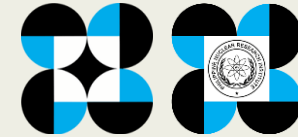


Effect of 2020 Taal volcano eruption on Lead-212 detection of CTBTO RN52 Station

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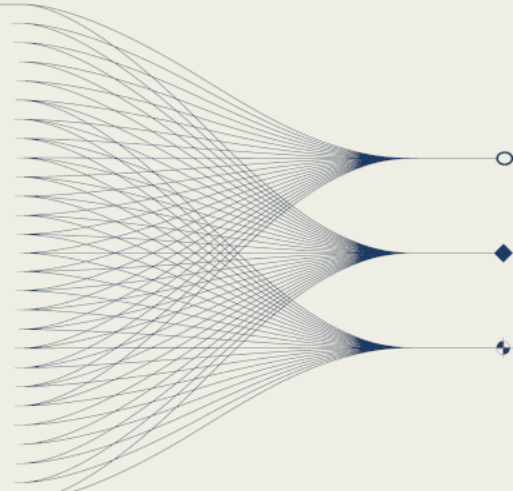
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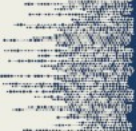
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INTRODUCTION AND MAIN RESULTS

This presentation aims to determine the effect of the 2020 Taal volcano eruption on Lead-212 detection of the RN52 Station. Increase in Lead-212 concentration has been reported in past volcanic eruptions due to the released magma. Using a regression model containing temperature, relative humidity, and wind speed, unusual Lead-212 concentration was observed for 16 March 2020. Atmospheric transport modelling results then revealed air masses from the northwest as source. The Taal volcano is located on the opposite side, and its activity has decreased significantly. Hence, the detection can be attributed to other factors not included in the model such as inversion layer changes and source variations.





Introduction

The radionuclide station RN52 in Tanay, Philippines was established in 2005 under CTBTO to detect anthropogenic radionuclides indicative of nuclear explosions. In addition, the RN52 Station detects other radionuclides such as Pb-212. Pb-212 ($t_{1/2} = 10.64$ h) is a natural radionuclide present in the atmosphere due to decay of Rn-220 emanating from the Earth's crust. It attaches to surface of aerosols before dispersing.

Pb-212 may also exist in the atmosphere through volcanic eruptions due to released magma. Increase in Pb-212 concentration has been reported in past eruptions, such as the 2000 eruption of the Miyake-jime volcano and 2004 eruption of the Asama volcano which are both located in Japan. The Taal volcano, which is located approximately 70 km southwest of the RN52 Station, erupted on 12 January 2020 which released products that may contain Pb-212 (Figure 1).

In this study, the effect of the 2020 Taal volcano eruption on Pb-212 detection of the RN52 Station was determined.



Figure 1. Eruption of Taal volcano on 12 January 2020 (CGTN).

Methods and Data

Data retrieval and processing

The activity concentrations of Pb-212 were retrieved using CTBTO RNToolkit. Only those with acceptable FWHM values for Be-7, as indicated in the CTBTO PRTTool, were used. The common logarithms of the activity concentrations were calculated.

Meanwhile, meteorological data (rainfall, relative humidity, atmospheric pressure, wind direction, wind speed) were retrieved using CTBTO Secure Web Portal. Their daily average values were calculated except for rainfall, in which the daily totals were obtained.

Data analysis

Forward multiple linear regression was performed using IBM SPSS Statistics Version 31.0.0.0 (117) to determine and remove contributions of meteorological parameters to the activity concentrations. The common logarithms of the activity concentrations and untransformed meteorological data from 01 January to 31 December 2019 were used.

The resulting regression model was then applied to the activity concentrations from 01 January to 31 March 2020. The absolute standardized residuals were computed, and those with values higher than 3 were considered unusual detections.

Atmospheric transport modelling

Atmospheric transport modelling (ATM) was performed for the unusual detections using Web-Grape IBS Version 3.2.3 to determine source location. The integral fields of regard based on meteorological data from ECMWF were obtained.

Results

The regression model contains three meteorological parameters, accounting for 62.3% of the variations in activity concentrations. Based on partial regression coefficients, temperature is directly related while relative humidity and wind speed are inversely related.

Unusual detection was recorded for 16 March 2020, with ATM results revealing air masses from the northwest as source (Figure 2). The Taal volcano is located on the opposite side, and its activity has decreased significantly. Hence, the detection can be attributed to other factors not included in the model such as inversion layer changes and source variations.

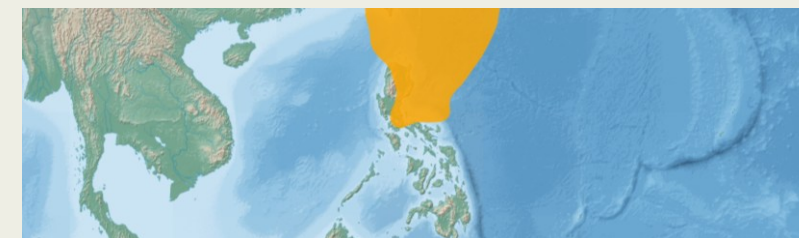


Figure 2. ATM results for RN52 Station for 16 March 2020.

Conclusions

The 2020 Taal volcano eruption did not have any significant effect on Pb-212 detected at the RN52 Station. Unusual detections can be attributed to other parameters such as inversion layer changes and source variations.

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