

Integrating Machine Learning for Sunspot Predictions

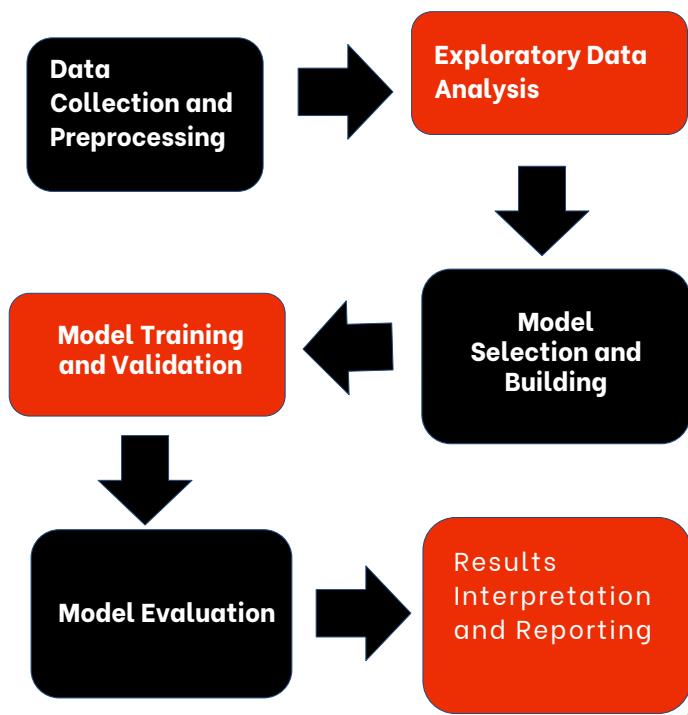
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1. What are sunspots, and how do they form?

- Sunspots** are areas that appear dark on the surface of the Sun.
- They appear dark because they are cooler than other parts of the Sun's surface.
- The magnetic field lines near sunspots often tangle, cross, and reorganize.
- This can cause a sudden explosion of energy called a **solar flare**.
- Solar flares are sometimes accompanied by a **coronal mass ejection** (CME).

