

Le rôle de l'âge des forêts dans les modèles du système terre

Ben Poulter



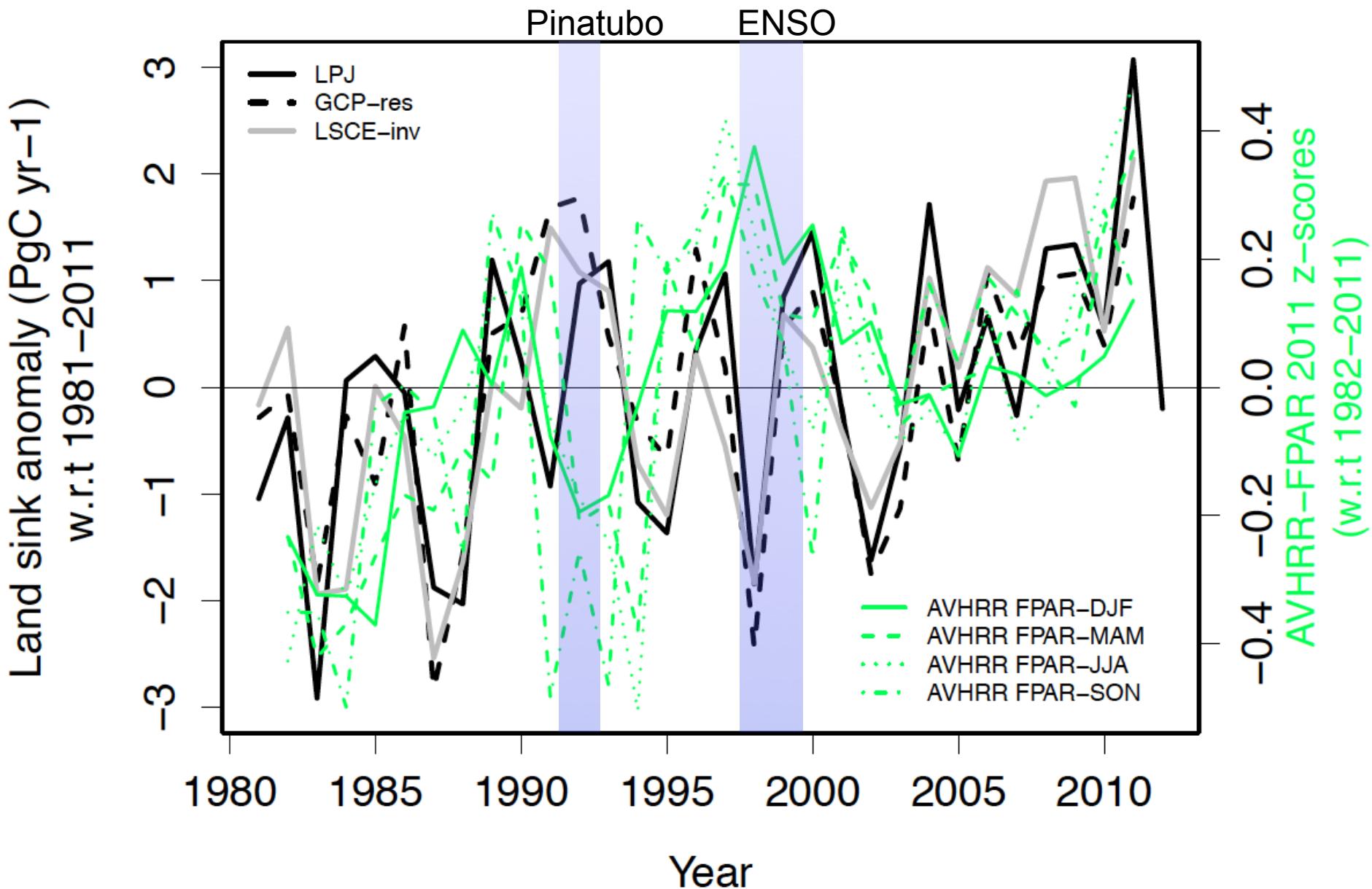
With contributions from L Aragão, V Bellassen, T Kato, X Lin, S Luyssaert, B Nachin, D McInerney, N Pederson, P Peylin, S Piao, D Schepaschenko, A Shvidenko, S Saatchi, M Schelhaas, S Sitch, P Ciais & TRENDY modelers



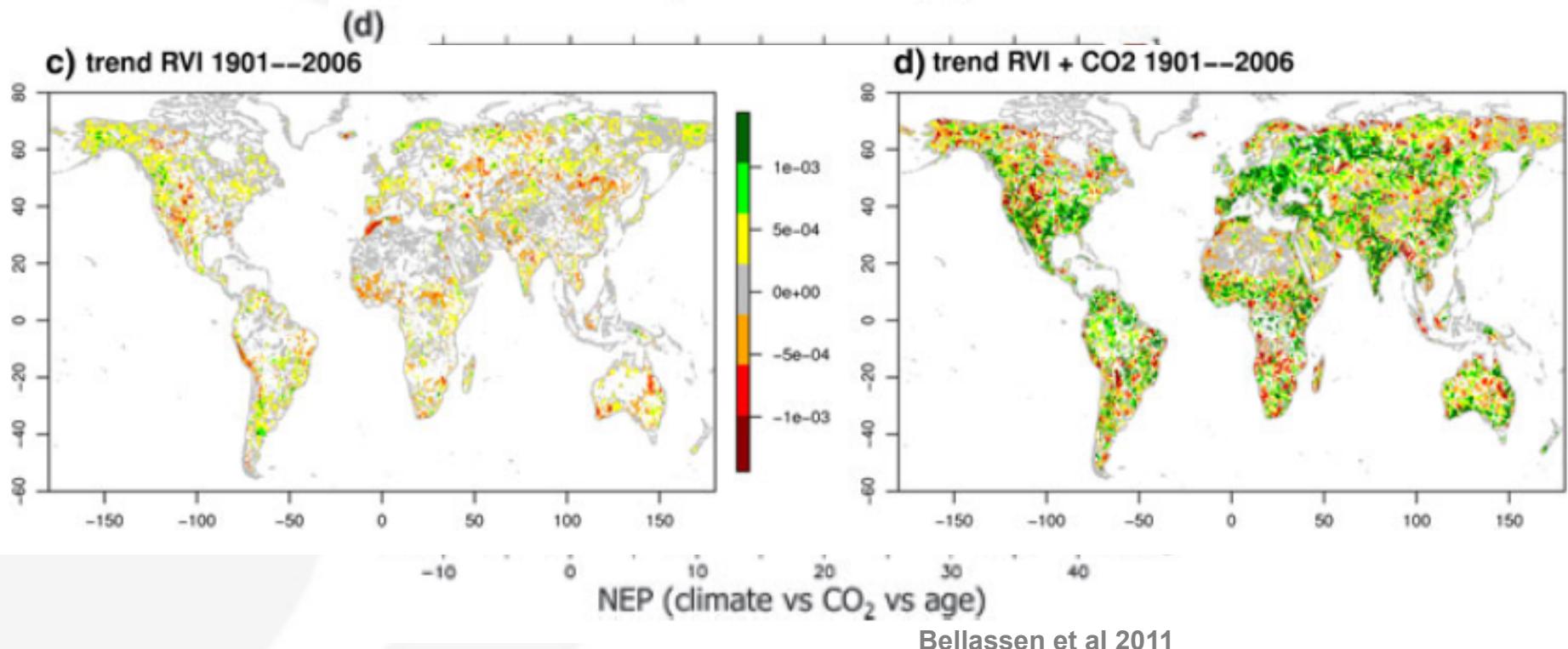
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Augmentation du puits de carbon terrestre



Causes de l'augmentation du puits de carbone?



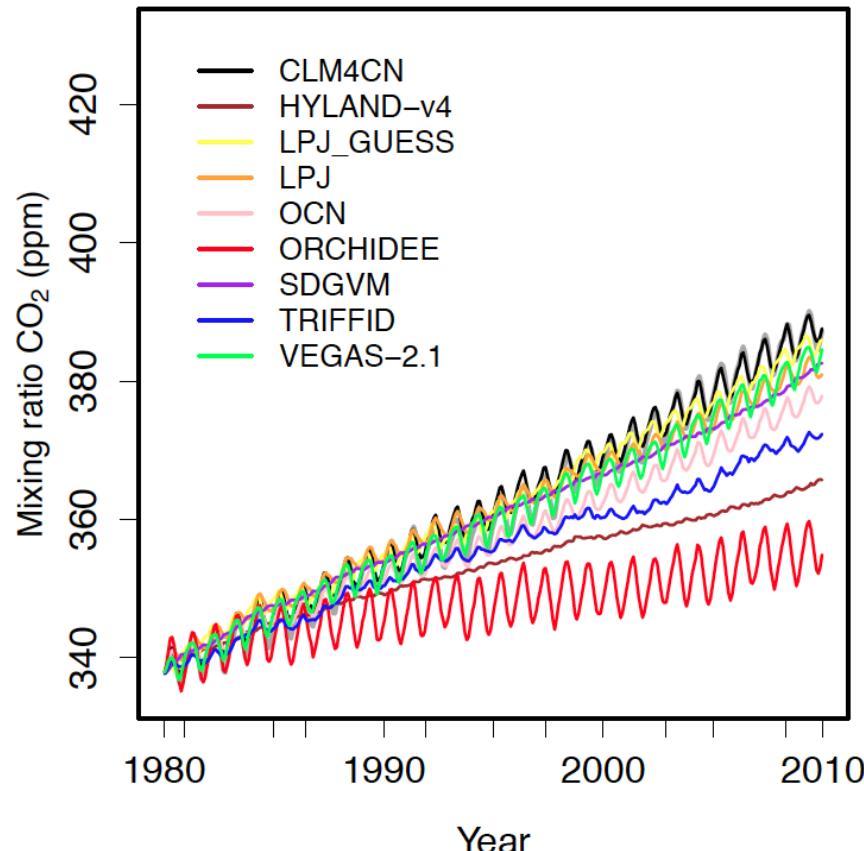
Los 2013



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Causes de l'augmentation du puits de carbone?

