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ABC MAUS

Modeling plume dispersion for near ground explosion scenarios in the framework of a decision support system

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ABC MAUS

ABSTRACT

The aim is to develop a strategy of protection for chemical, biological, radiological and nuclear threads (CBRN) for the Austrian armed forces.

Once the explosion is identified from infrasound and seismic measurements *(ref. contribution by Mitterbauer et al.)*, forward modeling assuming a predefined release term is undertaken to understand which area might be contaminated.

As soon as radiological measurements are available, the source term is adjusted. Tabletop-Exercises are developed and tested based on hypothetical near-ground explosion scenarios (ordnance, accidental or terror attack).

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INTRODUCTION

The project ABC-MAUS is undertaken by a collaboration of the Austrian Ministry of Defense, Joanneum Research, the Austrian national weather and geophysical service Zentralanstalt für Meteorologie und Geodynamik (ZAMG), including the Austrian National Data Center (NDC), as well as the private company GIHMM.

Main goal is to extend the operative decision support system ABC-IS by new methods and modules to ensure its reliability on all spatial scales, for a variation of possible events, including radiological, chemical and seismic disasters.

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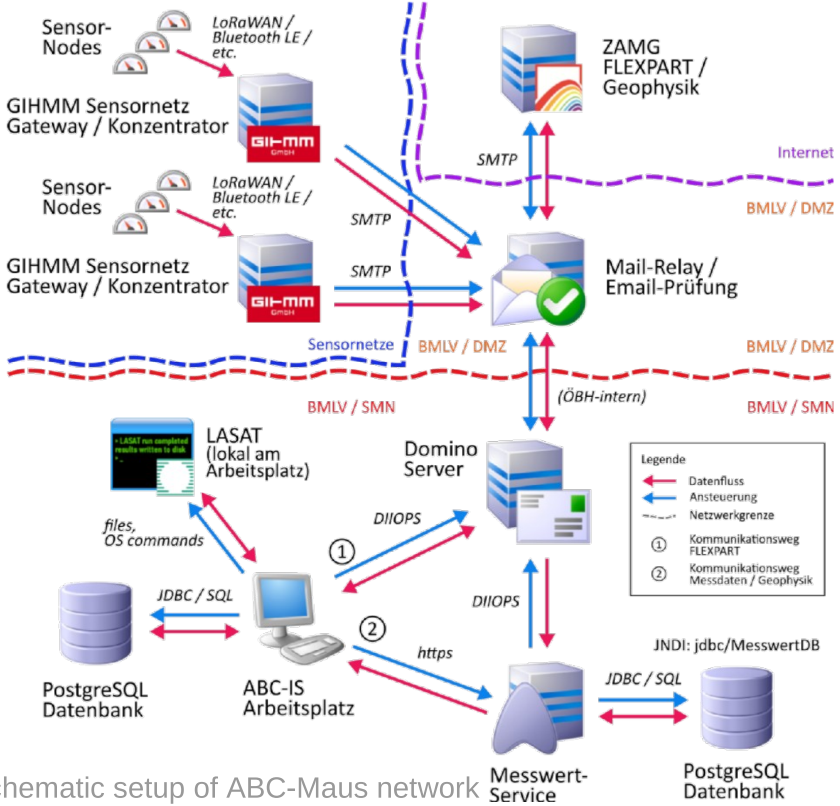
INTRODUCTION

Overview of the ABC decision support system:

An arbitrary amount of mobile sensor pushes data into the secure military network.

In case of a nuclear event an ABC-Working-Station triggers the large scale evaluation, processed by the dispersion models FLEXPART and receives additional information of geophysical measurements from the ZAMG servers.

For **local-scale plume dispersion forecasts and source identification** (release site or rate) triggered by sensor detections, the dispersion **model LASAT** is run locally on working stations.



Schematic setup of ABC-Maus network

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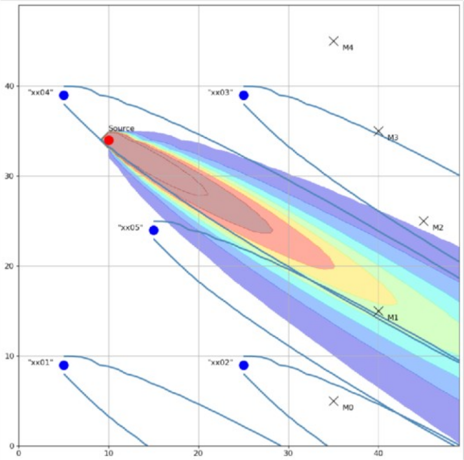
METHODS

