



Integrated European Long-Term Ecosystem Critical Zone & Socio-ecological Research Research Infrastructure

eLTER – The European Long-Term Ecosystem, Critical Zone and Socio-Ecological Research Infrastructure

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#### "Whole System"-Approach & cross-disciplinarity for the Life Supporting System



Site categories differ in their focus on different system layers

#### eLTER provides

- Basic site infrastructure
- Data nodes integrating
  - Baseline observation of "EEVs"
  - Multiple other data sources (RS, modelling)
- User access to data
- Site access

Continuous long-term operation of ~200 innovative hubs



# eLTER – The conceptual pillars

## Wide-Scale Coverage of Major Terrestrial and Aquatic Ecosystems in Europe





## eLTER – European Long-Term Ecosystem and socio-ecological Research Infrastructure















- 19 supporting countries
- ~ 80 EoC: 18 countries
- ~ 160 MoU: 27 countries
- 45/80/130 eLTER Sites
- 5/10/30 eLTSER Platforms
- 2020-2025: 14 Mio €
- 27 countries
- 40 partners
- 200 data providing sites
- 25 countries
- 400 LTER Sites
- 35 LTSER Platforms



# **eLTER PPP and eLTER PLUS Links**





# **eLTER PPP Framework**





#### **eLTER RI organizational structure**



#### **Topical Service areas**

**Quality Assurance for Data** - Data quality assurance, validation, & standards

*Modelling and Analysis Tools* - Analysis tool kits and community modelling platform

**Design Interoperability and Synthesis** - Outreach, interoperable design development, fostering transdisciplinarity, co-design and synthesis

*Technological Innovation and Development*- private sector, innovation, technologies.



## **Overview of eLTER services provided through the Service Portal**

- Research site access
- Long-term data & related models, tools & products
- Research design support
- Ground-truthing of Earth Observations
- Research technology R&D
- Education & training
- Outputs informing policymakers





#### Ambition for harmonisation and accessibility of legacy data from the various sites



eLTER

#### **eLTER RI Timeline**





# Distribution of formally accredited LTER-Europe sites within the European biogeographical regions



#### Platforms for long-term socio-ecological research (LTSER)



#### Regional scope

- landscape level
- local population and decision making



Courtesy: Orenstein (Technion), 2017



**Interdisciplinary**: Promote integration of natural and social science

Cross-sector stakeholder collaboration

Relevant knowledge for decision-making

# **eLTER Framework of Standard Observations**



Percentage of Testsites measuring Ecosystem Integrity Ecosystem Integrity Component eLTER Parameters 40 50 60 70 80 90 100 AirTemperatur Windspeed/-direction Air Humidity Barometric Pressure Abiotic Precipitation Heterogenity coming Shortwave Radiation Soil Moisture Soil Characterization Discharge Surface Water Temperature Surface Water pH Water Surface Water Specific Conductivity Budget Groundwater Temperature Groundwater Specific Conductivity Groundwater Elevation Surface Water- Nutrients and Ions Soil Core Sampling Matter Budget Atmospheric Deposition Surface Water (DOC) Soil Heat Flux Energy Radiation Budge Budget Concentration of CO2, Water vapor Birds Biotic Insects Diversity Vascular Plants

Mollenhauer, H., Kasner, M., Schima, R., Bumberger, J., Frenzel, M., Mirtl, M., & Zacharias, S. (2018). Long-term ecological monitoring systems in Europe– methods, scales, perspectives. Sci. Total Environ. 624, 968-978



Haase, P., Tonkin, J. D., Stoll, S., Burkhard, B., **Frenzel, M**., Geijzendorffer, I. R., Häuser, C., **Klotz, S., Kühn, I**., McDowell, W., **Mirtl, M**., Müller, F., **Musche, M**., Penner, J., **Zacharias, S., and D.S. Schmeller** (2018). The next generation of site-based long-term ecological monitoring: Linking essential biodiversity variables and ecosystem integrity. Science of the Total Environment, 613, 1376-1384

#### **eLTER Framework of Standard Observations**

- 1. Representation of key elements of the Ecosystem Integrity Concept
- 2. High sensitivity to environmental changes
- 3. Critical Relevance for environmental modelling





#### **eLTER Framework of Standard Observations**



# Simplicity (Parsimony)

"A design too complex increases the risk of premature demise."

(Henry Janzen, 2014)



