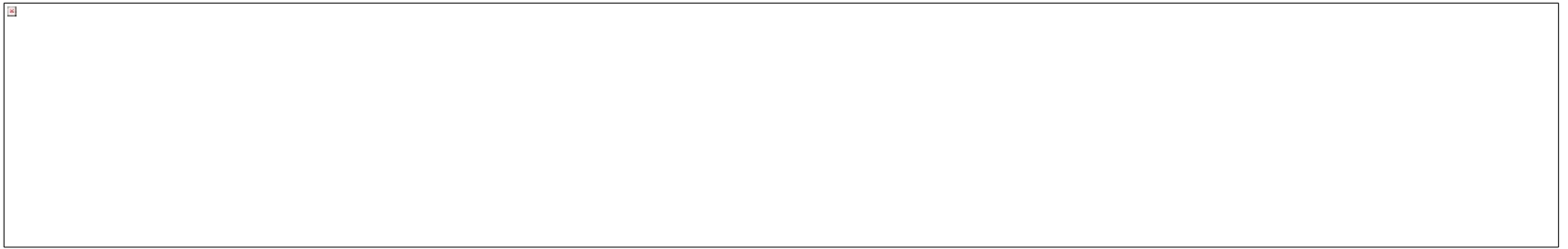




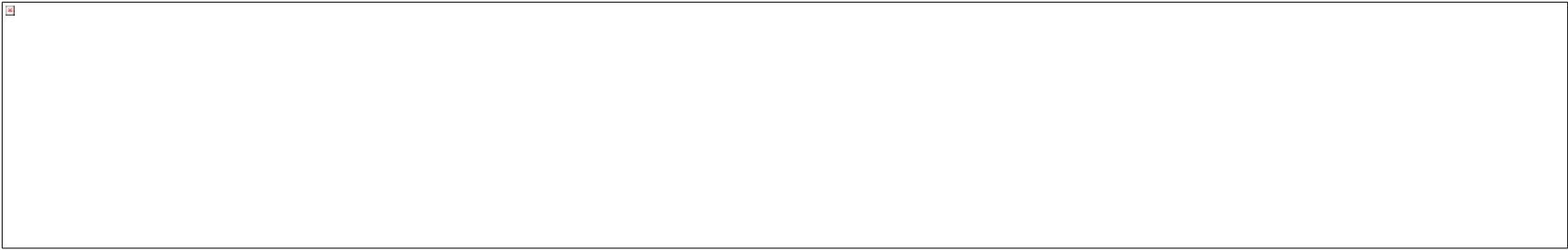
NASA's Land Cover Land Use Change Program

- **Status of the LCLUC program**
 - **Introduction**
 - **Landsat issues**
 - **LCLUC data issues**
 - **LCLUC book status**
 - **Land-Use/Land-Cover Change (LULCC)
Interagency Working Group**
 - **Major Regional Initiatives**
 - **NRA's**

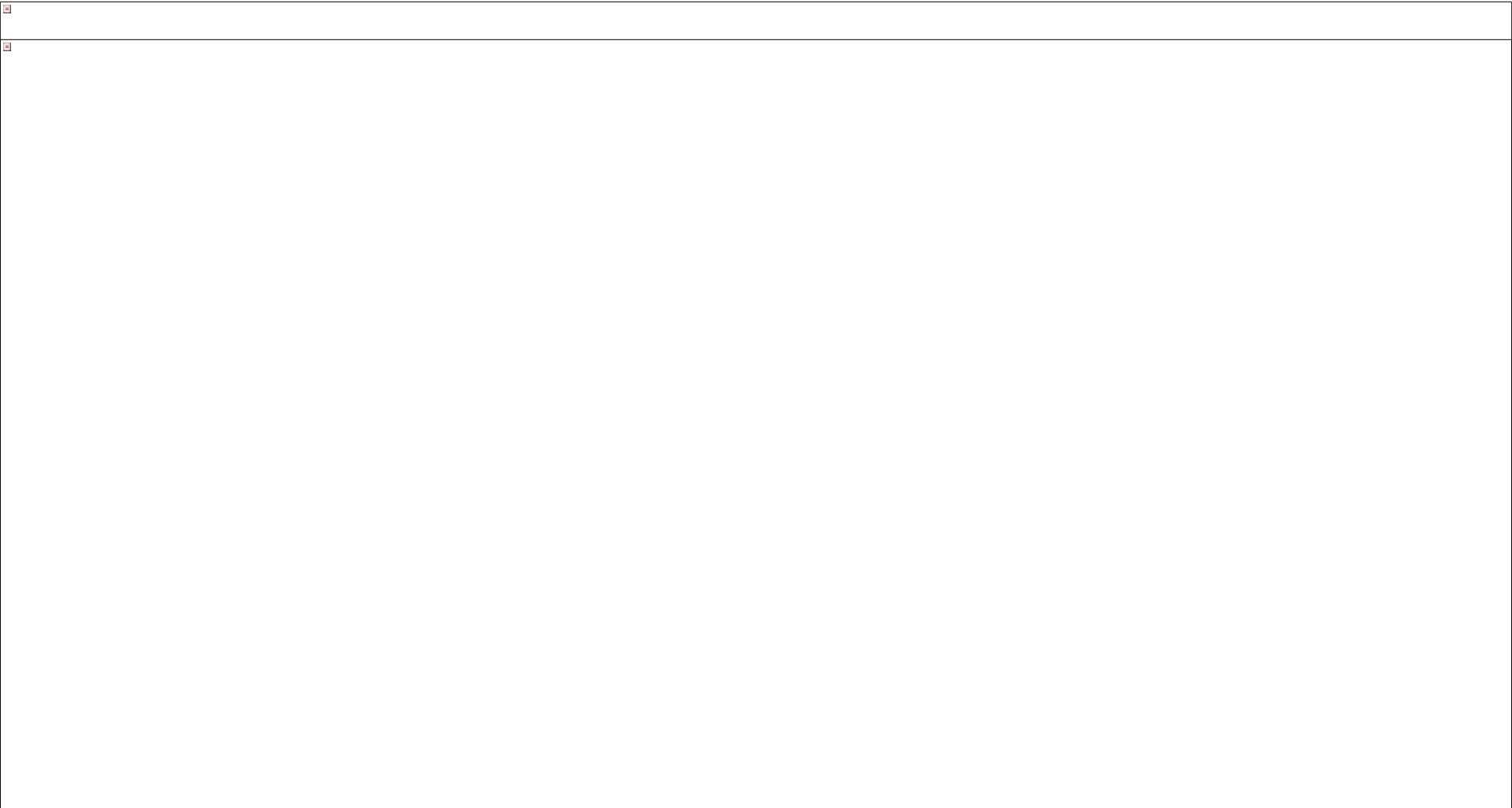


NASA's Land Cover Land Use Change Program

QuickTime™ and a
Photo - JPEG decompressor
are needed to see this picture.

