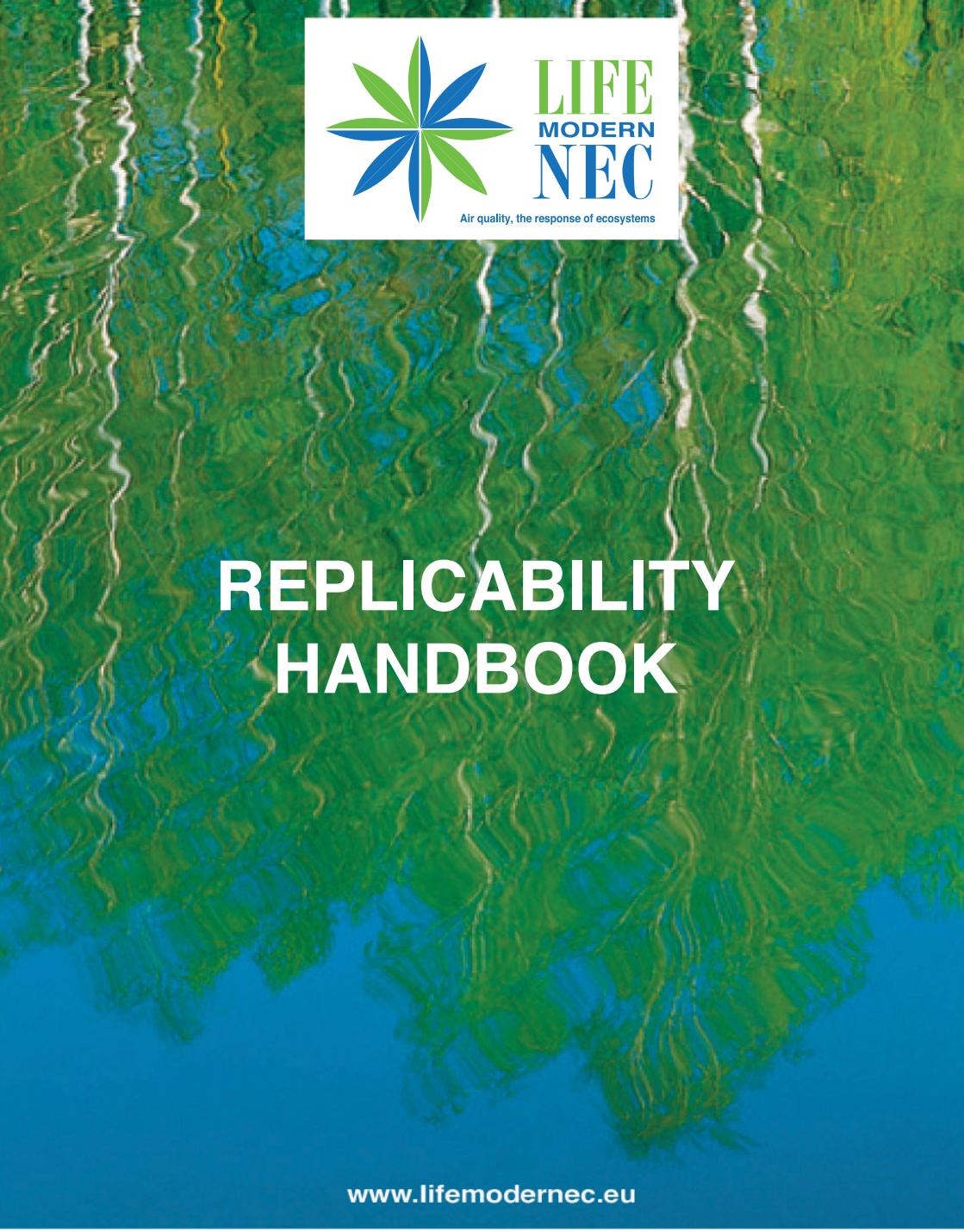

LIFE MODERN NEC

Air quality, the response of ecosystems

REPLICABILITY HANDBOOK

www.lifemodernec.eu

LIFE15 GIE/IT/000291
Realizzato con il contributo dello strumento finanziario LIFE dell'EU

