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Caesium activity concentration at Eastern Europe IMS Particulate stations in 2011 and the influence of metrological parameters

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INTRODUCTION AND MAIN RESULTS

The radiation was released into the atmosphere and water in the days after the Fukushima nuclear disaster. This study presents the activity concentrations of caesium-134, 136, and 137 at Eastern Europe IMS stations in 2011 and the influence of the metrological parameters.

The results of time series and caesium activity diagrams illustrated the increase of caesium activity concentration in March and April. Meteorological data. was used to elucidate the influence of these parameters on the variation of caesium activity concentration.

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Introduction

With the fast growth of the social economy and industrialization, the problem of urban air and water pollution has become more severe, which has become a significant part of controlling the construction of urban natural civilization. Many scholars studied the relationship between the particles' concentrations and wind direction, speed, and precipitation in different regions. Caesium is produced from the detonation of nuclear weapons and emissions from nuclear power plants. Caesium can affect anyone when breathed in, absorbed through the skin, irritate the eyes, and the lungs, causing coughing, and cause severe skin burns on contact. All these motivated the researcher to study the caesium activity concentration. Caesium (55Cs) has 40 recognized isotopes, making it, along with barium and mercury, one of the elements with the most isotopes. The atomic masses of these isotopes range from 112 to 151.

Objectives

This research has three main objectives:

- Characterize the variability of Cs 134, Cs 136 and Cs 137activity concentrations at Eastern Europe IMS Particulate Station (RUP 54, RUP 58, RUP 59, RUP 60 and RUP 61) in 2011.
- Investigate the influence of the meteorological factors (wind speed and precipitation) on Caesium activity concentrations.
- Construct wind rose diagram for each station.

Methods and Data

This research illustrates the activity concentrations of caesium134, caesium 136 and caesium 137 in Eastern Europe stations data (IMS stations RUP 54,58, 59, 60 and 61)) from January 2011 to December 2011.

The caesium concentration activity with meteorological data (derived from the NASA power access) were used to investigate the influence of meteorological conditions on the variation of caesium.

Diagrams for the caesium activity concentration, daily precipitation (mm/day) and 10 meters wind speed were created.

Also, a wind rose diagram was constructed based on hourly 10 meters wind direction, speed, and precipitation data using WRPLOT view software to reveal the wind direction at each station

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Results

- The final results of the influence of metrological parameters on caesium activity concentration are illustrated in the below figures.

- RUP 54 station

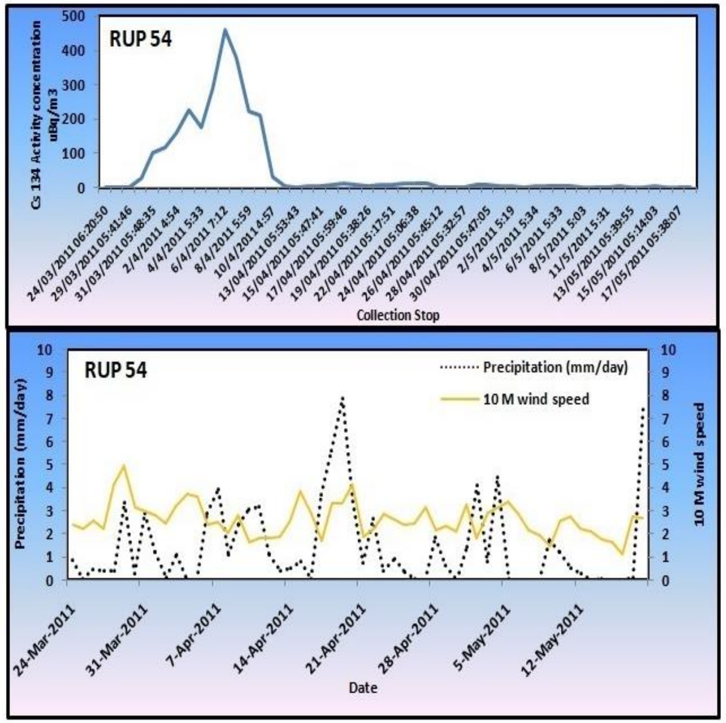

Figure 1. Reveals the slight effect of wind speed and precipittion on the Cs 134 activity concentration

