Soil Erosion Susceptibility map using LiDAR data

General information

Description	Improvement of risk map related with soil erosion based on LiDAR data	
Geographical area	Asturias, Euskadi, Galicia y Portugal	
Date	2018	
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Tool type	Map/remote sensing	
Tool format	Text	Cartography layers (SIG)
Language	English	Portuguese
Risk management plans to which the tools can be added	Neither Spain nor Portugal currently have soil degradation risk management plans. The tool described here (together with the other tools developed as part of the PLURIFOR project) forms part of the Soil Degradation Risk Management Plan proposed for the regions involved (Galicia, Basque Country, Asturias and Portugal).	
Risk management plans link	https://plurifor.efi.int/wp-content/uploads/WP2/plans/Soil-degradation-plan_ES.pdf	
This tool is…	☒ an improved tool	
Original tool of which this one is an improvement	LS factor map from European Soil Data Center (ESDAC) [https://esdac.jrc.ec.europa.eu/]	

Topic

Risk	Soil degradation		
Risk component	☐ hazard	☐ impact	☒ vulnerability
Risk area	Risk assessment		
Risk phase	Prevention		
Risk phase (alternative terms)	Recovery		
Level	Local		
Sendai priorities	☒ Priority 1: Understanding disaster risk ☒ Priority 2: Strengthening disaster risk governance to manage disaster risk ☒ Priority 3: Investing in disaster risk reduction for resilience ☐ Priority 4: Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction		
Contribution to Sendai targets	☐ Reduce global disaster mortality ☐ Reduce the number of affected people ☒ Reduce the direct disaster economic loss ☒ Reduce disaster damage to critical infrastructure ☐ Increase the number of national and local disaster risk reduction strategies ☐ Enhance international cooperation to developing countries ☒ Increase availability of and access to multi-hazard early warning systems and disaster risk information and assessment		

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Description and analysis

Summary

This tool is based on the use of ALS (aerial lidar scanner) data to improve previous maps from the European Soil Data Center (ESDAC). A methodologhy to calculate the LS factor of USLE equation (Universal Soil Loss Equation) is presented.
The potential of this type of data is that it provides the possibility of developing a high accuracy Digital Terrain Model, thus enabling the improvement of European maps. This methodology was applied at basin level with free LiDAR data of low resolution (0.5 points/m^2) to develop LS factor map

Place in national/regional policy

This tool is part of the soil risk management plan (RMP) developed in the PLURIFOR project. The RMP is a strategic risk plan which addresses the research areas and governance measures which need to be developed and adopted in order to minimize this forest risk.

Goals and achievements

This tool allows the prediction value of soil risk maps to be improved through the use of high accuracy Digital Terrain Model (DTM). At the regional level, this tool is important in order to establish soil degradation threat and plan preventive and corrective measures.

Stakeholders involved

Public and private forest managers, forest owners, public administration, researchers, service providers.

Implementation stage

This tool will be available to any interested party.

State of technical knowledge

This tool represents a Revised Universal Soil Loss Equation (RUSLE) model based on the most recently available pan-European datasets. The scientific technical knowledge is advanced, although it is necessary to disseminate this knowledge in an appropriate form to managers and to include it in the forest management plans.

Regulatory and/or socio-economic contexts

This tool can be integrated into planning systems, enabling timely decision making, reducing possible loss of forest production associated with soil losses, and contributing to the maintenance of various forest functions.

Impacts of the tool

To date, very little impact because the tool has not yet been adopted by forest managers. Efforts will be made to disseminate the Soil Risk Management Plan and this tool to forest authorities and to incorporate this tool into normal operating procedures.

Implementation requirements and durability

Description of the implementation steps

This tool can be integrated into planning systems, enabling timely decision making, reducing possible loss of forest production associated with soil degradation, and contributing to the maintenance of various forest functions.

Governance

The tool for estimating soil erosion vulnerability is public and can be used by all stakeholders at the regional or national level.

Regulatory framework

The tool is advisory only, and is intended to assist trans-regional planners and all parties involved in soil risk management in the SUDOE region. There is no regulatory framework at present.

Human resources requirements In order to analyse the resulting data and interpret susceptibility levels, personnel with technical knowledge are required.
Financial requirements No special resouces are needed.
Technical requirements To use the tool, LiDAR data from the zone is necessary. The use of LiDAR data enables Digital Elevation Models to be developed, which form the basis of the calculation of factors related to soil degradation (erosion, compaction, etc.). Final maps can be viewed in the free-software QGIS.
Priorities identified for successful implementation of the tool (political, technical, human, financial…) In the case of Spain, no soil degradation management plans exist, hence it is necessary in the first instance to develop the appropriate policies and regulations. The development of automatic tools which update soil degradation risk maps would enable planning to be oriented towards preventative actions and good practice in forestry operations.
Challenges or risk factors (legal, financial, safety…) expected during the implementation and solutions proposed The main challenge is to include the Soil Risk Management Plan and this tool within the regulatory framework and incorportate the resulting maps in the decision making process.
Additional and non-formal experiences to help the implementation of good practice To develop this methodology, technical personnel skilled in LIDAR processing and the use of SAGA and QGIS free softwares are required.

SWOT analysis

Strengths	**Weaknesses**
Repicable, comparable and can be extended to model soil losses in other regions. Higher spatial resolution tool compared to previous maps. Allows detection of priority areas and the implementation of good practices. Improvement of risk maps at regional level in order to incorporate RMP.	Model is not yet integrated in the current managemetn systems used in any of the regions. ALS data could be used to estimate C factor, allowing the estimation of vegetation cover of all the strata (trees and srubs).
Opportunities	**Threats**
It is possible to develop risk maps at European level from this methodology using low density LIDAR data Using higher resolution risk maps means it is easier to plan prevention and correction measures.	Difficulties in persuading people to use the maps because they add complexity to existing decision making. It is necessary for the forestry authorities to implement this tool and the risk plan in such a way as to establish preventive measures and a code of good practice in forestry operations.

Lessons learnt

Evaluation process, if exists (internal or external) Discussion with experts and authorities for the implementation of the tool and the development of regional maps. The process of evaluating the plans and tools developed in PLURIFOR will continue throughout the project (WP4), through presentations to the administration authorities and managers, training, etc.
Assessment of results (quantitative and qualitative) and comparison with main goals The quantitave results (LS values and soil losses in $t.ha^{-1}.year^{-1}$) were compared with ESDAC results, and the two methods were found to have similar average values but the PLURIFOR maps showed greater representation of extreme values. This is due to the fact that the PLURIFOR map has better resolution (pixel size of 5 meters, compared to 25 meters in the ESDAC map), meaning that steeper areas are represented with greater accuracy because at lower resolutions the values are smoothed.
Negative aspects identified In some regions LIDAR data is not available, and thus it is necessary to develop C-factor maps of the current vegetation to improve soil loss maps.
Unexpected consequences (short- / mid- / long-term) and corrective measures implemented None.

Access to complete tool

Files	Annex_methodology.pdf
Web links	https://plurifor.efi.int