



A f t e r - L I F E

Communication Plan



TABLE OF CONTENTS

***pag. 4* OVERVIEW OF THE PROJECT**

***pag. 5* ASSESSMENT OF THE SITUATION AT THE END OF THE PROJECT**

pag. 5 Summary of achieved results

***pag. 6* AFTER-LIFE MOTTLES OBJECTIVES**

***pag. 6* ACTIVITY CONTINUATION**

pag. 7 Maintenance of the monitoring network & data collection
(Action B1)

pag. 7 Refinement of critical levels for forest protection (Action B3)

pag. 7 Calculation and mapping of exceedance for the years following
the project (Action B4)

pag. 8 Dissemination (Action D1)

Active website

Participation to international workshops

Publication in national and international journals

pag. 9 Science-policy-stakeholder interaction (Action D2)

pag. 9 Knowledge Exchange Strategy

***pag. 11* REPLICABILITY AND TRANSFER OF THE METHODOLOGY**

***pag. 13* EVALUATION OF RISKS**

OVERVIEW OF THE PROJECT

LIFE MOTTLES project (LIFE15 ENV/IT/000183) proposed and demonstrated an integrated approach for deriving scientifically-based thresholds and proper critical levels for forest protection against ozone (O_3) in a context of climate change.

This issue is important and topical because European standards to protect vegetation from O_3 are currently based on the pollutant concentrations in the ambient air, not on the stomatal O_3 fluxes, e.g. how much O_3 is effectively uptaken by the plants through their stomata. Ozone is toxic to vegetation only after entering the plants via stomata.

The novel monitoring strategy implemented by MOTTLES is based on an active monitoring network, that means O_3 concentrations and all needed environmental parameters are recorded at forest sites by active sensors in real time (1-hour resolution), instead of the traditional passive monitoring (where passive samplers are collected and analysed every two weeks).

Real time O_3 concentrations are combined with meteorological and soil parameters (to estimate the stomatal ozone flux) and with plant response indicators (for estimating O_3 damage to vegetation, i.e. visible O_3 foliar injury, crown defoliation and hourly radial growth) in order to estimate new scientifically-sound critical levels for O_3 . The new derived critical levels are proposed to be used as new legislative standards in Europe.

The novel MOTTLES network consists of 17 sites in three European countries at medium and high risk for O_3 levels: Italy, France and Romania. The partners involved into the realization of the project are ARGANS and GIEFS in France, CNR and CREA in Italy, and INDCS in Romania.

Specifically, MOTTLES aimed to:

- Set up a permanent new-generation and active monitoring system of O_3 effects on European forests,
- Concurrently monitor forest response indicators and O_3 standards across Europe,
- Produce new criteria and usable legislative standards for protecting forests against O_3 and for establishing a long-term monitoring strategy,
- Support the elaboration of recommendations and adaptive strategies for sustainable forest management (SFM),
- Raise stakeholders' and experts' awareness about the innovative monitoring system and criteria of protection,
- Provide open-access data for incorporation into the European Forest Data Centre and the Forest Information System for Europe of the EC,
- Support future EU air quality decision making,
- Assess whether some EU regions are more exposed/vulnerable to effects of climate change and O_3 ,
- Allow exchanging know-how and best practices,
- Form a generation of young experts of O_3 and forests.

ASSESSMENT OF THE SITUATION AT THE END OF THE PROJECT

To define and test a new monitoring method based on real-time sensors for O₃ concentrations and to define new critical levels, i.e. the levels of pollution not to be exceeded for the protection of forests:

- 4 biogeographical areas
 - 9 forest types
 - 11 target tree species
 - 17 integrated monitoring stations at forest sites
- 1 controlled area for testing and checking (3D O₃ FACE, i.e. Free Air Controlled Exposure)
- 13 monitored parameters
 - 5304 measures recorded in every single day
 - 77 trees monitored continuously for radial growth
 - 340 trees evaluated for crown defoliation every year
 - 10,625 leaves/needles analysed for visible injuries every year

To monitor the impact of project activities:

- 50 of disseminated questionnaires to expert stakeholders
 - 155 of large-audience questionnaires
- 1 application of the total economic value (TEV) method to assess the economic impacts of O₃ on forests
- 1 Life Cycle Analysis (LCA) to assess the environmental impacts of active vs. passive O₃ monitoring at forest sites
- 8 SFM criteria for optimizing forest health and services under O₃ pollution

