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DETERMINATION OF THE ROLE OF MODELING IN THE SELECTED ODOUR EMISSIONS SOURCES IMPACT ASSESSEMENT

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RESEARCHES OBJECTS

Industrial plant – distillery

Distillery is located on the outskirts of a city with a population exceeding 500 thousand, in the industrial-service area. Nearest residential buildings are located approximately 1500 metres south from the plant. The distillery produces ethanol and gluten for industrial purposes. Processes causing the odour emission are: gluten drying, fodder drying and alcohol fermentation.

Agricultural object – swine farm

Swine farm is located in a rural area. Nearest residential buildings are located approximately 2500 metres away from the farm. On the site of a farm, there are 9 pigsties, an outbuilding and two manure lagoons. Odours emitted from the object are typical for this type of activity and deriving from pigsties and lagoons.

MATERIALS AND METHODS

Field inspections – measurements in the plume

Field measurements in the plume were conducted both in the area around and inside selected objects, in accordance to methodology included in German guidelines VDI 3940 part 1 (VDI 3940 Part 2, 2006). The objective of measurement was to determine the intensity of odours deriving from studied objects and the extent of their impact. Measurement date and number of measurement series: distillery: June 25 - 29, 4 series; swine farm 3 - 7, 2012, 5 series. An area where field measurements in the plume were conducted was set at the very beginnig of the study, depending on current wind direction and topography. The measurement was attended by 9 properly qualified field inspectors, whose was standing at the designated point, senses the surrounding air and every 10 seconds for 10 minutes, writes down the intensity of sensed odour and its type on a specially prepared protocol. Each odour was marked with a letter symbol presented in tables 1A and 1B.

A

Odour symbol	Odour character
A	no odour
B	agricultural odour
C	agricultural odour: manure
D	agricultural odour: pig breed
E	agricultural odour: cattle breed
F	agricultural odour: horse breed
G	agricultural odour: hay, grain
H	car exhaust odour
I	smell of burned coal
J	grass smell
K	other: specify
L	**smell of baked bread**
M	**gluten (pasta)**
N	**alcohol (yeast)**
O	sewage sludge

B

Odour symbol	Odour character
A	no odour
B	agricultural odour
C	**agricultural odour: pig breed**
D	agricultural odour: cattle breed
E	agricultural odour: horse breed
F	agricultural odour: hay, grain
G	car exhaust odour
H	smell of burned coal
I	grass smell
J	other: specify
L	**manure lagoons**
P	**carrion, rotten meat**
R	utilization 1
S	utilization 2

Odour dispersion modelling – CALPUFF model

In addition to field measurements conducted in the distillery area, odour dispersion calculations using CALPUFF model were performed. For this purpose, it was necessary to calculate odour emissions (E, ou_E/s), which were based on the knowledge of odour concentration and gas flow. The odour concentration in test samples was determined using the method of dynamic olfactometry. As written above, 3 characteristic odours are emitted from studied distillery area. Due to different chemical compositions of mixtures of these odours, they were treated as separate pollutants and propagation calculations were performed separately for each odour. Calculations were performed according to parameters current on June 25 - 29, 2012.

RESULTS

Field inspections

During field inspection in every measuring point geographic coordinates was determined. Field measurements results were visualised using a Geographic Information System (GIS) in ArcGIS 10.0 ESRI.

A B

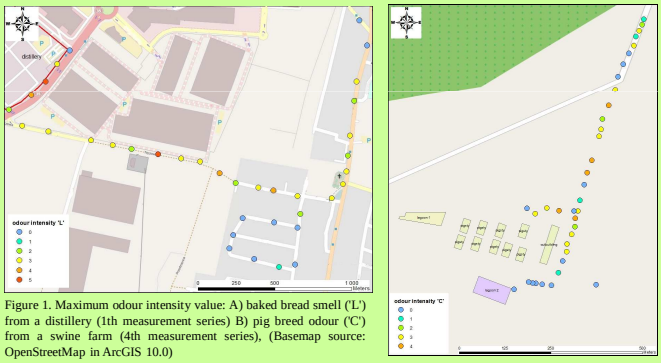

Figure 1. Maximum odour intensity value: A) baked bread smell ('L') from a distillery (1th measurement series) B) pig breed odour ('C') from a swine farm (4th measurement series), (Basemap source: OpenStreetMap in ArcGIS 10.0)

Ordinary Kriging

During such measurements, primarly due to procedures as well as time limits and the need to involve a team of inspectors, measurement can not be performed at any point. To measure odour intensity spatial distribution across tested area, a geostatistical interpolation can be performed. Kriging method is considered best in terms of accuracy but also most complicated.

A B

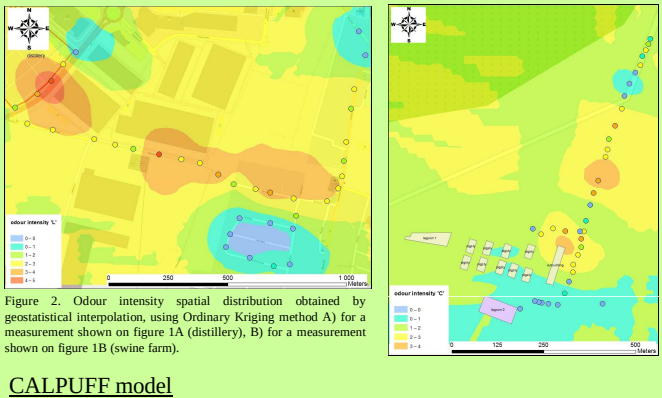

Figure 2. Odour intensity spatial distribution obtained by geostatistical interpolation, using Ordinary Kriging method A) for a measurement shown on figure 1A (distillery), B) for a measurement shown on figure 1B (swine farm).

CALPUFF model

The use of geostatistical interpolation allowed to estimate intensity values at points where measurements could not be made but in the range of performed field measurements. Using geostatistical methods, areas beyond measurement area cannot be analyzed (by extrapolation) due to high error values but it is possible using odour dispersion model.

A B

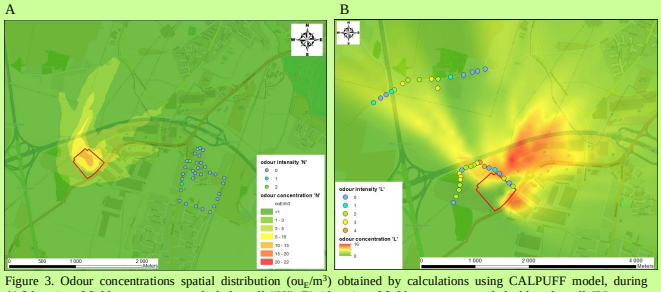

Figure 3. Odour concentrations spatial distribution (ou_E/m^3) obtained by calculations using CALPUFF model, during A) 3th series of field measurements, alcohol smell ('N'), B) 4th series of field measurements, baked bread smell ('L').

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'Development of a dynamic-statistical model of odour nuisance propagation in urban and industrial agglomerations', National Science Centre, Poland, 0188/B/P01/2011/40

The National Centre for Research and Development

National Science Centre Poland