The NASA LCLUC Program’s Support of NEESPI: Focus on Europe

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WELCOME TO ODESSA-MAMA!
Land-Cover/Land-Use Change Program

• LCLUC is an interdisciplinary scientific theme within NASA’s Earth Science program. The ultimate vision of this program is to develop the capability for periodic 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 to evaluate the consequences of observed and predicted changes.

• http://lcluc.hq.nasa.gov/
LCLUC: Drivers of Disturbance/Stress

- Natural Drivers
  - Natural hazards (fires, droughts, floods, hurricanes, landslides)
  - Invasive species
  - Climate

- Anthropogenic Drivers
  - Agricultural changes
  - Landscape modification, e.g. urbanization
  - Forest clearing, logging & fires
  - Grazing by domestic animals

- Socio-Economic Drivers
  - Technological change and macro-economic transformations
  - Political economy and institutional change
  - Values, attitudes, beliefs, individual and household behavior
  - Human population dynamics
LCLUC Consequences/Impacts

- Forestry
- Agriculture
- Wetlands and coastal zone
- Water resources and their quality
- Carbon storage and release
- Habitat degradation and fragmentation
- Atmospheric processes
Tools: Earth Observation Systems

• Optical & IR
  - Coarse resolution 1–2 km: AVHRR, SeaWiFS, OLS, ATSR, Vegetation, Geostationary, etc.
  - Moderate resolution 0.2–1 km: MODIS, MISR, MERIS, etc.
  - High resolution 5–30m: Landsat, ASTER, ALI, SPOT, CBRS, IRS, etc.
  - Fine resolution 1–4 m: IKONOS, Quickbird, etc.
  - Active: Lidars

• Microwave
  - Passive: DMSP/SSMI, AMSU
  - Active: Radars

• In situ observations and intensive field campaigns
• Modeling and integrative data analysis
• Data and information systems
Synergistic Use of Optical Remote Sensing

**VIIRS**
- 3300 km swath
- Spatial resolution, 400/800m (nadir (Vis/IR))
- Global coverage, 2x/day/satellite

**AVHRR/ MODIS**
- 2048 km swath
- Spatial resolution, 250m, 500m, 1000m
- Global coverage, 2 days

**MISR**
- 360 km
- Spatial resolution, 275m, 550m, 1100m
- Global coverage, 9 days

**Landsat**
- 183 km
- Spatial resolution, 15m, 30m
- 16 day orbital repeat
- Seasonal global coverage

**ASTER**
- 60 km
- Spatial resolution 15m, 30m, 90m
- 45-60 day orbital repeat
- Global coverage, years

**Commercial Systems**
- ~ 10 km
- Spatial resolution ~ 1m
- Global coverage, decades, if ever
Forthcoming Landsat Data-Based Product: Mid-Decadal Global Land Survey (GLS-2005)

• USGS-NASA joint effort
• Develop a **global orthorectified dataset** from Landsat observations based on measurements circa 2005 (2004-2007) with 30-m spatial res.
• Use Landsat-5 ground stations data where available, Landsat-7 composites, ASTER to fill the gaps, EO-1/ALI over islands
• Phase I – data compilation (completed)
• Phase II – data processing (ongoing); N.Eurasia - L-7 data ready; total completion - end of 2008
• Phase III – development of LCLUC products (starting in selected projects with available data)
LCLUC Program

• Total ~60 projects => 250-300 people involved
  – LCLUC Monitoring/Modeling
  – LCLUC-Carbon Cycle
  – LCLUC-Water Cycle
  – LCLUC-Climate-Environment-Biodiversity
  – New: Climate Impact on Land Use and Adaptation to Changes

http://lcluc.hq.nasa.gov/
Support of Regional Initiatives

• LBA: Regional Field Campaign in Amazon
• CARPE: Central African Regional Project on the Environment in Congo Basin (with US AID)
• MAIRS
• NEESPI
NEESPI Regions

Europe

Arctic

Far East

Siberia

Central Asia (Drylands)

MODIS 1-km true color composite: August 20-28 2004.
Shaded relief adjustment using SRTM GTOPO30 elevation data.
Produced by Mutlu Ozdogan, NASA GSFC
Regional NEESPI Meetings

• Far East Regional meeting, Harbin, China: Feb 2005

• Central Asia Regional meeting, Urumqi, China: Sep 2007

• Arctic Regional meeting, Helsinki, Finland: June 2008

• Europe Regional meeting: Odessa, Aug 2008
Central Asia
Mongolia
Kazakhstan
Uzbekistan
Tadjikistan
Kirgizstan
Turkmenistan

Russia

Far East
China
Japan
S. Korea

Baltics
Finland
Sweden
Norway
Estonia
Latvia
Lithuania

Caucasus
Georgia
Armenia
Azerbaidjan

Eastern Europe
Ukraine
Poland
Hungary
Bolgaria
Romania
Belarus
Moldova

Outside of NEESPI domain
EU
USA
Canada

~400 scientists
~200 institutions
>120 projects
30 countries
NEESPI Participation

18 institutions in Moscow participate in 21 projects

6 institutions in Beijing participate in 5 projects

Red dots: Principal Investigators
Blue dots: Co-Investigators
Green dots: Collaborators
Squares: Focus Research Centers and Science Data Support Centers
Partnerships

