Agroclimatic conditions in Europe under Climate Change

COST 734
May 2011 Topolčianky
Talk structure:

1. Introducing regional differences in agriculture production potential;

2. Range of agroclimatic conditions in this century;

3. A bit of historical context.

More details available in:


Production potential of agriculture:

- Solar radiation
- Air temperature
- Water availability
- Soil fertility and terrain configuration

Factors:
- Water unlimited
- Water limited
- Irrigation
- Crop rotation
- Fertilizers
- Machinery
- Pesticides
- Plant breeding
- Monitoring systems

Regional differences
Future agroclimate
Historical context
Production potential of agriculture:

- Solar radiation
- Air temperature
- Water availability
- Soil fertility and terrain configuration

Possitive influence:
- Irrigation
- Crop rotation
- Fertilizers
- Machinery
- Pesticides
- Plant breeding
- Monitoring systems

Negative influence: 

Production potential of agriculture:

**Water unlimited**

**Water limited**

1. Regional differences
2. Future agroclimate
3. Historical context
Environmental zones – rainfed productivity:

The Environmental Stratification of Europe

Environmental Zone
- ALN - Alpine North
- BOR - Boreal
- NEM - Nemoral
- ATN - Atlantic North
- ALS - Alpine South
- CON - Continental
- ATC - Atlantic Central
- PAN - Pannonian
- LUS - Lusitanian
- ANA - Anatolian
- MDM - Mediterranean Mountains
- MDN - Mediterranean North
- MDS - Mediterranean South
Change of the temperature and precipitation per 1°C warming

1. Regional differences
2. Future agroclimate
3. Historical context

IPCC 2007 WGI

- ALN_zone
- BOR_zone
- NEM_zone
- ATN_zone
- ALS_zone
- CON_zone
- ATC_zone
- PAN_zone
- LUS_zone
- MDN_zone
- MDS_zone
- MDM_zone
- PRESENT
- HadCM
- ECHAM
- NCAR
## Impact on the agroclimatic conditions

### 5°C

<table>
<thead>
<tr>
<th>Environmental Zone</th>
<th>Effective global radiation change (%)</th>
<th>Effective growing days change (days)</th>
<th>Huglin index change (%)</th>
<th>Date of the last frost change (days)</th>
<th>Proportion of dry days in AMJ change (%)</th>
<th>Proportion of dry days in JJA change (%)</th>
<th>Proportion of sowing days - early spring change (%)</th>
<th>Proportion of sowing days - fall change (%)</th>
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<tbody>
<tr>
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<td>-11</td>
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<td>-22</td>
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<td>2</td>
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<tr>
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<td>21</td>
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<td>34</td>
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<tr>
<td>MDN</td>
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<td>45</td>
<td>18</td>
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<td>1</td>
<td>-27</td>
<td>-16</td>
</tr>
</tbody>
</table>
1. Regional differences
2. Future agroclimate
3. Historical context

Proportion of dry days during JJA

Proportion of dry days in very dry year vs. very wet year.

- NO DROUGHT STRESS
- ALWAYS DROUGHT STRESS

Legend:
- ALN_zone
- BOR_zone
- NEM_zone
- ATN_zone
- ALS_zone
- CON_zone
- ATC_zone
- PAN_zone
- LUS_zone
- MDN_zone
- MDS_zone
- MDM_zone

Graph showing the proportion of dry days in very dry and very wet years for different regions.
Brief summary:

1. Throughout most of the environmental zones, there were clear signs of agroclimatic condition deterioration and a marked need for adaptive measures;

2. Rainfed agriculture might face more climate-related risks, although the analyzed agroclimatic indicators will most likely remain at a level that permits acceptable crop yields;

3. Evidence also suggests that there is the risk of an increasing number of extremely unfavorable years in many climate zones, which result in poor economic returns.
Historical context study of agroclimatic conditions
## Historical context study of agroclimatic conditions

<table>
<thead>
<tr>
<th>Period</th>
<th>Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>1800-1825</td>
<td>~1771 – last large-scale famine caused by crop failure</td>
</tr>
<tr>
<td></td>
<td>Introduction of Norfolk crop rotation system</td>
</tr>
<tr>
<td>1826-1850</td>
<td>~ 1827 – modern plow comes into use</td>
</tr>
<tr>
<td></td>
<td>1848 – abolition of corvée duties</td>
</tr>
<tr>
<td>1851-1875</td>
<td>wider use of mineral fertilisers</td>
</tr>
<tr>
<td>1876-1900</td>
<td>Massive introduction of new machinery (still relying on horse power)</td>
</tr>
<tr>
<td>1901-1925</td>
<td>Start of crop breeding institutions</td>
</tr>
<tr>
<td>1926-1950</td>
<td>Phasing out the horse power</td>
</tr>
<tr>
<td>1951-1975</td>
<td>Signs of agrosystem degradation</td>
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<tr>
<td>1976-2000</td>
<td>Phasing out many agrochemicals</td>
</tr>
<tr>
<td>1985-2008</td>
<td>Signs of changing climate conditions</td>
</tr>
</tbody>
</table>

### Legend

- **Studied area**
  - Stations
  - Brno
- **Map symbols**
  - Grain maize growing zone
  - Sugar-beet growing zone
  - Cereal-Potato growing zone
  - Forage and Grassland growing zone

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1. Regional differences  2. Future agroclimate  3. Historical context

Expected future agroclimatic conditions

„Observed“

1801 - 1825

1985 - 2008

„Future“

A2 High 2050 HadCM
Agroclimatic zones

A2 High 2050 ECHAM
Agroclimatic zones

A2 High 2050 NCAR
Agroclimatic zones
Brief summary:

1. Even local agroclimatic conditions tend to vary significantly;

2. However the expected change of agroclimatic conditions is unprecedented and likely beyond range experienced by modern agricultural systems;

3. Changes in climate will affect other parts of the landscape and soil processes in particular;

4. Adaptation is possible but will require substantial investment both in terms of finances, research and creative thinking….and the investment seems to be lacking!
Results presented could not be achieved without:

1. Colleagues from:
   - MENDELU (Z. Žalud, P. Hlavinka, J. Balek, D. Semerádová);
   - Masaryk University (R. Brázdil, P. Dobrovolný);
   - Institute of Atmospheric Physics (M. Dubrovský);
   - BOKU University (J. Eitzinger, H. Formayer);


Thank You for Your attention

May 2011??😊  2011…