Real-Time Prediction of Solar Flares and Coronal Mass Ejections

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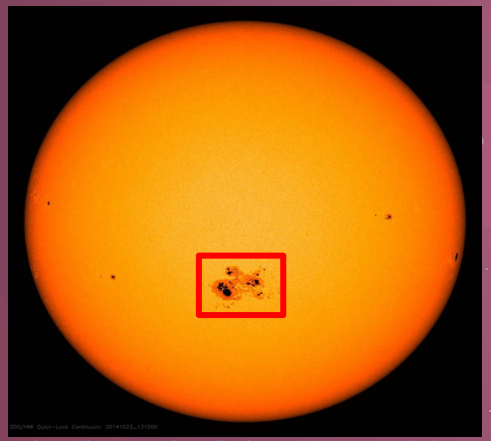
Research Question

RQ: Will predicting the likelihood of solar events reveal important characteristics of active regions and help prepare us for the next life-threatening solar event?



https://www.westhawaiitoday.com/wp-content/uploads/2020/09/web1_092620-sun-spot.jpg

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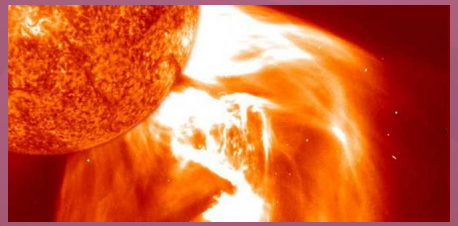


http://astronomy.com/~/media/CD642F1091B14B50A78519E1AB0921A8.jpg

https://i.ytimg.com/vi/SrapU4DSLec/maxresdefault.jpg

Methodology

Stage 1
Preprocessing

Compile times for solar events of 4 distinct classes

Associate each solar event with an active region (AR)

Add AR feature time dependency*

Stage 2
ML Model

Neural Network

Finetune Hyperparameters & Establish Overfitting Prevention Measures

Stage 3
Real-Time

Create Sun Image Collection Pipeline

Extract the most important features

Implement into Real-Time Solar Event Predictor

Analysis and Results

Machine Learning

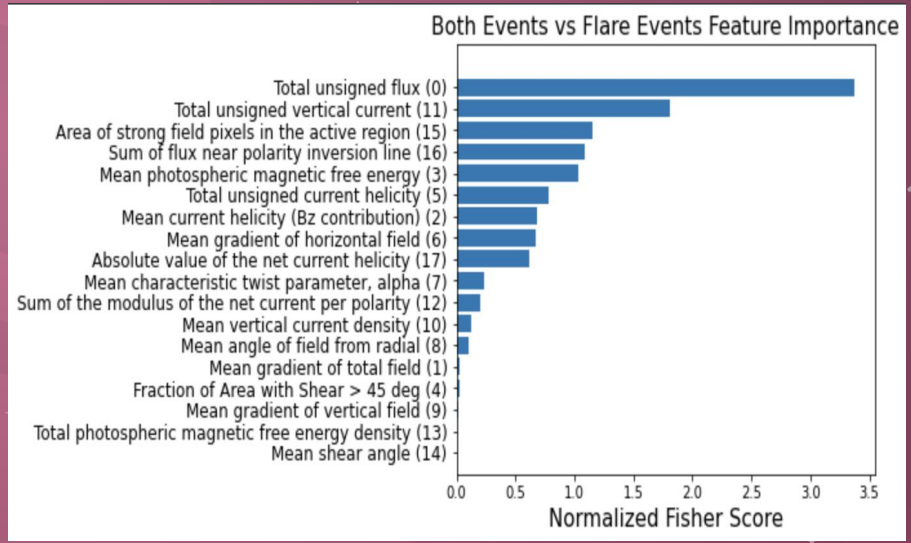
Actual Class

Predicted Class

83	3	0	0
7	212	1	0
0	0	138	0
0	0	4	180

Accuracy: 97.61%

Feature Analysis



Closing Statements/Summary/Future Work

Real-Time Event Prediction

Predicts likelihood of solar events at least 24 hours prior to actual event

Relevant Feature Analysis

Provides insight into the dependencies between solar flares and CMEs, a topic not intensively researched

Time-Dependent CME Predictor

To my knowledge, this is the first attempt at predicting CMEs using a time-based approach

Future Work

Improve time-dependent aspect of ML model

Conduct further feature analysis

Begin Real-Time implementation

Thank You/References

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Thank You! Any Questions?