

Impact of simulated present and historic management regimes on forest carbon cycling in Europe

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Background & Questions

Climate change mitigation aims:

■ Increase C storage in forests



■ Replace fossil fuel, concrete, ...
by wood

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Scenarios:

- Unmanaged
- Managed
 - Clear cut vs selective harvest
 - Actual vs natural species



- C pools and fluxes
- Species distributions
- Yields

Methods

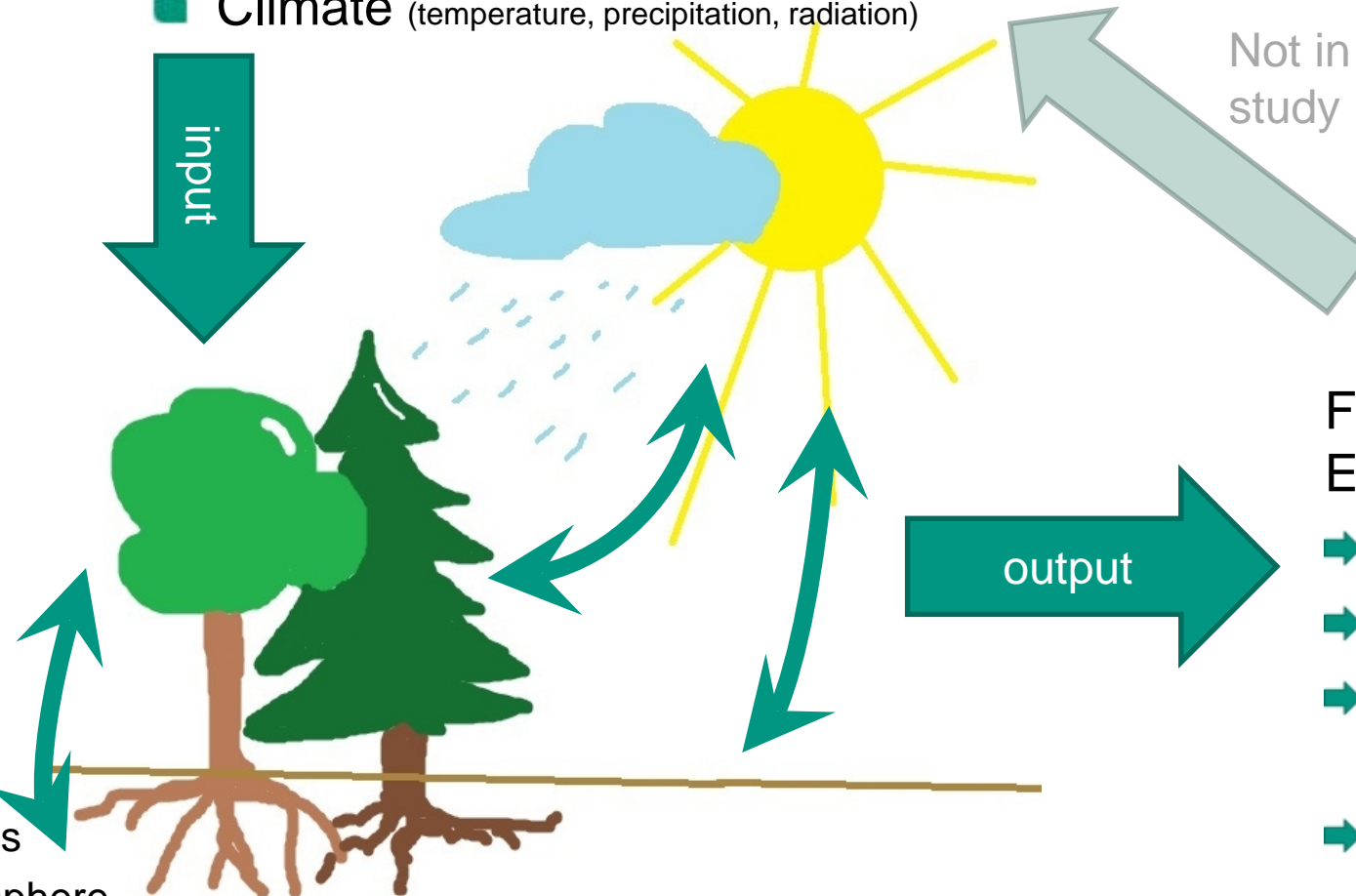
- Present and historic management (harvest demand, species)
- Atmospheric CO₂, soil texture, N deposition
- Climate (temperature, precipitation, radiation)

