

Forest fire risk in Brandenburg and Baden-Württemberg under climate change conditions

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Analysis of forest fire events

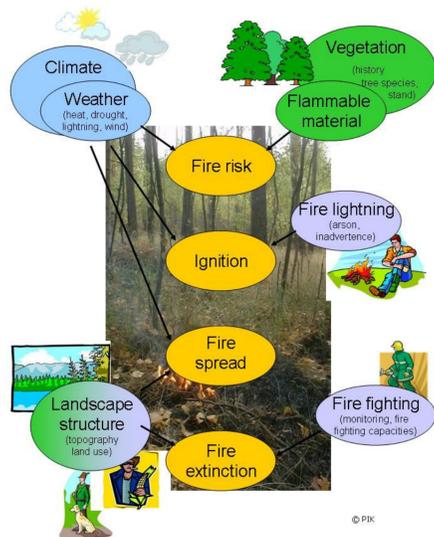


Figure 1 Causal chain of forest fire events

In landscapes used by man frequency and extent of vegetation fires depends on the state of ecosystems, the weather, and human activities. Fire risk increases with long lasting drought periods because litter layers and flammable plant parts dry out. Natural causes as lightning and anthropogenic ignition sources due to arson and inadvertence lead to ignition of fires. Landscape structure as well as fire monitoring and fire fighting capacities determine how big the fires can grow.

Calculation of climatic fire risk

Forest fire indices are used to characterise the climatic forest fire risk. The fire index M-68 (Käse) also used by the meteorological service (DWD) is mapped to daily climatic fire risk levels (Waldbrandwarnstufen). The annual average (April-September) of the risk levels at meteorological station Potsdam (1975-2003) is correlated ($r^2=0.63$) with the annual number of fires in Brandenburg (Fig. 2). The relatively high fraction of variance in annual fire numbers explained by weather only shows the relevance of climatic disposition for the probability of fire lightning.

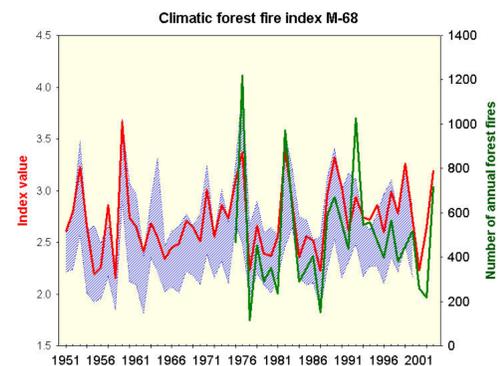


Figure 2 Annual average forest fire risk level at the site Potsdam M-68 (red line) in comparison with forest fire data of Brandenburg from 1975 to 2003 (green line). The blue shaded area shows the variation of annual index values at 59 climate stations in Brandenburg (1951-2000).

Climatic forest fire risk in Brandenburg 2001-2050

With a statistical scenario model 100 climate change scenarios at 59 climate and precipitation stations in Brandenburg were developed, for the period 2001-2055. They are characterized by a transient temperature increase (leading to a warming of + 1.4 ° Kelvin at the end of the scenario period) and different precipitation characteristics. Three were selected:

- **Sz1**: most probably scenario with precipitation decrease
- **Sz2**: scenario with a medium precipitation decrease
- **Sz3**: scenario with the strongest precipitation increase

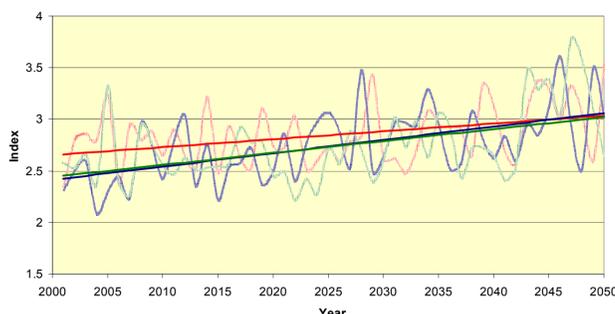


Figure 3 Trend of the climatic fire risk in Brandenburg under the climate change scenarios Sz1 (red), Sz2 (blue) und Sz3 (green) calculated and averaged for 59 stations.

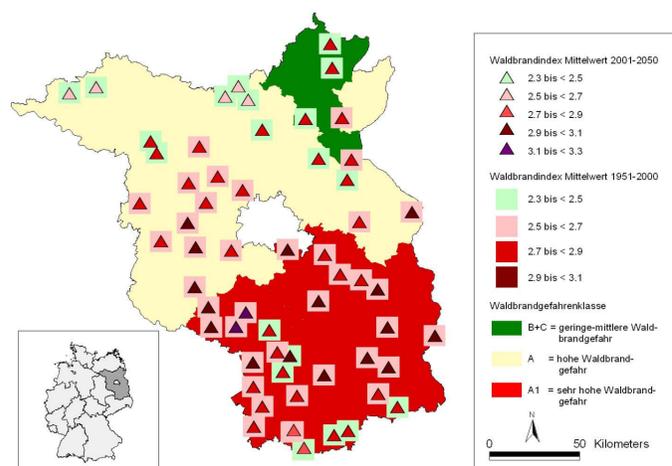


Figure 4 Map of changes in climatic fire risk (M-68) under the climate change scenario Sz1 from 2001 to 2050 (triangle symbol) at 59 climate stations in comparison with fire risk from 1951 to 2000 (squares). The coloured background shows regions that are rated in fire risk classes (decreasing risk from A1 to C) by the administration based on the long term fire records.

