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Sensitivity analysis in calculating the social value of carbon sequestered in British grown Sitka spruce

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Abstract

We describe a model that estimates the social benefits of carbon (C) sequestered in plantation Sitka spruce in Great Britain. Final net present values (NPV, base year = 2003) resulting from plausible variations in model parameters are calculated. The discount rate, social value of C, timber yield, rate of gain into live wood, length of rotation, lifetime of products, amount of C displaced by products and the changes in C flux on afforested peat soils are the most influential model components. The study predicts that C fluxes in actively managed forests in second or subsequent rotations or planted on peat soils will tend to have low or (on average) negative NPV.
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Introduction

The high likelihood of adverse climate change in the next 20–200 years is widely accepted, and much of this threat is attributed to the anthropogenic emission of greenhouse gases (GHGs). The single most important GHG in Great Britain (GB) with respect to both total volume produced and total global warming potential, is carbon dioxide (CO_2). CO_2 has been estimated to comprise 84% of the total global warming potential of UK GHG releases (DEFRA (Department for Environment and Food and Rural Affairs), 2002). Growing more trees has been suggested as a possible means of reducing atmospheric CO_2, and thus mitigating global warming. The tactic has limitations, and is most useful as a short-term stopgap rather than a long-term solution. Cannell (1999) observed that even if the current rate of new woodland creation almost doubled (from about 17,000 to 30,000 ha per annum), the new woodlands would still absorb less than 2% of the UK's annual carbon (C) emissions. Nevertheless, it is valid to include woodlands when calculating the C inventory for the entirety of GB, and to allow for the sequestration function when considering the overall balance of social costs and benefits generated by woodlands.

The authors produced a report (Brainard et al., 2003) for the British Forestry Commission that valued the C storage in GB woodland (GB, for our purposes = all of the UK except Northern Ireland, the Scilly Islands and the Channel Islands). In so doing we became very aware of the multitude of sources of uncertainty in making such valuations. This paper explores the sensitivities of model results to inputs, and attempts to assess the relative influence and importance of individual parameters. Assumptions pervade such modelling. C sequestration is usually modelled on a small unit basis – typically per hectare. These results are then scaled up to produce regional estimates. Even the scaling-up process itself tends to involve many assumptions and uncertainties.[1] As well as estimating net C gain (or loss, in some cases), valuation depends on the social (monetary) value per unit of C sequestered, along with the associated discount rate. The choices of which social value or discount rate to use are themselves highly contentious, and yet have huge impacts on the estimated total value of C sequestration (Price and Willis, 1993).

Thus, to thoroughly assess the uncertainties around an estimate such as the value of woodland C flux, at every step of each component model, is beyond what we can achieve in any short paper. But, we can realistically attempt to identify here which model inputs have most impact on a per hectare basis. This analysis should illuminate which areas of uncertainty would be most valuable to clarify in future efforts to calculate the social value of C sequestered in woodlands anywhere. There is also potential comparisons to be made with respect to other (non-forestry) possible land uses.

We assess impacts of model inputs on valuing sequestered C by focusing on the most commonly planted species in GB, Sitka spruce (*Picea sitchensis*). Sitka spruce

[1]Without stand-specific records, it can be very hard to estimate accurately, over a large afforested area, variables such as the average planting year, which rotation crops are likely to be in (on average), typical productivity, general soil type, the average density of stocking, frequency of thinning, etc.

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