



Grant Agreement 823805 MAIL H2020 MSCA RISE 2018

# Detection of marginal lands



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Carbon sequestration potential of Marginal Lands in Europe, MAIL final conference, 13 December 2021



# Researchers Involved

T2.3

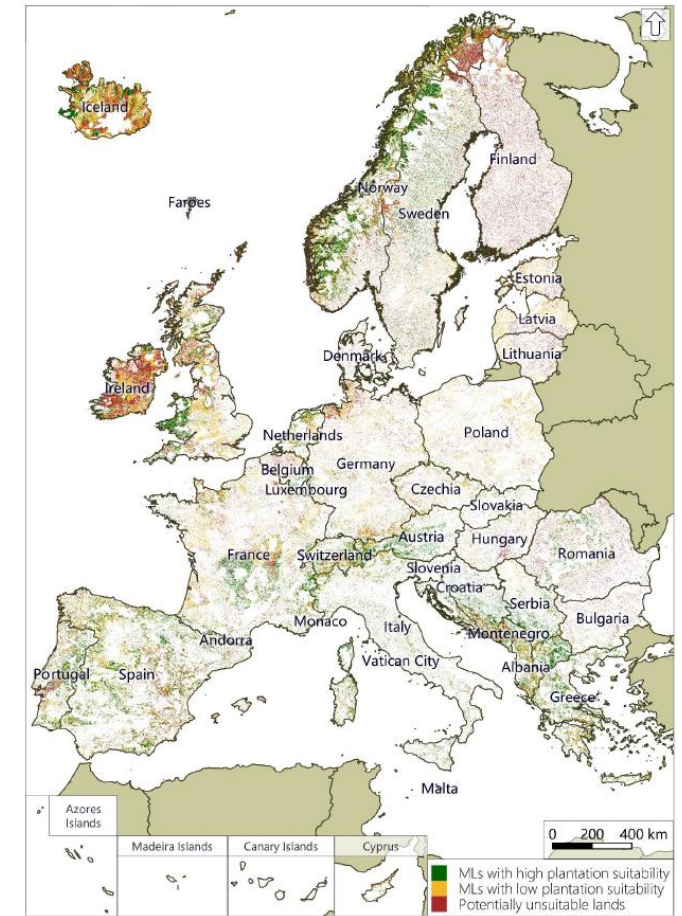
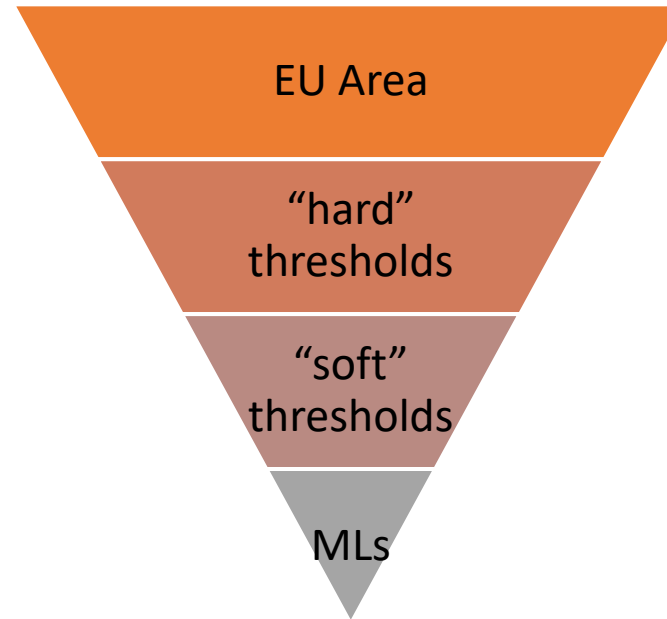
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T2.4

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# Overall approach

- Need of common methodology across EU
- Restriction: physical characteristics of each region
- Methodology in two steps:
  - “hard” thresholds (for all EU)
  - “soft” thresholds (region specific)

