Deutsches Biomasseforschungszentrum
gemeinnützige GmbH

DBFZ

A spatial approach to assessing land degradation in agricultural areas: Development of a high-resolution global data product

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Existing global spatial data on land degradation

Name	Resolution	Coverage	Unit	Reference
SDG 15.3.1 Land Degradation Indicator Rasters (Trends.Earth)	1km	2000 - 2023	5 degradation classes	Zvoleff et al. 2025
Global land degradation hotspots	5km	1981 - 2015	various indicators	Jiang et al. 2024
World Atlas of Desertification, 3rd Edition (WAD3), JRC	1km	2000 - 2015	various indicators	Cherlet et al. (2018)
Mapping the world's degraded lands	8km	1982 - 2006	Severity levels	Gibbs & Salmon 2015

Indicators

1. Land cover change
2. Land productivity dynamics (e.g. NDVI, NPP, FVC, Biodiversity)
3. Soil carbon stocks

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Indicators

Five specific threats: **Erosion** by wind and water; **Organic matter decline**; Compaction; **Salinization**; Landslides (FAO 2015)

Among the major soil degradation processes are accelerated **erosion**, depletion of the **soil organic carbon (SOC)** pool and loss in biodiversity, loss of soil fertility and elemental imbalance, acidification and **salinization** (Lal 2015)

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Research Question

Is it possible to create a simplified, spatially resolved geodatabase that maps land degradation using only spatially resolved data on erosion, soil organic carbon (SOC) content, and salinization?

Selected global spatial data on salinity, SOC and erosion

Name	Resolution	Coverage	Unit	Reference
Soil Salinity				
ISRIC Global Soil Salinity Maps	1km	1986 - 2016	Salinity classes based on dS/m	Ivushkin et al. 2019
Predicting Long-term Dynamics of Soil Salinity on a Global Scale	1km	1980 - 2018	Ece, ESP	Hassani et al. 2020
SOC & Bulk Density				
SoilGrids	250m	1961 - 2020	Content (%), Stocks (t/ha)	Poggio et al. 2021
OpenLandMap Soil Organic Carbon Content	250m	1950 - 2017	g / kg	Hengl & Wheeler 2018
Global Soil Organic Carbon Estimates (JRC / ESDAC)	1km	appr. 2009	Content (%), Stocks (t/ha)	Hiederer & Köchy 2012
Global Soil Organic Carbon Map (GSOCmap)	1km	2017 (base 1960-2016)	Stocks (t/ha)	FAO 2020
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Erosion				
Global Soil Erosion Modelling Platform (JRC GloSEM)	250m / 25km	2001, 2012	t/ha/yr	Borrelli et al. 2017
GloSEM 1.3 – High-Resolution Global (Cropland) Soil Erosion	100m	2019 (and projections)	t/ha/yr	Borrelli et al. 2022

