



## Towards Urban Climate Services: Urgency and Importance of Seamless Multi-Scale Modeling Tools to Support Climate Adaptation and Sustainable City Development

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Climate change poses a critical global challenge, threatening human well-being, ecosystems, economies, and societies. While mitigation efforts remain essential, the increasing severity and immediacy of climate impacts demand timely and effective adaptation measures. In the context of urban climate services (Baklanov et al., 2018, 2020), effective adaptation requires advanced modeling tools that provide higher spatial and temporal resolution, integrate urban structure, ecosystem processes, and social dynamics (Yang et al., 2025), and enable the assessment of diverse adaptation scenarios.

Seamless multi-scale and local-scale models—operating at the scales of streets, cities, administrative regions, countries, or specific domains—are particularly valuable, as they allow for the explicit representation of targeted adaptation measures and the generation of precise, context-specific information (Mahura et al., 2024; Ouyang et al., 2025; Esau et al., 2024). Such models play a crucial role in the development of tailored climate adaptation strategies and actionable planning frameworks.

This overview highlights the significance of seamless multi-scale modeling approaches and discusses the key scientific and practical challenges associated with their development and implementation. We emphasize the urgent need to accelerate progress in this area and call upon the scientific community and policymakers to prioritize the advancement of tailored local-scale modeling tools and integrated services. Strengthening these capabilities is essential to enhance urban resilience and to better support adaptive responses to the complex and rapidly evolving challenges of climate change and urbanization at the local level.

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