FAO workshop – Santa Marta (Colombia), July 2024

Using the `deforisk` QGIS plugin for making and comparing deforestation risk maps

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Outline

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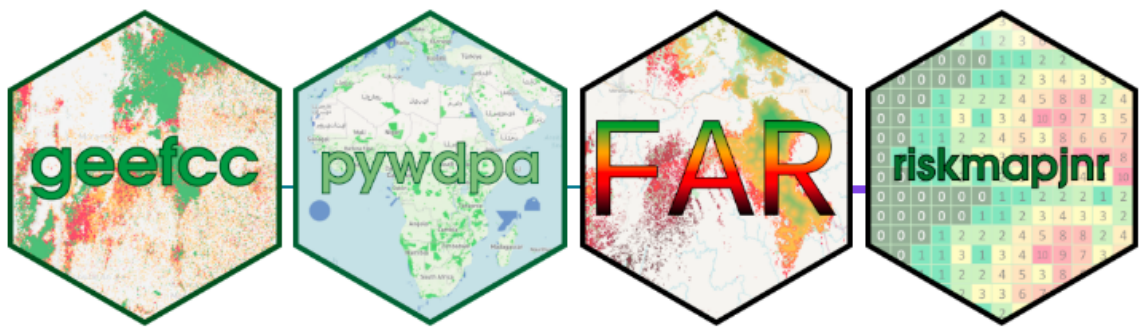
Aims

Specificities

Python based

Python based. The `deforisk` plugin relies on four Python packages developed specifically for modelling deforestation : `geefcc`, `pywdpa`, `forestatrisk`, and `riskmapjnr`.

- `geefcc` : make forest cover change maps from Google Earth Engine (GEE).
- `pywdpa` : downloading protected areas from the World Database on Protected Areas (WDPA).
- `forestatrisk` : model deforestation and predict the spatial deforestation.
- `riskmapjnr` : risk maps following Verra JNR methodologies.



Processing raster by blocks

- **Processing raster by blocks.** Raster files of forest cover change and explanatory variables might occupy a space of several gigabytes on disk. Processing such large rasters in memory can be prohibitively intensive on computers with limited RAM. Functions used in the `deforisk` plugin process large rasters by blocks of pixels representing subsets of the raster data. This makes computation efficient, with low memory usage. Reading and writing subsets of raster data is done by using functions from GDAL, a dependency of the plugin. Numerical computations on arrays are performed with the NumPy Python package, whose core is mostly made of optimized and compiled C code that runs quickly.

Running tasks in parallel

- **Running tasks in parallel.** State-of-the-art approach to select the best deforestation risk map and forecast deforestation implies comparing various models, fit the models using forest cover change over different time periods and predict the deforestation risk at several dates. This implies repeating a high number of tasks. To save computation time, the `deforisk` plugin use the QGIS task manager which allows running several analysis in parallel.

