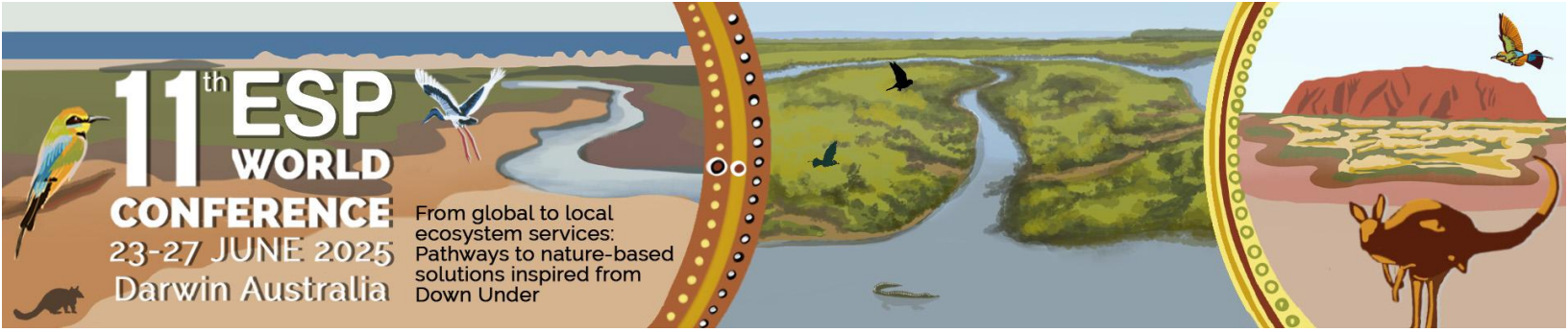


BOOK OF ABSTRACTS

I. SESSION DESCRIPTION

ID: T5a

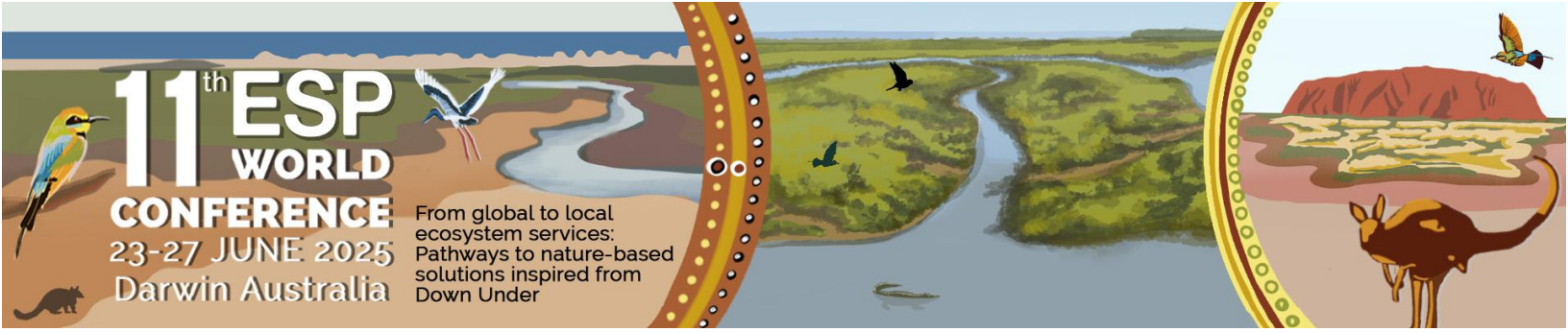
Modeling ecosystem services flows and implications for nature-based solutions

Hosts:

	Name	Organisation	E-mail
Host:	Kremena Burkhard	Ludwig Franzius Institute of Hydraulic, Estuarine and Coastal Engineering, Leibniz University Hannover, Germany	burkhard@lufi.uni-hannover.de
Co-host(s):	Stoyan Nedkov	National Institute of Geophysics Geodesy and Geography, Bulgarian Academy of Sciences, Sofia, Bulgaria	snedkov@abv.bg
	Rahul Yadav	Forest Ecology and Climate Change Division, Forest Research Institute, Dehradun, India	yadav.9394rahul@gmail.com
	Thomas Elliot	Aalborg University, Department of Sustainability and Planning, Denmark	thomaselliot@plan.aau.dk
	Fatima Ali	Center for Development Research, University of Bonn, Germany	fatti-avectoi@hotmail.com

