Direct and Indirect Effects of Climate Change on Public Health and the Environment

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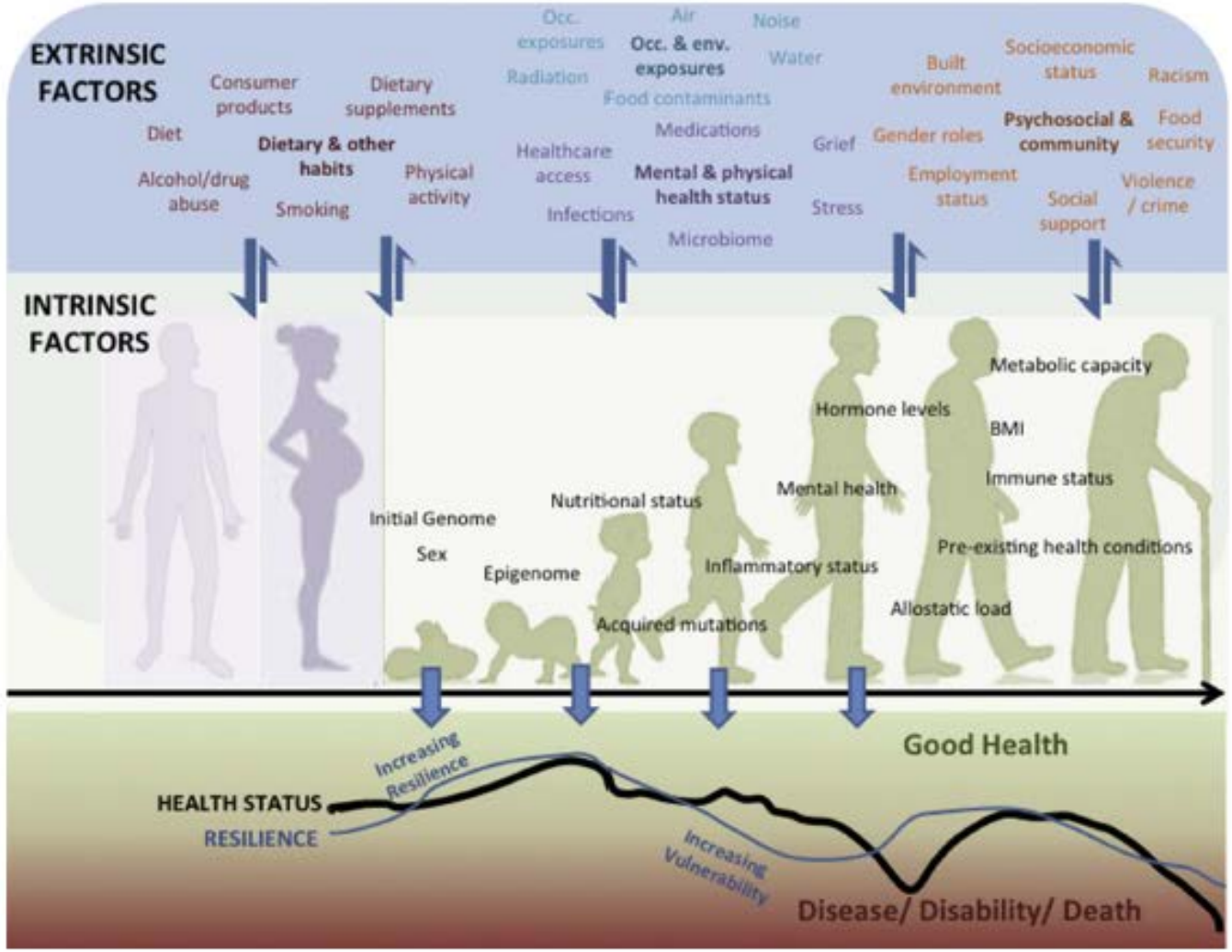
July 13, 2018