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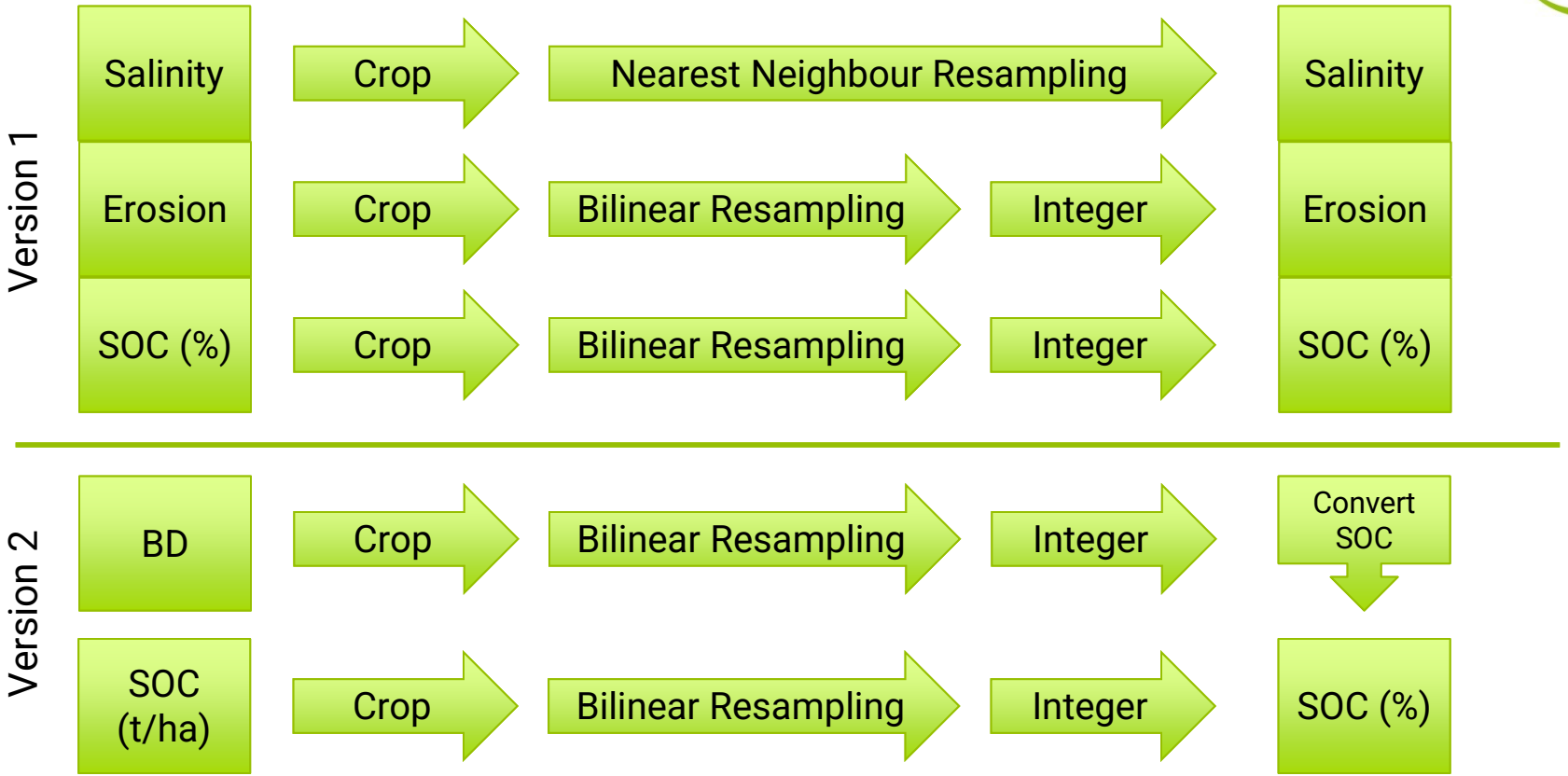
Appropriate thresholds for soil degradation

