Opportunities for graduation theses

We always welcome suggestions for graduation theses relating to the field of environmental analysis and planning. Information and inspirations for relevant topics can be found at the website (e. g. projects and publication) of the chair of Environmental Analysis and Planning in Metropolitan Regions. Please contact team members directly with your own graduation thesis exposés. Alternatively, you can choose from a list of specific topics for Bachelor's/Master theses that are adapted to recent research activities. Please write an e-mail to our team assistant, Mrs. Ingrid Bode, if you are interested to work on one of the following topics.

Available topics

Analysis of theories, methods and instruments in landscape planning
- Suggested method: Systematic literature review
- Starting date: As soon as possible
- Language: English or German

Spatial analysis of landscapes, ecosystem services and biodiversity (Urgently wanted! See below for specific information.)
- Suggested method: Systematic literature review, GIS-based analysis
- Starting date: As soon as possible
- Language: English or German

Development, analysis and application of knowledge management tools such as dashboards or ontologies
- Suggested method: Systematic literature review, ArcGIS Dashboards, Protégé
- Starting date: As soon as possible
- Language: English or German

Applied landscape planning and case study analysis
- Suggested method: Method mixes
- Starting date: As soon as possible
- Language: English or German

Development and application of digital, participatory approaches for the analysis of socio-ecological systems
- Suggested method: participatory GIS, survey
- Starting date: As soon as possible
- Language: English or German

Investigation of soundscapes
- Suggested method: Systematic literature review, machine learning techniques
- Starting date: As soon as possible
- Language: English or German

Graduation Thesis (Master)

Applying Artificial Intelligence for Environment & Sustainability (ARIES) for mapping and assessing ecosystem services: A pilot study in Eritrea

Background

Mapping and assessment of ecosystems and their services (MAES) is widely recognized as a crucial step towards sustainable policies and decisions that promote human well-being and preserve life-sustaining ecosystems (MA 2005; Maes et al. 2012). However, despite emerging literature, comprehensive approaches to MAES in the African context that address multiple ES, especially at the national level, are still rare. Knowledge gaps exist on how MAES could be implemented in the African context and how MAES assessments should be designed to best inform policy processes. Among other things, questions remain on how to address potential data scarcity, what spatial and temporal scale is the best suited to support decision-making, and what policies could benefit from the results (Adem Esmail et al., 2023).

Artificial Intelligence for Environment & Sustainability (ARIES) is a novel and flexible approach to MAES applicable in a variety of contexts. It is an integrated, open-source modelling platform for environmental sustainability, where researchers from across the globe can add their own data and models to web- based repositories. A specific application is the ARIES for SEEA Explorer, which allows users anywhere in the world to produce rapid, standardized, scalable and customizable ecosystem accounts for their area of interest that are consistent with the System of Environmental-Economic Accounting (SEEA) Ecosystem Accounting framework. The latter is an international statistical standard that uses a systems approach to bring together economic and environmental information to measure the contribution of the environment to the economy and the impact of the economy on the environment.

The country of Eritrea, located on the Horn of Africa, represents a suitable case study for advancing MAES approaches and methods, as it offers a diverse set of ecosystems and typical challenges of data scarcity in a relatively small spatial context (Adem Esmail et al., 2023). In this regard, Adem Esmail and colleagues recently carried out a MAES pilot study in Eritrea based on a tier-1 analysis, where ES assessment is mainly based on land cover types. After reviewing relevant policy documents since the country's independence in 1991, the study mapped and assessed 10 different ES for the years 2015- 2019, based in the Global Copernicus land cover dataset with a resolution of 100 m. Building on these findings, the aim of the thesis is as follows:

Aim and research questions

THESIS 1	THESIS 2
To map and assess the **recent temporal dynamics of key ecosystems and their services in Eritrea** to support policy and decision-making at national and sub-national levels. (i.) How have Eritrean ecosystems changed **recently**? (ii.) What impact might the changes have had on the potential supply of key ES? (iii.) How do changes in ecosystems and their services compare to previous MAES results reported in Adem Esmail et al.?	To map and assess the **long-term temporal dynamics of key ecosystems and their services in Eritrea** to support policy and decision-making at national and sub-national levels. (i.) How have Eritrean ecosystems changed during the **last three decades**? (ii.) What impact might the changes have had on the potential supply of key ES? (iii.) How do changes in ecosystems and their services compare with respect to the main policies implemented during the same period (as reported in Adem Esmail et al.?
Based on the results, we will reflect on how the tier-2 (3) applied ARIES methodology (i.e. ARIES vs matrix approach) affects the MAES results (compared to a tier-1 matrix approach) and the implications for policy and decision-making.	Based on the results, we will reflect upon implications for policy and decision-making considering an expanded time coverage (1992-2020) but reduced resolution (300 m).

Research design and methods

The research is mainly based on the ARIES for SEEA application and the underlying modelling platform, k.LAB (see links below). Six already implemented ES models will be considered, i.e.
A. Crop provisioning,
B. Biophysical values for water, C. Climate regulation (carbon storage), D. Crop pollination,
E. Sediment regulation, and F. Nature-based tourism. The assessment of yearly changes in ecosystems and their services focuses on the national, regional, and sub-regional levels. Comparison with previous MAES results based on tier-1 approach (Adem Esmail et al. 2023) will be carried out combining r and a GIS software (QGIS or ArcMap).

Recommended skills and experiences:

- Good GIS skills,
- Familiarity with R software,
- English language

Research stays abroad

This thesis project includes a training period of at least 4 weeks at the Basque Centre for Climate Change (BC3), Spain. This will give the student the opportunity to interact with the developers of the ARIES approach and tools and to receive training and support in the development of the thesis.

Funding for the research period abroad will be provided through THE PROMOS PROGRAMME (https://international.ruhr-uni-bochum.de/en/promos-stays-preparation-thesi, next Deadline June 1, 2023).The student will be fully supported in the application process.

Contacts:

Blal Adem Esmail (blal.ademesmail@rub.de)