

**Disclaimer**

The views expressed on this poster are those of the author and do not necessarily reflect the view of the CTBTO

## Introduction

One of the CTBTO achievements over the recent years was the implementation of the project Noble Gas (NG) into Operations. The main milestones included the certification of 25 NG systems of the International Monitoring System (IMS) and the installation of NG processing software pipeline in the International Data Centre (IDC).

Data from certified NG systems are reviewed by IDC Analysts on a daily basis. Automated and reviewed products are generated and made available to Member States via the IDC secure web site and through the new message system. These include analysis results for the four CTBT relevant xenon isotopes (Xe-133, Xe-131m, Xe-133m and Xe-135).

In addition, different radio-xenon measurement campaigns have been carried out by CTBTO at several locations of interest over the world, using mobile NG systems, with financial support through EU Council Decisions II to VI. The data is analyzed in IDC testbed.

IDC reviewed results over a long term period at various locations further contributed to a reliable characterization for better understanding the worldwide background of xenon isotopes.

## IMS Noble gas systems

So far, 25 systems from SAUNA and SPALAX technologies are certified. The daily transmitted data is processed in the IDC pipeline and then reviewed in routine mode, using dedicated software tools.



## Noble gas categorization scheme

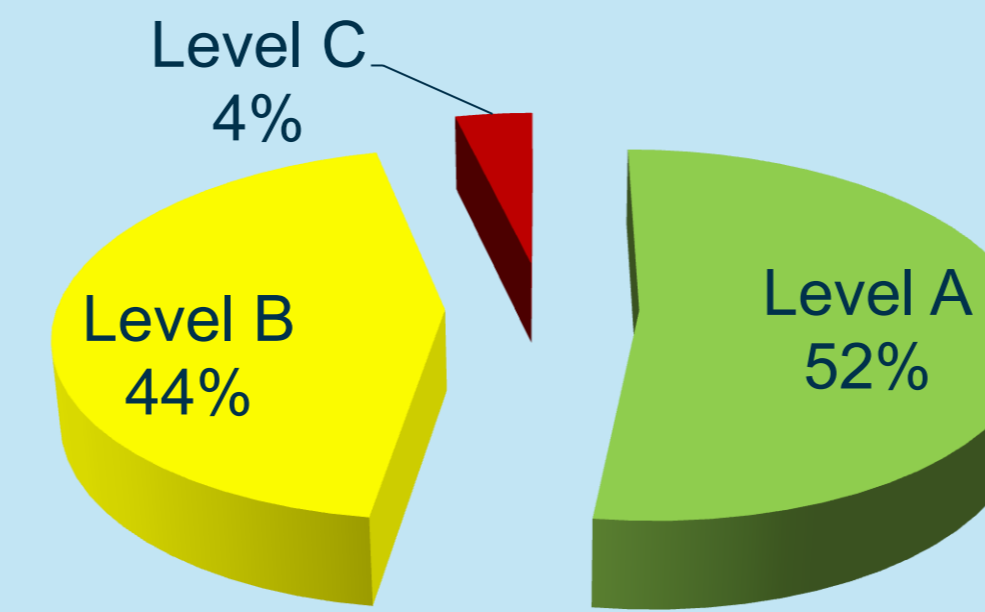
Data analysis system was upgraded in 2012 to accommodate categorization of the results. A 3-level based categorization scheme is implemented as a first screening layer of CTBT relevant xenon isotopes:

- Level A:** no radioxenon detected;
- Level B:** radioxenon detected and concentration is typical for the station;
- Level C:** radioxenon detected and the detection is atypical for the station.

