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Hybrid AI and multiscale physical modelling for optimal urban decarbonisation combating climate change

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Developing a hybrid model that integrates physics-based principles with advanced artificial intelligence (AI) techniques is a promising strategy for achieving accurate and efficient environmental prediction. This hybrid approach harnesses the strengths of both disciplines to enhance the precision and versatility of predictive modelling in the realm of environmental sciences. In this framework, the physics-based component incorporates established principles from fluid dynamics, thermodynamics, and other relevant physical disciplines. In this talk, I will first demonstrate the capability of multis-scale adaptive mesh physical modelling for urban environmental problems, where, the details of buildings, and impact of green infrastructures (trees, parks) are considered. Furthermore, I will introduce recently development on machine learning techniques and data assimilation for improved predictive accuracy and uncertainty optimisation and rapid responding modelling. Complementing the physics-based foundation, AI algorithms are employed to dynamically adapt and refine the model based on real-time data. The capability of deep learning combined with data assimilation is demonstrated through hourly/daily PM2.5/ozone forecasting globally and regionally (in China). Finally, the presentation underscores the significance of digital twin tools in the context of smart city management, drawing connections to a recently funded EPSRC project. This holistic approach not only showcases the potential of a hybrid physics-AI model in environmental prediction but also emphasizes its practical implications for advancing smart city initiatives

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