Global Change
RESEARCH SYMPOSIUM 2014

Università
DEGLI STUDI DI BARI
ALDO MORO

Human and Ecosystem
Response to Global Change

Evidence and Application

PROGRAMME & ABSTRACT BOOK

16-18
September
2014
Ostuni, Brindisi, Southern Italy

www.global2014.it

Port Isaac, North Cornwall captured from a Cessna light aircraft at 2000 feet.
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Edited by

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Accademia Italiana di Scienze Forestali

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PREFACE

Global change issues, including climate change, natural disasters, air and water pollution, urban expansion, and water resource shortages, are placing increasing pressures on a range of ecosystem services such as biodiversity, carbon storage, nutrient and water recycling, flood protection, soil quality, etc. For example, mounting changes in urbanization increase the risk of degrading ecosystem services provision through ecological consequences that can undermine efforts to promote a more sustainable and healthier society.

Recent studies recognize and focus on the particular challenges faced by resource managers in human-dominated landscapes. Yet, it has proven difficult to move from the scientific *evidence* about the ecosystem services approach to its practical. For example, there is increasing consensus on the importance of incorporating ecosystem services into management plans; however, quantifying the levels and values of these services is challenging. Without quantitative assessments, these services tend to be ignored by those making decisions on land use and resource management.

New scientific concepts and frameworks are emerging and urgently needed to understand the interactions that take place between natural (e.g., ecological, meteorological, hydrological, and environmental) and human (e.g., social, economic, institutional) subsystems. In particular, a daunting challenge is to understand how global change research can support management decisions and interventions that are most urgently needed to mitigate different stressors and protect ecosystem services and human well-being.

This volume contains some of the papers presented at the **Global Change Research Symposium 2014** held in Ostuni, Brindisi, Southern Italy on September 16-18, 2014. The papers in this volume cover a broad range of topics including coupled natural and human systems (CNHS). The contributions provide examples of successful ecological research conducted across regions and scales as well as implications on which to base ecosystem and landscape management. The contributions have been organized into six main sections that focus on: (A) Coupled human and natural systems; (B) Global change ecology; (C) Remote sensing of global change; (D) Ecosystem modelling and management; (E) Green infrastructure and biodiversity; and (F) Ecosystem services evaluation and policy making.

Raffaele Lafortezza and Jiquan Chen
The Editors

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The text of the abstracts has been produced by the authors under their supervision. Only minor corrections to the text and format may have been carried out by the Editors. The abstracts in this volume follow the order of the programme presentation of the Symposium.

SYMPOSIUM PROGRAMME

(Last updated: Sept. 5, 2014)

GLOBAL CHANGE RESEARCH SYMPOSIUM 2014 - SESSIONS SCHEDULE - www.global2014.it

Time		Sept. 15 (Monday)	Sept. 16 (Tuesday)		Sept. 17 (Wednesday)		Sept. 18 (Thursday)	
8:00	AM	Registration	Registration		Registration		Registration	
9:00	AM	Registration						
10:00	AM	Registration	Keynote address - introduced by Dr. Jiaguo Qi (MSU)		Session C	Session D	Session A	Session D
11:00	AM	Registration			Session B	Session F	Session B	Session F
12:00	AM	Registration						
13:00	AM	Registration	Lunch-break/Poster session		Lunch-break/Poster session		Lunch-break/Poster session	
14:00		GUIDOS 2.0 ToolBox Workshop (5 hours) by Peter Vogt (JRC-EC)	Session A	Session E	Networking/Project Meetings / Round-tables/Demo-desk		Networking/Project Meetings / Round-tables/Demo-desk	
15:00	PM							
16:00	PM				Field trip (Polignano)		Field trip (Ostuni)	
17:00	PM		Networking/Project Meetings / Round-tables/Demo-desk					
18:00	PM							
19:00	PM							
20:00	PM		Welcome Dinner (Ostuni-Rosa Marina)		Dinner at Polignano		Conference Dinner (Ostuni-Rosa Marina)	
21:00	PM							
22:00	PM							

Session A Coupled human and natural systems

Session B Global change ecology

Session C Remote sensing of global change

Session D Ecosystem modeling and management

Session E Green infrastructure and biodiversity

Session F Ecosystem services evaluation and policy making

Global Change
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Tuesday - September 16, 2014

8:00	**Registration**
9:00	**Symposium Opening** *Raffaele Lafortezza, University of Bari and Jiquan Chen, Michigan State University*
9:15	**Keynote address** *Introduced by Dr. Jiaguo Qi, Head of Center for Global Change and Earth Observations, and Department of Geography, Michigan State University*
9:30	**Emerging issues of forest ecosystem monitoring and assessment at global scale** *Piermaria Corona, Head of Forestry Research Centre (CRA-SEL), Italy*
10:15	**Global satellite observations and climate change at ESA** *Frank Martin Seifert, Earth Observation Programme – European Space Agency*
11.00	**Coffee-break & Demo-desk**
11:30	**Applications of remote sensing and big data in ecology and conservation** *David A. Coomes, Head of Forest Ecology and Conservation Group, Department of Plant Sciences, University of Cambridge*
12:15	**Amazonian deforestation and land cover change: human-environment interactions** *Emilio Moran, Center for Global Change and Earth Observations, and Department of Geography, Michigan State University*
13:00	**Lunch-break/Poster session**

	Session A - Coupled human and natural systems *chairperson: Jiquan Chen, USA* Room I	**Session E – Green infrastructure and biodiversity** *chairperson Clive Davies, UK* Room II
15:00	Landscape patterns in mountain pasture-woodlands under changing climate and management *Rebecca Snell, Switzerland*	The relationship between vegetation density pattern and soil macrofauna biodiversity *Gholami Shaieste, Iran*
15:20	Private fencing and its cascading effects on biodiversity, ecosystem functioning, and ecosystem services delivery at the landscape scale *Baltzinger Mari, France*	Assessing ecological tolerance of plants included in the green infrastructure of city of Yerevan, Armenia *Gayane Nersisyan, Republic of Armenia*
15:40	Impacts of land use changes on carbon and nitrogen stocks and fluxes of plants and soils *Atul Jain, USA*	Species richness of small urban parks in relation to park attributes and human activities *Zanariah Jasmani, Denmark*
16:00	**Coffee-break**	
16:20	Linking terrestrial processes to coastal ecosystem services in east and southeast Asia: outstanding issues, challenges, and consequences. *Jiaguo Qi, USA*	Green infrastructure and mapping of protected areas in Greece *Drosos C. Vasileios, Greece*
16:40	How does mining impacts on rural immigration of Mongolia? *Amarjargal Amartuvshin, Mongolia*	Modelling biodiversity in urban forests using a multi-taxa approach: towards a functional urban green infrastructure *Pedro Pinho, Portugal*
18:00-20:00	Networking, project meetings, round-tables, demo-desk	
21:00	**Welcome dinner (Ostuni Rosa Marina Resort)**	

Wednesday - September 17, 2014

8:00	**Registration**

	Session C - Remote sensing of global change *chairperson Frank M. Seifert, ESA* Room I	**Session D – Ecosystem modelling and management** *chairperson Emilio Moran, USA* Room II
9:00	Morphological analysis of state and trends of digital image objects *Peter Vogt, European Commission*	Sustainable land management for Germany: an interdisciplinary and transdisciplinary discourse *Johanna Fick, Germany*
9:20	Remote sensing and hydrological modeling in support of transboundary water cooperation in Central Asia *Aziza Baubekova, Kazakhstan*	Evaluating the effect of grain for green program on water cycle in China *Wenping Yuan, China*
9:40	Estimating trend survival probability in satellite observations of land cover activity over Europe *Maria Lanfredi, Italy*	Land use and land cover change scenarios for the Bolivian Amazon *Graciela Tejada, Brazil*
10:00	The GIO LAND activities: from the first results to the Sentinel-2 perspective *Daniela Iasillo, Italy*	Landscape prioritization logical modeling for discriminating hotspots in wildfires and slash-and-burn events in Bolivian Amazonia *Fabio Salbitano, Italy*
10:20	Very high resolution change detection of land cover/use target classes in mediterranean Natura 2000 sites *Cristina Tarantino, Italy*	Effects on forest and intrinsic motivations of payment for environmental services *Maria Claudia Lopez, USA*

10:40	**Coffee-break & Demo-desk**

	Session B - Global change ecology *chairperson David A. Coomes, UK* Room I	**Session F – Ecosystem services evaluation and policy making** *chairperson Giovanni Sanesi, Italy* Room II
11:00	The international networks to monitor and understand ecosystem-atmosphere GHGS exchanges *Dario Papale, Italy*	A spatial-explicit scenario analysis for assessing the effects of land cover changes on ecosystem services *Sandra Luque, France*
11:20	Crown fire - insect defoliation interaction in central Canada's forests: climate change and management implications *Richard Fleming, Canada*	Effects of urbanization and human activities on landscape change and local environment in the Bohai Rim Region, China *Wei Wei, China*
11:40	FLUXCOM, towards an ensemble of improved global data-driven products: cross-validation at site level and global scale *Gianluca Tramontana, Italy*	Fire, forest fragments and landscape change case of Madagascar highlands *Harifidy Rakoto Ratsimba, Madagascar*
12:00	Nutrient availability could constraint forest ecosystem response to global change in Europe *Jonard Mathieu, Belgium*	Land grabbing for urban development in vietnam perspective of rightful resistence *Nguyen Thao Thi Bich, Japan*

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12:20	Evaluating the effect of forest loss and degradation on ecosystem services provision at different spatiotemporal scales *Cristian Echeverría, Chile*	Mapping the hotspots of ecosystem services in China: spatial pattern and temporal trend *Lü Yihe, China*
13:00	**Lunch-break**	
14:00	**Poster session**	
15:00-17:00	Networking/project meetings/round-tables/demo-desk	
17:30	**Departure for Polignano (Field trip)**	
21:00	**Dinner (Polignano)**	

Thursday - September 18, 2014

8:00	**Registration**

Session A - Coupled human and natural systems *chairperson: Rebecca Snell, Switz.* Room I	**Session D – Ecosystem modelling and management** *chairperson: Francesco Gentile, Italy* Room II
9:00 Divergences of two coupled human and natural systems on Mongolia plateau *Jiquan Chen, USA*	The evaluation of ecological flow in mountain rivers a new approach considering hydromorphological alterations *Claudia Dresti, Italy*
9:20 Changing the structure of urban ecosystems to improve soil processes and functions *Alessandro Ossola, Australia*	Functional groups and tree growth along an elevational gradient in the atlantic forest, southeastern Brazil *Maurício Lamano Ferreira, Brazil*
9:40 Heat waves, urban vegetation, and air pollution *Galina Churkina, Germany*	Analysis of stem growth of scots pine in three European countries *Azimeh Motallebi, Estonia*
10:00 Winter heat island assessment in Bucharest using DS1921G thermochron iButton data logger monitors *Gabriel Vanau, Romania*	An individual-based model to design Anogeissus Leiocarpa seed dispersal under change in local climate variables and anthropogenic threats *Hodabalo Pereki, Germany*
10:20 A streamlined approach for the spatial allocation of fuel removals in wildland–urban interfaces *Mario Elia, Italy*	Evaluation of the mechanical effects of roots on slope stability using a finite element analysis *Francesco Gentile, Italy*

10:40	**Coffee-break & Demo-desk**

Session B - Global change ecology *chairperson Richard Fleming, Canada* Room I	**Session F – Ecosystem services evaluation and policy making** *chairperson Sandra Luque, France* Room II
11:00 Effect of climate on diametric growth and mortality of oak and beech in French mixed forests *Rubén Manso, France*	Ecosystem service valuations of mangrove ecosystems to inform decision making and future valuation exercises *Nibedita Mukherjee, Belgium*
11:20 Using litter decomposition for predicting exotic trees effects on new ecosystems *Ehsan Sayad, Iran*	Evaluation of private forest owners' management alternatives under biophysical climate-related and economic constraints *Brent Matthies, Finland*
11:40 Modeling the risk of bark beetle outbreaks in drought-stressed Norway Spruce stands *Sigrid Netherer, Austria*	Residents' welfare evaluation for the ecological restoration of landscape river in Suzhou, China based on the WTA investigation *Yifei Zhang, China*
12:00 Landscape dynamics and spatial analysis of mangrove case of Belo Sur Tsiribihina, western coast of Madagascar *Navale Ratovoson, Madagascar*	Multi-criteria evaluation for decision making about forest opening up works standard *Sarantis–Angelos Liampas, Greece*

| 12:20 | Harvesting model in mountainous areas of Greece *Vasileios Giannoulas, Greece* | Land abandonment at the periphery of former socialist cities: a precursor of urban sprawl the case of Bucharest Simona *Gradinaru, Romania* |

13:00	**Lunch-break**
14:00	**Poster session**
15:00-17:00	Networking/project meetings/round-tables/demo-desk
17:30	**Departure for Ostuni (Field trip)**
21.00	**Conference Dinner (Ostuni Rosa Marina Resort)**

Session A – Coupled human and natural systems

A1   Monitoring expansion of cultivation in the arid and semi-arid rangelands using remote sensing and ground survey data
Michael Elias, Germany

A2   Human impact on coastal landscape: a diachronic analysis of wildland-urban interface in a Mediterranean area
Roberto Ferrara, Italy

A3   Livelihoods, climate change and deforestation. an agent-based approach to understand coupled human and natural systems in southwest Madagascar
Jorge Llopis, Denmark

A5   Plant biodiversity conservation in urban green spaces of Guarulhos city, sp, southeastern Brazil
Mauricio Lamano-Ferreira, Brazil

A6   Changes in carbon and water vapor exchange due to spontaneous afforestation of a karst grassland
Klemen Eler, Slovenia

A7   An integrated approach to a complex case study of land degradation due to human and natural factors
Vito Imbrenda, Italy

Session B – Global change ecology

B1   Vulnerability of biodiversity to land use change under different socio-economic and climate change scenarios for Mexico
Ponce Alma Mendoza, UK

B2   Climate-driven impacts on potential agricultural and silvicultural transformations in Siberia
Elena Parfenova, Russia

B3   Simulated the effects of nitrogen deposition on global carbon budget using the IBIS model
Xuehe Lu, China

B4   Analysis of the role of climatic variables in co2 fluxes between ecosystems and the atmosphere through empirical models and time series of eddy covariance measurements
Daniela Cavalli, Italy

B5   Greenhouse gas budget of energy crops: the case of a land use change
from conventional agriculture to a poplar short rotation coppice
Simone Sabbatini, Italy

B6   Litterfall production, stock and decomposition in two fragments of the
Atlantic forest with different levels of atmospheric contamination
Ana Paula Nascimento, Brazil

Session C – Remote sensing of global change

C1   Semi-automatic segmentation of wood and foliage using terrestrial laser
scanner
Roberto Ferrara, Italy

C2   Spatial dynamics of the Sundarbans study between 1973 and 2014: a
robust remote sensing approach
Abu Mahmood, UK

C3   Combining airborne Lidar and field data to assess forest stand conditions
in urban forests
Vincenzo Giannico, Italy

Session D – Ecosystem modelling and management

D1   Modeling the influence of alternative forest management scenarios on
wood production in the Mediterranean region: the MIMOSE approach
Davide Travaglini, Italy

D2   Forest fire disasters prevention and management: the decision support
system
Dongiovanni Nicola, Italy

D3   Standardized value added geospatial products to support urban planning
and S.E.A. monitoring
Claudio La Mantia, Italy

D4   Application of risk assessment scheme to sustainable farming through the
"biodiversity friend" certification results from 3-year monitoring and
actions on table grape farms in the area of Bari monitoring
Giulio Benvenuti, Italy

D5   K4E - KHIRA for environment the contribute of khira project to the issue
of global change Claudio Rocco, Italy

Session E – Green infrastructure and biodiversity

E1   Residential green space contributions for biodiversity conservation in Piracicaba, SP, Brazil
Ana Paula Nascimento, Brazil

E2   Evaluation of the mechanical effects of roots on slope stability using a finite element analysis
Francesco Gentile, Italy

E3   Sustainable development and management of a multifunctional mountainous area in Greece sustainable multifunctional mountainous area
Vasileios Drosos, Greece

E4   Inventory of urban and periurban forests (UPF) in Lombardy results of the life project EMONFUR (LIFE + 10 ENV/it/399)
Enrico Calvo, Italy

E5   Is plant diversity of urban green infrastructure categories in correspondence with the diversity and quality of their ecosystem services?
Špela Božič, Slovenia

Session F – Ecosystem services evaluation and policy making

F1   Linking trajectories of land use change, land degradation processes and ecosystem services
Daniela Smiraglia, Italy

F3   Estimating coral reef attributes affecting scuba diving experience: a choice experiment application in Sipadan, Borneo
Diana Emang, Malaysia

F4   Landscape analysis of a critical coastal area using multi-temporal Landsat images and airborne hyperspectral data
Vito Imbrenda, Italy

F5   Rural urban fringe areas in changing land use. an application of multi-objective programming
Giovanni Ottomano Palmisano, Italy

F6   The role of vertical structure as a biomass indicator in urban forest
Lucia Pesola, Italy

KEYNOTE SPEAKERS

Piermaria Corona

Director of the Forestry Research Centre of the Italian Agricultural Research Council (CRA) - Full Professor of Forest Mensuration and Management, University of Tuscia, Italy

Director of the Forestry Research Centre of the Italian Agricultural Research Council (CRA), since 2013. Full Professor at the University of Tuscia (Italy). Coordinator of the 4.02.06 working unit (Resource Data in Boreal and Temperate Regions) of the International Union of Forest Research Organizations (IUFRO). Dean of the School of Forest and Environmental Sciences at the University of Tuscia (Italy), from 2002 to 2009. Director of the Department of Forest Environment and Resources of the University of Tuscia, from 2009 to 2011. Director of the Department for Innovation in Biological, Agro-Food and Forest Systems of the University of Tuscia, from 2011 to 2013. President of the Italian Society of Silviculture and Forest Ecology, since 2012. His main research field is forest resources inventory and management. He is the author of over 370 scientific and technical publications, of which more than 70 on ISI journals, and 14 books dealing with forest planning, management and monitoring issues.

Frank Martin Seifert

European Space Agency at ESRIN/Frascati

Frank Martin Seifert has been working for the European Space Agency at ESRIN/Frascati, Italy since 2000 as Earth Observation application engineer. His scientific expertise lies in SAR remote sensing with emphasis on system calibration and interferometry. Led by curiosity he moved from system aspects to applications of remote sensing data, not only SAR but as well optical sensors to study terrestrial surface processes and promote their applications towards operational implementation with user organisations. For ESA Frank Martin Seifert has been focal point for land and forest services from local to continental scale for GMES, now Copernicus, which led to the specification of the Sentinel-1 and -2 satellites. He became more involved in climate change research with applications in the cryosphere on glaciers and permafrost, precursors for ESA's Climate Change Initiative. His current interest lies in the use of remotely sensed data supporting developing countries to measure, report and verify the status of their forests in the framework of REDD+. To maximize the information value and impact of satellite images he is working on systematic space data coordination in GEO's Global Forest Observation Initiative (GFOI) and advocates for ESA Earth Observation at UNFCCC.

David Anthony Coomes

Plant Sciences Department, University of Cambridge

David Coomes has led the Forest Ecology and Conservation group in Cambridge since joining the staff in 2000, and is motivated by an interest in the fundamental process driving forest changing. Working with national forest inventories from various countries, he has shown how regeneration, growth and mortality processes are all influenced by climate, allowing him to explore the probable response of forest systems to climate change. His work on soil chronosequences has emphasized how poor drainage can interact with phosphorus impoverishment to drive changes in forests over long timeframes. His group is working with airborne remote sensing using lidar and hyperspectral sensors to detect the spread of ash dieback, distinguish areas of tropical forest that were logged in the past, and explore how human modification of tropical forests is influencing biogeochemical processes.

Emilio F. Moran

John A. Hannah Distinguished Professor,
Center for Global Change and Earth Observations, and Department of Geography, Michigan State University

Emilio F. Moran joined Michigan State University in January 2013 as John A. Hannah Distinguished Professor, associated with the Center for Global Change and Earth Observations, the Center for System Integration and Sustainability, and the Department of Geography. He was until 2012 Distinguished Professor and the James H. Rudy Professor of Anthropology at Indiana University, Professor of Environmental Sciences, Adjunct Professor of Geography, and Director of the Anthropological Center for Training and Research on Global Environmental Change (ACT) at Indiana University. Dr. Moran is the author of ten books, fifteen edited volumes and more than 180 journal articles and book chapters. His research has been supported by NSF, NIH, NOAA and NASA for the past two decades. His three latest books, Environmental Social Science (Wiley/Blackwell 2010), People and Nature (Blackwell 2006) and Human Adaptability, 3rd edition (Westview 2007) address broad issues of human interaction with the environment under conditions of change. His most recent book, Meio Ambiente & Florestas (Editora SENAC Sao Paulo 2010) addresses the value of forests in Brazil and the world. His book Developing the Amazon (Indiana U Press, 1981) was the first book-length study of the human and environmental impacts of the Transamazon Highway. He is a Fellow of the Linnean Society of London, Fellow of the American Anthropological Association and the Society for Applied Anthropology, Fellow of the American Association for the Advancement of Science, and was elected to the National Academy of Sciences in 2010.