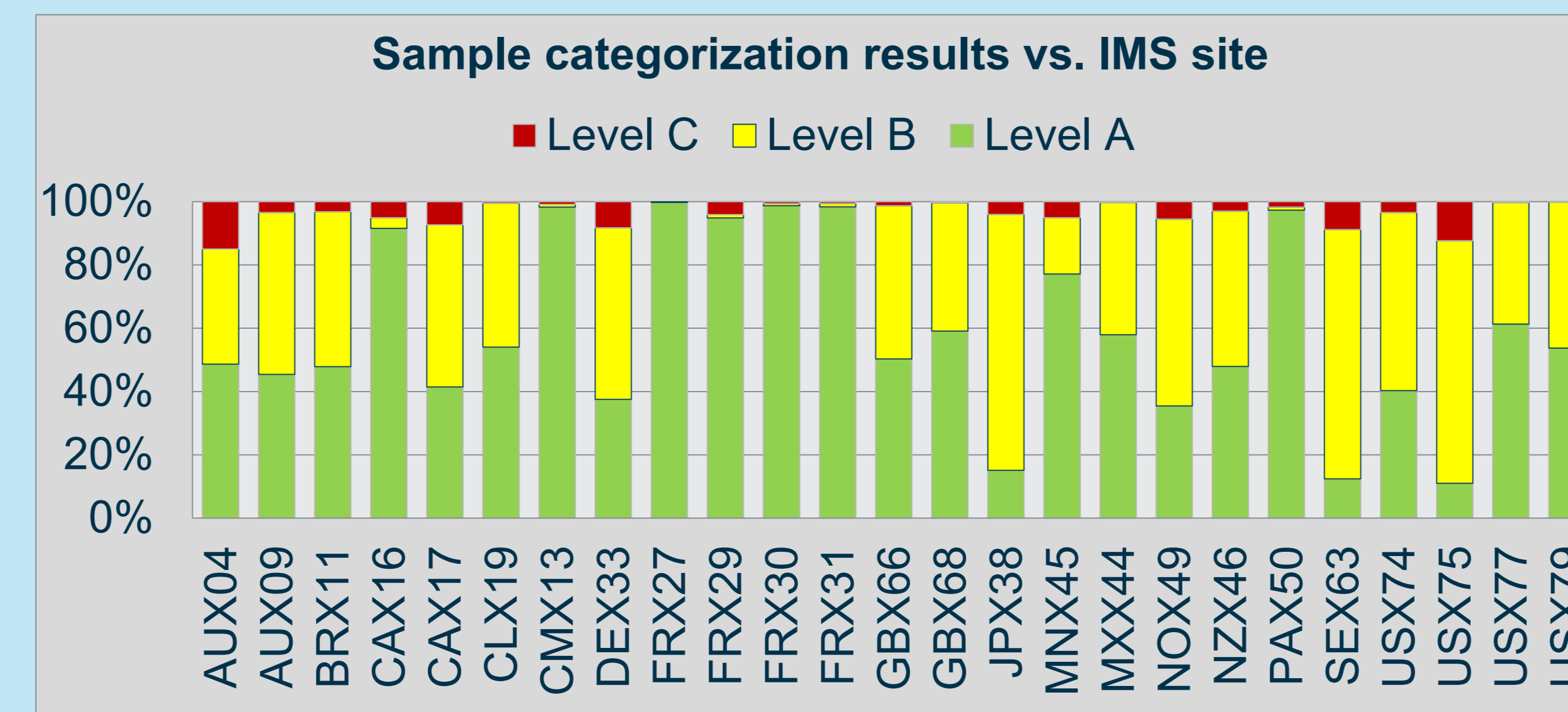
For each IMS site and isotope, the abnormal threshold is dynamically determined as **median + 3(Q3-Q1)** and the algorithm considers **up-to 365 days history**.

