



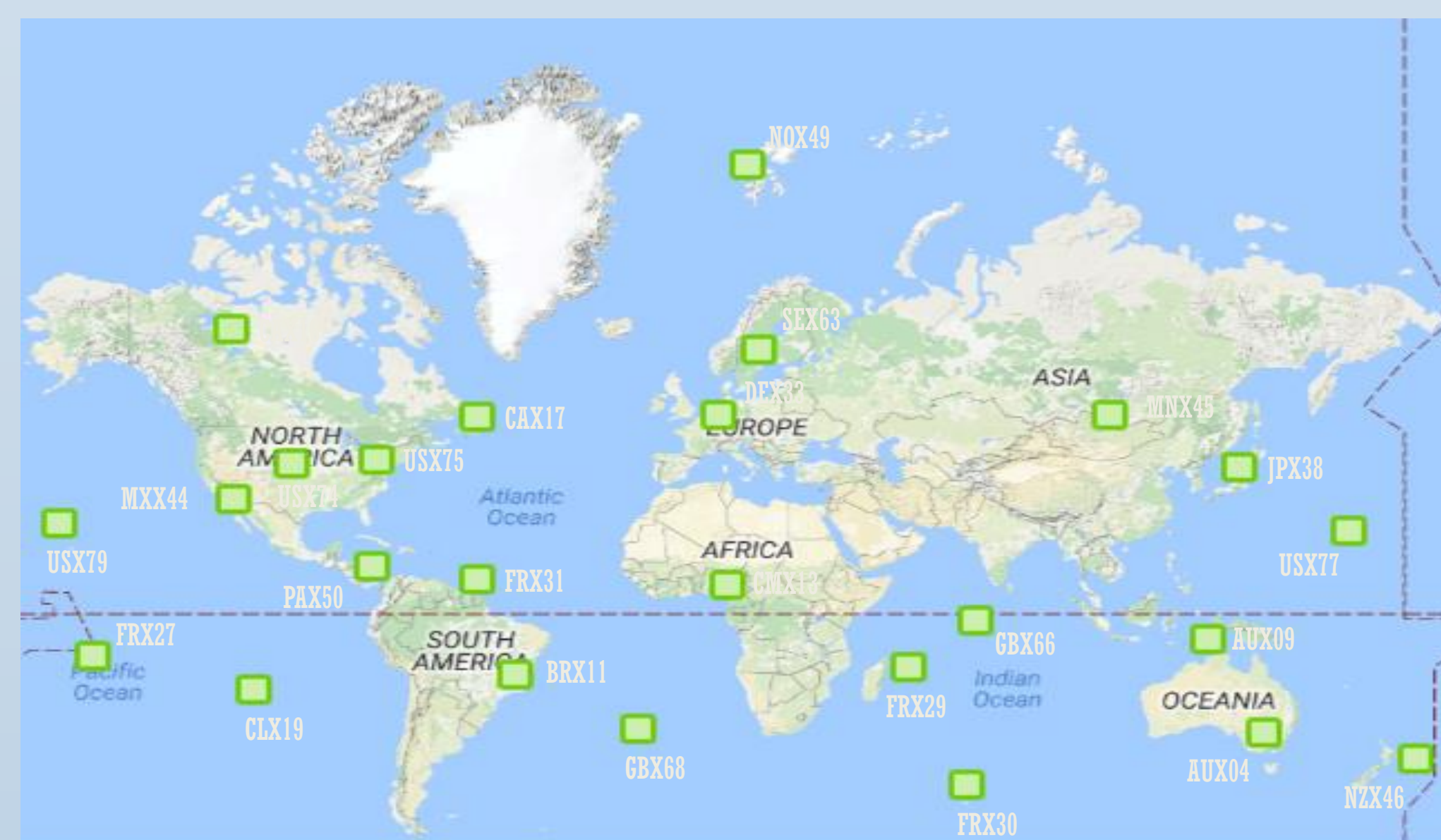
## Introduction

The CTBTO operates 25 certified Noble Gas (NG) systems of the International Monitoring System (IMS). The data is routinely processed in the International Data Centre (IDC) operations. Data from these 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 portal (SWP) and through the Verification Data Message System (VDMS). IDC products include a 3-level based categorization scheme as a first screening layer of CTBT relevant xenon isotopes. 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. The presentation aims at compiling results on radio-xenon detections at IMS NG systems, based on all data from June 2011 to August 2018. Covered aspects include major categories of observed trends in terms of detection frequency and air activity concentration.

