Leave a Reply

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Odors originating from industry sewage treatment plants or livestock breeding can create a great deal of air quality annoyance, particularly in densely populated areas. Odors may be encountered as a severe environmental stressor, depriving citizens of their quality of life and may even result indirectly in adverse health effects. Odors are a major source for complaints at environmental authorities in Europe. For many people, odors may also generate sociological conflicts or the dilemma “jobs versus quality of life.”

Figure 1: A citizen provides geo-located odor information. Image Credit: European Union, 2013

In contrast to air pollutants, there is no clear and harmonized European regulatory framework concerning acceptable odor emissions and non-acceptable odor nuisance levels, but a tangle of local, regional or national regulations. The subjectivity of odor perception makes it difficult to be monitored like an air pollutant. Nowadays though, emerging technologies make it possible to use human as sensors. Citizens can provide immediate odor information so as to help solve odor issues in many ways.

First, citizens’ observations enable operating companies or authorities to immediate awareness. Second, fast odor observations can help identify acceptable odor nuisance levels. Third, in case the odor sources are well understood and the odor dispersion conditions (wind and turbulent mixing) are known, fast odor information enables operating companies and authorities to identify critical odor emission loads or critical operation conditions under prevailing ambient conditions. Fourth, if an odor information, monitoring and propagation system is available, the odor situation of complex industrial facilities can be analyzed in depth, which enables representatives to act efficiently on odor sources. Finally, such a combined monitoring information system may be used to create a win-win situation.

OMNISCIENTIS, a research and innovation project funded by the European Union in the Seventh Framework Programme for Research (FP7), adopted a global approach to address the odor problem and developed an integrated solution based on a combination of technological and sociological approaches so as to manage olfactory nuisances with the highest degree of communication, collaboration and understanding between all the stakeholders involved including citizens, industrials and local authorities.

OMNISCIENTIS Answers and Feedback

OMNISCIENTIS brings together the state-of-the-art technologies and open communication capabilities to mitigate odor annoyance. Recent technological developments in information and communication technologies, atmospheric modelling, sensors and measurements were used to develop the OMNISCIENTIS Odour Environmental Information System. The solution is a service-oriented platform which also allows citizens to act as human sensors by providing odor perception, discomfort and nuisance through a geo-mobile application. The main components of the solution are briefly presented below.

1. **Living Lab environment to support mediation and empowerment of the citizens**: The challenge of OMNISCIENTIS lied in the integration of citizens as “community-based” observers in a monitoring and decision-making process that most immediately concerns them. Their participations were enhanced by the use of the platform and geomobile application which provided them with a means to deliver and receive information on odor perception. The idea was to create a physical and intellectual space for shared understanding and collaboration between all stakeholders impacted by the environmental problem of odor emission: the **Living Lab**. The Living Lab approach was implemented in the Pilot experiment in Belgium and involved citizens, public authorities, industry and environmental non-governmental organizations. As an enabler of local environmental governance, the Living Lab encompasses the definition of a common purpose, joint actions, a framework of shared values, continuous interactions . It helps achieve achieve collective benefits that cannot be gained by acting independently.