BENEFICIARIO COORDINATORE
CARABINIERI

BENEFICIARI ASSOCIATI
Consiglio Nazionale delle Ricerche
crea
ENEA
LEGAMBIENTE
TerraData
UNIVERSITÀ DEGLI STUDI FIRENZE

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Contents

1. The aims of project LIFE MODERn(NEC)

The European Directive "NEC" (National Emission Ceilings, 2016/2284/EU) binds Member States to:

- reduce the emissions into the atmosphere of some pollutants dangerous for human health and the environment, such as sulfur, nitrogen, non-methane volatile organic compounds, ammonia and fine particulate matter (PM), through the implementation of national air pollution control programs;
- monitor the effects of air pollutants on terrestrial and freshwater ecosystems.

European countries pursue the objectives of the Directive through a network of monitoring sites representative of the main European ecosystems.

In order to meet the requirements of the Directive, project LIFE MODERn(NEC) (LIFE20GIE/IT/000091, 2021-2025, Fig. 1) aims at improving the structure and representativeness of the NEC Italy Network, including new sites in forest and freshwater environments (Fig. 2). The project also intends to apply innovative "indicators" at the targeted sites, to reveal the effects of atmospheric pollution on forests and freshwater ecosystems (Fig. 3, Tab. 1). Where possible, the project will identify the sources of emissions and suggest governance actions for the control of air pollution, especially in remote and natural areas.