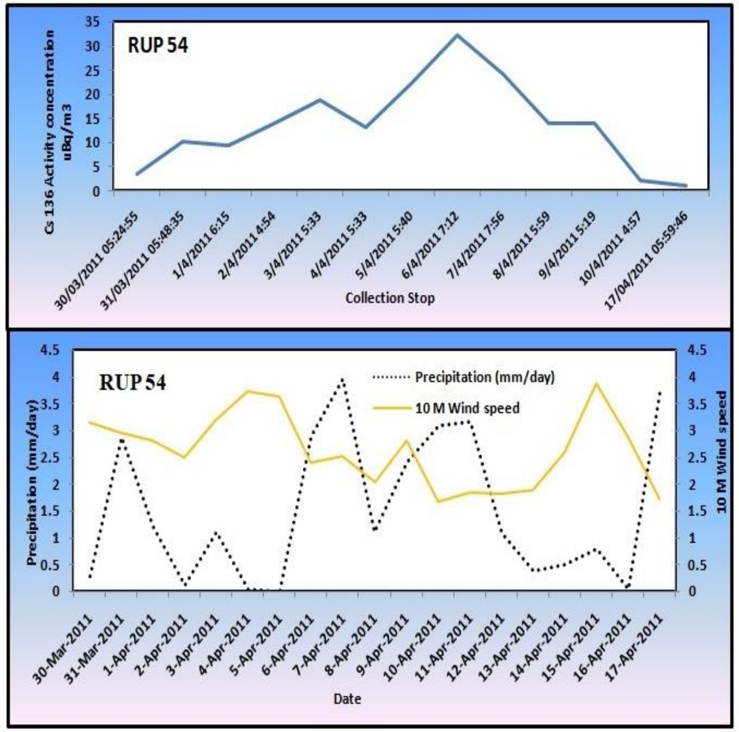

Figure 2. Illustrates the variation of Cs 136 activity concentration with the wind speed and precipitation

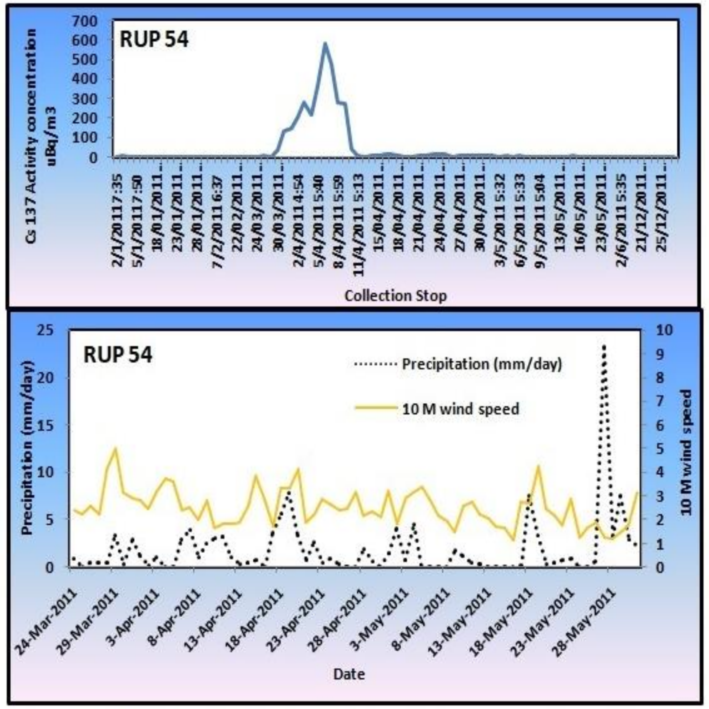

Figure 3. Displays that Cs 137 activity concentration increase with the increase of wind speed in the period between 24 March and 11 April

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- RUP 58 station

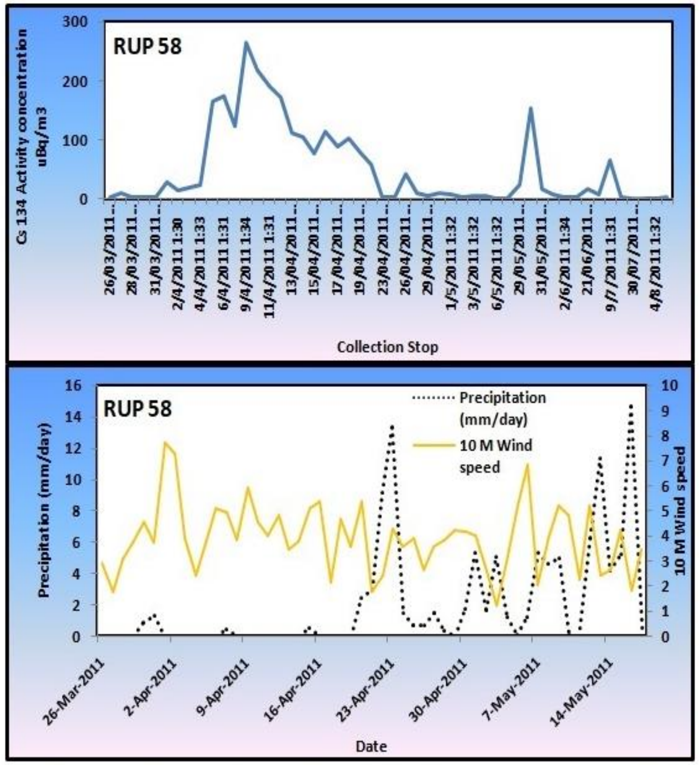

Figure 4. Shows that Cs 134 activity concentration and wind speed increase in the period between 26 March and 23 April with the decrease of precipitation