LPJ-GUESS

(Dynamic global vegetation model)

Simulation of

- C & N cycle
- H₂O
- plant and soil processes
- their interaction as well as
- exchange with the atmosphere
- competition

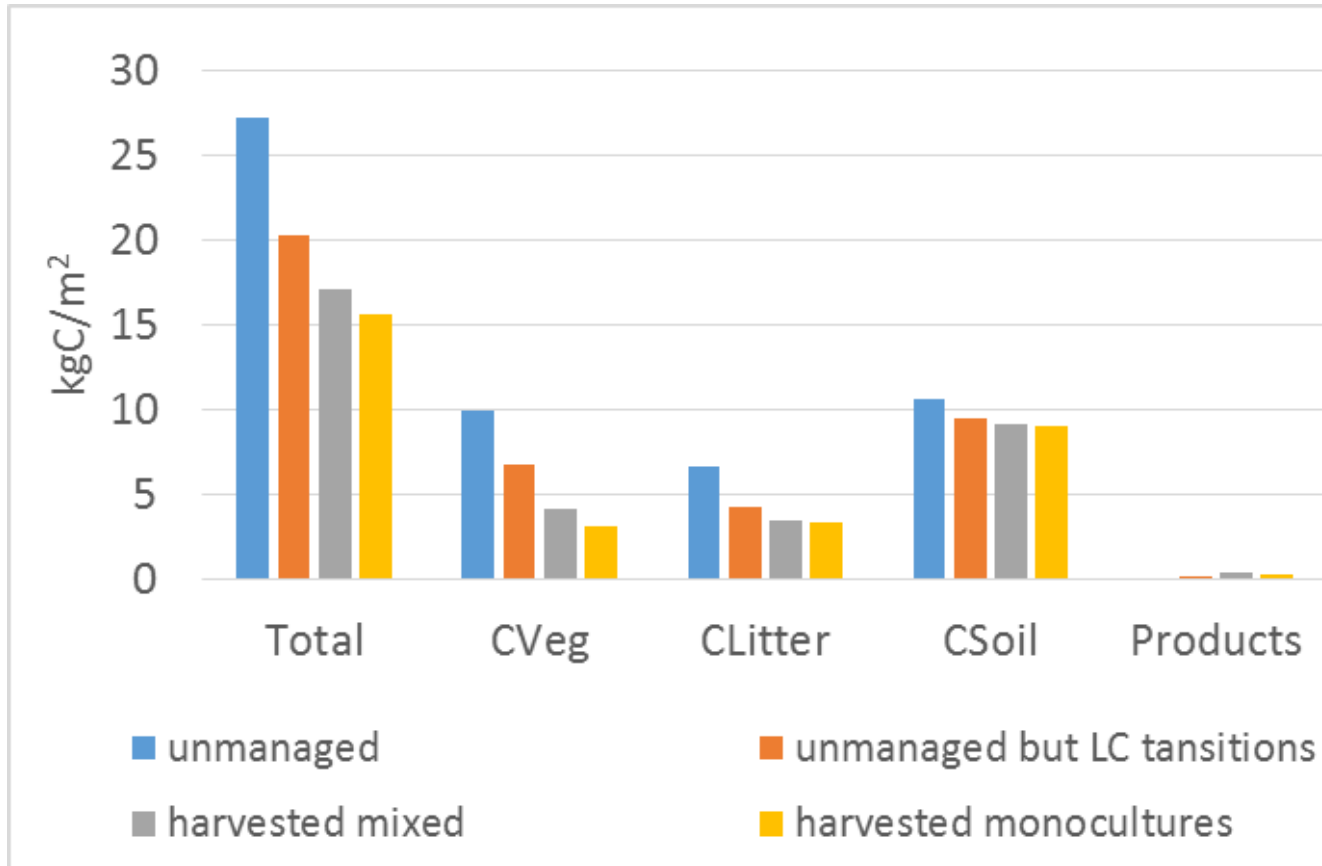


For each gridcell in Europe:

- ➔ C-fluxes
- ➔ C-pools
- ➔ Species distributions in mixed forests
- ➔ ...

