Emerging Environmental Issues

Kenneth Olden and
Jerry Schnoor

SAB/BOSC Joint Meeting

Background

- EPA and ORD have many successes in the past including safe drinking water, better air quality, control of pesticides and toxic chemicals, etc.
- Successes have been mainly at the local scale with single and conventional pollutants where legislative mandate was strong
- Now, the problems are at larger scale (regional to global) and involve many areas without solid legislative jurisdiction (agricultural runoff, land use and climate change, energy choices)

Drivers of Env Change

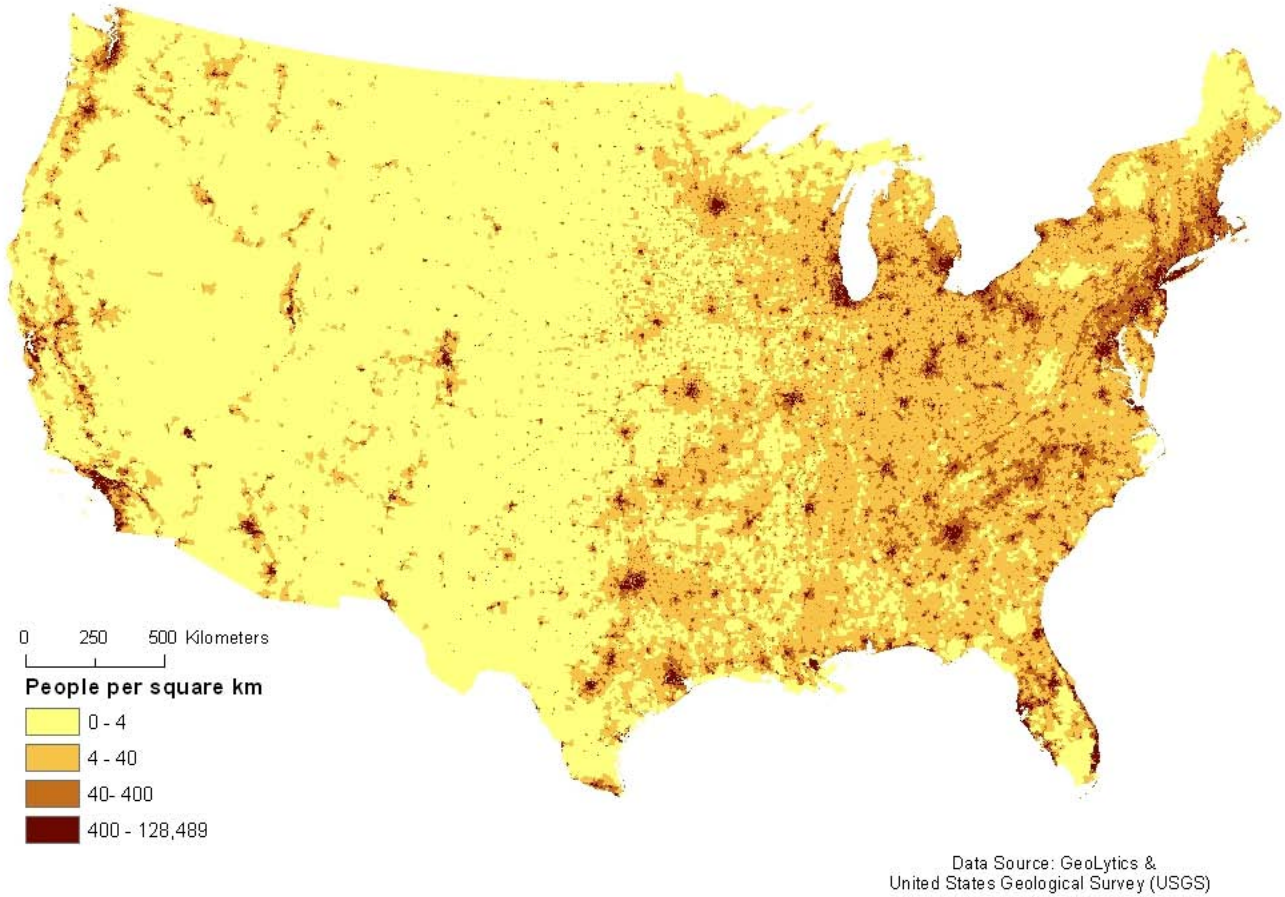
- Population growth and demographic shifts
- Land use change
  - Urban sprawl
  - Coastal development
- Energy Choices
  - Biofuels, hydraulic fracturing for shale gas, deep off-shore oil, wind, CSP