EMERGING ISSUES OF FOREST ECOSYSTEM MONITORING AND ASSESSMENT AT GLOBAL SCALE

Piermaria Corona

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Abstract

A number of international agreements and commitments (e.g. the Forest Principles of Agenda 21, the Convention on Biological Diversity and the Framework Convention on Climate Change) emphasize that appropriate monitoring and assessment are prerequisites for sound conservation and management of the world's forest ecosystems. Mandated periodic surveys, like forest inventories and mapping, provide a unique opportunity to identify and properly satisfy management information needs under a systemic forestry perspective. Distinctively, forest inventories and mapping can be regarded as effective tools for estimating the kind, amount, extent and condition of forest ecosystems over large areas. The use of remote sensing coupled with statistical sampling and periodic re-measurements of permanent sample units provides the basis for measuring and mapping changes in global forest ecosystem conditions and estimating trends. Forest inventories and mapping are currently and actually evolving towards multipurpose resources surveys and are broadening their scope in three major directions: (i) inclusion of additional variables not directly related to timber assessment and wood volume growth, such as biodiversity attributes; (ii) enhancement of carbon-related assessment issues (forest harvesting included), e.g. to supporting for REDD+ monitoring and reporting or for assessing emissions from forest fires; (iii) extension of the target population to include non-traditional objects, like urban forests and trees outside the forest. Furthermore, over the last decades there has been a worldwide trend of discontinuing stand-wise inventories in favour of regional and national forest inventories: e.g. this raises the need of taking into account small area estimation requirements within large scale forest inventories. Another topical point is the treatment of non response related to the field inaccessibility, that is a relevant issue in mountainous and tropical countries. Finally, as remote sensing technology and associated analytical methods continue to improve rapidly with reasonable costs, they are likely to play an even more substantial role for forest monitoring and assessment in the future: coupling the remotely sensed data with the sample inventory data to improve the precision of the inventory estimates; exploiting the inventory data for the correction of map areal estimates; coupling the remotely sensed data for an entire region with sample inventory data to produce maps of the inventoried forest attributes. An even more relevant issue is to exploit the potential of satellite and aerial laser scanning application for large area forest inventory purposes. However, proper sampling designs and field measurements remain the core issues of forest monitoring, as pillars which cannot be emphasised enough.

Key Words

Forest inventory, Forest mapping, biodiversity, carbon assessment, systemic forestry

GLOBAL SATELLITE OBSERVATIONS AND CLIMATE CHANGE AT ESA

Frank Martin Seifert

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Abstract

Climate change is arguably the greatest environmental challenge facing mankind in the twenty-first century. Its importance has been recognised in reports from the Intergovernmental Panel on Climate Change (IPCC) and from the United Nations Framework Convention on Climate Change (UNFCCC). Observations from space provide unique information, which greatly assists the successful understanding and management of climate change. IPCC's 5th Assessment Report regards it as extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century. The evidence for this has grown, thanks to more and better observations, an improved understanding of the climate system response and improved climate models. ESA developed on behalf of the COPERNICUS initiative (the former Global Monitoring for Environment and Security - GMES) with the European Commission the SENTINEL satellite family, an operational line of satellites to continue long-term systematic observations of our planet. Sentinel-1A – a C-band Radar, which was successfully launched on 3 April 2014, and Sentinel-2 – a multispectral optical sensor to be launched in spring 2015, will contribute significantly to world-wide high resolution systematic observations. They will be complemented by Sentinel-3 with frequent medium resolution land and ocean observations, Sentinel-4 and -5 dedicated to atmospheric monitoring and Sentinel-6 to measure global sea surface height. Two pillars of ESA's engagement for climate change research are the Climate Change Initiative with the production of currently 14 Essential Climate Variables (ECV) and activities related to the Reduction of Deforestation and forest Degradation (REDD+) for mitigation. ESA's Climate Change Initiative (CCI) is making full use of Europe's Earth observation space assets to exploit robust long-term global records of essential climate variables, such as greenhouse-gas (GHG) concentrations, sea-ice extent and thickness, sea-level change, land cover and glaciers. The ECV projects aim to produce stable, long-term, multi-sensor time series of satellite data with specific information on errors and uncertainties and are linked to climate modelling groups. 25% of GHG emissions are coming from Agriculture, Forestry and Other Land Use (AFOLU). UNFCCC recognised the importance of the forestry sector and established a process to reduce greenhouse gas emissions from deforestation and degradation (REDD) in developing countries. ESA has been engaged in the development of REDD from its early phase with service development and demonstration, and its participation in the Global Forest Observation Initiative (GFOI) to support developing countries in setting up national forest monitoring systems.

Key Words

APPLICATIONS OF REMOTE SENSING AND BIG DATA IN ECOLOGY AND CONSERVATION

David A. Coomes

Head of Forest Ecology and Conservation Group, Department of Plant Sciences, University of Cambridge, dac18@cam.ac.uk

Abstract

Remote sensing has become an integral component of biogeochemical research, but has found fewer applications in ecology. Since ecology is the study of interactions among individual organisms and their environment, remote sensing needs to track individuals in order to make a valuable contribution towards understanding ecological processes. I will demonstrate how high-resolution airborne remote sensing – from manned and unmanned aircraft – is revolutionizing ecology and conservation science by virtue of the fact that it can track individual organisms over large spatial scales. I will show how a spectranomic approach enables individual tree species to be identified from aircraft and how laser scanning can be used to monitor animal diversity. I will also discuss how laser scanning is providing fresh insights into disturbance processes, which are important for the maintenance of biodiversity.

Key Words

Imaging spectroscopy, ecological interactions, airborne remote sensing, spectranomics

AMAZONIAN DEFORESTATION AND LAND COVER CHANGE: HUMAN-ENVIRONMENT INTERACTIONS

Emilio Moran

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Abstract

This presentation will provide an overview of the trajectories of Amazon Basin deforestation since the 1970's and the changing spatial dynamics of land cover change. These changes are examined in relation to the changing political economy of Brazil, the national goals for economic development, and how these processes play out in various parts of the Basin. Different spatial and temporal dynamics are related to legacy effects, trajectories of migration, and levels of investment. Much of the land cover changes are related to national development policies, road building, and resettlement projects at the outset. Over time the dynamics changed with new elements becoming more important such as a land market, logging, soybean and cattle production. Much of the latter is geared at export markets where Brazil is now the world's largest exporter of beef and soybeans. The Amazon is viewed as an important region for producing these goods, and increasingly as a new frontier for biodiesel production.

Key Words

Deforestation, Land Cover Change, Brazil, Amazon, spatio-temporal dynamics

SECTION A

COUPLED HUMAN AND NATURAL SYSTEMS

LANDSCAPE PATTERNS IN MOUNTAIN PASTURE-WOODLANDS UNDER CHANGING CLIMATE AND MANAGEMENT

Rebecca S. Snell, Harald Bugmann

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Abstract

Pasture-woodlands are unique semi-natural landscapes that result from the combined influences of climate, management, and intrinsic vegetation dynamics. Highly heterogeneous landscape patterns emerge from fine-grained intensive management and grazing by cattle, which lead to different successional stages between grassland and forest. These cultural landscapes are not only valued for the production of dairy products, but also as habitats which support high species diversity, and have high aesthetic value. However, pasture-woodlands are expected to change in the future due to increasing land abandonment and climate change. Our ability to predict how these landscapes will change is limited due to the disparate scales in time and space that govern the dynamics of these systems.

To improve our understanding of the processes and interactions that shape these systems, we modified a dynamic forest landscape model to simulate a pasture-woodland landscape in the Jura region (Switzerland). This involved the inclusion of an herbaceous layer, grazing from cattle, and additional management routines. The new model version allows us to address the following questions: (1) What are the effects of current and possible future land management practices on the long-term development of the landscape patterns that are so characteristics of pasture-woodlands? (2) How are these trajectories influenced by future climate change? (3) How is the provisioning of various ecosystem services affected by changing these driving conditions?

Key Words
Dynamic model, LandClim, tree growth, encroachment, cultural landscape

PRIVATE FENCING AND ITS CASCADING EFFECTS ON BIODIVERSITY, ECOSYSTEM FUNCTIONING, AND ECOSYSTEM SERVICES DELIVERY AT THE LANDSCAPE SCALE

Marie Baltzinger, Anders Mårell, Juliette Mouche, Christophe Baltzinger

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Abstract

From the beginning of the "enclosure" movement in Britain - just a few hundred years ago - until our contemporary fenced landscapes, the fencing dynamics has been fast and worldwide spread. Fences have thus been recognized as one of the major fragmenting feature in rural areas. Privately owned lands are more prone to fragmentation than public areas, because private owners are not likely to self-commit in collective landscape planning if no incentives are provided; fragmentation by private fences strongly threatens both ecological connectivity and social connectivity at the landscape scale. Studying biodiversity and ecosystem functioning in privately owned landscape appears thus highly relevant. I studied how landscape connectivity, ecosystem functions and biodiversity are modified by the fencing phenomenon, and what are the ecosystem services at stake and the stakeholder groups involved in the fencing dispute in the Sologne Natural Region - 500 000 ha center of France. Private properties cover more than 90% of the area and this prevailing private ownership has led to the spread of private fences throughout the area. As regards the ecological side of the fencing issue, I focused on two different scales : (i) at the private property scale, how fences affect deer abundance, herbivory intensity and biodiversity (plant and bird diversity) via cascading effects, (ii) at the intermediate scale (deer home-range scale – 2 000 ha) how the fence design affects deer habitat selection. I also conducted stakeholder interviews in order to understand the human values involved in the fencing dispute: why do some owners erect fences and why do other stakeholders feel upset about these private forest fences? From already recorded but not yet analysed data on bird and plant diversity in fenced/unfenced properties, I will present my results on how fencing may affect forest diversity via cascading effects. I will also present my findings on how the fence design affects deer habitat selection, by enhancing the sheltering value of partially fenced forest patches. Thirdly, I will present the recorded stakeholder values associated with forest, wild animals and how they relate to the fencing debate. Eventually, I will explain how I plan to use these findings in a participatory modeling approach, aiming at describing the fencing dynamics, its effects on ecosystem services delivery and at exploring several future scenarii.

Key Words

Deer population management, Ecosystem services, Fenced landscape, Participatory modeling, Private forest.

IMPACTS OF LAND USE CHANGES ON CARBON AND NITROGEN STOCKS AND FLUXES OF PLANTS AND SOILS

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Abstract

Changes in Earth's vegetation cover have a potential to alter regional and global climate through changes in the biophysical and biogeochemical characteristics of the Earth's surface. Historically, land-use change (LUC) activities have generally released carbon (C) to the atmosphere through the conversion of forests to croplands and pastures, but in recent decades C stocks in forest ecosystems have increased through reforestation, afforestation and forest regrowth on abandoned land. However, such accumulation of C stocks can be constrained if the LUCs occur in nitrogen (N) limited regions. In addition, soil N supply through N fertilizer application and N deposition could reduce, or even eliminate the N limitation on C uptake. These additional sources of N in soils are a major source of nitrous oxide (N_2O) through nitrification and denitrification processes. Therefore, the terrestrial ecosystem responses to LUCs have a potential to change the concentrations of CO_2 and N_2O, two important greenhouse gases, and climate. In this study, a state-of-the-art land surface model, Integrated Science Assessment Model (ISAM), is used to examine the response of terrestrial C and N stocks to historical LUC activities and the interactions with atmospheric CO2, climate, N deposition and N fertilizer. By quantifying the spatial distribution of C and N sources and sinks, this study will help to determine accurately how much C and N are being stored in plants and soils or released to the atmosphere.

Key Words
Land use change, Carbon Cycle, Nitrogen Cycle

LINKING TERRESTRIAL PROCESSES TO COASTAL ECOSYSTEM SERVICES IN EAST AND SOUTHEAST ASIA: OUTSTANDING ISSUES, CHALLENGES, AND CONSEQUENCES.

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Abstract

At the interface between land and ocean there exist continuous material exchanges where the terrestrial ecosystems discharge nutrients into oceans to provide food sources for oceanic organisms but also causes red tides that are detrimental to fisheries. As climate change continues and human alteration of terrestrial ecosystems intensifies, ecological impacts on river deltas and fisheries have become a major environmental concern. This work is to deploy a process-based model to quantitatively examine how recent changes in land use, including rural restructuring of towns, villages, and farmlands, affect nutrient transport from terrestrial ecosystems to two very important deltas in Asia: small watersheds within the Mekong River Basin and Qiantang River in China.

Key Words

Coastal ecosystems, Ecosystem services, Process-based models, Small watersheds

HOW DOES MINING IMPACTS ON RURAL IMMIGRATION OF MONGOLIA

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Abstract

Mongolia was the second-longest communist country in the world between 1921 and 1991 and has undergone dramatic changes in its government since the collapse of the Soviet Union in 1992. It has only 2.7 million people on the vast 1.565 million km^{-2} of the Mongolian Plateau. Pastoral livestock has been the primary livelihood of Mongolians for three thousand years. However, due to rapid economic growth and modernization, as of 2012, only 12% of total population is herders. Nowadays, livestock sector become a main source of livelihood of rural poor and they strongly rely on pastoral territory. Most of them stay in nomads to feed livestock. Meanwhile, Mongolia since last decade has experienced a drastic increase in mining activities, resulting in only 50% of rural households earn their main income source from their livestock. We examine how the shifts from pasturing to mining practices may affect rural immigration and poverty in Mongolia and it is interesting question to investigate. We aim to investigate which region of Mongolian is under high concentration of immigration and does the mining boom in local area have impacts on the immigration. Rural mining leads rural poor to immigrate to peri-urban area. We employ OLS model to estimate dynamics of rural immigration. Regional dummies, herders groups in the immigrants pool will be regressed with the total number of immigrants of the each level of provinces /aimags/.

Key Words

Rural Immigration, Mining activity, livestock

DIVERGENCES OF TWO COUPLED HUMAN AND NATURAL SYSTEMS ON MONGOLIA PLATEAU

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Abstract

Central to the coupled natural and human (CNH) concept is that humans and nature are organized in interacting sub-systems that make a cohesive whole at multiple spatial and temporal scales. We use widely-available measures of the social, economic, and ecological systems to examined the CNH dynamics in Inner Mongolia (IM) and Mongolia (G) on the Mongolia Plateau during 1981-2010, including gross domestic product (GDP), population size (POP), net primary production (NPP), livestock (LSK), and their ratios. Our national-level analysis of the coupled changes over the past three decades demonstrated contrasting dynamics between IM and MG, with policy shifts played critical roles. We predict that, while climatic change has dominated divergences of IM and MG prior to 1980 and much greater changes in IM than in MG for 1980–2000 due to the economic reform, the relative importance of socioeconomic forces will gradually decrease in IM while continued in MG.

Key Words

CNH, climatic change, livestock, socioeconomic, Mongolia

CHANGING THE STRUCTURE OF URBAN ECOSYSTEMS TO IMPROVE SOIL PROCESSES AND FUNCTIONS

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Abstract

The urbanisation of natural and semi-natural environments represents one of the most prominent and recent examples of global change. Early in the new millennium the number of people living in cities surpassed the number of rural dwellers and this trend will continue in the future. Despite the importance of urban ecosystems as a global change phenomena, and our main contact with nature, little is known about how they function and their resilience to further environmental and anthropogenic change. This study aims to assess the effects of different vegetation management practices upon soil properties and processes and through that the ecosystem services that the soil in these urban ecosystems provide. In particular, we monitored the key biogeochemical processes of organic matter decomposition, soil carbon sequestration, water infiltration and storage. We established a network of 30 research plots in three ecosystem types differing for vegetation structure in the sand belt area of south-east Melbourne, Australia. High-complexity remnants (HCRs), high-complexity parks (HCPs) and low-complexity parks (LCPs) were selected since their structure reflects characteristic management practices. HCP and LCP plots age ranged from 43 to 100 years since their establishment. We addressed the following research questions: i) how do vegetation management practice and structural complexity alter key soil properties and processes in urban ecosystems? ii) does the age since vegetation establishment also affect these soil properties and processes? Our results demonstrate that surface leaf litter decomposition rates are slower in LCPs (tree canopies over mown grass). In particular, the degradation of organic matter driven by meso- and macro-decomposers is significantly lower possibly due to a reduced capacity of these organisms to survive in intensively managed systems. Soil bulk density was not significantly different among the three ecosystem types. Nevertheless, soil saturated hydraulic conductivity was more than ten times slower in the LCPs as compared to the other two more complex systems. Contrary to our expectations, the age since urban green space establishment did not significantly influence these soil properties or processes. Changing the way we manage our urban ecosystems, by creating more complex vegetation systems, can help adapt out urban landscapes to global climate change. Soil under more complex vegetation systems experience reduced run-off, increased infiltration, water holding capacity, soil organic matter content and fertility, in addition to the benefits provided by greater above-ground vegetation mass for C sequestration, cooling and biodiversity habitat.

Key Words

Management, urban ecosystems, structural complexity, soil processes

HEAT WAVES, URBAN VEGETATION, AND AIR POLLUTION

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Abstract

Fast-track programs to plant millions of trees in cities around the world aim at the reduction of summer temperatures, increase carbon storage, storm water control, provision of space for recreation, as well as poverty alleviation. Although these multiple benefits speak positively for urban greening programs, the programs do not take into account how close human and natural systems are coupled in urban areas. Elevated temperatures together with anthropogenic emissions of air and water pollutants distinguish the urban system. Urban and sub-urban vegetation responds to ambient changes and reacts with pollutants. Neglecting the existence of this coupling may lead to unforeseen drawbacks of urban greening programs. The potential for emissions from urban vegetation combined with anthropogenic emissions to produce ozone has long been recognized. This potential increases under rising temperatures. Here we investigate how global change induced heat waves affect emissions of volatile organic compounds (VOC) from urban vegetation and corresponding ground-level ozone levels. We also quantify other ecosystem services provided by urban vegetation (e.g., cooling and carbon storage) and their sensitivity to climate change. In this study we use Weather Research and Forecasting Model with coupled atmospheric chemistry (WRF-CHEM) to quantify these feedbacks in Berlin, Germany during the heat waves in 2003 and in 2006. We highlight the importance of the vegetation for urban areas under changing climate and discuss associated tradeoffs.

Key Words
Heat wave, urban vegetation, VOC, ozone, modeling

WINTER HEAT ISLAND ASSESSMENT IN BUCHAREST USING DS1921G THERMOCHRON IBUTTON DATA LOGGER MONITORS

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Abstract

The urban climate is a problem of extreme interest in the context of the urban population constantly increasing, already surpassing 50% of the total population, as UN data shows, and the climate change. The urban heat island (UHI) is the consequence of large artificial land cover presence in the urban environments. It raises important concerns for the inhabitant's quality of life. Our study aims at assessing the atmospheric winter UHI in Bucharest. We have used the values recorded during 2008-2009 winter by a network of DS1921G Thermochron iButton devices, located in and outside the city. Data was validated against data provided by one of the weather stations inside the city. To assess the UHI we have calculated the magnitude, duration, high amplitude variation periods (over 5 degrees). Using the collected data, we have drafted a UHI distribution map. Our map shows the atmospheric UHI and can be compared with data from Landsat and MODIS which can be used to assess the UHI at the soil level.

Key Words

Urban Heat Island (UHI), urban environments, quality of life, Bucharest

A SPATIAL ALLOCATION MODEL SUPPORTING FOREST FUEL REMOVALS IN WILDLAND URBAN INTERFACE (WUI)

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Abstract

Wildfires are progressively impacting the wildland-urban interfaces defined as zones where anthropogenic systems intermingle with rural areas, such as periurban forests. If an efficient fuel management activity is not adopted, wildfire can easily move from forest fuels to human developments. Therefore, there is a need to prevent fire spreading by determining the sound allocation of fuel treatment. To this end, we proposed a Spatial Allocation Index as a streamlined approach to identify where and what type of forest areas may be eligible for fuel removal in terms of wildfire prevention. In our study we consider "fuel treatment" as the removal of 1-hour dead fuel load (<0.6 cm in diameter) because it is the primary carrier of surface fire. We scaled up 210 plot-level data of 1-hour fuel load and developed maps for different forest types, using forest landscape in province of Taranto (Apulia region, Italy). These spatial predictions were combined with other landscape-level variables in relation to population density, urban density and road density. Through our modelling approach we were able to provide a more efficient allocation of fuel interventions over a large area and at a large scale using precise data from fuel sampling and land-cover maps. Based on the SAI frequency distribution we analyzed those portions of WUI (i.e., fuel types) whose SAI value exceeds given thresholds (the upper 85th, 90th and 95th. The areas in the map where the Spatial Allocation Index reaches its maximum value are those having the highest priority in terms of fuel removal; i.e., highest number of people, houses and roads benefitting from wildfire suppression. Our findings indicate that the amount of hectares likely to be treated decreased according to threshold; however, the proportion of fuel types requiring treatment remained similar across the thresholds with a predominance of the "maquis" fuel type. The index identifies areas where, as a result of considerable biomass accumulation, wildland fires might affect dwellings adjacent to urban areas and roads. Understanding where and what type wildland are more likely to be treated provides the basis for appropriately assessing wildfire prevention activity in terms of landscape management and budgeting of financial resources.