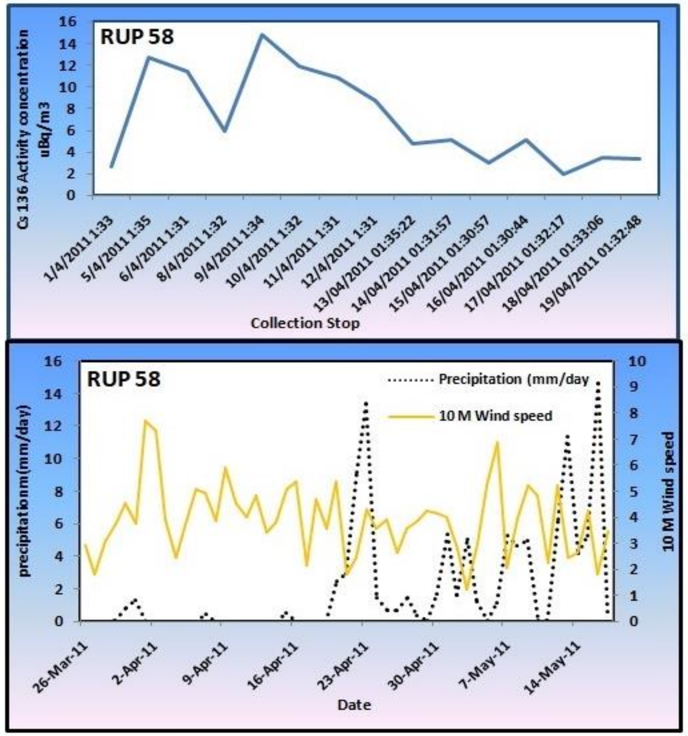

Figure 5. Displays that Cs 136 activity concentration and wind speed increase in the period between 1 April and 17 April with the decrease of precipitation

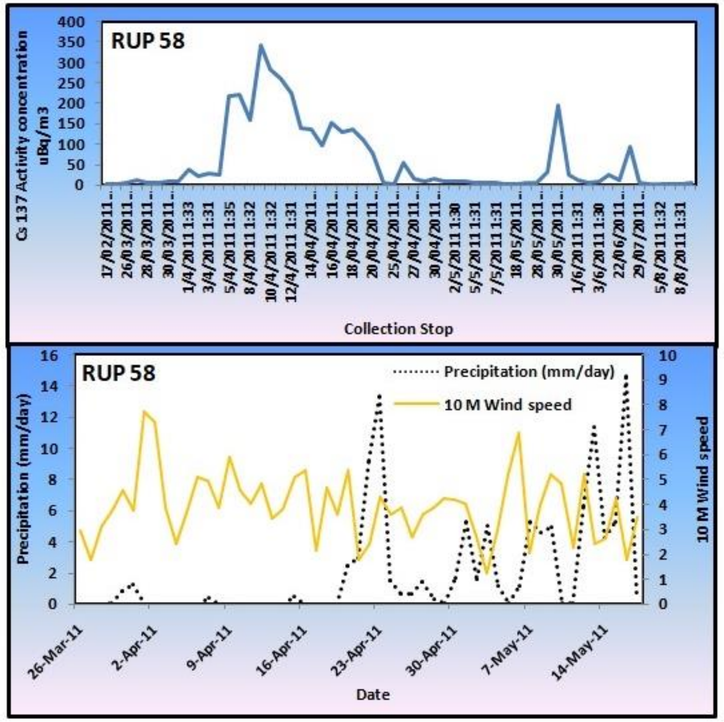

Figure 6.Shows that Cs 137 activity concentration and wind speed increase in the period between 26 March and 23 April with the decrease of precipitation

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- RUP 59 station

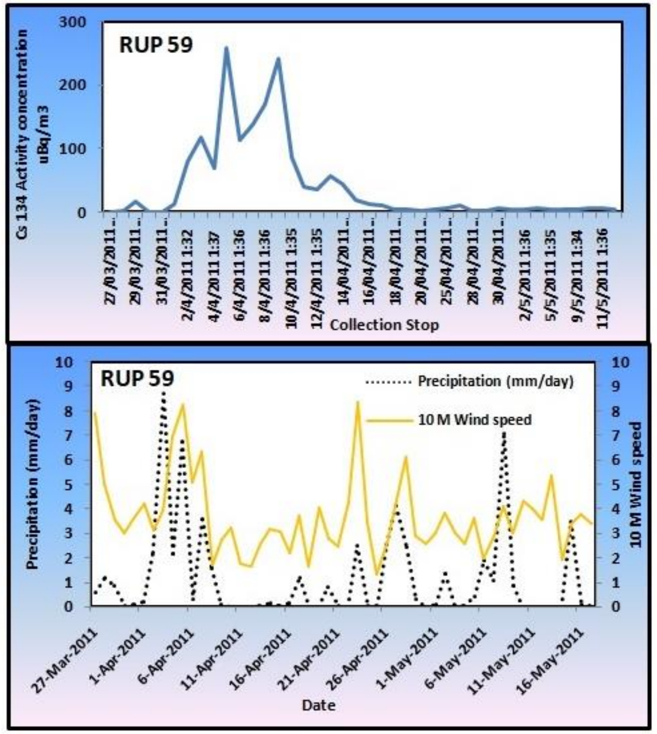

Figure 7. Displays that Cs 134 acivity concentration increase with the increase of wind speed and precipitaion in the period between 27 March and 11 April

