StormScam

By Prometeo Team

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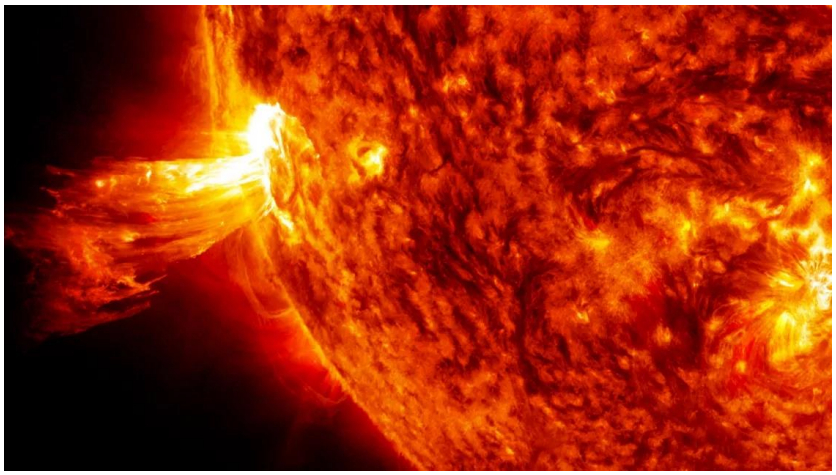
Summary

Power grids, communications systems, and near-Earth satellites can be affected by extreme emissions from the Sun (known as CME Coronal Mass Ejections). In order to study its behavior, a partnership between NOAA, NASA and the US Air Force created the Deep Space Climate Observatory, or DSCOVR, which is a spacecraft that orbits between the Earth and the Sun, observing and providing a series of data that serve to generate warnings about extreme coronal mass ejections.



Our proposal is to take the raw data generated by the DSCOVR to create software that can predict possible CMEs or extreme solar storms that affect terrestrial devices in order to take appropriate precautions.

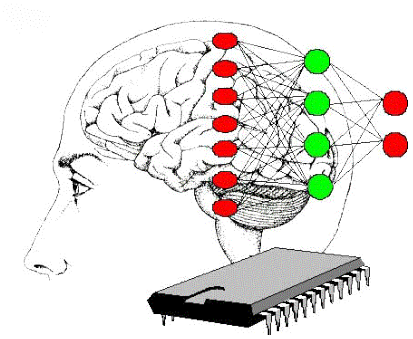
These are variables taken into account in the project:

- Geocentric solar ecliptic.
- Geocentric solar magnetospheric.
- Speed of protons in the solar wind.
- Proton density.
- Temperature of the protons in the solar wind.

Therefore, a neural network will be implemented that will handle the extracted data, both on normal days and on historical days that have recorded solar storms, so that artificial intelligence (AI) learns from this data and generates a forecast of possible extreme solar storm activities that affect satellite operators, electrical companies, the airline industry, and the armed forces.

Solution

Creating a series of processes managed in a neural network, the variables of geocentric solar ecliptic, geocentric solar magnetospheric, speed of protons in the solar wind, density of protons, temperature of protons in the solar wind will be processed. This network will use the NumPy software, which will perform logical and mathematical calculations on frames and matrices much more quickly and efficiently, with this we hope to create simulations that will lead us to predict possible solar activities and their behavior.



The data received from the satellite will be organized in a database, organizing the different variables that will be used in logical operations.

time	proton_vx_gse	proton_vy_gse	proton_vz_gse	proton_vx_gsm	proton_vy_gsm	proton_vz_gsm	proton_speed	proton_density	proton_temperature
dia 25/03/2023									
valor min	-635,50	-98,50	-15,60	-635,50	-133,40	-28,40	443,60	0,01	2000,00
valor max	-440,20	79,00	146,90	-440,20	58,90	148,50	636,50	16,45	855846,00
valor medio	-512,36	-15,33	35,97	-512,36	-25,86	26,62	517,66	7,91	291182,79
dia 24/03/2023									
valor min	-537,40	-47,80	-15,90	-537,40	-92,50	-23,30	392,60	0,59	4606,00
valor max	-390,30	76,40	132,00	-390,30	60,90	125,90	538,20	37,43	540708,00
valor medio	-435,83	17,79	33,80	-435,83	3,17	38,18	439,10	11,48	110597,56
dia 23/03/2023									
valor min	-517,90	-28,60	-10,80	-517,90	-81,40	-22,00	436,60	5,59	9996,00
valor max	-433,80	72,40	131,60	-433,80	45,50	133,20	519,80	64,37	485799,00
valor medio	-473,27	27,75	56,20	-473,27	2,70	62,32	478,25	13,03	121783,68

Once organized, the conversion is carried out in CSV to launch the software in order to obtain the predictions of solar storms.

```
# Extraccion de la data dscovr y conversion en csv
```

```
In [7]: pip install xarray pandas

Requirement already satisfied: xarray in c:\users\bersoza\anaconda3\lib\site-packages (0.20.1)
Requirement already satisfied: pandas in c:\users\bersoza\anaconda3\lib\site-packages (1.4.4)
Requirement already satisfied: numpy>=1.18 in c:\users\bersoza\anaconda3\lib\site-packages (from xarray) (1.23.5)
Requirement already satisfied: python-dateutil>=2.8.1 in c:\users\bersoza\anaconda3\lib\site-packages (from pandas) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in c:\users\bersoza\anaconda3\lib\site-packages (from pandas) (2022.1)
Requirement already satisfied: six>=1.5 in c:\users\bersoza\anaconda3\lib\site-packages (from python-dateutil>=2.8.1->pandas)
(1.16.0)
Note: you may need to restart the kernel to use updated packages.
```

```
In [13]: import xarray as xr
         import pandas as pd

         # Cargar el archivo .nc
         ds = xr.open_dataset('data/oe_fc1_dscovr_s20230323000000_e20230323235959_p20230324022056_pub.nc')

         # Convertir el conjunto de datos a un DataFrame de pandas
         df = ds.to_dataframe()

         # Guardar el DataFrame como un archivo .csv
         df.to_csv('nasa23.csv')

         # Cerrar el conjunto de datos
         ds.close()
```

Use of artificial intelligence

Just like the human brain, which can learn through experiences, loading different data, both from normal days and days with storms. Our network will be able to generate learning from these experiences and through artificial intelligence it will create patterns that will help us generate predictions of these events.

NumPy being a Python library specialized in numerical calculation and data analysis, we will import these libraries to be able to create our neural network especially for the large volume of data that we will handle, in this case an input greater than 20,000 data.

We will make an array with the inputs of temperature, density, wind speed, elliptical, thus defining the connection between the neurons, indicating their properties, the optimizer, loss indicator in order to train our model taking into account error and success functions. Therefore, in the end we obtain the training results of our network that will product in a possible prediction.

References

Space Agency Data

DSCOVR Space Weather Data Portal

https://www.ngdc.noaa.gov/dscovr/portal/index.html#/

National Centers for Environmental Information

https://ngdc.noaa.gov/

Atmospheric Science Data Center

https://asdc.larc.nasa.gov/data/DSCOVR/

Other sources

SpaceWeatherLive.com

https://www.spaceweatherlive.com/es/actividad-solar/llamarada-solar.html

NOAA's Deep Space Climate Observatory (DSCOVR) mission Quick

https://nesdis-prod.s3.amazonaws.com/migrated/dscovr_quick_reference.pdf

NumPy

https://numpy.org/