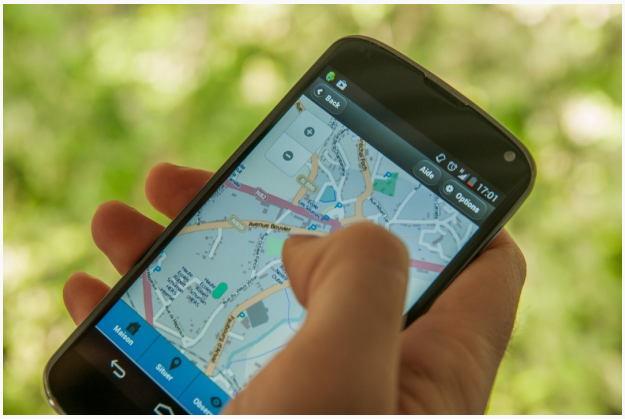

Figure 2: Living Lab enabling device. Image Credit: Spacebel, 2014

2. **Mobile applications to create a “citizen centric” approach**: In the OMNISCIENTIS solution, neighbors (citizens) can use a mobile device (smartphone, tablet) to provide environmental information on odor and get direct feedback. The geo-mobile application gives secured access to different functionalities to support field or ad hoc surveys in direct link to the central service platform including real-time recording of geo-located observations, real-time information availability, map viewing, bidirectional alert capabilities, individual or collective messaging service and off-line working.
3. **Real-time atmospheric dispersion model**: A new and transient odor dispersion model was developed based on the air pollutant dispersion model GRAL (GRAz Langrangian). The main parts of the model were transferred from CPUs (central processing units) to GPUs (graphical processing units) so as to speed up the computation time by a factor over two orders of magnitude. As a result, this model can produce an odor dispersion plume in a few minutes, thereby allowing near real-time spatial representation of odor exposure levels.
4. **In-situ collection of measurements and parameters**: The odor dispersion model needs specific data at the source of the nuisance. The OMNISCIENTIS monitoring system is based on an in-situ sensor network made up of electronic noses (e-noses), a meteorological station and parameters gathered from the industrial processes. Such a system makes it possible to monitor odors from emission to olfactory impact: industrial process variables provide continuous inferred information on odor emission rates at the source, e-noses equipped with a new series of gas sensors and improved odor recognition pattern provide continuous inferred odor information at reception and the meteorological station provides high-time resolution atmospheric parameters. Odor quantification and plume are then processed from these input data every six minutes by the dispersion model and can be further compared and validated by human observations.

5. **Web-oriented service platform**: The OdoMis platform provides near real-time access to the odor monitoring system information including e-nose measurements, atmospheric parameters, industrial variables and citizen observations. Through a simple dedicated interface, different groups of users have access to continuously refreshed information on the odor plume, citizen observations, validated monitoring statistics and impact levels. The OdoMis platform supports local authorities in their environmental decision-making, offers a diagnosis of the odor annoyance to industry and gives feedback to citizens on their complaints. Moreover, a better process-related understanding for all involved stakeholders can be achieved.

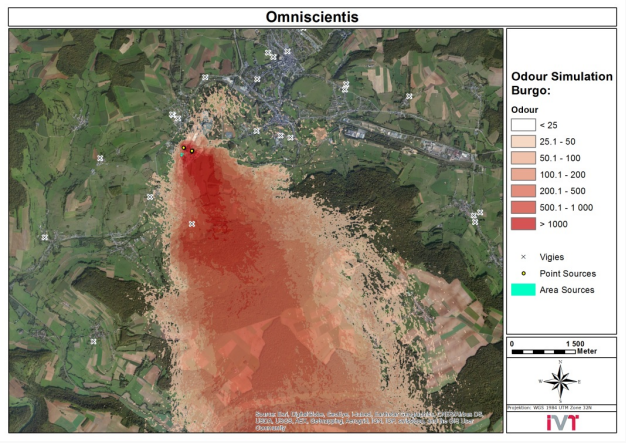

Figure 3: Odor dispersion calculated by the GRAL model. Image Credit: TUG Graz

Outcome of the Pilot Experiment

During the implementation and use of the installation on the pilot site of BURGO Ardennes paper mill, , neighbors were given a smartphone and invited to act as citizen observers. A total of 27 neighbors regularly transmitted their observations on odor perception and degree of annoyance around the site, providing 5,000 observations in total. A meteorological station and two in-situ e-nose sensors were installed and calibrated. Eighteen industrial parameters from the sensor network were collected in real time and 15 odor field surveys performed to obtain an improved understanding of the odor sources, the odor characteristics and their dispersion under various ambient conditions (wind direction, wind speed, atmospheric mixing by turbulence).

Monthly meetings organized between stakeholders, including industry representatives and citizens, contributed to turn claims by the neighbours into feedback and to help the industry improve the process and mitigate the impact on the neighbors. The beneficial results were decisive in the stakeholders' decision to keep the OMNISCIENTIS system going in 2015, after the end of the project.

Conclusion

An approach fostering active involvement of citizens and an improved unbiased communication between the parties involved based on the latest communication and technological tools offers a great potential to analyze and understand a complex environmental situation.

Due to the subjective nature of odor issues, the OMNISCIENTIS project adopted a holistic approach, combining new technologies from various disciplines with citizen participation. The collaboration of different stakeholders initiated during the project paved the way for improved environmental governance, limited conflicts and a fertile ground for a peaceful cohabitation.

Figure 4: An e-nose in the vicinity of the source of odor. Image Credit: European Union, 2013