

Pure

Scotland's Rural College

Upscaling of greenhouse gas emissions in upland forestry following clearfell

Toet , Sylvia; Keane, Ben; Yamulki, Sirwan; Blei, Emanuel; Gibson-Poole, S; Xenakis, Georgios; Perks, Mike; Morison, James; Ineson, Phil

Published in:

EGU General Assembly 2016

Print publication: 22/04/2016

Document Version

Publisher's PDF, also known as Version of record

[Link to publication](#)

Citation for published version (APA):

Toet , S., Keane, B., Yamulki, S., Blei, E., Gibson-Poole, S., Xenakis, G., ... Ineson, P. (2016). Upscaling of greenhouse gas emissions in upland forestry following clearfell. In *EGU General Assembly 2016* (pp. EPSC2016-13775)

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal ?

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.



Upscaling of greenhouse gas emissions in upland forestry following clearfell

Sylvia Toet (1), Ben Keane (1,6), Sirwan Yamulki (2), Emanuel Blei (3), Simon Gibson-Poole (4), Georgios Xenakis (5), Mike Perks (5), James Morison (2), and Phil Ineson (6)

(1) Environment Department, University of York, York, UK (sylvia.toet@york.ac.uk), (2) Centre for Sustainable Forestry and Climate Change, Forest Research, Alice Holt Lodge, UK, (3) School of Geosciences, University of Edinburgh, Edinburgh, UK, (4) Scotland's Rural College (SRUC), Edinburgh, UK, (5) Centre for Sustainable Forestry and Climate Change, Forest Research, Northern Research Station, Roslin, UK, (6) Department of Biology, University of York, York, UK

Data on greenhouse gas (GHG) emissions caused by forest management activities are limited. Management such as clearfelling may, however, have major impacts on the GHG balance of forests through effects of soil disturbance, increased water table, and brash and root inputs. Besides carbon dioxide (CO₂), the biogenic GHGs nitrous oxide (N₂O) and methane (CH₄) may also contribute to GHG emissions from managed forests. Accurate flux estimates of all three GHGs are therefore necessary, but, since GHG emissions usually show large spatial and temporal variability, in particular CH₄ and N₂O fluxes, high-frequency GHG flux measurements and better understanding of their controls are central to improve process-based flux models and GHG budgets at multiple scales.

In this study, we determined CO₂, CH₄ and N₂O emissions following felling in a mature Sitka spruce (*Picea sitchensis*) stand in an upland forest in northern England. High-frequency measurements were made along a transect using a novel, automated GHG chamber flux system ('SkyLine') developed at the University of York. The replicated, linear experiment aimed (1) to quantify GHG emissions from three main topographical features at the clearfell site, i.e. the ridges on which trees had been planted, the hollows in between and the drainage ditches, and (2) to determine the effects of the green-needle component of the discarded brash. We also measured abiotic soil and climatic factors alongside the 'SkyLine' GHG flux measurements to identify drivers of the observed GHG emissions. All three topographic features were overall sources of GHG emissions (in CO₂ equivalents), and, although drainage ditches are often not included in studies, GHG emissions per unit area were highest from ditches, followed by ridges and lowest in hollows. The CO₂ emissions were most important in the GHG balance of ridges and hollows, but CH₄ emissions were very high from the drainage ditches, contributing to over 50% of their overall net GHG emissions. Ridges usually emitted N₂O, whilst N₂O emissions from hollows and ditches were very low. As much as 25% of the total GHG flux resulted from large intermittent emissions from the ditches following rainfall. Addition of green needles from the brash immediately increased soil respiration and reduced CH₄ emission in comparison to controls.

To upscale our high-frequency 'SkyLine' GHG flux measurements at the different topographic features to the field scale, we collected high resolution imagery from unmanned aerial vehicle (UAV) flights. We will compare results using this upscaling technique to GHG emissions simultaneously measured by eddy covariance with the 'SkyLine' system in the predominant footprint. This detailed knowledge of the spatial and temporal distribution of GHG emissions in an upland forest after felling and their drivers, and development of robust upscaling techniques can provide important tools to improve GHG flux models and to design appropriate management practices in upland forestry to mitigate GHG emissions following clearfell.