Based on these findings, conclusions are drawn about the challenge NG monitoring faces due to the background created from normal operational emissions from nuclear facilities.

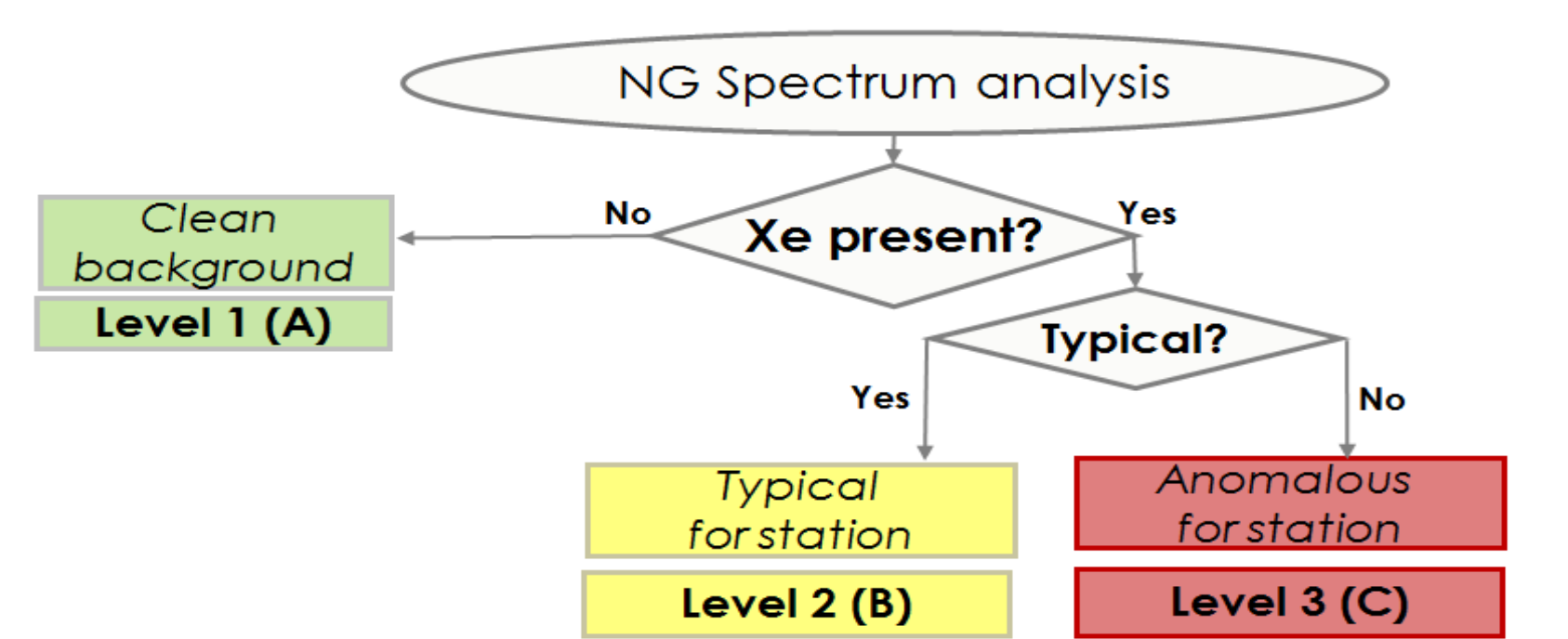
## IMS Noble gas systems

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.



