Global Change Research Program:
invasive species, biocriteria, land use change, climate-sensitive decisions

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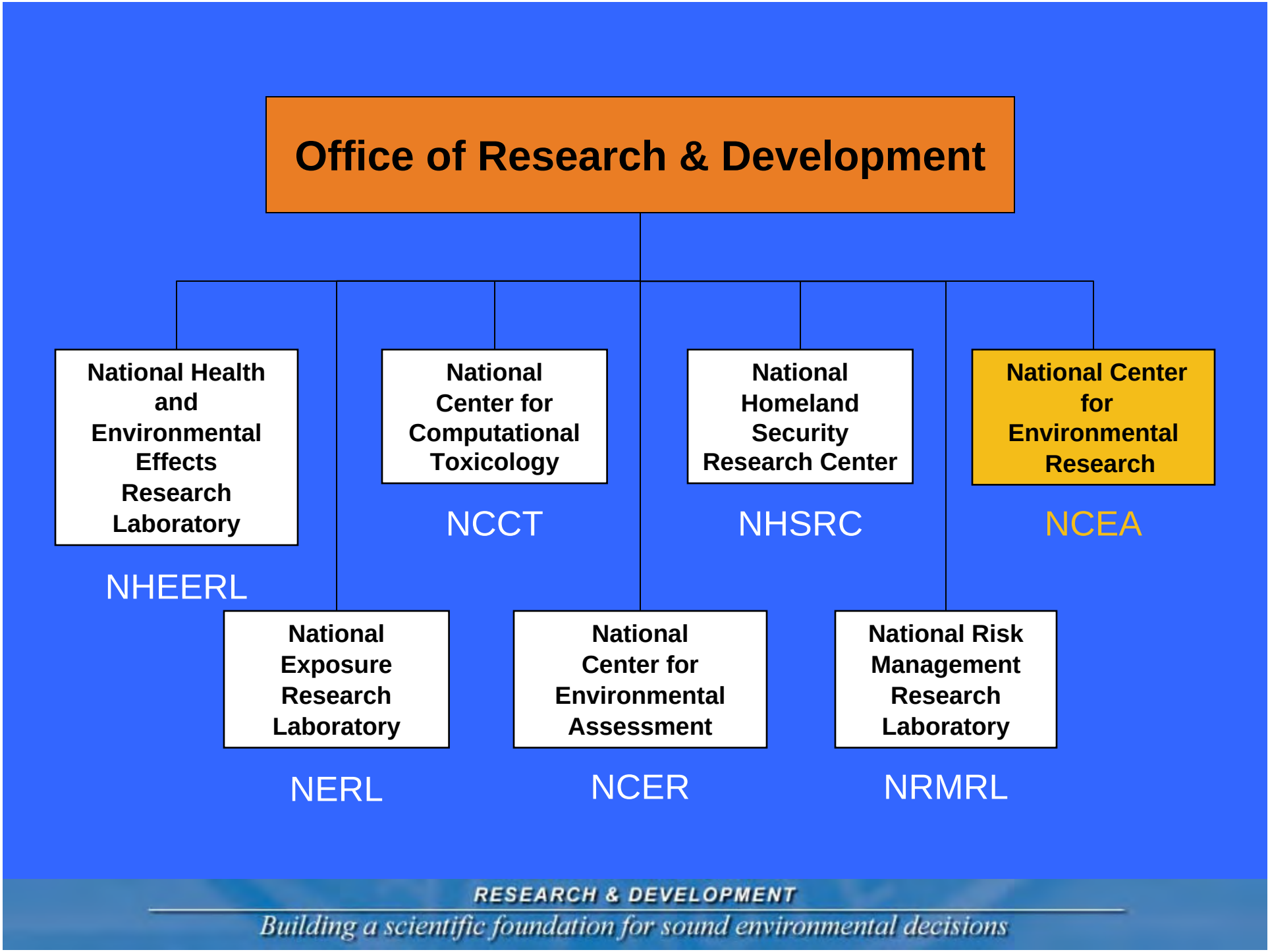
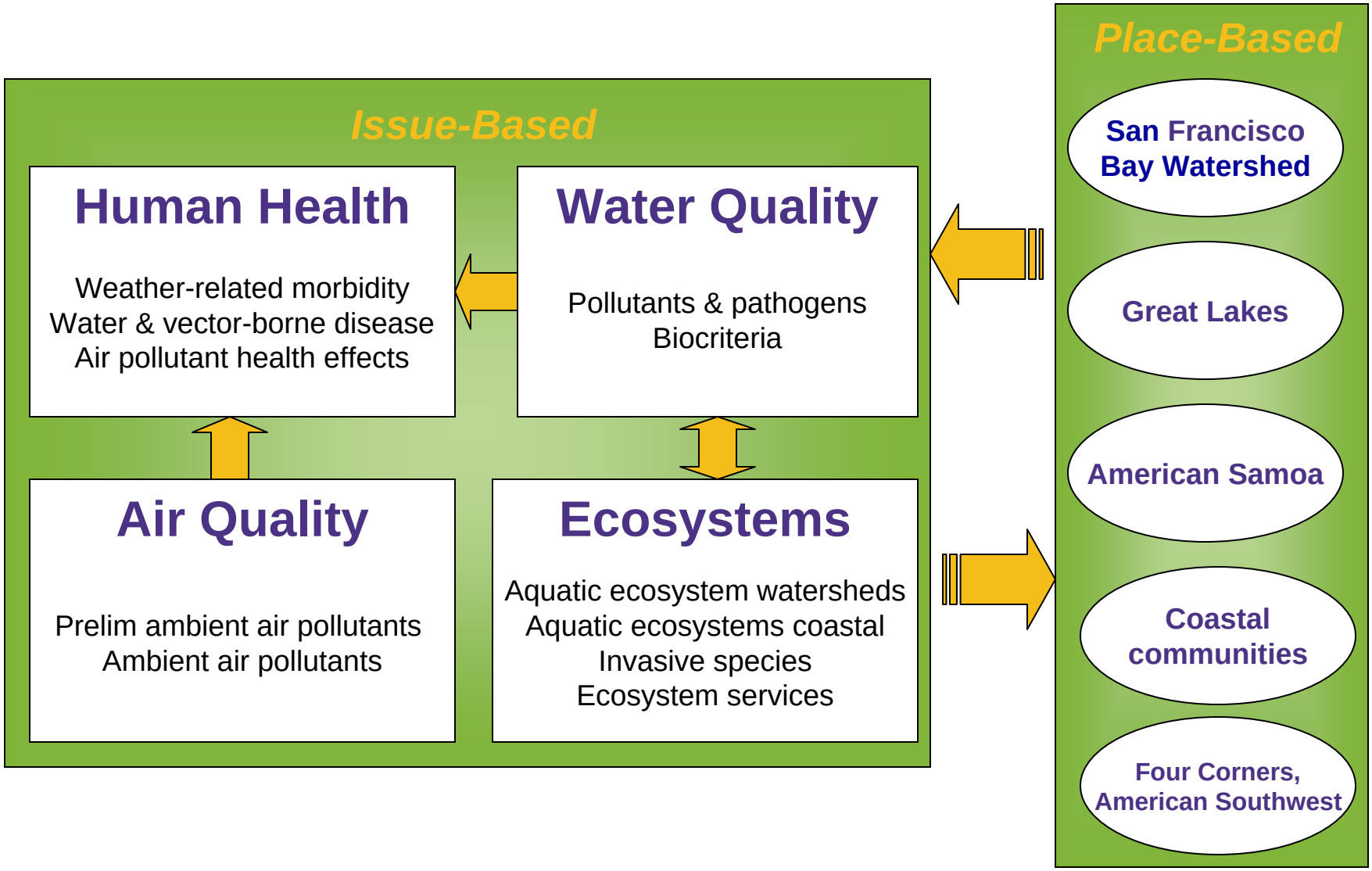
U.S. Environmental Protection Agency


