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“Report on Restructuring of network”

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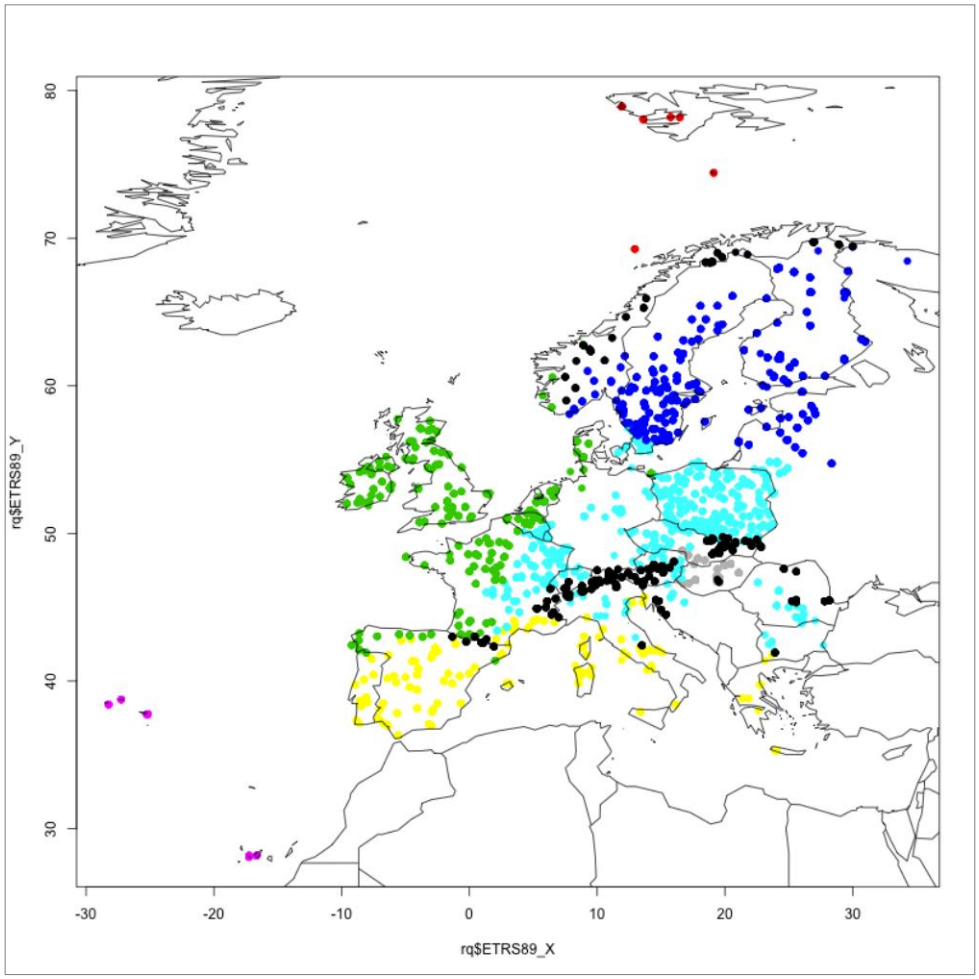
“In environmental monitoring, the term ‘design’ may be broadly defined as a step-wise process through which adequate decisions are taken to meet the needs of the investigations to be undertaken” *(Parr et al., 2002)*



1 - Introduction

1.1 State of the art of the LTER-Europe Network

The European Long-Term Ecosystem Research (LTER-Europe) network supports exemplary ecological researches on key driving processes on all major European ecosystem types, including mainly terrestrial and freshwater, but also some marine sites. A wide range of research topics, infrastructures and methodologies are employed.

LTER Europe (www.lter-europe.net) is based on sites, which are organized in national networks, according to national and institutional funding. These national LTER networks have their own research foci, research strategies and methods, infrastructure policy and governance structures. Consequently, although strategic overviews, organization, commitments and tasks are shared by the whole LTER-Europe community, the network still need to undertake some crucial steps towards harmonization at the European level. Furthermore, due to the “bottom up” process on which the network is based, an uneven coverage of the major European ecosystems has been identified and some gaps are likely to still exist.

The long-term monitoring of ecological systems need a shared scientifically-sound basis and a methodological harmonization at European scale, to improve the environmental management and to support the development of environmental policies and preservation planning through integrated approaches of objectives, resources and disciplines. Thus, the link between the ecological research network (LTER) and a complementary monitoring component (LTEM, Long-term ecosystem monitoring), which aim is to support research projects on the site level and multi-site projects with a clear scientific focus with trend information on the site level, is an indispensable prerequisite for LTER.

In this respect, the EnvEurope LIFE + project aims to produce a new LTER network design, specifically focussed on environmental high quality long-term monitoring, trough the establishment of an exemplary set of common parameters, indicators and methods across the largest site-based network in Europe.

Particularly, one of the most important aims of EnvEurope is the integration of LTER activities among the beneficiaries of the project and the comparison of LTER trends and results, with a trans-ecodomain approach. Moreover, the permanent trans-domain, ecological, long-term site network should represent a valuable system for *in situ* validation of satellite data, thus helping also the implementation of the GMES program (Regulation

EU n. 911/2010) and the Inspire Directive through the creation of a updated and accessible metadatabase and database of the LTER sites.

