SnT 2025 8 SEPTEMBER ONLINE DAY 9 TO 12 SEPTEMBER AT HOFBURG PALACE, VIENNA & ONLINE
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

P2.3-748

# Characterisation of Xenon-133 atmospheric civil source distribution using graph models on simulated data

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## INTRODUCTION AND MAIN RESULTS

This presentation explores Xenon-133 source distribution across IMS stations through graph modelling. By clustering stations based on their source exposure, it reveals distinct areas influenced by different sources. This method allows efficient source separation in simulations, opening the way for new perspectives for anomaly detection.

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## Introduction

Based on the current knowledge about Xenon-133 (Xe-133) civil sources, the atmospheric background has been simulated for the period 2020-2023. Source contributions are categorised into 9 Medical Isotope Producers (MIP) and 10 regions of Nuclear Power Plants (NPP), as shown in Figure 1.

Existing anomaly indicators are defined on a per-station basis and do not account for meteorological variations affecting source distribution over the IMS stations. Estimating each source's contribution from total concentration under real conditions could help to better characterise the Xe-133 background and enable more refined anomaly detection methods.

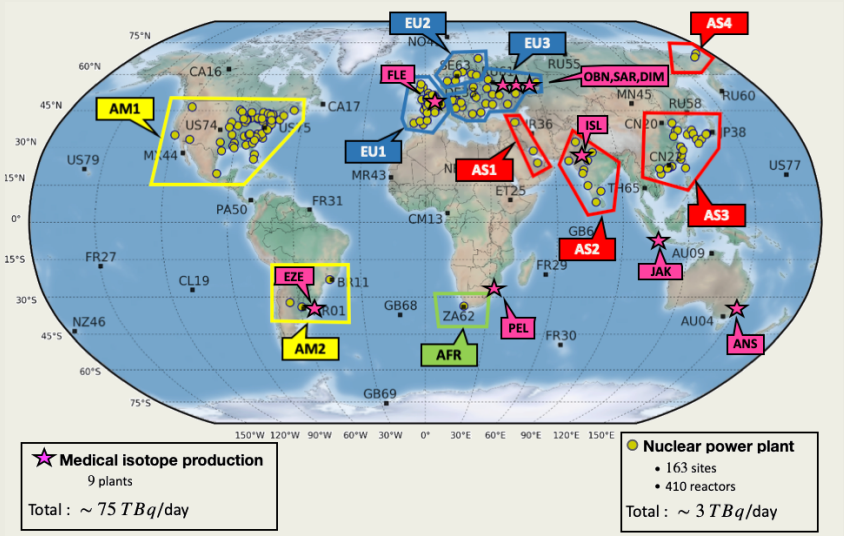


**Figure 1.** Illustration of MIP and NPP sources used in simulations.

## Method

- Graphs allow to exhibit regional cluster of stations, based on their source exposure, using **spectral clustering**.
- Clusters vary with season (Fig. 2) but each cluster presents a core of stations that remains the same.
- They serve as references for regional source distribution, with **partial spectral power** providing insights into global source distribution, at any time.
- Partial spectral power configurations are discretised into a few profiles. Linear models are trained on each profile to perform **source separation** (Fig. 3-4) from total concentrations.

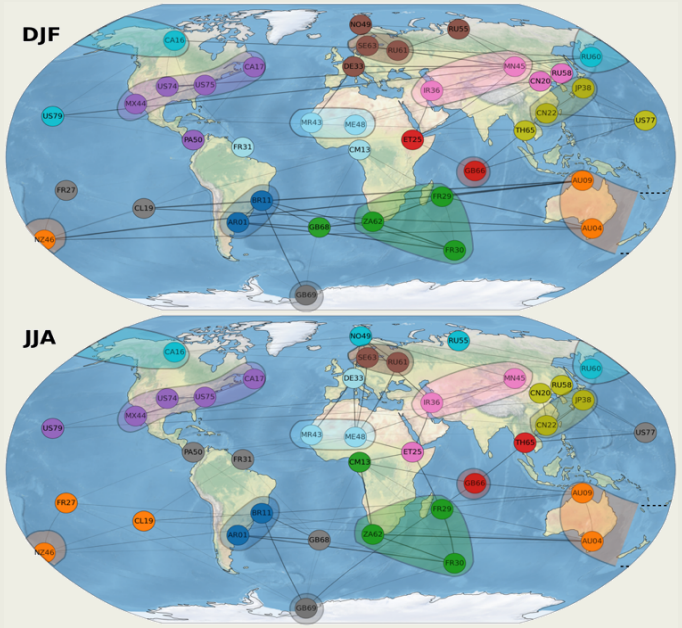


**Figure 2.** Spectral clustering of IMS stations by season : December-February (DJF) and June-August (JJA). Each colour represents a cluster.

## Results

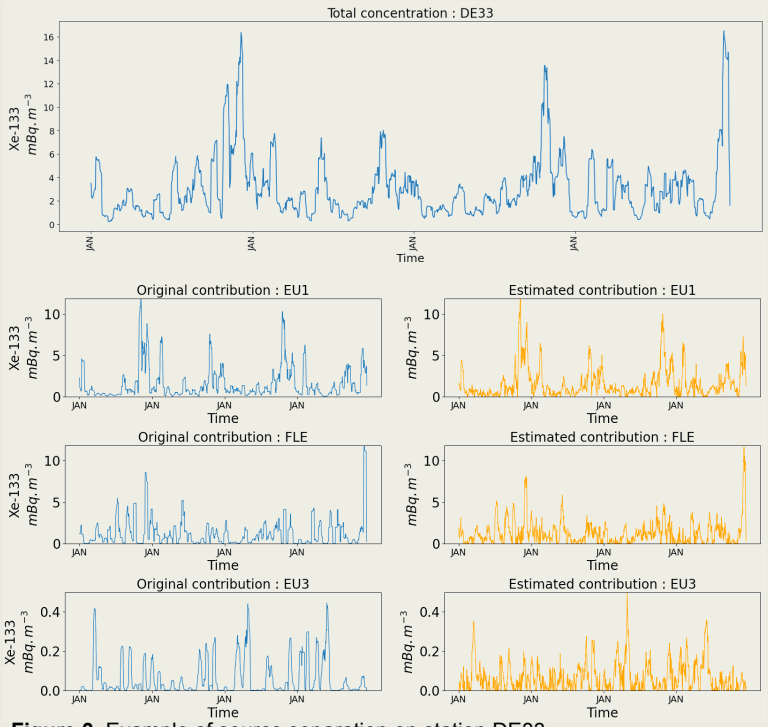


**Figure 3.** Example of source separation on station DE33.

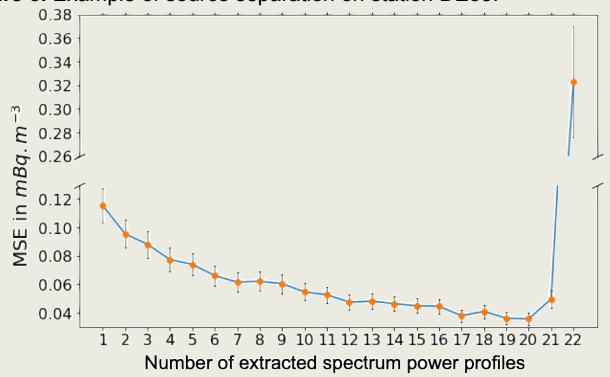


**Figure 4.** Mean squared error of source estimation by the number of spectrum power profiles, averaged over all stations.