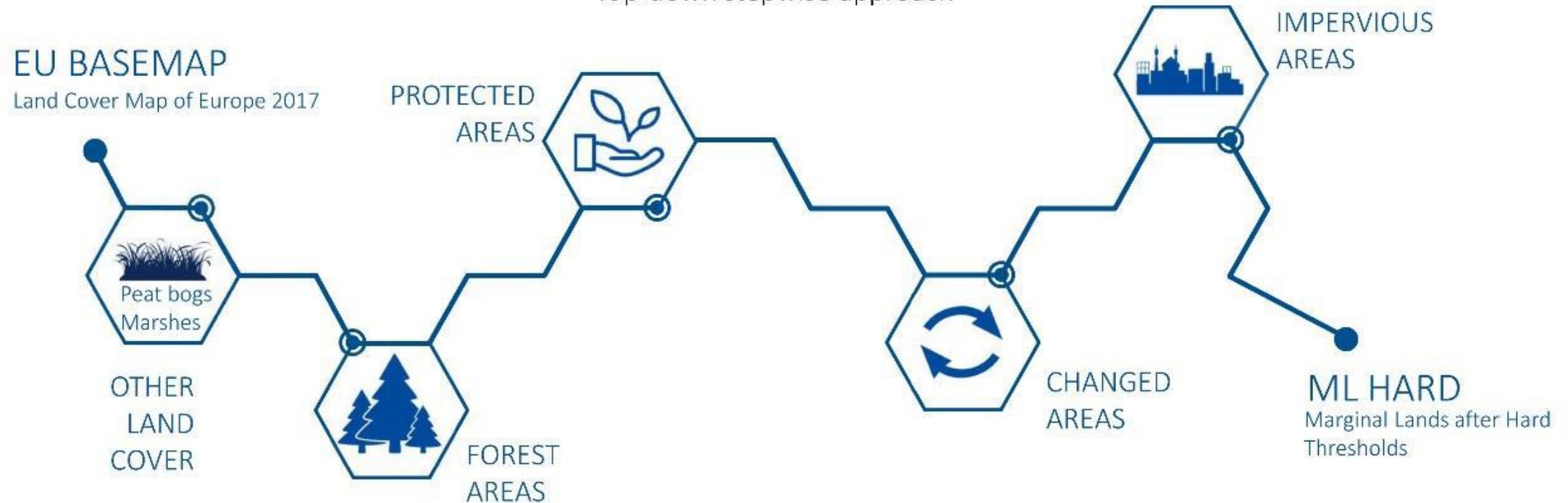


Source: MAIL D2.3

# Overall approach

## Hard Thresholds

Top-down stepwise approach



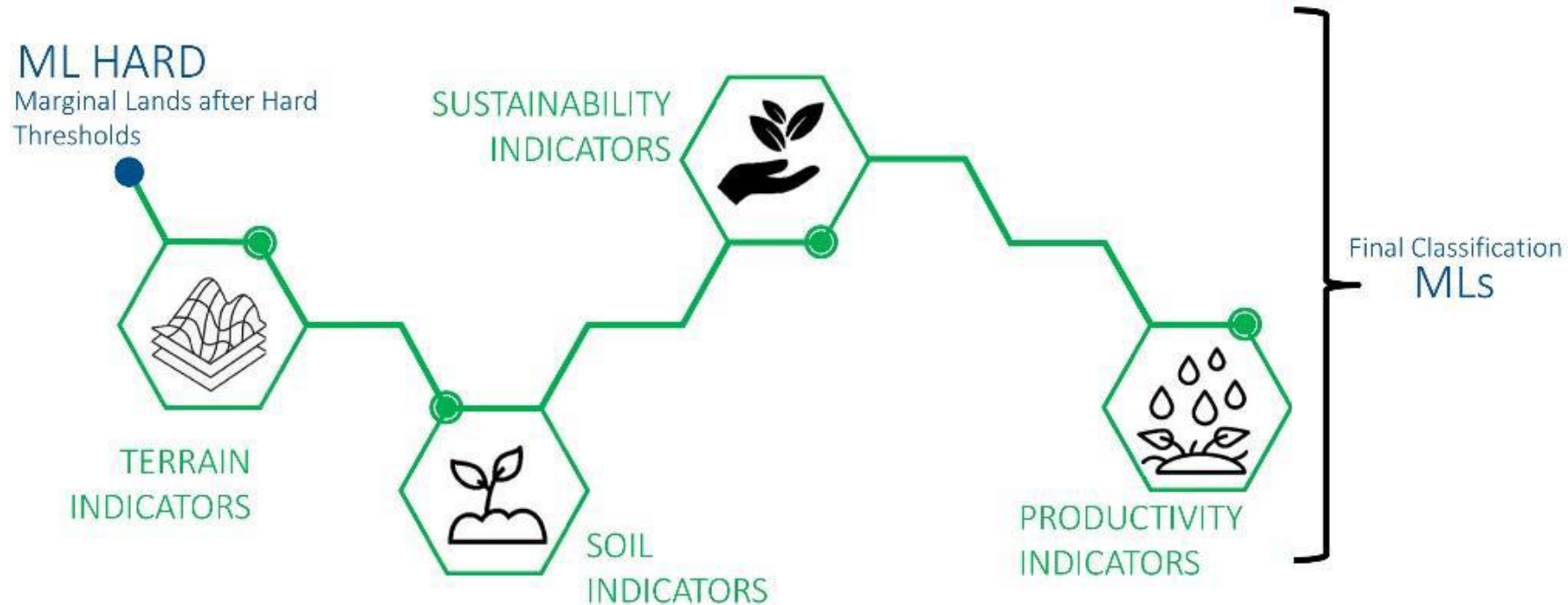
Source: MAIL D2.3, graphics developed by Maria Tassopoulou

