AFFORESTATION DESIGN

LIFE RESILIENT FORESTS will develop an afforestation of the forest land in Pedrão, close to Penhas Douradas – Manteigas – Guarda (Portugal) that was burned during a wildfire event of 2017 (see figure 1). This wildfire started on 15 October in Seia, burning an area of over 17,000 hectares and causing one fatality. In the area where the afforestation is to take place, the fire spread with such intensity that it limited the possibilities of natural regeneration. Since after 5 years this area is occupied by shrub vegetation, the [Portuguese] Institute for Nature Conservation and Forests has recommended that this area be reforested with native species. The afforestation will be carried out in December, 2022 and January, 2023, cover an area of 3 ha, will use *Quercus pyrenaica* and *Pinus sylvestris* species, and the species density as well as its management has been designed by using CAFE.

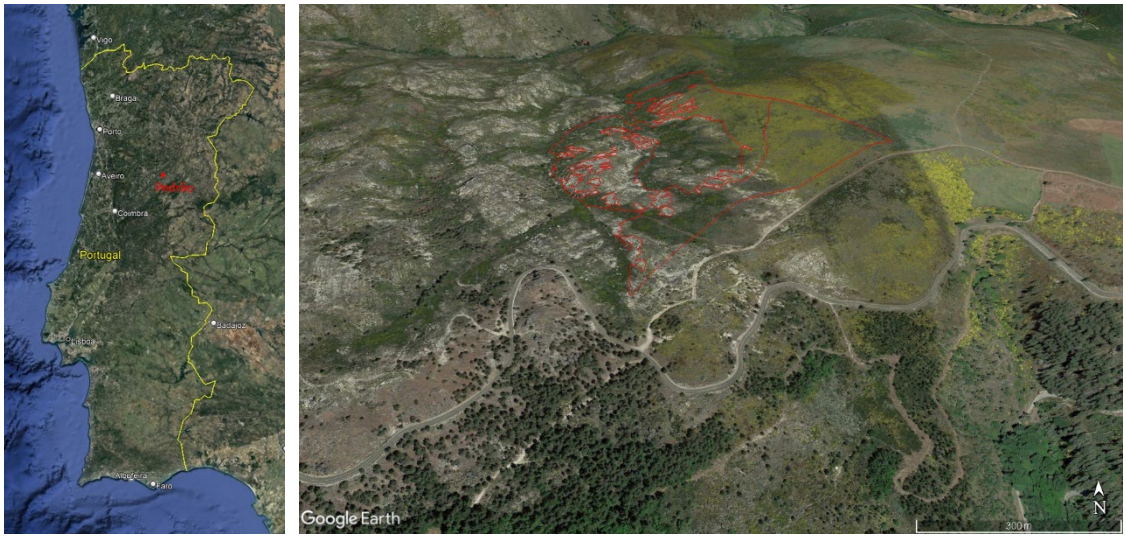

Figure 1: Location of the area to be afforested.

METHODOLOGY:

The selected model for this forest management design is BIOME_BGC_MuSo, and as such, the necessary data to run this case is:

1. Daily climatic time series of temperature (maximum, minimum and average), precipitation, vapor pressure deficit, solar radiation and daylight duration.
2. Soil properties: depth and texture.
3. Tree spices.

Climatic data have been gathered form a meteorological station nearby, the soil data have been obtained form the European Soil Database, and to represent the tree species the eco-physiological files of the potential cases developed by RESILIENT FORESTS have been used (enf and dbf files).

Once the data have been gathered, café has been used to optimize the plantation density and the management timing and intensity along 50 years. In this sense, only 2 management actions have been included as it is a protective forest that does not aim to produce timber.
The selected goals (ecosystem services) to optimize were: forest resilience, fire risk (in terms of upper soil moisture) and C sequestration.

RESULTS:

CAFE generated 31 possible afforestations that range from 500 to 2000 trees/ha with thinning from 20 to 80 % (see table 2 and figure 2). Using the interactive interface of CAFE, it is possible to select one solution by priorizing some G&S over the rest (see figure 2). In this sense, the selected solution corresponds to an afforestation of 1200 tree/ha, with 2 thinnings of 40 % each, carried out 6 and 27 years after the plantation, respectively. The goods and services provisioning of the selected solution are shown in table 1.

