

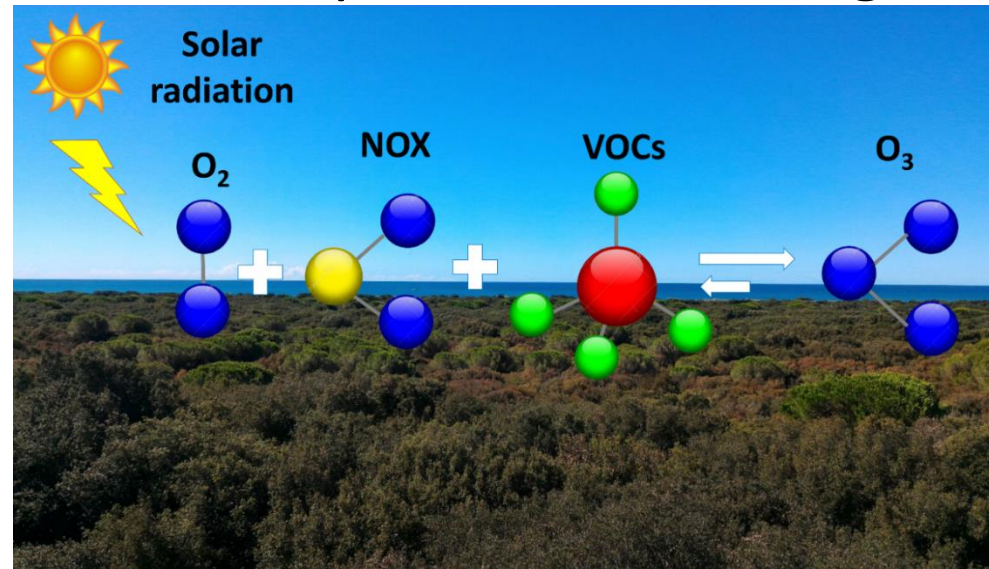
MONitoring ozone injury for seTTing new critical LLevels: A novel long-term monitoring strategy to produce new critical levels for forest protection against O₃

Carrari E. ⁽¹⁾, Badea O. ⁽²⁾, De Marco A. ⁽³⁾, Dalstein-Richier L. ⁽⁴⁾, Fares S. ⁽⁵⁾, Fasano G. ⁽⁶⁾, Giovannelli A. ⁽⁷⁾, Hoshika Y. ⁽¹⁾, Lazzara M. ⁽¹⁾, Materassi A. ⁽⁶⁾, Popa I. ⁽²⁾, Sabatini F. ⁽⁶⁾, Sicard P. ⁽⁸⁾, Silaghi D. ⁽²⁾, Paoletti E. ⁽¹⁾

⁽¹⁾Institute of Sustainable Plant Protection, National Research Council, Sesto Fiorentino, Italy ; ⁽²⁾Institutul Național de Cercetare Dezvoltare în Silvicultură "Marin Drăcea", Voluntari, Romania; ⁽³⁾Italian National Agency for New Technologies, Energy and the Environment, C.R. Casaccia, Italy; ⁽⁴⁾Groupe International d'Etudes des Forêts Sud-européennes, Nice, France; ⁽⁵⁾Council for Agricultural Research and Economics - Soil-Plant System, Rome, Italy; ⁽⁶⁾Institute of Biometeorology, National Research Council, Sesto Fiorentino, Italy; ⁽⁷⁾Trees and Timber Institute, National Research Council, Sesto Fiorentino, Italy; ⁽⁸⁾ACRI-HE, Sophia Antipolis, France

MOTTLES background: Ozone & European standards to protect forests

Tropospheric ozone (O₃) is a greenhouse gas and an important phytotoxic pollutant produced during the atmospheric photo-oxidation of Volatile Organic Compounds (VOCs) under the presence of nitrogen oxides (NOx).



Tropospheric ozone has doubled since pre-industrial times, with harmful effects on human and forest health. O₃ pollution has large impacts on plant functions, then on forest ecosystem productivity and other forest ecosystem services (water regulation & biodiversity).