To raise public awareness and disseminate project results:

- More than 20 announcements at conferences
- 12 scientific papers
- 9,000 visitors of website
- 17 noticeboards at forest sites
- 2,000 leaflets distributed
- 20 posters presented
- 4 technical publications
- 3 policy briefs
- 8 newsletters

Summary of achieved results

1. A new on-line atlas of typical foliar ozone injuries in different forest species
2. Improved modelling approaches
3. New criteria and thresholds for legislative standards to protect forests from O₃
4. Solid support for EU air quality decision making and forest monitoring
5. Inclusion of LIFE MOTTLES sites into the NEC network (National Emission Ceiling - EU Directive 2016/2284)
6. Definition of the best forest response to O₃: visible foliar O₃ injury

AFTER-LIFE MOTTLES OBJECTIVES

The present plan sets out how the activities are planned to continue and to develop after the end of the project, and how the longer-term management of the 17 sites will be secured. It gives details regarding what actions will be carried out, when, by whom, and using what sources of financing. Moreover, it defines how the beneficiaries plan to continue disseminating and communicating results after the end of the project, and indicates what external support could be helpful.



ACTIVITY CONTINUATION

Although the project has ended, several methods developed by the project will be further developed in other projects.

The **monitoring stations will continue collection of O₃ and environmental data** after the end of the project as this activity does not require additional resources if the sensors do not need maintenance. Beyond July 2020, only data storage will be indispensable, and this does not need any further co-financing. All the **European critical levels** are periodically revised as new scientific information becomes available. The analysis of the monitored data for estimating the critical levels as well as the **mapping of the critical level exceedances** will be carried out once a year as part of the partners' institutional activities, with the aim to assess the effectiveness of air pollution control strategies in the European Union.

The **validation of guidelines by MOTTLES** allows the transfer of these innovative methodologies for a more coherent policy on forest protection in Europe, in response to the climate change challenges. The application of the MOTTLES method will make a positive contribution to the convergence and policy leading up to the effectiveness of forest monitoring by providing a framework for research and analysis.

After completion of the project, **major dissemination** methods will be contacts with experts, through participation to conferences and meetings, publications and internet according with the **Knowledge Exchange Strategy**. The **website** will be regularly updated and maintained for free by CNR for at least 5 years. Partners are active in the main forest networks and programmes i.e. SISEF, IUFRO, EFI, WGE, ICP Vegetation, ICP Modelling and Mapping, ICP Forests and can get financial support for experience-sharing. MOTTLES is policy relevant. The results will be transferred to ICPs for **encouraging the adoption of this new monitoring approach at pan-European scale and beyond**. We wish that our results may stimulate the development of similar networks all over the world, because only monitoring at forest sites is truly representative of the actual stomatal O₃ flux conditions.

The project continuation is explained in details by action below.

Maintenance of the monitoring network & data collection (Action B1)

AIM - Maintenance of the integrated monitoring stations, core of MOTTLES: on-line recording of environmental and O₃ data at 1-h resolution, collecting of plant-response indicators.

DESCRIPTION - Thanks to the site maintenance carried out at the end of the project, the sites of the whole network are functional and under remote control. Remote stations will continue to record and transmit agrometeorological data, O₃ concentration and radial growth after the end of the project. In case sensors need further maintenance, financial support from national

and international sources will be searched for. Personnel support will be provided by the partners within their institutional activities. The national Ministries of the Environment recognized the importance of MOTTLES results, especially for the NEC implementation. MOTTLES, unique in Europe, is able to provide useful data for the NEC at large scale. In Romania and Italy, agreements were already established among the Ministries of Environment and the MOTTLES partners INCDS and CNR. Partners are committed to carry out the field surveys for O₃ visible injury and crown defoliation compatibly with the available funds. If the MOTTLES follow-up project will be funded, the novel active monitoring method implemented by MOTTLES will be extended to Croatia. CNR has already obtained the financial support by the Italian Ministry of Environment for establishing a

new monitoring station in Southern Italy, i.e. in an area at present not covered by the MOTTLES network.

BENEFICIARY RESPONSIBLE - CNR and CREA for Italian network; INCDS for Romanian network; ARGANS for French network

Estimated amount: 15 k€ per year (60 working days); 30 k€ per two years (national Ministries)

Continuation of the modelling of stomatal ozone flux (Action B2)

AIM - Provision of species-specific stomatal O₃ flux data estimated by the DO3SE model, as recommended by the NEC Directive, for the sites in France, Romania and Italy, by using data on soil type, hourly meteorological data (air temperature, relative humidity, soil water content and solar radiation) and hourly O₃ concentrations obtained from the MOTTLES monitoring stations.