1.2 Main objectives of Action 4

The Action 4 (A4: “Network Design”) is involved in the EnvEurope project for all those aspects concerning an improved LTER network design. Action 4 will consider and elaborate all the relevant EnvEurope outcomes (from all the other Actions) in order to produce a know-how on the organization (or re-structuring, if necessary) of the network to improve the information flow and high value research and monitoring.

The harmonized network designed by the A4 should:

1. Reflect the environmental and economic stratification of Europe (following Metzger et al., 2010) and key ecosystem types
2. Be connected to other site-based environmental networks
3. Interact with the European initiative GMES and its specific projects
4. Contribute to the implementation of SEIS and the Inspire Directive in LTER

In a first phase, the network design will mainly deal with the issue of “site gaps filling” in order to provide solutions to ensure the best site coverage for long-term ecological research and monitoring in Europe.
Successively, A4 through a thorough evaluation of the weaknesses and strengths of the present LTER-Europe network, based on the analysis of an updated set of site metadata, will contribute to organize the monitoring component at different scales of observation, with respect to standardized baseline monitoring for multiple use. Particularly A4 will take into account a cost-effective network design and the potential connections with other site-based environmental networks.
In order to accomplish these tasks it is important to involve all the LTER-Europe sites. Thus, a strict collaboration with the whole LTER-Europe community is required and all the initiatives that will focus on the update of existing metadata and further analyses will be carried out in close cooperation with the LTER-Europe Expert Panel “Information Management” and with the LTER-Europe Secretariat.
Finally, A4 will combine updated metadata at the site level from the whole LTER network with information provided by the other actions of the EnvEurope project, in particular A1, A2, A3 and A5. A special attention will be also directed to the cooperation with other intensive monitoring and conservation networks (e.g. UNECE, ICPs, Natura2000) in order to provide a proposal for the increasing efficiency of ecological monitoring in Europe.

1.3 Setting a baseline: exploratory gap analysis of EnvEurope and of LTER-Europe sites

The gap analysis by A4 started in July 2010 and followed a step-by-step procedure. The main reference tool for this activity was the LTER-Europe site metadatabase (LTER Infobase).

The first step was the analysis of the site list and of metadata available on the Infobase and that were updated to early 2009. Then, this information were integrated with the results of a questionnaire, produced specifically by A4 and sent to all the EnvEurope Beneficiaries, on the overlapping of the LTER sites with other networks, and, in particular, with GMES (product of SubAction A4.2 “Scheme of network reorganizing”). EnvEuropeEnvEurope

1.3.1 Site distribution

The data retrieved in this analysis concerned some specific dataset. The retrieval of metadata was performed using the parameters related to these three main topics:

1. Biogeographic regions
2. Research topics
3. Parameters monitored

The following graphs show the results of this analysis: the distribution of the EnvEurope sites according to the European biogeographic regions and to the main ecosystem type (terrestrial, marine and freshwater sites).