Visible foliar injury

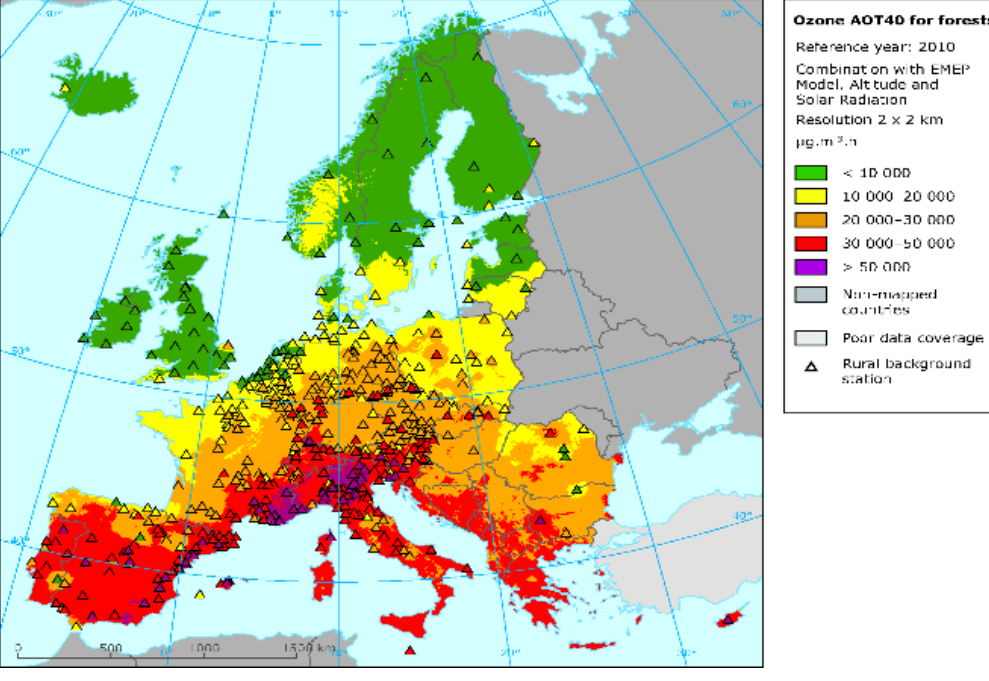
Crown defoliation

Growth reduction

Ozone effects on trees

Ozone-induced damages on plants include death of leaf cells (necrosis), crown defoliation, growth reduction and accelerated senescence. Plants under ozone stress are also more sensitive to parasitic attacks and abiotic stressors.

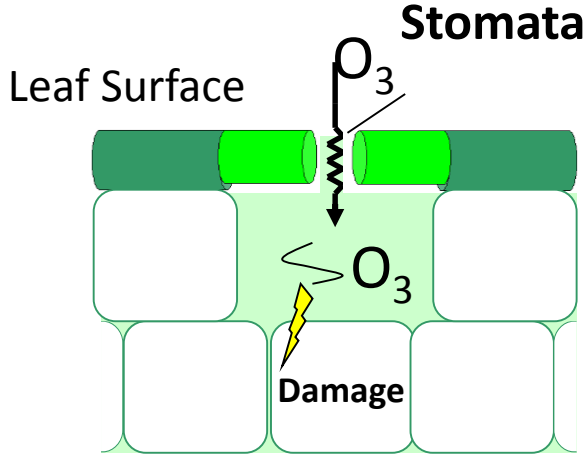
AOT40: the European index for forest protection based on the accumulated amount of ozone over the threshold value of 40 ppb



AOT40 often exceeds the limit for forests (5,000ppbxh), however, epidemiological analysis do not always find correlations with symptoms (visible foliar injury, tree growth, crown defoliation). This is because O₃ effect on vegetation does not depend only on ozone concentrations in the air, but also on the O₃ uptake through the stomata.

New critical levels based on accumulated stomatal ozone flux (POD)

MOTTLES will propose **new critical levels** for O₃ risk assessment defined as the accumulated stomatal O₃ flux above which negative effects on the forest may occur (Phytotoxic Ozone Dose). Stomatal flux is calculated using high temporal resolution O₃ concentrations and environmental variables, including soil moisture.



MOTTLES presents a new O₃ monitoring system based on active (high resolution) rather than passive monitoring of ozone, which is permanent and continuous

