Overview of UK NDC's Use of STAX "Source Term Analysis of Xenon" data

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Nuclear Test Monitoring - Radionuclides

Nuclear Treaty Verification

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AWE – Nuclear Test Monitoring

- The UK provides a national capability to monitor, analyse and advise on IMS events through both seismic and radionuclide monitoring

- AWE hosts the UK National Data Centre (NDC) which receives and analyses data from the CTBT monitoring network

- AWE conducts Independent analysis of the International Monitoring System (IMS) radionuclide (RN) data, which is used to advise the MoD of any possible violations to the Treaty.

- The UK NDC routinely receives STAX data from stax.isti.com and analyses the spectra independently

Figure 1. Aerial Photograph of AWE Aldermaston site

UK NDC Automated Analysis Pipelines
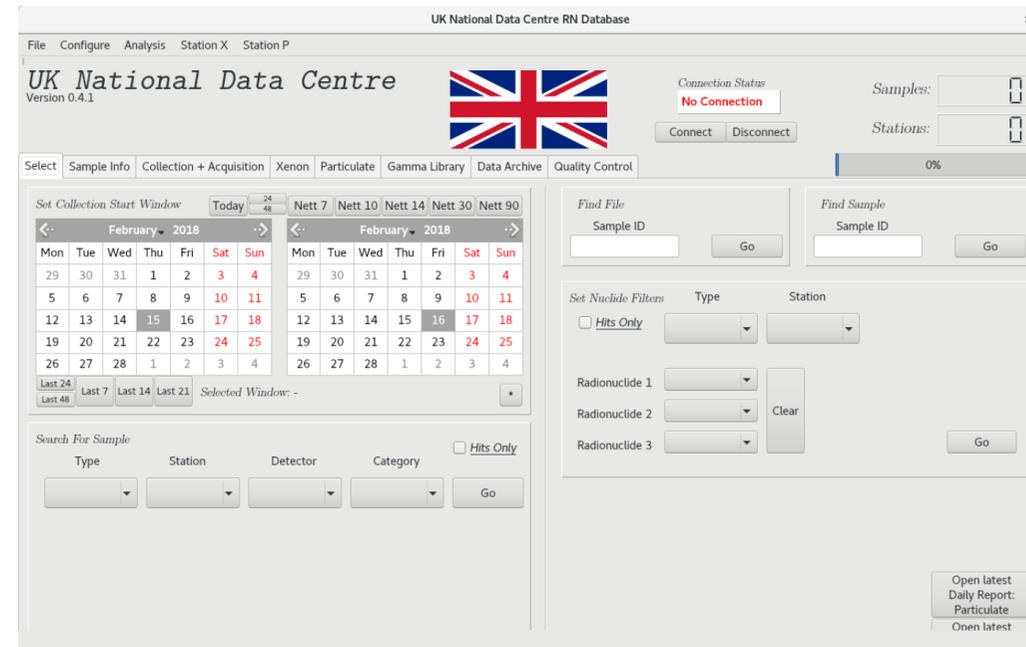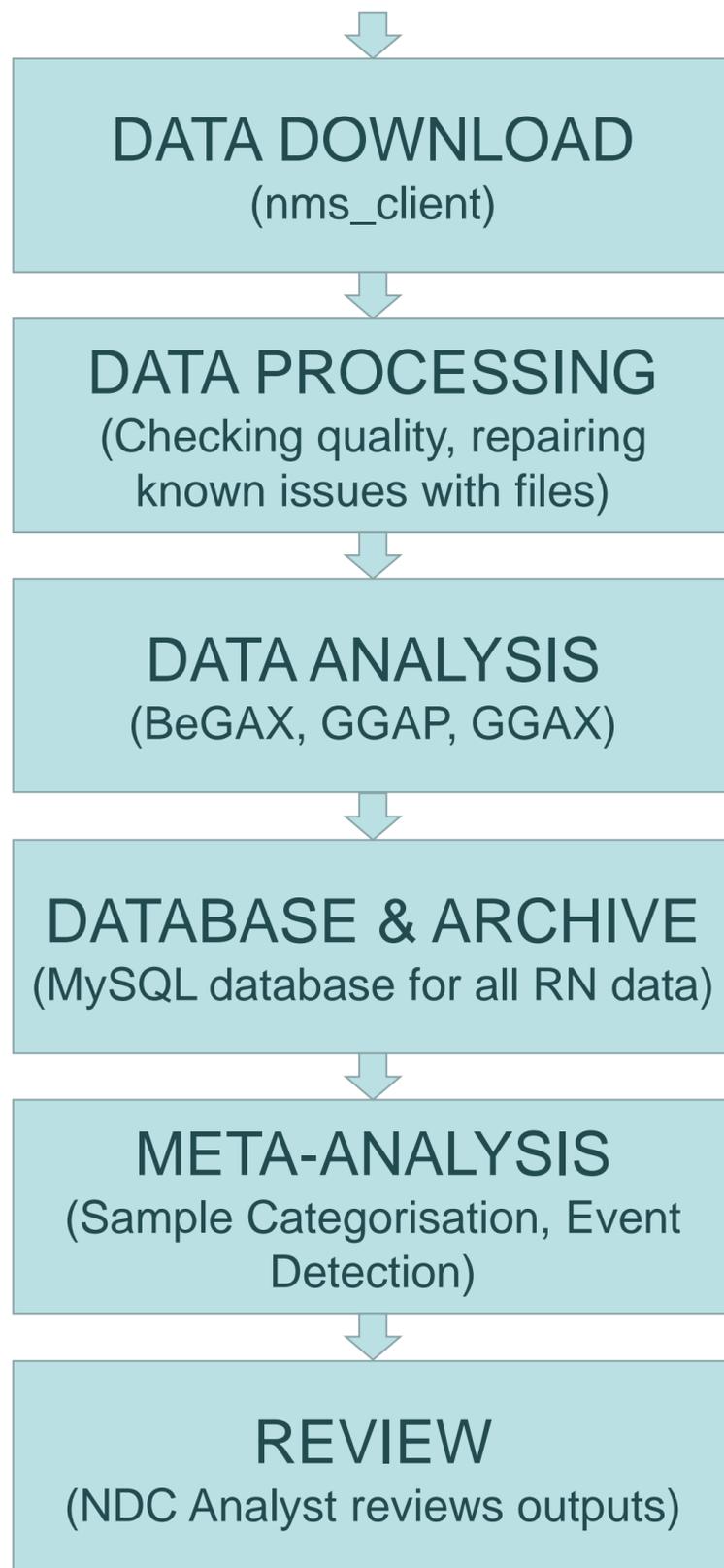
Figure 2.
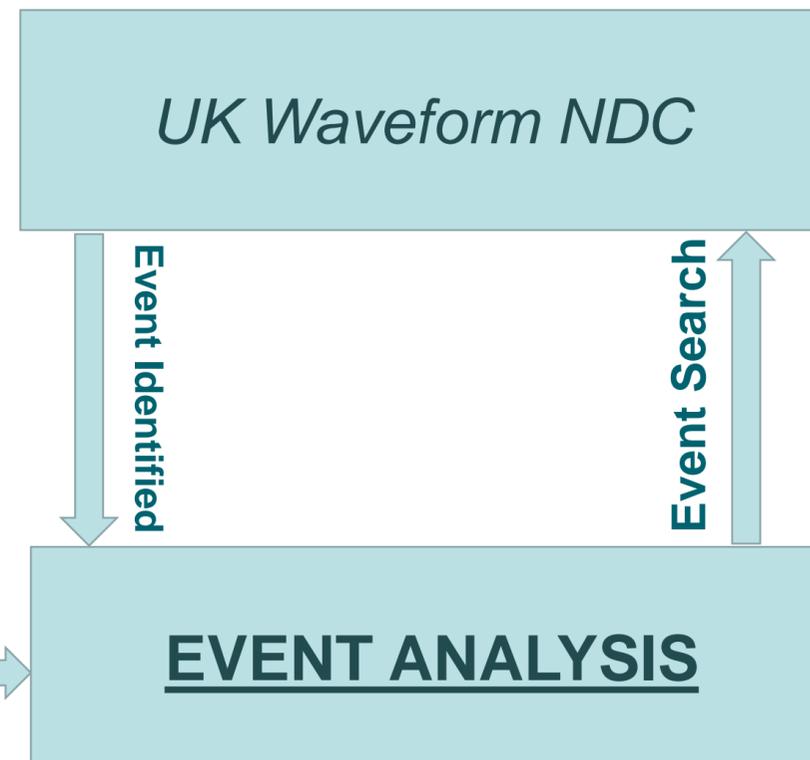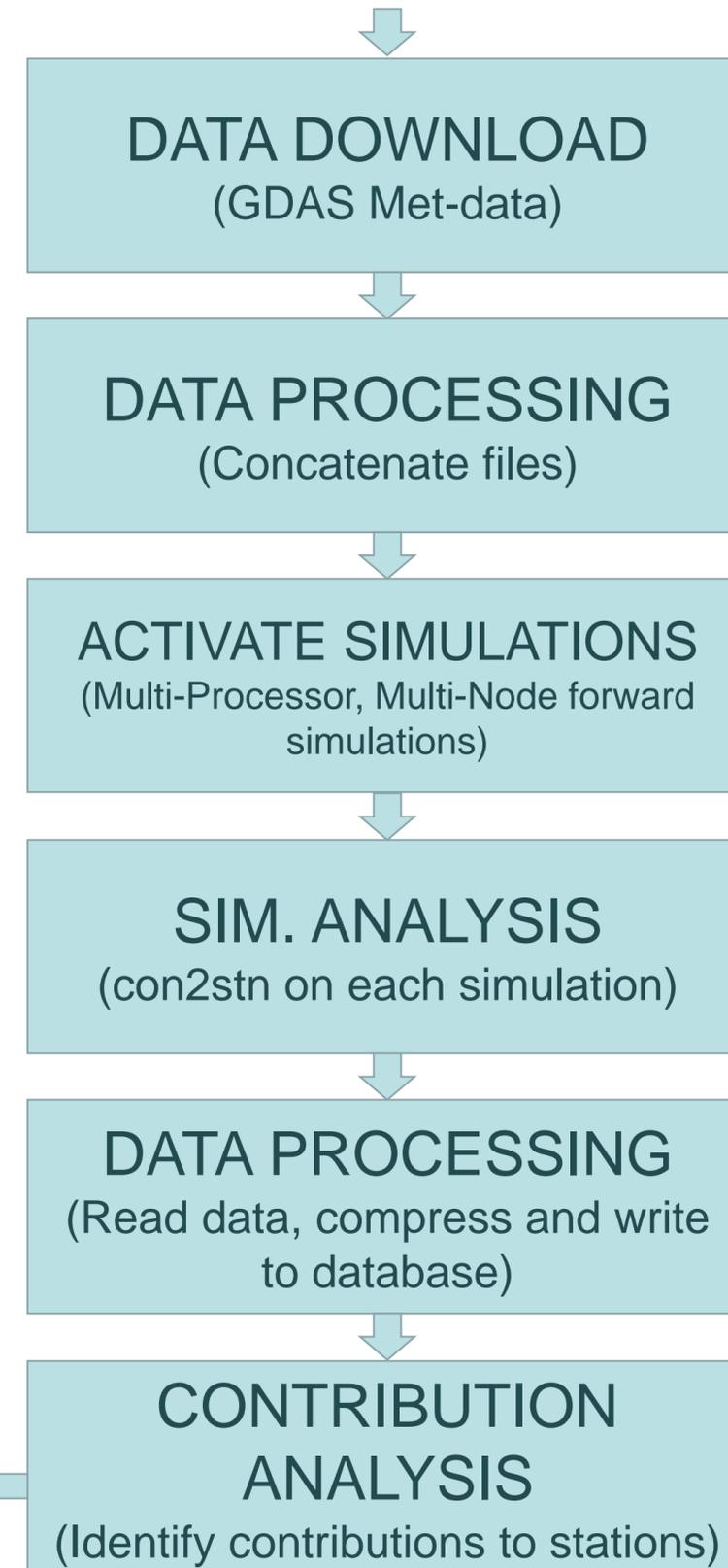
IMS Noble Gas Analysis