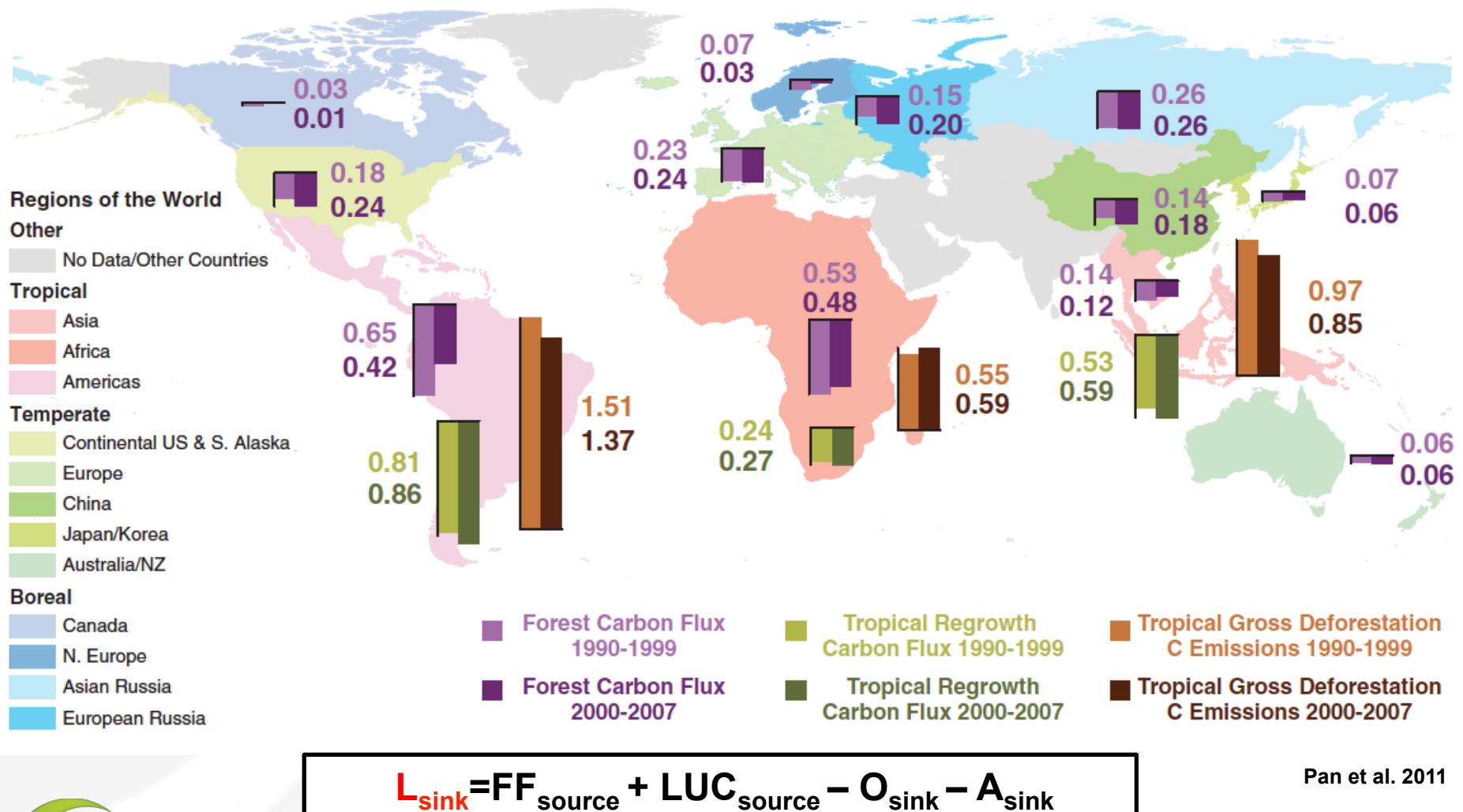


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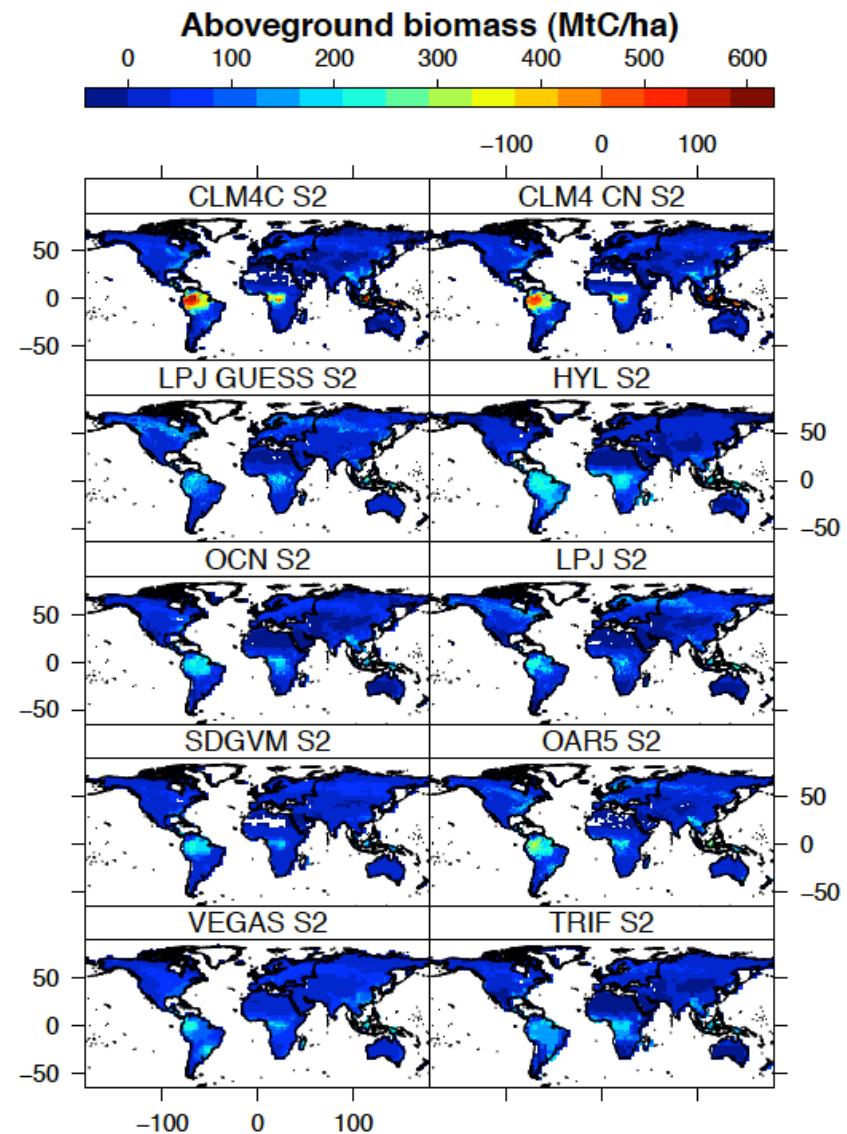
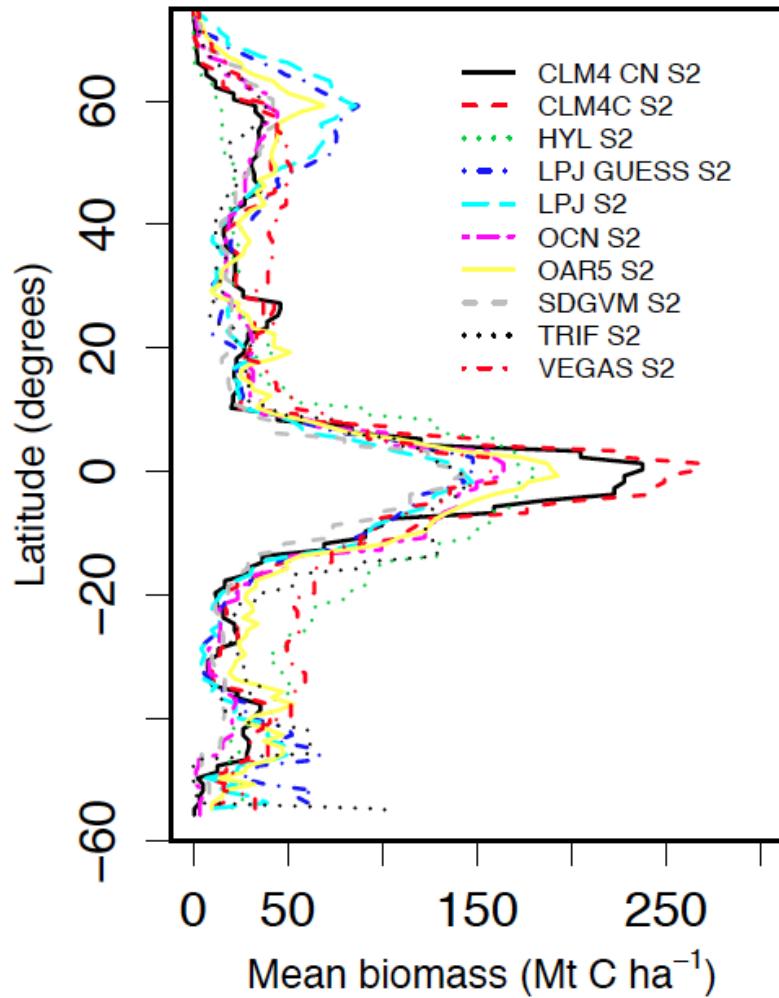
Fermeture du bilan de carbone



$$L_{\text{sink}} = FF_{\text{source}} + LUC_{\text{source}} - O_{\text{sink}} - A_{\text{sink}}$$

Pan et al. 2011

Modélisation de la biomasse aérienne

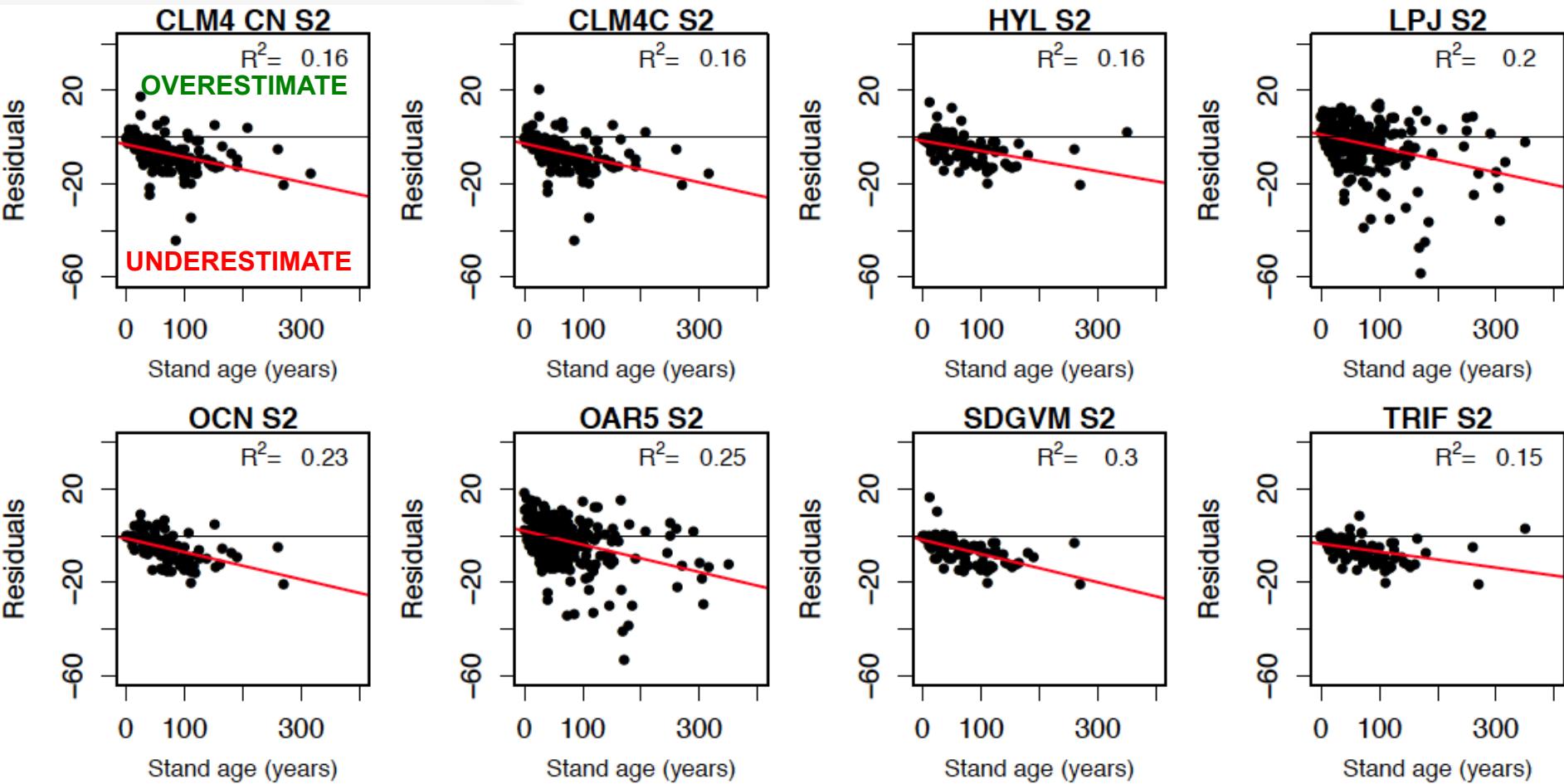


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Age des Forêt explique > 20% de l'erreur résiduelle

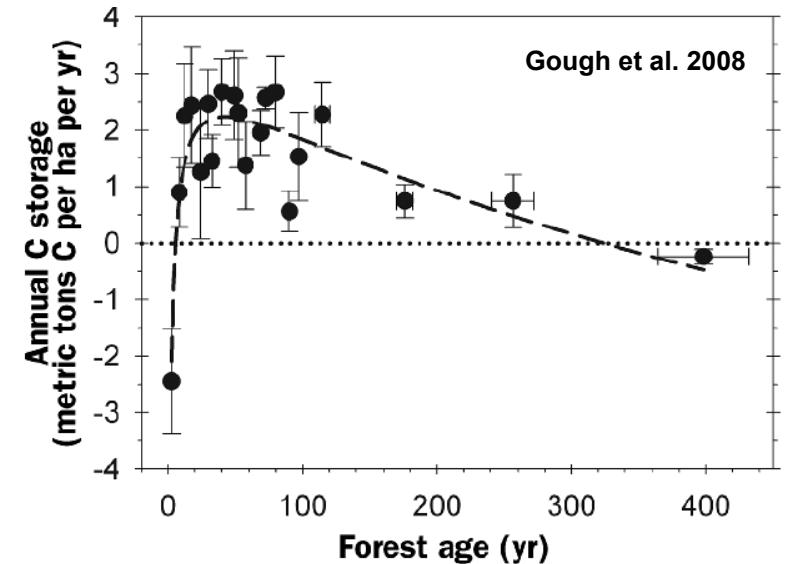
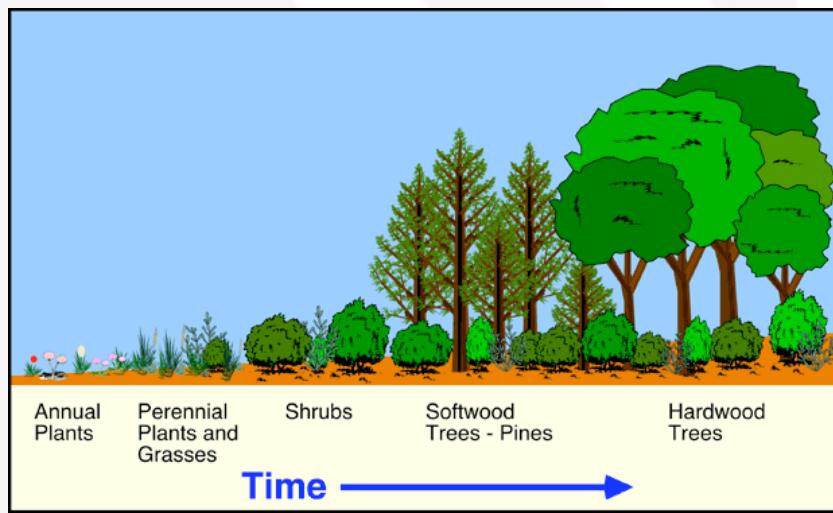


