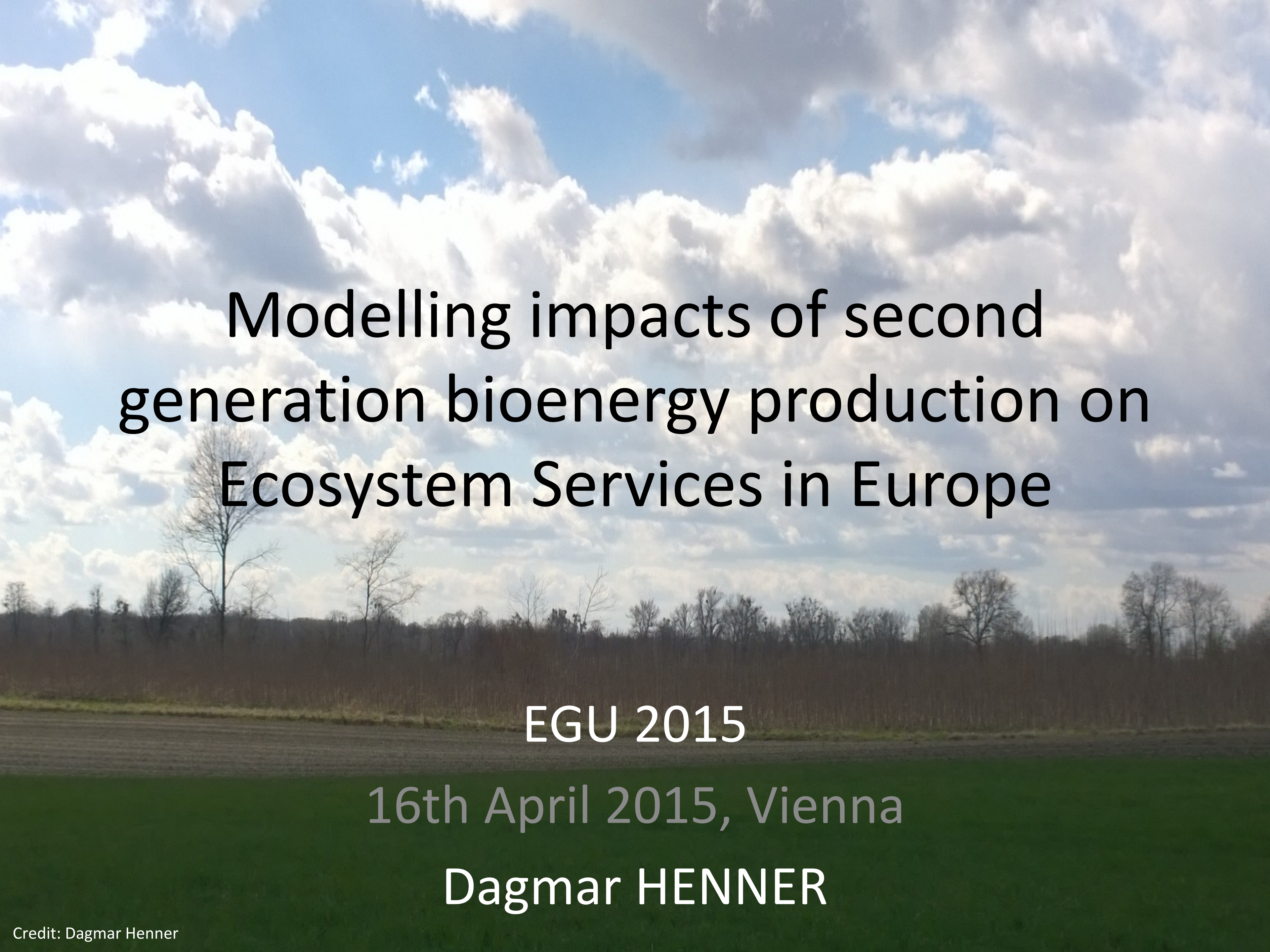

Modelling impacts of second generation bioenergy production on Ecosystem Services in Europe

EGU 2015

16th April 2015, Vienna

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Credit: Dagmar Henner

Short Overview

- Bioenergy Crops
- Ecosystem Services
- GHG Modelling
- Soil Carbon Change Modelling
- Ecosystem Services Valuation Tools
- Frameworks and Combination of Models
- Conclusions and future areas of interest

Importance of Bioenergy Crops

- Source of renewable energy
- Mechanism to mitigate global climate warming
  - Reducing fossil fuel
  - Uptake of CO_2
- Possible Synergies and Trade-Offs for Ecosystem Services

Second Generation Bioenergy Crops

- Miscanthus
- Short Rotation Forestry
- Short Rotation Coppice

Ecosystem Services

Provisioning Services

Products obtained from ecosystems

- Food
- Fresh water
- Fuelwood
- Fiber
- Biochemicals
- Genetic resources

Regulating Services

Benefits obtained from regulation of ecosystem processes

- Climate regulation
- Disease regulation
- Water regulation
- Water purification
- Pollination

Cultural Services

Nonmaterial benefits obtained from ecosystems

- Spiritual and religious
- Recreation and ecotourism
- Aesthetic
- Inspirational
- Educational
- Sense of place
- Cultural heritage

