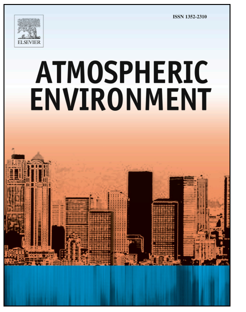

Detection of nuclear testing from surface concentration measurements: Analysis of radioxenon from the February 2013 underground test in North Korea

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Detection of nuclear testing from surface concentration measurements: Analysis of radioxenon from the February 2013 underground test in North Korea

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Abstract:

A method is outlined and tested to detect low level nuclear or chemical sources from time series of concentration measurements. The method uses a mesoscale atmospheric model to simulate the concentration signature from a known or suspected source at a receptor which is then regressed successively against segments of the measurement series to create time series of metrics that measure the goodness of fit between the signatures and the measurement segments. The method was applied to radioxenon data from the Comprehensive Test Ban Treaty (CTBT) collection site in Ussuriysk, Russia (RN58) after the Democratic People's Republic of Korea (North Korea) underground nuclear test on February 12, 2013 near Punggye. The metrics were found to be a good screening tool to locate data segments with a strong likelihood of origin from Punggye, especially when multiplied together to a determine the joint probability. Metrics from RN58 were also used to find the probability that activity measured in February and April of 2013 originated from the Feb 12 test. A detailed analysis of an RN58 data segment from April 3/4, 2013 was also carried out for a grid of source locations around Punggye and identified Punggye as the most likely point of origin. Thus, the results support the strong possibility that radioxenon was emitted from the test site at various times in April and was detected intermittently at RN58, depending on the wind direction. The method does not locate unsuspected sources, but instead, evaluates the probability of a source at a specified location. However, it can be extended to include a set of suspected sources. Extension of the method to higher resolution data sets, arbitrary sampling, and time-varying sources is discussed along with a path to evaluate uncertainty in the calculated probabilities.

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Kewords. Nuclear testing, mesoscale transport, radioxenon, CTBT

1. Introduction

Radiation measurement networks have been installed to monitor normal and accidental atmospheric releases from nuclear reactors (e.g. SPEEDI, Chino et al., 1993), nuclear isotope production facilities (Wotawa et al., 2010) and also from nuclear incidents and tests, e.g., Le Petit et al. (2008), CTBT(2013).