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PRECOS, a holistic approach for territorial resource security

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More than one in two men lives in urban areas. Cities spark innovation and produce wealth, but they also are abysses engulfing inexorable quantities of raw material, energy and through urban sprawl, land surface. From this perspective, they are a threat for their hinterland's environmental assets such as land and water.

The emergence of the notion of cross-linking risks brought to the fore, inter alia by IPCC studies [1], or of public regulations based on the notion risk management and control, involves awareness to and a need for monitoring resources in potentially vulnerable territories. Local authorities and stakeholders need to apprehend the key components of their territory's natural resource and ecosystems services they provide in a holistic way to be genuinely in a position to take some control over their future.

For a long time, information technology was a major bottleneck for appropriate monitoring and assessment of local resource, policies and for improving the efficiency of management practices. This is no longer the case: recent innovation in robotics, spatial metrology, modelling at different scales and interfacing of software opens a Pandora's Box of endless new integrative and dynamic predictive possibilities.

However, benchmark shows that the majority of integrative tools today do not as a rule provide dynamic assessments of ecosystem performances on territories. An array of EU research programmes on integrated urban modelling bears indicates that generic solutions, if too holistic, rapidly embark us on a slippery slope: they turn out to be so complex that measuring interpretation costs become a prohibitive impediment to any kind of predictive projection. Another lesson learnt from benchmark is that interdisciplinary work has not radically overcome the chasm between, urban and rural approaches; crossovers are few. The scope of modelling tools tends to be circumscribed to the urban fabric, the same goes for those devised for rural and agricultural areas.

Admittedly, integrated urban and regional modelling needs to be perfected (*data collection and treatment or for improving reliability of predictive scenarios with mathematical modelling, formal logic decision tools*). Territorial security is also increasingly calling for their deployment. They are critical for allowing policies to make a difference when dealing with complexity and preserving the productivity of ecosystem services against mounting pressures.

The “PRECOS” initiative (*Prediction of the impacts of climate change and urban sprawl on ecosystems*) stems out of a commitment from both public private sectors organisations - associated in a consortium, and whose authors belong to – to face the fire of user demand and through collaborative processes, facilitate the broad uptake of holistic modelling tools on territories. It was launched in 2013 under the auspices of the European Institute of Innovation

& Technology (EIT)'s Climate Knowledge and Innovation Community (KIC), an organisation dedicated to fight climate and anthropogenic pressures by getting promising R&D results off their shelves.

1. The PRECOS approach

The 2013-2014 “pathfinder” project allowed the consortium to design PRECOS as a methodology that seeks to assess over time, the resilience of ecosystem services in territories such as agro-forestry land occupation and its contribution to “feeding” functions; hydraulic storage capacities and flows, and their contribution to feeding, habitat, economic and/or natural risk prevention functions. It mainly targets territories where these functions play a significant role and where they are put at risk either by urban sprawl and/or by climate change. These territories thus have an agro-forestry potential and are neighbouring urban areas or through interactions with the latter, are impacted in some significant way.

Technically, the methodology focuses on a circumscribed number of ecosystem services connected to hydrology and agro-forestry land occupation. It consists in integrating data pertaining to water & soil resources, crop systems, and land use change (*urbanisation, infrastructure...*) and put this information in context through a territorial socioeconomic and regulatory analysis shedding light on major local constraints and challenges. The approach articulates around a modular architecture, modelling software and spatial and temporal representations tools. It produces indicators in three core domains: soil degradation, water and soil resources and agricultural production.

Medium-term scenarios ($t_0 + 20 \text{ years}$) are generated to assess possible land occupation changes and their implication for the services provided to the economy and society by natural and agricultural ecosystems.

The notion of “pathway” is strategic. The methodology operates dynamically, in recurrent rings with the real pathways replacing on a regular basis to the ones predicted in scenarios.

These simulations and their regular adjustments allow:

- To assess the effectiveness of public policies namely, their formulation and their relevance over time.
- To identify the necessary adjustments to the operational modalities of the ecosystems services themselves.

The PRECOS approach brings to local authorities and stakeholders the support of a scientific approach to shed light on their decision-making processes. It also helps actors living off a shared common good to organise themselves in a way compatible with the preservation of their territory and the sustainable management of their resources.

Indeed, the main drivers here are macro-economic. These include avoidance of costs incurred by the disturbances caused to ecosystem services, or because of them. Similarly, by receiving assurances as to their sustainability and resilience potential, through the implementation of approaches such the one experimented here, investors and insurers will be in a position to grant better financial terms to territories for their economic development.

2. From proof of concept to life-size demonstrators

The approach's proof of concept was been successfully assessed, in an area of France's Southeast Region, the Crau plain [2]. Indicators were defined, a socio-economic and regulatory analysis carried out and three predictive scenario covering land consumption and impact of land use change on aquifer renewal were generated. The synthesised and dynamic

vision thus produced gave immediate visibility to some of the more costly consequences of local decisions over the natural and economic system's equilibrium. In an area where the assumption is that an array of strong safeguards protects the environment from urbanisation, the lack of effectiveness of existing tools in spotting them was clear. Over the medium term, the entire system could very well capsized under the combined pressures of urban sprawl and climate change in which case and local authorities' leeway for undertaking new developments would be compromised in a major way.

The PRECOS consortium's objective is to spread worldwide such prospective approaches, and practically to organize the maintenance and the development of the standards of the methodology, and of their results, in the frame of a dedicated self-financed body.

Therefore initial feasibility test on the transposition of the approach in another environment was carried out in the framework of the EIT's Climate KIC pathfinder programme. It took place in the Italian Region of Emilia Romagna and its results proved most encouraging. In view of this, the Province of Modena has recently volunteered to become a life-size demonstrator for implementing the PRECOS approach again, under the patronage of a Climate KIC's innovation programme within which a three-year project is currently in the pipeline.

[1] "Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation" Intergovernmental Panel on Climate Change (IPCC) November 2011 and Summary for Policymakers from IPCC WGII (AR5) - March 2014

[2] Astuce & Tic (2011) Rapport final du programme FUI. Coord. De Mordant de Massiac J.C., Trolard F. & Bourrié G., 1480 pp.