

Secuestro de carbono en plantaciones y suelos forestales

Olmedo, Guillermo



Universidad de Concepción

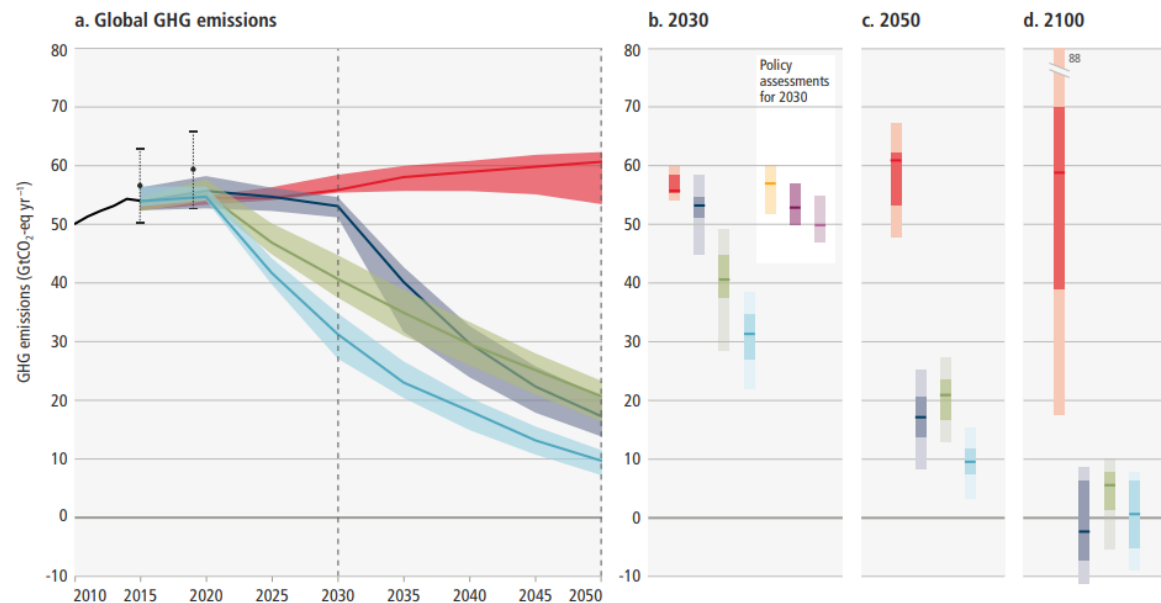


SEMINARIO INTERNACIONAL

Conexiones Carbono y Nutrientes: Suelos, Bosques y Plantaciones Forestales en el Día Internacional de los Suelos



Projected global GHG emissions from NDCs announced prior to COP26 would make it *likely* that warming will exceed 1.5°C and also make it harder after 2030 to limit warming to below 2°C.



Modelled pathways:

- Trend from implemented policies
- Limit warming to 2°C (>67%) or return warming to 1.5°C (>50%) after a high overshoot, NDCs until 2030
- Limit warming to 2°C (>67%)
- Limit warming to 1.5°C (>50%) with no or limited overshoot

—●— Past GHG emissions and uncertainty for 2015 and 2019 (dot indicates the median)

Policy assessments for 2030:

- Policies implemented by the end of 2020
- NDCs prior to COP26, unconditional elements
- NDCs prior to COP26, including conditional elements

Percentile:

- 95th
- 75th
- Median
- 25th
- 5th

Figure SPM.4 | Global GHG emissions of modelled pathways (funnels in Panel a, and associated bars in Panels b, c, d) and projected emission outcomes from near-term policy assessments for 2030 (Panel b).

IPCC, 2022: Summary for Policymakers. In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.001.

Protect

3.9

Gt CO₂e



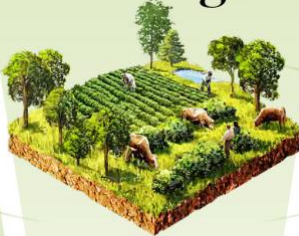
Protecting natural systems is the most efficient form of NCS mitigation. If we don't protect intact landscapes, the damage will outweigh work to manage and restore.

Most to least preferred

Manage

5.1

Gt CO₂e

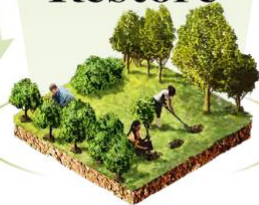


Improved forestry, agriculture, and grazing practices can significantly reduce emissions without changing land use.

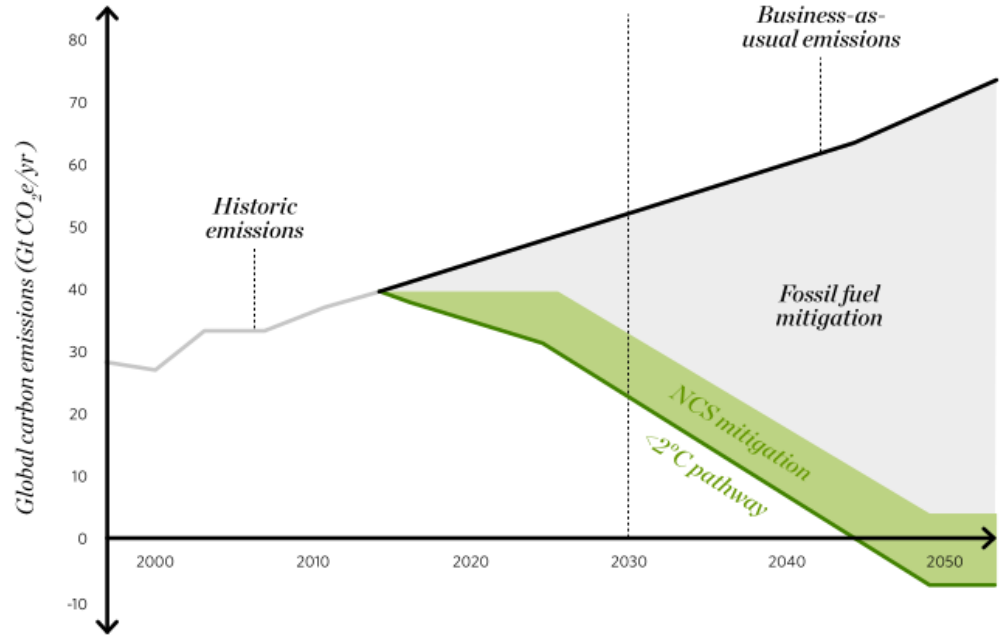
Restore

2.0

Gt CO₂e



Restoring forests, wetlands, and grasslands can be slow and expensive, but also provide vital benefits.



Maule

Bio-Bío

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Ñuble

A partir de la conquista y hasta 1950 **Deforestación del bosque nativo a gran escala para usos agrícolas generó profunda erosión de los suelos**

El uso que el agricultor da al suelo, es otro de los factores que influyen en la acción erosiva del agua de lluvia y el agua de escurremiento. Es conocido el hecho, que, en Chile, por una u otra causa, gran parte de los suelos están sometidos al monocultivo de trigo, principalmente. Esta práctica no es un hecho actual, sino que se viene repitiendo desde los albores de la Colonia.

