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Cosmogenic Radionuclide for Civil Application: Be-7 and Application of Trans-equatorial Method for Northeast Monsoon Forecasting in Malaysia

Mohd Fauzi Haris[1,3], Norita Md. Norwawi[1], Mohd Hafez Mohd Isa[2], Muhammad Rawi Mohamed Zin[3], Faisal Izwan Abdul Rashid[3], Mohd Zaid Hassan@Abdul Rahman[3], Azlai Ta'at[4]

[1]Cybersecurity and Systems Research Unit, Faculty of Science and Technology, Universiti Sains Islam Malaysia, 71800 Nilai, Negeri Sembilan, Malaysia
[2]Faculty of Science and Technology, Universiti Sains Islam Malaysia, 71800 Nilai, Negeri Sembilan, Malaysia
[3]Malaysian Nuclear Agency, 43000 Kajang, Selangor, Malaysia
[4]Malaysian Meteorological Department, Jalan Sultan, 46667 Petaling Jaya, Selangor, Malaysia

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INTRODUCTION AND MAIN RESULTS

The northeast monsoon (NEM) is an annual natural phenomenon in Malaysia, typically occurring from October to March. During this period, strong winds driven by two significant surges — the easterly surge and the meridional surge — bring heavy rainfall, often leading to severe flooding that can result in property damage and casualties. This study utilizes eight years of data (2011–2018) from International Monitoring System stations (IMS) alongside the Trans-equatorial technique to forecast the occurrence of NEM in Malaysia. A statistical approach incorporating data normalization and smoothing techniques was also evaluated to identify patterns in Be-7 measurements, which were then used as a reference for predicting the onset and withdrawal of the monsoon. By integrating IMS data with advanced processing techniques, the withdrawal of NEM in Malaysia was predicted with an accuracy of 341 days and a forecast horizon of ±7 days, achieving a correlation of 85%. However, the results for monsoon onset were less promising, indicating the need for further improvements to enhance forecasting accuracy. Although a strong correlation was observed for monsoon withdrawal, additional testing with more recent NEM seasons suggests that refinements are still required, particularly for improving monsoon onset predictions.

SnT 2025 8 SEPTEMBER 9 TO 12 SEPTEMBER
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

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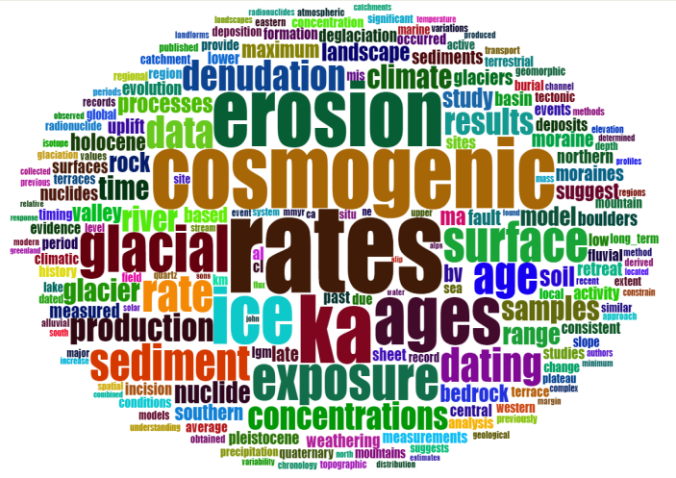
INTRODUCTION

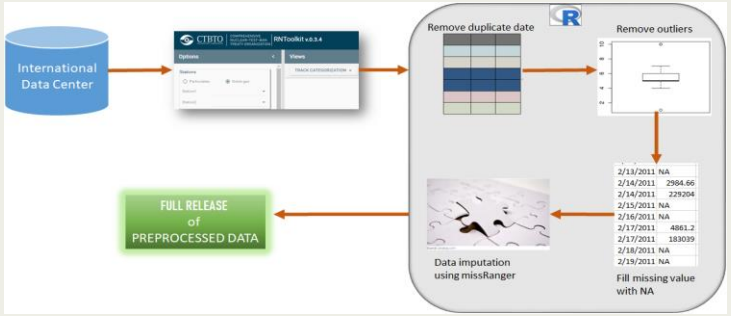


While cosmogenic radionuclides are often used to study erosion and surface processes, **This study introduces** the application of Beryllium-7 and the Trans-equatorial Method for forecasting the Northeast Monsoon in Malaysia