Key Words

Wildland-urban interface (WUI), Wildland fire, Landscape management, Fuel treatment, spatial index

MONITORING EXPANSION OF CULTIVATION IN THE ARID AND SEMI ARID RANGELANDS USING REMOTE SENSING AND GROUND SURVEY DATA

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Abstract

Rangelands are among the most important terrestrial ecosystems; they are rich in floral and faunal diversity of great importance to mankind, act as watersheds, sequester and store carbon, among other ecosystem services. They also support extensive livestock production, which is the mainstay of pastoral economies that dominate the vast arid and semi-arid rangelands of Africa. Conversion of these ecosystems to uses that do not conform to their requirements, therefore, undermine their potential to provide the ecological and socio-economic goods and services. One of the dominant contemporary forms of land conversion in Africa's rangelands is crop cultivation, which involves clearing of vegetation in favour of crops thereby leading to soil and vegetation degradation through loss of plant cover, soil erosion and loss of soil organic carbon. These processes consequently serve to undermine rangeland productivity, pastoral livelihoods, as well as the resilience of the rangeland ecosystems. Small scale cultivation is an age-long practice of diversifying asset portfolios among communities inhabiting the precarious drylands. However, the negative trade-offs associated with its adoption, especially in contemporary scales, have adverse implications for the very livelihoods and ecosystems services that it is meant to complement. A clear understanding of the land conversion dynamics and their impacts is therefore necessary for guiding decisions and policies on land-use and sustainability of dryland ecosystems. It is against this background that this study was conducted to examine the drivers and expansion of crop cultivation in the Borana rangelands using remote sensing and ground survey data. i.e. individual interviews from 265 agro-pastoral households, rainfall data and geospatial analysis of Landsat images of February 1985 and 2011. The results show that inadequate household income and large family sizes are the main reasons behind expansion of cultivation among the Borana pastoralists. In addition, they practice cultivation to complement pastoralism, which has been constrained by unreliable rainfall and diminishing of grazing pastures. During the period under study, cultivated land increased by 16% and bare land by 5%, while grassland, woodland and bush land decreased by 2%, 4% and 24.4%, respectively. The close similarity between the rate of decline in the rangeland biomes and the rate of increase in cultivated land is a pointer to the linkage between cultivation and loss of grazingland in the rangelands of Eastern Africa. More research is, however, needed to quantify the socio-economic trade-offs of practicing cultivation in the rangelands ecosystems.

Key Words

Drivers, Land Conversion, Remote Sensing, Land Cover Changes

HUMAN IMPACT ON COASTAL LANDSCAPE: A DIACHRONIC ANALYSIS OF WILDLAND-URBAN INTERFACE IN A MEDITERRANEAN AREA

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Abstract

During the last decades, Mediterranean areas have been affected by relevant modifications in the economic and social systems that have often produced transformations of the original landscape due to anthropization processes and land use changes. Large variations in residential expansion often occurred in coastal areas because of intensive tourism development. This is evident also in Sardinia, Italy, in particular in areas with high tourism potentials. In this areas and during the last fifty years, a large number of housing estates have been built near the coast, within and surrounded by natural vegetation, determining an important increase of wildland-urban interfaces (WUIs). From a geographical point of view, WUI indicates a variety of situations ranging from the expansion of urban areas towards the surrounding natural areas (classical WUIs) to the dissemination of buildings within natural areas. It is well known that Mediterranean shrubland is really prone to wildfire events. In addition, potential fire risk for villages, tourist resorts, other human activities and people increases during summer season, when human presence is larger, extreme weather conditions occur, and Mediterranean vegetation is more flammable.

Recently, several authors showed that the analysis of trends in expansion of WUI and its impacts on fire risk is crucial for reducing and preventing fire risk and making decisions on future land use planning. Temporal pattern and recent rate of expansion of WUI have been rarely documented in European Mediterranean countries. This study, based on data and information over the period 1954-2008 focuses on evaluating the temporal evolution of presence and properties of WUI areas in three coastal areas located in North Sardinia, Italy, and characterised by large tourism development during the last fifty years.

In particular, differences in WUI properties and dynamics among sites were examined and some implications of WUI expansion for fire risk were analysed.

Key Words

Landscape changes, Wild urban interface, Diachronic analysis, Fire risk, Coupled human/natural systems

LIVELIHOODS, CLIMATE CHANGE AND DEFORESTATION. AN AGENT-BASED APPROACH TO UNDERSTAND COUPLED HUMAN AND NATURAL SYSTEMS IN SOUTHWEST MADAGASCAR

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Abstract

Madagascar is one of the world's top conservation priorities but also one of the poorest nations. Its unique biodiversity richness faces several threats due to human actions that at the same time are being shaped by natural phenomena increasing in frequency and intensity as an outcome of climate change. This interdisciplinary case study focuses in the new multiple-use protected area Ranobe PK32, created in the Southwest region of Madagascar in 2008 and co-managed by WWF and local communities with the stated objectives both to conserve its unique spiny forest and to assure the sustainable use of natural resources by local dwellers. Despite conservation efforts, this area has continued to suffer one of the highest rates of forest loss in the country in the last decades. While some of the livelihood strategies pursued by local communities within the area – such as charcoal production and extraction of construction wood – are carried out with a more sustainable pace and manner, slash-and-burn agriculture for maize cultivation is responsible for intense and rapid land use/cover change (LUCC) processes often leading to deforestation. Furthermore, the south boundary of the study area is marked by the Fiherena River, forming a complex terrestrial and freshwater ecosystem where processes taking place at the local scale (e.g. forest cover loss and related erosion) have indirect lagged effects in the marine system downstream. Especially significant is the silting of coral and mangrove ecosystems, affecting human and natural systems at a broader regional scale, which together with the growing impact of droughts and cyclones is adding pressure to an already highly vulnerable context. The study relies on an agent-based model to explore how the decisions concerning LUCC made at the household level affect the natural system to which the human system is coupled. Quantitative data on economic activities and trends over time compiled through a household survey are analyzed together with qualitative evidence gathered with participatory methods to get a deeper understanding of the social context in the study site. This is contrasted with spatial patterns studied through the use of satellite and aerial imagery to assess the extent and direction of LUCC trends. Based on this research, I argue that if the challenges that conservation and poverty alleviation confront in Southwest Madagascar are to be addressed, the standpoint of local inhabitants living in and around protected areas and their perceptions on forest resources uses need to be fully taken into account.

Key Words

Slash-and-burn agriculture, Deforestation, Madagascar, Climate change, Land use/cover change,

PLANT BIODIVERSITY CONSERVATION IN URBAN GREEN SPACES OF GUARULHOS CITY, SP, SOUTHEASTERN BRAZIL

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Abstract

The Atlantic Forest is considered a biodiversity hotspot and has currently been occupied by human settlements, which has generated an intense decline in biodiversity. The construction and increase of cities are often not accompanied by environmental policies and conservation concerns. Currently, few articles on biodiversity conservation are directed at urban, suburban areas, or where human settlements are explicit. Thus, the present study investigated the occurrence of urban residential green spaces and plants grown in private homes in Guarulhos, a city of the metropolitan region of Sao Paulo, southeastern Brazil. Semi structured interviews was applied with 150 residents of this city and the green area and plant resources of the home gardens were assessed. Due to feed or ornamentation purposes, the plants could not be collected and herborized, so all plants present in the residential green areas were photographed and later identified according to the APG III. In Guarulhos 85% of the interviewees have residential home gardens and 98% of them cultivate plants for various purposes. A total of 57 botanical families cultivated were identified, and the most abundant families were Araceae, Asteraceae, Euphorbiaceae and Lamiaceae. Regardless of the purpose of planting, these plants also serve as resources for urban wildlife and biodiversity in large cities, such as Guarulhos, a city with just a few public green areas and refuge for local biodiversity. Thus, these results show that in Guarulhos, residential green spaces are serving as important gene bank, which promotes the preservation of diverse vegetal resources and serves as protection and shelter for urban wildlife.

Keywords

Biodiversity Conservation. Urban Green Spaces. Plant Resources. Sustentability.

CHANGES IN CARBON AND WATER VAPOR EXCHANGE DUE TO SPONTANEOUS AFFORESTATION OF A KARST GRASSLAND

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Abstract

Many marginal areas for agriculture in Europe and North America were abandoned in the last decades and were spontaneously overgrown by trees and shrubs. The functioning of such successional ecosystems in terms of matter and energy fluxes remains understudied. Presumably, the shifting dominance among herbaceous and woody vegetation significantly alters net primary production, plant allocation, rooting depth and ecosystem resilience to stress such as drought. In this contribution carbon and water exchanges of a spatially heterogeneous tree-shrub-grassland mosaic developed on former semi-dry calcareous grassland in the sub-Mediterranean region of Slovenia were studied and compared with the nearby grassland still in use (grazing). Using eddy covariance, yearly and seasonal net ecosystem exchange (NEE) and evapotranspiration of both ecosystems were examined together with their environmental controls during the period August 2008 - December 2012. The spontaneous succession was found to significantly change yearly carbon balance shifting annual NEE to much more evident carbon sink. Substantial differences in the phenology of carbon and water vapor exchange between ecosystems existed with grassland emerging as net daily sink for carbon earlier in the growing season but responding more abruptly to summer droughts. Due to poor soil water retention low rain use efficiency of both ecosystems was also observed, which was nevertheless larger in the successional ecosystem compared to the grassland. Large, more than four-fold variability of yearly carbon gain of both ecosystems was observed which was largely explained by summer drought events. Results prove considerable change in ecosystem functioning due to grassland succession but more research is needed to further investigate the limits of ecosystem resilience and plant survival to drought. Due to global change this factor is expected to increase its frequency and severity in many Mediterranean regions in the forthcoming decades.

Key Words

Ecological succession, Eddy covariance, Water-use efficiency, Net ecosystem exchange

AN INTEGRATED APPROACH TO A COMPLEX CASE STUDY OF LAND DEGRADATION DUE TO HUMAN AND NATURAL FACTORS

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Abstract

Although humans interact with the biophysical environment almost everywhere, this relationship is stronger in coastal areas that represent, since the beginning of human history, the most suitable place where to settle. The fragile equilibrium characterizing these areas can be easily damaged by the synergic contribution of natural events (storm events, floods, coastal regression) and anthropogenic stressors (tourism, urban sprawl, agriculture intensification) leading in some cases to the occurrence of land degradation phenomena. In this work, inserted within PRO-LAND project (PO-FESR Basilicata 2007-2013), we studied at plot scale a complex phenomenon of degradation (salinization) occurred in a coastal area of the Basilicata region (Southern Italy) that can be considered an interesting hotspot for analyzing the effects of multifaceted interactions between natural and human factors. The study area is located in the southernmost part of the Bradanic Trough along the sandy coastal plain of the Ionian coast, placed between the southern Apennines and the Apulian foreland. The main vulnerability of the examined natural system is linked to hydrogeological conditions that affect shallowness of the aquifer reaching the depth of 45-50 m below the ground level thus allowing the occurrence of seawater intrusion in areas close to the coastline. Moreover, throughout the 20th century, land reclamation works, the built-up of several dams and irrigation schemes, and the presence of farm and industrial activities, some of which not suitably planned and managed, have deeply altered the quality of soil and groundwater in the Ionian coast. The approach adopted in this work is inserted in a multidisciplinary framework combining *in situ* measurements (geomineralogical and geophysical) and remote sensed data (CASI sensor - Compact Airborne Spectrographic Imager). Geomineralogical parameters (granulometry, pH, temperature, clay fraction) were determined on several soil samples. Geophysical data were obtained using the GEM-300, an electro-magnetic induction (EMI) sensor providing Apparent Electric Conductivity measurements at various frequencies. The geophysical surveys were conducted along transects on three different zones inside the study area where the spatial structure of data was inspected. Airborne images were acquired on the study area by the hyperspectral CASI-1500 imager (76 bands with 1.5m of spatial resolution) to derive indices sensitive to soil degradation. We analyzed the collected data to find relationships between them at the aim of getting insights about the proximate causes and the underlying driving forces of the occurred degradation phenomena in the perspective of suggesting the most appropriate best practices and restoration activities to be undertaken.

Key Words

Land degradation, multidisciplinary approach, CASI, in-situ measurements, Basilicata

GLOBAL CHANGE ECOLOGY

THE INTERNATIONAL NETWORKS TO MONITOR AND UNDERSTAND ECOSYSTEM-ATMOSPHERE GHGs EXCHANGES

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Abstract

The organization of networks of sites to monitor the green house gases (GHGs) exchange between ecosystems and atmosphere started more than 15 years ago in Europe and USA. These networks are all based on the use the eddy covariance technique to measure carbon, water, energy and recently also CH4 and N2O net exchanges at high temporal resolution (typically 30 minutes), integrating fluxes over an area of hundreds of meters around the measurement point. The data collected are processed using standard and consolidated techniques that allow to estimate also flux components such Gross Primary Production and Total Ecosystem Respiration that are key variables in modeling and remote sensing data-assimilation and validation activities.

Today there are organized networks in most of the continents: ICOS in Europe, NEON and AmeriFlux in USA, AsiaFlux, ChinaFlux, USCCC, in Asia, LBA in Brazil, TERN in Australia and tens of additional small regional/national systems of sites or single groups managing eddy covariance towers. All the sites are inter-connected through a "self organized network", FLUXNET, that promotes the use, standardization and sharing of these measurements worldwide and the initiation of global synthesis activities.

In the last years the largest networks (ICOS, NEON and AmeriFlux) started a reorganization process: increased harmonization level, long-term prospective, open data access and data sharing are becoming key elements to ensure maximum and optimal use of the measurements by a broad scientific community. Additionally the interaction and standardization are for the first time done across the networks trying to ensure maximum comparability of the data independently of the network under which they are collected.

In this presentation first the actual status of the networks construction is presented, including the ongoing efforts to increase the harmonization and possibilities to contribute to the process. Then examples of scientific activities based in these data in different domains are discussed in order to stimulate the interest in accessing and using this unique source of information available.

Key Words

Eddy covariance, GHGs, monitoring, infrastructures, data access

CROWN FIRE - INSECT DEFOLIATION INTERACTION IN CENTRAL CANADA'S FORESTS: CLIMATE CHANGE AND MANAGEMENT IMPLICATIONS

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Abstract

The spruce budworm, *Choristoneura fumiferana*, and crown fire have been the major natural disturbance agents in Canada's forests since well before Europeans arrived. The spruce budworm, an insect defoliator, causes extensive forest damage during the peaks of its 30-year outbreak cycle. Fires that spread through tree crowns cause almost 97% of the total fire damage, yet constitute only about 3% of all fires.

We used both landscape analyses and field studies to explore the interaction between spruce budworm defoliation and crown fire and how climate change may affect this interaction. At the landscape level, the spatiotemporal relationships between these disturbances, as reflected in the spatially-explicit historical records for large fires and spruce budworm defoliation since 1941, showed that spruce budworm defoliation affects crown fire probability. Other spatially explicit data (forest composition, climate, lightning strikes) and factors (eco-region) helped explain the geographic variation in the strength of this interaction. This geographic variation in the strength of the interaction between spruce budworm defoliation and crown fire is the basis for one approach to inferring how climate change will likely affect this interaction.

We also examined fuel build-up and its vertical continuity in stands experiencing various spruce budworm outbreak intensities to quantify the interaction at the stand level. There is a brief time interval following defoliation during which the likelihood of crown fire is significantly enhanced. This 'window of opportunity' for crown fire is largely explained by the interaction of two opposing fundamental processes operating on different time scales: a pulse in the build-up of fuel due to the effects of spruce budworm defoliation and subsequent weathering of the attacked stand followed by the more gradual decomposition of the downed fuel.

The results suggest that managing insect populations to limit defoliation can also reduce fire hazard.

Key Words

insect-crown fire interaction, natural disturbance, insect defoliation, climate change

FLUXCOM, TOWARDS AN ENSEMBLE OF IMPROVED GLOBAL DATA-DRIVEN PRODUCTS: CROSS-VALIDATION AT SITE LEVEL AND GLOBAL SCALE

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Abstract

Global spatial-temporal fields of FLUXNET derived carbon and energy fluxes are increasingly used for analyzing variations of the global carbon and energy cycles, and to evaluate global land surface models. Here, we report the first results of the FLUXCOM activity that aims at providing an array of improved data-driven flux products. Carbon and energy fluxes measured by the eddy-covariance technique, have been used to train and validate eleven machine learning regression models and six ensemble methods. Two complementary sets of products with enhanced spatial and temporal resolution in comparison to existing products (Jung 2011) are under preparation: a 5 min spatially and 8 day temporally resolved product driven solely by remote sensing based variables, and a daily and vegetation type specific product at 0.5° driven by Meteo and mean seasonal cycle remote sensing based variables. For these purposes, the predictors have been objectively selected from a large number of potential drivers including remote sensing reflectances, leaf area index, and land surface temperature, to identify optimal predictors for the machine learning methods. In this presentation, the cross-validation strategy and results of the machine learning methods are presented. Significant differences in terms of model's performances, have been observed in relation to the predicted flux, with good results in terms of Nash's model efficiency (Meff) particular for Incoming net radiation (Rn), Latent (LE) and Sensible heat (H), Gross primary production(GPP) and Total ecosystem respiration (TER). Meff resulted greater than 0.8 for Rn, between 0.7 and 0.8 for H, LE and GPP and greater than 0.5 for NEE. Instead lower performance have been observed for Net Ecosystem Exchange (NEE, Meff less than 0.5) and Soil Heat Flux (G, Meff less than 0.4). The degree of agreement between predicted fluxes and the eddy-covariance reference values confirmed the potentiality of machine learning techniques. The output predicted by the machine learning models resulted very similar indicating consistency across the methods, and used drivers. Instead significant statistical differences of model performances were found for particular vegetation and climate classes. The on-going and future work is tied to   better understand which are the limiting factors in the simulation of these environments, such as potentially missing variables , not enough or representative data, and models not flexible enough.

Key Words
FLUXNET, Machine Learning Techniques, Carbon Fluxes, Energy Fluxes, Remote sensing

NUTRIENT AVAILABILITY COULD CONSTRAINT FOREST ECOSYSTEM RESPONSE TO GLOBAL CHANGE IN EUROPE

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Abstract

In Europe, the combined effects of the global enrichment in atmospheric CO_2 and the high atmospheric nitrogen (N) deposition have increased forest productivity during the last decades. Since N deposition is still high in many European regions and atmospheric CO_2 is still rising, forest productivity in Europe could continue to increase. However, if nutrient availability becomes a limiting factor, forest productivity will not continue its increase, which will inevitably decrease the carbon sequestering capacity of European forests.

The objectives of this study were to describe the nutritional status of the main European tree species, to identify growth limiting nutrients and to assess changes in tree nutrition during the past two decades. We analysed the foliar nutrition data collected during 1992-2009 on the intensive forest monitoring plots of the ICP Forests programme. This dataset is unique in its scope and size, and has the further advantage of being harmonized among all participating countries. Of the 22 significant temporal trends that were observed in foliar nutrient concentrations, 20 were decreasing and 2 were increasing. Altogether our results show a clear deterioration in P nutrition during the past two decades in some of the main tree species. Our study also highlights some downward trends that should be monitored closely in the future since they could become alarming: e.g. decrease in foliar S concentration in P. abies and P. sylvestris, in foliar Mg concentration in F. sylvatica, in foliar K concentration in Q. petraea and P. abies and in foliar Ca concentration in F. sylvatica and Q. petraea. Increased tree productivity, possibly resulting from high N deposition and from the global increase in atmospheric CO_2, has led to higher nutrient demand by trees. Soil nutrient supply was

however not always sufficient to meet the demand of faster growing trees. As tree nutrient status exerts a tight control on net ecosystem productivity, this deterioration in tree nutrition could have a strong impact on the response of forest ecosystems to climate change. Nutrient availability and tree nutrition should therefore be accounted for in global carbon cycle to allow climate models to better predict C sequestration capacity of forests and avoid overestimations. Our findings are totally in line with several recent global studies showing that the unbalanced inputs of C and N relative to P induced significant changes in organism stoichiometry resulting in profound and uncertain consequences on the structure, functioning and diversity of terrestrial and aquatic ecosystems.

Key Words

Forest monitoring, trend analysis, foliar chemistry, mineral nutrition, forest ecosystem

EVALUATING THE EFFECT OF FOREST LOSS AND DEGRADATION ON ECOSYSTEM SERVICES PROVISION AT DIFFERENT SPATIOTEMPORAL SCALES

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Abstract

Human activities are rapidly changing forest landscapes and ecosystem service (ES) provision. It is important to develop a framework of reference for assessing the role of forest ecosystems to provide services to humans in changing landscapes. In this work we evaluated the effect of forest loss and degradation on water quality and quantity by integrating research across different spatiotemporal scales. Changes in the landscape spatial patterns of a North Patagonian lake watershed was evaluated using remotely sensed data between 1986 and 2011. Changes in water quantity (streamflow regime) and quality (N and P concentrations) were modeled using N-SPECT, a spatially explicit hydrological model, over the study period. Within the watershed, we selected four subwatersheds ranging in human disturbance to study the influence of land use change on nutrient export and sediment grain size over a year. Our results showed that 21% of the native forests in 1986 was destroyed (by clearance for pasture land) and mainly degraded (by forest logging for fuelwood) by 2011 across the study watershed. These two human-induced processes significantly explained an increase in N and P concentrations across the watershed. Streamflow regime exhibited a substantial variation in steep areas affected by forest degradation in the last 25 years. N exports from the tributary subwatersheds increased from 33kg $TN/km^2/yr$ to 621kg $TN/km^2/yr$ as the proportion of pasture land increased. Likewise, the proportion of mud in the sediments was higher in the subwatersheds dominated by pasture land while the proportion of gravel was higher in forest subwatersheds. The spatial and temporal analyses of nutrient concentrations, streamflow and sediments reflect a decline in the provision of the ES in terms of water quality and quantity associated with changes in native forest cover. We highlight the importance of understanding how the ES respond to human actions in changing forest landscapes through different spatiotemporal scales. We present new challenges of research by studying the ES provision in landscapes affected by other drivers of change such as the rapid expansion of forestry plantation of exotic species in central Chile.

Key Words

Chile, landscape modeling, Patagonia, temperate forests, watershed

EFFECT OF CLIMATE ON DIAMETRIC GROWTH AND MORTALITY OF OAK AND BEECH IN FRENCH MIXED FORESTS

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Abstract

In forestry, diameter-increment and mortality tree models have traditionally considered climate through synthetized indexes, the Site Index (SI) being the most common one. The SI is thought to account for the mean climatic features of a given location and it is assumed to be constant over time. Because this assumption is no longer reliable due to climatic change, new modelling strategies need to be developed. A straightforward option is to include time-varying climatic variables in models as predictors. Providing that growth and mortality measurements are gathered at spaced occasions, covariates need to be averaged over the corresponding intervals. In the current work, diameter-increment and mortality individual-tree models that take into account such covariates are presented. The target species were oak and beech, two wide-spread and economically important taxa in France. The LERFoB (growth and mortality) and SAFRAN (climate) databases were used, with records dating back from 1958. Our results show that the mean temperature of the vegetative period at each measurement interval largely improved model fits. The variable adopted a quadratic functional form, meaning that there are optimal temperatures that enhance diametric growth and minimize mortality.