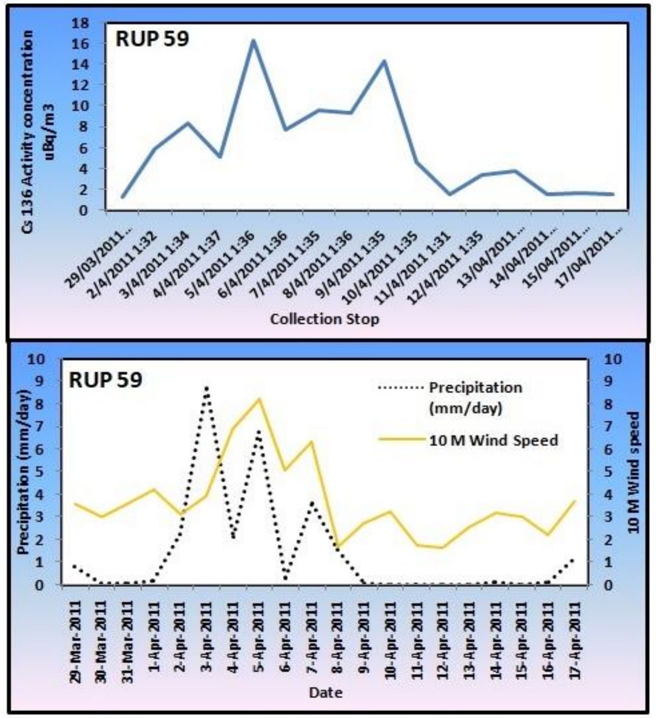

Figure 8. Represents that Cs 136 activity concentration increase with the increase of wind speed and precipitation in period between 29 March and 9 April

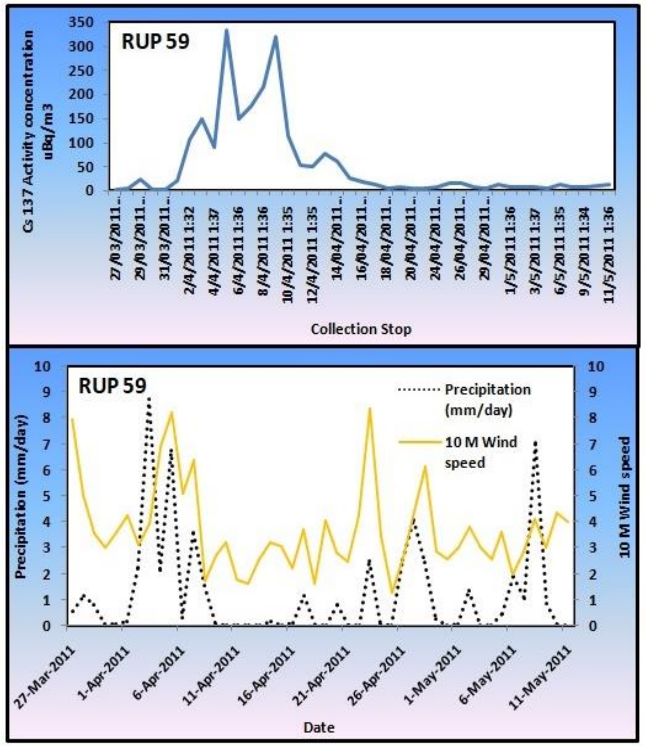

Figure 9. Explains that Cs 137 activity concentration increase with the increase of wind speed and precipitaion in the period between 27 March and 17 April

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- RUP 60 station

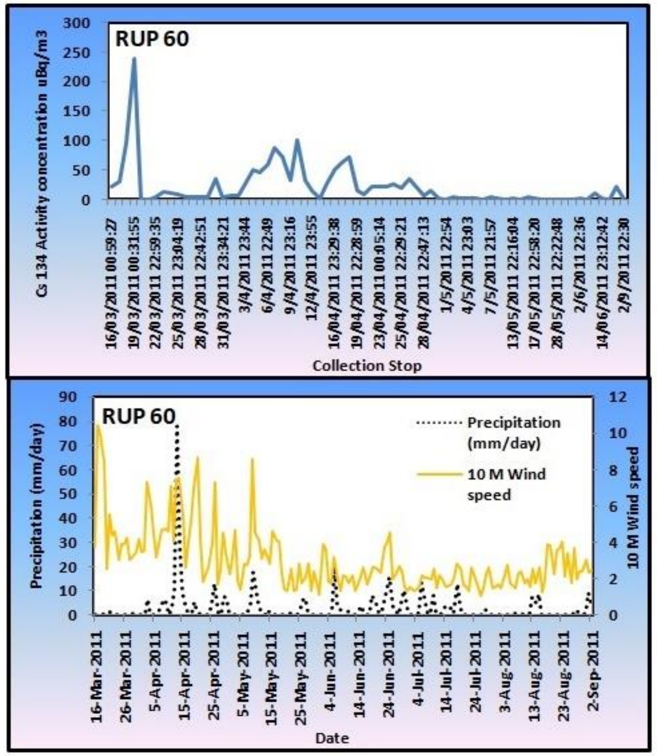

Figure 10. Explains the influence of wind speed and precipitation on the Cs 134 activity concentration in the period between 16 March and 28 April

