PRELIMINARY VALIDATION STUDIES OF EUMETSAT'S ACTIVE FIRE MONITORING PRODUCT FOR TURKEY

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Abstract

Early detection and coping with fire are two demanding issues both for operational and research agencies. Remote sensing may augment in accomplishing such a demanding task. In this respect, satellite based systems are indispensable tools for operational and research agencies to keep up with rapid occurring fire events. With frequent and continuous imagery capability, the geostationary satellites are feasible solution for early fire detection and monitoring systems.
In this study, active fire monitoring (FIR) products of EUMETSAT's Meteosat Second Generation (MSG) satellite mainly, for the summer of 2006, for Turkey are analyzed. The prototype processing chain in Turkish State Meteorological Service is presented. The initial findings are provided and preliminary results of the validation studies performed over Turkey in this period are summarized.

INTRODUCTION

2,027 hectare forest area was burned in 245 different events between 20 and 27 August 2006 in Turkey. Moreover, a total forest area of 136,210 hectares were destroyed during the period from 1994 to 2005 (Ministry of Environment and Forestry, MoEF 2006 a,b). Figure 1 represents the observed monthly fire counts and the annual cycle of fire activity that are obtained from MoEF reports for a period from 2000 to 2003 and for 2006 for Turkey. The maximum counts are observed from June to September coinciding with the hot summer days of Mediterranean region.

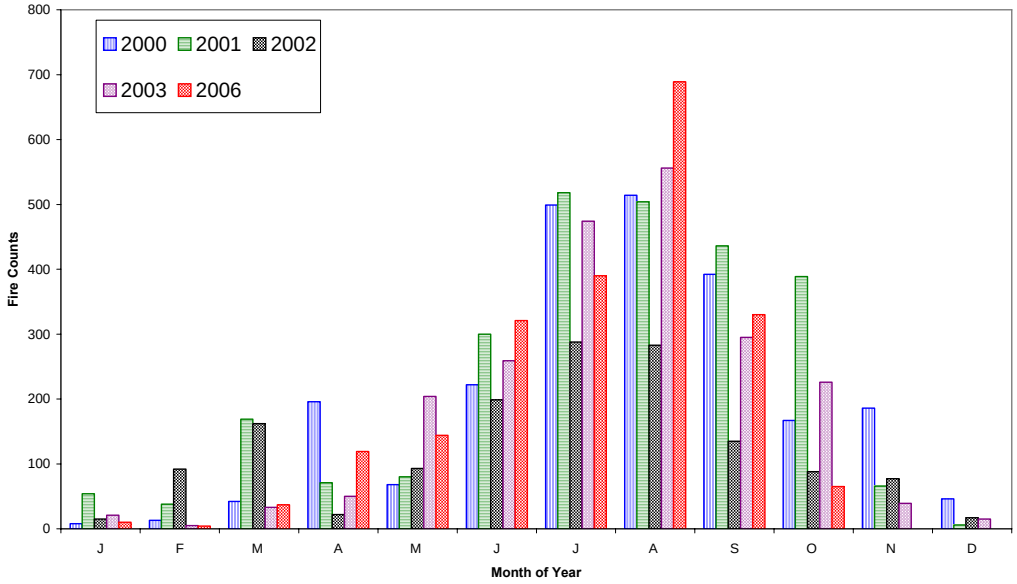

Figure 1: **Monthly observed fire counts**

METHODOLOGY

Fire product, FIR, derived from a stationary satellite namely, Meteosat Second Generation (MSG), is used in the present study. FIR is downloaded from EUMETSAT's ftp site, by an operational code. After every MSG cycle (i.e. every 15 minutes), the code connects to the EUMETSAT's ftp site and downloads the latest FIR product files. Date and time checks of the downloaded files are performed initially. If the date and time are not recent, the files are not processed any further. From the recent files, Turkey region is deducted. A jpeg file of the area is prepared with the fire locations indicated on. A text file of the determined fire locations and types are also prepared. The prototype processing chain in Turkish State Meteorological Service is provided in Figure 2.