Abstract:

Ecosystem service flows are complex and dependent on multiple environmental and anthropogenic factors. Models are often focused on the stock/capacity side of ecosystem services provision and their relation to the ecosystems' structures and functions. Measuring and modeling ecosystem services flows is much more related to the location and characteristics of the beneficiaries. Telecoupling, which represents the ES flows over greater distances, is often underrepresented in the sustainability agenda. This might have significant implications for incentivising and advocating nature-based solutions (NbS), by providing a better understanding on the complexity and diversity of benefits that specific NbS can provide. In this session we want to explore the different approaches for modeling



ecosystem services flows with focus on the interactions between service-providing and service-benefiting areas, important characteristics of ecosystem services flows that need to and could be addressed through modeling, telecoupling, relations to beneficiaries, and implications to NbS.

Goals and objectives of the session:

- Share existing tools and methods for modeling ecosystem services flows and telecoupling;
- Exchange know-how and experience from case studies from around the world on related tools and practices;
- Identify key perspectives of relevance for incentivising NbS, possible approaches to address them through ecosystem services flow modeling and implications;
- Identify gaps, obstacles and steps needed to advance the modeling of ES flows for advocating NbS.

Planned output / Deliverables:

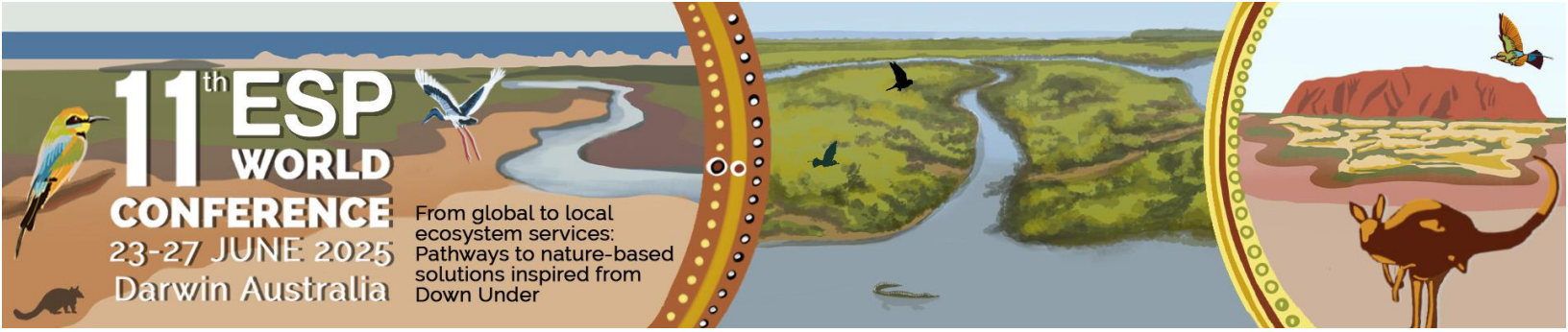
Short report on initiatives and tools for modeling ES flows and implementations for NbS.

II. SESSION PROGRAM

Room: Madla 2
Date of session: Thursday, 26 June 2025
Time of session: 10:30-12:30

Timetable speakers: 12 min presentation + 2 min Q&A

Time	First name	Surname	Organization	Title of presentation
10:30-10:40	Welcome and Introduction			
10:41-10:55	Ernest Frimpong	Asamoah	Queensland University of Technology, Biology and Environment Science, Australia	Global trade drives unequal burdens on Nature's Contributions to People
10:56-11:10	Ana	Turetta	Brazilian Agriculture Research Corporation - Embrapa Soils, Brazil	Identifying the ecosystem services flow as a strategy to ensure food security in areas vulnerable to extreme climate events
11:11-11:25	Bau-Show	Lin	National Taiwan University, Department of Horticulture and	Numerical simulation modeling the microclimate regulating services



