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Creating an Environmental Quality Index to Examine Health Outcomes

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Promoting Healthy Communities
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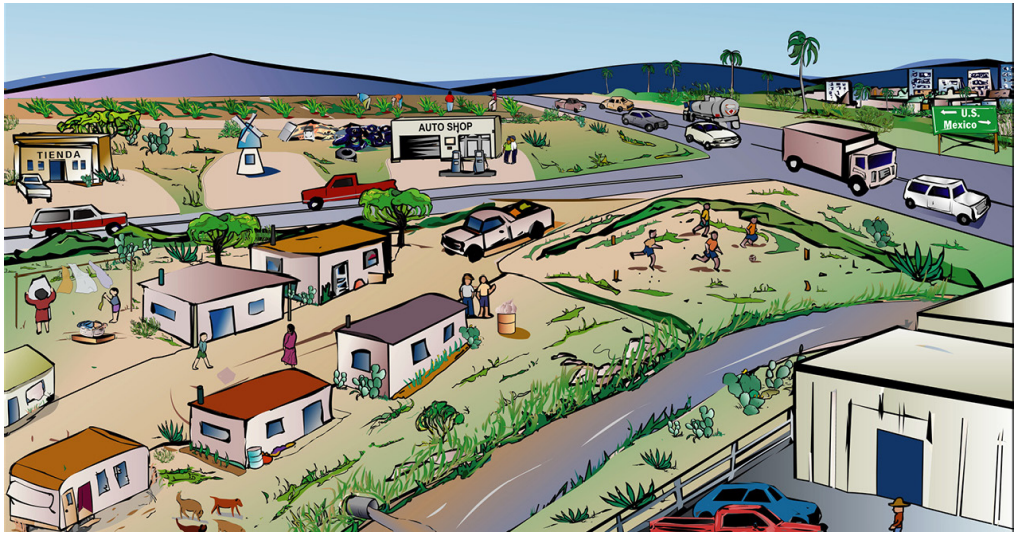
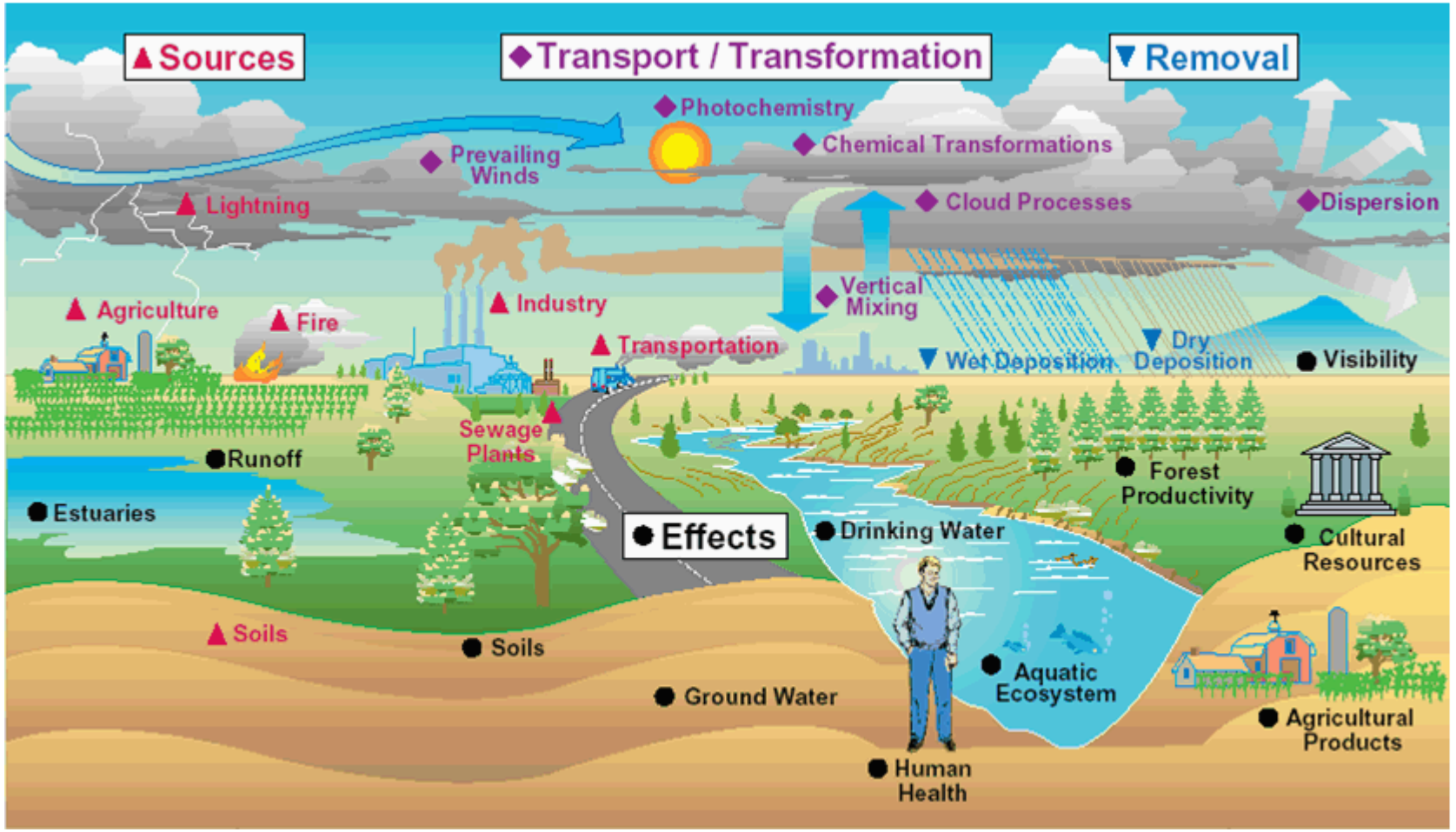
Multiple Environments