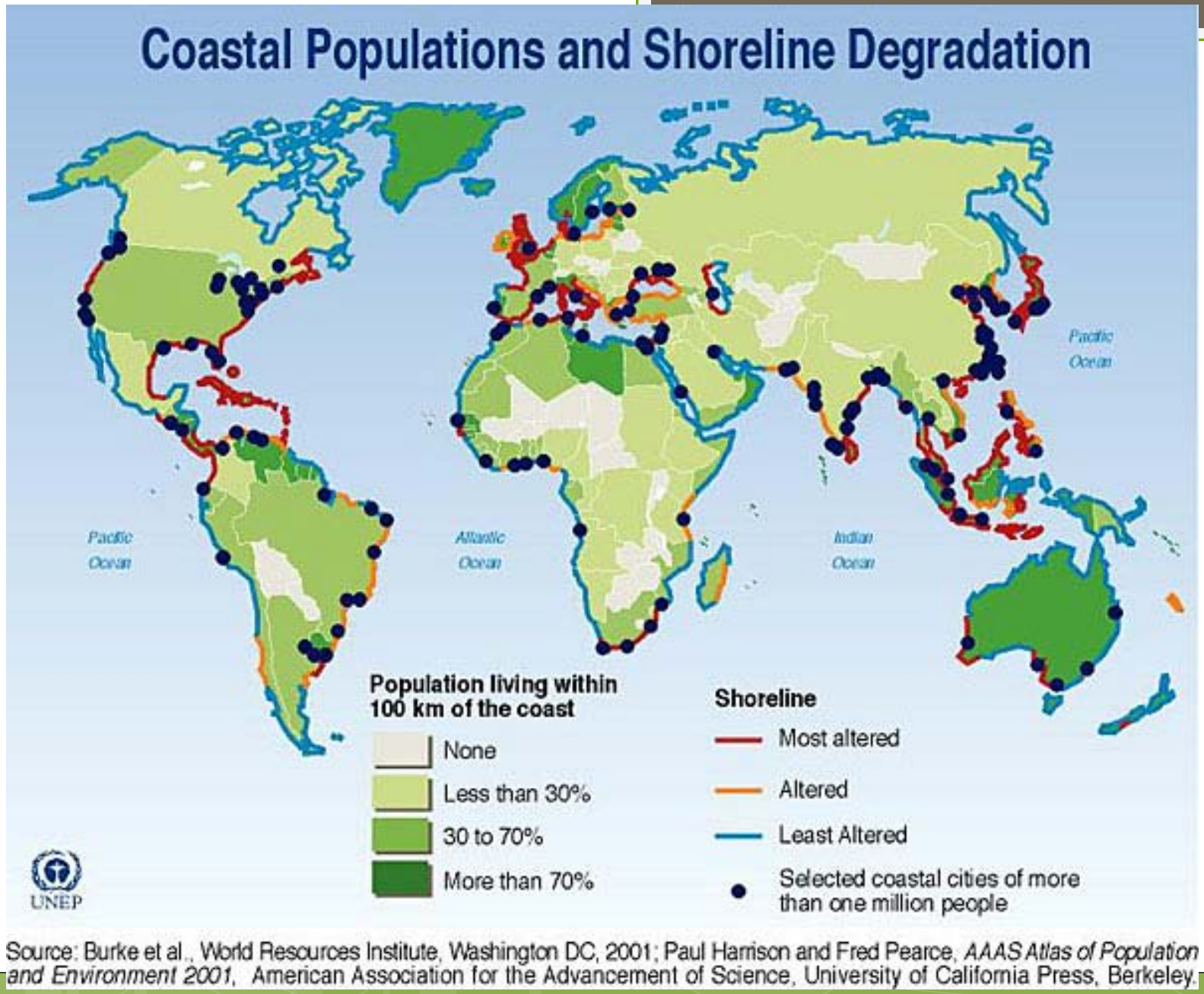
- No major legislative mandates since 1996
- Operationalizing "*Sustainability*" as a new paradigm is desirable but difficult

