

## Publication

## Delimiting affinity zones as a basis for air pollution mapping in Europe

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Affinity zones are defined as areas within which air quality displays consistent behaviour over space and time. Constructed using multivariate statistical techniques and physiographic and landscape variables reflecting underlying sources and spatial patterns of air pollution, affinity zones provide a spatial structure suited to exploring the representativity of monitoring networks and as a basis for air pollution mapping and exposure assessment. The affinity zone method is demonstrated using European air pollution monitoring sites, and environmental data compiled within a 1 km GIS. Organised into three main stages, this method involves: (i) indicator selection, using principal components analysis, (ii) zonation by cluster analysis to classify areas into distinct types, and (iii) site allocation, to confirm similarity within affinity zones in terms of monitored air pollution concentrations. Ten interpretable and coherent air pollution affinity zones were constructed for Europe, including two rural zones and eight related to different types of densely populated and built up environments. Concentrations between affinity zones differed significantly for NO<sub>2</sub> background and traffic sites and for PM<sub>10</sub> traffic sites only. Not all zones, however, were found to be sufficiently represented by monitoring sites, illustrating the importance of affinity zones in identifying deficiencies in monitoring networks. Spatial modelling within affinity zones is also demonstrated, showing that simple kriging of background NO<sub>2</sub> concentrations within zones (compared to kriging ignoring zones) produced a ca. 22% reduction in errors and increased R<sup>2</sup> by 0.25 at reserved validation monitoring sites. The affinity zone method developed here is a robust, statistical approach that can be used for evaluating the representativity of routine monitoring networks often used in continental level environmental and health risk assessments.

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