The EcoTrends Project: Long-term data provide ecological insights to scientists and non-scientists

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Introduction

Environmental drivers are changing at local to global scales with corresponding effects on ecological dynamics. Large amounts of data have been collected to document these changes. However, much of the data remain inaccessible to a broad audience. Therefore, solutions to these environmental problems have been elusive. The EcoTrends Project is one of the first attempts to standardize, simplify, integrate, and visualize data from diverse terrestrial, aquatic, and marine ecosystems to promote understanding and synthesis by a broad audience.

To illustrate the value of comparing data, we present an analysis of trends in multiple global change drivers (climate, atmospheric chemistry, human activities) and in ecological responses for 50 sites representing terrestrial (deserts, grasslands, forests), aquatic (freshwater, marine), and urban systems.

These data and more are available on the EcoTrends website (http://www.ecotrends.info). Currently, the website is primarily used by the scientific community. A book will be published this year: Peters DPC, Laney CM, including Yao J et al. 2012. Long-term trends in ecological systems: a basis for understanding responses to global change. USDA Agricultural Research Service Publication No. XX. Washington, D. C.

Methods

1. Sites

50 sites are currently included
- 26 LTER sites
- 14 USDA Forest Service sites
- 7 USDA Agricultural Research Sites
- 3 sites of other agencies

6 ecosystem types are represented
- Arctic and alpine
- Aridlands
- Coastal systems
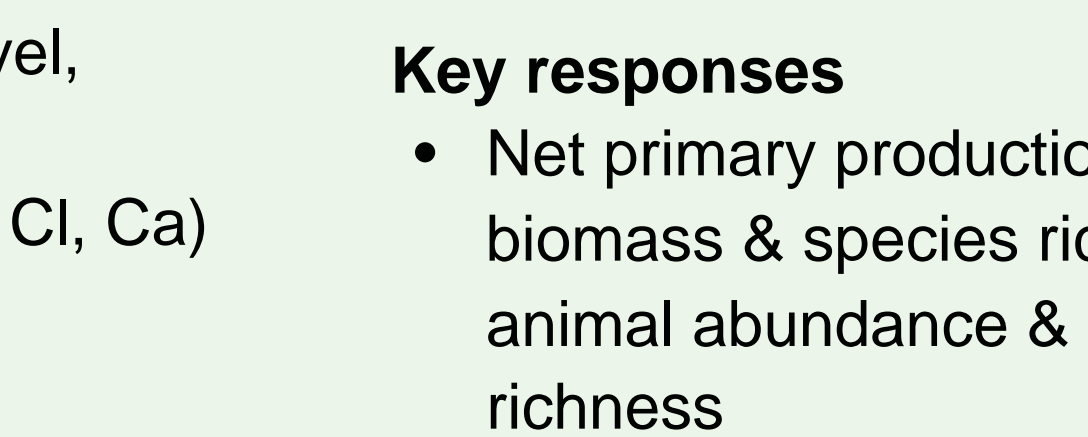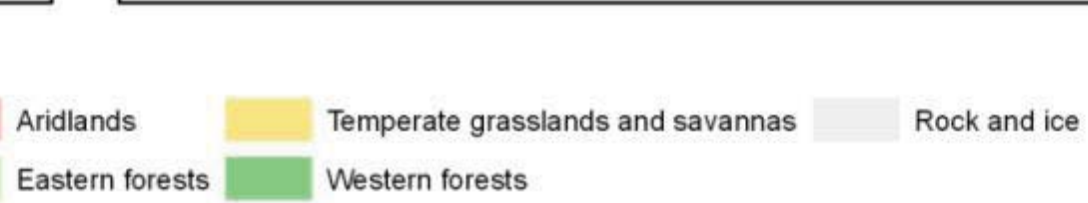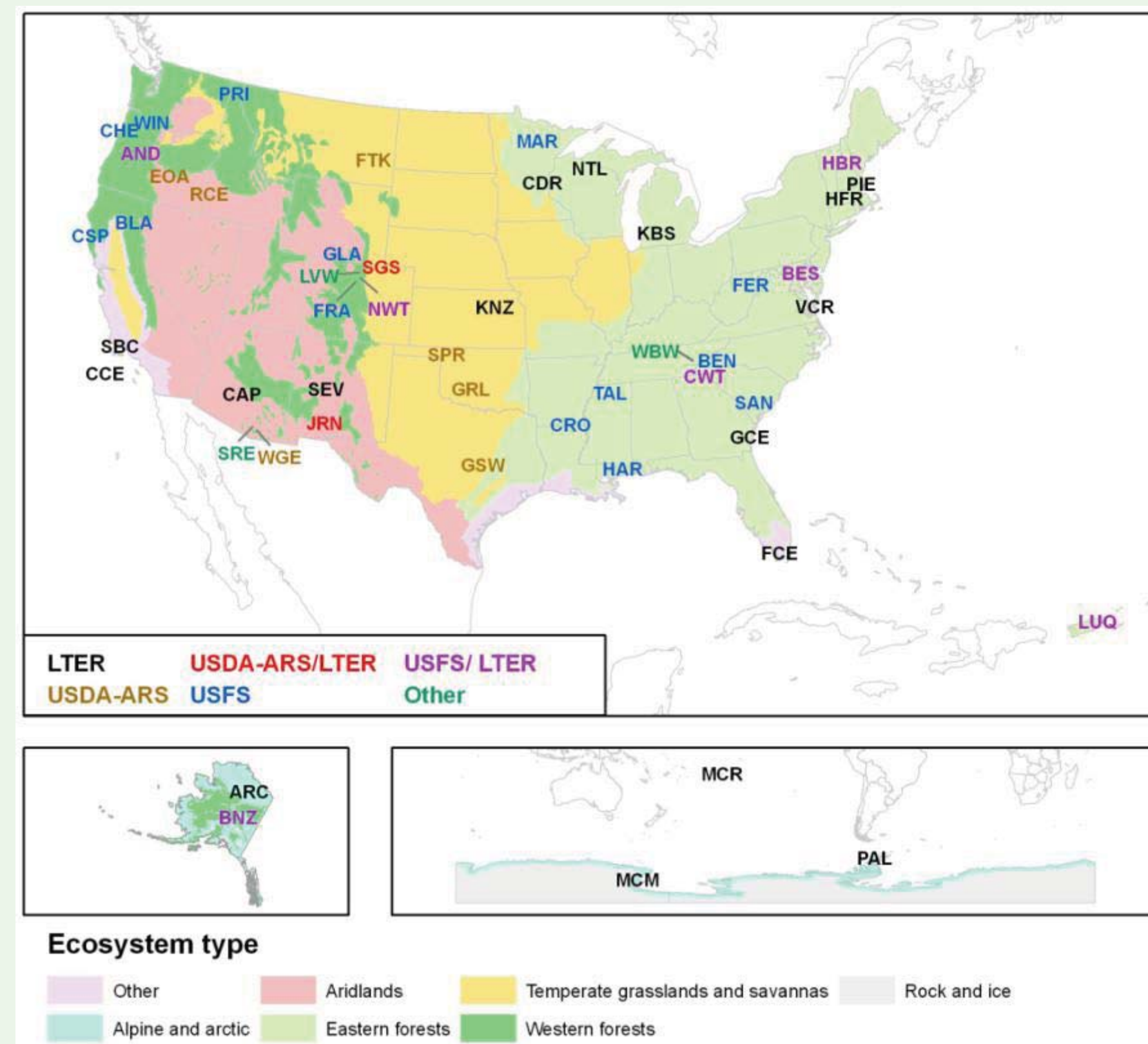- Forests
- Temperate grasslands & shrublands
- Urban systems

