Activities of DB AG

Workshop, October 19 & 20 2010, Paris

Roland Nolte, IZT Berlin
ARISCC - Adaptation of Railway Infrastructure to Climate Change

Extreme Weather Events in Germany – Elbe flood 2002
Consistent data bases (events, damage, status of assets)

Damage & delays caused by storms and gales

Heatwaves and extended dry periods
(track buckling, maintenance problems, safety, destabilization....)

Flooding (surface and fluvial flooding)

Long-term: Change in vegetation growth patterns
Activities of Deutsche Bahn

- Data analysis (weather-related incidents & delays)
- First assessment of regional climate scenarios
- Case study Rhine valley within ARISCC
- Dedicated on-line weather monitoring system (Bavaria)
Correlation between Temperature and the number of incidents

Average of number of incidents >150

Median

Number of incidents per day

8 10 12 14 16 18 20 22 24 26 28 30

daily mean temperature
## Assessment of regional climate scenarios

<table>
<thead>
<tr>
<th>Summer rain</th>
<th>Winter rain</th>
<th>Heat waves</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

![Map of Germany with climate scenarios]

- **Nordwestdeutsches Tiefland/Nord- und Ostseeküste**
- **Nordostdeutsches Tiefland**
- **Westdeutsche Tieflandsbucht**
- **Zentrale Mittelgebirge und Harz**
- **Südostdeutsche Becken und Hügel**
- **Links- und Rechtsrheinische Mittelgebirge**
- **Oberrheingraben**
- **Alp und Nordbayerisches Hügelland**
- **Erzgebirge, Thüringer und Bayerischer Wald**
- **Alpenvorland**

- **Alpen**
Expected Climate Loads for the Rhine Valley (1)

Number of hot summer days in NRW in 2046/2055 and change from the baseline 1951/2000
Changes in Winter Precipitation 1961-1990 and 2071-2100
(Mountain Ranges along the Rhine)

More winter rain!
### Expected Climate Loads for the Rhine Valley – „Event days“

<table>
<thead>
<tr>
<th>Nr.</th>
<th>cold days</th>
<th>very cold days</th>
<th>warm summer days</th>
<th>hot summer days</th>
<th>dry days</th>
<th>wet days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$T_{\text{min}&lt;0^\circ}$</td>
<td>$T&lt;0^\circ$</td>
<td>$T_{\text{max}&gt;25^\circ}$</td>
<td>$T_{\text{max}&gt;30^\circ}$</td>
<td>$N&lt;0,1\text{mm}$</td>
<td>$N&gt;10\text{mm}$</td>
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<tr>
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<td>-5,0</td>
<td>22,5</td>
<td>8,7</td>
<td>4,0</td>
<td>0,5</td>
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<tr>
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<td>-3,6</td>
<td>21,6</td>
<td>8,2</td>
<td>9,0</td>
<td>1,0</td>
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<tr>
<td>3</td>
<td>-20,7</td>
<td>-8,5</td>
<td>16,9</td>
<td>6,0</td>
<td>3,6</td>
<td>0,7</td>
</tr>
<tr>
<td>4</td>
<td>-16,2</td>
<td>-6,6</td>
<td>17,4</td>
<td>5,2</td>
<td>4,4</td>
<td>1,4</td>
</tr>
<tr>
<td>5</td>
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<td>-5,2</td>
<td>17,6</td>
<td>6,3</td>
<td>-3,9</td>
<td>1,8</td>
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<td>3,4</td>
<td>1,5</td>
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<td>-6,2</td>
<td>18,0</td>
<td>6,4</td>
<td>4,4</td>
<td>1,1</td>
</tr>
</tbody>
</table>

Change of the number of event days (1951/2000 compared to 2046/2055)
Expected Climate Loads for the Rhine Valley (3)

More and longer heat waves!

Periods with Tmax > 30°C 1981/90 and 2091/2100 for the upper Rhine Valley;
Source: WettReg 2007
**Expected Climate Loads for the Rhine Valley (4)**

Sources: Climate Study North Rhine Westphalia 2004 & 2006

Changes from 1951/2000 to 2046/2055

- Temperature change: $T_{av} +1.53^\circ$, $T_{max} +1.68^\circ$, up to $2^\circ$
- Most significant changes: “event days” (indicator for extreme weather events)
- Subzero days: -12….-30 days!, average $–20$ (30%)
- Summer days ($T>25^\circ$) $+9….+26$ days, average: $+63\%$ (max: $+100\%$)
- Hot Summer days ( ), $+2…+12$ days, av: $+136\%$, max $>150\%$
- Total precipitation will increase with regional and seasonal differences
- Mainly Wetter winters & dryer summers
- Regional and local differences! Influence on vegetation growth!