

Forest management developments and applications with ORCHIDEE-CN-CAN

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ORCHIDEE-CN-CAN

- Land surface model used the IPSL earth system model
- CN: Carbon-Nitrogen coupling
- CAN: Dynamic canopy structure

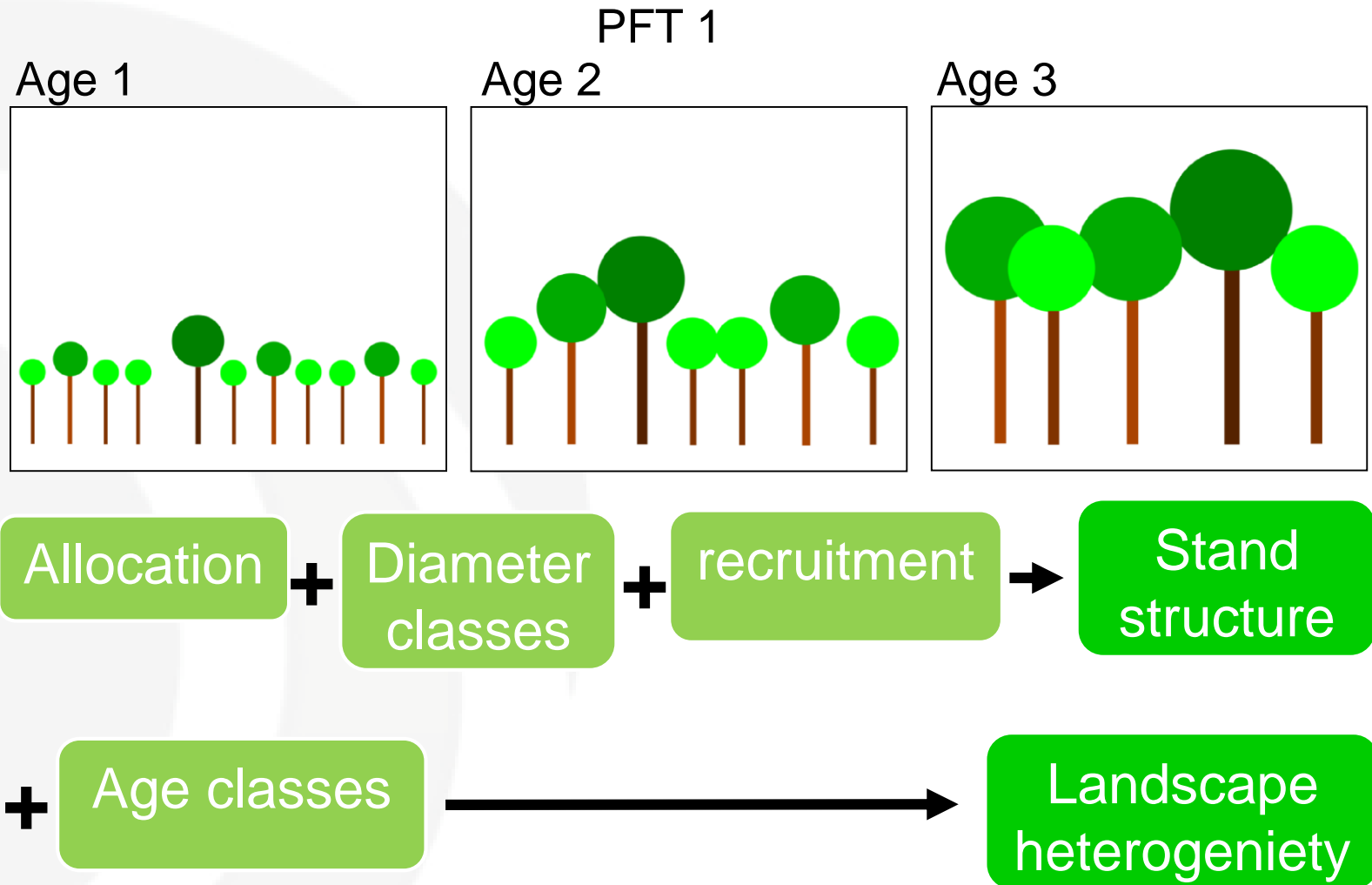


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Dynamic canopy developments



Forest Management

- Thinning regimes
- Final felling
- Coppicing
- Fertilization
- Species change
- Non-timber forest uses like litter raking
- Wind throw
- Bark beetle outbreaks