Website and documentation

Installation

Outline

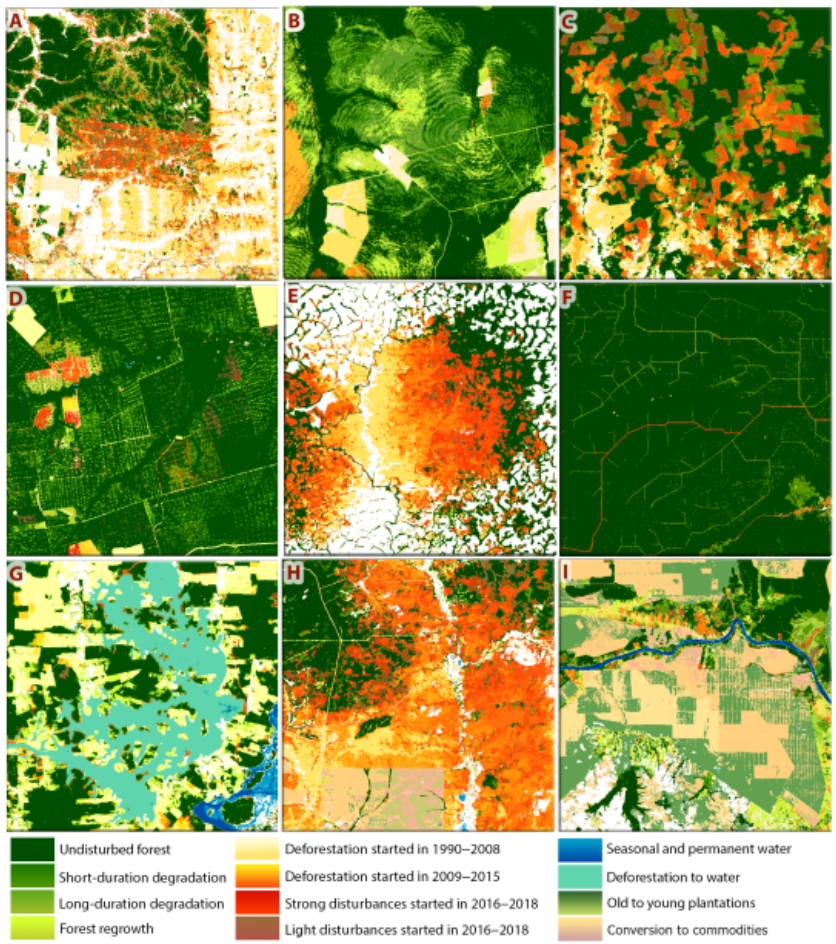
GFC dataset

TMF dataset

- Full Landsat archive (1982–2022), 30m pixel, time-series analysis.
- Classification tree based on expert knowledge.
- Tropical deforestation was underestimated (-33% in 2000–2012, Hansen et al. 2013).
- Maps and data : https://forobs.jrc.ec.europa.eu/TMF/.

TMF dataset

- Precise enough to visually identify the causes of deforestation (logging, fires, agriculture)