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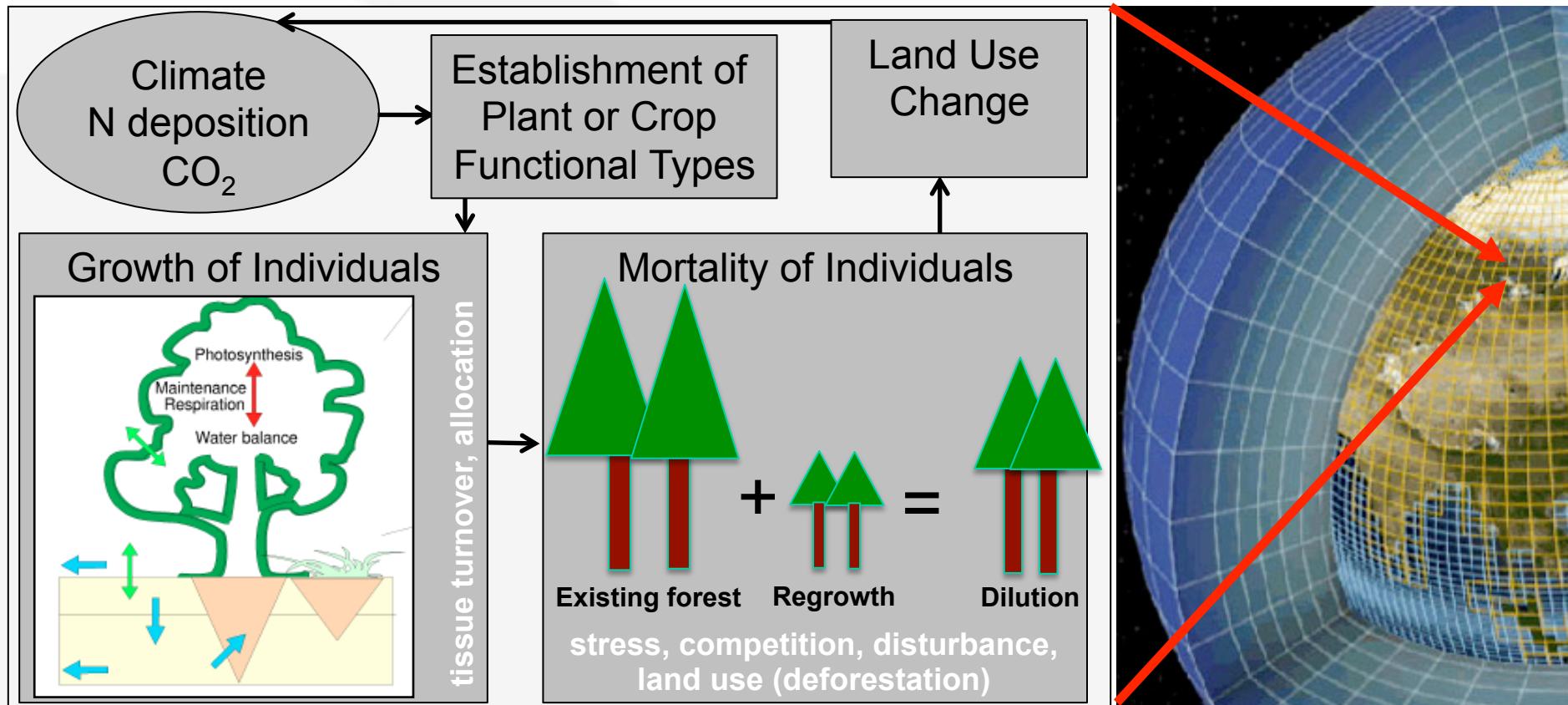
Processus dépendant de l'âge

- Carbon allocation
 - Root-sapwood-LAI feedbacks
- Productivity gradient
 - Progressive nutrient limitation
- Accumulation of dead biomass
 - Variation in ecosystem respiration



Modélisation dynamique de la végétation

- Coupled biogeography and biogeochemistry models
- *Predict* carbon, water, energy exchange at multiple scales



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Estimation de la structure en âge des forêts

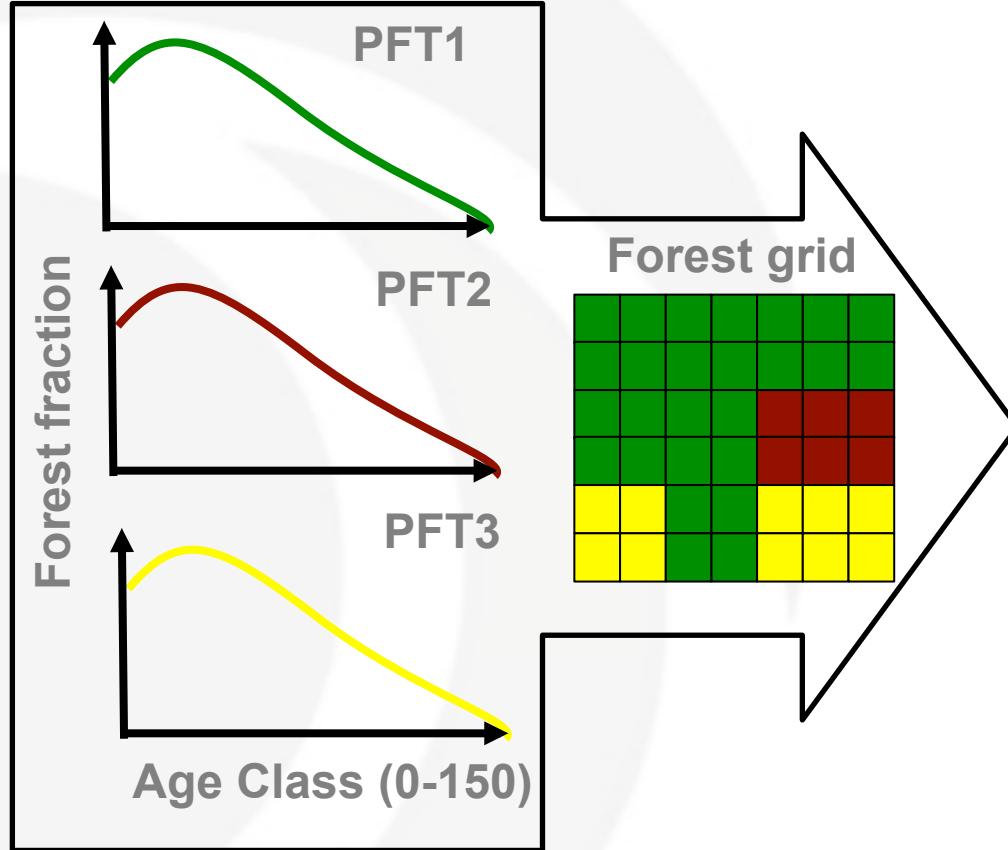
| Region/Country | Data Source | Managed/ Unmanaged | Ancillary data |
|-----------------|--|-----------------------|-------------------------------------|
| United States | US FIA | None | States |
| Russia | IIASA | None | |
| Canada | CanFl | Yes | Large fires database |
| Europe | EFISCEN | None | Provinces |
| Pan-tropics | Saatchi biomass | None | Marin-Spiotta biomass-age curves |
| China | 6 th National Forest Inventory | Yes | Plantations |
| Other countries | New Zealand NFI Mongolia NFI Japan NFI | None None Yes | Provinces |

- MODIS version 5.1 land cover converted to 0.5 degree plant functional types
- Spatial downscaling assumed homogeneous variance within each spatial domain
- For the tropics, climate-stratified biomass-age curves (Marin-Spiotta & Saatchi)