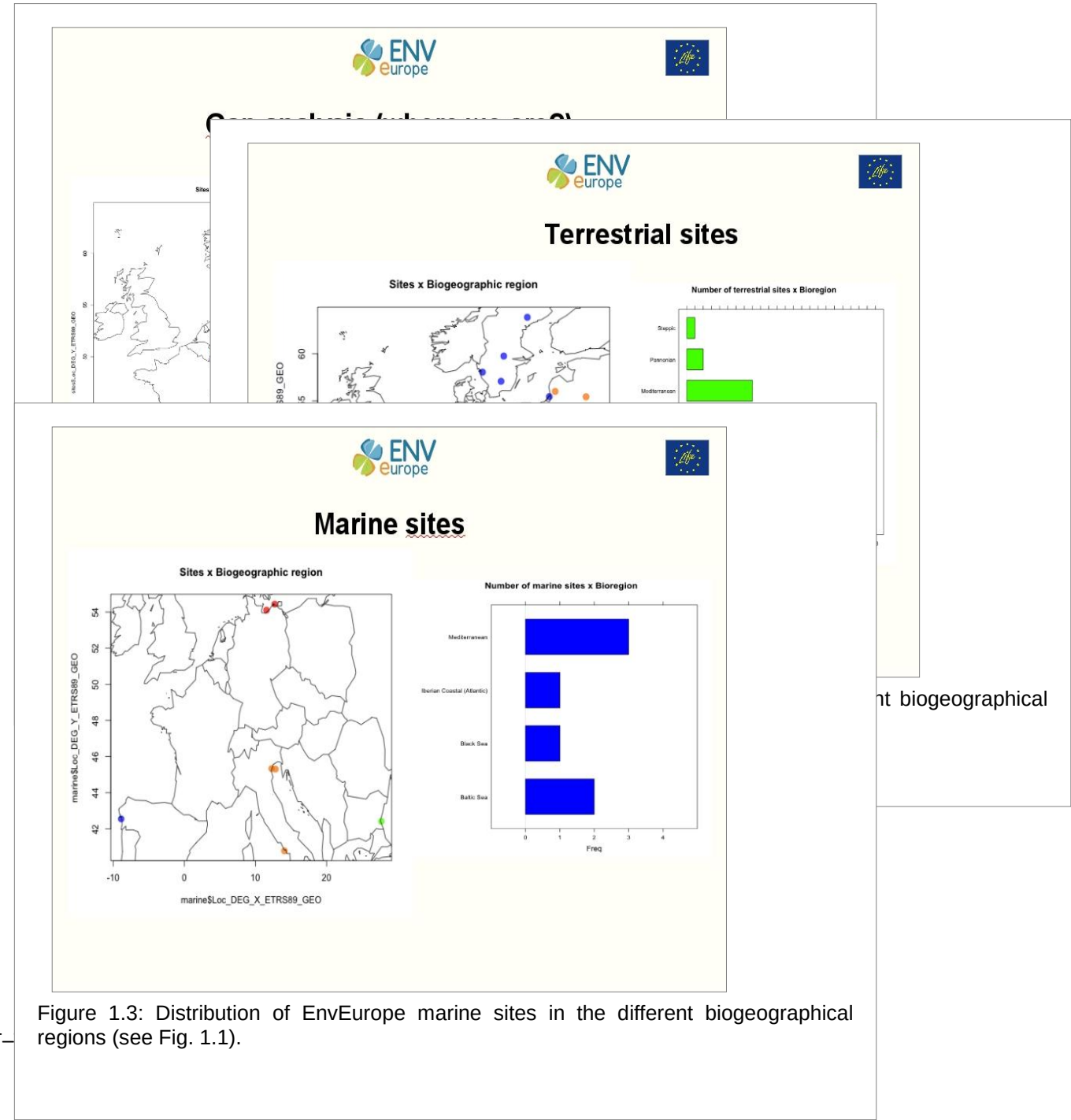


Figure 1.3: Distribution of EnvEurope marine sites in the different biogeographical regions (see Fig. 1.1).

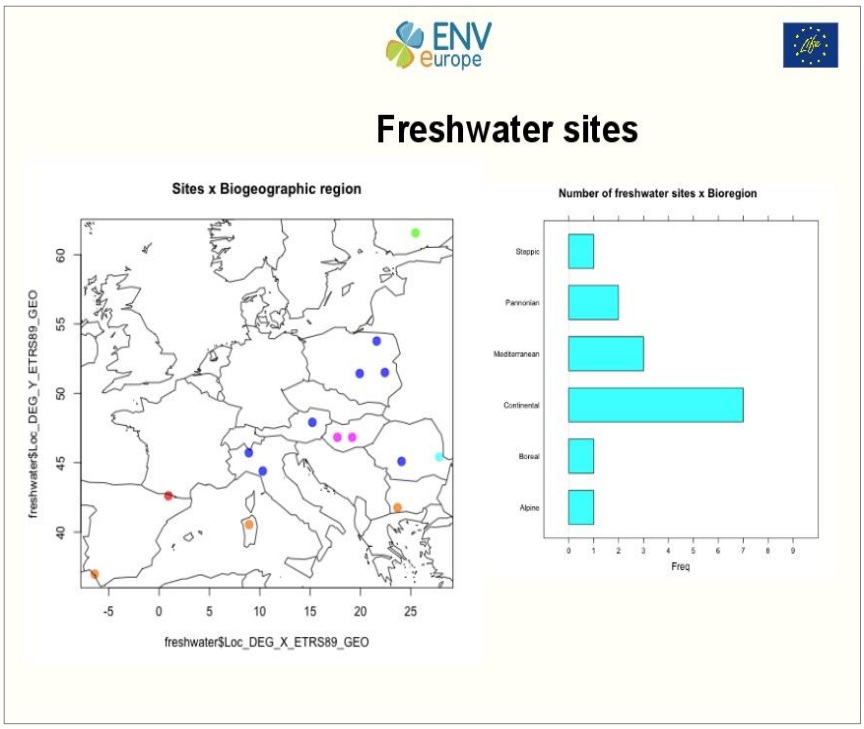


Figure 1.4: Distribution of EnvEurope freshwater sites in the different biogeographical regions (see Fig. 1.1).

1.3.2 Overlapping with other networks

A4 has also carried out a preliminary analysis of the overlapping between LTER Network and other relevant ecological networks in Europe (e.g. ICP Forests, ICP IM, Natura 2000). The investigation of the “overlap with the other network” is an important task because the presence of other networks (outside LTER, but shared by some LTER sites) could allow to solve some issues related to the filling of site gaps, i.e. common research topics, and to the use of common and harmonized parameters.

