

25HS_I4DS21: Using Machine Learning to Estimate the GOES X-ray Flux from STIX Quick-look Data

Advisor:	Sâm Krucker Paolo Massa	Priority 1	Priority 2
		Work scope:	P5 (180h pro Student) ---
		Team size:	2er Team ---
Languages:	German or English		
Study course:	Computer Science and Data Science		

Initial situation

Solar flares are eruptions in the Sun's atmosphere occurring when the energy stored in the Sun's magnetic field is explosively released. This process heats the solar atmosphere to tens of millions of degrees, and plasma at such hot temperatures emits strong X-ray radiation. Time profiles of the intensity of the X-ray emission provided by the Earth-orbiting satellites called GOES have been used over the past 40 years to describe the time evolution



of solar flares, and they are now considered as a standard reference [1]. With the launch of ESA's Solar Orbiter mission, which travels around the Sun away from Earth, we get for the first time a systematic view of the backside of the Sun not seen from Earth's view [2]. Solar Orbiter provides measurements of the X-ray emission in solar flares by means of an instrument, called STIX, which has been designed, built, and operated by FHNW [3].

Objective

We propose to train a Machine Learning (ML) model on a set of solar flare data consisting of quick-look STIX profiles and GOES light curves when both instruments see the Earth-facing side of the Sun. This model can then be used predict the GOES signal from flares seen only by STIX from the backside of the Sun.

Problem statement

To date, STIX has observed over 80'000 solar flares, roughly half of them from the backside of the Sun. STIX observes in a slightly different X-ray range (4-150 keV) than GOES (1.6-25 keV) and therefore it is not straight-forward to use the STIX quick-look profiles as a proxy for GOES (see above figure). We want to apply ML techniques on archived STIX and GOES data to predict backside GOES profiles from STIX observations alone. From initial studies using a simple correlation approach of STIX and GOES peak fluxes, we know that STIX data can be used to predict the peak value of the GOES flux. Hence, we are optimistic to achieve a positive result. If successful, we will implement the ML model on the STIX webpage [3].

Technologies/Technical emphasis/References

Existing python tools can be used to download and read both data sets. After a successful project, the resulting GOES proxy will be implemented into the STIX webpage [3].

- [1] <https://www.swpc.noaa.gov/products/goes-x-ray-flux>
- [2] https://www.esa.int/Science_Exploration/Space_Science/Solar_Orbiter
- [3] <https://datacenter.stix.i4ds.net/>

Note

This is a cutting-edge research project that will be carried out within an international team. No prior knowledge of the physics of the Sun is required. Please note that most of the STIX documents are in English, but the thesis may be written in German or English.

This Project is reserved for Alain Burger and Timon van den Nobelen