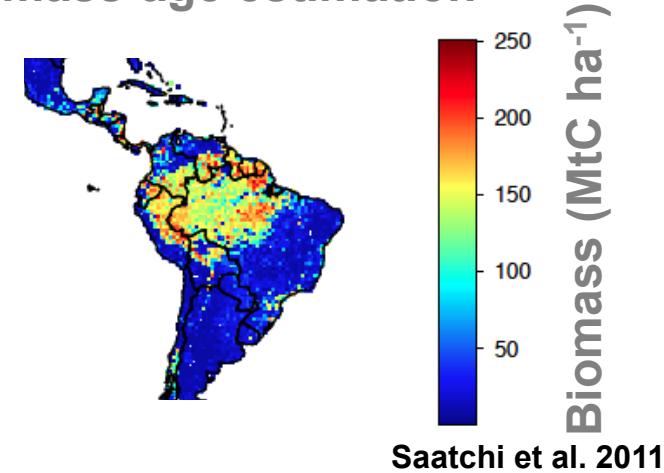


Estimation de la structure en age des forêts

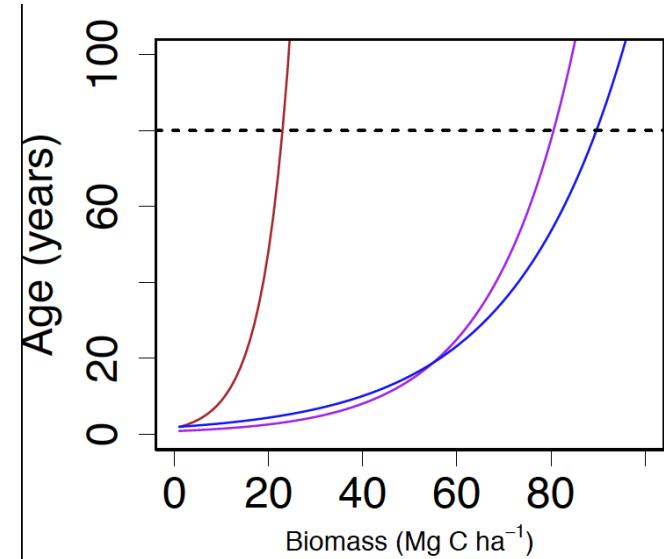
Forest inventory downscaling



Biomass-age estimation



Saatchi et al. 2011

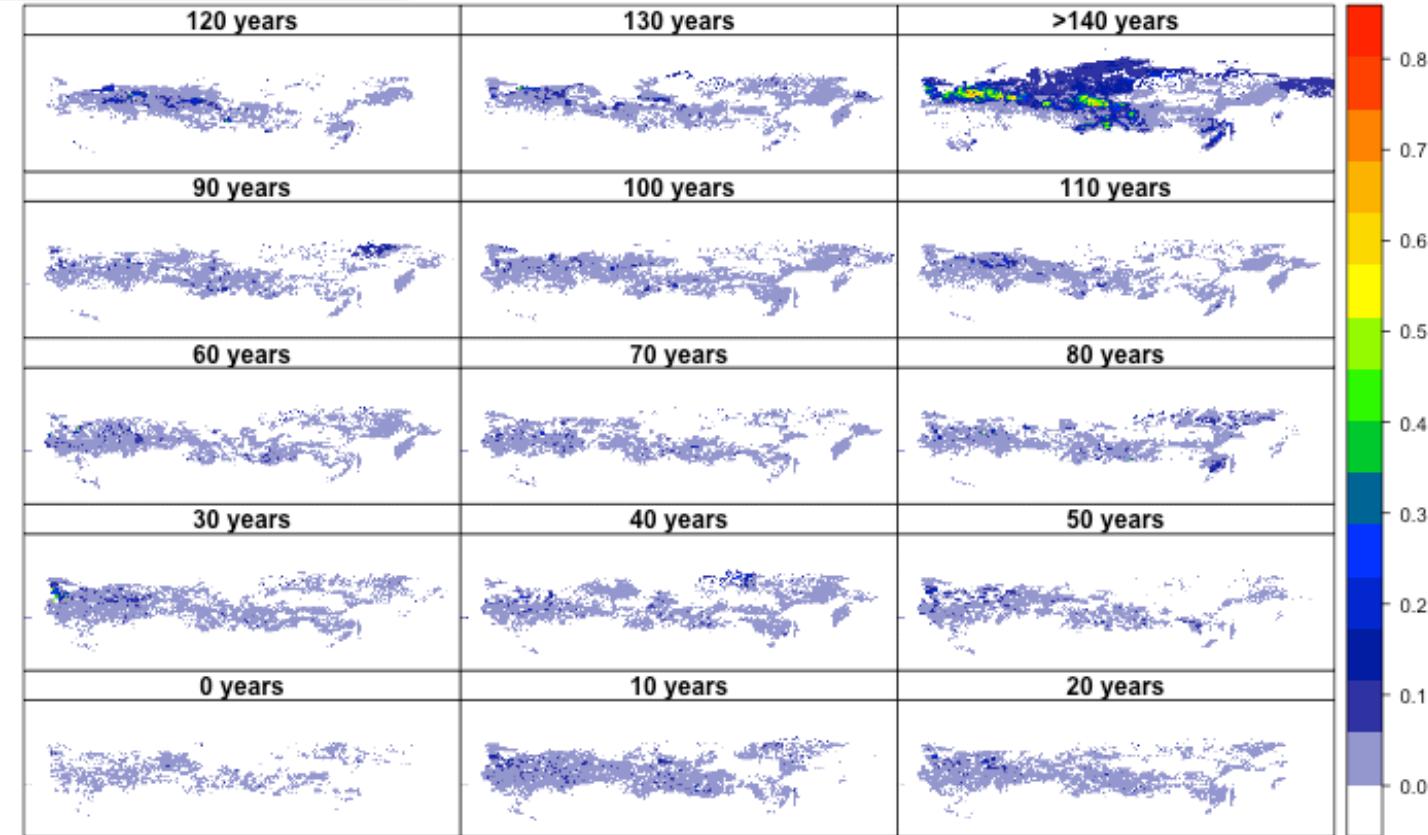


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Marin-Spiotta 2009

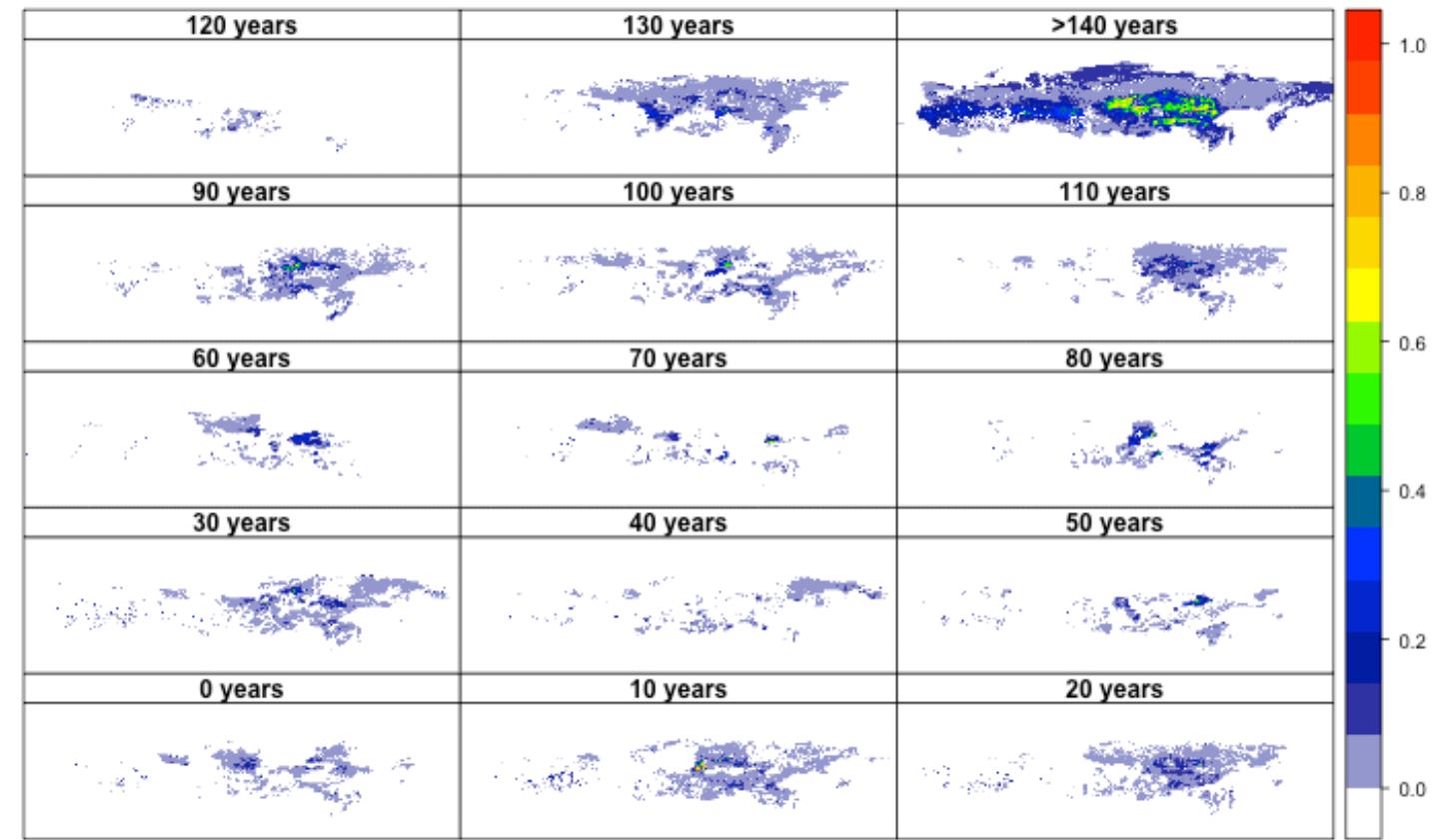
Russie: conifères sempervirents



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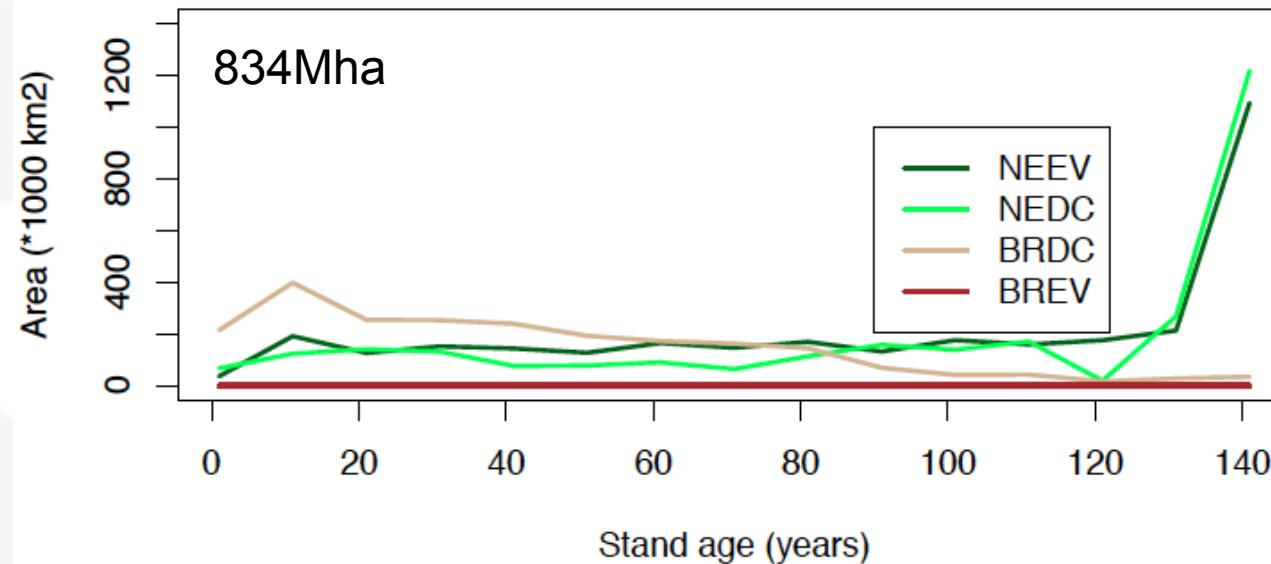
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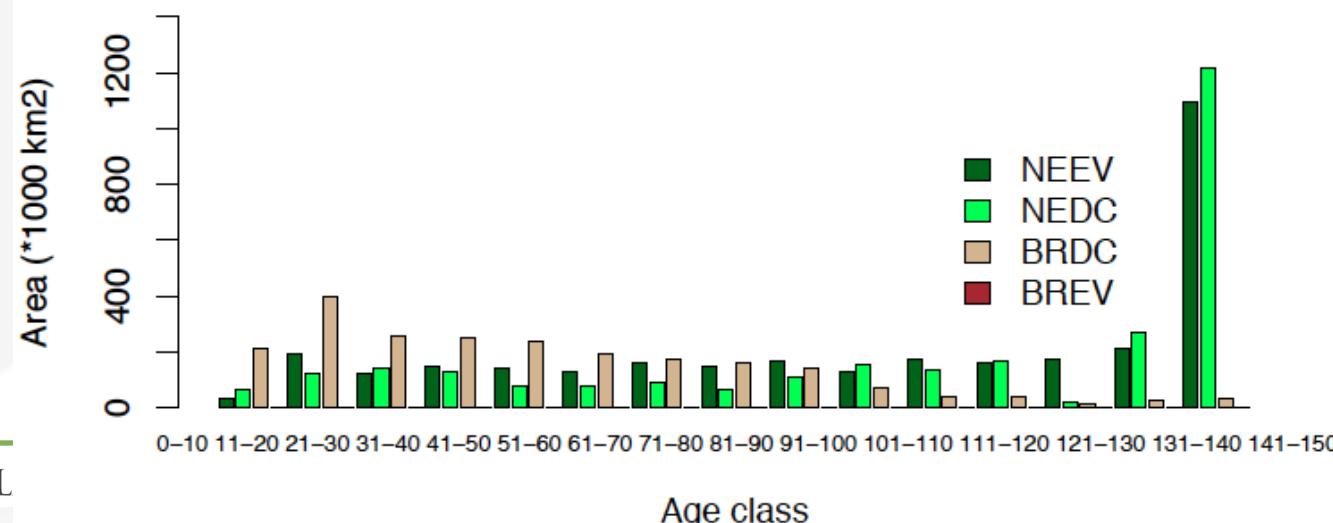
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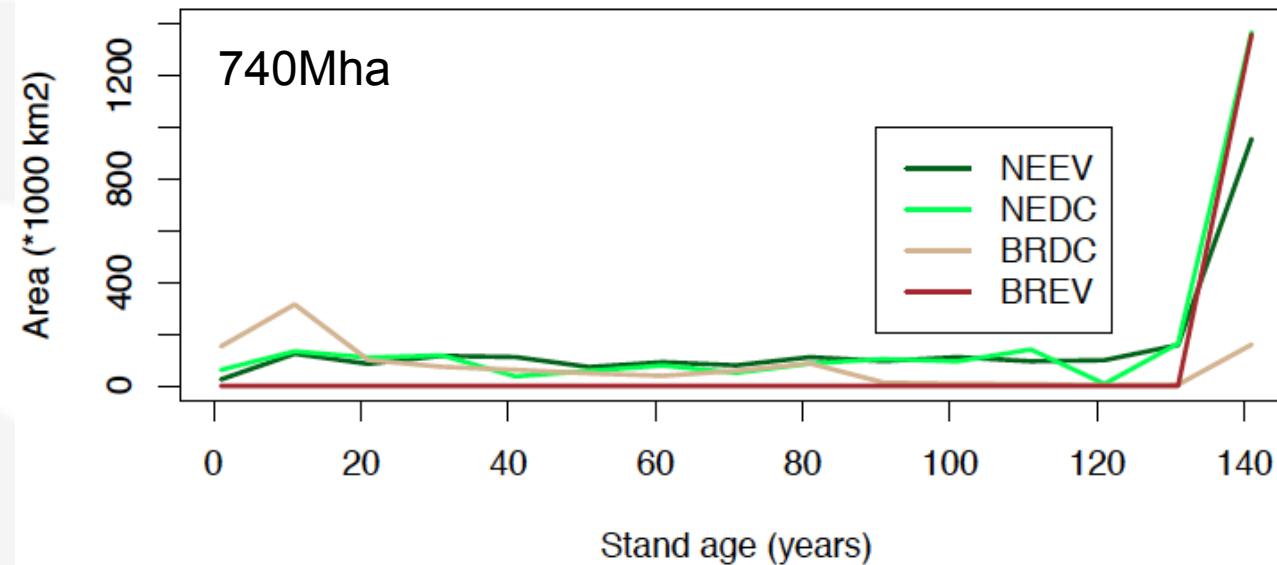
Cartographie globale de la structure en age



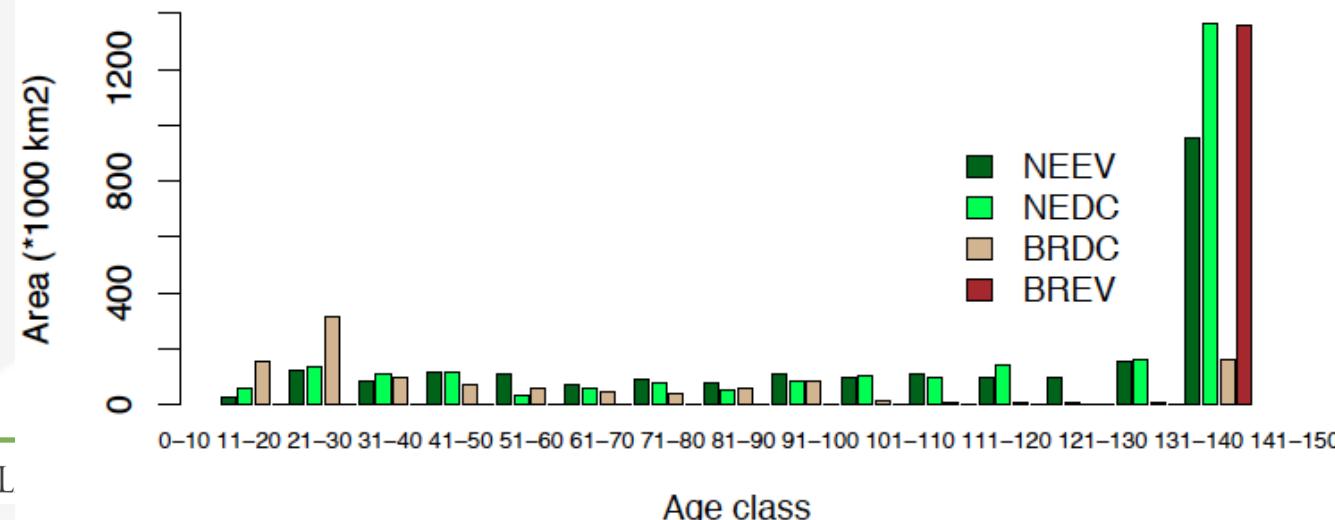
Russia age distribution



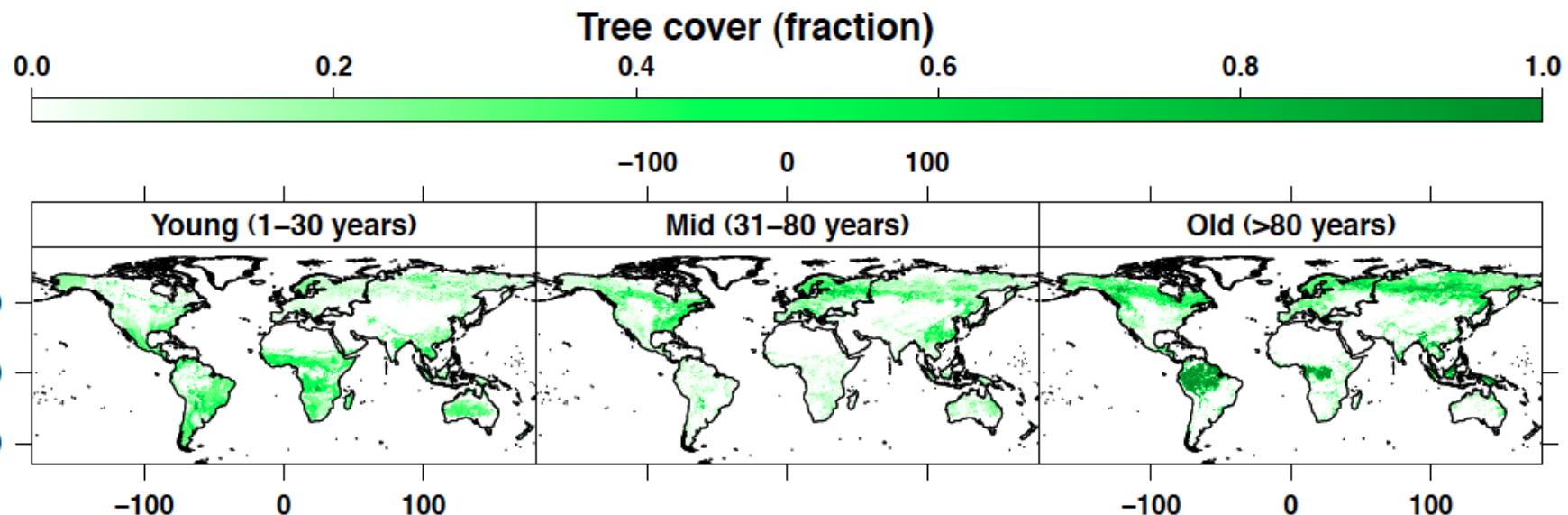
Cartographie globale de la structure en age



