Project title

Spatio-temporal assessments of ecosystem functions and services across different LTER Europe sites

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1. Aim (for EnvEurope and LTER):

To investigate the comparative development of ecosystem service supply and demand of various European LTER sites at the landscape level, to develop methods and indicators for respective assessments, to produce regional statistics and to provide ecosystem service maps of LTER regions.

2. Research questions and Hypothesis (500 words)

Among the main effects of human activities on the environment, land use and resulting land cover changes are important drivers of environmental dynamics. Such changes impact the capacity of ecosystems to provide goods and services to the human society. This supply of multiple goods and services by nature should match the demands of the society, if self-sustaining human–environmental systems and a sustainable utilization of natural capital are to be achieved. To describe respective states and dynamics, appropriate indicators and data for their quantification, including quantitative and qualitative assessments, are needed. By linking land cover information from, e.g. remote sensing, land survey and GIS with data from monitoring, statistics, modeling or interviews, ecosystem service supply and demand can be assessed and transferred to different spatial and temporal scales. The results reveal patterns of human activities over time and space as well as the capacities of different ecosystems to provide ecosystem services under changing land

use. Also the locations of respective demands for these services can be determined. As maps are powerful tools, they hold high potentials for visualization of complex phenomena. We developed an easy-to-apply concept based on a matrix linking spatially explicit biophysical landscape units to ecological integrity, ecosystem service supply and demand (from Burkhard et al. in *Ecological Indicators* 2011).

Exemplary applications in different European LTER site regions and respective maps for the years 1990, 2000 and 2006 will be carried out and produced, using the monitoring results at the different sites. Based on these data, the concept for appropriate quantifications and related spatial visualizations of ecosystem service supply and demand will be further developed and discussed with the site managers.

3. Spatial and temporal coverage
European LTER sites and appropriate surroundings (e.g. watersheds, administrative units) corresponding to CORINE land cover data's temporal availability years 1990, 2000 and 2006.

4. Parameters used/needed* (if not only aquatic habitat are to be selected then the parameter group could be enlarged)

Parameter group (theme)	Selected parameter	Details about the parameter	Should be taken from existing data (yes/no)	Feasibility/constraints regarding existing data	Should be recorded in field (A5 work) (yes/no)	feasibility/ constraints regarding field sampling
1) Climate and physical variability	**Water budget** (input, storage, output, additional state variables, efficiency measures) **Energy budget** (input, storage, output, additional state variables, efficiency measures)	water input water storage water output element concentrations biotic water flow energy capture exergy storage entropy production meteorology metabolic efficiency	Yes	Following the indicator concept suggested as guideline for the whole EnvEurope consortium; thus there should be good feasibility regarding existing data	No	
2) Biogeochemistry data	**Matter budget** (input, storage, output, additional state variables, efficiency measures)	matter input matter storage matter loss element concentrations nutrient cycling	Yes	Following the indicator concept suggested as guideline for the whole EnvEurope consortium; thus there should be good feasibility regarding existing data	No	
3) Structure and function of the ecosystems, communities and populations	**Biotic diversity** **Abiotic heterogeneity** **Regulating ecosystem services**	flora diversity fauna diversity habitat diversity additional variables soil heterogeneity water heterogeneity air heterogeneity habitat heterogeneity additional variables Local climate regulation Global climate regulation Flood protection Groundwater recharge Air Quality Regulation	Yes	Following the indicator concept suggested as guideline for the whole EnvEurope consortium; thus there should be good feasibility regarding existing data	No	

		Erosion Regulation Nutrient regulation Water purification Pollination				
4) Human population and economy	**Land use/cover**	CORINE data	Yes	Following the indicator concept suggested as guideline for the whole EnvEurope consortium; thus there should be good feasibility regarding existing data	No	
	Population numbers	Statistics				
	Provisioning ecosystem services supply demand	Crops Livestock Fodder Capture Fisheries Acquaculture Wild Foods Timber Wood Fuel Energy Biochemicals/Medicine Freshwater				
	Cultural ecosystem services supply demand	Recreation Aesthetic values Intrinsic value of Biodiversity				

5. METHODS USED

- Selection of suitable sites from the LTER Europe network.
- Collection of GIS shape files showing the borders of the selected LTER sites.
- Collection of CORINE land cover data for LTER site areas for the years 1990, 2000 and 2006.
- Compilation of ecosystem service matrices, linking land cover types with ecosystem functions (ecosystem integrity) and ecosystem services.
- Derivation of respective indicators quantifying ecological integrity and ecosystem services.
- Development of hypotheses for ecosystem integrity and service supply in the particular land cover types at the different sites.
- Map compilation for the different sites, showing spatial patterns of ecosystem integrity and service supply and demand and calculation of regional budgets including transfer of point data to larger areas.
- Feed-back with site managers regarding the results: integration of specific site information, derivation of site-specific indicators and quantification methods, model applications, questionnaires.
- Improvement of maps and quantifications.
- Site comparison: local peculiarities, spatial variations, times series,

6. EXPECTED RESULTS

- Ecosystem service tables, statistics and maps for various LTER sites.
- Scientific publication(s).
- Assessing potentials for further collaboration and research proposals.

7. REFERENCES

Burkhard, B., Kroll, F., Nedkov, S. & F. Müller (2011): Mapping supply, demand and budgets of ecosystem services. - *Ecological Indicators*: doi:10.1016/j.ecolind.2011.06.019.

Burkhard, B., F. Kroll, F. Müller & W. Windhorst (2009): Landscapes' Capacities to Provide Ecosystem Services – a Concept for Land-Cover Based Assessments. – *Landscape Online* 15: 1-22.