The results show that several LTER and EnvEurope sites share a common membership with other networks (Fig. 1.5). Particularly several Enveurope forest dites are part of ICP Forests and ICP IM networks (Fig. 1.6)

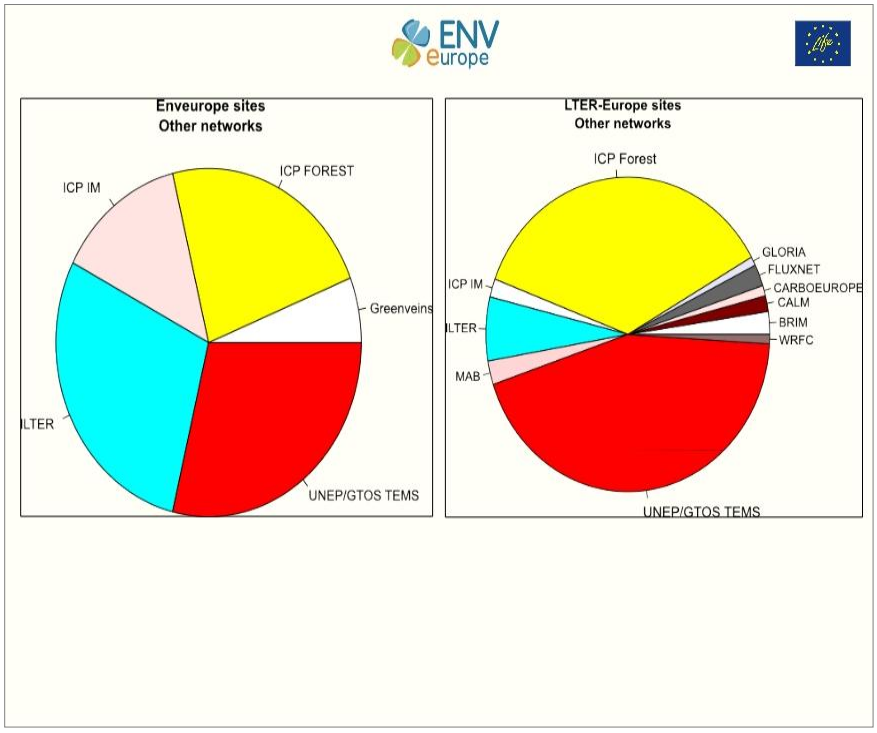


Figure 1.5: Overlapping of EnvEurope (on the right) and LTER (on the left) sites with other research and monitoring networks.

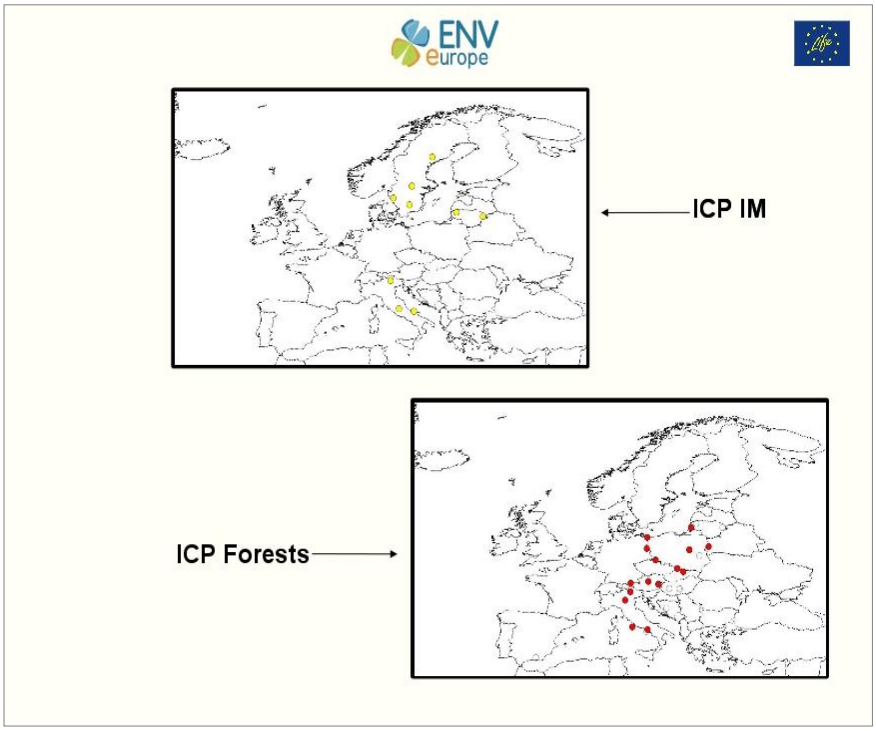


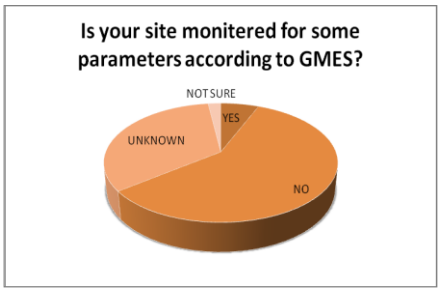
Figure 1.6: The map show that several sites share a common membership with ICP IM and ICP Forest networks.

1.3.3 Connections with GMES

In order to acquire information about connection between EnvEurope sites and GMES, A4 produced a questionnaire to explore this issue.

