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SHORT ABSTRACT

DRIFT modelling of the Desert Tortoise and FLADIS ammonia trials for the Jack Rabbit III model inter-comparison exercise

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Abstract text *(maximum 350 words.)*

As part of the Jack Rabbit III (JRIII) large-scale anhydrous ammonia release experiments (2023-2024), the Modelers Working Group (MWG) has been coordinating an international model inter-comparison exercise, which has involved studying six previous pressure-liquefied ammonia release experiments from the Desert Tortoise (1983) and FLADIS (1993-4) trials.

The MWG exercise has a number of aims: (i) to evaluate the performance of various dispersion models; (ii) to investigate the sensitivity of results to variability in certain input parameters; and (iii) to support the experimental design for the upcoming JRIII field trials. This paper focuses on the DRIFT integral model results that have been produced for the exercise. It has involved HSE working with the DRIFT model developer (GT Science & Software) and collaborating with DSTL on sensitivity analysis.

The coordinators of the modeling exercise provided participants with a consistent description of baseline input parameters plus suggestions of possible sensitivity tests that could be run, based on analysis of uncertainties in the Desert Tortoise and FLADIS trials. These included ranges of values for: liquid rainout and pooling, wind speed, Monin-Obukhov length, and relative humidity.

DRIFT results are presented in this paper for short and long time-averaged arc-max concentrations and plume widths. For the FLADIS trials, predictions are also compared to measurements with a moving reference frame (following the plume centerline). A Gaussian process emulator is used to perform a global sensitivity analysis and results are presented to show how the variable model inputs affect the predicted concentrations at different downwind distances in the dispersing plume.

Motivation*

DRIFT is the model used by HSE for regulatory purposes in the UK, e.g., for the provision of advice on land-use planning around major hazard sites, such as refineries and chemical plants. The present work is motivated by the desire to validate DRIFT against data from the Desert Tortoise and FLADIS ammonia trials, to benchmark the model against other atmospheric dispersion models and to understand the sensitivity of the model to variability in its input parameters.

Ammonia is currently widely used in the UK to produce fertiliser, as a chemical feedstock and as a refrigerant. Its use is projected to increase significantly in the coming years with the use of green ammonia as a renewable energy vector. This could see ammonia being transported in large quantities by ship and stored in bulk at ports around the UK. Analysis of the dispersion behaviour of ammonia is therefore timely.

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