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# Overall approach

## “Soft” constraints

Development of different sets of indicators

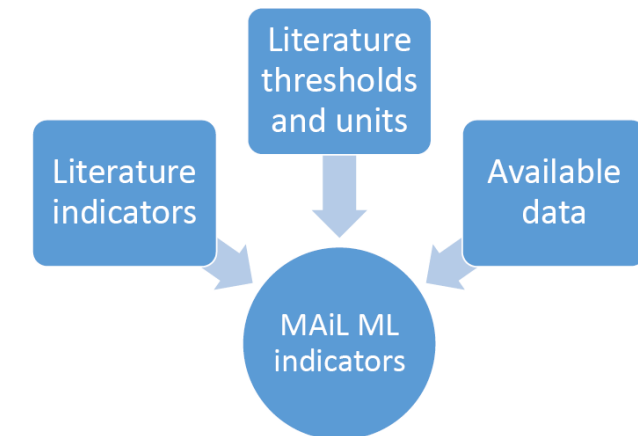


Source: MAIL D2.3, graphics developed by Maria Tassopoulou

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# Overall approach

| Hard Layers                        | Soft Layers                                    |                          |  |
|------------------------------------|--|--------------------------|--|
| Land Cover                         | Terrain and soil                               | Sustainability           | Productivity   |
| S2GLC                              | EU DEM   | Soil pH in Europe        | Soil Organic mater                                   |
| CLC                                | EUROPEAN Soil Database derived data (5 layers) | WISE (3 layers)          | Soil biomass productivity of forest areas            |
| CLC change                         |  | RUSLE 2015               | Soil biomass productivity of grasslands and pastures |
| HRL imperviousness                 |  | JRC Global surface water | SoilGrids250m  |
| HRL imperviousness change          |  | TerraClimate (2 layers)  |  |
| Global Forest Change               |  |                          |  |
| Nationally designated areas (CDDA) |  |                          |  |
| Natura2000                         |  |                          |  |



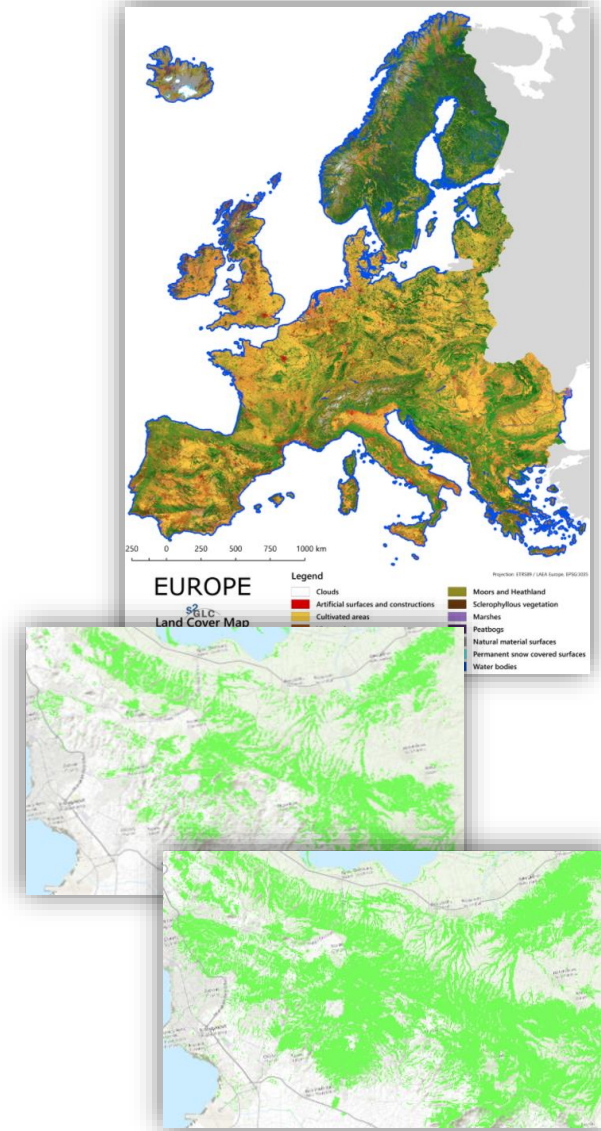
- ✓ **10 m spatial resolution**
- ✓ **European Terrestrial Reference system (ETRS89)**
- ✓ **Lambert Azimuthal Equal-Area (LAEA) projection**



# Hard Layers

## *Land Use – Land Cover Datasets*

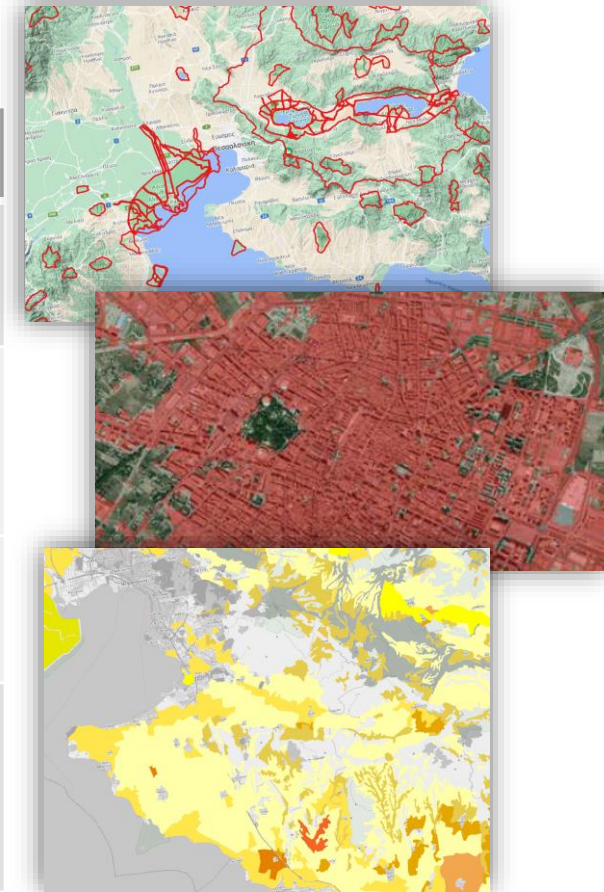
| Dataset       | Action  |
|---------------|---|
| S2GLC 2017    | Mask other LC: water, permanent snow, peatbogs, marshes |
| GFC loss 2018 | Mask forest areas                                       |
| GFC 2000-2015 | Mask forest change (re-growth)                          |
| HRL TCD       | Mask tree cover density                                 |