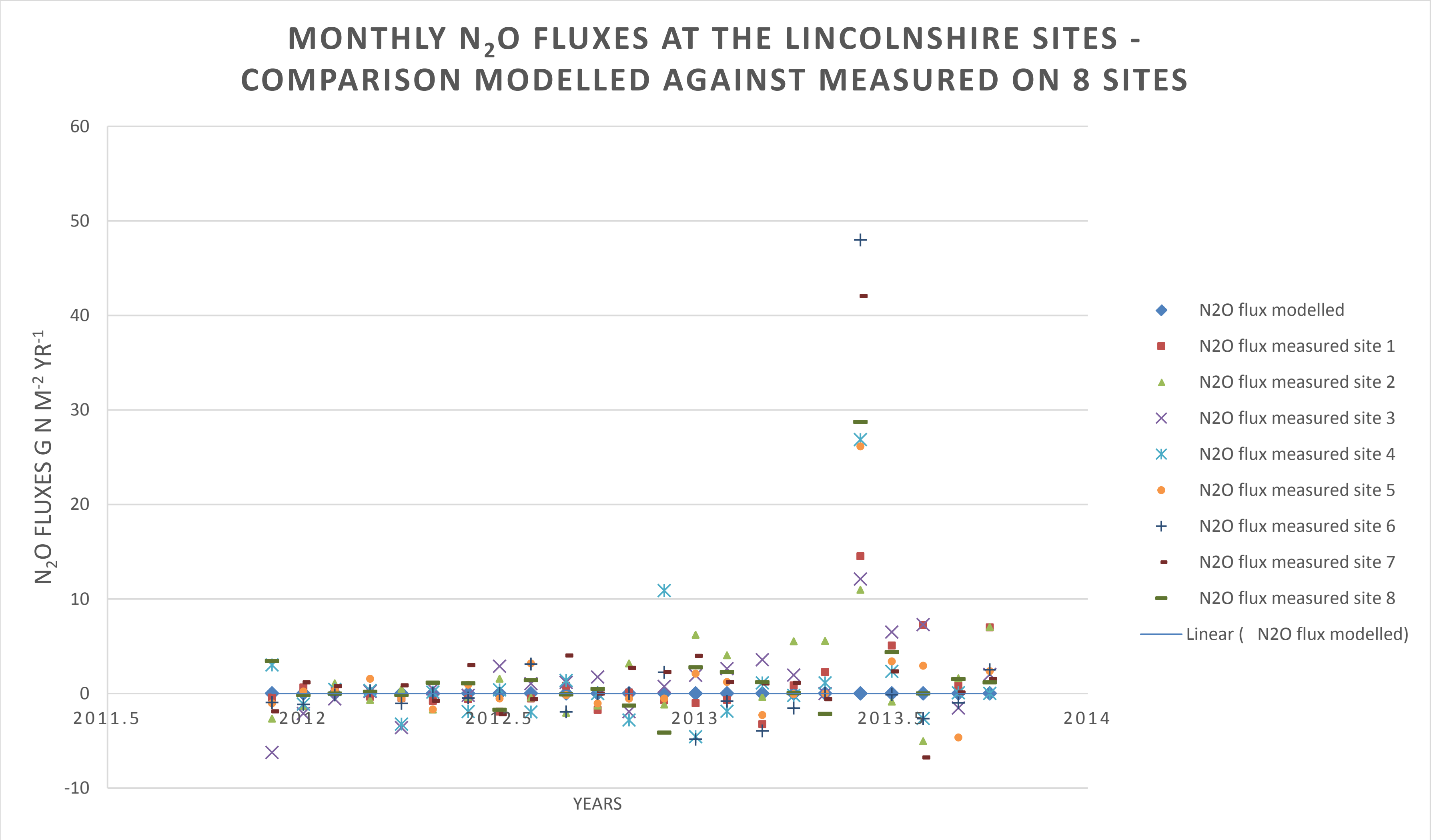
Supporting Services

Services necessary for the production of all other ecosystem services

- Soil formation
- Nutrient cycling
- Primary production

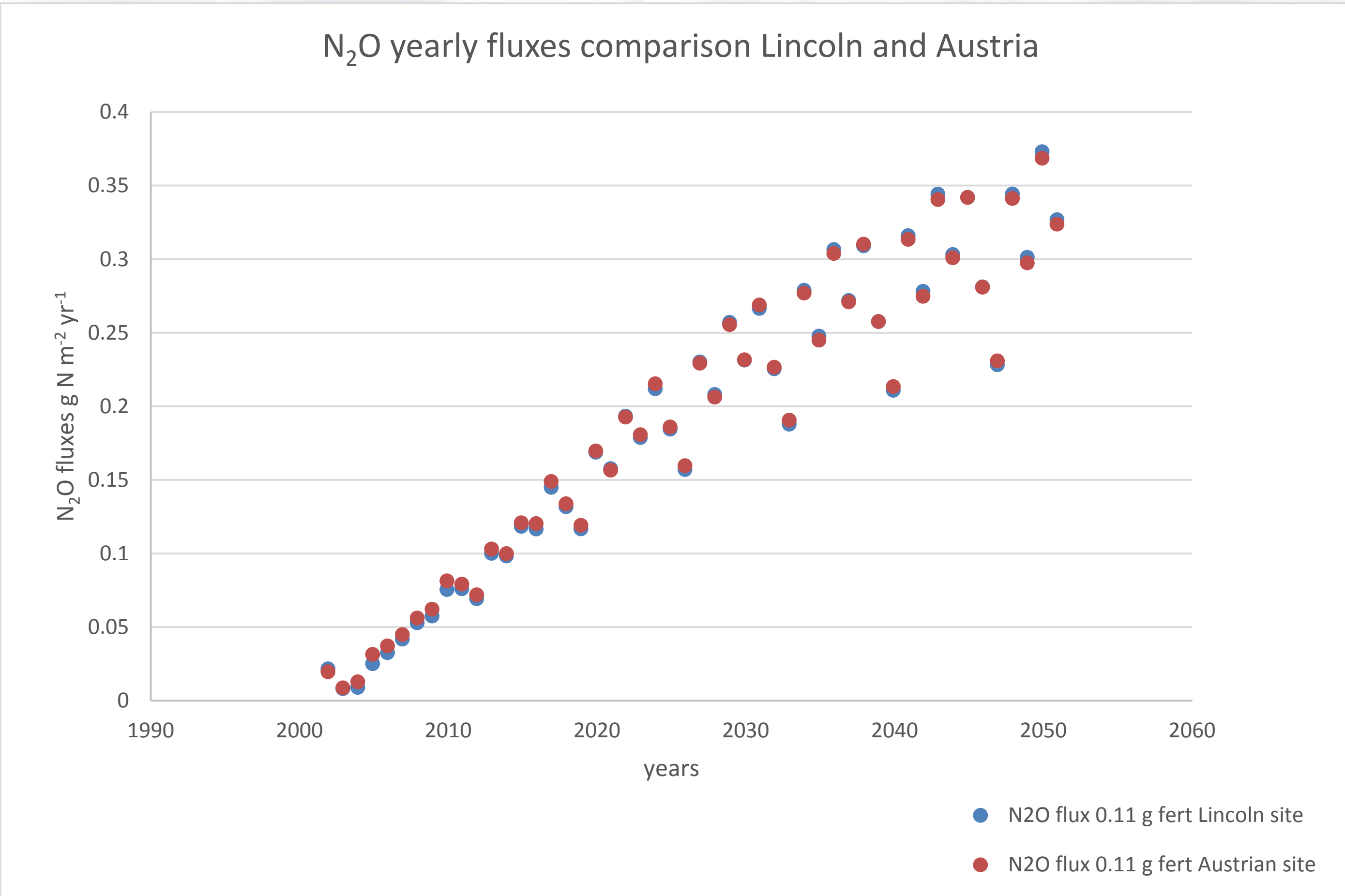
Source: Millennium Ecosystem Assessment
