Laboratoire de climatologie
Université de Liège
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Automatic 1958-2007 daily weather patterns classification applied to an analysis of climatic conditions of wildfires in eastern Belgium

M. Erpicum(1) , X. Fettweis (1) , G. Mabille (1) and L . François (2)

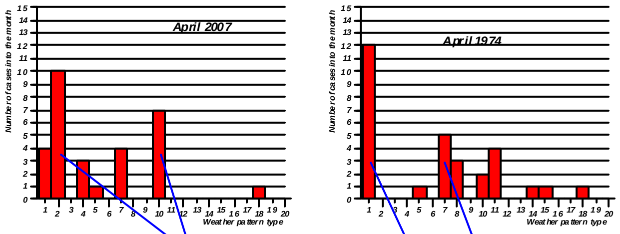
(1) Laboratoire de Climatologie, Université de Liège, Belgium, michel.erpicum@ulg.ac.be
(2) Climate and Biogeochemical Cycles Modelling, Astrophysics, Geophysics and and Oceanography Department, Université de Liège, Belgium

Abstract

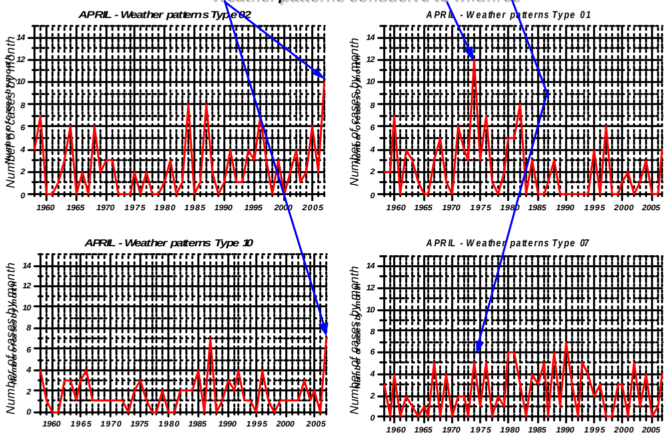
The daily weather pattern classification is founded on a 100 km regular grid centred on Belgium. The geopotential heights of 850 hPa level was extracted from the ERA-40 database on the period 1958-2002 and from ECMWF operational analysis until the end of year 2007. The classification was based on a similarity index calculated on the orientation of exaggerated slopes of different daily geopotential fields.
Wildfire occurrences (in peaty heaths) were analysed in April-May and September-October (which are the two periods with the most frequent wildfire-days in the *Hautes-Fagnes* region, situated in the eastern side of Belgium, altitude higher than 550m). These wildfire occurrences were compared with monthly frequency and persistence of daily weather patterns classes as well as with yearly variability of weather patterns climate conditions.
On this poster, we only focus our analysis on the daily weather patterns extracted for April (1500 different days).