- Raw data is downloaded from International Data Centre (IDC) and analysed using custom codes.

- 'Plume' detection results are stored in an SQL database table

- Currently assessing correlated events in nearby NG stations
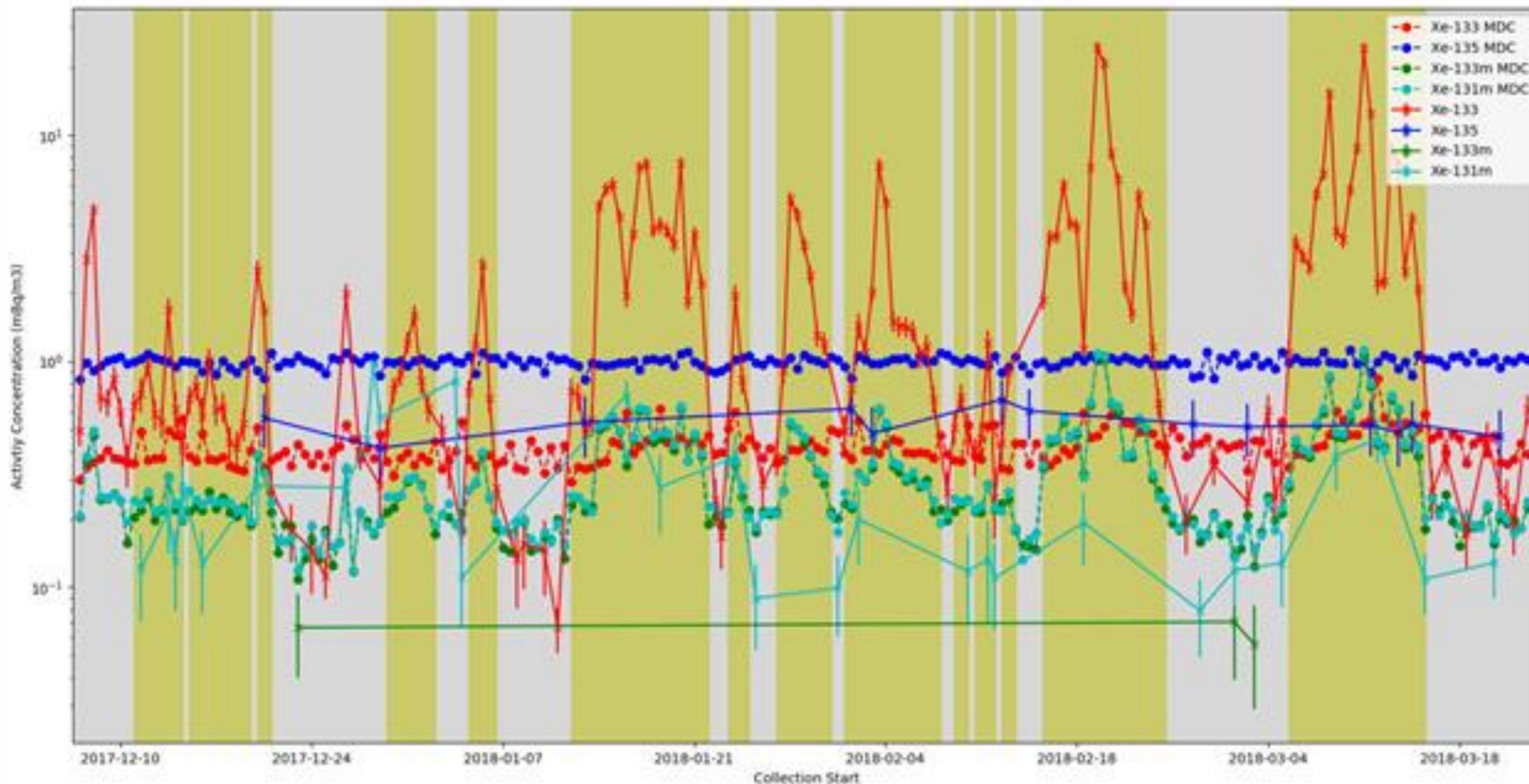
Figure 3.
Radioxenon events highlighted (yellow shading) using an automated 'plume detection' algorithm. Data shown for station SEX63.

