

FORECASTING SPACE WEATHER: AN ANALOGUE ENSEMBLE OR "SIMILAR DAY" APPROACH



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OVERVIEW

Space weather

- What is it?

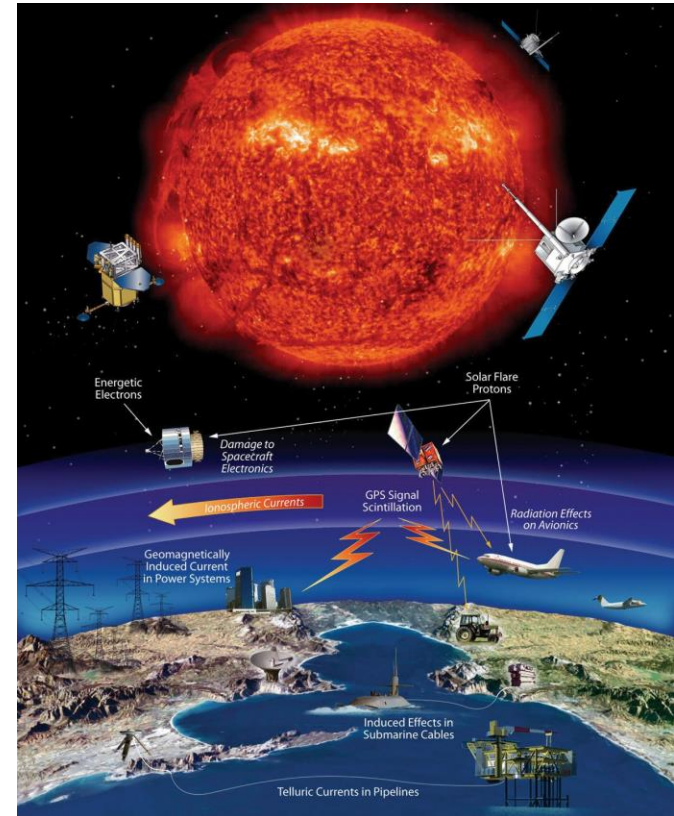
Analogue Ensemble (AnEn):

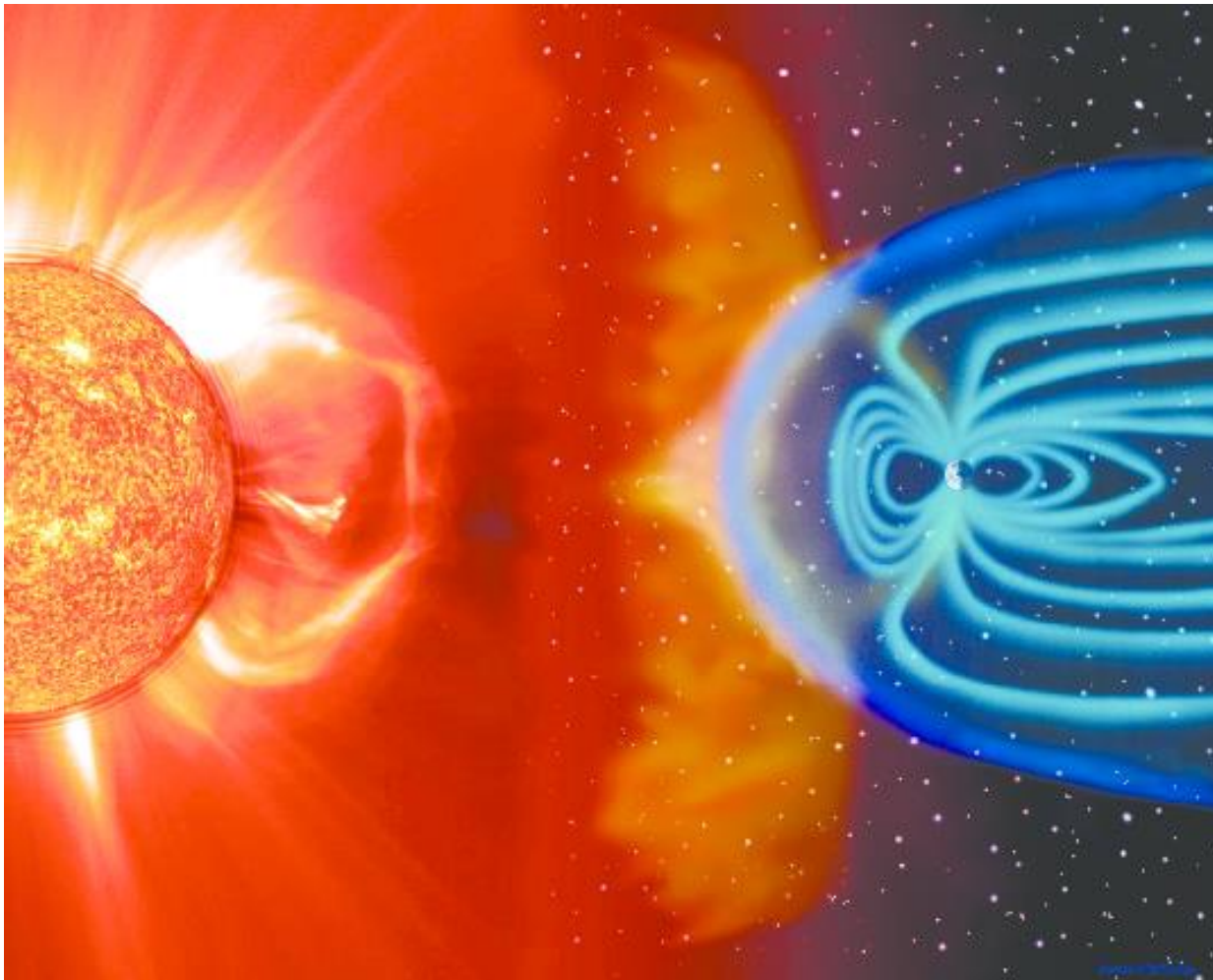
- What is it?
- How well does it work?