LTER	USDA-ARS/LTER	USFS/ LTER
USDA-ARS	USFS	Other

Ecosystem type

Other	Aridlands
Alpine and arctic	Temperate grasslands and savannas
Eastern forests	Western forests
Rock and ice	

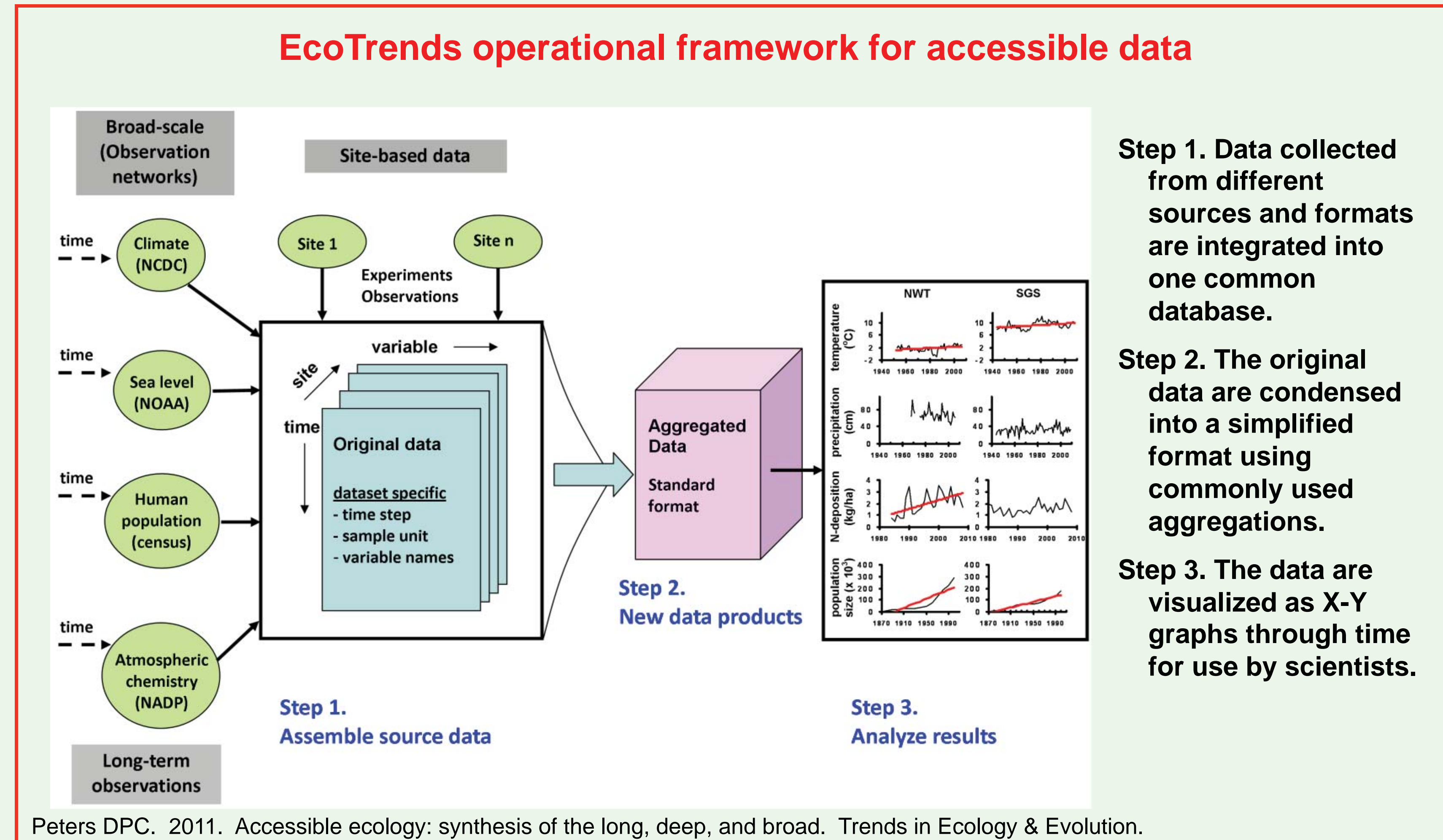### 2. Variables: drivers and responses

Key drivers
- Climate: air temperature, precipitation, ice duration, sea level, streamflow, water clarity, water temperature
- Precipitation and surface water chemistry (NO_3, NH_4, SO_4, Cl, Ca)
- Human demography and economy: total population size, population density, %urban population

Key responses
- Net primary production, plant biomass & species richness, animal abundance & species richness

EcoTrends operational framework for accessible data

Step 1. Data collected from different sources and formats are integrated into one common database.

Step 2. The original data are condensed into a simplified format using commonly used aggregations.

**Step 3.** The data are visualized as X-Y graphs through time for use by scientists.

Peters DPC. 2011. Accessible ecology: synthesis of the long, deep, and broad. Trends in Ecology & Evolution.

3. An example synthesis study

Long-term data collected from multiple sites can be used to test hypotheses related to patterns and processes at broad spatial scales.

