Criteria for AnaEE Enclosed platforms

AnaEE platforms will take form in two categories: level 1 and level 2.

Criteria that should be fulfilled for each category are listed below. **Details on these criteria are provided per question, as in the questionnaire, in the addendum in this document.** For some criteria, additional information is requested in the current feedback to platform owners.

Criteria for level 1 and level 2 platforms:

- The platform offers sufficient space for new ecosystem-level experiments. It provides sufficient statistically independent units (minimum 12 but well-motivated exceptions are possible, e.g. facilities with exceptionally large individual units), scientific and technical staff to facilitate the access to the site (at least 1 each), lab and storage space, and sample handling facilities.
- The platform offers state-of-the-art techniques for manipulating pressures (mentioned in the call) at the ecosystem level. It meets the requirements for artificial light and/or sunlight reduction.
- The platform is highly instrumented, i.e. state and process variables can be monitored within each experimental unit (i.e. a replication for a given treatment).
- Platforms have proven experience with model collaboration.
- The platform will follow common AnaEE data sharing policy and, if needed, adapt data management approaches to meet AnaEE standards.
- It is possible to manipulate at least two pressures in an experiment, of which at minimum two at the same time (study of interaction).
- Facilities provide the capacity to run long-term experiments (> 1 year). Well-motivated exceptions, given nature of the platform (e.g. aquatic ecosystems) can be considered.

In addition, Level 1 should reach the following excellence criteria:

- A significant number of process variables are routinely measured by the facility (or facility staff). Processes may include exchange with the atmosphere (gas fluxes such as CO_2, H_2O, CH_4, N_2O, BVOC's), benthic-pelagic exchange processes in aquatic systems, soil and sediment processes (e.g. mineralization, leaching), community dynamics (gene flow, dispersal), etc.
- The key process variable measurements are automated, if technically possible. Well-motivated exceptions are possible, e.g. for biotic response variables that cannot be automated.
- Multiple interactions between pressures can be studied. At least one pressure is directly related to climate change (e.g. elevated CO_2, climate-warming (incl. heat waves), precipitation changes (incl. extreme rain events, droughts), hydrological changes (incl. drainage, sea level rise)).
- Background state variables (e.g. air temperature, air humidity, atmospheric pressure, incident PAR, soil temperature, soil water content) are measured automatically, if technically possible. Well-motivated technical exceptions can be considered, e.g. for biotic state variables that cannot be automated.

Additional in Enclosed/Open-air criteria (national level): Each country must provide at least one Level 1 platform (either Open-air or Enclosed)

ADDENDUM

Detailed criteria in relation to EOI questions.

Three types of questions were distinguished from the questionnaire:

- *Informative*: the reply is not critical for the quality of the platform, so no minimum threshold needs to be defined.
- *Case-dependent:* the reply is critical for the quality of the platform, but should be evaluated on a case by case basis because no general minimum threshold can be defined. For example, a platform aiming at macrocosms should have a larger available area (Q15) than a platform for microcosms, so there is no single answer.
- *Minimum criterium:* the reply is critical for the quality of the platform, and there is a general minimum threshold that all platforms should meet. For example, according to the call text, the number of independently controlled experimental units (Q19) should be at least 12 (or lower if it can be justified).

Assigning the questions to the categories and determining thresholds where needed

Q12: Which ecosystem pressures combinations are currently manipulated at the site?

MINIMUM CRITERIUM: at least 2 pressures

Call text: It is expected that a minimum of two relevant pressures can be simulated in the facility at the same time, allowing combinations of these pressures. Facilities should also focus on mitigation and adaptation options for these pressures.

Q13: Can you do cross-ecosystem-type manipulations (e.g. ecosystem boundaries)

INFORMATIVE

Q14: Which experimental facilities, if any, are available for specific studies in addition to the

previously mentioned ecosystem-level facilities?

INFORMATIVE

Q15: What is the total area available for manipulations at the experimental facility? (in m^2)

CASE-DEPENDENT

Call text: The facility can provide sufficient space, time and flexibility to accommodate external research projects and is open to such projects

Q17: What is the total area available for new experiments at the facility? (in m^2)

CASE-DEPENDENT

Call text: The facility can provide sufficient space, time and flexibility to accommodate external research projects and is open to such projects

Q19: What are the area and height of the independently controlled experimental units?

CASE-DEPENDENT

Q21: What is the number of independently controlled experimental units?

MINIMUM CRITERIUM: 12

Call text: The facility contains a minimum of 12 independently controlled units, but deviations from this can be accepted if justified

Q23: If artificial light is used what is maximum PAR? If sunlit, what is the light reduction relative to outside in percent?