Context and Perspective

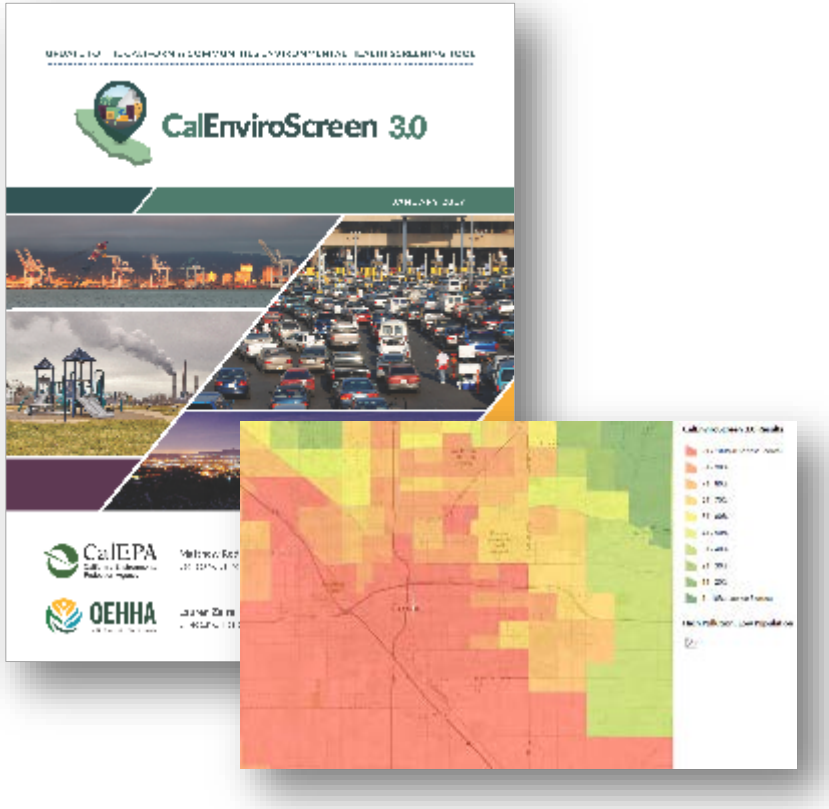


McHale CM, Osborne G, Morello-Frosch R, Salmon AG, Sandy MS, Solomon G, Zhang L, Smith MT, Zeise L. Assessing health risks from multiple environmental stressors: Moving from G×E to I×E. Mutat Res. 2018 775:11-20.

Topics

- CalEnviroScreen
- Climate Change Indicators
- Health Impact Profiling

CalEnviroScreen 3.0



- Spatial analysis of relative burdens in California communities from pollution and population vulnerability
- 20 indicators combined into a single score
- Census tract scale