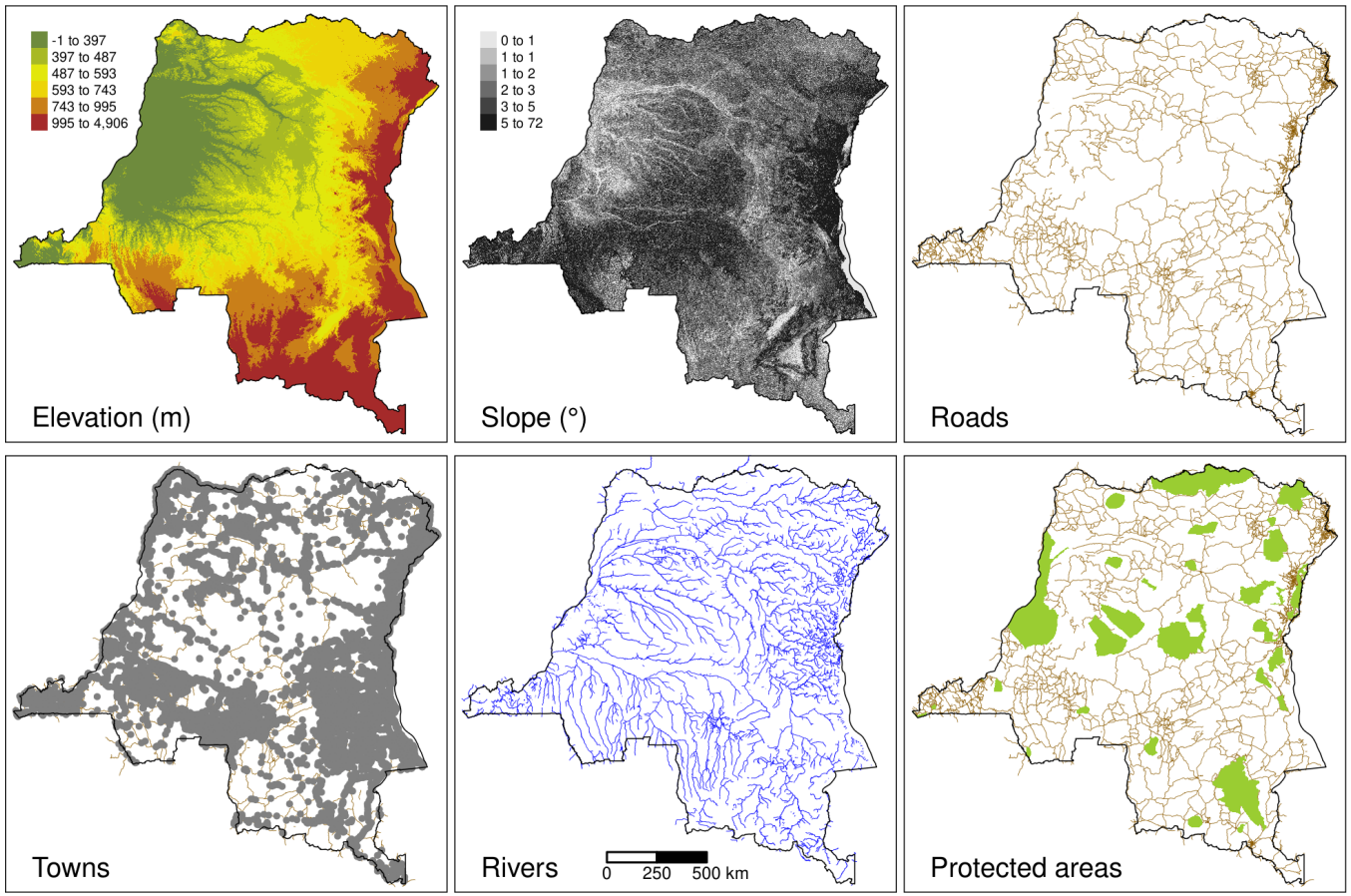


Spatial variables

- Height explanatory variables

Product	Source	Variable derived	Unit	Resolution (m)	Date
Forest maps (2000-2010-2020)	Vancutsem et al. 2021	distance to forest edge	m	30	–
		distance to past deforestation	m	30	–
Digital Elevation Model	SRTM v4.1 CSI-CGIAR	elevation	m	90	–
		slope	degree	90	–
Highways	OSM-Geofabrik	distance to road	m	150	March 2021
Places		distance to town	m	150	March 2021
Waterways		distance to river	m	150	March 2021
Protected areas	WDPA	presence of protected area	–	30	March 2021