STAX Data Analysis (1)

- Raw spectral data and the analysis results file is downloaded from stax.isti.com using wget

- ATS files parsed and archived. Results are stored in the SQL database

- PHD files analysed and archived. Results are stored in the SQL database

- 'Emission' detection algorithm analyses RN data to identify emissions. The results are stored in a 'emissions' table; recording the emission start, duration and total activity of ^{133}Xe

- ATM Forward model is triggered and contributions to IMS locations are quantified
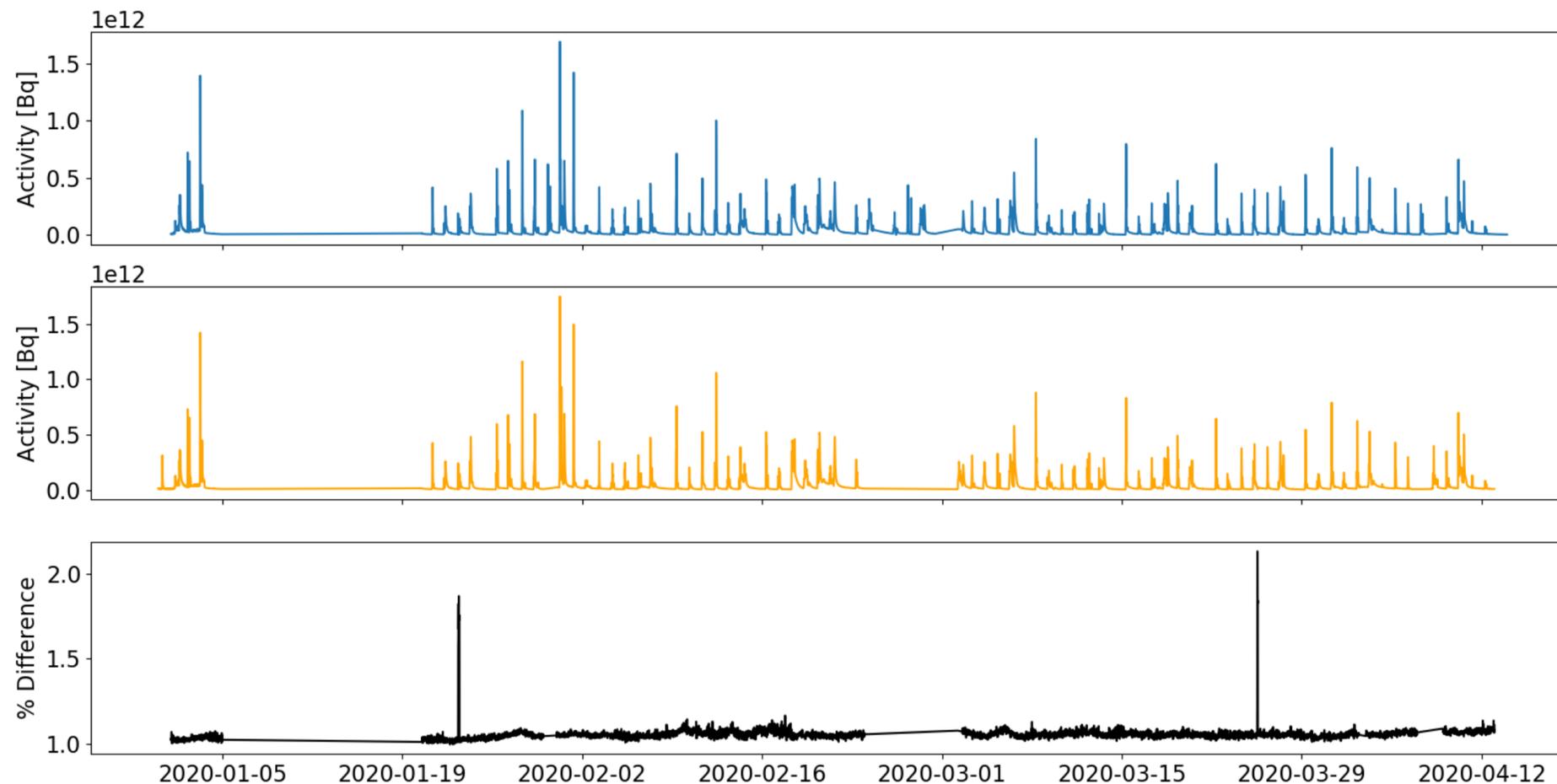
Figure 4.
^{133}Xe activity comparison of UK NDC analysis (blue) and ATS processed data (orange) for 2020. Percentage difference shown in black plot.