MINIMUM CRITERIUM: see below

Call text:

Units with artificial light have sufficient photosynthetically active radiation (PAR) **300 µmol m^{-2} s^{-1}**

Sunlit units reduce PAR only to a limited extent **<25%**

Call text: The controlled environment provides a realistic simulation of the outdoor microclimate (temperature, atmospheric humidity, precipitation, etc.) and of ecosystem structure (soil, species composition, etc.). Units with artificial light have sufficient photosynthetically active radiation (PAR) and sunlit units reduce PAR only to a limited extent. Larger-scale units are expected to allow the study of more complex ecosystems

Q24: Duration of additional experiments - For how long time can an experiment be run? (Several Ticks Possible)

MINIMUM CRITERIUM: > 1 year should be possible, but check nature of platform if not met

Call text: The facility can provide sufficient space, time and flexibility to accommodate external research projects and is open to such projects

Q26: Which laboratory facilities are available at the site? If no laboratory facilities are available at the facility/site, what is the distance to the nearest lab? (please insert 0 if lab is on site, or alternatively the distance in km)

MINIMUM CRITERIUM: at least basic soil/plant/animal sample handling on site

Call text: Basic laboratory services for initial sample handling and storage on-site, while more sophisticated laboratory services may be available at further distance

Q27: Which temporary storage facilities are available for external users?

MINIMUM CRITERIUM: **at least refrigerator, freezer, freeze drier, drying oven**

Call text: Basic laboratory services for initial sample handling and storage on-site, while more sophisticated laboratory services may be available at further distance

Q28: Which instruments are available for spot (not online) measurements? (list up to 10 instruments)

CASE-DEPENDENT *(depends on the pressures studied). Links to Q32: if all necessary process measurements are automated, then no spot measurements are needed, otherwise spot measurements are required.*

Call text: State-of-the-art measurements of system responses typically focus on processes related to biogeochemical cycles and biodiversity. They may include exchange processes with the atmosphere (gas fluxes such as CO2, H2O, CH4, N2O, BVOC's), benthic-pelagic exchange processes in aquatic systems, soil and sediment processes (e.g. mineralisation, leaching), community dynamics (gene flow, dispersal), etc

Abiotic and biotic state variables are also measured (e.g. air temperature, air humidity, atmospheric pressure, incident PAR, soil temperature, soil water content, nutrient status, canopy cover, species richness, population densities, etc.), in an automated fashion where available technology allows it

Q29: Which quality assurance procedures do you have, if any?

INFORMATIVE

Q31: Which meteorological and state variables are automatic/continuously measured or spot

measured?

MINIMUM REQUIREMENT FOR TERRESTRIAL: air temperature, air humidity, atmospheric pressure, incident PAR, soil temperature, soil water content

MINIMUM REQUIREMENT FOR AQUATIC: air temperature, water temperature, pH, conductivity, oxygen content

Call text: Abiotic and biotic state variables are also measured (e.g. air temperature, air humidity, atmospheric pressure, incident PAR, soil temperature, soil water content, nutrient status, canopy cover, species richness, population densities, etc.), in an automated fashion where available technology allows it

Q32: Which processes are continuously measured?

CASE-DEPENDENT

Call text: State-of-the-art measurements of system responses typically focus on processes related to biogeochemical cycles and biodiversity. They may include exchange processes with the atmosphere (gas fluxes such as CO2, H2O, CH4, N2O, BVOC's), benthic-pelagic exchange processes in aquatic systems, soil and sediment processes (e.g. mineralisation, leaching), community dynamics (gene flow, dispersal), etc

Abiotic and biotic state variables are also measured (e.g. air temperature, air humidity, atmospheric pressure, incident PAR, soil temperature, soil water content, nutrient status, canopy cover, species richness, population densities, etc.), in an automated fashion where available technology allows it

Q33: Is all your data captured digitally?

INFORMATIVE

Call text: Data will be collected at relevant time intervals for the studied ecosystem and parameter; they will be stored in local digital data storage systems

Q34: Is your data stored in a database management system?

MINIMUM CRITERIUM: yes

Call text: Data will be collected at relevant time intervals for the studied ecosystem and parameter; they will be stored in local digital data storage systems

Q35: What kind of quality checking procedures are applied to the data? (please select multiple answers

if needed)

INFORMATIVE

Q36: What kind of standards do you follow AT MOST for data management and sharing (selected

multiple answers if needed)

INFORMATIVE

Q37: What is the data access policy for external users?

MINIMUM CRITERIUM: "Data are not generally shared" is not acceptable (final policy not yet determined)

Call text: Collected data and metadata (abiotic variables, ecosystem state variables and processes) will be supplied to the AnaEE central database. Facilities will be involved in the development of common intellectual property rights protocols

Q38: Do you expect participation in AnaEE creating new demands on your data management and

storage capacity that would require significant new investments?

