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ABSTRACT

GAUSSIAN AND COMPUTATIONAL FLUID DYNAMICS DISPERSION MODELLING OF ODOROUS COMPOUNDS FROM WASTEWATER TREATMENT PONDS NEARBY URBAN AREAS

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Summary

Odorous compounds are atmospheric pollutants that may cause many kinds of diseases and mainly annoyance. Monitoring the sources is especially important to assure the population well-being who lives nearby those sources. The wastewater treatment plants (WWTP) are one of the main contributors to emissions of hydrogen sulfide (H_2S) and ammonia (NH_3) in neighboring populated areas. The present study aims to estimate the emission of H_2S and NH_3 from WWTP stabilization ponds, using USEPA WATER9 mathematical emission model, and modelling their dispersion, using Gaussian model (AERMOD) and Computational Fluid Dynamics (CFD). The main motivations are the methodological differences between the two dispersion models, despite the simulation time and results detailing. The sources are in southeastern coast Brazil. The effluent data was obtained with the local WWTP company. We found that the period of greatest emission was winter (mean temperature equals to 295.75 K) and the one with the lowest emission was summer (299.92 K). The results of emission rate from WATER9 were implemented in both gaussian and CFD models. For the Gaussian model, the domain had 20.25 km² and the grid for concentration calculation 2,025 receptors points. For the CFD model, the domain was smaller to consider the geometry details and the heights of the buildings near the source. The peak-to-mean ratio (Ψ_0=2.26) considered stable atmosphere and the average time of 1 minute. Aermod showed that the maximum hourly concentrations occurred between 7 p.m. and 7 a.m. (stable atmosphere) and the most impacted areas were beachfront and the neighborhood nearest the WWTP. For CFD predictions the inlet boundary condition prescribed vertical log wind velocity profiles. The wind directions simulated for CFD calculations were northwest and west, and the roughness were 0.2 m (for restinga area), 0.02 m (for airport runaways) and 0.95 m (for trees). The preliminary results for CFD showed that the areas most affected were beachfront and neighborhood, but the concentration in those areas were significantly higher than the concentration of Gaussian model. It is relevant that Aermod does not consider the influence of the

concentration build-up due to building downwash and the recirculation zones located between them. In addition, the CFD code considered the effects of an important vegetation barrier surrounding the sources. Finally, CFD seemed to be a powerful tool for the present investigation as we were able to identify the concentration distribution along different streets and heights.

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- ☐ Source characterization and odour/VOC mapping.
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