**Prediction of Maximum Amplitude of Solar Cycle 25 using Machine Learning**

T. Dani1 and S. Sulistiani1

1 Space Science Center, National Institute of Aeronautics and Space, LAPAN  
Bandung, Indonesia 40173

ABSTRACT

Prediction of maximum amplitude of Solar Cycle 25 is obtained by using four different machine learning regression methods, i.e. Linear Regression (LR), Random Forest (RF), Radial Basis Function (RBF) and Support Vector Machine (SVM). Monthly mean sunspot number data during the 1856-June 2018 (solar cycles 10-24) from the World Data Center SILSO, Royal Observatory of Belgium, Brussels are used as machine learning inputs. According to LR, RF, RBF and SVM, the maximum of Solar Cycle 25 is predicted to occur in September 2023 (sunspot number of 159.4±22.3), in December 2024 (sunspot number of 110.2±12.8), in December 2024 (sunspot number of 95.5±21.9) and in July 2024 (sunspot number of 93.7±23.2), respectively. The prediction using LR and RF methods suggested that the Solar Cycle 25 maximum will be similar to the current cycle, while the remaining two suggested much lower cycles. It was also found that the Solar Cycle 25 is predicted to begin in the year of 2020 according to all four methods.

*Keywords: Solar Activity; Solar-Cycle Prediction; Machine Learning; Sunspot Number*

References

|  |  |
| --- | --- |
| [1] | Cameron, R. H., Jiang, J., Schüssler, M., *Astrophys. J.* **823** (2016) L22 |
| [2] | Frank, E., Hall M. A., Witten, I. H., Morgan Kaufmann, Fourth Edition, (2016). |
| [3] | Gopalswamy, N., Mӓkelӓ, P., Yashiro, S., Akiyama, S., *J. Atmos. Solar-Terrestrial Phys* (2018) 1–8 |
| [4] | Hathaway, D. H., Upton, L. A., *J. Geophys. Res. Sp. Phys.* **121** (2016) 10,744-10,753 |
| [5] | Hall, M. A., Frank E., Holmes G., Pfahringer B., Reutemann P., Witten, I. H. *SIGKDD Explorations* **11** (2009) |
| [6] | Helal, H. R., Galal, A. A., *J. Adv. Res.* **4** (2013) 275–278 |
| [7] | Javaraiah, J., *New Astron.* **34** (2015) 54–64 |
| [8] | Li, K. J., Feng, W., Li, F. Y., *J. Atmos. Solar-Terrestrial Phys* **135** (2015) 72–76 |
| [9] | Pishkalo, M. I., *Kinemat. Phys. Celest. Bodies* **24** (2008) 242–247 |
| [10] | Rigozo, N. R., Souza Echer, M. P., Evangelista, H., Nordemann, D. J. R., Echer, E., *J. Atmos. Solar-Terrestrial Phys.* **73** (2011) 1294–1299 |
| [11] | SILSO, World Data Center - Sunspot Number and Long-term Solar Observations, Royal Observatory of Belgium, on-line Sunspot Number catalogue: http://www.sidc.be/SILSO/, 1856-2018 |