Multiple Environmental Hazards



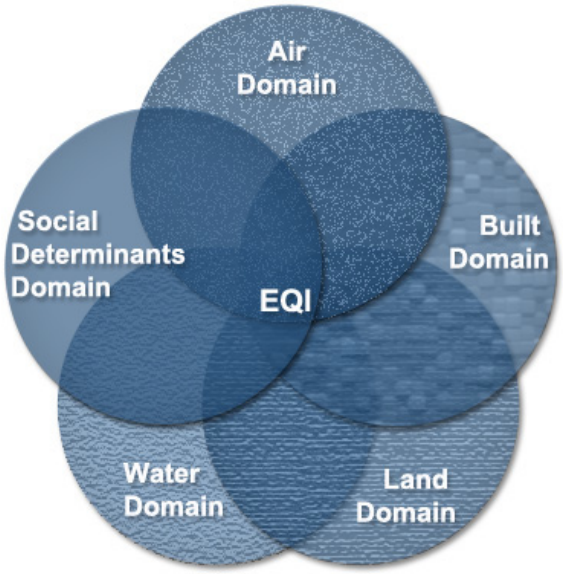
http://www.epa.gov/oar/airtrends/2007/graphics/Air_pollution_pathways_textbox.gif

Background – Agency Problem Addressed

- Human health and disease - a complex process
- Exposures to harmful and benign substances occurring simultaneously
  - Environmental exposures tend to cluster
    - environmental disamenities such as landfills or industrial plants often located in neighborhoods with high a percent of minority and poor residents
    - conversely, high income neighborhoods frequently contain amenities conducive to promoting and maintaining optimal health, such as parks
- No single exposure can be held responsible for good or poor health
  - Not just good quality air or high income that produces health, but probably the combination of these and other various exposures

Goals of EQI

- This research will attempt to construct an environmental quality index (EQI) for all counties in the U.S. taking into account:
  - multiple domains that influence exposur and health
    - five domains: air, water, land, built environment, and SES
  - incorporates data representing the chemical, natural and built environment



Project Aims of EQI

- Collect and standardize data representing broad environmental data for multiple geographies across the U.S.
- Assess counties of greater or lesser environmental quality
- Assess the relationship between “environmental quality” and human health outcomes
  - Assessing predictive utility for disparate reproductive health outcomes (e.g., infant mortality, preterm birth, birth weight
  - Analyses with non-reproductive outcomes, like asthma, gastrointestinal morbidity
- Develop a measure that can be used as a baseline for communities to use for comparison
- Specific EQI variable loadings will suggest the magnitude of each domain’s contribution to the overall environmental quality
- Used by investigators interested in specific environmental exposures (e.g., air quality researchers) to adjust for the overall environmental quality, to better isolate specific exposure effects.

