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PROFILE

Ground-level ozone (O_3) pollution and its impacts on vegetation: an attribute to Prof. Evgenios Agathokleous

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The Journal of Forestry Research (JFR) is pleased to highlight a collection of ten papers published by Prof. Evgenios Agathokleous and colleagues in 2020–2022. In recognition of the current heightened attention into ground-level ozone (O_3) pollution and its impacts on vegetation, this collection addresses effects of ozone on plants, methods to counteract plant stress effects, and assessment of potential ozone risks.

An open-top-chamber field experiment newly identified compounds in epicuticular wax and essential oils modified by elevated ozone, specifically elevated ozone altered leaf nitrogen, n-icosane, geranyl acetate, and elixene, and elevated CO_2 alleviated many of the ozone effects (Novriyanti et al. 2021). In a series of experiments, phaeophytinization was found to be affected by both ambient and elevated ozone conditions, in real-world conditions (Agathokleous et al. 2022a). An array of studies provided evidence that the synthetic chemical ethylenediurea, an antiozonant used in the rubber industry, effectively protects tall willow trees, saplings of Japanese larch and its hybrid, and Japanese larch seedlings against ozone-induced damage (Agathokleous et al. 2021; Agathokleous et al. 2022b, d). These studies reveal diverse physiological mechanisms via which ethylenediurea acts in protecting plants against ozone-induced damage, indicating the pleiotropic biology of this chemical and offering a perspective for potential application in forestry programs in the future. Similarly, two different studies evaluated the interactions among container-grown plants of Japanese larch, fertilization, ozone (or drought), and soil microbes, providing new insights with the potential to produce healthier container-grown seedlings that are used in modern forestry industry (Agathokleous et al. 2020; Agathokleous et al. 2022c).

Besides these experimental works, Prof. Agathokleous and his colleagues shed new light on the spatiotemporal variations of ozone exposure and its risks to human health and vegetation across a gradient of elevations, adding also a new dimension into the understanding of potential unequal risks to sub-population groups, with indications for increased risks to remote communities at high-elevation sites (Agathokleous et al. 2022f). In addition to the value of these findings to policy making, Agathokleous et al. made a further step to improve the way ozone risks to vegetation are assessed. In particular, they developed an improved ozone exposure index based on the Annual Ozone Spectrum Profile (AO3SP) (Agathokleous et al. 2022e). This provides an advanced and more biologically relevant version of the AOT40 index (accumulated ozone exposure over a concentration threshold of 40 nmol mol^{-1}), which is also currently used by legislative standards in the European Union. This upgraded index is promising for more accurate and representative assessment of ozone risks to vegetation and can have policy implications. Last but not least, Prof. Agathokleous and his colleagues provided a new insight into the role of volatile compounds emitted by plants in the communication between plants and insects in urban and suburban areas (Masui et al. 2021).

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These studies extend beyond science, are all openly accessible to the public, and can have significant industrial and policy application. The potential policy application is further signified by four papers by different authors, which provide further insights into ozone fluxes trends over time, flux-based critical levels, and risk assessment for the protection of European forests from ozone injury (Sicard et al. 2020, 2021; Proietti et al. 2021; Shashikumar et al. 2022). We hope that our readers find these studies enlightening and useful.

References

Agathokleous E, Kitao M, Komatsu M, Tamai Y, Saito H, Harayama H, Uemura A, Tobita H, Koike T (2020) Effects of soil nutrient availability and ozone on container-grown Japanese larch seedlings and role of soil microbes. J For Res 31:2295–2311. https://doi.org/10.1007/s11676-019-01056-y

Agathokleous E, Kitao M, Wang X, Mao Q, Harayama H, Manning WJ, Koike T (2021) Ethylenediurea (EDU) effects on Japanese larch: an one growing season experiment with simulated regenerating communities and a four growing season application to individual saplings. J For Res 32:2047–2057. https://doi.org/10.1007/s11676-020-01223-6

Agathokleous E, Kitao M, Koike T (2022a) Testing phaeophytinization as an index of ozone stress in trees. J For Res. https://doi.org/10.1007/S11676-022-01556-4

Agathokleous E, Kitao M, Koike T (2022b) Ethylenediurea (EDU) effects on hybrid larch saplings exposed to ambient or elevated ozone over three growing seasons. J For Res 33:117–135. https://doi.org/10.1007/s11676-021-01352-6

Agathokleous E, Kitao M, Komatsu M, Tamai Y, Harayama H, Koike T (2022c) Single and combined effects of fertilization, ectomycorrhizal inoculation, and drought on container-grown Japanese larch seedlings. J For Res. https://doi.org/10.1007/s11676-022-01565-3

Agathokleous E, Kitao M, Shi C, Masui N, Abu-ElEla S, Hikino K, Satoh F, Koike T (2022d) Ethylenediurea (EDU) spray effects on willows (*Salix sachalinensis* F. Schmid) grown in ambient or ozone-enriched air: implications for renewable biomass production. J For Res. https://doi.org/10.1007/S11676-021-01400-1

Agathokleous E, Saitanis CJ, Agathokleous S, Savvides C, Calatayud V, Sicard P (2022e) isoAOT40: an improved ozone exposure index based on the annual ozone spectrum profile (AO3SP). J For Res. https://doi.org/10.1007/s11676-022-01537-7

Agathokleous S, Saitanis CJ, Savvides C, Sicard P, Agathokleous E, De Marco A (2022f) Spatiotemporal variations of ozone exposure and its risks to vegetation and human health in Cyprus: an analysis across a gradient of altitudes. J For Res 1:1–16. https://doi.org/10.1007/S11676-022-01520-2

Masui N, Agathokleous E, Mochizuki T, Tani A, Matsuura H, Koike T (2021) Ozone disrupts the communication between plants and insects in urban and suburban areas: an updated insight on plant volatiles. J For Res 32:1337–1349. https://doi.org/10.1007/S11676-020-01287-4

Novriyanti E, Mao Q, Agathokleous E, Watanabe M, Hashidoko Y, Koike T (2021) Elevated CO_2 offsets the alteration of foliar chemicals (n-icosane, geranyl acetate, and elixene) induced by elevated O_3 in three taxa of O_3-tolerant eucalypts. J For Res 32:789–803. https://doi.org/10.1007/s11676-020-01133-7

Proietti C, Fornasier MF, Sicard P, Anav A, Paoletti E, De Marco A (2021) Trends in tropospheric ozone concentrations and forest impact metrics in Europe over the time period 2000–2014. J For Res 32(2):543–551. https://doi.org/10.1007/s11676-020-01226-3

Shashikumar A, Biárová S, Laurence DR (2022) The effect of ozone on pine forests in south-eastern France from 2017 to 2019. J For Res. https://doi.org/10.1007/s11676-022-01496-z

Sicard P, De Marco A, Carrari E, Dalstein-Richier L, Paoletti E (2020) Epidemiological derivation of flux-based critical levels for visible ozone injury in European forests. J For Res 31(5):1509–1519. https://doi.org/10.1007/s11676-020-01191-x

Sicard P, Hoshika Y, Carrari E, De Marco A, Paoletti E (2021) Testing visible ozone injury within a light exposed sampling site as a proxy for ozone risk assessment for European forests. J For Res 32(4):1351–1359. https://doi.org/10.1007/s11676-021-01327-7