INFORMATIVE

Q39: If needed are you willing to change/adapt your data management approach to more fully participate in AnaEE? Including participation in developing common data standards and harmonized protocols?

MINIMUM CRITERIUM: yes

Call text: Common AnaEE protocols will be adopted to ensure data uniformity across facilities and data quality. Facilities will be involved in the development of such common AnaEE standards and protocols

Q40: How do you record your supporting metadata?

INFORMATIVE

Q41: Who is undertaking data management at your site?

INFORMATIVE

Q42: How many modellers, if any, are part of the scientific staff of the facility?

CASE-DEPENDENT, related to requirement in Q46

Call text: A staff member of the facility or an identified scientist will be expected to be involved in the development and/or application of ecosystem models. This dedicated modeller will interact with and be supported by national or supranational modelling facilities within AnaEE.

Q43: Which models, or model platforms, if any, are routinely applied at the facility?

CASE-DEPENDENT, related to requirement in Q46

Call text: A staff member of the facility or an identified scientist will be expected to be involved in the development and/or application of ecosystem models. This dedicated modeller will interact with and be supported by national or supranational modelling facilities within AnaEE.

Q44: Which models, or model platforms, if any, were involved in developing experimental designs

and data acquisition?

INFORMATIVE

Call text: A staff member of the facility or an identified scientist will be expected to be involved in the development and/or application of ecosystem models. This dedicated modeller will interact with and be supported by national or supranational modelling facilities within AnaEE.

Q45: Which models, or model platforms, if any, do you use for data quality and consistency

checking?

INFORMATIVE

Call text: A staff member of the facility or an identified scientist will be expected to be involved in the development and/or application of ecosystem models. This dedicated modeller will interact with and be supported by national or supranational modelling facilities within AnaEE.

Q46: Do you have experience with model collaboration?

MINIMUM REQUIREMENT: yes

Call text: A staff member of the facility or an identified scientist will be expected to be involved in the development and/or application of ecosystem models. This dedicated modeller will interact with and be supported by national or supranational modelling facilities within AnaEE.

Q47: Regarding Model-Data interaction - which kind of data/processes have been modeled?

CASE-DEPENDENT, related to requirement in Q46

Q48: Are there major limitations for model collaboration and model applications?

CASE-DEPENDENT, related to requirement in Q46

Call text: A staff member of the facility or an identified scientist will be expected to be involved in the development and/or application of ecosystem models. This dedicated modeller will interact with and be supported by national or supranational modelling facilities within AnaEE.

Q49: Please provide a rough estimate of the construction costs (in Thousands of Euro) of your platform (including only the equipment and the infrastructure dedicated to experimental ecosystem research)

INFORMATIVE

Q50: Please provide the planned investments in the next 5 years towards experimental ecosystem research in the facility (in Thousands Euro). If No investment are planned insert 0.

INFORMATIVE

Q51: Please specify here the annual running costs of your facility (in Euros, not including salaries, and including only the portion dedicated to experimental ecosystem research)

INFORMATIVE

Q52: Please specify here the average annual salary costs of the staff engaged with running the facility (in Euros, including only the portion dedicated to experimental ecosystem research)

INFORMATIVE

Q53: Please specify the number of staff running the facility (including only the portion dedicated to experimental ecosystem research)

MINIMUM CRITERIUM: there should be a dedicated technician and a dedicated scientist, but not per se full-time (infrastructure size and complexity varies)

Call text: Technical assistance in using the infrastructure (not to run the experiment), as well as assistance with experimental design and setup

Q54: Please specify the funding sources of the facility (percentage from each category. Please include only the portion dedicated to experimental ecosystem research)

INFORMATIVE

Q56: Does the facility make profit?

INFORMATIVE

Q57: Which is the current cost policy for researchers visiting the facility? Researchers pay for: (tick if applies**)**

INFORMATIVE

Q58: What is the average number of projects per year?

INFORMATIVE

Q59: What is the average number of users per year?

INFORMATIVE

Q60: What is the expected future number of users per year?

INFORMATIVE

Q61: Which is the estimated total number of "user days" per year at the site?

INFORMATIVE

Q62: Is there a limit on the number of users allowed in the facility at any given time? (please specify or ignore if not applicable)

INFORMATIVE

Q63: How many full time equivalent technicians are available for assisting with user experiments?

MINIMUM CRITERIUM: at least 1 technician should be available (cfr. Question 53), but not per se full time

Call text: Technical assistance in using the infrastructure (not to run the experiment), as well as assistance with experimental design and setup

Q64: Which is the percentage of users in terms of provenance?

INFORMATIVE

Q65: Which is the percentage of user in terms of sector?

INFORMATIVE

Q66: Do you have experience with coupling different projects with each other to increase the value of an experiment?