Interestingly, these optimal values coincide in both models, which seems to indicate that we are correctly predicting non-catastrophic mortality, as the most vigorous trees are the less vulnerable to the effects of competition. Should temperature increase at the current rate in France, tree vigour may be affected, probably resulting in higher non-catastrophic mortality rates. Eventually, a more elevated risk of catastrophic mortality via pest and diseases would be expected due to tree weakening. These perspectives urge managers to adopt measures accordingly, such as promotion of mixtures or others aimed at reduce competition.

Key Words
Individual-tree models, Site Index, Vegetative period

USING LITTER DECOMPOSITION FOR PREDICTING EXOTIC TREES EFFECTS ON NEW ECOSYSTEMS

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Abstract

Litter decomposition is a critical ecosystem process that regulates plant-soil relationships through influence on soil organic matter. Litter decomposability also is viewed as a key controller of nutrient availability because under plants that produce recalcitrant litter, nutrients are immobilized in detrital pools for extended periods, whereas under species with labile litter, nutrients cycle rapidly back into plant-available forms. Despite these strong linkages between plant litter quality and soil nutrient availability, and despite the great amount of attention focused on ecosystem-level effects of plant invaders, there has been surprisingly little evidence for ecosystem-level impacts of exotic plants mediated by changes in litter decomposability. In order to studying the invasion potential of tree species and, we studied litter decomposition in a common garden tree plantations in Dez River floodplain, at 14 to 15 years old. The plantations were consist of *Populus euphratica* Oliv., *Eucalyptus camaldulensis* Dehnh., *E. microtheca* F. Muell., *Acacia salicina* Lindl., *A. saligna* (Labill.) H. Wendl., *A. stenophylla* Benth. and *Dalbergia sissoo* Roxb. . *P. euphratica* was the native species of the ecosystem and the others were exotics. Litterbag method was used to study the leaf litter decomposition. Newly fallen leaf litter was collected and air dried for decomposition study. Ten grams of leaf litters were placed inside 10 cm × 25 cm litterbags with 1.0 mm mesh. Five litterbags of each species were pinned in direct contact with soil in the center of each plot of the same species in 1 November 2006. One litterbag of each species from each plot was collected at 40, 90, 180, 270 and 365 days after placement of litterbags. Litter was removed from each litterbag, brushed gently to remove soil and oven dried at 65ºC. The annual decomposition constant (k) of each species were calculated. The results of ANOVA showed that *P. euphratica* had the fastest litter decomposition with the 1.5 k ratio while *A. saligna* and *A. stenophylla* had the lowest litter decomposition with respectively 0.32 and 0.46 k ratio. The litter decomposition of other species was intermediate. Based on these results none of the introduced species had the potential to invade this ecosystem. But for better prediction of the invasion potential of these species to this ecosystem the other traits of nutrient cycle such as litterfall mass and nutrient pool should be considered.

Key Words

Litter decomposition, Exotic trees, Invasion potential, Species introduction, Plantation

MODELING THE RISK OF BARK BEETLE OUTBREAKS IN DROUGHT-STRESSED NORWAY SPRUCE STANDS

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Abstract

European conifer forests provide a variety of important ecosystem-services, ranging from soil and water protective functions over benefits for tourism and recreation to wood production. These services are highly put at risk by extreme climatic events, such as wind throw or prolonged drought periods, which have increasing potential to cause extensive forest mortality under changing climatic conditions. Drought stress is assumed to increase stand susceptibility to biotic attacks. So have outbreaks of the Eurasian spruce bark beetle (*Ips typographus*) frequently been associated with impaired water supply of Norway spruce. Comprehensive risk assessment is limited by the still significant lack in empirical data regarding the interrelationships between tree water supply, physiological responses and attractiveness to the biotic agent. The interdisciplinary, three-year case study ROSALIA ROOF PROJECT was launched in October 2011 to develop a model for the dynamic evaluation of tree and stand disposition to bark beetle attack. Within a risk assessment framework, we investigated the potential utility of a mechanistic ecosystem water balance model (CoupModel) for the simulation of stand water balances and stress thresholds. Modeling is based upon a comprehensive empirical dataset gained over three study seasons for the experimental drought treatments full drought, partial drought, and control, which were established in a mature Norway spruce stand in Eastern Austria. Monitored parameters range from weather data and soil water content over tree physiological indicators of drought stress and defense capability (e.g. pre-dawn twig water potential, sapflow, resinflow) to controlled attacks by the bark beetles. The dynamic predisposition assessment system (DPAS) is intended to improve the evaluation of tree and stand susceptibility to outbreaks of the Eurasian spruce bark beetle by the consideration of current host tree stressors (drought) and of seasonal and spatial variations in predisposition. By identifying water deficit thresholds at which the trees' defense systems become compromised, the model has potential to serve as useful instrument in forest management and protection. The model shall allow for the monitoring of actual stand susceptibility as affected by short-term water deficits and also the simulation of short-term trends, e.g. on the basis of weather forecasts. In combination with remote sensing, we further expect an improved understanding of landscape scale outbreak dynamics and advancements in over-regional risk management.

Key Words
Drought stress, Norway spruce, bark beetles, predisposition model, risk management

LANDSCAPE DYNAMICS AND SPATIAL ANALYSIS OF MANGROVE CASE OF BELO SUR TSIRIBIHINA, WESTERN COAST OF MADAGASCAR

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Abstract

Landscape dynamics analysis is recently known as a methodology to determine ecosystem resilience to perturbation such as human activities and climate change. However, review of literature on mangrove shows less interest of the application of this approach on mangrove ecosystem, which is although well known for its vulnerability. The aim of this paper is to extend the scope of remote sensing to this approach in order to understand mangrove ecosystem long-term dynamics in Madagascar and its relationship to the evolution of natural resources governance and policy. In fact, the area was under community based management and is planned to become a category V IUCN protected area. The analysis is performing image classification approaches for mapping mangroves with Landsat Thematic Mapper (TM), Enhanced Thematic Mapper Plus (ETM+) and Operational Land Imager (OLI) data. Hybrid and object-based classification techniques have been used. Mangrove deforestation is quantified by the comparison of classifications over three periods (1994, 2004 and 2014). Landscape metrics was used to quantify mangrove structure and configuration. The results show that significant loss of mangrove class area is observed during this period with a net variability of its localization depending on spatial accessibility and previous disturbance. The implementation of Markov chain model shows a diminution of mangrove area and the complexity of mangrove edge density. The mangrove spatial pattern tends to be fragmented into independent patches, unappropriated for mangrove species viability. Charcoal production, shrimp farming and social migration are the main drivers of change and their impacts are still very significant in the area. An upscale of the study at national scale will help to understand the global trend of mangrove landscape in Madagascar.

Key Words

Landscape dynamic, Mangrove, Landscape ecology, Landscape metrics, Markov chain, Modelling, Madagascar

HARVESTING MODEL IN MOUNTAINOUS AREAS OF GREECE

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Abstract

Forest exploitation and wood utilization represent a very important function within the framework of forestry activities. Greece is an extremely mountainous country but it has at its disposal a few forests, mainly growing on degraded sites and steep terrain with reduced production potential. The condition of the forests, and consequently, the need for a careful silvicultural treatment renders more difficult the application of highly mechanized exploitation methods.

The use of bioenergy from wood biomass and technical timber of constructions requires its technical-economic optimal harvest. The mountainous forests are usually and the most productive ones in our country, where harvested-skidded-transported primarily the wood products. The aim of this paper is the optimization of the harvest-skidding of wood in Greece with mechanical means.

As research area was chosen the forest complex of West Nestos in prefecture of Drama belongs to the East Macedonia and Thrace region in Greece.

The planning of rationally designed forest exploitation systems requires an integrated way of contemplation (from forest to the final product) and a global optimization must be pursued in any case. The full protection of the forest requires skidding with cable cranes in combination with tractor roads or passages parallel with the contour line for stacking of logs in cable line. However during the transitive stage of full mechanization with cable crane is not excluded the combination of cable line uphill and tractor road downhill.

Key Words

Forest exploitation, Skidding, Cable crane, Mechanical means

VULNERABILITY OF BIODIVERSITY TO LAND USE CHANGE UNDER DIFFERENT SOCIO-ECONOMIC AND CLIMATE CHANGE SCENARIOS FOR MEXICO

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Abstract

Biodiversity is threatened by Land Use Cover Change (LUCC) and Climate Change (CC). Identifying which biological hotspots will be more vulnerable to these threats could help to determine biodiversity conservation strategies in developing countries where funding and resources are scarce. Therefore, the aim of this study is to identify the sites most vulnerable to LUCCs to establish a biological diversity priority conservation strategy according to the different socio-economic and CC scenarios analyzed for Mexico. LUCC models were developed using the DINAMICA EGO software for three time slices: 2020s, 2050s and 2080s for A2 and B2 IPCC scenarios, called Special Report on Emission Scenarios (SRES). This software was selected because it allows creating dynamic systems using different changes of socioeconomic and climate drivers for each time slice. The inputs for this model were national land use and cover maps for the years 1993, 2002 and 2007 (1:250,000), socioeconomic drivers (population density, GDP, index of marginalization, distance to roads, to rivers and to human settlements, and to natural protected areas) and biophysical variables (aridity index, potential evapotranspiration, temperature, soils, altitude and slope) at 1km x 1km resolution. Our results show that the most affected covers will be temperate forests, natural grasslands and tropical evergreen forests. Expansion of agriculture explains the loss of more than 50% of natural covers. Expansion of agriculture was explained by medium values in population density, medium to high values in marginalization index, and distance to roads and to human settlements (<2km). By integrating all possible LUCCs and climatic scenarios, our analysis suggests that >15% of the area of the top most vulnerable areas is concentrated in eleven out of the total 2,456 Mexican municipalities . Five of these eleven municipalities are located in the north of the country, four in the centre and two in the south. These vulnerable regions overlap with the distribution of many highly endangered species such as mammals (*Alouatta palliata, Antilocapra americana*, *Ateles geoffroyi*, *Castor canadensis*, *Eira barbara*, *Leopardus pardalis*, *Leopardus wiedii,Panthera onca*, *Tamandua mexicana*, *Tapirus bairdii*, *Tayassu pecari ringens*)*;* birds (*Ara macao, Colinus virginianus, Spizella wortherni*) and some plants such as *Amoreuxia wrightii*. In conclusion, we consider this approach could be implemented in other biodiversity regions to prioritize biological conservation strategies.

Key Words
Land use change, climate change, vulnerability, biodiversity, and Mexico

CLIMATE-DRIVEN IMPACTS ON POTENTIAL AGRICULTURAL AND SILVICULTURAL TRANSFORMATIONS IN SIBERIA

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Abstract

Increased warming predicted from general circulation models (GCMs) by the end of the century is expected to dramatically impact Siberian forests. Both natural climate-change-caused disturbance (weather, wildfire, infestation) and anthropogenic disturbance (legal/illegal logging) has increased their impact on Siberian boreal forest. The Siberian BioClimatic Model (SiBCliM) was used to simulate Siberian forests, and the resultant maps show a severely decreased forest that has shifted northwards and a changed composition. Predicted dryer climates would enhance the risks of high fire danger and thawing permafrost, both of which challenge contemporary ecosystems. Our goal is to evaluate the climate-change effects in forestry versus agriculture, to question supporting forestry, agriculture or a mixed agro-forestry at the southern forest border in central Siberia predicted to undergo the most noticeable landcover and landuse changes. We developed and used forest and agricultural bioclimatic models to predict forest shifts; novel tree species and their climatypes to be introduced in a warmer climate and/or potential novel agriculture with a potential variety of crops to be introduced by the end of the century. To minimize negative climate change effects two strategies were developed for adapting climate change effects, motivated by forest disturbance in the south. One is a genetic means of assisting trees and forests to be harmonized with a changing climate by developing management strategies for seed transfer to locations that are best ecologically suited to the genotypes in future climates. The second strategy is the establishment of agricultural lands in new forest-steppe and steppe habitats, because the forests would retreat northwards. Currently, food, forage, and biofuel crops primarily reside in the steppe and forest-steppe zones which are known to have favorable climatic and soil resources. During this century, traditional Siberian crops are predicted to gradually shift northwards and new crops, which are currently non-existent but potentially important in a warmer climate, could be introduced in the extreme south. A resulting criterion of the best strategy to adapting climate change is based on optimizing economic loss/gain effects in forestry versus agriculture or mixed agroforestry.

Key Words

Bioclimatic modeling, boreal forest, tree species climatypes, agriculture, agroforestry, Siberia

SIMULATED THE EFFECTS OF NITROGEN DEPOSITION ON GLOBAL CARBON BUDGET USING THE IBIS MODEL

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Abstract

Since the 20th century, Atmospheric nitrogen deposition had increased significantly over the past 100 years and it will likely be double in the next 25 years. Anthropogenic activities had greatly changed the ways and rate of nitrogen deposition from atmosphere to terrestrial ecosystems, thus many researchers focused on the issue of the effects of atmospheric nitrogen deposition on ecosystem carbon budget.

This study aims to evaluate the effects of nitrogen deposition on global carbon budget using process based terrestrial ecosystem model. Firstly, the time variations of global atmospheric nitrogen deposition were estimated atmospheric NO_2 column density remote sensing data. Moreover, literatures were collected to summarize the effects of nitrogen deposition on terrestrial ecosystem carbon cycling using meta-analysis, and then the results of the meta analysis were integrated into a terrestrial ecosystem model, IBIS(Integrated BIosphere Simulator). Finally, to compare the results of multiple simulation experiments, the effects of nitrogen deposition on terrestrial ecosystem carbon budget were be evaluated.

The results show that both of the global total NPP and NEP had increased during the historical period. In the early first decade of this century, the total NPP increased to 52.8 Pg C yr^{-1} and total NEP increased to 3.5 Pg C yr^{-1}. Comparing with the simulated results in 1970s, the total NPP and NEP had increased by 9.3% and 29.6%, respectively. In the past 40 years, the global terrestrial nitrogen deposition had increased significantly, but it did not lead NPP and NEP change significantly. The average levels of nitrogen deposition during 2000-2009 was the highest among the past 40 years, which had increased by 53% compared with that in 1970s. At the meanwhile, the average NPP and NEP had only increased by 0.64% and 4.6%, respectively. The reasons for the weak effects of nitrogen deposition on carbon budget were the uneven distribution of carbon budget and nitrogen saturation. Most of the terrestrial ecosystem had not been affected by the intense nitrogen deposition. The high value of nitrogen deposition was mainly distributed in the area where have strong human activities. Forests are important to carbon assimilation and sequestration, but nitrogen deposition had not increased significant in forests generally, particularly in boreal forests. Moreover, the high level of nitrogen deposition lead nitrogen saturation which also limited nitrogen positive effects on carbon budget.

Key Words

Carbon budget; nitrogen deposition; IBIS model; NO_2 column density

ANALYSIS OF THE ROLE OF CLIMATIC VARIABLES IN CO2 FLUXES BETWEEN ECOSYSTEMS AND THE ATMOSPHERE THROUGH EMPIRICAL MODELS AND TIME SERIES OF EDDY COVARIANCE MEASUREMENTS

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Abstract

The aim of this study is to contribute to the understanding of how climatic drivers affect the carbon and water balance across different ecosystems. This is particularly important because directly related to climate change ascribable to the increase of greenhouse gas concentrations in the atmosphere and his impact on ecosystem.

Long time series of CO_2 and H_2O fluxes by the eddy covariance technique (over 7 years), measured together with the main meteorological variables are now available for several sites in the world, allowing studies on interannual variability and drivers-fluxes relations.

In this analysis different empirical methodological approaches are used (Artificial Neural Networks, Self Organization Maps and Random forests) in order to compare the results obtained and verify their reliability and robustness. The first methodological approach considered were artificial neural networks (ANN). In general the ANN are used as predictive tool to estimate output starting from the drivers. In this analysis ANNs are trained and then analyzed in order to quantify the relative importance of each of the drivers (environmental factor) in determining the ecosystem exchanges of carbon and water. ANNs are in general considered a "black box" tool where it is difficult to understand the relations between inputs and outputs but recent techniques are allowing to extract information about the role of each single variable allowing an ecological interpretation of the results.

Air temperature (Ta), precipitation (P), short wave radiation incoming (SWin), vapor pressure deficit (VPD) and soil water content (SWC) and their variability, including lag effects, are used as drivers to predict NEE, LE and H for different sites in Europe, spanning from Mediterranean to Boreal regions and their role analyzed at different time scales.

The results will contribute to understand for each site which are the environmental factors that primarily affects the ecosystem carbon and energy balances also the view of the predicted climate change and its effect on ecosystems.

Key Words

GREENHOUSE GAS BUDGET OF ENERGY CROPS: THE CASE OF A LAND USE CHANGE FROM CONVENTIONAL AGRICULTURE TO A POPLAR SHORT ROTATION COPPICE

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Abstract

Transition from fossil to renewable energy sources is one of the main strategies conceived by the European Commission (Directive 2009/28/CE) for the reduction of greenhouse gas (GHG) emissions. Production of biomass for energy purposes (energy crops) as poplar short rotation coppice (SRC) plays a major role for this target. GHG offsets due to fossil fuel substitution with renewable biomass go along with biogenic fluxes to and from the atmosphere, emissions from farming operation, and the consequences due to the substitution of a pre-existing land use (land use change, LUC) in terms of foregone sequestration/emission of GHG and soil organic carbon (SOC) changes. The suitability of a LUC from a rotation between clover grassland – winter wheat (reference) to poplar SRC was investigated by means of an experiment set up in Viterbo, Italy, aiming to compare the GHG budgets of the two systems. High-frequency eddy covariance (EC) measurements were carried out in both sites to calculate the net ecosystem exchange (NEE). Chamber measurements were performed to have N_2O and CH_4 emissions. Diesel consumption for farming operations was monitored, as the amounts of fertilisers and of water provided with irrigation. Soil analyses were carried out to calculate the difference in SOC content. All the contributions were cumulated over a 24-month period, corresponding to a cultivation cycle, and inserted in the budget considering their global warming potential (GWP). The net balance of the reference site represented the foregone contribution. GHG offsets were estimated comparing the emissions for the production of the same amount of energy in biomass and natural gas systems through a life cycle assessment (LCA). The suitability was finally assessed comparing the budgets of the two sites. The most important contribution was NEE for both the systems, while CH_4 and N_2O fluxes were almost negligible. In the cycle considered SRC had a NEE of -958 ± 61 gC m^{-2}, against -501 ± 29 gC m^{-2} of the reference site. Farming operations weighed around the 5% on the total budget for both. The net balance for the reference site summed to -445 ± 30 gC m^{-2}. Loss of SOC was estimated to be 140 gC m^{-2}. The aboveground biomass of SRC was estimated to be 623 ± 93 g m^{-2}, with a GHG offsets of 32 ± 5 gC m^{-2}. The GHG budget of SRC was -376 ± 68 gC m^{-2}, meaning that the reference site accumulated 69 ± 74 gC m^{-2} more than the SRC. Thus, emissions due to the LUC counterbalanced the positive aspects of biomass SRC.

Key Words

Poplar SRC, GHG budget, Land use change, Global warming, Eddy covariance

LITTERFALL PRODUCTION, STOCK AND DECOMPOSITION IN TWO FRAGMENTS OF THE ATLANTIC FOREST WITH DIFFERENT LEVELS OF ATMOSPHERIC CONTAMINATION

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Abstract

The uncontrolled growth of urban centers and the increase of industrialization have promoted some environmental impacts with serious consequences for biodiversity maintenance. São Paulo is a metropolis with approximately 21 million people and a vehicle fleet of nearly 7 million cars. The products emitted into the atmosphere from cars and industries involve heavy metals, and oxides of nitrogen with high potential for tropospheric ozone formation, a highly phytotoxic secondary pollutant. Thus, theoretically, urban forests of the urban center of São Paulo suffer more drastically than communities farther from the urban center. This study aimed to evaluate litterfall production in two fragments of tropical forests, one in the center of São Paulo city (Guarapiranga park) and another 50 km distant (Curucutu park). Over 1 year litterfall production was assessed by suspended collectors at 1 meter above the ground and randomly distributed in both areas. To assess the stock of litterfall a leaked mold (0.5 x 0.5 meters) was thrown randomly 20 times a month in the forest floor. The decomposition rate was calculated by Shanks and Oslon model (1961), by dividing the annual litter production by the annual average of stock. The results showed that the annual litterfall production was 11% higher in Guarapiranga (7.31 Mg.ha.ano^{-1}) than in Curucutu (6.47 Mg.ha.ano^{-1}). In both sites the production was higher during the months of highest precipitation (September-January). The average litterfall stock was higher in Guarapiranga than in Curucutu (3.9 and 3.7, Mg.ha.ano^{-1}, respectively). The decomposition constant k at both areas was 1.85 and 1.75 (Guarapiranga and Curucutu, respectively) and the estimated time to decompose 50 and 95% of litterfall in the Guarapiranga park was 4.4 and 19.4 months, respectively. For Curucutu park, the estimated time for such decompositions was 4.8 and 20.6 months, respectively. These results show a slight variation in the assessment of litterfall in the two studied forests and suggest that probably Curucutu community is suffering the effects of emissions from São Paulo city, however, interannual studies have been conducted followed by chemical analysis of the deciduous material to confirm this suspicion.

Key words

Litterfall dynamics, Environment monitoring, Air pollution, Tropical forest.

