ORIGINS OF THE LCLUC PROGRAM

Dave Skole. Michigan State University
Years Ago perhaps before ppt
Carbon in Soils in India
0.5° x 0.5°
Grid Resolution

CONTEMPORARY
IGBP Core Project on Land Use and Cover Change (LUCC)

Ca. 1992-1995

Begins thinking on land use and cover change as the “other” global change.

Focus on integration of natural and social science

Today’s vernacular: Couple Human Natural Systems.
LUCC places emphasis on global scale research with strong regional focus

Development of networks

Examples include:
Miombo
SEARRIN
OSFAC
TEACOM
SAFNet
START Program is implemented with strong LUCC and LCLUC contributions and collaborations.
LUCC is implemented within the IGBP and IHDP with strong US leadership (ca. 1996)
LUCC leads the dialog

- Integration of social and natural sciences
- Prior recognition is now matched with a way forward
- A community of scientists was forming
- Linking remote sensing with understanding: pattern to process
Pattern to Process: Land Cover

- GIMMS group at GSFC: AVHRR GAC and LAC
- Landsat Pathfinder: global Landsat
- IGBP 1 km Land Cover Product
- Landsat 7 and MODIS in 1999
“Socializing the Pixel” and “Pixelizing the Social” in Land-Use and Land-Cover Change

Jacqueline Geoghegan, Lowell Pritchard, Jr., Yelena Ogneva-Himmelberger, Ritika Roy Chowdhury, Steven Sanderson, and B.L. Turner II

Remote sensing—both data and image processing—and analysis through geographic information systems (GIS) are increasingly affecting the research agendas on global environmental change, as evidenced by various reports of the Intergovernmental Panel on Climate Change (IPCC) and the International Geosphere-Biosphere Programme (IGBP), as well as a number of initiatives by agencies and organizations that fund research on global change. The impacts of remote sensing and GIS to date have been greatest within the environmental and policy arenas because space-based and other imagery is used primarily to determine the physical attributes of the biosphere and the earth’s surface, such as forest cover or size of housing—information that is needed in spatially explicit form by various stakeholders and decision makers. The majority of the social sciences have been slow to incorporate remote sensing and GIS as basic elements of research and reluctant to respond to global-change science. The reasons are many and complex, and cannot be addressed within the scope of this chapter (see B.L. Turner, 1991, 1997a). It is sufficient to note here that the core questions of the social sciences are seen as difficult (even impossible) to address through these imaging techniques, and the understanding that might be gained in those areas from spatially explicit approaches has not been fully demonstrated or appreciated.

There are now a number of opportunities to pursue some of the core social science research issues more closely through remote sensing and GIS. Examples are issues of equity/equality, gender, demography, institutions, democratization, (under)development, and decision making as they relate to resource use and environmental change. One such opportunity is represented by the core research project on Land-Use/Cover Change (LUCC) of the IGBP and the International...
Bretherton Diagram
A Supplement to the President’s Fiscal Year 1997 Budget

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NRC Report on Grand Challenges

Tom Graedel, Chair

Actually brought to NRC by the National Science Board of NSF

Initiated many NSF Programs that included LCLUC
NSF Environmental Research and Education (ERE)

Includes LCLUC

Biocomplexity in the Environment

Coupled Human-Natural Systems

New: SEES
Land Use and Land Cover Change

- **Primary Questions**
  - What processes determine the temporal and spatial distribution of land cover and land use change at local, regional, and global scales and how can land use and land cover be projected over time scales of 10-50 years?
  - How will the dynamics of land use, management, and cover change affect global environmental changes and regional-scale environmental and socioeconomic conditions, including economic welfare and human health?

