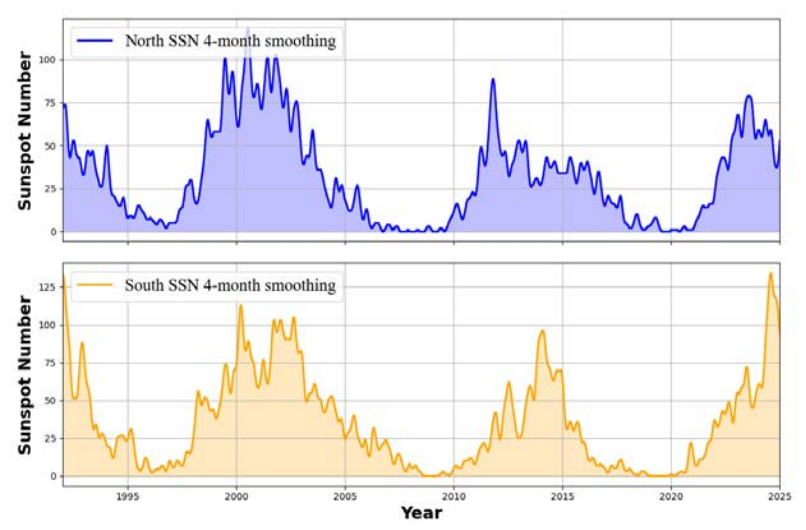
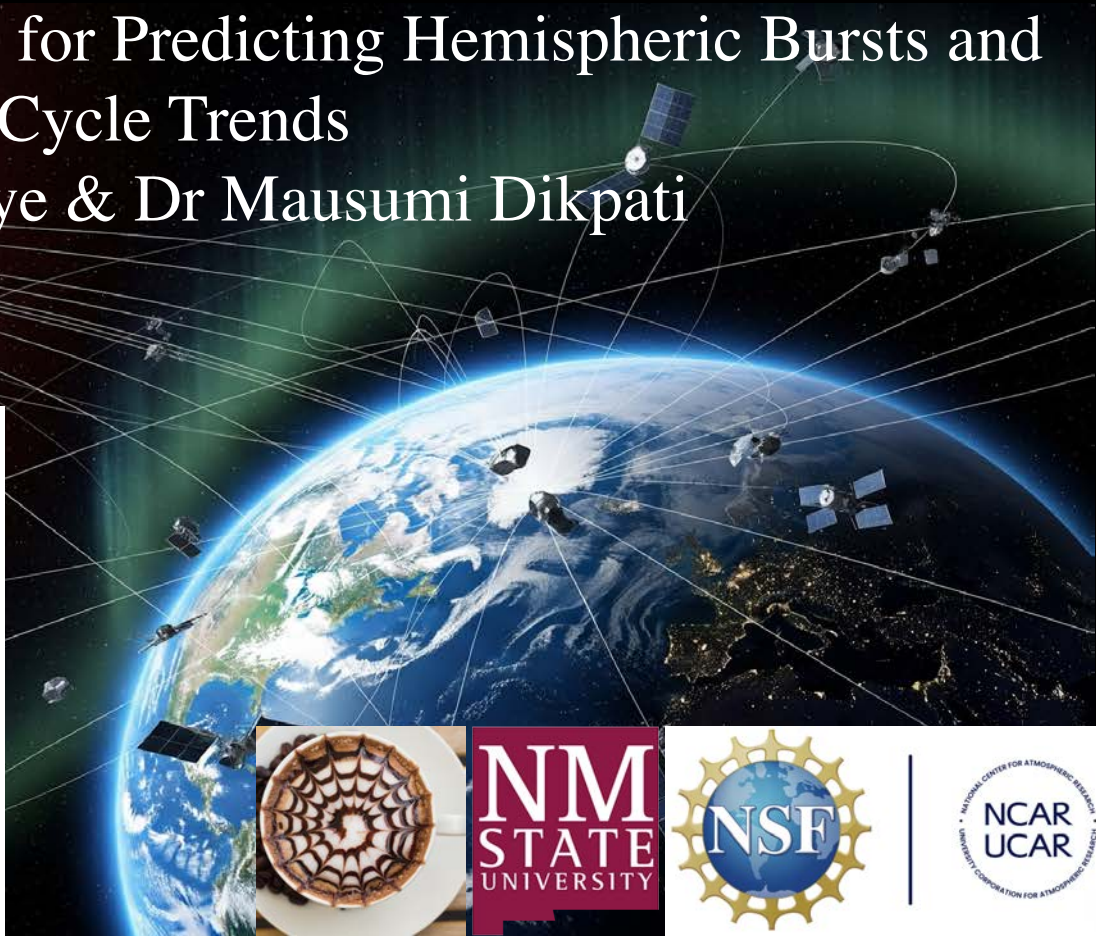
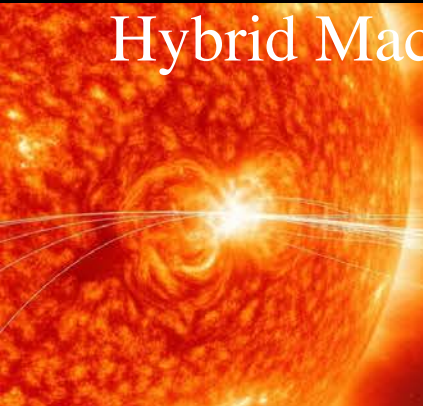


