

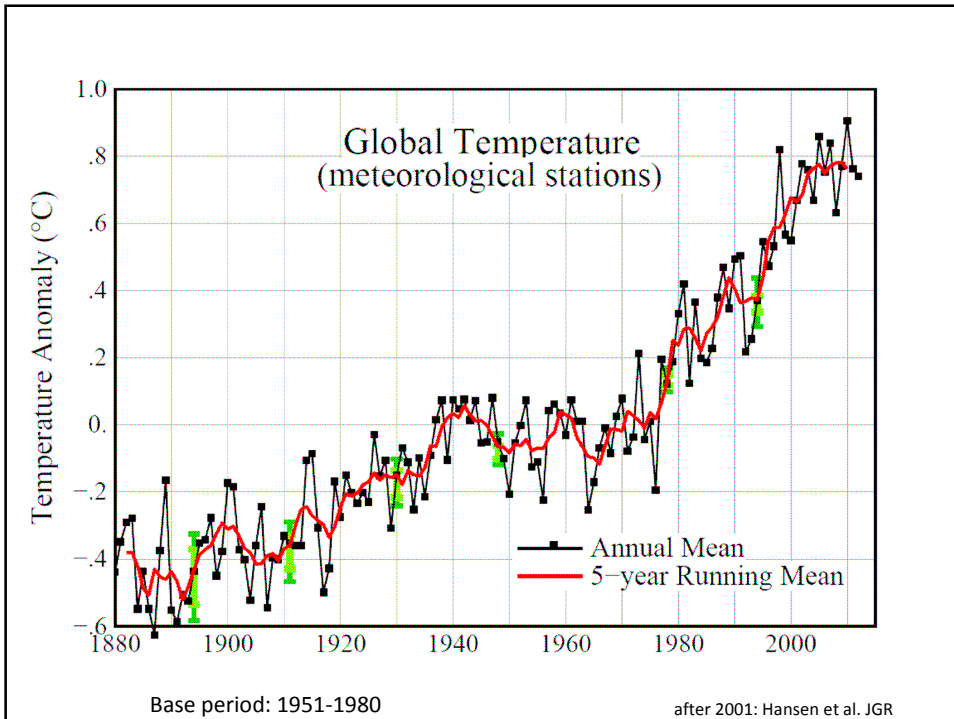
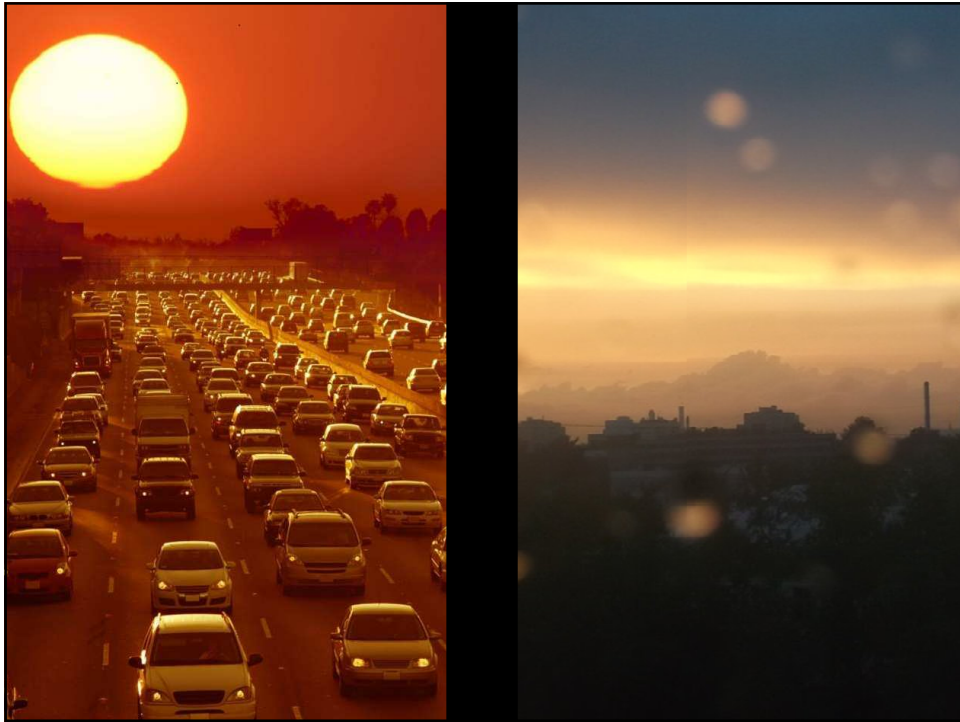
Adaptation to Climate Change in Cities

