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Forest fire danger indices under extreme meteorological conditions in a complex topography – the situation in the Bavarian Alps in autumn 2011

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Temperature inversions in mountainous areas cause situations in which spatial forest fire danger distribution is quite different than under normal conditions. Due to this effect, fire danger can vary distinctively within a relatively small scale with much greater fire danger at higher than at lower elevations. This paper investigates such a peculiar situation in a case study in the Bavarian Alps and its representation by standard forest fire danger indices.

A persistent high pressure system caused a major drought event and a pronounced temperature inversion in the northern part of the European Alps in autumn 2011. This drought, during which no precipitation at all was registered over more than a month in some locations, came at a time when normally the first snow would have been expected (November). In addition to the drought, the atmosphere was stratified very stable with cool, humid conditions in the lower and warmer, dryer conditions in the elevated regions. The result was a massive drying of fuels in higher elevations, which lead to a very high fire danger level and multiple fire occurrences in these areas (e.g. November 7th near Bayrischzell and November 20th near Fall). On the other hand, lower overall temperatures and nightly wetting due to dew and even rime occurred in the valleys, therefore fire danger remained moderate there.

To assess the accuracy of fire danger rating indices in this situation, meteorological data and selected indices (Angstrom, M-68, Fine Fuel Moisture Code, Duff Moisture Code, hourly calculated FFMC) from two close-by stations at the valley floor (719m a.s.l.) and a south-facing mid-slope position (1260m a.s.l.) near Garmisch-Partenkirchen (Germany) were compared against the actual fire danger as apparent from expert observations, multiple fire occurrences and some fuel moisture measurements. The results revealed that during temperature inversion, differences in the daily cycle of meteorological parameters have a major influence on fire danger and that these are not well resolved by fire danger indices using daily inputs only. However, there are some indices available which can potentially deal with this situation.