# Hard Layers

## *Land Use – Land Cover Datasets*

| Dataset   | Action                 |
|---|------------------------|
| CDDA + Natura 2000 sites                              | Remove protected areas |
| S2GLC 2017 artificial areas                           | Mask artificial areas  |
| CORINE artificial areas + HRL IMD                     |                        |
| S2GLC 2017 cultivated areas + CORINE croplands        | Mask croplands         |
| HRL TCD Change, HRL IMD Change, CORINE change classes | Mask changed areas     |



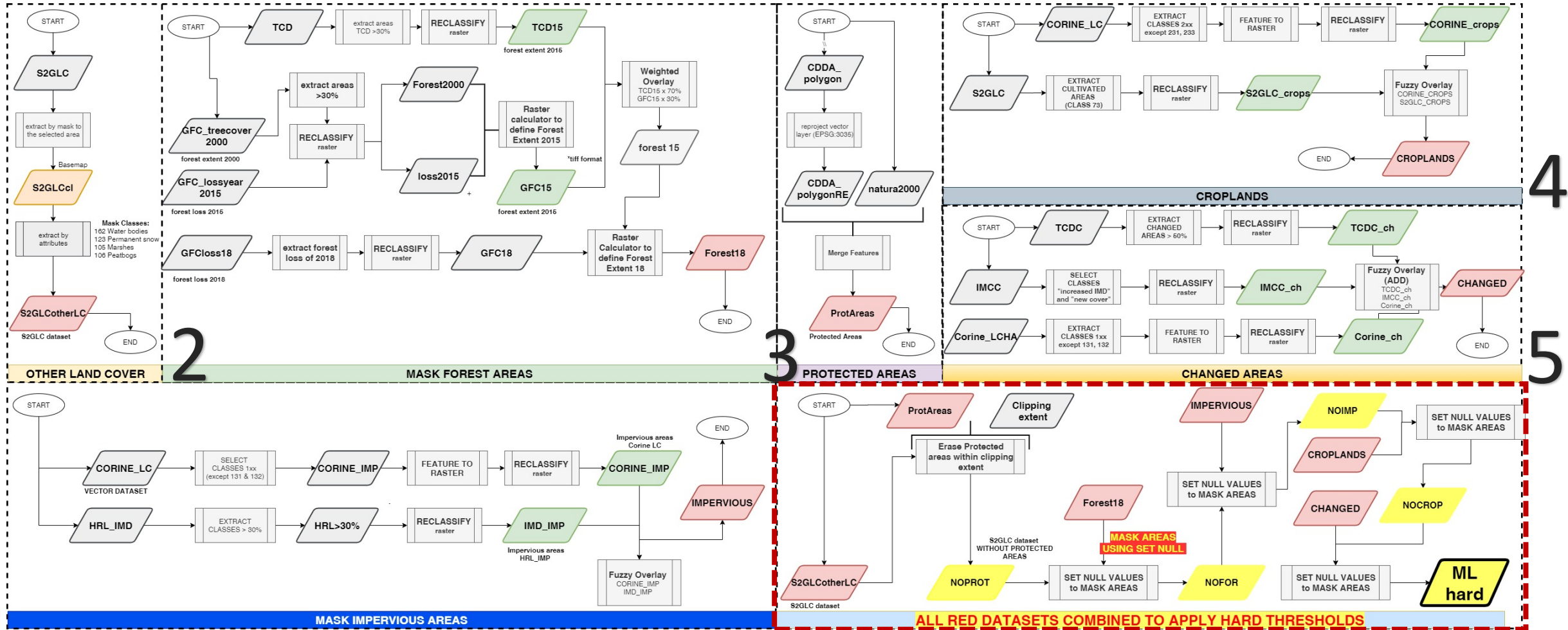




# Hard Layers

- Several combinations of the available datasets for each land use – land cover type were tested
- Fuzzy Overlay, Weighted Overlay and more.
- All data were transformed into Binary raster (0 = no data, 1 = data).

