

Evaluation of MCP Correlation Algorithms Applied to Wind Data Series

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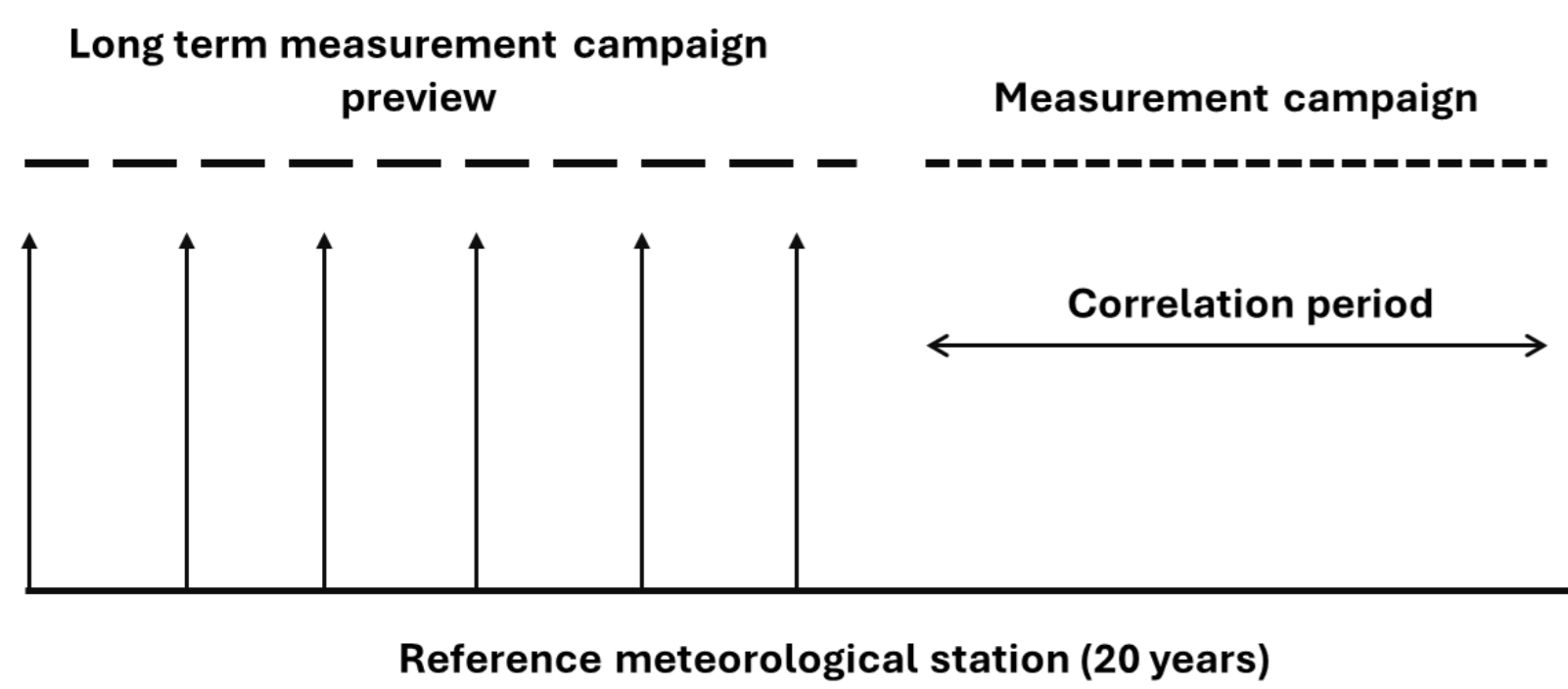
Objectives

This work aimed to develop methodologies for analyzing statistical correlations among wind data series using various Measure-Correlate-Predict (MCP) methods, with the goal of selecting the most suitable method for extrapolating long-term data with minimal associated uncertainty. Furthermore, the study intends to investigate how the concurrent period used to build the correlation can affect the performance indicators of MCP methods.

Methodology

- 15 wind measurement stations were selected (nine measurement stations were chosen in **Portugal**, two in **Romania**, two in **Poland**, and two in **South Africa**);
- The reanalysis series closest to the measuring location were selected based on the best correlation obtained, measured by the coefficient of determination **R²**;
- For each measurement mast, tests were performed using periods ranging from **6 months** to a maximum of **10 years**, according to the available total measured data period;
- The correlation algorithms were tested for each measurement period, including **13 regressions**, **1 matrix**, and **1 artificial neural network**;

MCP Methodology



- Calculating errors such as **RMSE** (Root Mean Square Error) and **MBE** (Mean Bias Error) to evaluate the quality of correlation;
- Single-factor ANOVA** analyses were performed for the years with the lowest associated errors to understand the significance of the measurement year;
- t-significance tests** were performed for the selected years to identify MCP algorithms with significantly different means.