Some Emerging/Continuing Environmenal Issues

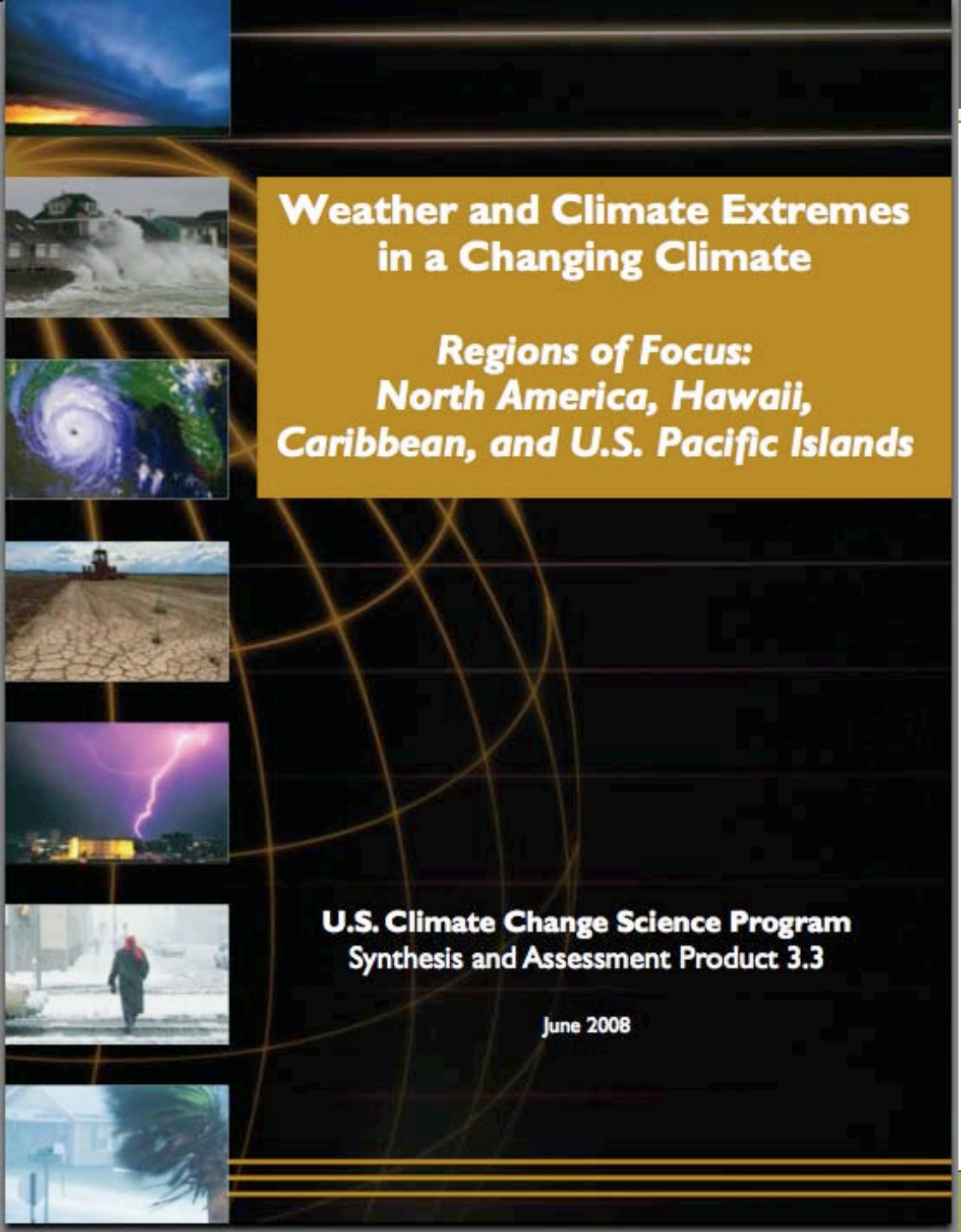
- Air quality deterioration from climate change
- Agricultural runoff and nutrient quality criteria
- Urban stormwater and by-pass
- Terrestrial ecosystem degradation (even the indicators are missing for birds, bees, butterflies, bats)
- Coastal waters ecosystems (hypoxia)
- Whole new Risk and Exposure Assessments in future (dioxin, chromium, arsenic, BPA, etc.)
- Climate change, acidifying oceans, coral reef decline, fisheries decline
- Sensing + Data Mining + High Performance Computing in real time = Env Forecasting