Fuente: "Evaluación de la erosión Cordillera de la Costa entre Valparaíso y Cautín"
(Instituto de Investigación de Recursos Forestales, 1965)

EROSION POR PROVINCIAS, EN EL AREA ESTUDIADA

PROVINCIA	AREA ESTUDIADA	% SUPERFICIE TERRITORIAL	EROSION MODERADA A MUY SEVERA CON ZANJAS DE DISTINTOS TIPOS (HAS).	% DEL AREA EROSIONADA
Valparaíso	326.639,3	62,55	207.396,3	63,5
Santiago	602.130,9	34,04	381.944,2	63,4
O'Higgins	105.615,0	14,86	56.142,0	53,2
Colchagua	489.921,4	58,83	259.086,2	52,9
Curicó	143.744,8	27,29	125.954,2	87,6
Talca	113.957,9	11,23	101.426,6	89,0
Maule	558.103,0	100,00	382.802,5	68,6
Nuble	339.110,6	24,30	227.600,4	40,8
Bío-Bío	161.810,6	14,53	93.062,3	57,5
Concepción	464.145,6	81,69	318.393,9	68,6
Arauco	509.264,4	100,00	275.383,4	54,0
Malleco	563.672,7	39,99	324.228,9	57,5
Cautín	462.532,7	25,16	101.877,6	22,0
TOTALES	4.840.648,9		2.855.298,5	59,0

A partir de la segunda mitad del S.XX
**Se promueve reforestación
 como solución ambiental
 para frenar proceso erosivo
 de los suelos**

Fuente: "Evaluación de la erosión Cordillera de la Costa entre Valparaíso y Cautín" (Instituto de Investigación de Recursos Forestales, 1965)

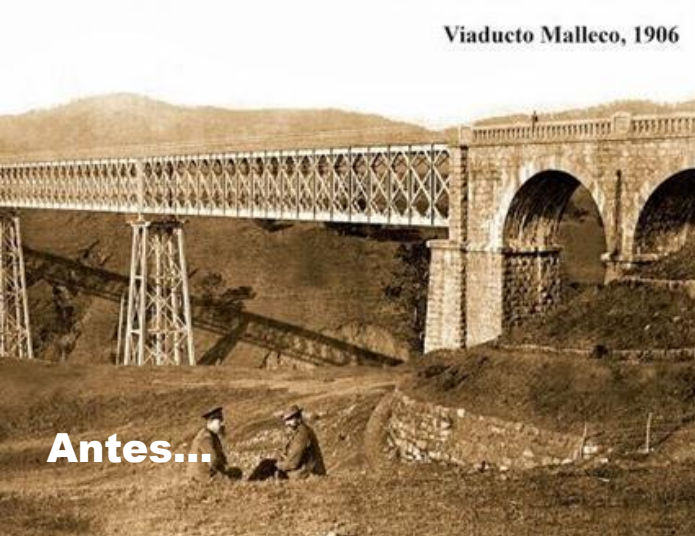
"Las ventajas que acarrea la **reploblación de los faldeos** de cerros para el país u los particulares son inmensas. A mas de la influencia que ejercen los bosques sobre la regularización de las lluvias, las vertientes de regadío, la humedad atmosférica, las heladas, los granizos, la higiene, etc., se obtienen así todavía resultados no despreciables."

(Albert, 1904)

"Es fundamental proteger los terrenos mediante la **implantación de especies forestales adecuadas** y el manejo de los bosques existentes, ya sean de especies nativas o exóticas."

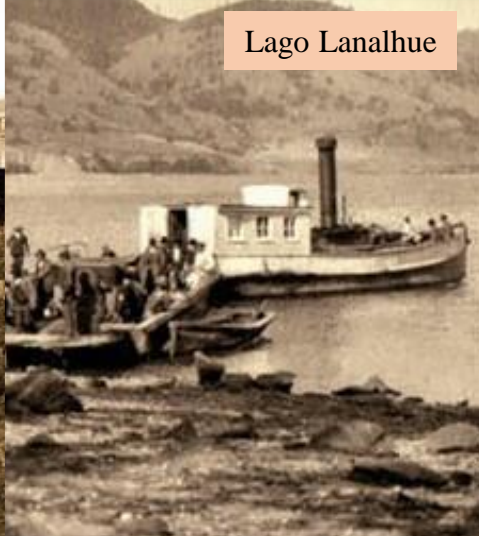
(Peña Mac Caskill y Fernández, 1979)

Viaducto Malleco, 1906

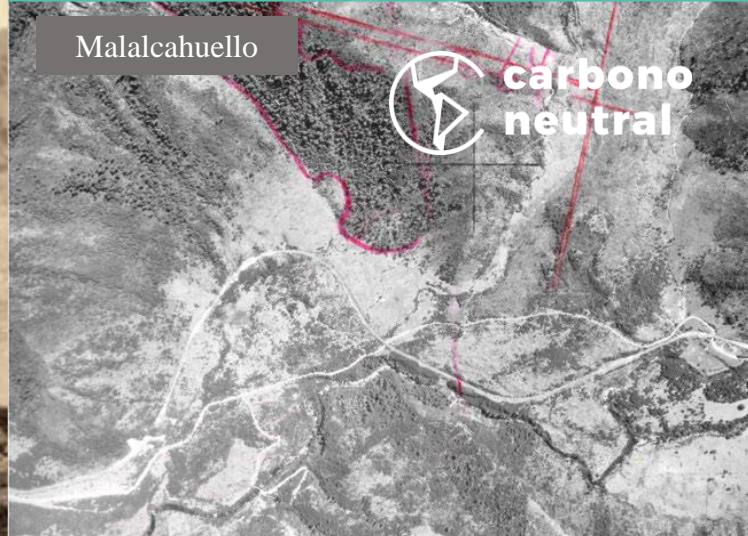


Antes...

