SPATIAL ANALYSIS AND DECISION SUPPORT

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ENVIRONMENTAL GEOGRAPHY

Spatial heterogeneity of the environment and human activity causes the impacts of global environmental change to depend on location and context.

The Department Spatial Analysis and Decision Support investigates the role of spatial variation in environmental systems. Human activity responds to the variation in the natural environment, but also leaves a spatially-diverse imprint on the environment. The identification of vulnerable people and places under conditions of environmental change is of prime importance in designing effective environmental management strategies and planning.

The Department develops innovative methods for monitoring environmental change by remote sensing and using state-of-the-art methods for analyzing spatial patterns to better understand, model and communicate processes across different scales. Explicit attention is given to feedback mechanisms and the emergence of spatial patterns as a result of interacting human-environment processes.

The interdisciplinary expertise of the Department has been used in a wide variation of integrated projects. The researchers have a strong expertise and experience in bridging different disciplinary perspectives of environmental change and integrated assessment modelling. The complexity of the environmental problems requires the integration of data from many sources and multiple disciplinary perspectives. For this reason, the department staff is capable of resolving problems of integration that are both technological and human in nature.
The Department addresses four main research themes. Many cross-cutting issues between the themes are addressed. Examples of such cross-cutting research are projects related to Sustainable Cities and Global Assessment Models.

**SUSTAINABLE CITIES**
Research to support the development of sustainable cities in the context of global environmental change is a cross-cutting research topic of the Department. In multiple research projects, adaptation options and the provision of urban ecosystem services are studied using interdisciplinary and integrated systems.

**GLOBAL ASSESSMENT MODELS**
The Department conducts research at multiple spatial and temporal scales, linking local to global dynamics. Multiple research themes come together in our work on environmental assessment models at the global scale, including the development of global land change.
ADAPTATION TO GLOBAL CHANGE RISK

We develop methods for risk analysis and evaluation of associated costs of damage due to flooding and droughts.

Dynamic links between hydrological models, land use models and economic damage assessments have been established to allow an integrated analysis of exposure, damage and possible adaptation options. These studies involve projections of people, assets and their location, in combination with estimates of future hazard probabilities based on climate scenarios. Adaptation measures are evaluated in different contexts ranging from local measures such as small sand dams to store water in areas suffering droughts (e.g., in Kenya and Ethiopia) and urban planning and risk management in coastal cities such as Rotterdam (the Netherlands), Jakarta (Indonesia), Ho Chi Minh City (Vietnam), and New York (USA). Several new research activities focus on the impacts of climate change and climate variability on water related issues at the global scale, including developing models to assess flood risk at the global scale, assessments of the impacts of El Niño on flooding, global assessments of adaptation costs in the water supply sector, and global analyses of spatial and temporal patterns in water scarcity.

Ecosystem Services have received increasing attention from both scientists and policy makers as a means to address the multiple benefits received from our environment. It is a common challenge to incorporate the concept of ecosystem services into environmental management strategies and operational policy. To meet this challenge, new methods to monitor, quantify and valuate ecosystem services are needed. In addition, assessments of ecosystem services must be incorporated in scenario studies to explore the future dynamics under changing policy conditions. The Department aims at preparing a tool box for the mapping and quantification of ecosystem service provision making use of a thorough understanding of ecological processes, both in terrestrial and marine environments. Such information is of importance for the valuation of these services. The Department contributes to several projects in which, together with environmental economists, new approaches to valuation of ecosystem services are explored.

Insights are used to inform policy design, schemes for PES (payments for environmental services), multi-functional land use strategies and rural development.

Land use change occurs at the interface of human and natural systems, being both a cause and effect of changes in socio-ecological systems.

Land use change is the result of many interacting processes across multiple scales involving different economic sectors and a wide variation of actors. Different land uses may lead to competing claims given that land is a limited resource. Policy and land use planning should aim at enhancing the synergies between different land uses and carefully addressing the trade-offs between different choices. The Department aims at improving the overall understanding of land use change using a spatial, multi-sectoral perspective across multiple spatial and temporal scales. Spatial models for simulating scenarios of land use change are developed and applied. Models range from agent-based models at local scales to integrated models of land use system change at continental to global scales. Models are used to test hypotheses of land use transitions, evaluate integrative scenarios and make ex-ante assessment of specific policies, including agricultural policy reform or biofuel policies. Researchers of the Department have developed the CLUE (including CLUE-s, CLUE-Scanner and Dyna-CLUE) model that is one of the best-known operational land use models and widely-used throughout the world. Besides land cover change the CLUE model is capable of addressing dynamics in livestock distribution, agricultural intensity, forest dynamics, urbanization and land functions.

In practical terms, the best plan makes optimal use of the information available, and has the largest possible support of the stakeholders. Because the information load is high, spatial decision support should complement design by the landscape architects. Important issues are: fragmentation, landscape patterns, spatial design algorithms, and evaluation under uncertainty. The communication of scientific findings to policy makers and the discussion of alternative management strategies and land use planning require techniques that allow the involvement of stakeholders. Within the Department, different techniques and tools are evaluated that support such stakeholder dialogue. These include the use of spatial multicriteria analysis on an interactive ‘touch table’ to support spatial planning; the use of photorealistic landscape scenarios for participatory workshops on rural development options and a contribution to a European discussion support system for rural areas.


INTERNATIONAL LEADERSHIP
The Department chairs, under the overall auspices of the Earth System Science Partnership, the Global Land Project. The Project has evolved into the largest network in the field of Land Science. In addition, the Department is a core member of Alternet (Europe’s biodiversity research network), the Ecosystem Service Partnership, and the European Land Use Institute. Within Amsterdam the Department collaborates within the Amsterdam Global Change Institute.

COMMITMENT TO TEACHING
The Department is highly active in several teaching programmes, especially IVM’s multidisciplinary MSc ‘Environment and Resource Management’ and the BSc and MSc in Earth Sciences and Economics.
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