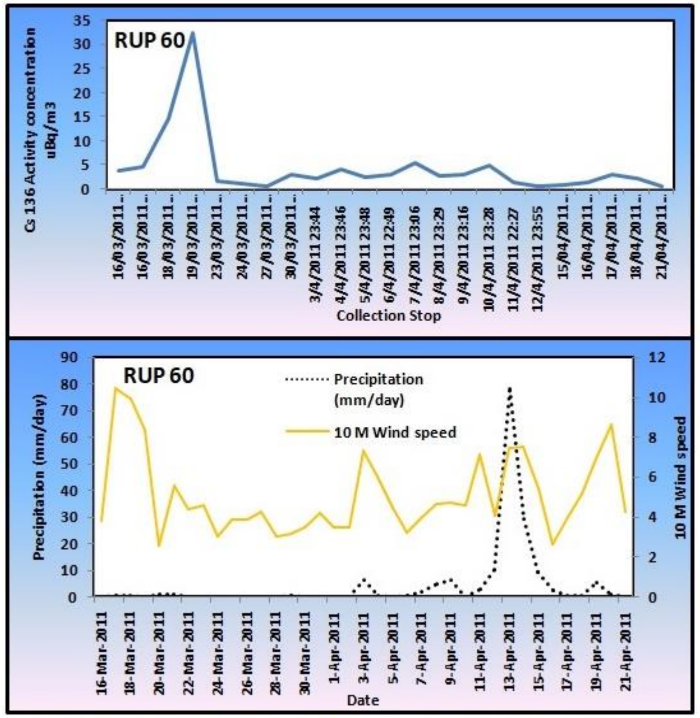

Figure 11. Clarifies that Cs 136 activity concentration increase with the increase of wind speed and the decrease of precipitation in the period between 16 March and 1 April

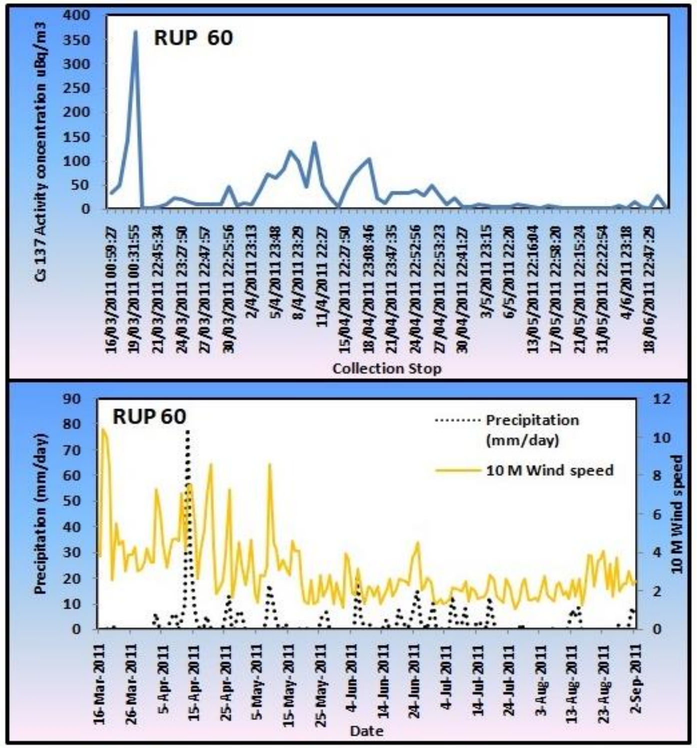

Figure 12. Represents the influence of wind speed and precipitation on Cs 137 activity concentration in the period between 16 March and 18 June