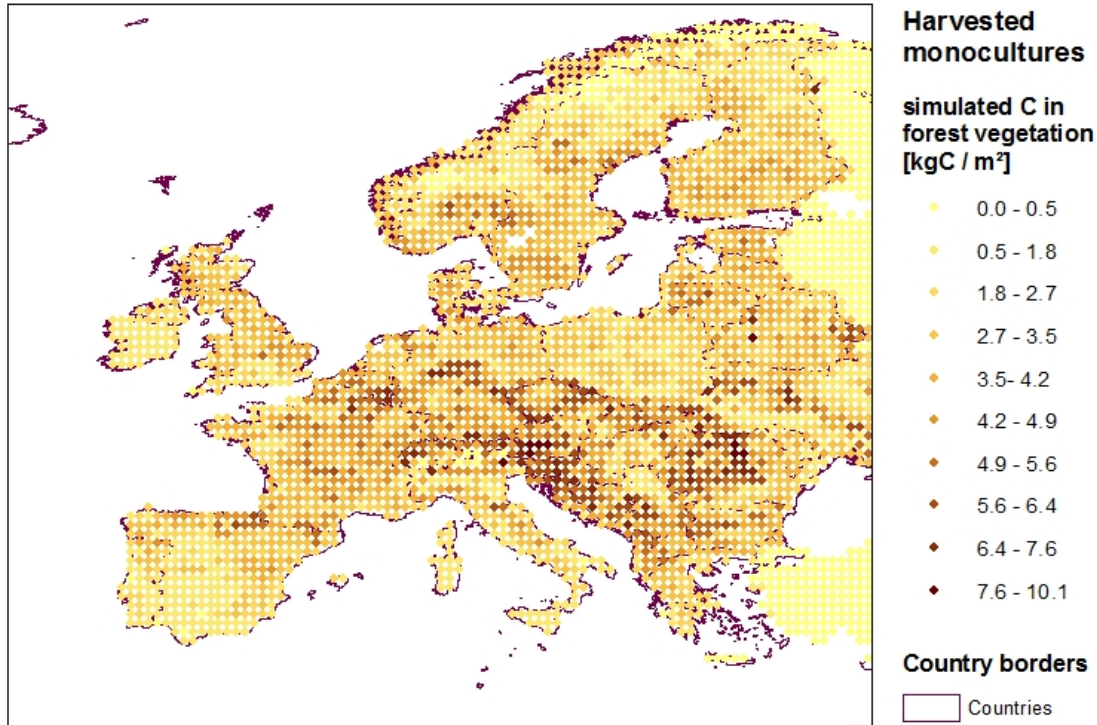
Results & Discussion

C-pools: mean for Europe's managed forests for yrs 1995-2010

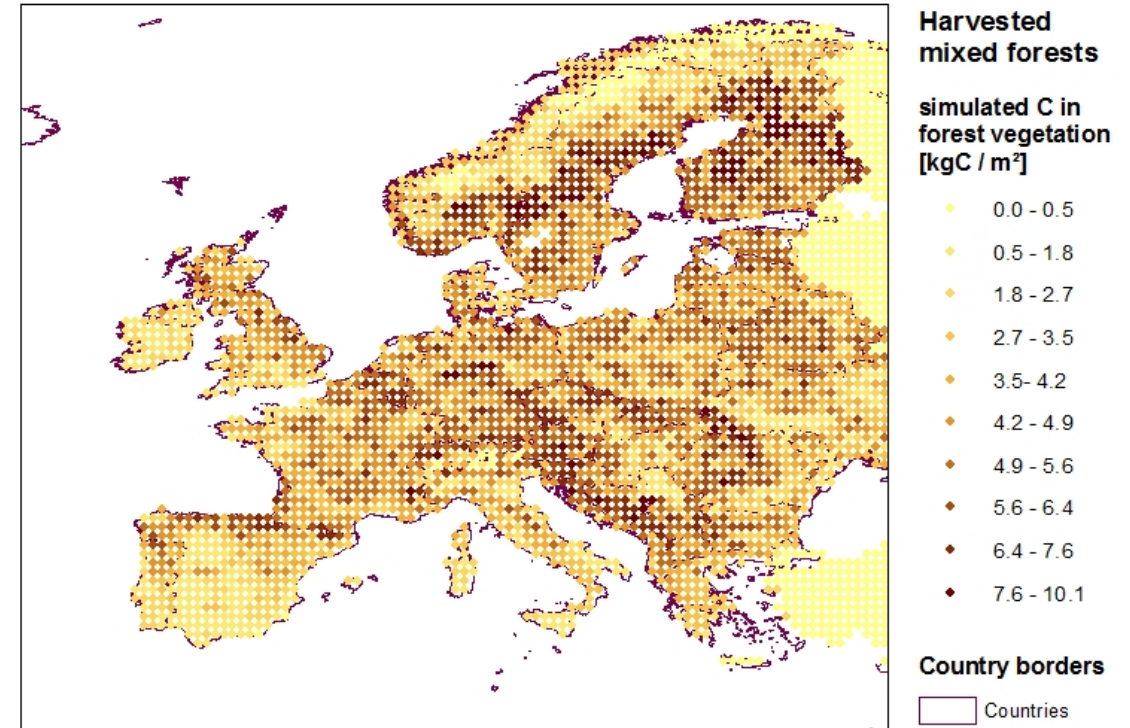


- Europe forests would store 1.73 times more C if they were unmanaged
- Largest differences occur in the vegetation C pool (3.25 times more C)
- Hardly any changes in soil C as: differences in litter are less pronounced and root litter has a higher proportion
- Forests with natural species composition store 1.33 times more C than planted forests

Monocultures vs mixed



Monocultures, LUH2 harvest



Mixed, LUH2 harvest

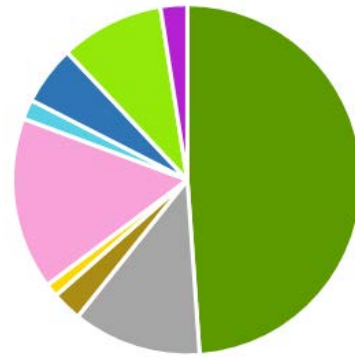
- A natural species composition could increase the C stock without reducing harvested yield. Especially in N-Europe, and NE-Europe but there is potential in all countries.

