# Land Change Science Program

The Land Change Science (LCS) Program sits within the **Climate and Land Use Change (CLU) Mission Area** of USGS, and is focused on understanding the types, rates, causes, and consequences of land change. LCS scientists conduct studies of the land cover and disturbance histories of the United States and selected overseas areas in order to determine the reasons for and the impacts of land-surface change. They seek to answer questions such as "What kinds of changes are occurring and why?", and "What are the impacts of these changes on the environment and society?" LCS researchers are actively monitoring and investigating a number of important aspects of land change.

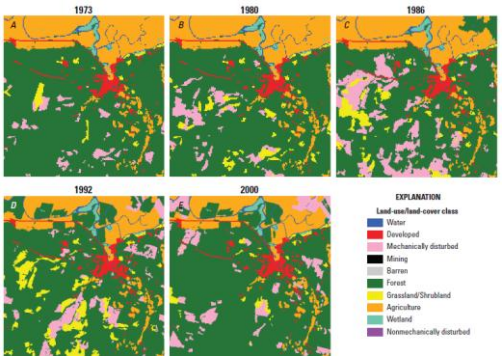


Figure 1: Maps showing changes in land cover classes from 1973 to 2000 near Clatskanie, Oregon. Over 43% of this sample area experienced some form of land change.

## Land Change

The surface of the earth is a patchwork mosaic of natural and cultural landscapes. Each of these patches is part of a very diverse and interconnected spectrum of landscapes ranging from relatively pristine natural ecosystems to completely human-dominated urban and industrial areas. The mosaic is not static, but regularly shifts due to changes from human activities and natural phenomena. Changes to the surface of the earth from weathering, fire, glaciers, and other natural events have always occurred. Since the appearance of humans on the earth, natural landscapes have been converted to human-dominated areas for cultivation, occupation, and economic activity. Change on the land surface over time can be documented using series of remotely sensed images (Figure 1). The scale of landscape change ranges from local (e.g. conversion of a farm into a suburb) to regional (e.g. conversion of tall grass prairie ecosystems to agriculture) to global (e.g. climate change). Recently, climate change has been widely recognized as having the potential to profoundly transform both ecological and cultural landscapes. Increasing interest in understanding changes on the landscape has led to the emergence of a new field of study, Land Change Science. Land change scientists treat the complex dynamics of land cover and land use as a coupled human-environment system, and develop new concepts, approaches, and tools for improved understanding and management of land resources (Turner et al., 2007).

## National Land Cover Database (NLCD)

LCS staff have developed the NLCD, the authoritative, geospatial database on the Nation's land cover (Figure 2), and are studying long-term changes in land cover associated with climate variability, fire disturbance and changes in management activities such as intensifying biofuel development and irrigated agriculture.


Figure 2: The National Land Cover Database (NLCD) serves as the definitive, Landsat-based, 30-meter resolution, land cover database.

## LandCarbon

LCS staff are leading a major national assessment, called **LandCarbon**, to identify and quantify biological stocks of carbon, and the fluxes of carbon between terrestrial, aquatic, and atmospheric pools. This definitive, rigorous assessment involves complex biogeochemical modeling at fine spatial resolutions over very large regions (Figure 3). Globally, LCS scientists are involved in **SilvaCarbon**, an effort to connect forest carbon sequestration experts in the USGS and other organizations with scientists in developing countries responsible for quantifying their national forest biomass carbon stocks and fluxes.

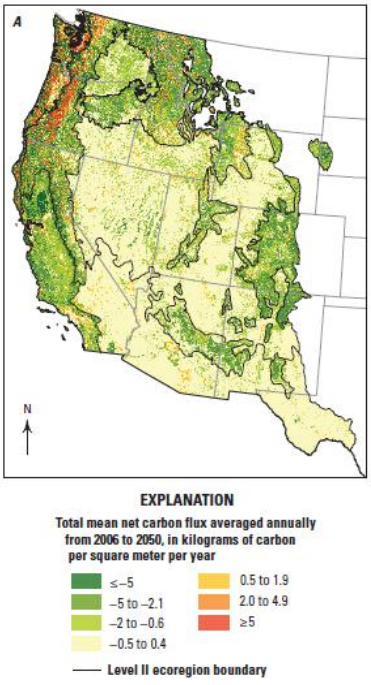


Figure 3: Map showing projected fluxes of carbon from 2006 to 2050 in kilograms of carbon per square meter per year for the western United States. Negative values (greens and yellow) show areas where carbon is accumulating (carbon sinks); positive values (orange and red) show areas where carbon is being lost (carbon sources).

## Ecosystems and Their Benefits

As the source of goods (food, fiber, water, fuel, etc.) and services (flood control, water provision, maintenance of soil fertility, pollination, etc.) critical for human survival, ecosystems are an important focus of study. In order to document changes in ecosystem extent and function, it is important to know what ecosystems are found on the landscape, and where they are located. LCS scientists are involved in national and global ecosystem mapping efforts to identify and delineate these ecosystems (Figure 4), researching their production of goods and services, and developing methods for assessing their economic and social values. The optimal use of such information in resource allocation decisions is another key research area.

## Risk and Vulnerability

The objective of risk and vulnerability studies is to develop quantitative, qualitative, and geospatial methods characterizing and communicating the vulnerability of both human communities and natural ecosystems to hazard events (Figure 5). Research efforts include assessing catastrophic hazards (for example, tsunami, earthquakes, and volcanoes) and chronic hazards (for example, coastal erosion, wildfires and sea level rise).

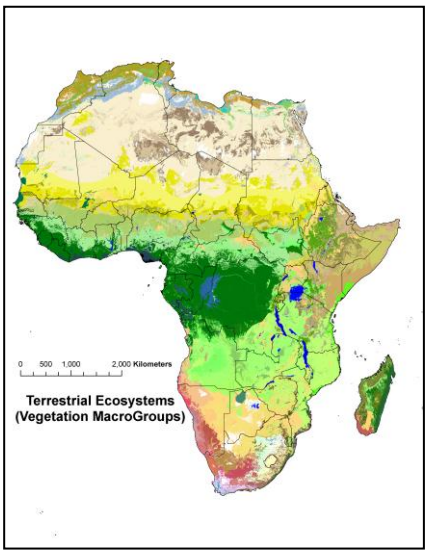


Figure 4: A new map of standardized terrestrial ecosystems of Africa, produced in collaboration with African and US vegetation ecologists. The map shows the distribution of 126 ecosystems, and can be used for conservation priority setting, climate change impact assessments, and resource management.

Figure 5: Photograph of Mount Rainier and Orting, Washington. Orting is one of many communities that are in lahar-prone areas below the flanks of Mount Rainier. Lahars (volcanic mudflows) are a significant hazard for the community. Photograph: Nathan Wood.

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