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Andy Delcloo (RMI), Pieter De Meutter (SCK CEN),
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POSTER

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ABSTRACT


- The National Institute For Radioelements (IRE), located at Fleurus in Belgium, is an important emitter of radioactive xenon into the atmosphere. These emissions are not harmful to the environment, but can interfere with the very sensitive noble gas detection stations that are part of the verification regime of the Comprehensive Nuclear-Test-Ban Treaty Organization.

- Near real time Atmospheric Transport Modelling the xenon concentrations emitted by the IRE institute can help us to discriminate real events (radioactive xenon detections that originate from a nuclear explosion) from false alarms (radioactive xenon detections that originate from a civilian nuclear facility).

- In this work, we will present the additive value of using the STAX data from the Fleurus site in order to show its capability to model the radioactive xenon background on the CTBTO noble gas stations, using the Lagrangian particle dispersion model Flexpart and numerical weather prediction data from the European Centre for Medium-Range Weather Forecasts (ECMWF).

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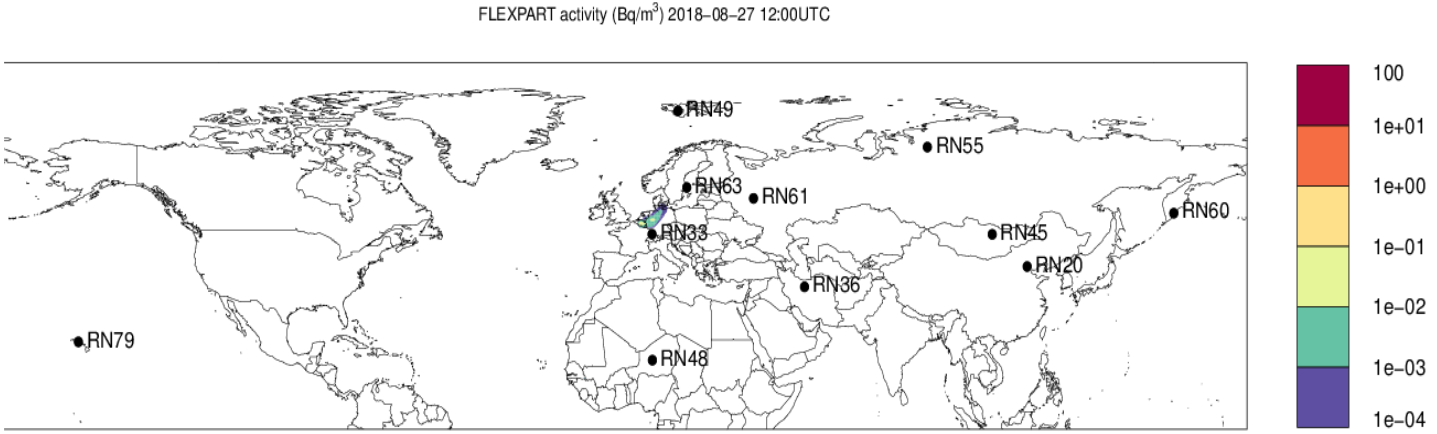
INTRODUCTION

## $^{133}$Xe activity concentration from IRE for the period of study

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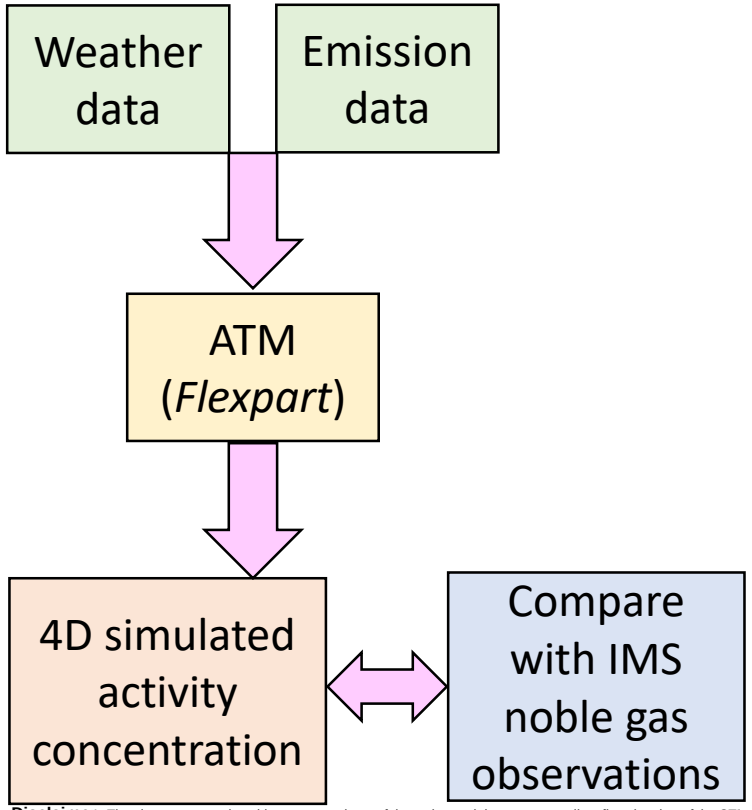