The climatic fire risk increases all-over Brandenburg under the assumed climate change in more humid areas (fire risk class B+C) as well as in the areas which are very dry already under current conditions (Fig. 4). Especially in the fire risk class A1 (highest risk, red coloured part of the map in southern Brandenburg) very high values of climatic fire risk in 2001-2050 on average could arise.

Climatic forest fire risk in Baden-Württemberg 2001-2050

In the framework of the project KLARA („Klimawandel – Auswirkungen, Risiken, Anpassung“) a time series of current climate (1951-2000) and a transient scenario for the period 2001-2055 were generated for 245 stations in Baden-Württemberg with a temperature increase of about 1.2 ° Kelvin derived from a ECHAM4-T42-OPYC-run (global circulation model).

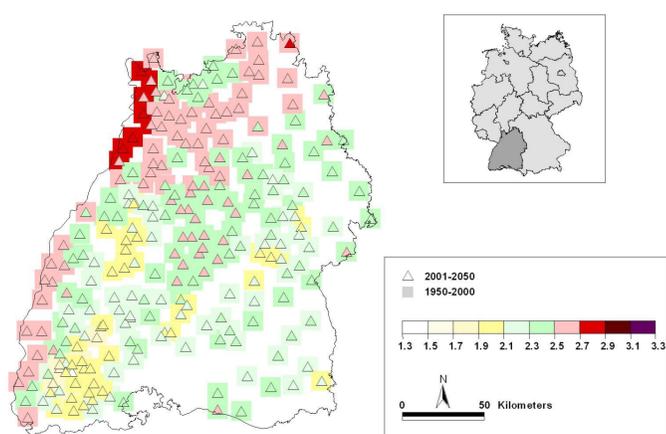


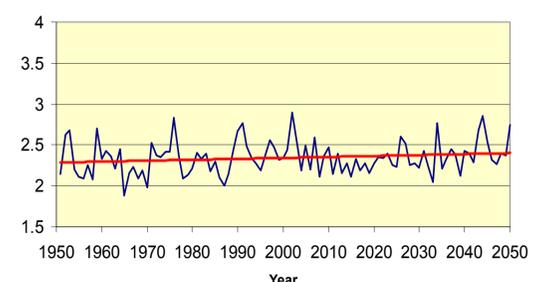
Figure 5 Climatic forest fire index (M-68) under current (squares) and climate change (triangles) conditions. A slight increase of forest fire risk can be expected in the lee of the Black forest and a decrease in the northern and western part.

Climatic fire risk clearly is higher in Brandenburg in comparison with Baden-Württemberg under current climate. Climate change will probably lead to sensible increases in fire risk in Brandenburg while the climatic fire risk in Baden-Württemberg increases only slightly (Fig. 5 and 6). This is mainly caused by the low precipitation levels in Brandenburg that are even decreasing in the most likely climate change scenario (see Tab.1) in parallel with higher atmospheric evaporative demand due to increasing temperatures.

| | 1951-2000 | | 2046-2055 | |
|-------------|-----------|--------|-----------|--------|
| | T [°C] | P [mm] | T [°C] | P [mm] |
| Brandenburg | 8.8 | 556 | 10.9 | 471 |
| Baden-W. | 8.4 | 992 | 9.9 | 983 |

Table 1 Long term annual means and sums of climatic characteristics in Brandenburg and Baden-Württemberg under current climate and for the climate change scenario (SZ1), calculated by averaging data for all climate stations.

Figure 6 Trend of the climatic fire risk index M-68 in Baden-Württemberg from 1951 to 2050 using current climate and a climate change scenario. For the period 1992-2000 a low correlation of $r=0.41$ was found between the annual risk level and the number of fires.



An expected climate change characterised by a temperature increase between 1.2 and 1.4 ° Kelvin for the next 50 years leads to clearly different climatic fire risk in Brandenburg and Baden-Württemberg.

In 2003 the very dry weather conditions in Brandenburg resulted in a remarkable forest fire year with about 747 forest fire events. Also in Baden-W. 2003 was an exceptional fire year with 136 reported fires, the highest fire number in the period 1992-2003. Thus, an increased frequency of extreme heat wave years is expected to increase fire risks. However, even in 2003 the fraction of the total forested area affected by fires was one order of magnitude lower in Baden-W. than in Brandenburg.

