ATBC 2019 – Saturday, 3rd of August – Antananarivo

The fate of African tropical forests:
High resolution continental maps of deforestation risk and future forest cover

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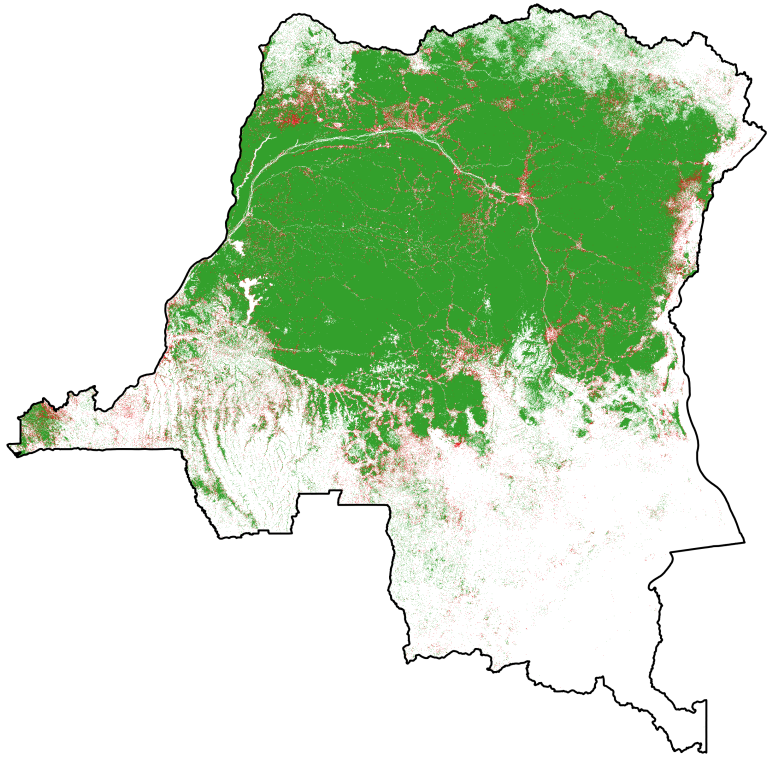
Long term projections

- Tropical forests shelter most of the terrestrial biodiversity and carbon stocks
- They are currently being deforested at rates close to **1%/yr**



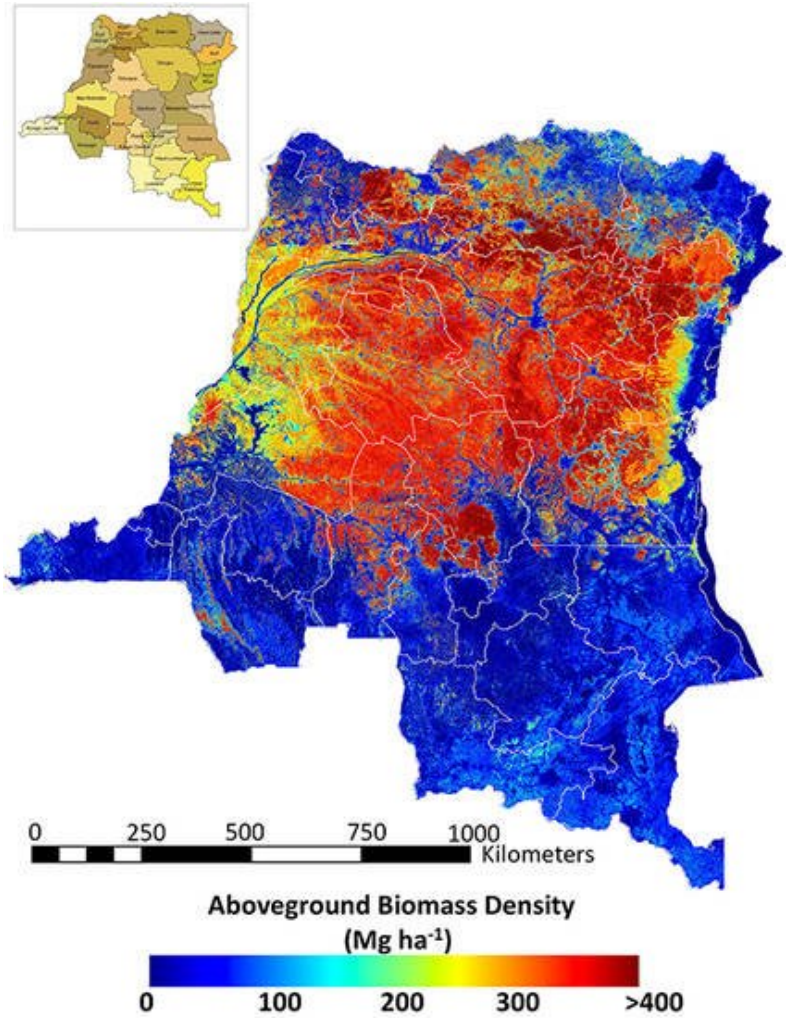
2005-2015 deforestation in Democratic Republic of the Congo