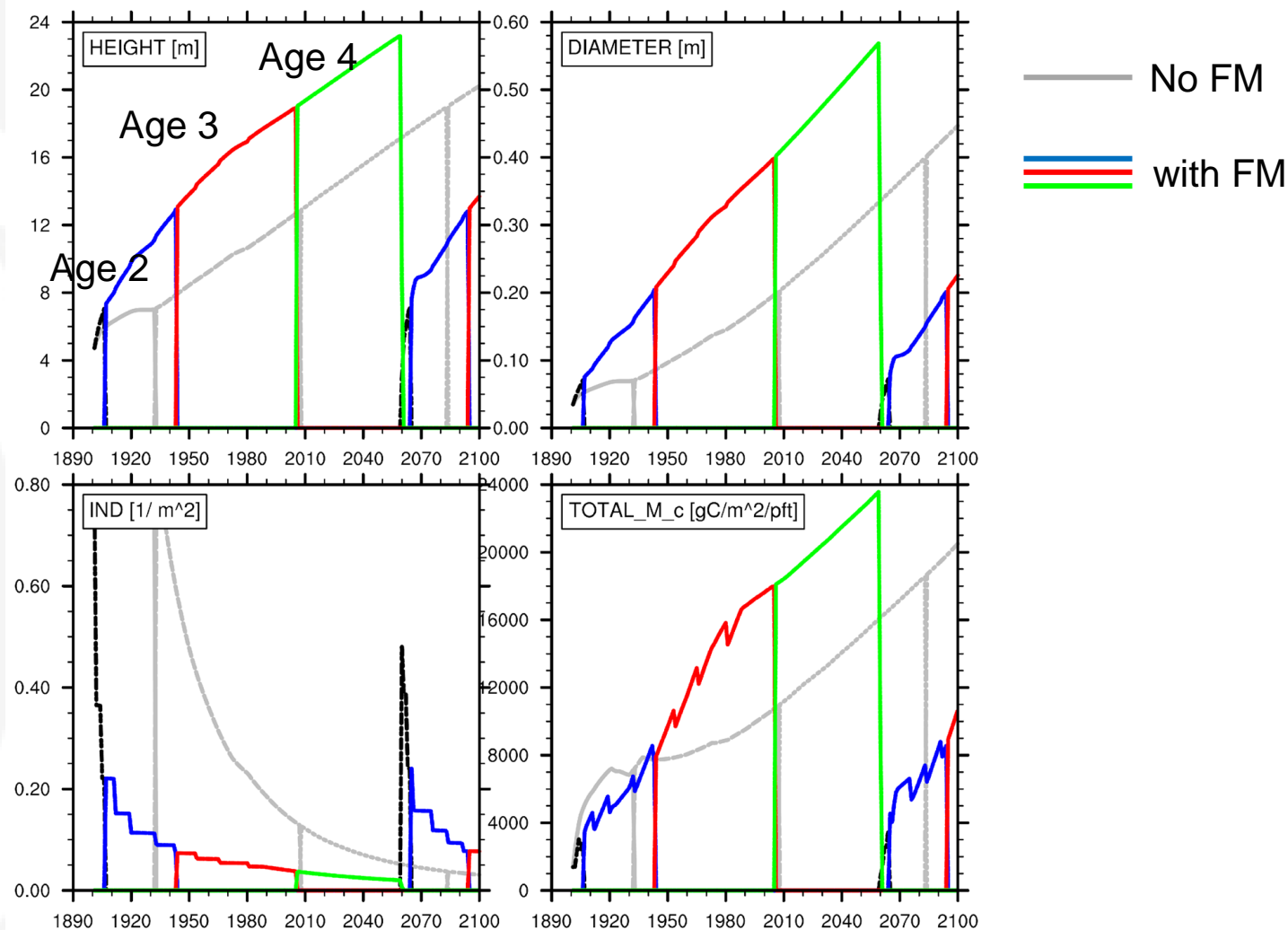
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