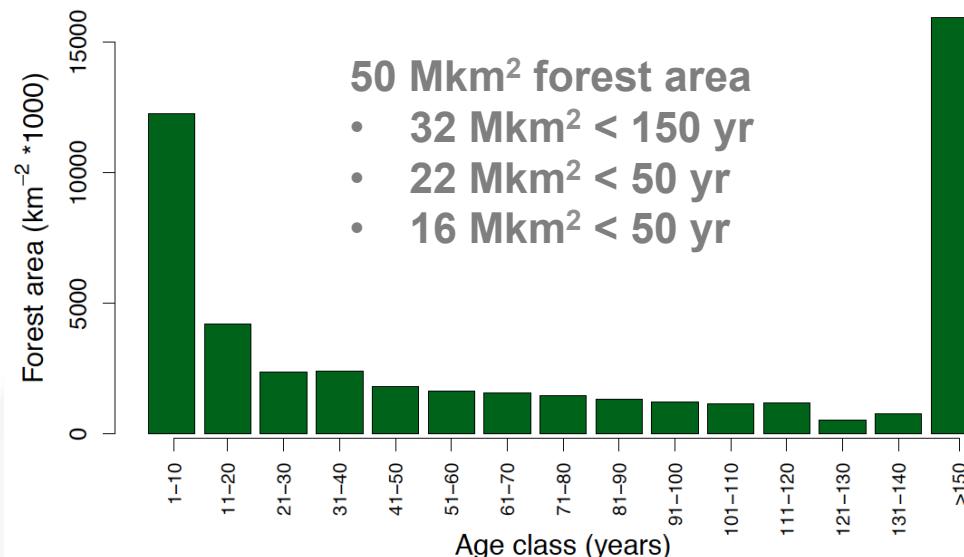
Russia age distribution



Cartographie globale de la structure en âge



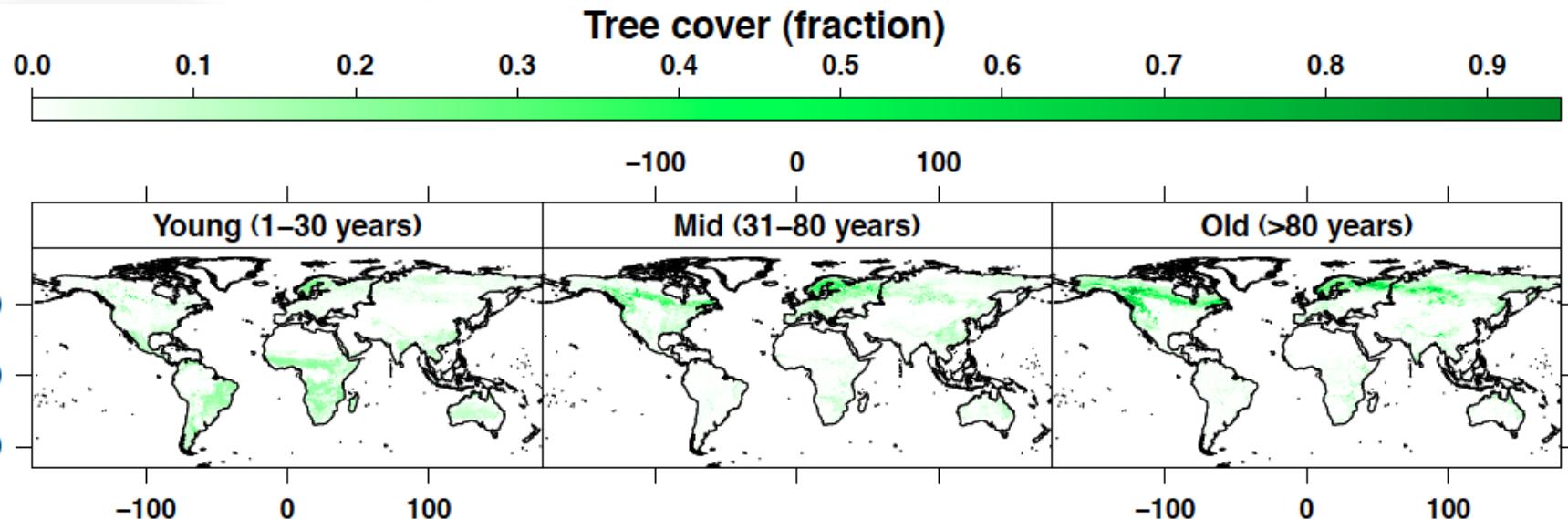
Global Forest
Age



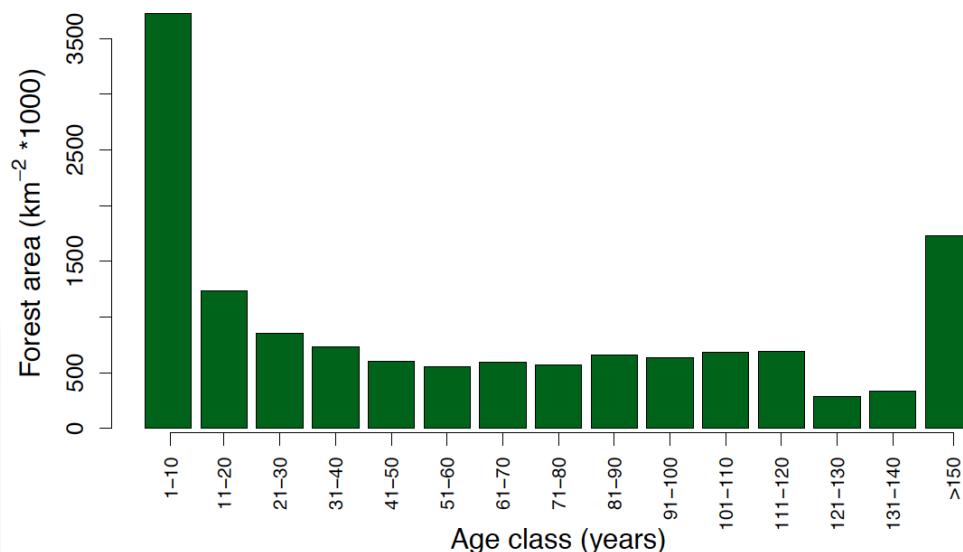
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Cartographie globale de la structure en âge



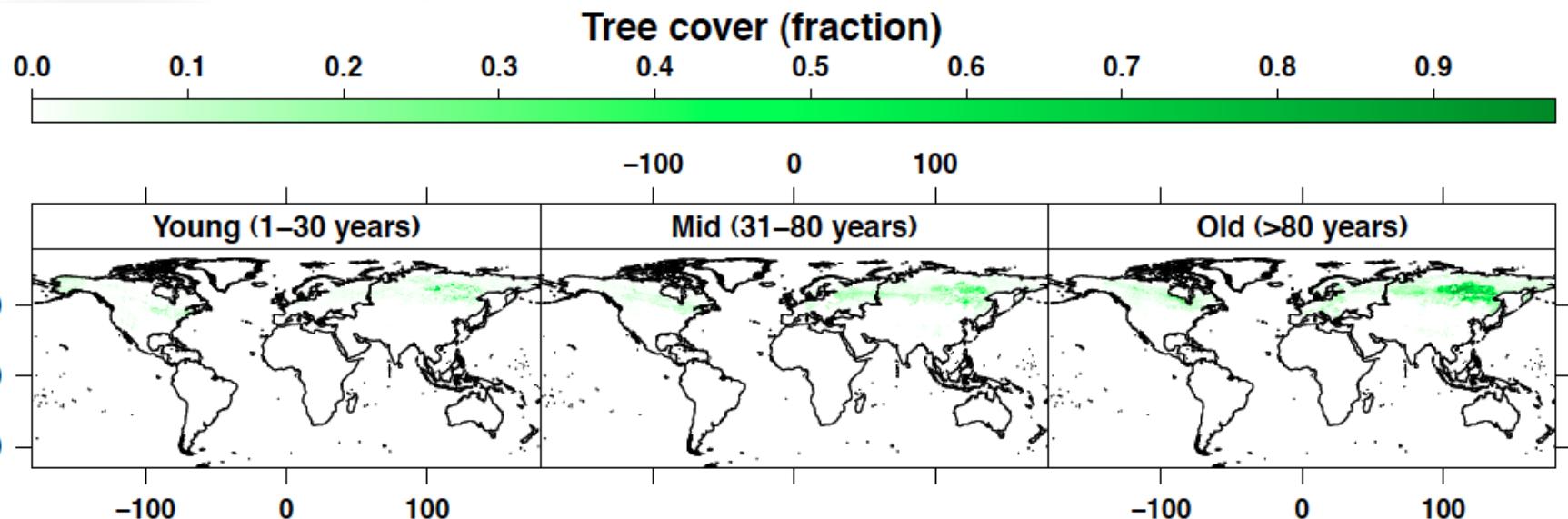
Needleleaf
evergreen
forest age



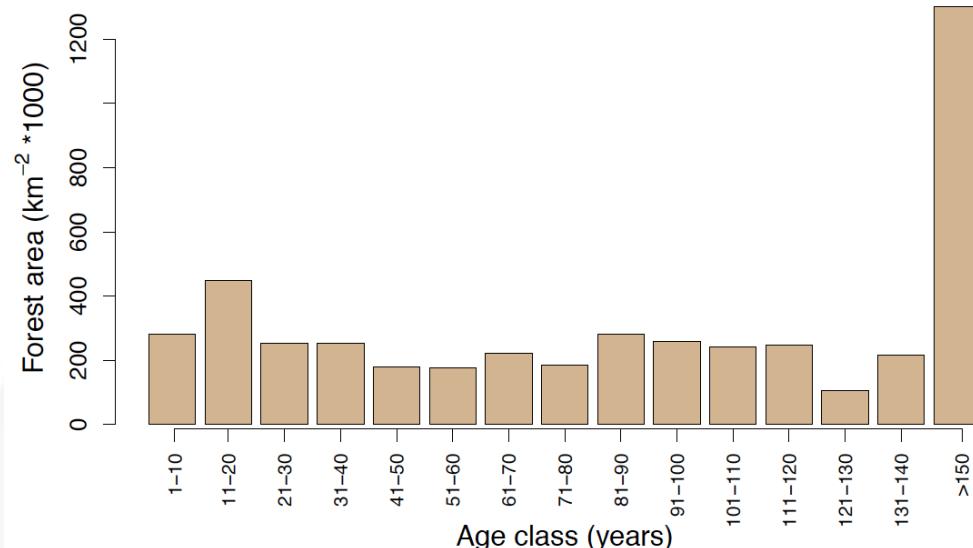
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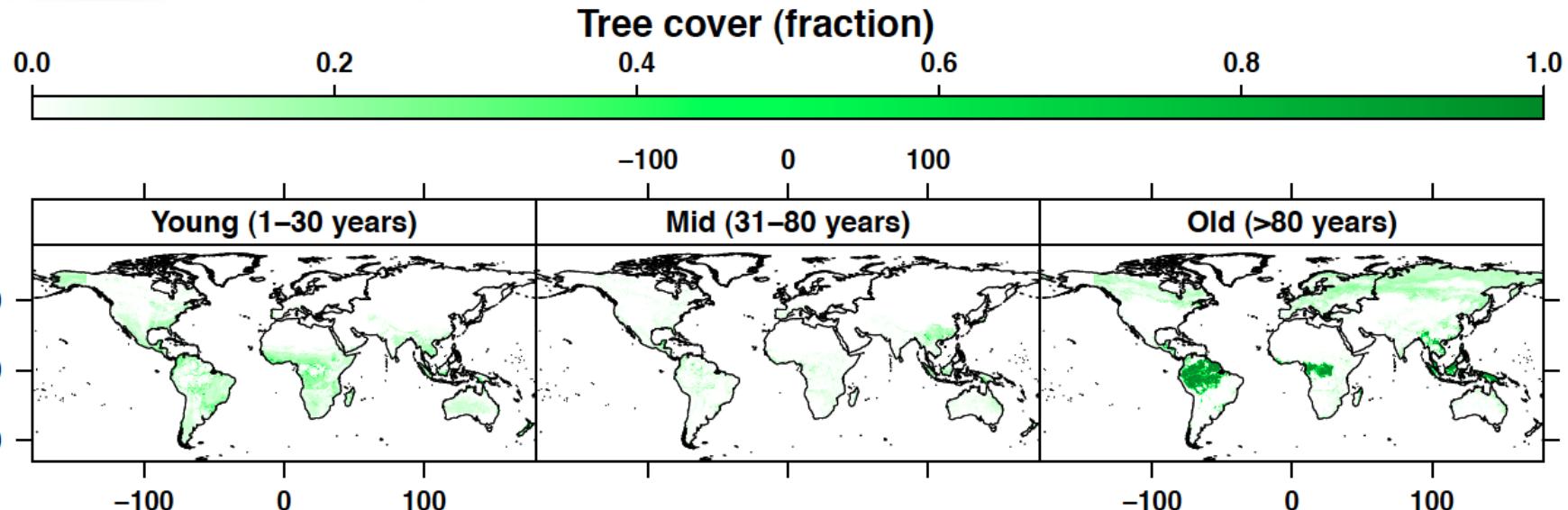
Needleleaf
deciduous
forest age