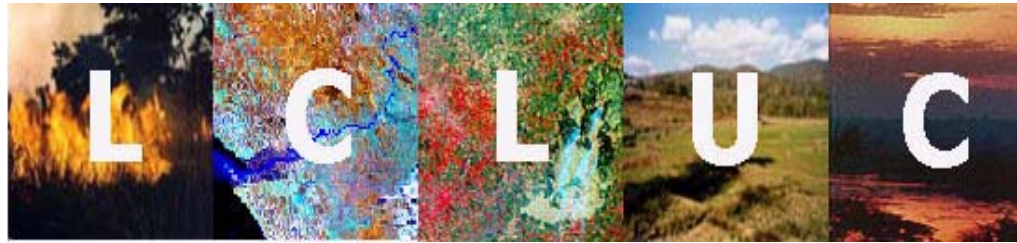


NASA's Land Cover Land Use Change Program





NASA Land Cover and Land Use Change



- LCLUC is an interdisciplinary scientific theme within NASA's Earth Science Enterprise (ESE). The ultimate vision of this program is to:
 - *develop the capability to perform repeated global inventories of land-use and land-cover from space, to develop the scientific understanding and models necessary to simulate the processes taking place, and evaluate the consequences of observed and predicted changes.*
 - **further our understanding of the consequences of land-use and land-cover changes on environmental goods and services, the carbon and water cycles and providing the science underpinning for improved management of natural resources**
 - **improve understanding of human interaction with the environment, and thus provide a scientific foundation for sustainability, vulnerability and resilience of land systems and their use.**
- <http://lcluc.gsfc.nasa.gov/>

NASA ESE Context of LCLUC

How is the Earth changing and what are the consequences for life on Earth?

Variability, Forcing, Response, Consequences, Prediction

- *What changes are occurring in global land cover and land use, and what are their causes?*
 - Where are land cover and land use changing, what is the extent and over what time scale?
- *What are the consequences of land cover and land use change for human societies and the sustainability of ecosystems?*
 - What are the consequences of increased human activities for coastal regions?
- *How do ecosystems respond to and affect global environmental change?*
 - What are the impacts of climate variability and changes on LCLUC and what is the potential feedback?
- *How will land cover change on time scales from years to centuries?*
 - What are the projected changes in land cover and their potential impacts?



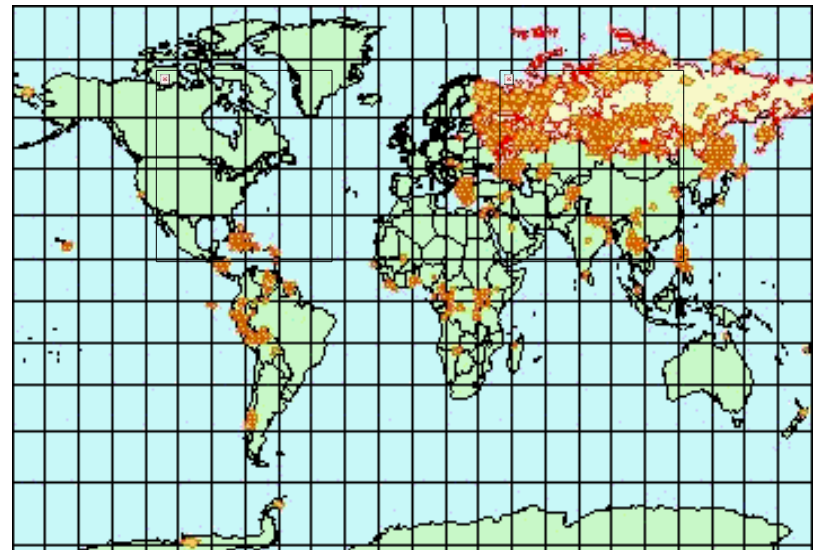
NASA LCLUC Program - Building Blocks

<ul style="list-style-type: none">• Forcing Factors (Processes)<ul style="list-style-type: none">– Climate and Ecological Drivers– Socioeconomic Drivers	<ul style="list-style-type: none">• Technique Development<ul style="list-style-type: none">– Remote Sensing R and D– In-situ data collection - surveys / validation / process studies– Data Management
<ul style="list-style-type: none">• Responses and Consequences<ul style="list-style-type: none">– Land cover conversion, abandonment– Land use intensification– Land degradation– Landscape fragmentation	<ul style="list-style-type: none">• Satellite Observations<ul style="list-style-type: none">– Long -term measurements<ul style="list-style-type: none">• Landsat series L7>LDCM• AVHRR.>MODIS>NPP (VIIRS)– Experimental missions<ul style="list-style-type: none">• EO-1 - hyperspectral– Commercial Data Buy<ul style="list-style-type: none">• Ikonos - hyperspatial• Geocorrected Global Landsat Database
<ul style="list-style-type: none">• Modeling and Implications<ul style="list-style-type: none">– LCLUC modeling & projections– Coupled modeling of LCLUC with biogeochemical and water cycles– Modeling land-atmosphere interactions– Climate impacts on land use	

A Broader View of LCLUC Team

Science Team consists of LCLUC research funded through various elements in NASA ESE programs but administered under LCLUC Theme

- LCLUC Projects
- LBA Projects
- IDS Projects
- Carbon Cycle Projects
- Landsat Projects
- Water Cycle Projects
- EOS Projects



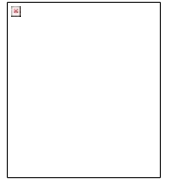
These projects have the same reporting responsibilities to LCLUC management and are treated equally

How do we organize ourselves

- Science Team Meetings
 - program status and feedback from the PI's
 - reporting, exchanging ideas, discussing program directions
- Regional network support and topical workshops
- Outreach: brochure, web site , significant results for management, mentioning/acknowledgments in publications, videos.
- Science: the “Land Change Science” book, publications in peer-reviewed literature, special workshops and sessions at conferences.
- Data: LCLUC data provision through the program

Reporting

- The Web site (submit all to *Deirdre Smith*)
 - Abstracts
 - Annual progress reports (cc: to me by e-mail)
 - Significant results (summaries + visuals)
 - Lists of publications and references
 - Project metadata and data set links
- Common format - for programmatic reasons
- Sensitive info - to me by separate e-mail
- Outreach/PR (discoveries, journal covers, etc.)



Landsat Issues

- Landsat Data Continuity Mission (LDCM) - on hold.
- Landsat-7 experienced failure of the Scan Line Corrector a few months ago. Three quarters of data, however, are intact - at the edge of the scan there are gaps. Development of innovative products in the new situation is underway.