Time	First name	Surname	Organization	Title of presentation
			Landscape Architecture, Taiwan	flow of urban green land and its demand
11:26-11:40	Marie	Dade	University of Melbourne, Australia	Spatial strategies to expand urban forests can influence the provisioning of multiple ecosystem services
11:41-11:55	William Sidemo	Holm	University of Minnesota, USA	Global modeling of ecosystem services and biodiversity in protected areas
11:56-12:10	Srishti	Gwal	Indian Institute of Technology, School of Public Policy, India	Geospatial approach for prioritizing conservation areas for enhanced hydrological ecosystem services
12:11-12:30		Session hosts		Discussion and closing

III. LIST OF ABSTRACTS

The first author is the presenting author unless indicated otherwise.

1. Global trade drives unequal burdens on Nature's Contributions to People.

First authors(s): Ernest Frimpong Asamoah

Other author(s): Jonathan Rhodes, Brooke Williams, Keiichiro Kanemoto

First author affiliation: Queensland University of Technology, Brisbane, Queensland, Australia

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Keywords: International trade, ecosystem services, nature's contribution to people, deforestation

Global trade in commodities can have significant environmental and societal impacts far beyond the areas where commodities are consumed. These effects are well recognised through studies estimating the environmental footprints of consumption, yet their impacts on Nature's Contributions to People (NCP) and distributional equity of nature losses are rarely considered

below national scales. This oversight can mask substantial variability in how communities are affected by remote markets. In this study, we integrate state-of-the-art ecosystem service models, material flow analysis, economic trade data, and remote sensing information to produce an innovative approach for understanding the impacts of deforestation on NCPs and the roles of remote markets. We examine five fine-scale contributions relevant to local populations: water quality regulation, crop pollination, biodiversity, and carbon emissions. We demonstrate that between 24% and 49% of the nature loss responsibility during the 2001–2015 economy can be attributed to final consumption in high-income developed and developing economies. Depending on the indicator considered, at least 50% of the total NCP losses for five countries were in remote regions. Our findings illustrate that the effects of trade on ecosystem services exhibit considerable variation depending on the local context in which deforestation occurs, and therefore facilitate broader policy decisions to minimise the environmental and social impacts of consumption and to seek more equitable policy solutions on a global scale.

2. Identifying the ecosystem services flow as a strategy to ensure food security in areas vulnerable to extreme climate events

First authors(s): Ana Paula Turetta

Other author(s): Daniel Marques de Abreu, Vitória Ramos de Oliveira Moraes, Eliane Gonçalves Gomes

First author affiliation: Brazilian Agriculture Research Corporation - Embrapa Soils

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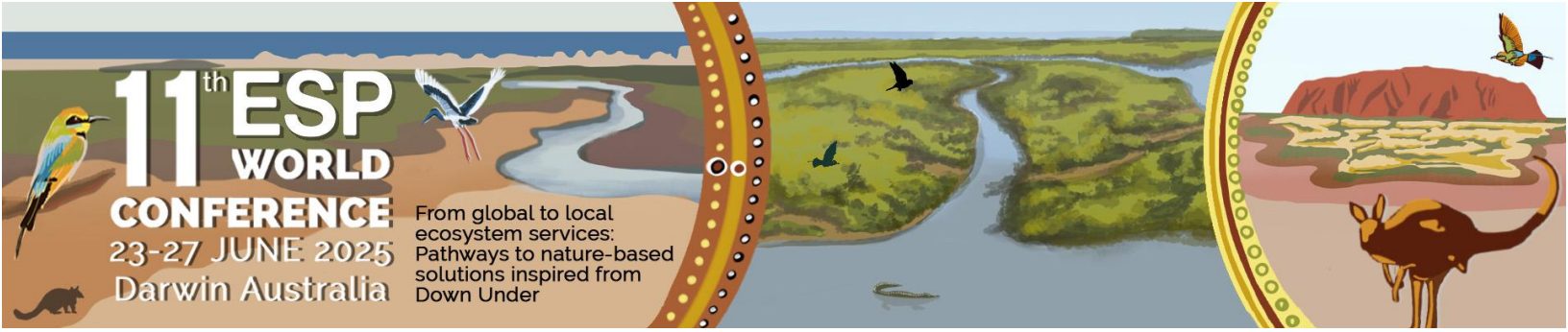
Keywords: climate change; ecosystem services flow; ecosystem services modelling; tropical areas

In the face of increasing extreme weather events, food insecurity is a global issue exacerbated by several factors, including climate change. It threatens agricultural systems, which depend on it for production and maintenance. Thus, food security faces serious challenges that jeopardize food supply and quality.