Monocultures vs Mixed - Explanation

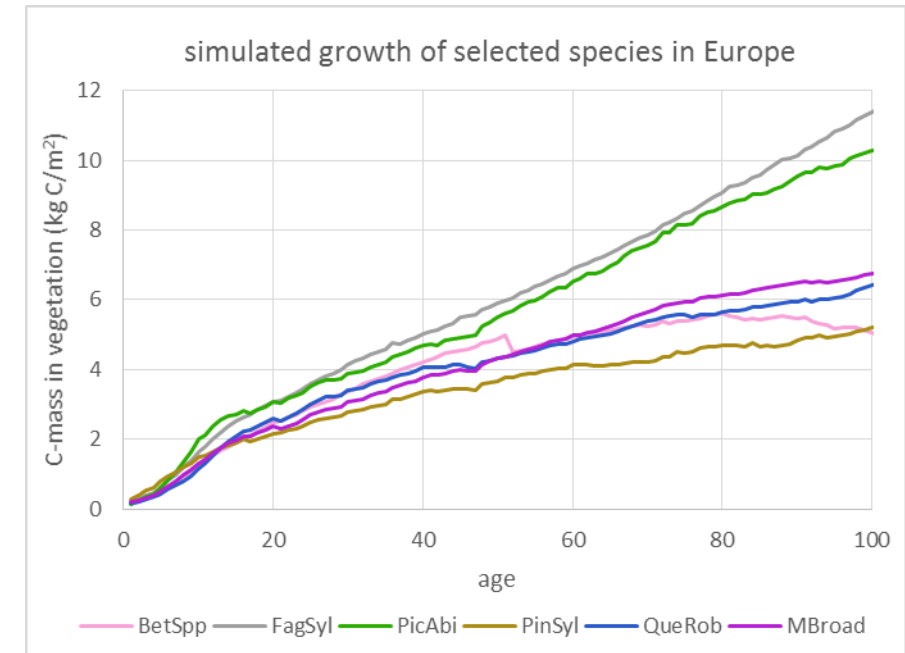
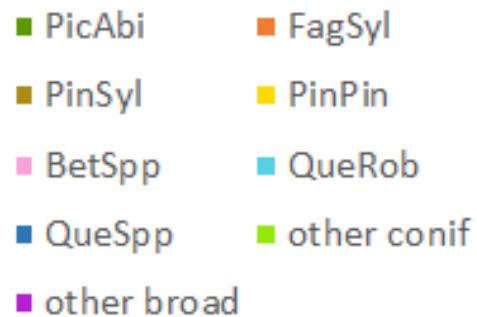
Percentage of each species on total vegetation C in Europe



Monocultures

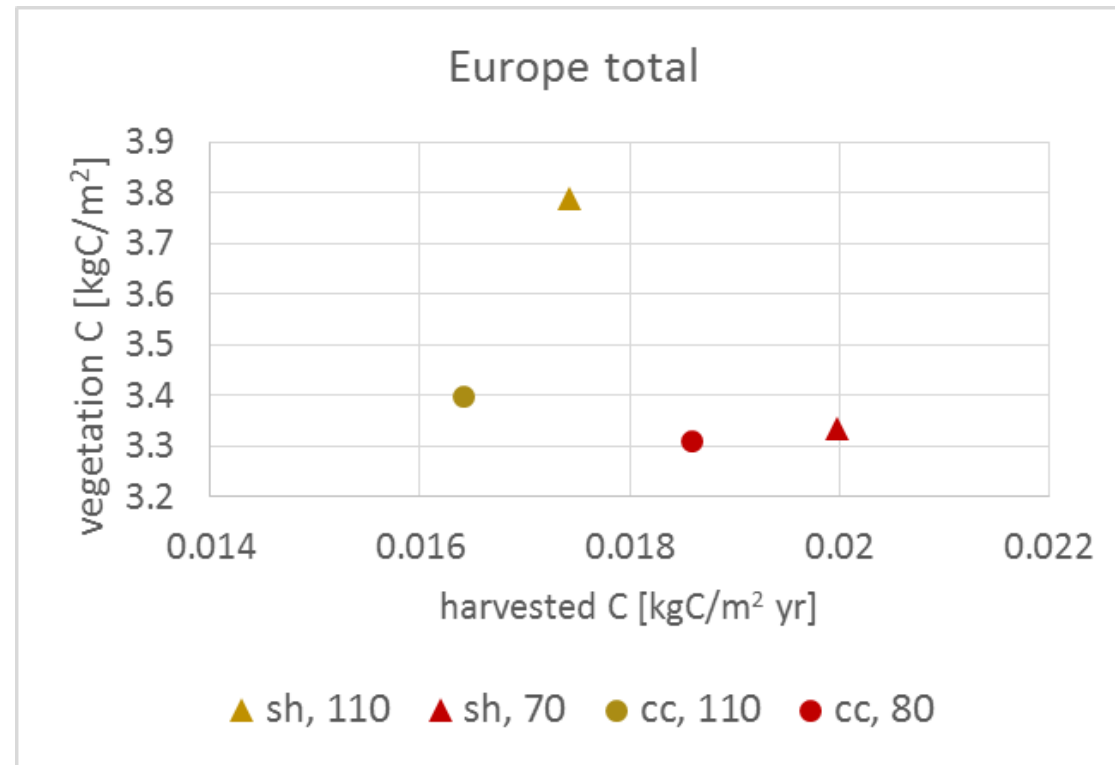


Mixed



- ➡ Pine is widely planted but has relative low vegetation C
- ➡ Global review: Ø 23. 7% higher productivity in polycultures than in monocultures (Zhang et al. 2012) due to niches and positive interactions (e.g. Richards et al. 2010)