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**Urban
Areas**

**Climate
Change**





Urban Heat Island Effect

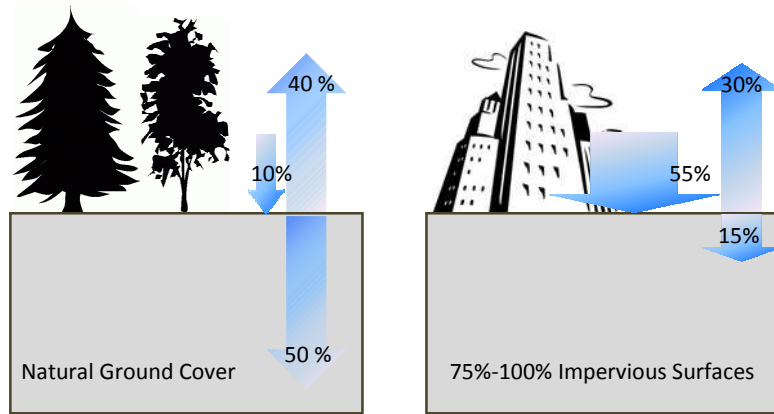


Impervious
surfaces:
re-radiation
of heat

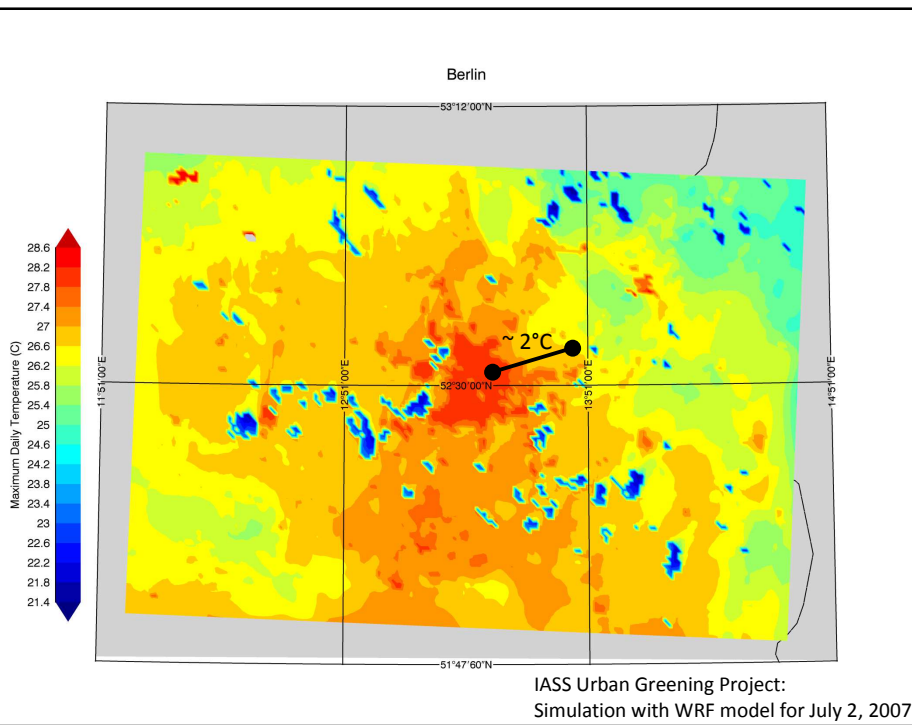


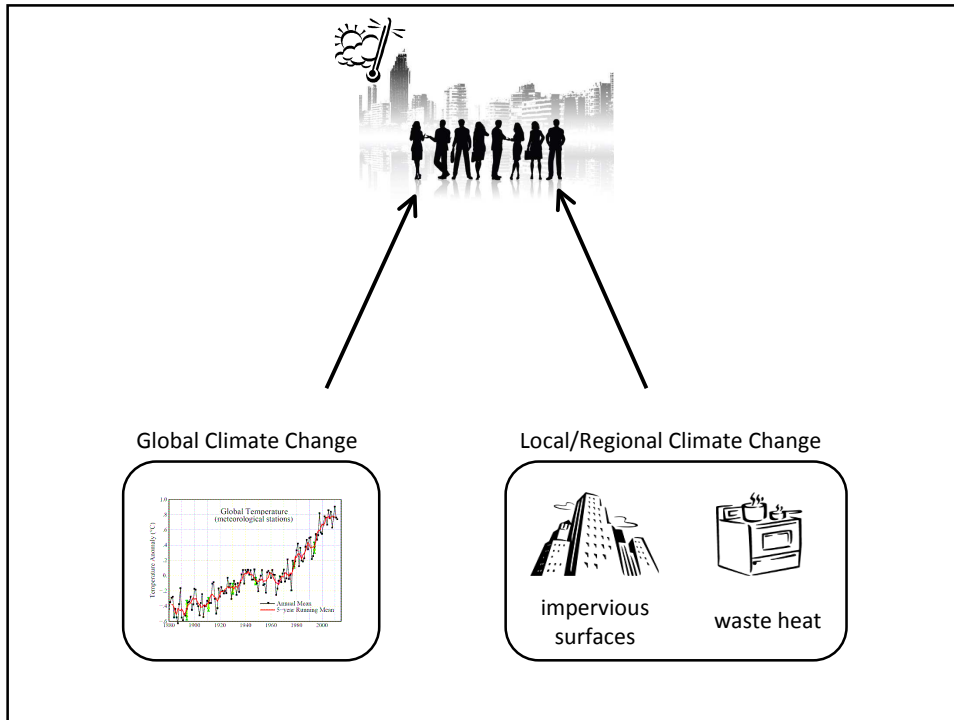
Photo: Leanne Yanabu

Impervious surfaces: water re-routing

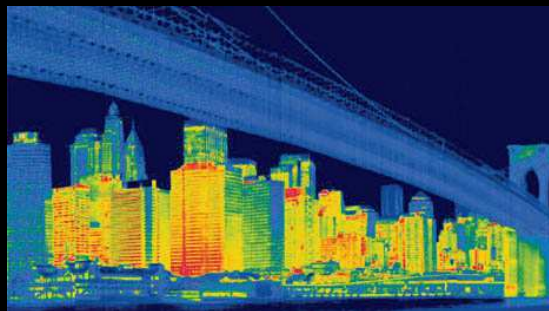


After FISRWG: 1998



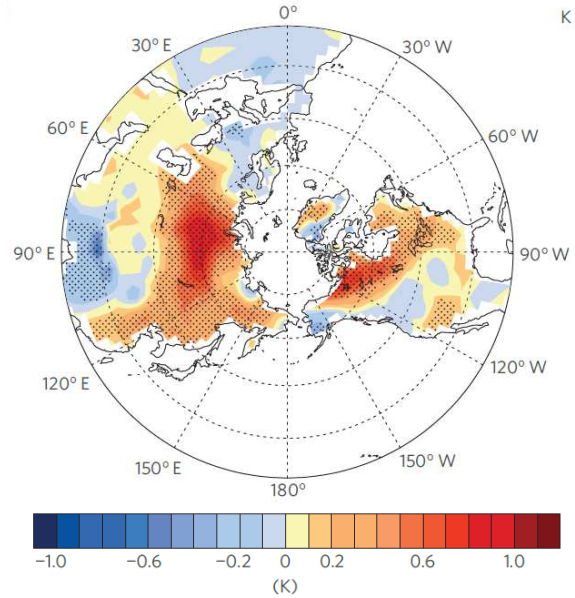


