DETECTING FOREST FIRES IN CROATIA – TESTING THE MPEF ACTIVE FIRE MONITORING (FIR) PRODUCT

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ABSTRACT

The possibility of using the geostationary satellite data in forest fire detection and monitoring over Croatian region is tested here. In the previous years the possibility of detecting fires from satellite was tested only for the largest fires such as the one around the city of Dubrovnik, beginning of August 2007 but also on a small but devastating fire on the island Kornat on 30 August 2007, whereas in this work all known fires in Croatia from the fire season 2009 are examined. Data set is based on fire-records from Croatian protection and rescue agency. All recorded fires were compared to 3.9 μm satellite images and RGB combinations as well as MPEF active fire monitoring product (FIR). The results of the analysis are not promising, since only about 7 % of actual fires were detectable in 3.9μm channel data.

INTRODUCTION

Early detection of fires in uninhabited areas is one of the biggest challenges of the remote sensing. Theoretical background of fire monitoring from space comes from the fact that forest fires typically develop temperatures in the range of 500 K to 1000 K and, according to Wien’s Displacement Law, if the temperature of an object is in the mentioned range, the wavelength of the peak of its emission will be around 4μm. This property has been used to build the sensors on many meteorological satellites in order to be able to detect the hot-spots connected to potential or active fires. One of these is also SEVIRI instrument on board METEOSAT second generation satellites, which measures radiation at 3.9μm. The brightness temperature of channel 3.9μm reveals the hot spots caused by the fire (Weaver and Purdom, 1995). Its sensitivity is so high that it can even show small, sub-pixel size fires. However, the measurements are only possible in cloud-free areas and can, by some extent, be spoiled by CO2 and WV absorption or small, sub-pixel clouds.

Mediterranean basin is the most fire-endangered region in Europe. In Croatia the average number of forest fires per year for the period from 1995 to 2000 was 300, but there has recently been a dramatic increase in the number of fires. In 2007 as much as 750 fires were reported and the burnt area was about 159,000 ha. 2008 was a year with rather low number of fire episodes, whereas in 2009 the number of fires and the burnt area were again rather big. In the previous years the possibility of detecting fires from satellite was tested only for the largest fires such as the one around the city of Dubrovnik, on 04 August 2007 (Fig 1), in which not only hot-spots but also smoke could be seen in the satellite images.
The second type of the fires that has been analyzed is presented through the example of the catastrophic fire on the island Kornat, on 30 August 2007, in which the burnt area was rather small but the fire was fatal for 12 fire-fighters (Fig 2).

In both cases the fire could be clearly detected by means of IR 3.9 μm brightness temperature. However, the temperature values are very different. In case of the small fire the IR 3.9 μm temperature was even below the usual threshold, but the values can be explained by the fact that the fire was of sub-pixel size and that there were some clouds above the fire. In case of the big fire very high IR 3.9 μm brightness temperature was detectable for several hours with values ranging from 310 to more than 335 K.

Even though the early detection of forest fires from satellite is much more appropriate for vast uninhabited areas, the possibility of using the geostationary satellite data in operational forest fire detection and monitoring over Croatian region is tested here.

FIRES IN 2009

The data set for the analysis consists of the records of all known fires on Croatian territory in the period from 1 June to 30 September 2009. The data were acquired from Croatian
protection and rescue agency. According to their records, during the summer months of 2009 464 fires affecting area larger than 1 ha were recorded in Croatia. Out of this, only 34 could be seen in the MSG satellite data. The rest was either covered by clouds (almost 50% of the cases), or were too small (29%) to be detected. Detection was also less successful during the night (Fig 3). Most of the detected fires were affecting the area of 10-50 ha, but there was also a certain number of small fires (1-10 ha) that could also be seen (Fig 4).

Figure 3. Percentage of the fires in 2009 detected or not detected from the MSG satellite due to different reasons.

Figure 4. Distribution of the sizes of detected fires in 2009.

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One of the largest fires in 2009 was the one near the city of Senj, on 30 August 2009. The images follow the fire from 10:45 to 11:45 UTC showing the change of 3.9 μm temperature (Fig.5).
Figure 5. MSG 3.9 μm temperature displayed for the pixels with T(3.9) > 308 K and T(3.9) - T(10.8) > 10 K for 30 August 2009, 10:45, 11:00, 11:15, 11:30 and 11:45 UTC. The blue dot at 11:00 UTC marks the detection by MPEF FIR product.

Temperature values larger than 308 K are shown, with a restriction of T(3.9)-T(10.8) > 10 K. Fire in Senj was one of only three fires in 2009 which were detected also by the MPEF Fire Monitoring product (EUMETSAT, 2010). The blue dot on the image at 11:00 UTC shows the location of the fire as seen by the FIR product.

CONCLUSION

Analysis of the 2009 fire season in Croatia showed that the probability of detection of the fires from MSG data is rather low. It was shown that out of 464 fires larger than 1 ha only 7.3% could be seen in satellite data and only 3 fires were detected by the MPEF FIR product. From the point of view of the operational use, these results are far from being satisfactory. However, it has been noticed that sometimes even very small fires, with area of 1-10 ha, can be seen in 3.9 μm temperature data. It appears that the criteria implemented in the algorithm of the MPEF FIR product are too strict, since only the largest fires are detected. However, if the criteria are lowered, false alarms are more likely to occur. False alarms are regularly found in the inland of Dalmatia (stone ground) and sometimes over eastern Croatia (vegetation covered plains), but the causes have not been tested yet.

REFERENCES