What happens when you project annual deforestation on the medium to long term (2050-2100) ?

$\rightarrow$ Long term projections

Spatial projections

- Not all forests are equally threathened
- And biodiversity and forest carbon stocks vary spatially



Aboveground biomass in Democratic Republic of the Congo

What are the consequences of long term deforestation for biodiversity and

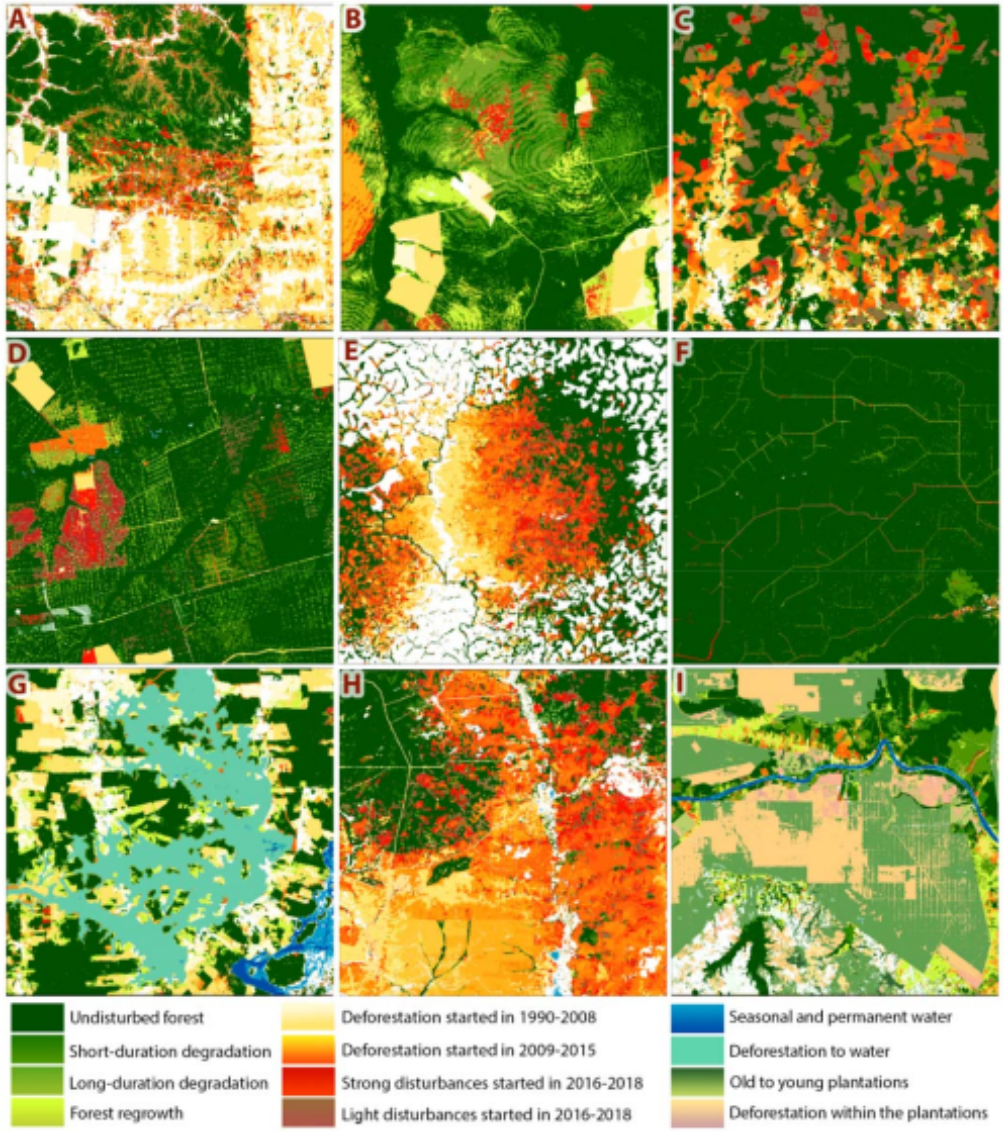
Objectives

- Deriving high-resolution maps of the spatial probability of deforestation
- Projecting forest cover change until 2050 under a business-as-usual scenario

Historical deforestation

- Wall-to-wall map of **tropical moist forest cover** change at 30 m resolution from 1990 to 2018
- Using the 37-years full Landsat satellite archive and Google Earth Engine
- Time-series analysis at the pixel scale using a complex decision tree based on expert knowledge

Historical deforestation



Historical deforestation

- **Vancutsem Ch., F. Achard , J.-F. Pekel , G. Vieilledent, S. Carboni , D. Simonetti , J. Gallego.** Long-term monitoring of the tropical moist forests dynamics reveals unprecedented deforestation rates. Submitted to *Nature Communications*.