DESCRIPTION - Calculation of stomatal ozone flux (PODY) for the MOTTLES sites will be conducted also after the end of the project thanks to the refining of the parameterization for the major forest species, the validation of DO3SE model, and the selection of the best species-specific approach achieved during the project. The partners are committed to continue this activity within their institutional goals also after the end of the project.

BENEFICIARY RESPONSIBLE - CNR, ARGANS

Estimated amount: 12 k€ per year (50 working days)

Refinement of critical levels for forest protection (Action B3)

AIM - Definition of the best criteria for the protection of European forests from O₃ in a changing climate as well as of proper flux-based critical levels, with a major aim of contributing

to the UNECE activities and supporting the elaboration of sustainable management strategies.

DESCRIPTION - This after-LIFE action will be possible thanks to the methodology developed during the project, in particular, thanks to the definition of the best response effect and O₃ metric. The partner ARGANS is committed to refine the critical levels within its institutional activities.

BENEFICIARY RESPONSIBLE - ARGANS

Estimated amount: 1,800 € per year (2 working days)

Calculation and mapping of exceedance for the years following the project (Action B4)

AIM - i) identifying ozone hot-spots; ii) assessing large-scale forest injury by O₃; iii) defining which thresholds of stomatal ozone flux are the most biologically-based for at least five years after the end of MOTTLES.

DESCRIPTION - Beneficiaries will produce exceedance maps after 2020 in order to support the future EU air quality decision making. The realization of the guidelines book “How to assess the effectiveness of air pollution control strategies for ecosystem protection” produced by MOTTLES will help policy makers to apply the know-how developed by the project and to guarantee the processing of effect-based abatement strategies in pollutant emissions. CNR is committed to continue this activity by in-kind contribution.

BENEFICIARY RESPONSIBLE - CNR

Estimated amount: 3,000 € per year (2 working days)

Dissemination (Action D1)

Aim - Synthesize key findings, collate, maintain and disseminate reliable information generated by MOTTLES, provide the basis of dissemination campaigns and results exploitation, prepare and conduct outreach activities with a wide range of stakeholders, create the basis for long-lived exploitation of MOTTLES results, help practitioners and decision makers to make use of the new knowledge generated by MOTTLES.

ACTIVE WEBSITE

The MOTTLES website will be used actively for real time dissemination of information and will be available for at least 5 years in the after-LIFE. Next, the majority of the information at the MOTTLES website will be transferred into the websites of the partners. Also by keeping on-line and upgraded the website it will be possible to continue to offer visibility to the project results after the end of the project itself. This will be achieved by a website editor (Elisa Carrari) who is willing to update the text/images/others even after the project end.

PARTICIPATION TO INTERNATIONAL WORKSHOPS

MOTTLES experts will present the project results in various seminars and meetings, including ICP workshops. To allow the project continuity and durability, workshops will be planned to allow exchanges of experiences such as the biennial IUFRO RG8.04.00 conference. These actions are intended to diffuse results in order to obtain an active communication between different actors: public, scientists, political decision-makers, local authority. After completion of the project, educational activities and information for forestry will be implemented, in order to use the project outputs (e.g. list of sensitive tree species) and guidelines/recommendations for the sustainable forest management and adaptation to climate change challenges.

In particular partners will participate to the International workshop “Air Pollution threats to Plant Ecosystems Conference” to be held in Paphos

(Cyprus) on May, 2021. The conference includes a specific session focused on MOTTLES and titled: *Forest protection against ozone: new approaches towards an effective policy decision-making.*

The session contributes to i) develop a better understanding of ozone impacts on forest; ii) evaluate many different metrics for forests protection, with a focus on stomatal O₃ flux; iii) provide best practices for sustainable forest management; and iv) guide management decisions and efficient policy recommendations toward increased health, sustainability and productivity forest resilience worldwide.

