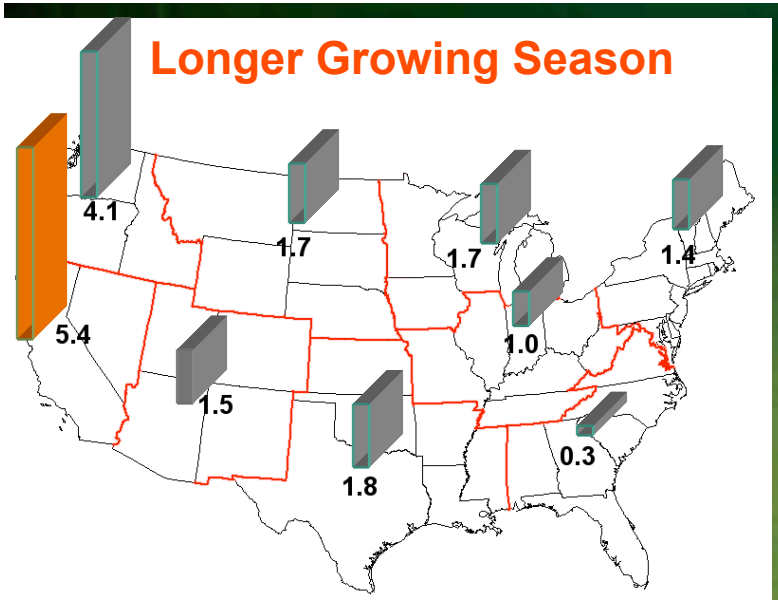
1 Tg = 10^{12} g

Water use of the perfect US lawns



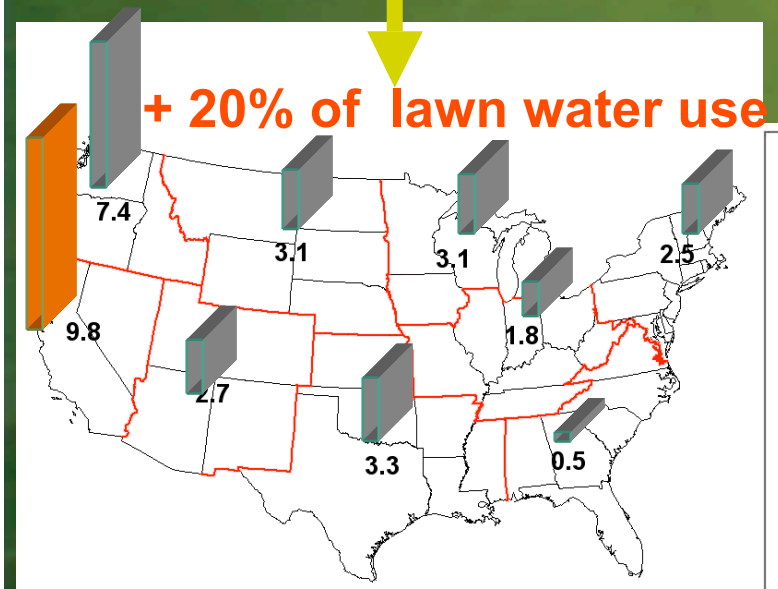
Increase in regional outdoor water consumption depends on urban growth….





Days/decade (1948-1999)