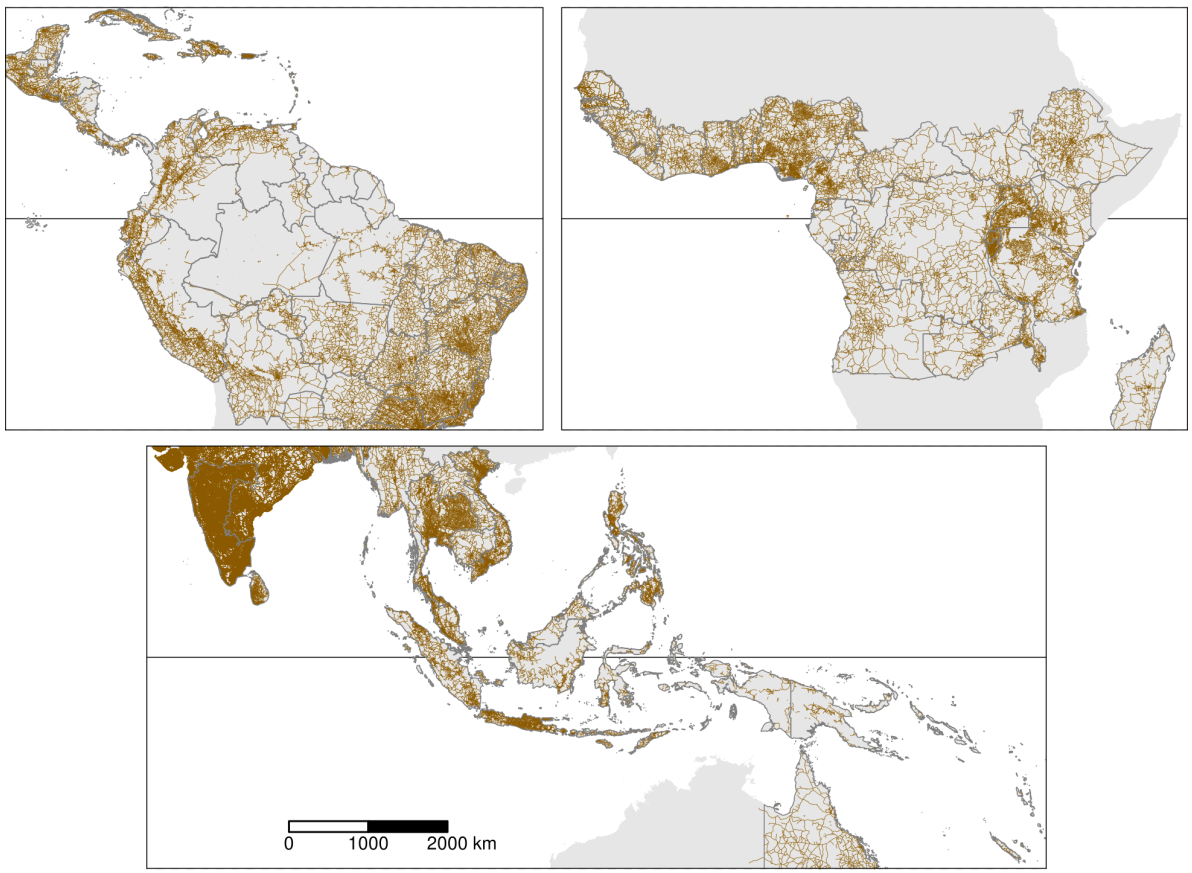
Spatial variables



Spatial explanatory variables in DRC

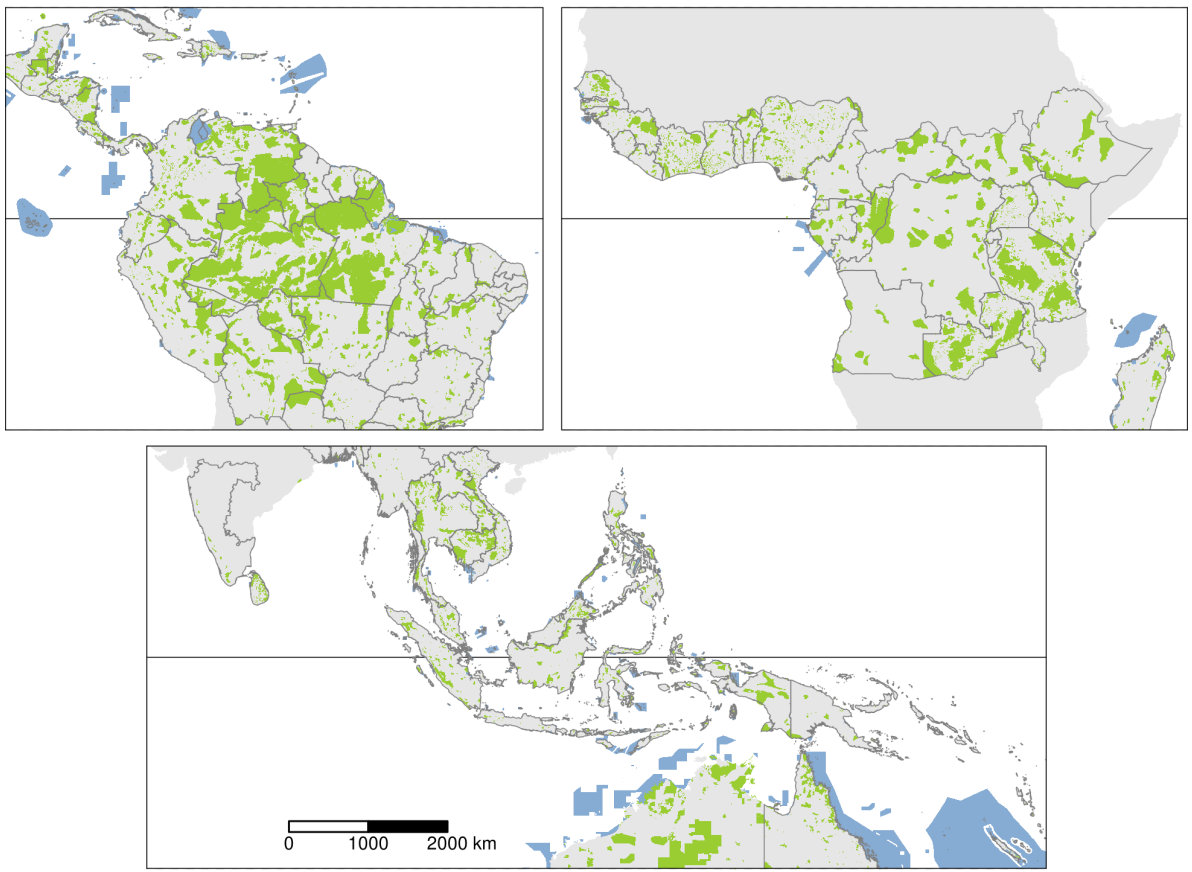
Roads

- OpenStreetMap (OSM)
- “motorway”, “trunk”, “primary”, “secondary” and “tertiary” roads
- 3.6 million roads from OSM



