Dispersion modeling of accidental toxic GAS releases – Sensitivity studies and optimization of the meteorological input

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Introduction

Dispersion modeling of accidental toxic gas releases is needed to analyze release scenarios ("worst-case scenarios") for the preparation of emergency response plans as well as for real-time risk assessment and management.

Results

Additionally to automatic meteorological station data, the use of the observation-based **analysis and forecasting system INCA** (Integrated Now-casting through Comprehensive Analysis) for this application is discussed. INCA data are compared to measurements conducted at two near-traffic sites (Fig.1, Fig.2, Fig.3) and are found to provide valuable on-line meteorological input for hazardous gas dispersion modeling e.g. for traffic accidents with toxic gas release.

Uncertainties in the meteorological input together with incorrect estimates of the source play a critical role for the model result. Sensitivity studies with the models TRACE (SAFER Systems) and MET (Keudel av-Technik GmbH) are presented: wind speed (Fig.4), atmospheric stability (Fig.5), air temperature (Fig.6), roughness length (Fig.7 left), air humidity, precipitation (Fig.7 right). The influence of the meteorological input on the hazard distance calculation furthermore depends on the chemical characteristics of the toxic release. Worst case weather scenarios for emergency response planning therefore are not necessarily the same for different toxic substances.(e.g. chlorine and ammoniac).

Figure 1: Site for the meteorological measurements at Vienna / Inzersdorf

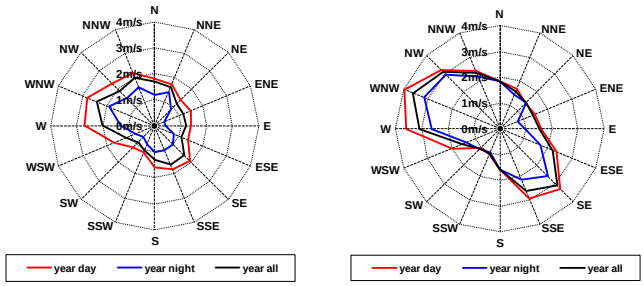

Figure 2: Mean wind speeds averaged for wind direction sectors from the measurements (left) and INCA analysis (right) for the Inzersdorf station in Vienna

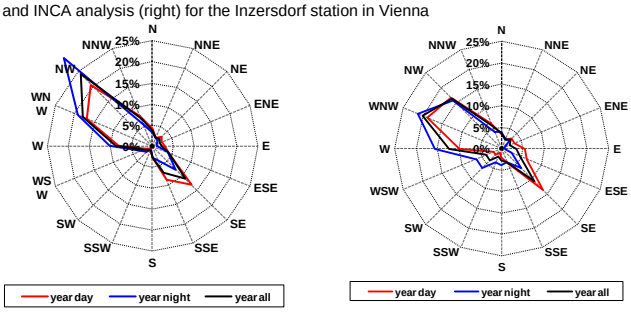

Figure 3: Wind direction frequency observed (left) and INCA analysed (right) for the Inzersdorf station in Vienna

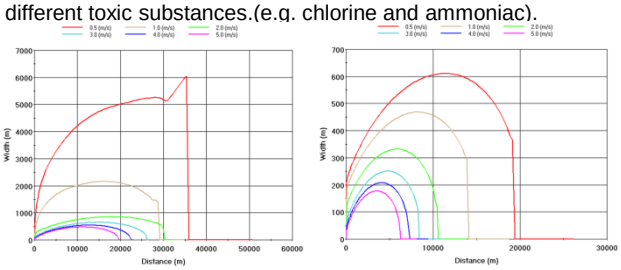

Figure 4: Sensitivity of the toxic distances to wind speed (left: chlorine, right: ammoniac). The calculations are conducted with the model TRACE for stable atmospheric conditions (class F) and release over city (100 cm roughness length)

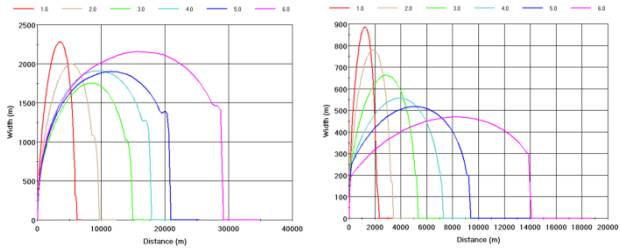

Figure 5: Sensitivity of the toxic distances to atmospheric stability (left: chlorine, right: ammoniac). The calculations are conducted with the model TRACE for 1 m/s wind speed, release over city (100 cm roughness length)

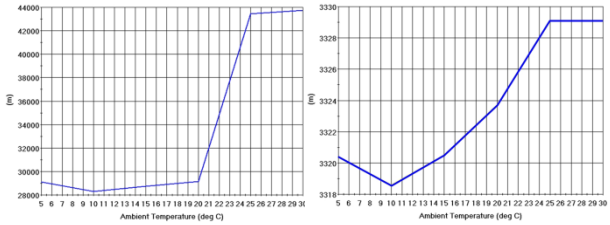

Figure 6: Sensitivity of the maximum toxic distance to air temperature (left: chlorine, right: ammoniac). The calculations are conducted with the model TRACE for release over city (100 cm roughness length), 1m/s wind speed and stable conditions (class F) for chlorine release and unstable conditions (class B) for ammoniac release

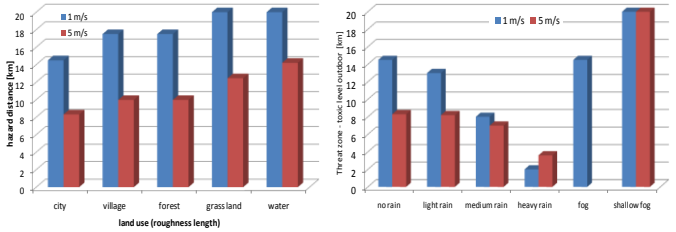

Figure 7: Sensitivity of the maximum hazard distance to roughness length (left) and precipitation (right). The calculations of a chlorine release are conducted with the model MET

References

Baumann-Stanzer, K., S. Stenzel (2010). Uncertainties in modeling hazardous gas releases for emergency response. Meteorologische Zeitschrift, accepted.

Haiden, T., A. Kann, K. Stadlbacher, M. Steinheimer, and C. Wittmann (2007): Integrated Nowcasting through Comprehensive Analysis (INCA) - System overview. ZAMG Documentation, 49p. http://www.zamg.ac.at/fix/INCA_system.doc

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