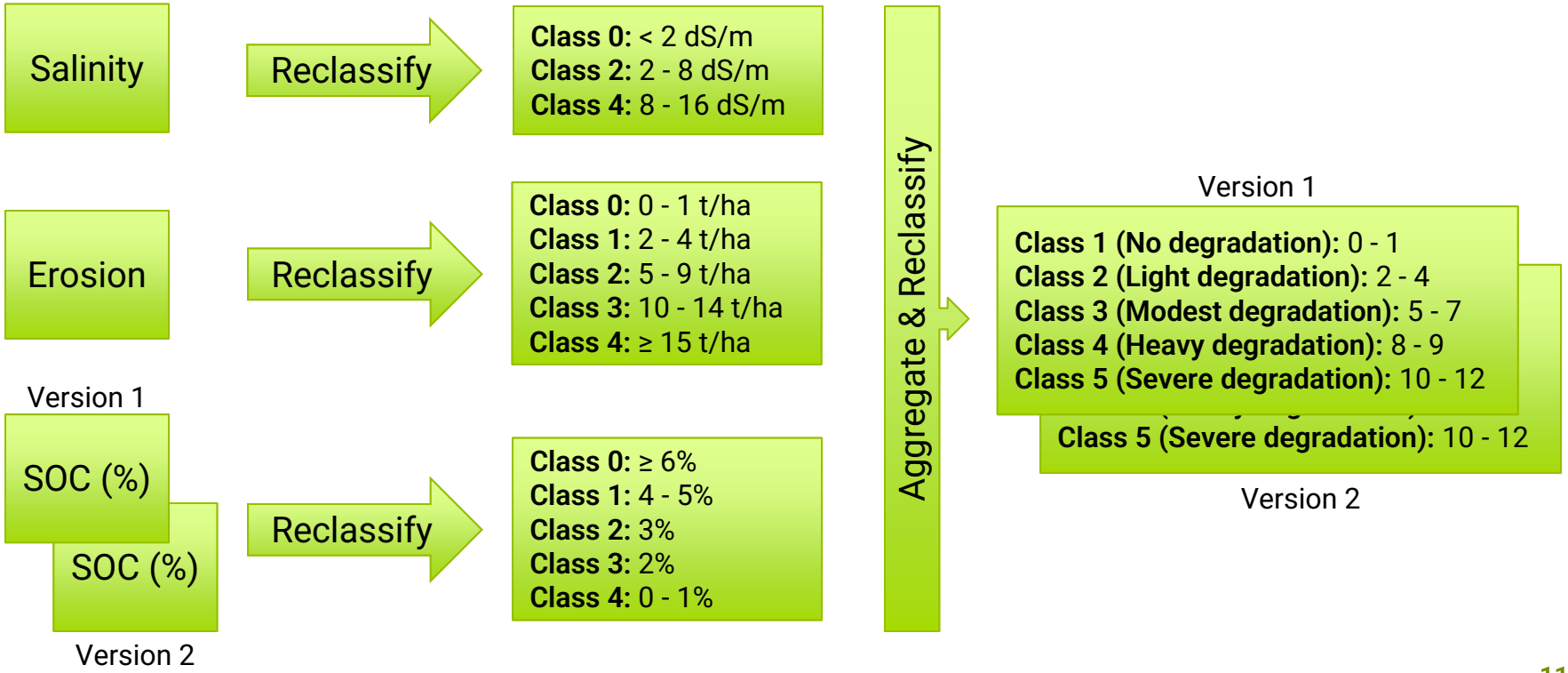
Criteria	Draft Certification threshold (stringent)	Proposed threshold (modest)	Rationale for proposed value
Significantly low soil organic matter content	<1%	<3.4%	Commonly used values in literature are between 1-2% soil organic carbon, which is equivalent to 1.7-3.4% soil organic matter
Severely eroded	All topsoil has been removed + 25% of the area of the plot show signs of erosion	>1.5 t/ha/y soil loss, proven using maps or photographic evidence	Stopping erosion before it is irreversible
Significantly salinated	>8.0 dS/m	>4.0 dS/m	Similar values to literature and JRC's LUCAS project

From: **Guidehouse (2024).** OutwitSupport for the implementation of the provisions on ILUC set out in the Renewable Energy Directive – Lot 2 Mitigating ILUC: Pilots and review