Office of Research & Development
National Health and Environmental Effects Research Laboratory
NHEERL
National Center for Computational Toxicology
NCCT
National Homeland Security Research Center
NHSRC
National Center for Environmental Research
NCEA
National Exposure Research Laboratory
NERL
National Center for Environmental Assessment
NCER
National Risk Management Research Laboratory
NRMRL
RESEARCH & DEVELOPMENT
Building a scientific foundation for sound environmental decisions

Integrated Issue & Place-Based Research

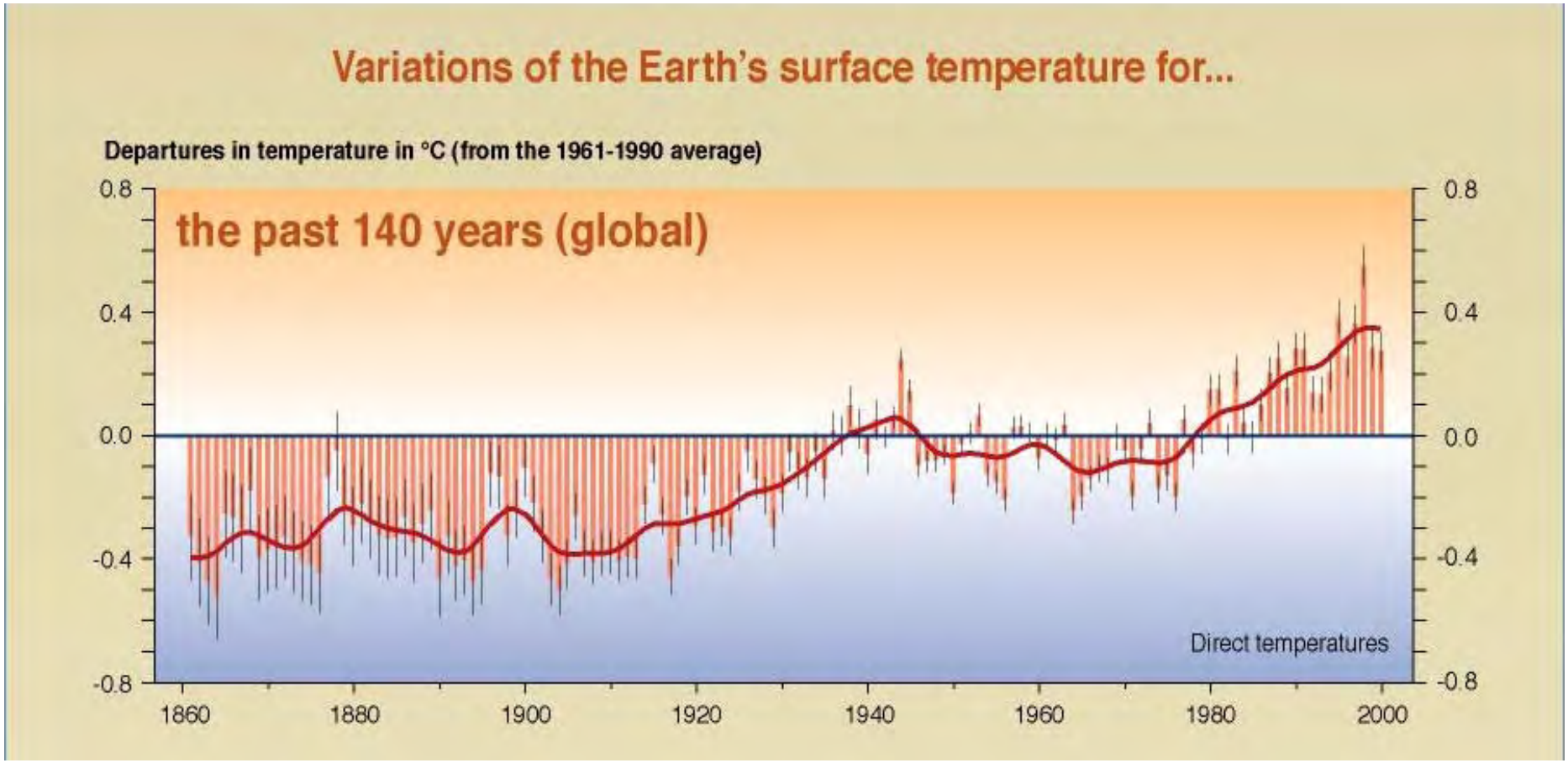


Four brief examples

GCRP is currently working on:

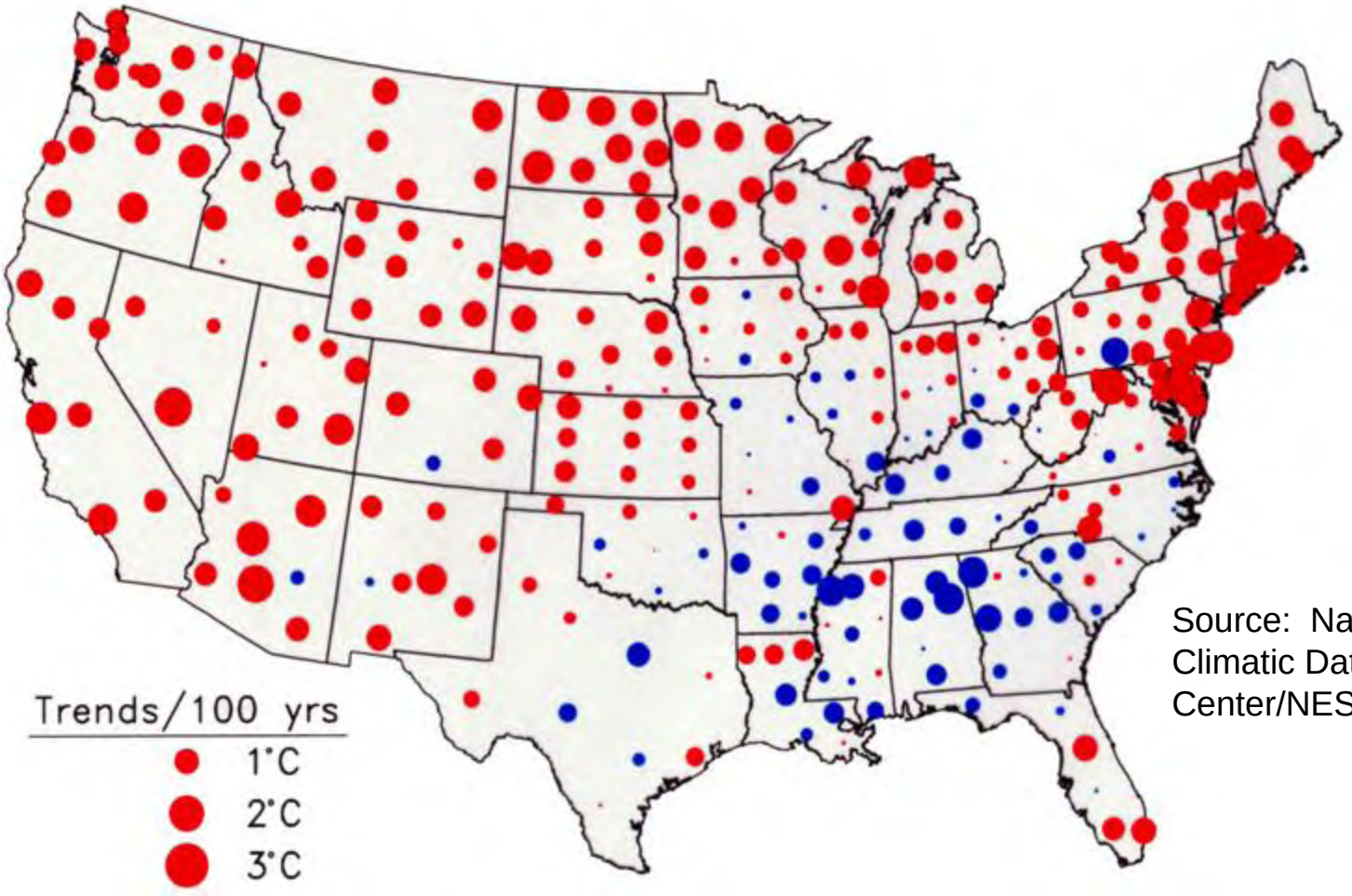
- Invasive species
- Biocriteria
- Land use change
- Water quality BMPs

