Global patterns and drivers of land degradation at global scales

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Land degradation, the reduction or loss of the productive potential of land, is a **global challenge**

A significant portion of the Earth's vegetated surface is estimated to be **degraded**, affecting over **1.3 billion people**, with an economic impact of up to **US$10.6 trillion.**

Drivers of land degradation include **natural** processes and **human** activities, and **understanding** such drivers is key for deploying **effective interventions** for addressing it.

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More than **120 country Parties** of the United Nations Convention to Combat Desertification (**UNCCD**) have pledged to the **Sustainable Development Goal (SDG) target 15.3** for **assessing** and **monitoring** land degradation at **national** scale

Sustainable Development Goal **(SDG) target 15.3** is essential to **improve** the livelihoods of those most affected, and to build **resilience** to safeguard against the most extreme effects of climate change

We applied the **framework** developed by the **UNCCD** and TRENDS.EARTH **-** measuring **three sub-indicators** (changes in **land cover**, changes in **soil organic carbon**, and changes in **primary productivity) -** to assess **land condition globally** for the period **2001-2015**, the SDG 15.3.1 **baseline** period

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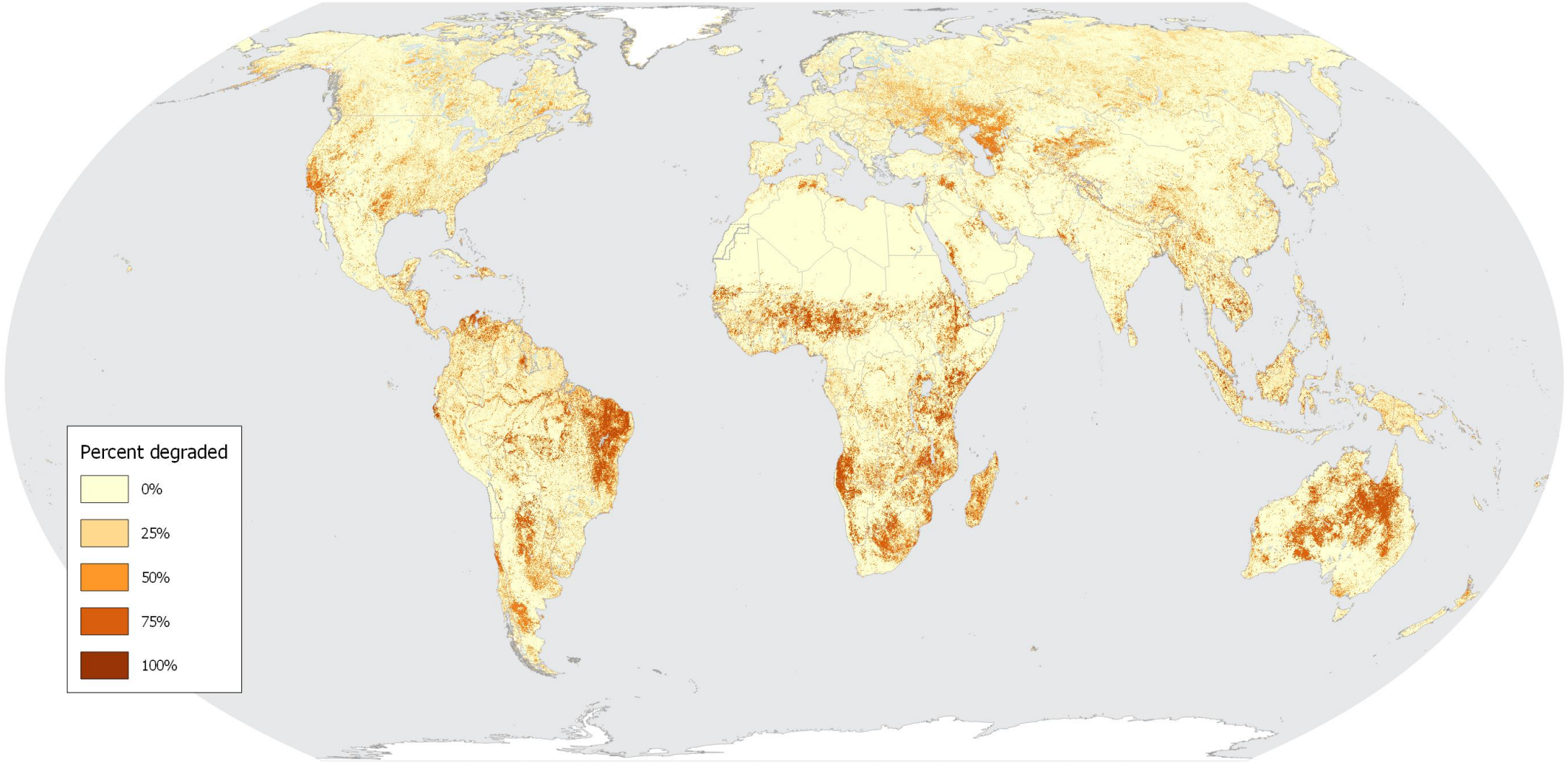
Outcome variable: percent land degraded based on SDG 15.3.1
(combines land cover, productivity, and soil organic carbon indicators)



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Using a **Bayesian hierarchical** model, we assessed the contribution of **19 drivers** of land degradation, including key **biophysical** and **anthropogenic variables** to provide insight into the **main drivers** of land degradation at **global, regional,** and **national** scales.