## Analysis results from IDC Operations

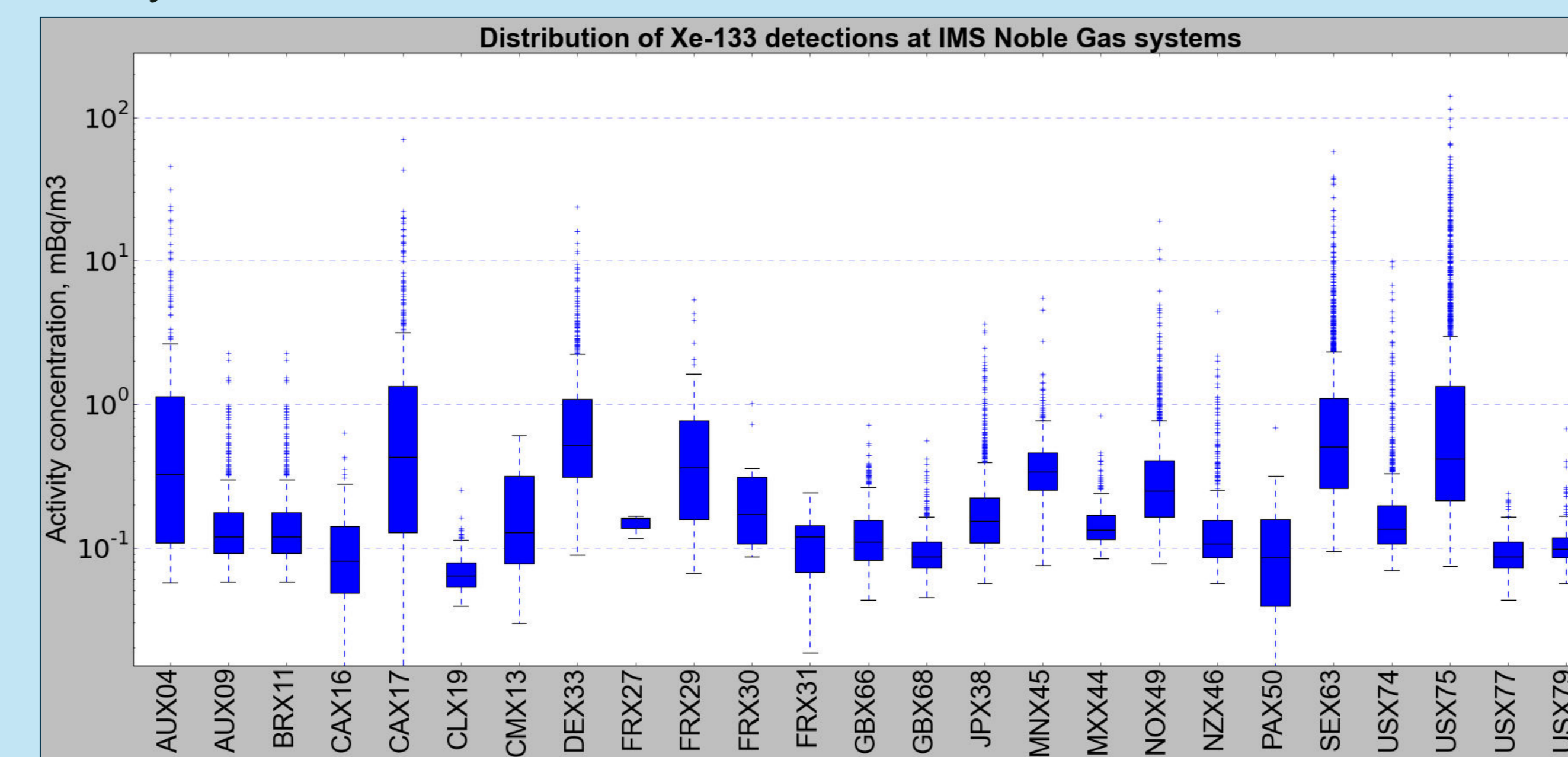
Reviewed analysis results of more than 50 000 sample spectra (Sep. 2012 – May 2017) from the 25 certified systems confirmed 4% of samples at Level C.



