

INTRODUCTION

For nuclear explosion monitoring, isotopic ratios of xenon are used for characterizing an event. If only one pair of isotopes is detected it may still be possible to draw conclusions about the relevance of an observation for nuclear explosion monitoring. For certain isotopic ratios, screening flags are defined and applied in the IDC products. Another approach is to show the isotopic ratios in scatter plots and look for outliers and clusters. More generally, isotopic ratios can be compared to the history of background observations at a given station, to determine whether it is anomalous or not. It may also be used for event origin time determination, to test the hypothesis that the observation of interest may indicate a prompt or delayed release that is associated with a seismic event at a certain time and location.

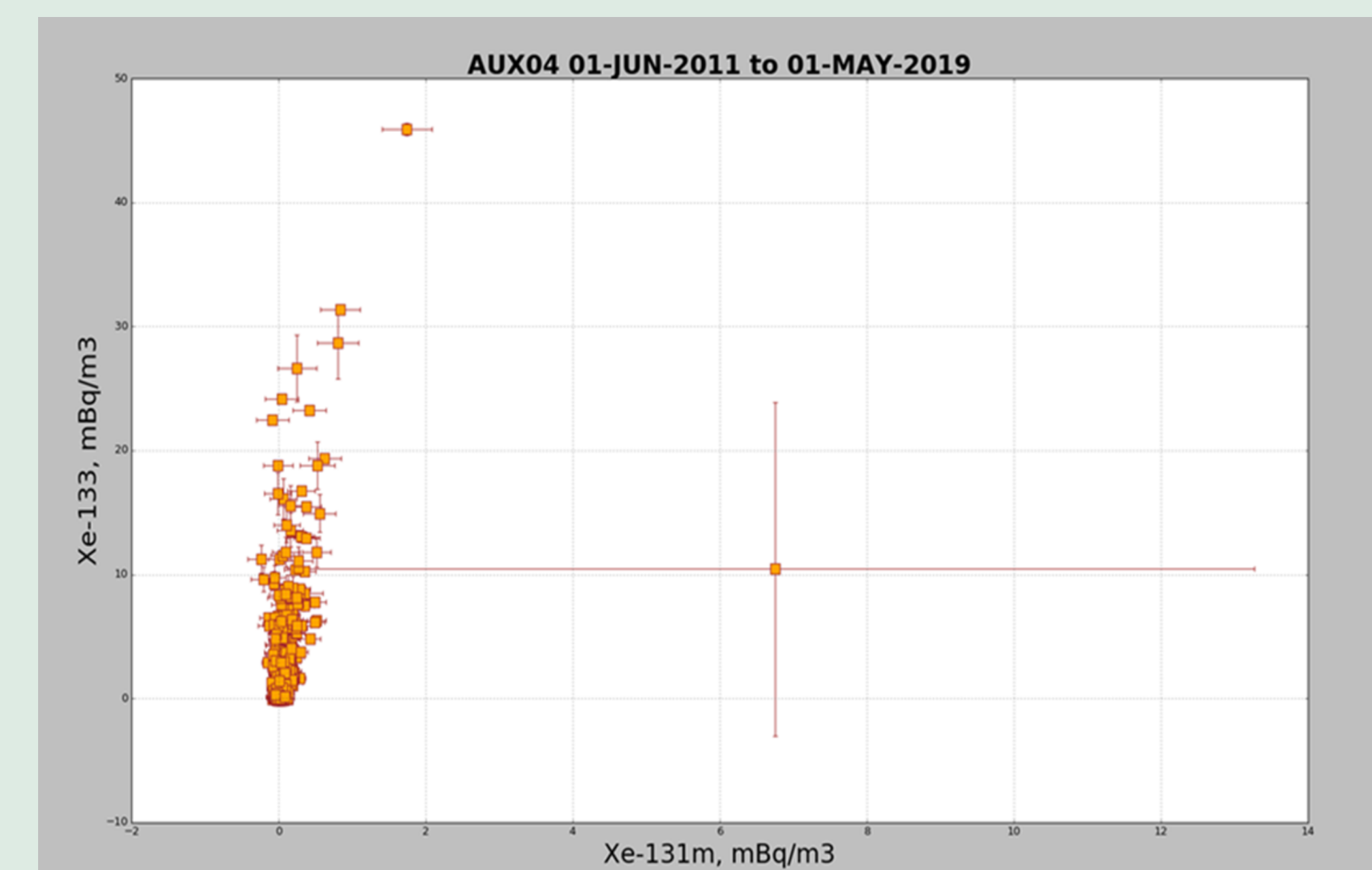
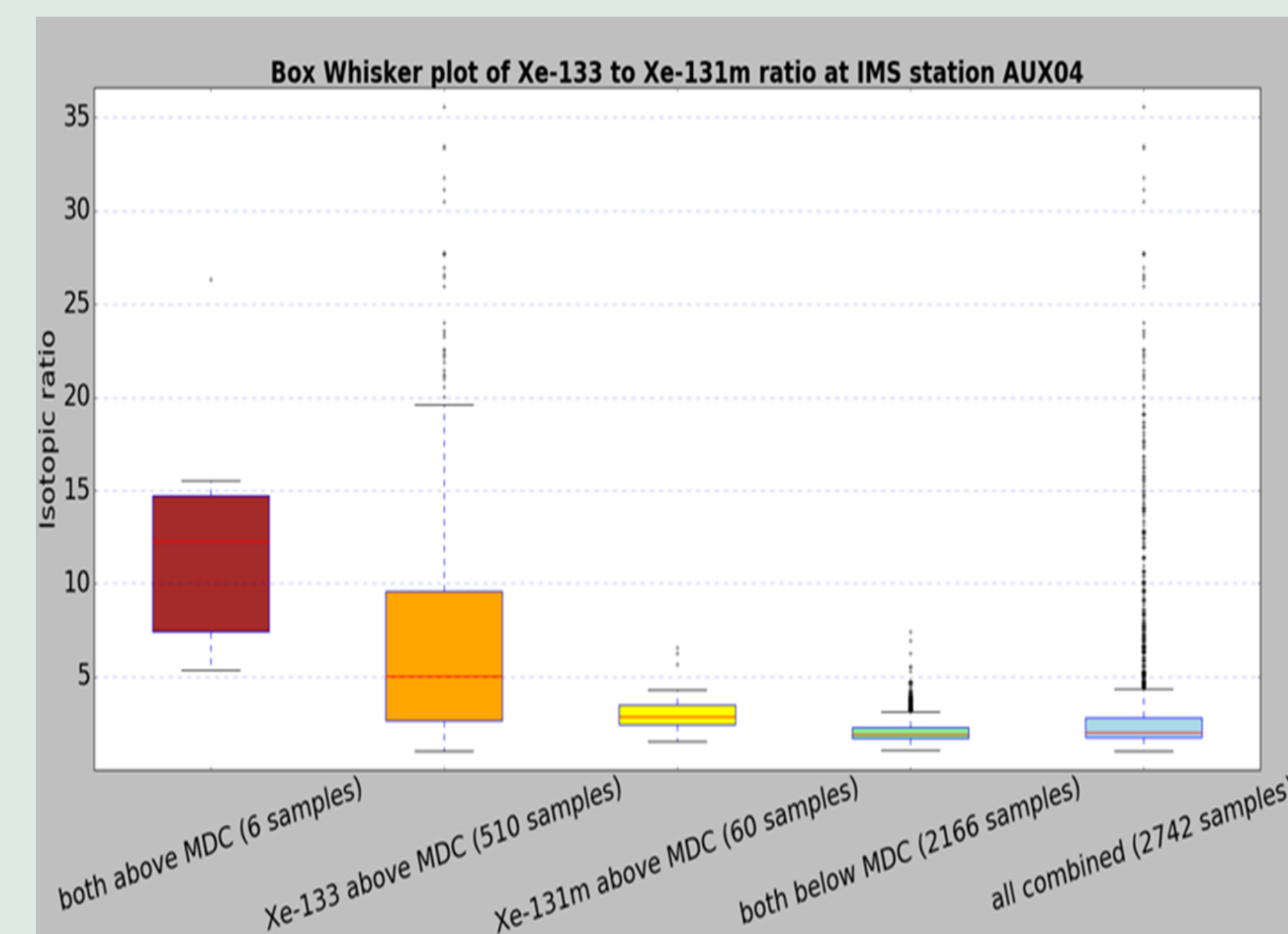
This presentation demonstrates selected visualizations and statistical tests that have the potential to be applied for CTBT monitoring purposes.

