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# A high-resolution modelling approach on spatial wildfire distribution in the Tyrolean Alps

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Global warming will cause increasing danger of wildfires in Austria, which can have long-lasting consequences on woodland ecosystems. The protective effect of forest can be severely diminished, leading to natural hazards like avalanches and rockfall. However, data on wildfire frequency and distribution have been sparse and incomplete for Austria. Long-lasting postfire degradation under adverse preconditions (steep slopes, limestone) was a common phenomenon in parts of the Tyrolean Alps several decades ago and should become relevant again under a changing fire frequency.
The FIRIA project compiles historical wildfire data, information on fuel loads, fire weather indices (FWI) and vegetation recovery patterns. The governing climatic, topographic and socio-economic factors of forest fire distribution were assessed to trigger a distribution model of currently fire-prone areas in Tyrol.

By collecting data from different sources like old newspapers archives and fire-fighter databases, we were able to build up a fire database of wildfire occurrences containing more than 1400 forest fires since the 15th century in Tyrol. For the period from 1993 to 2011, the database is widely complete and covers 482 fires. Using a non-parametrical statistical method it was possible to select the best suited fire weather index (FWI) for the prediction. The testing of 19 FWI's shows that it is necessary to use two discriminative indices to differentiate between summer and winter season. Together with compiled topographic, socio-economic, infrastructure and forest maps, the dataset was the base for a multifactorial analysis, performed by comparing the maximum entropy approach (Maxent) with an ensemble classifier (Random Forests). Both approaches have their background in the spatial habitat distribution and are easy to adapt to the requirements of a wildfire ignition model. The aim of this modelling approach was to determine areas which are particularly prone to wildfire. Due to the pronounced relief curvature we based our model on 100 x 100 m cells to identify individual slopes and their topography. The first provisional result is a map of fire probability under current climate conditions (fire hot-spots). Our modelling approach indicates the fire weather index as the main driver, which is followed closely by socioeconomic (population density) and infrastructure factors (roads density, aerial railways, building density). The leverage of the forest community or its management is rather low; the same applies to topographic influences like aspect or sea level. The derived fire hot-spots are either placed close to the valley ground or around touristic infrastructure, with an overall preference for inner alpine areas and south-facing slopes.

In the next step, the impact of climate change on the distribution and frequency of fires will be assessed by calculating a climate change model adapted to the 1x1km INCA dataset and based on different regional climate change models. Finally, a selection of fire-hot-spots from the previous modelling steps will be used for enhanced 3D-modelling approaches of natural hazards after wildfire-driven deforestation.