# Cracking the Solar Code:

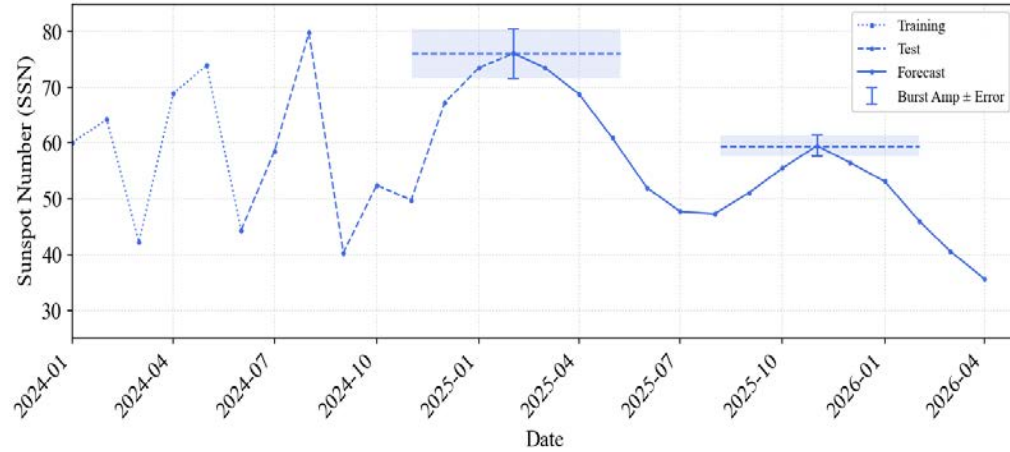
Hybrid Machine Learning for Predicting Hemispheric Bursts and Cycle Trends