INFORMATIVE

Q67: What kind of decision procedure is currently applied if external users want to use the facility?

INFORMATIVE

Q68: Is there experience with handling of confidentiality of results and IPR?

INFORMATIVE

Q69: Will you be willing to take part in development of common IPR protocols within AnaEE?

INFORMATIVE

Q70: Is there experience with patents?

INFORMATIVE

Q71: Are land-water interactions studied?

INFORMATIVE

Q72: Are benthic-pelagic interactions studied?

INFORMATIVE

Q73: Does the facility include substreams (paired

streams)?

INFORMATIVE

Q74: Does the facility include multi lakes in order to apply a "Paired lakes" approach?

INFORMATIVE

Q75: Do you have a mobile mesocosm system available?

INFORMATIVE

Q76: Water types

INFORMATIVE

Criteria for AnaEE Open-air platforms

21 February 2025

The following criteria should be fulfilled by AnaEE open-air facilities. If criteria are not met, an action plan for how and when the criteria are planned to be met in the future should be provided.

Criteria for Open-air facilities

Technical characteristics and requirements

- Ensured long-term operability (>5 years) of the facility including scientific and technical staff dedicated to running the facility.
- The total area available for pressure manipulation experiments* is adequate for the ecosystem type examined to provide state-of-the-art experimental setups at ecosystem level, including space for undertaking new projects, for example as a result of AnaEE user access projects.
- An experimental scheme enabling long term (>5 years) manipulations (aquatic facilities exempted).
- The facility is capable of running experiment(s), which are state-of-the-art with respect to statistical power, i.e. normally 3 or more replicates of each treatment and 12 experimental units (plots) in total. Preferably, multifactorial experiments can be run including the treatment combination(s). If the number of replicates / experimental units is lower than stated above, the statistical power of the alternative setup should be properly justified to still be state-of-the-art.
- State-of-the-art techniques should be applied for manipulating given pressures at the ecosystem level.
- A meteorological station providing continuous platform-level data (All facilities: Air T, Air humidity, Atm. Pressure, PAR. Terrestrial facilities: Soil temperature, Soil water content. Aquatic facilities: Water temperature).
- On-site adequate consumables (e.g. power and/or water supply, internet, etc.) to run state-of-the-art experiments.
- State-of-the-art measurements should be possible for key ecosystem characteristics and functions.
- Core state variables related to the experimental focus can be measured continuously within each experimental unit (each replication for a given treatment).
- At least one core process variable can be measured automatically, while others can be measured routinely by the facility staff. Processes may include exchange with the atmosphere (gas fluxes such as CO_2, H_2O, CH_4, N_2O, BVOC's), benthic-pelagic exchange processes in aquatic systems, soil and sediment processes (e.g. mineralisation, leaching), community dynamics (gene flow, dispersal), etc.

Data and modelling

- Data collected at relevant time intervals and stored and maintained in data storage systems.
- Application of standards and data quality assurance procedures: data should follow FAIR principles, and a Data Management Plan (DMP) should be in force, compliant with the AnaEE-ERIC DMP.
- Facilities will be involved in the development of common AnaEE standards and protocols.
- Supply measured data and metadata and link it to the AnaEE-ERIC DMC server.

- Facilities will be involved in the development of common AnaEE intellectual property rights protocols.
- Open data access policy for external users (Categories accepted: Open access, access after some embargo period).
- The common AnaEE data sharing policy will be followed and, if needed, adapted data management approaches to meet AnaEE standards.

Provided services

- Sufficient hosting capacity for visiting scientists (remote and virtual access exempted).
- Technician(s) are available to assist with user experiments.
- Assist users with experimental design and setup.
- Provide users with background site information as well as relevant site data.
- Commit to participating in cross-cutting hypothesis testing and development within AnaEE platforms and supra-national centers.
- Take active part in technology and knowledge exchange within AnaEE facilities and supra-national centers as well as with other infrastructures.
- Take active part in training of early-career researchers as well as established researchers and technical staff, and in capacity building.

*Non-exhaustive list of examples of pressures to be manipulated at AnaEE open-air facilities:

- CO_2 level (or other atmospheric gases)
- Warming
- Precipitation addition or removal
- Hydrological change
- UV / light regime
- Fire regime
- Soil eutrophication
- Water eutrophication
- Air pollution
- Soil erosion
- Desertification
- Management:
  - Nutrients (levels or nutrient type)
  - Tilling or other physical manipulation
  - Pesticides (or other non-nutrient chemicals)
  - Conventional vs. organic or other eco-friendly practice
  - Grazing (pressure or animal species)
  - Rotation practice
  - Species and/or ecotype combinations
  - Traditional (or native) vs. new (or non-native) species