Table 1: Results of the selected solution

Biomass (t/ha)	NEP t/ha yr	Blue water mm/yr	Surface Soil moisture (%)	Wood (t/ha)	Potential costs (€)
16.5	2.3	310.26622	33	8.2	2553.3

Table 2: Results from the DSS CAFE. In yellow is highlighted the selected solution.

density	**seedling_kgC**	**When0**	**When1**	**Thinning0**	**Thinning1**	**Biomass**	**DeepMoisture**	NEP	Percolation	Resilience	Respiration	SoilCarbon	SurfaceMoisture	SurfaceWater	Transpiration	Wood	n_tree_curt	OperationCosts	Solution
1900	0.00057	6	30	0.2	0.3	0.00	0.34	1183.47	11266.13	1.01	0.01	5.41	0.32	2812.06	3429.29	0.00	836	2584.56	3
1900	0.00057	6	27	0.2	0.5	2.31	0.34	1126.90	11926.08	1.04	0.01	5.36	0.33	2849.04	3217.26	1.15	1140	2724.4	8
2000	0.0006	6	20	0.4	0.2	0.31	0.34	1156.01	11755.57	1.04	0.01	4.99	0.32	2849.59	3243.68	0.15	1040	2678.4	25
1600	0.00048	6	21	0.2	0.2	0.39	0.34	1157.24	11787.18	1.04	0.01	4.96	0.32	2852.18	3232.55	0.19	576	2464.96	28
1600	0.00048	6	28	0.3	0.4	1.92	0.34	1114.35	11993.01	1.04	0.01	4.96	0.33	2859.50	3152.99	0.96	928	2626.88	19
1800	0.00054	6	26	0.3	0.8	3.29	0.35	929.58	13203.30	1.05	0.01	4.92	0.33	2941.59	2692.07	1.65	1548	2912.08	23
2000	0.0006	6	27	0.5	0.7	3.09	0.34	1030.94	12627.30	1.06	0.01	4.89	0.33	2898.65	2916.33	1.55	1700	2982	4
1700	0.00051	6	27	0.4	0.7	3.07	0.34	1025.09	12686.56	1.06	0.01	4.82	0.33	2903.81	2889.47	1.53	1394	2841.24	13
1500	0.00045	6	27	0.4	0.8	3.42	0.35	962.22	13057.37	1.07	0.01	4.59	0.33	2929.36	2723.03	1.71	1320	2807.2	9
1700	0.00051	6	26	0.4	0.6	2.40	0.34	1037.69	12799.11	1.07	0.01	4.76	0.33	2918.52	2869.17	1.20	1292	2794.32	6
1800	0.00054	6	23	0.4	0.4	1.12	0.34	1132.99	12354.23	1.07	0.01	4.76	0.33	2892.16	3055.52	0.56	1152	2729.92	10
2000	0.0006	6	27	0.7	0.5	2.12	0.34	1062.88	12575.54	1.08	0.01	4.54	0.33	2905.36	2918.87	1.06	1700	2982	21
1200	0.00036	6	27	0.4	0.4	1.65	0.34	1064.70	12601.28	1.09	0.01	4.34	0.33	2912.04	2896.29	0.82	768	2553.28	26
1500	0.00045	6	22	0.4	0.4	0.86	0.34	1105.42	12548.37	1.09	0.01	4.42	0.33	2911.28	2944.19	0.43	960	2641.6	14
1600	0.00048	6	27	0.7	0.3	1.22	0.34	1070.03	12557.90	1.09	0.01	4.22	0.33	2913.60	2899.11	0.61	1264	2781.44	16
1500	0.00045	6	24	0.6	0.3	0.87	0.34	1086.33	12622.36	1.09	0.01	4.24	0.33	2921.76	2889.57	0.43	1080	2696.8	1
1700	0.00051	6	26	0.7	0.8	2.95	0.35	872.63	13809.91	1.09	0.01	4.10	0.33	2995.32	2413.16	1.48	1598	2935.08	30
1900	0.00057	6	19	0.2	0.8	1.02	0.34	1046.06	13161.96	1.12	0.01	4.13	0.33	2952.46	2698.24	0.51	1596	2934.16	7

800	0.00024	6	25	0.3	0.5	1.53	0.35	991.28	13447.19	1.13	0.01	3.77	0.33	2981.09	2557.52	0.77	520	2439.2	5
1600	0.00048	6	23	0.6	0.7	1.74	0.35	1002.72	13579.00	1.14	0.01	3.97	0.33	2985.52	2544.00	0.87	1408	2847.68	12
900	0.00027	6	24	0.3	0.7	1.89	0.35	952.08	13863.94	1.15	0.01	3.71	0.33	3013.89	2395.03	0.95	711	2527.06	29
900	0.00027	6	24	0.5	0.6	1.51	0.35	965.65	13773.55	1.15	0.01	3.53	0.33	3010.04	2416.22	0.76	720	2531.2	2
1000	0.0003	6	24	0.5	0.8	2.10	0.35	882.33	14291.50	1.16	0.01	3.49	0.33	3049.54	2193.21	1.05	900	2614	17
800	0.00024	6	28	0.8	0.7	2.62	0.35	864.26	14056.87	1.16	0.01	3.02	0.33	3023.58	2224.45	1.31	752	2545.92	22
900	0.00027	6	25	0.8	0.6	1.51	0.35	866.96	14335.89	1.19	0.01	2.97	0.33	3055.45	2129.66	0.76	828	2580.88	18
500	0.00015	6	22	0.4	0.5	0.60	0.35	906.62	14069.06	1.19	0.01	2.77	0.33	3042.70	2203.58	0.30	350	2361	27
600	0.00018	6	20	0.7	0.4	0.22	0.34	889.52	14047.97	1.20	0.01	2.55	0.33	3047.68	2167.45	0.11	492	2426.32	24
600	0.00018	6	21	0.7	0.5	0.39	0.35	868.14	14272.64	1.21	0.01	2.48	0.33	3063.40	2081.65	0.20	510	2434.6	11
900	0.00027	6	17	0.7	0.8	0.20	0.35	845.60	14364.63	1.22	0.01	2.32	0.33	3072.02	2014.96	0.10	846	2589.16	20
500	0.00015	6	13	0.4	0.8	0.03	0.35	817.65	14497.32	1.24	0.01	2.06	0.33	3087.66	1929.37	0.02	440	2402.4	15
700	0.00021	6	16	0.7	0.8	0.11	0.35	792.45	14694.38	1.25	0.01	1.99	0.33	3102.54	1846.07	0.05	658	2502.68	0