#### eLTER Framework of Standard Observations (biotic, abiotic)

| EI components         | LTER standard observations                   |  |  |  |  |  |  |  |  |
|-----------------------|--|--|--|--|--|--|--|--|--|
|                       | air temperature                              |  |  |  |  |  |  |  |  |
|                       | windspeed & wind direction                   |  |  |  |  |  |  |  |  |
| abiotic heterogeneity | humidity                                     |  |  |  |  |  |  |  |  |
| (climate)             | barometric pressure                          |  |  |  |  |  |  |  |  |
|                       | precipitation                                |  |  |  |  |  |  |  |  |
|                       | incoming shortwave radiation                 |  |  |  |  |  |  |  |  |
| abiotic heterogeneity | soil characterization (e.g. texture)         |  |  |  |  |  |  |  |  |
| (soil)                | soil moisture                                |  |  |  |  |  |  |  |  |
| abiotic heterogeneity |  |  |  |  |  |  |  |  |  |
| (motor)               | surface water temperature                    |  |  |  |  |  |  |  |  |
| (water)               | discharge                                    |  |  |  |  |  |  |  |  |
| water budget          | surface water pH                             |  |  |  |  |  |  |  |  |
| (surface water)       | surface water specific conductivity          |  |  |  |  |  |  |  |  |
| water budget          | groundwater temperature                      |  |  |  |  |  |  |  |  |
| water budget          | groundwater specific conductivity            |  |  |  |  |  |  |  |  |
| (groundwater)         | groundwater elevation                        |  |  |  |  |  |  |  |  |
|                       | surface water nutrients and ions             |  |  |  |  |  |  |  |  |
| mottor budget         | soil core sampling                           |  |  |  |  |  |  |  |  |
| matter budget         | atmospheric deposition                       |  |  |  |  |  |  |  |  |
|                       | surface water dissolved organic carbon (DOC) |  |  |  |  |  |  |  |  |
|                       | soil heat flux                               |  |  |  |  |  |  |  |  |
| energy budget         | radiation budget                             |  |  |  |  |  |  |  |  |
| chickey budget        | leaf area index (LAI)                        |  |  |  |  |  |  |  |  |
|                       | concentration of $CO_2$ & water vapor        |  |  |  |  |  |  |  |  |
|                       | abundance and identity of birds              |  |  |  |  |  |  |  |  |
| biotic diversity      | abundance and identity of insects            |  |  |  |  |  |  |  |  |
|                       | abundance of vascular plants                 |  |  |  |  |  |  |  |  |



#### Number of eLTER standard parameters currently measured by eLTER sites





#### **Relative frequency of eLTER standard observations – "status quo"**



Mollenhauer et al. 2018. Long-term environmental monitoring infrastructures in Europe: observations, measurements, scales, and socio-ecological representativeness. Science Total Environ. 624: 968-978



#### **Site-Specific Characterization**





Biodiversity







## **Geographical distribution of eLTER sites**

Level of development



Mollenhauer et al. 2018. Long-term environmental monitoring infrastructures in Europe: observations, measurements, scales, and socio-ecological representativeness. Science Total Environ. 624: 968-978



# eLTER RI – The process of designing a network



| EI components                      | LTER standard observations  |  |  |  |  |  |  |  |  |  |
|------------------------------------|---|--|--|--|--|--|--|--|--|--|
| abiotic heterogeneity<br>(climate) | air temperature<br>windspeed & wind direction<br>humdfdty<br>barometric pressure<br>precipitation<br>incoming shortwave radiation |  |  |  |  |  |  |  |  |  |
| abiotic heterogeneity<br>(soil)    | soil characterization (e.g. texture)<br>soil moisture   |  |  |  |  |  |  |  |  |  |
| abiotic heterogeneity<br>(water)   | surface water temperature   |  |  |  |  |  |  |  |  |  |
| water budget                       | discharge   |  |  |  |  |  |  |  |  |  |
| (surface water)                    | surface water pH<br>surface water specific conductivity   |  |  |  |  |  |  |  |  |  |
| water budget                       | groundwater temperature   |  |  |  |  |  |  |  |  |  |
| (groundwater)                      | groundwater specific conductivity<br>groundwater elevation  |  |  |  |  |  |  |  |  |  |
| matter budget                      | surface water nutrients and ions<br>soil core sampling<br>atmospheric deposition<br>surface water dissolved organic carbon (DOC)  |  |  |  |  |  |  |  |  |  |
| energy budget                      | soil heat flux<br>radiation budget<br>leaf area index (LAI)<br>concentration of CO <sub>2</sub> & water vapor                     |  |  |  |  |  |  |  |  |  |
| biotic diversity                   | abundance and identity of birds<br>abundance and identity of insects<br>abundance of vascular plants                              |  |  |  |  |  |  |  |  |  |





|   |         |         |        |   |                |        |            |   | $\cup$  | ~ | • |        | • | ~ | $\cup$ | • | ~ | • |  |
|---|---------|---------|--------|---|----------------|--------|------------|---|---------|---|---|--------|---|---|--------|---|---|---|--|
|   |         |         |        |   |                |        |            |   |         |   |   |        |   |   |        |   |   |   |  |
|   |         | 1       | 1      | 3 | $\overline{5}$ | $^{4}$ | 9          | 3 | $^{2}$  | 3 | 4 | $^{2}$ | 1 |   |        |   |   |   |  |
|   |         | ۰       | ۰      | 0 | 0              | 0      | $\bigcirc$ | 0 | •       | 0 | 0 | 0      | ۰ |   |        |   |   |   |  |
|   |         |         |        |   |                |        |            |   |         |   |   |        |   |   |        |   |   |   |  |
| 1 | 7       | 6       | 16     | 4 | 5              | 5      | 2          |   | 4       |   | 1 |        |   |   |        |   |   |   |  |
| ^ |         |         | -      |   | · ·            |        | ~          |   |         |   | ^ |        |   |   |        |   |   |   |  |
| ۰ | $\circ$ | $\circ$ | ()     | 0 | $\circ$        | 0      | 0          | 0 | $\circ$ |   | ۰ |        |   |   |        |   |   |   |  |
|   |         |         | $\sim$ |   |                |        |            |   |         |   |   |        |   |   |        |   |   |   |  |



d EI

J

2 4 6 8 10 12 14 16 18 20 22 Number of measured LTER standard observations





