Interannual variability in the carbon balance of a young *Larix sibirica* plantation in eastern Iceland

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Established in 2003
Iceland, Denmark, Greenland, Finland and Sweden

Main goal:
To obtain a better understanding of the factors regulating the carbon balance of typical sub-arctic and boreal ecosystems
• Vallanes (65°19’N, 14°56’W and 60 m a.s.l.) in eastern Iceland.
• The study site is a 60 ha plantation on former heathland pasture.
• Planted 1992 by Siberian larch mixed with some lodgepole pine.
• The soil type of Vallanes is Andosol, a volcanic soil that characterizes Iceland.
• The ground vegetation consists mainly of dwarf bushes (*Betula nana, Vaccinium uliginosum*), grasses and bryophytes.
• The site was protected from grazing, ploughed and planted.
Forest floor
Wetland
Eroded land
Eddy flux measurements on CO₂ and H₂O
Climatic factors (air temperature, soil temperature, radiation, humidity, precipitation etc.)
Changes in carbon stocks (trees, soil, understory, litter) are followed and compared to unplanted heathland
Leaf area index (LAI)
Soil respiration and photosynthesis on three different surface types (Forest floor, wetland, eroded land)
Automatic and manual dendrometers
CO$_2$ balance in 2004-2006

-641 g CO$_2$ m$^{-2}$ a$^{-1}$

-727 g CO$_2$ m$^{-2}$ a$^{-1}$

-295 g CO$_2$ m$^{-2}$ a$^{-1}$
2005

Graph showing CO₂ flux (g CO₂ m⁻² d⁻¹) over a year with a red box highlighting a specific time period.

Graphs showing daily NEE (g CO₂ m⁻² d⁻¹), GPP (g CO₂ m⁻² d⁻¹), and Rad. flux density (MJ m⁻² d⁻¹) with temperature minima (°C) for selected dates.
The diagram shows the temperature (Tave °C) and CO₂ emissions (g CO₂ m⁻² d⁻¹) over the years 2004 to 2006. The temperature fluctuates significantly with peaks around 25°C and troughs around 0°C. The CO₂ emissions show a cyclical pattern with peaks in January and July for each year.

The table on the right provides the mean temperature and mean precipitation for each year:

<table>
<thead>
<tr>
<th></th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Temp °C</td>
<td>4.4</td>
<td>4.1</td>
<td>4.4</td>
</tr>
<tr>
<td>Mean precip mm</td>
<td>457</td>
<td>462</td>
<td>584</td>
</tr>
</tbody>
</table>
Where, in the ecosystem, is the carbon sequestration taking place??

- Trees
- Understory
- Soil
- Litter
- Roots
Only 12% of the total sequestration could be explained by the trees and the ground vegetation. Roots and litter also contribute to the carbon pool but are not included here.

<table>
<thead>
<tr>
<th></th>
<th>C-stock</th>
<th>C-sequestration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trees</strong></td>
<td>231</td>
<td>65</td>
</tr>
<tr>
<td><strong>Understory</strong></td>
<td>258</td>
<td>23</td>
</tr>
</tbody>
</table>

*Results from Sigurdsson et al, 2005*
The top 30 cm of the soil contained on average 1000 g C m\(^{-2}\) more than adjacent pasture; equals 280 g CO\(_2\) m\(^{-2}\) y\(^{-1}\)
Conclusions

- The site is a sink (from -295 up to -727 g CO$_2$ m$^{-2}$ y$^{-1}$)
- Although not statistically significant, the top 30 cm of soil at the measurement site contained 1000 g of C m$^{-2}$ more than the control site
- The trees and the understory sequestered approx. 12% of the total sequestration
- Other carbon stocks, like roots and litter should also be included
- In 2005, the seasonal carbon uptake was greatly affected by a late spring frost in May
- Will such spring frost spells become more frequent in Scandinavian forests with warmer future climate??
Thank you!!