http://www.millenniumassessment.org/documents/document.300.aspx.pdf

N_2O monthly fluxes



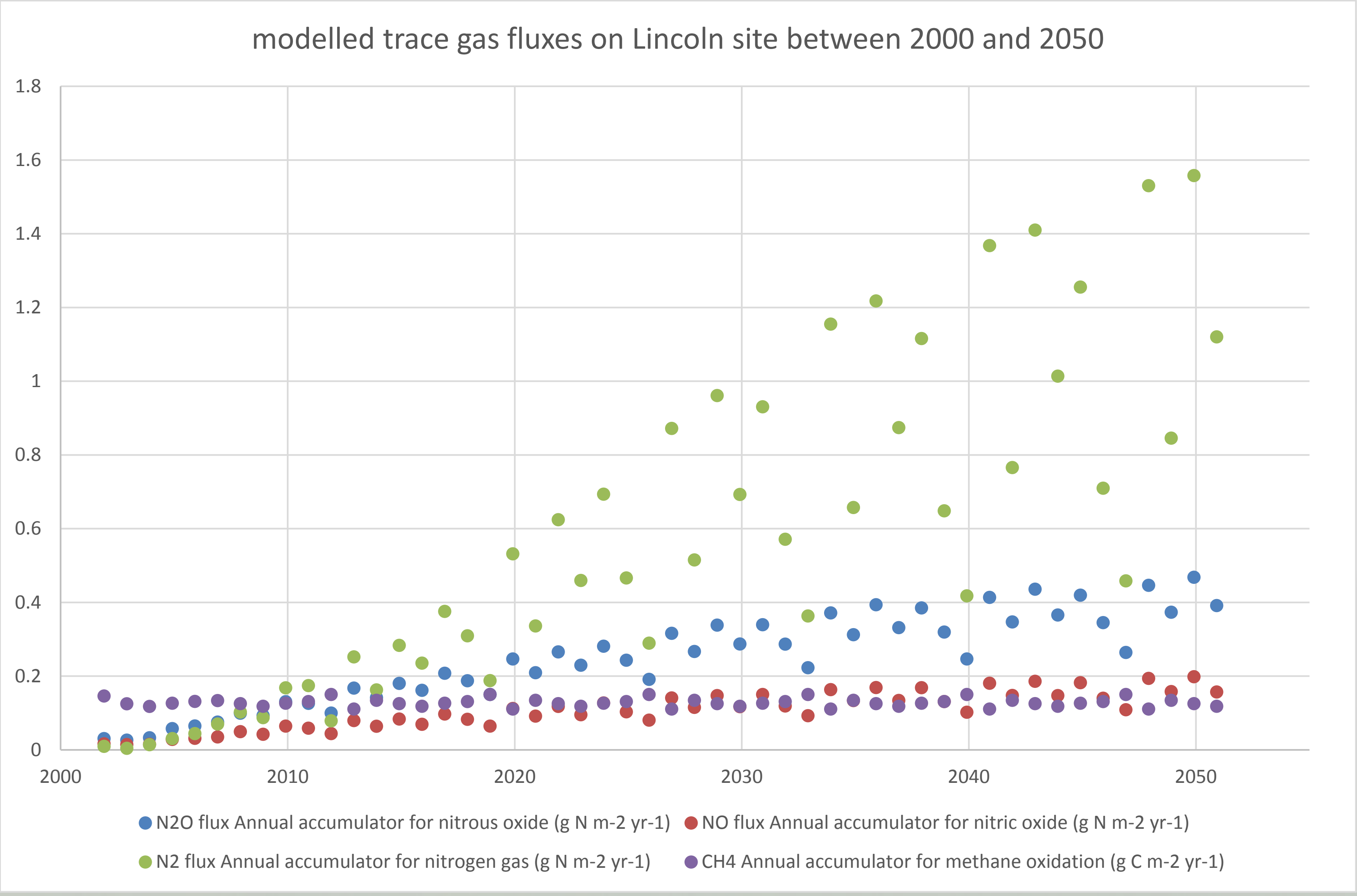
Monthly N_2O fluxes from Miscanthus modelled with Daily Daycent based on data from 8 Lincolnshire sites. The modelled output was compared with two years of measured output currently available.