PUBLICATION IN NATIONAL AND INTERNATIONAL JOURNALS

Detailed information on the results from the project is communicated to professionals by means of articles in national and international journals. Publications produced by the project will be available for open access in a PDF-format at the project website. These publications will be also delivered to experts. Hereafter the tentative list of scientific publications, based on the results of MOTTLES, foreseen in the next years:

- **Ozone weekend effect in cities: deep insights for urban air pollution control** - Pierre Sicard (ARGANS)
- **New critical levels for forest protection from ozone over a network of field sites** – Pierre Sicard (ARGANS)
- **Exceedances of ozone critical levels for forest protection in three European countries** – Alessandra De Marco (ENEA)
- **Comparison of modelled and measured AOT40 and POD data for ozone risk assessment in forests** – Ionel Popa (INCDS)
- **Economic and life cycle analysis of passive and active monitoring of ozone for forest protection** – Alessandra De Marco (ENEA)
- **A comparison of measured soil water content at different depths and its effect on stomatal ozone fluxes** – Yasutomo Hoshika (CNR)

- The effect of root depth on stomatal ozone fluxes – Yasutomo Hoshika (CNR)
- Relevance of visible foliar ozone injury for the national emission ceilings directive – Yasutomo Hoshika (CNR)
- Dendrometer signals and data management processes – Alessio Giovannelli (CNR)
- Meteorological conditions in a spruce stand before, during and after the Vaia storm – Alessio Giovannelli (CNR)
- Stem growth phenology across different plant physiognomic classes – Alessio Giovannelli (CNR)
- Ambient ozone impacts on the radial growth of forest trees – Alessio Giovannelli (CNR)

Science-policy-stakeholder interaction (Action D2)

AIM - propose to policy-makers and forest/park managers usable legislative standards and proper regional policies for forest protection and monitoring.

DESCRIPTION - We expect that MOTTLES will address future EU forest monitoring policies, by encouraging the adoption of the demonstrated integrated monitoring system; and support future EU air quality decision making by providing large scale epidemiologically-validated species-specific critical levels and scientific support for the NEC implementation.

All partners are active in dissemination and will perform these after-LIFE activities back-to-back with the activities supported by other projects.

Knowledge Exchange Strategy

MOTTLES will keep the promotion of its best-practices amongst competent authorities to transfer results for a more coherent policy in EU. MOTTLES Knowledge Exchange Strategy establishes the approach to engaging with target stakeholders, and the mechanisms and media to be used, taking into account different policy sectors and audiences relevant to the work of LIFE MOTTLES.

Main tools for the best practices dissemination are the following technical guidelines produced by MOTTLES:

1. *How to assess the effectiveness of air pollution control strategies for ecosystem protection*
2. *Integrated tool box of practices summarizing the new knowledge for evaluating expected risks and benefits of adaptation/mitigation options*
3. *Guideline with recommendations and effective adaptation measures for sustainable forest management*

Those will be largely disseminated at conferences and thorough websites, social networks and newsletters in order to reach any type of stakeholders to allow the continuity of harmonized, comprehensive and long term monitoring of forest. However, other tools are also implemented. Hereafter, the Knowledge Exchange Strategy of MOTTLES is described by different target stakeholders:

Forest and Park managers: frequent contacts for site network management; managers are involved in the site maintenance, for this reasons they are well informed regarding the functioning of the network.

Practitioners: specific seminars and workshops will be organized for the transfer of project best practices. Practitioners are included in MOTTLES mailing lists, receiving the project newsletter.

Local authority: one day meetings with local authorities will be frequently organized in order to involve local authorities in afterlife MOTTLES activity. Many local authorities are included in MOTTLES mailing lists, receiving the project newsletter.

Policy officers: policy officers at national and international level will be invited at main MOTTLES afterLIFE event, e.g. “Air Pollution threats to Plant Ecosystems Conference” to be held in Paphos (Cyprus) on May, 2021. This type of stakeholder will be also engaged through numerous announcements at conferences they normally attend, such as IUFRO, ICP, AISF, SISEF conferences. Policy officers are included in MOTTLES mailing lists, receiving the project newsletter.

Scientists: scientific papers, announcement at conferences will involve on MOTTLES activity scientist all over the world. Around 100 scientists will participate at the event in Paphos. Scientists are included in MOTTLES mailing lists, receiving the project newsletter.

Citizens: public awareness on MOTTLES activities will be kept thanks to the maintenance of the website, social networks, noticeboards, articles on newspapers and school visits.

BENEFICIARY RESPONSIBLE – All partners

Estimated amount: 3,500 € per year (3 working days)



REPLICABILITY AND TRANSFER OF THE METHODOLOGY

Thanks to the numerous targeted discussions with the SIB and other relevant stakeholders (IUFRO, EFI, EEA, SISEF, ICPveg, ICP Forests) and publications, MOTTLES practices are available to be **replicated** by other entities, especially under NEC directive.