STAX Data Analysis (2)

STAX PIPELINE RATIO ANALYSIS
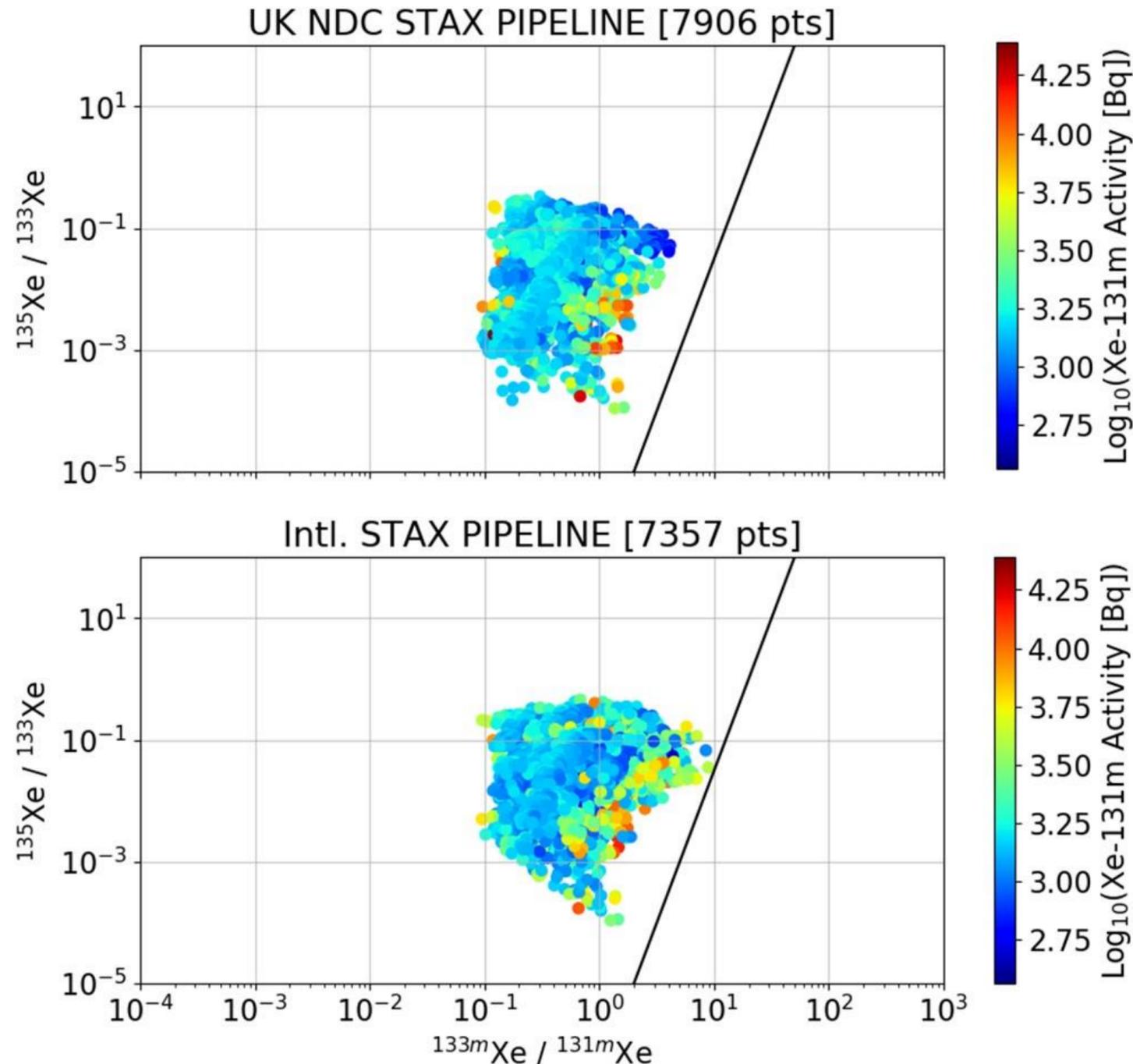
Figure 5.
Comparison of isotopic ratios of UK NDC results (provisional) and International STAX results. Differences in the data are investigated and used to fine-tune the analysis code.

Accurate quantification of the metastable isotopes (Xe-131m & Xe-133m) is important to discern between the civil (left) and military (right) domains of discrimination line of the 4-isotope plot

Case study: Detections at AWE (1)