Impact of management on fluxes



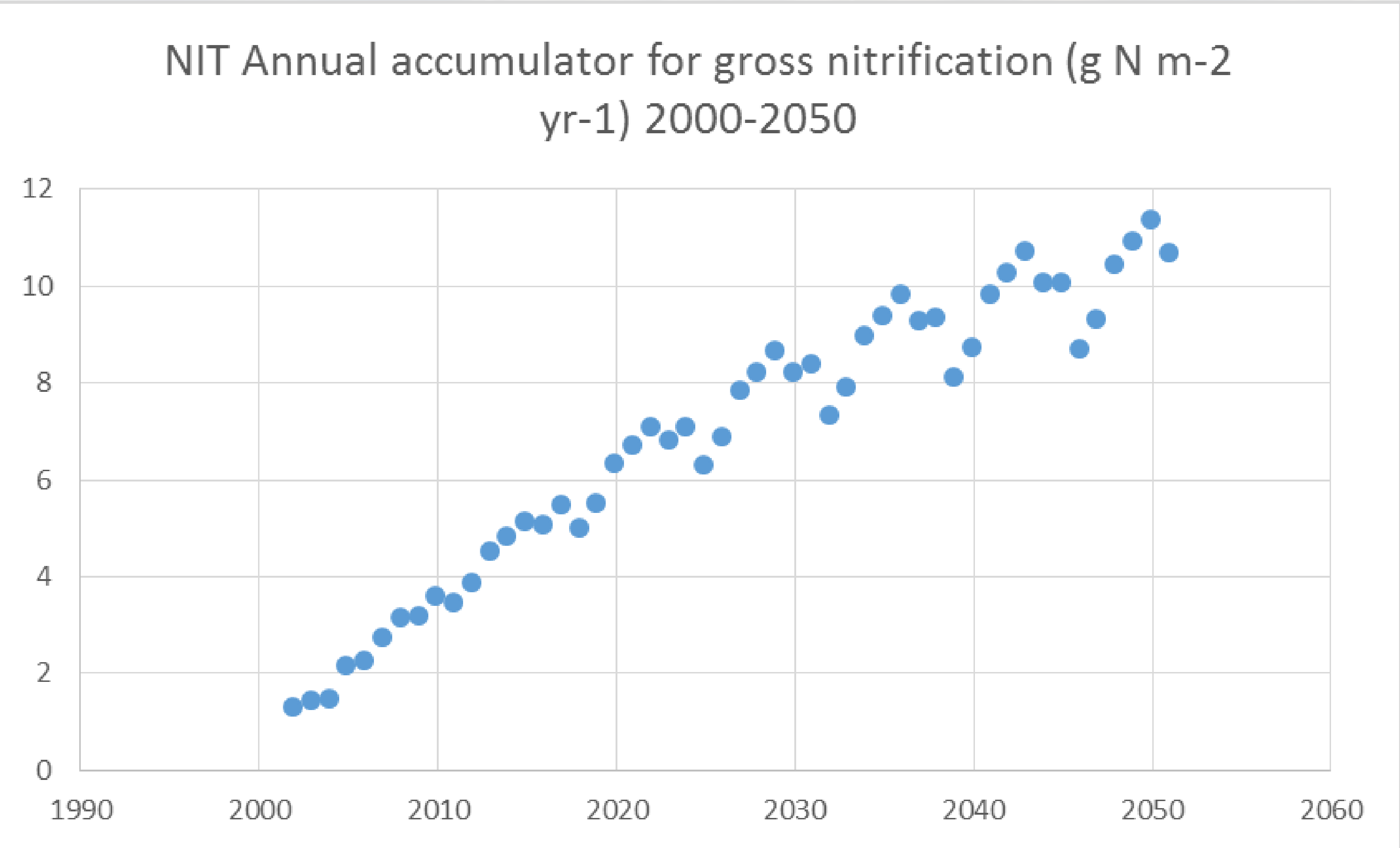
Yearly N_2O fluxes from Miscanthus modelled with Daily Daycent based on data from the Lincoln site. The Austrian site is based on Lincoln data (weather, soil, …) but the management practice, especially the planting and harvest, has been adapted. Most difference in the results can be seen during the first years (after planting) and during the last years of the cycle.

