COMPARISON OF LAGRANGIAN AND GAUSSIAN DISPERSION MODELLING AT AIRPORTS USING THE SAME EMISSION INVENTORY

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Abstract: One of the objectives of the Airport Local Air Quality Studies (ALAQS) project initiated by EUROCONTROL was to promote a better understanding of the emission inventory and dispersion mechanisms impact air quality around airports.

In order to achieve this goal, the ALAQS-AV emission inventory tool for airports was designed. ALAQS-AV is a movement driven emission inventory model which is highly flexible in the way it describes all features of an airport (aircraft movements, gates, road vehicles, stationary sources for any pollutant). ALAQS-AV is embedded within a Geographical Information System (GIS), allowing for the precise geo-positioning of the airport's emission sources. One of the particularity of ALAQS-AV lies within the format of its output: for each hour of the simulation, a specific 3 dimensional grid is created. That grid contains all information related to the quantities emitted together with their position. The ALAQS-AV output format was created in order to compare the dispersion performances of various modelling approaches - in particular Gaussian (plume rise and transport) and Lagrangian (random walk particles) models. As a consequence, and to allow for meaningful comparisons between Gaussian and Lagrangian dispersion, a specific approach ("Smooth and Shift") was used in ALAQS-AV to account for the initial dynamics of moving and fixed emission sources (in particular aircraft) when distributing the emissions within the cells of the 3D grids.

This paper describes a simplified airport emission inventory scenario that was set up in ALAQS-AV. Once emissions have been calculated, the resulting 3D emission grid sources are used in two dispersion models well known in the airports modelling community: the US Environmental Protection Agency Gaussian model AERMOD and the Lagrangian model LASAT (developed by Janicke Consulting, Dunum, Germany).

Differences in concentrations from ALAQS+AERMOD and ALAQS+LASAT are evaluated and explained. The greatest differences were observed in the near-field of the runways, where the emissions are at their highest rate, and also where the source dynamics of aircraft's engines (vertical and horizontal shift / extent of the plume) are at their maximum. Finally, variations in the method to derive meteorological parameters were also found to be of importance.