CARBON-NITROGEN INTERACTIONS DURING AFFORESTATION: EVIDENCE FROM FIELD EXPERIMENTS IN DANJIANGKOU RESERVOIR REGION OF CENTRAL CHINA

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Abstract

Afforestation has been proposed as a major measure to sequester carbon (C) from the atmosphere and thus mitigate climate change. However, impacts of afforestation for soil C and nitrogen (N) dynamics are not fully understood. We conducted a field study in Danjiangkou Reservoir region of central China to evaluate soil C and N dynamics following afforestation by comparing soil organic C and N (SOC and SON), soil net N mineralization and nitrification, inorganic N (NH_4^+-N and NO_3^--N) concentrations and soil microbial C and N biomass (MBC and MBN) in the plant rhizosphere and open areas in the afforested (implementing woodland and shrubland plantations) and the adjacent croplands in central China. Afforestation increased SOC but did not significantly affect SON in the plant rhizosphere. Due to large quantity of low-quality litter (with high C:N ratios) inputs, afforestation enhanced soil C recalcitrant indexes (RIC), MBC, MBN and MBN: TN ratio; but decreased soil N recalcitrance indexes (RIN) and MBC: SOC ratio in the plant rhizosphere. Both SON and RIN significantly decreased following afforestation in the open areas. Afforestation decreased inorganic N concentrations, net N mineralization and nitrification. Decreased MBC: SOC ratio following afforestation was correlated with low-quality litter input. MBN was positively correlated with soil NH_4^+-N concentration, but negatively with soil NO_3^--N concentration, indicating that ammonium was the more preferred form of N for microbial immobilization following afforestation. Soil net N mineralization and nitrification were negatively correlated with soil C:N ratios across land use types and seasons. These results suggest that afforestation could increase SOC stocks resulting from large low-quality litter input, but over the long-term, this increase was likely limited due to decreased soil N availability.

Key Words
Land use change, Soil C and N recalcitrance indexes, Soil fractionation, Soil organic matter, Soil microbial biomass, Net N mineralization, Net N nitrification

CARBON SEQUESTRATION POTENTIAL OF COPPICED VS. FORESTED PLANTATIONS

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Abstract

It remains debating whether forested versus coppiced plantation of willow has more potential for carbon sequestration in both biomass and soil. Case studies indicate that longer cutting cycle significantly increased soil carbon storage for short rotation coppiced willow. Impact of cutting cycle on the carbon sequestration potential of coppiced woody system is evaluated in PEcAn framework through meta-analysis of the data provided in BETY-db. Previously validated mechanistic model (BioCro) is used to perform regional simulations (32 km^2 grid) on the abandoned and degraded cropland in the USA for unmanaged short rotation coppiced willow under different scenarios for identifying management strategies to maximize the long-term potential of carbon sequestration on such systems. Regional simulations indicate that 4-yr coppice cycle can provide up to 0.65 PG yr^{-1} of harvestable biomass from abandoned and degraded land in the USA. Finding of this work will be helpful to quantify the long-term carbon saving through short rotation coppice plantation on the US abandoned land. Strategies to maintain the potential of C sequestration on the marginal land is also discussed with focus on identifying areas where plantation may have to be shifted in future as willow responds to change in environmental conditions such as ambient CO_2 and temperature.

Key Words
Short Rotation Plantation, Carbon Sequestration, BioCro, Marginal Land

REMOTE SENSING OF GLOBAL CHANGE

MORPHOLOGICAL ANALYSIS OF STATE AND TRENDS OF DIGITAL IMAGE OBJECTS

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Abstract

Morphological Spatial Pattern Analysis (MSPA) provides an intuitive, repeatable, and scale independent description of the configuration and pattern of image objects. Dedicated additional routines describe and quantify the connectivity network, including key nodes and links defining connectedness in raster images. Moreover, these tools can be applied to setup appropriate input files for enhanced graph theory analysis using the freeware Conefor Sensinode (http://www.conefor.org). A morphological based change analysis aims to reliably detect coherent change areas by excluding uncertainties due to differences in image quality, ortho-correction, and classification accuracy of the input images. These and other tools are geared to provide utilities for a comprehensive quantitative analysis of digital images. They may facilitate a holistic assessment or contribute to studies conducted with other software packages. Based on geometric concepts only these tools can be applied in any field, for example to generate GoogleEarth image overlays (http://forest.jrc.ec.europa.eu/download/data/). Complemented by pre- and post-processing routines and a complete GIS environment (http://www.qgis.org) these tools are available in the portable freeware GUIDOS Toolbox (http://forest.jrc.ec.europa.eu/download/software/guidos).

The principal features are explained and illustrated on sample data sets in forest landscape studies where pattern, connectivity, and spatial fragmentation are the key drivers. The reliable assessment of the configuration of forest patches and its change in time is a prerequisite for a meaningful understanding and interpretation of forest landscape dynamics. As an additional benefit it permits measuring progress in biodiversity and landscape planning projects. The provision of tools for monitoring and especially quantifying the impact of human activities on forest landscapes facilitates the design of efficient and assessable forest resource policies and risk assessment studies.

Key Words

Pattern, morphology, connectivity, change analysis

REMOTE SENSING AND HYDROLOGICAL MODELING IN SUPPORT OF TRANSBOUNDARY WATER COOPERATION IN CENTRAL ASIA THE CASE STUDY OF ILI-BALKHASH WATERSHED

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Abstract

The global warming consequences aggravate the deficit of water resources in the arid part of the Central Asia. Emerging conflicts in water sector and lack of cooperation reduce the capacity of the states to adapt to the climate change. Kazakhstan's territory relates to arid zone that makes it dependent from the neighboring countries, especially China and Uzbekistan. On the one hand, the scarce water availability is limiting the economical development; on the other hand, it pushes country towards sustainable management of resources through the introduction of innovative technologies and water saving practices. Currently the regional cooperation on the Aral and Caspian Sea is developing and with help of international organizations such as UNEP and UNECE are managing to produce a platform for policy makers. Therefore potential area of conflict has shifted from Aral Sea region to the Kazakhstan - China border where the population growth and expansion of water use for energy and agriculture is reducing the flow of Ili River into Balkhash and heavily polluting it. The project aimed to show how ICTs can facilitate decision-making in water security and management analyzing remotely sensed data and using it for the watershed model. In this study remote-sensing products is used for derivation of water body's extents and for detection of land use patterns for the area of Ili- Balkhash Basin with particular attention to Balkhash Lake itself. The results are used as input data for Ili-Balkhash basin modeling. The ArcGIS extension for The Soil and Water Assessment tool (SWAT) ArcSWAT is used to develop and run the model. Three scenarios of potential regional development have been formulated and analyzed, based on Climate Change scenarios from the IPCC reports with the consideration of economical development plans of China and Kazakhstan that have major impact on environment. The model reaffirmed that ecosystem of Balkhash Lake deteriorates due to increase of water diversion from Ili River and water pollution from developing industry in the Xinjiang-Uighur Autonomous Region. It was found that the water inflow into the reservoir is significantly decreasing in the future threatening sustainable water supply and numerous water-dependent activities in the region. The study suggests improving transboundary cooperation with particular attention to ecosystem conservation, by reducing water uptake and restoring the inflow of water as a way to preserve the lake's ecosystem. Using remotely sensed data and watershed modeling as a decision-making tool can help in achieving agreements between Kazakhstan and China and maintaining regional environmental security.

Key Words

Transboundary Water Management, Environmental Security, Climate Change, Remote Sensing, Ecosystem Modeling

ESTIMATING TREND SURVIVAL PROBABILITY IN SATELLITE OBSERVATIONS OF LAND COVER ACTIVITY OVER EUROPE

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Abstract

Vegetation cover activity signals, as recorded by satellite sensors, are good tracers of Global Change. These signals are particularly informative not only to evaluate modifications in structural and functional aspects of ecosystems but also for assessing more general effects, since vegetation acts as a bio-indicator for the whole environmental quality.

Currently, long-time/large-scale satellite imagery acquired by the NOAA-AVHRR sensor, which are available since the earliest 80's, provide the most comprehensive time series data on the terrestrial land cover at regional and global scale.

Maps of vegetation indexes, such as NDVI, can be synthesized as mathematical surfaces whose morphology varies in time. Within this scheme, the dynamics of the land cover activity can be investigated by exploiting concepts, models, and analysis tools designed to study surface dynamics.

In particular, this contribution focuses on the estimation of trend survival probability in the GIMMS-NDVI time series (1982-2006) obtained from the NOAA-AVHRR imagery. In the recent past we developed a procedure for the estimation of the tendency of NDVI to increase or decrease from initial reference conditions by means of linear fits that cover ever longer periods. Persistence probability (functional form and parameters) of such NDVI trends can give us very useful insights into the long term correlation properties of land cover activity so verifying stationarity or change hypotheses linked to climate or human pressure over large scales.

We apply this technique to the European continent by estimating persistence probability of ten-year trends (1982-1992) of NDVI annual maximum values within pixel aggregations defined by biophysical/geographical parameters. Our results support long term stationary behaviors globally over Europe even if slight differences are detected by analyzing positive and negative trends separately. The probability decay of positive trends is well resented by pure exponentials with comparable characteristic time scales whereas negative trends show more complicated decay laws. This asymmetry highlights the presence of non-random patterns in the interannual variability of vegetation activity very likely linked to climate.

Key Words

Land cover, NDVI trends, Survival probability, Climate, Human pressure

THE GIO LAND ACTIVITIES: FROM THE FIRST RESULTS TO THE SENTINEL-2 PERSPECTIVE

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Abstract

Europe is one of the most urbanized continent on the Earth. More than half billion of people lives in the European Union countries and this number is increasing. The European urban areas are characterized by a significant sprawl phenomenon, which has the most important impact on natural and rural environments. This affects also the biodiversity since it decreases habitats, the living space of a number of species, and fragments the landscapes that support and connect them. Since the '80s of the past century in the European institutions arose the need to monitor the land cover and land cover change in the continent. The European Environment Agency (EEA) is the authority of the European Union devoted to the monitoring of European environment. Many initiatives have been taken with this aim by EEA, and, one of the more recent is the production of several land cover datasets using satellite images. They are: artificial surfaces, forest areas, agricultural areas (permanent grasslands), wetlands, and water bodies. The satellite input dataset used for this production is composed by data coming from SPOT-5, Resourcesat 1 and 2 and RapidEye satellites which have up to five bands in visible and near infrared wavelengths with a spatial resolution of 20m. Starting from the 2015 European Commission (EC) and the European Space Agency (ESA), in the framework of the Copernicus Programme, will start a new mission called Sentinel-2, a constellation of two satellites with the objective to monitor the environments of the Earth. Each Sentinel-2 will carry the Multi-Spectral Imager (MSI), a pushbroom sensor with 13 spectral bands spanning from the VIS/NIR to SWIR part of the electromagnetic spectrum. Four of these bands have a spatial resolution of 10 m, while other six bands, 20 m and three bands has a spatial resolution of 60 m. The aim of this work is to evaluate the use of simulated Sentinel-2 data, using hyperspectral satellite and airborne sensors, to produce the land cover maps according to the requirements of the EEA with a semi-automatic approach.

Key Words
Remote sensing, Land cover map, Sentinel-2

VERY HIGH RESOLUTION CHANGE DETECTION OF LAND COVER/USE TARGET CLASSES IN MEDITERRANEAN NATURA 2000 SITES

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Abstract

Earth Observation data and techniques can offer the possibility to monitor large areas at multi-scale and high temporal frequencies according to the requirements of ecological processes' monitoring studies aimed at biodiversity and ecosystems conservation. Anthropic induced changes in land cover/use (LU/LU) composition and extension are important landscape features that affect ecosystem status and functioning. Hence, the availability of archive data from past and new satellite missions offers significant opportunities for the detection of changes. The three-years BIO_SOS (Biodiversity Multisource Monitoring System: from Space TO Species, www.biosos.eu) project, funded within the European Union FP7-SPACE third call, developed a pre-operational system (EODHAM, EO Data for Habitat Monitoring) for cost effective and timely monitoring of changes in land cover/land use and habitats within and along the borders of protected areas in support to policy makers using multi-temporal Very High Resolution (VHR) remote sensed data. The novelty consists in the production of LC/LU maps, to be compared for the detection of changes, through a knowledge-based (deductive learning) object-oriented approach. Although in-field data are not required for training the classifier, significant overall accuracy of the LC/LU maps can be obtained. As well-known, the accuracy of a change map depends on the accuracy of the input LC/LU maps compared. The FAO-LCCS taxonomy was used for LC maps. This paper shows the change detection results obtained for two sites by comparing a VHR LC/LU map produced by EODHAM and a pre-existing validated LC/LU map. One problem related to change detection at fine scale is the lack of VHR archive imagery on the whole earth surface, consequently, often pre-existing validated maps as obtained by different sources have to be used, with this introducing errors and uncertainty in the analysis. Two Natura 2000 sites in the Southern Italy were analyzed focusing on the class transitions (*from-to*) of some specific target LC/LU classes with high impact on the landscape (focal classes). A change matrix was adopted to evaluate the class transitions and the percentage of change of the focal class from time T_0 to T_1. The first site, "Le Cesine", is a wetland coastal area exposed to coastal erosion, often due to unwise management of the coast. Consequently the transition from the target class "sandy beaches" to "sea water" was considered by analyzing the bi-temporal co-registered data set composed by a QuickBird image acquired on June 2009 and a Worldview-2 image acquired on October 2010. The result evidenced a 34% occurrence of change as a decrease of the target class into the sea advance between 2006 and 2010. The second site is located in the "Murgia Alta" National Park and the transitions from the target class "semi/natural grasslands" to other classes were considered. A 5% decrease of the target class into "Cultivated Graminoids" was measured as occurred between 2006 and 2012. Four multi-seasonal co-registered Worldview-2 images were considered for the analysis. The work will discuss the potentiality and limits of the technique, with these mainly related to the availability of useful multi-seasonal VHR images in the past for regular change detection at fine scales.

Key Words

Change Detection, Earth Observation, Biodiversity

SEMI-AUTOMATIC SEGMENTATION OF WOOD AND FOLIAGE USING TERRESTRIAL LASER SCANNER

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Abstract

Terrestrial Laser Scanner (TLS), based on Lidar technology, has been widely applied for a number of environmental applications. Several authors have reported the use of TLS for forestry applications and in forest inventory (i.e. tree height, diameter at breast height, tree distribution, etc.). TLS technology can be an effective alternative to overcome the limitations of the conventional ground based forest inventory techniques: expensive, time consuming, limited accuracy, destructive measurements. In addition, post-processing of TLS point clouds could enable extensive analysis of data by automatic or semi-automatic methods. Recent applications of TLS data analysis have been focused on detailed description of the canopy structure: canopy density, leaf area density, crown bulk density, etc. However, the operational use of TLS techniques for canopy characterization of broadleaf forests needs further investigations. In particular, segmentation between points representing woody material, leaves and small branches is a key factor to improve the accuracy of tree and canopy description.

The main objective of this work was to develop a semi-automatic segmentation method of broadleaf tree species for improving the estimate of both canopy density distribution and woody material volumes.

A voxel-based approach was developed and tested using a TLS data set collected in field by multiple scanning on four cork oak trees. After using noise reduction filters, voxels were used as input to generate clusters through a point density algorithm. Clustering process led to the identification of wood and leaf voxels. Points belonging to each voxel were then classified and quantified as wood, foliage and noise.

Experimental results show that the semi-automatic segmentation algorithm can accurately discriminate wood and foliage clusters and consequently give the points of cloud associated to foliage, trunk and main branches.

Key Words

Terrestrial lidar, forest inventory, tree volume, crown volume, broadleaf trees

SPATIAL DYNAMICS OF THE SUNDARBANS STUDY BETWEEN 1973 AND 2014: A ROBUST REMOTE SENSING APPROACH

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Abstract

Over 60% of Bangladesh's population of 157 million are at severe risk from coastal flooding and cyclone impacts and an even greater number are threatened across the Indian Ocean region because of climate change. Mangrove forests (or mangroves) provide a critical natural coastal defence that can reduce the impact of cyclones, tsunami and short- and long-term sea-level change; particularly in low-lying countries like Bangladesh. Mangroves are also carbon rich and highly efficient sinks for carbon emissions. Despite these important roles, mangroves are a little understood and poorly managed element of the coastal ecosystem. Moreover, mangroves are highly sensitive to changes in salinity and temperature that are driven by increases in sea level, deforestation, and land-cover change. As a result of this sensitivity, over half of the world's original mangroves cover has been destroyed, and one-third of that decline has occurred in the last 50 years. There is, therefore, an urgent need for reliable maps of the extent of current mangrove forests. There are two fundamental knowledge gaps in our understanding of mangrove ecosystems that this paper contributes to: i) helping quantify the amount of CO_2 sequestrated and emitted by mangroves, and ii) potential of mangroves for mitigating future sea-level rise and coastal flooding. We uses unique historical forest survey records (1923-1926, 1957-1959, 1983-1985, and 1995-1997), recent survey (2011-2012), and remote sensing data (1973-2014) to quantify change in forest area and forest carbon content of the Sundarbans. The Sundarbans is the largest intact, contiguous, and biologically highly diverse mangrove forest area on Earth, located in the Ganges-Brahmaputra delta. Declassified American spy satellite imagery (CORONA KH4-B) (1972), RapidEye (2011) (6.5 m), and GeoEye (2011) (0.41 m) are used to map and validate geometrically and atmospherically corrected satellite imagery from 1973 to 2014. We demonstrate that the carbon content of the mangrove forests of the Sundarbans has declined by a third over the past 100 years, largely due to increases in salinity triggered by sea-level rise and climate change that forced ecosystem structure and composition to alter. Over the last 42 years (1973-2014) forest cover has declined at a rate of 16 km^2yr^{-1}. By using models that together account for the dynamics of sea-level, salinity, and cyclone as a response to the mangroves carbon fluxes, it would be possible to predict the future response of these ecosystems to various scenarios of future sea-level rise, including low frequency but high magnitude cyclones and tsunami in Bangladesh and across the Indian Ocean.

Key Words

Mangrove, forest area, carbon, change

COMBINING AIRBORNE LIDAR AND FIELD DATA TO ASSESS FOREST STAND CONDITIONS IN URBAN FORESTS

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Abstract

Most of the ecosystem services provided by urban forest areas are the consequence of the forest stand characteristics and conditions, which in turn depend on a wide range of abiotic and biotic factors of stress (e.g., climate change, plant diseases). Assessing the status of forest stands in highly dense urban areas is therefore a priority as this could inform the process of land-use planning and management. Estimating forest stand using only field data could be very expensive in terms of cost and time. Approaches that involves remote sensing techniques and field data, could substantially improve the assessment of the forest stand characteristics and conditions. LiDAR (Light Detection and Ranging) technique is a valuable source for mapping forest attribute at stand and tree level (e.g. Heights, Diameter at breast height, Volume, Biomass, Stand density, etc). In this paper, we aim to discuss some preliminary results based on a multi-source approach that use as input laser scan data (LiDAR) and field data. In particular, we present a map of forest stem volume, derived from a semi-empiric approach, in an urban forest located in the Nord of Milan.

Key Words

Ecosystem services, Green infrastructure, LiDAR, Urban forest

ECOSYSTEM MODELLING AND MANAGEMENT

SUSTAINABLE LAND MANAGEMENT FOR GERMANY: AN INTERDISCIPLINARY AND TRANS-DISCIPLINARY DIS-COURSE

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Abstract

Many societal demands are placed on land use in Germany. In addition to the existing demands, land use demands for climate protection are increasingly growing. At this time about 10 to 12 percent of German greenhouse gases (GHG) are emitted through land use. The main sources of emissions in land use are the agricultural use of organic soils (i.e., bogs), methane gas emissions through nitrogen fertilization, and organic manure. In 2012 in Germany, 53% of the land was used for agriculture, 30% for forestry and about 13% for settlement and transportation. While the areas of the forest sector, and in particular due to the societal priority for settlement and transportation, are (slightly) rising, the agricultural areas are reducing. Questions on land use affect all land using sectors (agriculture and forestry, settlements and transportation) and cannot be answered on a sectoral basis. That is whey area management is of special social importance and requires answers to the question: How will land use be in Germany in 2030? How many areas will be available for the different societal demands? Which competition and subsequent conflicts will result from intensive land use? What consequences does the general development of land use have for the production of food and feedstuffs as well as bio energy? How can nature and environmental protection be attained and how can land use contribute to climate protection? The project CC-LandStraD (Climate Change – Land Use Strategies) studies these questions and develops solutions for sustainable land management. Sustainable land use strategies for Germany are developed in an intensive interdisciplinary and trans-disciplinary discourse. Here both the process between stakeholders and scientists to develop scenarios and strategies for sustainable land management, as well as the modeling of measures/bundles via biophysics and socioeconomic model networks are of similar importance. Central is the level "Strategies" comprised of the baseline and four strategies. The baseline CC-LandStraD serves the development of land use in Germany while continuing the current framework conditions until 2030. The four strategies are a) climate protection b) climate protection with biomass c) climate protection with nature and environmental protection and d) prospective climate adaptation. The contribution shows the exchange between national participation processes and simulations of the model network, and presents results on the current status of the developed land use strategies for Germany. In summary the areas in which the land use sectors can contribute to climate protection is shown.