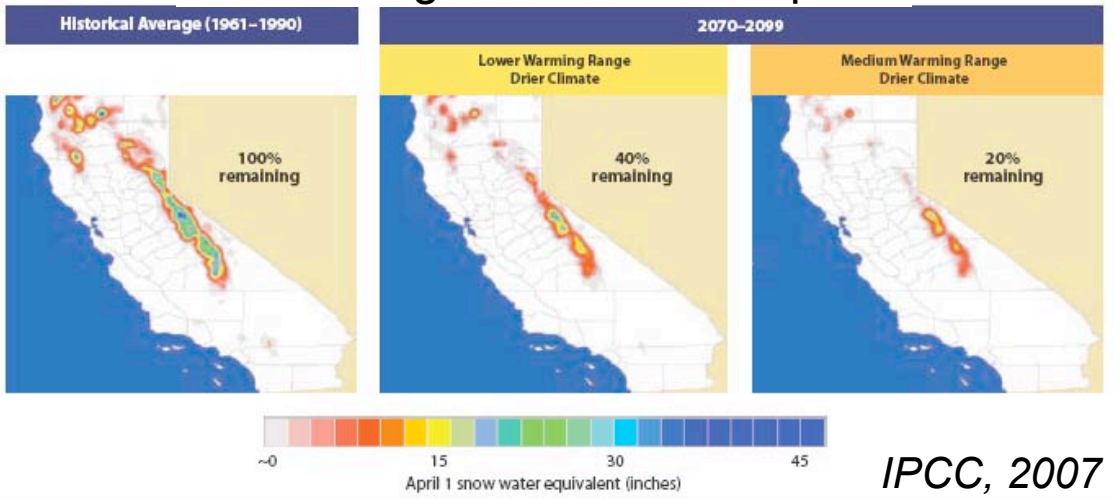
Easterling, 2002



cm/yr

Increase in urban outdoor water consumption is also affected by a changing climate (temperature, precipitation, growing season length)