The results are reported in Figure 1.7. The number of sites somewhat related to GMES is very low: 6.3% of the sites carry out monitoring of parameters suitable for GMES, 8.5% of the sites are somehow involved in the GMES initiative.

Thus, it is evident that GMES is still not integrated into the EnvEurope community, thus strategies focusing on a better integration of GMES and LTER/EnvEurope should be planned



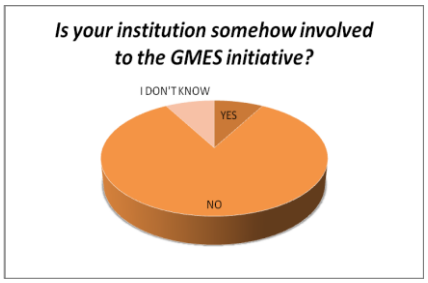


Figure 1.7: The graph reports the answers about the presence of GMES in the EnvEurope sites.

2 Network design

The existing LTER-Europe presents four core characteristics differentiating it from other networks and forming part of its uniqueness (Mirtl 2009):

1. In situ: LTER-Europe generates field data at different scales (up to the regional scale) and across ecosystem compartments.
2. Long-term: LTER-Europe dedicates itself to the provisioning, documentation and continuous use of long-term information and consistent data on ecosystems with the time horizon of decades to centuries.
3. System: LTER-Europe contributes to better understanding the complexity of natural ecosystems and coupled socio-ecological systems.
4. Process: LTER-Europe´s research aims at the identification, quantification and interaction of processes of ecosystems driven by internal and external drivers.

The selection of sites in LTER Europe was not decided with a top-down approach and, therefore, it did not follow an a priori “design”. The proposal of a network “design” would necessarily result in a post-hoc stratification of sites, taking into account the core characteristics of LTER network and according mainly to user requirements, focal ecosystems and biome or socio-ecological strata of Europe. To achieve this goal we will adopt a step-wise process to produce a proposal of a LTER network re-design (Fig. 2.1)