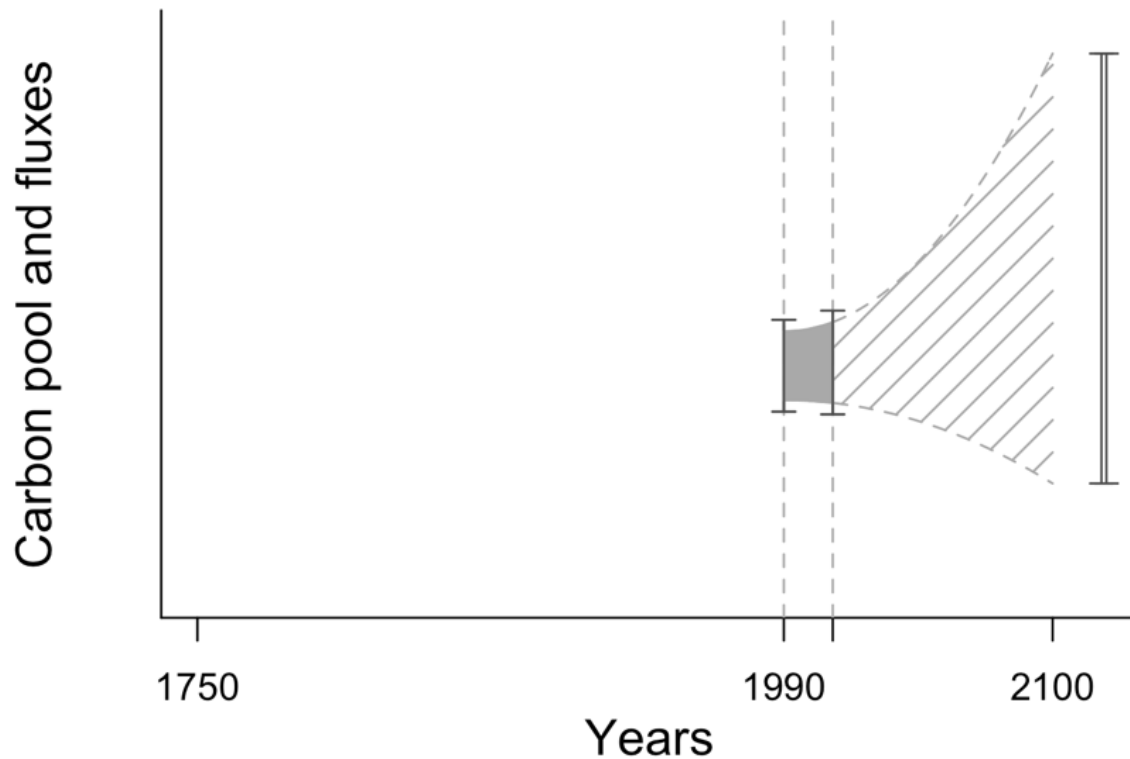