Key Words

Land Use, Germany, Climate Mitigation, Land Management

EVALUATING THE EFFECT OF GRAIN FOR GREEN PROGRAM ON WATER CYCLE IN CHINA

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Abstract

Forests play an important role in controlling water erosion. The Grain for Green Program (GGP) is one of the largest ecological programs in China aiming at converting croplands on steep slopes to forests to mitigate erosion problem in China. Large scale of afforestation has been implemented for more than a decade, and it's important to investigate its influence on the water cycle in China. In this study, we estimated the changes in water fluxes caused by forests converted from croplands under the GGP using a process-based ecosystem model (i.e., IBIS). The simulations were executed in two experiments (Control simulation and GGP simulation). Our results showed that the afforestation practice caused soil water increasing in most areas of China in the first two decades. The regional average soil water fraction for this period increased from 24.98% to 33.29, 32.33% to 40.12%, and 30.43% to 35.73% for the North China, Northeast China, and Northwest China, respectively. But for the long term, this increment is not significant. In Ningxia Province, the soil water fraction even decreased significantly after afforestation. The evapotranspiration increased significantly in the South China and decreased slightly in the North China; the runoff decreased in North China and increased in South China, but the difference between Control and GGP simulations is not significant.

Key Words: Grain for Green Program; Integrated BIosphere Simulator; Modelling; Water Cycle

LAND USE AND LAND COVER CHANGE SCENARIOS FOR THE BOLIVIAN AMAZON

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Abstract

Bolivian lowland forests still cover more than 50 % of the country and have the potential of being an important carbon sink that holds tremendous biodiversity. On the other hand, Bolivia is between the 12th countries with the highest worldwide deforestation from 2000 to 2012. The current political decisions pretend to increase the agricultural frontier, explore oil and construct roads in protected areas and indigenous territories. In Bolivia there are no land use and cover change (LUCC) scenarios only projections. In this context we present three spatially explicit LUCC scenarios until 2050 for the Bolivian Amazon forest. The most optimistic situation (Sustainability, where all the environmental laws are enforced "Scenario A"), the actual deforestation trends (business as usual BAU "Scenario B") and the worst situation (the expansion of the agricultural frontier "Scenario C"). In this study, the LuccME framework (<http://www.terrame.org/doku.php?id=luccme>) was used taking into account the LUCC modeling of the Brazilian Amazon experience. Determinant variables are, distance to roads, protected areas and indigenous territories, connectivity index to regional markets and the flat slope. Scenario A is the one with less deforestation showing the relevance of protected areas and indigenous territories and few new roads construction to avoid deforestation. This scenario is not likely to happen unless there is a high environmental law accomplished. Scenario B or BAU shows high deforestation in all places where there are no longer protected areas due to oil exploration or increment in road networks (consequently more connection to regional markets). Scenario C tries to show the worst situation in terms of deforestation with an immediate increase of road construction, agriculture frontier expansion and less protected areas and indigenous territories. This scenario is not far off from reality taking into account recent events regarding deforestation. The LUCC scenarios do not pretend to predict the future but to show how the actual and future policies could affect the deforestation trend. The real scenario could be a mixture, but to be able to see the possible impacts of deforestation in a spatially-explicitly way, can help, depending upon the decision-making, prevent (or reduce) deforestation as in the case of the Brazilian Amazon.

Key Words

Bolivian Amazon forest, Land use and cover change (LUCC) scenarios, deforestation, LuccME

LANDSCAPE PRIORITIZATION LOGICAL MODELING FOR DISCRIMINATING HOTSPOTS IN WILDFIRES AND SLASH-AND-BURN EVENTS IN BOLIVIAN AMAZONIA. APPLYING MAXIMUM ENTROPY MODELING AND GEOSTATYSTICAL ALGORITHMS ALONG THE AMAZONIA SIN FUEGO PROJECT (PASF)

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Abstract

The use of slash-and-burn in farming and grazing practices is still one of the factors driving landscape ecology and dynamics in the greater part of Amazonia. The slash-and-burn events start, traditionally, during the late austral dry winter, at the very first beginning of rainy season (August to October). This pattern changed dramatically in the last decade due to the local climate changes very likely related to forest cover modifications. The probability of uncontrolled development from slash and burn to wildfires increased. In fact, fire events are dramatically increasing in the last ten years in Bolivia either as number and as surface burned. The information and the relative statistics on wildfires are, at present, derived from hotspots maps obtained by the analysis of remote images provided by satellites (INPE, MODIS, NOAA-AVHRR Hotspot Detection). According to the analysis of hotspots (temperature-sensitive pixels) from images provided for INPE Brazil, the Departments of Santa Cruz, Beni, La Paz and Pando are showing the largest number of hotspots. The Programme Amazonia sin Fuego -co-funded by the CAF (the Latin-America Development Bank), the Governments of Italy and Brazil, the Bolivian Ministry of Environment and Water- implemented a series of actions to combat the recurrence of fires and to propose alternatives to the use of slash-and-burns. Among the other actions, it was started a specific project of landscape modeling aiming to highlight the most sensitive areas to slash and-burns and to wildfires and oriented to propose a GIS-based system user friendly to detect in real time the probability of a hotspot (as derived by the current remote images interpretation systems) to be a Wildfire vent or a Slash-and-Burn. The landscape (environmental, climatic, topographic and anthropogenic) variables were crossed checked with the historical surveys of hotspot and then tested through maximum entropy modeling for the determination of susceptibility ranking of the pixels to fire and slash-and-burn. The more informative predictors were evaluated for the classification of Leave-One-Out through statistical procedures, in particular the predictors have been tested according to the method jackknife resampling (JRR). The results, validated in four municipalities of Eastern Bolivia, show a level of confidence of the model overtaking the 85% as average.

Key Words
Landscape changes, Wildfire, Slash-and-Burn, Maximum Entropy modeling

EFFECTS ON FOREST AND INTRINSIC MOTIVATIONS OF PAYMENT FOR ENVIRONMENTAL SERVICES

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Abstract

Payments for Environmental Services have been implemented all over the world as a solution to the problematic environmental damages many ecosystems are facing. However, little is known about the effects that these programs are having on resource users' intrinsic motivations and how such motivational influences affect forest conditions locally. In this paper, we present the results of field economic experiments conducted with rural villagers in Uganda where PES are being implemented.

Key Words

Payment for Environmental Services, Natural Resource Management, Experimental Economics

THE EVALUATION OF ECOLOGICAL FLOW IN MOUNTAIN RIVERS - A NEW APPROACH CONSIDERING HYDROMORPHOLOGICAL ALTERATIONS

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Abstract

The hydropower production in the Alpine region has caused very altered hydromorphological conditions in most rivers, due to the massive withdrawal of water and to the construction of dams, weirs and other human infrastructures. These alterations cause modifications of habitat for rivers fauna and, in some cases, their destruction. In addition, less water is available for aquatic invertebrates and fish because of climate change that cause change in rainfall regime and, in particular, modifications in extreme events of rainfall and snow in mountain areas. In this context, the evaluation of ecological flow, that represents the river flow optimal for ecosystems, is a very important issue for river management, since it makes ecosystems more resistant to climate change. A new approach taking into account hydromorphological quality for ecological flow evaluation has been developed. In order to evaluate these characteristics, the method CARAVAGGIO (Core Assessment of River hAbitat VAlue and hydro-morpholoGIcal cOndition) has been used. This method, developed by CNR IRSA (Institute of Water Resource) in collaboration with CNR ISE (Institute of Ecosystem Study), allows to register features such as the type of flow, the type of substratum, the modifications of substratum and banks, the type of vegetation etcetera, in a sampling unit of 500 m along the longitudinal axis of the river. The study area is the Province of Verbano – Cusio – Ossola in the north-western part of Piedmont Region in Italy. The method CARAVAGGIO has been applied to River Toce and all its affluents, in addition to other rivers in the Province area, in around 50 different sites, and for each site, three synthesis indexes have been calculated: Habitat Modification Score (HQA) which gives indications about the quality of habitats in the site, Habitat Modification Score (HMS), which quantifies the alterations due to human infrastructures in the site, and Lentic – Lothic River Descriptor (LRD), which characterizes the site considering lentic or lothic features. The river sites were in this way classified in according to the requests of Water Framework Directive (2000/60 CE). Contextually to the CARAVAGGIO applications, flow discharge was measured in different sections, upstream and downstream withdrawals, to evaluate the Minimum Flow and to define, using also data of macroinvertebrates samplings, the ecological flow. Statistical analysis, correlation with a particular attention to hydromorphological data was used to evaluate and quantify the ecological flow in mountain rivers.

Key Words

Ecological flow, ecosystems, hydromorphological quality, river management , water cycle alterations

FUNCTIONAL GROUPS AND TREE GROWTH ALONG AN ELEVATIONAL GRADIENT IN THE ATLANTIC FOREST, SOUTHEASTERN BRAZIL

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Abstract

Ecological studies have evaluated the tree growth dynamics in Amazon and other tropical forests, but little is known about the functioning of the Atlantic forest, the second largest rain forest in South America, and a hot spot of biodiversity. The objective of this study was to evaluate the intra-annual variation in tree growth along an elevational gradient (1,000 m a.s.l.) of tropical moist forest in SE Brazil. We contrasted different functional groups based on wood density (stem with 0,55 g/cm^3; 0,56-0,7 g/cm^3; >0,7 g/cm^3), light availability (crown illumination index; high illuminated crown - IIC1, medium illuminated crown - IIC2; shaded or partially illuminated crown - IIC3), and, size class (trees < 10, 10-30 cm, 30-50 cm dbh; > 50 cm dbh), across three elevational sites located at 100 m a.s.l. (lowland forest), 400 m a.s.l. (submontane forest) and at 1,000 m a.s.l. (montane forest). We installed 1532 dendrometric bands stratified by size classes and taxonomic family level. Our sample was evenly distributed along the gradient in six 1-ha plots (two plots sampled by altitude level). Monthly measurements of diametric increment were taken from digital caliper. The highest mean annual tree growth of the gradient was observed at the submontane forest, followed by lowland forest and montane forest sites. In general, tree communities had greater tree growth during the rainy season (December-February). The absolute growth rate was higher in larger and IIC1 trees, but diameter increment variation between categories of each functional group was more evident when data were evaluated in relative terms. Mean annual growth was positively correlated with precipitation and temperature. NMDS analysis showed that for the period of this study the functional category had a greater influence on tree growth than elevation, showing that regardless of the altitudinal level of the community, size as well as light availability were important for clustering trees. It is suggested that the profile of tree growth occurs differently along the altitudinal gradient and each functional group may respond differently. Future studies with interanual monitoring are necessary to evaluate such variation.

Key Words

Tropical Forest. Dendrometry. Tree growth. Functional groups. Environmental Gradient.

ANALYSIS OF STEM GROWTH OF SCOTS PINE IN THREE EUROPEAN COUNTRIES

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Abstract

Four data sets were investigated in this study. The first set consists of 31 stem analysis trees that were sampled from 4 research plots reflected three different development stages at Järvselja in Estonia. The second set includes 24 stem analysis trees located in three plots at Vastseliina, Estonia. At this site, the soil nutrient regime was deliberately modified by fertilization. The third set is formed by time series data from Strážnice in the south-east of the Czech Republic and includes 47 Scots pine trees. The fourth data set was collected at the managed part of Białowieża Forest (Hajnówka Forest District) in eastern part of Poland and includes 12 stem analysis trees of Scots pine. The objective of this work was to develop a methodology of quantifying the allocation principles in terms of height and diameter growth of Scots pine based on the allometric coefficient. Observed allocation pattern was used to establish a typology for identifying exposure to different development stages and management. Annual height and diameter increment data were studied by cluster analyses for developing this typology. Ten dominant patterns of allometric relationships were found in plots. The allometric relationships were not unique for each development stages and our results indicate no significant growth and allocation patterns in response to development stages and management in Scots pine.

Key Words

Height and diameter growth, Allometric coefficient, Cluster analysis, Scots pine.

AN INDIVIDUAL-BASED MODEL TO DESIGN *ANOGEISSUS LEIOCARPA* (DC.) GUILL. & PERR. SEED DISPERSAL UNDER CHANGE IN LOCAL CLIMATE VARIABLES AND ANTHROPOGENIC THREATS IN ABDOULAYE WILDLIFE RESERVE (TOGO, WEST AFRICA)

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Abstract

Seed dispersal is a major phenological phenomena that predefines vegetation patterns and influence forest biomass. Understand how seeds are dispersed in a landscape is important for vegetation dynamics prediction. In this study we designed an individual-based model to perceive how human actions influence seed dispersal and how forest stands are patchily distributed in a vegetation matrix by considering temperature and soil moisture of the stand. Specifically, the study aimed at highlighting the patchily distribution of *Anogeissus leiocarpa* both found in pure gregarious or/and in isolated status. We hypothesized that *A. leiocarpa* seeds land in "safe sites" where locale environmental conditions (temperature, soil moisture and anthropogenic factors) are optimal for seedlings establishment. Results from our simulation attested that because seeds in communities are able to escape threats and have movement ability to avoid unfavorable conditions, they set assemblages for their survival, while isolated seeds in their restricted areas are easily threatened. Such results were closed to empirical observations and could lead to a suitable management of degraded areas and to restore open spaces where *A. leiocarpa* individuals are supposed to grow.

Key Words

Seed dispersal, anthropogenic disturbance, patterns, behavior, West Africa

These scenarios were applied for a time interval of 20 years using common GIS tools. The preliminary results we achieved constitute the basis for a future implementation of ES modeling.

Our approach was implemented with specific reference to ES in the Mediterranean region, but was developed in a way that it could be transferred to any ecological region across the globe.

Key Words

Ecosystem services, Forest management, Mapping, Modeling, MiMoSe project

MODELING THE INFLUENCE OF ALTERNATIVE FOREST MANAGEMENT SCENARIOS ON WOOD PRODUCTION IN THE MEDITERRANENAN REGION
THE MIMOSE APPROACH

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Abstract

Ecosystem services (ES) are defined as the benefits that human obtain from ecosystems. Forest ecosystems provide many essential goods and services, such as flood and landslides control, erosion prevention and maintenance of soil fertility, water and air quality, biodiversity, wildlife habitat, recreational space for humans and aesthetic appreciation of natural landscapes, wood for fuel, construction and fibre, biomass for energy, and non-timber forest products. The quality and quantity of these goods and services are influenced by forest management, especially in the Mediterranean area where the forest has been exploited for a long time.

In this study, we propose a methodology (namely, Multiscale Mapping of ecoSystem services - MiMoSe) based on the integration of remotely sensed images and field observation to produce a wall-to-wall geodatabase of forest parcels accompanied with several information useful as a basis for future trade-off analysis of different ES. Here, we present the application of the MiMoSe approach to assess the effects of three forest management scenarios on wood production in a study area of 4,438 km^2 coincident with the administrative Molise Region in Central Italy. The procedure is based on a vector forest parcels map created by multidimensional image segmentation that was populated with information on forest types, silvicultural systems (coppices and high forests), forest age, growing stock volume, slopes and protected areas. Forest management scenario A was designed based on local forest regulation in order to reflect current business-as-usual conditions. Two alternative scenarios were defined to reflect management strategies more oriented to nature conservation (scenario B) or wood production (Scenario C) than scenario A.

FOREST FIRE DISASTERS PREVENTION AND MANAGEMENT: THE DECISION SUPPORT SYSTEM

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The management of the fire emergency is one of the most important environmental issues across worldwide. A fast and effective wildfire prevention and suppression may limit extreme damages in terms of forest resources and human losses. Fire dynamic character leads to the need to act timely and properly by orienting available resources in the areas affected by fire. This work presents a Decision Support System (DSS) which is a comprehensive solution allowing to support decision-makers and operators involved in the issue of natural disasters management, especially forest fires. The system is a web-oriented solution designed to evaluate, plan, and manage wildfire events in different landscape scenarios through appropriate real-time work-flow procedures. Following the work-flow, the system manages wildfires lookout across a certain landscape. If the fire incident is validated by the field observation, the control room alerts the burn teams, ground vehicles and aircraft resources according to the critical situations needed. Furthermore, using a wildfire simulator assessing wildfire behaviour and its effects, the system provides a plan of prevention actions. Preventive operational planning is allowed through the integration of predictive modules for fire risk based on standard fire behaviour model simulator progressively implemented. These modules uses a series of acquired information on the landscape, such as: topography, weather and fuel models that allow to support decision-making processes. By adopting this system, forest managers and decision makers may avail of a fast and operative tool to improve efforts in forest fire disasters prevention and management.

Keywords

Decision Support System (DSS), Forest Fire Fighting, Fire behavior Models, Fuel Management

STANDARDIZED VALUE ADDED GEOSPATIAL PRODUCTS TO SUPPORT URBAN PLANNING AND S.E.A. MONITORING FROM EO IMAGES TO LINKED OPEN DATA

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Abstract

More and more urban planning processes need updated knowledge regarding the current situation of the areas, tools that can support planning processes and also systems to monitor the impact of the plans on the area.

All the planning stages (from the determination of the current situation, to the definition of the index that will be used to assess the Strategic Environmental Assessment (SEA), up to the creation of communication channels with the most important stakeholders) can be put in just one continuous planning process, that starts with the planning process and lasts throughout the validity of the plan.

This process can be supported with the use of geospatial products that help defining the synoptic frame through default and standardized informative layers and geospatial indicators. This knowledge base can be shared through web portals that support the interaction with the citizens in order to start and keep the participatory planning process going.

Planetek Italia has developed standardized geospatial products, based on very high spatial resolution remotely sensed data, designed in particular to support the planning process and currently used by several local authorities in Italy.

Key Words

Earth Observation, urban planning, policy making, soil loss, Strategic Environmental Assessment

APPLICATION OF RISK ASSESSMENT SCHEME TO SUSTAINABLE FARMING THROUGH THE "BIODIVERSITY FRIEND" CERTIFICATION RESULTS FROM 3-YEAR MONITORING AND ACTIONS ON TABLE GRAPE FARMS IN THE AREA OF BARI

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Abstract

"Biodiversity Friend" is a standard certification developed in 2010 by World Biodiversity Association to evaluate the biodiversity and promote its conservation in agriculture. The procedure to obtain the certification considers the environmental impacts of the agricultural activities on the agrosystem and the biodiversity and suggests operational strategies to improve the environmental quality of the agriculture areas. The evaluation is referred to 12 actions related to low-impact methods of pest and weed control, reconstitution of soil fertility, rational management of water resources, diffusion of hedges, woodlands and nectariferous plants, conservation of agricultural biodiversity, soil, air and freshwater quality through Biodiversity Indices, use of renewable sources for energy supply, lower CO_2 production and CO_2 storage and other actions that may have beneficial effects on biodiversity and human activities. The environmental conditions of the agrosystem are evaluated by biomonitoring of air, water and soil. The biodiversity of soil and aquatic macroinvertebrates and the biodiversity of epiphytic lichen communities decrease very quickly when the soil, water and air conditions are altered by different causes such as pollution, synthetic and organic pesticides, bad land use practices, etc. The protocol of the three indices of the standard certification "Biodiversity Friend": Lichen Biodiversity Index (LBI-bf), Freshwater Biodiversity Index (FBI-bf), and Soil Biodiversity Index (SBI-bf) are presented in detail. Univeg Trade Italia, from 2011 to 2013, applied this Scheme inside a marketing Program named "Filiera Univeg", where the "hotspots" of Sustainability, either as environmental aspects or Social Responsibility, has been focused. This approach, based on current existing leader standards, such as ISO 14001, EMAS III, SA8000, Global G.A.P., G.R.A.S.P., etc., applied on the table grape farming system let put in evidence the possible critical points, coming from bibliography and experience. These "hotspots" has been subject of monitoring and actions in a 3-years experience in 8 farms located in the Province of Bari (Noicattaro, Polignano a mare, Rutigliano, Triggianello). The results of these activities give a road-map for growers and traders towards the valorisation of fruit and vegetables coming from Sustainable farming systems.

Key Words

Biodiversity; bioindicators; Sustainable farming; Certification; agrosystem.

K4E - KHIRA FOR ENVIRONMENT
THE CONTRIBUTE OF KHIRA PROJECT TO THE ISSUE OF GLOBAL CHANGE

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Abstract

KHIRA (Knowledge Holistic Integrated Research Approach) project aims to overcome the limits of the current product lifecycle management approach according to a more integrated and holistic vision.

The results of product and process innovation that KHIRA project intends to achieve are: the creation of a framework that covers the whole product life cycle, including design, production, maintenance, testing and validation, ensuring gathering, usability and reuse of knowledge; the definition and implementation of an environment able to support knowledge-based decision-making processes, catching key information from all product life cycle phases in order to set and maintain customer requirements, product standards and quality, efficiency and environmental constraints. These main objectives are pursued through the use of PLM systems.

The project is currently involved in supporting a CoP (Community of Practice) focused on knowledge sharing and knowledge creation in the field of Life Cycle Assessment (LCA). The KHIRA LCA CoP is formed by a group of researchers who share concerns, problems and a passion about the LCA topic, and who have deepen their knowledge and expertise in this area. The worldwide attention towards a more sustainable product development made engineers conscious about environmental issues along with the more classical problems like costs and industrial success. LCA is widely considered as a systematic approach where a product, a process or a service is analyzed in each stage of its life, from raw materials extraction and processing, through production, distribution and use, to disposal and recycling. The LCA methodology is based on the collection, the quantification of all inputs and outputs of materials and energy in order to produce an assessment of environmental impacts associated to a system within its boundaries throughout its whole life cycle. Starting from these considerations, Product Lifecycle Management (PLM) can be even more effective when it is integrated with a LCA tool, which may assess environmental impacts of a product or a service in order to address future design activities.

The KHIRA LCA CoP wants to be a sharing point for open discussion and exchange of views among researchers belonging to different research projects in a multidisciplinary context. The community, moreover, deals with the following issues: LCA, simplified LCA and standard ISO 14000 series; Environmental Product Declaration; Assessment of software and methods for LCA and simplified LCA; Eco-design and Life Cycle Thinking; Sustainable business development.