Lago Lanalhue



Malalcahuello



carbono neutral



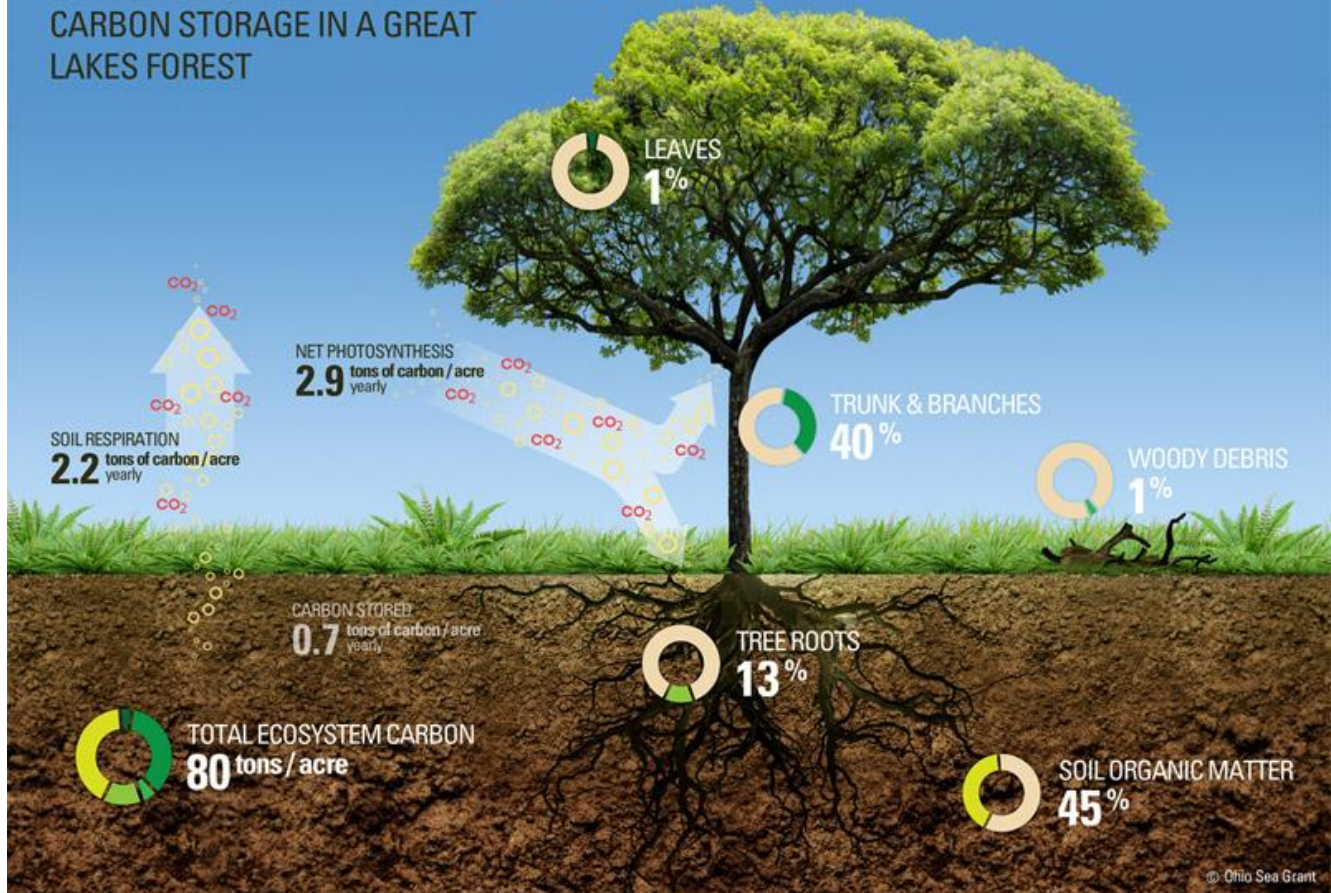
Después...



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WHERE DOES CARBON GO?

CARBON STORAGE IN A GREAT LAKES FOREST



Article

Baseline of Carbon Stocks in *Pinus radiata* and *Eucalyptus* spp. Plantations of Chile

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Abstract: Forest plantations have a large potential for carbon sequestration, playing an important role in the global carbon cycle. However, despite the large amount of research carried out worldwide, the absolute contribution of forest plantations is still incomplete for some parts of the world. To help bridge this gap, we calculated the amount of C stock in three fast growing forest species in Chile. Carbon pools in above-ground and below-ground biomass, forest floor, and soil were considered for this analysis. Across the plantation forests of Chile, carbon accumulated in the above-ground biomass was 181–212 Mg · ha⁻¹ for *Pinus radiata*, 147–180 Mg · ha⁻¹ for *Eucalyptus nitens*, and 95–117 Mg · ha⁻¹ for *Eucalyptus globulus* (age 20–24 years for *P. radiata* and 10–14 years for *Eucalyptus*). Total C stocks were for 343 Mg · ha⁻¹ for *P. radiata*, 352 Mg · ha⁻¹ for *E. nitens*, and 254 Mg · ha⁻¹ for *E. globulus*, also at the end of a typical rotation. The carbon pool in the forest floor was found to be significantly lower (less than 4% of the total) when compared to the other pools and showed large spatial variability. Our results agree with other studies showing that 30–50% of the total C stock is stored in the soil. The baseline data will be valuable for modelling C storage changes under different management regimes (changes in species, rotation length and stocking) and for different future climates. Given the contribution of soils to total carbon stocks, special attention should be paid to forest management activities that affect the soil organic carbon pool.

Keywords: forest carbon cycle; climate change mitigation; plantation forestry; soil carbon

Forests 2020, 11, 1063; doi:10.3390/f11101063

www.mdpi.com/journal/forests

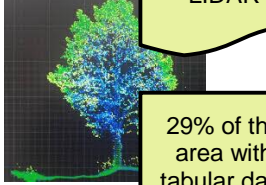
Received: 2 September 2020; Accepted: 29 September 2020; Published: 30 September 2020



<https://doi.org/10.3390/f11101063>



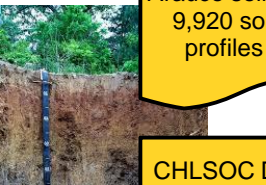
36,421 forest inventories + LIDAR



29% of the area with tabular data



100 forest floor observations



Arauco soilDB 9,920 soil profiles

CHLSOC DB 10,616 soil observations

Data projected to 2018

49,826 stands w/ merchantable volume per area

Biomass expansion factors

Above-ground Biomass per area

Above-ground Biomass C pool

Above to below-ground ratio

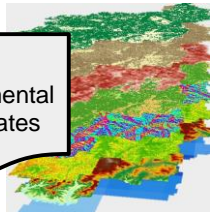
Below-ground Biomass C pool

5 fold 5 times repeated cross validation

Digital soil mapping

Forest floor C pool

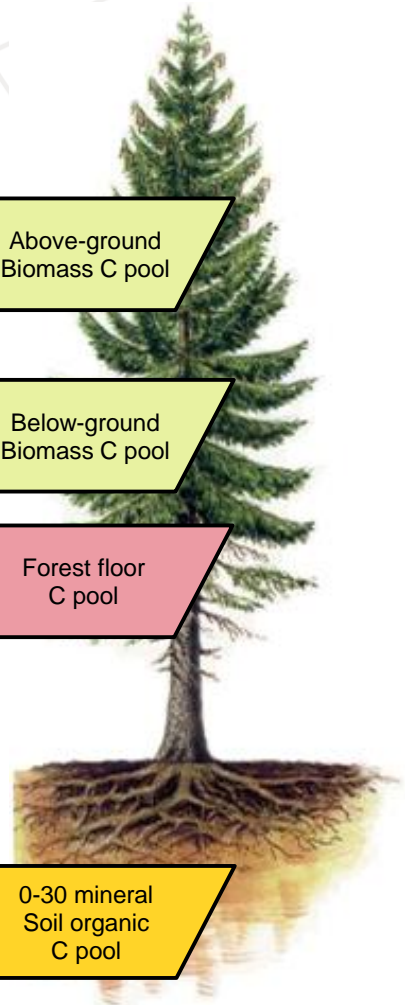
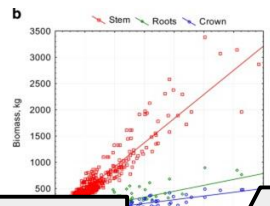
43 environmental covariates



75% calib data set 25% test data set

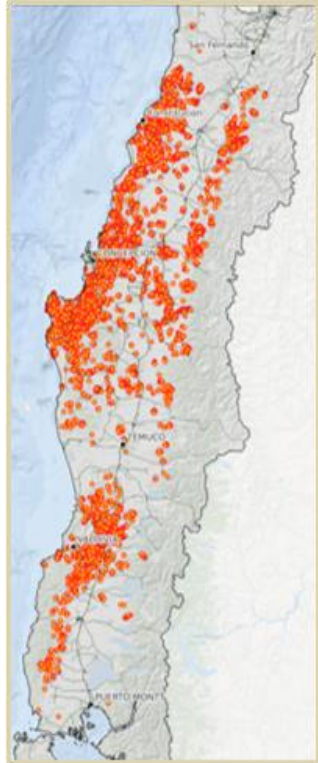
Digital soil mapping

0-30 mineral Soil organic C pool



Digital soil mapping

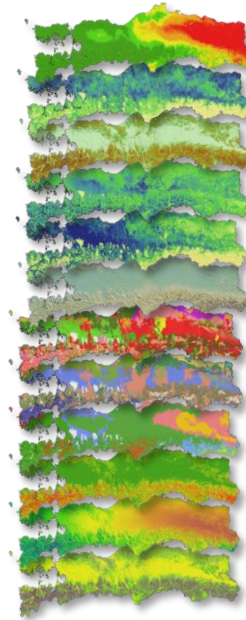
9920 Soil profile
[1991~2018]



