Land Cover Applications, Landscape Dynamics, and Global Change

The Land Cover Applications, Landscape Dynamics, and Global Change project at the U.S. Geological Survey (USGS) Center for Earth Resources Observation and Science (EROS) seeks to integrate remote sensing and simulation models to better understand and seek solutions to national and global issues. Modeling processes related to population impacts, natural resource management, climate change, invasive species, land use changes, energy development, and climate mitigation all pose significant scientific opportunities. The project activities use remotely sensed data to support spatial monitoring, provide sensitivity analyses across landscapes and large regions, and make the data and results available on the Internet with data access and distribution, decision support systems, and online modeling. Applications support sustainable natural resource use, carbon cycle science, biodiversity conservation, climate change mitigation, and robust simulation modeling approaches that evaluate ecosystem and landscape dynamics.

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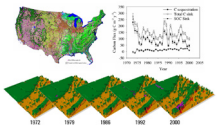
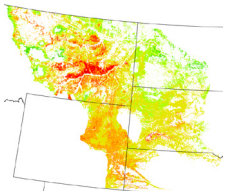
Biogeochemical cycle and land performance studies in North America



Carbon Status and Trends

We contribute to quantifying the status and trends of carbon stocks in vegetation and soils and to the assessment of the effects of land management actions and climate change on the carbon cycle. Our goal is to understand and quantify the magnitude, mechanisms, spatial distribution, and temporal changes of carbon stocks, sources, and sinks in the conterminous United States.
(http://edcintl.cr.usgs.gov/carbon_cycle/BiogeochemicalModelingResearch.html)



Regional Carbon Extrapolation in the Northern Great Plains

We estimate net ecosystem exchange and gross primary production in the Northern Great Plains. Carbon sink and source areas in grasslands are identified using remotely sensed data as an input to a piecewise regression model. The quantitative estimates of net ecosystem exchange across the landscape will provide validation for total system biogeochemical modeling and allow climate change scenarios to be simulated.
(http://edcintl.cr.usgs.gov/carbon_cycle/FluxesResearchActivities.html)

Carbon Fluxes and Climate Change in the Great Plains

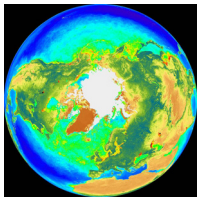
In cooperation with South Dakota State University, we evaluate the net exchange of carbon at many sites including the AmeriFlux and AgriFlux networks, create models of carbon fluxes, and simulate those fluxes at high resolution (1-km or less) across the Great Plains. (http://edcintl.cr.usgs.gov/carbon_cycle/FluxesResearchActivities.html)

Carbon Status and Potential on Federal Lands

The Federal government has direct responsibility for about 29 percent of the nation's land. Carbon stocks on those lands vary in intensity from high in the north to low in arid areas. Focusing on lands of the Department of the Interior, our goal is to understand and quantify the magnitude, mechanisms, spatial distributions, and temporal changes of carbon stocks, sources, and sinks so that land management and policy decisions can reflect an understanding of biogeochemical cycles and ensure sustainability.
(http://edcintl.cr.usgs.gov/carbon_cycle/BiogeochemicalModelingResearch.html)

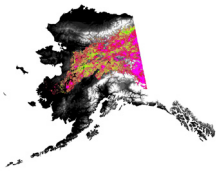
Biogeochemical Cycle Modeling for Fort Benning

We are developing an advanced, spatially distributed biogeochemical cycle modeling system for Fort Benning, Georgia. The modeling system simulates the dynamics of ecosystem carbon and nitrogen cycles under historical, current, and future land use and disturbance scenarios to help planners evaluate the environmental consequences of various military training activities. (http://edcintl.cr.usgs.gov/carbon_cycle/BiogeochemicalModelingResearch.html)



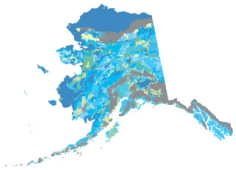
Climate Change in the Yukon River Basin

Understanding the carbon cycle in high northern latitudes is critical because climate warming leads to thawing soils and changing ecosystems. Changes in the carbon cycle could create strong positive feedbacks involving the release of greenhouse gases such as carbon dioxide (CO_2) and methane (CH_4), potentially accelerating global warming. We collaborate with many scientists to conduct research on the underlying processes of the carbon cycle, create models of whole systems, and make increasingly reliable estimates of carbon fluxes between the land and atmosphere. (http://edcintl.cr.usgs.gov/carbon_cycle/index.html)



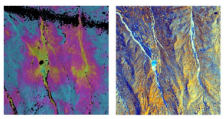
Ecosystem Performance in the Yukon River Basin

We are developing a model of expected ecosystem performance in the boreal forests of the Yukon River Basin of Alaska and Canada. We identify trends in areas that are under-performing (lower productivity than expected) and over-performing (higher productivity than expected), based on an analysis of remotely sensed images, climate data, and estimated site potential. Collaborating with Canadian remote sensing scientists, we will do a seamless analysis for the Yukon River Basin at 1-kilometer resolution from 1985 and at 250-meter resolution from 2000 to the present.