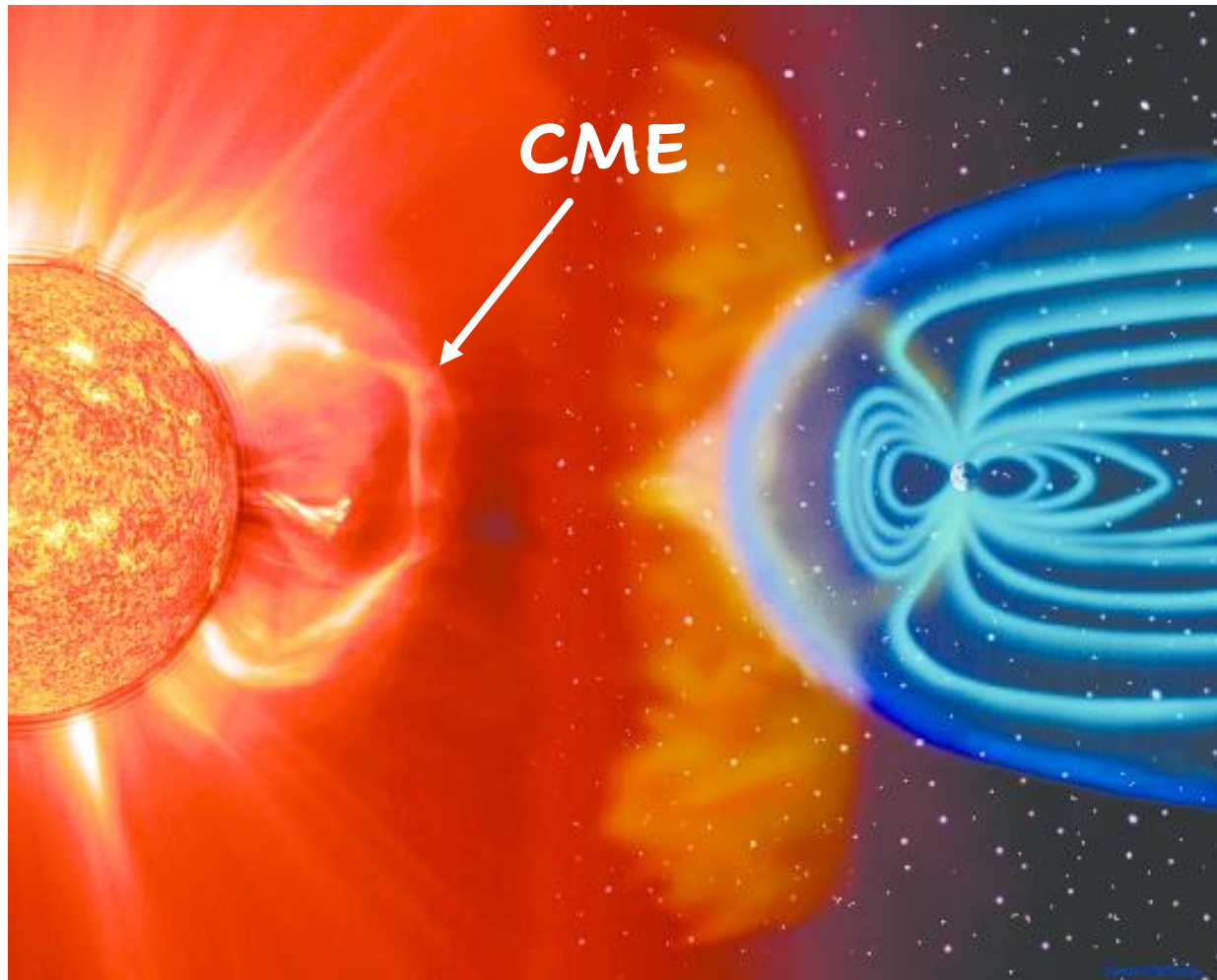
Support Vector Machine (SVM):

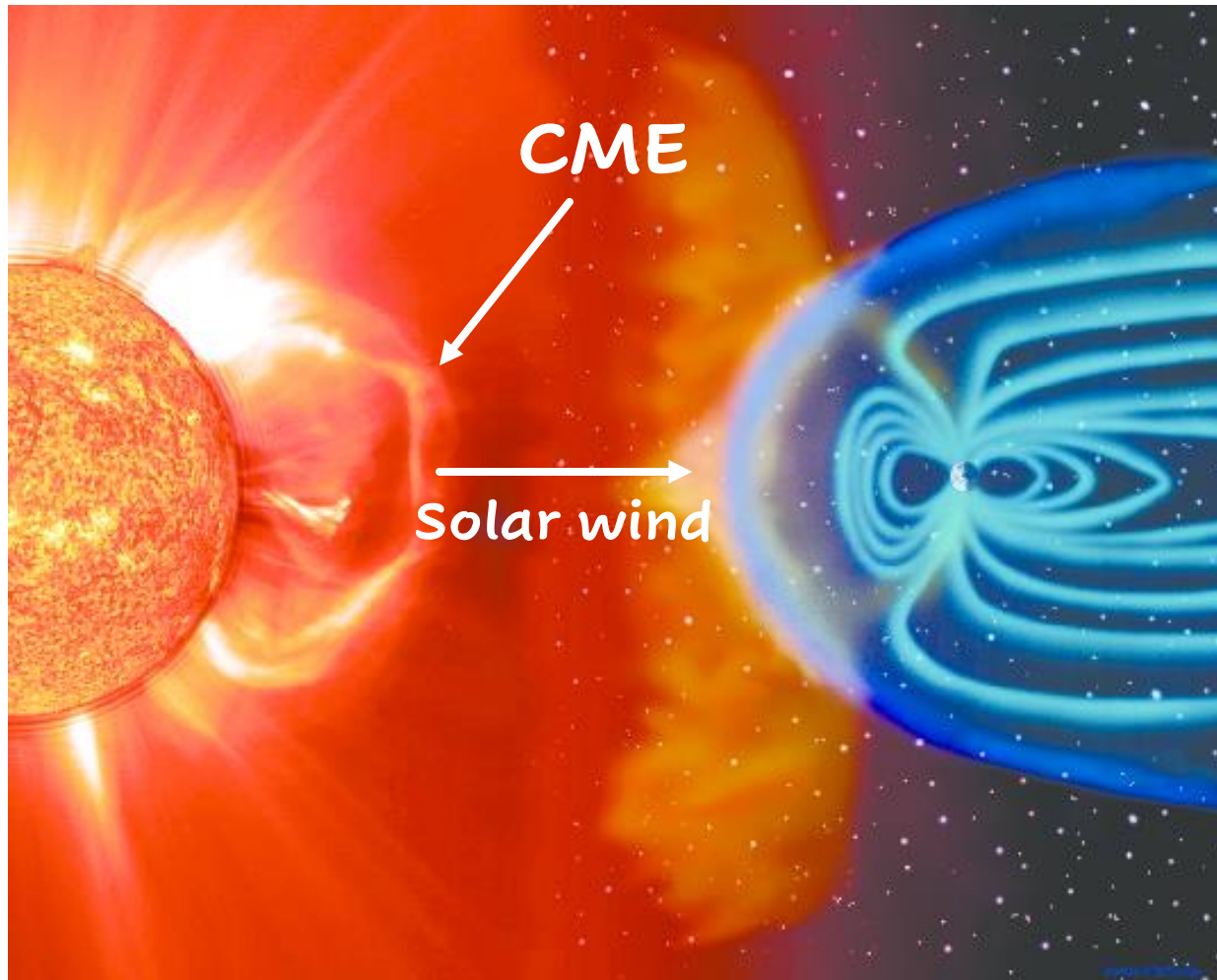
- What is it?
- How well does it work?