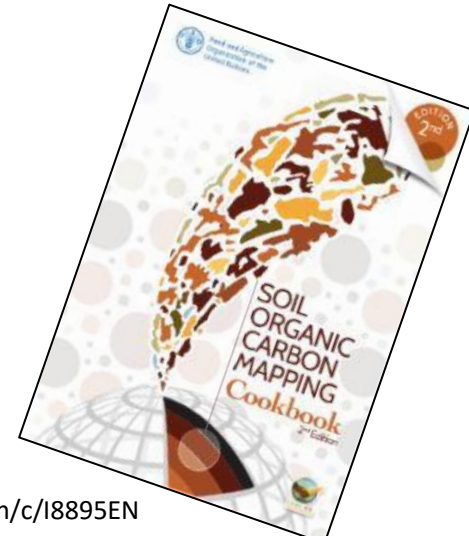
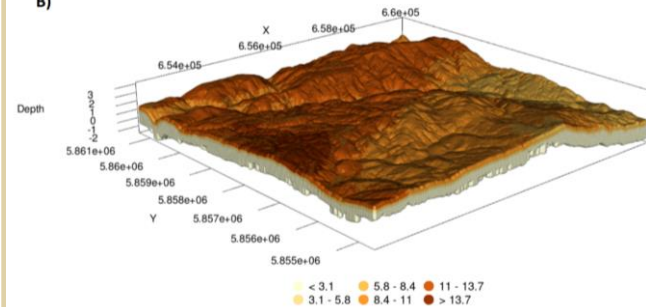
$$S = f(s.c.o.r.p.a.n)$$

- S** - Soil
- C** - Climate
- O** - Organisms (landcover & vegetation)
- r** - Topography
- p** - Parent Material
- a** - Age or time
- n** - Spatial location or position

Soil Formation Factors



B)



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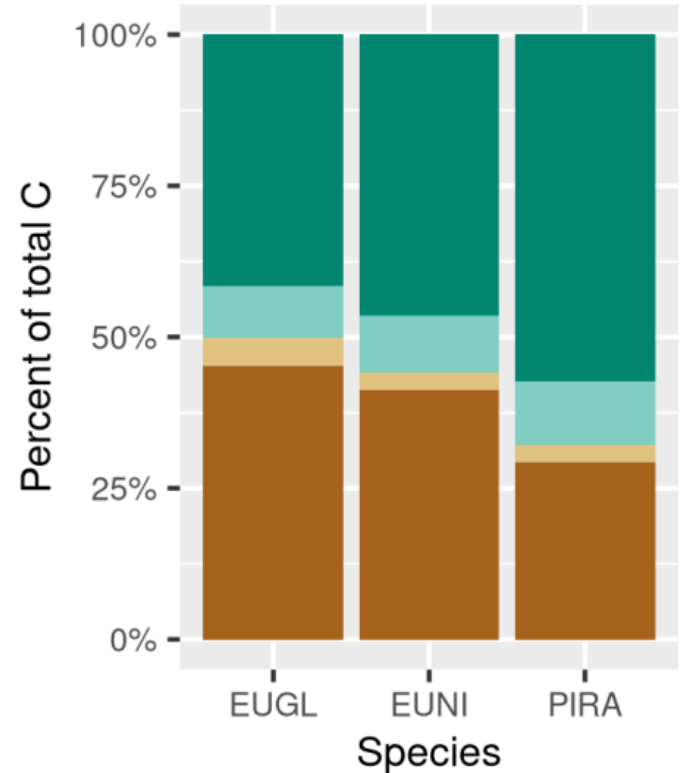
A edad de cosecha:

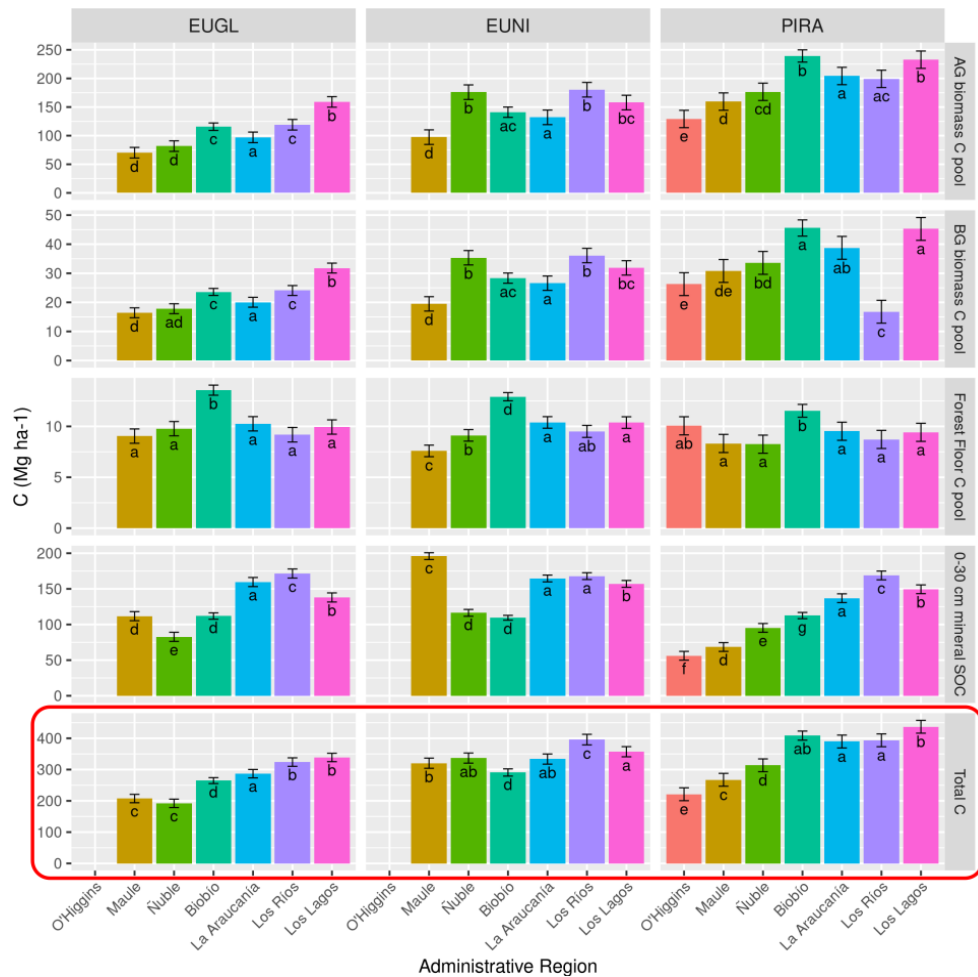
El C en la biomasa aérea representa el 57 % del total para PIRA, 47 % para EUNI y 41 % para EUGL.