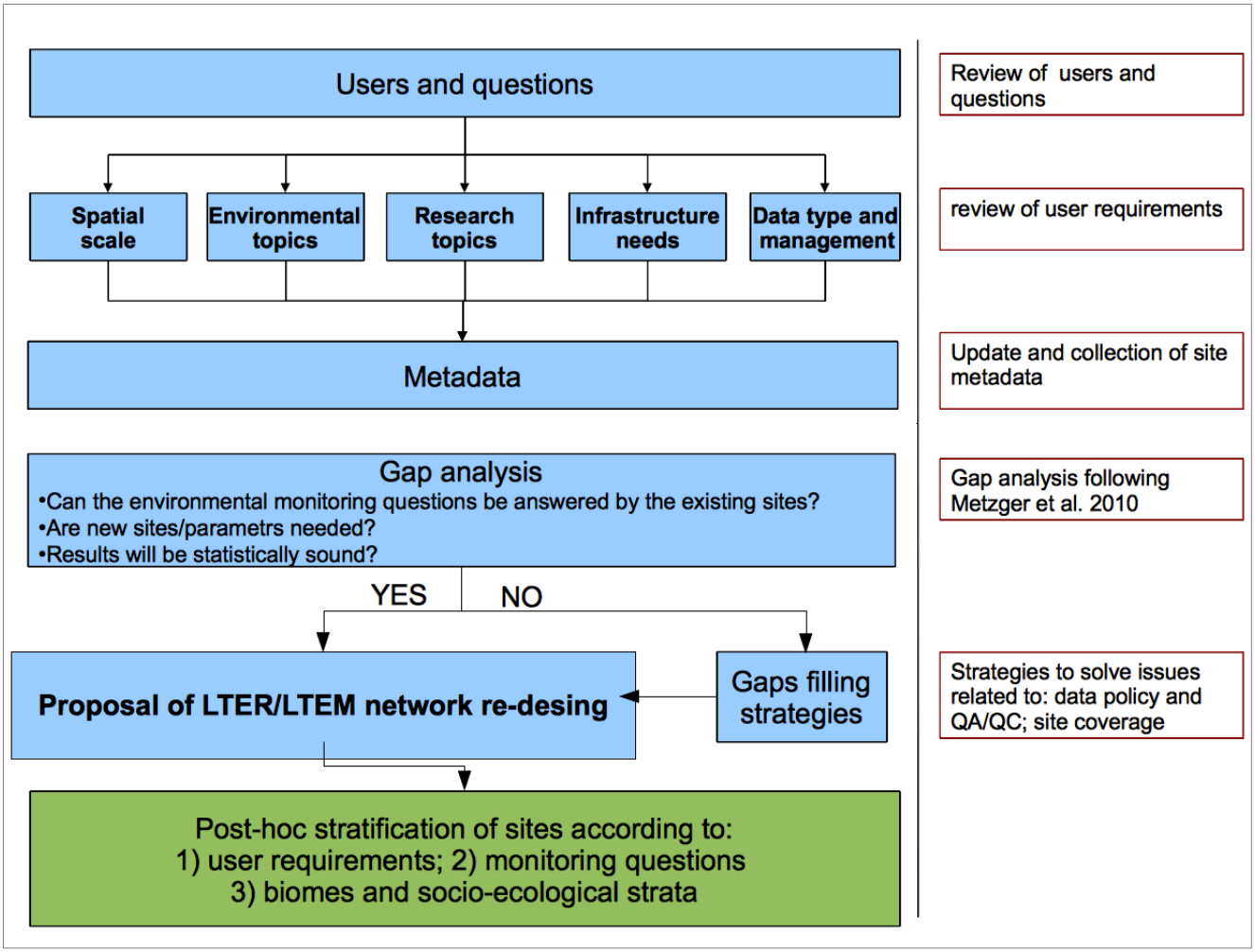


Figure 2.1: step-wise process toward a proposal for LTER/LTEM network re-design

The process consists of some crucial steps that are summarized below. Each step represents also a key strategic product according to the Action Plan of A4.

1. Identification of key users (for LTER-Europe) and their respective requirements. This will concern also issues of spatial and temporal scales, infrastructure, data accessibility, etc.
2. Identification of clear and meaningful monitoring and research questions that fit with the user requirements and review of key themes for which the network shall form the reference for scientifically-sound environmental monitoring:
   a) For what themes does the network fit, as it is?
   b) For what other high priority themes do we need a network re-design?
   c) Evaluation of feasibility.
3. Updated site metadata definition (in cooperation with EnvEurope Action 1, LTER-Europe EP Information Management) and collection (A4 team together with LTER-Europe secretariat); see paragraph 1.3.3 of this report.
4. Gap analysis according to M. Metzger (2010):
   a) Analysis of the updated 2011 site metadata for whole LTER-Europe network.
   b) Check if gaps have been filled or new ones emerged.
5. Review of existing standards developed for site sampling design, statistical issues, data sharing policies issues, aspects related to QA/QC of metadata and data, metadata and data validation.
6. Proposal of LTER network re-design:
   a) Cooperation with LTER-Europe through the Expert Panel on Network Design to secure harmonized, synergistic and integrated activities.
   b) Guidelines: what gaps could ideally be filled by the countries.
   c) Clarification of options for establishing LTER-Europe as a ground-truth network for the validation of GMES satellite data.
   d) Remote sensing: tool for cross-domain monitoring and potential use of LTER sites for ground truth validation Synergies and collaboration with other European environmental strategies (Natura2000, etc.).
   e) Proposals for network integration with other *in situ* networks at the national scale (e.g., which well instrumented ICP-Forest sites should be included in the LTER network)

2.1 Review of potential users and requirements for the LTER network

An integrated long-term monitoring network has the potential to meet the data and information requirements of a range of users (Parr et al., 2002).
The following list represent a proposal of potential users of the LTER network. These users can be divided in subjects directly interested in research and monitoring on sites (i.e scientific community) , or subjects not directly involved in the monitoring or researches but interested in the outcomes (i.e decision-makers).

Potential users can be classified according to:

1) User type (e.g. decision makers, researchers, commerce, educators, NGOs)
2) Scale of interest (i.e. local, national, European, global)
3) Data type: aggregate or raw data[1]
4) Infrastructure needs

Potential user list according to type, scale, data type and environmental issues

User type: European scientific community
Scale: Global (ILTER) to European to National to site/local
Data required: aggregated and raw
Infrastructure: very specific requirements, i.e particular environmental sensors, facilities (laboratory and analytic instruments), staff availability.

1. University
2. Research centre
3. Environmental agencies

User type: European monitoring programs
Scale: European
Data type: aggregated
Infrastructure: specific requirements (particular environmental sensors, measurement

[1] We focused on two data type categories: aggregate and raw data. These categories concern the potential use of the information provided by the sites. Aggregate data are easy to read and ready to be used while raw data are not meaningful if not properly analysed.

devices, staff availability).

1. European Environment Agency (EEA)
2. GMES
3. EBONE
4. GEOBONE
5. GTOS
6. Natura2000

User type: Decision-makers (Agencies, Institutions and departments responsible for supplying data and information to the EC on environmental quality)
Scale: European, national and local
Data type: aggregated
Infrastructure[2]: no specific requirements

1. European Environment Agency (EEA)
2. European Commission Directorates-General (DGs)
3. FAO
4. European Earth Observation Community
5. Local municipalities

User type: media and educational programs
Scale: European and local
Data type: aggregated
Infrastructure: no specific requirements

[2] We used two possible infrastructure requirements categories: specific or very specific requirements and no specific requirements. The first means that the users have some specific needs (i.e some particular measurement devices) or the necessity to access directly to the site. Thus, very specific information on the available facilities are required. The second category (no specific requirements) means that the users do not have specific needs, because is supposed that they will not work directly in the sites but that they are more interest in the information (often aggregated) provided by the sites.