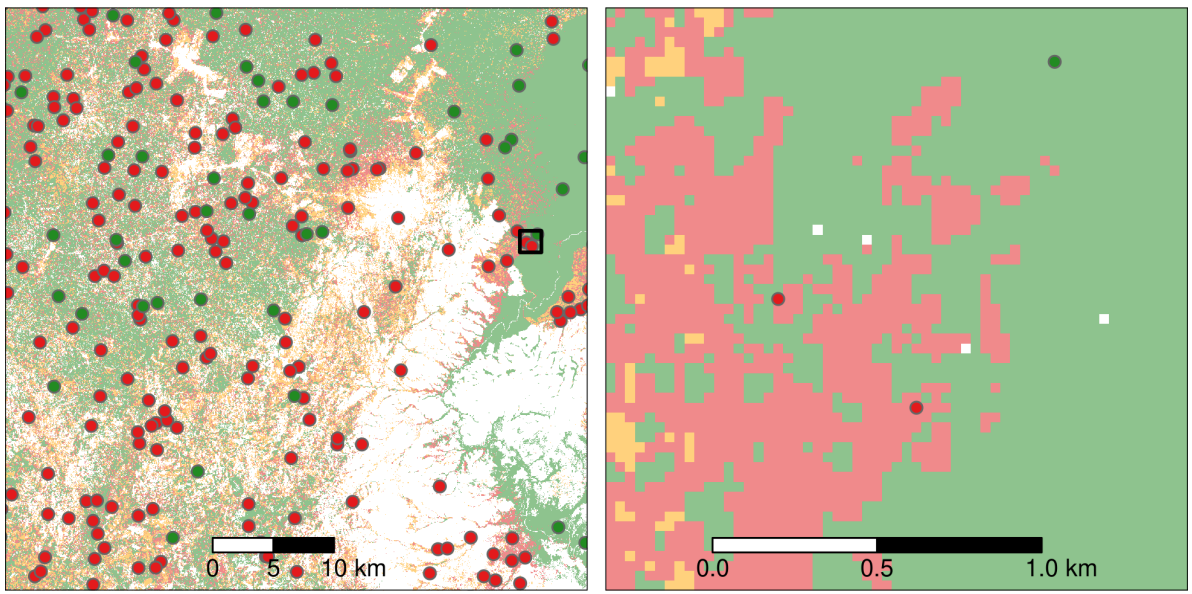
Protected areas

- PA status : “Designated”, “Inscribed”, “Established”, or “Proposed” before 1st January 2010
- 85,000 protected areas from WDPA



Sampling

- Stratified sampling between deforested/non-deforested pixels in 2010–2020
- Total number of points proportional to the forest cover in 2010 (from 20,000 to 100,000 points per study area)



Outline

Benchmark model

Forestatrisk models

iCAR model

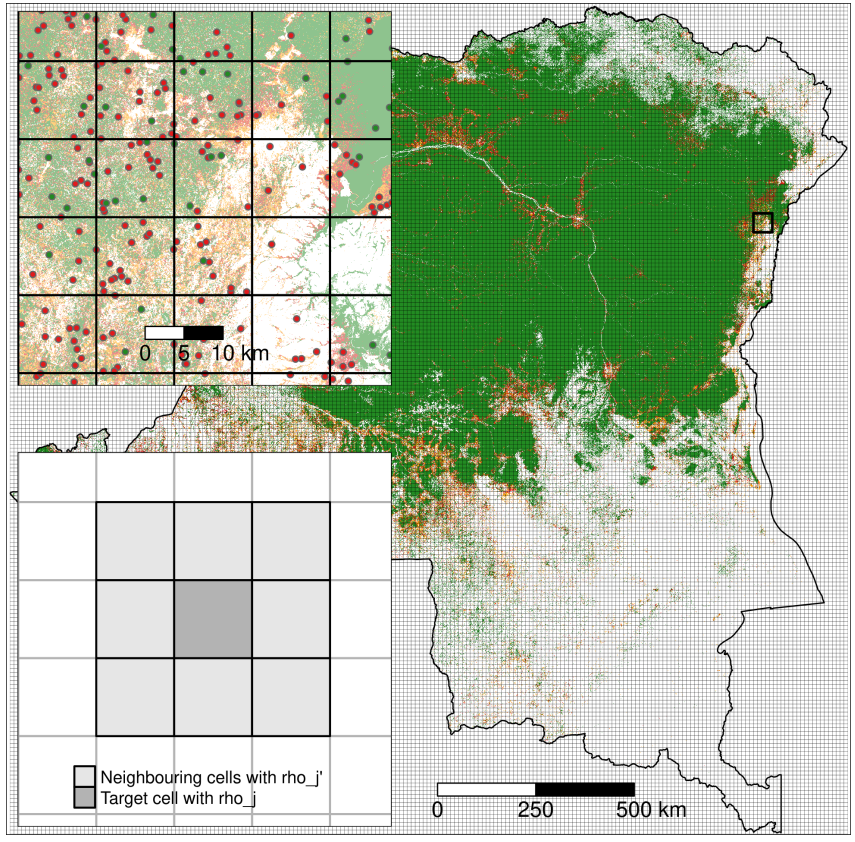
A logistic regression model with iCAR process

