Integrated Assessment of Climate Change Mitigation and Adaptation Impacts at Field and Farm level in the Austrian Mostviertel Region

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Global change at landscape level

drivers
- climate change
- CAP reforms & climate change policies
- international market developments

impacts
- land use & livestock change
- farm welfare
- Abiotic environmental impacts
- biodiversity
Case study landscape

**Mostviertel**
geological transition zone  
between flat land (Danube valley, N)  
and alpine region (Nördliche Kalkalpen, S)

Farms: N=113

N

1000mm | 8-9°C

Farms: N=118

1250mm | 7-8°C

Strauss et al., 2013.

Int. J. of Climat. 33, 430–443.
**Methods and Data**

### Input

- Natural & socio-economic data
- Input and output prices
- CAP
- Production functions
- Farm labor supply
- Livestock – herd sizes
- Observed land use
- Spatially explicit field data
- Landscape elements
- Climate scenarios
- Topography
- Soil characteristics

### Models

- **CropRota**
  - **EPIC**
  - **CALDIS VATIS**
  - **FAMOS[space]**

### Output

- Socio-economic & RD indicators
  - Farm gross margin
  - Public budget spending
  - Farm labor demand
  - Landscape diversity & appearance
- Agri-environmental indicators
  - Agric. & forestry land use change
  - Biodiversity
  - SOC
  - Soil sediment loss
  - N & P nutrient balances
  - GHG emissions
- Food production indicators
  - Crop & livestock production

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2. e.g. Izaurralde et al. (2006). Ecol Modell 192, 362-384.
EPIC – model run settings

**Input Data**
- Field
  - soil
  - slope
  - elevation
- ACLiReM
  - Climate change (precipitation) scenarios
    - CS01 +0%
    - CS05 +20%
    - CS09 -20%
- Periods
  - 1990-2005
  - 2025-2040

**Management**
- Cropland
  - Tillage
  - Intensity
  - Irrigation
    - conventional
      - high
      - moderate
      - low
    - reduced
      - high
      - moderate
      - low
    - cover crops
      - high
      - moderate
      - low
- Grassland
  - 1-cut/3-cut
    - high
    - moderate
    - low

**Output**
- Crop yield/forage yield
- Above ground biomass
- Sediment yield
- Runoff
- Evapotranspiration
- Nutrient loads (N, P)
- Nutrient uptake (N, P)
- Soil organic carbon
- ...
## Impact, mitigation & adaptation scenarios

<table>
<thead>
<tr>
<th>Name</th>
<th>CC</th>
<th>AEP</th>
<th>CAP reform</th>
<th>Mitigation policies</th>
<th>Adaptation policies</th>
</tr>
</thead>
<tbody>
<tr>
<td>REF_2008</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>REF_2040</td>
<td>No</td>
<td>No</td>
<td>no dairy quota; no livestock premiums; regional farm payment; greening; LFA payments from 2008</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS[CC]_i</td>
<td>Yes</td>
<td>No</td>
<td>like REF_2040</td>
<td>energy crops on set aside; subsidies for landsc. elements, SRF, afforestation, cover crops, min. tillage and extensive land use</td>
<td></td>
</tr>
<tr>
<td>CS[CC]_m</td>
<td>Yes</td>
<td>No</td>
<td>like REF_2040</td>
<td></td>
<td>no greening, subsidies for maintenance of steep slope grass land and irrigation</td>
</tr>
<tr>
<td>CS[CC]_a</td>
<td>Yes</td>
<td>No</td>
<td>like REF_2040</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS[CC]_m&amp;a</td>
<td>Yes</td>
<td>No</td>
<td>like REF_2040</td>
<td>like CS[CC]_m</td>
<td>like CS[CC]_a</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Climate Change (CC) Scenario Name</th>
<th>∆ temperature (°C)</th>
<th>∆ precipitation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS01</td>
<td>+ 1.6</td>
<td>0%</td>
</tr>
<tr>
<td>CS05</td>
<td>+ 1.6</td>
<td>+20%</td>
</tr>
<tr>
<td>CS09</td>
<td>+ 1.6</td>
<td>-20%</td>
</tr>
</tbody>
</table>
Results – average changes in farm gross margins
1990-2005/2025-2040
Results – changes in farm gross margins
1990-2005/2025-2040
Results – land use change
1990-2005/2025-2040; northern region
Results – soil management
1990-2005/2025-2040; northern region
Results – changes in GHG emissions
1990-2005/2025-2040
Results - farm land biodiversity indicators
1990-2005/2025-2040
Discussion on results

- Both mitigation and adaptation increase farm incomes eventually at the cost of public budgets.
- Adaptation policies that increase flexibility can come at environmental costs (trade-off between production and environmental protection).
- Diverse climate change impact among regions and farms despite proximity of both case study landscapes.
- Differences among climate scenarios depends on the region and can be small compared to the policy impacts.
- Increasing productivity on average increases intensification pressures.
  - Permanent grassland, extensive land use and landscape elements may be threatened.
  - Future AEP design must take changing productivity into account.
Discussion on methods

- High spatial resolution of integrated assessment framework
- Abiotic and biotic environmental indicators
- Rich in crop and livestock management variants
- Detailed representation of agricultural policies

+ Covers two case study landscapes only
- No interactions among farms so far
- High data and computational demand
- Assumption on max. gross margin
Outlook
Analysis of trade-offs and synergies

Kirchner et al., 2014. Ecological Economics (in press).
Outlook
Landscape visualization
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