Soil Landscape Modeling in Alaska

We use site-specific soil profile data as input to biogeochemical models. A soil landscape model is being developed that integrates existing topographic, soil, vegetation, and solar insolation data to stratify the landscape for carbon stock and flux modeling. Carbon flux modeling is summarized into carbon budgets for large areas. All of our Alaska and Yukon River Basin work supports the International Polar Year.
(http://edcintl.cr.usgs.gov/carbon_cycle/carbonstocks.html)

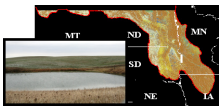


Satellite Radar for Measuring Permafrost Subsidence

Using data from the Japanese Earth Resources Satellite-1 (JERS-1) in an interferometric synthetic aperture radar (InSAR) analysis, we quantified about 10 centimeters of subsidence near Toolik Lake, Alaska. We are collaborating with the Canada Centre for Remote Sensing to map changes associated with permafrost degradation in Arctic Alaska and Canada, with an emphasis on the Yukon River Basin and Herschel Island. We will use Radarsat 2 and Advanced Land Observing Satellite (ALOS) data in addition to JERS-1 and JERS-2. (http://edc2.usgs.gov/Geo_Apps/)

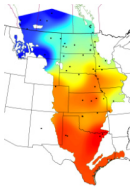
Ecosystem Services

The Integrated Landscape Monitoring Prairie Pilot is one of four pilot projects developing and implementing remote sensing and modeling approaches to understand, quantify, and map ecosystem services. Our goal is to develop a regional monitoring framework that can be used to model and estimate the performance of ecological processes in the delivery of specific goods and services at multiple scales under various management, policy, and climate change scenarios.



Habitat and Wetland Dynamics in the Prairie Pothole Region Pilot Project

In this pilot project, we are developing a modeling approach that integrates field data and Landsat imagery to monitor wetland dynamics and changes in ecosystem performance over large regions. We use data mining and multi-sensor integration to extend the traditional methods of remote sensing image interpretation.



Stable Isotope Distributions and Paleoclimate Reconstructions in the Great Plains

Carbon isotopic analyses of soil carbon in native grasslands and analyses of biodiversity are combined to provide the first comprehensive paleotemperature record in the Great Plains of North America. This dataset is being used to reconstruct Great Plains climate anomalies, show links to sea surface temperatures, and project the future effects of climate change on ecosystem performance, species distributions, and carbon sequestration.

Land cover change and biodiversity studies in Africa

Sahel Land Use and Land Cover Trends

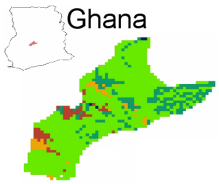
We are monitoring national and regional land use and land cover changes from the 1970s to the present. We integrate multi-temporal and multi-sensor imagery to provide an improved understanding of human and climate drivers of rapid landscape changes, build land analysis capacity in the region, and identify land degradation and improvement. (http://edcintl.cr.usgs.gov/sahel.html)

Global Integrated Trends Analysis Network (GITAN): Senegal Biodiversity Pilot Study

We collaborate with local scientists to monitor biologically significant woodlands and forests in Senegal, building upon 40 years of geographic data and imagery. Within a national framework, local communities work to set aside community forests for sustainable management and protect cultural resources and endangered species.

Human Impacts on Land Performance in the Sahel

We are identifying and quantifying changes in land productivity across many countries in the Sahel. We document major successes in land management by local communities that have led to improved vegetation, soil, and agricultural conditions. We integrate measured increases in biomass and soil carbon stocks with biophysical modeling to assess the potential for increasing land productivity and carbon sequestration over large regions. (http://edcintl.cr.usgs.gov/landcover.html)



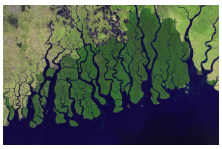
Sequestration of Carbon in Soil and Biomass in the Sahel

