**ALPFFIRS, WP4**
**Fire conditions**
**Weather index**

## Fire Regime

We used two periods datasets, both longer than the project common period, to enhance the number of events. The relationships on fires occurrences and burnt areas to weather indices were studied for a period of 1995-2009. When the fire regime is analysed separately from weather parameters, the period was enlarged to 1991-2009 to define the more relevant profile.

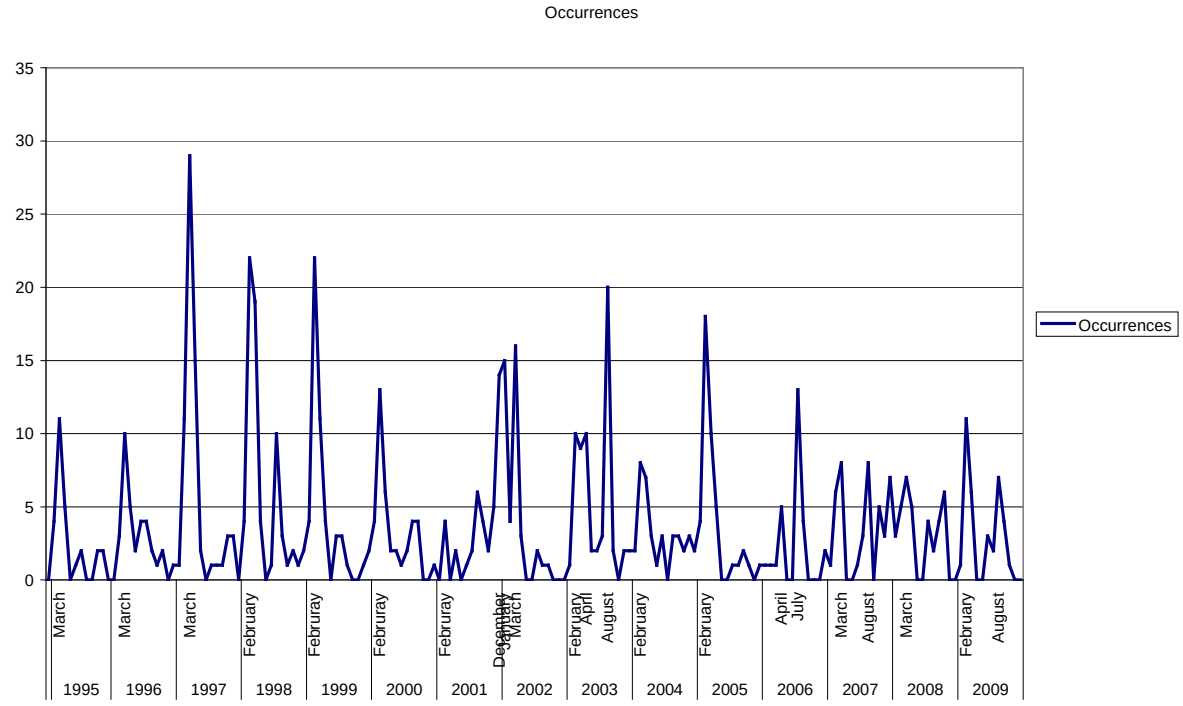


**Figure 1 : Chronologie des départs de feux période 1995-2009**

We observe a large inter-annual variability for occurrences and burnt surfaces. The only years of 1995, 1997, 1998 and 2002 total up a third of the events and half of the areas burnt during the whole 1991-2009 period (Figure 1).

