Characterising diurnal- and synoptic-timescale changes in urban air quality using Radon-222

Scott Chambers1, Dafina Kikaj2, Agnieszka Podstawczyńska3, Jagoda Crawford1, and Alastair Williams1

1Environmental Research, ANSTO, Lucas Heights, Australia
2Dept. Environmental Sciences, Jožef Stefan Institute, Ljubljana, Slovenia
3Dept. Meteorology and Climatology, University of Łódź, Łódź, Poland

Urban air quality is strongly influenced by the atmosphere's ability to disperse primary emissions and opportunities for secondary pollution formation. In mid- to high-latitude regions that experience enduring winter snow cover or soil freezing, regional subsidence and stagnation associated with persistent anti-cyclonic conditions such as the “Siberian High” can lead to “cold pool” or “persistent inversion” events. These events can result in life-threatening pollution episodes that last for weeks. While often associated with complex topography [1,2], persistent inversion events can also influence the air quality of urban centres in flat, inland regions [3]. This presentation will describe a recently-developed radon-based technique for identifying and characterising synoptic-timescale persistent inversion events, which is proving to be a simple and economical alternative to contemporary meteorological approaches that require regular sonde profiles [1]. Furthermore, key assumptions of the radon-based technique to characterise diurnal-timescale changes in the atmospheric mixing state described by Chambers et al. [4] are violated during persistent inversion conditions. Here we demonstrate how atmospheric class-typing, through successive application of radon-based techniques for identifying synoptic- and diurnal-timescale changes in the atmospheric mixing state, improves understanding of atmospheric controls on urban air quality in non-summer months across the full diurnal cycle. This knowledge translates directly to statistically-robust techniques for assessing public exposure to pollution, and for evaluating the efficacy of pollution mitigation measures. Lastly, we show how atmospheric class-typing can be used to enhance the evaluation of chemical transport models [5].
