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Optimizing the Chances for Detecting Nuclear Test Signatures of Prompt and Early Releases Using Radioxenon Isotopic Ratios

In the context of CTBT verification, isotopic ratios of xenon are used to distinguish civilian sources of radioactivity from nuclear test events using a threshold value that separates the reactor and nuclear test domains. Two methods exist to calculate the confidence range of the ratios: Bayesian decision method, and Fieller's Theorem. The purpose of this project is to select the best method tuned to provide the optimized screening results. This is accomplished by comparing the effectiveness and robustness of each method for source discrimination. First each method is applied to data from IMS radionuclide stations twice, once using a one standard deviation confidence interval, and once using a two standard deviation confidence interval. A threshold isotopic ratio for screening is then defined by setting the rate of false positives (type II error) to 5%. Next, the results of each method and choice of confidence interval were "scored" using hypothetical data from simulated nuclear tests added to real atmospheric background in selected IMS samples. The best method is the one with the highest detection rate.

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