Yearly trace gas fluxes modelled



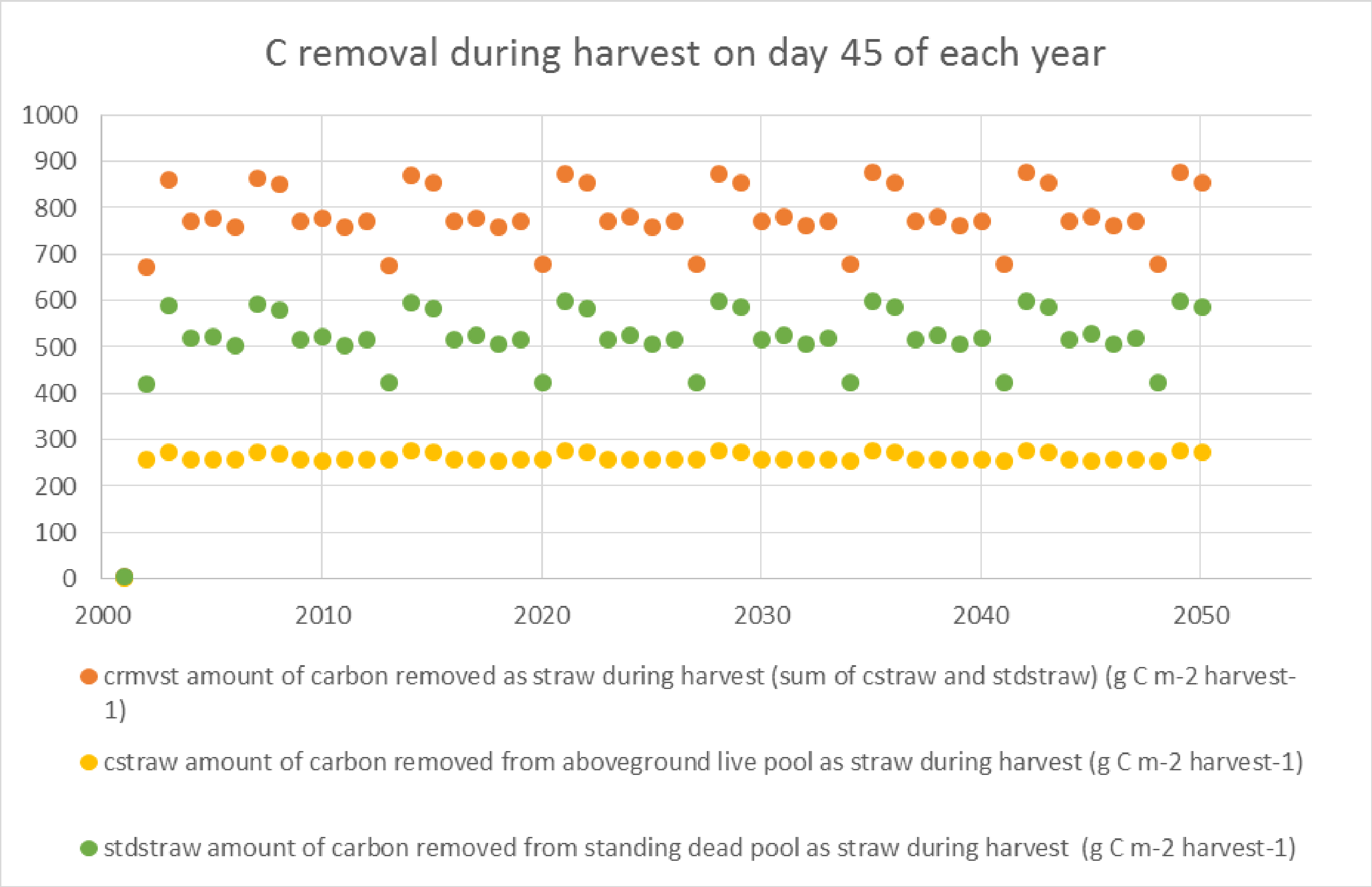
Yearly trace gas fluxes from Miscanthus modelled with Daily Daycent based on data from the Lincoln site.

