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WRF-based fire risk modelling and evaluation for years 2010 and 2012 in Poland

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Wildfires are one of the main ecosystems' disturbances for forested, seminatural and agricultural areas. They generate significant economic loss, especially in forest management and agriculture. Forest fire risk modeling is therefore essential e.g. for forestry administration.

In August 2015 a new method of forest fire risk forecasting entered into force in Poland. The method allows to predict a fire risk level in a 4-degree scale (0 – no risk, 3 – highest risk) and consists of a set of linearized regression equations. Meteorological information is used as predictors in regression equations, with air temperature, relative humidity, average wind speed, cloudiness and rainfall. The equations include also pine litter humidity as a measure of potential fuel characteristics. All these parameters are measured routinely in Poland at 42 basic and 94 auxiliary sites. The fire risk level is estimated for a current (basing on morning measurements) or next day (basing on midday measurements). Entire country is divided into 42 prognostic zones, and fire risk level for each zone is taken from the closest measuring site.

The first goal of this work is to assess if the measurements needed for fire risk forecasting may be replaced by the data from mesoscale meteorological model. Additionally, the use of a meteorological model would allow to take into account much more realistic spatial differentiation of weather elements determining the fire risk level instead of discrete point-made measurements.

Meteorological data have been calculated using the Weather Research and Forecasting model (WRF). For the purpose of this study the WRF model is run in the reanalysis mode allowing to estimate all required meteorological data in a 5-kilometers grid. The only parameter that cannot be directly calculated using WRF is the litter humidity, which has been estimated using empirical formula developed by Sakowska (2007). The experiments are carried out for two selected years: 2010 and 2012. The year 2010 was characterized by the smallest number of wildfires and burnt area whereas 2012 – by the biggest number of fires and the largest area of conflagration.

The data about time, localization, scale and causes of individual wildfire occurrence in given years are taken from the National Forest Fire Information System (KSIPL), administered by Forest Fire Protection Department of Polish Forest Research Institute. The database is a part of European Forest Fire Information System (EFFIS). Basing on this data and on the WRF-based fire risk modelling we intend to achieve the second goal of the study, which is the evaluation of the forecasted fire risk with an occurrence of wildfires. Special attention is paid here to the number, time and the spatial distribution of wildfires occurred in cases of low-level predicted fire risk. Results obtained reveals the effectiveness of the new forecasting method. The outcome of our investigation allows to draw a conclusion that some adjustments are possible to improve the efficiency on the fire-risk estimation method.