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DISCUSSION PAPER ON OPERATIONAL ECOSYSTEM INDICATOR MONITORING FOR WESTERN INDIAN OCEAN REGION

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Session II: Promoting Linkages between Science and Policy in the WIO region

Discussion paper: Operational ecosystem indicator monitoring for Western Indian Ocean (Example from UNEP/GRID-Geneva for the Mediterranean 2017 Quality Status Report).

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Summary and general context

A large proportion of the world population lives in coastal areas. These provide many benefices supported by several sectors such as habitat, transports, fisheries, tourism, to name just a few. However, these developments are generating pressure on the natural environment through water demand, wastes (including waste water), industrialisation, tourism and housing, transports infrastructures. These developments not only are converting large natural areas into built areas, but also can lead to water, soil and atmospheric pollution. This is impacting the biodiversity, affects the climate, the land cover, freshwater rivers and aquifers as well as the coastal and marine environment. These areas are already under high pressure from climate change, with sea level rise leading to coastal erosion, salinization of coastal aquifers and intensification of extreme events (floods, drought and related forest fires, tropical cyclones) generating impacts on population, health, economic and on the ecosystems. The quality of coastal and marine ecosystems is deteriorating at an accelerating rate, leading to significant impacts for the natural environment, but also impacting the livelihood of the population (fisheries, tourism, water,...). It is important to monitor these changes, as well as to support countries in their effort to improve the situation. Identifying built areas, their location, extent and rapidity of these changes, are important indicators for supporting land planning and Integrated Coastal Zone Management (ICZM).

The Mediterranean Action Plan (MAP) and its partners produced the 2017 Quality Status Report on the Mediterranean. Through several sessions, experts have identified a set of indicators and methodologies for monitoring the state of the environment for the Mediterranean sea and coastline.

UNEP/GRID-Geneva was in charge of producing the web platform for hosting this report (see: http://www.medqsr.org), but also for developing the methodology for the inclusion of the EO8 Common Indicator. This one aims to address the need for a systematic monitoring in Mediterranean regarding the physical disturbance of coastline due to the influence of manmade structures. This methodology is based on global datasets generated by satellite imagery analysis. The indicator was generated by aggregating this information for various in-land distance from the coastline, as well as for aggregating these under different administrative levels using Geographical Information System technology. This methodology can be replicated on any of the world's coastlines.

UNEP/GRID-Geneva is an office from the UN Environment Science Division. It includes 20 Environment Data Scientists who are transforming data (geospatial, satellite imagery,

statistics) into usable information to support environmental governance decisions processes. Thanks to its partnership with the University of Geneva it has strong computing power and can deal with big data processing. It is specialized in generating environment assessment, creation of indicators and data platforms. It is part of the GRID-Centres network from the One Global Partnership.

Rationale

The whole Mediterranean coastal zone clearly shows a constant increase in the built-up area since 1975. Mediterranean coastal areas are threatened by development that modifies the coastline through the construction of buildings and infrastructure that are needed to sustain residential, tourism, commercial, transport and other activities. This development can cause irreversible damage to landscapes; habitats and biodiversity; and shoreline configuration.
Ecological objective: The natural dynamics of coastal areas are maintained and coastal ecosystems and landscapes are preserved.
Pressure: Negative impacts of human activities on coastal areas are minimized through appropriate management measures

Development

With the aim of monitoring the evolution in the built-up areas on the coastal zones in the Mediterranean area, a set of data processed from the Landsat collection between 1975 and 2015 was used. These data were provided by the European Commission, Joint Research Center (EC-JRC) and are a subset of the Global Human Settlement (GHS)[1] collection.
The GHS dataset is available also for Western Indian Ocean Region.

The concept of "the built-up areas" concerns enclosed constructions above ground which are intended or used for the shelter of humans, animals, things or for the production of economic goods, and that refers to any structure constructed or erected on the site.

Indicators were calculated for the whole Mediterranean area (aggregated): for individual countries, as well as at subnational scale (NUTS) for selected countries. Statistics were collected for three distinct coastal belts measuring respectively 150 m, 1 km and 10 km width from the shoreline. Whole analyses were performed working at a resolution of 38 m.

The GIS procedure of the analyses are summarized in figure 1:

[1] Pesaresi M., Ehrlich D., Ferri S., Florczyk A.J., Freire S., Halkia S., Julea A.M., Kemper T., Soille P. and V. Syrris (2016) Operating procedure for the production of the Global Human Settlement Layer from Landsat data of the epochs 1975, 1990, 2000, and 2014. Publications Office of the European Union, EUR 27741 EN, 2016. doi: 10.2788/253582.