We are evaluating the effects of land management strategies and climate change in West Africa's vulnerable Sahel region. We use remote sensing and geospatial data to quantify the modification of land cover by humans and climate. For example, the conversion of forests at a site in Ghana led to large releases of carbon. Without nitrogen inputs, carbon loss continues; in addition, climate change can further jeopardize crop yields. We integrate socioeconomic and biophysical assessments to model current and future scenarios to develop information for policy decisions. (http://edcintl.cr.usgs.gov/carbonsequestration.html, http://edcintl.cr.usgs.gov/SEMSOC/)

Global biodiversity studies

Biodiversity Characterization

We are mapping biodiversity distribution, monitoring changes in land cover, and studying the effects of climate change on biodiversity and land cover. We have created new land cover datasets of North America (1 km) and Greater Mesoamerica (500 m), prepared data on the species distribution of mammals, birds, and reptiles, and identified priority conservation areas of Greater Mesoamerica.



Mangrove Forest Dynamics

We are studying the dynamics of mangrove forests using historical Landsat imagery to understand the role of mangrove forests in saving lives and protecting property from natural disasters such as tsunamis. The rates and causes of mangrove deforestation are identified for the period 1975-2005. (http://edcintl.cr.usgs.gov/mangrove/)

Caribbean Land Cover Analyses – TNC Conservation Planning

This cooperative project with the Agency for International Development (AID), The Nature Conservancy, the International Institute of Tropical Forestry, and several Caribbean countries provides a consistent analysis of changes in land cover, forests, and other geographic features in response to management and climate. The implementation of rich databases and Internet map servers in key islands assists national management and conservation development. (http://edcintl.cr.usgs.gov/macga/landcover.php)

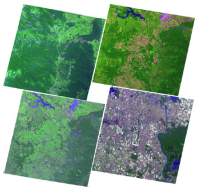
Information systems and data distribution

My Community, Our Earth

MyCOE is forming a biodiversity youth cadre under the guidance of the Association of American Geographers and local mentors engaged in local and regional biodiversity activities. Forming the youth cadre will build long-term local capacity to use geography and geographic technologies to better understand the effects of global change. (http://edcintl.cr.usgs.gov/mycoe/)

IABIN-DGF Geointegrator

USGS EROS and the World Bank support the implementation of online GIS systems that help decision makers and the public obtain data and visualize the impacts of climate change in Mesoamerica and the Caribbean. The Geointegrator project conducts research on biodiversity and supports the InterAmerican Biodiversity Information Network (IABIN) that links 10 national ministries of the environment and 14 other institutions. (http://edcintl.cr.usgs.gov/iabin.html)

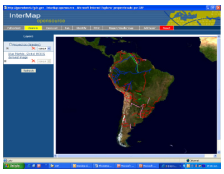


TerraLook

The TerraLook product expands and broadens the remote sensing user community by providing a user-selectable collection of satellite images, distributed as simulated natural color images in JPEG format. TerraLook collections will be of value to anyone who wants to see the changes to the Earth's surface over the last 30 years. (http://terralook.cr.usgs.gov/)

Solar and Wind Energy Resource Assessment

As energy planners seek cleaner energy solutions to reduce CO_2 emissions and to preserve our remaining stock of fossil fuel, the availability of reliable, accurate, and easily accessible solar and wind energy resource data is critical. SWERA makes it easier for anyone to find accurate information on clean energy. SWERA also hosts a long-term archive of energy information. (http://swera.unep.net/)



GeoSUR South American Geospatial Network

The Andean Corporation Bank (CAF) is supporting EROS to initiate the development of the South American Geospatial Network within each country of South America. The network will support studies of biodiversity, climate change, infrastructure development, and other projects. GeoSUR will provide access to spatial information from more than 30 agencies in South America via Internet map servers, multi-viewers, clearinghouses, and geospatial portals. Consistent derived products from SRTM 30m elevation source data, land cover, ecosystem maps, and other spatial data will be integrated. (http://edcw2ks42.cr.usgs.gov/imstemplate/default.asp?strSite=iirsa)

ANACAFE

We continue the implementation of the GeoCafe systems for specialty coffee in Guatemala with an integration of the coffee spatial databases, maps, coffee regions, and related material. This is being incorporated into a Google Earth application in support of coffee ecotourism in the country. (http://edcintl.cr.usgs.gov/geocafe/)

FGDC

We support the Federal Geographic Data Committee (FGDC) in its role to promote the coordinated development, use, sharing, and dissemination of geospatial data on a national basis. This nationwide data publishing effort is known as the National Spatial Data Infrastructure, a physical, organizational, and virtual network designed to enable the development and sharing of this nation's digital geographic information resources. (http://www.fgdc.gov/)