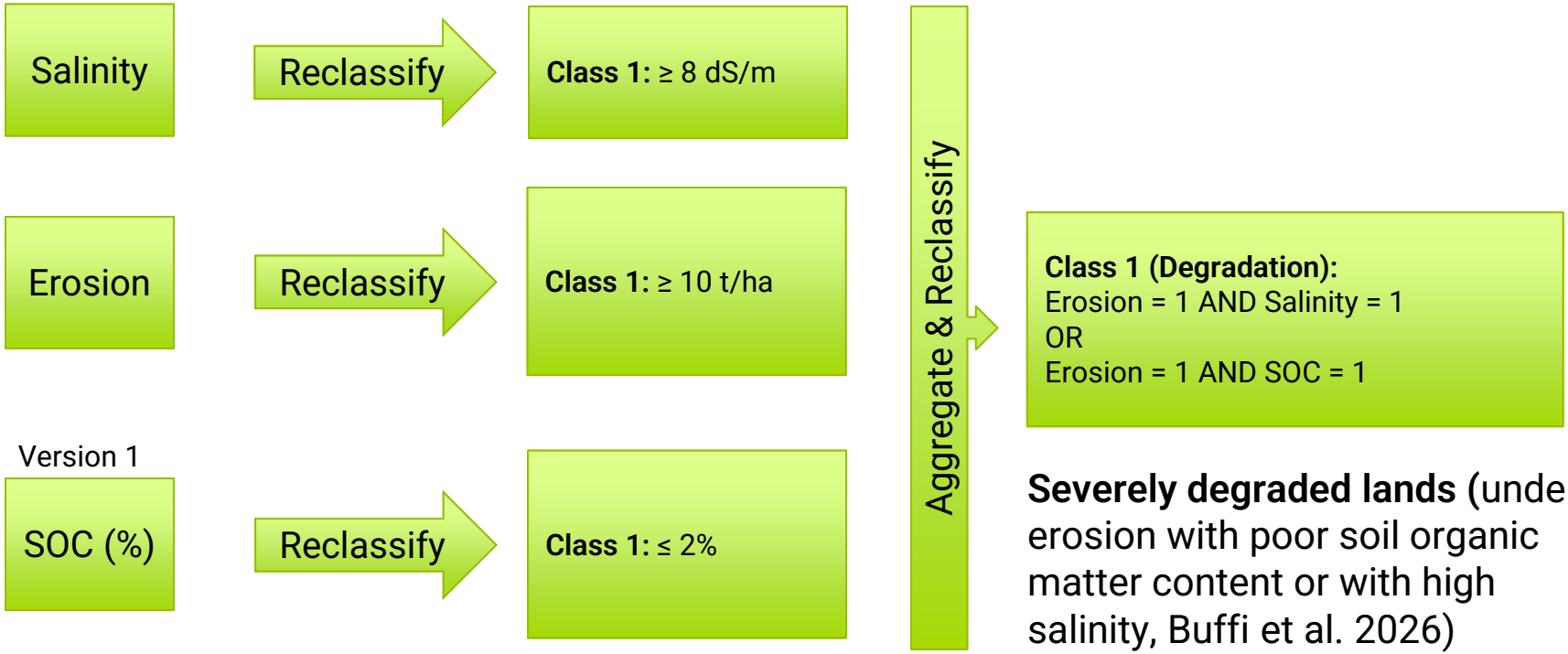
Preprocessing Workflow



Aggregation workflow for degradation levels

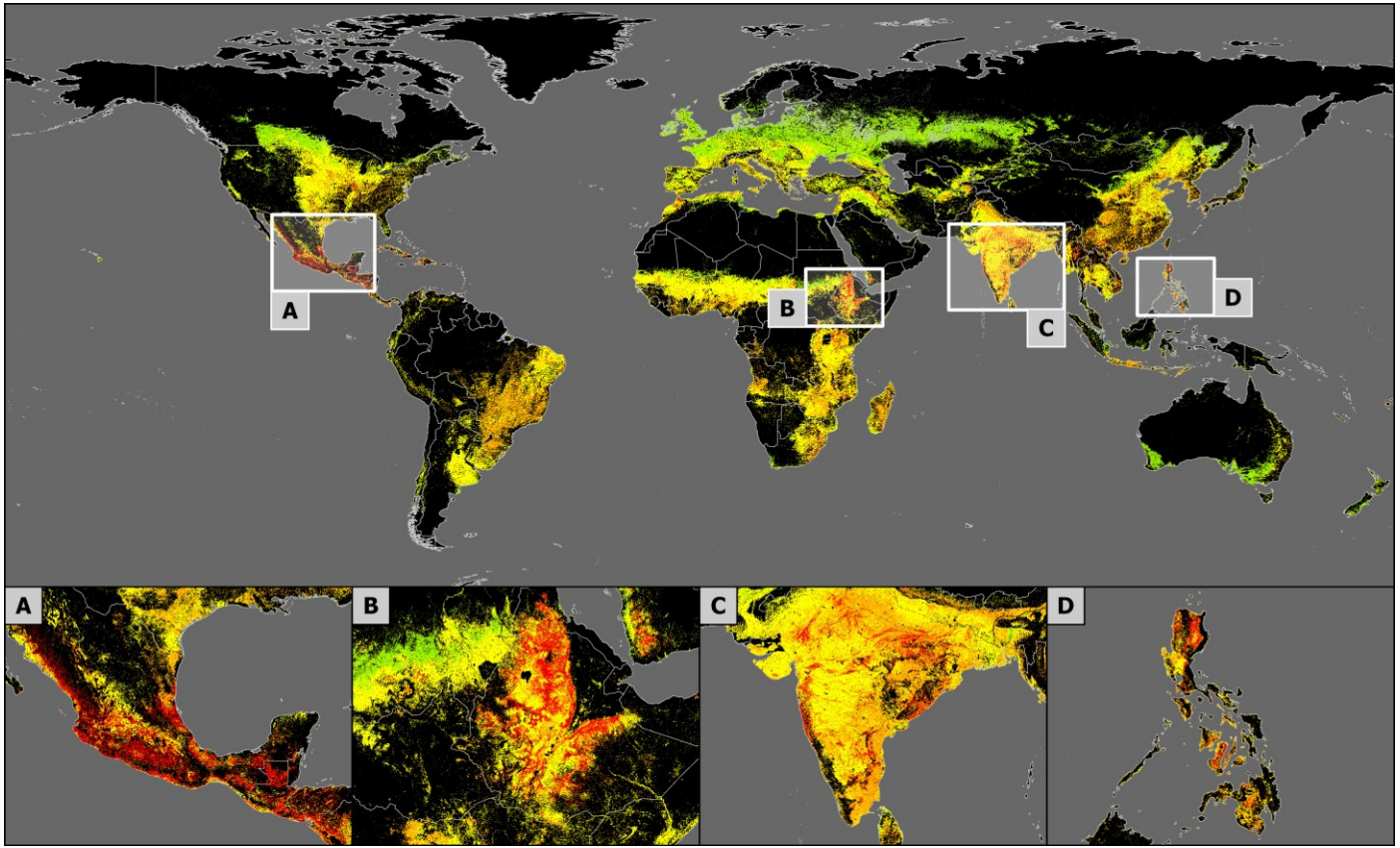


Aggregation workflow for binary levels



Severely degraded lands (under erosion with poor soil organic matter content or with high salinity, Buffi et al. 2026)