## Using stack emission data from MIPF for Treaty verification: principle

FLEXPART activity (Bq/m$^3$) 01 01 2014 0300 UTC

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METHODS

## Data:

- oper (0.5 x 0.5) and hres (0.1 x 0.1) ECMWF meteorological fields
- STAX data at IRE: January 2020 – December 2020
- IMS noble gas observations ($^{131m}$Xe, $^{133}$Xe, $^{133m}$Xe , $^{135}$Xe) @ RN33 and RN66

## Model:

- Flexpart coupled to ECMWF to calculate the activity concentrations originating from IRE at IMS stations RN33 and RN63

## Purpose:

- Comparison between simulated and observed $^{13xx}$Xe activity concentrations
- Comparison between simulations using STAX data

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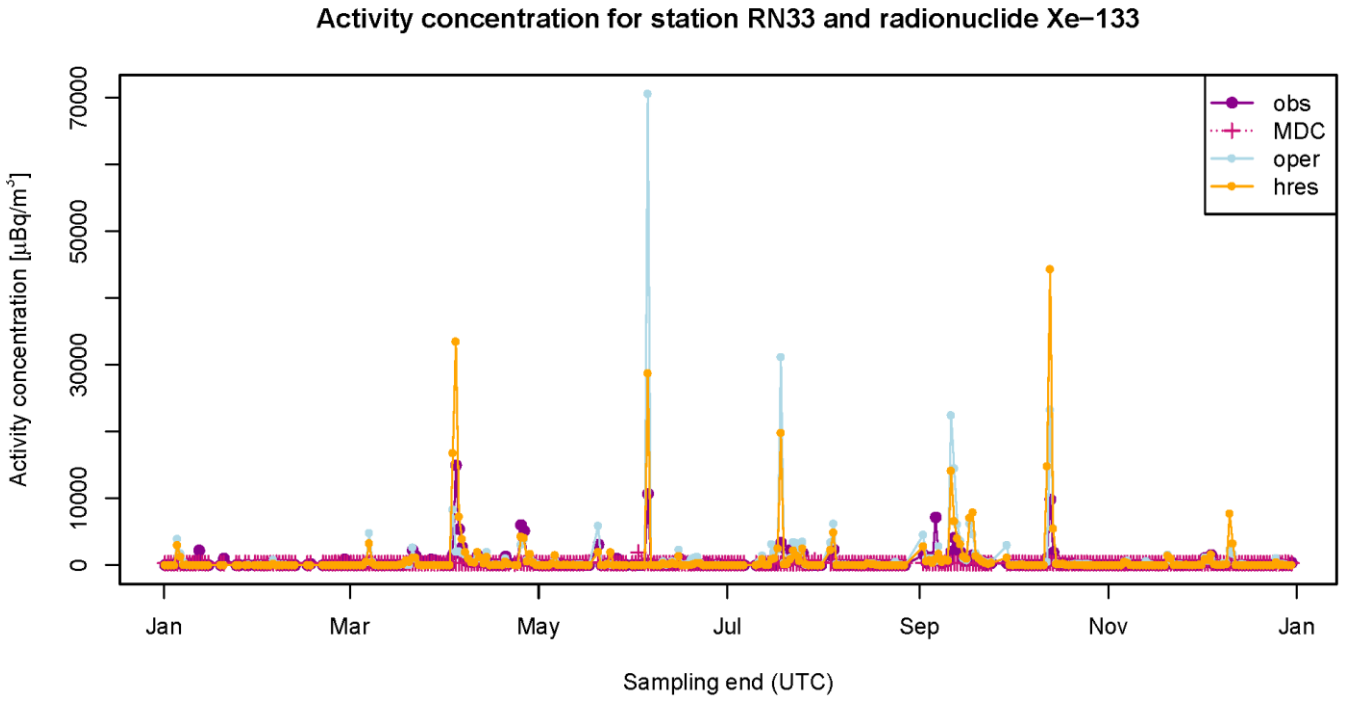
RESULTS