A major innovation of NEC is “*monitoring air pollution impacts*” on ecosystems. According to art. 9, “*Member States shall ensure the monitoring of negative impacts of air pollution upon ecosystems through a cost-effective & risk-based approach, based on a network of monitoring sites that should be representative of ... forest ecosystem types*”. Critical levels are used to map and identify areas in Europe in which the levels are exceeded, and to plan optimized effect-based abatement strategies in pollutant emissions. Derivation of new flux-based critical levels for European tree species represents a considerable progress in the development of methods for quantifying effects of O₃ on vegetation at the regional scale. The exceedance of PODY critical levels and visible foliar O₃ injury are now included in the NECD, so that Member States must monitor the negative O₃ impacts on forests. The interest for species-specific PODY critical levels is thus **seriously rising** in EU.

The funding of LIFE15 program to the MOTTLES project, allowed Italy, France and Romania to have an active monitoring network able to provide data on ozone damage according to the new directive. **In order to reply to the NEC other countries can replicate the MOTTLES monitoring system.**

The **validation of guidelines** by MOTTLES allows the transfer of these innovative methodologies for a more coherent policy on forest protection in Europe, in response to the climate change challenges. The application of the MOTTLES method will make a positive contribution to the convergence and policy leading up to the effectiveness of forest monitoring by providing a framework for research and analysis.

CNR obtained the financial support by the Italian Ministry of Environment for establishing a new monitoring station in Southern Italy, i.e. in an area at present not covered by the MOTTLES network.

In the after-LIFE, MOTTLES plans to extend the network to Croatia, a new country at high O₃ risk. The upgraded network will cover larger soil and climatic gradients, extending from the sclerophyll forests of the Mediterranean area to the mountainous beech forests of the Alpine region.

A **follow-up LIFE proposal** (MOTTLES-NEC), will be submitted with a major focus on transfer to policy. The main expected result is to bring EU directives towards a new standard, based on O₃ stomatal flux, and the development of a larger trans-European monitoring system of forests responses to climatic changes by setting up national monitoring stations.

MOTTLES-NEC is fully compliant with requirements of NEC directive art. 9 by giving long-term information on air pollution impacts on forests and by using key indicators according to Annex 5 (visible foliar O₃ injury, exceedance of flux-based CL), hourly measurements (O₃ concentration, meteorology, radial growth) and the DO3SE model (CLRTAP). MOTTLES-NEC fulfills the art. 9 by ensuring that the EU countries carry out monitoring activities to provide risk assessment and long-term quantification for O₃ effects on forests. From the information reported, the EC will improve the monitoring requirements of art. 9 during the 2nd phase of NEC directive implementation.

MOTTLES-NEC will support the national authorities for the NECD implementation and the ENV NEC team of DG.ENV c.3 about key monitoring issues, in particular data checks and processing, reference monitoring

protocols, distribution of monitoring sites, geographical consistency in monitoring of key indicators and reporting. MOTTLES-NEC is the only large-scale network able to provide this kind of support about O₃ impacts on forests.

MOTTLES-NEC will contribute to 2015 EU policy priorities, EU Forest Strategy and 2030 EU Biodiversity Strategy by improving EU decision-making to strengthen forest health.

EVALUATION OF RISKS

No serious issue was reported during the MOTTLES project. Then, we foresee no legal, regulatory or administrative risks also for the after-LIFE MOTTLES activities.

VANDALISM is the major risk to a successful set-up of the integrated monitoring systems. The MOTTLES sites are restricted access. The stations are installed far away from roads and labelled as dangerous and fenced. The occurrence of potential damage is promptly transmitted via GPRS so that fast repair and maintenance are possible. In case of very serious damage, a station can be quickly replaced.

DATA ACCESS: CNR personnel responsible for the data center validation and storage is well experienced as Italian World Meteorological Organization data center. Risks of data loss is minimized by copying the data from the FTP to separate hard disks.

TRANSMISSION FAILURE: Power supply is assured by solar panels or mains, when present, and backup batteries. In case of transmission failure, the data-logger memory ensures the integrity of acquired data.

STAKEHOLDER DISENGAGEMENT: We have implemented solid networks, regularly update the website, and use social media to circulate relevant messages to keep project activities in the minds of target audiences.

PARTNERS



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www.mottles-project.wixsite.com/life



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