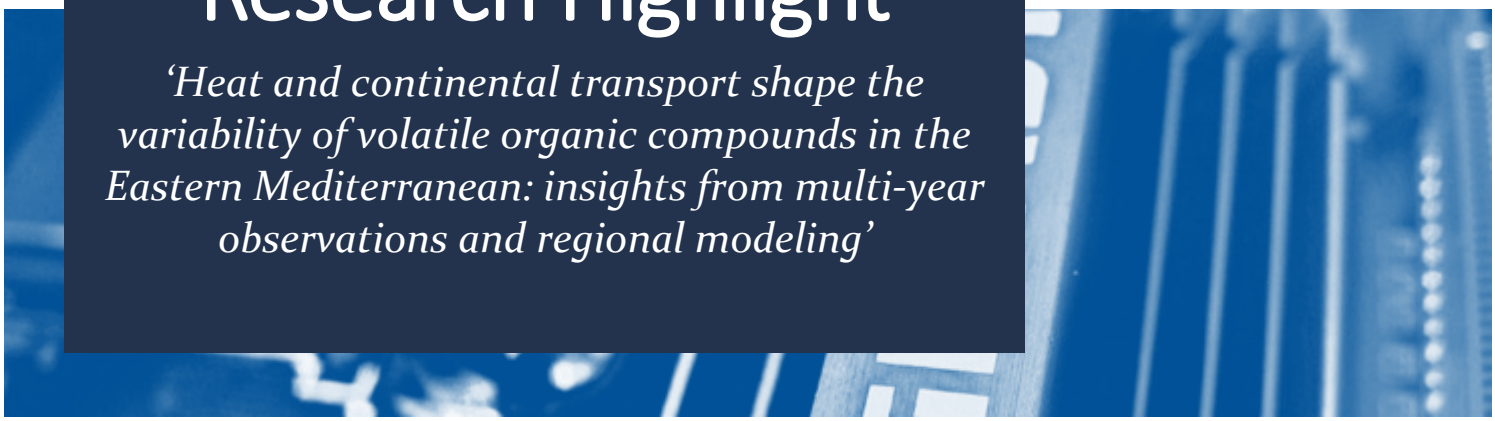
Research Highlight

'Heat and continental transport shape the variability of volatile organic compounds in the Eastern Mediterranean: insights from multi-year observations and regional modeling'



Summary

Cyprus and Eastern Mediterranean often experience high ozone levels, yet long-term measurements of the gases responsible for its formation are scarce, and emissions of volatile organic compounds (VOCs) remain poorly characterized in the region. To address this gap, we conducted continuous measurements for three years (April 2022-June 2024) at the rural background site of the Cyprus Atmospheric Observatory, monitoring 76 VOCs with a high-resolution proton-transfer-reaction time-of-flight mass spectrometer and analyzing their seasonal, daily, and transport-driven variability. The observations revealed large variability in VOCs level and sources with highest level during summer for most of the compounds. Among VOCs, oxygenated VOCs (OVOCs) dominated the total VOC burden (~79%), reflecting strong contributions from secondary formation, primary emissions, and long-range transport. Many VOCs increased during warm daytime conditions, highlighting the role of heat and photochemistry. Plant-related emissions such as isoprene rose with temperature up to about 35–38 °C and then declined, suggesting heat-stress effects, while several oxygenated gases increased during hot, dry periods. Combustion-related aromatic compounds were generally higher in winter, influenced by air masses from the Middle East, whereas most transported pollution originated from Europe and Northwest Asia. Model simulations reproduced seasonal patterns but underestimated many VOCs, indicating gaps in current emission inventories and chemistry. Overall, the results show that heat, seasonal changes, and regional transport are key drivers of VOC variability in the Eastern Mediterranean.

Authors' bios

Dr Anchal Garg is currently

a Post-doctoral Research Fellow at The Cyprus Institute, where her work focuses on volatile organic compounds (VOCs) and their role in regional air quality in the Eastern Mediterranean. Previously, she conducted postdoctoral research at Stanford University on indoor air pollution from gas stoves and associated public health impacts. She earned her PhD in Environmental Sciences from India. With over 20 peer-reviewed publications and several international presentations, her research spans VOCs, PAHs, particulate matter, exposure

Impact

This work provides one of the first long-term, high-resolution VOCs dataset for the Eastern Mediterranean from the Cyprus Atmospheric Observatory, helping to fill a major observational gap in the EMME region. The findings improve understanding of how extreme heat, regional transport, and photochemistry control VOC variability, which is essential for predicting future ozone formation and secondary organic aerosol production in one of the climate-sensitive hotspots. The dataset offers a valuable benchmark for evaluating and improving regional chemical transport models such as WRF-Chem, particularly in refining emission inventories and oxidation pathways that are currently underestimated. In addition, the results highlight the increasing importance of temperature-driven and stress-induced emissions under intensifying heatwaves, providing scientific evidence to support more accurate air-quality forecasting, climate-chemistry interactions studies, and region-specific mitigation and management strategies in the Eastern Mediterranean and Middle East.

Reference

Garg, A., Desservettaz, M., Christodoulou, A., Christoudias, T., Kanawade, V. P., Savvides, C., Vrekoussis, M., Naqui, S., Jokinen, T., Byron, J., Williams, J., Mihalopoulos, N., Liakakou, E., Sciare, J., and Bourtsoukidis, E. (2026). Heat and continental transport shape the variability of volatile organic compounds in the Eastern Mediterranean: insights from multi-year observations and regional modeling. *Atmospheric Chemistry and Physics*, 26, 2597–2622. doi: https://doi.org/10.5194/acp-26-2597-2026

Contact details

Dr Anchal Garg – Email: a.garg@cyi.ac.cy

Dr Efstratios Bourtsoukidis – Email: e.bourtsoukidis@cyi.ac.cy

assessment, and air pollution-related health outcomes.

Dr Efstratios Bourtsoukidis is a tenure-track Assistant Professor in Atmospheric Sciences at the Cyprus Institute, where he leads the Reactive Trace Gases research group within CARE-C. He earned his PhD in Natural Sciences from the University of Frankfurt in 2014 and subsequently worked as a postdoctoral fellow and research associate at the Max Planck Institute for Chemistry in Mainz, Germany. He has participated in numerous ground-based, ship, and aircraft field campaigns and has authored over 40 publications. His research explores how emitted reactive trace gases affect the Earth's atmosphere, focusing on the atmospheric chemistry that governs the land-atmosphere interactions.