Fire Detection over Africa using MSG/SEVIRI data

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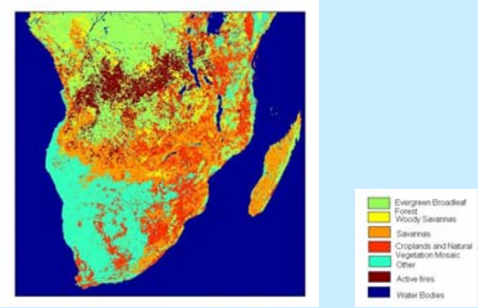
BACKGROUND AND MAIN OBJECTIVES

The potential of the **SEVIRI instrument** on-board the **MSG series**, for applications related to a wide range of **fire processes**, has long been recognized. **Applications** vary from pre-fire signal and **fire detection** to **fire monitoring** and burnt scar discrimination.

EUMETSAT's **Satellite Application Facility for Land Surface Analysis (LSA SAF)** is currently committed to **develop an algorithm** capable of **detecting and monitoring active fires**, particularly over Africa, that will lead to the operational generation, archiving and dissemination of the so-called **Fire Detection and Monitoring (FD&M) product**.

The **major contribution** of MSG/SEVIRI to the question of fire in Africa lies in the **reduction of uncertainties** in **biomass burning** estimation, and in the analysis of its diverse **environmental consequences**. It is also expected that active fire monitoring at **high frequency** will allow characterizing the **diurnal fire cycle**.

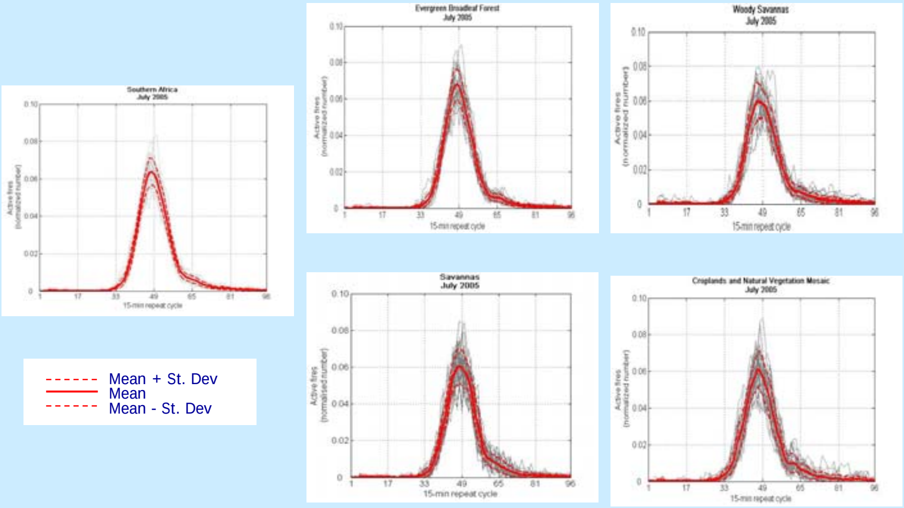
In **southern Africa** the burning season coincides approximately with the boreal summer, and fires progress in a West-East direction, from northern Angola and southern Congo in June-July, to Tanzania and Mozambique in September-October.



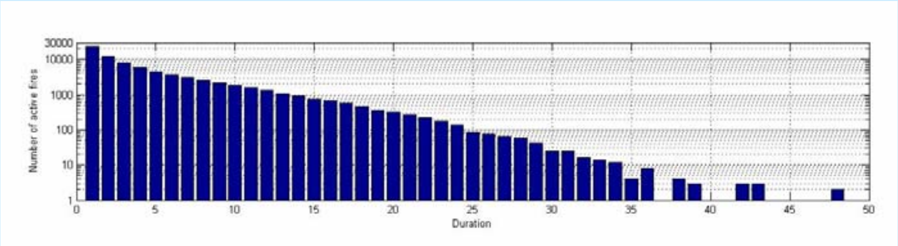
We present the first results obtained with a **contextual algorithm for active fire detection** based on **information from MSG/SEVIRI**. The algorithm was applied to a set of **Meteosat-8 images** covering the month of **July 2005**, with intervals of **15 minutes**.

We have paid special attention to the **diurnal fire cycles** over **southern Africa** as well as over **four different types of vegetation cover**. We have also looked at the **duration of fire events** on each fire pixel and the obtained **exponential-type** distribution is worth being noted.

DIURNAL CYCLE OF ACTIVE FIRES



DURATION OF ACTIVE FIRES



FIRE DETECTION ALGORITHM

1st step - Masks

- Mask of inland water bodies including rivers and lakes
- Mask of desert regions

2nd step – Selection of potential fire pixels

- Day time: $[(TB(3.9) \geq 318K) \cap (TB(3.9) - TB(10.8) \geq 10K)]$
- Night time: $[(TB(3.9) \geq 308K) \cap (TB(3.9) - TB(10.8) \geq 3K)]$

3rd step – Rejection I (clouds)

- Day time: $[R(0.6) + R(0.8) > 1{,}2] \cup [TB(12) < 265K] \cup [(R(0.6) + R(0.8) > 0{,}8) \cap (TB(12) < 285K)]$
- Night time: $[TB(12) < 265K]$

4th step – Rejection II (high reflective surfaces)

- Day time only: $[R(0.8) \geq 0{,}25]$

5th step – Rejection III (sun glint)

- Day time only: $[\theta_g < 5^\circ] \cup [(\theta_g < 15^\circ) \cap (R(0.8) > 0.2)]$

6th step – Confirmation of potential fire pixel

- Day time: $\left[TB_{PF}(3.9) > \overline{TB}(3.9) + \delta(3.9) - 3\right] \cap \left[\Delta T_{PF} > \overline{\Delta T} + MAX(2{,}5 * \delta(\Delta T), 4)\right]$
- Night time: $\left[\Delta T_{PF} > \overline{\Delta T} + MAX(2{,}5 * \delta(\Delta T), 4)\right]$

where: $\overline{TB}(3.9) = \frac{1}{N}\sum_{i=1}^{N}[TB_i(3.9)]$

$$\delta(3.9) = \frac{\sum_{i=1}^{N}\left|TB_i(3.9) - \overline{TB}(3.9)\right|}{N}$$

$$\overline{\Delta T} = \frac{1}{N}\sum_{i=1}^{N}[TB_i(3.9) - TB_i(10.8)] = \frac{1}{N}\sum_{i=1}^{N}\Delta T_i$$

$$\delta(\Delta T) = \frac{\sum_{i=1}^{N}\left|\Delta T_i - \overline{\Delta T}\right|}{N}$$

The above statistics are computed over valid [1] neighbouring [2] pixels.

[1] i.e. non-water, free-cloud, not affected by high reflection or sun glint and not potential fire pixels

[2] i.e. inside a 5×5 pixel window centered at the considered pixel