La biomasa enterrada es el 10 % en PIRA, 9 % en EUNI y 8 % en EUGL.

El reservorio mas pequeño lo constituye el piso forestal, siendo 3 al 5 % del C total.

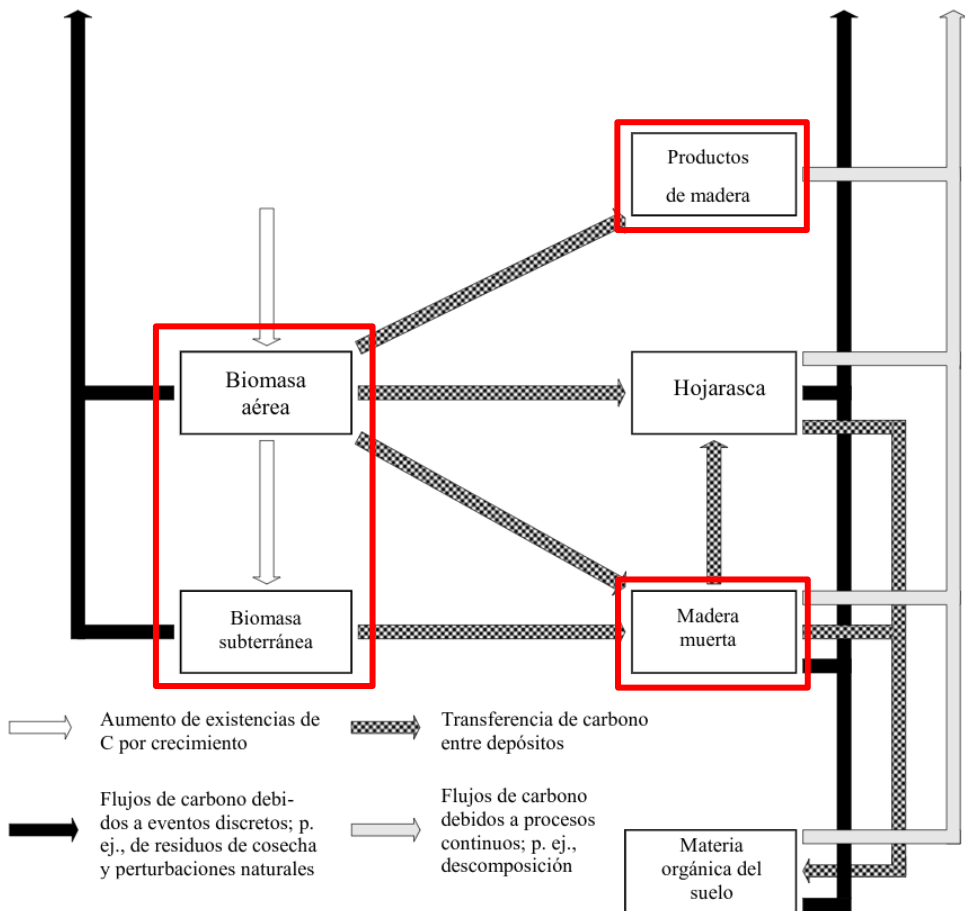
El suelo mineral 0–30 cm representa 29 al 45 % del total del ecosistema.



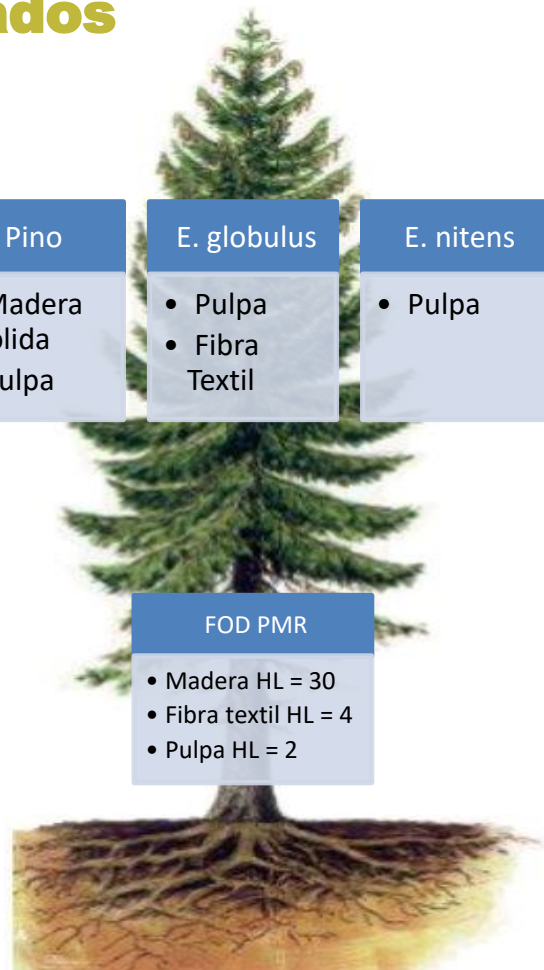




Reservorios de carbono considerados



Pino	E. globulus	E. nitens
<ul style="list-style-type: none">• Madera sólida• Pulpa	<ul style="list-style-type: none">• Pulpa• Fibra Textil	<ul style="list-style-type: none">• Pulpa



FOD PMR
<ul style="list-style-type: none">• Madera HL = 30• Fibra textil HL = 4• Pulpa HL = 2

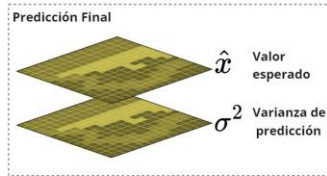
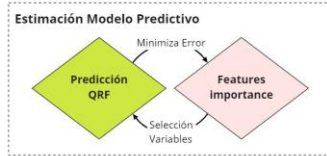
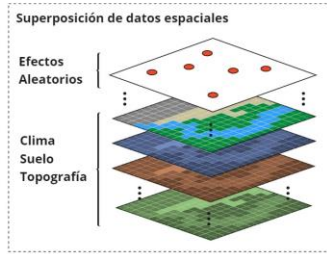
renovables para una vida mejor



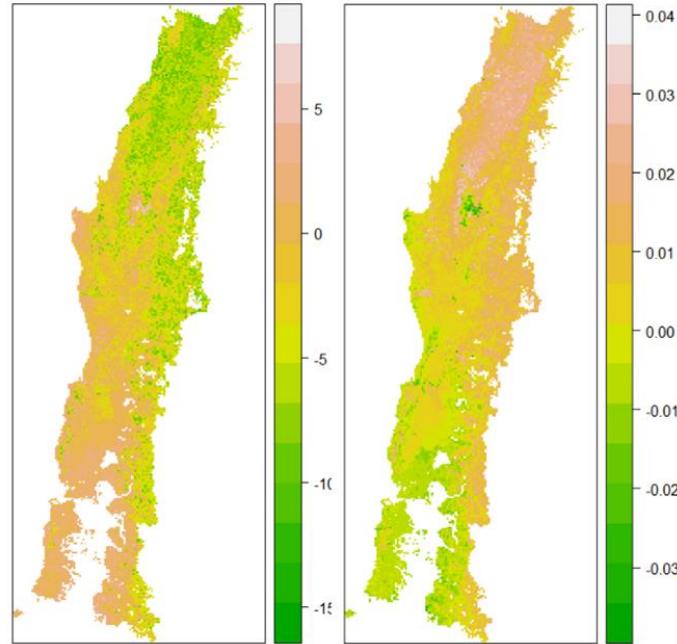
Modelo de crecimiento forestal

Modelo de efectos

$$H_{ij} = (\alpha_1 + a_j) (1 - e^{-(\beta_1 + b_j)A_{ij}})^{1/\gamma_1} + \varepsilon_{ij}$$