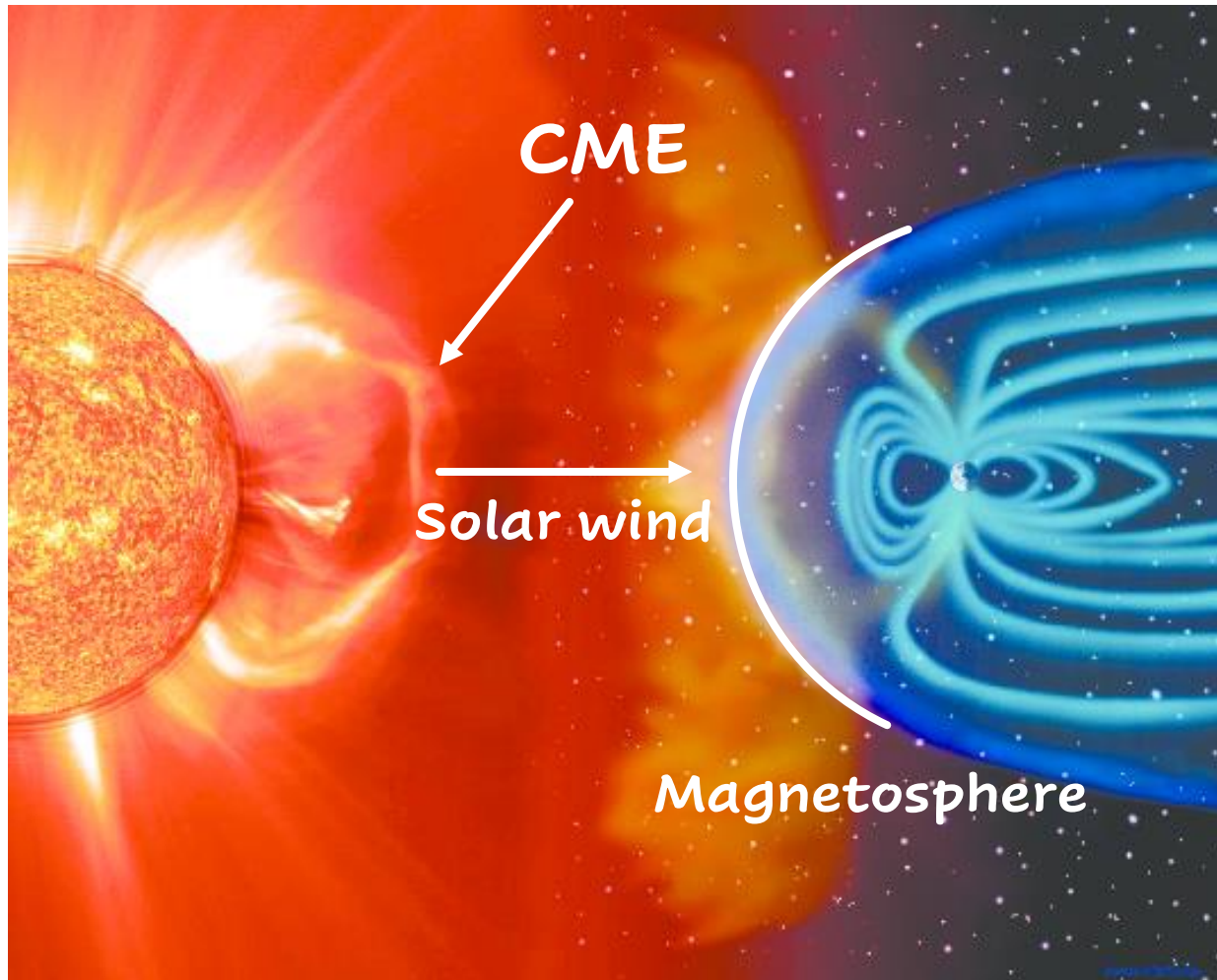
Comparison of AnEn and SVM

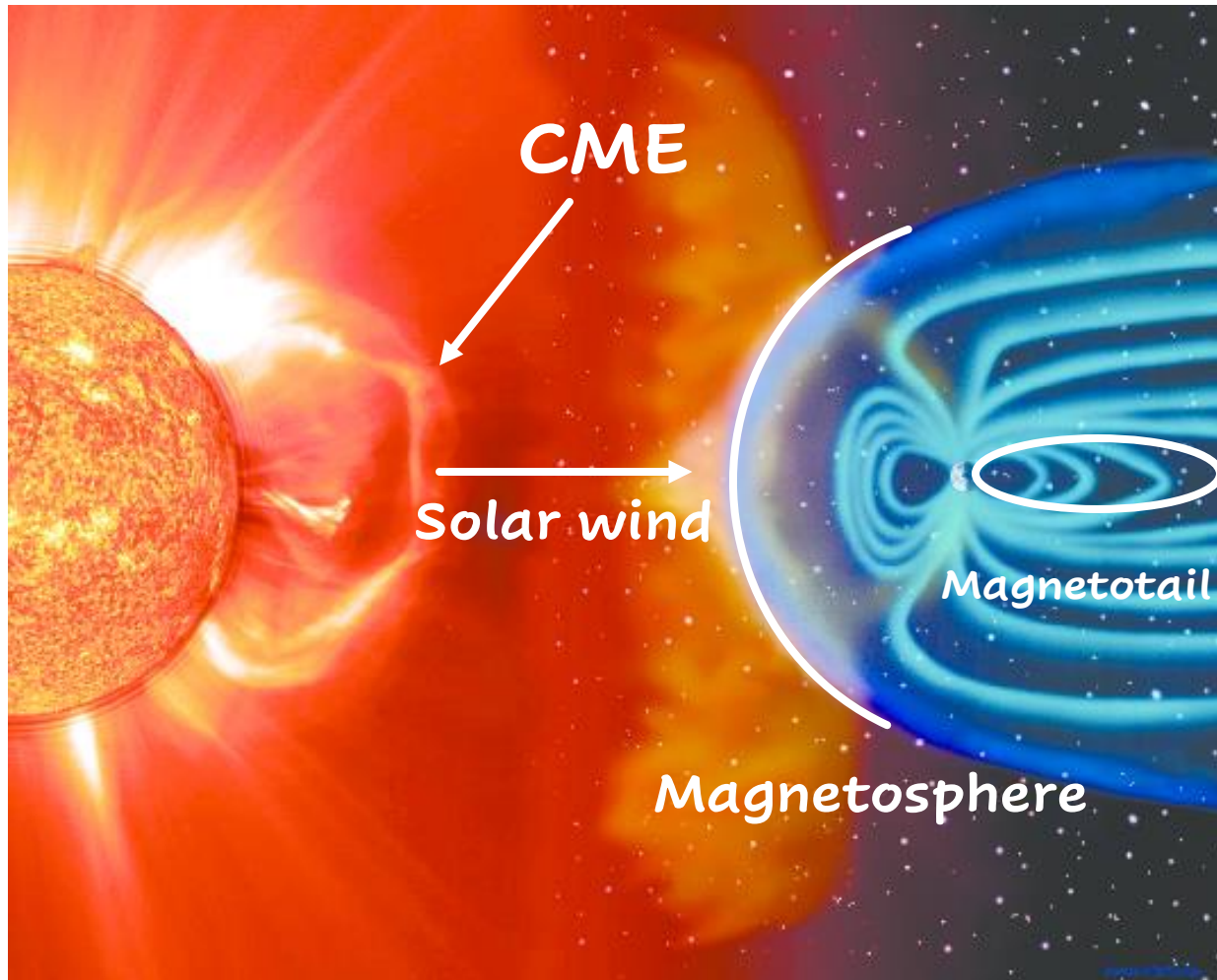


