Thinking globally, acting locally:

"The role of e-Infrastructures: Linking biodiversity and ecosystems through the deployment of new technologies in lakes and reservoirs for advanced water management"

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NETLAKE MC and WG MEETING

21/23 January 2014 Catalan Institute for Water Research (ICRA), Girona



PART I Introductory Context

Is the Earth sustainable?

Have we exceeded the Earth's capacity to heal itself?



To answer this we need to **UNDERSTAND**:

 environmental limits/ecosystem resilience

 relationship BIODIVERSITY & ESSENTIAL ECOSYSTEM SERVICES



Which actions to ensure long-term sustainability

Can we adapt to environmental change

What are the impacts of changes in climate, pollution and land/sea-use on biodiversity How to manage multi-functional land/sea-scapes

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Where are the thresholds in ecosystem structures and functions

How do changes affect the provision of ecosystem services





doing what IPCC did for Climate Change for biodiversity

Nagoya – 2010 – CBD targets

The mission of the Strategic Plan is to "take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services, ...

Thereby securing the planet's variety of life, and contributing to human well-being, and poverty eradication ...

GEO GROUP ON EARTH OBSERVATIONS



GEO BON

Biodiversity Observation Network

Implementation plan to 2015

The ECONOMICS of Ecosystems and Biodiversity (TEEB) - 2010

IT IS NECESSARY:



MAINSTREAMING THE ECONOMICS OF NATURE A SYNTHESIS OF THE APPROACH, CONCLUSIONS AND RECOMMENDATIONS OF TEEB ✓ Provisioning SERVICES

✓ Regulating SERVICES

✓ Suporting SERVICES

✓ Cultural SERVICES

A KEY: INTERNATIONAL COOPERATION



How to

Integrate across scales?

...and stakeholders needs?

...taking into account the <u>COMPLEXITY</u> of data, model and tool resources...BUT...



- ...Many models? Poorly linked
- Not enough relevant or accessible data?
- Too much data not enough synthesis and understanding

Courtesy of T. Parr

Sergei Ashmarin, Russia

✓...All these topics meet in River Basins, where Decision Makers, Researchers, different socio-economic Stakeholders (mainly from Agro-food, Water and Energy sectors) and rest of Citizens (in general terms), come together as members of Communities of Practice sharing these common concerns (González-Aranda et al., 2006) not only at their regional/local river basin, but also at international level (González-Aranda, 2010).

✓ Monitoring, modelling and understanding River Basins is a real challenge that requires the experience and knowledge cumulated along many decades, but today it can greatly benefit of the new streams of information, like high resolution satellites images, or real time monitoring sensors, and also from more complex and accurate models covering from global climate to local hydrological and water quality predictions.

✓Therefore, the provision of proper service-oriented e-Infrastructures, integrating the whole chain from instrumentation and databases to supercomputers where models can be executed, taking benefift of the "state-of-art" of the Information Society Tecnologies, will support to understand the environmental limits, ecosystem resilience and relationship between Biodiversity & Essential Ecosystem Services.

✓ In that sense, this abstract presentation shows a set of on-going case studies and initiatives based on the framework of the ESFRI LIFEWATCH, putting in practice many of these concepts.

PART II What is LifeWatch?

NOW, we will focus on how to measure the impact of previous issues on Earth **Biodiversity**



...and HOW TO INTEGRATE them with the building blocks of any <u>RESEARCH INFRASTRUCTURE</u>



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European Strategy Forum on Research Infrastructures



LifeWatch Research Infrastructure Enhancing Biodiversity & Ecosystem Science

LifeWatch is an e-infrastructure that gives access to:

- Distributed observatories/sensor networks,
- Interoperable databases, existing (data-)networks, using accepted standards
- Computational power
- Software and tools for visualization, analysis and modeling





(CC)



28 European Union Countries

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Candidate and Associate Countries (Turkey, Israel,...)

+

Other Countries (USA, China, Japan, Latin-America, SouthAfrica, etc.)

Service Centre Lecce, Italy



Virtual Labs Amsterdam, The Netherlands

LifeWatch Common Facilities



ICTS de la Reserva Biológica de Doñana





Statutory Seat & ICT CORE, Seville (Andalusia, Spain)

Basis for Spanish general interest in LW

- Spain is a highly biodiverse country.
- Concern about the anthropogenic impacts (particularly climate change) on biodiversity at different scales, <u>for example, in River Basins.</u>
- Potential of LIFEWATCH as a tool for biodiversity research and to define research-based environmental policies (e.g., in <u>River Basins</u>).
- Strong scientific community on biodiversity research (top 10 in scientific citations in Ecology and Animal and Plant Sciences in the last 10 years).
- Solid ITC infrastructures, researchers and technical staff:
 - It is important to remark the big investment of Spain in Singular Scientific & Technological Infrastructures (ICTS), such as the Doñana Biological Reserve in Andalusia;
 - The Spanish Network for Supercomputing (RES) and the National Grid Initiative (NGI), tightly connected with (strategical) Portugal's one (IBERGRID).

LIFEWATCH SPAIN GOVERNANCE SCHEME



MAJOR INSTITUTIONAL ACTORS



MINISTERIO DE AGRICULTURA, ALIMENTACIÓN Y MEDIO AMBIENTE





CONFEDERACIÓN HIDROGRÁFICA DEL GUADALQUIVIR







CITIC Centro Andaluz de Innovación y Tecnologías de la Información y las Comunicaciones

THEREFORE...

