CONFIRM: Copernicus Data for Novel High-Resolution Wildfire Danger Services in Mountain Regions

Ruxandra-Marla Zotta¹, Clement Atzberger², Jörg Degenhart³, Markus Hollaus¹, Markus Immitzer², Haimo Krajnc⁴, Heinz Lick⁵, Mortimer M. Müller⁶, Harald Oblasser⁷, Andreas Schaffhauser⁷, Stefan Schlaffer¹, Harald Vacik⁵, and Wouter Dorigo¹

¹Vienna University of Technology (TU Wien), Department of Geodesy and Geoinformation, Vienna, Austria
²University of Natural Resources and Life Sciences (BOKU), Institute of Geomatics, Vienna, Austria
³Landesfeuerwehrverband Tirol, Telfs, Austria
⁴Berufsfeuerwehr Graz, Graz, Austria
⁵Landesforstdirektion Steiermark, Graz, Austria
⁶University of Natural Resources and Life Sciences (BOKU), Institute of Silviculture, Vienna, Austria
⁷Amt der Tiroler Landesregierung, Abteilung Waldschutz, Innsbruck, Austria
⁸Zentralanstalt für Meteorologie und Geodynamik (ZAMG), Vienna, Austria

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Forest fires in Austria 2020

Chronik
Großeinsatz für Feuerwehr bei Waldbrand
Bei Saubersdorf (Bezirk Neunkirchen) ist Dienstagabend ein Waldbrand ausgebrochen. Mehr als 300 Einsatzkräfte von 50 Feuerwehren kämpfen gegen die Flammen. Betroffen waren laut Landesfeuerwehrkommando 30 Hektar Wald.
1. April 2020, 16:15 Uhr (Update: 7. April 2020, 17:27 Uhr)

Chronik
Brände sorgen für Großeinsätze
Ein Böschungsbrand hat Dienstagmorgen zu einem Großeinsatz der Feuerwehr an der Brennerautobahn bei Patsch geführt. In Kirchdorf (Bezirk Kitzbühel) geriet ein gelegtes Feuer außer Kontrolle.
7. April 2020, 18:37 Uhr (Update: 8. April 2020, 8:56 Uhr)
FIRE in Austria

EFFIS

Forecasts

FIRE DANGER FORECAST

Source: ECMWF (8 km res.)

Index: Fire Weather Index (FWI)

Date: 25 Apr 2020

Fire Danger Forecast (ECMWF/FWI)

GHSL - Global Human Settlement Layer

EFFIS - Copernicus [Ver. 2.4.0], Brexit disclaimer, © OpenStreetMap contributors
Overview

- **Fire Danger Forecast** based on
  - Expert knowledge
    - **Stakeholder involvement** (fire departments, forest managers, weather services, infrastructure providers)
  - Machine Learning to estimate
    - Fuel moisture and structure
    - Forest fire danger
  - 3-day weather forecast
- Demonstration during fire season 2021
- Target spatial resolution: 100m
- Expert-based approach
  - Individual factors are combined by weights
  - Definition of thresholds for fire danger rating (1 – 5)
  - Different weighting scenarios are tested against fire occurrences

- Quantitative modelling approach
  - Feed the input data into the machine learning algorithm
  - Compare different approaches
  - SOFIA (Forkel et al. 2017), Random Forest, MaxEnt (Arpaci et al. 2014)
Stakeholder Involvement

- Development workshops:
  - Stakeholders will actively participate in concept development and refinement

- User evaluation
  - Potential users will test prototype IFDS during demonstration phase (April 2021 - February 2022)
  - Empirical evidences will be compared with various predictions of IFDS
    - Expert knowledge based on interpretation of real situations in the field
    - Interpretation of satellite-derived moisture- and vegetation-related products and interpretation of fire weather indices (FWI based on INCA weather forecasts)
Burned area equals vegetated area $A \cdot f$:

$$BA_t = \sum_{g=1}^{N} A_g \cdot f_{g,t}$$

Environmental controls: product of several logistic/exponential functions based on climate, vegetation or socioeconomic variables $x$:

$$f_g = \prod_{i=1}^{N} f(x_{i,g})$$

$$f(x_{i,g}) = \min\left(1, \frac{\max_{g,i}}{1 + e^{-s_{i,g} \times (x - x_{0,i,g})}}\right)$$

Sum of relative importance of rankings of variables in RF and Max Ent based on 10 runs. Each run gives 12 points at maximum, so the highest possible score is 120.
Satellite data

Sentinel-2
Forest type/tree species
Vegetation state

+ Weather data

LiDAR

Forest structure
Topography

+ Infrastructure data

+ Fire occurrence data

Data
Satellite data

Sentinel-1
Soil and vegetation water content

+ Weather data

LiDAR

Forest structure
Topography

+ Infrastructure data

+ Fire occurrence data

Data
Visualisation tool

- **prototype** [http://www.waldbrand.at](http://www.waldbrand.at) combines datasets on topography, vegetation, human impact, lightning, meteorology, fuel classes, fuel moisture content
- supports the definition of weighting scenarios by experts
- documentation and retrieval of fire danger on fire / non fire days

With contributions from:
- Arpaci et al., 2011
- Arpaci et al., 2013
- Arndt et al., 2013
- Grima, 2011
- Albers, Jasper, 2012
- Müller et al., 2013
- Müller et al., 2020
- Vacik et al., 2011
References