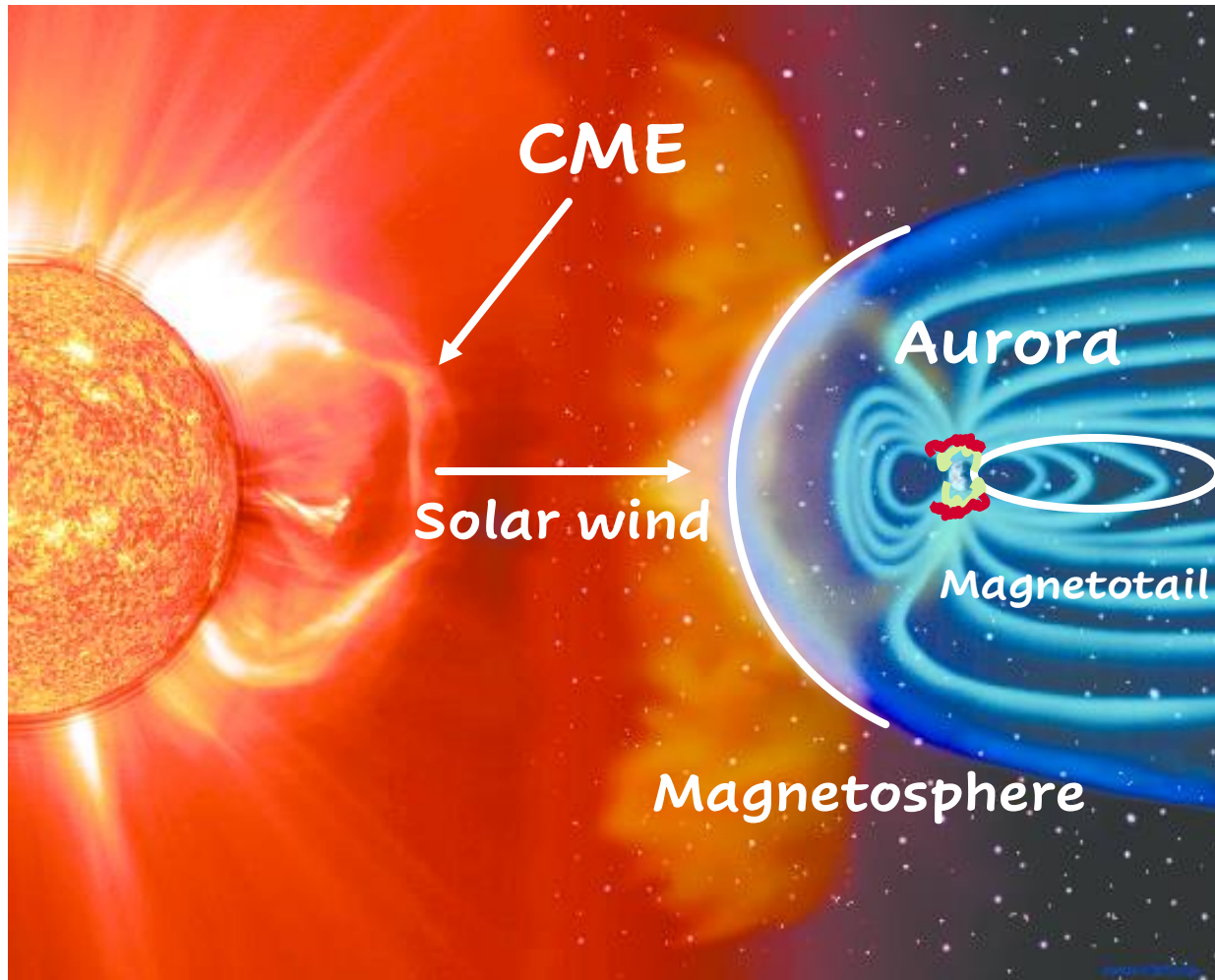


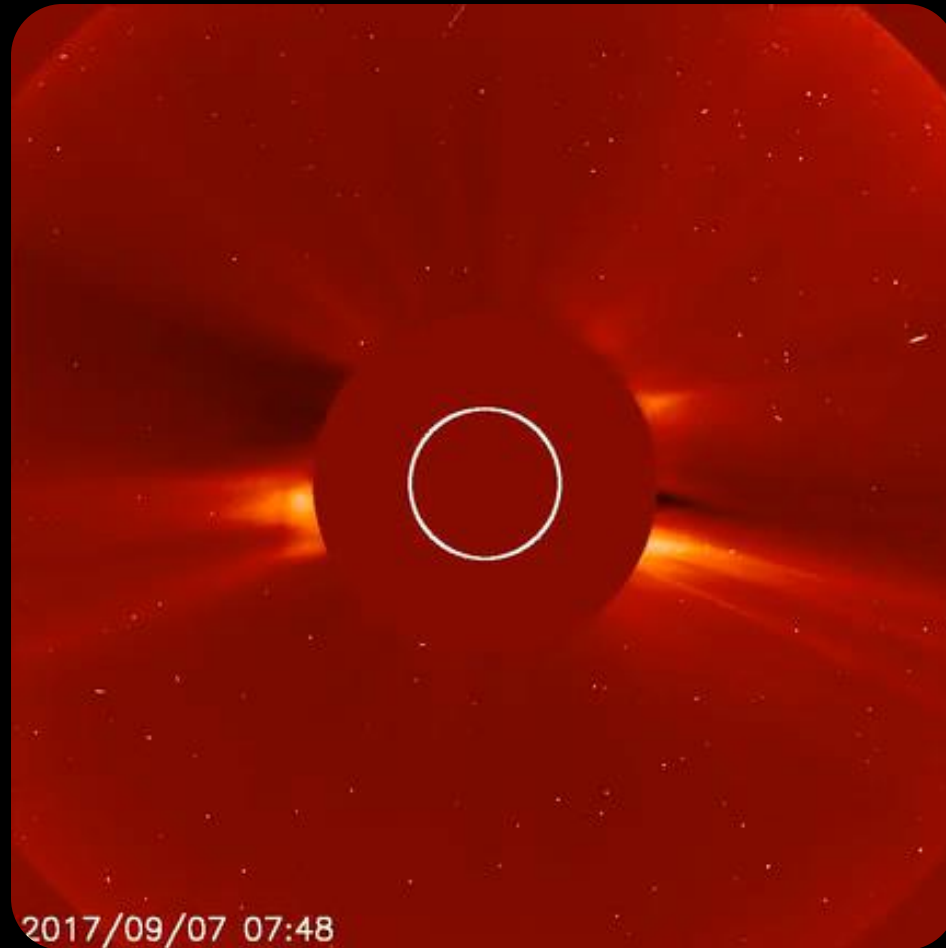


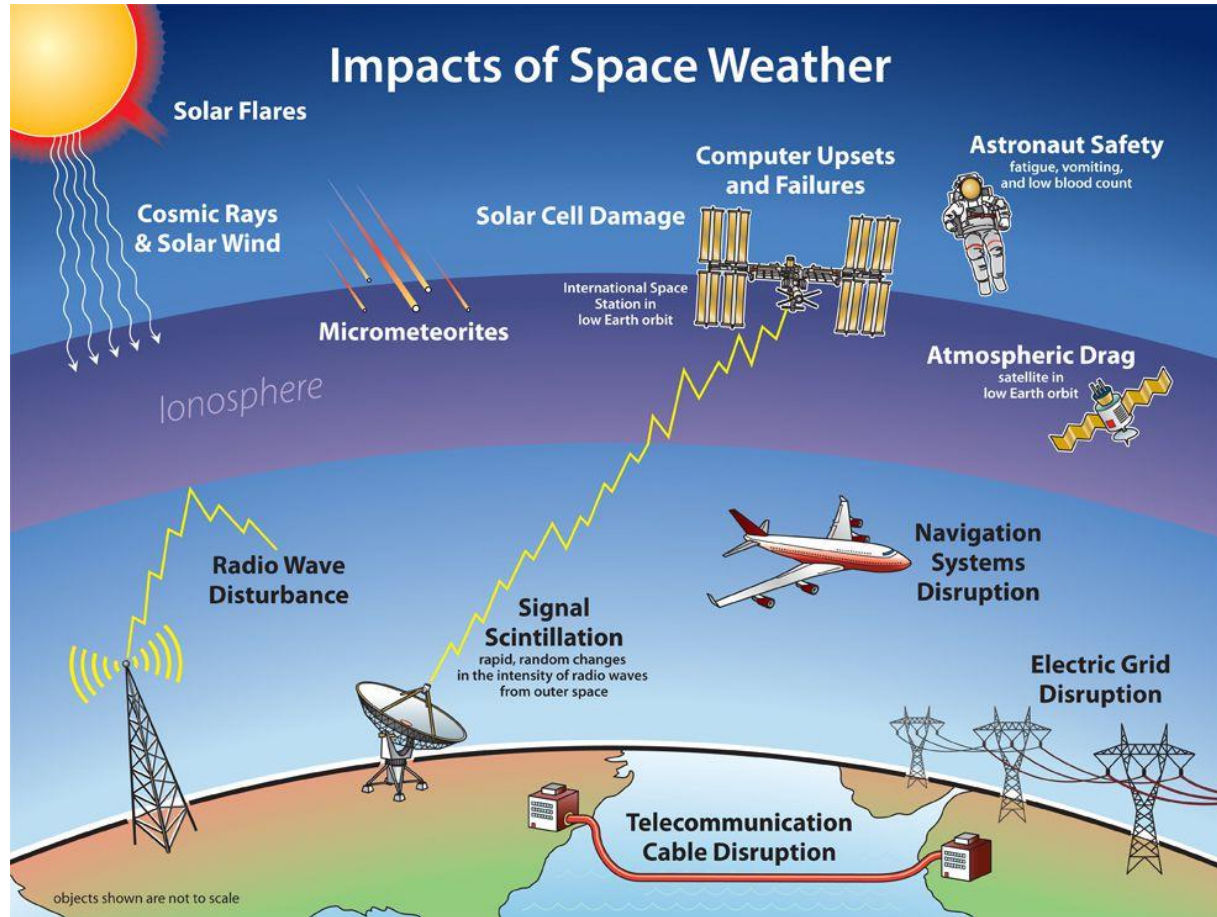