Key Words
KHIRA, Life Cycle Assessment, Product Lifecycle Management, Sustainable Development

GREEN INFRASTRUCTURE AND BIODIVERSITY

THE RELATIONSHIP BETWEEN VEGETATION DENSITY PATTERN AND SOIL MACROFAUNA BIODIVERSITY

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Abstract

The relationship between aboveground and belowground biota are major ecological drivers in terrestrial ecosystems. This study was conducted to determine whether vegetation density affect on spatial pattern of soil macrofauna biodiversity in the riparian forest landscape of Karkhe River, southwestern Iran. The macrofauna was sampled by hand sorting 150 (50 cm×50 cm×25 cm) soil monoliths along parallel transects (perpendicular to the river). The sampling procedure was hierarchically, maximum distance between samples was 0.5 km, but the samples were taken at 250m, 100m, 50m and 20m at different locations of sampling. All soil macrofauna were identified to family level. At each transect point the field data for vegetation density (percent) was recorded (20m × 20m plots). Remote sensing applications and using the NDVI could help to define the spatial variability of vegetation density. Hence the NDVI was measured using Indian Remote Sensing Satellite (IRS P_6), Linear imaging self scanner (LISS III).Then at each sampling point, NDVI was correlated with vegetation density. Soil macrofauna biodiversity (Shannon H' index) and NDVI data were analyzed using geostatistics (variogram) in order to describe and quantify the spatial continuity. The both variograms were spherical and revealed the presence of spatial autocorrelation. Soil macrofauna biodiversity significantly correlated with NDVI(r=0.35, p<0.01). Also the similarity observed between both spatial patterns of them (range and model), may signify that macrofauna was distributed spatially in this area depends on vegetation density. We concluded that spatial pattern of vegetation density affect the macrofauna distribution that could be used to evaluate the conditions of landscape and to decision-making for managing the ecosystem of riparian forest in this area.

Key Words

Spatial pattern, Soil macrofauna biodiversity, geostatistics, NDVI.

ASSESSING ECOLOGICAL TOLERANCE OF PLANTS INCLUDED IN THE GREEN INFRASTRUCTURE OF CITY OF YEREVAN, ARMENIA

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Abstract

Nowadays, urban target tree planting problem purchased more social, ecological and economic importance due to the increasing anthropogenic pressure on the environment whose solution requires holistic approaches. Plants accomplish environmental, recreational, aesthetic and extremely important sanitation and hygiene functions; therefore, gaining of sustainable green spaces in urban areas is extremely needed. To develop urban tree planting system, one should consider levels and peculiarities of pollution with different pollutants to assure specific diversity and tolerance of plants.

Since recently the area of green zones of Yerevan – Armenia's capital – has been reduced noticeably as a result of intensive site development and increasing environmental pollution levels. This research aimed to provide ecological assessment and tolerance of plants in Yerevan. The research included a study of condition of plants and determination of specific composition of the most widespread trees and shrubs. Basic species were studied in ten parks and squares and twenty streets throughout the city. The implemented ecological assessment allowed evaluating condition of Yerevan parks and squares as unsatisfactory since for a studied period a share of severely weakened and dying species made 41% of a total amount of plants. Geochemical data for Yerevan indicate that soils and plants throughout the study area are severely polluted with heavy metals emphasizing lead, molybdenum and copper; in recent years high contents of mercury and nickel were detected, too. So, ecological tolerance of plants to the detected pollutants was studied as well. As found out, the most tolerant tree species in conditions of Yerevan are *Robinia pseudoacacia L., Fraxinus excelsior L., Fraxinus pennsilvanica Marshall, Populus alba L.* and *Koelreuteria paniculata Laxm.* Range of ecologically sustainable plant species for target tree planting of parks and streets of c.Yerevan was designed based on the derived results.

The research was implemented by stages employing a complex method of ecological assessment of plants developed by us: Studying the assortment of plants, Plant condition assessment, Geochemical investigations of the site, Studying tolerance of different tree species to man-made environment of the site. The approach helps indicate ecologically tolerant tree and shrub species to complement a plant assortment designated for urban green zones.

Key Words

Plants, pollutants, tree species, ecological assessment, tolerance

SPECIES RICHNESS OF SMALL URBAN PARKS IN RELATION TO PARK ATTRIBUTES AND HUMAN ACTIVITIES

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Abstract

The function of urban parks in hosting human activities can conflict with their role in providing biodiversity. This is true especially for small urban parks, which are often subjected to intensive pressure, also from the surrounding urban areas. This study aimed to investigate the relationships between park attributes, human activities, species richness and ecological quality. We conducted a pilot study in five small urban parks within a city of Petaling Jaya, Malaysia. The five parks are: (1) MBPJ Park, (2) SS2 Park, (3) Aman Park, (4) SunwayMas Park, and (5) PJS10 Park. The sizes of the parks range from 0.5 to 2.8 hectares. Structured field observations were undertaken, with observation data recorded under three broad categories: (1) *physical characteristics of the park* (size, structure, land-use, infrastructure and water bodies), (2) *species richness* (plants species, birds, butterfly and dragonflies) and (3) *human factors* (such as park use and nearby activities, user density, noise level, types of abuse, smells). Each park was observed three times, once during morning (7.30am to 9.30am), afternoon (12.30pm to 3.00pm) and evening (5.30pm to 7.30pm). All data were analysed and formatted for comparison and correlation. Although observations were few and based on visual recording of a few animal species only, they provide an indication of species richness and its possible relation to park attributes and human activities. Results show that birds and butterfly species were positively correlated with vegetation diversity. Birds are attracted to fruit trees for foraging while butterfly preferred on flowering shrubs. MBPJ Park hosted a high number of butterflies and dragonflies species but fewer birds. Human activities seemed to affect the presence of birds, but not of butterfly and dragonflies. Abundance of invasive birds was noted especially in SS2 Park as a result from extensive outdoor eating facilities in the park. Proximity to road and infrastructure, and high noise level seem to be other factors affecting the presence of birds. Not surprisingly, the presence of a lake in Aman Park and PJS10 Park was important for the birds and dragonflies. SunwayMas Park has fewer trees, more impervious surface and is closer to a main road, but as it is situated near a neighbourhood park, it still hosted a high number of bird species. Continuous and intensive human pressure can negatively influence the presence of birds in the park. These indicative study findings can be used by landscape architects and park manager in their efforts to develop and manage more biodiverse small urban parks.

Key Words

Urban parks, Species diversity, Vegetation, Human impact, Ecological quality

GREEN INFRASTRUCTURE AND MAPPING OF PROTECTED AREAS IN GREECE

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Abstract

In recent years the collection, management, analysis, modeling and visualization of spatial data (geodata) using databases, geographic information systems, image processing systems, etc., has become a very important field of research and practice.

The EU has set itself an ambitious target of halting the loss of biodiversity in Europe by 2020. At the heart of its efforts is the establishment of an EU-wide network of protected areas spanning all over 28 EU countries. Natura 2000 lies at the very core of Europe's Green Infrastructure. It not only acts as an important reservoir for biodiversity and healthy ecosystems, which can be drawn upon to revitalize degraded environments across the broader landscape but also delivers many ecosystem services to society. In this paper, we dealt with the digitization and mapping of the protected areas in a prefecture of Greece, using GPS and computer programs after the digitization of analogue maps. This was done by input the data collected by GPS, in the program AutoCADMap, and export them in shape form. Then was processed with the program AGRGIS and the drawn out digitally the protected areas. Integrated G.I.S software enabling the establishing of nationwide geodatabase, including vector and raster data, digital elevation models and attributes attached to the geometric features. AutoCAD Map software, ArcGIS and Google Earth contain all necessary tools to perform the above mentioned tasks: built-in thematic mapper, map editor, analyzing tools, digital image processor, digital surface modeler, relation database manager and report writer.

The rapid development of technology and the increasing use of digital spatial data bases, multiplied portability and exchange of information between users. These data are now addressed in several extended circle of potential users who in order to assess whether and how the available data meet their needs require longer recording quality of the information provided. From the perspective of the producer of information essentially "required" to perform, record and publish the results of a number of checks and other important issues related to information in order to enable the potential user to evaluate and assess the suitability use. There is a strong relationship between Green Infrastructure and protected areas (Natura 2000) as they provide a strategic focus for improving our natural environment and enhancing the quality of our lives with the offer of practical examples of how can be used in a way that provides multiple socio-economic benefits to people as well as to nature.

ACKNOWLEGEMENTS

Key Words

Geographic Information Systems (GIS), Data, Digitization, G.P.S., AutoCAD

MODELLING BIODIVERSITY IN URBAN FORESTS USING A MULTI-TAXA APPROACH: TOWARDS A FUNCTIONAL URBAN GREEN INFRASTRUCTURE

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Abstract

Land-use changes and forest fragmentation associated to urban sprawling have exacerbated the effects of global change factors. An increase in urban green areas is claimed to ameliorate such effects. However, most policies assume that all types of green cover have the same value and an area increase is enough. Our hypothesis is that not all green areas value the same and that based on a multi-taxa approach it is possible to draw a more functional green infrastructure in urban environments. The diversity of lichens, butterflies and other arthropods, birds and mammals was evaluated in Mediterranean urban forest in south-west Europe (Almada, Portugal). Birds and lichen communities presented urban-tolerant and urban-sensitive species, which could be used as functional groups and ecological indicators of the effects of urbanization. For lichens, birds and mammals, the effect of forest surroundings and characteristics were more important than forest quantity alone. Thus not all types of green infrastructure have the same value for biodiversity. Further, a model to predict forest functional diversity based on remote sensing information was built and applied to all forests of the municipality. This helped decision-makers to increase green infrastructure functionality and ultimately ecosystem services in urban areas.

Key Words

functional green infrastructure , multi-taxa, modelling, urban forests

RESIDENTIAL GREEN SPACE CONTRIBUTIONS FOR BIODIVERSITY CONSERVATION IN PIRACICABA, SP, BRAZIL

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Abstract

Nowadays, there is a new approach on the importance of providing urban green spaces for biodiversity conservation. Studies on this area are scarce and have been done in places like gardens, squares and parks. The green residential areas are becoming an important refuge for native biodiversity and have a special importance due to the everyday human interactions in the daily routine. The present study aimed to verify the occurrence of homegardens and its use for plant cultivation in Piracicaba, SP, southeastern Brazil. 182 semi-structured interviews were conducted with part of the population in Piracicaba, southeastern Brazil, being 51 interviewees from rural areas and 131 from urban areas. To evaluate the plant diversity we used Shannon index. 90.8% of the interviewees from the urban centers and 94.1% from rural area have gardens in the residence, but only 25.2% in urban areas and 62.7% in rural areas use these spaces for plant cultivation. Plant diversity was higher in rural than in urban areas (H: 1.57; 1.46, respectively). In general, 45% of householders consume plant production daily and 65% weekly, even though plants are not cultivated just for feed purposes. These results indicate that residents of both, urban and rural areas, have enough space for cultivating plants, even this habit of cultivation was different in the studied areas. Thus, we suggest a special attention for public policies and campaigns towards to the use of residential green spaces in urban areas, since this reinforces the biodiversity conservation in the actual world population increasing scenario.

Key Words

Green Space, Biodiversity, Homegarden, Sustenability.

EVALUATION OF THE MECHANICAL EFFECTS OF ROOTS ON SLOPE STABILITY USING A FINITE ELEMENT ANALYSIS

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Abstract

In soil bioengineering techniques the use of vegetation for slope stability works is largely adopted. For this reason the quantification of the effect of vegetation on the overall stability of a slope, with relation to different conditions (e.g. position of the vegetation, characteristics of the slope), is quite important.

The paper deals with the assessment of the mechanical effects provided by the root system to slope stability. The presence of roots within the soil increases, with respect to the case of soil without vegetation, the material effective cohesion with no significant change in its friction angle. At the same time, the vegetation controls the hydrological flow of water within the slope through infiltration, runoff and evapotranspiration processes. In this work, the mechanical role of vegetation on the stability of artificial slopes has been investigated using a finite element analysis. The use of this technique proves to be quite effective as it allows to modify the soil properties of individual slope elements including roots. In particular, different scenarios have been considered: a homogeneous vegetal cover, with or without a retaining structure at the foot of the slope, and a discrete distribution of vegetation along the slope surface. The results of the analysis give interesting information on the soil-vegetation interaction: the use of vegetation distributed only along the sloping face leads to a small increase of the factor of safety, while the use of retaining structures at the toe of the slope considerably improves its overall stability. Nevertheless, the vegetation mechanical effects are less significant in slopes with high values of effective cohesion where deep-seated failure mechanisms are likely to occur.

Key Words

Slope stability, root reinforcement, apparent cohesion, finite element method, bioengineering techniques

SUSTAINABLE DEVELOPMENT AND MANAGEMENT OF A MULTIFUNCTIONAL MOUNTAINOUS AREA IN GREECE
SUSTAINABLE MULTIFUNCTIONAL MOUNTAINOUS AREA

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Abstract

Sustainable development of mountainous regions has as objective to increase the economic investments to profit of residents of region, without however it influences drastic the natural environment. The respect to the natural environment and the goods that to us offers, gives the possibility of its sustained use. The refuting opinions for the effect of anthropogenic action of economic nature come in contrary with the interdependent of the coexistence of men and nature, as the men is piece of nature. The manner of coexistence of development and natural environment is the sustainable development, which was used soft rhythms, without the intense intervention in the more wide space in which it is practiced. Green Infrastructure (GI) can be broadly defined as a strategically planned network of high quality natural and semi-natural areas with other environmental features, which is designed and managed to deliver a wide range of ecosystem services and protect biodiversity. More specifically GI, being a spatial structure providing benefits from nature to people, aims to enhance nature's ability to deliver multiple valuable ecosystem goods and services in perpetuity, such as timber, clean air or water. Above all, GI offers us a smart, integrated way of managing our natural capital.
As research area is chosen Samarina Grevenon a typical example of a multifunctional GI one that is capable of combining forestry, farming, housing, as well as tourism and recreational activities in the same space whilst at the same time keeping our freshwater systems clean, our air healthy and our wildlife safe. Aim of the paper is to indicate manners of sustainable development with direct priority the maintenance of natural environment. The potential of social and ecological factors is examined as it concerns the promotion of the protected area within sustainable rural development. Advantages of registration in the form of a spatial tool, especially when many types of information participate, are presented and give us a visual potential of how can forest operation and ecosystem services can be create a large multi-functional landscape.

INVENTORY OF URBAN AND PERIURBAN FORESTS (UPF) IN LOMBARDY   RESULTS OF THE LIFE PROJECT EMONFUR (LIFE + 10 ENV/IT/399)

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Abstract

The realization of the Inventory of urban and periurban forests (UPF) in Lombardy region was one of the main objectives of the Life Project EMoNFUr (LIFE + 10 ENV/IT/399).
This paper aims to describe the final results of the inventory of UPF and the activation of the regional urban forests cadaster (www.forestemonfur.eu). The regional inventory and the cadastre of UPF are important tools for land use planning, management and valorization of this forests. They are, furthermore, a detailed representation and dissemination of the urban forestation activities results occurred in the last 35 years. The inventory identified and classified all the forest areas recognized within the urban and periurban area that were defined according to the Moland method (2004, 2013). This model describes the main forest features and spatial characteristics of this area. The cadaster, however, is a database that collects all the data related to the UPF, dividing them into different description sheets and making them available for everyone with the support of WebGIS. Overall, the inventory classified 21% regional areas as urban forests, which concern 714 municipalities (46% of the total) and over 8 million of inhabitants. The 19.3% of urban forests is in the plains, 50.8% in the hills and the remaining 29.9% in the mountains. The cadaster of urban forests and plain woods was created in addition to the inventory activities. It consists in the compilation of seven description sheets for each forest planted since the 80's. Collected data are related to several aspects such as general and local information, forest and management plans, financial aspects and public fruition. The Cadastre is completed online by the forest owners and managers, public and private technicians, environmental organizations and farmers. This tool enables to assess and monitor continuously the urban forests giving the opportunity to know them through a WebGIS visualization hosted on www.forestemonfur.eu. With the inventory and the Cadastre, Lombardy Region adopted useful tools for the planning and monitoring of urban forests which play an important role in improving the environmental quality of the regional densely urbanized populated area. At the same time, these tools allow to manage and disseminate information which is necessary for participation of the different stakeholders in a participatory management of these forests.

Key Words

Inventory, UPF, Cadastre, Lombardy Region, Life Emonfur

IS PLANT DIVERSITY OF URBAN GREEN INFRASTRUCTURE CATEGORIES IN CORRESPONDENCE WITH THE DIVERSITY AND QUALITY OF THEIR ECOSYSTEM SERVICES?

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Abstract

As shown by recent research many ecosystem services are dependent on biodiversity of ecosystems. In urban ecosystems such as public parks, private gardens, allotments, cemeteries, urban forests, green roadsides, landfills, etc. biodiversity is under the strong pressure due to overuse, pollution, climate change and invasive species. Yet, these ecosystems are expected to offer many ecosystem services ranging from provisioning of food and wood, regulation of climate and pollutants, supporting of nutrient cycles and provisioning of the recreational, educational and aesthetical human needs. The assessment of the overall (urban) biodiversity is a difficult task; many groups of organisms, despite presumably important for ecosystem functioning, are difficult, tedious and expensive to be assessed. In this sense a surrogate of overall biodiversity is needed and should be tested. Here, the plant diversity of some urban green infrastructure (UGI) of Ljubljana, capital of Slovenia, was assessed and compared with the diversity and quality of ecosystem services, provided by these UGIs. The research included urban parks, pocket parks, urban forests, allotment gardens, private house gardens, green sport facilities and ruderal sites. Three units of each UGI category were surveyed using the same sampling design in late spring and in autumn period. Ecosystem services were attributed to each UGI unit and its quality was estimated using literature data and expert knowledge. The contribution will focus on functional and causal relationship between plant diversity and ecosystem services of UGI of Ljubljana. The usability of plant diversity as an easier-to-assess measure of biodiversity will be discussed. We will also emphasize how much of effort is given to the protection of biodiversity in UGI of Ljubljana from the municipality administration, UGI management concessionaires and urban people.

Key Words

Urban biodiversity, Plant species, Urban green spaces

Key Words

Samarina, Green Infrastructure, Forestry, Farming, Recreational Activities

ECOSYSTEM SERVICES EVALUATION AND POLICY MAKING

A SPATIAL-EXPLICIT SCENARIO ANALYSIS FOR ASSESSING THE EFFECTS OF LAND COVER CHANGES ON ECOSYSTEM SERVICES

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Abstract

Information on land cover and land cover change is believed to be one of the benchmark data sets because of its value as an environmental change indicator. In a world of shrinking forests worldwide, Europe is expanding its forest area. This poses forest planners and policy makers with a difficult task: how to make decisions that affect the future delivery of ecosystem services when faced by rapid land cover change shifts? One approach is to consider how a range of futures may unfold and stimulate interdisciplinary debate about land cover changes scenarios. Given the relationship between space and time scales appropriate for observing different aspects of patterns and processes, the understanding of forest dynamics can only be perceived on a scale of tens to hundreds of years.

We used Dinamica-EGO, a spatially explicit simulation model of landscape dynamics that presents multi-scale vicinity-based transitional functions to develop plausible scenarios of future land-cover change trajectories in the Vercors Mountains (French Alps). The area is considered as a forested "hot spot" of biodiversity for Europe and also part of a LTSER worldwide network. This model is parameterized with knowledge on past landscape trajectories, from 1840 to 2000's, biophysical variables and socio-economic constraints. Landscape trajectories revealed by this model confirm past trends like closure of pasture and loss of farmlands and increasing artificialization in the valleys.

We moved forward on scenario development that has direct application to improve forest management and conservation within an ecologically intensive agricultural context. Therefore, we brought the future trends of land-cover face to face with environmental conditions using biodiversity indicators, potentiality of production and forest accessibility parameters.

This case study is part of the EU FP7 OpenNess project http://www.openness-project.eu/ and is still work in progress, therefore a discussion and exchange it is expected to build up common research interests.

Key Words

Ecosystem services, mountain systems, afforestation, ecological intensification, temporal changes.

EFFECTS OF URBANIZATION AND HUMAN ACTIVITIES ON LANDSCAPE CHANGE AND LOCAL ENVIRONMENT IN THE BOHAI RIM REGION, CHINA

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Abstract

During the past several decades, great changes in landscape pattern and ecosystem regime have taken place in the context of global urbanization and accelerated human activities. These changes can markedly influence the local environment and residents' welfare. In this study, we choose a typical rapid-expansion region, the Bohai rim area in Northern China, as a case study. Three typical periods of remote sensing data and collected socioeconomic materials were analyzed from 2000 to 2010. Results firstly showed that different kinds of land use varied in different periods. Cropland declined highest, from 59.3% in 2000 to 53.3% in 2010, while the area of urban and impervious land use sharply increased from 9.7% to 12.8% during the mentioned years. Under the strong human disturbance and urbanization rate, secondary forestland and grassland in this region also decreased. Due to the artificial reforestation project, however, the declining rates of total areas of forests and grasses were not high. Secondly, the mean ecological capacity in this area generally declined. Compared with the earlier stage of 2000-2005, the decreasing rate of ecological capacity in the later stage of 2005 to 2010 was much higher, mainly due to the accelerated development and increased population density. More attention thus should be paid to this situation. Thirdly, surface water quality remained a big problem in the three major watersheds (Liaohe, Haihe and Yellow rivers) within the Bohai rim area. The major contributors can be attributed to the distribution and development of various industries and extensive water based managements. Meanwhile, due to the increased extreme rainfall events and improper urban pattern design, the increased urban flooding in the city zones also was blamed. Complicated countermeasures and solutions should be carried out, targeting for achieving the sustainability of the relationship between human and nature.