Emissions of Waste Heat

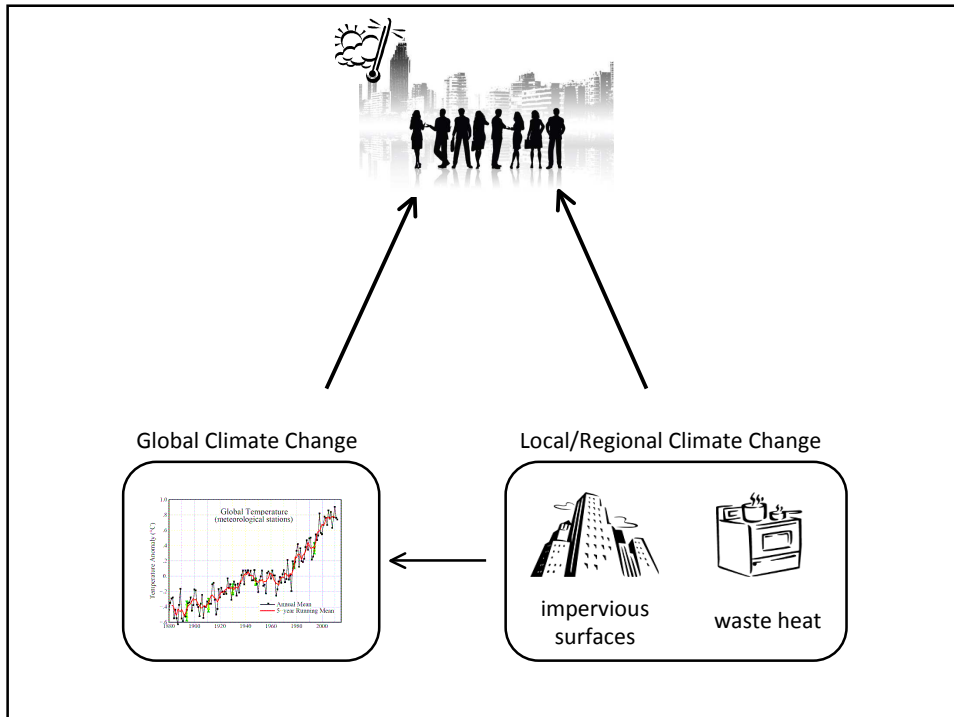


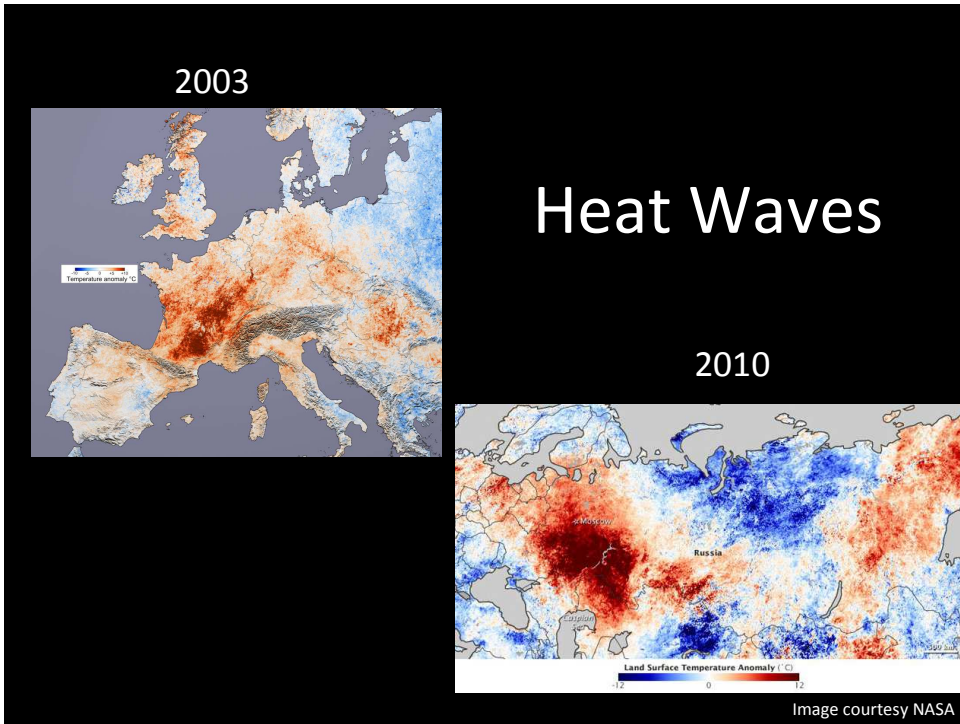
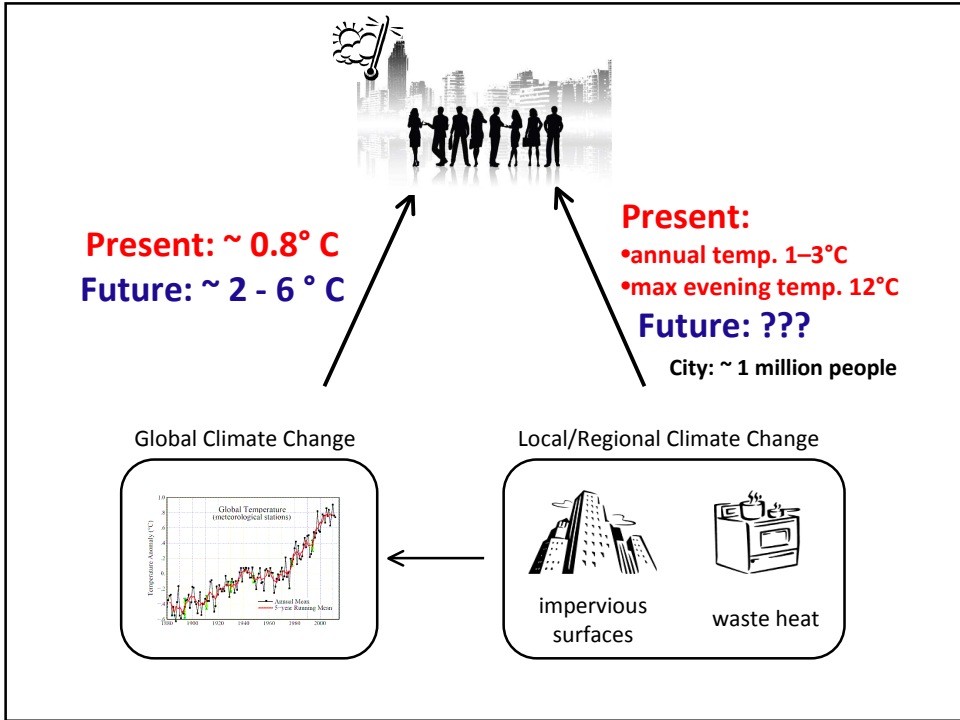
Infrared image of New York city from Tyrone Turner