GBL15 SAUNA II system can operate in 'IMS' mode – identical to an IMS station
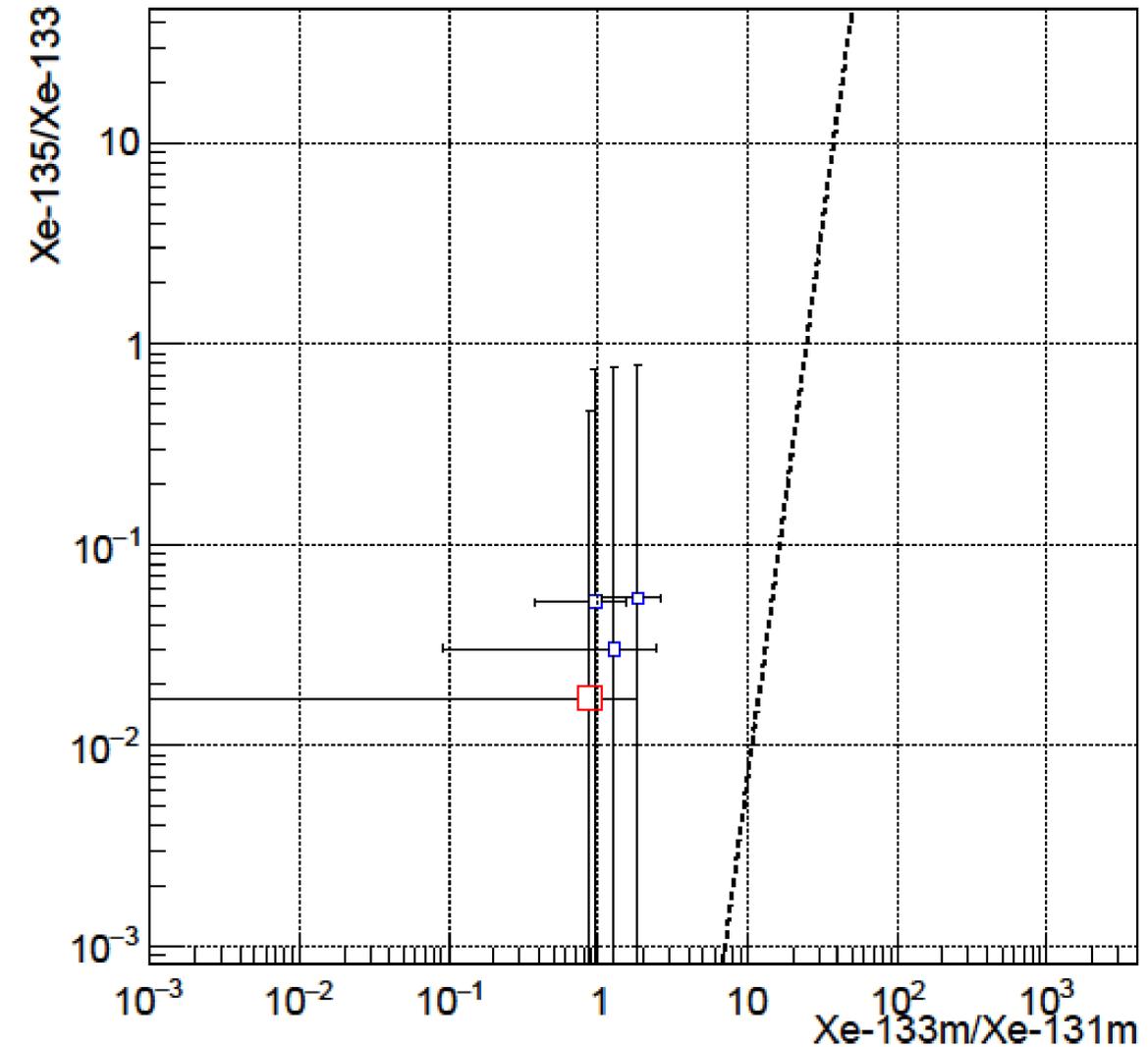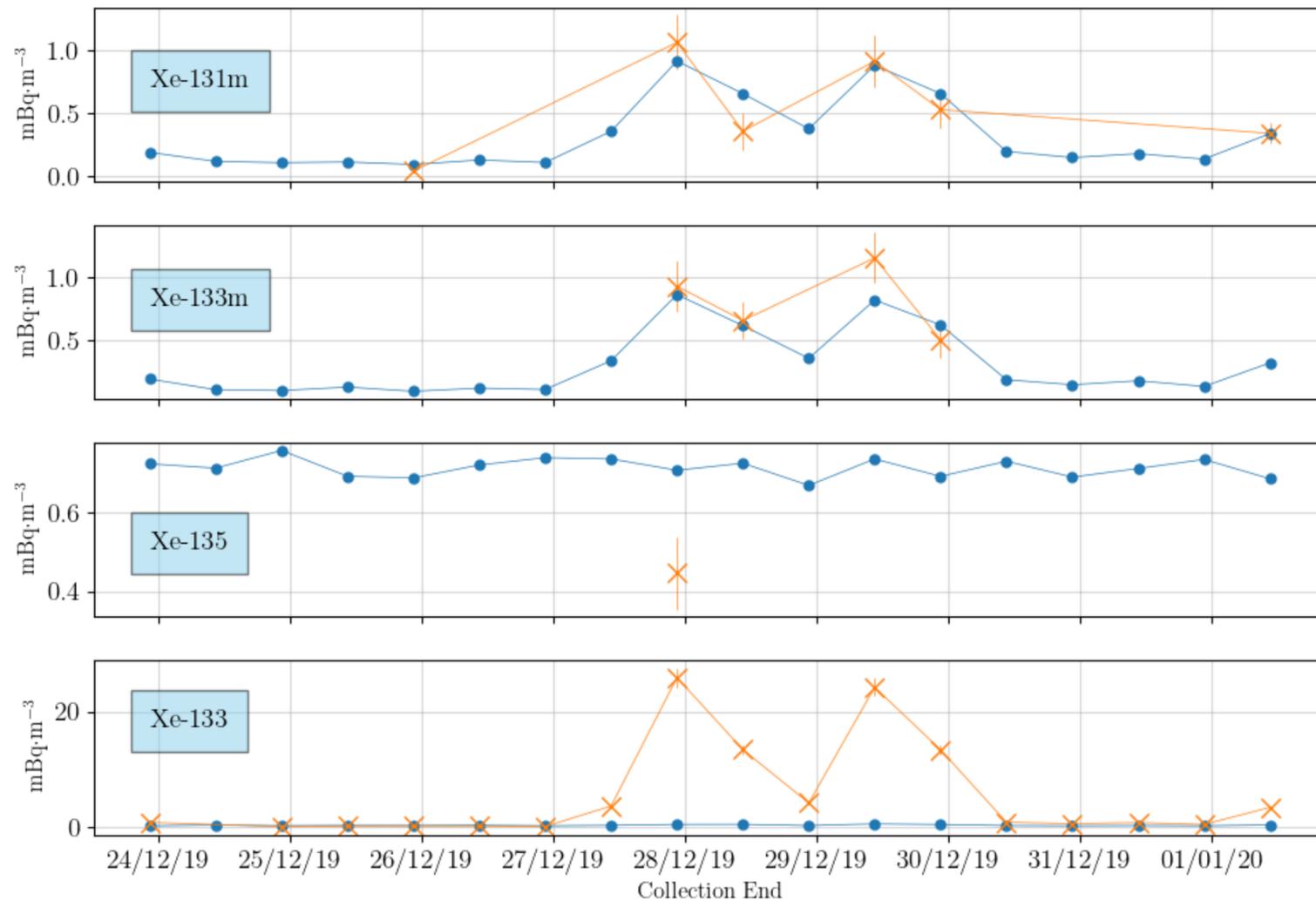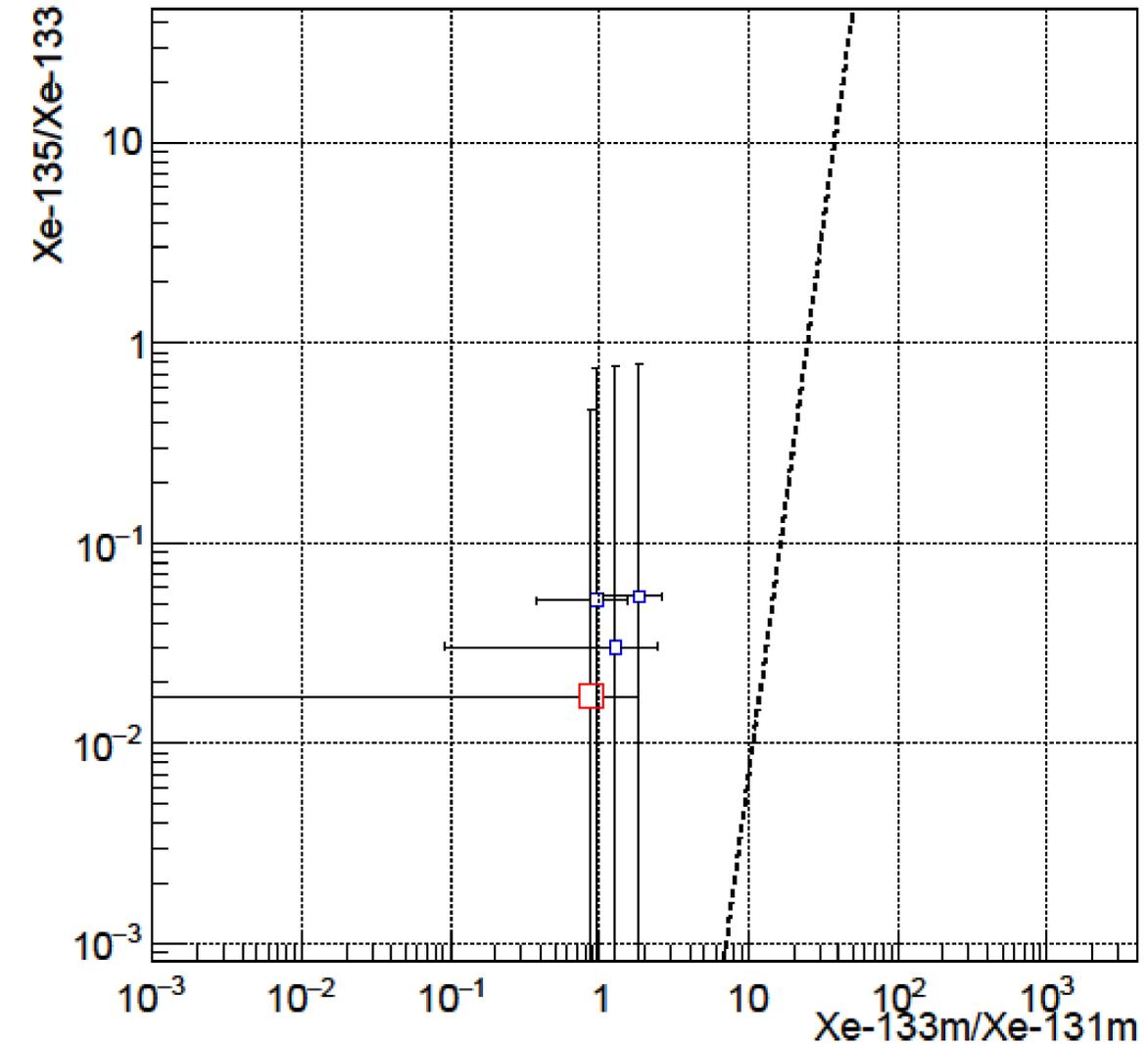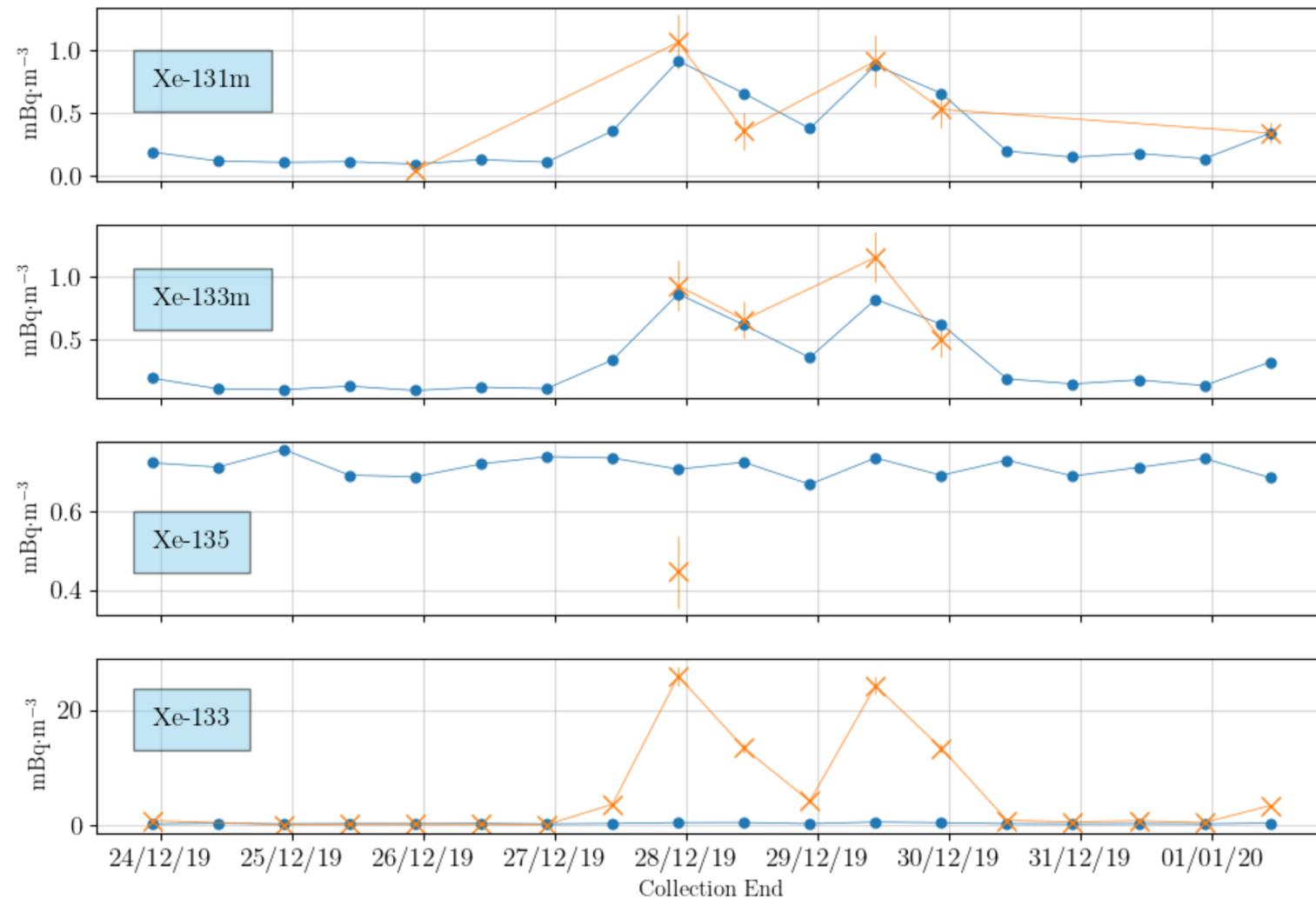
Figure 6.
(Left) data from the AWE SAUNA for December 2019, showing several detections with multiple isotopes. The data is plotted on the 4-isotope chart (right).

Case study: Detections at AWE (2)

Figure 6.

(Top) STAX Pipeline data (NDC and Intl.) and (below) modelled HYSPLIT simulation from IRE (Belgium) showing plume moving over the UK

GBL15 SAUNA II system can operate in 'IMS' mode – identical to an IMS station

Figure 6.
(Left) data from the AWE SAUNA for December 2019, showing several detections with multiple isotopes. The data is plotted on the 4-isotope chart (right).

Summary

STAX data is crucial for explaining IMS detections

Questions?

With thanks to IRE and PNNL for provision of data