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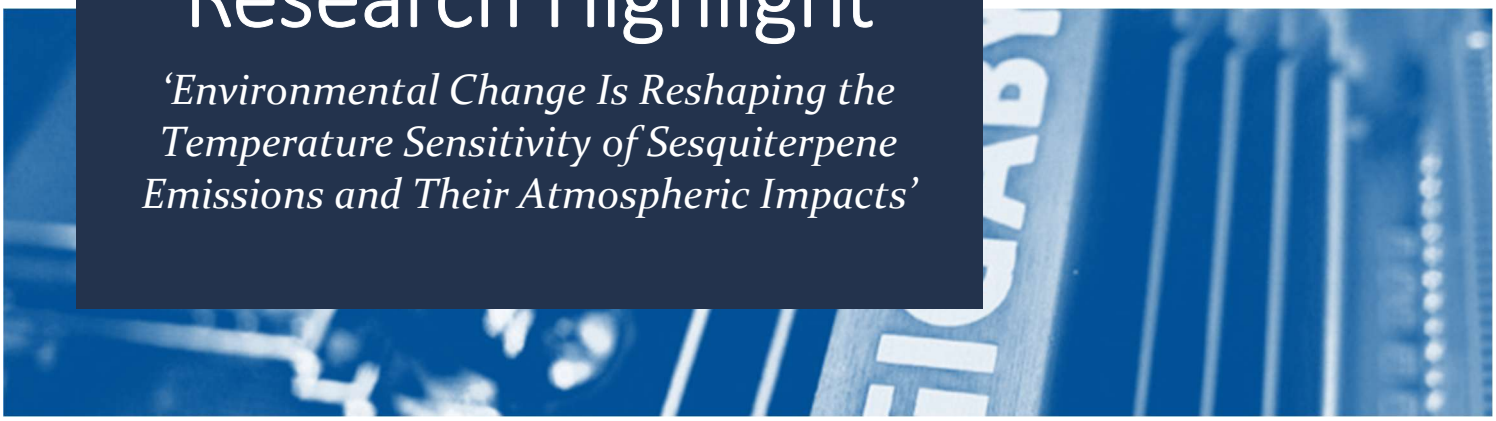
Research Highlight

'Environmental Change Is Reshaping the Temperature Sensitivity of Sesquiterpene Emissions and Their Atmospheric Impacts'



Summary

Air temperature is a critical regulator of ecosystem functions, including the release of biogenic volatile organic compounds (BVOCs) that mediate biosphere-atmosphere interactions. Among these, sesquiterpenes (SQTs) stand out for their dual role as ecologically significant compounds and highly reactive atmospheric constituents. Despite the inherently complex relationship between temperature and biogenic emissions, global emission estimates rely on simplistic parameterizations, assuming a fixed exponential response across all ecosystems and environmental conditions. Here, we synthesize two decades (1997–2019) of SQT emission studies, uncovering significant variability in temperature responses and basal emission rates driven by plant functional types (PFTs) and diverse environmental co-factors. When PFT-dependent parameterizations are integrated into emission-chemistry simulations, the results reveal sensitive feedbacks on atmospheric processes, including ground-level ozone (O_3) production and secondary organic aerosol (SOA) formation. Surprisingly, we identify a statistically significant decline in SQT temperature responses over time, suggesting that evolving environmental changes are reshaping the fundamental relationship between temperature and SQT emissions. This meta-analysis highlights the temperature sensitivity of sesquiterpenes (βSQT) as a key parameter at the interface of the biosphere, abiotic and biotic environmental change, and atmospheric processes, with cascading effects on air quality and climate. Our findings emphasize the potential to consider βSQT as a "volatile stressometer" for ecosystem-atmosphere interactions, where environmental stresses regulate the emission responses, with cascading effects on atmospheric chemistry and wider implications for future climate-vegetation feedbacks.

Author's bio

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.

Impact

This research demonstrates that environmental change is fundamentally altering the way plants emit sesquiterpenes, compounds that play a pivotal role in air quality, climate, and ecosystem health. The findings reveal that plant emissions are becoming less predictable under global warming, as they are increasingly influenced by multiple stressors such as drought, pollution, and pest activity. This dynamic and shifting relationship between vegetation and the atmosphere challenges long-standing assumptions in climate and air quality models. The work highlights the need for broader observations across diverse ecosystems (such as urban environments) to capture these evolving patterns, and it underscores the importance of integrating adaptive plant responses into future climate and atmospheric simulations.

Reference

Reference list

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