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# The Potential of Radionuclide Ratios for Spectrum Categorization Algorithms

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Developing effective algorithms for event screening is a crucial responsibility of the Provisional Technical Secretariat (PTS) of the Comprehensive Test Ban Treaty Organization (CTBTO). Only these algorithms can make an international monitoring system - which is acquiring gigabytes of raw data every day – effective in supporting Member States in their work for verifying compliance with CTBT.

To guarantee an effective verification of the CTBT, a monitoring system including 80 radionuclide stations all over the world is being installed. Most of the collected data is not of interest and only very few so called samples might signify a possible nuclear test. Therefore, algorithms are needed to help the human analyst to handle all the incoming data and focus on the significant samples only.

These algorithms rely on many variables. First of all it has to be checked whether the sample meets the minimum requirements, the so called state of health criteria (SOH). Most samples pass this check and are sorted in those without any relevant information and those that might be of interest and warrant further investigation. By this way as many as possible samples have to be eliminated and the wheat has to be separated from the chaff.

This can be done my comparing the actual investigated sample to previous samples of the same station or to mean values of the station. Thresholds for abnormal quantities can be defined and used to categorize each sample.

Radioactivity can be measured on particulates or as isotopes of gaseous elements. Especially for underground tests, for example those conducted by the Democratic Peoples Republic of Korea (DPRK), noble gases play a crucial role as they can hardly be contained. The noble gas Xenon is of special interest, particularly the four isotopes Xe-131m, Xe-133m, Xe-133 and Xe-135.

The ratios of these four isotopes are a relatively distinct parameter to distinguish between civil releases and nuclear tests. Nevertheless this has not yet been implemented in the algorithms of the CTBTO. During the work described here an algorithm was further developed, combining the SOH preconditions with an efficient categorization concept. The latter describes a method of how to take into account the different variables and to categorize all samples such, so as to not have too many inappropriate high-level cases (a so called type two error) without sorting out samples that may indicate the conduct of a nuclear test (type one error).

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