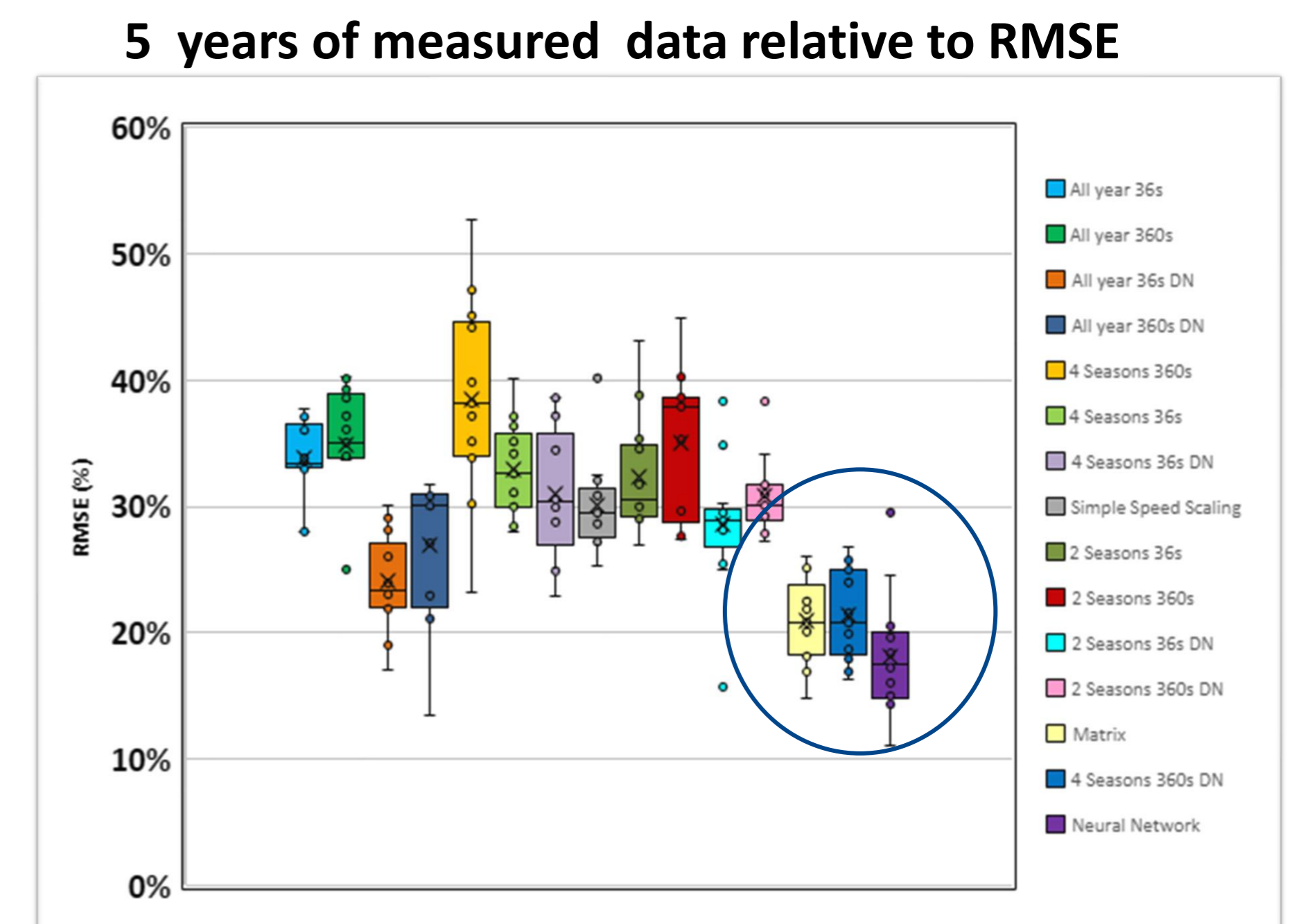