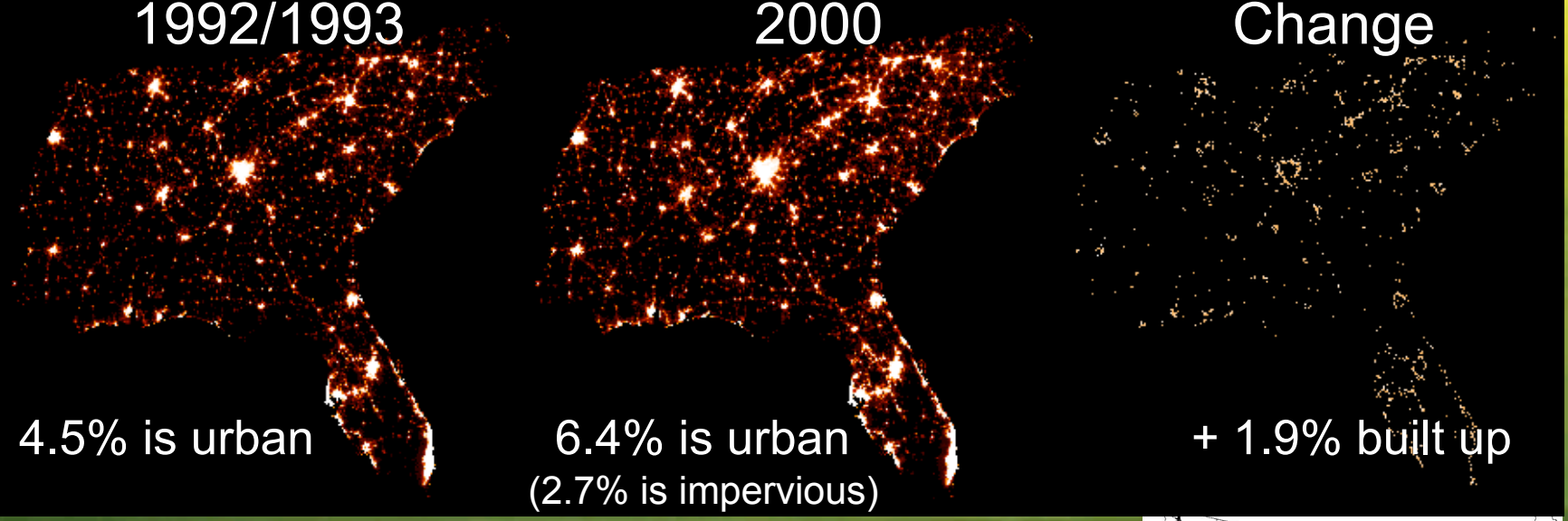
Decreasing California Snowpack



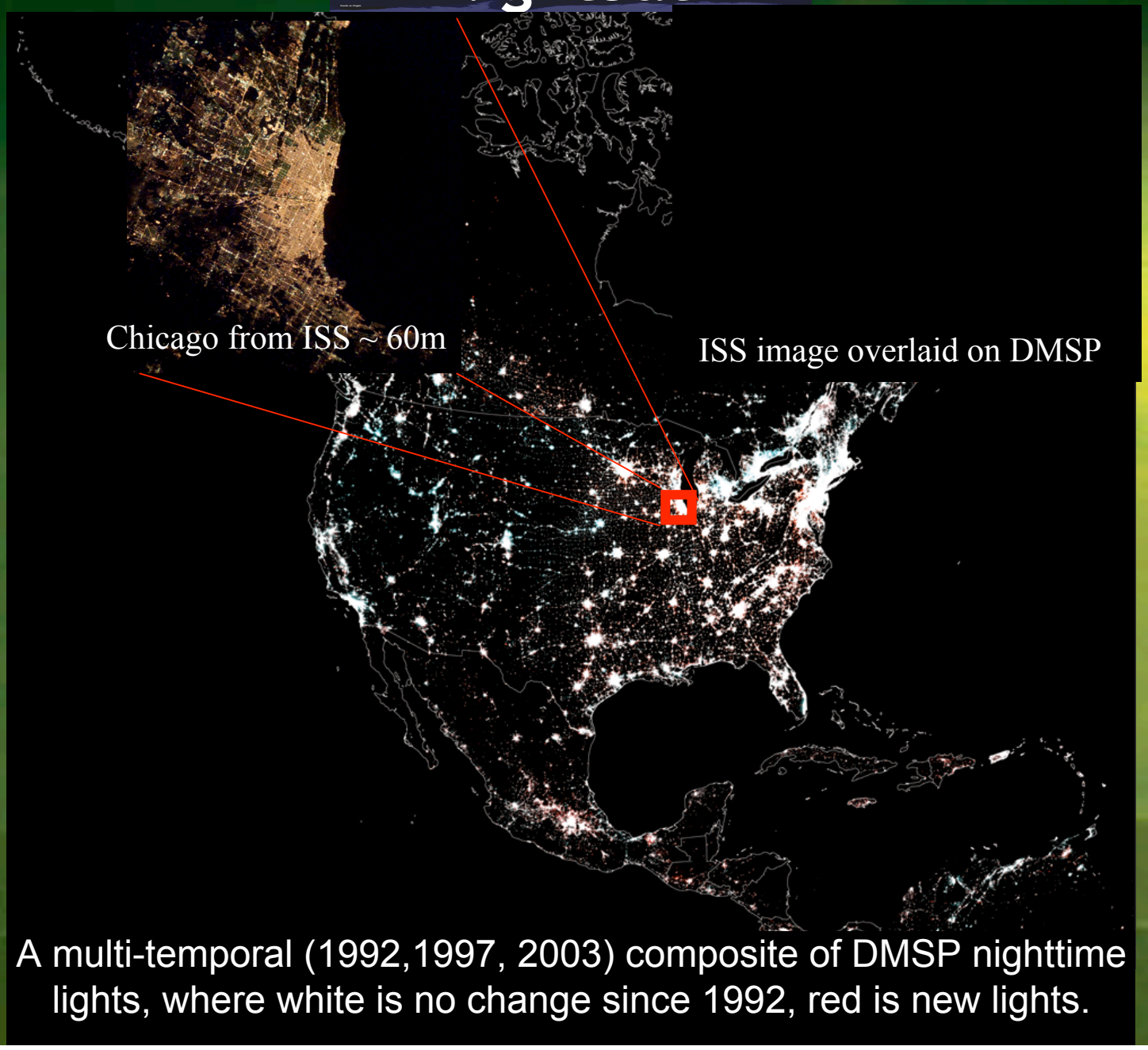
IPCC, 2007

Assessing changes in environmental variables is well established, better tools are needed to monitor urban land cover changes

Urban sprawl in the Southeastern United States from DMSP/OLS



NightSat



A multi-temporal (1992,1997, 2003) composite of DMSP nighttime lights, where white is no change since 1992, red is new lights.

Thank you!