5. Methodology

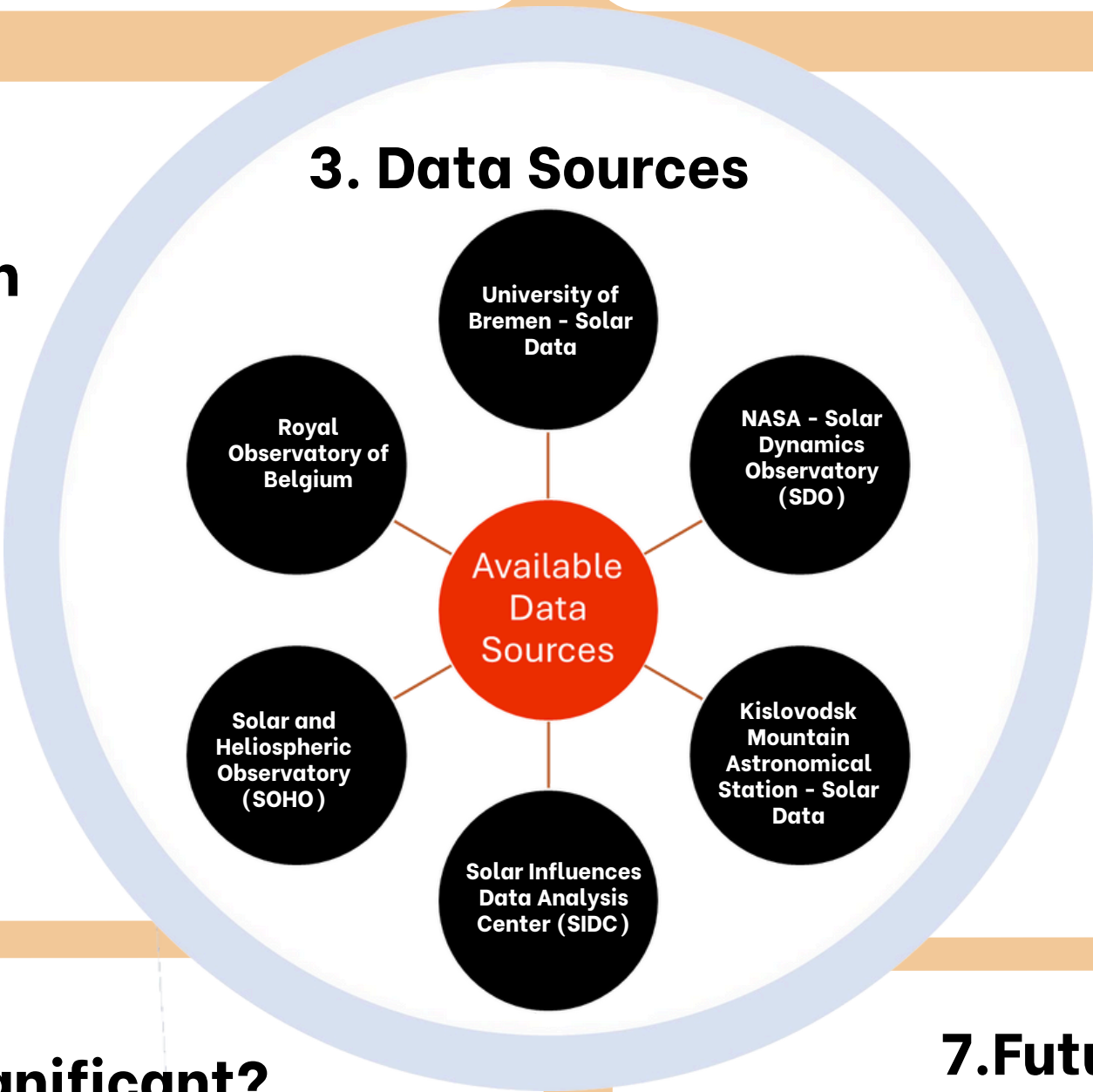
- Gathering and cleaning sunspot data to ensure accuracy and consistency.
- Analysing data to identify patterns and relationships.
- Exploring diverse ML models for enhanced accuracy.
- Utilising LSTM networks to capture sequential patterns in sunspot data for improved prediction.



2. What is the primary objective to research on sunspot prediction?

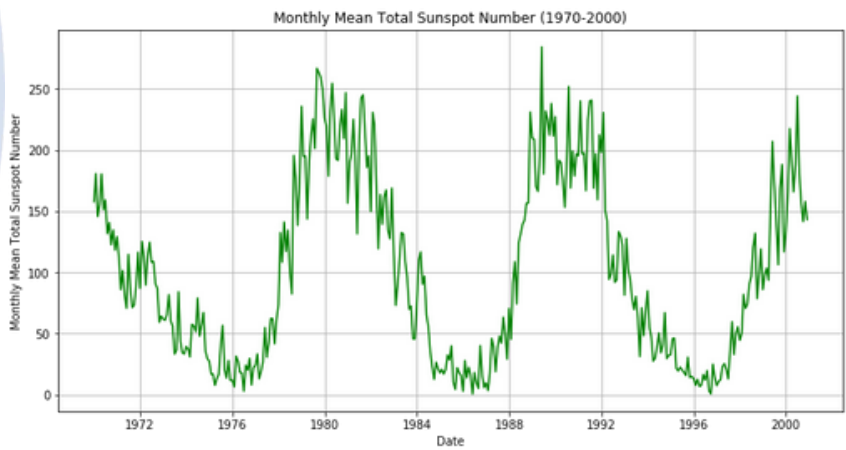
The aim is to analyse the variation in the sunspot number with time. How might the next cycle be predicted? As this is an important aspect of predicting the activity on the Sun's surface, which creates a type of weather called **space weather**.

3. Data Sources



6. Results

The plot shows how sunspot activity changes over time, indicating the periodic nature of sunspot numbers and providing insights into the solar cycles.