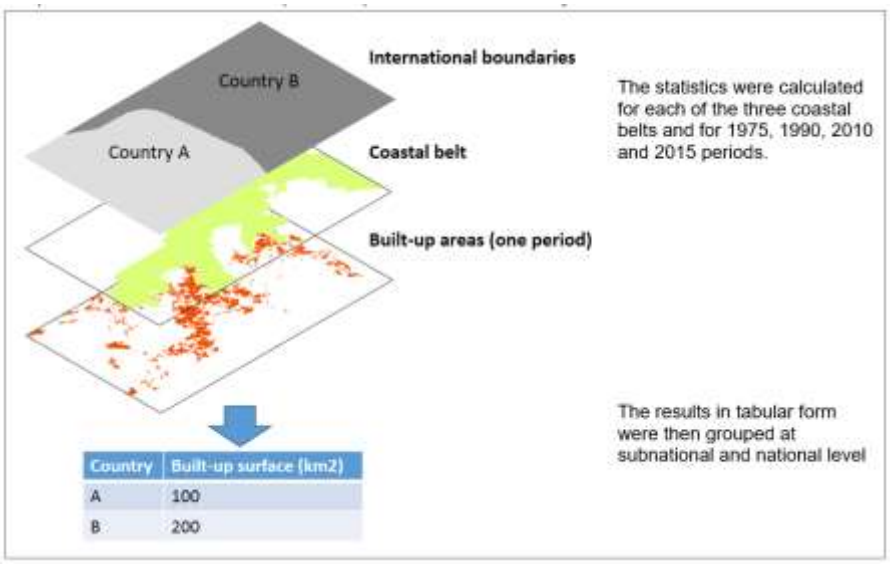


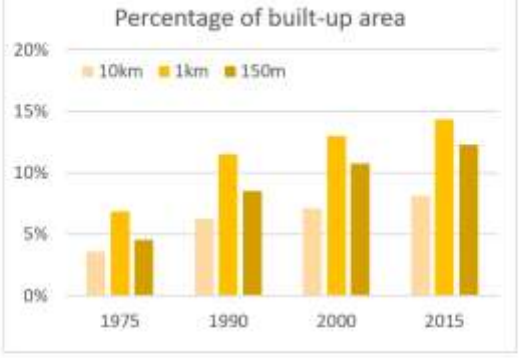
Figure 1 schematic GIS workflow

For each of these geographical and temporal subdivisions the following indicators were calculated:

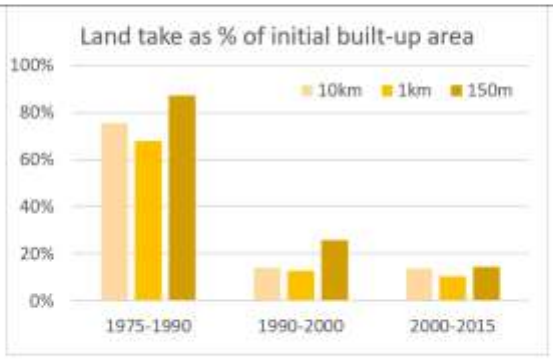
1. **Percentage of built-up area**.: the area of built-up land in coastal zone as a proportion of the total area in the same unit
2. **Land take**: urbanization on previous undeveloped land. Land take represents a proportion (%) of a specific area that changed between two land cover inventories from a non-artificial to an artificial area.

The results of these analyses are available in the form of tables, charts, and maps are available at: **https://owncloud.unepgrid.ch/index.php/s/xonWxU0VDpUvIO7**
Below are some examples selected from the collection:

Example 1: whole Mediterranean area evolution of Built-up from 1975 to 2015

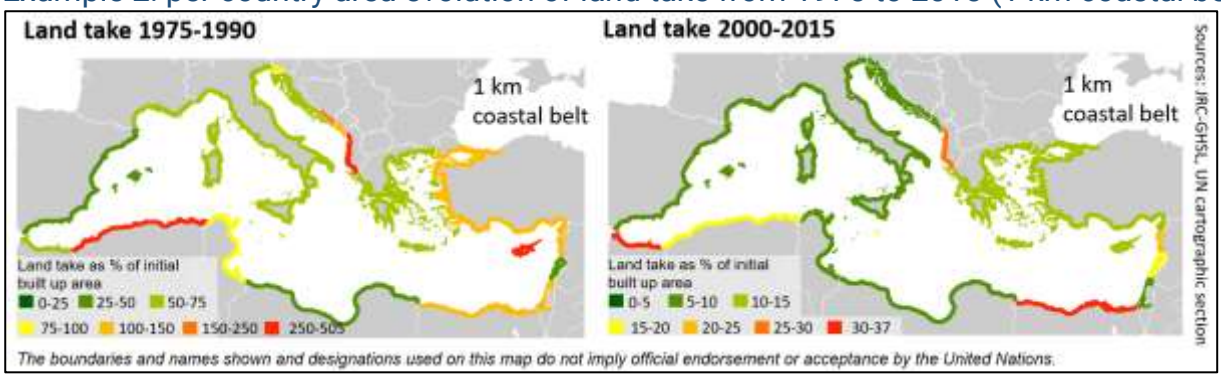


The whole Mediterranean area shows a constant and regular increase of the built-up area during the entire period of observation. The graph also shows that the development appears relatively homogeneous within the three different coastal belt areas.