Impervious surfa

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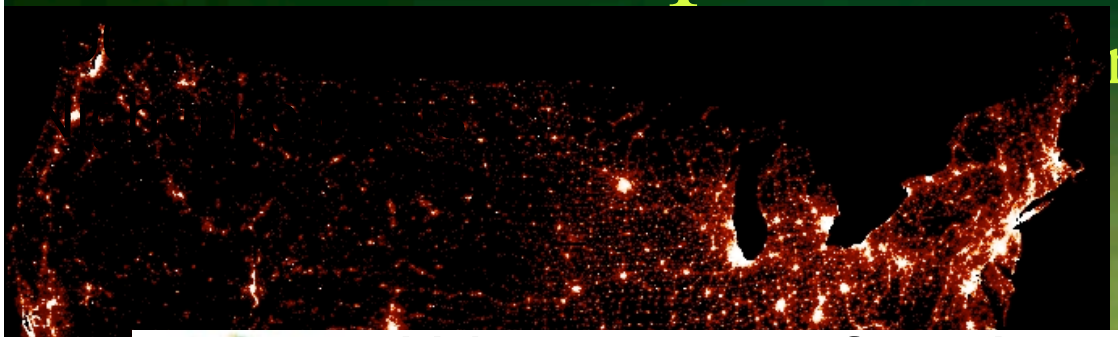
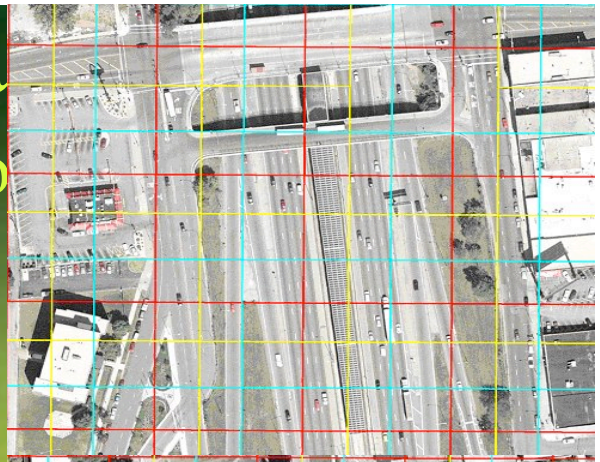
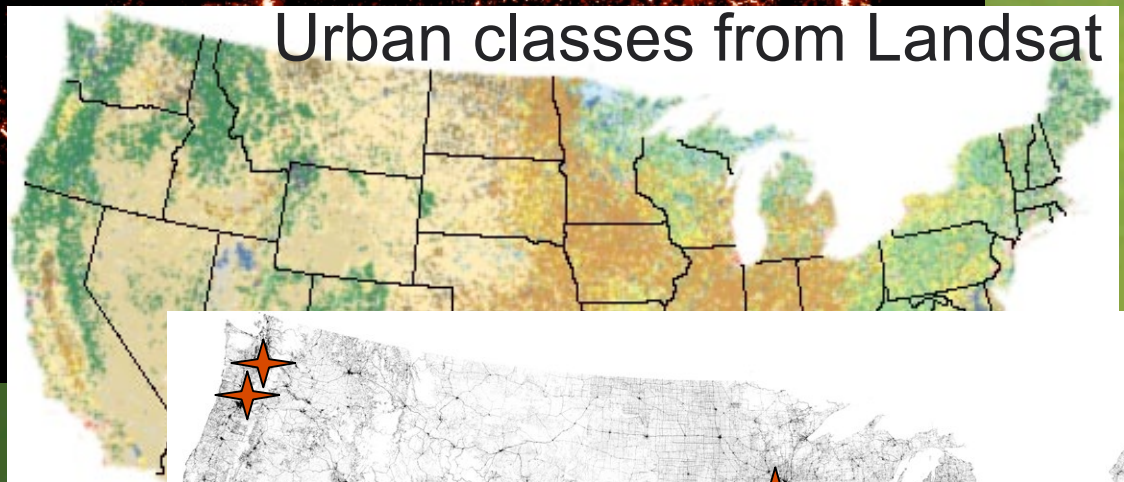
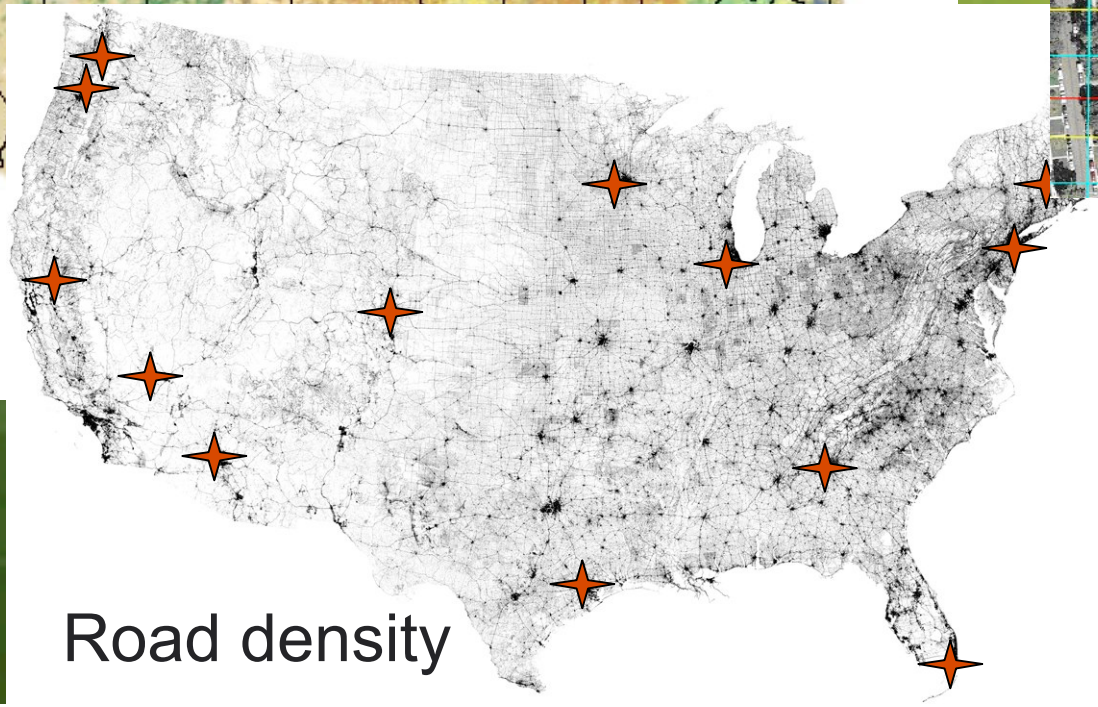