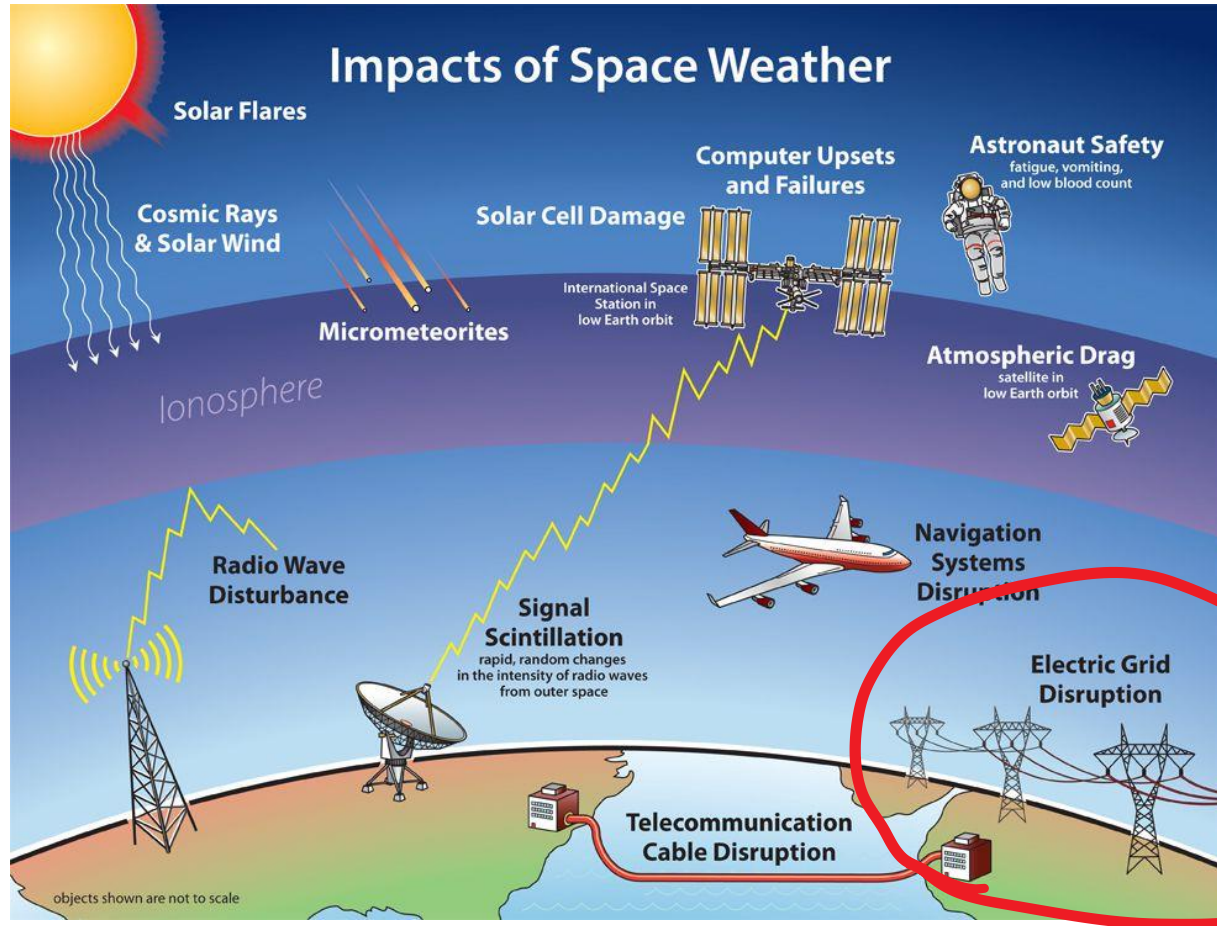










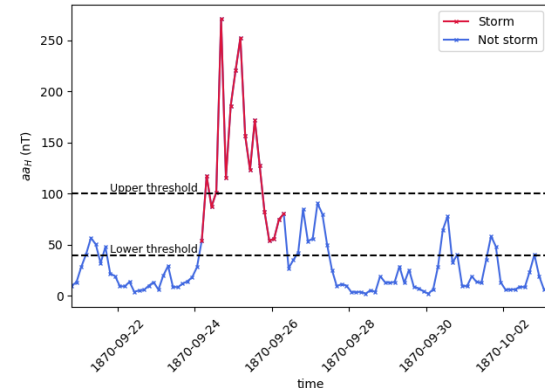
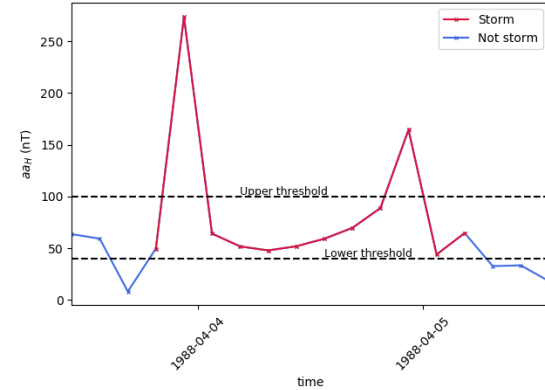