Forest Management

NE Temperate



Applications: Tree rings



Jeong et al., in prep

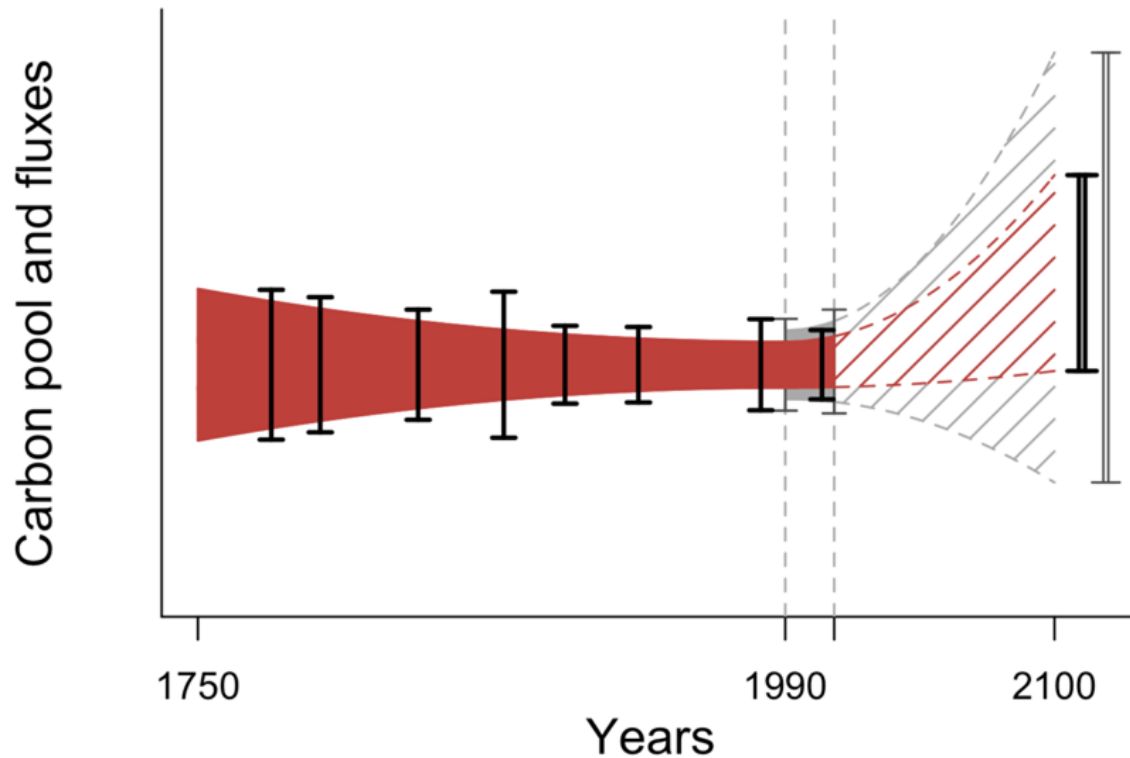


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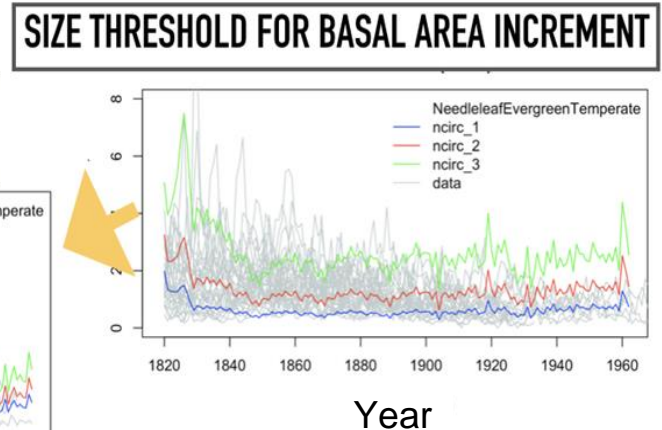
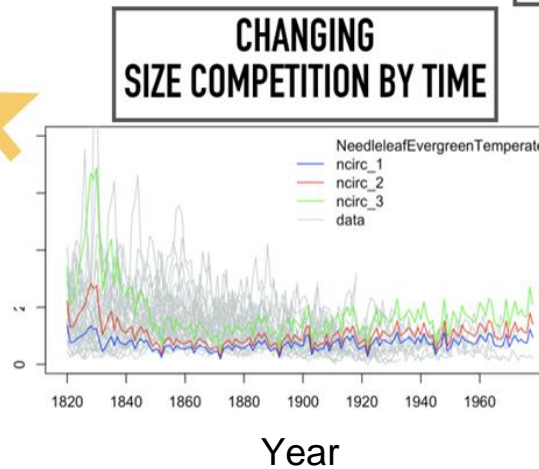
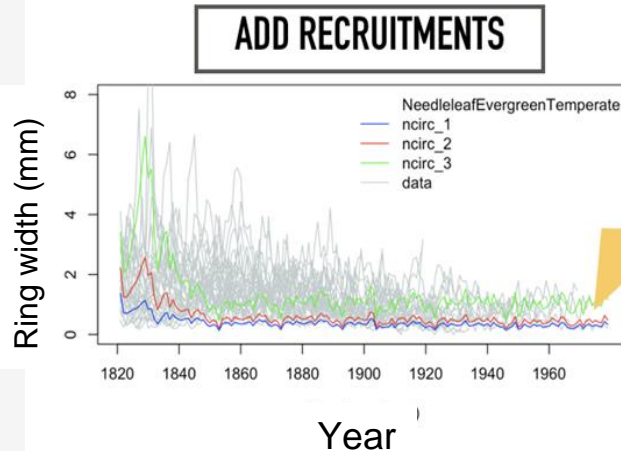
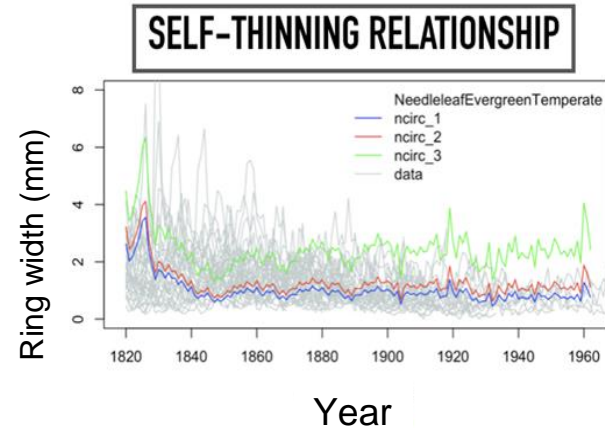
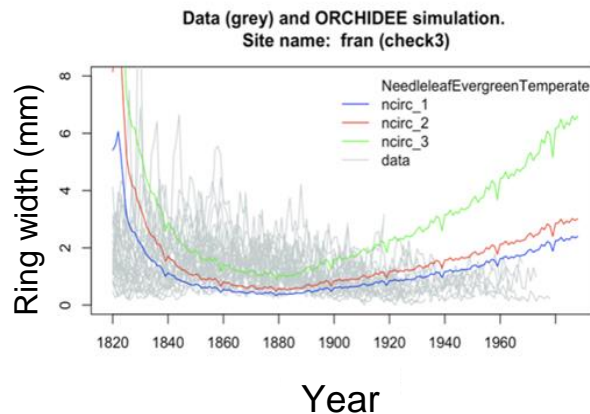


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Applications: Tree rings



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Jeong et al., in prep



Applications: Legacy effects of litter raking



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Applications: Legacy effects of litter raking



2018 Californien forest fires



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Applications: Legacy effects of litter raking