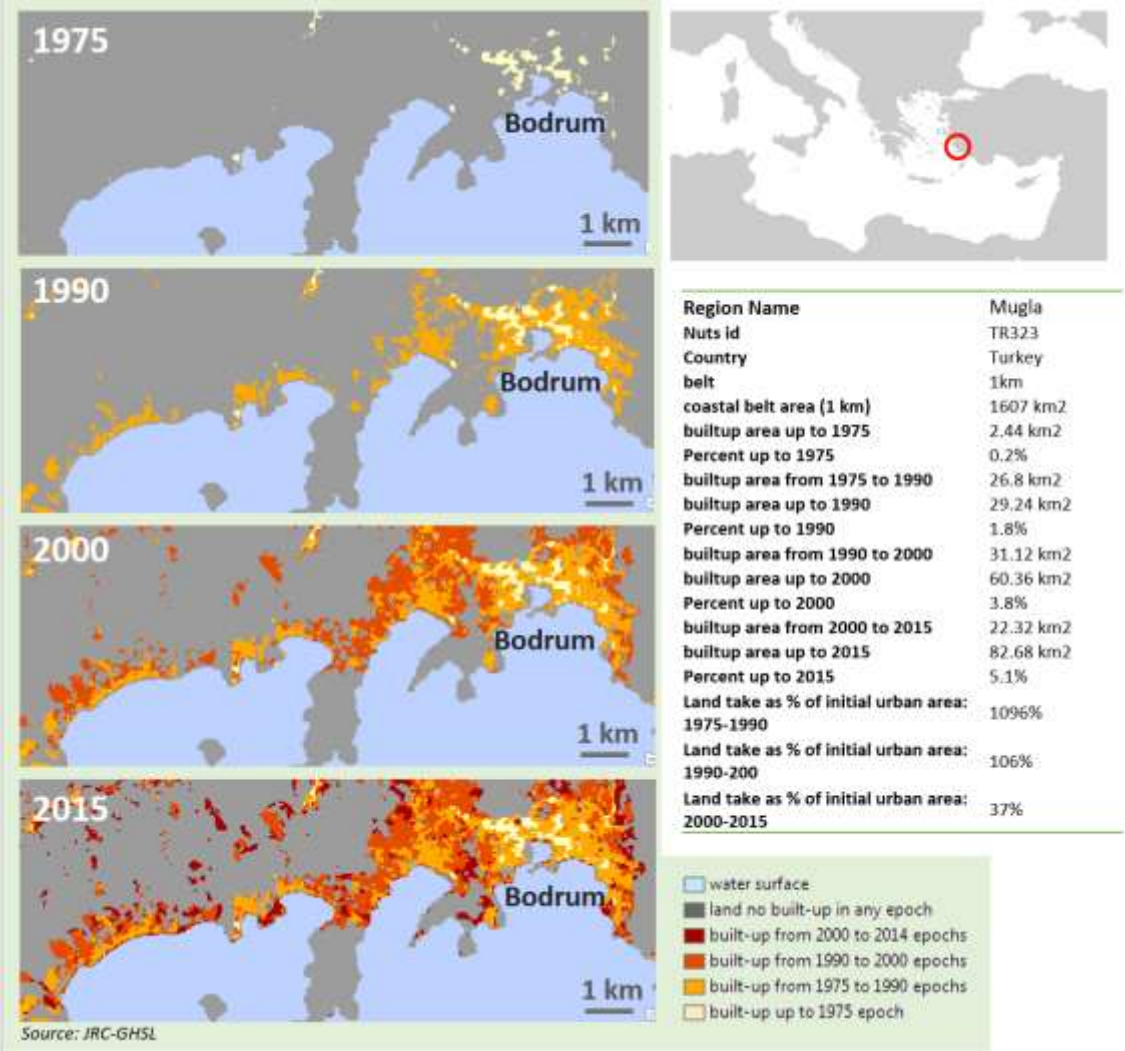


This graph shows quite clearly how the greatest coastal development occurred between 1975 and 1990, with a land take between 65 and 80%, depending on the coastal belts. In the following two periods the urbanization on previous undeveloped land remains clearly more limited.

Example 2: per country area evolution of land take from 1975 to 2015 (1 km coastal belt)



Example 3: local scale evolution of built-up from 1975 to 2015 for Mugla region (Turkey)



Region Name	Mugla
Nuts id	TR323
Country	Turkey
belt	1km
coastal belt area (1 km)	1607 km2
builtup area up to 1975	2.44 km2
Percent up to 1975	0.2%
builtup area from 1975 to 1990	26.8 km2
builtup area up to 1990	29.24 km2
Percent up to 1990	1.8%
builtup area from 1990 to 2000	31.12 km2
builtup area up to 2000	60.36 km2
Percent up to 2000	3.8%
builtup area from 2000 to 2015	22.32 km2
builtup area up to 2015	82.68 km2
Percent up to 2015	5.1%
Land take as % of initial urban area: 1975-1990	1096%
Land take as % of initial urban area: 1990-200	106%
Land take as % of initial urban area: 2000-2015	37%

The Mugla region in Turkey has turned out to be one of the sectors that has undergone the greatest increase in land take. The map shows very clearly the growth of the built-up areas with an impressive increase between 1975 and 1990 of about 10 times. Between 1975 and 2015 the built-up area has gone from 2.4 km2 to 82 km2, thus multiplying the initial area by 32-fold.

General conclusions

- The whole Mediterranean coastal zone clearly shows a constant increase in the built-up area since 1975;
- The period that shows a major built-up increase is between 1975 and 1990; the most affected areas are the coastal belts of 1 km width;
- Considering land take between 1975 and 1990, and a coastal belt of 10 km, Algeria, Albania, Cyprus and State of Palestine show very high values of land take (above 250%), with Albania which has increased its initial values by 450 %;
- Considering the most recent period (2000-2015), the countries with the greatest development of the built-up areas are Albania, Egypt, Malta, Morocco, Slovenia and Syria. None of them exceeds the 50% land-take threshold in all three coastal belts examined;

- Several regions (NUTS3) show an increase in land take that is significantly higher than the national average. These regions are mainly located in Greece, Italy and Turkey;
- For these regions a more detailed analysis within a local knowledge would be necessary to explain and understand the causes of this type of evolution.

Application

On several occasions (e.g. CORMON meeting on Coast and Hydrography in March 2017, PAP/RAC Focal Points meeting in May 2017) it was indicated that the "Land-use change" indicator is already mature enough to become a common indicator, and to be included in the following revision of the IMAP as well as in the following edition of the Quality Status Report 2023.

For the purpose of assessing and testing this indicator at the Mediterranean level, this analysis of land-use changes in Mediterranean coastal zones can provide a good insight in the evolution of built-up areas in coastal zones, since "urbanization, or land-take, is the most dramatic change of coastal zones given the (almost) irreversibility of the process.

Implications and challenges

The results of this analysis will also be used in various environmental reports within the Mediterranean Action Plan (MAP) such as the State of Environment and Development in the Mediterranean report (by Plan Bleu), where reporting of the evolution and state of coastal zones will be using, for the first time, the same relevant methodology and data sources (the same resolution, level of precision) for all countries. In this way, comparability of results between countries is ensured. An ecosystem monitoring indicator framework for the WIO region will be important in facilitating States have relevant information and data in the preparation/revision of their state of the coast reports and even regional reports as well. Additionally, the same information will enable SDG reporting esp SDG 14 and other associated SDGs.

The availability of data together with the experience and knowledge gained in the preparation of these indicators makes it possible to implement them for the Western Indian Ocean Region.

Recommendations

The Secretariat is requested to work with partners and develop a robust ecosystem monitoring indicator framework for the WIO region with specificity for application at country level.

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