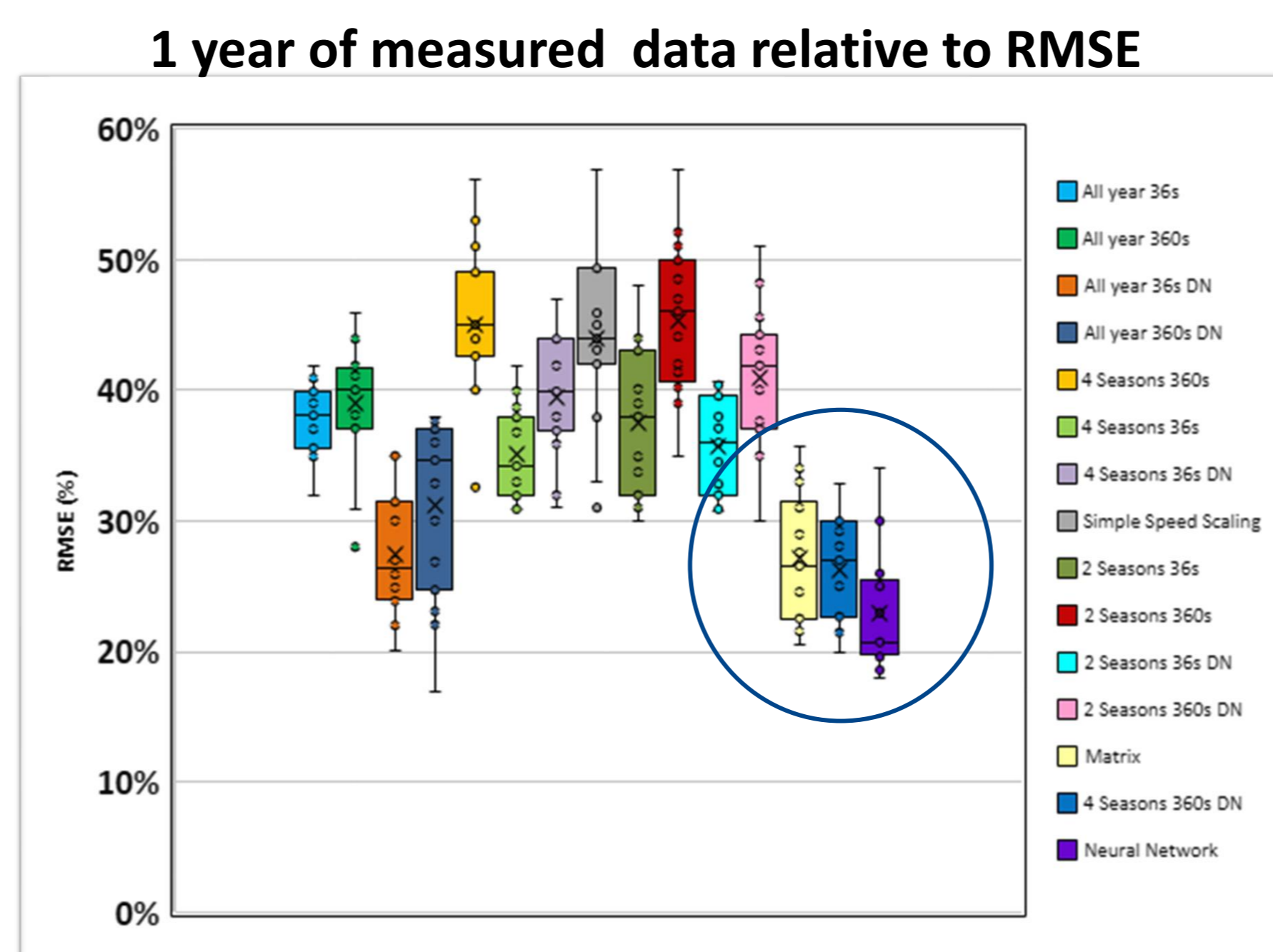
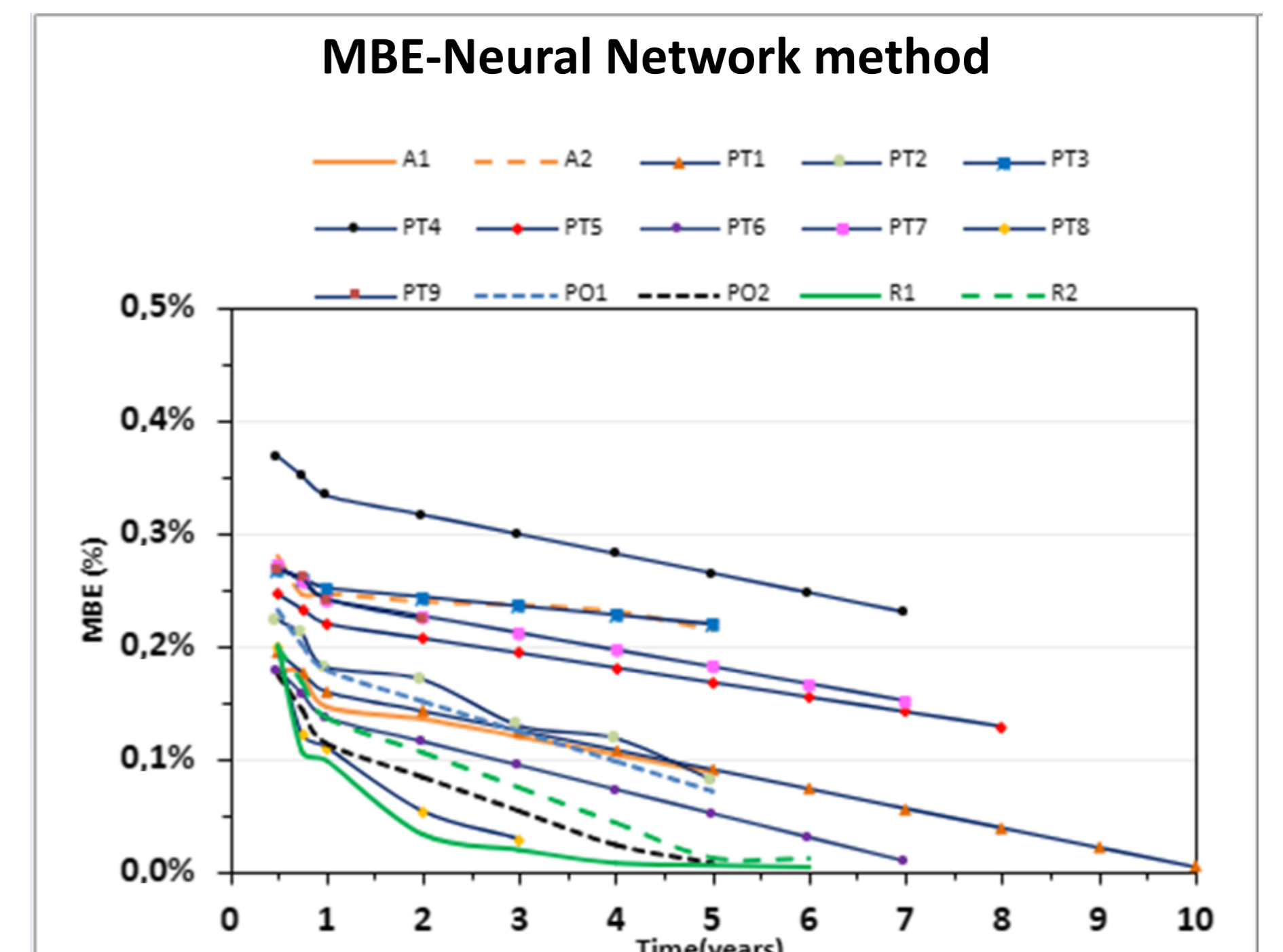