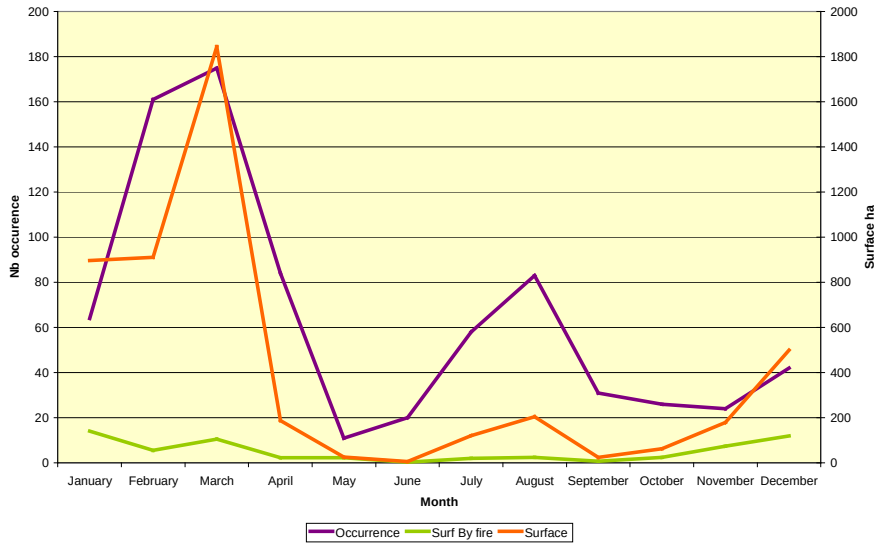


**Figure 2 : Cumulated occurrence and surface of fires : 1991-2009**

L'hiver est la période la plus critique du point de vue des départs de feux, cette saison d'hiver est centrée sur les mois de février et mars avec plus de 160 feux (Figure 2). Un maximum secondaire apparaît en été, au mois d'Août. Cette criticité se traduit également dans la superficie incendiée par feu avec 10ha l'hiver et plutôt 2ha l'été.

Pour caractériser les relations des paramètres météorologiques et définir des seuils adaptés, il est préférable d'analyser les données sur des périodes homogènes. L'échelle mensuelle nous paraît trop fine, elle limite le nombre d'événement et elle sépare « arbitrairement » des périodes de comportement similaires. Aussi définissons nous les bornes temporelles de ces périodes en appliquant un test non paramétrique de Mann-Kendall qui permet de détecter des ruptures dans une série.

## Seasons characterization

We applied mann-kendall tests to determine breaks in month evolution.