Winter temperatures are up to 1° higher because of **urban waste heat**



2013: Zhang et al, Nature CC



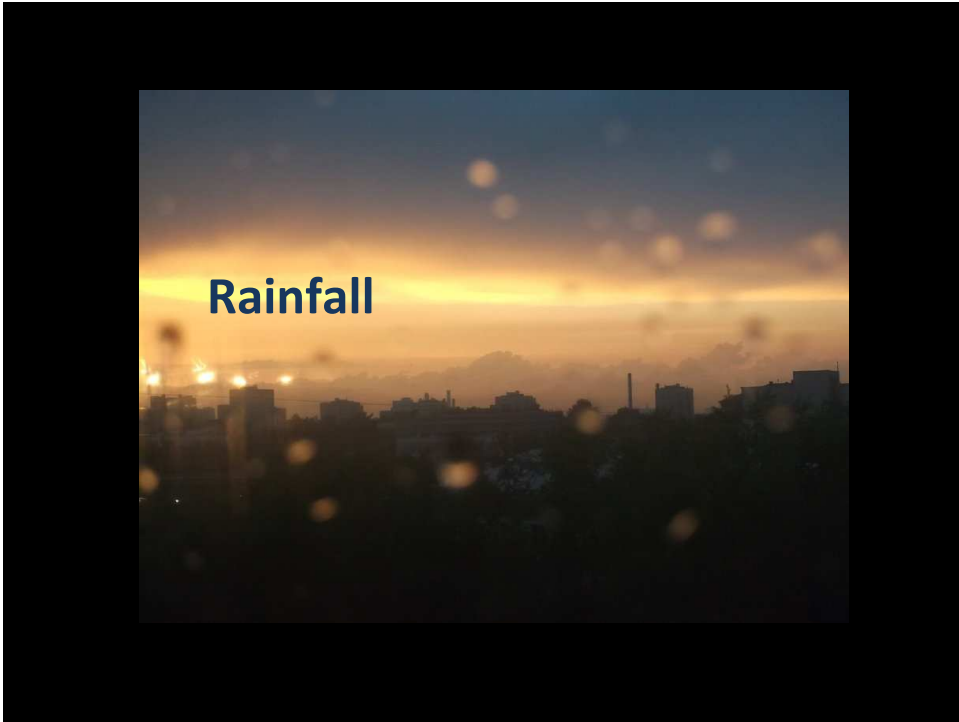


Synergistic interactions between urban heat islands and heat waves: the impact in cities is larger than the sum of its parts