- Response variale : deforestation on 2005-2015

Explicative variables

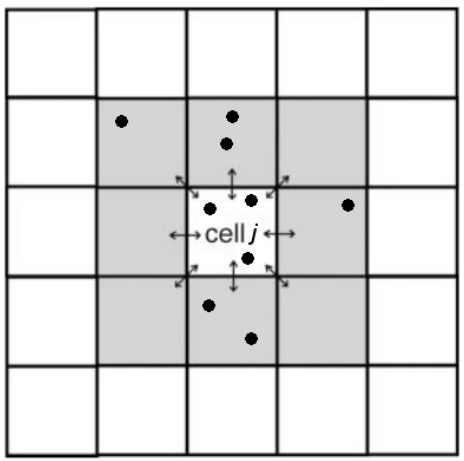
- Variable types : **landscape**, **accessibility**, **protection status**

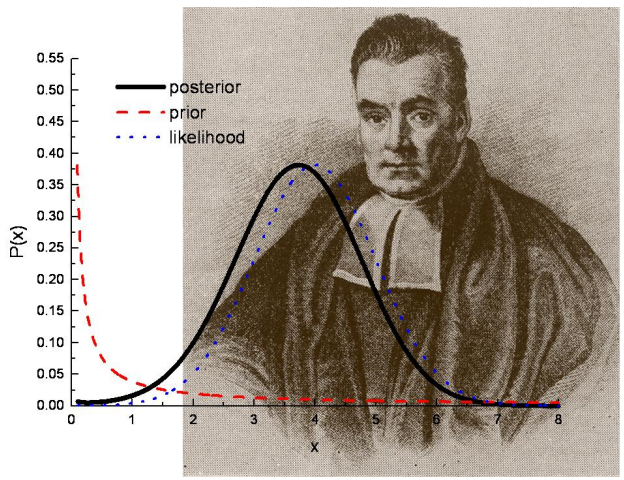
Product	Source	Variable derived	Unit	Resolution (m)
Deforestation maps (2005-2015)	Vancutsem et al. (1)	forest/non-forest	–	30
		distance to forest edge	m	30
		distance to previous deforestation	m	30
Digital Elevation Model	SRTM v4.1 CSI-CGIAR (2)	altitude	m	90
		slope	°	90
Highways	OSM - Geofabrik (3)	distance to roads	m	150
Places		distance to towns	m	150
Waterways		distance to river	m	150
Protected areas	WDPA (4)	presence of protected area	–	30

(1) Vancutsem et al., (2) http://srtm.csi.cgiar.org,
(3) http://www.geofabrik.de, (4) http://protectedplanet.net

Statistical model

- $Y_{ij} \in \{0, 1\} \sim \mathcal{B}ernoulli(\theta_{ij})$
- $\text{logit}(\theta_{ij}) = f(\text{spatial factors}_i) + \rho_j$
- Autocorrelated spatial random effects ρ_j (10 km) to account for **unmeasured** or **unmeasurable** factors : population density, soil type, geographical barriers, law enforcement locally
- Hierarchical Bayesian framework

