

## FOREST FIRES IN EUROPE FROM JULY 22 – 25, 2009

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*Abstract* - According to the official data of the FAO, in 43% of cases it is unknown how forest fires come about. By analyzing the available data, a hypothesis has been tested according to which such situations are a result of the connection between the burning of the biomass by charged particles coming from the Sun. It turned out that there was also an analogy in this concrete case, i.e. a temporal link between the processes on the Sun and fires in Europe in the period from July 22<sup>nd</sup> to 25<sup>th</sup> 2009. Nevertheless, the hypothesis demands additional laboratory research.

*Keywords:* Forest fires, Sun, charged particles, Europe.

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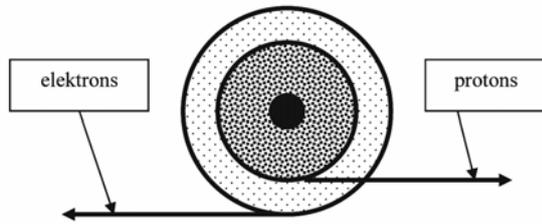
### INTRODUCTION

The origin of forest fires is most often attributed to the direct or indirect behavior of man. However, the official data of the FAO (2002) showed that the cause is unknown in 43% of the cases. According to the mentioned source, areas affected by fire comprised over 920 000 hectares in Europe in 2000 alone. Regarding the area of the Mediterranean concerned, Goldammer (2002) pointed out that the average annual number of forest fires was close to 50 000. A large increase in the number of forest fires has been registered from the beginning of the 1970s in those countries where data has been available since the 1950s: Spain (from 1 900 to 8 000), Italy (from 3 000 to 10 500), Greece (from 700 to 1 100), Morocco (from 150 to 200) and Turkey (from 600 to 1 400). According to the FAO (2002), the absolute values showed that for the period from 1999 to 2001 the largest number of forest fires with known cause was recorded in Russia in 1999 (28 300) and Spain in 2000 (20 084), whereas fires with unknown cause were most numerous in Portugal in 2001 (25 943) and Poland in 1999 (23 655).

Some scientists, without direct evidence, tried to connect this issue with global warming. The expression 'without direct evidence' should be taken literally, because there is no established

mechanism proving that the initial phase of the origin of flames is an aspect of climate (Radovanovic and Gomes, 2009). It is generally known that a minimum of 300°C is necessary for a spark to appear (Viegas, 1998). On the other hand, textbook literature shows that even in deserts, a ground surface temperature of over 90°C has never been measured. It is unnecessary to discuss an absolute maximum air temperature as a potential cause, because it is considerably below the necessary minimum. In searching for an explanation, some ideas came up connecting forest fires to lightning. This kind of an approach also had some weaknesses, because the occurrence of lightning most often coincides with precipitations. Besides, over 17 000 naturally ignited wildfires were observed in Arizona and New Mexico from April to October in the period 1990-1998. Lightning strikes linked to these fires were calculated to be less than 0.35% of all registered cloud-earth lightning strikes that occurred within this period (Hall, 2007). Cases occurring on the ground were specifically intriguing for scientific research.

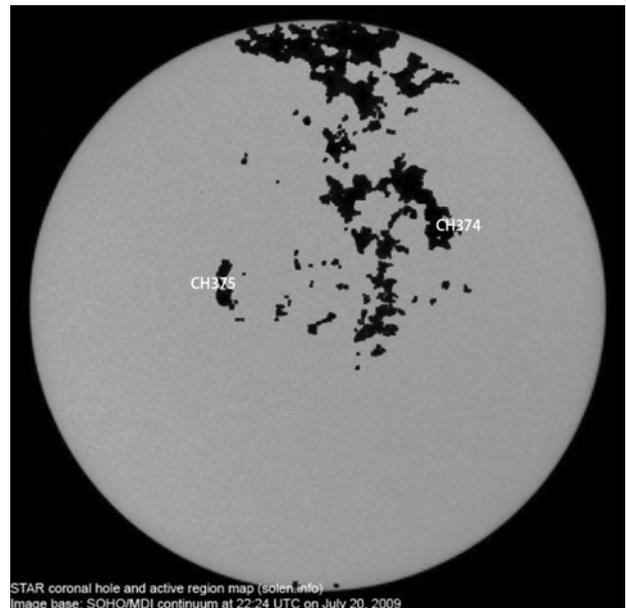
Taking the existing knowledge into consideration, Gomes and Radovanovic (2008) analyzed 11 cases of wildfires that occurred in Europe in the period from 2002 to 2005.