Key Words

Urbanization; landscape change; human activity; environment; Bohai rim

FIRE, FOREST FRAGMENTS AND LANDSCAPE CHANGE CASE OF MADAGASCAR HIGHLANDS

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Abstract

Wild fires occur annually in many regions of Madagascar and are responsible of landscape change and most of fauna and flora biodiversity losses. This pressure is more critical in the Highlands where edge effects emphasized threats on the remnants fragments of this center ecosystem forest. Despite developed knowledge about the cause of fire, lack of spatial understanding on local fire characteristics as driver of landscape dynamic is still less explored. This study investigates in this aspect on the basis of landscape ecology approaches. MODIS fire data is used to characterize fire occurrence and burnt area dynamic over time and Landsat time series data is used to map forest area. The analysis is focused on fire variability depending on space and time which shape the dynamic of small patches and has effects on forest fragmentation process. Results highlight net change of forest fragment and burnt area dynamic modeling show a periodical trend over time. Structure and configuration of fire patches have a significant effect on forest fragments structure. Also, edge effects and patch sizes are significant on biodiversity resilience. An upscale of the study at national scale will help to understand the global trend of the relationship between fire characteristics and forest fragmentation process in Madagascar.

Key Words

Landscape ecology, Fragmentation, Fire dynamic, Edge effect, Biodiversity

LAND ACQUISITION FOR URBAN DEVELOPMENT IN VIETNAM: PERSPECTIVE OF RIGHTFUL RESISTENCE

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Abstract

Urban transformation and rapid inflows of investment from international and local economic corporations in Vietnam since the 1986 Doi Moi economic reforms has resulted in massive acquisition of agricultural land in peri-urban areas from local communities. This process has impacted millions of rural Vietnamese. This paper examines the differences in reactions of local farmers to the practices of large-scale agricultural land acquisition in two peri-urban areas of Vietnam. In particular, in An Hoa Ward, Hue City in Central Vietnam, local farmers accept the official acquisition of their agricultural land although they still have some concern regarding the discrepancy between official land price evaluation and market prices. Their mild reaction was based on two accounts. Firstly, considering historical and political background of An Hoa Ward, a poor community just north of Hue City, almost all of farmers were old soldiers and their second generations of defeated Republic of South Vietnam army. They appreciate official allocation of agricultural land in 1993 as a state's favor to them, the losers of the Second Indochina War. Secondly, local practice of acquisition and compensation follows the legal framework and does not violate their claims to livelihoods. All of the affected farmers are nearly or already out of working age whose matured children having non-farming employments in the city refuse to work as farmers. Therefore, with the compensation for the acquired land, they are happy to have saving credits during their retirement. On the contrary, in other peri-urban areas in northern Vietnam, official agricultural land acquisition of paramount unaccountability and coercion not only violates the law but is also against the local farmers' normative belief as their right to land. That is because generations of their families have devoted their lives to bringing official institution to power during the struggle against imperial and colonial forces to ultimate independence in 1975. It is unjust that official institution takes away their most-needed agricultural land as the only viable factor of production that this farming community relies on. This forces the local farmers to the rightful resistance to claim their rights to land and livelihoods, which were, threaten by "unjust" official acquisition. This study concludes that local historical and political context plays an important role in the reactions to official development narration.

Key Words

Land grabbing, agricultural land, compensation, rightful resistance, land politics.

MAPPING THE HOTSPOTS OF ECOSYSTEM SERVICES IN CHINA: SPATIAL PATTERN AND TEMPORAL TREND

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Abstract

The spatially explicit mapping of ecosystem services (ESs) is an essential step of incorporate ESs into policies and practices in order to ensure the continuous provision of ESs and associated benefits to humans. This study using a set of swift biophysical mapping models which mainly based on the Net Primary Production (NPP) and other environment variables to quantitatively map the relative provision capability of four ESs (carbon capture, soil protection, water regulation, and habitat provision) in China from 2000 to 2010. After evaluating and contrasting the reliability of the models, the spatial distribution patterns and time trends characteristics of ESs of the eleven eco-regions in China were revealed. This study illustrates that (1) the biophysical models to map the spatial and temporal characteristics of ESs are reliable, particularly in the quantitative assessment of ESs at broad spatial scale; (2) the average annual summed ESs of China from 2000 to 2010 increased from the Northwest to the Southeast, and the lowest provision capability areas of ESs located at the adjoining areas of Northwest Arid Area, Inner Mongolia Plateau and Qinghai-Tibet Plateau eco-regions, while the highest areas located at the Southern areas of Hengduan Mountains, Yun-nan and Guizhou, Middle and lower reaches of the Yangtze River as well as the whole regions of Yunnan-Guizhou Plateau and South China eco-regions; (3) the time trends characteristics of annual summed ESs in China from 2000 to 2010 are increased in the most eco-regions except the eco-regions of Northeast and Northern China. This concise mapping model provided a reliable and practical tool to assess the provision of ESs at the large spatial scale, and can be used in many aspects, for example, to identify tradeoffs in ESs caused by land-use changes, during land-use planning, to prioritize target areas for the conservation and restoration of important ESs.

ECOSYSTEM SERVICE VALUATIONS OF MANGROVE ECOSYSTEMS TO INFORM DECISION MAKING AND FUTURE VALUATION EXERCISES

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Abstract

The valuation of ecosystem services is a complex process as it includes several dimensions (ecological, socio-cultural and economic) and not all of these can be quantified in monetary units. The aim of this paper is to conduct an ecosystem services valuation study for mangroves ecosystems, the results of which can be used to inform governance and management of mangroves. We used an expert-based participatory approach (the Delphi technique) to identify, categorize and rank the various ecosystem services provided by mangrove ecosystems at a global scale. Subsequently we looked for evidence in the existing ecosystem services literature for monetary valuations of these ecosystem service categories throughout the biogeographic distribution of mangroves. We then compared the relative ranking of ecosystem service categories between the monetary valuations and the expert based analysis. The experts identified 16 ecosystem service categories, six of which are not adequately represented in the literature. There was no significant correlation between the expert based valuation (the Delphi technique) and the economic valuation, indicating that the scope of valuation of ecosystem services needs to be broadened.
Acknowledging this diversity in different valuation approaches, and developing methodological frameworks that foster the pluralism of values in ecosystem services research, are crucial for maintaining the credibility of ecosystem services valuation. To conclude, we use the findings of our dual approach to valuation to make recommendations on how to assess and manage the ecosystem services provided by mangrove ecosystems.

Key Words

Ecosystem services, Delphi technique, Mangrove ecosystems, Economic valuation

EVALUATION OF FINNISH FOREST OWNERS' MANAGEMENT ALTERNATIVES UNDER BIOPHYSICAL CLIMATE-RELATED AND ECONOMIC CONSTRAINTS

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Abstract

The boreal forest supports important feedback systems related to climate protection and social and economic pressures. Changing demand for forest goods and services away from traditional forest products towards bioenergy and services means that an assessment of the associated ecosystem service trade-offs is timely and vital. This study uses Finnish National Forest Inventory data from the Hyytiälä locality in the Pirkanmaa region in southwestern Finland. Five scenarios for future management using MOTTI stand projection software, each with six initial age classes, were produced. The scenarios were based on management for: business-as-usual, biomass production for energy use, carbon sequestration, and biodiversity protection. Differences between scenarios are based on changes in: regeneration treatments and species mixtures, rotation ages, distribution of harvested wood products, and age structures. All scenarios utilized full climate accounting. This includes the impacts of radiative forcing and albedo on carbon sequestration potential of the different management scenarios. The impact of payments for ecosystem services on expected returns is evaluated using current practices in Finland. All trade-offs associated with these shifts in management are combined within a framework of economic, environmental, and social sustainability criteria. The evaluation criteria are based on local stakeholder's feedback, economic indicators, and ecological thresholds outlined by experts. Previous studies on the multiple objectives of forest management, including considerations for biomass production for bioenergy, have not produced a comprehensive analysis of the complete radiative forcing potential of various management strategies. This study's results indicate the challenges associated with abrupt shifts in forest management policies under time-bounded climatic mitigation constraints. They also present the obstacles associated with defining the role of forest mitigation when normative judgments by stakeholders are considered. Finally, the study demonstrates the potential for alternative management strategies to meet social and economic concerns under coordinated climate focused policies.

Key Words

Boreal forest, Climate change mitigation, Global change, Landscape management, Finland

RESIDENTS' WELFARE EVALUATION FOR THE ECOLOGICAL RESTORATION OF LANDSCAPE RIVER IN SUZHOU, CHINA BASED ON THE WTA INVESTIGATION

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Abstract

Many rivers got ecological restored by the central and local government in China in the past several years. To what extent the residents' welfare can be improved owing to the river restoration is essential for the input-output analysis of governmental spending. Compared with WTP (willingness to pay), WTA is a better index to reveal the improved welfare in a hypothetical market of ecosystem degradation especially in developing country. WTA for Pingjiang river degradation was investigated in Suzhou based on the sample of 426. There were 48.4% samples denied to accept any money compensating for the river degradation or landfill even though provided huge amount of money. The mean value of samples who are willing to accept compensation is 39,607 RMB, and median value is 25,000 RMB. Result by a Logit model showed residents who donated for environmental issue before, more satisfied with river, contacted with the river more frequently, in employed status, own the house are more likely to deny the WTA. Moreover, results from linear model of WTA indicated residents with longer living period around the river, much younger, nearer the river, holding smaller family, never donated for environmental issue and unsatisfied with the green belt around the river are willing to accept more money. The results not only provided the average welfare improved of the river restoration, but also indicate welfare changed differs among residents with different characteristics.

Key Words

River restoration, River degradation ,Welfare, WTP (willingness to pay), WTA (willingness to accept)

MULTI-CRITERIA EVALUATION AND GEOGRAPHIC INFORMATION SYSTEMS FOR DECISION MAKING ABOUT FOREST OPENING UP WORKS STANDARD ENVIRONMENTAL COMMITMENTS ON FOREST OPENING UP WORKS

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Abstract

Forest ecosystems are increasingly being influenced by human activity, including rapid expansion of urban land cover, which may alter forest processes, functions, and the services forests provide. Forest opening up is one of the most important interventions in a forest ecosystem and is carried out by planning and constructing a transport network (forest roads, skidding tracks etc.), satisfying not only the need for skidding and transporting of forest products, but also forest protection and recreation activities. The rapid development and combination of PC technology and GIS software provides an objective and effective evaluation of the Environmental Impact Assessment (E.I.A.) or Standard Environmental Commitments (SEC). Aim of this paper is the presentation of an integral opening up plan taking into consideration the environmental impact assessment with the help of modern techniques such as digital photogrammetry and GIS. The combination between the technology of the digital photogrammetry and the GIS technology was used in order to evaluate the compatibility between the general forest opening up works and the natural environment. In order to evaluate the compatibility, practical criteria of the intensity of the human influence as well as criteria of the environment absorbency to the opening up works were used. Multi-criteria evaluation (MCE) analysis (the implementation of decision-making rules to identify and enable the combination of many criteria, in the form of GIS layers, into a single map) and Geographic Information Systems (GIS) are two examples of tools that aid in the development of geographic data and maps for different purposes, such as conserving land for forestry uses. The results proves that the usage of this method provides the ability to evaluate the compatibility of the existing opening up works with the natural environment and the possibility to choose the most compatible for the environment solution.

Key Words

Absorbency, Natural environment, Digital photogrammetry, GIS, Intensity

LAND ABANDONMENT AT THE PERIPHERY OF FORMER SOCIALIST CITIES: A PRECURSOR OF URBAN SPRAWL
THE CASE OF BUCHAREST, ROMANIA

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Abstract

Agricultural land abandonment has become a serious social, economic and ecological issue in Europe. It takes place in two geographically distinct areas: 1) in marginal areas, e.g. mountains, and 2) in the vicinity of larger cities, the paper's topic. In former socialist countries the once sharp edge between large agricultural patches and urban built-up has been replaced by fragmented patches of urban and agriculture. Due to the resulting small agricultural patches, many plots have become unprofitable. At the same time the opportunity to convert agricultural patches to built-up opened new sources of income for owners and local authorities. The latter view(ed) it as an easy way to generate taxes. To assist local authorities to control abandonment and subsequent sprawl, the following research questions are decisive: a) what is the trend of land abandonment at the periphery of former socialist cities with a high pressure of urban sprawl?; b) is land abandonment a valid precursor of urban sprawl and c) could it be used to forecast urban sprawl? Bucharest, Romania, was used to explore abandonment and sprawl in three distinct periods between 2002 and 2013: 1) the beginning of urban sprawl in the early 2000s, 2) the peak, and 3) the decreased speed of sprawl during and after the economic recession. Orthophotos and field observations have been used to obtain data on abandoned patches as well as their transitions. We used logistic regression to test the importance of land abandonment as a predictor of urban sprawl along with other variables such as land price, taxation, former land use, distance to public infrastructure and facilities, and nuisance areas. Land abandonment increased rapidly after 2002, and reached a peak in 2010, with almost 15% of the total city area. Geographically, the plots have been predominantly located along the city`s periphery. Depending on the period considered, between 5% and 22% of the abandoned land patches changed to urban in the following year. Long term abandonment is thus quite typical for the area. During the peak years (2010), we observed a predominant unidirectional transition from abandoned to urban, whereas during the economic recession, multidirectional transitions occur, e.g. a return to agricultural use or public green areas. The results of the regression analysis showed that land abandonment has a very high explanatory power, with the odds of urban sprawl to occur on previously abandoned land being 5.4 times higher than on land with another land use.

Key Words

LINKING TRAJECTORIES OF LAND USE CHANGE, LAND DEGRADATION PROCESSES AND ECOSYSTEM SERVICES

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Abstract

Land Degradation (LD) is a complex process of causal factors resulting in a reduction in the capacity of providing ecosystem services. The aim of this study is to relate the trajectories of land use change to LD processes which in turn can affect ecosystem services provision. The adopted scheme defines which LD processes are relevant for each trajectory of land use change identified, the evaluation of the ecosystem services implicated and the possible sustainable land management (SLM). The process takes into account also the forecast of the increase in temperatures and the reduction of precipitation over the period 2021-2050. To support the whole process, a SWOT analysis was carried out in order to set the goals and identify the internal and external factors that are favorable and unfavorable to achieve them. The study areas are the Fortore valley and a portion of the Po plain (Italy). Regarding the Fortore valley the main trajectory identified is related to land abandonment due to the progressive emigration started from '50 and the ageing population. The most relevant LD processes are the soil erosion and the geomorphological instability, consequently affecting "regulating services" as natural hazard and erosion regulation. The results of the assessment of soil loss show the 42% of the territory affected by high soil erosion (52-156 t/ha/year) and the 30,7% and 13,9% of the territory affected by very high (229 t/ha/year) and severe (437 t/ha/year) soil erosion, respectively. SLM should consider interventions to contrast geomorphological instability, the promotion of typical products to contrast land abandonment, the promotion of climate smart agriculture and an efficient water resources management in the perspective of climate changes. As for the Po plain, the main trajectories identified relate to urban expansion and to the farmland abandonment, which entail soil sealing and land take as LD processes. The reduction of food production has been selected as the most relevant "provisioning services" affected, resulting in a loss of 915 tons of potential agricultural yield in the period 1954-2008. SLM should envisage best practices finalized to water saving and soil consumption reduction: efficient irrigation system, climate smart agriculture and "zero soil sealing" policies. This study highlight the diagnostic value of the suggested approach according to which LD processes are elicited from land use change trajectories and linked to specific loss of ecosystem services. This can represent a support both for the assessment of the ecosystem services and for addressing SLM.

Key Words
Ecosystem services assessment, Soil degradation, Land take, SWOT analysis, Sustainable land management

ESTIMATING CORAL REEF ATTRIBUTES AFFECTING SCUBA DIVING EXPERIENCE: A CHOICE EXPERIMENT APPLICATION IN SIPADAN, BORNEO.

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Abstract

Failure to consider environmental benefits of protecting coral reefs, could lead these resources to be subject of overexploitation and resulting in environmental degradation. From this perspective, we considered an economic valuation study in an attempt to capture the economic values of protecting and enhancing the coral reefs status. This study applies choice modelling to discover divers´ willingness to pay (WTP) for various characteristics of the diving experience, including conservation status of coral reefs. Sipadan Marine Park at Borneo has been chosen as the case study due to its outstanding marine biodiversity that become a hotspot for avid scuba divers. In this study, we identified five main attributes relevant for divers: litter pollution levels in the water, number of divers in the dive, coral cover, fish diversity and daily permit fee. These attributes were outlined into choice experiment that formed the choice sets and used in survey questionnaire. A number of divers were interviewed on site about their diving experience along the same attributes. We investigate to which extend their experience influence their WTP for improvement in the diving attributes. This approach may shed light on the economic value through the understanding of the benefits of coral reefs as seen by divers. The outcome could provide economic evidence for the use in conservation measures and integrated in management policy to safeguard the sustainability of coral reefs at Sipadan.

Key Words

Economic value, Willingness to pay, Questionnaire, conservation, Management policy

LANDSCAPE ANALYSIS OF A CRITICAL COASTAL AREA USING MULTI-TEMPORAL LANDSAT IMAGES AND AIRBORNE HYPERSPECTRAL DATA

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Abstract

Landscape analysis plays a crucial role in the management of coastal areas because of the constant changes that are strictly connected with land and water resources use intensification, e.g. urbanization, tourism expansion and agricultural intensification. Anthropogenic sources of disturbance in conjunction with the effects of climate change and the inherent fragility of coastal environments threaten the ecological stability of coastal ecosystems.

The recent availability to obtain long-term series of Landsat satellite images at no cost represents a useful source for multi-temporal analysis of land use/cover changes and the evaluation of ecosystem services.

In this case study, we investigate the coastal area located along the Ionian side of the Basilicata region (Southern Italy), which is characterized by the mouths of five main rivers and by a stripe of forested areas protected by the European Community (Sites of Community Interest - SCI and Special Protection Area - SPA).

The main objective of this study is to evaluate the evolution of different natural and anthropic covers and their interconnections, i.e. land cover trajectories and ecological conditions, by using multi-temporal Landsat TM, ETM+ (SLC-on) and Landsat 8 data (with a 30 m Ground Sampling Distance – GSD) from 1987 until 2013 and a hyperspectral imagery acquired on July 2013 from the airborne hyperspectral CASI-1500 imager (76 bands with a GSD of 1.5 m). We explore the spatial configuration of land cover trajectories occurred in the analyzed period through the use of different land cover maps obtained for the study area from the classification of the Landsat data. We also evaluate the added value of the hyperspectral data classification and investigate the evolution of the vegetation patterns to provide suitable information about the ecological conditions of the study area by means of a set of landscape metrics indicators based on the patch configuration, i.e. number, size, shape, and arrangements of the different land cover types.

Key Words

Ecosystem services, Landsat satellite images, Airborne hyperspectral imagery, Coastal area,

RURAL URBAN FRINGE AREAS IN CHANGING LAND USE. AN APPLICATION OF MULTI-OBJECTIVE PROGRAMMING

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Abstract

Rural urban fringe areas (RUFAs) are the interface between the urban space and the countryside, the belt where the transformation process is the most dynamic (Bittner & Sofer, 2012). RUFAs are characterized by a random territorial organization that causes land use changes: impairment of agricultural activities, degradation of natural resources, loss of the landscape identity values and deteriorating quality of life. If properly managed, these areas can become the potential key for a new relationship between the urban space and the countryside, ensuring their sustainable development (economic, environmental and social).

Three RUFAs were selected within the municipality of Bari (Italy) with the aim of identifying optimal land use patterns in terms of sustainability performances, according to the provisions of the future urban plan. The first area is a system of peri-urban vegetable plots, where the economic aspect is very important. The second area includes the airport, with a well-defined social profile, and the third area includes the "Lama Balice" Regional Natural Park, with a clear environmental profile.

The multi-objective optimization (Multi Objective Programming, MOP, Koopmans, 1951; Kuhn & Tucker, 1951; Cochrane & Zeleny, 1973) is a suitable model to identify the land use patterns that ensure the highest level of sustainability, because it enables assessment of the performance for each of the sustainability pillars, taking into account the constraints of the study area. The MOP model consists of a multi-objective vector function composed of single objective functions to be minimized or maximized, each one expressed by a linear combination of the decision variables (or criteria).

Since the objective functions are conflicting, there is a possibly uncountable set of solutions, the so-called non-dominated solutions or Pareto optimal set, representing different compromises or trade-offs between the objectives (Ngatchou et al., 2005). Therefore, a multi-objective problem can be solved by applying traditional scalar optimization techniques (i.e.: weighted-sum method, Zadeh, 1963) to convert it into a single-objective problem.

Key Words

Rural urban fringe areas; Multi Objective Programming; sustainable development; sustainability indicators.

THE ROLE OF VERTICAL STRUCTURE AS A BIOMASS INDICATOR IN URBAN FOREST

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Abstract

Urban development and expansion are placing increasing pressures on a range of ecosystem services (ES), such as reduction of above and below ground carbon storage, biodiversity loss, changes in nutrient and water recycling and other services. In this context, the vertical stratification of tree crowns is a forest attribute that influences both the supply of ES and tree growth. Stratification is the result of the interaction between bio-ecological factors and human activities. This knowledge represents an important step for analyzing and managing urban forests. The vertical distribution of the crown interferes with the presence of suitable habitats of different plant and animal species. However, there is no consensus on how the vertical stratification influences some ES simultaneously. In this paper, we aim to asses some preliminary results on the vertical stratification of tree crowns in an urban forest located in the North of Milan using a method developed by Latham et al. (1998). Furthermore, we have analyzed the abundance of trees and biomass for each layer to investigate the carbon storage present in the different vertical strata. Our results suggested a highly differentiated ecosystem which is characterized by multiple layers of vegetation ensuring high biodiversity levels. As a result, vertical stratification was considered the main structural factor affecting plant biodiversity and biomass. The linkages existing between vertical structure, plant biodiversity and biomass endow this study of great practical application for decision makers and landscape manager of urban and peri-urban forest.

Key Words

Biodiversity, Biomass, Ecosystem services, Landscape management, Urban forest, Vertical structure

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