Links to Global ESSP Projects (IGBP, IHDP, WCRP)
NASA Contribution to NEESPI

• ~30 research projects + forthcoming “small” projects contributing to non-NASA projects
• Project Scientist
• International Project Office
• Meetings
• Data
  • Global Land Survey -2005 data products
  • MODIS, ASTER products
  • EO-1 (ALI, Hyperion)
  • IKONOS from previous acquisitions
  • ACCESS climate dataset
Education Component in NEESPI

- Education component is an important part
- Most NEESPI projects include earlier career scientists
- A structure for NEESPI-Education is being established (Georgia Tech., U.Michigan, Moscow AEROCOSMOS, Tomsk CERT)
- NEESPI Early Career Scientist Conference is planned
- Several summer schools are planned
- Post-doc exchanges to be coming soon
- GLOBE – for bringing kids into science
NASA NEESPI Science

- Carbon Cycle/LCLUC
  - 9 projects (completed)
- New Investigator Program
  - 2 biodiversity projects (completed)
- LCLUC (Hydrology)
  - 7 projects (final year)
- LCLUC (Climate, Environmental Impacts)
  - 6 projects (final year)
- Terrestrial Hydrology
  - 6 projects (final year)
- ACCESS (Data Systems Program)
  - 1 project (final year)
- Interdisciplinary Program (Biodiversity)
  - 2 projects (mid-term)
- IPY – 3 projects (first year)
- LCLUC - 4 projects (first year)

Total > $6M per year,
~30 projects

Special issue in Global Planetary Change
http://www.sciencedirect.com/science/journal/09218181
http://neespi.org
NASA-NEESPI Projects on Europe

- Tubeillo (Columbia U., GISS, IIASA) Carbon, Climate and Managed Land in Ukraine: Integrating Data and Models of Land Use for NEESPI

- Curtis Woodcock (Boston U.) Quantifying the Effects of Land Use Change on Carbon Budgets in the Black Sea Region and China

- Keith Eshleman (U. Maryland) Exacerbation of Flooding Responses Due to Land Cover/Land Use Change

- Volker Radeloff (U. Wisconsin) Post-USSR Land-Cover Change in Eastern Europe – Socio-Economic Effects on Biodiversity and Future Scenarios

- Greg Taff (U. Memphis) Land Use Change in Latvia

- Anatoly Gitelson (U. Nebraska) LCLUC effect on surface water quality (Dnieper and Don river basins and their reservoirs)

- Mutlu Ozdogan (U. Wisconsin) LCLUC in Temperate Forests of European Russia

- Alex Shiklomanov (U. New Hampshire) Northern Eurasian Landscapes: Interactions between Humans, Hydrology and LCLUC
Land-Cover Changes in Eastern Europe in Post-Soviet Era

Radeloff et al., U. Wisconsin

- Marked differences in forest cover, dominant forest species, and agricultural fragmentation.
- These differences can largely be explained by socialist forest management.
- Post-socialist land-cover change was greatest in Ukraine, where there was high agricultural fragmentation and widespread early-successional shrublands indicating extensive land abandonment.
- The abundance and pattern of arable land and grassland was attributed to land tenure in socialist times and economic transition since 1990.
- These results suggest that broad-scale socioeconomic and political factors are of major significance for land-cover patterns in Eastern Europe.

A comparison of land cover in the Polish, Slovak, and Ukrainian Carpathian Mountains in 2000 from Landsat images

Tobias Kuemmerle, Patrick Hostert, Volker C. Radeloff, Sebastian van der Linden, Kajetan Perzanowski, and Ivan Kruhlov, 2008: Cross-border Comparison of Postsocialist Farmland Abandonment in the Carpathians Ecosystems, DOI: 10.1007/s10021-008-9146-z
Natural landscape in Gauja National Park:
(largest contiguous forest patch)

Gregory N. Taff
The University of Memphis

Research question:
How has Latvia’s post-Soviet land reform affected landuse and landcover change (LULCC) in Gauja National Park’s natural and cultural landscapes?

![Diagram showing area of largest forest patch over time from 1985 to 2002.](image)
Can MODIS data be used to create value-added products that enable monitoring of key surface water quality variables?

Can we see significant LCLUC following the collapse of the Soviet Union using satellite data?

Roughly 90% of croplands and forested land in Dnieper Basin showed no significant trends during Soviet epoch.

Don Basin exhibited more significant positive trends than Dnieper Basin during Soviet epoch.

Recovery epoch shows minimal presence of significant trends in croplands.

Forest in Don Basin exhibited less significant positive trends than Dnieper Basin during the recovery epoch.
Carbon, Climate and Managed Land in Ukraine

Tubiello, Rosenzwieg, Fischer, Shvidenko, Zalogin (Columbia U., NASA GISS, IIASA, Ukr.MinEnv)

• What are the consequences to carbon storage from changes in agricultural management due to both socio-economic trends and climate change impacts?

• No strong dependence on fertilizer use (soils are rich, less dependent on fertilizer application for optimal crop production)

Projections of changes in suitability of winter wheat in Ukraine computed in 2080 projections and compared to the current climate IIASA product by G. Fischer et al.
Thank You, Enjoy Odessa!