2.2 Proposal for the update of the metadata in collaboration with LTER-Europe EP Information Management, LTER-Europe secretariat and EnvEurope Action 1

The identification of useful sites requires a detailed knowledge of the characteristic of the sites. This can be achieved by the query of available metadata already present in the LTER Infobase. However, there is a common idea within the LTER community, also supported by recent scientific papers that focused on the LTER network facilities (Metzger et al., 2010), that, at present, for the majority of the sites there is still a limited number of metadata available, despite major efforts. Particularly the existing metadata information do not allow a clear definition of researches carried out in most of the sites and the available infrastructure.

Thus, the updating of the metadata at site level represents a critical prerequisite for any network design proposal. The update of some metadata, particularly those concerning the data storage and data management (including sharing policies), is a task of the EnvEurope project - Action 1. Other aspects also need to be updated, particularly those concerning the research topics and the infrastructure and facilities available at the sites.

Action 4 is collaborating with EnvEuropeAction 1 (Data collection and management) and LTER-Europe EP Information Management and LTER-Europe Secretariat in order to produce a new metadata factsheet. All the EnvEurope Beneficiaries and all the LTER-Europe site managers were requested to fill this new version of the Infobase and the results were then elaborated by A4 and shared with the whole LTER-Europe community.

Due to the high heterogeneity of ecological researches carried out within LTER-Europe, most of the sites can be grouped, on the basis of a keyword set, according to broad research categories (i.e. pollution, population dynamic, hydrology, etc.). The new metadata factsheet will allow to provide detailed information on site through a field that can be freely filled (up to 3000 characters) where the site manager can provide a detailed explanation of the research carried out in the site.

The factsheet covers other important set of metadata that are lacking or only partially present in Infobase. These metadata concern:

a) Site Characteristics (information about the environmental characteristics were

improved by adding location, protection status, design and management)

b) Infrastructure (attributes about the access and infrastructure of the site)
c) Research Network (the networks in which the site is included)
d) Parameter groups (observed parameters on the level of parameter groups)
e) Data Management (the data management environment and the data policy for data sharing)
f) Habitat characteristics (information about the existing habitats according to the EUNIS classification).

3 GMES: potential use of LTER sites for ground truth validation of environmental data from the space

GMES is a EU-user-driven programme with support of ESA (European Space Agency).
In June 2010 the European Parliament approved the European Commission's proposal for a regulation on the GMES programme and its initial operations from 2011-2013 to allow an operational GMES system by 2014 (regulation EU No 911/2010).
The GMES programme comprise the following:

4. A service component ensuring access to information of the areas:
   - Atmosphere monitoring;
   - Climate change monitoring in support of adaptation and mitigation policies
   - Emergency management;
   - Land monitoring;
   - Marine environment monitoring;
   - Security.

   Considered as "public goods", these services should be accessible to any organization or citizen.
5. A space component ensuring sustainable space borne observations for the services;
6. An in-situ component ensuring observations through airborne, seaborne and ground-based installations for the services.

The sustainability of the GMES operational services will be ensured through public funding from EU intergovernmental agencies and Member States and the users are policy makers and public authorities.
Several projects have been developed within GMES and 7th FP:

7. Geoland (Land monitoring Service)
8. Myocean (Marine monitoring)
9. Macc (Atmosphere Monitoring Service)
10. Safer (Emergency Response Service)
11. Gmosaic (Security Service)

GISC

GISC (GMES in-situ Coordination) project is in support of the GMES Bureau, financed by

the EU's 7th Framework Programme and will run for 3 years (January 2010 – December 2012).

The goal of the project is to secure sustainable provision of *in situ* data to GMES, according to end user requirements and to resolve the barriers for cost effective and sustainable data provision.

The process encompasses 5 steps:

1) Identify and classify in situ data required by the GMES services
2) Compare with available data and identify gaps
3) Design and implement solutions that will close gaps
4) Make use of existing capacities
5) Concluding agreements

An important prerequisite is the open access of data and the harmonization to INSPIRE and SEIS: data and information aim to be managed as close as possible to its source in order to achieve a distributed system, by involving countries and existing capacities which maintain and operate the required observation infrastructure

The Initial stakeholders list with selection analysis and linked to in-situ data requirements (v. Oct 2010) and the Draft Report on in situ requirements (v. March 2011) are the main documents of the project, so far, and are accessible at the project website (http://gisc.ew.eea.europa.eu/gisc-project/deliverables).

3.1. GMES and the LTER Community

The GMES in-situ stakeholders are International, European, regional (public or private) and national organizations that collect, hold, coordinate and provide the required in-situ data needed for the GMES services to deliver their products. The LTER-Europe network is interested to be one of such stakeholders LTER-Europe network can play an important role as an official validation network and in-situ data provider for the GMES products. These are the main questions that Action 4 will address and answer by the end of the project.

Furthermore, GMES explicitly look for harmonized in-situ network and harmonizing LTER is one of the main goals of EnvEurope.

The activity of Action 4, in terms of GMES, has been started in 2010 with the acquisition of necessary information, the establishment of first contacts with persons/Institutions direct involved in GMES projects (i.e. My Ocean Project and GISC) and the presentation of proposals to public conferences (i.e. "Data Flow from Space to Earth" International

Conference hosted by Corila, Venice Italy, March 2011).

