Co-creating data based on human nose perceptions to study odour nuisance from an oilseed industry

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Abstract

Odour nuisance is the second environmental problem with more citizen complaints after noise. This fact and the lack of odour regulation in Portugal led way to develop a bottom-up approach focused on citizens to co-create the analysis. Despite the existence of odour measuring instruments, the human nose is a universal sensor with high sensitivity that allows to assess the impact of discomfort on human receptors. A sensorial method was conducted in a community neighbor of an oilseed industry that cause impact on their daily life because of the "cereal/flours/feeds" odour (based on citizens' complaints, industry type, exploratory survey). Two monitoring campaigns were conducted with the help of a group of citizens forming an observers panel (OP) whose function was to record odourobservations. A road circuit was outlined by the technical team also to register odour observations but essentially to verify the OP registers. For both cases a meteorological analysis was conducted with a weather station. Results showed that the "cereal/flours/feeds" kind of odour was registered by the OP 150 times during a six month period. The intensity level, although week, was several times perceived when the meteorological conditions were week wind and wind blowing from the northwest which led the plume towards the population.

Keywords: Odour nuisance; odour assessment; sensorial methodology; bottom-up approach.

1. Introduction

Citizens perceptions of their environmental surroundings in terms of odours are in general, ignored by local governance, since, in most cases, there´s no background legislation to regulate odour pollution. Environmental odours are an emerging issue since complaints regarding odour nuisance are increasing. However people are more empowered having assess to social media and formal institutions to expose their concerns. An engagement between citizens, industries and local power is necessary to improve community relations so not to diminish life quality but at the same time not affect local economy (De Feo, 2013). One of the tools to manage this science society gap is the co-creation of data using the human nose as a valid sensor (Arias, 2018). Using citizens records (OP) as a main tool it was possible to evaluate odour impact on sensitive receptors from the vicinity of an oilseed industry in the Lisbon area designing a year monitoring program.

2. Methods Design- The three "N"approach: Nose, Nuisance, Network

With the goal of the odour assessment of the limited area between Almada and Seixal, two citizen groups (16 males and 27 females, with ages between 20 and 60 years old, living or working in the study area) were assembled with the aim of register daily odour perceptions in a period of seven month time, divided in two monitoring campaigns (winter and summer). The OP elements were volunteers, living or working in the area, with no link to any odorous emission activity. A standard form was developed to collect data from the OP that respected the FIDOL factors (Bull et al, 2018), the weather conditions and the types of possible odours from the study area. In addition, a road circuit (inspired on field inspections from VDI 3940:2nd part) was developed in order to validate the OP records and to obtain complementary data through independent observations from the technical team. This geographically delineated routes were established to reach the locations of the OP elements and were applied in random days. This way the ambient air was evaluated in 23 different spots. These two ways approach was combined with a meteorological analysis with data collected from a weather station installed in a strategical place in the oilseed plant. To have a graphic representation of the plume extension and its possible reach to sensitive receptors, a Lagrangian dispersion model was used. The modeling was performed for the days with the higher record numbers of odour observations. The outputs of the model combined with the results of the circuit routes and the meteorological analysis was an additional way to validate the OP records (Capelli, 2013). Thus, the citizen network, the nose perceptions (both OP elements and technical team) and the tools design for the monitoring, may provide information to analyze odour nuisance in a perspective bottom-up: from the citizen to the industry (Irwin, 2018).

3. Results and Discussion

Having an OP with 43 elements divided by 2 monitoring campaigns, a total of 356 odour records (odour observations registered by the OP) was achieved, from which the most signed were 150 of "cereal/flours/feeds" type for 201 days of observation (Table 1).

Table 1. Number of odour records from the OP

Monitoring Campaigns / Odour Type	1st	2nd	Total
Garbage	79	13	92
Manure	34	5	39
Rotten cabbages/Rotten eggs	54	8	62
Cereal/flour/feeds	74	76	150
Others	0	13	13
Total	241	115	**356**

This kind of odour was perceived in several locations of Almada municipality (Figure 1) and categorized as unpleasant with weak intensity.

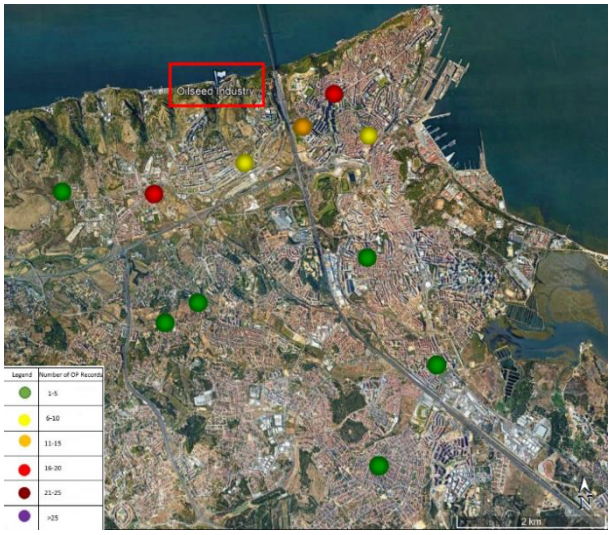

Figure 1. Mapping the OP records of "cereal/flour/feeds" odour

The records were made especially during week days, mainly at morning and at night and the duration of the observations was for a few hours, so this kind of odour has an intermittently aspect. The OP data, combined with the meteorological data, showed that on days with more odour records, the wind was from south and the height of the mixture layer was low, which generated low atmospheric dispersion conditions. The average wind intensity was weak throughout the analysis period. Using a lagrangian dispersion model (HYSPLIT with a dataset input of meteorological information, and with specific information from the oilseed industry (e.g., mass flow), was possible to analyze the plume on some selected days (e.g. days with more than 3 records of "cereal/flour/feeds" from the OP). The results showed that the dispersion of the plume matched the locations of the OP elements. The technical team carried out 35 road circuits where only the "cereal/flour/feeds" type of odour was detected. Although there were 101 records of this kind of odour, in the majority of the time, the road circuits were performed in the absence of any kind of atmospheric odour.

4. Conclusions

Using a sensorial approach and a network of citizens, academia and industry was possible to develop an odour monitoring program which led to an environmental odour characterization of the study area from a nuisance perspective. The main conclusion was that the odours from the oilseed industry had a significant impact on the OP. This problem affects more the citizens in the locations (a higher number of records of the "cereal/flours/feeds" odour type) near the emission source and in the hot season. Although the industry was in continuous operations all the time but the odour was intermittent, this could mean that the meteorological conditions played an important part in the human positive perceptions.

Finally, this combined approach although disruptive from other forms of action to assess atmospheric odours showed that with the interaction of citizens and technical validation was possible to engage an industry in a response to an environmental problem, in this case, without a legal framework, that has been undervalued. The results from this work were presented to the municipal entities which are now part of the working group developing a second phase of the monitoring program.

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