

# Principles and Methodological Background of Northern Eurasia Earth System Studies

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## Major features of IIASA approach/methodology to Studying Northern Eurasia's Earth System

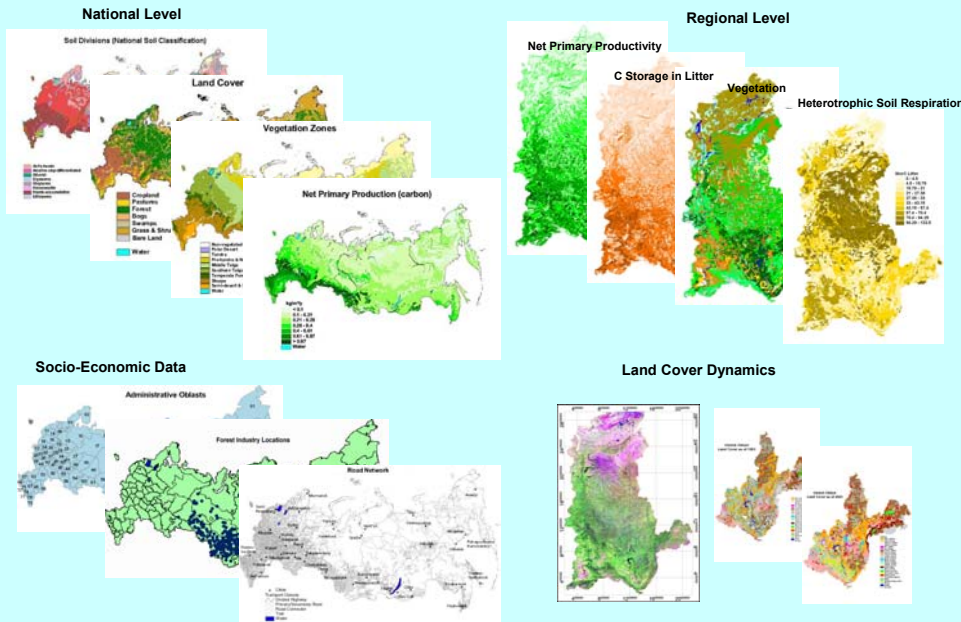
- (1) consistent use of system (holistic) principles as the overall philosophy;
- (2) landscape-ecosystem approach as the scientific background;
- (3) understanding that ecosystems are socio-ecological systems;
- (4) transparent, verifiable and comprehensive assessment of uncertainties at all stages and for all modules of studied systems;
- (5) understanding the fuzzy character of natural systems;
- (6) fusion of on-ground data, multi-sensor remote sensing concepts and models of different types (ecological, social, etc.) and scale;
- (7) multiple constraints of major results by complimentary use of different methods and models;
- (8) close collaboration with scientists/institutions of countries across the continent.

## Need of development of Integrated Observing Systems as an overall information basis

"On-ground" basis: georeferenced comprehensive quantification of properties of individual landscapes & ecosystems in the form of an Integrated Land Information System;  
 multi-sensor remote sensing concept;  
 system of measurements of environmental and other indicators (fluxes of greenhouse gases, concentration of atmospheric gases, socio-ecological indicators, etc.);  
 sets of auxiliary models.

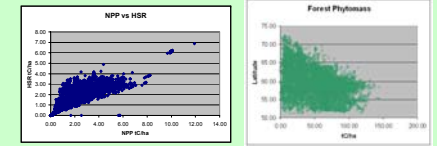
## Integrated Land Information System

Multi-layer GIS at relevant scales with corresponding attributive databases



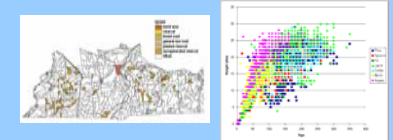
## Databases of experimental data and measurements

- Biomass by fractions
- Net Primary Production
- Heterotrophic soil respiration
- Forest litter
- Coarse woody debris, etc.



## Data of different inventories and surveys

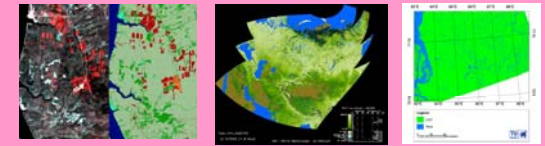
- Time series of forest inventory at different scales
- Land-use/land-cover dynamics
- Anthropogenic impacts and management (harvest of wood, consumption of vegetation products, etc.)
- Disturbances by land class (fire, insects, diseases, etc.)



## Earth Observation Data

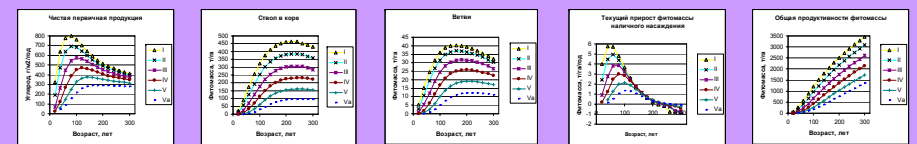
Available databases limited to the Siberia-II region

- Land cover
- Wetlands and water bodies
- Phenology (freeze/thaw, green-up etc.)
- Environmental Indicators (surface temp., snow depth etc.)
- LAI, biomass
- Disturbances



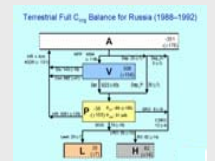
## Sets of different semi-empirical models and aggregations - examples

- DB of models of growth of forests of major forest forming species in Northern Eurasia (about 400 regional dynamic rows by dominant species as a result of the unified modeling system of growth and productivity of Northern Eurasia's forests);
- Models of biological productivity of Northern Eurasia's forests (contain dynamics of phytomass by 6 fractions and dynamics of NPP - about 400 regional dynamic rows);
- Models of forest phytomass (by dominant species as a function of age, site index and relative stocking);
- Models of transformation of organic matter in ecosystems of Northern Eurasia (decomposition of litter, CWD, dead roots, etc.);
- Amount of vegetation combustibles (aggregated data by land classes and types of fuel by grids 0.5x0.5 for the territory of Russia).



## Principles of Analysis

- Integrated consideration of different dimensions of Earth Systems
- Closing the balance of flows of energy and matter
- Multiple harmonizing of results for different models, processes and components of the biosphere
- Complex consideration of responses and feedbacks
- Superimposition of different characteristic times
- Special emphasis to "small" impacts and interactions
- Evaluation of risk and sustainability
- Limits to management possibilities of Earth Systems



## References

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