**Fig. 1.** Schematic representation of the dispersion of protons and electrons after the magnetic shell weakening of the main solar wind stream

The essence of their work refers to the check of the heliocentric hypothesis on the origin of forest fires for which causes have not been established. Disregarding the fact that it was a statistically unsatisfying group of samples, the authors concluded that immediately before the destructive power of fires occurred, there had been a coronal hole on the Sun and/or energetic region in the geo-effective position. The emission of charged particles, characterized by high speeds, temperature and density, represents an initial step in the explanation of the mentioned hypothesis. Analyzing the astrophysical parameters, the authors concluded that the penetration of charged particles towards the earth has developed in two basic ways. The first one occurs in polar areas where the reconnection of the interplanetary magnetic front and the geomagnetic field of our planet takes place. This process is known as reconnection and it occurs only if the resultant vector of the interplanetary magnetic front is negative. In the second case, the solar wind penetrates towards the ground over the parts of the Earth where the geomagnetic field is the weakest. The process takes place exclusively under the influence of solar wind kinetic energy and specifically in tropical areas.

The kinetic energy of the solar wind becomes weaker with deeper penetration through the atmosphere due to friction with much denser layers of air, and by itself it brings about the weakening of the magnetic shell of the main stream (Stevancevic et al., 2006). The separation of protons and electrons appears by the dispersal of the primary stream, and so the protons turn left and electrons right in



**Fig. 2.** Position of the coronary hole on the Sun on July 20<sup>th</sup> 2009.

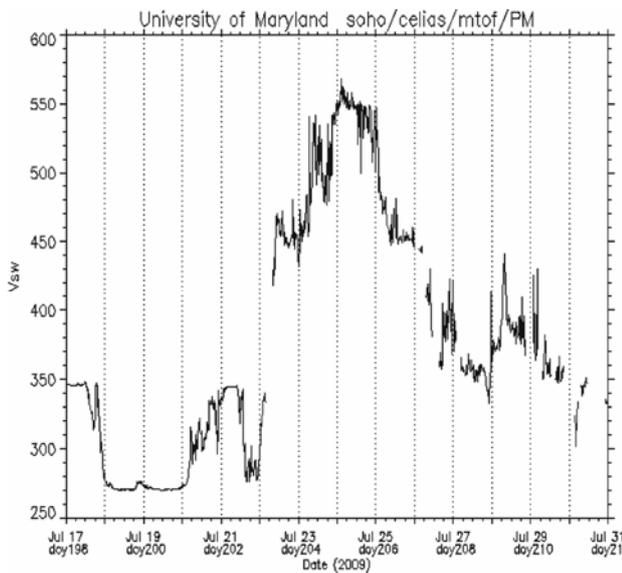
relation to the radial direction of solar wind movement (Figure 1).

Based on the presented results and with the aim of checking the heliocentric hypothesis, the analysis of astrophysical parameters which preceded the fires in Europe from July 22<sup>nd</sup> to 25<sup>th</sup> 2009 was done.

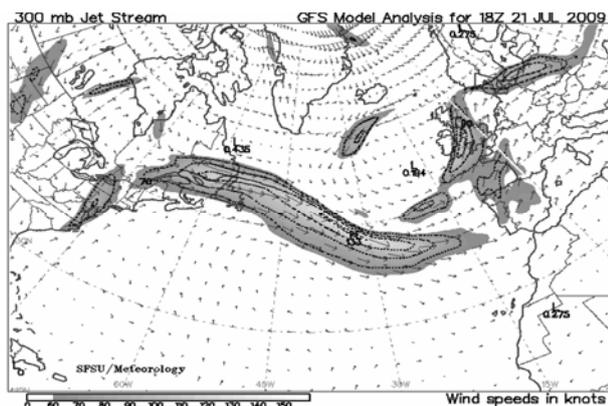
## MATERIALS AND METHODS

Throughout the mentioned period, the public was being informed several times on the successive fires that spread over the southern parts of Europe. Not being able to come to information as to whether the causes were known in the mentioned cases, it was decided to check the validity of the heliocentric hypothesis in this case, too.

Due to the impossibility of explaining the quantitative indices of the spatial distribution of the locations encompassed by fire, the temporal analogy method was applied. The first step in establishing potential causality looked to the existence of a coronary hole on the Sun and/or energetic region in the geo-effective position. In



**Fig. 3.** Speeds of protons exceeding 550 km/s on July 24<sup>th</sup> 2009 (<http://umtof.umd.edu/pm/crn/CRN>).



**Fig. 4.** Jet-streams over the north Atlantic on July 21<sup>st</sup> 2009.

Fig. 3, the CH374 coronary hole could clearly be seen two days before the fire in southern Europe (<http://www.dxl.com/solar/index.html>).

The emission of energy from the geo-effective position represents a specific problem in the explanation of prognostic models. The geometry of the ejection of some streams of solar wind is characterized, from case to case by different particle dispersal in space, so that even under the assumption of standardized dynamics, i.e. reduced pulsa-

tion, the possibilities of a quantitative explanation of the distribution of energy through the atmosphere are limited. Meloni P. et al. (2005) also emphasized the significance of the positioning of the geo-effective location on the sun.