# Hard Layers



Source: MAIL D2.3, graphics developed by Maria Tassopoulou



# Classification results

Hard layers marginal land classification

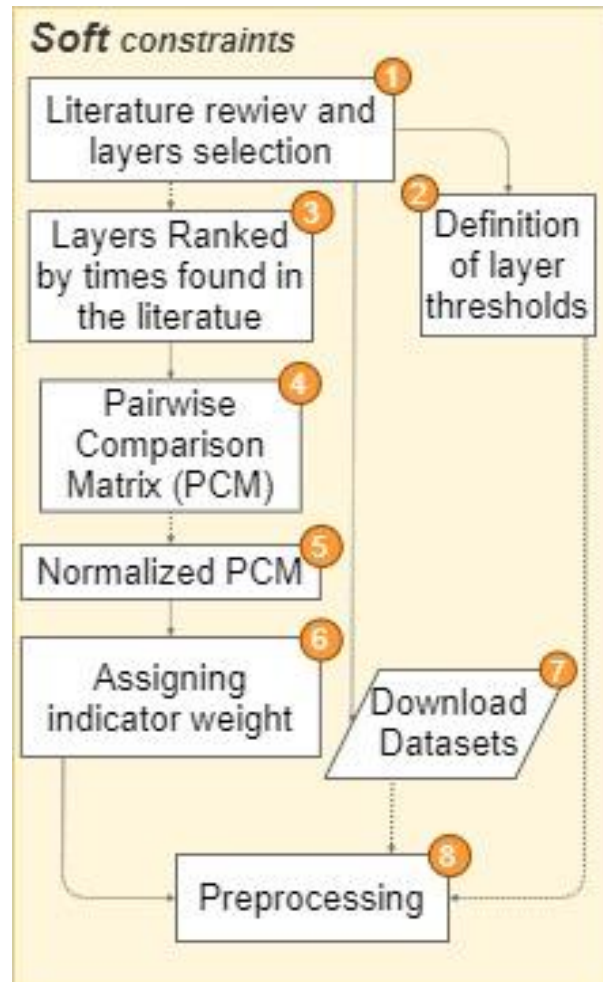


Source: MAIL D2.3

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# Soft Layers



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| Indicator                | Times Found in Literature | Rank |
|--------------------------|---------------------------|------|
| slope                    | 18                        | 1    |
| depth available to roots | 18                        | 1    |
| acidity (pH)             | 9                         | 2    |
| texture                  | 9                         | 2    |
| erosion                  | 8                         | 3    |
| stoniness                | 8                         | 3    |
| soil organic matter      | 8                         | 3    |
| water capacity           | 6                         | 4    |
| flood                    | 6                         | 4    |
| sodicity                 |                           |      |
| clay                     |                           |      |

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|                          | slope | depth available to roots | acidity (pH) | texture | erosion | stoniness | soil organic matter | water capacity | flood | sodicity | clay | sand | contamination | cation exchange capacity | productivity |
|--------------------------|-------|--------------------------|--------------|---------|---------|-----------|---------------------|----------------|-------|----------|------|------|---------------|--------------------------|--------------|
| slope                    | 1.00  | 1.00                     | 2.00         | 2.00    | 3.00    | 3.00      | 3.00                | 4.00           | 4.00  | 5.00     | 6.00 | 6.00 | 6.00          | 6.00                     | 6.00         |
| depth available to roots | 1.00  | 1.00                     | 2.00         | 2.00    | 3.00    | 3.00      | 3.00                | 4.00           | 4.00  | 5.00     | 6.00 | 6.00 | 6.00          | 6.00                     | 6.00         |
| acidity (pH)             | 0.50  | 0.50                     | 1.00         | 1.00    | 1.50    | 1.50      | 1.50                | 2.00           | 2.00  | 2.50     | 3.00 | 3.00 | 3.00          | 3.00                     | 3.00         |
| texture                  | 0.50  | 0.50                     | 1.00         | 1.00    | 1.50    | 1.50      | 1.50                | 2.00           | 2.00  | 2.50     | 3.00 | 3.00 | 3.00          | 3.00                     | 3.00         |
| erosion                  | 0.33  | 0.33                     | 0.67         | 0.67    | 1.00    | 1.00      | 1.00                | 1.33           | 1.33  | 1.67     | 2.00 | 2.00 | 2.00          | 2.00                     | 2.00         |
| stoniness                | 0.33  | 0.33                     | 0.67         | 0.67    | 1.00    | 1.00      | 1.00                | 1.33           | 1.33  | 1.67     | 2.00 | 2.00 | 2.00          | 2.00                     | 2.00         |
| soil organic matter      | 0.33  | 0.33                     | 0.67         | 0.67    | 1.00    | 1.00      | 1.00                | 1.33           | 1.33  | 1.67     | 2.00 | 2.00 | 2.00          | 2.00                     | 2.00         |
| water capacity           | 0.25  | 0.25                     | 0.50         | 0.50    | 0.75    | 0.75      | 0.75                | 1.00           | 1.00  | 1.25     | 1.50 | 1.50 | 1.50          | 1.50                     | 1.50         |
| flood                    | 0.25  | 0.25                     | 0.50         | 0.50    | 0.75    | 0.75      | 0.75                | 1.00           | 1.00  | 1.25     | 1.50 | 1.50 | 1.50          | 1.50                     | 1.50         |
| sodicity                 | 0.20  | 0.20                     | 0.40         | 0.40    | 0.60    | 0.60      | 0.60                | 0.80           | 0.80  | 1.00     | 1.20 | 1.20 | 1.20          | 1.20                     | 1.20         |
| clay                     | 0.17  | 0.17                     | 0.33         | 0.33    | 0.50    | 0.50      | 0.50                | 0.67           | 0.67  | 0.83     | 1.00 | 1.00 | 1.00          | 1.00                     | 1.00         |
| sand                     | 0.17  | 0.17                     | 0.33         | 0.33    | 0.50    | 0.50      | 0.50                | 0.67           | 0.67  | 0.83     | 1.00 | 1.00 | 1.00          | 1.00                     | 1.00         |
| contamination            | 0.17  | 0.17                     | 0.33         | 0.33    | 0.50    | 0.50      | 0.50                | 0.67           | 0.67  | 0.83     | 1.00 | 1.00 | 1.00          | 1.00                     | 1.00         |
| cation exchange capacity | 0.17  | 0.17                     | 0.33         | 0.33    | 0.50    | 0.50      | 0.50                | 0.67           | 0.67  | 0.83     | 1.00 | 1.00 | 1.00          | 1.00                     | 1.00         |
| productivity             | 0.14  | 0.14                     | 0.29         | 0.29    | 0.43    | 0.43      | 0.43                | 0.57           | 0.57  | 0.71     | 0.86 | 0.86 | 0.86          | 0.86                     | 0.86         |