From the analysis of the available information it clearly comes out that some peculiar LTER features (e.g. the long-term perspective, the ecologically meaningful in-situ measured parameters, the quality of data and the availability of biodiversity data), represent important and attractive issues for the GMES program.

From the preliminary analysis of Services it emerged that, while the Marine Service is in an advanced state of definition, the Land service of GMES is still in a preliminary phase. This is an opportunity for LTER-Europe. Specifically, the terrestrial component of the LTER network could be involved in the Land Monitoring Core Service with the in situ data component that are requested by the Service. The role of this kind of data is to provide:

1. Control points for calibration (many LTER-Europe sites measure important atmospheric parameters for image calibration)
2. Training information for supervised image classification (most of LTER-Europe sites have updated fine-scale land cover maps)
3. Ground truth data for the validation of the interpreted products (LTER-Europe sites will be harmonically measuring common parameters across the whole network and different ecological domains)
4. Complementary data in the monitoring, detection and understanding of environmental changes for parameters that cannot be derived from remote sensing data (the long term character of measurements provided by LTER-Europe network strengthens the ability to evaluate sensor radiometry drifts on the different supporting GMES missions through time and to assess observed global and regional changes at the LTER site local scale by using ancillary data not retrievable with remote sensing images).

In the next future the following strategies are proposed to the EnvEurope/LTER community in order to improve the connections with GMES:

1. Interact with the project GISC (EEA)

2. Define contacts with EUMETNET (important stakeholder of GMES) and ESA Opportunity missions (CarbonSat, Flex, Biomass)
3. EnvEurope as GMES user: attend the next User Forum of GMES
4. Develop Sensor Web Enablement (SWE) service.

3.2. Ground truth data validation and the upscaling exercise (in connection with Action 2, Ricardo Díaz-Delgado and Mark Frenzel)

EnvEurope sites are located at every biogeographical region in Europe, representing characteristic and relevant landscapes, habitats, land uses and cover plant communities of the whole continent.

Accordingly, the EnvEurope network of sites may be used to address upscaling issues when validating GMES products with in-situ data. In situ measurements need to be extrapolated to pixel sizes for what different methods have been proposed.

These aspects stress the need to synergize efforts from LTER-Europe and GMES/SEIS initiatives in order to provide in situ assessment of usability and applicability of large scale remote sensing products for long term ecosystem monitoring in Europe.

It is also expected, as one of the main results of the interaction between LTER-Europe and GMES, the diffusion of new tools for supporting the environmental management policies and decisions.

The most suitable set of GMES products to be widely used by EnvEurope network in a preliminary exercise comes from the GMES Land Monitoring Service. BioPar (Biogeophysical Parameters), integrated in the Geoland2 Project, will provide many of the parameters and indicators datasets proposed to be measured at the EnvEurope network what makes this service valid for the ground-truth validation exercise. In addition, High Resolution biophysical products are proposed for 4 pilot areas from which 2 include EnvEurope sites.

GMES products are provided at several resolutions according to source sensors going from 1 km down to 200 m. LTER-Europe sites range from few hundred square meters to hundred of hectares according to ground reference for every measurement. Ground truth-data provided by EnvEurope should have to be aggregated by using scaling approaches. The purpose of this preliminary exercise is to set up a standard procedure to scale up in situ data to pixel size of GMES products.

On the other hand, although most of resource sensors have a high temporal resolution, acquisition of optical images is conditioned by cloud cover. Temporal availability might therefore be a constraint on ground-truth and validation procedures. In addition, remote sensing surrogates for ground parameters may show unexpected changes in their range values, which may be easily checked by secured provision of ground-truth data in the long-

term run. Signal saturation for remote sensing measurements might also be assessed for GMES derived products, enabling fine-tuning accounting for landscape heterogeneity.

References

Metzger, M.J., Bunceb, R.G.H., van Eupen, M., Mirtl, M., 2010. An assessment of long term ecosystem research activities across European socio-ecological gradients. Journal of Environmental Management, Volume 91, Issue 6, June 2010, Pages 1357-1365

Mirtl, M., Boamrane, M., Braat, L., Furman, E., Krauze, K., Frenzel, M., Gaube, V., Groner, E., Hester, A., Klotz, S., Los, W., Mautz, I., Peterseil, J., Richter, A., Schentz, H., Schleidt, K., Schmid, M., Sier, A., Stadler, J., Uhel, R., Wildenberg, M., Zacharias, S., 2009. LTER-Europe Design and Implementation Report – Enabling “Next Generation Ecological Science”: Report on the design and implementation phase of LTER-Europe under ALTER-Net & management plan 2009/2010. Umweltbundesamt (Federal Environment Agency Austria). Vienna. 220 pages. ISBN 978-3-99004-031-7

Parr, T.W., Ferretti, M., Simpson, I.C., Forsius, M., Kovács-Láng, E., 2002. Towards a long-term integrated monitoring programme in Europe: network design in theory and practice. Environmental Monitoring and Assessment, 78: 253–290.