THE DATA: aa_H

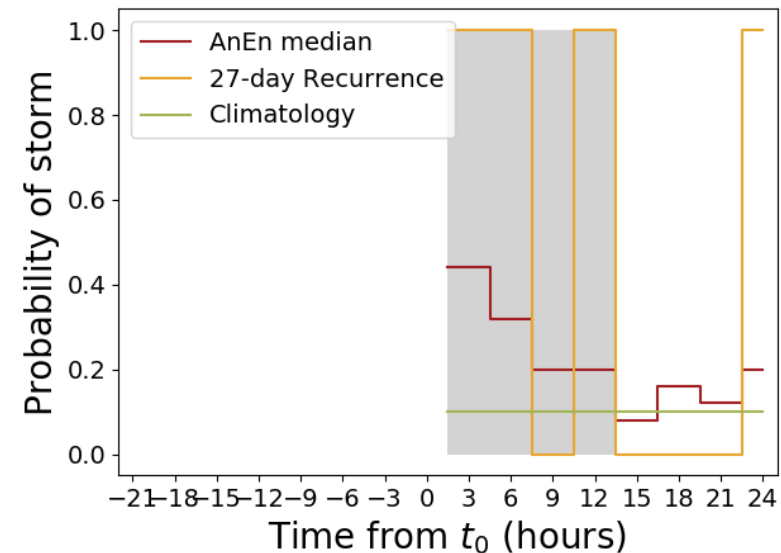
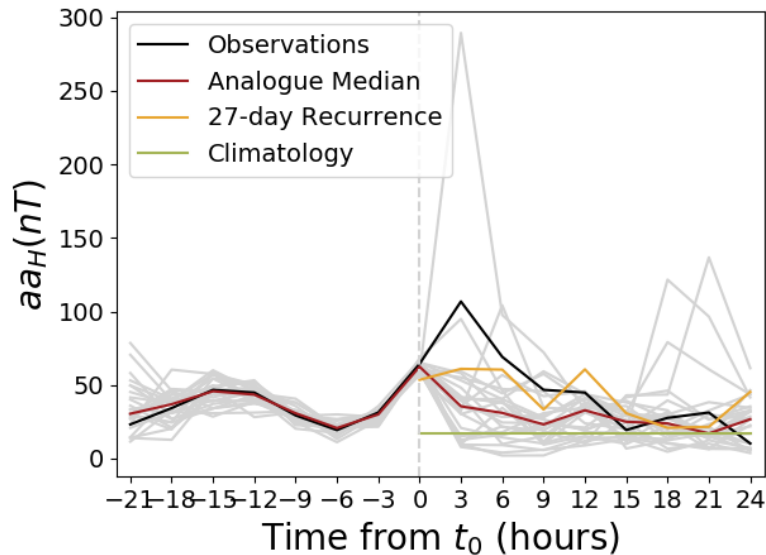
- Timeseries with 3-hour cadence
- 1868–2017 (150 years!)
- A global measure of space weather activity
- Combination of measurements from 2 locations

EVENT DEFINITION

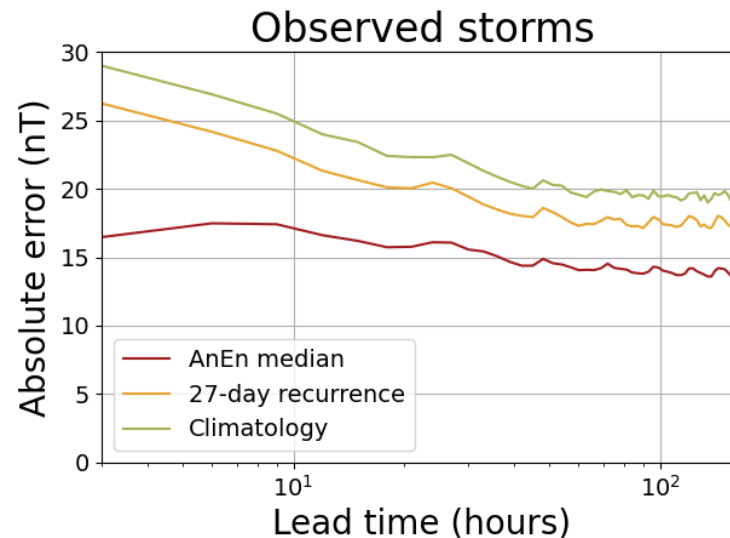
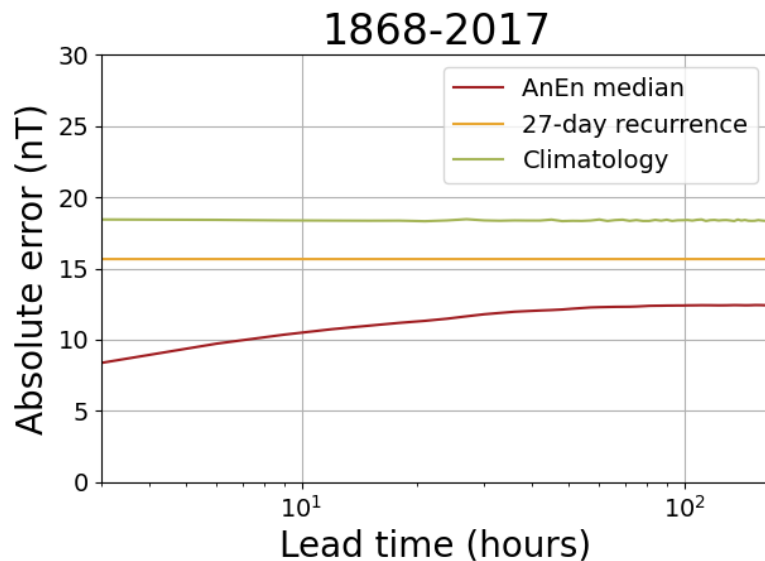
- A storm is above the 90th percentile
- Therefore 1 in 10 datapoints is a storm
- Class imbalance between “storm” and “not storm”



ANEN SINGLE EVENT

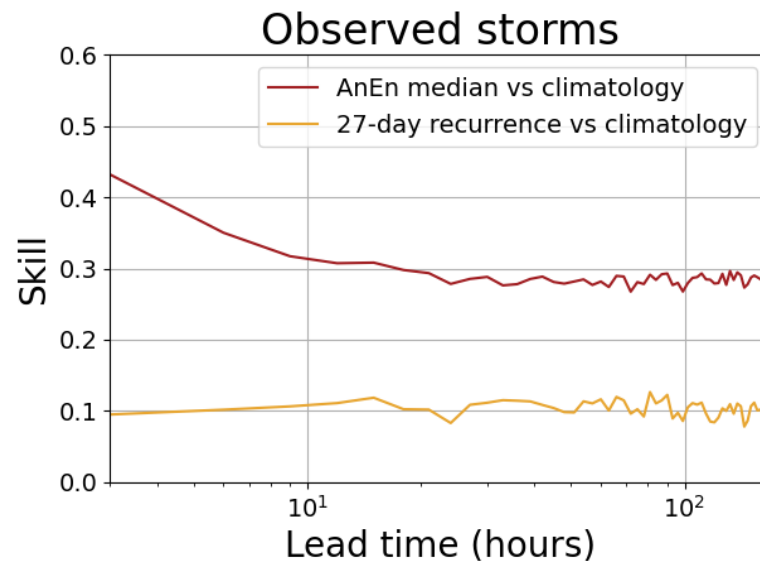
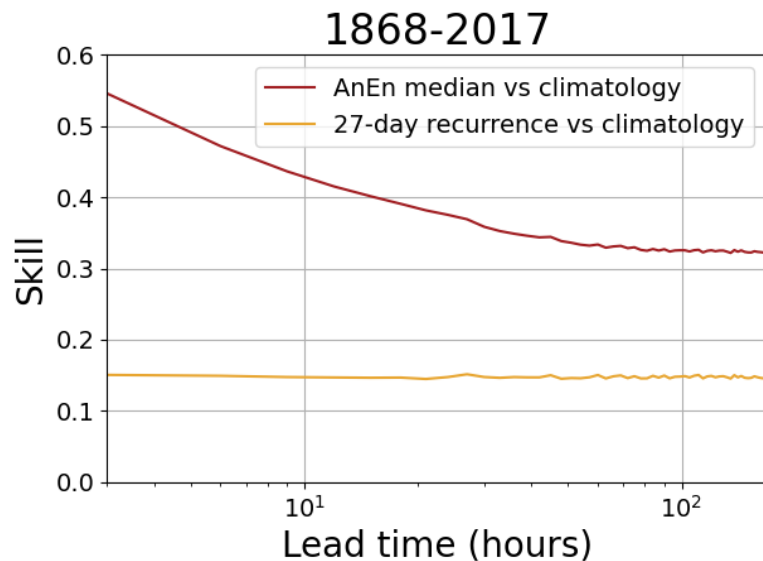