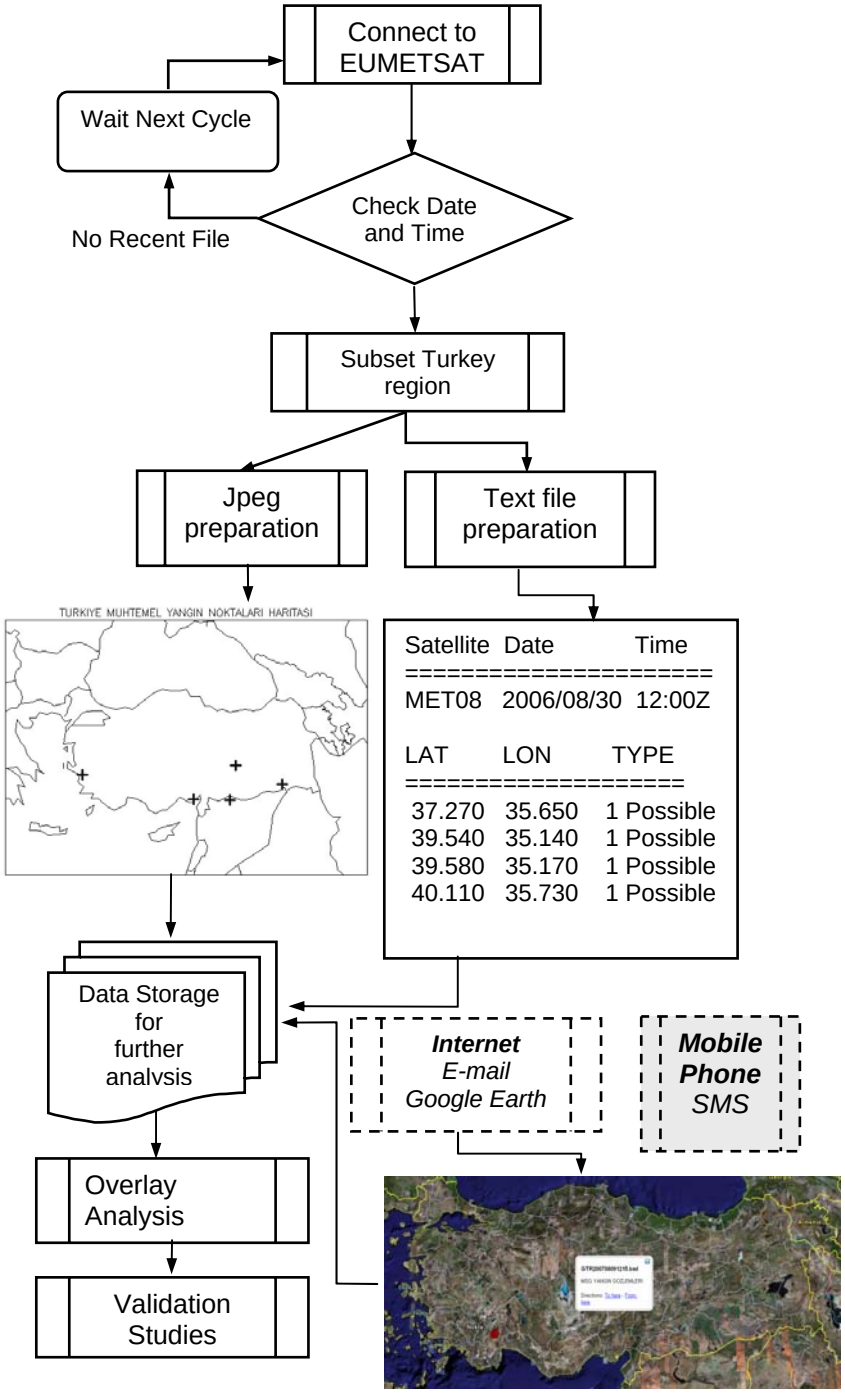

Figure 2: **Processing chain in TSMS**

VALIDATION

The daily fire cycle obtained from FIR product and previous year's ground observations are provided in Figure 3. Figure represents a good agreement between FIR product for 2006 and ground reports of 2003 and 2005. These findings are in parallel to previous studies indicating that the daily fire activity trend mostly makes peaks in the early afternoon (Menzel and Prins 1996, Eva and Lambin 1998, Pack et al. 2000, Csiszar et al. 2005).

