Current and future fire weather risk in Tyrol

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FIRIA Project

Partners:
- Institute of Geography and Regional Science (IGR), University of Graz
- University of Natural Resources and Life Sciences (BOKU), Vienna
- alpS - Centre for Climate Change Adaptation Technologies, Innsbruck

Objectives:
- Identify driving factors of wildfires in Austria
- Model current and future fire hazard in Tyrol
- Analyze natural hazards, which could be triggered by wildfires
Forest fires in Austria

Forest Fires in Austria
1874 - 2011
Factors contributing to fire danger

<table>
<thead>
<tr>
<th>Factor</th>
<th>Average contribution %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population density at r = 3 km</td>
<td>30.4</td>
</tr>
<tr>
<td><strong>Fire Weather indices (number of fire risk days)</strong></td>
<td><strong>29.67</strong></td>
</tr>
<tr>
<td>Forest type</td>
<td>11.59</td>
</tr>
<tr>
<td>Building density at r = 0.3 km</td>
<td>9.65</td>
</tr>
<tr>
<td>Aspect</td>
<td>4.25</td>
</tr>
<tr>
<td>Railroad density</td>
<td>3.63</td>
</tr>
<tr>
<td>Elevation</td>
<td>3.63</td>
</tr>
<tr>
<td>Aerial passenger lines density</td>
<td>3.02</td>
</tr>
<tr>
<td>Slope</td>
<td>2.09</td>
</tr>
<tr>
<td>Paved streets density</td>
<td>1.16</td>
</tr>
<tr>
<td>Forest roads and hiking trails density</td>
<td>0.59</td>
</tr>
<tr>
<td>Forest protective management type</td>
<td>0.08</td>
</tr>
</tbody>
</table>

(A. Arpaci, 2nd FIRIA Interim Report)

University of Natural Resources and Life Sciences, Vienna
- Department of Water, Atmosphere and Environment
Canadian Fire Weather Index System

Fire weather observations
- Temperature Relative humidity
- Wind
- Rain
- Wind speed

Fuel moisture codes
- Fine fuel moisture code (FFMC)
- Duff moisture code (DMC)
- Drought code (DC)

Fire behavior indices
- Initial spread index (ISI)
- Buildup index (BUI)

Fire weather index (FWI)

Used
April – November („summer“)
M68 (DWD)

\[ M68_t = k_3 \cdot pM68_t \]

\[ pM68_t = k_1 \cdot pM68_{t-1} + \max \left[ 0, k_2 \cdot \frac{T_{13_t} + k_3}{10} \cdot \Delta e_{13_t} \right] \]

\[ k_1 = \begin{cases} 
1, & \text{if } P_t < 1 \\
0.5, & \text{if } 1 \leq P_t < 5 \quad \text{or } \text{Snowcover} \geq 1 \text{ cm since } t \\
0.25, & \text{if } 5 \leq P_t < 10 \quad \text{or } \text{Snowcover} \geq 1 \text{ cm since } t-1 \\
0, & \text{if } P_t \geq 10 \quad \text{or } \text{Snowcover} \geq 1 \text{ cm since } t-2 
\end{cases} \]

\[ k_2 = \begin{cases} 
0, & \text{if } P_t \geq 20 \quad \text{or } \text{Snowcover} \geq 1 \text{ cm since } t-2 \\
0.5, & \text{if } P_t < 20 \text{ and } (P_{t-1}, P_{t-2} \text{ or } P_{t-3}) \geq 20 \\
1, & \text{if } P_t, P_{t-1}, P_{t-2} \text{ and } P_{t-3} < 20 
\end{cases} \]

\[ k_3 = \begin{cases} 
3, & \text{for } t < t_1 \\
2, & \text{for } t_1 \leq t \leq t_2 \quad \text{with } t_2, \text{first occurrence of rainfall} \geq 5 \text{mm after the start of the phenological phase } "\text{Robinia, first blossom}" \\
1, & \text{for } t_2 < t < t_3 \quad \text{with } t_3, \text{first occurrence of rainfall} \geq 5 \text{mm after 14th of August, at the latest 1 September} \\
0.5, & \text{for } t \geq t_3 
\end{cases} \]

Used December – March
(“winter“)

June 6th, 2013
## Danger Levels

<table>
<thead>
<tr>
<th>Danger level</th>
<th>Lower threshold percentile</th>
<th>Upper threshold percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>50</td>
<td>75</td>
</tr>
<tr>
<td>4</td>
<td>75</td>
<td>99.7</td>
</tr>
<tr>
<td>5</td>
<td>99.7</td>
<td>100</td>
</tr>
</tbody>
</table>

### Map of Forest-mask Tyrol 1x1 km

[Map of Forest-mask Tyrol 1x1 km]

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June 6th, 2013

Institute of Meteorology  I  David Leidinger
Regional Climate Models

bias-corrected, localised RCMs:

- Aladin
- RegCM3

Bias-correction was performed using E-Obs and Frei and Schär dataset

Localisation was used INCA dataset
Change in Temperature (summer)
Change in Temperature (winter)
Change in Precipitation (summer)
Change in Precipitation (winter)
Nuber of days with danger level 4-5
BUI (summer) - Aladin
Nuber of days with danger level 4-5 
BUI (summer) - RegCM3
Number of days with danger level 4-5
M68 DWD (winterer) - Aladin
Nuber of days with danger level 4-5

M68 DWD (winterer) - RegCM3
Nuber of days with danger level 4-5
M68 DWD (winterer) - Aladin
Anomaly on Elevation
BUI - Aladin

Anomaly on elevation step
number of days of BUI (Aladin) in danger level 4-5
1981 - 2010

Anomaly on elevation step
number of days of BUI (Aladin) in danger level 4-5
2011 - 2040

2041 - 2070

2071 - 2100
Thank you for your attention!

Any questions...?

This work was carried out as part of the Austrian Climate Research Programme (ACRP) part of the Klima und Energiefonds (Kli.En).