Pairwise Comparison Matrix (PCM) of the ranks (Zolekar & Bhagat 2015)

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|                          | slope | depth available to roots | acidity (pH) | texture | erosion | stoniness | soil organic matter | water capacity | flood | sodicity | clay | sand | contamination | cation exchange capacity | productivity | dryness | natural toxicity | Weights |
|--------------------------|-------|--------------------------|--------------|---------|---------|-----------|---------------------|----------------|-------|----------|------|------|---------------|--------------------------|--------------|---------|------------------|---------|
| slope                    | 0.17  | 0.17                     | 0.17         | 0.17    | 0.17    | 0.17      | 0.17                | 0.17           | 0.17  | 0.17     | 0.17 | 0.17 | 0.17          | 0.17                     | 0.17         | 0.17    | 0.17             | 0.17    |
| depth available to roots | 0.17  | 0.17                     | 0.17         | 0.17    | 0.17    | 0.17      | 0.17                | 0.17           | 0.17  | 0.17     | 0.17 | 0.17 | 0.17          | 0.17                     | 0.17         | 0.17    | 0.17             | 0.17    |
| acidity (pH)             | 0.09  | 0.09                     | 0.09         | 0.09    | 0.09    | 0.09      | 0.09                | 0.09           | 0.09  | 0.09     | 0.09 | 0.09 | 0.09          | 0.09                     | 0.09         | 0.09    | 0.09             | 0.09    |
| texture                  | 0.09  | 0.09                     | 0.09         | 0.09    | 0.09    | 0.09      | 0.09                | 0.09           | 0.09  | 0.09     | 0.09 | 0.09 | 0.09          | 0.09                     | 0.09         | 0.09    | 0.09             | 0.09    |
| erosion                  | 0.06  | 0.06                     | 0.06         | 0.06    | 0.06    | 0.06      | 0.06                | 0.06           | 0.06  | 0.06     | 0.06 | 0.06 | 0.06          | 0.06                     | 0.06         | 0.06    | 0.06             | 0.06    |
| stoniness                | 0.06  | 0.06                     | 0.06         | 0.06    | 0.06    | 0.06      | 0.06                | 0.06           | 0.06  | 0.06     | 0.06 | 0.06 | 0.06          | 0.06                     | 0.06         | 0.06    | 0.06             | 0.06    |
| soil organic matter      | 0.06  | 0.06                     | 0.06         | 0.06    | 0.06    | 0.06      | 0.06                | 0.06           | 0.06  | 0.06     | 0.06 | 0.06 | 0.06          | 0.06                     | 0.06         | 0.06    | 0.06             | 0.06    |
| water capacity           | 0.04  | 0.04                     | 0.04         | 0.04    | 0.04    | 0.04      | 0.04                | 0.04           | 0.04  | 0.04     | 0.04 | 0.04 | 0.04          | 0.04                     | 0.04         | 0.04    | 0.04             | 0.04    |
| flood                    | 0.04  | 0.04                     | 0.04         | 0.04    | 0.04    | 0.04      | 0.04                | 0.04           | 0.04  | 0.04     | 0.04 | 0.04 | 0.04          | 0.04                     | 0.04         | 0.04    | 0.04             | 0.04    |
| sodicity                 | 0.03  | 0.03                     | 0.03         | 0.03    | 0.03    | 0.03      | 0.03                | 0.03           | 0.03  | 0.03     | 0.03 | 0.03 | 0.03          | 0.03                     | 0.03         | 0.03    | 0.03             | 0.03    |
| clay                     | 0.03  | 0.03                     | 0.03         | 0.03    | 0.03    | 0.03      | 0.03                | 0.03           | 0.03  | 0.03     | 0.03 | 0.03 | 0.03          | 0.03                     | 0.03         | 0.03    | 0.03             | 0.03    |