- **Goals**
  - Learn from the past – retrospective assessment
  - Understand the present – monitoring, measuring, mapping
  - Model the future – forecasting changes in land use / cover
  - Land use relation to other global changes – integrative modeling
Scientific Importance

- Land cover/land use change is the other global change
- Global and regional distribution and rates of change are poorly quantified and the causes are poorly understood
- The science of land use dynamics is starting to emerge
- Findings from improved monitoring of land cover dynamics are challenging conventional wisdom
- Dynamic spatially explicit models needed incorporating change drivers and processes, land use interactions, role of institutions, biophysical feedbacks and climate change – to permit realistic projections
- Land Use Dynamics identified by NRC as one of the Grand Challenges in Environmental Science
Practical Importance

- Land use is key to questions of societal vulnerability and resilience and integral to local and regional policy, resource management and development issues.
- Better scientific understanding of land cover/land use change is needed for carbon trading, air quality and for assessing potential impacts of climate variability – food security, flooding.
- Realistic projections of land use change are needed for water resource and ecosystem management and regional planning.
LCLUC and early implementation criteria for USGCRP

- LCLUC is truly ‘emerging interdisciplinary research’
- LCLUC’s regional emphasis – will necessitate development of approaches for regional research and interactions
- LCLUC as a strong human dimension – understanding the cause and effect of land use change requires social science
- LULCC element has direct societal relevance
- Critical dependencies from other USGCRP elements on understanding changes in land use and land cover (baselines, historic record and projections) e.g. from carbon and water cycle, atmospheric composition, ecosystem functioning and services and human welfare
- Research currently being supported by different agencies would benefit from interagency coordination
Tractability

- NRC Grand Challenge addresses scientific readiness
  - Newly available databases permit new research e.g. NASA’s global orthorectified Landsat coverage for 1990’s and 2000 and Moderate Resolution global land cover, % tree cover, fire distributions
  - Recent advances in imagery analysis and geographic information science
  - Advances in the analysis of spatial data
  - Increased interdisciplinary and multidisciplinary interest in the science of land use/cover change

- LULCC has an established and well documented international science plan currently in the implementation stage

- Some LULCC research already underway within federal agencies combining physical and social science e.g. USDA, USGS, EPA, NASA — shows feasibility and needs strengthening to gain critical mass
Land Cover Land Use Change Element – Final Draft (Nov. 6, 2000)

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Land-use/Land-cover change

Land cover refers to everything covering the land surface, including vegetation, bare soil, buildings and infrastructure, inland bodies of water, and wetlands. Land use refers to societal arrangements and activities that affect land cover. Land cover and use influence climate and weather at local to global scales; they can have direct impacts on climate by affecting the composition of the atmosphere and the exchange of energy between continents and the atmosphere. Because of this, land-cover characteristics are key inputs to climate models. Land cover and use also affect water runoff, the carbon and nitrogen cycles, and the distribution of plants and animals in ecosystems.

CCSP-supported research on land-use/land-cover change focuses on processes that determine changes in land cover and land use at local, regional, and global scales, and on how land cover and use will change over timescales of 10-50 years. Research will quantify the human influence on the land, improve monitoring, measuring, and mapping; and develop projections of changes in land cover and land use based on assumptions about climate, demographic, economic, and technological trends.

Benefits from this research include:

- Identifying areas of rapid land-use and land-cover change and the extent and impact of major disturbances such as fire, insects, drought, and flooding on land use and land cover.
- Identifying past and projected trends in land cover or land use that are attributable to changes in climate (e.g., changes in forest types, forest margins, agriculture, and desert margins), and identifying U.S. regions where climate change may have the greatest implications for land management.
- Identifying the effects of land-use and land-cover change on carbon dynamics and the mitigation and management of greenhouse gases.

[Image of deforestation in Brazil]
ecosystems is mandatory for continued provision of ecological goods and services.

2. Rationale for this New Element of USGCRP

2.1. Science Rationale

The global change research community has converged on the need to address the multiple forces and types of change that impact the environment at scales that matter to everyday societal choices. Land use is a root cause of environmental change occurring at a wide range of scales and an understanding of the rates, causes, and consequences of land use change is essential if we are to effectively address the range of global environmental issues. However, our scientific understanding of the process of land use change is poorly developed. The NRC reports that address future directions for the global change community have identified land use change as a key
Land Change Science

Observing, Monitoring and Understanding Trajectories of Change on the Earth’s Surface

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