Efectos aleatorios modelados espacialmente



Sistema

$$\frac{dH}{dt} = \frac{\beta_1 \alpha_1^{\gamma_1}}{\gamma_1} H^{1-\gamma_1} - \frac{\beta_1}{\gamma_1} H$$

$$\frac{dN}{dH} = -\alpha_2 H^{\beta_2} N^{\gamma_2}$$

$$\frac{dW}{dH} = \alpha_3 H^{\beta_3} N^{\gamma_3} - \gamma_3 W \frac{d \log(N)}{dH}$$

Función de

Volumen

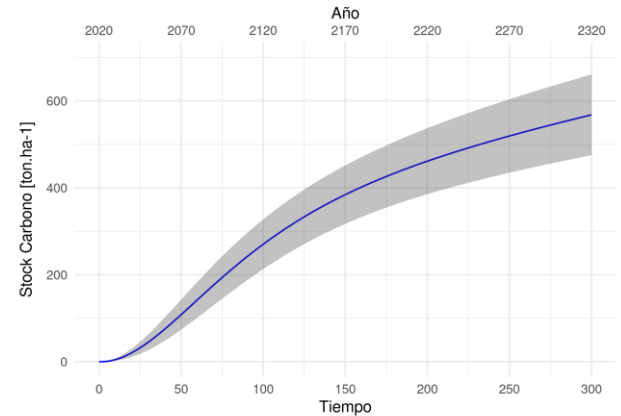
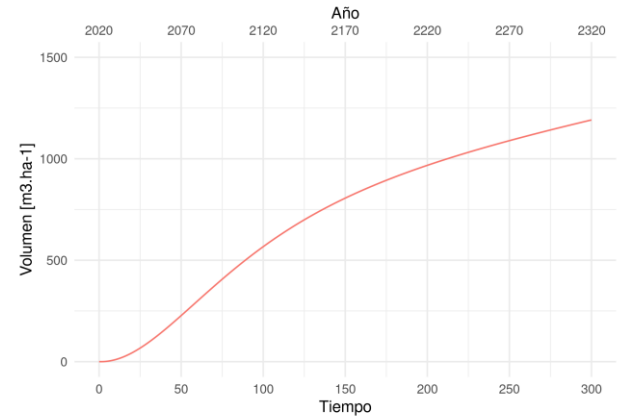
$$V = \alpha H^\beta G^\gamma N^\delta$$