Dr Juie Shetye & Dr Mausumi Dikpati



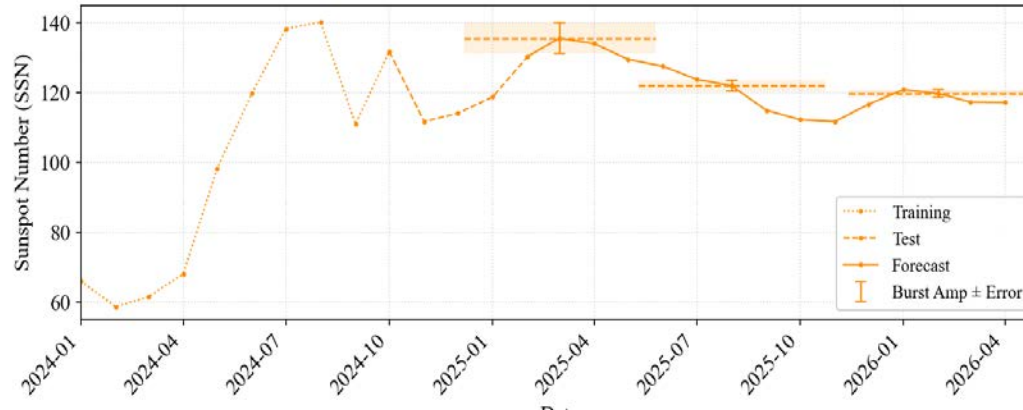
## Northern Hemisphere Forecast:

- **Next Predicted Solar Activity Burst:**
  - **Hindcast/Test:** Around March 2025 with amplitude around 70 SSN
  - **Peak Timing:** Around November 2025
  - **Projected Amplitude:** Approximately 55–65 SSN
  - **Estimated Duration & Span:** About 5 months (occurring between October 2025 and March 2026)



## Southern Hemisphere Observations and Forecast:

- **Recent Primary Burst (Peaked March–April 2025):**
  - **Peak Amplitude:** 130–140 SSN (noted as stronger)
  - **Characteristics:** Exhibited an extended duration with activity lasting into mid-2025 and featured multiple short triggers.
- **Next Predicted Solar Activity Burst:**
  - **Peak Timing:** Jan 2026
  - **Projected Amplitude:** 120 SSN
  - **Estimated Duration & Span:** About 6 months from Oct 2025 to May 2026.



# Why Predict the Next Solar Activity Burst?

## 1. Avoid Disruption

Enable early warnings for satellites, aviation, and power grids.

## 2. Improve Accuracy

Refine space weather forecasts and long-range solar cycle predictions.

## 3. Protect Human Spaceflight

Reduce radiation risks for astronauts and high-altitude flight crews.

## 4. Safeguard Earth Technologies

Prevent damage to GPS, radio, and communication infrastructure.



**Lloyd's highlights risk of extreme space weather as latest scenario reveals potential global economic loss of \$2.4trn**

04 Mar 2025

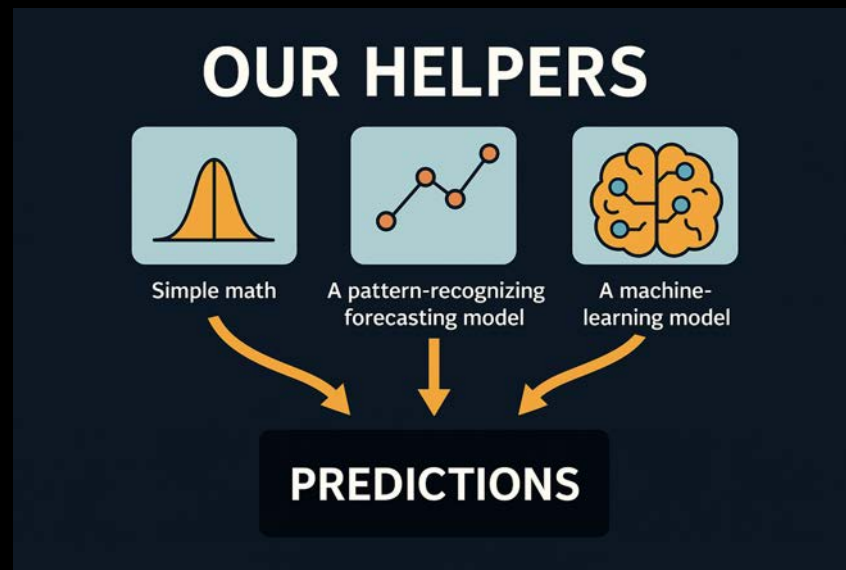
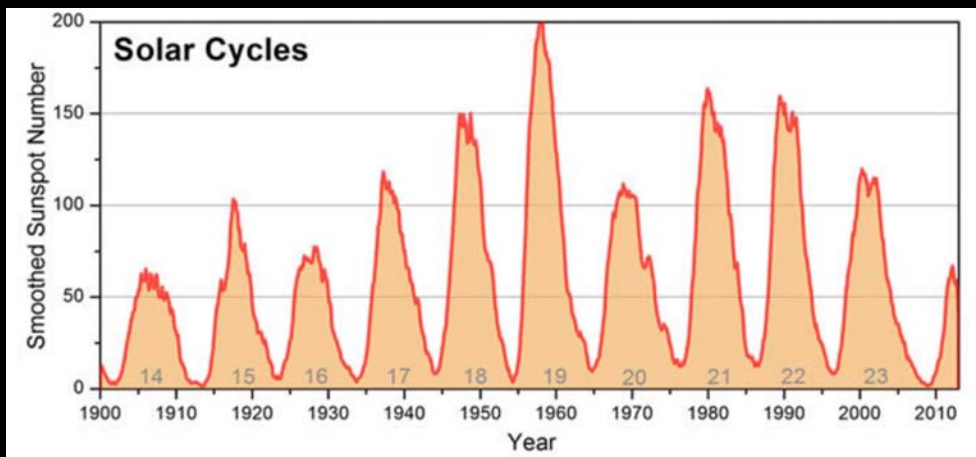
<https://www.lloyds.com/about-lloyds/media-centre/press-releases/extreme-space-weather-scenario>