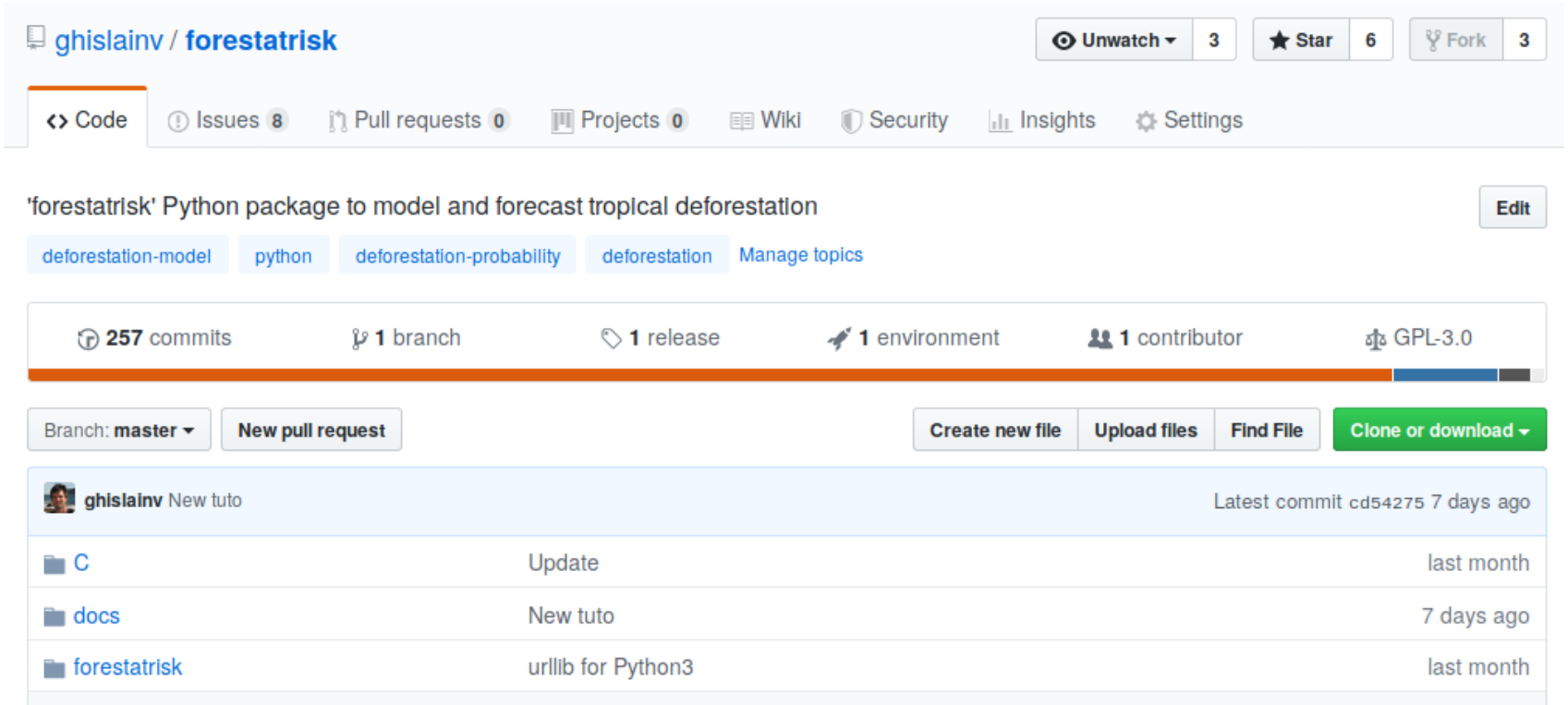




Statistical model

- One model per country
- 40,000 sample points (balanced sampling deforested/non-deforested areas)
- Variable selection based on expert knowledge regarding effect sign

Software



- `forestatrisk` Python package : https://github.com/ghislainv/forestatrisk
- Rasters processed by chuncks : high resolution (30 m, large spatial scale)
- Fast, without memory issues
- Parallel computation : one node per country

. . . Thank you for your attention . . .

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