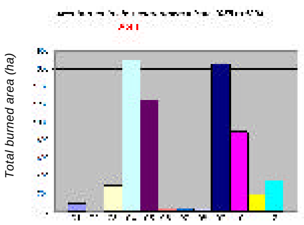
Extremely hot and dry month

Cold and dry month

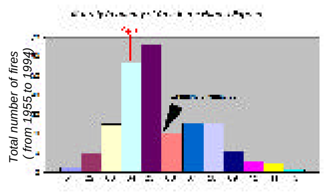


Weather patterns conducive to wildfires





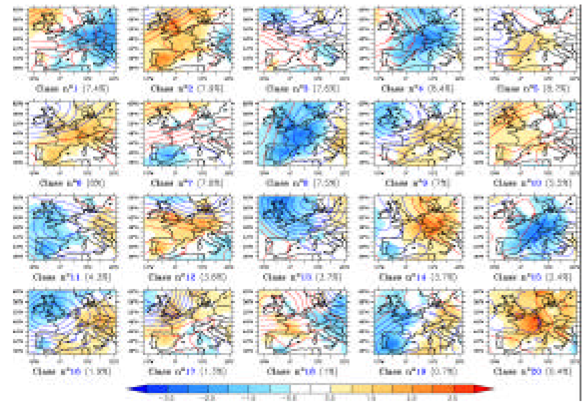
Months



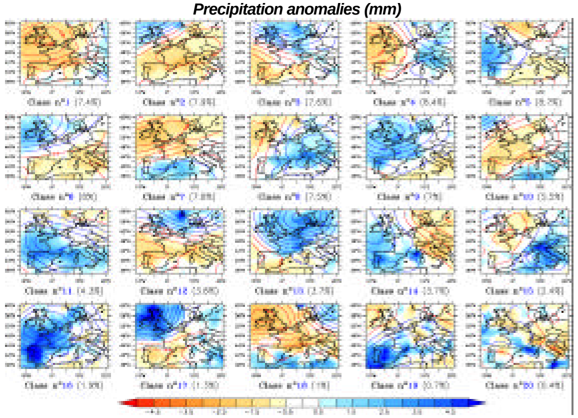
Months

20 weather patterns extracted by the automatic classification

2m-Temperature anomalies (°C)

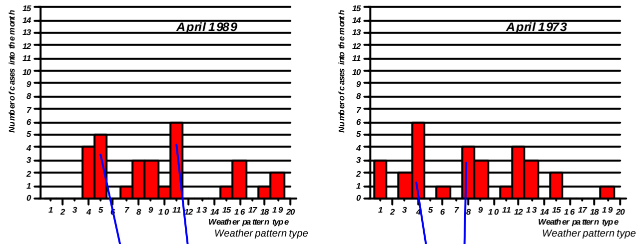


Precipitation anomalies (mm)

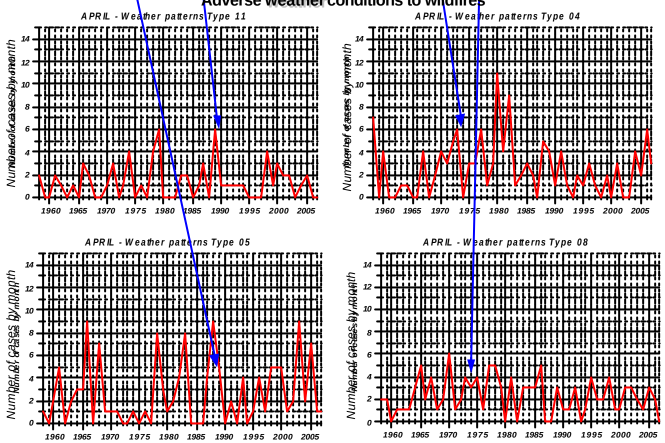


Extremely wet month

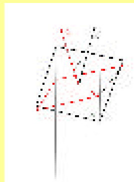
The coldest and snowiest month



Adverse weather conditions to wildfires



Weather classification algorithm



1. We compute firstly a similarity index i_1 based on the slope between two weather maps.
We compute the geometrical 3D direction of the vertical vector of the 850hPa geopotential surface for all grid points. We compute the cosine value of the angle between all the couples (between two different days) of vertical vectors for each grid point. We sum these cosines to create a similarity index for all couples of the weather maps (from 1958 to 2007). This index is normalised by the number of grid points. It equals 1 for the weather map with itself. It is near zero if the two weather maps (i.e. days) are very different.

2. We compute a second similarity index i_2 based on the absolute difference between two weather maps. This index is the sum on the grid points of the absolute difference in meter of geopotentiel between two weather maps. This index is normalized to vary between 0 and 1. It equals 1 for the weather map with itself. It is near zero if the two weather maps (i.e. days) are very different.

3. For a given similarity index threshold, for each weather map, we compute the number of similar weather maps (i.e. their similarity index (=0.5 i_1 + 0.5 i_2) are higher than the similarity index threshold). The weather map reference of the first class is the weather map which contains the maximum of similar weather maps, the second one is the 2nd largest class and so on ...for a fixed similarity index threshold.

4. We decrement the similarity index threshold from 1 to 0 until 100% of weather maps are classified. This similarity index threshold (just as it) is used to classify the elements in the class #1. To classify elements in the class #2, we use this similarity index threshold minus a fixed rate. In class #3, we use this similarity index threshold minus 2 times this fixed rate. The similarity index threshold and the fixed rate are chosen to classify 100% of weather maps and to minimise the total classes-pondered standard deviation.