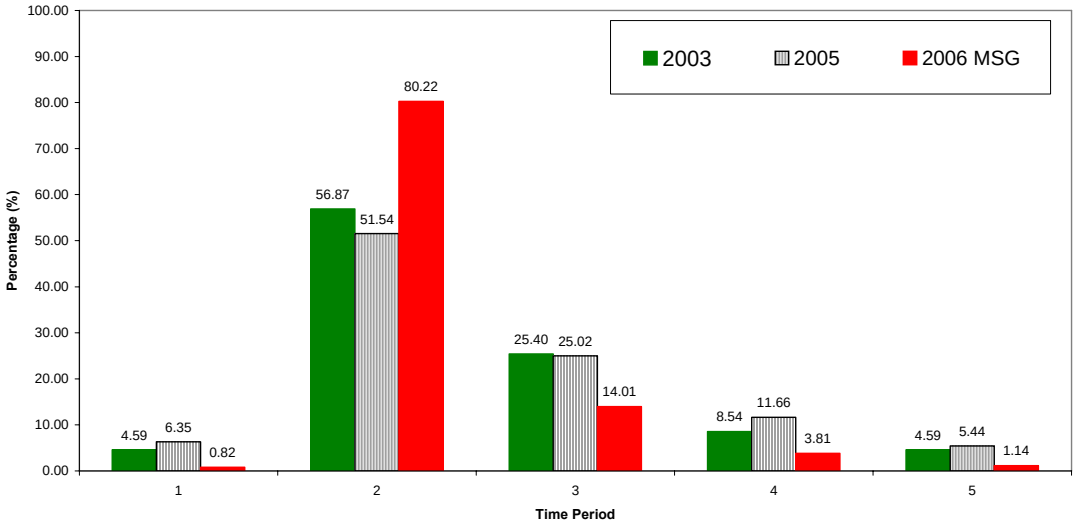

Figure 3: **Daily time distribution of observed fires**

Fire reports are obtained in tabular format from MoEF. These tabular data include information about fire location, start time, end time, burnt area and some more attribute information. Regional distribution map of MoEF offices indicated on Geographic Information Systems (GIS) on municipality level are also used to locate the fire areas.

DISCUSSION OF RESULTS

1909 FIR observations determined in the available data extending from 12 July to 30 August 2006 are compared with MoEF reports. Preliminary findings are provided in Table 1. FIR hit ratio indicates the percentage of FIR fires which falls not only within the starting and ending time of an observed fire that is listed in MoEF report but also has the same location information. 15.6 % of the FIR product matches with the MoEF report when all the FIR data are used in the analysis. For a preliminary study of the product validation, the result can be accepted as quite satisfactory. A cross-check is also performed against MoEF reports (Table 2). Out of 943 fire records in MoEF reports for July 12-August 30 duration 51, leading 5.4 %, matched with FIR observed fires.

	MSG Fire Observation			
MoEF	Fire	No fire	Total	Hit Ratio
	297	1612	1909	15.6%

Table 1: **FIR hit ratios**

	MoEF Fire Observation			
MSG	Fire	No fire	Total	Hit Ratio
	51	892	943	5.4%

Table 2: **Cross-check hit ratios**

Analyses are re-performed for various burnt area values to evaluate the area effect on accuracy. Table 3 summarizes the area effect on hit ratios and cross checks. MSG hit ratios are computed as %12.94, % 10.84, % 10.42 and % 10.32 where as, the cross-checks yielded 8.55, 11.61, 15.60 and 16.00 percents for burnt areas greater than or equal to 0.5, 1, 2.5 and 5 ha re-analysis, respectively. The slope information (hit ratio difference/area and cross check difference/area) is also provided in Table 3.