The new active Monitoring Network

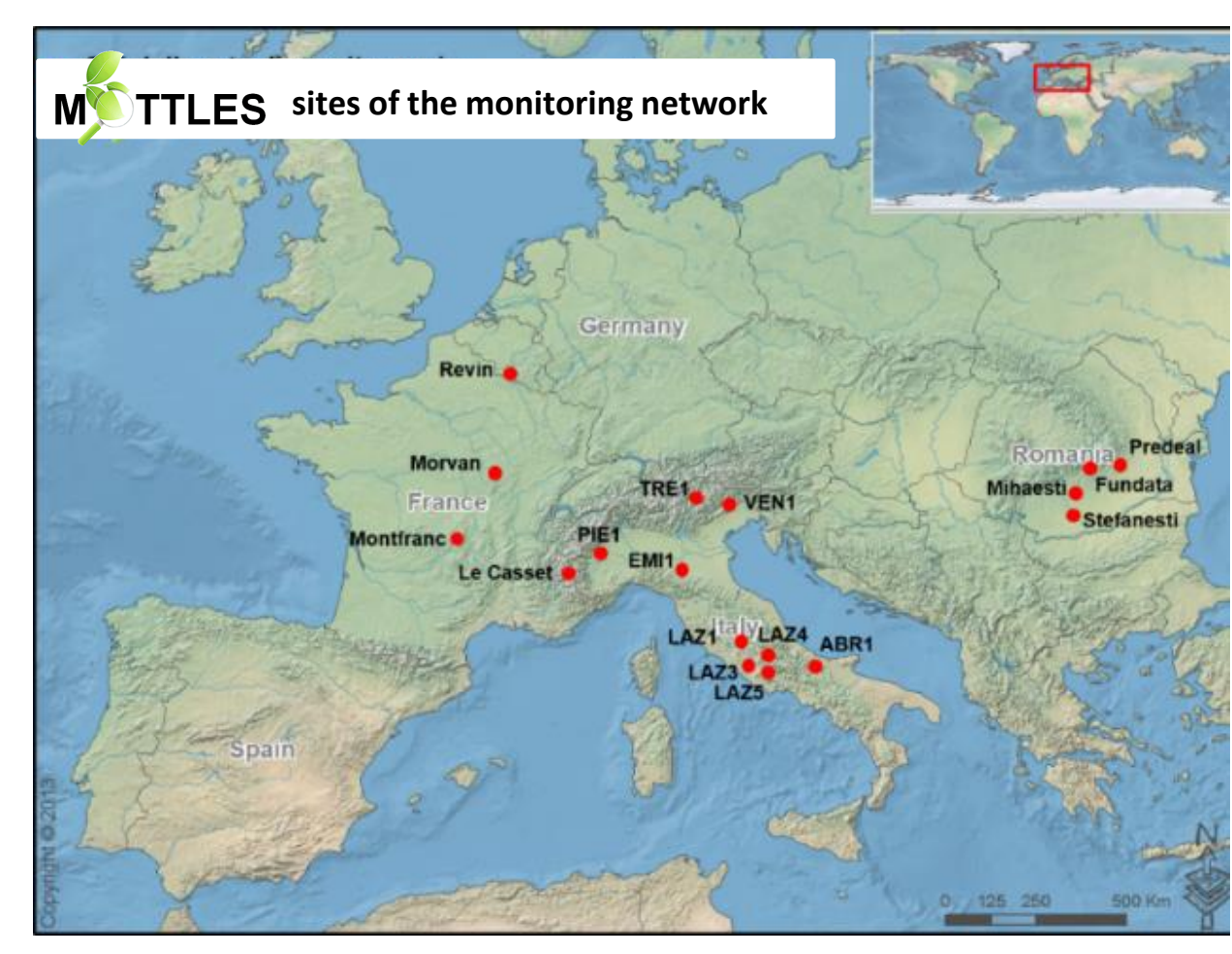
The new system is implemented in 17 sites selected from **European Networks (e.g. ICP Forests)** in France, Italy and Romania. Each site is made up by an **"open-field station"** and an **"in-the-plot station"**, where main meteorological variables and plant response indicators of forest health are collected to validate the **new critical levels based on stomatal fluxes**.

In-the-plot station

Open-field station

MOTTLES objectives

- Set up a permanent **new-generation monitoring system** for the effects of O₃ on EU forests
- Produce **new criteria and usable legislative standards** for forests against O₃
- Contribute to the achievement of **forest policies & EU 2020 Biodiversity strategy** and policy efficiency by development of proper standards
- Provide **open-access data** for incorporation into the European Forest Data Centre and the Forest Information System for Europe
- Monitor forest **response indicators** and **O₃ standards** across Europe
- Raise **stakeholders' and experts' awareness** about the innovative monitoring system and criteria of protection
- Assess the **exposure** and the **vulnerability** of EU regions to effects of Climate Change & O₃
- Support the elaboration of **recommendations & adaptive management strategies** for sustainable forest management
- Support future EU **air quality decision making**
- Form a generation of **young scientists**
- Allow exchanging **know-how and best practices**



MOTTLES ID	
Countries	Italia, Francia, Romania
Budget	1,838,406 euro
Period	July 2016-June 2020
Coordinator	IPSP-CNR (IT)
Partners	ACRI-HE (FR), CREA (IT), GIEFS (FR), INCDS (RO)