Observed climate changes - temperature



Source: IPCC 2001

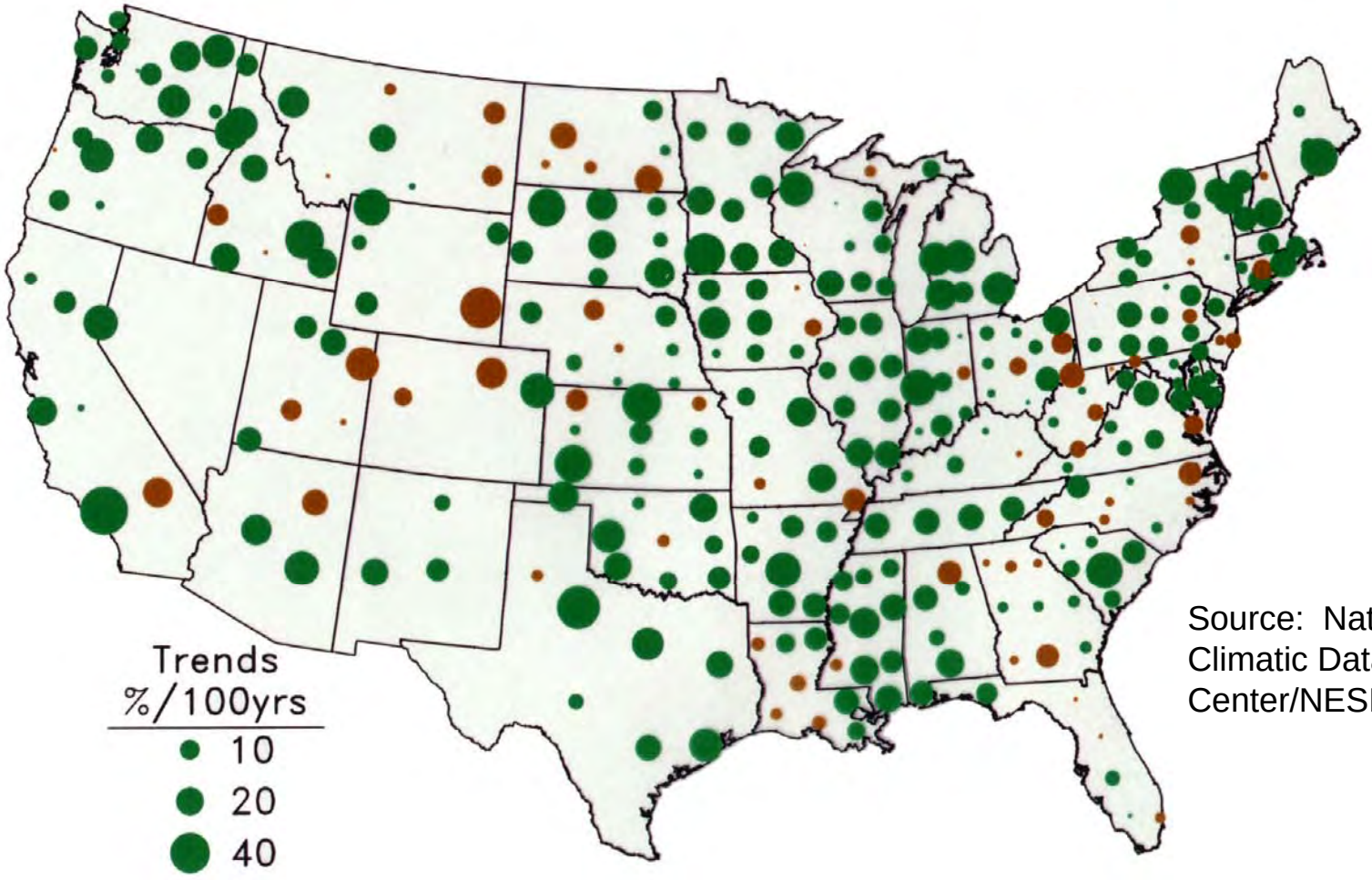
Temperature trends: 1901 to 1998



Source: National Climatic Data Center/NESDIS/NOAA

Red circles reflect warming;
Blue circles reflect cooling.
All stations/trends displayed regardless of statistical significance.