Population growth and sprawl



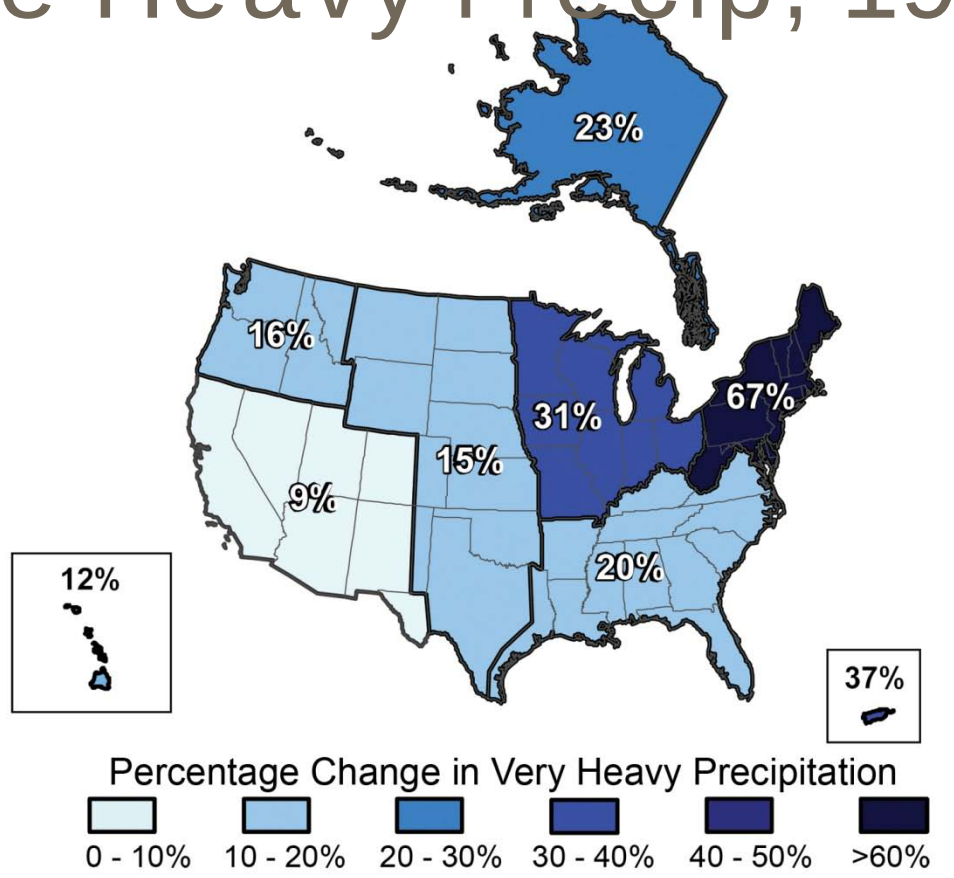


Source: Burke et al., World Resources Institute, Washington DC, 2001; Paul Harrison and Fred Pearce, *AAAS Atlas of Population and Environment 2001*, American Association for the Advancement of Science, University of California Press, Berkeley.



"One of the clearest trends in the United States observational record is an increasing frequency and intensity of heavy precipitation events… Over the last century there was a 50% increase in the frequency of days with precipitation over 101.6 mm (four inches) in the upper midwestern U.S."