Available at: http://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30

Indicators

CalEnviroScreen 3.0

Pollution Burden

Exposures

Ozone

PM2.5

Diesel Particulate Matter

Drinking Water Contaminants

Toxic Releases from Facilities

Traffic

Pesticide Use

Environmental Effects

Solid Waste Sites and Facilities

Cleanup Sites

Groundwater Threats

Impaired Water Bodies

Hazardous Waste Generators and Facilities

Population Characteristics

Sensitive Populations

Asthma

Cardiovascular Disease

Low Birth Weight Infants

Socioeconomic Factors

Educational Attainment

Housing Burdened Low Income Households

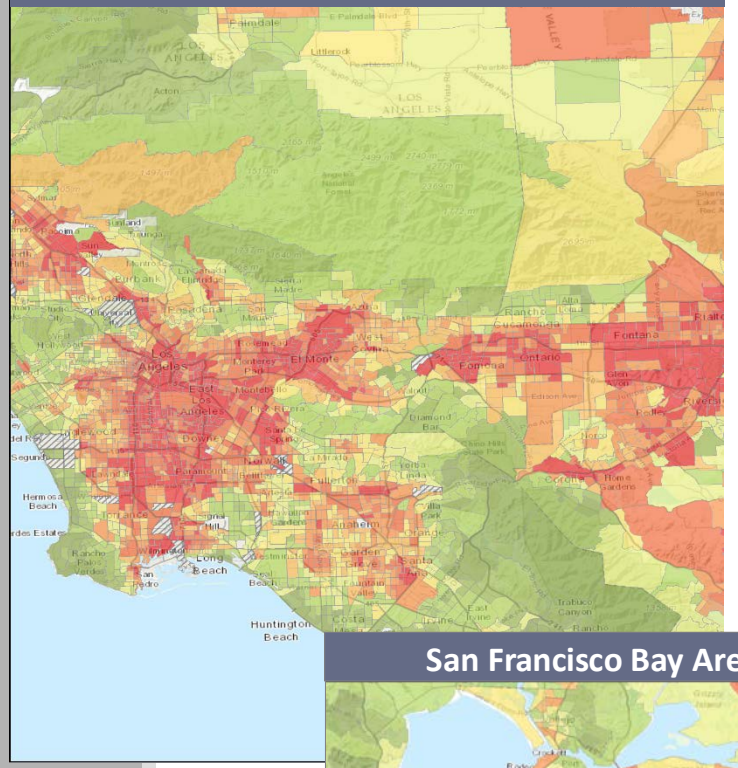
Linguistic Isolation

Poverty

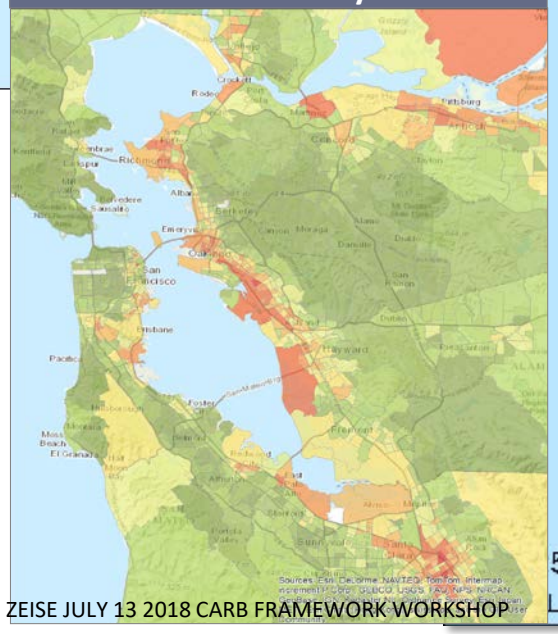