Precipitation trends: 1901 to 1998



Source: National Climatic Data Center/NESDIS/NOAA

Green circles reflect increasing precipitation;
Brown circles reflect decreasing precipitation.
All stations/trends displayed regardless of statistical significance.

Invasive species & climate change

Methods

Contract with Environmental Law Institute to:

- Review implications of climate change for aquatic invasive species
- Review management activities in each state
- Identify adaptive opportunities and research gaps

Climate change and other stressors may lead to selection regime modification that favors invasions (Byers 2002):

- Advantages of native species decline or disappear
- Success of invasive species' propagules increases
- New niches or microhabitats available

Management under a changing climate

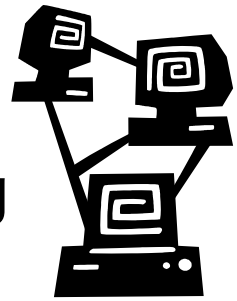
Climate change will create challenges for the management of invasive species:

- Prevention activities will be challenged as species move outside current ranges
  - Integrated Vector Management (J. Carlton)
  - Precautionary principle for new species

Management under a changing climate

Climate change will create challenges for the management of invasive species:

- Monitoring networks will need to detect new species in new places
  - Regional coordination
  - Landscape-scale monitoring
  - Alteration of timing and frequency of monitoring
  - Modeling to determine when non-natives become invasive



Management under a changing climate

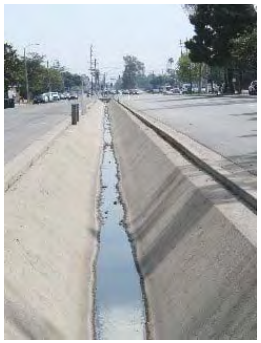
Climate change will create challenges for the management of invasive species:

- Control and eradication activities will face new species and changing circumstances
  - Rapid response teams
  - Targeted research

Invasive species infrastructure

- Management activities are based on a growing **infrastructure** of personnel, practices, experience, and resources
- Climate change **challenges assumptions** about the breadth of infrastructure
- Design, implementation, and maintenance of invasive species infrastructure requires **targeted research** to better understand and anticipate the effects of climate change





Biocriteria

Climate Change & Biocriteria

- Additional stressor on ecosystem
- Affects both reference & non-reference sites
- Current indicators may be confounded by climate change effects on ecosystems
- Biocriteria Management goals
  - Difficult to establish goal if baseline is changing
  - Or goals may be impossible to meet





Climate Change Effects on Metrics

Rivers & Streams

- Range shifts (thermal tolerance)
  - Warmwater fish range expansions
  - Coldwater fish range contractions
- Spawning (flow, temperature, turbidity)

Climate Change Effects on Metrics

Coastal wetlands

- Species composition shifts (salinity tolerance)
  - Salt tolerant plant and invertebrate species expansion
- Community shifts (sea level rise)
  - Water depth changes affecting SAV

Sensitive to Climate Change	*Insensitive to Climate Change*	*Sensitive to Climate Change and Other Stressors*
River and Stream Biocriteria		
Fish species comparison	Warmwater fish Selected inverts Periphyton – general	Coldwater fish Ratio of drought sensitive to insensitive mussel spp. Periphyton – sediment algae
Wetland Biocriteria		
Vegetation (freshwater, coastal) Shellfish, fish, inverts (coastal)	Timing of amphibian breeding (freshwater)	Amphibian populations, invertebrates, bird populations, mammals, fish (freshwater)

Adaptive Management Options

- Use information on impacts to understand how metrics respond
- Monitor reference and non-reference sites for similar changes
  - Landscape-level assessments
- Adjust assessment plans based on threats

Integrated Climate and Land Use Change Scenarios (ICLUS)