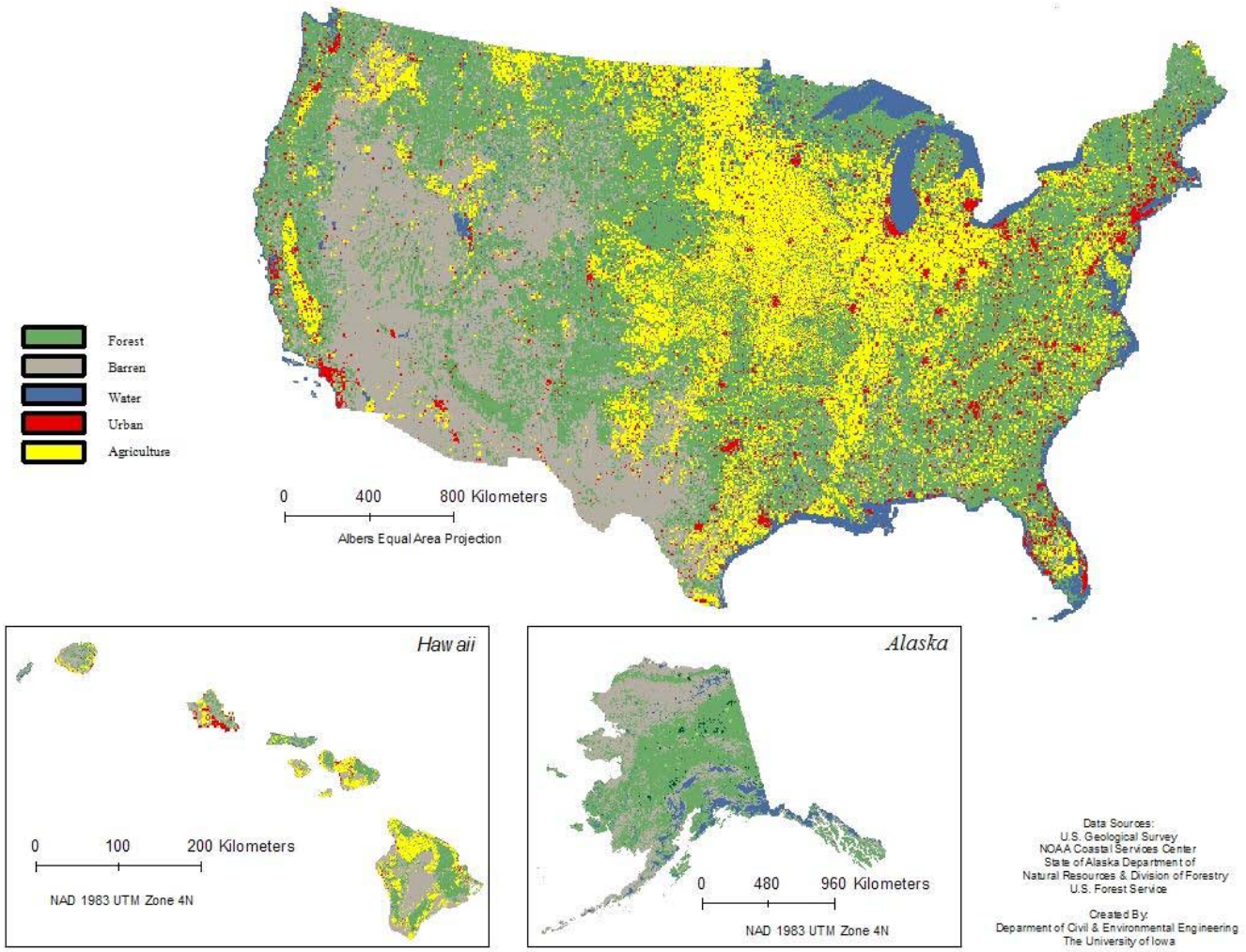
Increase Heavy Precip, 1958-2007



Updated from Groisman *et al.*[113]

The map shows the percentage increases in very heavy precipitation (defined as the heaviest 1 percent of all events) from 1958 to 2007 for each region. There are clear trends toward more very heavy precipitation for the nation as a whole, and particularly in the Northeast and Midwest.

Land Use Change



Water Energy Nexus

- *You can't have energy without water, and*
- *You can't have water w/o large energy inputs*

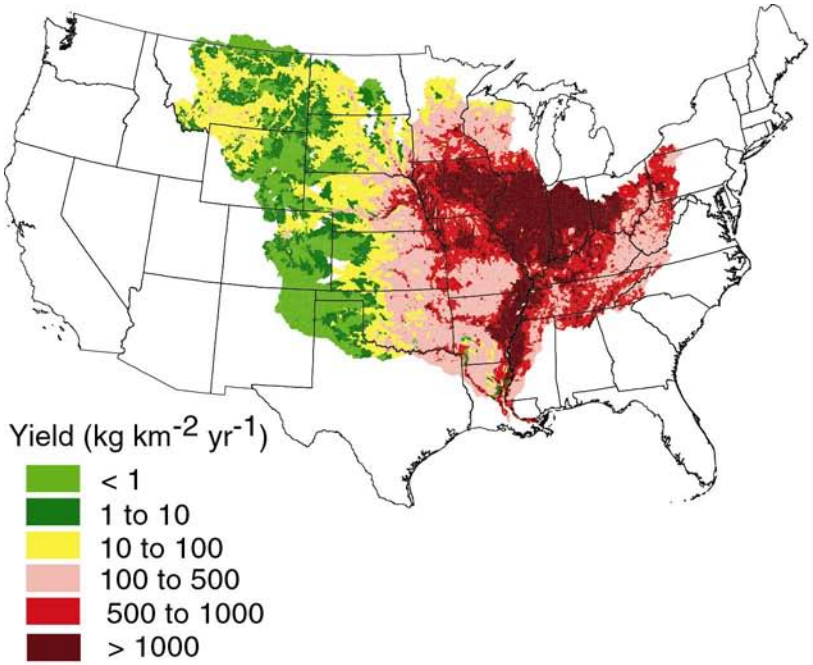
Water (gal) per MMBTU of Energy Produced

