STUDY OF ODOR EPISODES USING ANALYTICAL AND MODELING APPROACHES

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1. INTRODUCTION

Odor episodes are of particular concern in Catalonia, a region in NE Spain with an important industrial sector whose facilities, on many occasions, are located very close to population areas. In this contribution we show a methodology that has been applied to investigate the origin of bad odors episodes. The procedure combines, on one hand, an analytical approach, based on the acquisition of samples, and which requires the participation of the affected population; and on the other hand, a modeling approach, based on the use of mesoscale meteorological models to track back in time the origin of the air mass responsible of the discomfort. The system has been applied to the investigation of odor episodes suspected to be caused by a landfill facility.

2. ANALYTICAL APPROACH

The Laboratory of the Environment Center (LCMA) has been working for several years on the development of odor maps for several regions. The group has developed an analytical system which detects the VOCs responsible of the bad odors. Since odor nuisance is a result of several factors (both physiological and psychological) that determine the behavioral response of the individual, the system relies on the collaboration of members of the affected community, which turn on the sampler device whenever they experience the smell problem.

Measurements are acquired with a VOC sampler developed at LCMA (and whose main characteristics are: remote activation, operating range 40-200 ml/min, constant flow model, solid adsorbent multi-bed tubes Carbotrap+Carbopack X+ Carboxen 569). Samples are taken for short-term air sampling (2-6 hour) during odor episodes by affected residents. Representative VOC standards (C_6-C_{10} aliphatic hydrocarbons, C_6-C_8 aromatic hydrocarbons, C_5 esters, C_2 aliphatic halocarbons, C_6 aromatic halocarbons and C_{10} monoterpenes) are used for calibration and validation purposes. An optimized

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thermal desorption-gas chromatography-mass spectrometry (TD-GC-MS) method is used to quantify these analyses down to 0.01-100 mg/Nm^3 in outdoor air samples.
The analytical system is an effective tool for the identification of sources responsible for the odor events. Identification of the VOC component, correlated with the meteorological records prevailing during the hours of the episodes (wind direction), can lead to the identification of the wind sectors from where the odor was originated.

3. MESOSCALE MODELING APPROACH

To further confirm the causes of the episodes, a modeling approach has been added to the methodology explained above, by using a 3-D mesoscale meteorological model at high resolution. The ideal situation for this kind of study would be to perform a full dispersion simulation of the suspicious source. However, this is not always possible since most of the times the industrial activity under investigation is not willing to provide information about its emissions. For this reason the developed methodology makes use only of the meteorological module of the mesoscale model. The high-resolution wind fields provided by the model are used to track back in time the air-mass that has caused the bad odor episode at a given moment in a certain location.

The model used for the simulation was the Australian model TAPM, and five nested domains were defined, consisting of 50x50 cells of 15, 6, 3, 1.5 and 1-km horizontal resolution and 30 vertical σ-layers, with the lowest one situated at 10-m AGL. Figure 1 shows kinematic backtrajectories starting at different times and calculated using the winds in the first σ-level predicted by the mesoscale model over the inner domain. Backtrajectory calculations have proven to be useful to confirm the origin of the episode, as the ones reaching the monitoring station during the times of the episode (reported from 5:30 UTC to 7:30 UTC) passed a few hours before above the questioned source (in this case, the landfill facility).

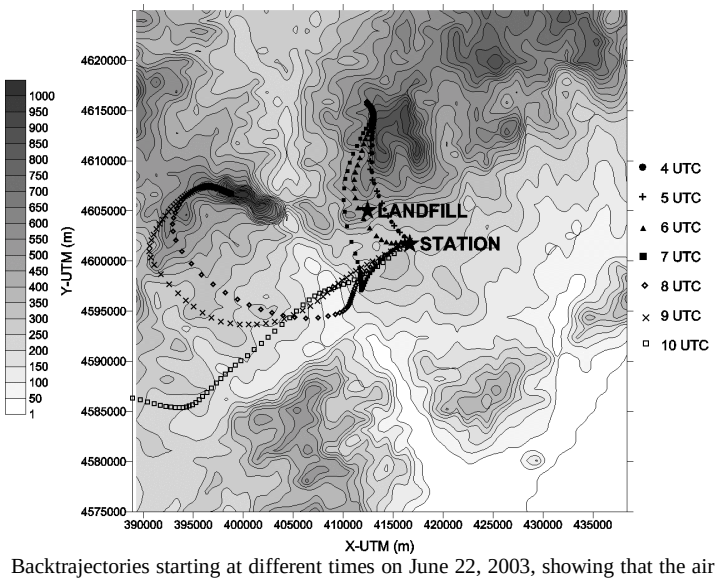

Figure 1. Backtrajectories starting at different times on June 22, 2003, showing that the air mass reaching the station that detected typical VOCs of landfill activity came from the landfill area at the times of the episode.