EGU22-8334
https://doi.org/10.5194/egusphere-egu22-8334
EGU General Assembly 2022

Information theory solution approach for air-pollution sensors' location-allocation problem

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Urbanization and industrialization processes are accompanied by adverse environmental effects, such as air pollution. The first action in reducing air pollution is the detection of its source(s). This is achievable through monitoring. When deploying a sensor array, one must balance between the array's cost and performance. This optimization problem is known as the location-allocation problem. Here, a new solution approach, which draws its foundation from information theory is presented. The core of the method is air-pollution levels computed by a dispersion model in various meteorological conditions. The sensors are then placed in the locations which information theory identifies as the most uncertain. The method is compared with two other heuristics typically applied for solving the location-allocation problem. In the first, sensors are randomly deployed, in the second, the sensors are placed according to the maximal cumulative pollution levels (i.e., hot spot). For the comparison two simulated scenes were evaluated, one contains point sources and buildings, and the other also contains line sources (i.e., roads). It shows that the Entropy method resulted in a superior sensors' deployment compared to the other two approaches in terms of source apportionment and dense pollution field reconstruction from the sensors' network measurements.