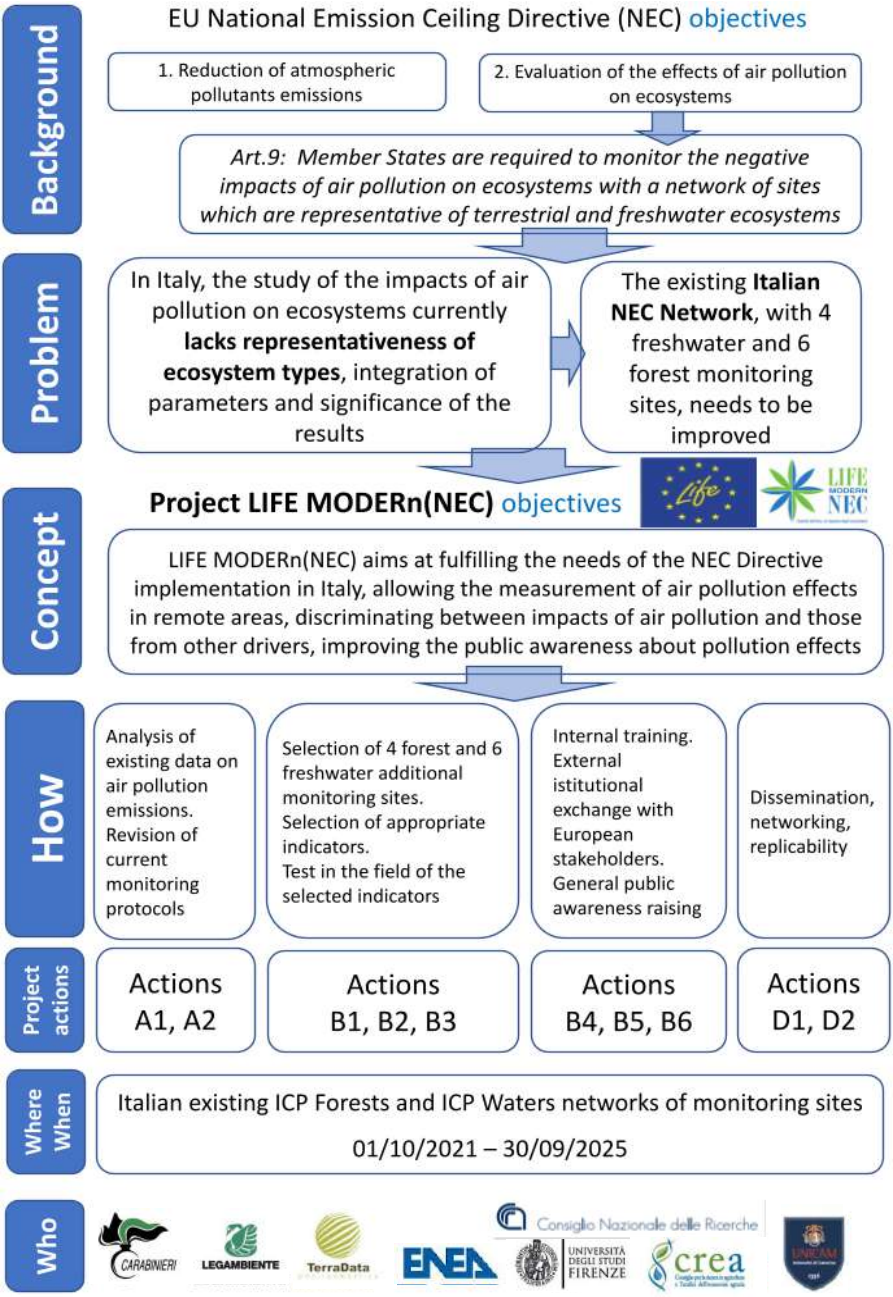

Figure 1 - LIFE MODERn(NEC) concept. (from LIFE MODERn(NEC) Action C1 "Monitoring of project impact and socio-economic impact").

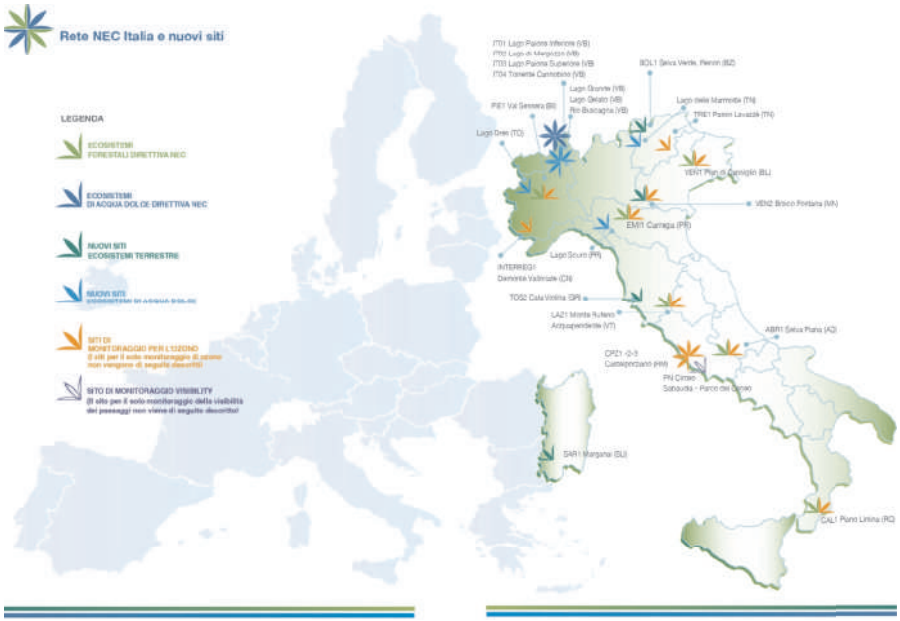

Figure 2 - The revised NEC ITALY Network, according to Action B1 ("Selection of new NEC Italy sites") of LIFE MODERn(NEC).