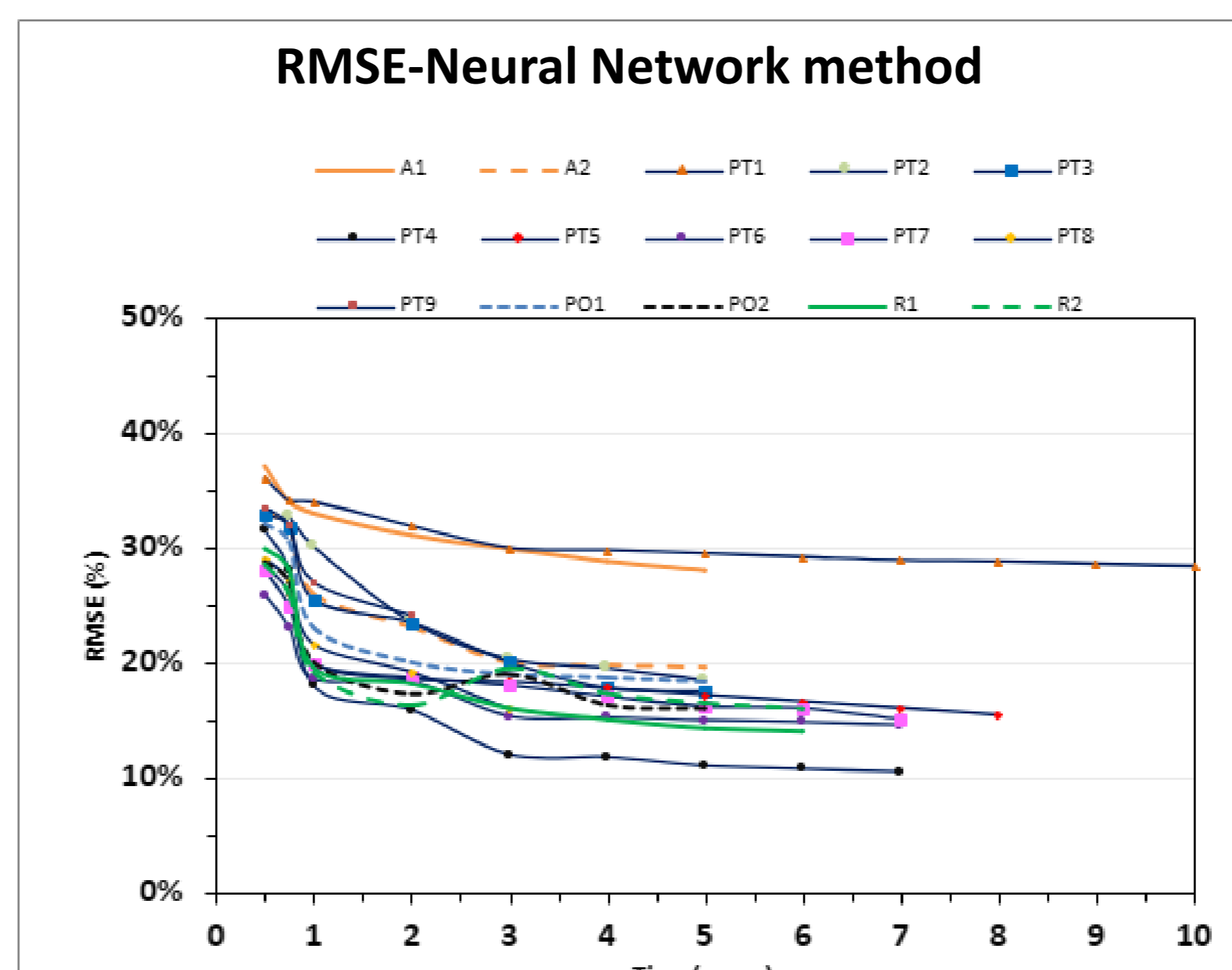