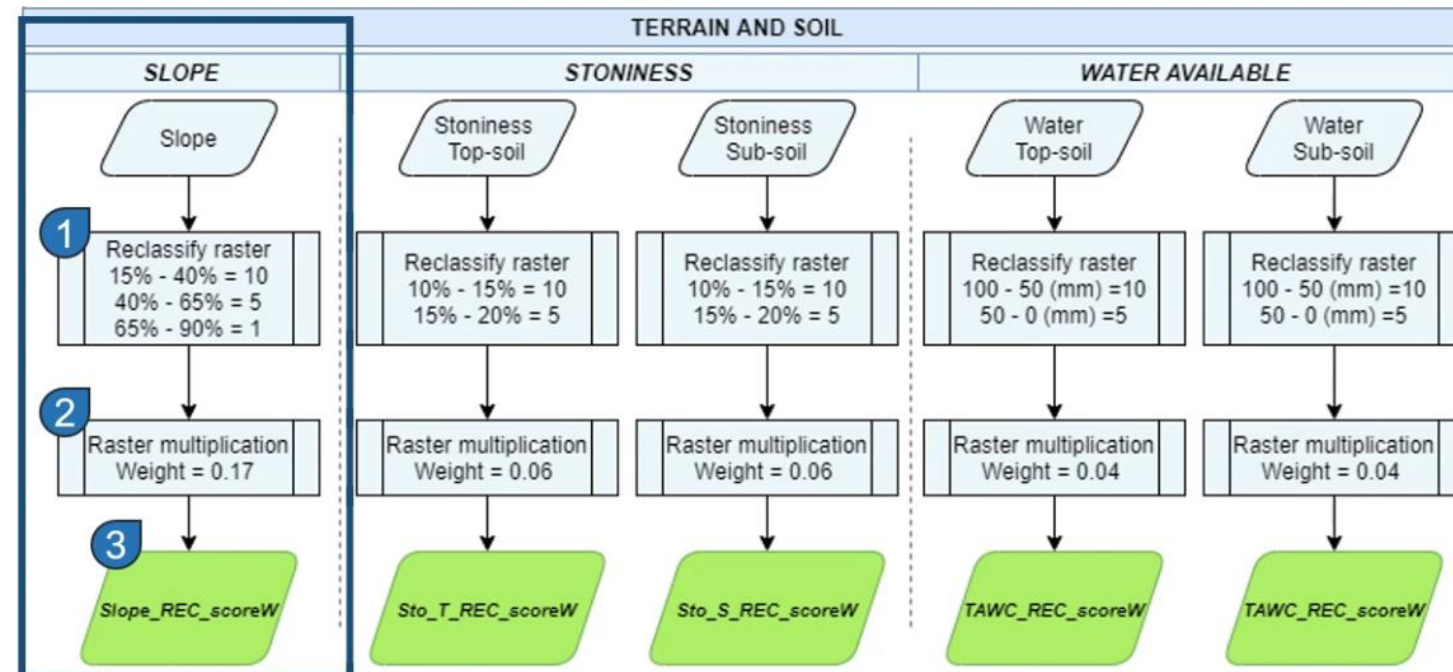
6

Source: Jesús Torralba Pérez



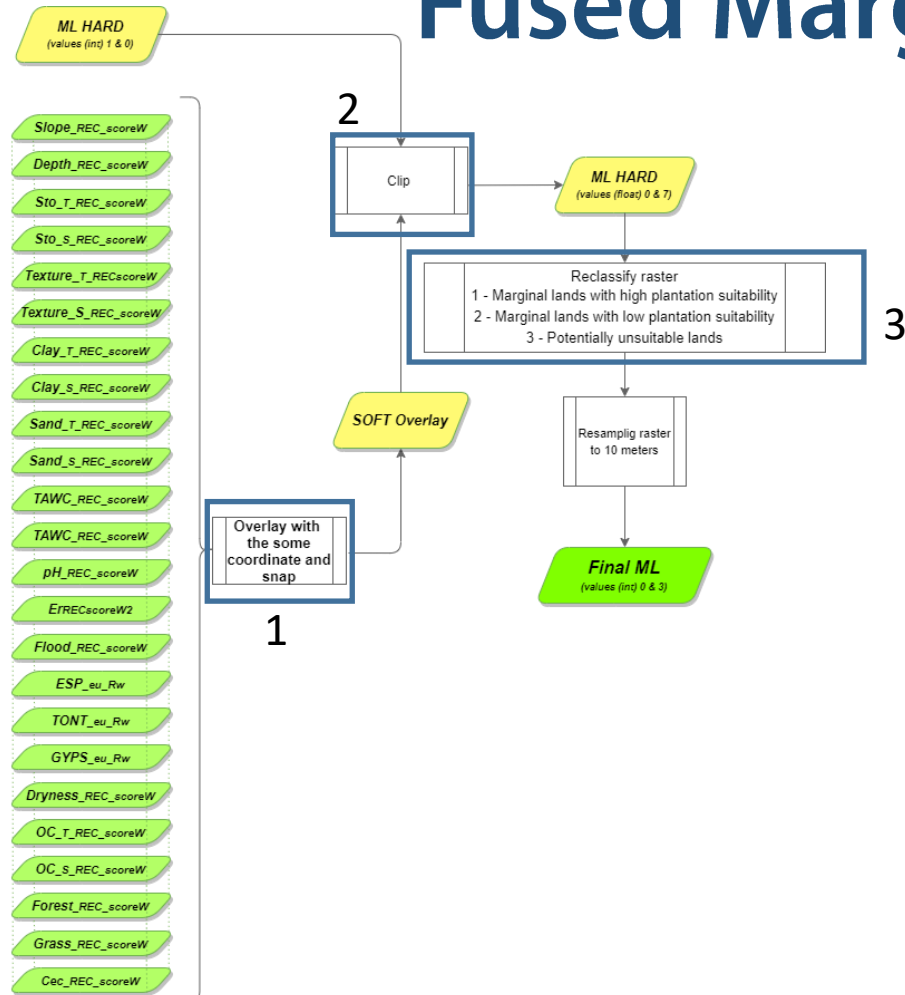
# Soft Layers

- Raster values are reclassified into 2 or 3 values representing marginality
- Values are multiplied by the weight calculated by the PCM