METHOD OF ANALYSIS

Due of the reliability of the data extracted from the IMS database, this method makes it possible to visualize the general shape of the box and whiskers, which gives indications of symmetry or asymmetry and atypical values.

DATA AND PLOTS

The data for this presentation are from the Noble Gas station AUX04 in Austria located at VIC. These data are from 01-JUN-2011 to 01-MAY-2019. The following Boxes and Whiskers plots record isotopic xenon Xe-133 ratios and Xe-131m. we have visual Boxes and Whiskers plots with outliers and scatters with error bars.



ANALYSIS

These 5 boxes and whiskers plots were automatically generated by a program from the isotopic ratios data for radioxenon Xe-133 / Xe-131m using Minimum Detection Concentration (MDC).

According to the graph each box and whiskers plot is obtained according to:

- Red: both above MDC
- Orange: Xe-133 above MDC and Xe-131m below MDC
- Yellow: Xe-133 below MDC and Xe-131m above MDC
- Green: both below MDC
- Blue: all samples combined.

They have very different interquartile values which show a varying dispersion of the distribution.

The latter two have very small interquartile deviations, i.e. a homogeneity of the distribution. However, they have many outliers. These outliers can be relevant signals that will require careful analysis.

The scatter plot shows a cluster of elements with a few outliers.

The points that separate from the cluster are maximum values and the minimum is the lowest of the cluster

The outliers may be due to the variability inherent in the observed data .

Also they indicate that the distribution is highly asymmetrical.

In addition, it is unlikely that this distribution is a normal distribution because the box diagram contains a relatively large number of outliers

STATISTICAL TESTS

The assumptions provided through these boxes are consistent with the reality.

The observations of outliers allows for a more in-depth analysis, to draw a conclusion and confront it with the reality and make a decision as a result of this confrontation.

The boxes are considered as confidence intervals and are quantitative type. Boxing plots are an effective visual.

We conducted the study on 15 stations with the following results:

The isotopic ratios have statistically very interesting value

73.33% of the “both above MDC” ratios are without outliers with near-antipodal median axes and very large inter-quartile differences that justify the heterogeneity of the dispersion.

With the exception of three stations, 86.66% of the stations have a probability of less than 1% of “both above MDC” samples.

100% of stations have their "both below MDC" and "all combined" which show the most outliers 100% “the ratio of all combined “shows a homogeneous distribution that is similar to the threshold of the detector background.

CONCLUSION

These values of outliers should be examined to see if they are really outliers depending of detector quality .

These real observations show a heterogeneity of the dispersion.

The MDC ratios of the radioxenon isotope Xe-133 and Xe-131m collected at the IMS station are unique with respect to the station radioxenon isotope background history.

After having read the statistical data of the history of the background, by visualization isotopic ratios we could draw a conclusion whether it is nuclear test explosion or not.

The result illustrates high capability of the IMS noble gas network to detect multiple signals of the releasing of radioxenon. The isotopic ratios can show if the noble gas released is from nuclear explosions.