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Characterisation of Prompt and Delayed Atmospheric Radioactivity Releases from Underground Nuclear Tests at Nevada as a Function of Release Time

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A database with information on about 500 cases of atmospheric radioactivity releases from underground nuclear tests is analysed. The data are statistically evaluated and systematically aggregated in order to characterise prompt uncontrolled as well as delayed operational releases of radioactivity into the atmosphere. The focus is put on the latter. The reported data compare well with theoretically derived xenon activities for reasonable nuclear test scenarios. Conclusions are drawn on the main features of releases that can be expected from underground nuclear tests as a function of release time. These findings are relevant for developing and validating methods to be applied in global monitoring of atmospheric radioactivity with respect to indications of an underground nuclear explosion.

In particular, it is important for fusing radionuclide and seismic events to have an understanding of the possible delay time between the explosion and the radioactive release. For uncontrolled test releases, the release time uncertainty is smaller than or similar to the time resolution of state-of-the-art atmospheric transport simulations for source location (3 hours). They occur typically with a delay of a few minutes up to several hours and have durations of one minutes up to about 10 hours. However, the more frequent operational releases can have a significant delay, typically between one day and one week.

The Nevada data are consistent with full in-growth from the precursors prior to release irrespective of the release time. As a conclusion, there is no significant fractionation between the xenon isotopes and the precursors on any of the relevant pathways of operational releases. Accordingly, the isotopic activity ratios are a reliable parameter to facilitate source discrimination and assessment of the event time.