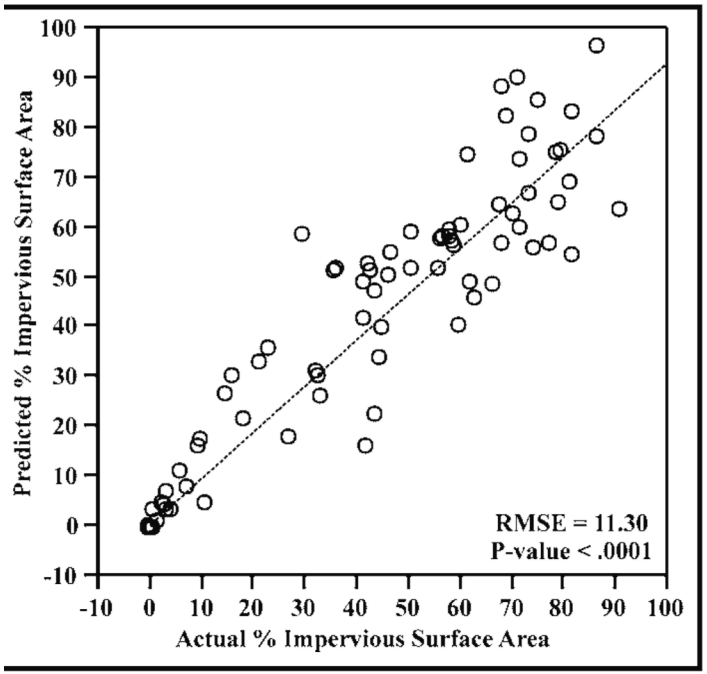




Urban classes from Landsat



Road density



Total Urban Area: 3%
Total Impervious Surface: 1.3%

Elvidge et al. (2004), EOS Transactions