Data Issues

- *NASA promotes the free and open sharing of data*
- **LCLUC expects its PI's to make their data and products available to the broader community**
- NASA is being encouraged to consider commercial data buys
 - Science Data Purchase (SDP) program (Data Buy)
 - Landsat Data Continuity Mission
- Data systems and services are currently one of the biggest challenges to earth observation systems
- NASA ESIPS provide new approaches to data services – some have been funded through REASON
- LCLUC Landsat Data Buy to help meet PI data needs
 - Incremental purchases as funds are available
 - Data sharing is encouraged
 - Much of Landsat data will be provided through GSFC Land Cover Project Office (known as Landsat Project Office)

The Book

- Land Change Science: Observing, Monitoring, and Understanding Trajectories of Change on the Earth's Surface - 26 Chapters
 - SECTION I. LCLUC concepts, national and international programs
 - SECTION II. Observations of LCLUC: Case Studies
 - SECTION III. Cross Cutting Themes, Impacts, and Consequences
 - SECTION IV. Methodological issues, modeling
 - SECTION V. Synthesis and Lessons: Biophysical Change and Beyond
- Planned as 2003 book - will be 2004
- At KLUWER ACADEMIC PUBLISHERS

LULCC Interagency Activities

US Climate Change Science Program

- Focus on short-term deliverables
- Providing decision-making/management resources
- Land-Use/Land Cover Change element
 - LULCC interagency working group (LUIWG)
(consisting mostly of representatives from Federal agencies)

LUIWG Functions

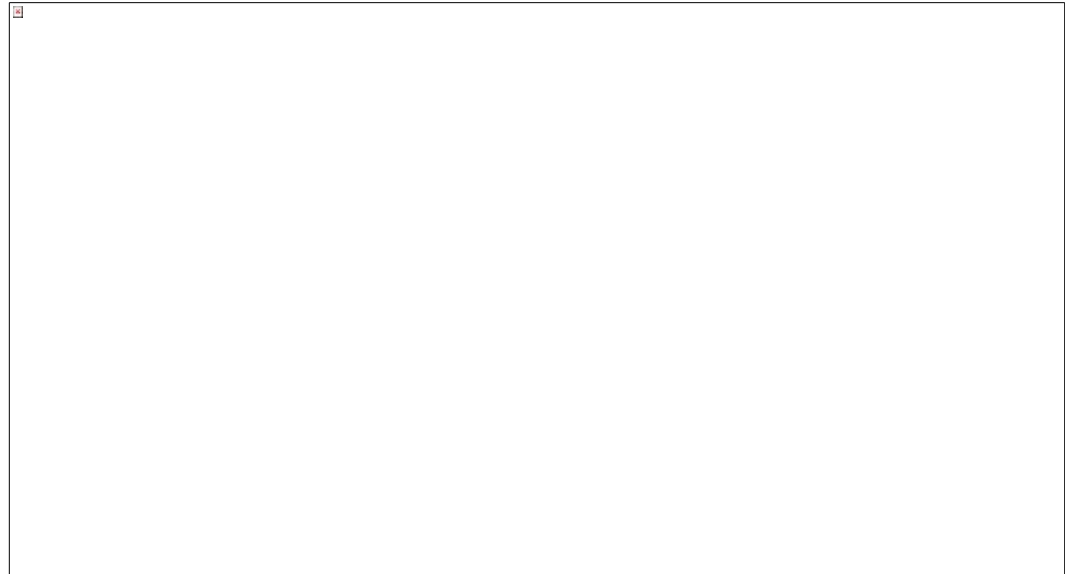
- Purpose of LULCC Interagency Working Group (LUIWG)
 - Interagency coordination
 - Securing resources
 - Potential joint agency initiative/solicitation (FY06? or even FY05?)
- LUIWG activities
 - Bi-weekly housekeeping meetings
 - CCSP Chapter 6; LULCC representation at CCSP meetings
 - Inventory of projects by agencies
 - Preparation of workshops; linkages to other CCSP elements
- Scientific Guidance to LUIWG
 - To be provided by the LULCC Science Steering Group (LUSSG- to be formed)
 - LUSSG will periodically review the LULCC science in terms of gaps and priorities

LCLUC Support of Major Regional Initiatives

- **LBA:** Regional Field Campaign in Amazon
- **NACP:** North American Carbon Project
- **NEESPI:** Northern Eurasia Earth Science Partnership Initiative

LBA: The Regional Field Campaign in Amazon

- LCLUC LBA support
 - Project Office Support
 - Research projects
 - LCLUC
 - LCLUC + TE
 - First results @ LCLUC Science Team Meeting, Reston, Va in April 2000

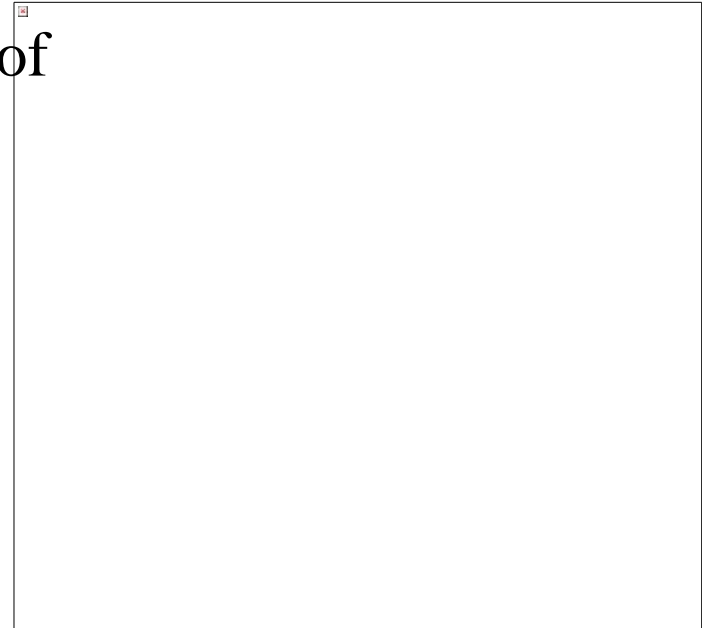


LBA Results

- **Excellent examples of land cover modeling based on socioeconomic drivers, and some excellent examples of land cover mapping.**
- **Better depiction of the explicit linkages between patterns and processes, between satellite and ground observations, and between scales**
- **Improved land cover classification using a consistent spectral mixture analysis and decision tree classifier on co-registered LANDSAT MSS, TM, and ETM+ data.**
- **Improved understanding of interannual signal, critical to understanding the global signal**
- **From modeling studies: there is a strong interannual signal in the carbon flux from Amazonia. Land-cover change has strong interannual variability as observed from space.**
- **Seasonal phenological changes are visible from space.**
- **These are potentially important inputs to data assimilation models because remote sensing quantifies seasonal and interannual phenological variability.**

Challenges

- Regional estimates of logging area and carbon effects using remotely sensed data
- Prediction of fire risk for logged areas
- Predictions of water quality in regions of explosive land-use change and development (effect of land-cover and land-use change – sustainability)
- A comprehensive dynamic LUCC model, which could be applied basin wide, yet at fine scales at which the LUCC processes occur



NACP: North American Carbon Project

- **Pre-NACP LCLUC-funded carbon-related studies for North America**
 - Josef Cihlar (CCRS): Satellite Observation of Boreal Land Cover: Methods, Data Sets and Applications
 - Turner (Clark U.): LCLUC in the Southern Yucatán Peninsular Region: Refining Models Projections of Deforestation with Application to the Carbon Cycle...
 - McDonald (JPL): Monitoring Boreal Landcover and Ecosystem Dynamics at Regional Scales using Integrated Spaceborne Radar Remote Sensing and Ecological Modeling.
 - Pastor (U. Minnesota): Mapping and Modeling Forest Change in a Boreal Landscape
 - Gong: Development of a Long-term Inventory of Fire Burned Areas and Emissions of North America's Boreal and Temperate Forests
 - Loveland: The Spatial and Temporal Dimensions of Contemporary U.S. Land Cover and Land Use Change and Implications for Carbon Dynamics
 - Elvidge: Development Sprawl Impacts on the Terrestrial Carbon Dynamics of the United States
 - Binford: Land-Use and Land-Cover Change: Decadal-Scale Dynamics of Land Ownership, (Land Management) and Carbon Storage Patterns in the Southeastern Lower Coastal Plain Region of the U.S.
 - Johnson (Kansas U.): Scaling Up the Ecosystem Consequences of Forest Expansion in the Great Plains Region: A Renewal Proposal
 - McGuire (U.Alaska): The Role of Land Cover Change in High Latitude Ecosystems: Implications for Carbon Budgets of North America
- **The 2004 Carbon Cycle Solicitation**

