Effective and efficient combination of weather and radioactive source ensembles

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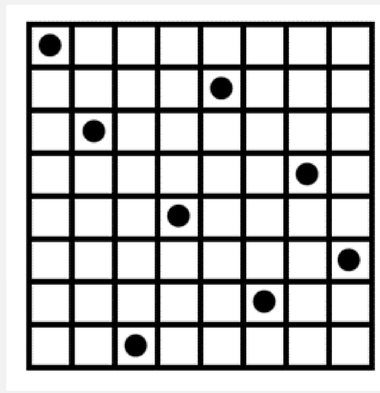
Background

- The estimation of uncertainties is a growing need in dispersion modelling, especially concerning Nuclear Power Plant (NPP) accidents
- The number of dispersion runs grow fast depending on how large the weather and source ensembles are

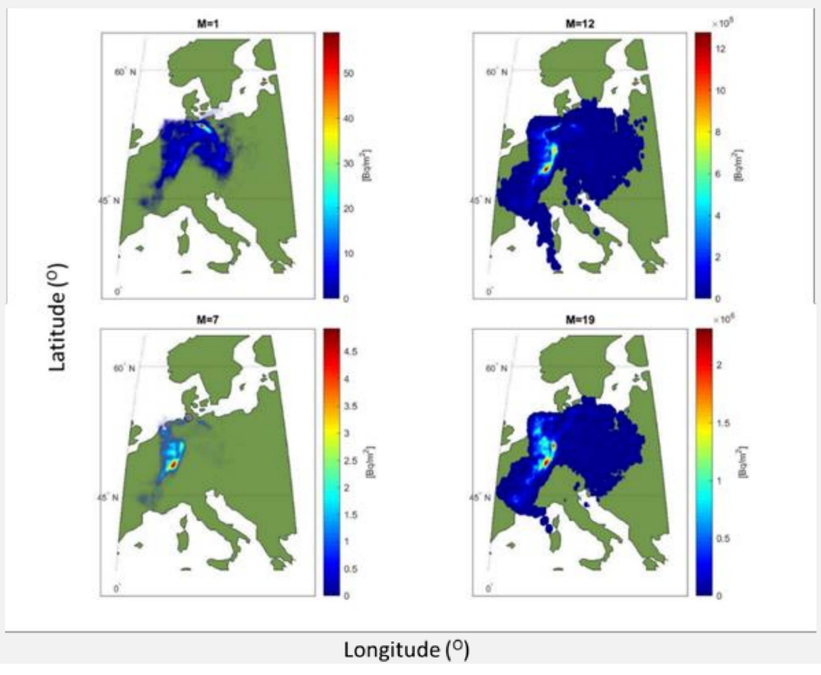
Goal

- To reduce the number of dispersion runs and still get a good estimation of the uncertainties



Method

- Add radioactive source properties after the dispersion run and using a unit-run approach in the Lagrangian Particle dispersion calculations
  - Store information of when the particle is born and add source properties afterwards
  - Add radioactive decay
- Use LHS (Latin Hypercube Sampling) to generate combinations of weather ensemble members and selected dispersion model parameters
  - Stratified sampling from predefined probability distributions (in this case normal or uniform)
  - Only use one interval once
  - Input: weather ensemble members, dry deposition velocity, scavenging coefficient and release height



Results

The figure shows an example of the deposited field of Cs-137 using the FOI model PELLO for a weather situation in July 2018. We have chosen one of the LHS generated combinations drawn from the predefined probability parameter distributions. The PELLO model is a Lagrangian Particle model with a random displacement approach. The generic boiling water reactor source term ensemble consists of 19 members and results are presented for members 1, 7, 12 and 19. These are added after the dispersion run. This source term ensemble is based on calculations done in the project AVESOME. The source is assumed to be located at Brokdorf. Here the results can directly be related to the magnitude and temporal behavior of the source terms. These results are not equally probable and it is up to the decision maker to judge the most likely valid source term.

Conclusions and reference

Adding source properties afterwards together with LHS generated dispersion calculations is an effective and efficient way of combining the uncertainties in the radioactive case. The number of dispersion runs in our setup corresponds to the size of weather ensemble.

Havskov Sørensen, J., F. Schönfeldt, R. Sigg, J. Pehrsson, B. Lauritzen, J. Bartnicki, H. Klein, S. Cordt Hoe, and J. Lindgren. Added Value of uncertain-ty Estimates of SOurce term and MEteorology (AVESOME) – final report. NKS-420, ISBN 978-87-7893-509-0(2019)