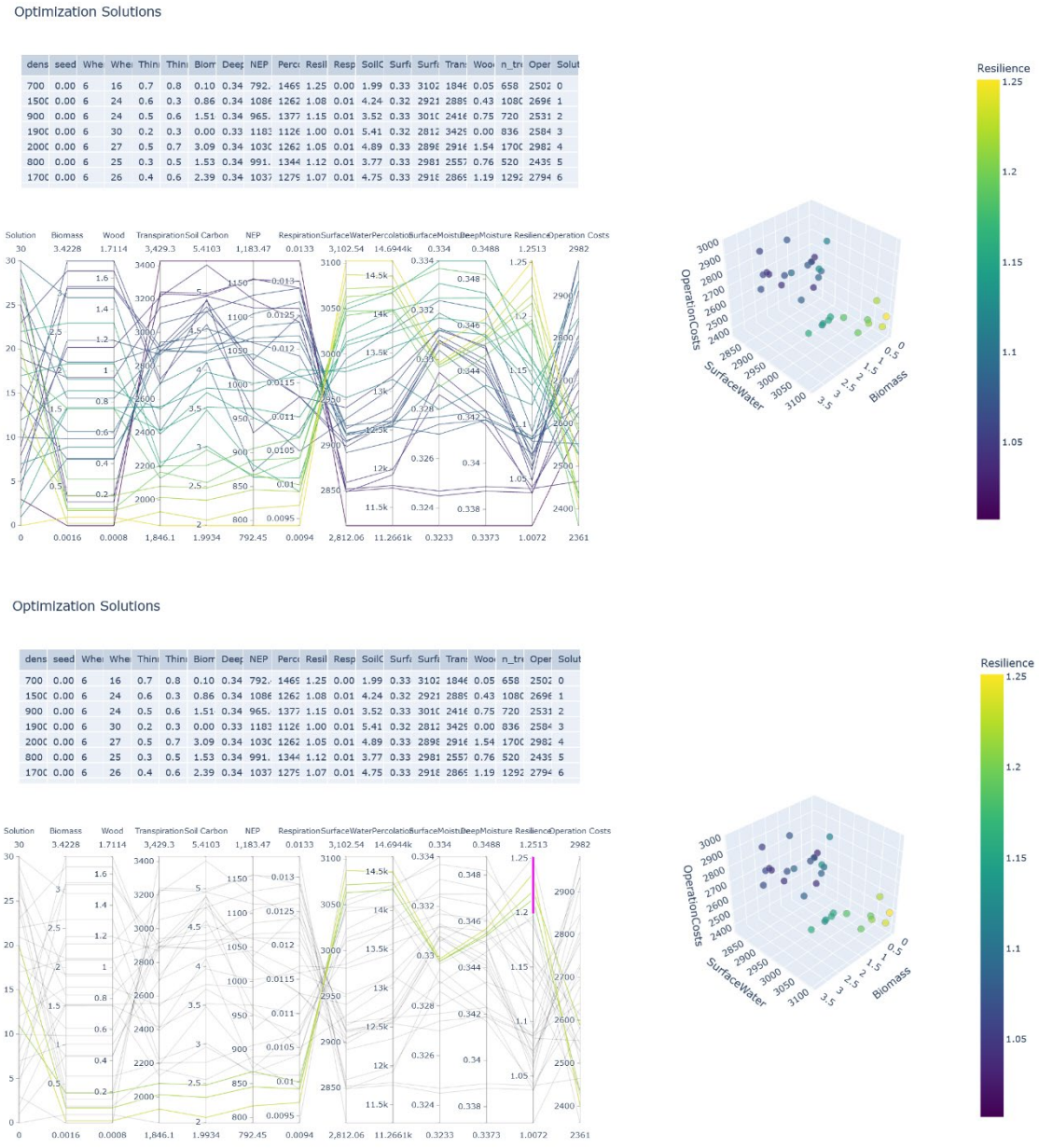

Figure 1: Results of the DSS CAFE with (bottom) and without filtering (upper).