Chesapeake Energy 2010

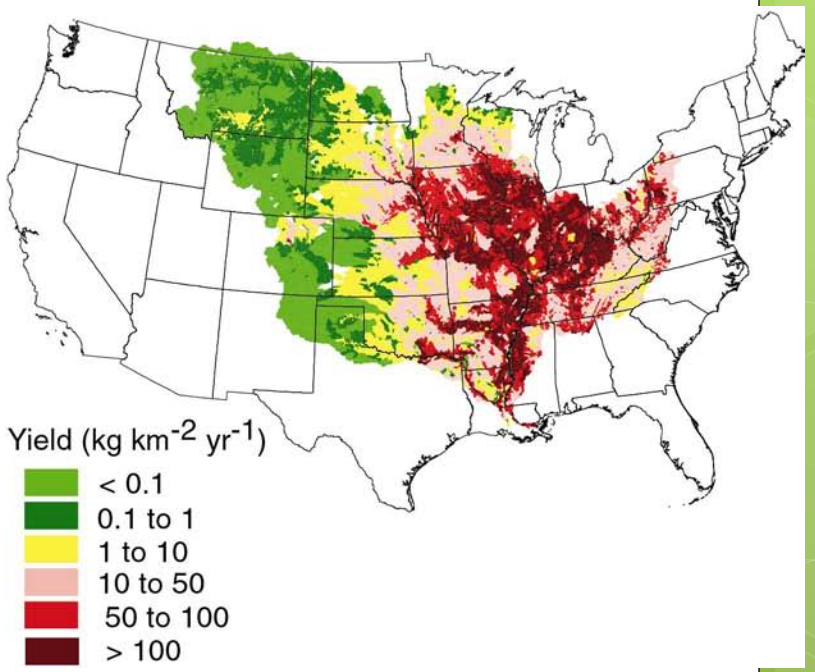
Deep Shale Natural Gas[1]	0.84 – 3.70[2]
Coal (no slurry transport) Coal (with slurry transport)	2 – 8 13 – 32
Nuclear (uranium ready to use in a power plant)	8 – 14
Conventional Oil	8 – 20
Synfuel - Coal Gasification	11 – 26
Oil Shale	22 – 56
Tar Sands	27 – 68
Synfuel - Fisher Tropsch (from coal)	41 – 60
Enhanced Oil Recovery (EOR)	21 – 2,500
Biofuels (Irrigated Corn Ethanol, Irrigated Soy Biodiesel)	> 2,500

