



MAIL Newsletter 4

Editorial

Dear friends and colleagues,

Welcome to the new issue of the MAIL (Identifying Marginal Lands in Europe and strengthening their contribution in a CO₂ sequestration strategy, GA No. 823805, H202-MSCA-RISE-2018) project newsletter. MAIL is a cooperation European project funded by the Research Executive Agency (REA). This is the fourth of a total of six newsletters over the course of the MAIL project. The 4th issue presents a brief outline of the progress that has been achieved over the previous period..

Since the official start of the MAIL project almost two and a half years ago, there have been significant advances in realizing MAIL's objectives. The methodology for the identification of marginal lands in European level has been developed and the European map of marginal lands has been produced. Furthermore, the customization, evaluation, and validation of existing models for the estimation of carbon sequestration in marginal lands has been performed. In addition, a methodology for the estimation of biomass volume using SAR and Lidar data has been developed and assessed. Finally, the 2nd pilot case of the project which examines the quantification of carbon sequestration capacity in m/sm marginal lands is currently being finalized.

During the period, a total of 24 secondments adding to approximately 60 person months have been implemented.

I believe that this brief review of technical progress included in our 4th newsletter, is a good opportunity for us to present our activities and results, exchange information with you and create awareness in management and usage of marginal land as potential carbon stocks. Please do not hesitate to send your suggestions on this publication as well as on project activities.

Petros PATIAS

MAIL Coordinator

Director of AUTH's Laboratory
of Photogrammetry and Remote Sensing

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The MAIL project

The global climate change is a worldwide problem where its mitigation is one of the 17th Sustainable Development Goals of the UN. An effective mitigation strategy should assess all the possible sustainable actions that can contribute to this direction. A challenging and very prominent contribution to raise CO₂ sequestration could come from the Land Use Land Use Change and Forestry sector (LULUCF sector) and the utilization of Marginal Lands (MLs) that today are widely available in the EU. MLs can play significant role as potential Carbon Sinks. Especially those on mountainous and semi-mountainous areas (m/sm MLs) are of great capacity and can contribute actively to that goal having no effect in the agri-food production sector. Even though MLs' contribution is acknowledged the influence of their active inclusion in the climate change mitigation strategies has not yet been estimated in depth.

MAIL focuses on m/sm MLs in order to classify them into Carbon sequestration capacity categories based on innovative approaches fully consistent with the IPCC methods and the UNFCCC requirements. The final goal is to deliver a methodology and application set in a web-based platform format, which will be valuable for policy makers, stakeholders or researchers. Free open access data of other EU initiatives will be combined, (land cover, soil, topography, climate, etc.) in order to detect the potential existence of m/sm MLs. These, will be further examined, validated and classified in Carbon sequestration capacity groups through stratified field sampling. State of the art remote sensing (RS) techniques and free open access satellite images with improved spatial and radiometric resolution will be used in order to augment the accuracy of the produced pilot thematic maps. In addition, actions that have to be taken in order to increase the Carbon sequestration capacity will be proposed, while their feasibility will be assessed. A final methodology will be delivered for on-demand production of thematic maps within Europe.



Map of Marginal Lands in Europe

The concept of marginal land is very dynamic and depends on various factors related to the environment, climate, scale, culture, and economic sector. Mapping of MLs in Europe required the bibliographic review and analysis of various indicators and databases. The final methodology consisted of combining land use data and soil quality data. The land-use constraints were divided into two, "soft" constraints which were factors with variable thresholds (e.g., slope), and "hard" constraints were considered as binary exclusion factors (e.g., protected areas). The majority of the factors that indicate marginality could be considered "soft". These included biophysical factors such as slope, elevation, soil quality/fertility, and erosion, which are inherent properties of the land or soil. Current land-use and policy can be classified as "hard" constraints.