Source: Jesús Torralba Pérez

# Fused Marginal land classification

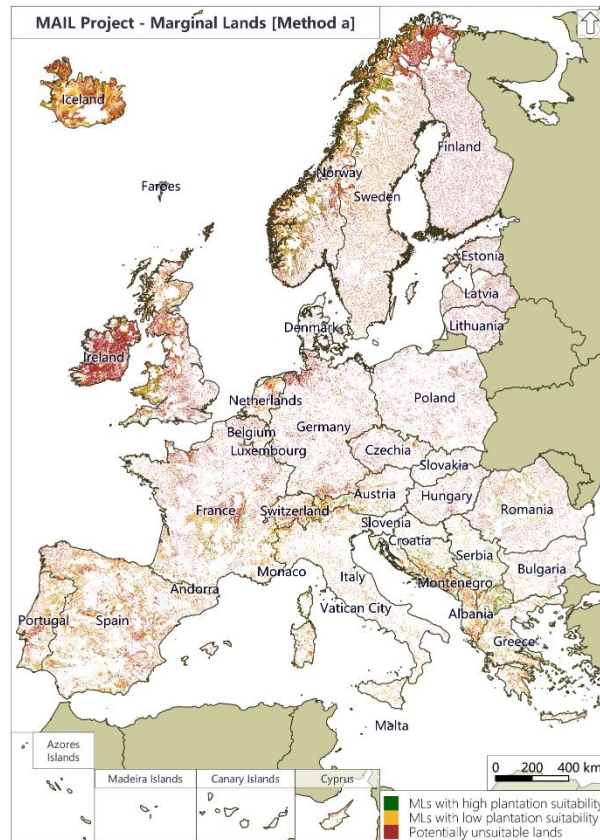


1. **Soft** layers fusion
2. **Soft** layers fusion with *Hard* layer
3. **3 MLs classes:**
  - “Marginal lands with high plantation suitability”
  - “Marginal lands with low plantation suitability”
  - “Potentially unsuitable lands”

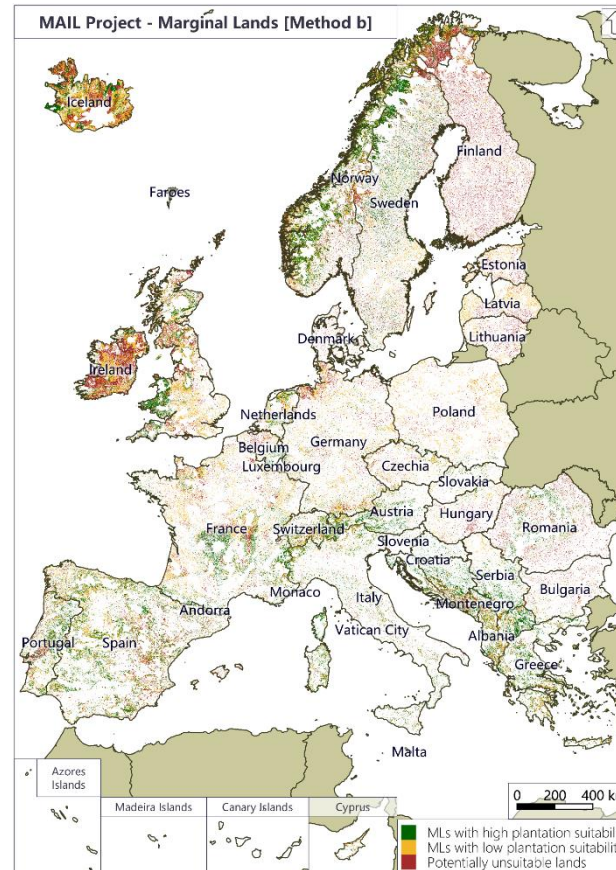
Source: MAIL D2.3

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# Classification results

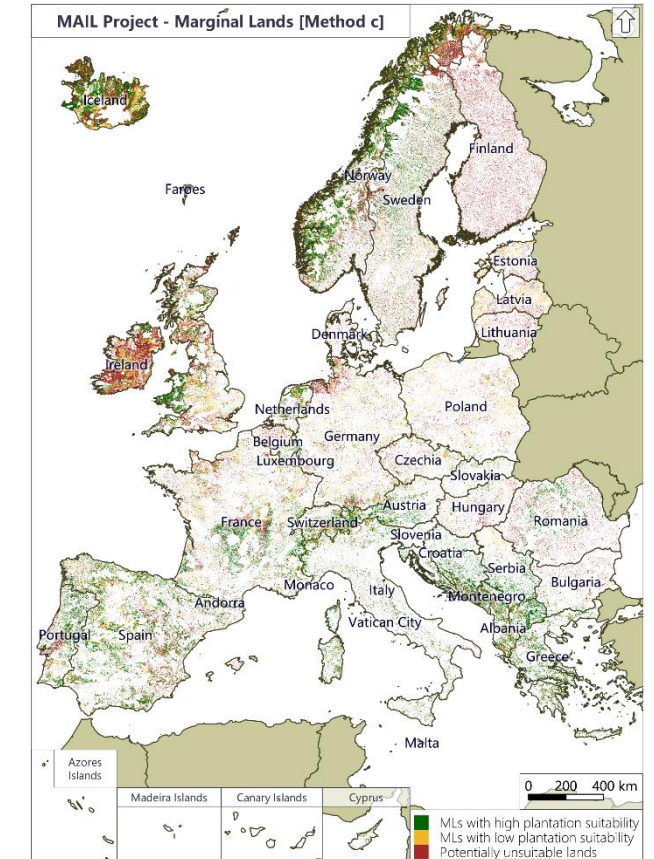


Min max range divided by 3



25<sup>th</sup> and 75<sup>th</sup> percentile

Source: MAIL D2.3



33<sup>rd</sup> and 66<sup>th</sup> percentile

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# Thank you for your attention!



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