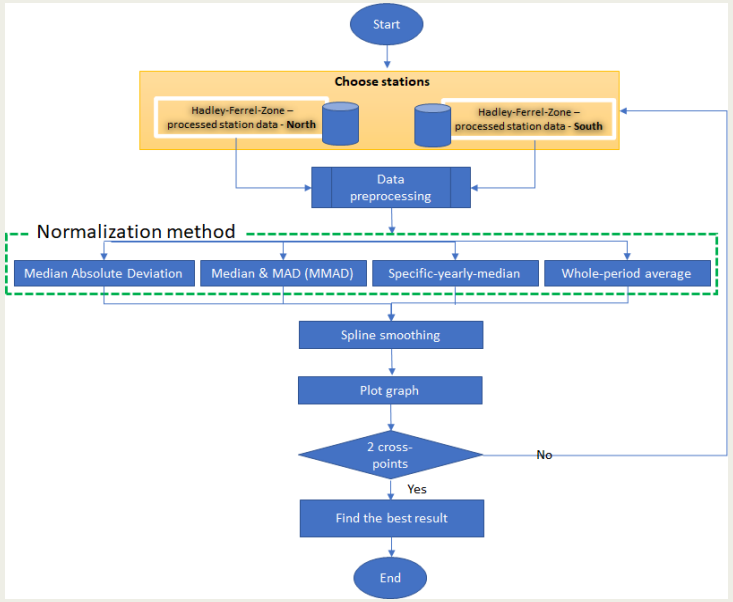
Objective: Assess suitability of combining Trans-equatorial and statistical approaches for forecasting monsoon onset/withdrawal in Malaysia.

Data: 8 monsoon seasons (2011–2018); calculated average day & standard deviation.

DATA AVAILABILITY, ACCESSIBILITY AND PRE-PROCESSING



METHODOLOGY



RESULTS AND CONCLUSIONS

Average, Standard Deviations, and Correlation for Onset and Withdrawal with the Best Result Selected by Normalization Method

Station Pair	Average (days)	Std. Deviation (days)	Correlation	Crosspoint (CP)	Onset / Withdrawal	Normalization Method
AUP04 – RUP61	207.1250	8.6262	0.8424	CP1	Onset	MAD
AUP10 – RUP54	347.5000	8.8034	0.8593	CP1	Withdrawal	MAD
AUP04 – RUP61	207.5000	9.3197	0.8122	CP1	Onset	MMAD
AUP10 – RUP54	350.0000	8.4853	0.8626	CP1	Withdrawal	MMAD
NZP47 – RUP54	40.7500	15.4157	0.5186	CP2	Onset	Specific-Yearly-Median
AUP10 – RUP59	351.8750	11.5373	0.4751	CP1	Withdrawal	Specific-Yearly-Median
AUP04 – RUP61	203.6250	9.0859	0.8219	CP1	Onset	Whole-Period Average
AUP10 – RUP54	340.8750	7.3389	0.8469	CP1	Withdrawal	Whole-Period Average

- (Pearson) Correlation is a value between NEM onset (withdrawal) and predicted onset (withdrawal) using the Trans-equatorial method (CP + averaged lead time)
- A negative correlation score shows significant disparities between crosspoint + average and the observed dates for that particular year or season. After the CP is added to the average value, some or most of the date exceed the observed date, making it unreliable.
- The best result selection is based on the highest correlation value among the pair stations with two crosspoints for each normalization method.

Key finding: AUP10–RUP54 + Whole-Period-Average normalization → best for withdrawal forecasting (SD ±7 days; correlation >0.8).

Normalization: CP1 generally outperformed CP2 for onset/withdrawal calculations.

Limitation: No method achieved reliable onset forecasting despite varied station combinations and normalization methods.

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