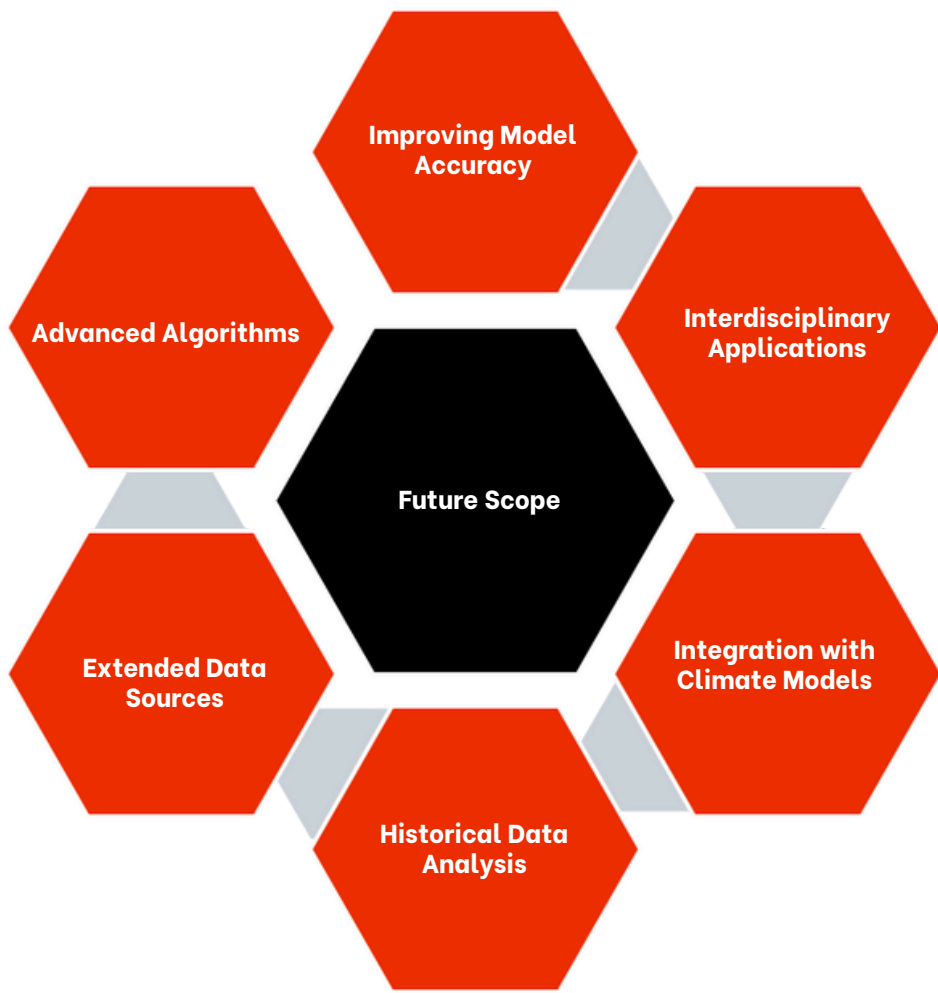


4. Why are sunspots significant?

These are the different aspects of the importance of sunspot prediction:

- Impact on Satellite Communications
- Forecasting Geomagnetic Storms
- Influence on Earth's Climate
- Mitigating Radio Communication Disruptions
- Safeguarding Power Grids
- Ensuring Astronaut Safety
- Adaptation for GPS Systems
- Advancing Solar Physics Research
- Planning Space Missions
- Enhancing Global Readiness

7.Future Scope



References:

- Solanki, S. Sunspots: An overview. The Astron Astrophys Rev 11, 153–286 (2003). <https://doi.org/10.1007/s00159-003-0018-4>
- Stetson, H.T., 2013. Sunspots and their effects. Read Books Ltd.
- De Saa, E. and Ranathunga, L., 2020. Comparison between arima and deep learning models for temperature forecasting. arXiv preprint arXiv:2011.04452.
- M. M. Mahdi, M. M. Anisuzzaman Nour Tipu, C. Halder and K. F. Rahman, "Comparative Analysis of Prediction of Coronal Mass Ejections (CME) based on Sunspot Activities Using Various Machine Learning Models," 2019 International Conference on Robotics,Electrical and Signal Processing Techniques (ICREST), Dhaka, Bangladesh, 2019, pp. 588–591, doi: 10.1109/ICREST.2019.8644272.

Further information

Please see <https://github.com/meekhasaji/Sunspots> for the code and data

Please email: mm23mes@leeds.ac.uk if you have a question or comment.