Ecosystem services (ES) are the outcomes of landscape interactions and biological processes that maintain ecosystem functioning for species existence. ES are related, generating fluxes between areas due to physical, political, commercial, and resource management decisions in a given region, which might affect ecosystems and biodiversity elsewhere. Measuring and analyzing ES flow patterns can show complex variations, like supply-demand imbalances. This study aims to evaluate the flow of food production-related ecosystem services in selected municipalities in Rio de Janeiro's mountainous region and examine the impact of extreme weather events. This Atlantic Forest area was selected due to its high vulnerability to catastrophic weather disasters and its role as Rio de Janeiro's largest fresh food producer.

In this study, we explored and investigated passive biophysical ecosystem fluxes, which provide beneficial flows like fresh water supply, and avoid detrimental flows like flooding. To address water, food, and biodiversity challenges, we created ES compartments and indicators. We used secondary data from several platforms to obtain more detailed spatial information.

This approach may improve land use decision-making, especially in harsh, weather-prone areas. For example, condensing the hydrography X land use, and land cover segment shows a water shortage in pasture-covered springs, highlighting the need for effective natural resource management strategies in the area.

3. Numerical simulation modeling the microclimate regulating services flow of urban green land and its demand

First authors(s): Bau-Show Lin

Other author(s): Han-Chin Chang, Chin-Chung Yu, Cheng-I Hsieh

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Keywords: Green infrastructure, Numerical simulation, Urban heat island

As global warming intensifies, the demand for microclimate regulating services in urban areas increases. From urban planning and design perspectives, spatial match/mismatch of microclimate regulating services flow and demand matter in the configuration and allocation of green infrastructures. However, the spatial-temporal microclimate regulating services flow and demand data are rare. This study used ENVI-met in modeling the microclimate regulating services flow of urban green lands to reveal the spatial-temporal temperature regime of the five main urban green lands: building greening, street greening, parks, and urban forests at 8 am, 12 pm, and 6 pm. By observing people's outdoor activities, this study assessed and mapped the public outdoor usage hot areas, which was deemed as the demand for microclimate regulating services. Further, this study overlayed the microclimate regulating services flow and demand to detect the match/mismatch of the microclimate regulating services of the urban green lands. The study results indicated that the microclimate regulating services flow of urban green lands was highly correlated with the location of the green lands, indicating that the CRS of green lands had spatial limitations and could not extend too far. Parks and urban forests with greater size resulted in greater microclimate regulating services flow, both in cooling intensity and coverage. Urban open spaces with walkable areas were potentially hot usage areas for the public. Among these, open spaces with shading were highly used by the public, including shading from the buildings and trees. Street greening and parks were the places that spatially matched the microclimate, regulating services flow and demand. However, street greening and building greening are limited in size, and the matching level should be improved.

4. Spatial strategies to expand urban forests can influence the provisioning of multiple ecosystem services

First authors(s): Marie Dade

Other author(s): Monique Burns, Chelsea Andrews

First author affiliation: University of Melbourne

Contact: marie.dade@unimelb.edu.au

Keywords: Ecosystem services; Nature-based solutions; Urban forest; Urban Sustainability