The methodology was divided into five steps:

- criteria and thresholds for identifying marginal lands
- selection of the datasets and pre-processing
- implementation of the "hard" thresholds and constrains methodology which relies on the exclusion of areas that do not meet the requirements of the definition of Marginal Lands (i.e., agricultural lands, forest and impervious areas, permanent water, and snow areas, peat bogs, marshes, and more)
- "additional indicators/thresholds" phase based on the development of specific sets of additional indicators (i.e., "soft" constrains). A weighted overlap analysis was then performed considering the physical characteristics of the possible areas of interest across Europe.
- mapping of marginal lands, was the reclassification of the resulting product of the weighted overlay into 3 classes, depicting marginality: 1) Marginal lands with high plantation suitability, 2) Marginal lands with low plantation suitability and 3) Potentially unsuitable lands.

As a result, a marginal land maps (hard constraints) and marginality maps (soft constraints) were obtained for Europe and the pilot sites proposed in the MAIL project. The results are currently being validated in task 2.4. The developed methodology will be adjusted and fine-tuned based on the results of the accuracy assessment evaluation.

Soon, interactive maps of marginal lands will be available via our geoportal. Detailed description of methodology used for marginal lands mapping can be found in [Deliverable 2.3](#) on MAIL project website.



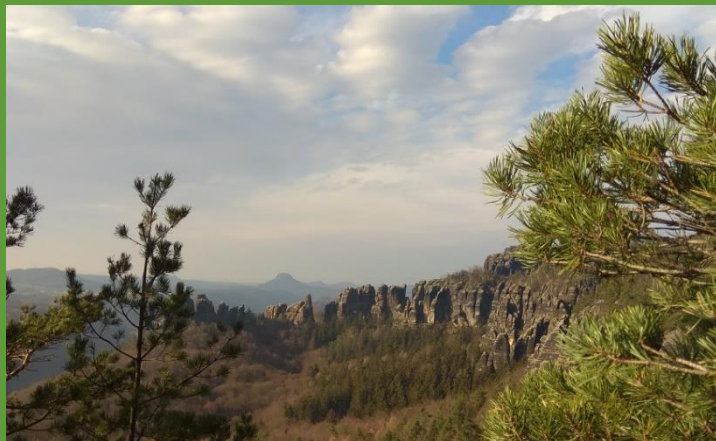
Figure 1: Map of Marginal Lands divided into 3 categories according to Method b.



Carbon stock estimation methods

Biomass is defined as the mass of live or dead organic matter. Changes of vegetation biomass per unit area (biomass density) are a direct measure of sequestration or release of carbon between terrestrial ecosystems and the atmosphere. Biomass can be measured by Direct methods, such as on-field destructive direct biomass measurement or on-field non-destructive biomass estimations and Indirect Methods such as remote sensing and allometric equations.

There are no international validated standards available for biomass estimation from remote sensing. The most important advisory document right now is the IPCC's "Good Practice Guidance" (2006) that recognizes three "tiers" of methodology for estimating carbon stocks.



In the context of the **MAIL** project, after evaluating the existing methodologies on carbon stock estimation, it has been concluded that the Tier 1 default method is most suitable, as this is detailed in the IPCC Guideline (2006) and their recent refinement (2019). The Tier 1 method may be applied for the estimation of carbon stocking in the European marginal lands for all carbon pool types, even if soil carbon is not obligatory to be assessed under Tier 1. The default factors for various land use categories and pools can be chosen according to climate zones, soils type and/or global ecological zones. For this reason, classification schemes and maps have been created and made available on the Forest Resources and Climate Unit website to help a Member State to select default factors in line with the IPCC Guidelines (2006). Regarding the Land Area Representation for the estimation of carbon stocks in European marginal lands several land-use databases may be used (see **MAIL**, D.2.2). Other sources for representation of tree species composition in Europe may be followed such as Tree species maps for European forests or Forest Map of Europe developed by the European Forest Institute (EFI). Furthermore, carbon stock estimation may be fine-tuned by employing supplementary methods of remote sensing-based techniques complemented with additional statistical information, such as national statistics or NFI data.