Data Sources by Domain

DOMAIN	DATA SOURCES
Air	Air Quality System (AQS); National Air Toxics Assessment (NATA)
Land	County pesticide use estimates; 2002 Census of Agriculture Full Report; Dun and Bradstreet Agriculture Data; Web Feature Service for National Priority List (NPL) Sites; National Geochemical Survey (NGS); Map of Radon Zones
Water	National Water Information System (NWIS)/STORET; WATERS Program/Reach Address Databases; National Contaminant Occurrence Database (NCOD); Safe Drinking Water Information System (SDWIS); Estimates of Water Use in U.S.; Drought Monitor Data; National Atmospheric Deposition Program; Nutrient Loss Database for Agricultural Fields in U.S.
Built Environment	Duns and Bradstreet North American Industry Classification System (NAICS) codes; Topologically Integrated Geographic Encoding and Referencing (TIGER); Rural-Urban Commuting Area (RUCA) Codes; Fatality Annual Reporting System; Housing and Urban Development
Socio-demographic	Uniform crime reports; U.S. Census; Home Mortgage Disclosure Act (HDMA) Data

Lobdell DT, Jagai JS, Rappazzo K, Messer LC. 2011. Data Sources for an Environmental Quality Index: Availability, Quality, and Utility. Am J Public Health. Published online ahead of print August 11, 2011: e1-e9. doi:10.2105/AJPH.2011.300184

Proto-EQI Development

- Air Domain
  - Criteria air pollutants: mean annual values of PM10, PM2.5, CO, SO2, NO2, and O3.
    - Monitor data from Air Quality System taken and kriged across the U.S. to obtain values at each county centroid
  - Hazardous air pollutants: annual emissions in tons for 103 pollutants (e.g., toluene, hydrochloric acid, methanol, hexane, etc)
    - Modeled ambient concentration estimates from the National-Scale Air Toxics Assessment (NATA)

Proto-EQI Development

- Water Domain
  - WATERS Database: Percent of stream length impaired in county, number of discharge permits in county, number of days a beach is closed for advisories
  - Estimates of Water Use (USGS): percent of population using ground water, surface water for domestic use
  - National Atmospheric Deposition Program: Precipitation weighted mean deposition of elements
    - Ca, Mg, K, Na, NH4, NO3, Cl, SO4, Hg
    - Measured data kriged across the country to obtain county level values
  - Drought Monitor Data: Percent of county in extreme drought conditions
  - National Contaminant Occurrence Database: Average of measured values for contaminants (i.e., arsenic, dioxin, atrazine, uranium)