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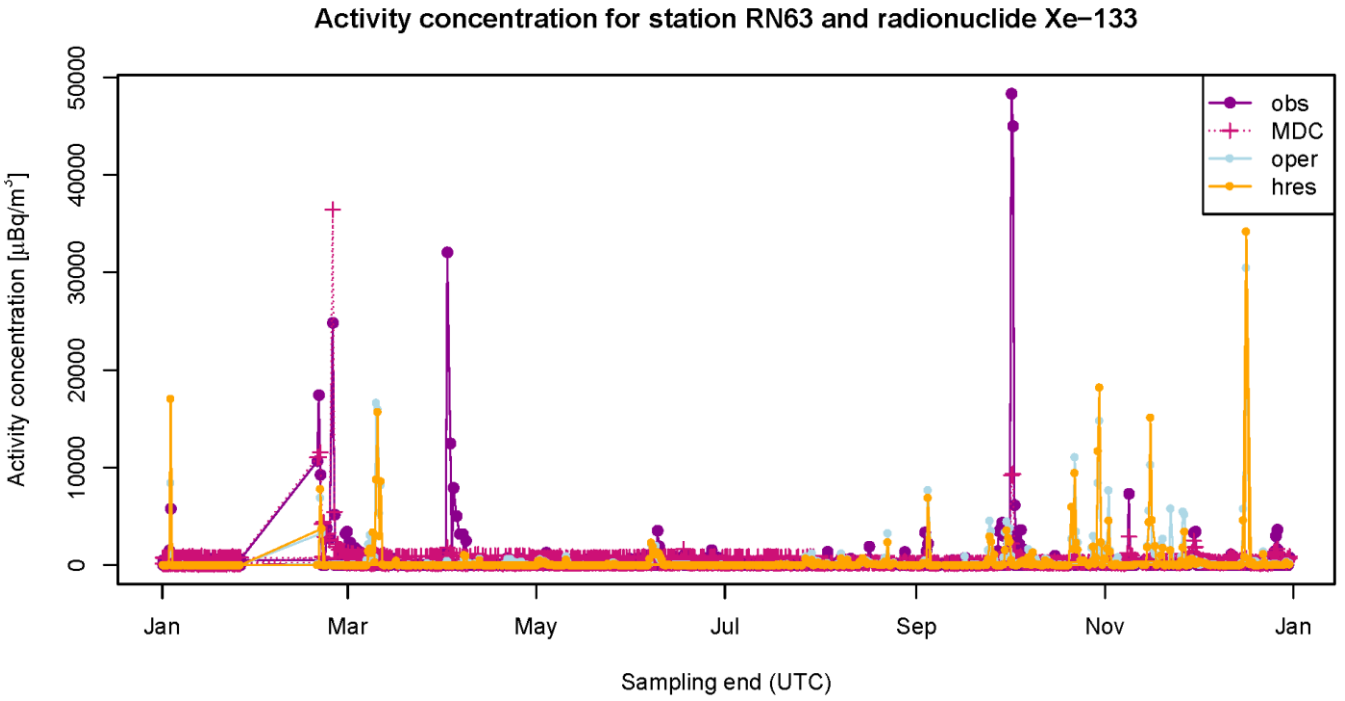

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# Statistical scores for IRE emissions

## RN33 oper, $^{133}$Xe

Correlation: 0.59

NMSE: 37.33

WNNR: 15.80

NNR: 5.46

Fractional bias: 0.75

Rank: 2.37

## RN33 hres, $^{133}$Xe

Correlation: 0.81

NMSE: 20.77

WNNR: 8.53

NNR: 5.30

Fractional bias: 0.72

Rank: 2.74

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CONCLUSIONS

- Simulating the radioxenon contribution at IMS noble gas stations from civilian nuclear facilities is important for Treaty verification

- For the IRE study:
  - First time that we used a full year of data for validation, using STAX data (2020)
  - For the RN33 station, there is a better agreement between the simulated and observed $^{133}$Xe activity concentration, especially for the high resolution simulations

- The agreement between the simulated and observed $^{13xx}$Xe activity concentration is time- and station-dependent: other MIPFs and NPPs can also contribute to the observed activity concentration, this is especially the case for RN63 (Ringbom et al, 2020) . Also contributions from Dimitrovgrad and Chalk River (Achim et al., 2016) are important contributors here

- To assess the added value of the high resolution meteorology, additional measurements at higher temporal resolution would be helpful