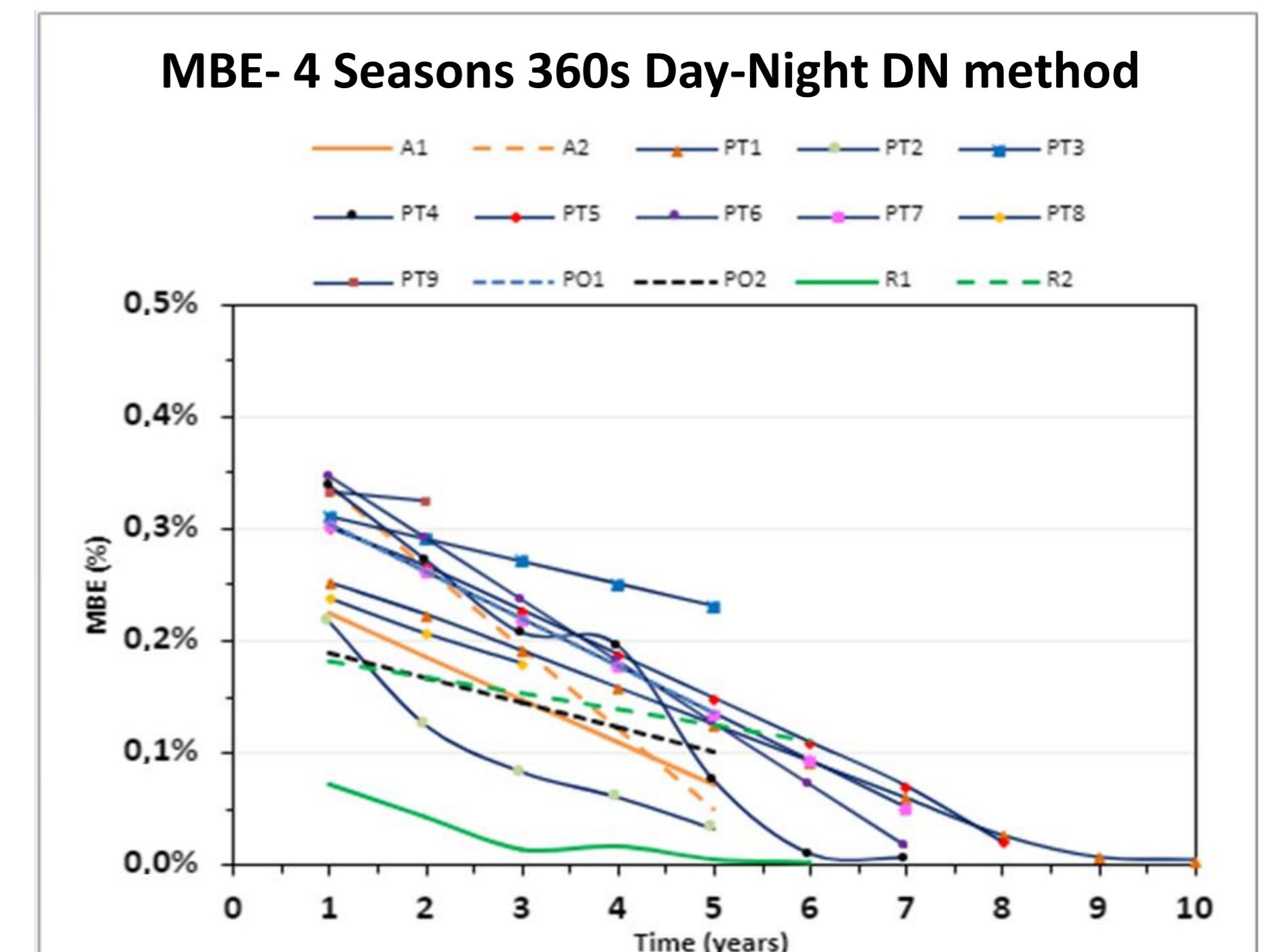
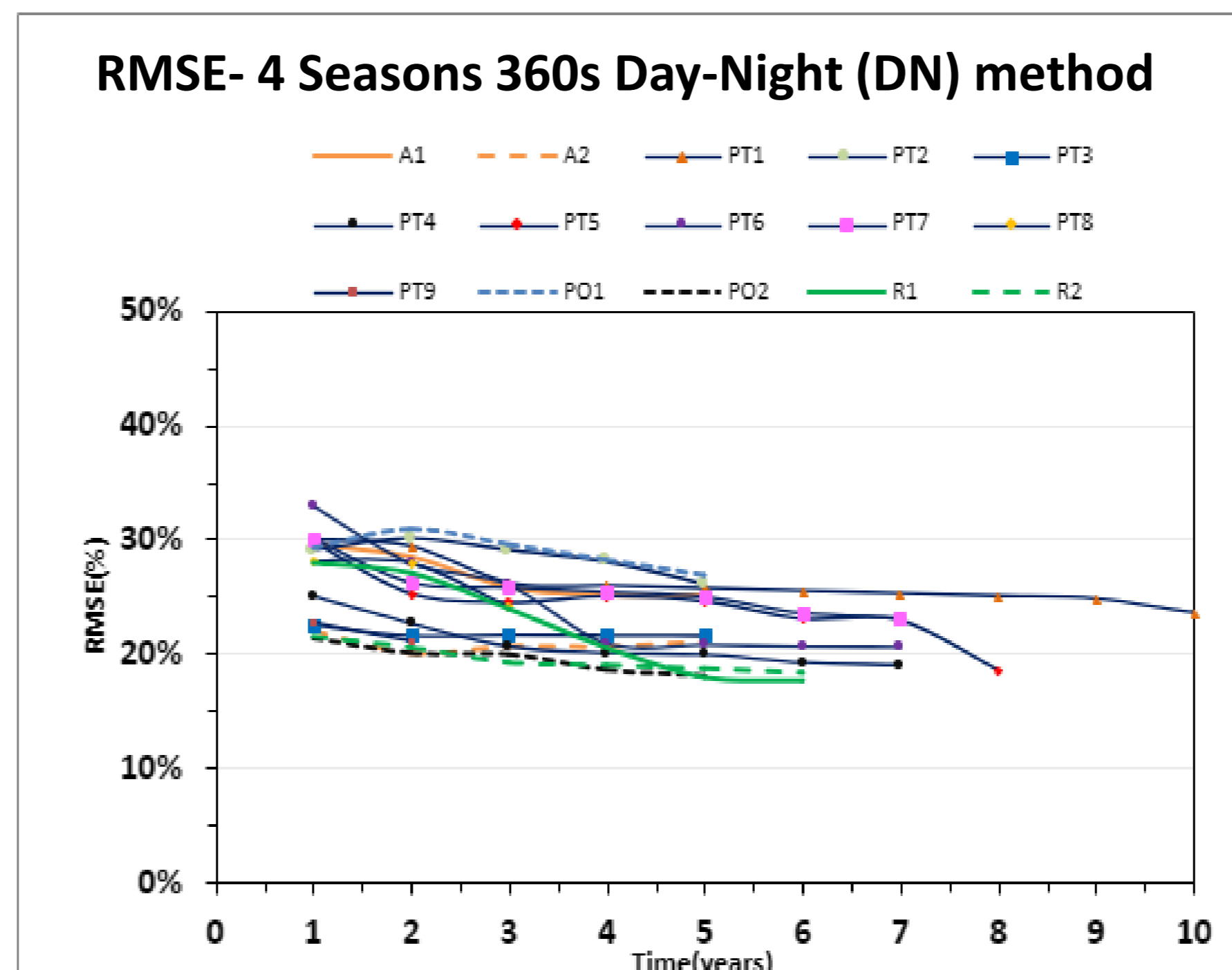