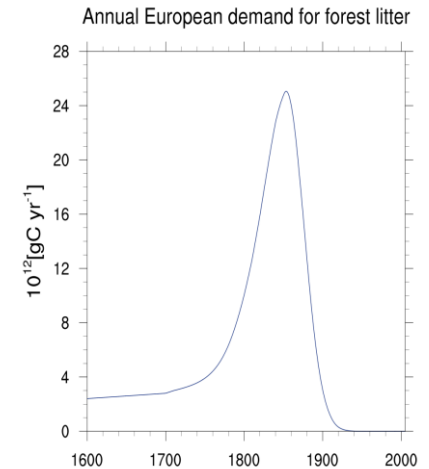
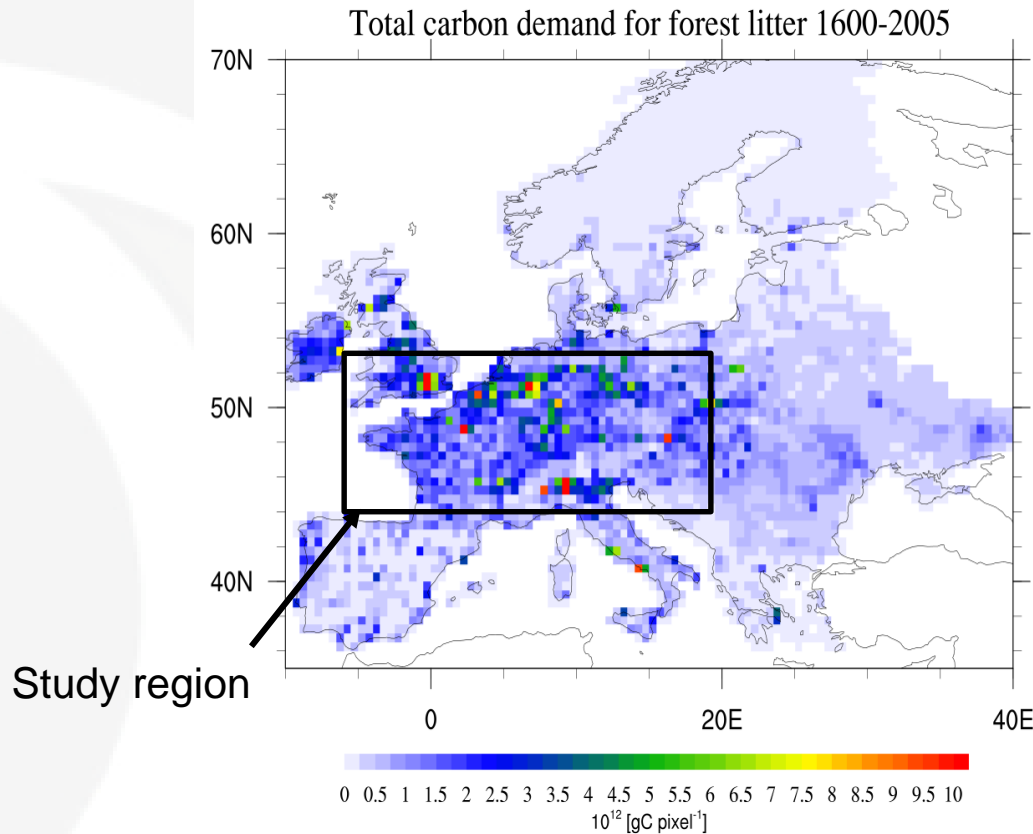
2018 Californian forest fires