Land use scenarios

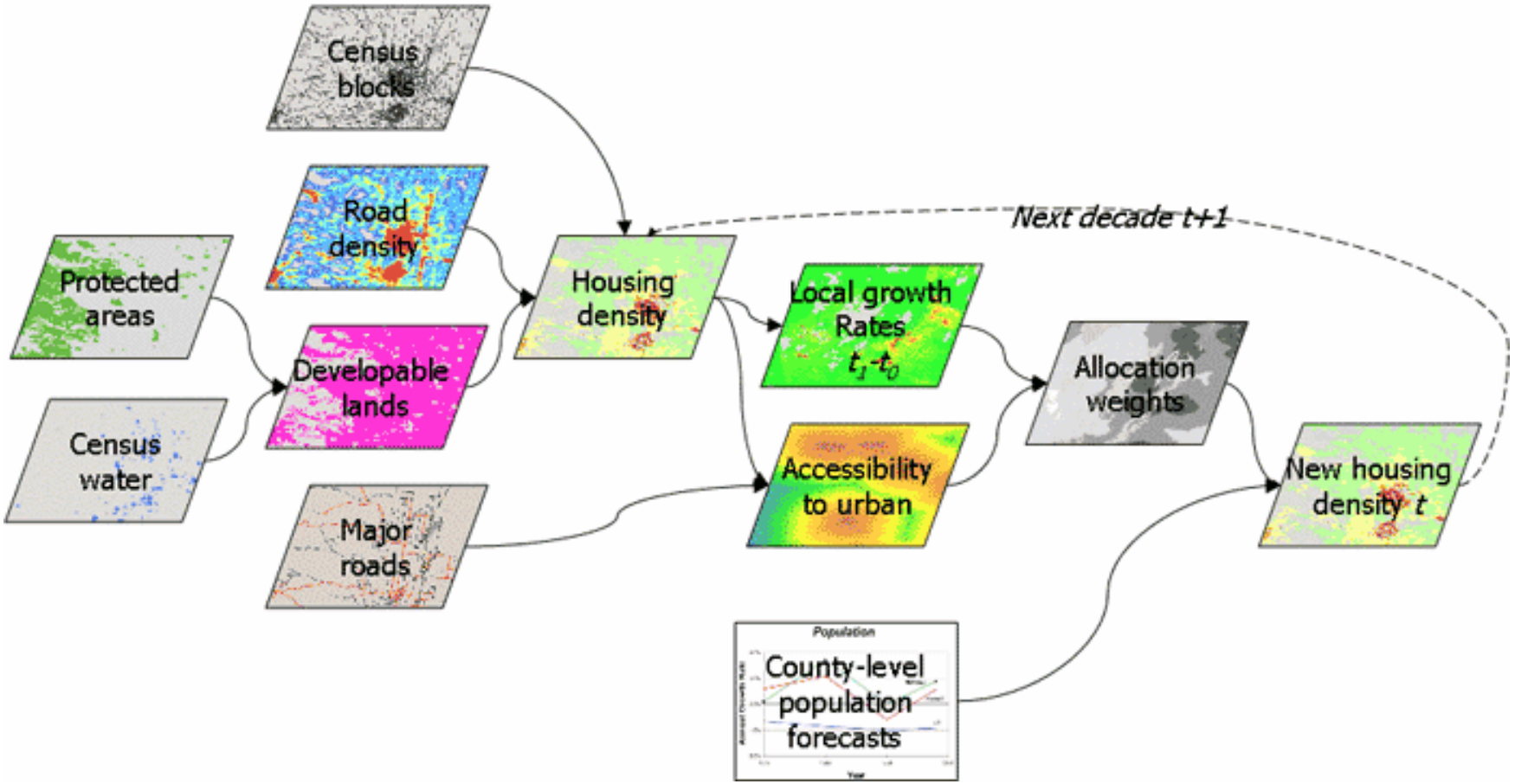
Demographic and economic conditions based on:

1. **IPCC* scenarios:** Socioeconomic conditions consistent with IPCC storylines

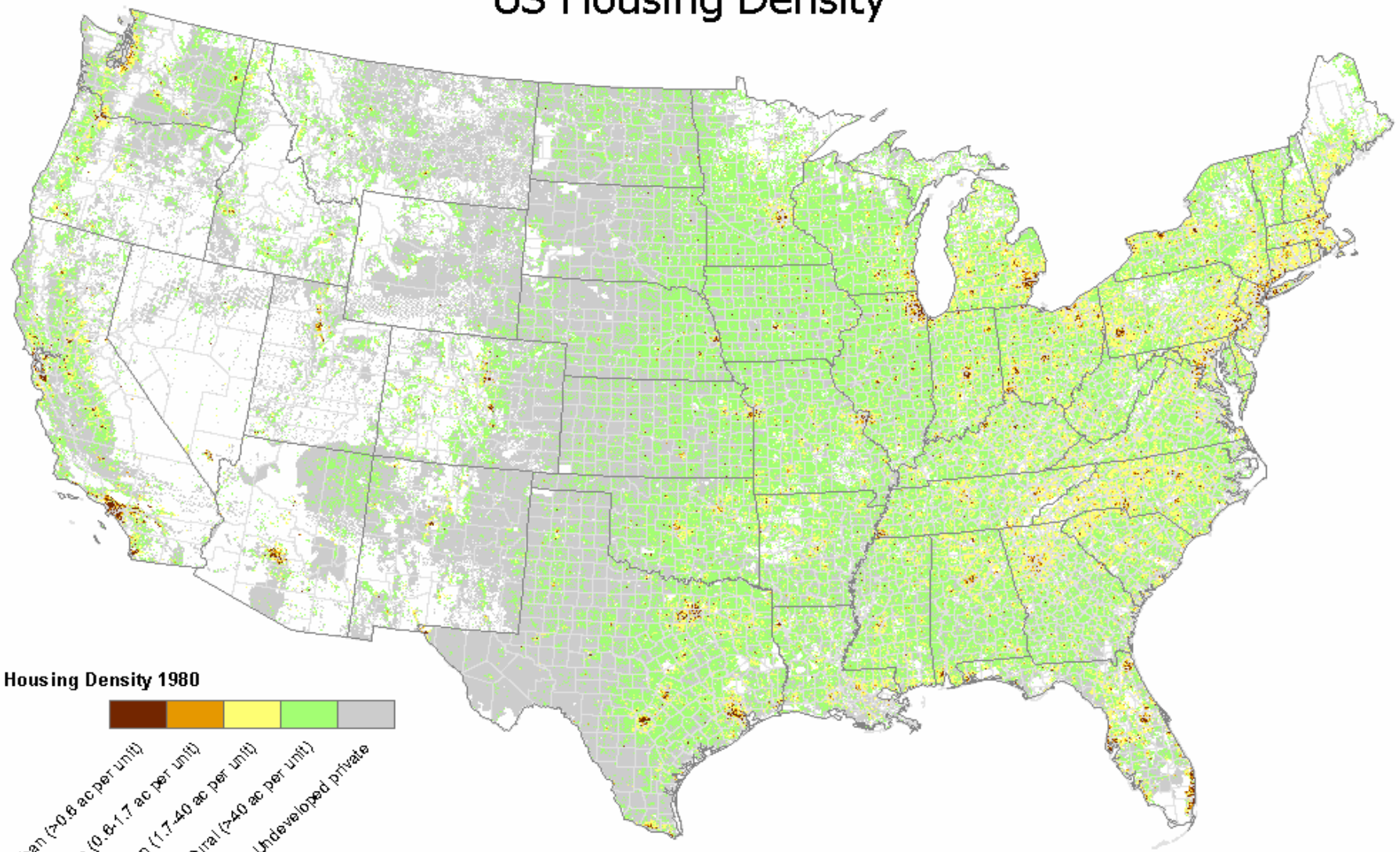
2. **Decision-focused scenarios:** Socioeconomic conditions specified by stakeholder groups