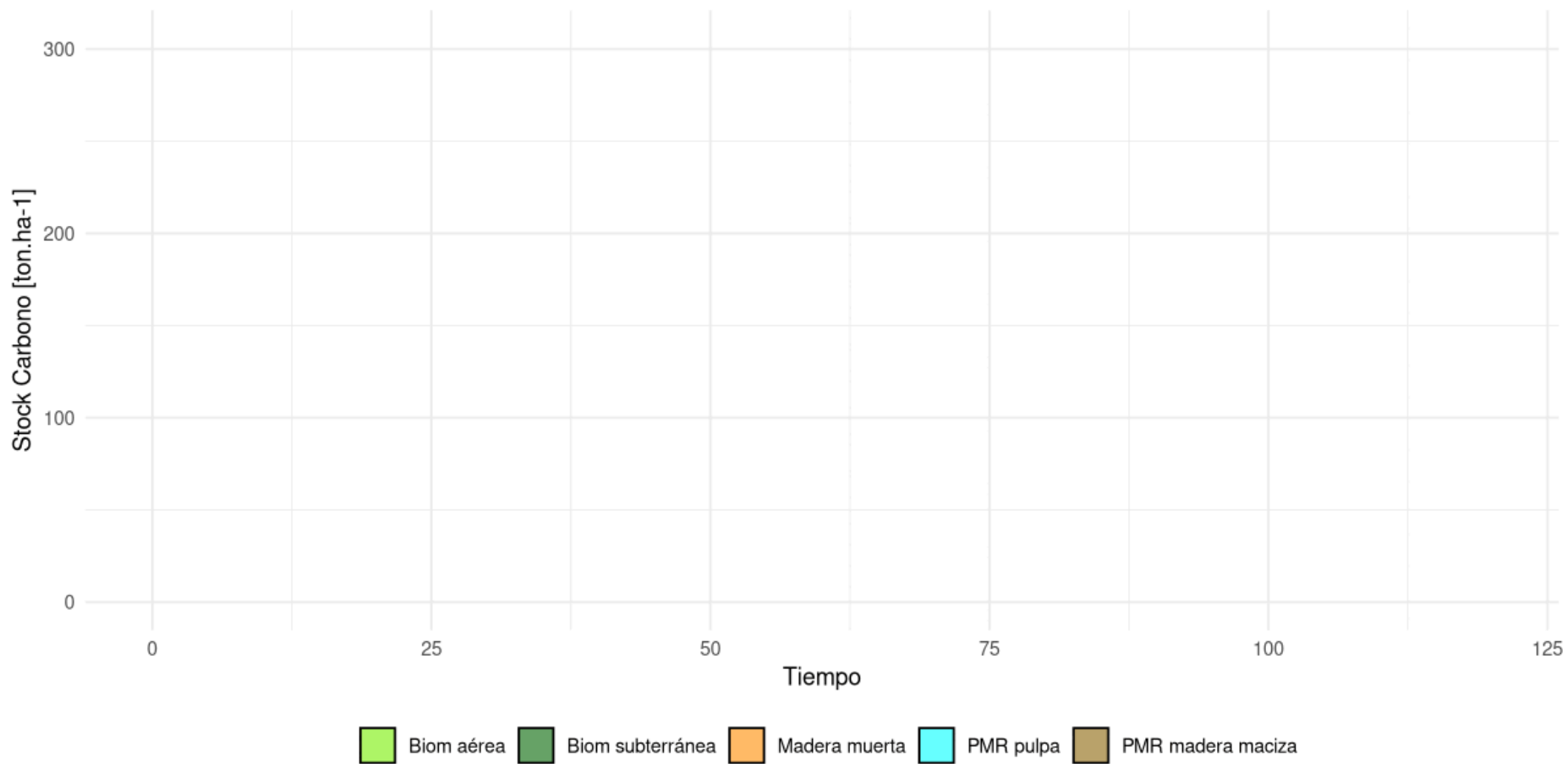
$$W = GH$$

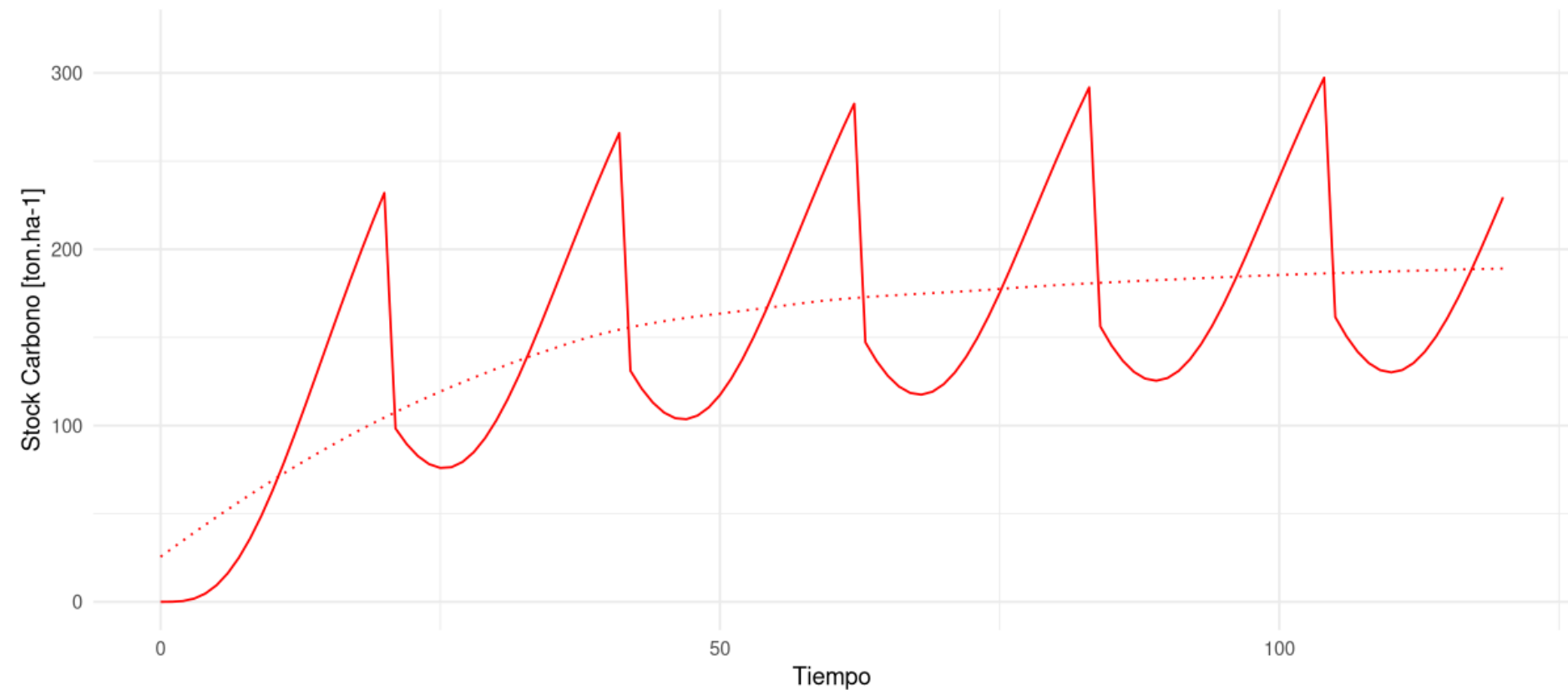


Modelo de crecimiento bosque nativo

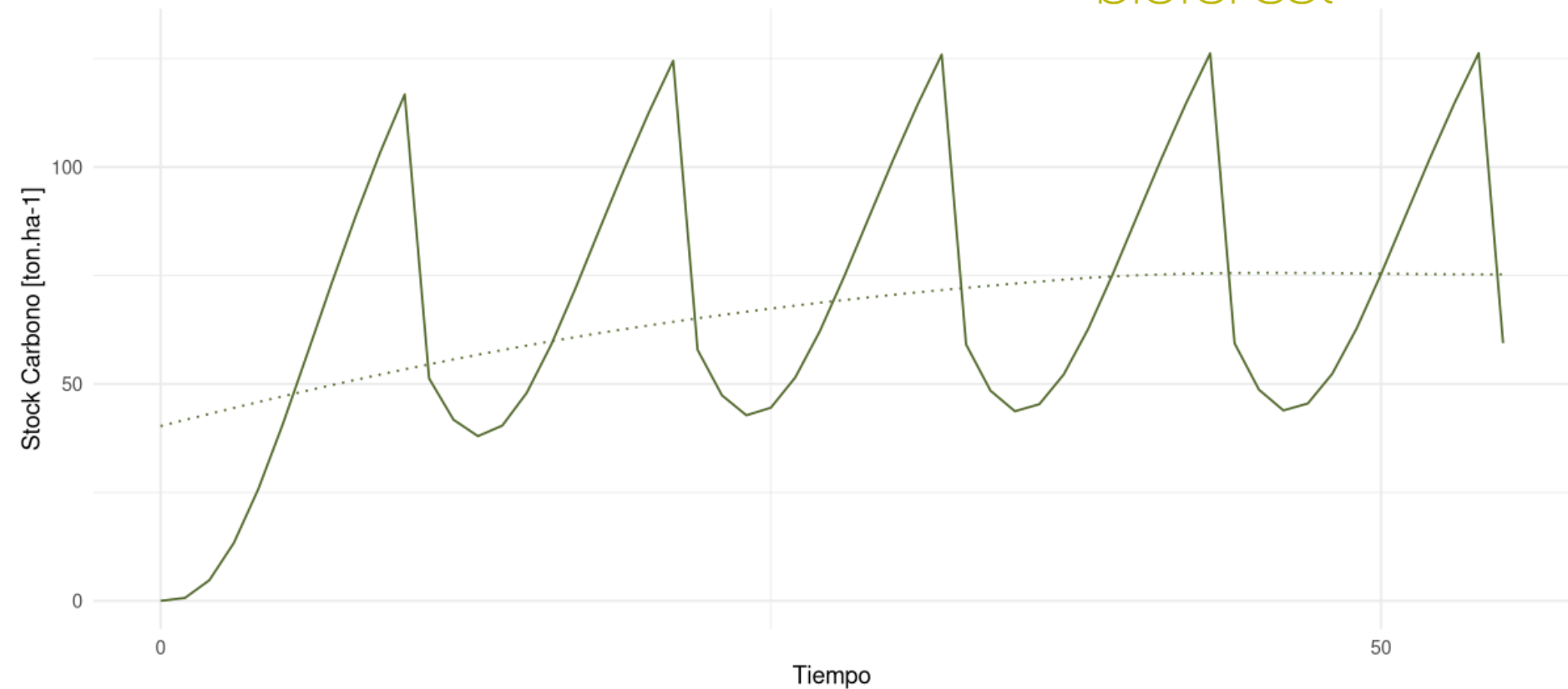
- Modelamos el crecimiento de un bosque nativo a partir del **modelo Nothopack**.
- Se modeló un bosque de **RORACO**, con Roble como dominante, hasta una edad dominante final de **300 años**, con densidad inicial entre **850 y 2500 árboles** y un índice de sitio entre **5 y 25 metros** a 20 años.
- Se utilizó el área basal estimada para un rodal de **2 años**.