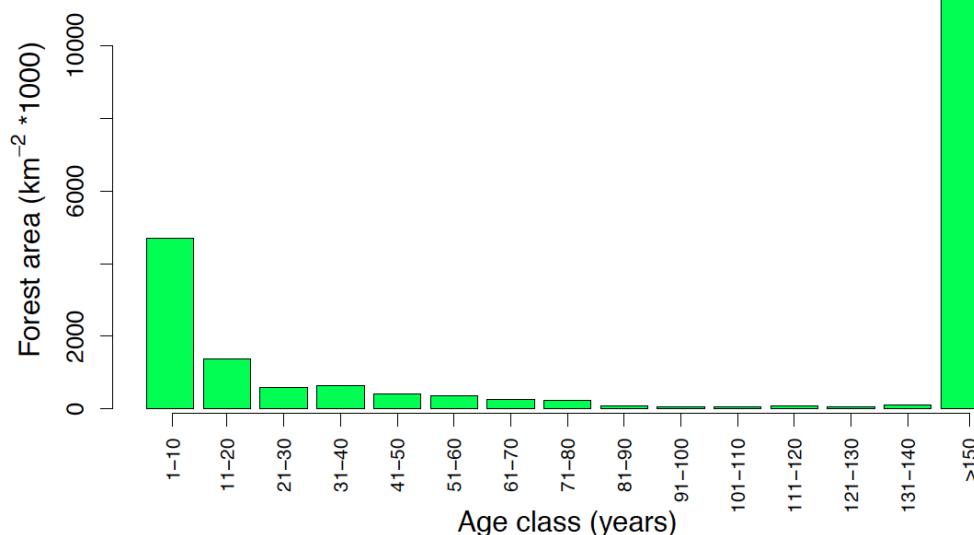
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Cartographie globale de la structure en âge



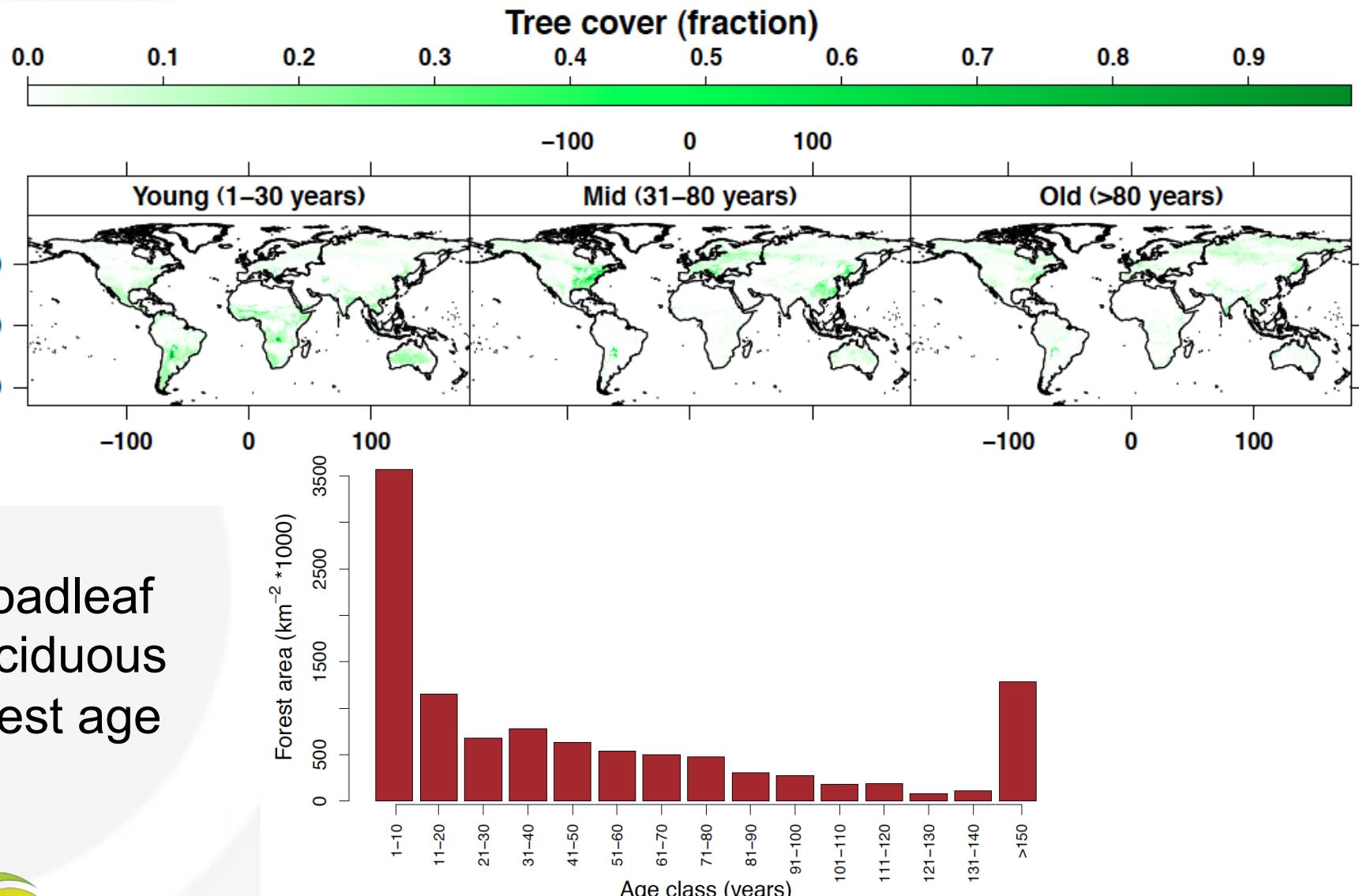
Broadleaf
evergreen
forest age



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Cartographie globale de la structure en âge



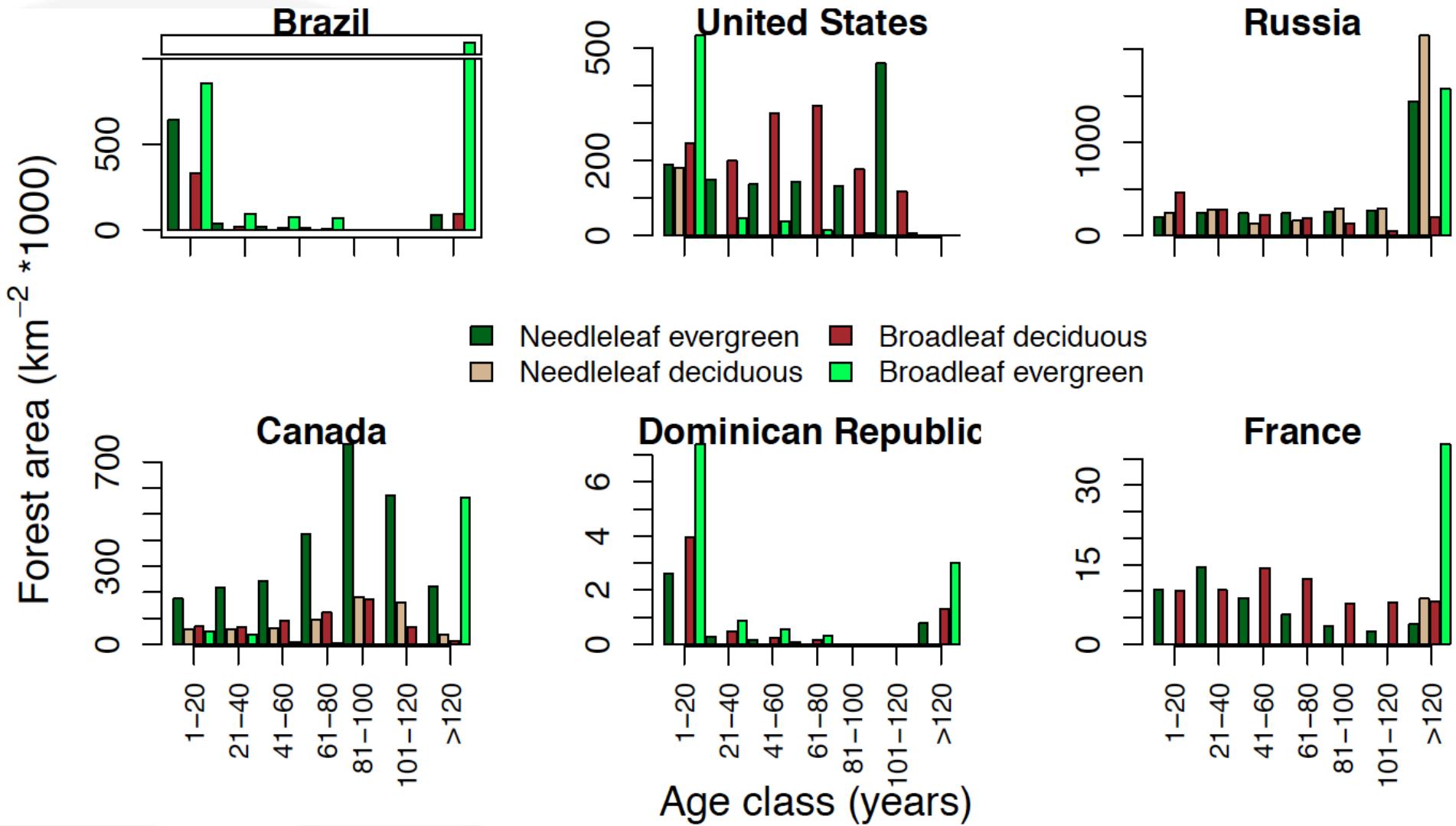
Broadleaf
deciduous
forest age



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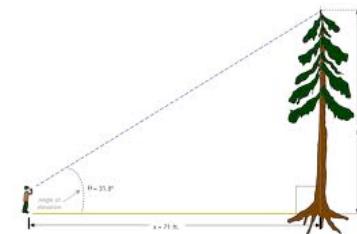
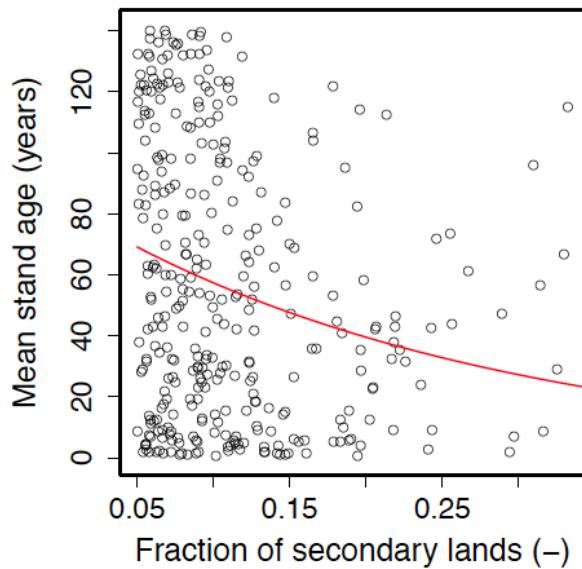
Cartographie globale de la structure en âge



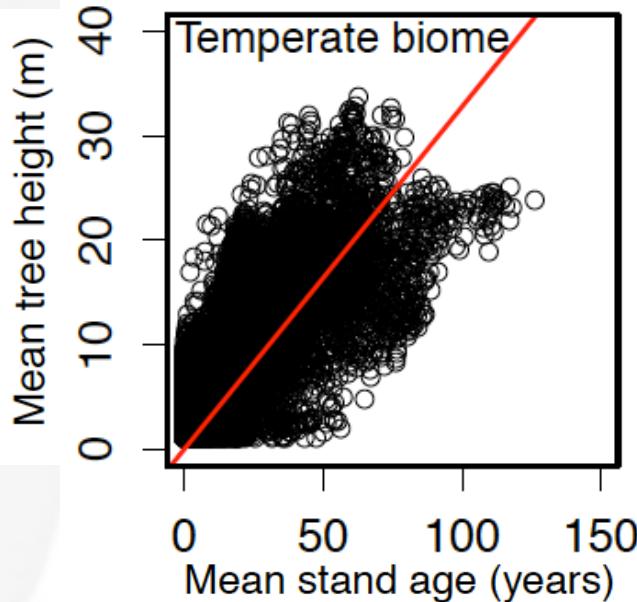
Cartographie globale de la structure en âge