Historic non-timber forest management practice



Applications: Legacy effects of litter raking



Accumulated carbon demand for forest litter over the period 1600-2005

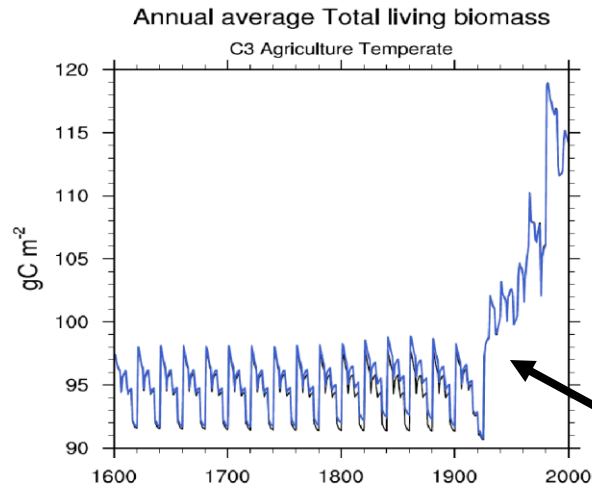
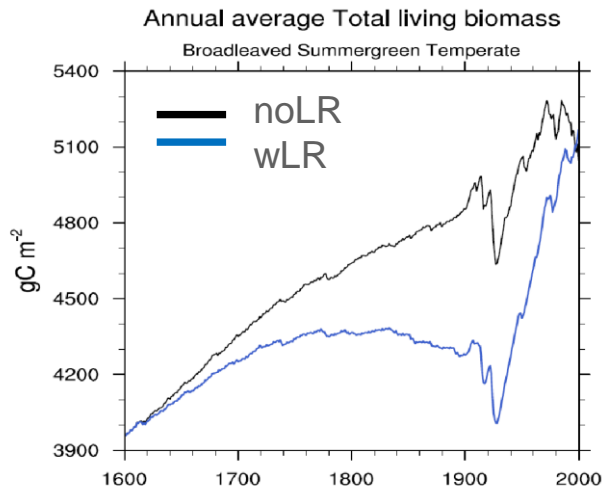
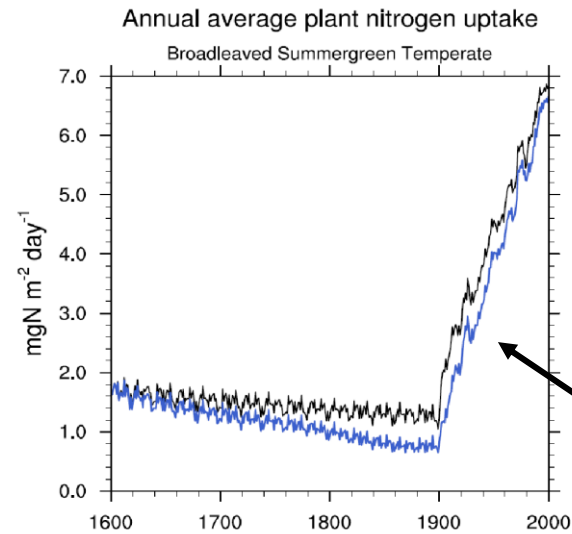
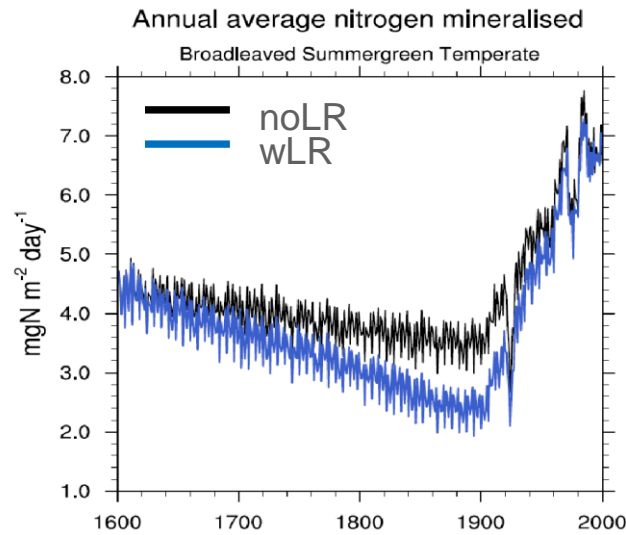