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- RUP 61 station

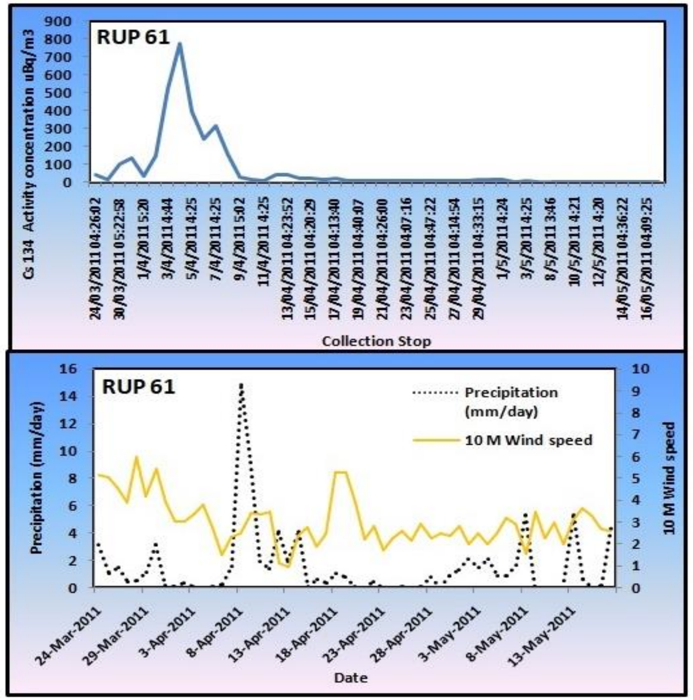

Figure 13. Displays the influence of wind speed and precipitation on Cs 134 activity concentration in the period between 24 March and 18 April

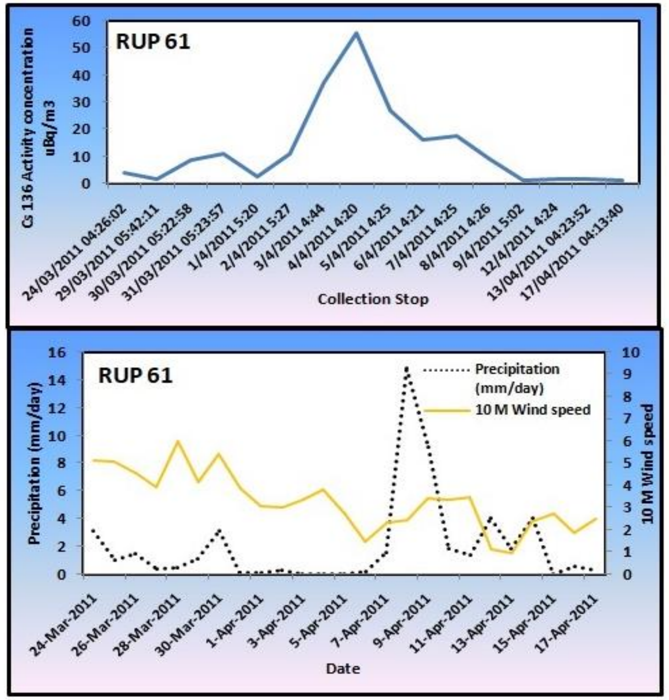

Figure 14. presents the influence of wind speed and precipitation on Cs 136 activity concentration in the period between 24 March and 17 April

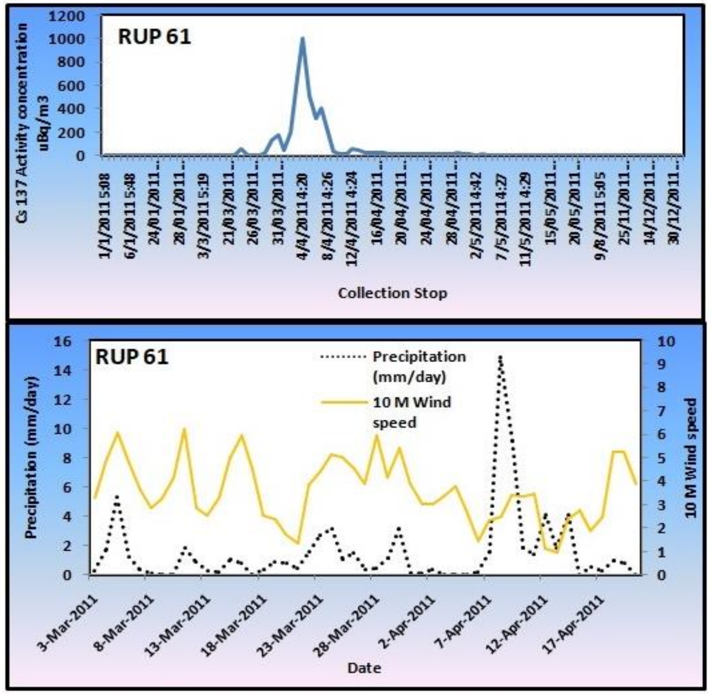

Figure 15. Reveals the influence of wind speed and precipitation on Cs 137 in the period between 26 March and 17 April

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- The below figures represent the wind rose diagram and wind class frequency distribution at each station site

