WP4. Multi-scale tools, methods and models for integrated assessment Task 4.2. LEAC	Tool Fact Sheet

The University of Nottingham

Tool: Land and Ecosystem Accounts (LEAC)

Authors: Emil Ivanov, Roy Haines-Young and Marion Potschin   University of Nottingham (UNOTT)

Land and Ecosystem Accounts (LEAC) have been recognized as an important tool for decision makers. Such accounting covers a broad range of environmental issues. In PEGASO the application of Land and Ecosystem Accounts to coastal issues is developed in the context of the goals of Integrated Coastal Zone Management (ICZM).

What are ecosystem accounts?

Land and Ecosystem Accounts can support different aspects of spatially explicit environmental assessments and monitoring. In particular it can provide spatial indicators for regional assessments on the status and change (gain or loss) of natural capital due to human actions.

These Accounts are based on the following type of measurements:

- Stocks (or resource) levels expressed as a mass (e.g. biomass) or volume (e.g. water per area of forest, arable land etc.);

- Flows (expressing temporal changes that can be interpreted as benefits or losses), measured in terms of a rate of some kind (for example the change in agricultural to developed land, annual consumption of water, or the harvest of crop, or number of tourists visits/yr); and,

- Balances are calculated to account for the relations between stock and flows and their changes for a given period of time, e.g. annual or five-year period etc.

What role do Accounts play in PEGASO?

The LEAC methodology (EEA, 2006) provides multi-scale (hierarchical) outputs, designed to facilitate the assessment of processes that take place at different spatial scales e.g. continental, country, region and local levels. By applying LEAC to the different scales, the following outputs can be generated:

- Assessment of the quantity and quality of the existing ecosystem capital (such as arable land, biodiversity, wood biomass);

- Assessment of the quality and quantity of the derived annual flows of related ecosystem services or functions (such as crops harvest, carbon sequestration etc.) according to the volume of the opening stocks and according to the conditions of use (pollution and degradation, or restoration and enhancement of ecosystem capital); and,

- Assessment of the 'balances' of remaining natural capital in a given year and also the potentials or trends in longer term.

Understanding the trends in terms of what is required to maintain or improve major ecological functions, or the impacts of the simplification of ecological systems, or the degradation of the ecosystems, and hence the future potential of natural capital is the main objective of the accounting exercise.

The accounts can be used to assess of the general integrity or 'health' of ecosystems and issues like the quality of the landscape, and also to identify hotspots, trends and patterns of changes of major concern. Such outputs are therefore designed to support more informed decision-making.

In PEGASO the accounts provide inputs to the work on scenarios, indicators, and also inputs for the cases and the regional assessments. All of the accounting elements are expressed in physical terms.

How can we test/apply them?

LEAC uses bio-physical assessments for the calculation and mapping of major ecosystem properties, with the aim of diagnosing ecosystem integrity or health. The following methods are applied for this purpose:

- Continuous interactive mapping and estimation of accounts, validation and improvements on at least two levels – regional and case-study level;

- Designing a diagnostic accounting framework to support specific subjects or themes;

- Bringing multiple sources of evidence on complex socio-ecological problems and performing multi-criteria assessments to derive consistent conclusions; and,

- Assessing the effectiveness of this new information for supporting decisions and solving practical problems.

What do we need to do to implement accounts?

For implementing the accounts the following steps are required:

- Identify main issues at regional scale and the cases where LEAC can be applied for improved understanding of the issues;

- Agree on working concepts for coastal and marine zones;

- Collect, process (harmonize) LEAC input data in cooperation with the PEGASO SDI;

- Prepare first version of the relevant LEAC tools and accounts;

- Present to partners first results and collect feedback;

- Improve the LEAC tools and the accounts.

Key References

EEA (2006): *Land accounts for Europe 1990–2000. Towards integrated land and ecosystem accounting*. European Environment Agency, EEA report 11/2006, 107p, Copenhagen, authored by Roy Haines-Young.

EEA (2010): *Ecosystem Accounting and the Cost of Biodiversity Losses: The Case of Coastal Mediterranean Wetlands.* Edited by Haines-Young, R.; Potschin, M.; Kumar, P. and J.L. Weber. EEA Technical Report No3/2010.

Haines-Young, R. (1999): Environmental accounts for land cover: Their contribution to state of the environment reporting. *Transactions of the Institute of British Geographers* 24: 441-456.

Ivanov, E. (2011): *Report on LEAC methodology for coast and marine accounts* (Internal Deliverable ID4.2.2). With contributions from Françoise Breton and Roy Haines-Young. EU Project PEGASO - Grant agreement nº: 244170.

Ivanov, E.; Haines-Young, R. and M. Potschin (2013): Applications of LEAC in PEGASO: An Overview. CEM Working Paper No 12, 11pp.

Weber, J.-L. (2007): Implementation of land and ecosystem accounts at the European Environment Agency. *Ecological Economics* 61: 695–707.