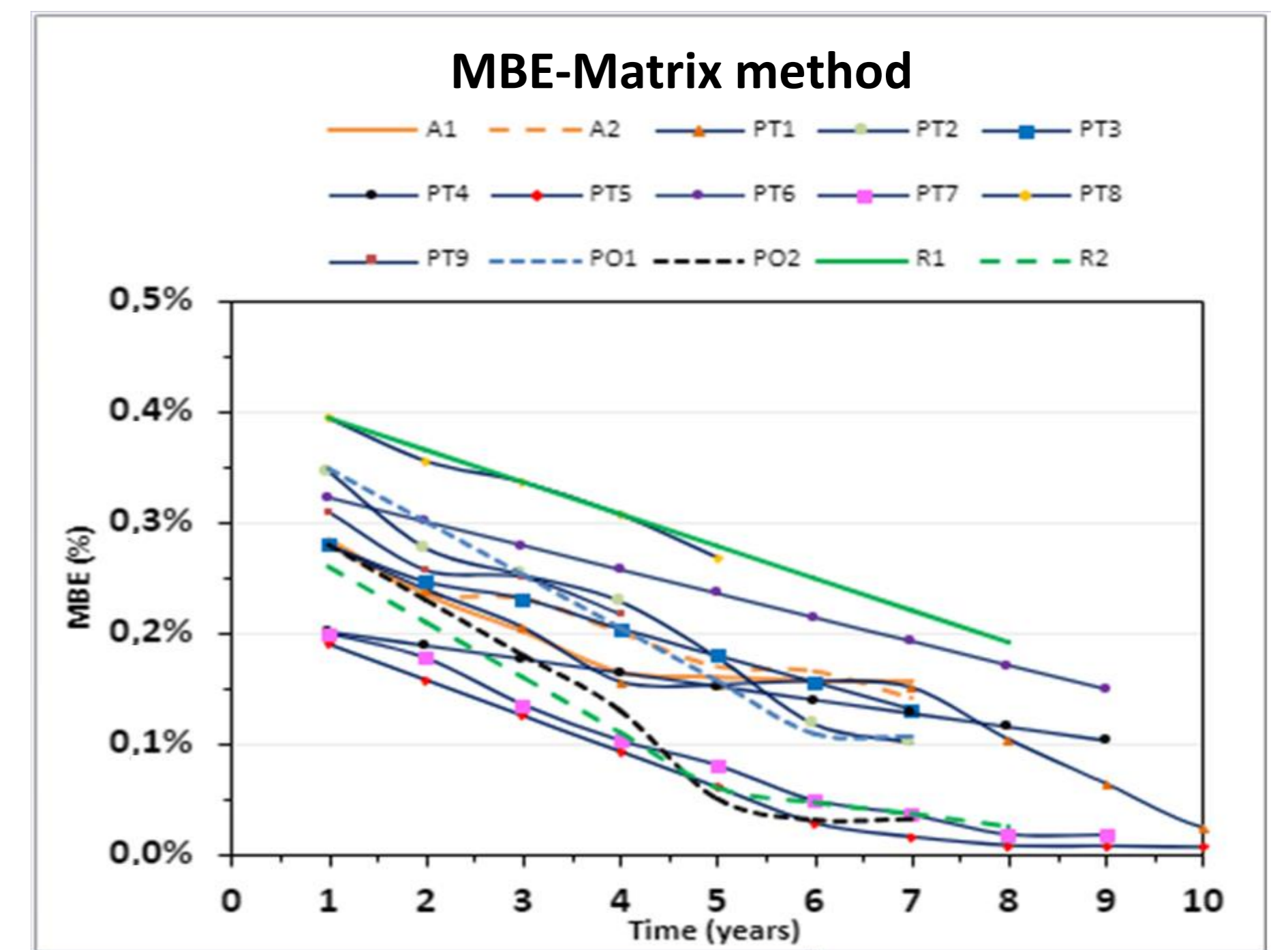