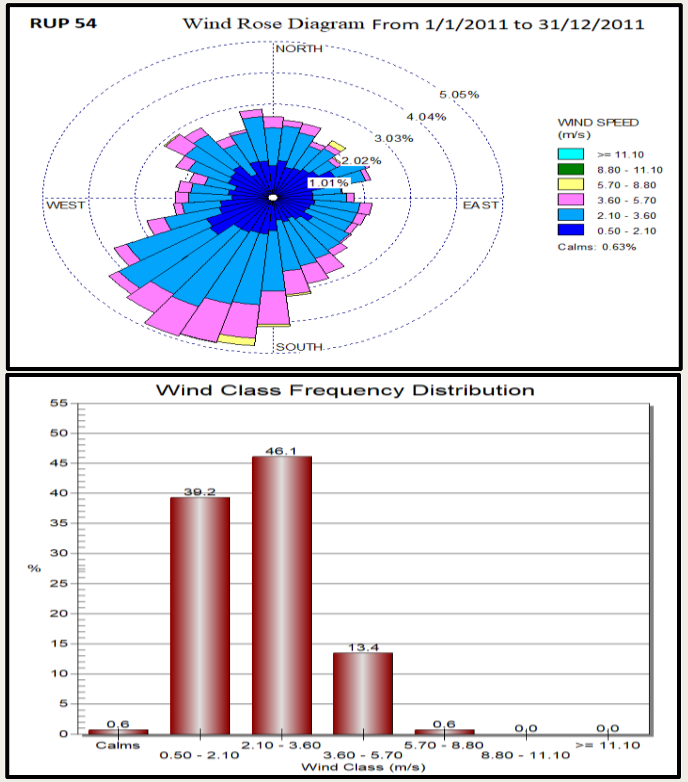

Fig 16. Wind rose diagram and wind class frequency distribution at RUP 54 station site

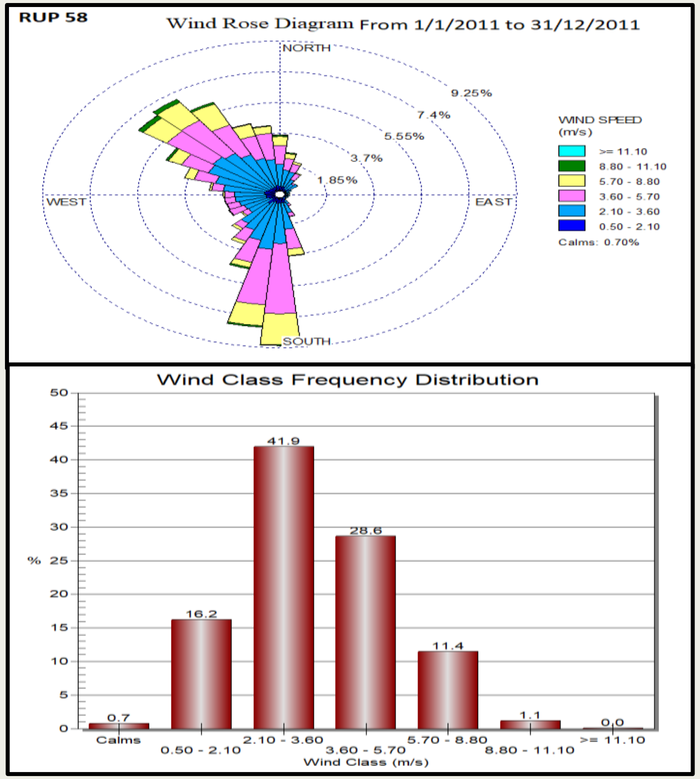

Fig 17. Wind rose diagram and wind class frequency distribution at RUP 58 station site

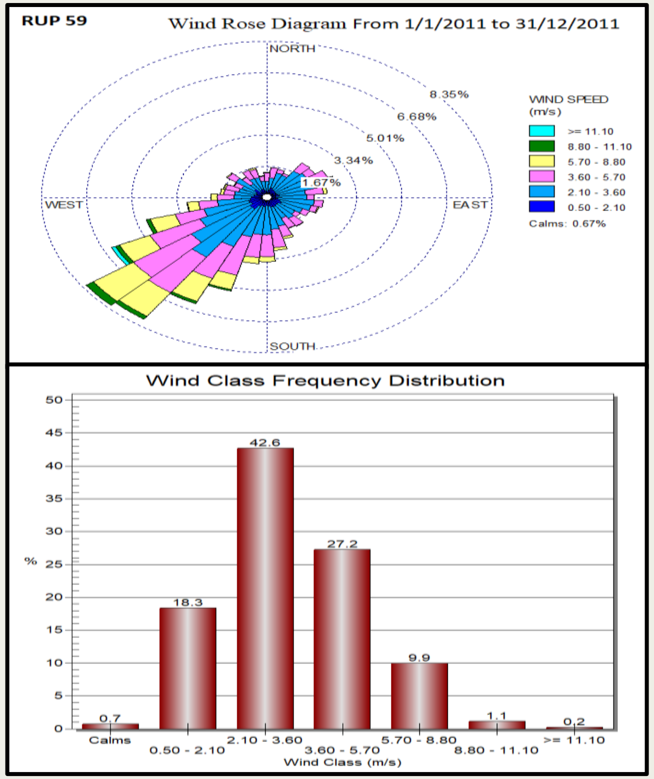

Fig 18. Wind rose diagram and wind class frequency distribution at RUP 59 station site

