Grant Agreement 823805 MAIL H2020 MSCA RISE 2018

Quantification of carbon sequestration capacity in m/sm MLs

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 823805

Dzhaner Emin, IABG
Fernado Bezares, Cesefor
Michal Krupinsk, CBK
Jesus Torralba, UPV

MAIL Final Presentation, 13.12.2021

Definitions

- Carbon sequestration is the process of storing carbon in a carbon pool.
- Capacity is the potentially reachable amount of carbon storage.
- Afforestation is the establishment of a forest in an area where there was no previous tree cover.

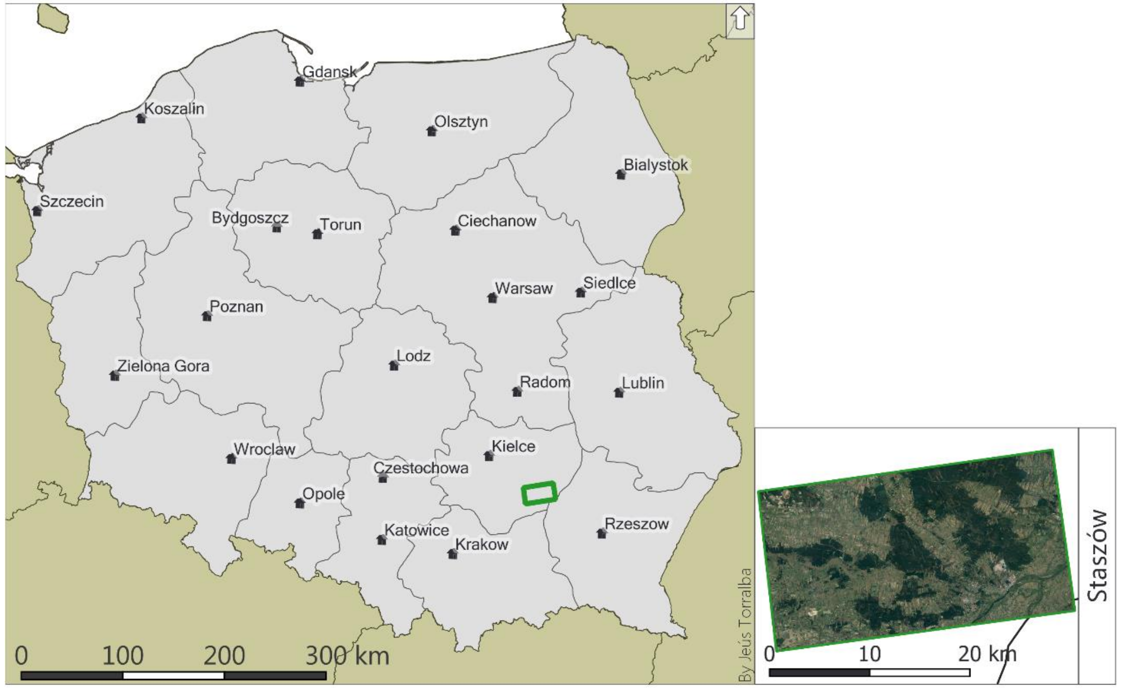
Outline

Goal: Model carbon sequestration capacity into the future and forecast how certain planted species would evolve in the marginal lands