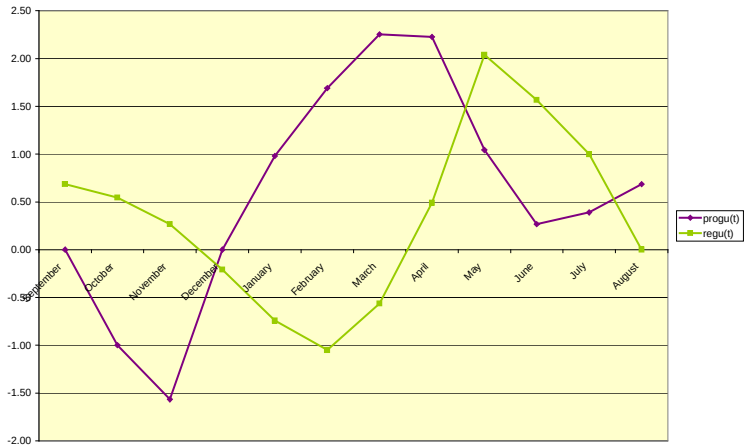


**Figure 3 : Mann Kendall test for occurrences – period 1991-2009**


**Figure 4 : Mann Kendall test for surfaces – period 1991-2009**

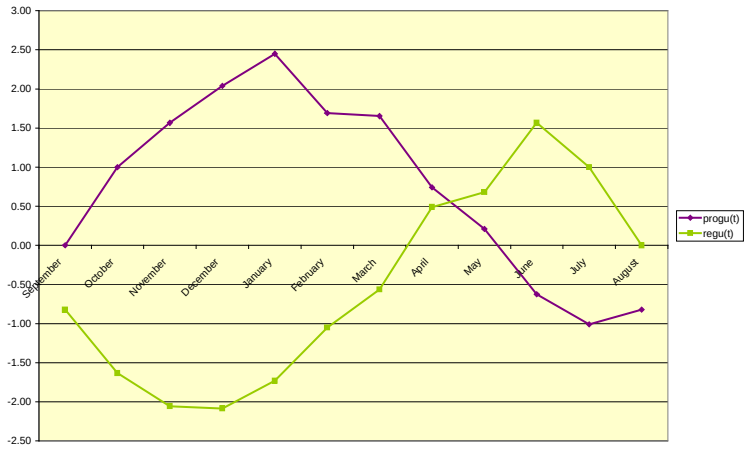


**Figure 5 : Mann Kendall test for surface burnt by fire – period 1991-2009**

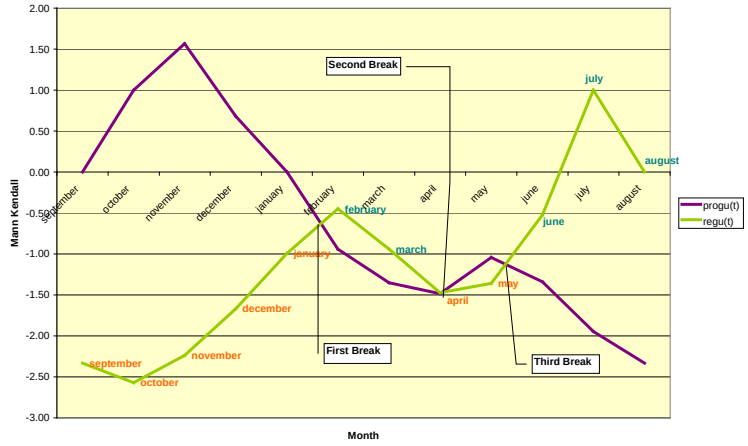


**Figure 6 : Breaks in monthly mean profile , Mann Kendall Test**

When the periods obtained for occurrences, surfaces, surface by fire are crossed three periods can be determined that we define as « seasons » (Figure 3 to Figure 5) :

- SW : January-April
- SS : May-August
- SA : September-December

## Paramètres d'indice de feu

The WSL and BOKU teams have developed a tool to generate weather indices based on meteorological parameters : temperature, wind speed, humidity, and precipitations. Its use need only a few input parameters related to location, initial values and snow period (Figure 7). This tool allow an harmonized computation on FWI and sub-indices and also several other fire indices to help to refine the danger index forcasting.