Annual gross nitrification modelled



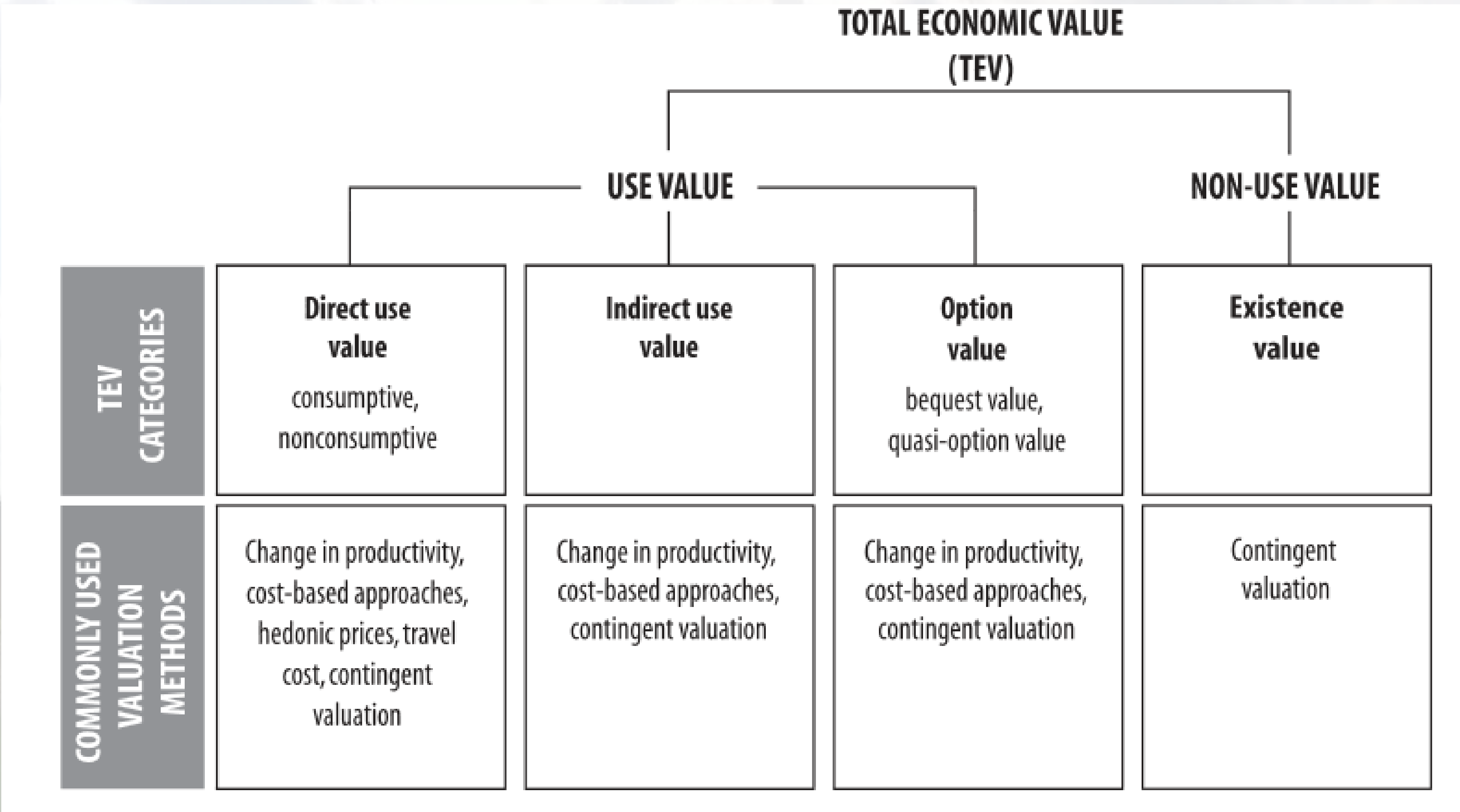
Yearly gross nitrification from Miscanthus modelled with Daily Daycent based on data from the Lincoln site.

C removal during harvest modelled



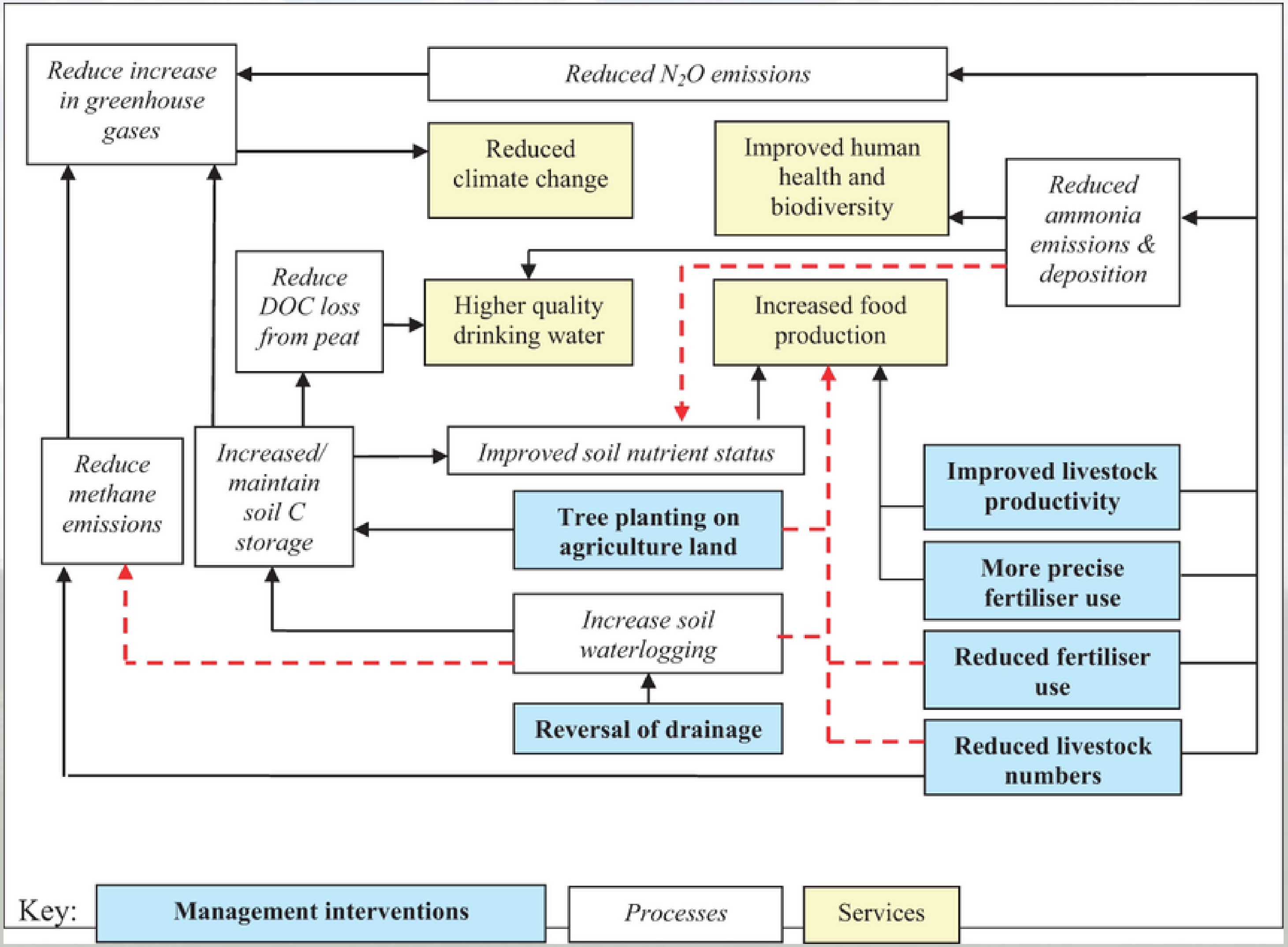
Yearly C removal during harvest on day 45 of each year from Miscanthus modelled with Daily Daycent based on data from the Lincoln site.