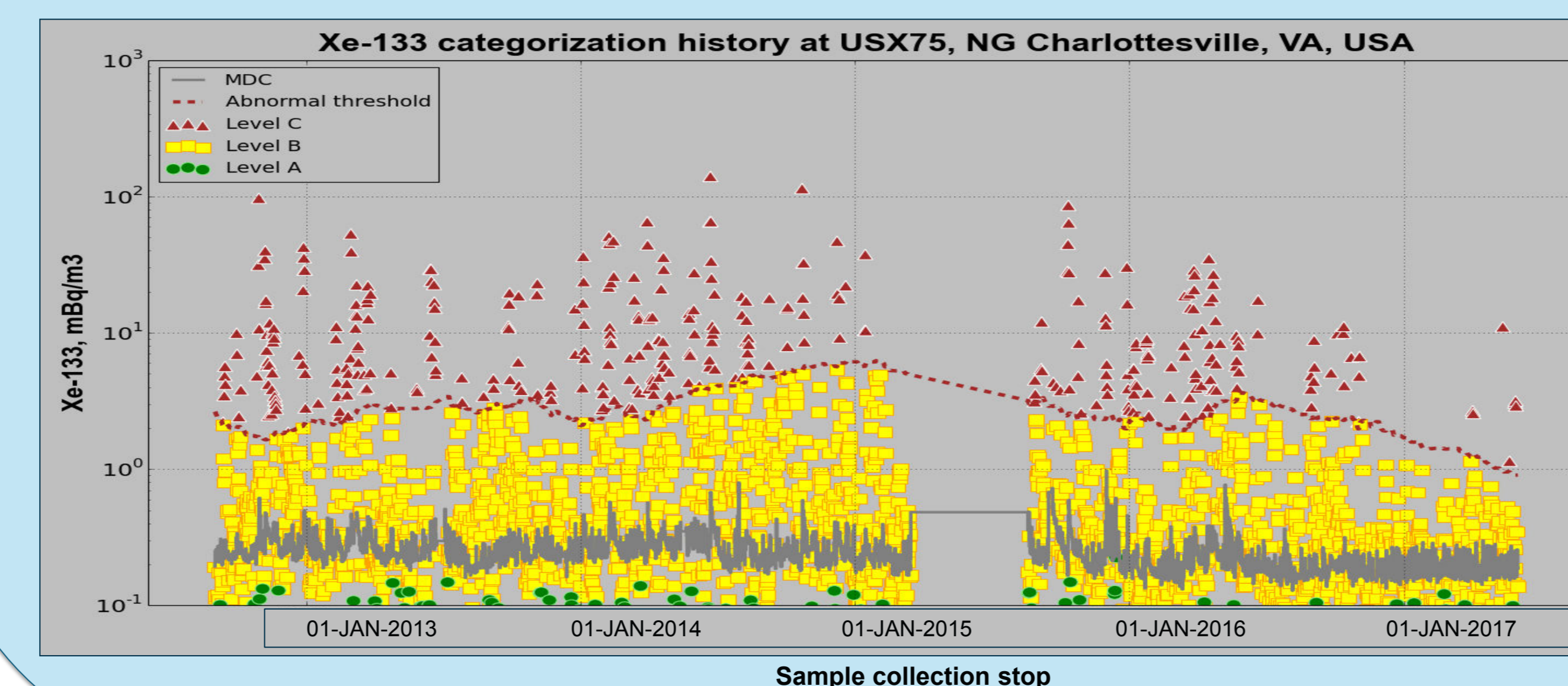
Site specific categorization results is strongly correlated with the presence of civil emission facilities at the regional scale.



The following Box-Whisker-Plots represent Xe-133 distributions at the 25 certified IMS systems.



In terms of long term pattern, the first certified Noble Gas system USX75 (Charlottesville, USA) is characterized with frequent detections until the affecting Medical Isotope Production Facility (MIPF) in Chalk river (Canada) is shut down (late 2016).



## Background campaigns

Several background campaigns were conducted with mobile systems since 2008, as reported in the below table.

Country, location	System type	Local partner	Start campaign date	Stop campaign date
Fleurus, Belgium	SAUNA I	IRE	Jun-08	Jul-08
Kuwait City, Kuwait	SAUNA I	KISR	Sep-08	Nov-08
Mafikeng, South Africa	SAUNA I	NECSA	Nov-08	Dec-08
Cape Point, South Africa	SAUNA I	SAWS	Jan-09	Feb-09
Chiang Mai, Thailand	SAUNA I	CMU	Feb-09	Apr-09
Jakarta, Indonesia	TXL-SAUNA II	BATAN	Dec-12	Aug-13
Mutsu, Japan	TXL-SAUNA II	JAEA	Jul-14	Oct-14
Kuwait, Kuwait City	SPALAX	KISR	Dec-12	Ongoing
Manado, Indonesia	TXL-SAUNA II	BATAN	Feb-15	Ongoing

The campaign in Jakarta was a good example of high background location where the detection of small releases from another source was difficult. Typical detections include all four xenon isotopes. Up to 10 Bq/m<sup>3</sup> of radioxenon were recorded. This is due to a close-by medical isotope production facility (INUKI, former BATEK).



The second background location in Indonesia (currently ongoing in Manado, North Sulawesi) didn't show any significant detection.

The measurement campaign in Kuwait in cooperation with Kuwait Institute for Scientific Research (KISR) is ongoing since May 2012, using a "Rapid Deployment" SPALAX system.



The results show typical low background xenon.

## Summary

- ❖ The knowledge of xenon background at IMS sites is of critical importance while dealing with CTBT verification related activities.
- ❖ Recent achievements in Noble Gas monitoring technology allowed reliable assessment of radioxenon background at IMS sites. A 3-level based categorization scheme is implemented as a first screening layer of Noble Gas observations.
- ❖ Reviewed analysis results confirmed globally ~4% of samples at category level C, but regionally varying between 0% and 15%.
- ❖ Radioxenon detections at IMS sites under influence releases from civil sources:
  - up to 48% of the samples are affected by one or more xenon isotope(s)
  - activity concentrations up to 100-1000 times the detection limit (LC) are recorded.