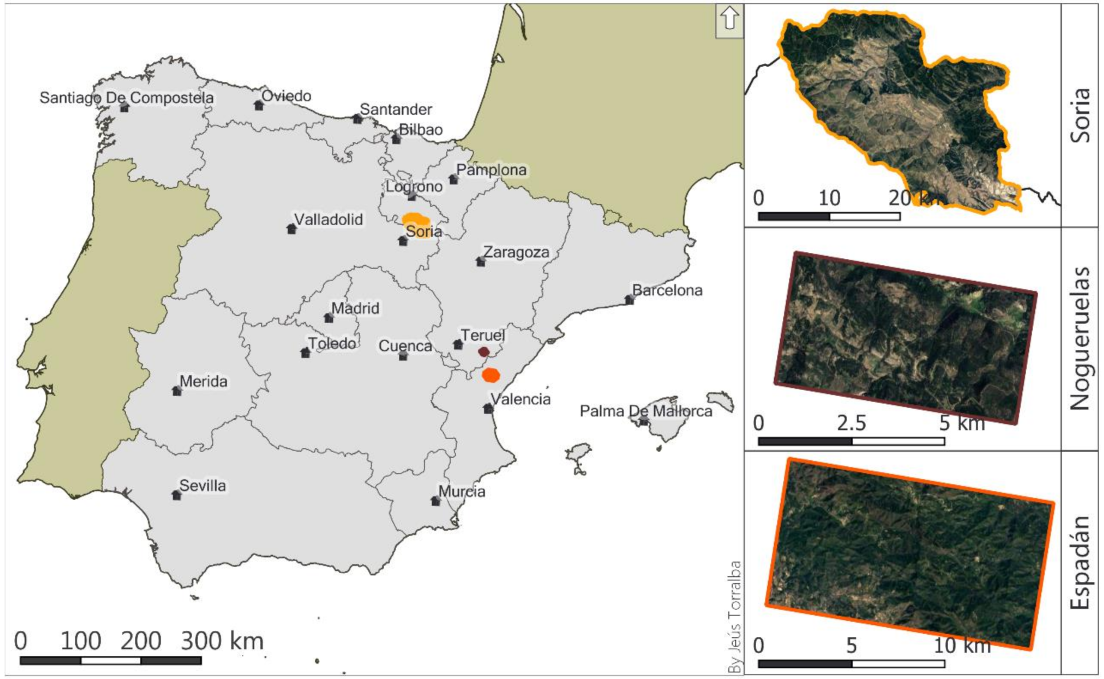
1. Marginality Classes
2. Marginal Land Area
3. Suitable species identification
4. Simulation of forest growth
5. Carbon sequestration for the test site