Urban forests can help mitigate many sustainability challenges that cities face due to the multiple ecosystem services they provide. Thus, cities worldwide have established goals to expand their urban forests, and there is growing interest in understanding how to maximise the ecosystem services urban forests provide. In this study we investigated whether the spatial distribution of urban forest expansions can influence ecosystem service provision, regarding a) the supply of multiple ecosystem services produced, and b) who benefits from the multiple ecosystem services produced. Using Melbourne, Australia, as a case study, we compared two different spatial scenarios for increasing the urban forest by 15%: Scenario 1) the urban forest is expanded to areas of Melbourne that have high heat vulnerability; Scenario 2) the urban forest cover is expanded to areas of Melbourne that are high priority for biodiversity habitat restoration. We modelled and compared the supply of two ecosystem service provided by urban forests, urban heat mitigation and stormwater retention, under each scenario. Our results found that though the urban forest was increased by 15% in both scenarios, urban heat mitigation was slightly higher under Scenario 1, whereas stormwater retention was slightly higher under Scenario 2. Under Scenario 1, increases in the supply of both services were more widely distributed spatially, whereas in Scenario 2 the increases were more concentrated in smaller areas. Our results suggest that the spatial distribution of urban forest expansion could affect overall ecosystem service supply but will have a larger impact on access to ecosystem services. Where and how we expand urban forests across cities plays an important role in ecosystem service provision, but more research is required to understand how the spatial arrangement of urban forests impacts the provision of multiple ecosystem services.

5. Global modeling of ecosystem services and biodiversity in protected areas

First authors(s): William Sidemo-Holm

Other author(s): No

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Keywords: Ecosystem services, biodiversity, protected areas, modeling

Protected areas are the backbone of biodiversity conservation and provide essential ecosystem services to humanity. However, the full extent of these benefits remains largely unquantified, often leading to the assumption that protected areas have lower economic values than alternative land uses. This perception can result in the exploitation rather than preservation of essential biodiversity areas. In this project, we compare the opportunity costs of protected areas with their contributions to biodiversity and various ecosystem services, including carbon storage and sequestration. To this end, we use different process-based models such as the Integrated Valuation of Ecosystem Services and Trade-offs (InVEST). Key results include a deeper understanding of the relationship between various aspects of biodiversity and ecosystem services, as well as the biophysical and social conditions that determine when the value derived from ecosystem services exceeds the opportunity costs. Our findings will provide valuable guidance on how to expand protected area networks cost-effectively while meeting qualitative conservation objectives.

6. Geospatial approach for prioritizing conservation areas for enhanced hydrological ecosystem services

First authors(s): Srishti Gwal

Other author(s): Dipaka Ranjan Sena, Prashant K. Srivastava, Rajarshi Dasgupta

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Keywords: Aglar watershed, Ecosystem Service, Forest ecosystem, Indian Himalayan Region, SWAT

Hydrological ecosystem services (HES) are the benefits provided by terrestrial ecosystems in relation to the water cycle. Prioritizing the most critical areas of HES ensures the continued provision of essential services, optimizes resource allocation, promotes the sustainable use of natural resources, and supports effective watershed management strategies. This study focused on identifying the hot and cold spot areas of HES in the Aglar watershed of the Indian Himalayan

Region. Six HES descriptors, representing water balance components, were derived from a process-based model called the Soil and Water Assessment Tool (SWAT). These descriptors were further evaluated using a weightage-based approach, both individually and under broad categories of ecosystem services (provisioning, regulating, and supporting), to highlight conservation priority areas within the watershed. Results from this analysis revealed a consistent pattern of areas delivering high levels of HES predominantly located in the south to southwest regions, whereas the eastern region was characterized by low HES supply. Within broader ecosystem service categories, areas delivering high values of multiple HES were concentrated in the southern part of the watershed, whereas areas with low values were scattered, particularly in agricultural and scrubland areas. Pixel-level uncertainty analysis revealed that 0.57 km^2 and 6.86 km^2 of the watershed were consistently identified as cold and hot spots, respectively, using the individual HES approach. In contrast, when considering broad ecosystem service categories, 2.30 km^2 and 6.97 km^2 were classified as cold and hot spots, respectively. Significant synergies were identified among different HES descriptors, specifically between base flow and water yield, as well as between sediment retention and water yield. Variations among HES descriptors were attributed to factors such as land use and topography, which influence the watershed's water balance components. The findings of this study emphasize the importance of targeted conservation efforts to protect ecologically sensitive regions within the watershed.