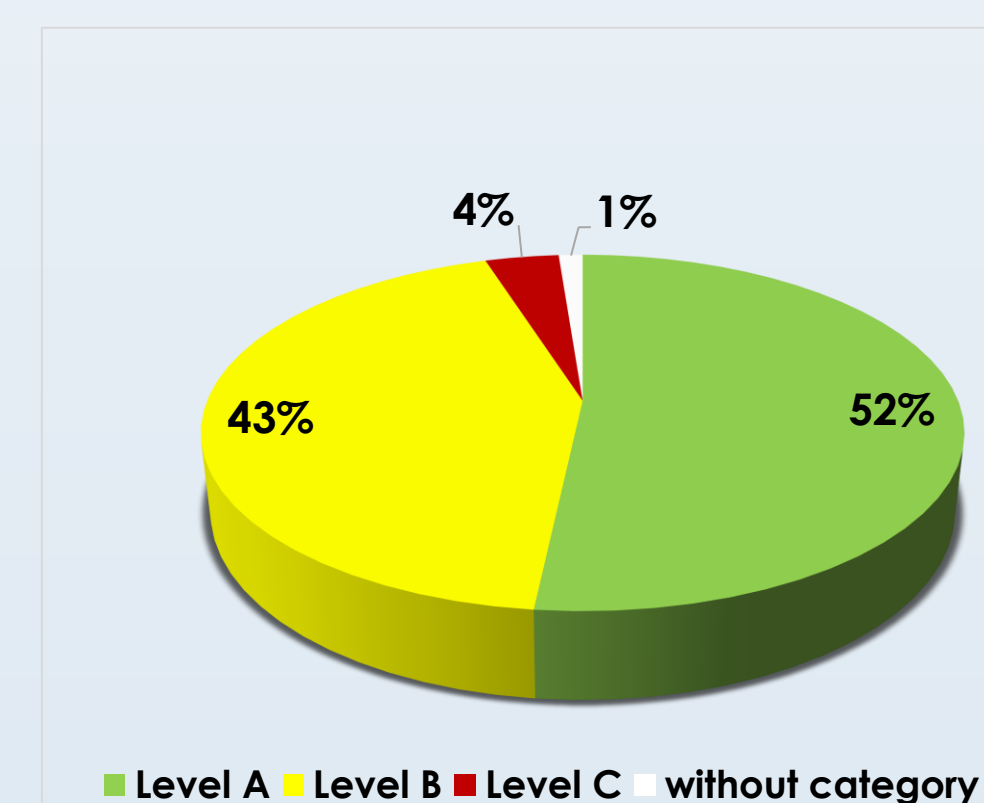
## Noble gas categorization scheme

**Concept:** Three-level activity concentration based scheme (up to 365 days distribution) + Flagging system (short term - 30 days)