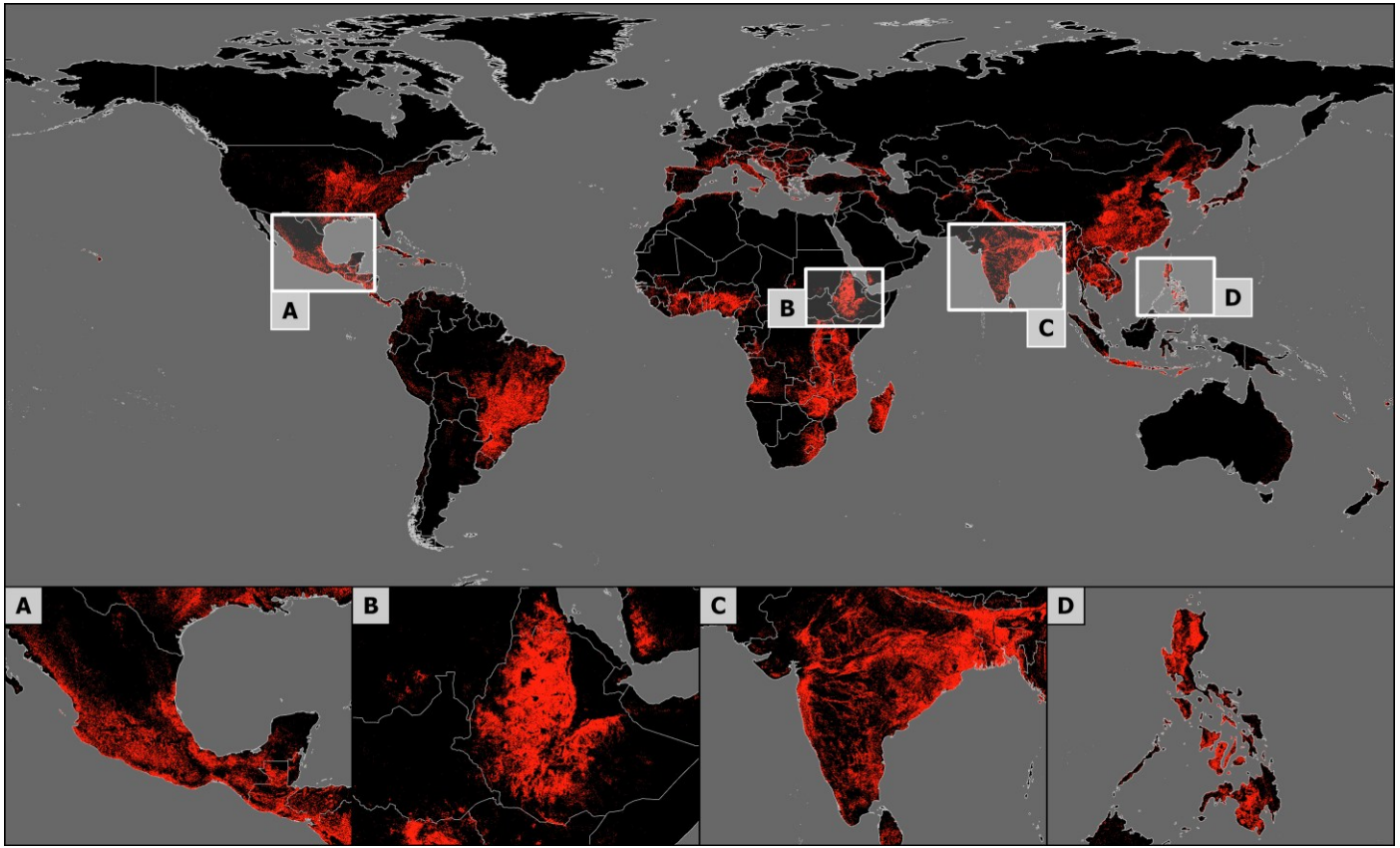
Results



Global hotspots of land degradation

- No degradation
- Light degradation
- Modest degradation
- Heavy degradation
- Severe degradation

Results



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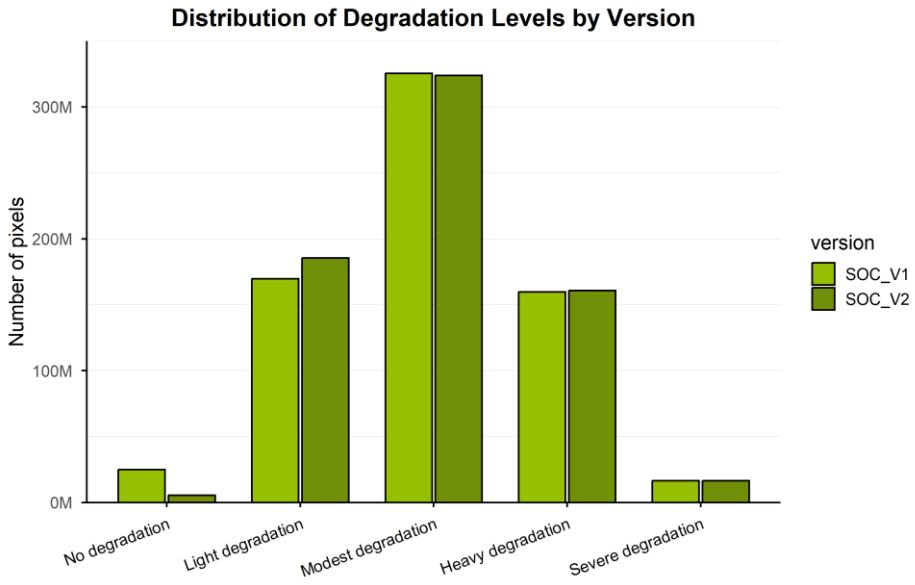
Degraded croplands

Results



Continent	Degraded Croplands (%)
Africa	13.27%
Asia	9.77%
Europe	9.68%
North America	7.54%
Australia and Oceania	0.78%
South America	16.08%

Amount of degraded cropland per continent according to Buffi defintion.

Discussion

- Product in the making: Uncertainties in the validation of results
- What are the optimal thresholds for the parameters salinity, erosion, and state of carbon (SoC)? Are they all equally relevant for quantifying degradation, and must regional differences be considered?
- How can marginal areas be derived from degraded lands, and what indications arise from this regarding ILUC effects and biofuels?

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Smart Bioenergy – Innovations for a sustainable future

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