Spatio-temporal Bayesian models for environmental epidemiology: methods and examples

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In this talk I will give an overview of the statistical modelling approach used for analysing data characterised by spatial and temporal dependence and will focus on applications in the field of environmental epidemiology. I will start introducing the general statistical framework used in environmental epidemiology when dealing with spatial and temporal data and then present how these methods have been used on two different real-world applications:

1. **Air pollution sources and their health impact** - Particulate matter (PM) is a complex mix of organic and inorganic compounds of distinct sources, with a range of physical and chemical properties, which might have a different harmful effects to health. Disentangling total ambient PM concentration into its sources is key for developing strategies to reduce PM through targeted actions. I will present a Bayesian model for (i) apportioning airborne particles into sources using a nonparametric approach and (ii) assessing the impact of each source on health outcomes. To illustrate the proposed model framework, I will use particle size data measured at an urban background site in London (UK) and cardio-respiratory hospital admission.

2. **Wastewater based epidemiology in the COVID pandemic** - The utility of wastewater-based epidemiology as an early warning tool has been explored widely across the globe during the current COVID-19 pandemic. However, no attempt has been made to develop a model that predicts wastewater viral concentration at fine spatio-temporal resolutions covering an entire country, a necessary step towards using wastewater monitoring for the early detection of local outbreaks. I will first show how we can model the relationship between weekly viral concentration in wastewater at specific locations and a collection of covariates covering socio-demographics, land cover and virus-associated genomic characteristics. I will then discuss the potential for joint modelling of wastewater data and COVID-19 prevalence on a space-time resolved domain to improve the performance of public health surveillance systems.