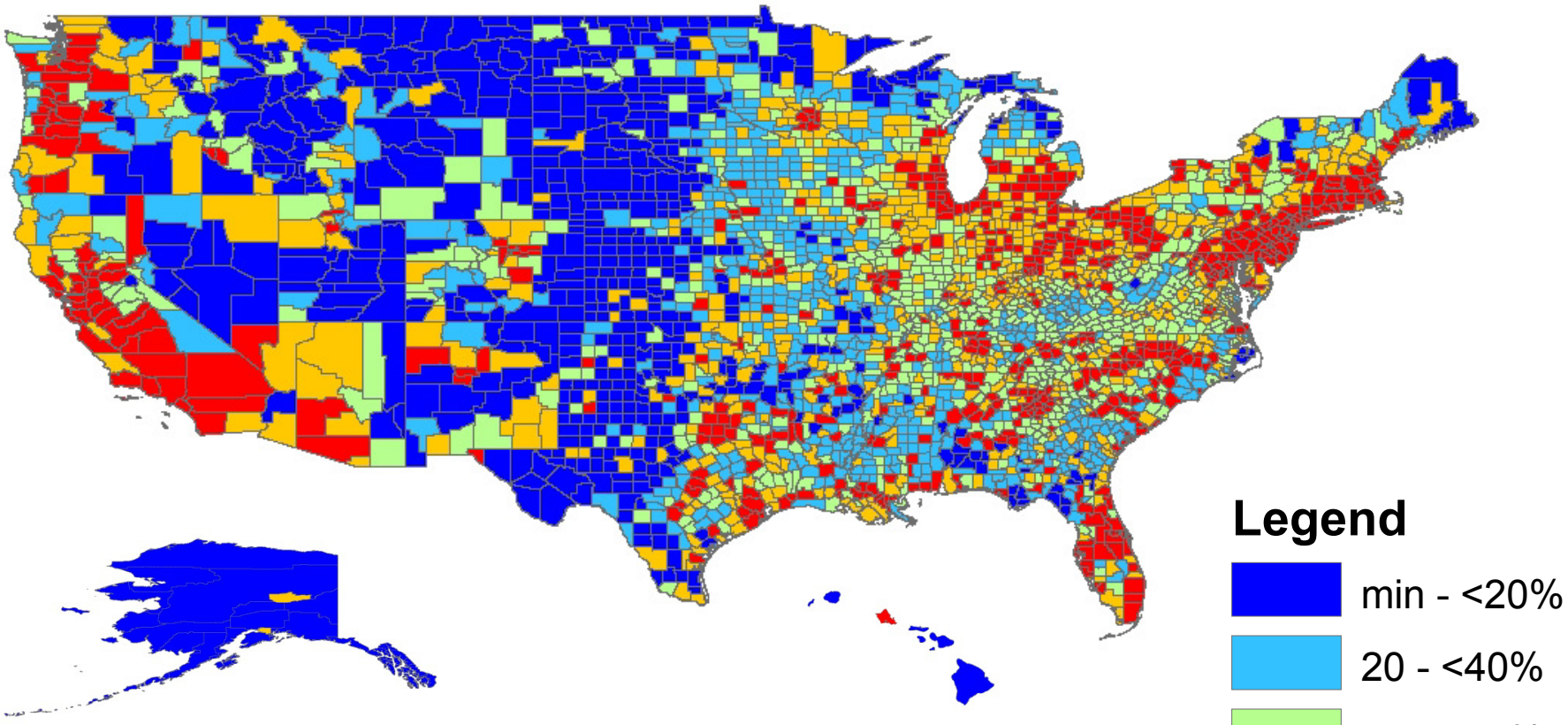
Proto-EQI Development

- Land domain
  - NGS data (means of soil samples taken from stream beds for various minerals (n=14), including arsenic, lead, copper, sodium, iron)
  - Radon zones (3 category variable)
  - Agriculture data (number of farms, irrigated acres and harvested acres in 2002, acres in crops (e.g., wheat, corn, soybean, tobacco) and insecticide-treatment)
- Sociodemographic domain
  - Census data (housing characteristics, poverty, language, unemployment)
  - Crime rates (violent, murder, rape, robbery, aggravated assault, property, burglary, larceny, vehicular

Proto-EQI Development

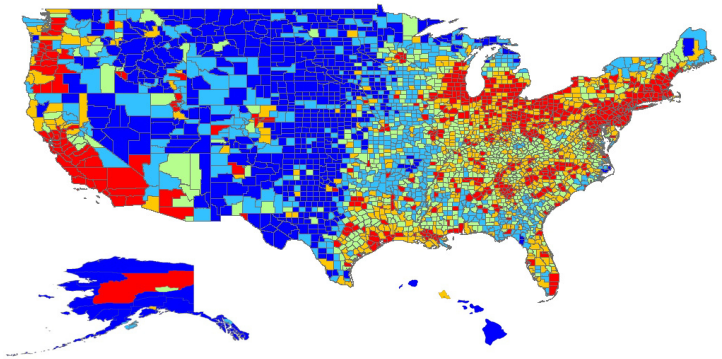
- Built domain
  - Road-way data (density of highways, secondary roads, streets)
  - Three transportation-related census variables (percent taking public transportation, mean commute time, percent working outside county of residence)
  - Transportation-related fatalities (density of fatal accidents)
  - Public housing (Section-8 and low-rent housing density)

