

# eLTER STANDARD OBSERVATIONS

Establishing a standardised and harmonised research infrastructure (RI) design is essential to enable the efficient exchange and integration of data between and across sites, and for creating and providing spatially and temporally harmonised datasets to enable continental-scale analysis. Standard Observations (SOs) are the central building block for this process. The primary purpose of the eLTER Preparatory Phase Project (eLTER PPP) and the eLTER PLUS project is to transform existing research infrastructures into a continental, harmonised, inter- and transdisciplinary research infrastructure. eLTER SOs include all the variables, methods and protocols considered to be a priority for eLTER. The selection of SOs will affect the design of the RI, the services it will deliver and its operational costs. Their selection is therefore one of the critical challenges in establishing eLTER RI.

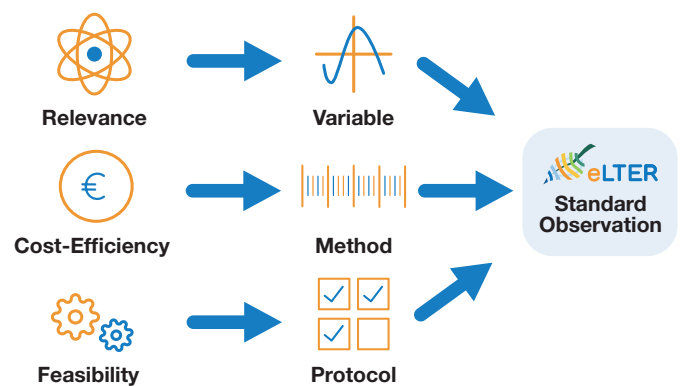


## eLTER Standard Observations – the concept

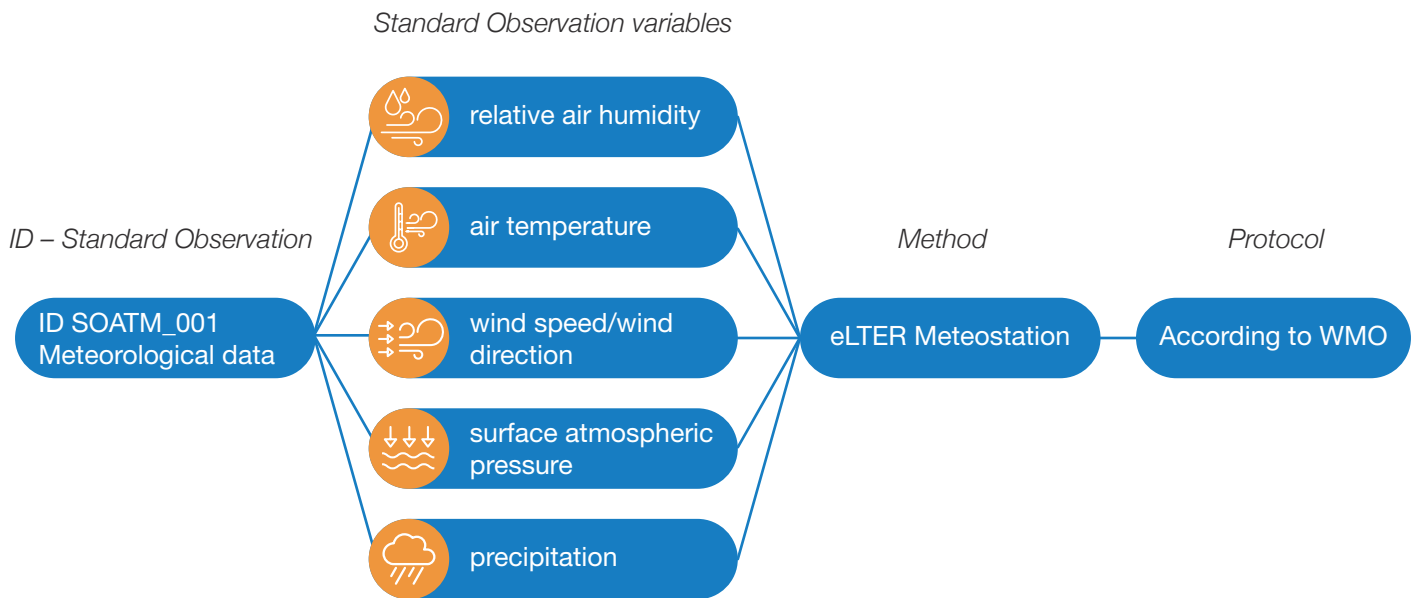
Based on eLTER’s whole system approach, the WALLS concept, the eLTER Standard Observations (SOs) will include the minimum set of variables and the associated methods and protocols that can adequately characterise the current state and future trends of the Earth’s systems. SOs should be relevant for determining the system’s state and development and they should have high impact, high feasibility and high cost-efficiency, both in terms of implementation and operation. They should also have sufficient spatiotemporal coverage in order to capture main trends in environmental states and fluxes across Europe (Masó et al., 2020; Reyers et al., 2017).

eLTER SOs are also a part of the harmonisation process, providing the most critical information from the diverse primary observations in a standard format. In this sense, SOs resemble “Essential Variables” as developed in various scientific disciplines. When selecting a SO it is necessary to balance scientific requirements with practical considera-

tions such as the cost of making the measurement (methods and protocols), risks to operators, and the feasibility of making the measurement in a wide range of environments. In accordance with these requirements, the eLTER SOs are defined as the combination of the environmental variable(s) to be measured and the associated measurement method and protocol to be used (see Fig. 1 and Fig. 2).