$$y_i \sim \mathcal{B}ernoulli(\theta_i)$$

$$\text{logit}(\theta_i) = \alpha + X_i\beta + \rho_{j(i)}$$

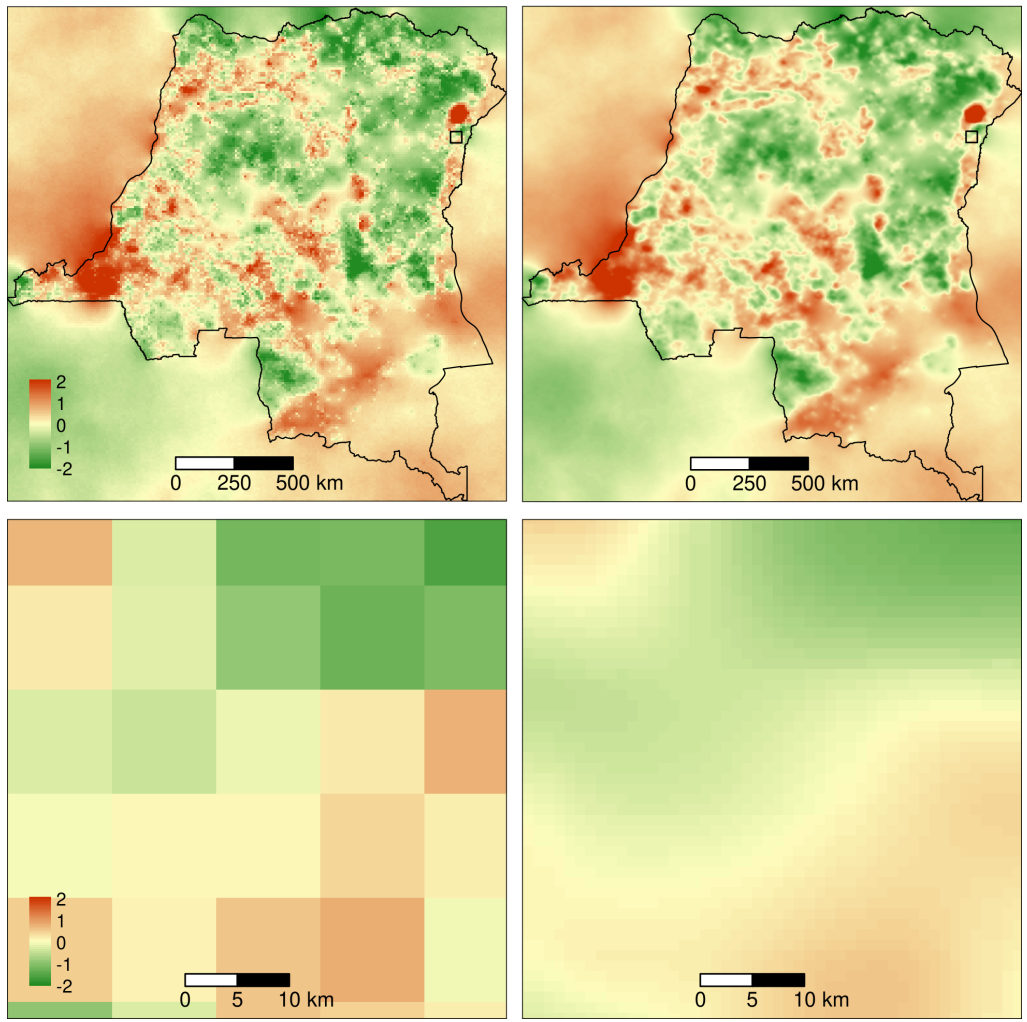
$$\rho_{j(i)} \sim \mathcal{N}ormal(\sum_{j'} \rho_{j'}/n_j, V_\rho/n_j)$$

(NB : We can compare this model with a simple GLM and a Random Forest model using a cross-validation procedure)