ANEN ERROR

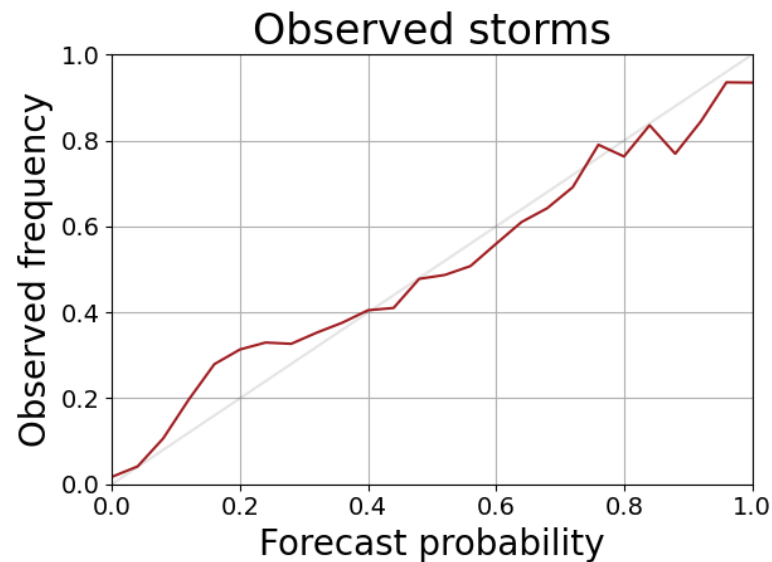
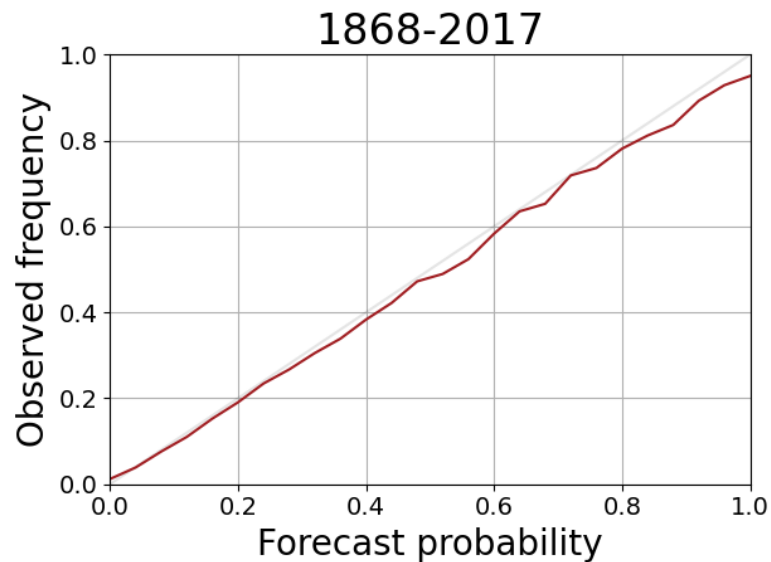


$$\text{skill} = 1 - \frac{\text{forecast error}}{\text{reference error}}$$

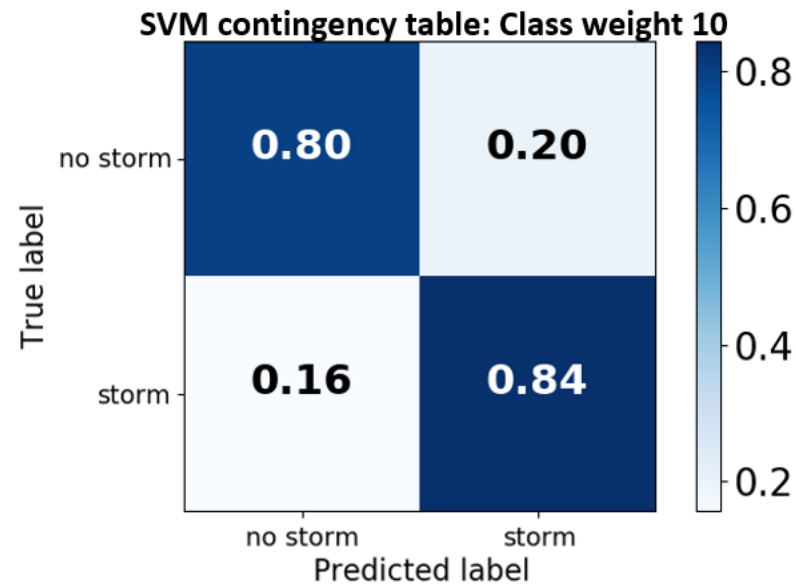
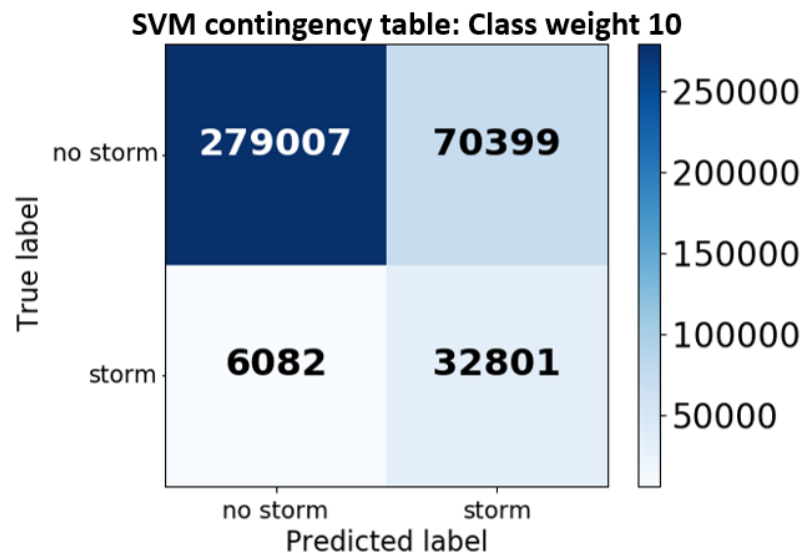
ANEN SKILL



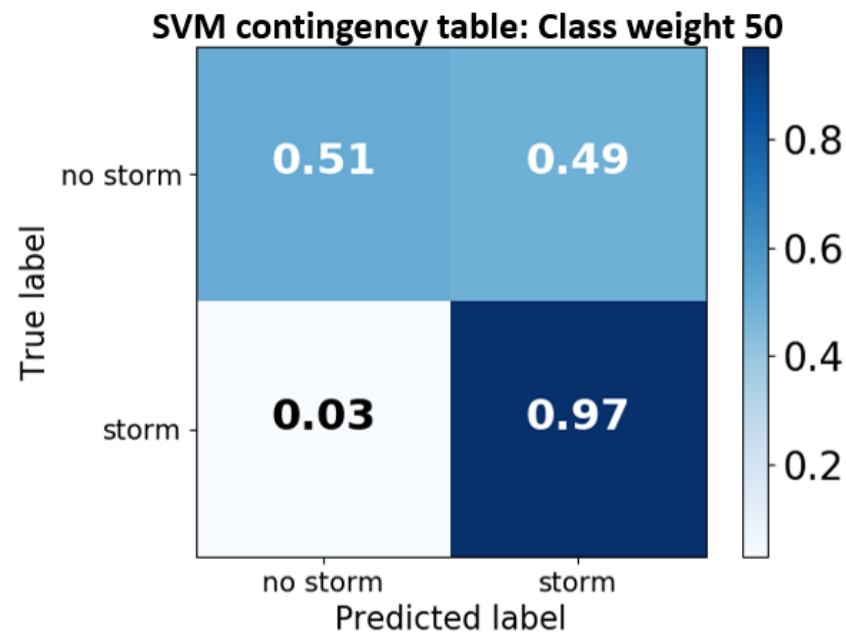
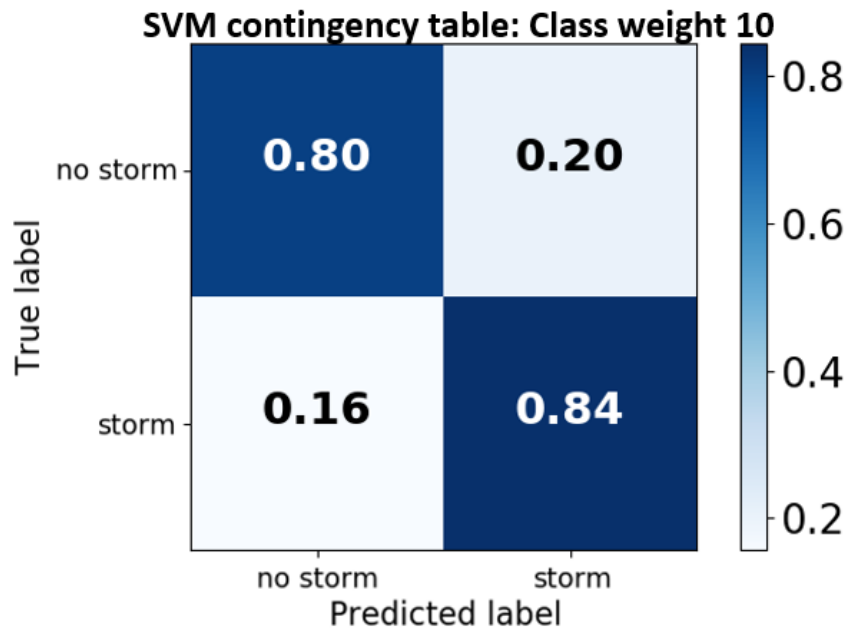
PROBABILISTIC ANEN