NACP Intensive Field Campaigns

- Under evaluation:
 - Southern Great Plains
 - West Coast
 - Enhanced Forest Land Measurements
 - Midwest
 - Chesapeake Bay region
 - Southeastern Forest Biome

NACP Data Challenge



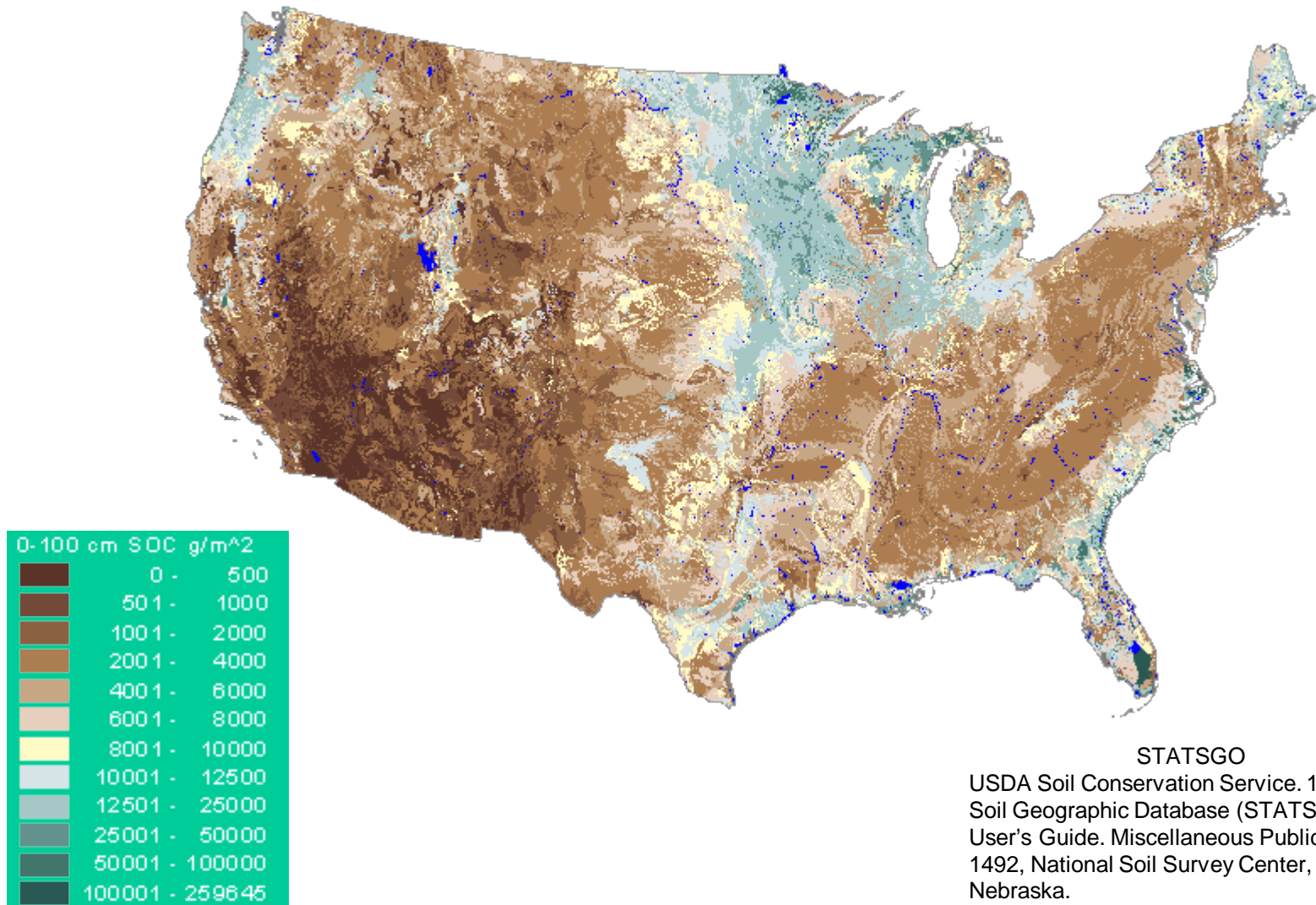
CDIAC AmeriFlux Data
Oak Ridge National Lab

Many of the required data streams exist today, but are not produced consistently at the time/space resolution needed, and the data are not assembled into an integrated set for data fusion.

Because of the diversity of data and multiple temporal and spatial scales, it will be a significant challenge to make these data available for data assimilation activities and for public use. Hence, enabling activities are needed in this area.

NACP Report (Wofsy and Harriss, 2002, pg. 25)

Soil Organic Carbon (0-100 cm)



STATSGO
USDA Soil Conservation Service. 1994. State
Soil Geographic Database (STATSGO),
User's Guide. Miscellaneous Publication No.
1492, National Soil Survey Center, Lincoln,
Nebraska.



NEESPI

Northern Eurasia Earth Science Partnership Initiative

The Northern Eurasia Earth Science Partnership Initiative (NEESPI) is being designed to establish a large-scale, international, interdisciplinary program aimed at developing a better understanding of the interactions between ecosystem, atmosphere, and human dynamics in northern Eurasia in support of international science programs with particular relevance to U.S. Climate Change Science Program interests and funding priorities. NEESPI's first major goal is to identify the critical science and applications questions and coordinate research on the state and dynamics of terrestrial ecosystems in northern Eurasia and their interactions with Earth's climate system(<http://neespi.gsfc.nasa.gov>).