Unemployment

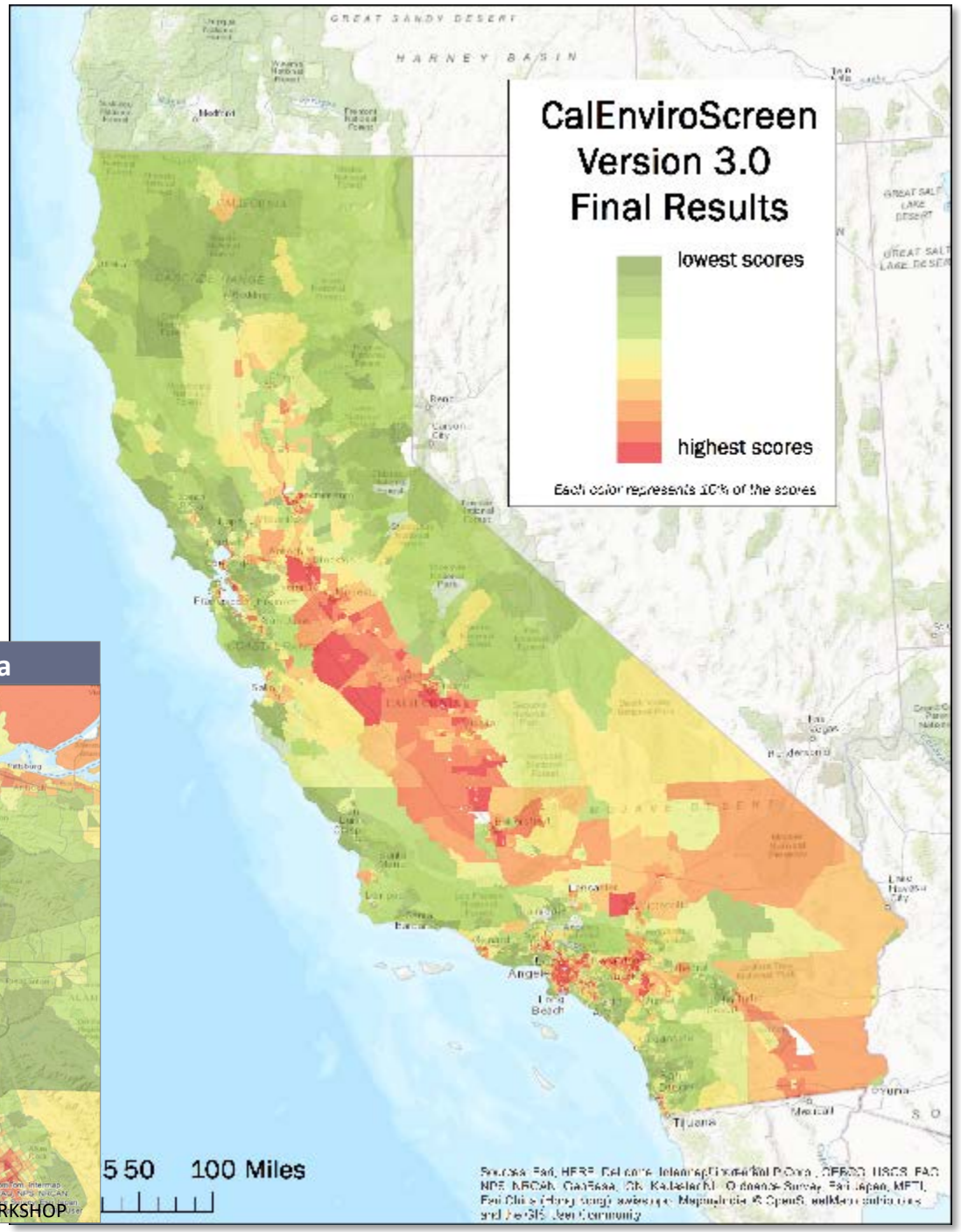
Results

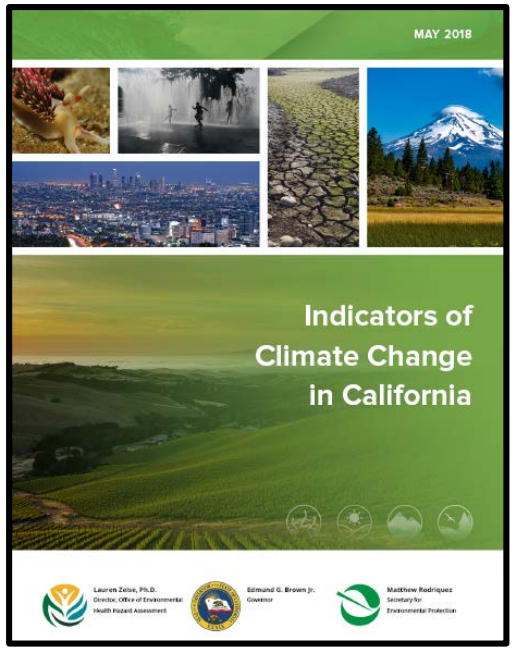
Los Angeles Area



San Francisco Bay Area







INDICATORS OF CLIMATE CHANGE IN CALIFORNIA

CLIMATE CHANGE DRIVERS

- Greenhouse gas emissions
- Atmospheric greenhouse gas concentrations
- Atmospheric black carbon concentrations
- Acidification of coastal waters

CHANGES IN CLIMATE

- Annual air temperature
- Extreme heat events
- Winter chill
- Cooling and heating degree days
- Precipitation
- Drought

IMPACTS OF CLIMATE CHANGE ON PHYSICAL SYSTEMS

- Snowmelt runoff
- Snow-water content
- Glacier change
- Lake water temperature
- Coastal ocean temperature
- Sea level rise
- Dissolved oxygen in coastal waters