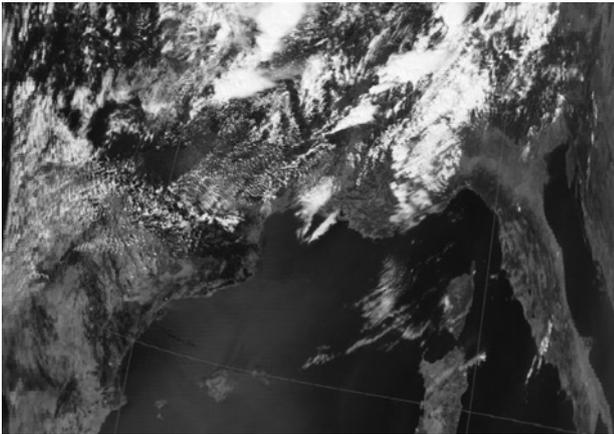
Previous research pointed out that the arrival of protons in conditions of reduced cloudiness could hypothetically be connected to the origin of forest fires (Gomes et al, 2009). A sudden rise in the speed of protons directed towards the Earth from July 20<sup>th</sup> of this year can clearly be observed in Figure 3.

A satellite image (Fig. 4) showed that the collection of air masses occurred in conditions of reconnection and their main moving direction was from northwest towards southeast.

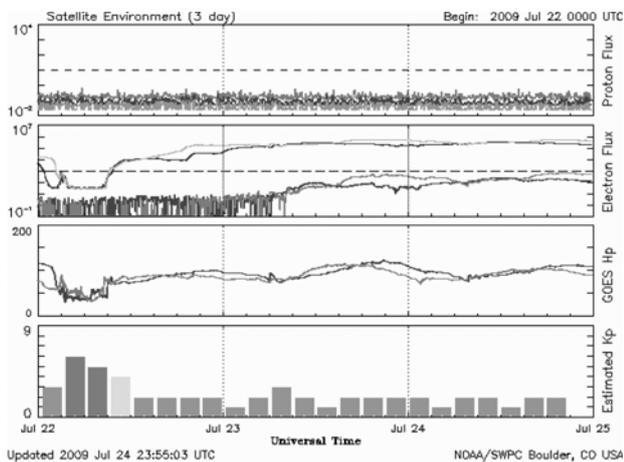
Taking the limiting scope of the paper into consideration, it is simply impractical to show chronologically all satellite images of the fires in Europe in the mentioned period. Therefore, only one image will be presented (Fig. 5) which refers to July 23<sup>rd</sup> 2008 (<http://rapidfire.sci.gsfc.nasa.gov/realtime/single.php?A092041250>).

The red spots in the satellite image denote areas of at least 1.1 km<sup>2</sup> where the temperature of the Earth is considered to be hot enough to indicate the presence of fires. The temperature is measured by AVHRR (advanced very high resolution radiometer) sensors, set on NOAA satellites.

If the theoretical supposition about the dispersal of protons and electrons is correct (Fig. 1), then electrons are expected to be responsible for the situation in Fig. 5. It appeared that the continuation of the movement of air masses from the southwest to the northeast of central Europe in the observed period and the weakening of the magnetic shell, i.e. the wall of the main solar wind stream, occurred in that process. Fires appeared from the right side of the basic radial moving direction of the solar wind (SW), and the parameterization of the separation of electrons and protons from the primary stream represented the most sensitive part of the hypothesis. Observing the previous image more carefully,



**Fig. 5.** Satellite image of the part of Europe with locations covered by forest fires.



**Fig. 6.** Flux of protons and electrons and Kp index from July 22<sup>nd</sup> to 25<sup>th</sup> 2009.

one can see plumes of smoke above the fires in Corsica, Sardinia and south-eastern Spain. Their direction is not at a right angle in relation to the direction of clouds over the Alps, but it should not be forgotten that air masses move at different heights. Penetrating downwards, friction is stronger the denser the air layer, so it is logical to expect a certain turning in relation to the right angle towards the main stream of the solar wind.

There were no fires left of the SW stream (north of the Alps), which can be seen in Fig. 5. However,

it seems that a certain quantity of protons succeeded in reaching the ground on July 25<sup>th</sup>, so that several fires were recorded in the northern France, towards the English Channel (<http://rapidfire.sci.gsfc.nasa.gov/realtime/single.php?A092061240>). Analyzing fires in Russia, Todorovic et al (2007) assumed that the low spinning movements of air masses caused by protons moved in a counter-clockwise direction. However, in processes in which electrons dominate, the direction of the spinning movements should be clockwise. Future research, based on the reports of fire departments or meteorological stations, could confirm or refute the validity of the presented hypothesis.