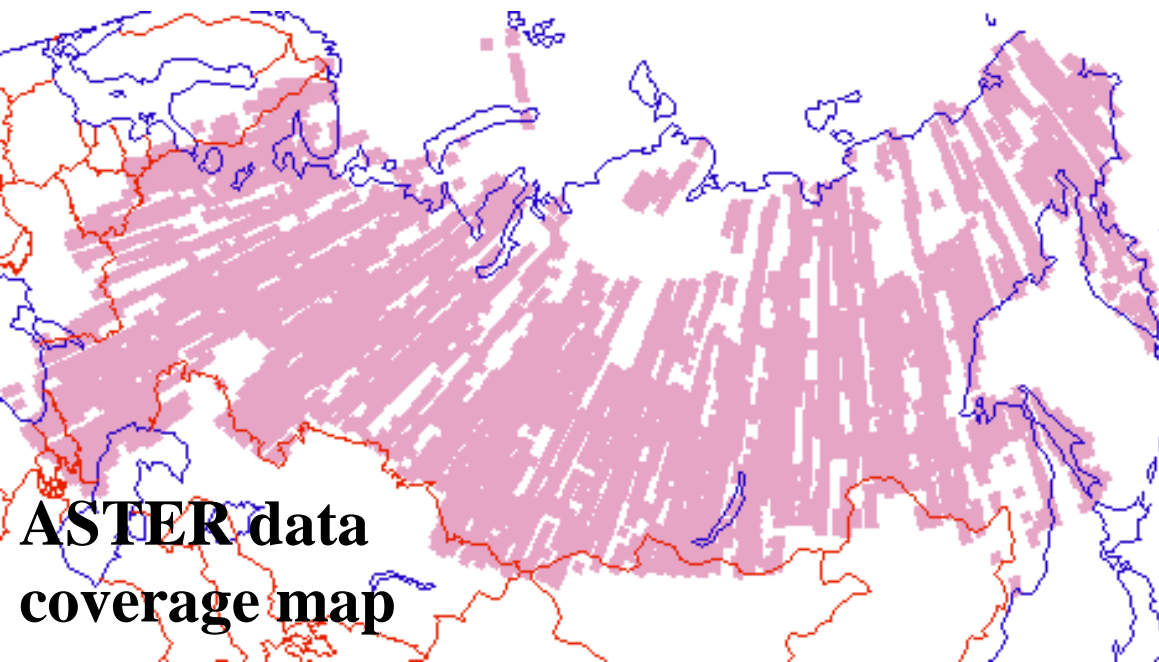


NEESPI Science

CARBON, ENERGY & WATER CYCLES

- Glaciers
- Tundra
- Boreal Forests
- Forest/Steppe
- Arid Ecosystems
- Aquatic Ecosystems

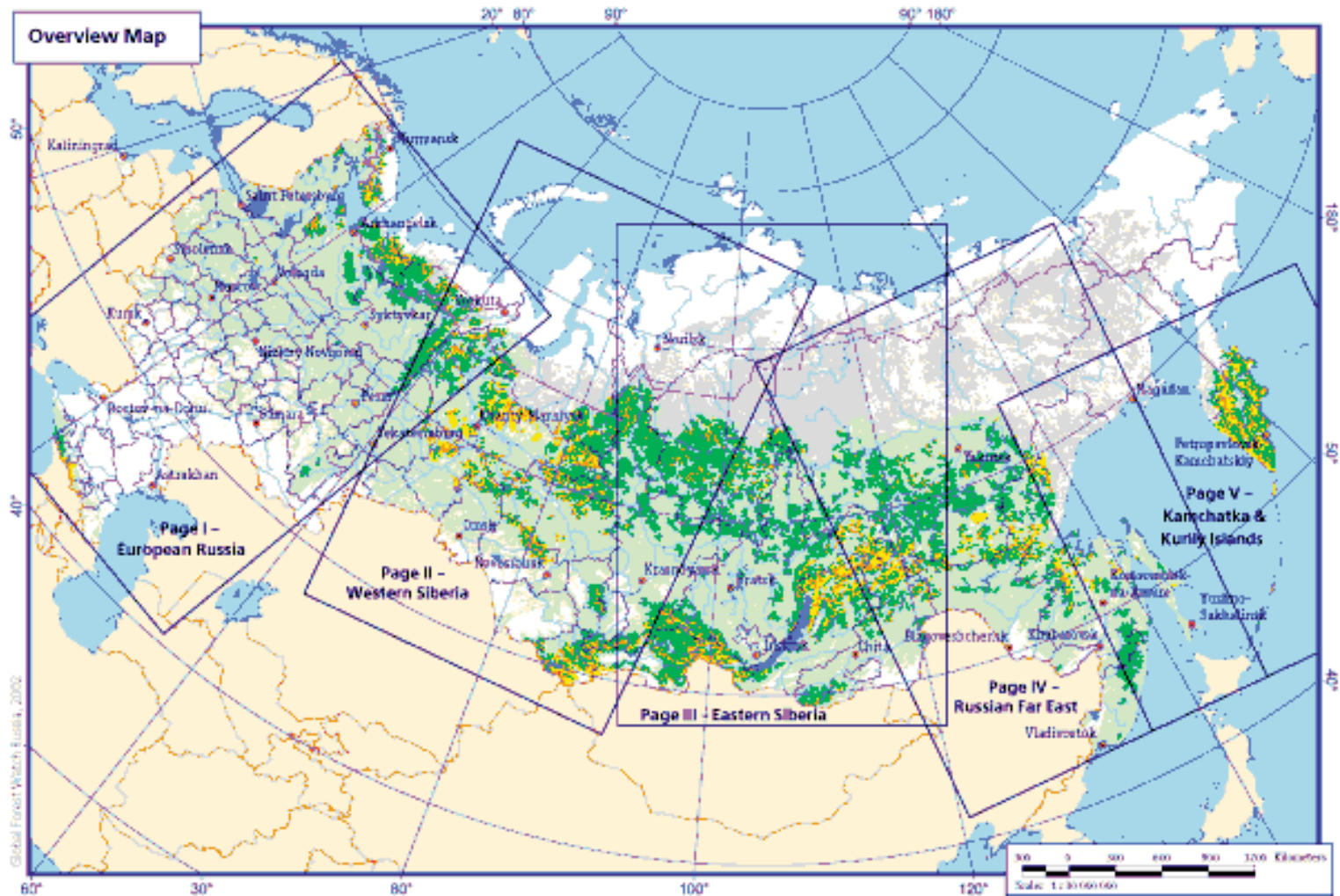
Landsat-7 Images Library

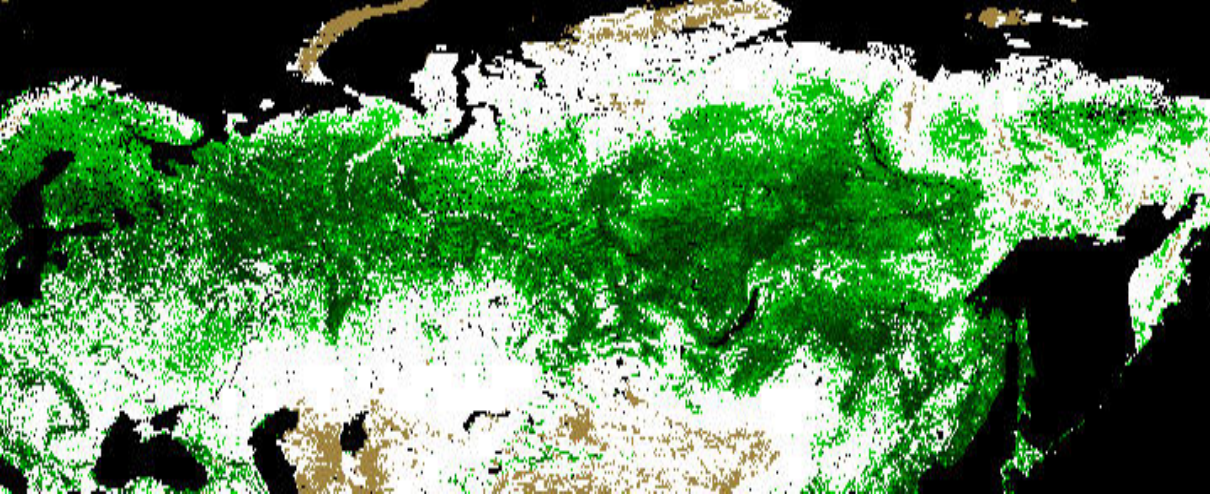


Landsat-7 scenes that currently are available from the Transparent World Cooperative Library. You can search and order these scenes with an on-line catalogue.