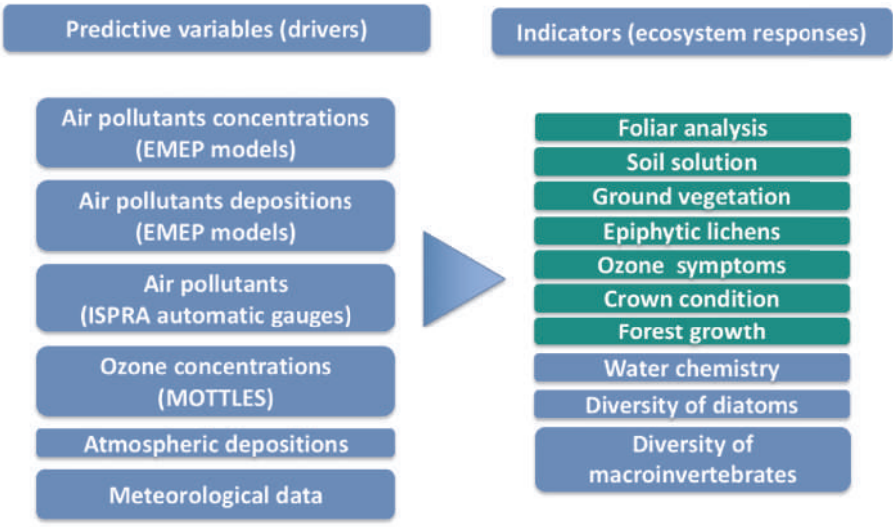

Figure 3 - Simplified conceptual scheme grouping the variables in "drivers" and "ecosystem responses" according to LIFE MODERn(NEC). (From LIFE MODERn(NEC) Action A1 Deliverable "Analysis and evaluation of existing data")

Indicator	Details of measured parameters	N. variables	Beneficiary responsible
Forest Ecosystems			
Atmospheric Depositions	Pollutants measured at plot depositions	13	CNR (IRSA)
Analysis of foliar nutrients	Concentrations of elements in leaves	6	CNR (IRET)
Soil solutions chemistry	Surface and deep pH, nitrates, sulphates	6	UNIFI (DST)
Plant Diversity	Species list and diversity	6	UNICAM
Epiphytic lichen Diversity	Species list and diversity	6	TerraData
Animal Diversity	Birds: species list and diversity	6	CNR (IRET)
	Bats: species list and diversity	2	CNR (IRET)
	Soil biological quality	4	CNR (IRET)
Crown Conditions	Crown defoliation and pathogens damage	11	CUFAA, UNIFI (DAGRI)
	Crown defoliation remote sensing data	1	CNR (IREA)
Tree growth	Volume and increment, C content	3	CREA
Ozone	Effects on plants: % symptomatic species ; % symptomatic leaves	3	CNR (IRET)
	Concentrations at forest sites	5	CNR (IRET)
Meteorological data	Main climate parameters at forest site	24	CREA
Freshwater Ecosystems			
Water chemistry	Chemistry data according to ICP Waters Manuals	22	CNR (IRSA)
Diatoms Diversity	Species list and diversity	12	
Macroinvertebrates Diversity	Species list and diversity	5	
Atmospheric pollution data			
EMEP models data	Air concentrations at forest and freshwater sites belonging to the monitoring network: PM_{10}, NOx, O_XN, RDN, SO_4, SO_2	6	TerraData
Regional ARPA data	Air concentrations at forest sites belonging to the monitoring network: C_6H_6, CO, NO_2, NO_X, O_3, PM_{10}, $PM_{2.5}$, SO_2	12	ENEA, ISPRA
Air chemistry and transparency	Air concentrations of PM_{10} and $PM_{2.5}$, air optical transparency	3	CUFAA, ENEA

Table 1 - List of project indicators (From Brunialti et al. 2022).

