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Harmonious methods

Drs Alessandra Pugnetti, **Michael Mirtl** and **Ricardo Díaz-Delgado** discuss their work coordinating a pan-European case study into ecological research methods and monitoring

To begin, could you highlight the overall design and purpose of EnvEurope?

EnvEurope is a Life+ project (2010-13). It is a case study and pilot for an ecological research and monitoring workflow based on the distributed network of European Long-Term Ecosystem Research Network (LTER-Europe) sites. It uses data gathered at these sites comprising both their data legacy and new data generated in the runtime of EnvEurope. For selected thematic fields of ecology, concerning ecosystem status and ecological integrity, priority parameters and methods are determined. Data is collected, compiled, quality assured and analysed in exemplary analyses.

What is the relationship between EnvEurope and LTER-Europe and the overlapping aims and objectives?

EnvEurope was motivated and conceived in response to challenges of research within the site network of LTER-Europe. The technical 'Actions' of the project are strongly linked with several LTER-Europe 'Expert Panels'.

This reflects the integrative approach of both LTER-Europe and EnvEurope, and is targeted to make maximum use of previous investments of the European Commission in redesigning the European Research Area and its infrastructure.

By what means do you intend to maintain and develop a successful integrated environmental information management system?

The EnvEurope Information Management team aims to support the network of long-term ecological and environmental research and monitoring sites of LTER-Europe with the necessary data and metadata infrastructure as a conceptual test case for the Shared Environmental Information Systems (SEIS). In fact, a specific 'Action' of the EnvEurope project (led by Environment Agency, Austria) is focused on this subject. The provided solutions are based on metadata collection and management with standardised methods (INSPIRE, Open Geospatial Consortium and Ecological Metadata Language) enabling the discovery.

How do you intend to divide your time effectively among the three ecosystem types: terrestrial, marine and freshwater?

The resources devoted to each ecosystem type vary across 'Actions' and countries according to the structure of the respective national LTER-network. We would like to stress that the project and its 'Actions' have an explicit trans-ecodomain approach: this means that we are framing and developing individual activities, whilst giving the same overall consideration to each of the three systems.

Can you explain the relevance of EnvEurope within the LTER-Europe framework for the European research infrastructure policy?

There are several links. EnvEurope contributes to the integration and functional linking of extensive observational methods and research requiring heavy technical equipment for detailed ecosystem observation, as well as experimental approaches. LTER-Europe is playing a key role in this integration. The open and integrative nature of LTER-Europe has also led to collaborations with the ESFRI project LifeWatch, where EnvEurope and LTER sites belong to key data providers.

What have been the biggest challenges or obstacles encountered during the initial phase of the project?

The biggest challenge of this project is related to its intrinsic complexity, both institutionally and ecologically. Many project beneficiaries are involved in their national LTER-network and therefore also represent the national LTER

Integrating Europe

Echoing the assimilation and collaborative nature of European policy making, the EU-funded **EnvEurope** Life+ project sets out to harmonise methods of ecosystem research and monitoring across the continent

IN MANY WAYS, Europe is characterised as an integrated region: 17 countries share a common currency; European citizens enjoy visa free travel across the continent and EU political collaboration is on the rise. Yet the realm of ecology does not currently share this unified approach. EnvEurope, a case study and pilot scheme for ecological research and monitoring workflow, aims to lay the foundations for a more integrated system for successful long-term ecosystem research and monitoring. The key principles of the project are scientific knowledge, common information management and harmonisation of parameters and methods at a European scale.

Utilising the network of European Long-Term Ecosystem Research Network (LTER-Europe), EnvEurope combines existing data with new data generated during the project to achieve a deeper understanding of ecosystem functioning, improved environmental management and support for the development of EU environmental policies and conservation planning through the integration of objectives, resources and disciplines.

A PAN-EUROPEAN APPROACH

EnvEurope is being developed within the LTER-Europe sites which represent more than 400 locations across Europe. Under the coordination of Dr Alessandra Pugnetti at the Institute of Marine Sciences of the National Research Council in Italy, the project takes a cross-domain approach with 67 LTER-Europe sites encompassing terrestrial, continental waters, wetlands and marine ecosystems from 11 countries including Spain, Bulgaria and Finland.

Given the pan-European nature of EnvEurope, projects are co-financed. Up to 50 per cent of funding comes from the European Commission, which has pledged €3 million between 2010-13, with national contributions making up the remainder. In addition to monetary assistance, project partners provide extra support ranging from promotion and strengthening of collaborations to the facilitation of further projects, strategies and funding.

The project has been structured to play a role in the conceptual and operative context of the Shared Environmental Information System (SEIS) promoted by the European Commission and in the development of some components of the Global Monitoring for Environment and Security (GMES), a joint initiative of the European Commission and European Space Agency.