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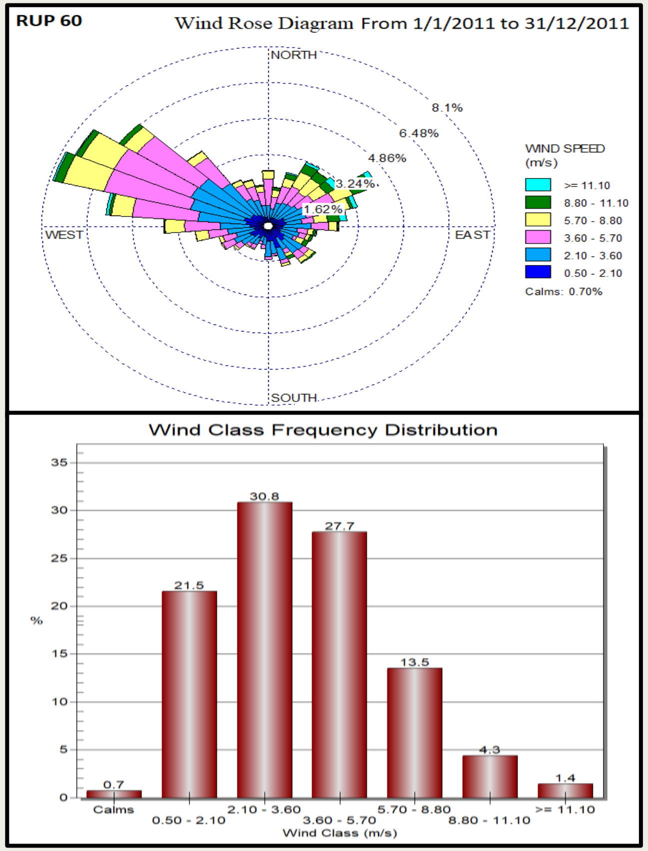

Fig 19. Wind rose diagram and wind class frequency distribution at RUP 60 station site

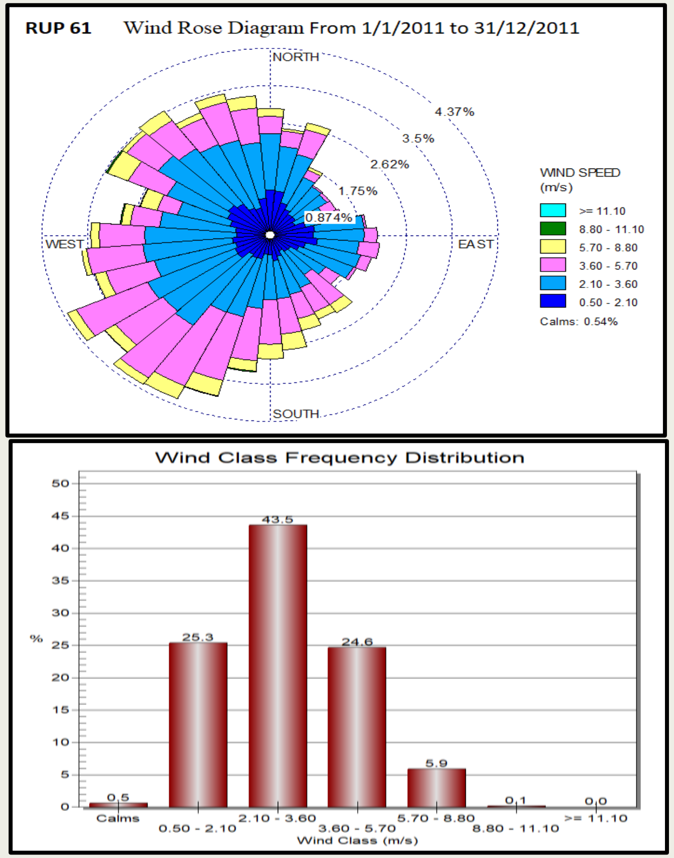

Fig 20. Wind rose diagram and wind class frequency distribution at RUP 61 station site

Conclusion

This research displays the activity concentrations of caesium 134, caesium 136, and caesium 137 in Eastern Europe IMS particulate stations in 2011. Low and high activity concentrations of caesium 134 are reported at RUP 60 (0.7197 uBq/m³) and RUP 61 (773.4387 uBq/m³); caesium 136 level has reached 0.66403 uBq/m³ at RUP 60 and 55.34395 uBq/m³ at RUP 61, while caesium 137 ranges from 0.4809777 uBq/m³ to 1004.487 uBq/m³ at RUP 61 as low and high activity concentrations, respectively. The results of time series and caesium activity diagrams illustrated the increase in caesium activity concentration in March and April. Meteorological data (wind direction, speed, and precipitation) were used to elucidate the influence of these parameters on the variation of caesium activity concentration. Also, a wind rose diagram was constructed to clarify wind parameters at station sites.