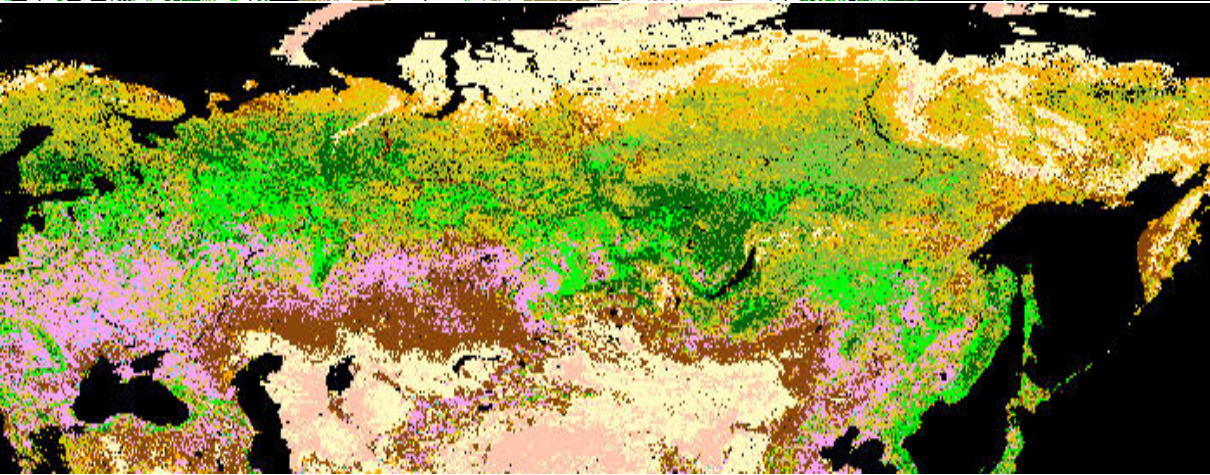
<http://www.globalforestwatch.org>

The Intact Boreal Forest Landscapes

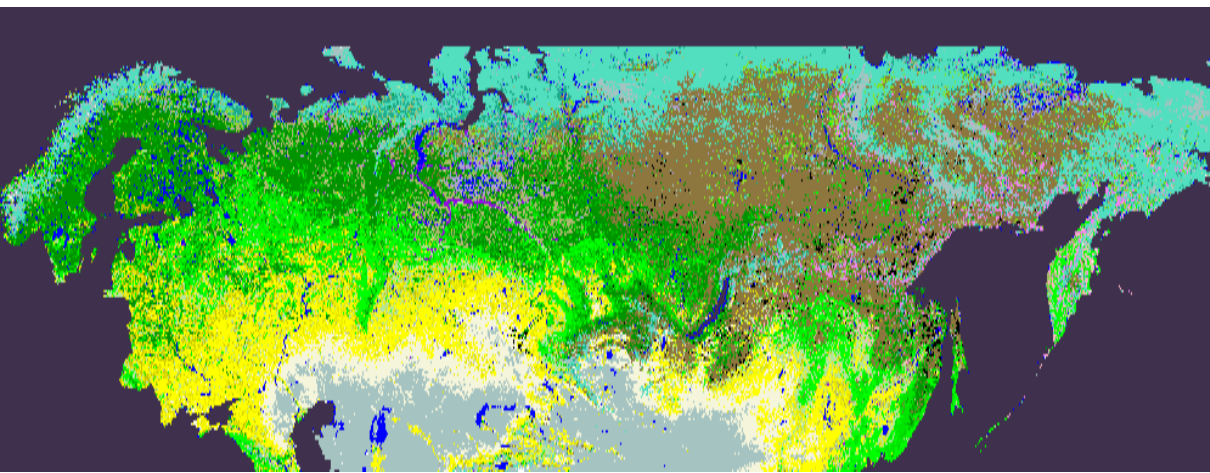




**AVHRR Continuous
Fields Tree Cover
Product
1992-04-01 -
1993-04-01**

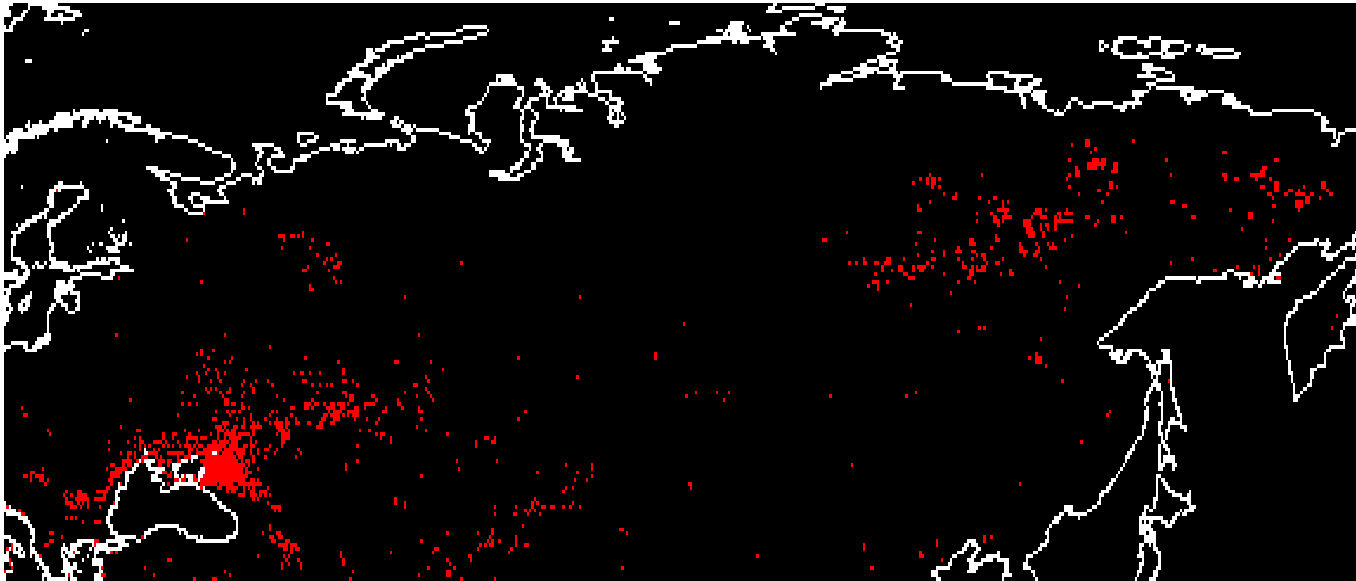


**AVHRR Global Land
Cover Product
1981-01-01 -
1994-12-31**

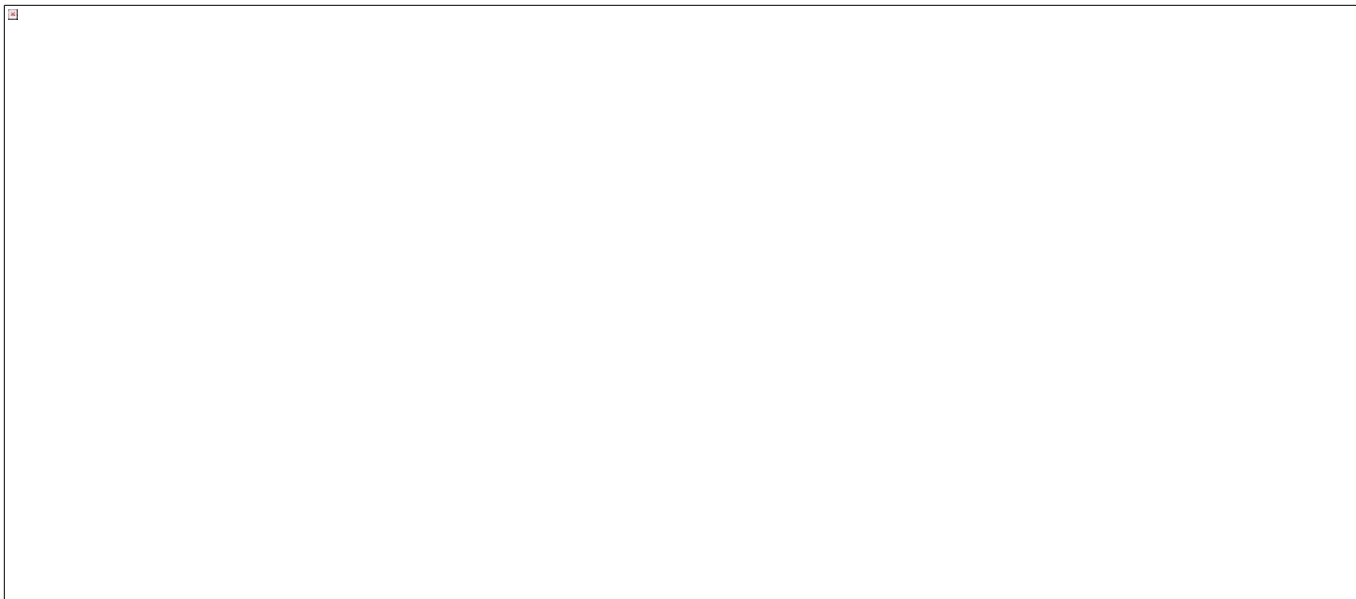


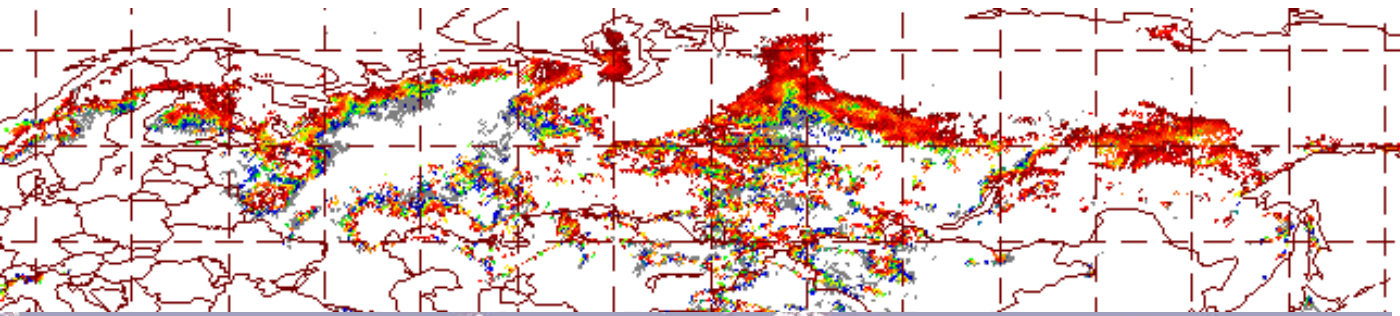
**VEGETATION
Land Cover Product**

ATSR Hot Spots (Active Fires): July 2001



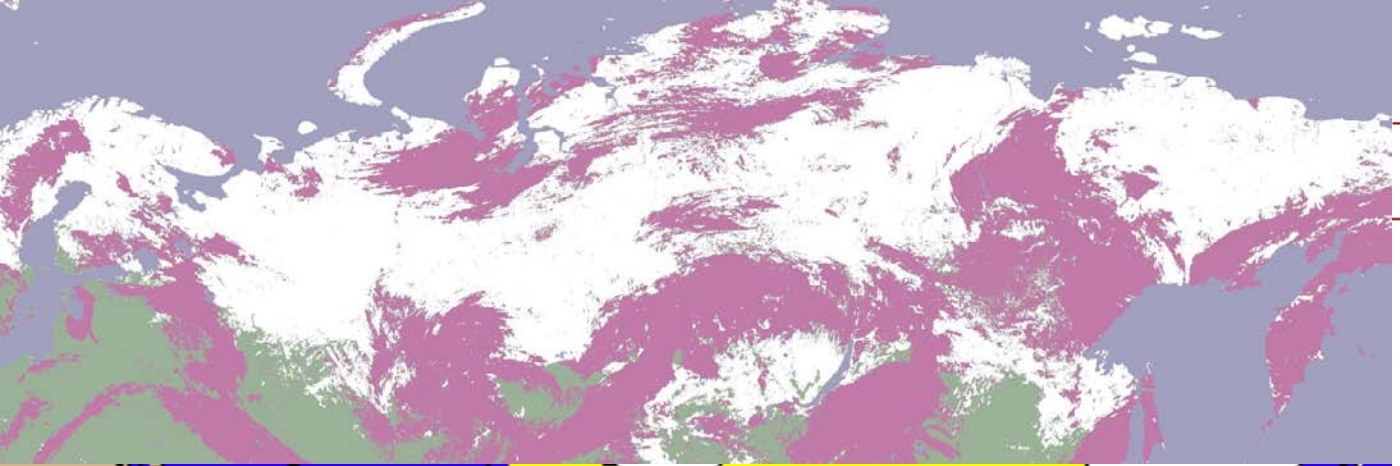
MODIS Active Fires: July 2001





SSM/I Dry Snow Depth Apr 5, 2003

The snow depth product
measures the depth of
recently accumulated dry
snow

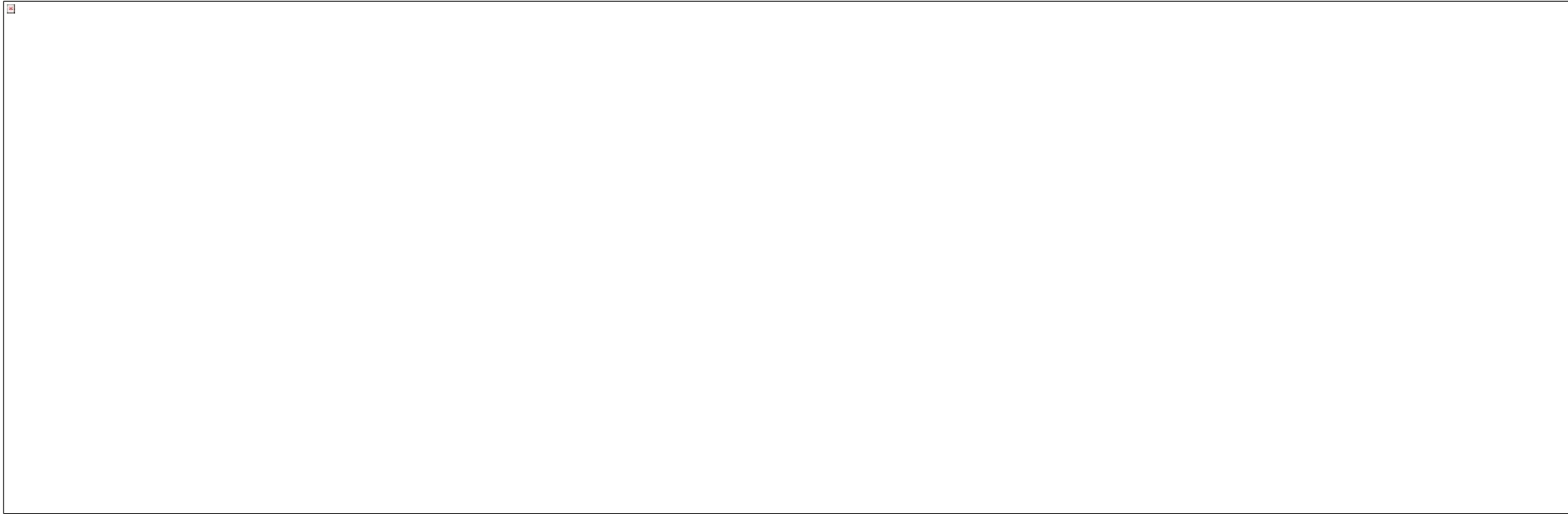


MODIS Snow Cover: April 5, 2003



NOAA Snow Cover Analysis April 1, 2003