Carbon sequestration potential

The assessment of carbon sequestration capacity is necessary to evaluate how the proposed afforestation strategies may be beneficial as carbon sinks. Eight test sites from four countries (Germany, Poland, Spain and Greece) were analysed and used as show cases to present to the potential of marginal lands in details. In the first step, data about dominant species and their characteristics were gathered. Next, for each test site, the dominant species were identified, and for them the optimal biomass and carbon estimation method was selected. Simulations of potential forest properties were done using yield tables as prediction for future (from 20 to 140 years).

Carbon sequestration capacity estimations for test sites using mixtures of dominant species were prepared for ~50 years into the future.

Spain Noguerauelas method C												
ML 1	Pinus sylvestris [%]	0	10	20	30	40	50	60	70	80	90	100
	CSC [t/ha]	157.9	152.9	148.0	143.0	138.0	133.1	128.1	123.1	118.1	113.2	108.2
	CSC [kt/ML1]	2.0	1.9	1.9	1.8	1.7	1.7	1.6	1.6	1.5	1.4	1.4
	Pinus nigra [%]	100	90	80	70	60	50	40	30	20	10	0
ML 2	Pinus sylvestris [%]	0	10	20	30	40	50	60	70	80	90	100
	CSC [t/ha]	144.2	138.6	133.1	127.5	122.0	116.4	110.8	105.3	99.7	94.2	88.6
	CSC [kt/ML2]	1.2	1.1	1.1	1.1	1.0	1.0	0.9	0.9	0.8	0.8	0.7
	Pinus nigra [%]	100	90	80	70	60	50	40	30	20	10	0

Figure 2. Example of carbon sequestration capacity of mixed species (*Pinus sylvestris* and *Pinus nigra*) in "Noguerauelas" test site, for two types of Marginal Lands.



Secondments

1. Ms. Anna Argyroudi (HOMEOTECH) successfully finished her secondment to CESEFOR working on Task 4.3
2. Mr. Abdulrashid Hassan (IABG) successfully finished his secondment to UPV working on Task 2.4
3. Mr. Jesus Torralba Perez (UPV) successfully finished his secondment to IABG working on Task 4.2
4. Mr. Michał Krupiński (CBK PAN) successfully finished his secondment to IABG working on Task 4.2 and 2.8

5. Mr. Mateus Mendes (IABG) successfully finished his secondment to CESEFOR working on Task 4.3
6. Mr. Dzhaner Emin (IABG) successfully finished his secondment to CESEFOR working on Task 2.7
7. Ms. Ewa Gromny (CBK PAN) successfully finished her secondment to IABG working on Task 4.4
8. Mr Alfonso Abad (CESEFOR) successfully finished his secondment to HOMEOTECH working on T2.9 and T4.1



My name is Anna Argyroudi and I am a biologist. I graduated from the Aristotle University of Thessaloniki (2007) and I hold a Master Diploma in Integrated Water Resources Management (IWRM) from the Swedish University of Agricultural Sciences (SLU) of Uppsala (2009).

I am an active professional on providing environmental services consultancy since 2011. My interests and experience focus on the Management of Protected Areas of Natura 2000 network, Management of Ecosystems under Climate Change, Water Resources Management etc. and all relevant European Funding Mechanisms for Programmes oriented towards Environmental Management.

During my secondment in CESEFOR, at Soria of Spain, I have been working from October till December 2020 on Task 4.3 "Pilot Case Study 3: estimation of carbon stock in forest products" (paper, wood panels and sawn wood). The structure of the task was set, in collaboration with the secondees Fernando Bezares (CESEFOR) and Mateus Mendes (IABG). Through my secondment I began to examine the contribution of wood products to the mitigation of carbon emissions, through either storing wood-based carbon or substituting environmentally unfriendly sources of material and energy such as concrete for construction and fossil fuels.

[Watch video](#)



My name is Abdulrashid Hassan. I see myself as a remote sensing and image processing scientist. I worked on the MAIL project at IABG as a master's thesis student to finish my study program in environmental remote sensing and modelling at the University of Trier, Germany.