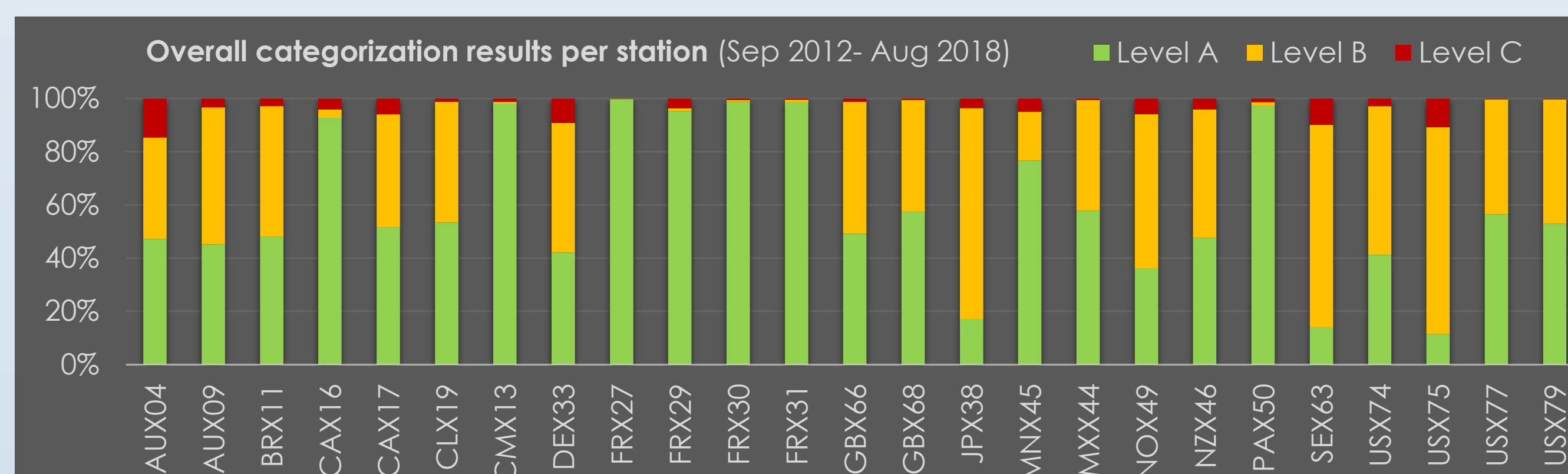


## Analysis results in IDC Operations

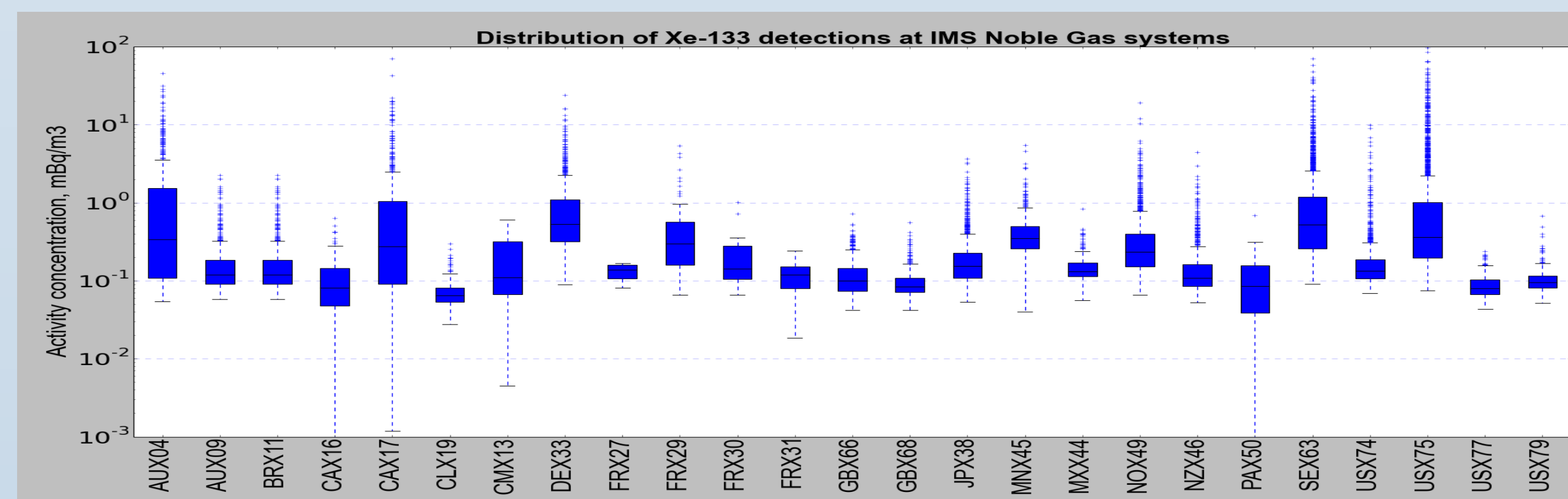
Reviewed analysis results of more than 80 000 sample spectra (Sep. 2012 – Aug 2018) from the 25 certified systems confirmed 4% of samples at Level C.



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.



## Correlation of detection vs. location

Highest frequencies are observed at IMS sites under influence from Medical Isotope Production Facilities (MIPF) and Nuclear Power Plants (NPP)

Examples:

- **USX75**, Charlottesville, VA; **CAX17**, St. John's, Canada: *influenced by MIPF in Chalk River (Canada)*
- **SEX63**, Stockholm; **DEX33**, Freiburg, Germany: *influenced by MIPF in Flurus (Belgium)*
- **AUX04**, Darwin, Australia; **NZX46**, Chatham Island, New Zealand: *influenced by MIPF in Sydney (Australia)*
- **JPX38**, Takasaki, Japan: *influenced by local and regional NPPs*