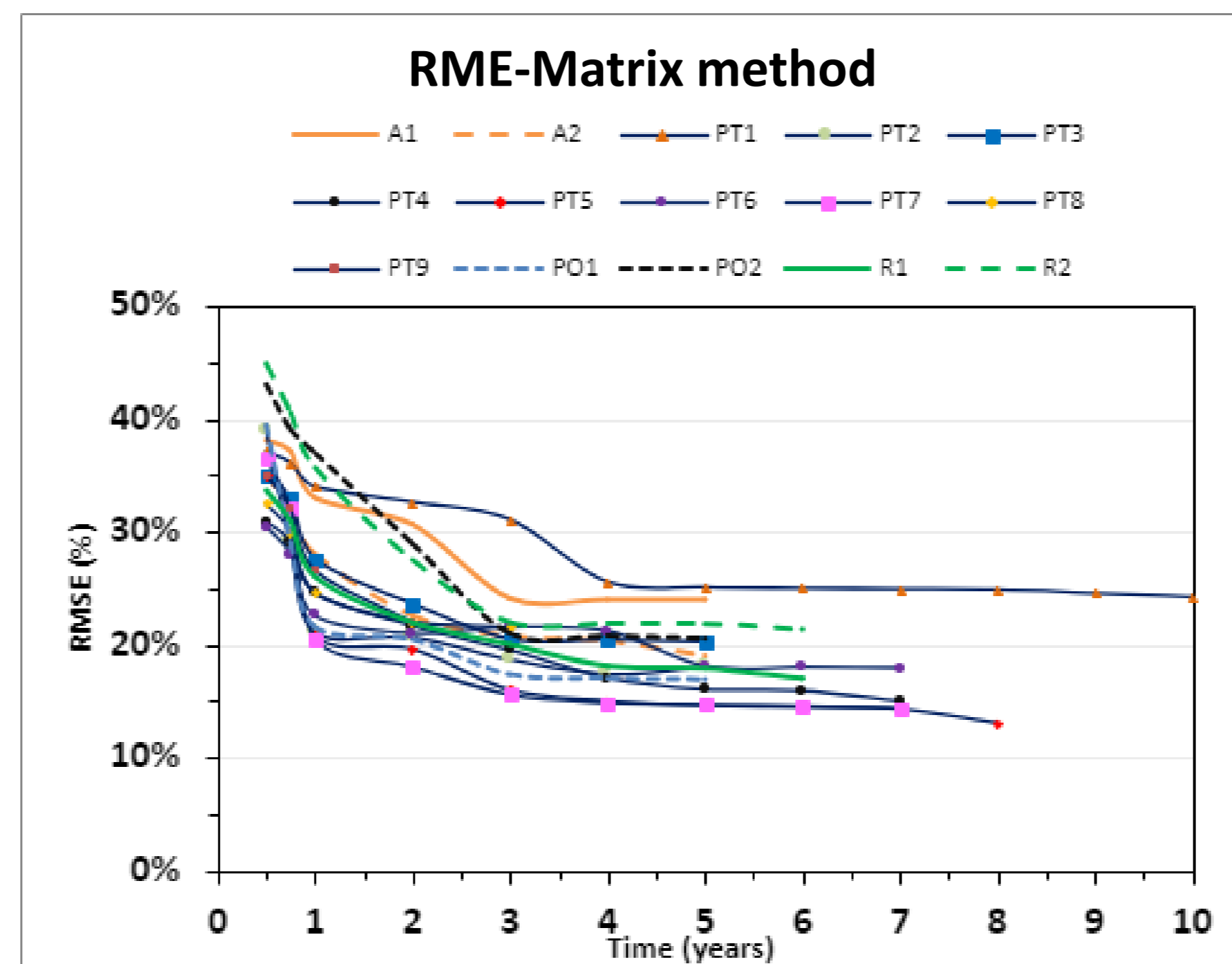
Conclusions