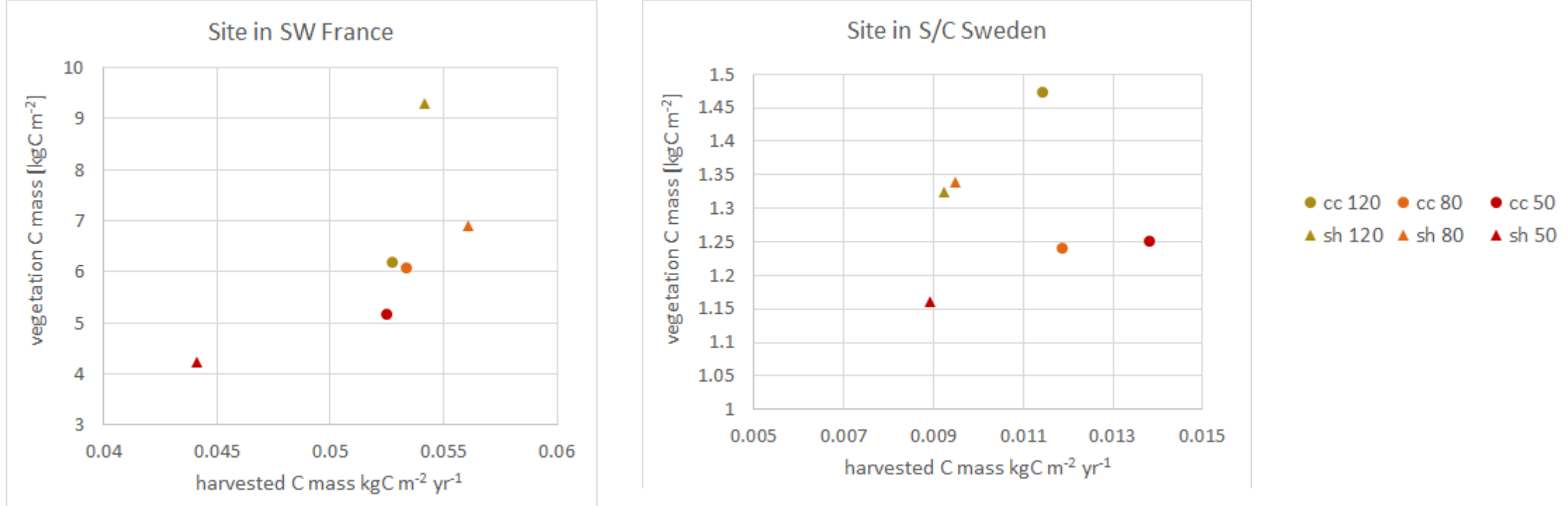
Clear-cut vs Selective harvest



SH = selective harvest
CC = clear cut

- Selective harvest results in higher C storage in vegetation and larger harvested yield

Clear-cut vs Selective harvest – site scale



- France: SH => beech, stores more C than spruce mixed with others, resulting from CC
- France: SH, 50 years rotation => Pinus nigra dominates => lower C
- Sweden: CC => spruce mixed with pine and birch stores more C than spruce, resulting from SH
- ➡ Location, rotation period length and (resulting) species composition matters!

Conclusions

- ➡ Growing demand on harvested products (substitution of fossil fuel, concrete, ...) could further reduce the C in forest vegetation, but:
- ➡ Stored C in forest soil might be concerned to a lesser extend
- ➡ There are management options for increasing C stock without reducing harvested yield (adjusted species selection, harvest method and intensity)

Thank you for your attention!