* Intergovernmental Panel on Climate Change

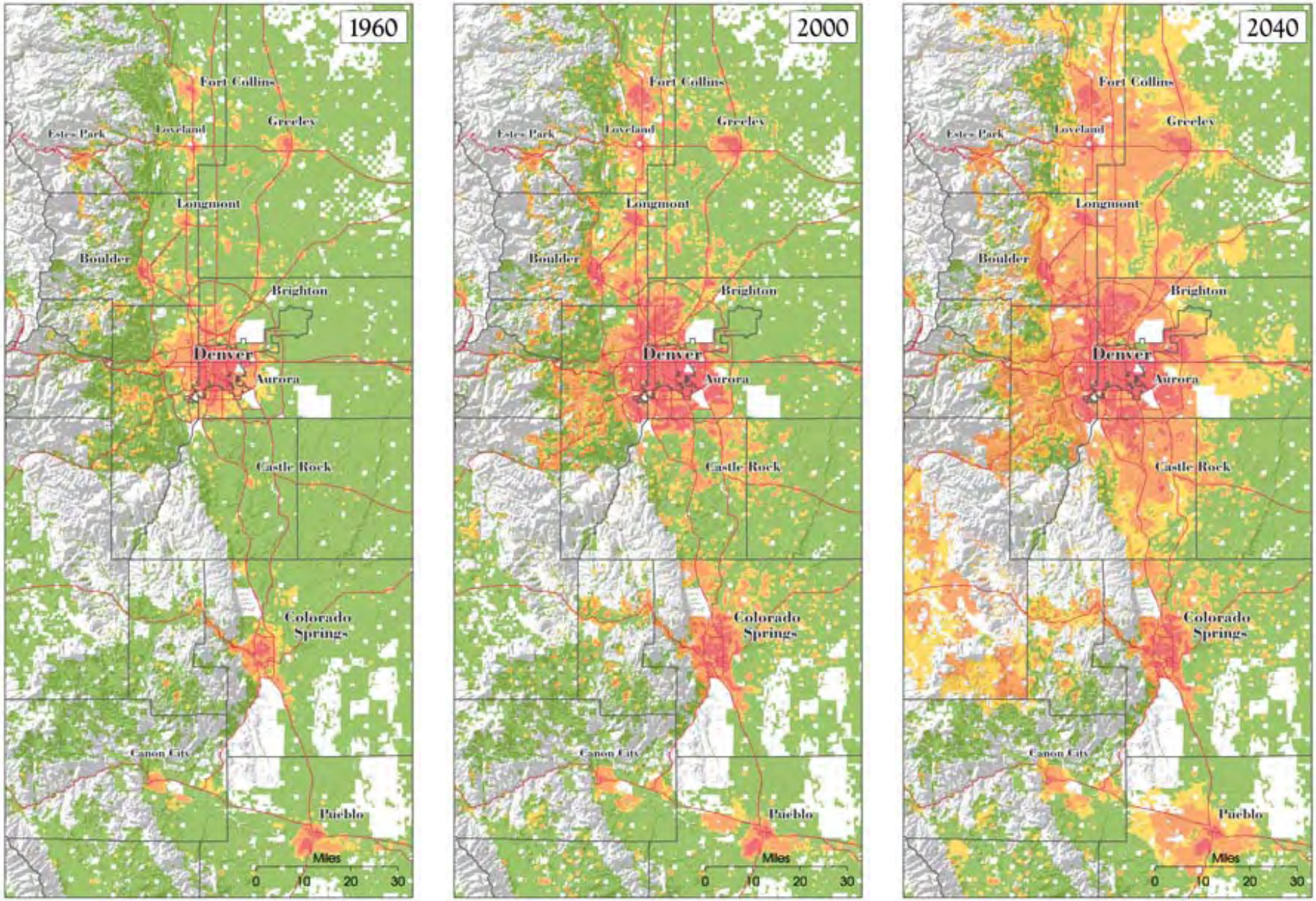
SERGoM v1


Census blocks
Road density
Protected areas
Developable lands
Census water
Major roads
Housing density
Next decade t+1
Local growth Rates t_1-t_0
Accessibility to urban
Allocation weights
New housing density t
Population
County-level population forecasts

US Housing Density



Data source: US Census Bureau 2000 block-groups and blocks.
Created by David Theobald, Colorado State University. 21 June 2004.