- Among the 15 models tested, **matrix algorithms**, **neural networks**, and the **4 Seasons 360s Day-Night (DN)** method exhibited the lowest error values;
- The analysis of errors revealed that the **Neural Network** was the most suitable MCP method due to its **lowest RMSE and MBE** values;
- Regarding the period of concurrent data to be used to perform an MCP, it was concluded that the minimum period of measured data should be between **2 and 3 years**.

References

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 [2] [1] J. V. P. Miguel, "Influência da duração da campanha de medição anemométrica na avaliação de recursos eólicos com base na aplicação de métodos de MCP," Instituto da energia e do ambiente, São Paulo (2016), pp 21-26.
 [3] J. T. Jervell, "Estudo da influência das características do vento no desempenho de aerogeradores", Tese de Mestrado em Engenharia Mecânica, Porto (2008), Porto, pp 8-18.
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Best results



RMSE *stat_t* and *p_value* values resulting from the left-sided t tests of significance

Years	Matriz vs 4 Seasons 360s DN	Matriz vs Neural Network	4 Seasons 360s DN vs Neural Network
	<i>stat_t</i> / <i>valor_p</i>	<i>stat_t</i> / <i>valor_p</i>	<i>stat_t</i> / <i>valor_p</i>
1	-0.0555/0.4780	2.0657/0.02448	2.5436/0.0086
2	-1.3282/0.0978	1.7130/0.04930	3.0167/0.0028
3	-2.4752/0.0104	1.1091/0.1392	3.5452/0.0008
4	-2.7288/0.0061	0.7711/0.2244	3.0526/0.0029
5	-2.0739/0.0055	0.7343/0.2353	2.9767/0.0034

MBE *stat_t* and *p_value* values resulting from the left-sided t tests of significance

Years	Matriz vs 4 Seasons 360s DN	Matriz vs Neural network	4 Seasons 360s DN vs Neural network
	<i>stat_t</i> / <i>valor_p</i>	<i>stat_t</i> / <i>valor_p</i>	<i>stat_t</i> / <i>valor_p</i>
1	-1.4776/0.0757	1.4060/0.0858	2.7377/0.0055
2	-1.2422/0.1126	0.9236/0.1821	2.0374/0.0259
3	-0.8572/0.1999	0.4675/0.3222	1.2792/0.1065
4	-0.9942/0.1654	-0.3219/0.3752	0.5333/0.2996
5	-0.0125/0.4950	-0.2034/0.4204	-0.1995/0.4218