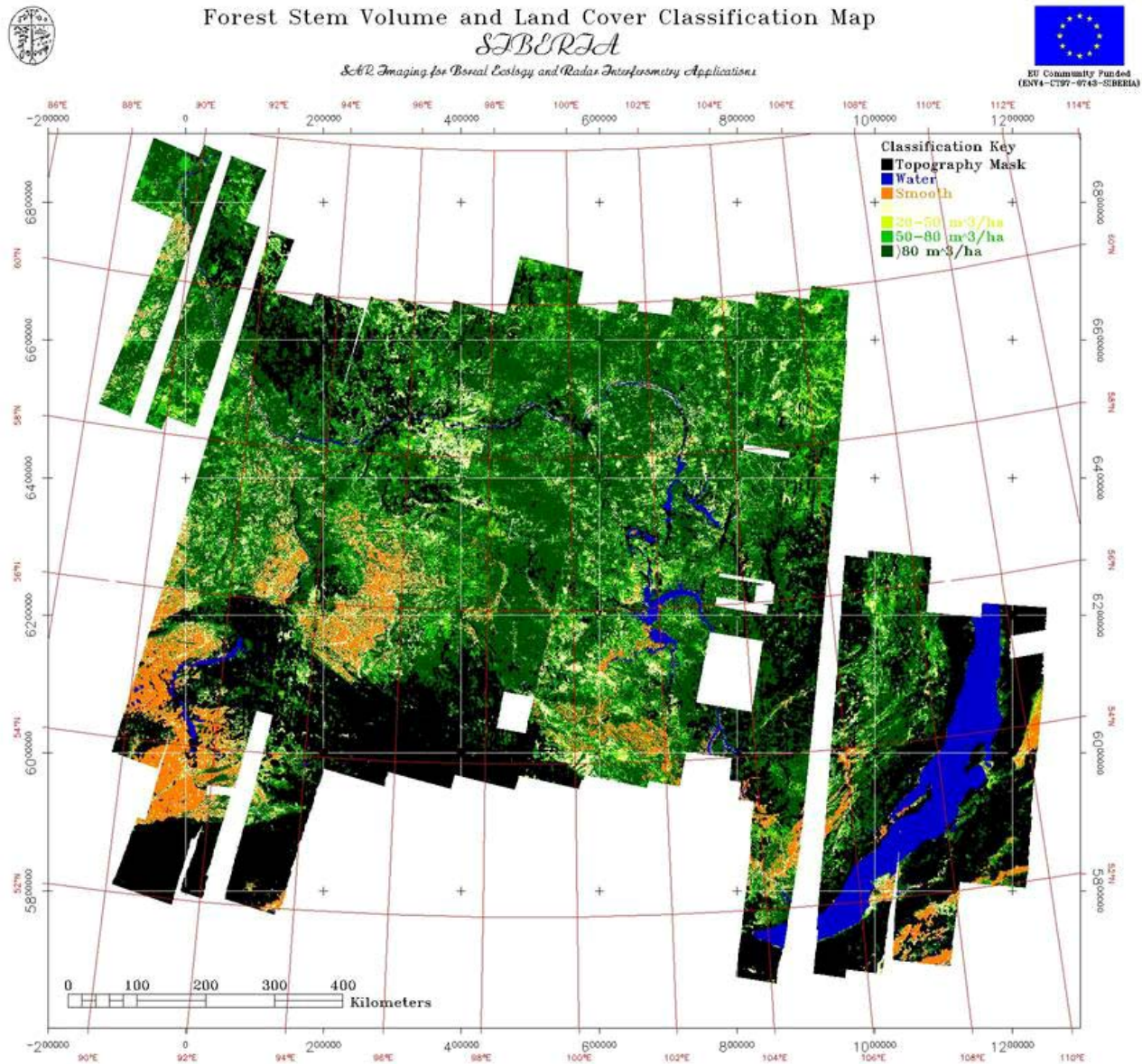
SRTM Topography



DMSP OLS Night Lights



IGBP Central Siberia Transect: SAR Biomass



The Russian Land Cover data archived and distributed by the **ORNL DAAC** were generated by scientists at the **Woods Hole Research Center**. The goal of their research was two-fold. First, by providing GIS products for Russia, they hoped to enable Russian forest ecologists to use GIS information in the management, characterization, and measurement of Russian forest resources. In addition, they wanted to create land use and land cover data for Russian land management.

IIASA (Austria)

Together with the Russian Academy of Sciences IIASA's Forestry (FOR) project has released a CD-ROM titled Land Resources of Russia, containing socioeconomic and biophysical datasets on important targets of international conventions — climate change, wetlands, desertification and biodiversity.

The land databases on Russia are the most comprehensive ever assembled, inside or outside of Russia. The databases have been enriched by remotely sensed data (Remote Sensing and GIS), biogeochemical functionality (Carbon Analysis), and socioeconomic frameworks (Institutional Framework).



LCLUC NRA's

- **NASA Research Announcements (NRA's):**
 - **Carbon Cycle round (NRA-2000) ending in August**
 - **LBA Phase II just started**
 - **New starts: IDS and EOS**
 - **Carbon Cycle NRA - is out. Water Cycle NRA soon to be out. Both have LCLUC components.**
 - **Joint LULCC NASA-USGS-NSF solicitation is planned for the middle of this year**
 - **Joint NASA-NIH (under HEED program) is planned for the end of next year**