Consistency check:

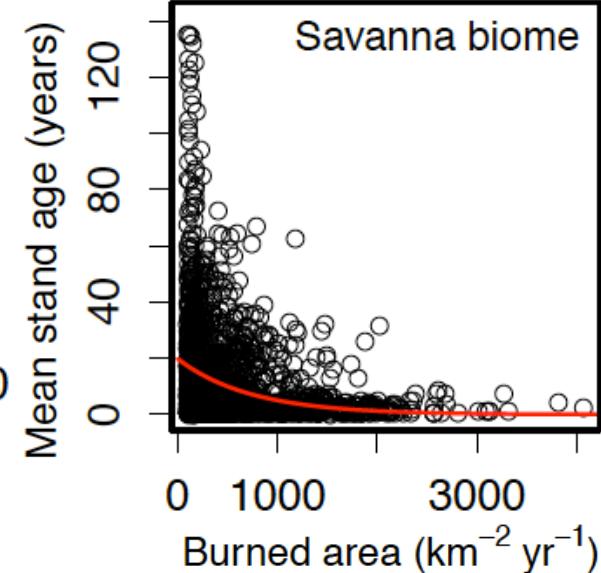
Tropical Secondary Forests



Tree Height (Simard et al)



Burned area (GFED v3.1)



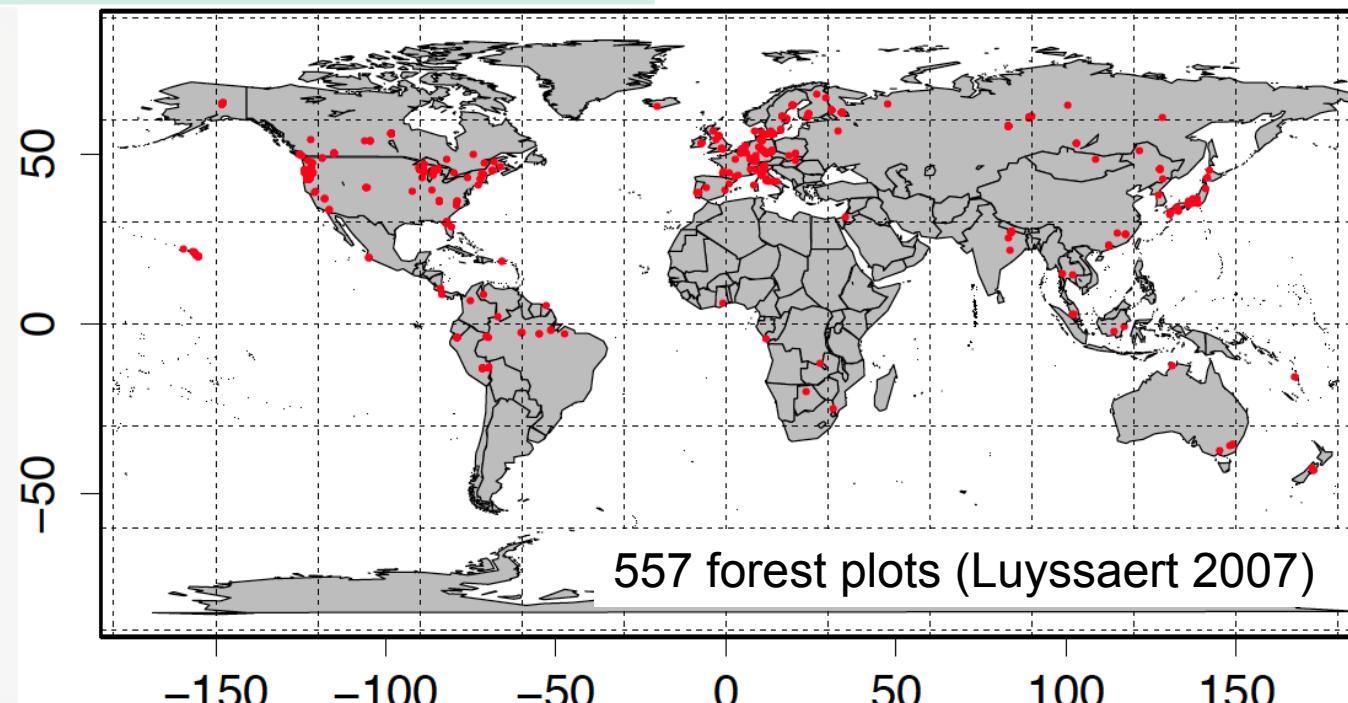
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Modeling stand level carbon cycle processes

Modeling set-up

| | |
|------------|--|
| DGVM Model | LPJ ORCHIDEE-AR5 ORCHIDEE-FM |
| Climate | CRU-NCEP |
| Management | No age initialization Stand initialized in correct year |



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Modeling stand level carbon cycle processes

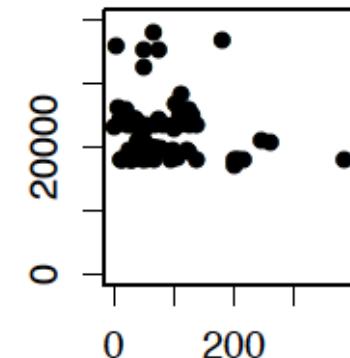
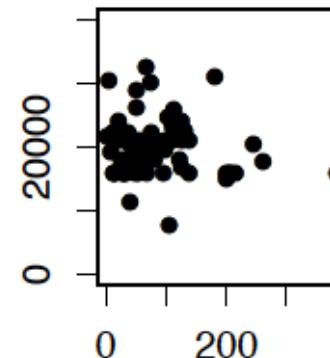
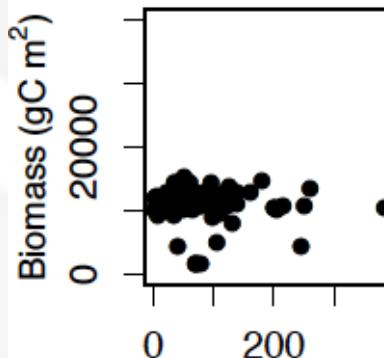
Boreal PFT

LPJ
(pipe model)

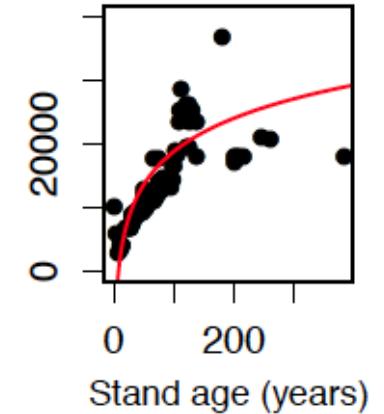
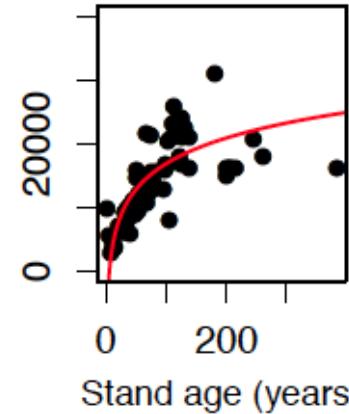
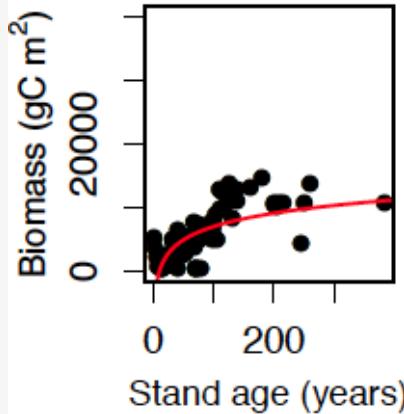
ORCHIDEE
(resource model)

ORCHIDEE
(FM model)

Standard model run



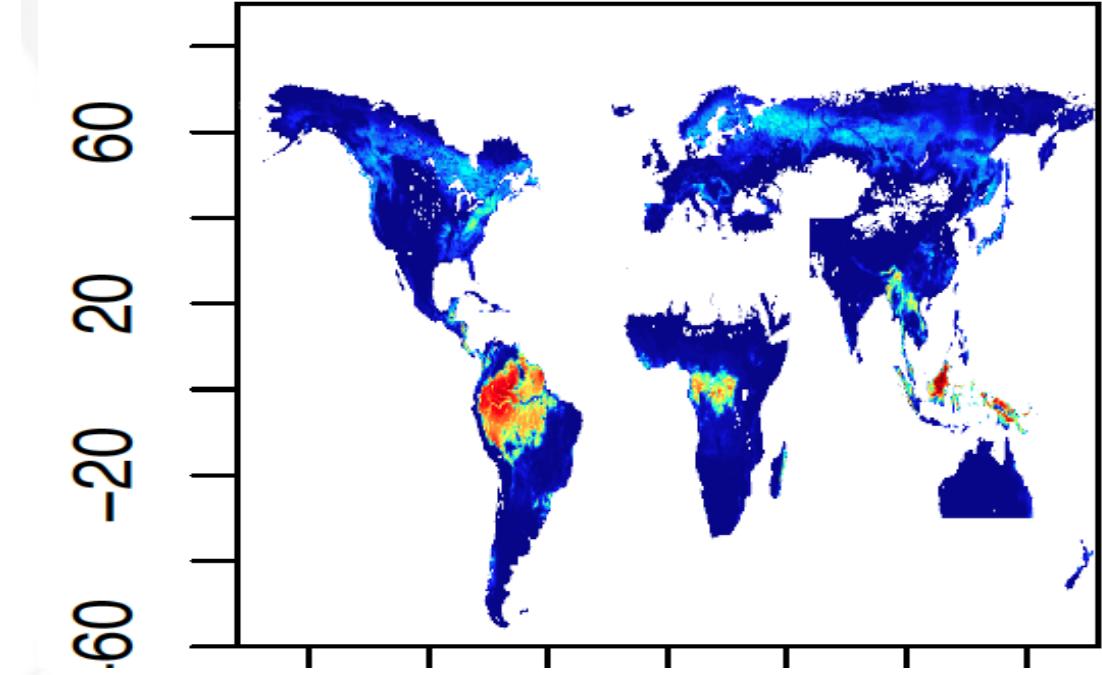
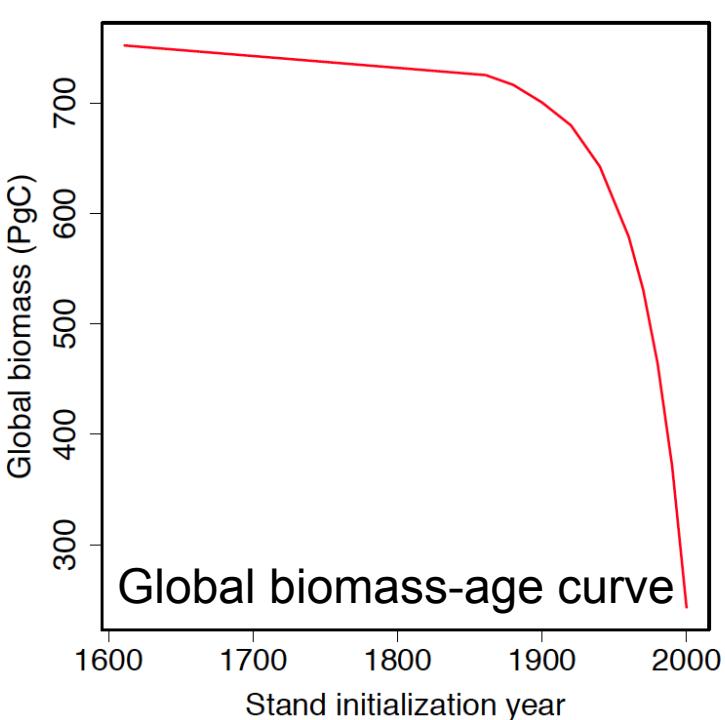
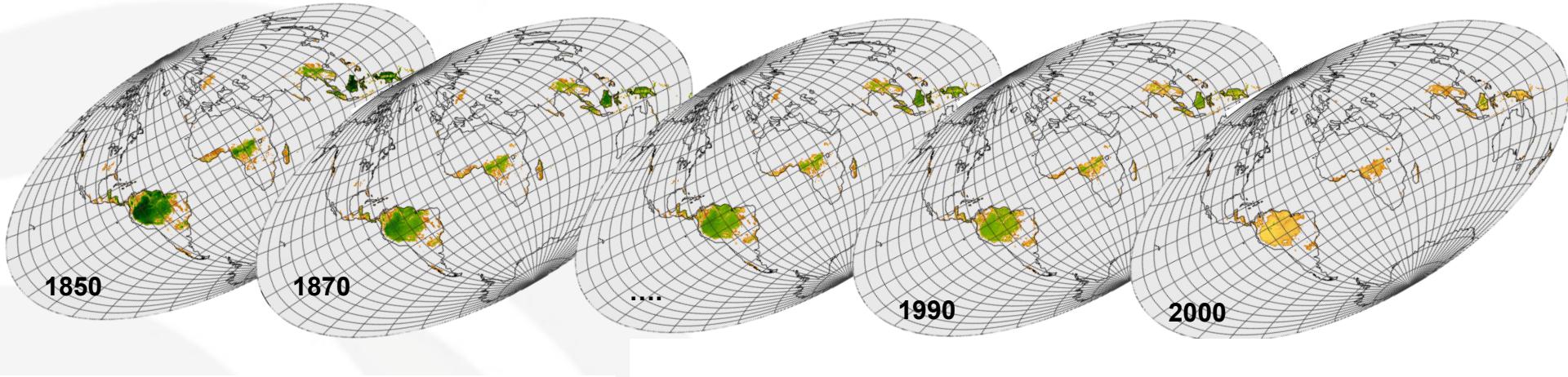
With age initialization