My research interests and experience have been in land use and land cover classification, time series analysis, accuracy assessment, and area estimation, forest mapping and stress detection, and general spatial data processing in the context of climate change using remote sensing and GIS data.

My secondment was from January 1st to March 31st, 2021 at the Polytechnic University of Valencia in Valencia, Spain. I worked with the Geo-Environmental Cartography and Remote Sensing Group (CGAT). During this period, I worked on project task 2.4. "Accuracy assessment of m/sm MLs detection". I carried out the accuracy assessment, area estimation, and land cover analysis of the produced marginal land layer and wrote a reliable and quantitative report on accuracy assessment to support confidence in the information generated.

[Watch video](#)





My name is Jesús Torralba Pérez, a Forestry and Natural Environmental Engineer from the University of Castilla-La Mancha (Spain) and I studied a master's degree in Remote Sensing at the Universidad Mayor (Chile). Since the end of 2017, I am a PhD student in Geomatics Engineering at the Geo-Environmental Cartography and Remote

Sensing Group (CGAT) at the Polytechnic University of Valencia. My PhD is focused on the characterization of forest structure and forest fuel by integrating analysis of methods based on Terrestrial Laser Scanning (TLS), airborne LiDAR and imaging. My interests and experiences are focused on the analysis and management the forest resources and natural environments with remote sensing and GIS in the framework of climate change.

During my stay at the IABG in Dresden/Germany from October 2020 to February 2021 I was working on task 2.3 "Methodology development of ML detection" and 4.2 "Pilot case study 2: Quantification of carbon sequestration capacity in m/sm MLs". During this period, I finalized the methodology for identification and classification of marginal lands using products derived from remote sensing and auxiliary data. To process the information, ArcGIS Pro and Google Earth Engine were used. In Task 4.2 I worked together with Krupiński and Bezares in the estimation and analysis of the carbon sequestration capacity of 50-year reforestations in 8 pilot sites, based on yield tables and using a mix of tree species.

[Watch video](#)



My name is Michał Krupiński and work as geospatial analyst in Space Research Centre of the Polish Academy of Sciences in Warsaw (Poland). I received B.S. (2010) and M.S. (2012) degree in geodesy and cartography from Military University of Technology in Warsaw. I was involved

in number of R&D projects focused on geospatial data analysis. My research interests include novel methods for satellite imagery classification and imaging spectroscopy. I'm also strongly involved in the Copernicus User Uptake in Poland.

My secondment took place in IABG (Germany) from October 2020 to April 2021. Within this time, I worked mostly with Bezares and Torralba on the task 4.2 which is focused on estimation of carbon sequestration potential for selected test site areas in Poland, Germany, Spain and Greece. The second part of my secondment was devoted to task 2.8 and the literature review as the first step of augmented precision of marginal lands detection using satellite data.

[Watch video](#)



My name is Mateus Mendes. I am a Forestry Engineer from the Federal University of Viçosa (Brazil) and I studied the first year of my master's degree in Mediterranean Forest at the University of Lleida (Spain) and finishing now in University of Tuscia (Italy). Since my bachelor's I have worked with different strategies of climate action,

such as the development of systems to optimize and reduce emissions on the use of forest biomass to energy and models to estimate the carbon stocked in a forest. In my Master the focus is to apply the same knowledge of carbon combined with geospatial data. I'm currently working as a Master Student in IABG in the task related to the use of remote sensing and climate data to understand and estimate the carbon stocked in the pilot sites of Marginal Lands and in the wood products.

My secondment in the CESEFOR in Soria, Spain takes place during the months of February and May/beginning of June. It was a really awesome experience to be involved with so many experts in the Forest area and to have all the support and help of them to carry out the activities. My involvement in the project was on task 4.3 "Pilot case study 3: Estimation of Carbon Stock in forest products" During my secondment I worked using the methodology developed in the previous task to estimate the carbon and also carry out a study of the wood products from the marginal lands.