Test sites

- **Poland**

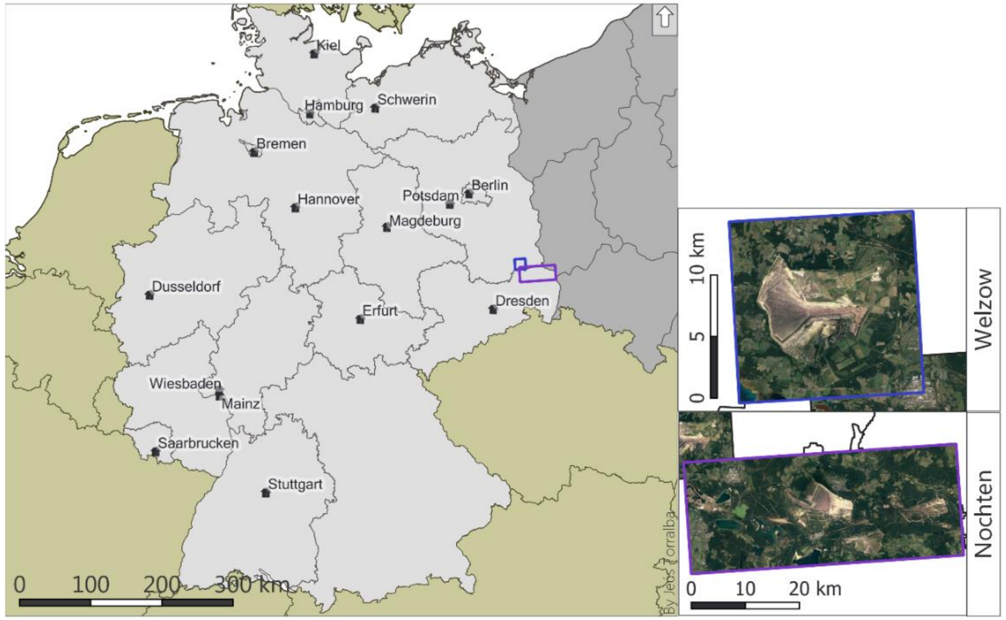


- **Spain**

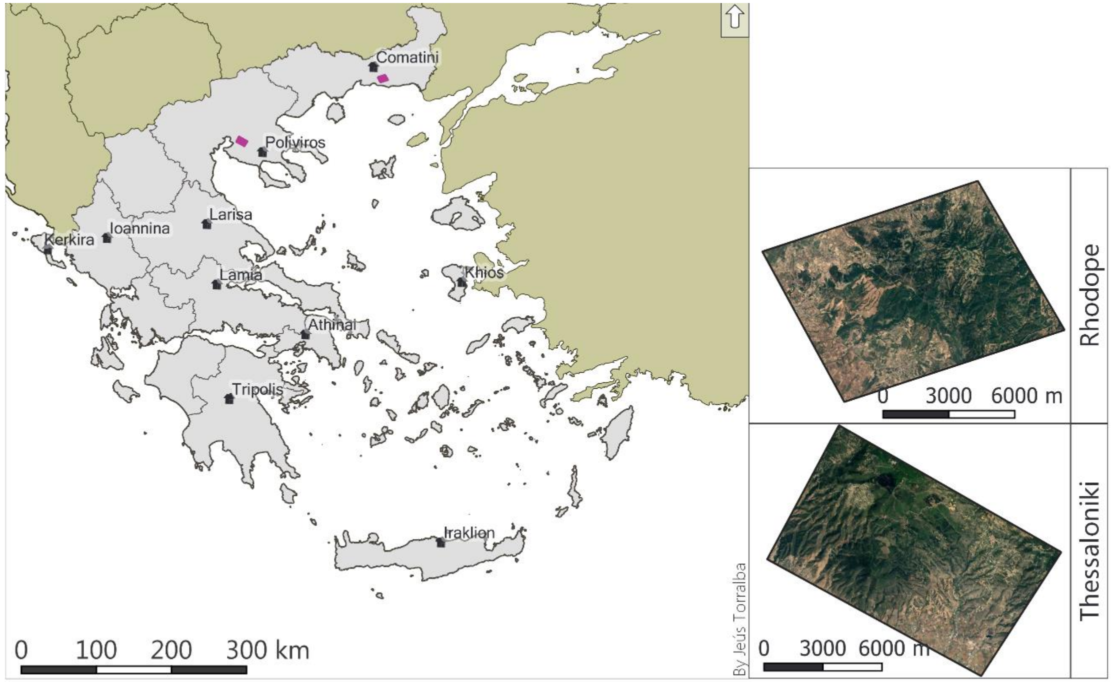


Test sites

- Germany

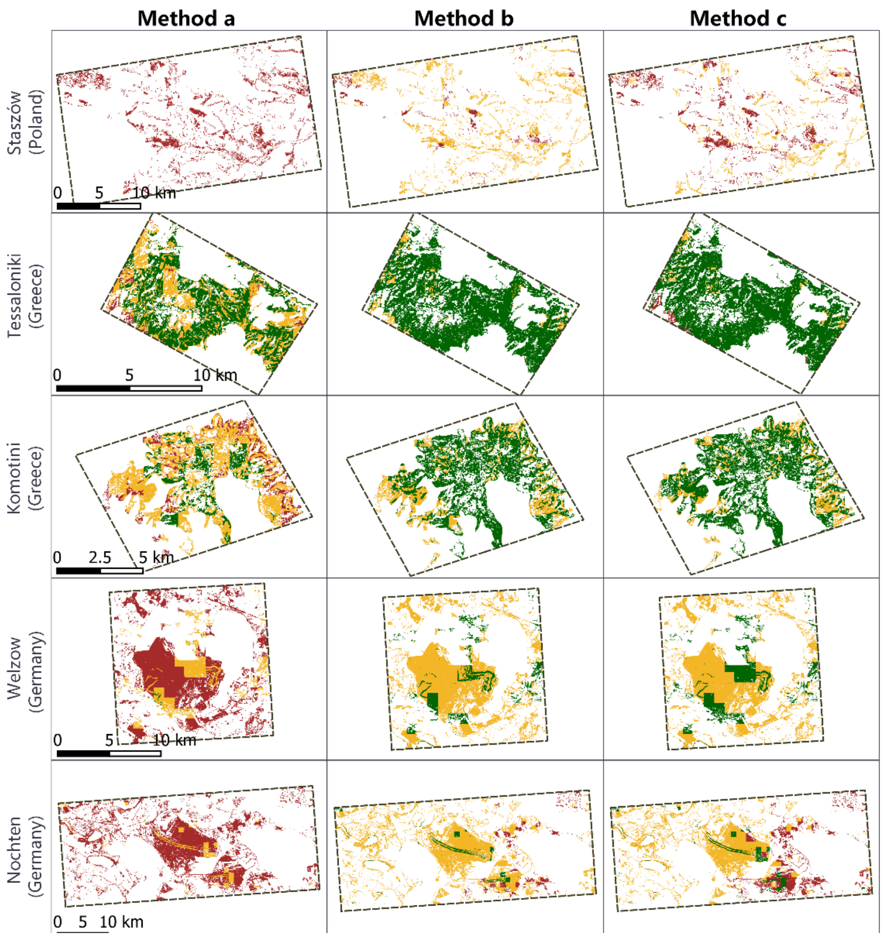


- Greece



Marginality classes estimation

- A – equal interval
- B – 25th and 75th percentile
- C – 33rd and 66th percentile



Marginal Land Area

Grant Agreement 823805 MAIL H2020 MSCA RISE 2018

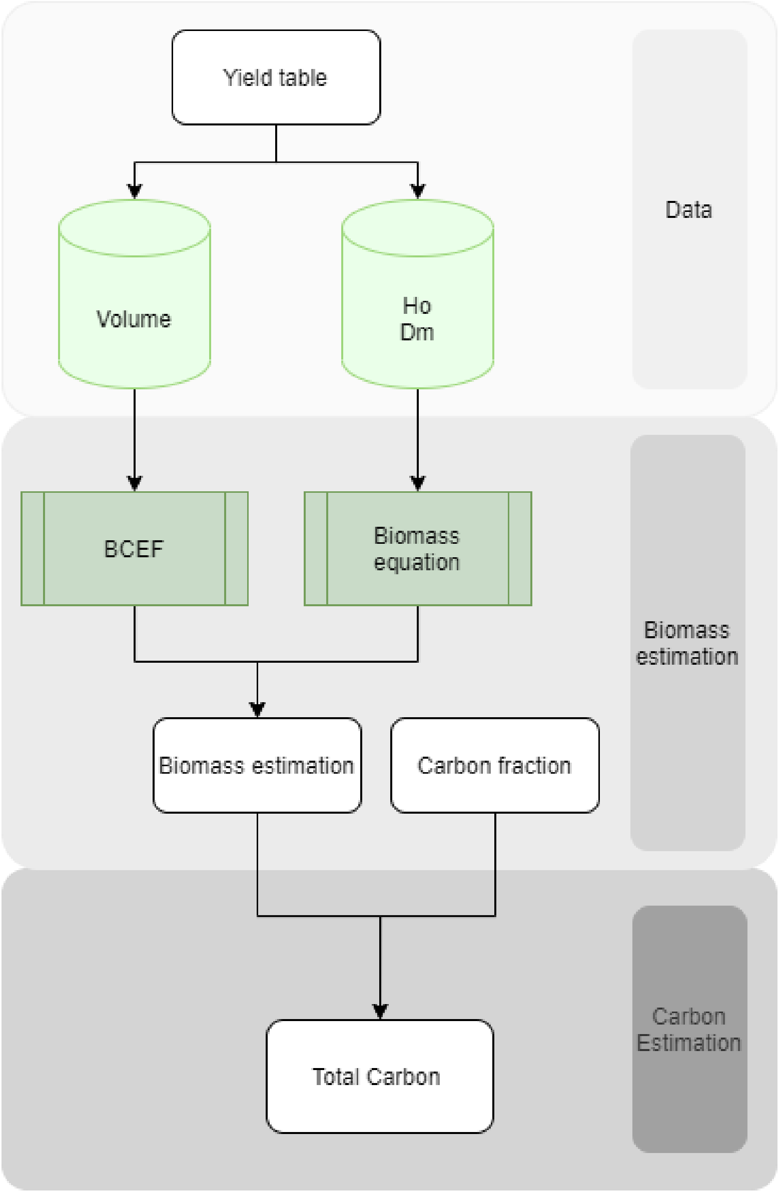
		Poland (Staszów)		Greece (Isenli)		Germany (Welzow)		Germany (Nochten)		Spain (Nogueruelas)		Spain (Espadán)		Spain (Soria)	
Method	Type	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
A	***MLs with high plantation suitability***	0.0	0.00	450.6	22.64	27.1	0.11	6.6	0.01	0.0	0.00	0.0	0.00	3611.5	3.66
	MLs with low plantation suitability	19.6	0.03	315.2	15.84	1554.8	6.26	2023.3	1.62	12.7	0.39	341.8	2.14	19194.2	19.45
	Potentially unsuitable lands	4076.4	6.23	2.2	0.11	4951.2	19.95	19090.6	15.31	14.6	0.45	282.0	1.77	2913.7	2.95
	Total MLs	**4096.0**	**6.3**	**768.1**	**38.6**	**6533.0**	**26.3**	**21120.5**	**16.9**	**27.3**	**0.8**	**623.9**	**3.9**	**25719.3**	**26.1**