IMPACTS OF CLIMATE CHANGE ON BIOLOGICAL SYSTEMS

On humans

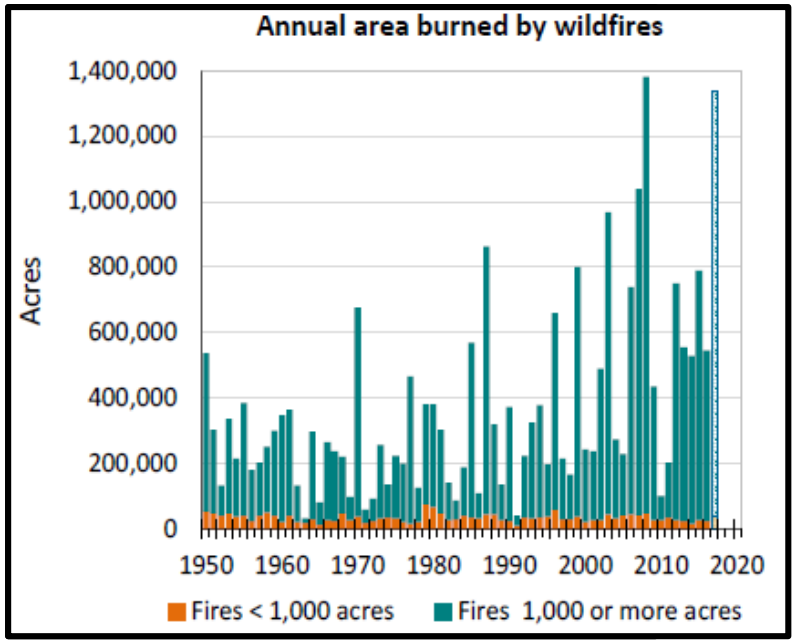
- Vector-borne diseases
- Heat-related mortality and morbidity

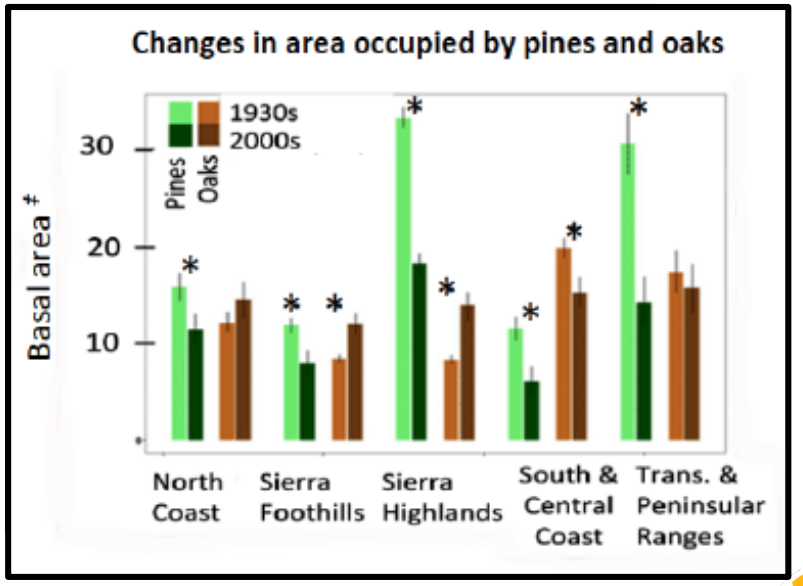
On vegetation

- Forest tree mortality
- Wildfires
- Ponderosa pine forest retreat
- Vegetation distribution shifts
- Changes in forests and woodlands
- Subalpine forest density
- Fruit and nut maturation time

On wildlife

- Spring flight of Central Valley butterflies
- Migratory bird arrivals
- Bird wintering ranges
- Small mammal and avian range shifts
- Effects of ocean acidification on marine organisms *(Type III")*
- Nudibranch range shifts
- Copepod populations
- Sacramento fall-run Chinook salmon abundance
- Cassin's auklet breeding success
- California sea lion pup demography