LifeWatch is:

A LARGE **DISTRIBUTED** RESEARCH FACILITY

ADDRESS **NEW RESEARCH FIELDS** TEST INNOVATIVE HYPOTHESIS

DEEPEN SCIENTIFIC KNOWLEDGE HIGHLIGHT SOLUTIONS TO ENVIRONMENTAL ISSUES

LifeWatch is **NOT**:

A NEW/LARGER DATA REPOSITORY

PART III What for ?

LIFEWATCH STAKEHOLDERS



Why LIFEWATCH is going to have an impact on the provision of Biodiversity services?



...LifeWatch IT framework. Example of one possible type of "customers": ENVIRONMENTAL MANAGERS)



PART IV

On-going case studies and initiatives based on the framework of the ESFRI LIFEWATCH

CASE STUDY

AN OUTSTANDING EXAMPLE OF INTEGRATION: Monitoring Cyanobacterial Blooms at Cuerda del Pozo reservoir

ECOHYDROS SL for Confederación Hidrográfica del Duero (CHD) DORII (FP7 project with IFCA-CSIC), ROEM & ROEM+ (Avanza & LIFE projects with ITG)



New generation of smarter complex sensing platforms

Advanced water quality measurement

Relevant environmental measurements Atmospheric-meteorological variables Hyperspectral solar radiation in water Nutrients

High sampling frequency (minutes/hours) + data transmission to cloud services (replicated database, on-line monitoring system)

Mobility (GPS integrated) plus **Profiling** (wincher programmed/remote down to 50m)



(Coterillo, 2012).



ONLINE ACCESS (data, profiles, images) USING CLOUD RESOURCES AT IFCA



THE CHALLENGE:

Integration of information and models using e-infrastructures for advance water reservoir management

INFORMATION:

-DMP(DataManagementPlan)integratinginternalandexternalinformation,keyforpreservation(PID).

-GIS system

MODELS: -DELFT3D (open model) Water reservoir modeling *Running: Cloud + Supercomputer* -physical (abiotic) VALIDATED ! -water quality (biotic) Working on it

DECISION/MANAGEMENT TOOLS NEXT STEP!



CASE STUDY ||

CASE STUDY II: Harmonized and consolidated data, such as those systematically provided by river basin authorities and integrated modelling will enable the researchers on water-related issues to establish inter-linkages with other environmental drivers, such as climate change or anthropic impacts, and even to work at different temporal and spatial scales.



CASE STUDY III

<u>CASE STUDY III:</u> AQUALIFE Advanced Surveillance Environmental & Decision Support System for River Basins



 ✓ AQUALIFE is a multi-stakeholders organizational knowledge and information management system

✓ "In real time" and "on-demand" managed (e-) services

 ✓ Assessment and management of flood risk and river restoration best practices

✓ Cost, energy saving and crop management recommendations for Agro-food sector

✓ Citizens participate (web and mobile) transmitting their opinions and suggestions in regards to water conflicts and River Basin preservation and restoration

Prototypes will be deployed in Guadalquivir River Basin (including the Doñana Natural Area) under the auspices of the Guadalquivir River Basin Authorities Body, in cooperation with the Andalusian Institute of Technology

<u>ALL TOGETHER:</u> AQUALIFE – LIFEWATCH e-Infrastructure based Information system Architecture





WP6 for Global Use Case

High interest in WP6 on use case presented at NEON meeting: Connecting biogeochemistry observations across research infrastructures

> Observing the global carbon cycle: coupling terrestrial and ocean



Example of potential contributions on phenology from WP6: EU: Teams in Spain (UGr) and Belgium (ULov.) ——— NEON (contact with Andrea Thorpe)



Snow

Vegetation

Remote sensing

Solar energy

In the framework of LifeWatch the Wallonia-Brussels Federation is financing a research program withi The LifeWatch Wallonia-Brussels (LW-WB) team has a strong experience in land cover and land use methods and GIS analysis.



COOPEUS WP6 (Biodiversity)



WP6 for Global Use Case

We would very much like to interconnect/exploit data and also experience & knowledge:



Bob Cook NORTH AMERICAN CARBON PROGRAM

LifeWatch as Research Infrastructure is already exploring this use case on the processing/modeling side within the framework of EGI.eu (European Grid Infrastructure), with the aim to provide a complete Virtual Research Environment on the topic. This framework integrates many different components required.



COOPEUS WP6 (Biodiversity)

In summary:

- The role of e-Infrastructures is essential so they allow to link biodiversity and ecosystems, to better understand the different Biodiversity Ecosystem Functioning (BEF) components, through the deployment of new water quality technologies in river basins.
- New e-Infrastructures (such as LifeWatch) are based on a new paradigm of DISTRIBUTED European Research Infrastructures integrated within ESFRI Roadmap, where there is a perfect combination between the state-of-art of Information and Communication Technologies (ICT) with Environmental (Biodiversity, etc.) developments, addressed to different Society Stakeholders: Researchers, Decision Makers and Citizens (in general terms).
- ✓ Therefore, these e-Infrastructures need high levels of coordination and management efforts in order to guarantee INTEROPERABILITY not only among Data, Information and Knowledge, but also among their Community Members.
- ✓ LifeWatch is an excellent opportunity for participating stakeholders to put in value their developments investments on new water quality technologies (Integrated Water Resources Management in general terms), as it was shown in the different case studies of this abstract presentation.

Thank you very much for your attention !

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Pictures from Doñana by Héctor Garrido (CSIC)