B	***MLs with high plantation suitability***	17.8	0.03	742.0	37.28	1095.4	4.41	1255.5	1.01	0.3	0.01	103.0	0.64	20367.3	20.64
	MLs with low plantation suitability	3487.6	5.33	26.0	1.31	5437.6	21.91	17891.5	14.35	21.0	0.65	272.1	1.70	5082.2	5.15
	Potentially unsuitable lands	590.6	0.90	0.0	0.00	0.0	0.00	1973.5	1.58	6.0	0.18	248.7	1.56	269.9	0.27
	Total MLs	**4096.0**	**6.3**	**768.1**	**38.6**	**6533.0**	**26.3**	**21120.5**	**16.9**	**27.3**	**0.8**	**623.9**	**3.9**	**25719.3**	**26.1**
C	***MLs with high plantation suitability***	18.9	0.03	746.4	37.50	1581.1	6.37	1933.4	1.55	12.7	0.39	341.2	2.14	22587.9	22.89
	MLs with low plantation suitability	1682.5	2.57	21.6	1.09	4952.0	19.95	14043.5	11.26	8.3	0.25	33.7	0.21	2751.0	2.79
	Potentially unsuitable lands	2394.6	3.66	0.0	0.00	0.0	0.00	5143.6	4.13	6.4	0.20	249.0	1.56	380.5	0.39
	Total MLs	**4096.0**	**6.3**	**768.1**	**38.6**	**6533.0**	**26.3**	**21120.5**	**16.9**	**27.3**	**0.8**	**623.9**	**3.9**	**25719.3**	**26.1**