[Watch video](#)





My name is Dzhaner Emin. I am a Remote Sensing Specialist at IABG mbH Dresden.

I hold an undergraduate degree in Ecology and Nature Conservation from the Forestry University of Bulgaria and a master's degree in Remote Sensing and Environmental Modelling from the ITC Twente (The Netherlands) and Lund University (Sweden).

I consider myself a professional with experience in the fields of environmental science, data science, modelling, information technologies, Remote Sensing and GIS.

During my secondment in CESEFOR Soria Spain, for the MAIL project, May 2021, I was working on task 2.7, developing and implementing a machine learning prediction model for biomass inside marginal lands and classification of marginal lands into carbon sequestration groups based on their biomass volumes.

[Watch video](#)



My name is Ewa Gromny. I am a graduate of Military University of Technology and currently I am working for Space Research Centre of the Polish Academy of Science in Warsaw as a geospatial analyst in the Earth Observation Department. My area of interest covers among others the classification of satellite images.

So far I have been mostly focused on optical imagery from Sentinel-2 satellites and lately I took part in the project S2GLC which outcome is the Land Cover map of Europe for 2017. Recently I took part in part of Sat4Envi project which aim was to create an operating system for flood detection in Poland using Sentinel-1 data.

In May 2021 I have been seconded to IABG in Dresden/Germany. Within this time I have been working on the task 2.8. and 4.4 which are focused on increasing the precision of marginal lands detection and change detection mapping in forest marginal lands. I have been working mostly on investigating trends and behaviour of marginal lands over time in order to discover any regularities that might be helpful with distinguishing marginal lands on satellite images and representing occurring changes.

[Watch video](#)



My name is Alfonso Abad Technical Officer of the ICT and Knowledge Management area of CeseFor. I was graduated as Forestry engineer at Universidad de Valladolid, (Spain). Above all, I consider myself as an adaptable professional with experience in the fields of environmental management, information technologies and GIS.

I have acquired a relevant academic profile supported my postgraduate studies (MSc) on "Integrated planning for rural development and environmental management".

During my secondment in HOMEOTECH, at Thessaloniki/Greece, for the MAIL project, from January to March 2021, I was working on task 4.1, developing and implementing a regional marginality detection system based on the methodology developed on task 2.3 and comparing results at regional and European scale).