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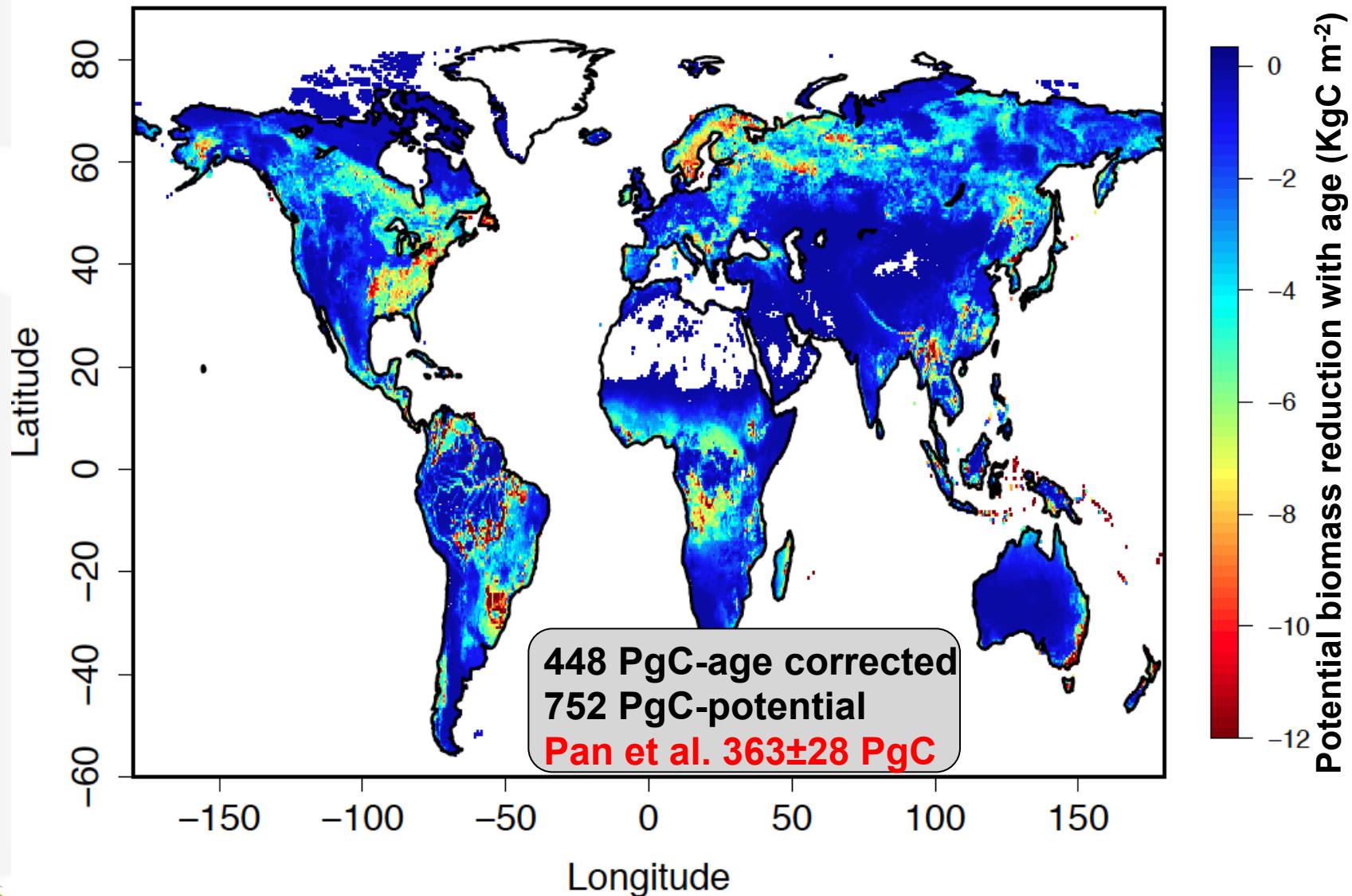
Biomass benchmarking



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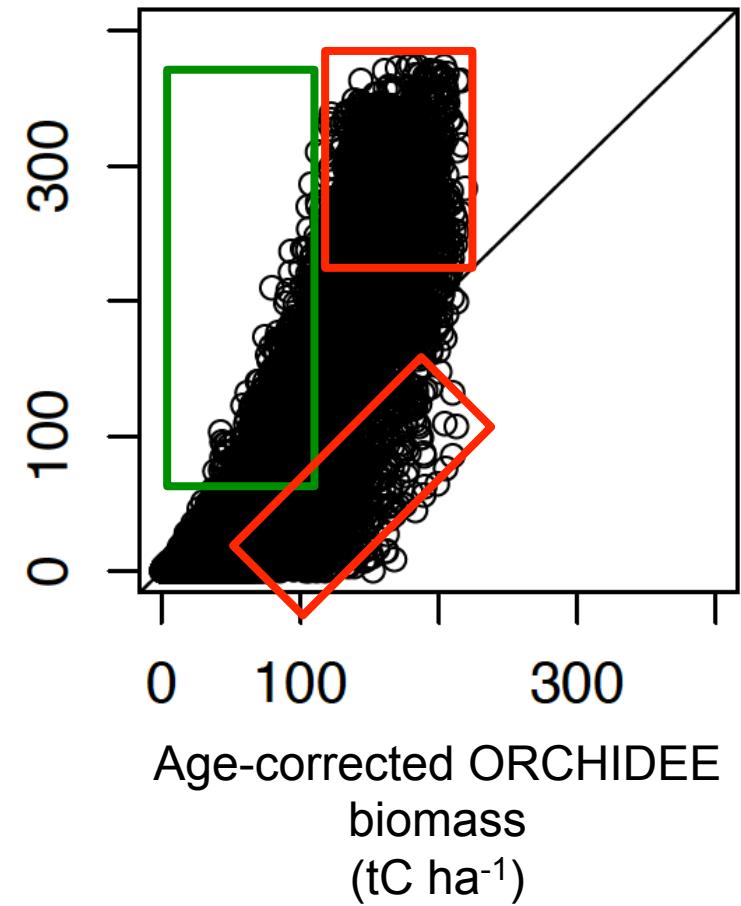
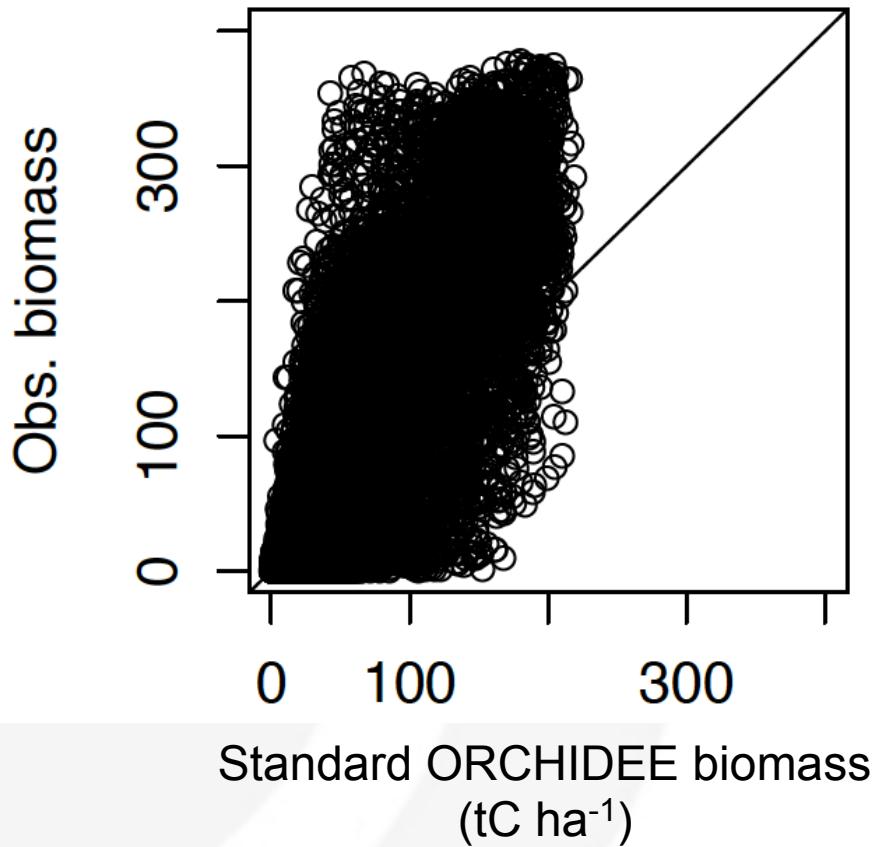
Biomass benchmarking



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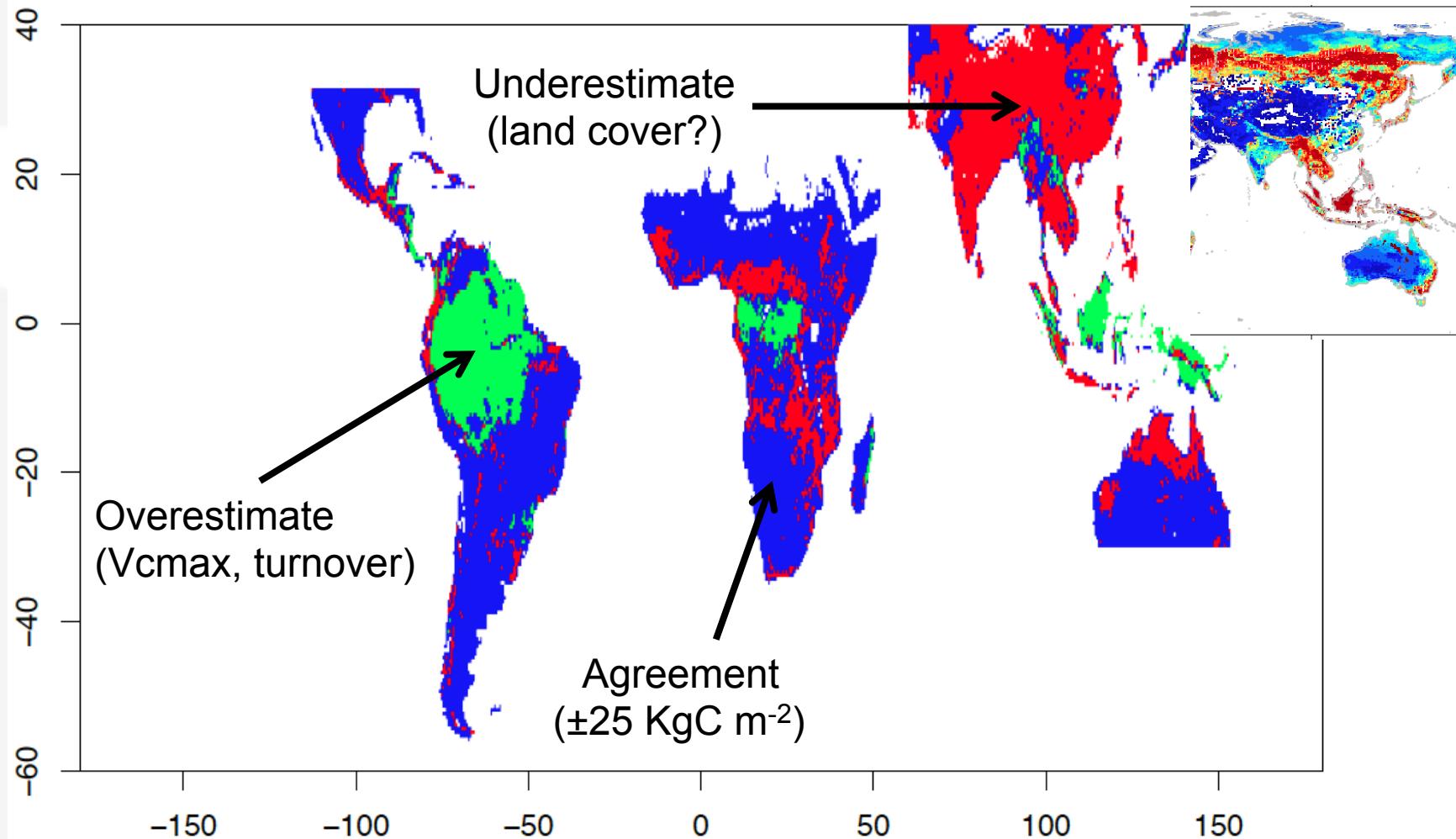
Biomass benchmarking



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Biomass benchmarking



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Summary

Imprint of human activities on forest structure has consequences for carbon cycle

Global models trade efficiency for forest complexity

Forest complexity, represented via age, has strong effects and improvements on carbon cycling at global scales

Improvements in forest management datasets and measurements of forest dynamics have direct consequences for earth system models