For more information on LEAC as part of PEGASO see CEM working papers no 10 and no 11

visit: http://www.nottingham.ac.uk/cem/WorkingPapers.html

Example of accounting inputs and outputs

Land cover inputs

An extension of CORINE Land cover over the Mediterranean and Black Sea basins was developed using a set of data-sources: the European CORINE land cover for training a supervised maximum likelihood classification of MODIS multispectral and other geographic data.
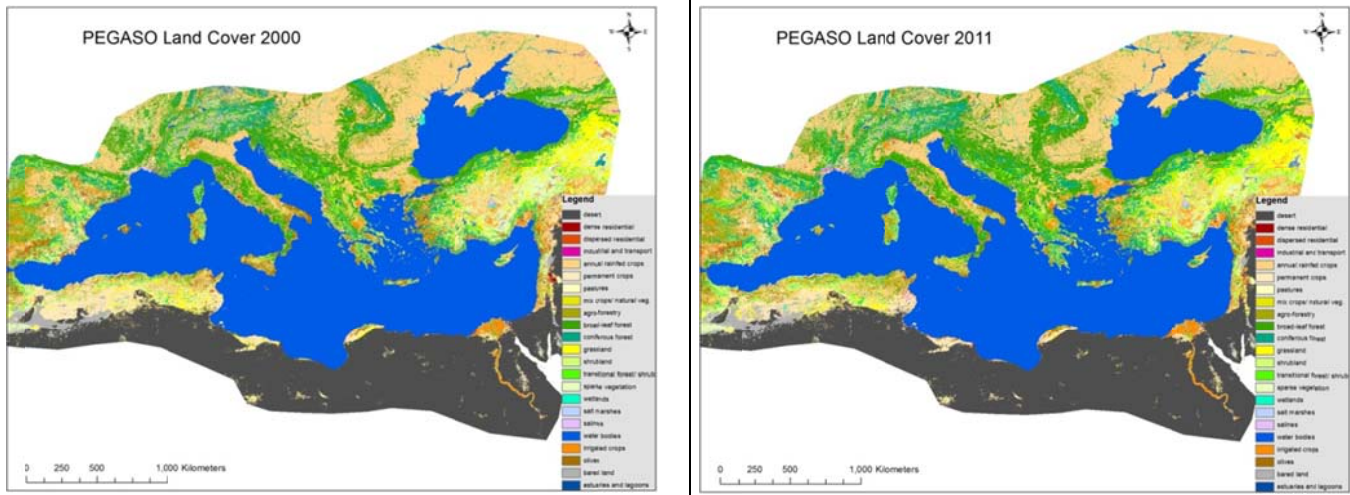
Extension of CORINE land cover in the Mediterranean and Black Sea Basins (Ivanov E., 2013)

Land accounts outputs

The outputs are extracted by deriving the number of hectares of each land class per unit area of interest. An example of urban land 'stocks' (Ivanov E., 2013) within three coastal buffers in the Mediterranean and Black sea countries is shown below:

Opening 'stock' of Urban area (ha) in year 2000 and closing 'stock' in year 2011						
Buffer (km) from coast	1 km		10 km		50 km	
Year	2000	2011	2000	2011	2000	2011
Mediterranean basin	433894	446519	1678125	1735475	1695056	1805063
Black Sea basin	30969	32988	86681	92694	89025	92419

At such an aggregated level the 'stocks' reveal similar trends of expanding urban areas in both basins and in the three buffers around the coastline. Spatial disaggregation by country highlights where most of the changes occurred. The next figure shows percentages of urban and artificial area in 2011 for units defined by the countries and the three buffers' boundaries:
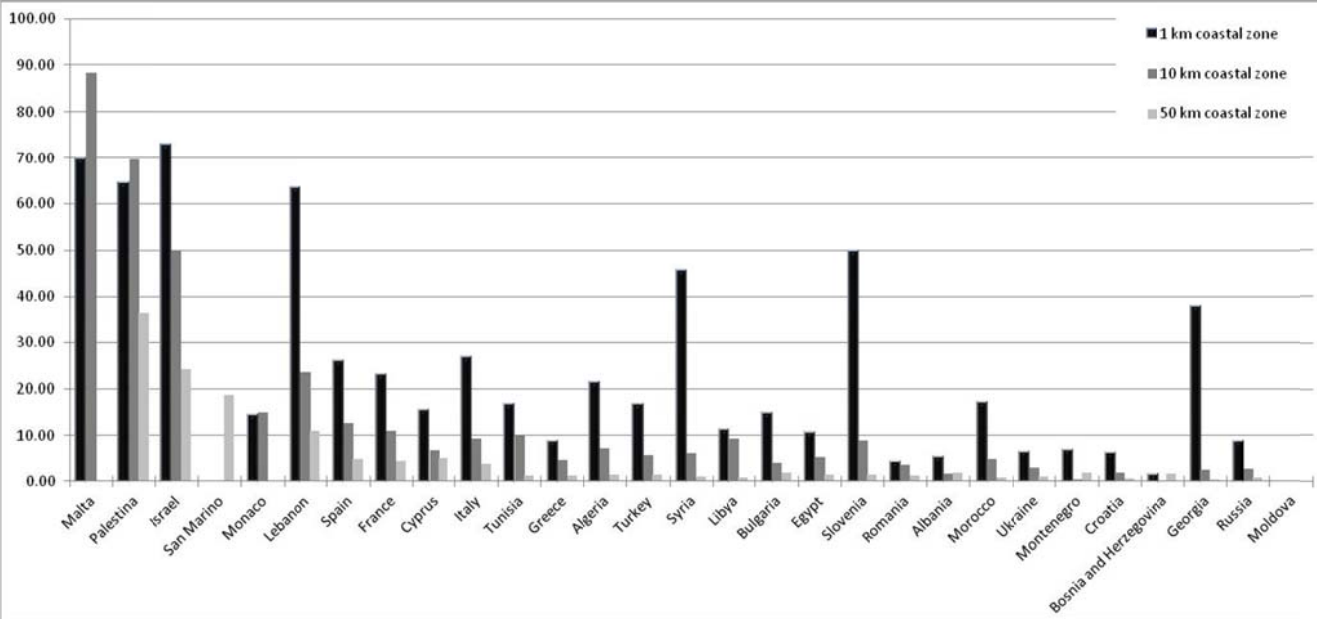
The percentages of urban and artificial land cover in 2011 (Ivanov E., 2013) show there is generally a high concentration of urban areas within the first km of the coast throughout the study region.