In Fig. 6, a weak flux of protons can be noticed, despite the sudden increase in speed (Figure 3). On the other hand, the flux of electrons is considerably more expressed. The interactive connection between the charged particles' emission and Earth, from the previous figure, can also be noticed by the sudden rise of Kp index. Palamara and Bryant (2004) came to similar results as follows: "therefore, we conclude that geomagnetic activity plays an important role in recent climate change, but that the mechanism behind this relationship needs further clarification".

## RESULTS AND DISCUSSION

With all accomplishments of the modern age, as well as measures that have been taken (on a global level), the conclusion is that society has been caught up by the phenomenon of fire. In such circumstances, "the blame" is most often attributed to intentional or unintentional actions of man or by electrical discharges from the atmosphere. The situation we are now in is generally characterized by the impossibility of making successful prognostic models, and thereby, prevention. Observed from this perspective, Lynch et al (2004) understood in which domain the key issue lies, but had no clear vision as to how to develop further protection: "Our results therefore support other recent studies demonstrating that warmer/drier climatic conditions do not necessarily induce greater fire importance. ...These results contradict the current

understanding of modern fire–climate relationships. It is also inconsistent with model predictions that a drier and warmer climate, as a result of glasshouse warming, will lead to increased fire activity in boreal systems.” Gorte (2000) was categorical: “Research information on causative factors and on the complex circumstances surrounding wildfire is limited. The value of wildfires as case studies for building predictive models is confined, because the a priori situation (e.g., fuel loads and distribution) and burning conditions (e.g., wind and moisture levels, patterns, and variations) are often unknown.”

On the basis of research, also presented in this study, the conclusions could be the following:

1. Coronary holes and energetic regions in a geo-effective position on the Sun preceded the forest fires in Europe by several days in all cases for which data were gathered. The emission of strong electromagnetic and thermal corpuscular energy preceded the fires from these sources in each concrete situation. The correlation with fires was established in a similar way in Deliblatska pescara, Serbia, on July 24<sup>th</sup> 2007 (Gomes et al., 2009).

2. Preliminary research points to the necessity of applying specific statistical methods. All previous attempts have resulted in weak correlative connections, which is understandable. If the stochastic behavior of charged particles is taken as a starting basis, then it is evident that the same regions on Earth will not be endangered in all situations. Besides, the distribution of protons and electrons towards the lower layers of troposphere depends on the presence of clouds, density of the particles, strength of the solar wind, but also the angle of its movement through the atmosphere. The parameterization of the solar wind variables has been of great significance as a basis for future prognoses. A group of experts has been engaged in the examination of neuron networks, from which it can be expected that the presented hypothesis will be mathematically examined.

3. Basic modes of SW penetration through the magnetosphere are: a) reconnection (in the area of

geomagnetic poles), and b) direct penetration of the solar wind under the dominant effect of kinetic energy (near geomagnetic anomalies).

4. Solar wind, directed towards the Earth, gets weaker as it penetrates towards the topographic surface. The modifications of the main stream, which occur above the Atlantic anomaly and above the magneto-spherical tropics, also represent the maximum achievement of modern science.

5. Cloud cover represents one of the most important factors determining whether the charged particles are going to be deposited on the topographic surface.

6. Based on the preliminary results, there are indications that cosmic radiation (particularly in the period of reduced solar activity) can also cause fires. “However, the physical mechanism of solar activity effects on weather phenomena remains unclear. It is suggested that a significant part in the transfer of the solar variability to the lower atmosphere may be played by charged particles of solar and galactic origin, mainly protons, with energies ranging from ~100 MeV to several GeV” (Veretenenko and Thejll, 2004).

7. The research into the conditions under which the dispersal of charged particles over vegetation can cause the initial phase of ignition demands experimental testing. Due to the impossibility of precise prediction as to which locations it might be affected, the simulation of similar conditions in laboratories seems to be the first step.

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## ШУМСКИ ПОЖАРИ У ЕВРОПИ 22-25. ЈУЛА 2009. ГОДИНЕ

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Шумски пожари представљају велики проблем не само у Европи, већ у свим деловима света где постоје биљне састојине. Према званичним подацима ФАО, за 43% случајева се не зна на који начин је дошло до оваквих елементарних непогода. Анализирајући расположиве податке, у раду је тестирана хипотеза по којој су такве ситуације повезане са прогоревањем биљне масе од стране високоенергетских честица које долазе

са Сунца. Показало се да и у овом конкретном случају постоји аналогија, односно повезаност временског следа догађаја између процеса на Сунцу и појављивања пожара у Европи у периоду од 22-25. јула 2009. године. Хипотеза ипак захтева додатна лабораторијска истраживања, као и разраду модела који образлаже понашање протона и електрона у доњим деловима тропосфере.