Square grid of 10km cells over DRC

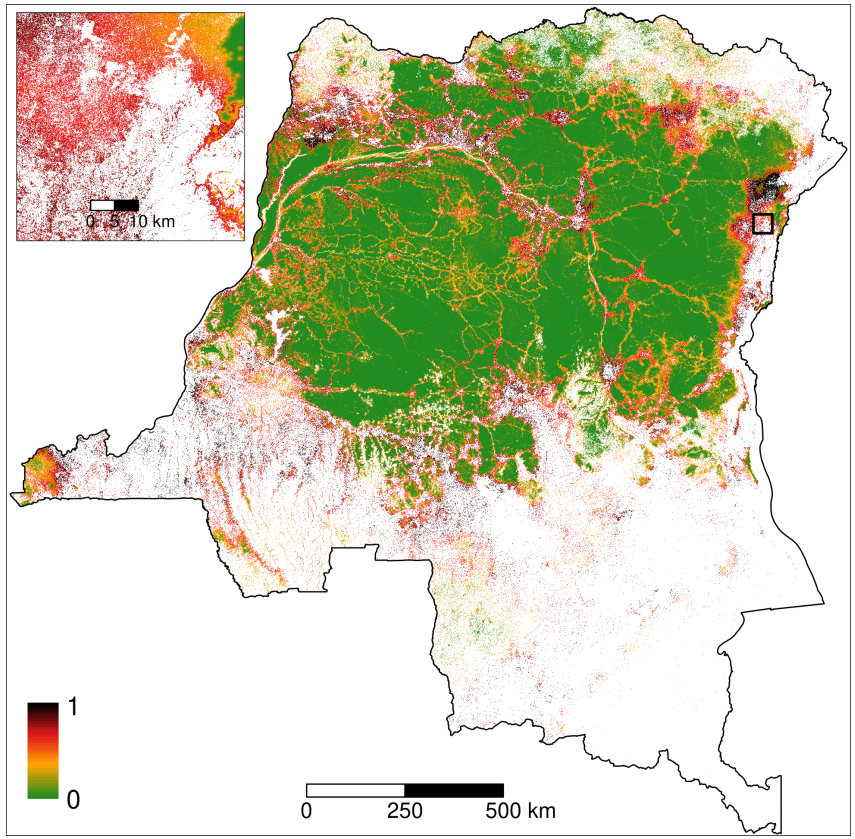
Spatial random effects



Interpolation of spatial random effects at 1km in DRC

Spatial probability of deforestation

We use the fitted model to compute the spatial probability of deforestation.



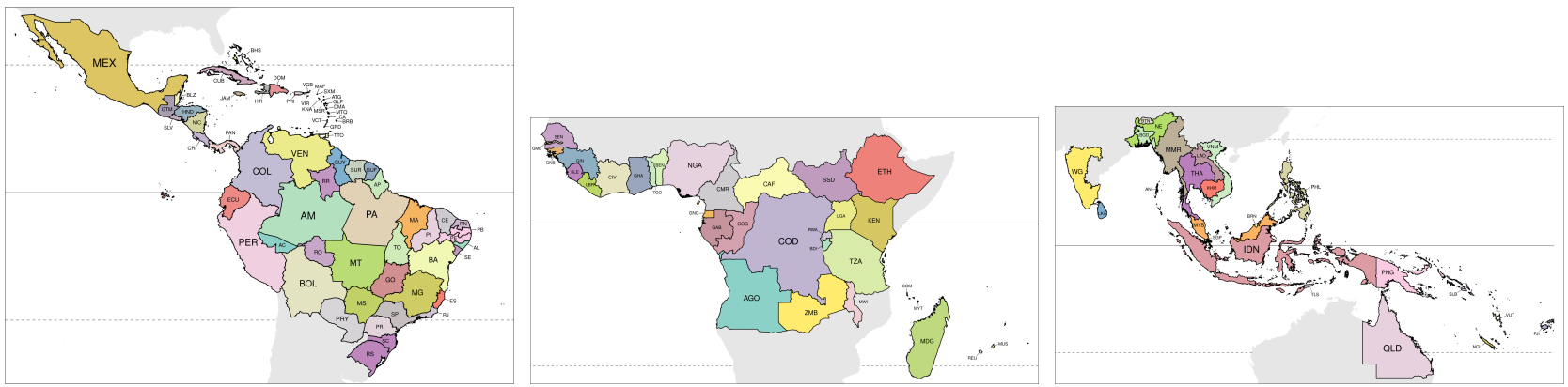
Relative spatial probability of deforestation in DRC for the year 2020