2013: Li, D., Bou-Zeid, E., JAMC



Rainfall

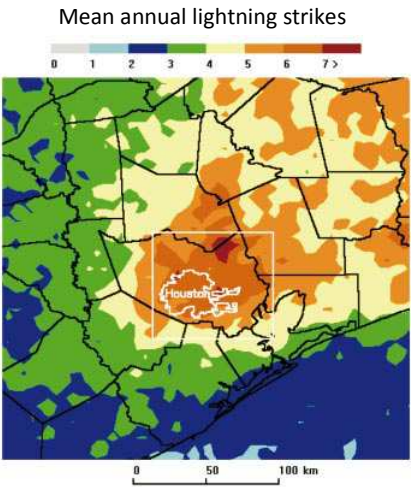


Heat Island



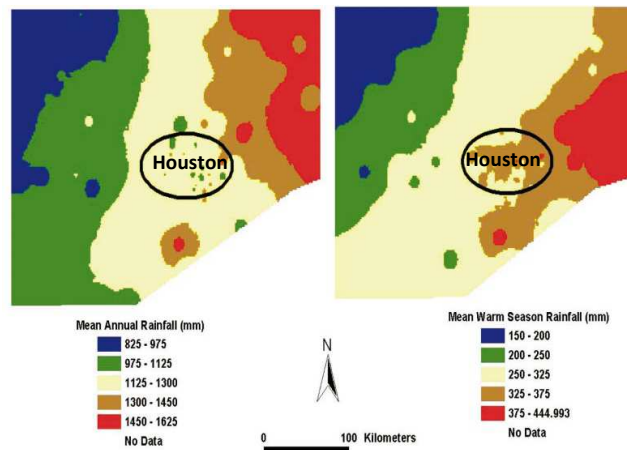
Image: Susan Gonnelli Byrne

Max density of lightning strikes is over/downwind of city



2001: Orville et al, GRL

High rainfall in warm season is over city



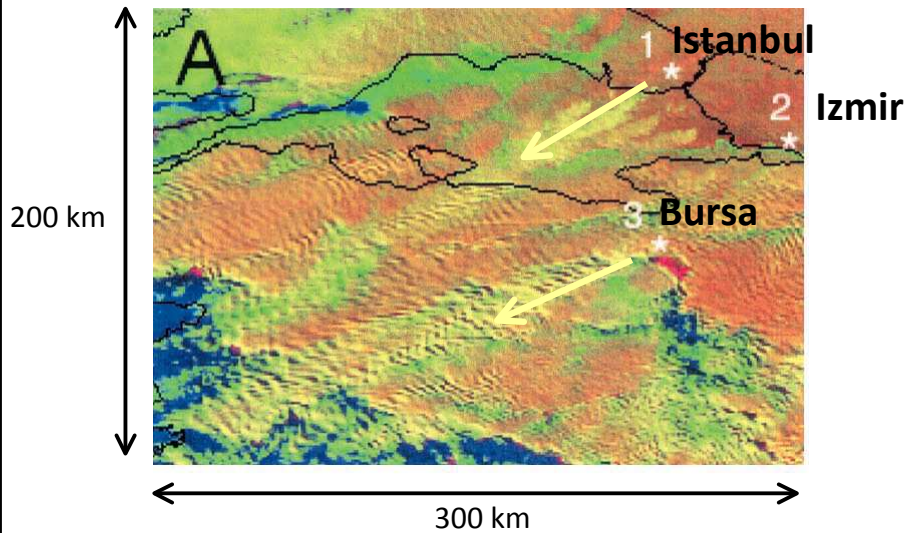
2003: Shepherd and Burian, Earth Inter.