Proto-EQI

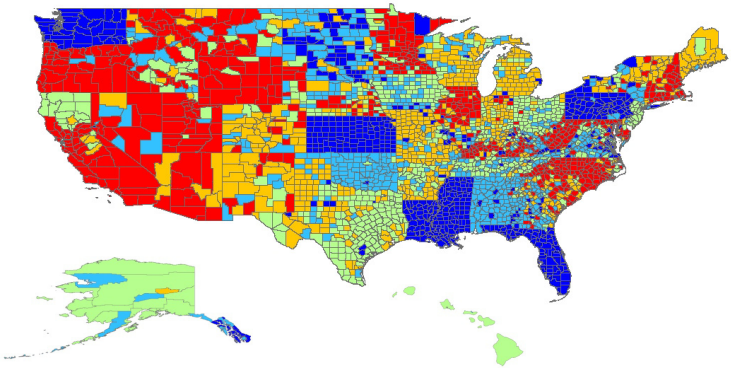


Domains

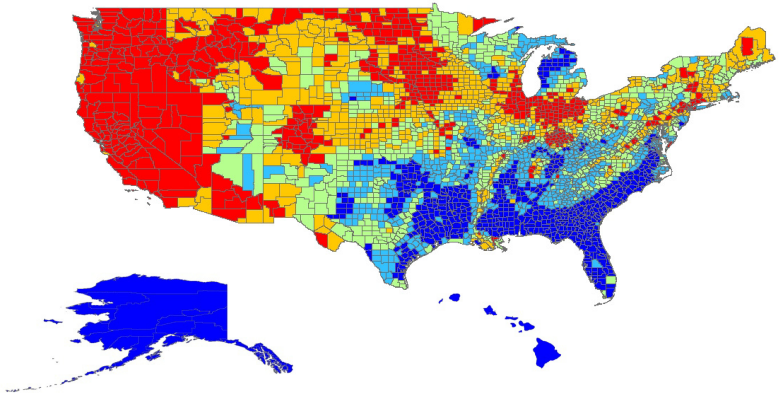
Air



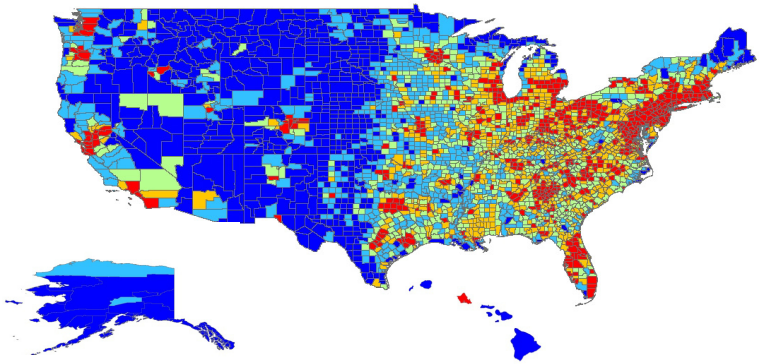
Water



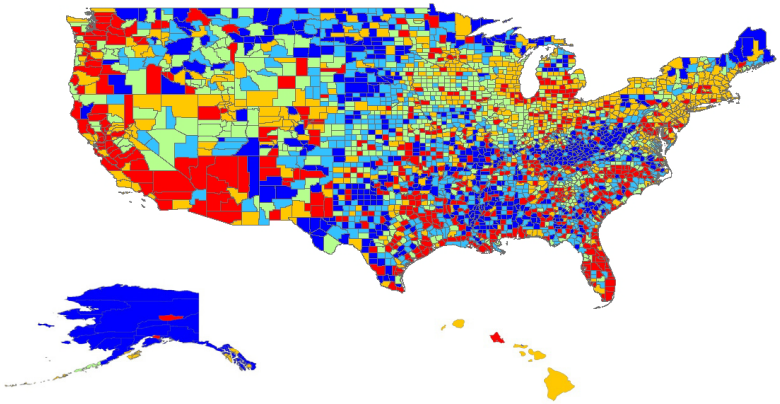
Land



Built Environment



Sociodemographic



Legend

- min - <20%
- 20 - <40%
- 40 - <60%
- 60 - 80%
- 80% - max

Rural-Urban Continuum Code (RUCC)

- Will Stratify by RUCC
  - 9-item categorization code of proximity to / influence of major metropolitan areas on counties
    - RUCC1 (metropolitan urbanized = codes 1+2+3)
    - RUCC2 (non-metro urbanized = 4+5)
    - RUCC3 (less urbanized = 6+7)
    - RUCC4 (thinly populated =8+9)

Timeline

Timeline

FY 09 – Exploring sources of data

FY 10 – Obtain, clean and prepare data

FY 11 – Produce draft indices

FY 11 – Revise data based on initial analyses and indices development

FY 11 – Finalize indices and analyze data

FY 11/12 – Produce manuscripts

FY 12 – Apply methods to other health outcomes

Keep updated with progress of project through our website at:
http://www.epa.gov/nheerl/eqi/

Ongoing Related Projects

- Utilizing impairment data collected under the Clean Water Act for public health analysis
  - Linear random effects model at county level
  - Limited data availability but associations seen with gastrointestinal infections and recreational water impairment
- Multiple Environmental Contexts and Preterm Birth Outcomes
  - Linear regression for county level risk of preterm birth with proto-EQI
  - Variety of effects found across urban/rural and racial strata
    - E.g., air domain associated with increased prevalence of preterm birth in urban counties, decreased in rural counties.
- NC MEDI-EQI – Birth Outcomes
  - Multilevel model of various birth outcomes (low birth weight, small for gestational age, preterm birth) in NC associated with MEDI –EQI
  - No significant associations demonstrated, but may need to stratify analysis by rural / urban areas

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Questions?