1960
2000
2040
Fort Collins
Greeley
Estes Park
Loveland
Longmont
Boulder
Brighton
Denver
Aurora
Castle Rock
Colorado Springs
Canon City
Pueblo
Miles
0
10
20
30

Decision assessment

Evolution of decision support

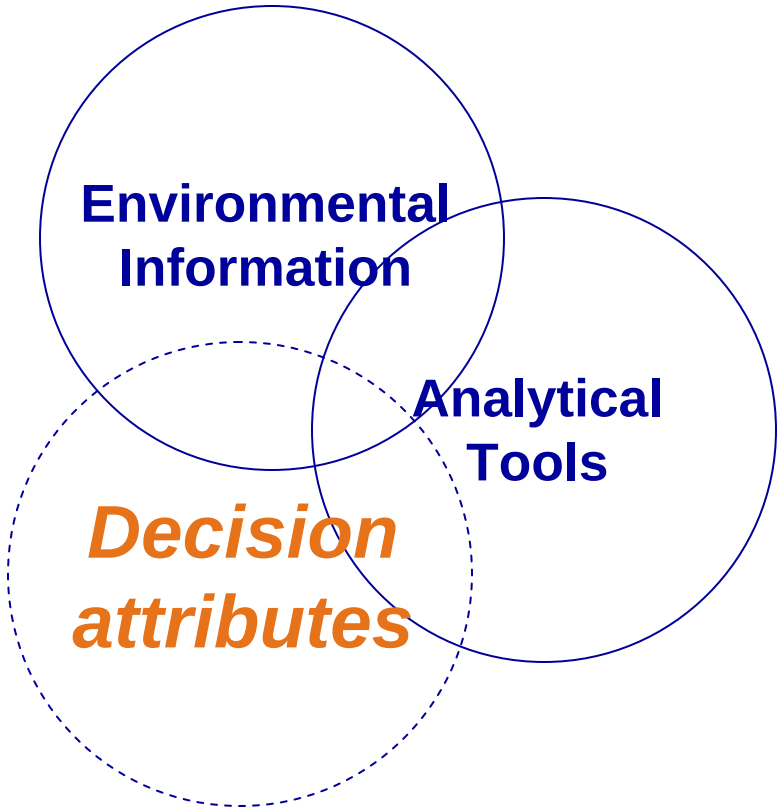
Our goal is to support adaptation to climate change:

- Identify important, climate-sensitive management decisions
- Target climate-sensitive decisions likely to benefit from research and development activities
- Conduct research that helps achieve environmental management goals under changing climatic conditions

Decision assessment

A systematic inventory and analysis of climate-sensitive decisions:

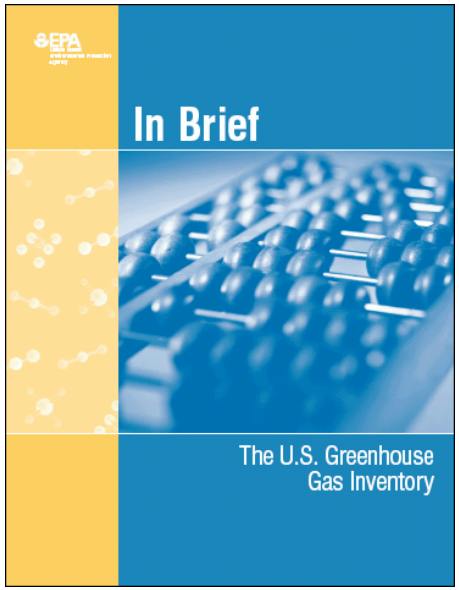
- Understand the characteristics of decisions
- Identify climate-related decisions relevant to adaptation
- Prioritize decision support resources



Decision inventory products

- Inventory of **emissions sources**
- Foundation for **mitigation policy**

Emissions Inventory



- Inventory of **adaptation decisions**
- Foundation for **adaptation policy**

Decision Inventory

Chesapeake Bay BMPs

State tributary strategies including:

- Urban tree planting
- Erosion and sediment control
- Riparian forest buffers
- Stormwater management – retention ponds
- Stormwater management – wet ponds & wetlands
- Conservation tillage
- …

Preliminary highlights

Screening of water quality BMPS:

- ~ 72% of BMPs may be sensitive to lower low flows, higher high flows, or higher temperatures
- ~ 33% of BMPs have expected performance periods over 25 years

For more information:

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