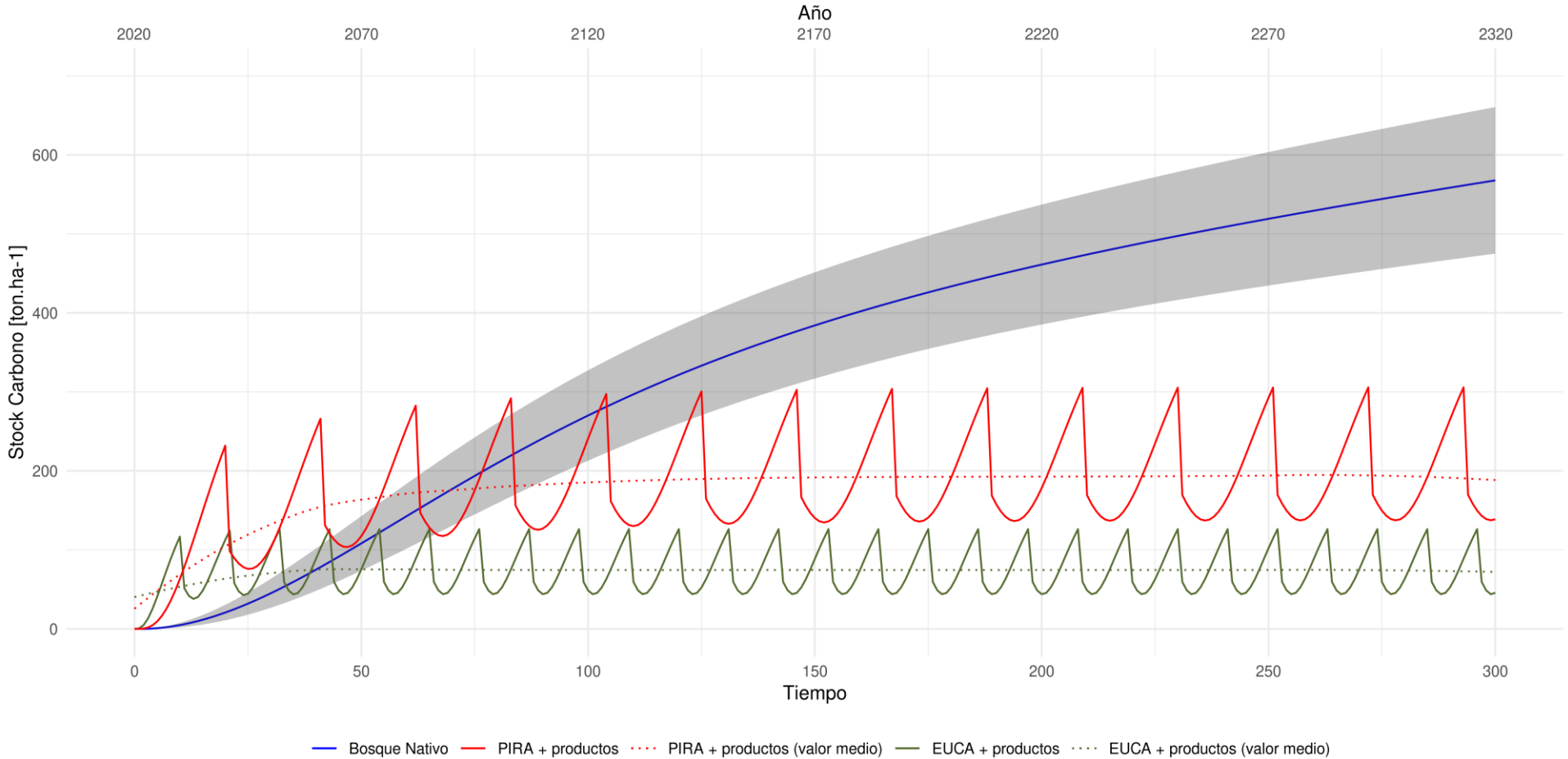


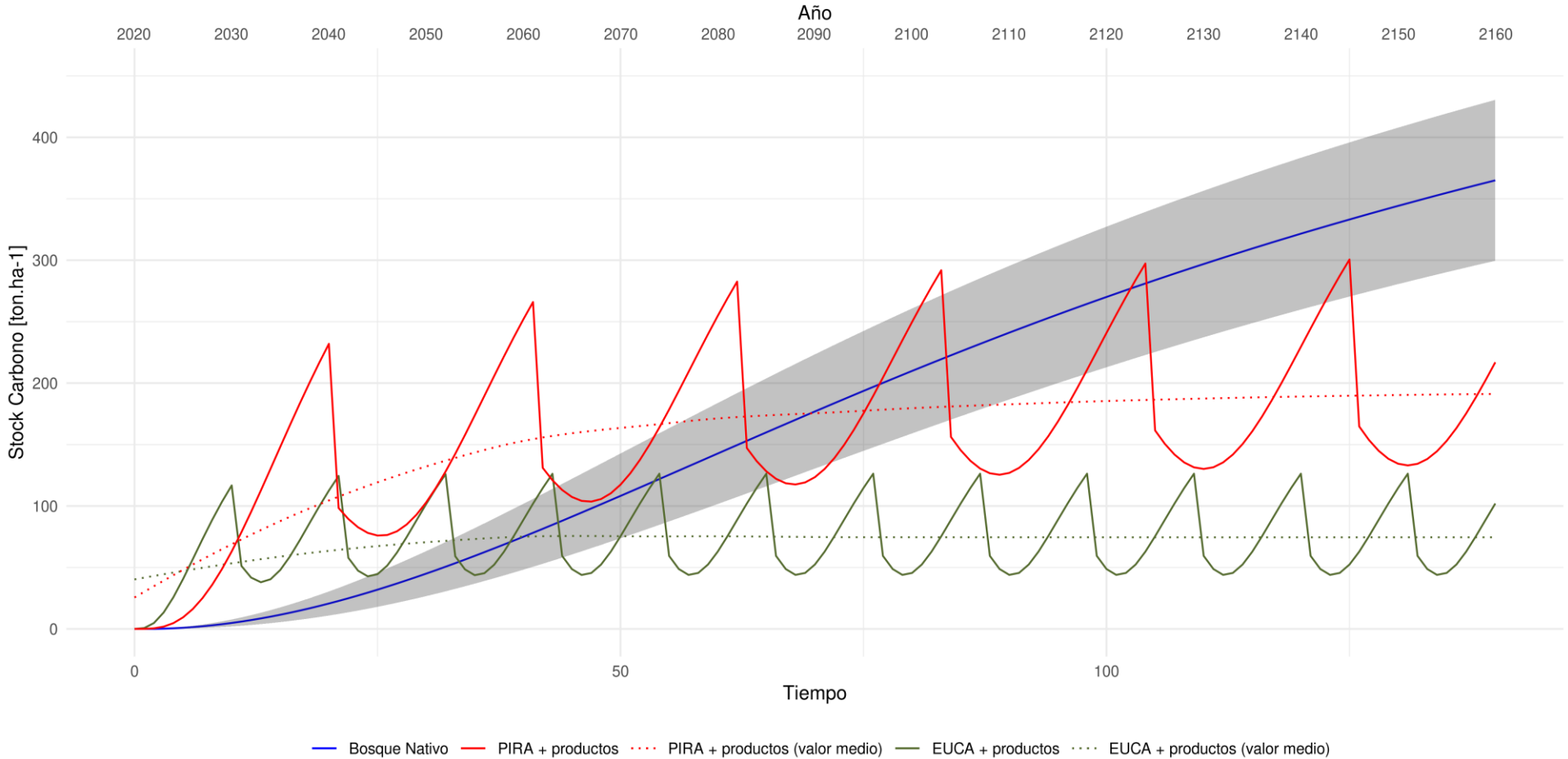


— Bosque Nativo
 — PIRA + productos
 ⋯ PIRA + productos (valor medio)
 — EUCA + productos
 ⋯ EUCA + productos (valor medio)



— Bosque Nativo
 — PIRA + productos
 ⋯ PIRA + productos (valor medio)
 — EUCA + productos
 ⋯ EUCA + productos (valor medio)





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Conexiones Carbono y Nutrientes: Suelos, Bosques y Plantaciones Forestales en el Día Internacional de los Suelos