GLM model

Random Forest model

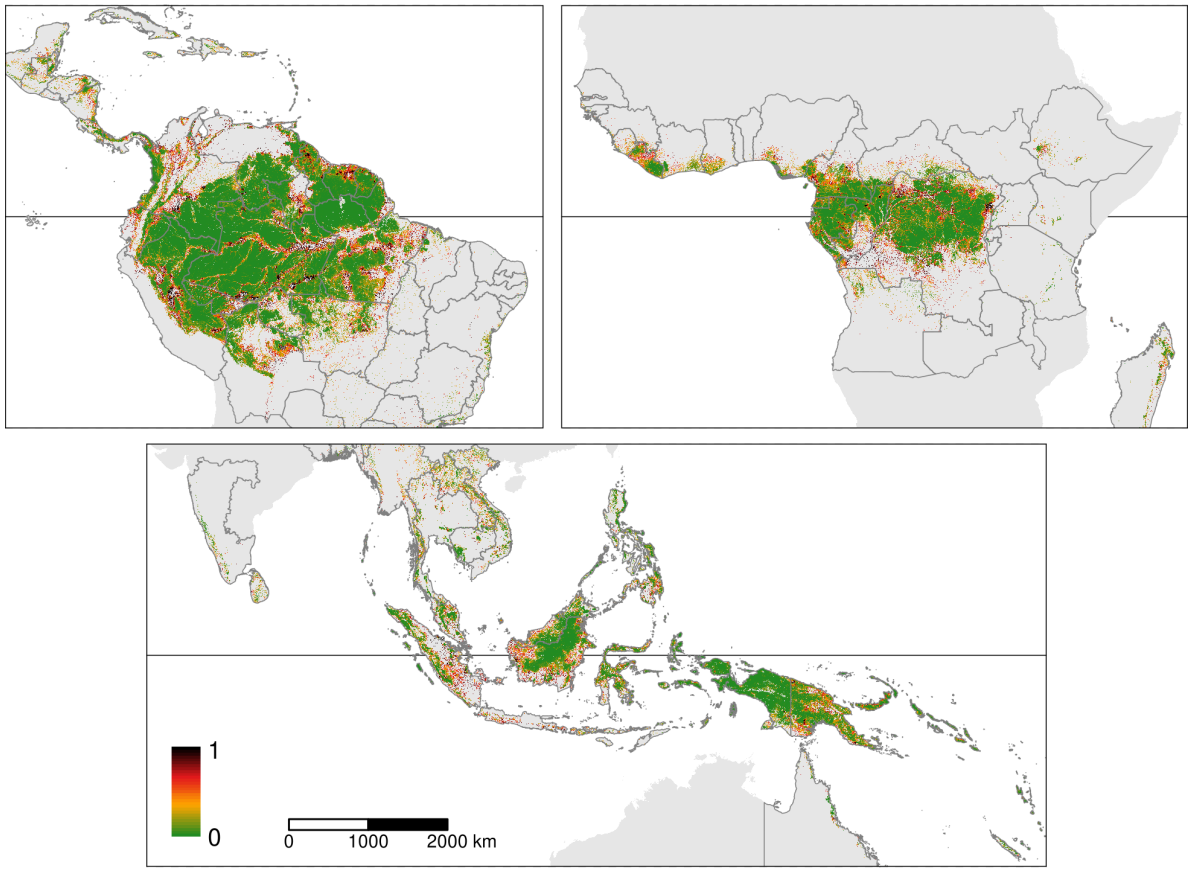
ForestAtRisk in the tropics

- **i.** Consider tropical moist forest in **92** countries (119 study areas)
- **ii.** Estimate the current deforestation rate and uncertainty in each country
- **iii.** Model the spatial risk of deforestation from environmental factors
- **iv.** Forecast the deforestation assuming a business-as-usual scenario
- **v.** Consequences in terms of carbon emissions



The 119 study areas in the 3 continents

ForestAtRisk in the tropics



Pantropical map of the spatial probability of deforestation

Article in review : 10.1101/2022.03.22.485306

https://forestatrisk.cirad.fr/maps.html

Moving window models

Outline

Allocating deforestation

Subnational jurisdictions

User's data

Outline

Week agenda

Perspectives

- Increase computational speed (for predictions on large areas).
- Adding more alternative models (MLP).

. . . Thank you for attention . . .

https://ecology.ghislainv.fr/deforisk-qgis-plugin

> **Articles** > **References** > **Presentations**

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