PLAN OF ACTION

In light of the broad-scale and cross-domain strategy, the main goals of EnvEurope have been broken down into six 'Actions':

• Action 1 – Data Collection and management. Development of an integrated ecological data management system

• Action 2 – Parameter and method elaboration. Harmonisation of parameters and methods across ecosystems

• Action 3 – Cause-effect analysis and scientific evaluation. Elaboration of long-term ecological data to deliver scientific information to scientists, policy makers and the public

• Action 4 – Network Design. Improvement of the network design, through the evaluation of the present LTER-Europe network and considering the potential connections with other site-based environmental networks

• Action 5 – Testing in the field. Performing common and harmonised field activities using shared parameters

• Action 6 – Strategic actions and dissemination. Dissemination of the LTER mission, ecological data and knowledge about ecosystem functions and processes to meet the needs of decision makers

The responsibility for addressing these actions is divided between the various countries and organisations participating in the project. For example, Action 2, concerning the development of a conceptual framework for ecosystem research and monitoring, is led by UFZ in Germany. Researchers will collate indicators and parameters currently used to monitor and investigate structures and processes within ecosystems and select a core set of ecological parameters to be sampled at all sites. Action 3, which sees selected multi-site research questions answered using a combination of existing long-term data and new data gathered by EnvEurope, is led by the University of Bucharest in Romania.

Capitalising on the diverse geographic spread of its partners, EnvEurope intends to develop an integrated environmental information management system, thus contributing to the technical components of SEIS. This activity will supply ecological data and information on the status and long-term trends of terrestrial

community. The EnvEurope partnership itself is actually even larger, since it involves so many external partners. Securing effective communication and integration between all these elements, and the ability to take into account the complex features of each ecosystem typology to enable a fruitful and meaningful synthesis, have been the major hurdles to overcome.

What impact do you expect the project to have?

The project will provide substantial and proof-tested proposals for the network structure, standard procedures and cross-site workflows of the LTER-Europe network (ie. through database interoperability, harmonisation of methods and parameters, long-term ecological data analyses and syntheses, improvement of the network design). Ultimately, the products of EnvEurope will support scientific excellence by securing indispensable information management infrastructure and data at LTER sites for multiple uses.

Finally, could you outline your contribution to Global Monitoring for Environment and Security (GMES)?

Aside from its main tasks, EnvEurope is also concerned with contributing to the GMES initiative. The GMES in situ stakeholders comprise international, European, regional (public or private) and national organisations that collect, hold, coordinate and provide the required in situ data needed for the GMES services to deliver their products. The LTER-Europe network, with its sites located across Europe's environmental zones, can certainly play an important role as an official validation network and in situ data provider for GMES in this regard. Specifically, EnvEurope will contribute to this process by addressing up-scaling issues and providing independent validation of GMES products with in situ collected data.

ENVEUROPE

ENVIRONMENTAL QUALITY AND PRESSURES ASSESSMENT ACROSS EUROPE

OBJECTIVES

To contribute mainly to the definition of the potential and effective use of long-term datasets in addressing important scientific questions, while also allowing integration of the specific information and knowledge into EU environmental policies.

PARTNERS

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habitats, as well as continental waters, wetlands and marine ecosystems from across the region, based on field data gathered at different scales. Crucially, this semantically consistent metadata architecture will not only be accessible to the scientific community but also to EU environmental policy makers, conservation planners and stakeholders.

Of the six Actions, the first three are perhaps the most fundamental to the success of EnvEurope: "One of the main objectives of the project is the elaboration and harmonisation of methodologies for the selected environmental quality parameters at EU level as well as the elaboration of long-term ecological data," affirms Pugnetti. Achieving this synergy of parameters and methods is a major challenge for a large European network totalling hundreds of LTER sites. Using existing long-term datasets and recently collected field data, EnvEurope will select a set of key environmental quality indicators able to characterise ecosystems and delineate those sensitive to major natural and anthropogenic stressors. The identification of such parameters, recommended for use across the whole LTER community, will also be valuable in the validation of remote-sensing techniques and GMES products.

LTER INTEGRATION

Much of the EnvEurope project is conducted with the LTER network in mind. "The most suited information management practices are chosen in strong consideration of expertise and practical experiences gathered internationally," remarks Pugnetti, who goes on to cite the global LTER network (ILTER) and the US-LTER as primary influences. In the fullness of time, she hopes the EnvEurope project will act as a trigger for innovation in the LTER-Europe network in a number of ways. Firstly, the IT solutions of EnvEurope touch critical challenges of a distributed research network and are elaborated in direct interaction with LTER-Europe and its Expert Panel on information management: "The LTER-Europe network analyses, based on a comprehensive metadata update of hundreds of sites, form the basis for national decisions in redesigning in situ networks".

Moreover, a viable web portal will give access to long-term homogeneous ecological datasets linked to harmonised thesauri and web-map servers. "In the face of global change and necessary adaptation measures," explains Pugnetti, "policy makers strongly demand such knowledge. The development of a web portal will be one of the main modules of the LTER integrated environmental information management system".

NEXT STEPS

The project has just finished the initial phase of preparing standards and fieldwork. Notable results achieved so far include the definition of the meta-database architecture, a comprehensive proposal for standard indicators; creating a user-friendly manual containing a review and selection of abiotic and biotic indicators and methods for parameters; the definition of main research topics and related data typologies for the elaboration of long-term ecological datasets; and beginning field tests at some sites.

The next steps are to extend the testing in the field activities with shared parameters at all the EnvEurope sites; elaborate long-term data within specific research topics, (such as 'Eutrophication and climate change', 'Ecosystem function and services' and 'Phenological variations'); develop a controlled vocabulary through the evaluation of the existing terms in the identified standard controlled vocabularies and the definition of missing terms; and set up data flows and data management structures.

Although EnvEurope is in its early stages, looking ahead, Pugnetti expects the project to streamline the standard procedures required to support scientific research, and increase the visibility of LTER-Europe as a reference network for policy makers and environmental managers at the European level.