**Fig. 1:** Definition of Standard Observations (variable/ variables + method + protocol) based on consideration of scientific relevance, cost and operational feasibility



**Fig. 2:** Elements of the eLTER Standard Observation “Meteorological Data” - variables, method, protocol

**For the bulk of the SO variables, two levels of methods and protocols will be defined:**

- “prime”: these methods and protocols represent the highest eLTER standard (in terms of accuracy, spatial and temporal resolution) for the measurement of the respective variable,
- “basic”: these methods and protocols represent a less elaborated (and in most cases more cost-efficient) combinations of measurement method and protocol.

**eLTER Standard Observations – the process of development**

Developing the eLTER Standard Observations began in the eLTER H2020 and Advanced eLTER projects and is continuing in the current eLTER PPP and eLTER PLUS projects.

The eLTER SOs are an essential building block for the in-situ design of the sites and thus the basis for categorising the sites. Site categories are an elementary prerequisite to:

- facilitate screening sites with respect to their “quality” and focus in terms of instrumentation,
- indicate the thematic scope, science priorities and involved disciplines,
- group sites consistently across biomes,
- assess requirements in terms of costs and other resources,

- facilitate a national dialogue in terms of structuring and aligning national site networks.

In this sense, SOs are a key criterion for the site labelling process. In eLTER four different site categories are available:

- **eLTER site Category-1:** represent the highest site category. The holistic approach at Category-1 Sites covers all ecosystem spheres and all variable groups of the eLTER Standard Observations at least with the basic method. In addition, such sites specialise on at least two spheres, where the Standard Observation variables are measured with the prime method.
- **eLTER site Category-2:** sites at which observation and investigation of the whole ecosystem is carried out at a basic level. All ecosystem spheres and their related Standard Observations variables are studied with the basic method.
- **eLTER site Category-3:** sites, which do not (yet) cover the entire ecosystem. Not all ecosystem spheres/layers/strata are simultaneously observed and investigated and therefore WAILS is not (yet) put into practice.
- **eLTER Platforms:** are spatially explicit living laboratories for conducting transdisciplinary, long-term, socio-ecological research and for implementing eLTER RIs Whole Systems research approach. Research is conducted at the landscape scale using diverse disciplinary, interdisciplinary, and transdisciplinary approaches in tight coordination with local and regional stakeholders. A platform needs to include at least one eLTER site of Category-2.

**Table 1:** Labelling criteria applying to eLTER site categories 1 and 2

Criterion	Cat-1	Cat-2
Observational design covering the whole system (WAILS)	X	X
All system spheres covered with eLTER Standard Observation (BASIC)	X	X
Focusing: for at least two spheres the eLTER Standard Observation – PRIME is applied	X	
Secured capacity for Transitional (physical) Access (TA), Remote Access (RA)	X	
Guaranteeing Virtual Access (VA, i.e. open data access)	X	X
All-year access guaranteed (road infrastructure or other)	X	(X)
Roles populated: site coordinator, data manager	X	X
Full documentation in the eLTER site registry and nationally acknowledged	X	X
Long-term operation: past operation $\geq$ 10 years and future operation in accordance with eLTER RI planning	X	X

The following table provides a comparative overview of criteria applying to the eLTER sites categories 1 and 2, respectively.