Species suitabilty

Country	Source	Species	Selection Method
Spain	Spanish Forest Map	Pinus sylvestris Pinus halepensis Pinus pinaster Pinus nigra	Highest frequency for the test sites
Greece	Inventory of the test sites	Pinus halepensis Quercus species	Highest frequency for the test sites
Poland	Polish National Forest Inventory / Forest Data Bank	Pinus sylvestris Quercus species	Highest frequency for the test sites
Germany	National Forest Inventory	Pinus sylvestris Picea abies	Highest frequency for the test sites

Forest Growth Simulation

- Two ways for estimating biomass
  - Biomass equations
    - Data required: diameter and height
  - Biomass expansion factors
    - Provides biomass ratio for a species



Yield tables

Remaining inventory								
Age	HG	HO	G	DG	N	VS	VD	VB
years	m	m	m^2	cm	trees/ ha	m^3	m^3	m^3
30	6.6	7.8	19.4	5.8	7317	70	20	123
35	7.7	9	21.2	7.3	5129	88	43	129
40	8.8	10.1	22.8	8.8	3754	106	72	141
45	9.9	11.2	24.1	10.4	2850	123	99	155
50	10.9	12.2	25.3	12	2233	140	122	171
55	11.8	13.1	26.2	13.6	1795	155	142	186
…	…	..	..	…	…	….	….	…
120	19.4	20.2	29.2	32	362	261	267	306
125	19.7	20.4	29.1	33.1	338	262	269	307
130	19.9	20.6	28.9	34.1	316	262	270	308
135	20	20.7	28.7	35.1	297	262	271	308
140	20.1	20.8	28.5	36	280	261	270	307

- **A is the stand age in years,**
- **HG is the stand mean height (base area mean height) in meters,**
- **HO is the stand top height (height of the base center trunk of the 100 strongest trunks/ha) in meters),**
- **G is the basal area in m2,**
- **DG is the stand mean diameter (diameter of the base area mean stem) in cm,**
- **N is the number of trees per hectare, VS in the stand timber volume per hectare in m3,**
- **VD in the stand solid wood volume per hectare in m3, and VB stand tree wood volume per hectare in m3.**