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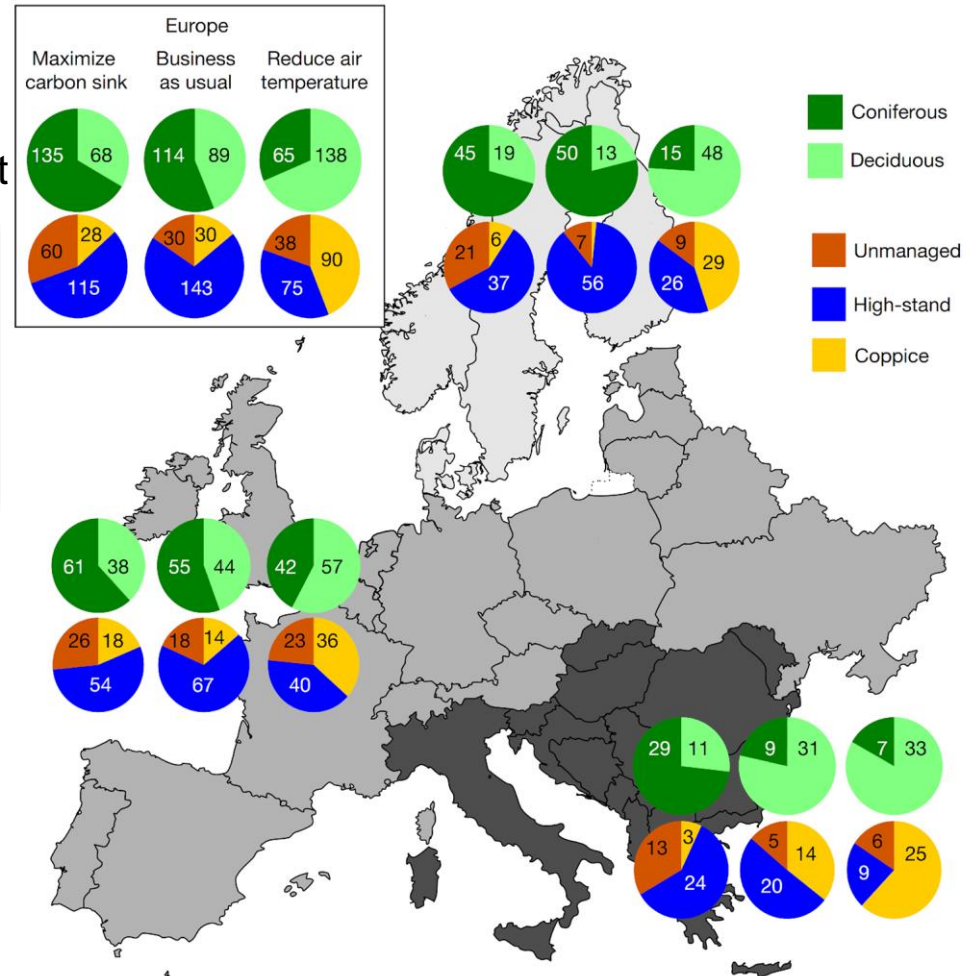
Applications: Legacy effects of litter raking



Applications: FM to mitigate climate change?

To comply with Paris Agreement

- Reduce growth rate of atmospheric CO₂
- Reduce radiative imbalance at TOA
- Do not increase near-surface temperature
- Do not decrease precipitation



Luyssaert et al., 2018

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Applications: FM to mitigate climate change?

Table 1 | Biogeochemical and biophysical effects over Europe in 2100 for four different forest-management portfolios

Variable (units)	Business as usual	Maximize carbon sink	Maximize albedo	Reduce air temperature
Global average TOA (W m^{-2})	4.31 ± 0.01	4.31	4.33	4.32
Change in CO_2 sink and avoided emissions between 2010 and 2100 (Pg C)	4.7	12.8	5.0	8.1
Change in net cumulated atmospheric CO_2 between 2010 and 2100 (Pg C)	-2.7	-7.0	-2.8	-4.5
Atmospheric CO_2 (p.p.m.)	934.6	932.6	934.6	933.8
Air temperature (K)	283.84 ± 0.001^a	283.84	283.83	283.81
Annual precipitation (mm)	734.7 ± 0.1	732.6	730.0	730.9
Summer precipitation (mm)	166.1 ± 0.1	165.2	163.7	165.0
Wood harvest (Tg C y^{-1})	203.2	179.5	144.5	151.6
Surface albedo (-)	0.113 ± 0.0001^a	0.113	0.128	0.126
Evapotranspiration (mm)	555.5 ± 0.1	552.8	546.4	549.2
Latent heat (W m^{-2})	44.35 ± 0.01^a	44.13	43.60	43.82
Sensible heat (W m^{-2})	26.67 ± 0.01^a	26.82	27.28	27.00
Total cloud cover (%)	46.8 ± 0.1^a	46.7	46.7	46.6



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- The climate benefits of sustainable FM are limited, local rather than global
- Focus on adapting forest to climate change - any changes will likely have small impacts on climate



Summary

- More realistic representation at stand and landscape scales
- Management of forest systems
 - Improved historic representation of European forest
 - Better assess future forest systems
- Besides forest management, the developments allow for
 - Better benchmarking of LSM
 - Nutrients limitations in forests
 - Water stress of forest stands