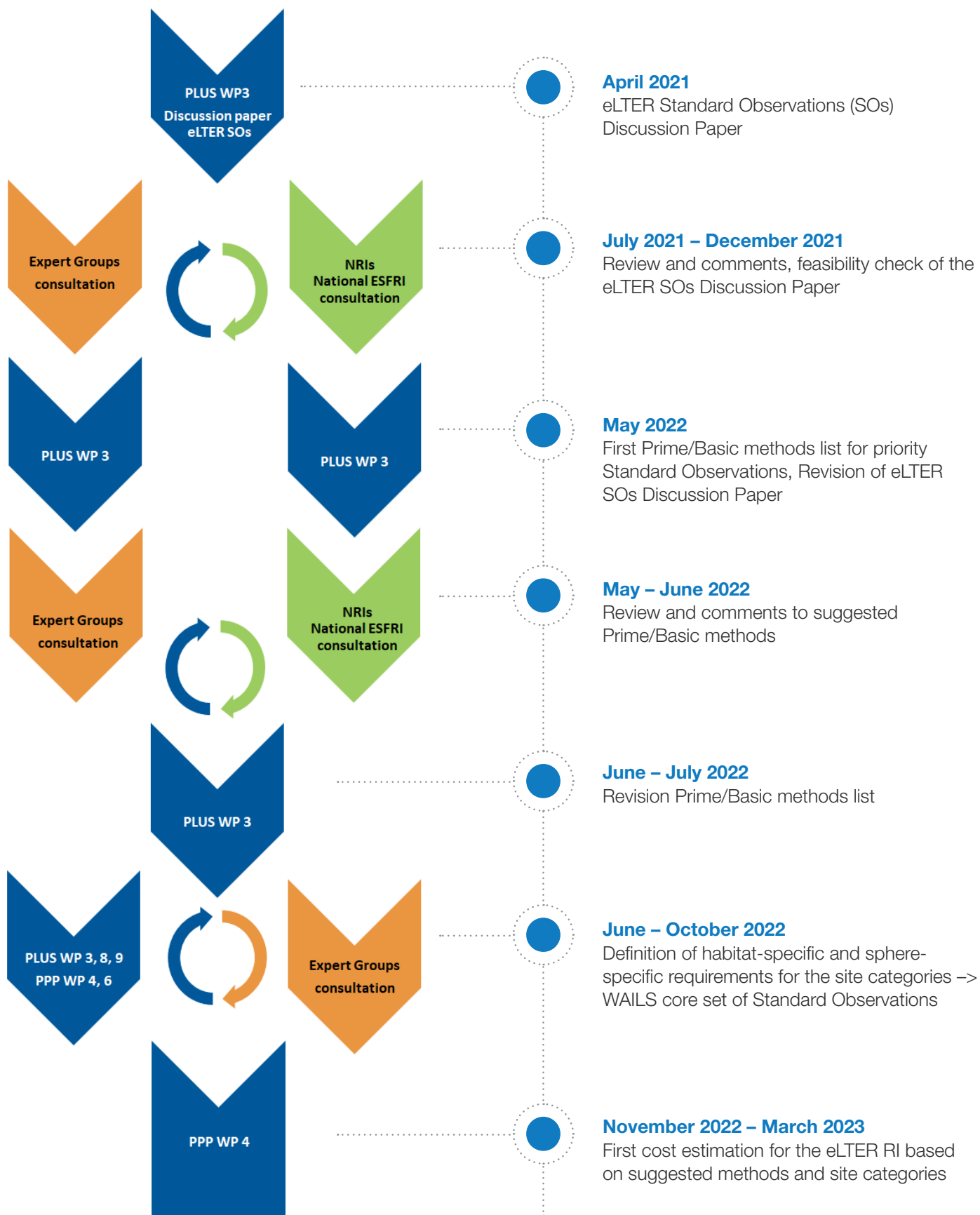
Developing the eLTER SOs and transforming this information into criteria for the site hierarchy is a multi-step process (see Fig. 3). According to the nature of the eLTER ESFRI process towards concerted decisions across all participating countries, these activities are being iteratively repeated as the eLTER SOs evolve towards a final version that the eLTER Interim Council will adopt.

A process of consulting with, and gaining feedback from, various stakeholders and user groups was started in 2020. First, a selection of priority environmental variables and appropriate measurement methods and protocols was based on scientific relevance. In the next step, these SOs were rated considering three criteria: relevance, feasibility, and cost efficiency. The feedback and critical revision of the discussion paper by the National LTER networks and Sites and Platform Coordinators was particularly important in assessing the feasibility of the SOs. Furthermore, the feedback process was extended to the viewpoints of scientific disciplines as represented by the eLTER Expert Groups (EGs). All this aimed to find a balance between scientific requirements and the feasibility of SOs at the European level.

The results of the various consultation steps formed the basis for version 2.0 of the discussion paper, which provides a comprehensive overview of the prioritised SOs. This was followed by a further series of consultations aimed at defining the ‘minimum set’ of SOs – the WAILS core set of Standard



Observations - required to describe the respective habitat in terms of WAILS for the habitat types covered by the eLTER RI network. Following the EUNIS (European Nature Information System) Habitat Classification, developed by the European Topic Centre for Biodiversity for the European Environment Agency (EEA), nine habitat groups were defined, which form the basis for the classification of eLTER sites. With input from the eLTER Expert Groups, the Research Themes from eLTER PLUS, and the National LTER networks and Sites and Platform Coordinators, a habitat-specific selection of SOs was developed. This selection enabled further elaboration of the methods and protocols, and an initial cost estimate for the eLTER RI.



**Fig. 3:** Detailed workflow towards the first provisional cost estimate for the eLTER RI

## References

Masó, J. et al. 2020. Earth observations for sustainable development goals monitoring based on essential variables and driver-pressure-state-impact-response indicators. *Int J Digit Earth* 13(2), 217-235.

Reyers, B. et al. 2017. Essential Variables help to focus Sustainable Development Goals monitoring. *Curr Opin Env Sust* 26-27, 97-105.