Nutrient Yield Delivered to the Gulf of Mexico

Total Nitrogen

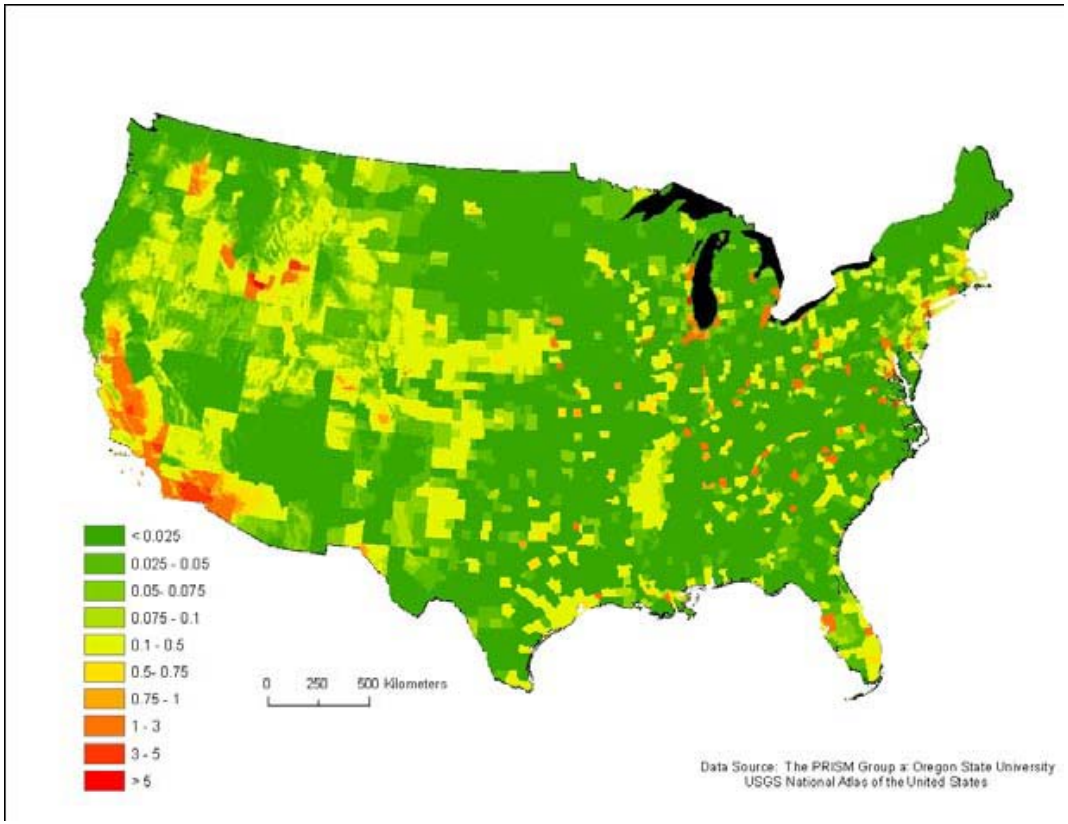


Total Phosphorus



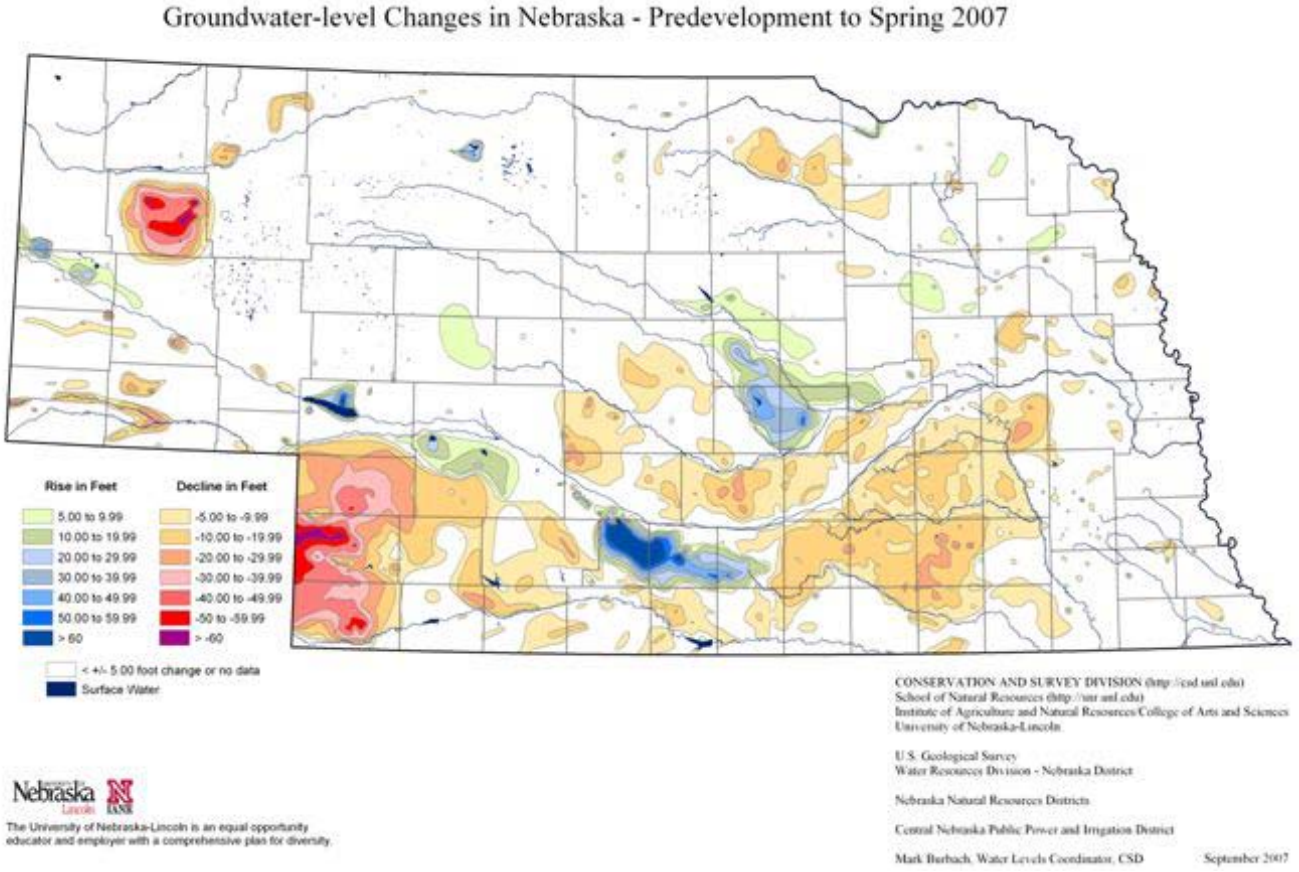
Source: Alexander et al., ES&T, 2008

Water Stress Map (water use/precip)