Hypothesis: changes in atmospheric deposition are related to changes in population density for some sites.
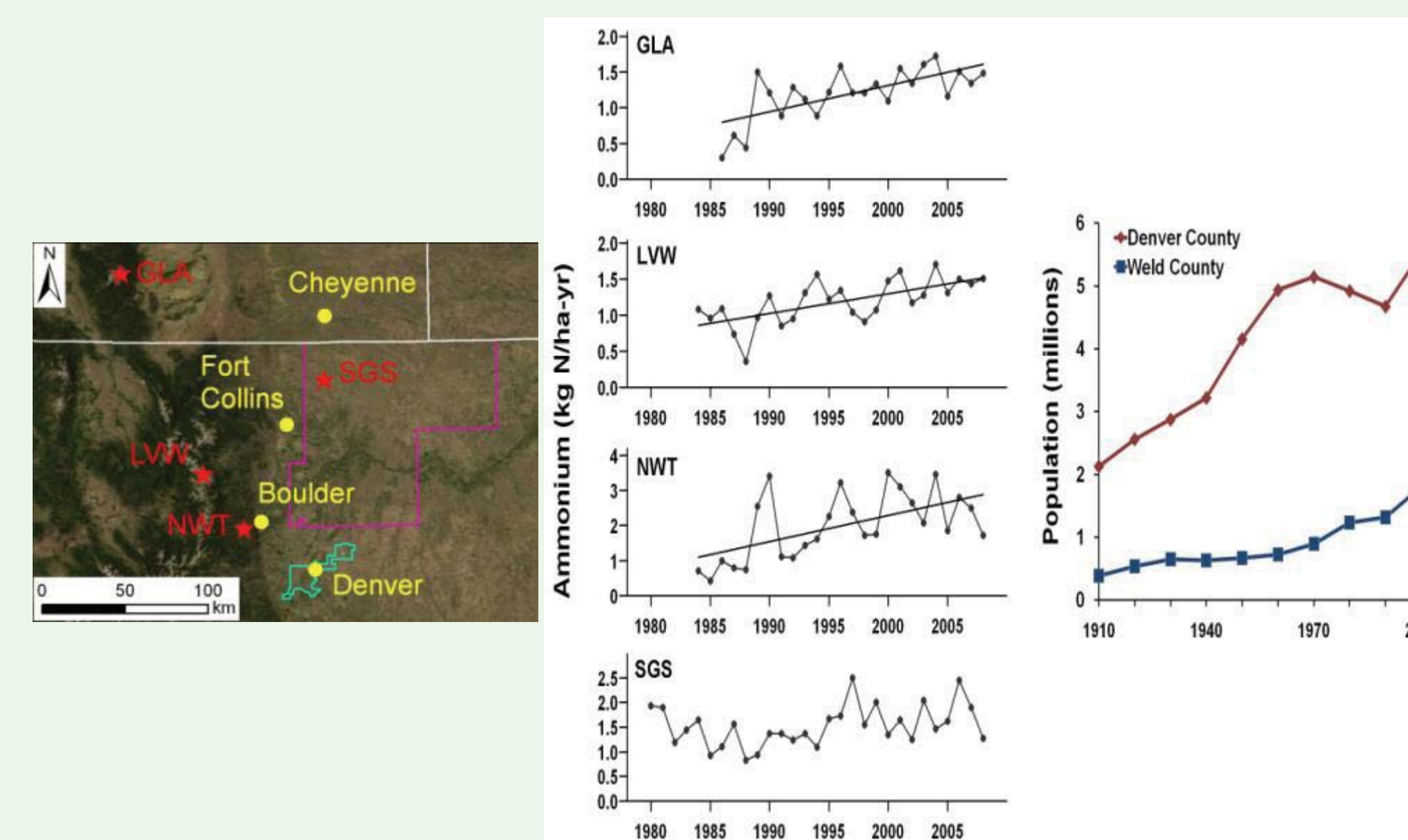
For three high elevation sites located in the central Rockies (GLA, LVW, NWT), ammonium deposition has increased through time, while there is no trend at the grassland site at lower elevation east of the mountains (SGS).

Spring and summer moisture at the mountain sites are mainly influenced by westerly upslope storm events from the Front Range; these storms provide an important source of atmospheric nitrogen deposition to explain trends at GLA, LWV, and NWT sites.

EcoTrends-ED: website being designed for non-scientist users of the EcoTrends data

Community Education

1. Desert Data Jam Competition
- The EcoTrends website was recently used by Mayfield High School students in first annual Desert Data Jam
- Several example projects are on display at the Asombro Institute for Science Education booth
- The EcoTrends Project hired 4 of the students for the summer to work on improving use of website

2. Future Data Jams
- Plans for the 2013 competition are underway
- Other LTER sites are developing Data Jams for their communities

Paula Hoffmann Landau, first place winner at the 2012 Desert Data Jam Competition (NMSU photo by Jay A. Rodman)

Improve access to and understanding of data

Anticipated Products

1. A new, user-friendly website will:
- Access the same long-term ecological data
- Enable the non-scientific community to find and use the long-term ecological data
- Utilize the students' and teachers' suggestions for improving the current EcoTrends website