To account for expected correlation at the national and sub-national levels, random intercepts were included by country and sub-national unit.

Context	Elevation	GMTED2010
	Slope	
	Distance to cities	Uchida and Nelson, 2009
	Population (2000)	WorldPop
	Population growth (2000 to 2015)	
	Cattle density	Robinson et al. 2014
Climate	Temperature	WorldClim
	Temperature (change)	
	Precipitation	
	Precipitation (change)	
Initial land cover	Forest area (in 2001)	European Space Agency CCI Land Cover
	Area in grassland (in 2001)	
	Area in agriculture (in 2001)	
	Area in urban (in 2001)	
Land cover change	To agriculture (2001 to 2015)	
	To urban (2001 to 2015)	
	To natural (2001 to 2015)	
	Forest to grassland (2001 to 2015)	
	Grassland to forest (2001 to 2015)	

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Outcome variable:
Hectares of land degraded
(following methodology for SDG 15.3.1)

Unit of analysis:
Second sub-national region
(nested within first sub-national regions, and nested within countries)

Data in Model
166 countries
2818 first-subnational units
45,914 second-subnational units

All input variables
defined on a 1 km^2 grid, and then extracted by sub-region

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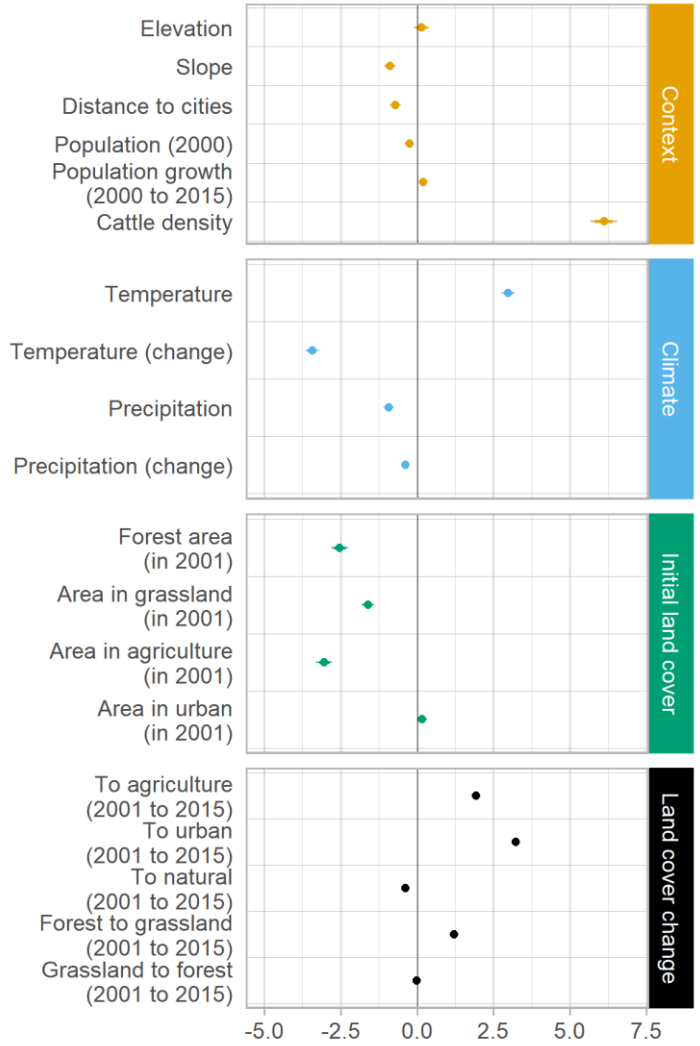

Results from hierarchical Bayesian hierarchical model. All covariates were modeled in the same model – colors and groupings shown above are only to facilitate interpretation. Points indicate median values of each parameter, while thick and narrow bars indicate areas containing 80% and 95% of the posterior density, respectively. Model implemented in STAN.

At a global scale, results indicated expected **positive association** between elevation, proximity to urban areas, population growth rate, cattle density, temperature and degradation.

Areas with higher populations at the start of the period, greater slopes, and greater changes in temperature and precipitation are **negatively associated** with degradation.

Areas with greater area under forest, grassland, or agricultural in 2001 are associated with **less degradation**, while areas that were urban in 2001 with **more degradation**.

Areas that saw transition from 2001-2015 to agriculture, to urban, or from grassland to forest are associated with **more degradation**, while areas that converted to natural types with **less**.

Results/discussion:

- From 2001-2015, 23% of land area degraded following the approach used for SDG Indicator 15.3.1
- Agriculture, urbanization, loss of natural cover, livestock density are most strongly associated with degradation at global level
- At global-level coefficient on slope indicates less degradation occurring at higher slopes – likely this is a result of lower incidence of human activities at higher slopes rather than these areas being less prone to degradation where human activity does occur

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Next steps

- Disentangling regional differences in drivers by allowing parameters to vary nationally (such that modeled impacts of drivers can vary regionally)
- Accounting for agricultural suitability to better discriminate between direct impact of biophysical drivers (slope/elevation) where human modification does occur, versus impacts of these variables on the likelihood of modification in the first place

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TARGET 15.3
END DESERTIFICATION AND RESTORE DEGRADED LAND

Thank you!

For more information:

- QGIS Plug-in: Trends.Earth
- Website: http://trends.earth/
- Web map: maps.trends.earth

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