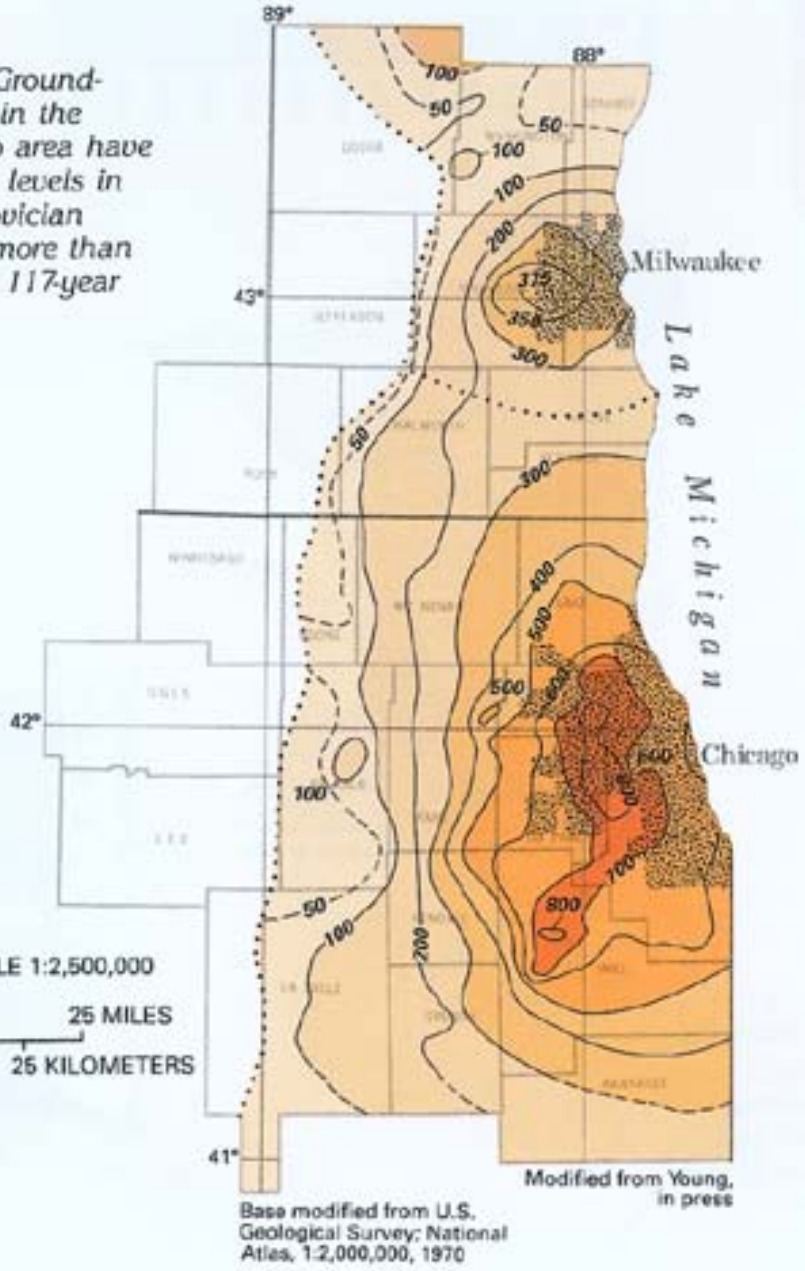
K. J. Hutchinson, M.S. Thesis
University of Iowa, 2008.

Nebraska Draw-Down of Wells in High Plains Aquifer



Cambrian-Ordovician Aquifer Drawdown

Figure 125. *Groundwater withdrawals in the Milwaukee–Chicago area have drawn down water levels in the Cambrian–Ordovician aquifer system by more than 800 feet during the 117-year period, 1864–1980.*



EXPLANATION

Water-level decline in Cambrian–Ordovician aquifer system, in feet

- Less than 100
- 100 to 300
- 300 to 500
- 500 to 700
- Greater than 700

300 — **Line of equal water-level decline— Dashed where approximately located. Intervals 50 and 100 feet**

Ground-water divide

WATERS Network for sensing, understanding, forecasting water