Predicting and Quantifying Health Effects

Epidemiology studies

Criteria Air Pollutants

- Particulate matter (e.g., PM2.5, Coarse particles)
- NO_2 and Ozone

Traffic Exposure, e.g.,

- Miscarriage/Sensitive Populations
- Children's respiratory health

Temperature, e.g.,

- Heat and infant death
- Heat wave morbidity and mortality
- Temperature and emergency room visits
- Temperature and preterm delivery

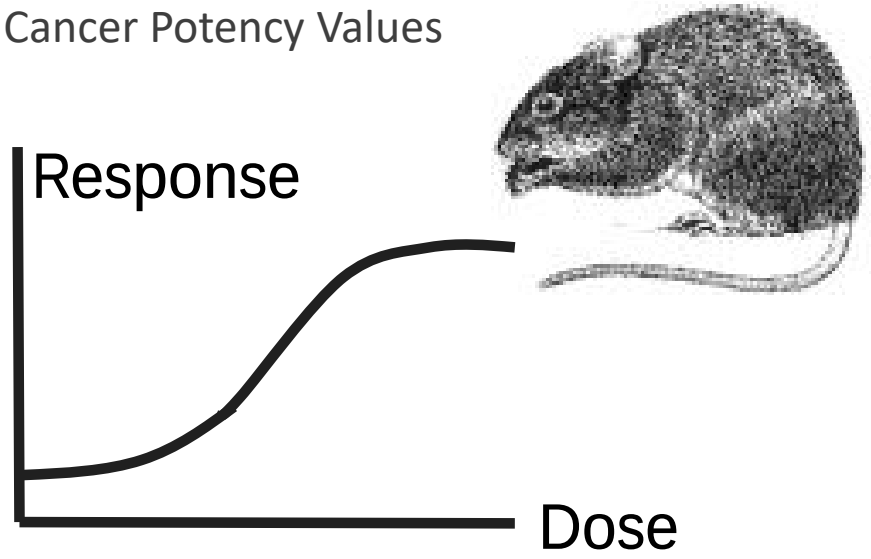
Toxicology

Hazard Identifications

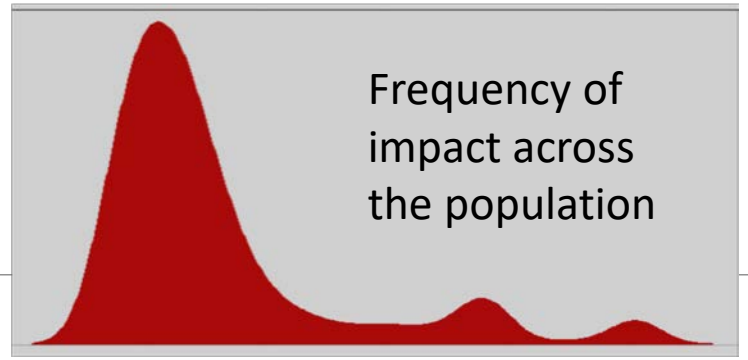
- Endpoints and hazard traits

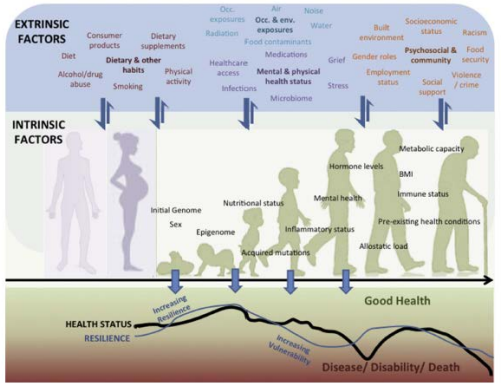
Dose Response Assessments

- Reference Exposure Levels
- Cancer Potency Values



Predicting health impacts of actions





Community Monitoring

Emissions Inventory

Biomonitoring

Predictions: Exposure Reductions

Predictions: Exposure Response Relationships

Epidemiology

Toxicology

New Tools