SVM

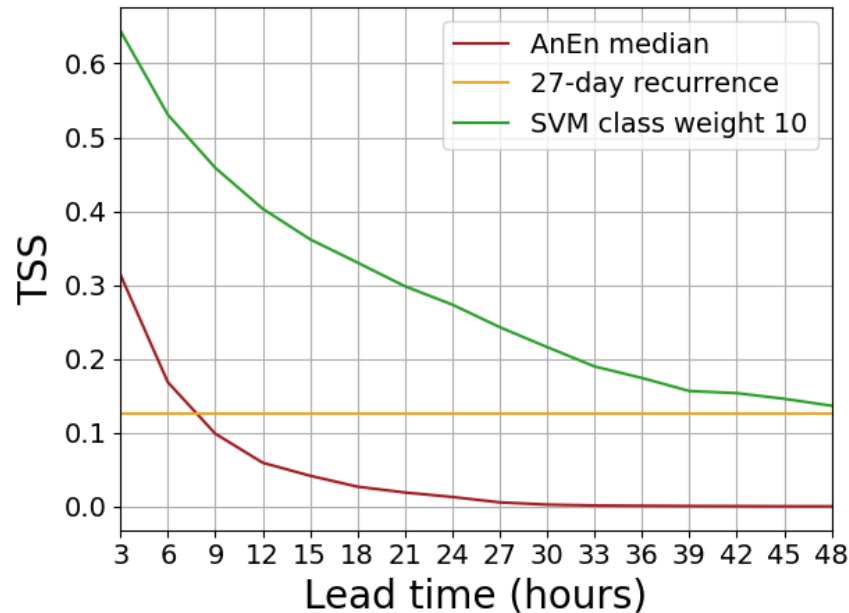
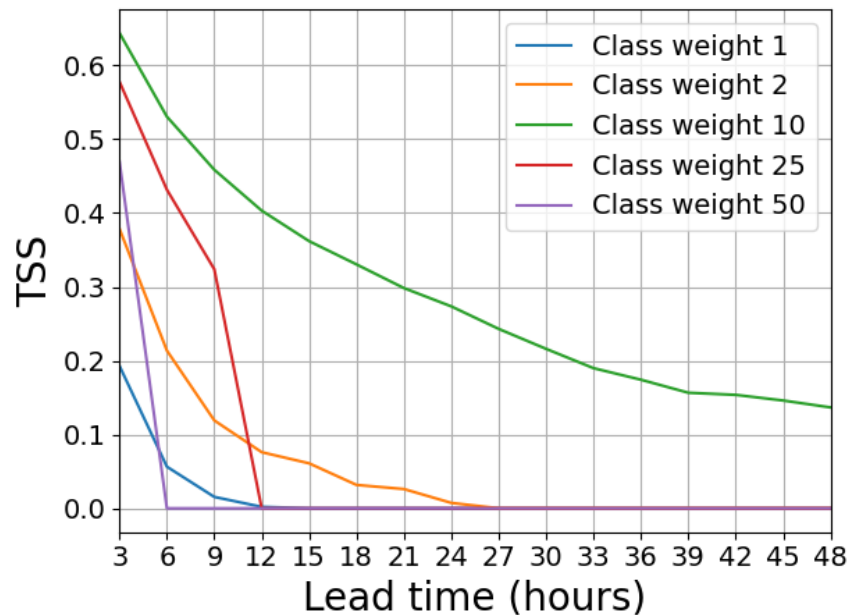


SVM CLASS WEIGHT



TRUE SKILL SCORE

$$TSS = \frac{TP}{TP + FN} - \frac{FP}{FP + TN}$$



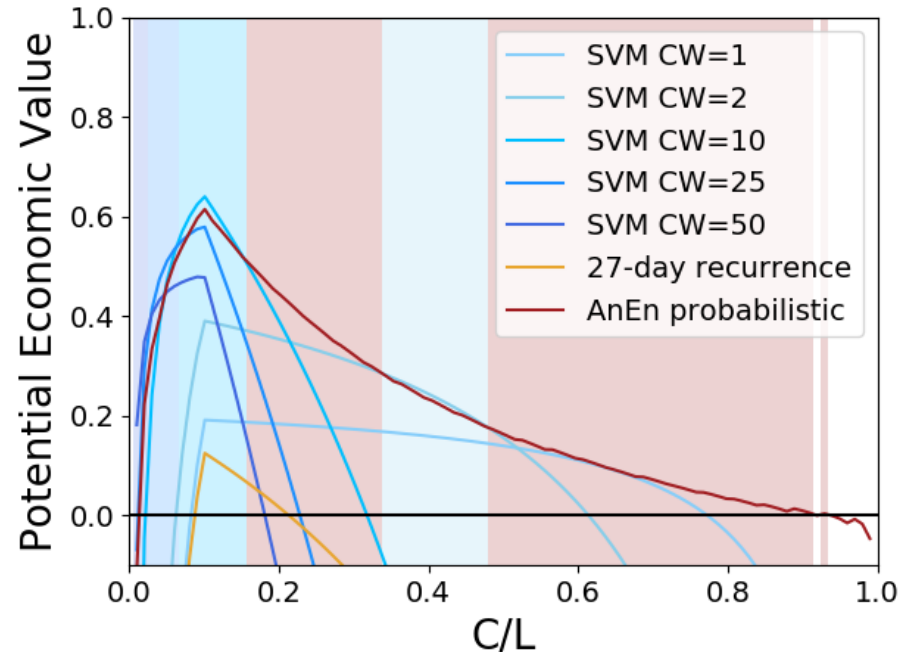
COST/LOSS ANALYSIS

$$PEV = \frac{E_C - E}{E_C - E_0}$$

E: cost of forecast

E_c: cost of climatological forecast

E₀: cost of perfect forecast



SUMMARY

- Space weather intensity and events have been forecast
- The analogue ensemble (AnEn) and support vector machines (SVM) provided valuable forecasts
- The best method depends on the needs of the end user

