DOI: 10.20396/revpibic.

Discovery of association between parameters of solar explosions type M and X

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Abstract

This project aims at the exploitation of a data set of a base of solar explosions in order to mine association rules of explosions of type M and X. Such explosions present danger to several terrestrial systems and to find patterns of occurrence of the same is a problem important. A Java language tool for displaying the rules was also developed. Results showed important associations between the parameters according to the solar cycle 24.

Key words:

Solar Explosions, Association Rules, Data Mining

Introduction

A solar explosion can temporarily alter the upper atmosphere of our planet by creating signal transmission breaks such as: mobile telephony, satellites, GPS and other technological systems that make transmission from wavelength (FOX, 2013). The objective of this work is to generate association rules for the occurrence of explosions M and X in order to discover patterns of association between the parameters of the rules. One of the experiments carried out for the solar cycle 24 is presented in this work.

Results and discussion

The methods used for the project were: (i) preprocessing of solar explosion data, (i) APRIORI algorithm, (iii) rules validation, support and trust techniques, (iv) JAVA language. The APRIORI algorithm works by searching the data by generating sets of patterns by searching for frequent items in a rule (BASU et al., 2016). The frequency of items in a rule is called support, and the frequency of combining rule items is called trust (HAN, 2012).

Experiment for solar cycle 24 with magnetic parameters

One experiment used data from the solar cycle 24 (Figure 1). The selected parameters were its magnetic characteristics that are considered the most important for a solar explosion. This experiment was carried out based on the work of (Liu, 2017).

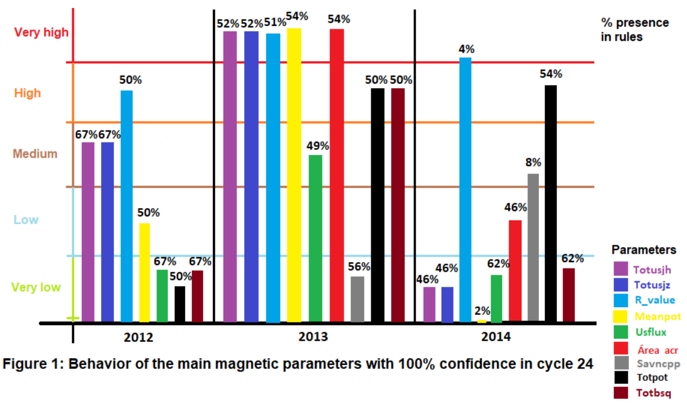

Figure 1: Behavior of the main magnetic parameters with 100% confidence in cycle 24

With minimum support of 0.2% and 100% confidence, the experiment recorded explosion rules of type X for the three-year peak of cycle 24 (ISES, 2018): 2012, 2013 and 2014. It was possible to verify the rise of all magnetic attributes in 2013 compared to 2012 and its decay in 2014 (Figure 1).

This behavior coincided with the solar activity of cycle 24 in the same period. No explosion rules X were found for the other years of the cycle, also confirming the behavior of explosions X.

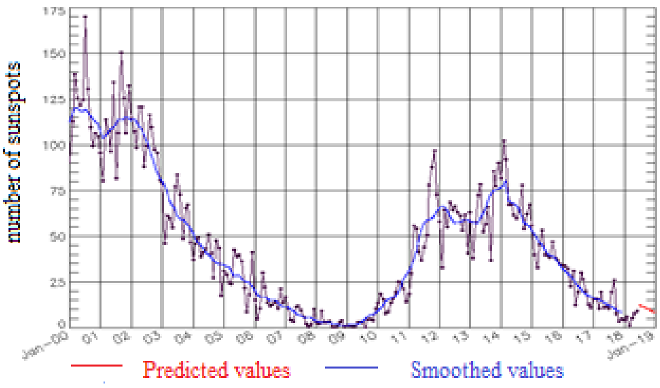

Figure 2: Behavior of solar cycle 24. (Figure adapted from (ISES, 2018))

Conclusions

The result of this experiment obtained associations between the parameters of greater occurrence in solar explosions, as well as, the period in which each attribute has more occurrence. It was possible to verify the behavior of the 9 main magnetic parameters in cycle 24. In addition, a software was developed in Java language for the visualization of the found rules.

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