THE USE OF HIGH RESOLUTION AERIAL PHOTOGRAPHY TO ESTIMATE SOURCE AREA CONTRIBUTIONS TO HETEROGENEOUS ECOSYSTEM FLUXES

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Using high resolution aerial photographs to estimate source area contributions  
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Objectives & Hypothesis

› upscaling of C-uptake/release is important because of the small-scale heterogeneity of the environment
› Eddy Covariance systems cover the locale scale
› upscaling based on point measurements needed for larger scale
With increasing resolution of the remote sensing product we increase the detailed knowledge of the area under study and get a more realistic estimate of the surface characteristics (area and surface flux estimation)

(Becker et al. 2008)
Study Area

“Salmisuo”, Eastern Finland

62°47’N, 30°56’E
Oligotrophic low-sedge pine fen

mosaicked image of the field site
red circle: representative area for flux
calculation of the eddy covariance system
Near Aerial Photography & Remote Sensing

1. georeferenced marker
2. registered image (GCPs)
3. mosaic to cover the area
Classification

classification from RGB into four classes: hummocks (olive-green), lawns (orange), flarks (green) and shadows (black)
Closed Chamber & Eddy Covariance

› closed-path eddy-covariance system

› closed chamber measurements (CCM) with dark and light chamber, LI-840 (infrared gas analyzer) and cooling system
Footprint Model

› Detects a flux over larger area
› Models are used to describe the so called footprint.
› Per definition the footprint is infinite in size, hence a maximum area needs to be defined.

Combination

› Each pixel is weighted with the footprint function for each 30min flux and summed up for each microform type over the season
## Results

<table>
<thead>
<tr>
<th>Resolution</th>
<th>Flarks</th>
<th>Lawns</th>
<th>Hummocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25 m</td>
<td>1208.32 m</td>
<td>43582.68 m</td>
<td>79450.30 m</td>
</tr>
<tr>
<td>0.60 m</td>
<td>1220.76 m</td>
<td>43565.04 m</td>
<td>79377.12 m</td>
</tr>
<tr>
<td>1m</td>
<td>1230.86 m</td>
<td>43551.32 m</td>
<td>79348.41 m</td>
</tr>
</tbody>
</table>

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Chamber vs. Eddy at Resolution

<table>
<thead>
<tr>
<th>Resolution</th>
<th>Flarks</th>
<th>Lawns</th>
<th>Hummocks</th>
<th>Total</th>
<th>EC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25 m</td>
<td>-0.1328 g/m²</td>
<td>-12.6002 g/m²</td>
<td>-27.7879 g/m²</td>
<td>-40.5210 g/m²</td>
<td>-39.92 g/m²</td>
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<tr>
<td>0.6 m</td>
<td>-0.1342 g/m²</td>
<td>-12.5956 g/m²</td>
<td>-27.7632 g/m²</td>
<td>-40.4930 g/m²</td>
<td>-39.92 g/m²</td>
</tr>
<tr>
<td>1 m</td>
<td>-0.1354 g/m²</td>
<td>-12.5946 g/m²</td>
<td>-27.7597 g/m²</td>
<td>-40.4896 g/m²</td>
<td>-39.92 g/m²</td>
</tr>
</tbody>
</table>

› CO²-C uptake over a period of 50 days (26.07.-13.09-2005)
› minor changes in area covered at different resolutions
› slightly overestimated CO²-C uptake compared to EC results
Conclusion

› resolution does not matter!
› upscaled closed chamber measurements are very close to EC measurements

› resolution independent area contribution is in contradiction with earlier studies
› possible explanation: methodological approach differs
  -> upscaled classification results vs. upscaled aerial photograph with subsequent classification
Future Work

› inverse Monte Carlo approach to determining the upwind fluxes based on measurements from a single EC tower
Thank you for your attention