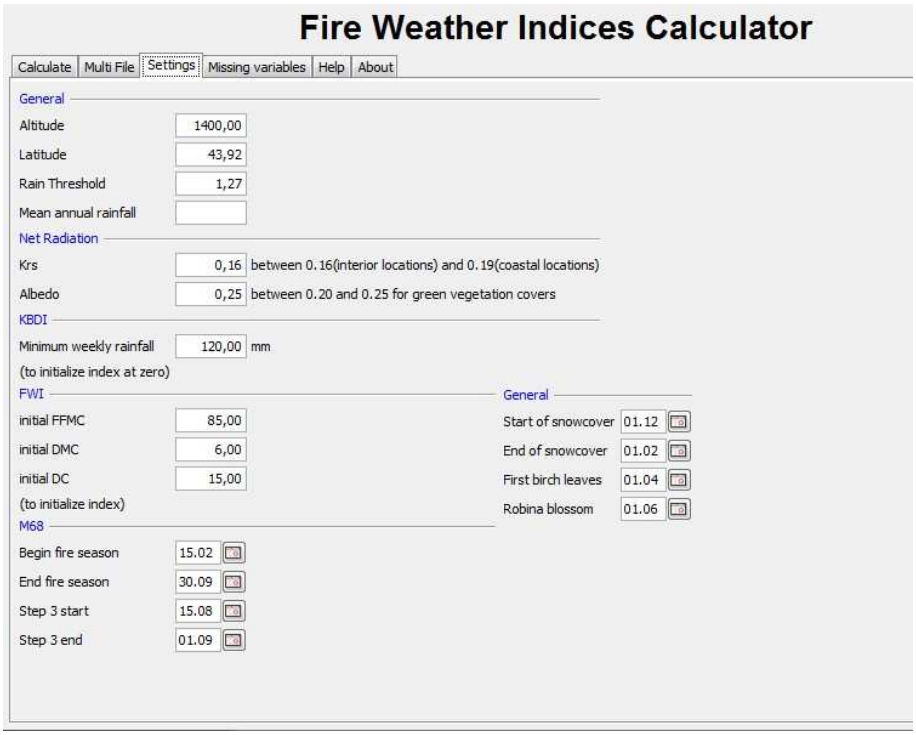


**Figure 7 : Input parameters in fire index calculator**

We have generated the indices on the complete period (1995-2009) and on the shorter one which constitute the common one for the project (2003-2009).

Our first task was to compare the French data of fire weather index (IFM) and its sub-indices which are computed and used in an operational way, to the one computed in the frame of the project. High relationship ensure a shared platform for the comparison to border countries, and relevance to climate change simulations.

We discovered very high correspondence on some periods and variation on some days. It is not related to any difference in the equations used to derive indices, the procedures are exactly the same and it explain the good correspondence in a part on the period. The observed deviation is related to a difference in the dataset used. On one hand we were addressed the validated observed data of MeteoFrance on 12TU. But the data actually used in the fire indice and danger indice is based on 6TU data, which can introduce a distance, especially for precipitation parameter when it is raining between 6 and 12TU. We assume that with the same data we would have the same generated output as we use the same equations. And we will check it on a short period (summer 2001) during autumn.

Our second task is to propose the best danger indice based on weather parameters.

## Weather indices evaluation

We analysed the fire weather indices generated to evaluate their ability to describe fire conditions. We applied several test to assess the quality of indices relationship to fires occurrences (and surfaces). The test were developed in R, we analysed which index or combination of indices have the best performances. As the tests analysis can be computed on several temporal frames, they were applied according to the seasons of fires previously defined. So that indices or thresholds set could be different regarding season. We retained non parametric tests as many indices distributions cannot be modelled :

- Kendall and Spearman test : are the evolution curves similar
- Alpffirs partners test of percentile skills and auc : in order to have a common basis to assess index performances
- Contingency: is there a different profile on fire/not fire days

## Indice combinations

We proposed to define an index based on the combination of the two best contributions. The first one has the best performance and the second one is chosen for its valuable add.

- For winter season FFMC and humidity are combined.

We compared mean index values to fire history data of fire occurrences classes (no fire, 1 fire, more than one) and surface classes (<5ha, over 5ha) in Table 1.

| Moyenne SW Index | Surface | | |
|---|---|---|---|
| Occurrence | 0 | 1 | 2 |
| 0 | 1.34 | | |
| 1 | | 1.88 | 2.30 |
| 2 | | 1.96 | 2.68 |

**Table 1 : SW index vs fire occurrences and surfaces classes (based on 308 fire events/1804 days)**

- BUI and water storage are retained for summer period (Table 2).

| Moyenne SS Index | Surface | | |
|---|---|---|---|
| Occurrence | 0 | 1 | 2 |
| 0 | 1.44 | | |
| 1 | | 2.24 | 2.67 |
| 2 | | 2.92 | 6.00 |

**Table 2 : SS index vs fire occurrences and surfaces classes (based on 118 fire events/1804 days)**

- The index is based on DMC and Humidity during autumn period (Table 3).

| Moyenne SA index | Surface | | |
|---|---|---|---|
| Occurrence | 0 | 1 | 2 |
| 0 | 1.42 | | |
| 1 | | 2.18 | 2.38 |
| 2 | | 3.20 | |

**Table 3 : SA index vs fire occurrences and surfaces classes (based on 96 fire events/1804 days)**