**Motivation:** Solar cycle (11 year sunspot cycle) is not uniform, but has season (Dikpati et al. 2021). These seasons are our solar cycle bursts in activity, where we see more sunspots.

**Our Assumption:** More Sunspot numbers -> More bursts -> More flares

**Our Aim:** Find Patterns in 50000+ sunspot numbers detected since 1878 (a huge dataset)

**Our Helpers:** Simple mathematical gaussian function, a pattern recognising forecasting model, and a Machine-Learning model.



# Solar storms—also known as geomagnetic storms—are powerful and unpredictable forces. When one strikes, it triggers a media frenzy and widespread public concern



Times of India  
Solar Storms: NASA issues emergency ...



UNILAD Tech  
solar storm threatens bl...



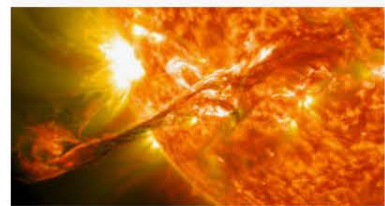
YouTube  
Solar Storm Warning ...



TikTok  
Severe Solar Storm ...



Facebook  
potential dangers in...



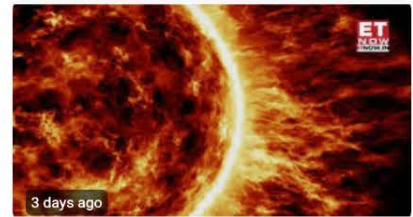
Times of India  
NASA warns! Massive solar storm ...



Daily Mail  
urgent warning over solar s...



YouTube  
NASA warns solar flares could cause ...



ET Now  
Solar storm NASA warning: Emergency ...



Sada Elbalad english  
Major Solar Storms on Earth ...



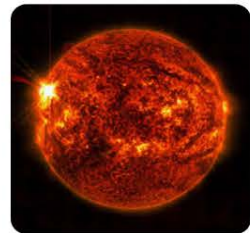
DNA India  
big warning, claims massive solar ...



YouTube  
NASA Warns of Powerful Solar St...



AS USA - Diario AS  
NASA warns of two solar...



Global News  
sun is producing strong ...



TikTok  
Prepare for the Imp...



UNILAD  
NASA issues warning for major solar ...



Yahoo  
solar storm emergency drill ...