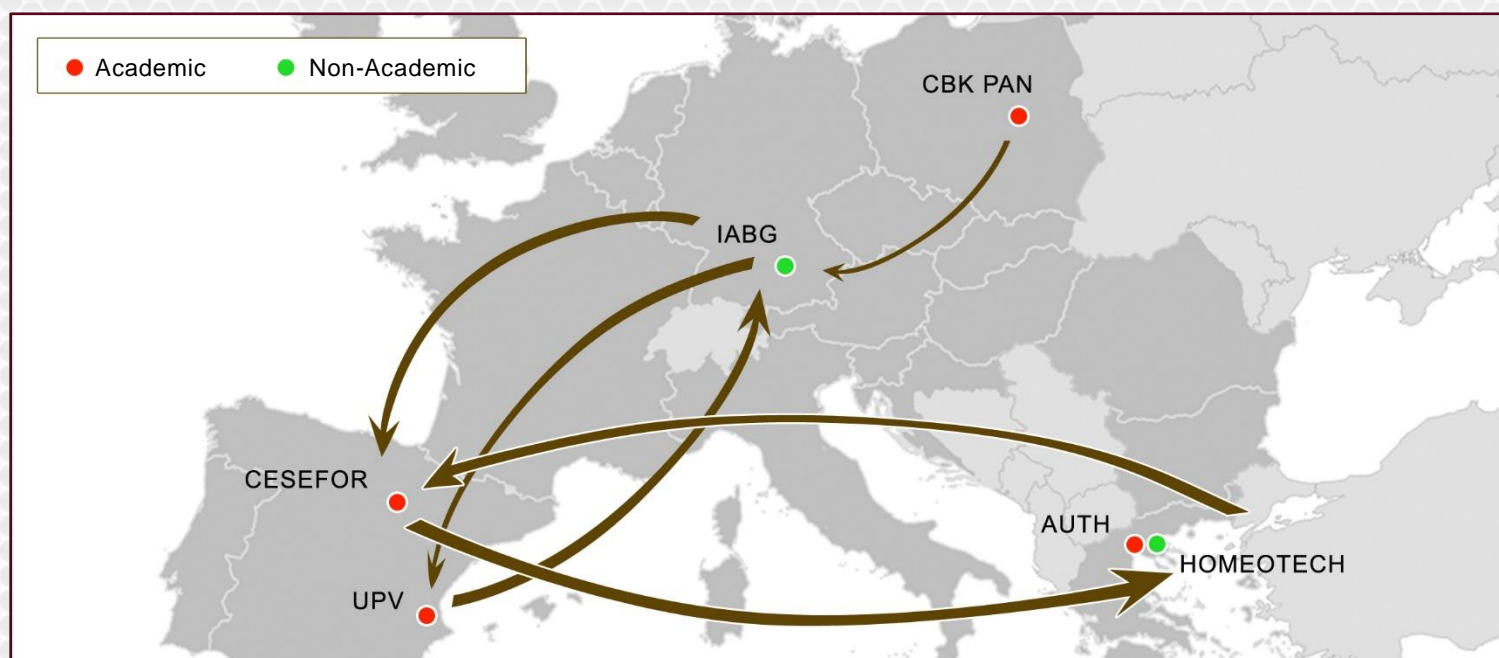
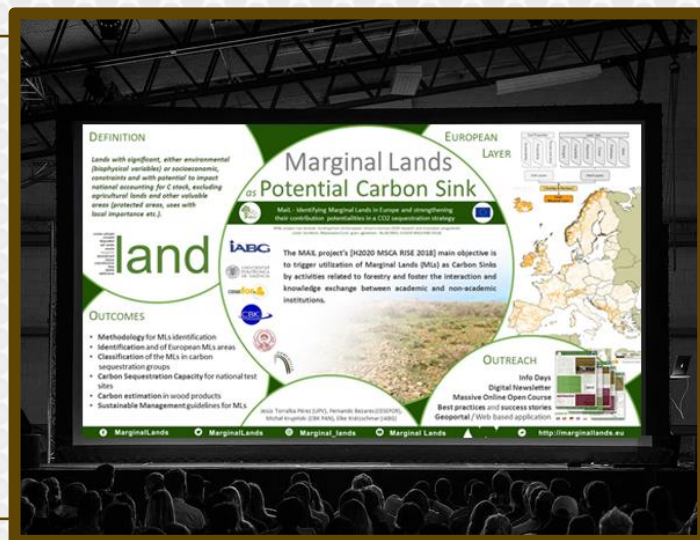
[Watch video](#)





Dissemination

Recently, the **MAIL** project was presented at 4 events. A virtual poster was presented during the National Copernicus Forum in Germany (23-24 of March). An info Day in Poland was organised on March, 31st 2021 during the online conference for EO data users from the public and private sector. An international workshop (June, 15th) focused on monitoring and reporting of GHG emissions and removals was an occasion to discuss about possible interactions between the MAIL and DG CLIMA projects. The methodology for MLs identification was presented during a scientific conference in Valencia (Spain): Tercer Congreso en Ingeniería Geomática (July, 7- 8th).



The directions of secondments from period November 2020 and May 2021

About the Project

- Topic: MSCA-RISE-2018 Marie Skłodowska – Curie Research and Innovation Staff Exchange
- Title: Identifying Marginal Lands in Europe and strengthening their contribution potentialities in a CO2 sequestration strategy
- Project Duration: 36 months
- Official start of the project: 01/01/2019
- Total budget: 800,400.00 €
- EU funding: 800,400.00 €

Consortium