2. Library of infographics
- Innovative, creative and interesting ways to display ecological and non-ecological data

Example Infographic

Concentration of Nitrate in Precipitation at the EcoTrends Sites (1979-2008)
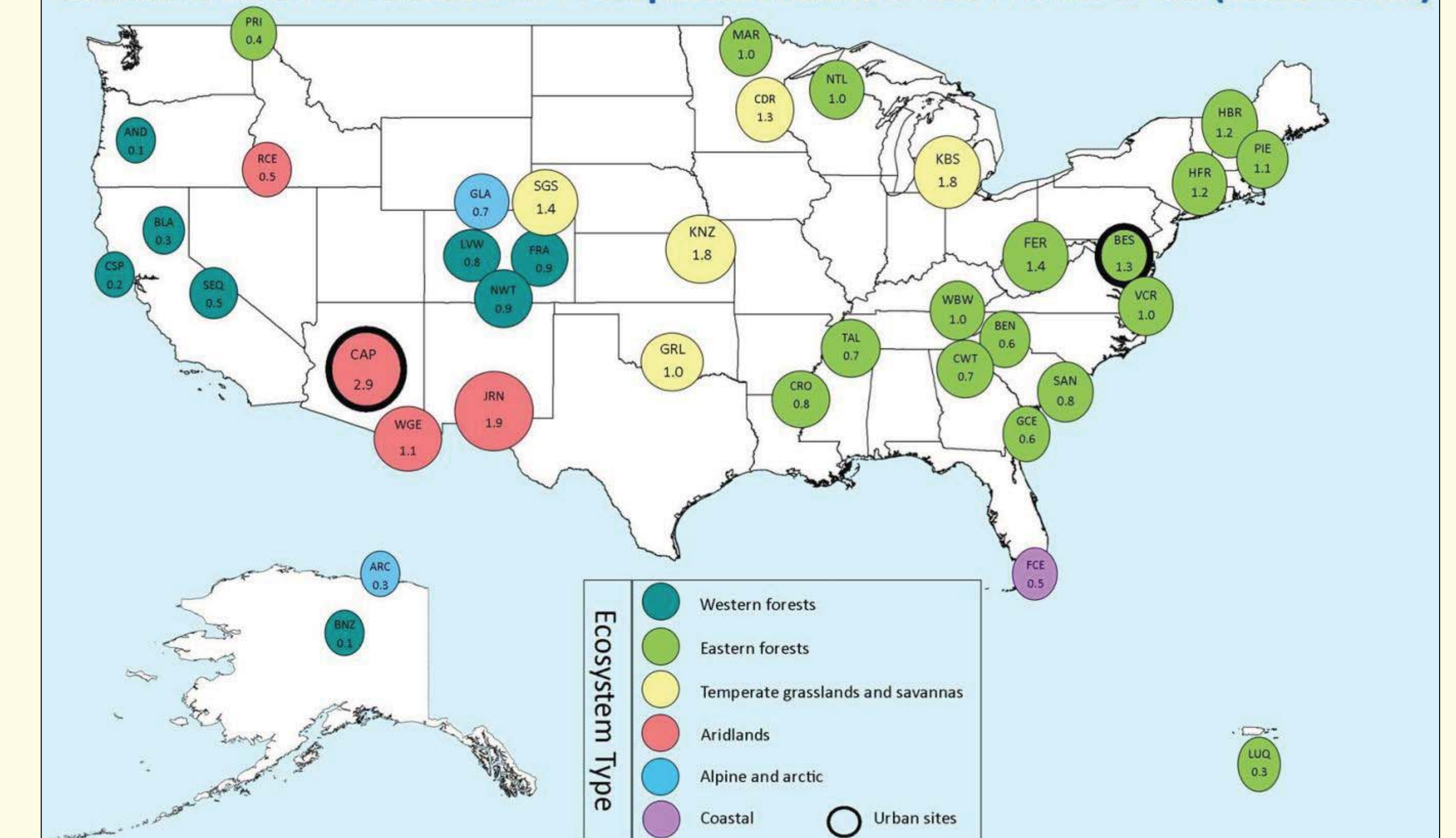
The average nitrate concentration in precipitation for aridlands was 1.4 mg/L and 1.5 mg/L for grasslands, both of which are significantly higher than the overall average (p<0.05).

The urban site in drylands (CAP) had the highest concentration (2.9mg/L) of all the sites.

The average nitrate concentration for western forests was significantly lower than the average nitrate concentrations of both the grasslands and aridlands separately (p<0.05).

Most of the eastern U.S. sites had similar nitrate concentrations (0.3 to 1.4 mg/L).

Data were obtained from the EcoTrends Project (http://www.ecotrends.info) funded by the National Science Foundation and USDA Agricultural Research Service.

Photos courtesy of the LTER network