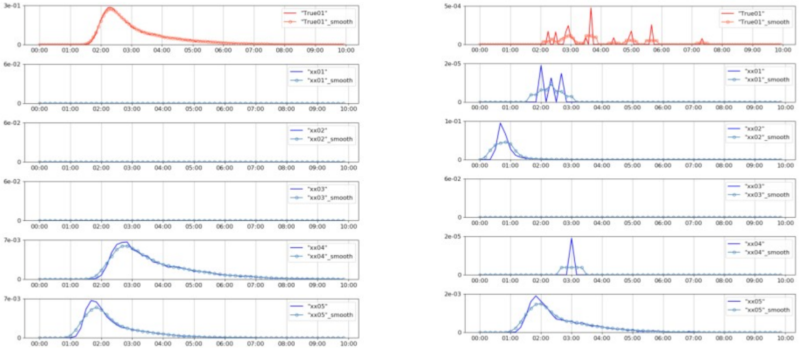
I) Forward-Modelling:



Schematic data set. Blue dots represent the simulated dispersion while the red dot gives the position of the (unknown) true dispersion event. Crosses show the locations of the sensor nodes.

The idea is to use a random set of simulated dispersions, respecting the meteorological and geographical conditions and compare the expected signal at the sensor nodes to the true measurements.

The all-over correlation (spatial, temporal & amplitude) of the signals should provide a valid estimation of the source's location.



Real measurements (red) in comparison with simulated measurements (blue) for two sensors

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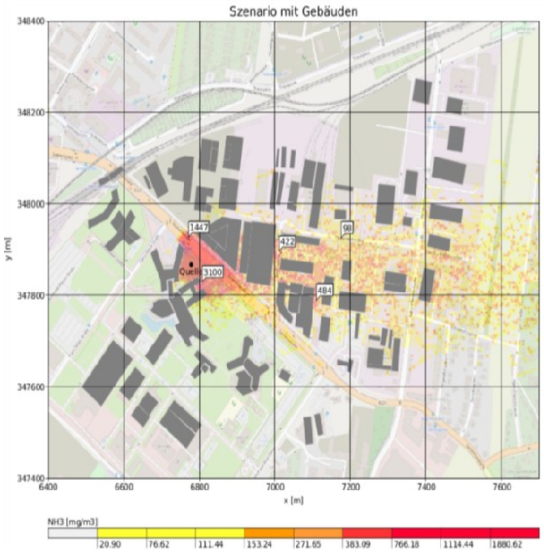
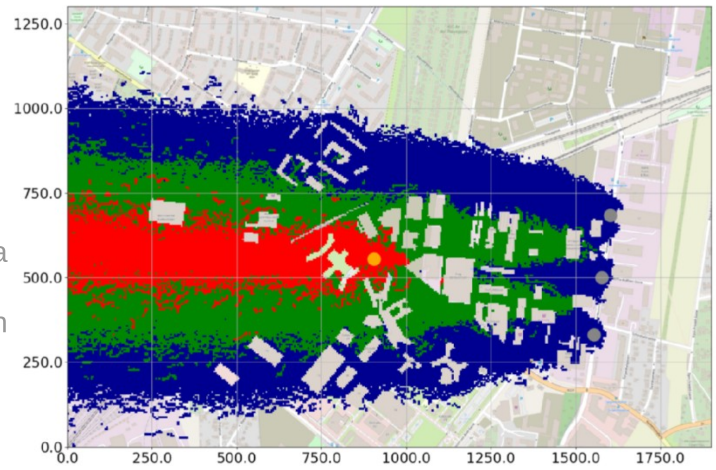
METHODS

II) Backward-Modelling:

A well known an reliable approach of estimating probability regions is to reverse the temporal order of the model and starting multiple dispersions originated at the locations of the sensor nodes with respect to the measured concentrations.



Schematic view of a near ground dispersion in an urban environment



Estimation of source area
Probability regions
blue: low, red: high

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CONCLUSIONS

Method I (source identification based on forward modeling) shows a high rate of uncertainty, especially when applied to more realistic test cases, including buildings and/or complex terrain.
Due to the high number of degrees of freedom, a large amount of randomly generated dispersion fields and additional a priori information (e.g. on release time and/or release rate) are required to achieve a significant estimation of the source.
Due to the high computational effort and limitation of a priori information, the method is found to be at present inappropriate for the operational use for local-scale source identification in urban or complex terrain.

Time reversed approaches (Method II) are well known and approved for transnational to global source detection and source term estimation.
This approach also yields sufficient results in urban/complex terrain with reasonable computational costs.

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OUTLOOK

A Tabletop-Exercise, conceived in August 2021, will demonstrate the compatibility of all network nodes and provide a real case data set which can be used for further developments.