Increase in rainfall documented in

- Europe: London, Bucharest
- Americas: Houston, St. Louis, Atlanta, Phoenix, New York, Mexico City



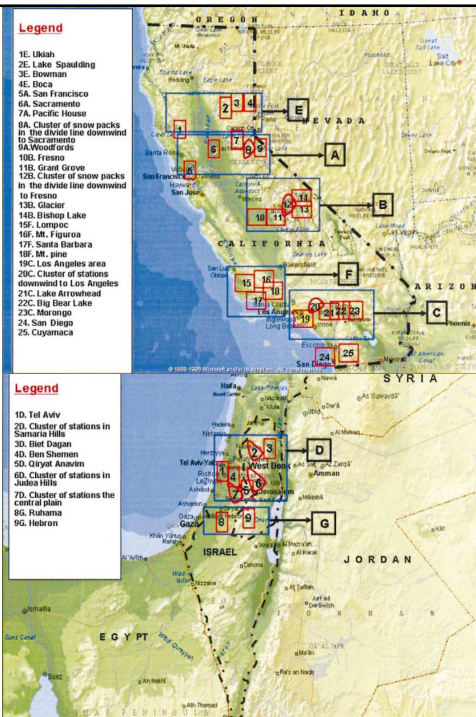
Industrial Air Pollution



2000: Rosenfeld, Science

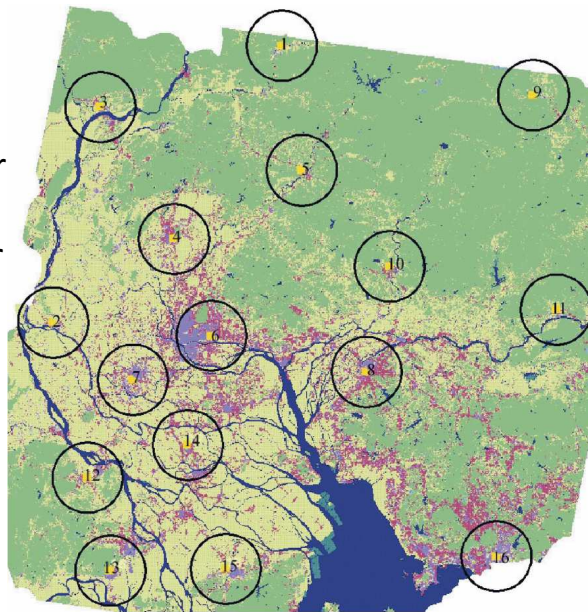
Air pollution downwind from cities in California, USA and Israel:
 15%–25% reduction of annual rainfall

1945 (1970) - 2000



2004: Givati & Rosenfeld, J. of App.

300% urban area
increase in Pearl River
Delta, China:
Suppression of winter
rainfall from 1988 to
1996

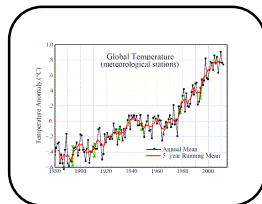


2007: Kaufmann et al., J. of Climate

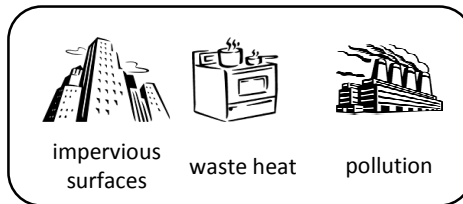


**High intensity or
suppressed rainfall**

Global Climate Change



Local/Regional Climate Change



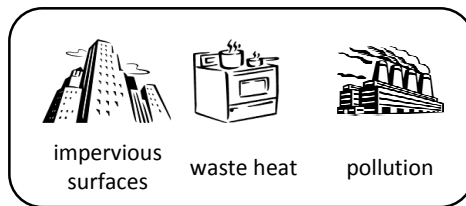


Local temperature changes may exert greater influence on urban areas than global temperature increases

Urban heat and aerosol pollutions may enhance or inhibit rainfall and storm over and downwind of city



Adaptation Measures



Urban soils (session 1.4): October 30th

Global Soil Week, Berlin, October 27-31

<http://globalsoilweek.org/>