Biomass equations

Species	Type	Comp.	Equation
Pinus sylvestris	Simple	stw	$0.0624 \cdot dbh^{1.9322} \cdot sth^{1.0414}$
		stb	$0.0077 \cdot dbh^{1.8127} \cdot sth^{0.8732}$
		stwb	stw + stb
		cww	$0.0173 \cdot dbh^{2.0072} \cdot h^{0.914}$
		cwb	$0.0055 \cdot dbh^{2.0108} \cdot h^{0.5374}$
		cwwb	cww + cwb
		sw	$0.1316 \cdot dbh^{2.444} \cdot h^{-0.949}$
		nd	$0.1484 \cdot dbh^{2.332} \cdot h^{-1.2026}$
		agb	Sum of all components
Picea abies	Simple	stw	$0.022 \cdot dbh^{2.1212} \cdot sth^{0.6056}$
		stb	$-0.0128+0.0067 \cdot dbh^{1.7268} \cdot sth^{0.5947}$
		stwb	stw + stb
		cww	$0.0142 \cdot dbh^{1.7414} \cdot h^{1.2401}$
		cwb	$0.0038 \cdot dbh^{1.6076} \cdot h^{1.0528}$
		cwwb	cww + cwb
		sw	$1.8472 + 0.0243 \cdot dbh^{2.9671} \cdot h^{-0.8183}$
		nd	$-1.6847 + 0.285 \cdot dbh^{2.1173} \cdot h^{-0.8334}$
		agb	Sum of all components

Component	Description
stw	Stump wood
stb	Bark of stump wood
stwb	Stump wood incl. bark
cww	Coarse wood (≥ 7 cm in diameter)
cwb	Bark of coarse wood (≥ 7 cm in diameter)
cwwb	Coarse wood (≥ 7 cm in diameter) incl. bark
sw	Small wood (< 7 cm in diameter) incl. bark
nd	Needles
agb	Total above-ground biomass

4.3 Carbon sequestration calculation

$$Biomass_i = f(DBH, Heigth, Volume)$$

$$Carbon_i = f(biomass)$$

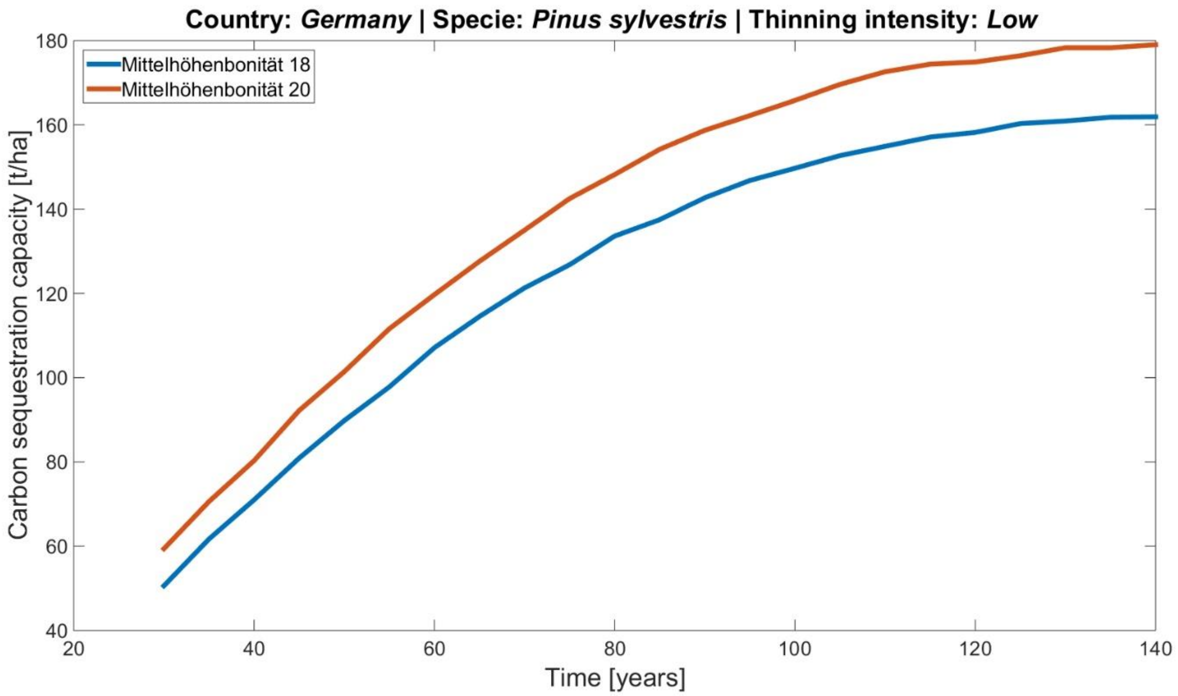
$$C\ Sequestration_i = \sum_{i=1}^{n} Area_i * Carbon_i$$