2. Air pollution in Europe: concentrations and effects

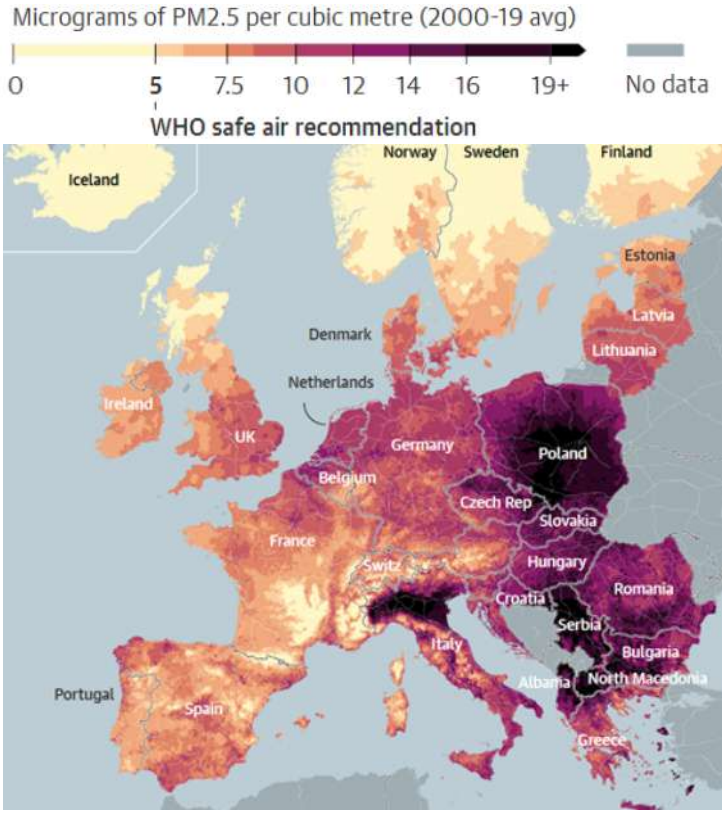

Figure 4 - Map based on satellite images and measurements from more than 1.400 ground monitoring stations, revealing the air pollution worst-hit areas on the European continent (Guardian Graphic; Source: Expanse Project, Guardian Analysis, 2023).

FACTS

- 98% of Europeans breathe in areas with high fine particulate air pollution that exceeds World Health Organization guidelines limit (max annual average concentrations of $PM_{2.5}$ = 5 µg/m^3);
- $PM_{2.5}$ pollution causes about 400.000 deaths a year across the continent;
- in Italy**,** more than a third of those living in the Po valley and surrounding areas breathe air that is four times the WHO figure for the most dangerous airborne particulates;

- residents in seven countries in eastern Europe – Serbia, Romania, Albania, North Macedonia, Poland, Slovakia, and Hungary – have double the WHO guidance;
- air pollution affecting Italian forest ecosystems is primarily in the form of nitrogen (N) deposition and tropospheric O_3;
- N deposition on forests may affect species composition, plant diversity, nutrient balance and produce susceptibility to secondary stress; O_3 may produce foliar injury and reduction of net primary production by reducing CO_2 assimilation at leaf level (De Marco et al. 2019);
- freshwater chemistry at long-term monitoring sites showed a coherent response to changing NO_3 and SO_4 deposition (Rogora et al. 2022).

3. The Replicability Strategy of LIFE MODERn(NEC)

What does "replicability" mean?

Replicability can be defined as a model or an organized set of activities to obtain consistent results across two or more studies answering the same scientific question, each of which based on its own data.
In the framework of LIFE MODERn(NEC), replicability is aimed at multiplying the impact of the project, beyond its duration and outside the national partnership, in other EU Member States committed to the NEC Directive.

Would you like to test LIFE MODERn(NEC) indicators in your country?

In this "Replication KIT" LIFE MODERn(NEC) replicability strategy is presented to other European interested stakeholders to guide the reader to the concrete replication of project activities.
The Replicability Strategy of LIFE MODERn(NEC) was developed by the partners within the second year of the project and firstly put into practice with the cooperation of the Romanian National Institute for Research and Development in Forestry «Marin Dracea» (INCDS), who supported LIFE MODERn(NEC) project proposal and is currently involved in the accomplishment of the NEC Directive in Romania. The strategy includes 4 steps (Step I, II, III, IV).

3.1 Step I

As a start for replication, the interested stakeholder (EU NEC Member State) should take first and preliminary contacts with LIFE MODERn(NEC) partners. Suitable actions are:

- navigation into project's website and social profile;
- awareness about project's aims;
- email exchange between the interested stakeholder and project partners;
- phone calls/videocalls.