Ecosystem Services Valuation Tools



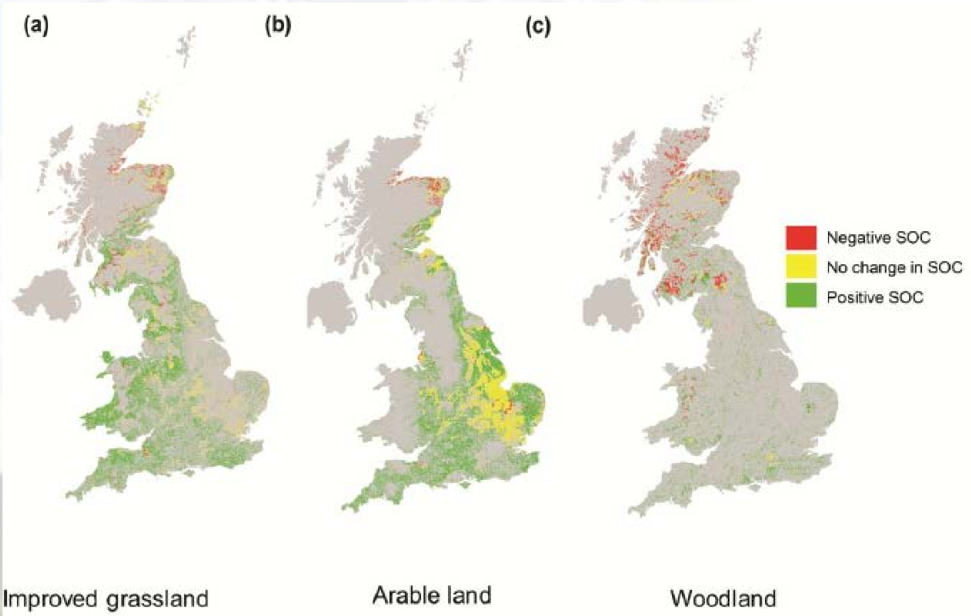
Source: Millennium Ecosystem Assessment
http://www.millenniumassessment.org/documents/document.304.aspx.pdf

Importance of Frameworks

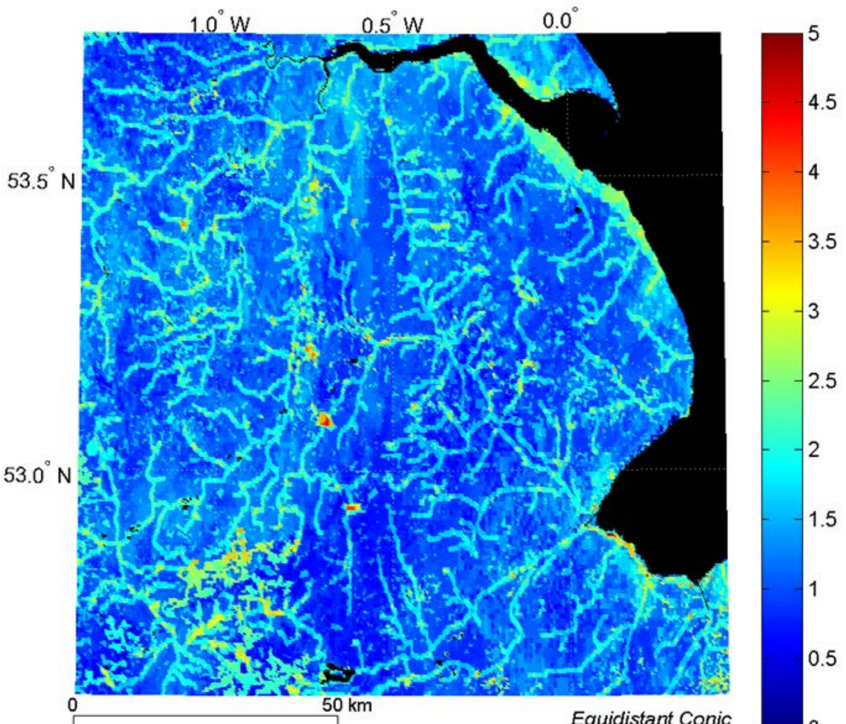


Source: Smith et al (2012) The role of ecosystems and their management in regulating climate, and soil, water and air quality Journal of Applied Ecology Volume 50, Issue 4, pages 812-829, 21 DEC 2012 DOI: 10.1111/1365-2664.12016. http://onlinelibrary.wiley.com/doi/10.1111/1365-2664.12016/full#jpe12016-fig-0001