	MSG Hit Ratio					Cross Checks				
	All	**≥0.5**	**≥1.0**	**≥2.5**	**≥5.0**	**All**	**≥0.5**	**≥1.0**	**≥2.5**	**≥5.0**
Fire	297	247	207	199	197	51	37	26	22	20
No fire	1612	1662	1702	1710	1712	892	396	198	119	105
Total	1909	1909	1909	1909	1909	943	433	224	141	125
Hit Ratio (%)	***15.56***	***12.94***	***10.84***	***10.42***	***10.32***	**5.41**	**8.55**	**11.61**	**15.60**	**16.00**
Slope		***-5.24***	***-4.20***	***-0.28***	***-0.04***		**6.28**	**6.12**	**2.66**	**0.16**

***Table 3: Area effect on hit and* cross-check ratios**

CONCLUSIONS

It is seen that, burnt area is an important parameter in the detectability of the fire by satellite systems and accuracy increases with the increasing values.

The study period matches with the stubble burning season and manual checks indicated that some of the FIR product indicates fire in the region of stubble but not forest. Thus, FIR product is also capable of detecting burning of the stubble. However, stubble fires are mostly not included in MoEF reports and leads a reduction in the accuracy. Thus, it is believed that accuracies will increase if they are included in MoEF reports.

During the analysis, inadequacy of the town naming led some problems. Similar case was mentioned by Hyvärinen (2006). Figure 4 shows a case of where the fire is recorded as 4 separate fires by FIR. However, it is indicated with one record with the name of only one town (Karacahisar) as forest fire in the MoEF report.

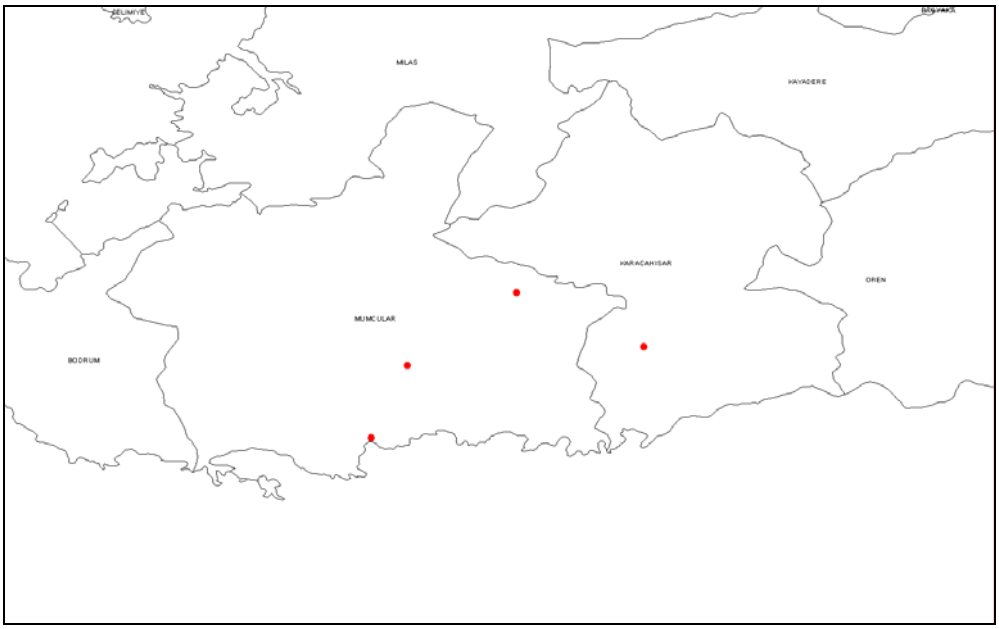

Figure 4: **Fires extending town boundaries**

FIR products were disseminated by ftp during the study. Some ftp connection problems occured and some of the MSG cycles could not be captured. This might also have reduced the hit ratios. FIR products have been disseminated via EUMETCast since 2007 February. This might overcome the data loss due to ftp connectivity problems.

The present study provides an preliminary assessment of EUMETSAT's FIR product. Despite being a new product, it is seen that it may be used as an early warning system for countries that suffer a lot from the wildfires.

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