The aim is making a bridge between LIFE MODERn(NEC) and the other interested EU NEC Member State.

STEP I STATEMENT

To start with replication, take contact with LIFE MODERn(NEC) partners
Email lifemodern.nec@gmail.com info@lifemodernec.eu
web site https://lifemodernec.eu/
project leader giancarlo.papitto@carabinieri.it

3.2 Step II

Step II of the replication strategy focuses on a deeper evaluation of measurements the two "replicating Member States" do to accomplish the NEC Directive requirements. This is aimed at revealing the overlaps of research/monitoring activities or variables measured at the two EU NEC Member States, where potential replication is possible. At this stage, overlapping research/monitoring topics or variables should be evaluated by means of the available databases. For this reason, it may be useful to rely on the "NEC reporting template", delivered by the European Commission and compiled by each Member State. Suitable actions at this step are:

- to compare the databases (or NEC reporting templates) of the two cooperating Member States;
- evaluation of measured parameters/indicators and available data series of the two NEC Networks;
- online meetings for the selection of the most relevant and overlapping template sections of the two NEC Member States.

STEP II STATEMENT

Share your NEC databases. Search for overlapping monitoring/research parameters/activities. Remember that the NEC Reporting Template for each EU NEC Member State is available for download at this link. (EIONET Central Data Repository of the European Environment Agency)

3.3 Step III

At this stage, research/monitoring overlapping should be considered for more detailed evaluation of available variables needed to calculate LIFE MODERn(NEC) indicators. The possibility to replicate the project indicators with data belonging to the participating Member State should be discussed during plenary meetings and then during one-to-one meetings. During this phase, accessibility to additional funds necessary for the replication should be discussed, together with new equipment and/or expertise to use the data to replicate the indicators. The participating Member State should also consider study trips to Italy to calibrate data collection in the field and data analysis. Study trips of project partners to the participating Country are also suggested to visit the sites (and their ecosystems). This step is the crucial step, when the basis for replicability are established. Suitable actions at this step are:

- evaluate and discuss the variables needed to calculate LIFE MODERn(NEC) indicators;
- organize plenary meetings or one-to-one meeting;
- consider and discuss the possible need of additional funds and of new equipment

and expertise in order to be able to calculate LIFE MODERn(NEC) indicators;
- organize study trips to LIFE MODERn(NEC) sites in Italy;
- invite LIFE MODERn(NEC) partners to visit your study sites.

STEP III STATEMENT

Answer the question: are any data available at NEC sites in my Country that I may use to calculate (= replicate) any MODERn(NEC) indicator? Do we need additional funds or new equipment/expertise to use our data to replicate the indicators?

3.4 Step IV

In this final step, calculation of selected project indicators in collaboration with LIFE MODERn(NEC) is provided. The results of the replication activity should be discussed during plenary meetings. Participating Institutes should cooperate as co-authors in manuscripts and scientific publications presenting the results of the replication. Replication should also be reported properly within LIFE MODERn(NEC), for example during dissemination and training events and within Action B5 "control room". Suitable actions at this step are:

- calculate the selected LIFE MODERn(NEC) indicators;
- discuss the results with the other experts involved;
- work at manuscripts and scientific publications to present the results;
- take part to dissemination.

STEP IV STATEMENT

In cooperation with project partners, calculate LIFE MODERn(NEC) indicator/s at NEC sites in your country, discuss, compare and disseminate the results.

4. References

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EIONET Central Data Repository of the European Environment Agency
https://cdr.eionet.europa.eu/ReportekEngine/searchdataflow?dataflow_uris=http%3A%2F%2Frod.eionet.europa.eu%2Fobligations%2F768&years%3Aint%3Aignore_empty=&partofyear=&reportingdate_start%3Adate%3Aignore_empty=&reportingdate_end%3Adate%3Aignore_empty=&country=&release_status=released&sort_on=reportingdate&sort_order=reverse&batch_size=

Photos by Luigi Di Battista, Michela Rogora and Manuela D'Amen

NOTES 

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