Combination of models with ArcGIS maps to represent frameworks

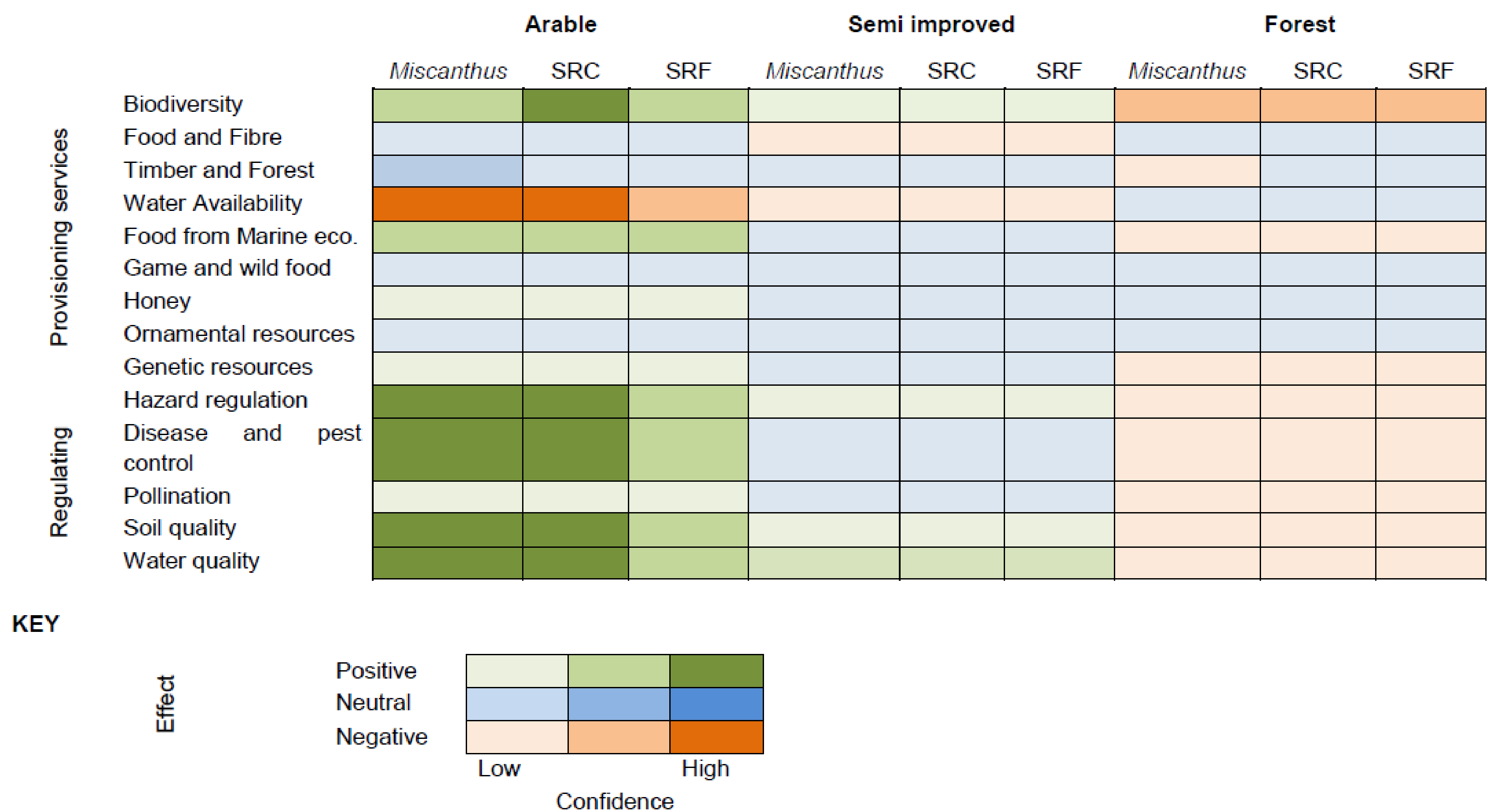


Milner et al (2015). Potential impacts on ecosystem services of land use transitions to second generation bioenergy crops in UK. GCB Bioenergy. doi: 10.1111/gcbb.12263



Source: University of Oxford. http://www.biodiversity.ox.ac.uk/researchthemes/biodiversity-technologies/assessing-ecological-value-of-landscapes-beyond-protected-areas-left/

Threat matrix of ecosystems service effects of transitions to differing bioenergy crops



Source: Ecosystem Land-Use Modelling & Soil C Flux Trial (ELUM). Review of the Effects of Bioenergy Crops on Ecosystem Service in the UK Context. Robert Holland, Donna Clarke and Gail Taylor (2013) Faculty of Natural & Environmental Sciences, University of Southampton, Southampton, SO17 1BJ

Conclusions

- From cultivation to use some biofuels emit significantly less CO_2 compared to conventional petrol
- Under certain circumstances CO_2 capture is possible
- Depends on management, type of crop and initial land use – sustainability
- First results look promising

Future Areas of Interest

- Research on potential synergies and trade-offs among ecosystem services
- Food security and undeveloped or arable land
- Modelled output and framework for Europe
- Research and inclusion of climate change effects on ecosystem services

Source: Shell
http://www.shell.com/global/environment-society/environment/climate-change/biofuels-alternative-energies-transport/biofuels.html

Thank you for your attention

Please feel free to ask questions now.

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