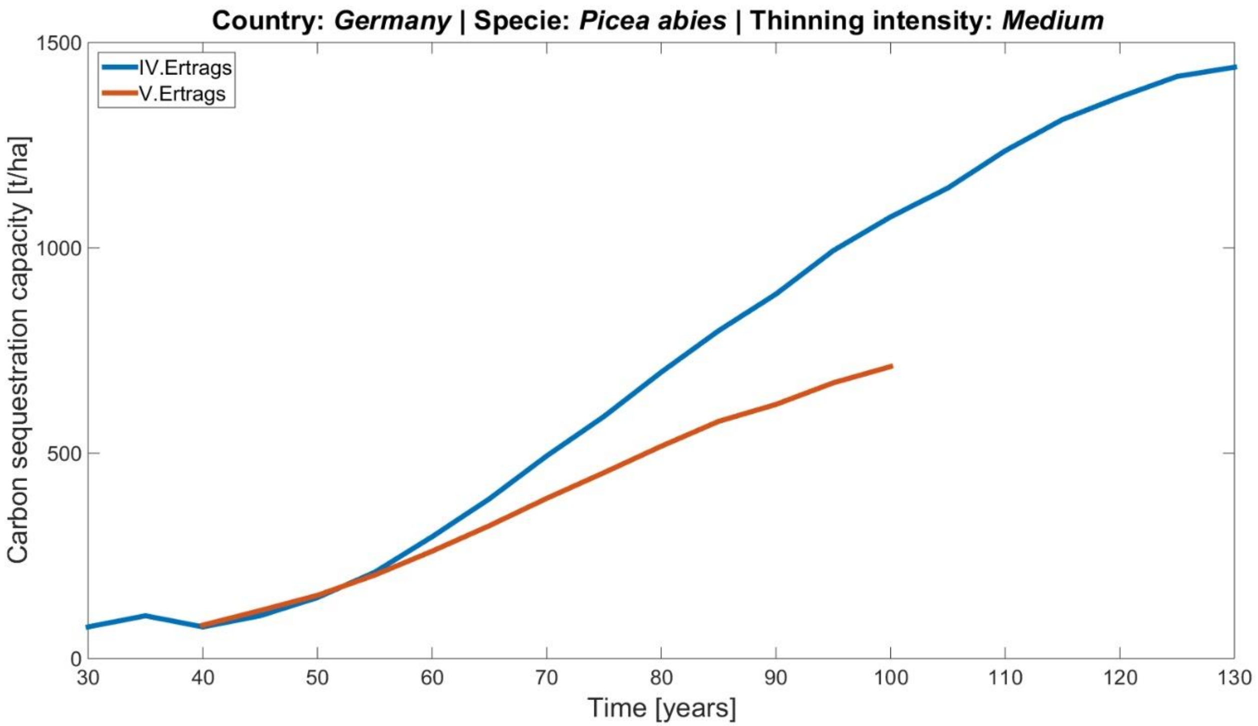
$i = Marginal\ land\ type$

Species mixture selection for the MLs

- 3 marginality classes:
  1. MLs with high plantation suitability
  2. MLs with low plantation suitability
  3. Potentially unsuitable lands
- 3 species combinations for each class:
  1. 70% species with higher carbon fixing rates and 30% with lower
  2. 30% species with higher carbon fixing rates and 70% with lower
  3. No actuation

Simulations





Thank you for your attention!

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 823805

Dzhaner Emin, IABG