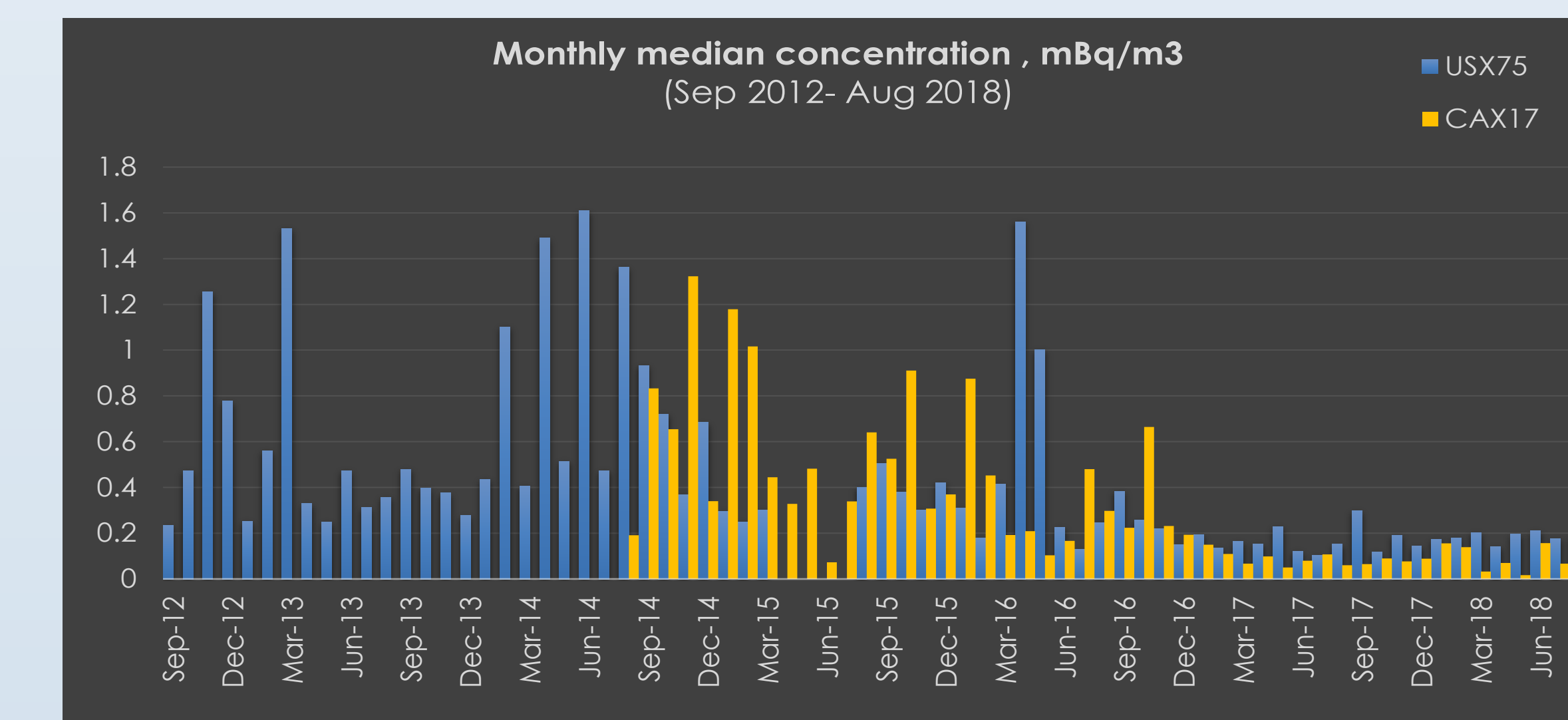
On the other hand, a clean background is observed at IMS sites that are not impacted by civil sources.

Examples:

- **CMX13**, Douala, Cameroon
- **FRX27**, Papeete, Tahiti, France
- **PAP50**, Panama City, Panama

## Trend in USX75 and CAX17 detections

Early November 2016, the NRU multipurpose reactor in Chalk River Nuclear Labs (Canada) was phased out and eventually halted production of medical radioisotopes. Resulting release decline is clearly reflected in detections at IMS NG systems USX75 (Charlottesville, USA) and CAX17 (St. John's, Canada).



## Summary and Conclusions

CTBTO achievements in Noble Gas monitoring technology allowed **reliable assessment of radionuclide background at IMS sites.**

- ❖ **More than 8 years of NG sample data were reviewed in IDC operations** (since June 2011).
- ❖ **Since September 2012, a 3-level based categorization scheme is implemented as a first screening layer of Noble Gas observations.**  
*Activity concentrations due to nuclear explosions may fall within the same range (or lower) than emissions from Radiopharmaceutical facilities !*
- ❖ **In addition to sample category in NG products, Flags on isotopic ratios and short term based statistics (30 days) are also provided.**  
*Isotopic ratios are similar for nuclear explosions and emissions from Radiopharmaceutical facilities !*
- ❖ **About 47% of the samples contain one or more isotope(s).** Reviewed analysis results based on 80 000 spectra confirmed **~ 4 % of samples at category level C.**  
*4% of considered IMS stations (average of ~1 sample per day) is still considerable from the CTBT verification perspective.*

❖ Geographical distributions of radionuclide detections show a **clear impact of emissions from Medical Isotope Production Facilities and Nuclear Power Plants.**

❖ Highest activity levels and detection frequencies of radionuclide were observed at IMS sites under predominant wind directions from Medical Isotope Production Facilities.