



## Modelling and forecasting tropical deforestation: advances and perspectives



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## 1 Deforestation and demography in Africa

- Model
- Results
- Reflexion

## 2 `forestatrisk` Python module

- Functionality
- Improvements
- Model performance

## 3 Forecasting spatial deforestation spatially

- Extending at the tropical scale
- Computational challenge

## 4 Perspectives

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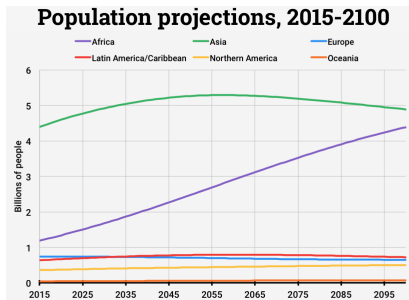
## 4 Perspectives



Model

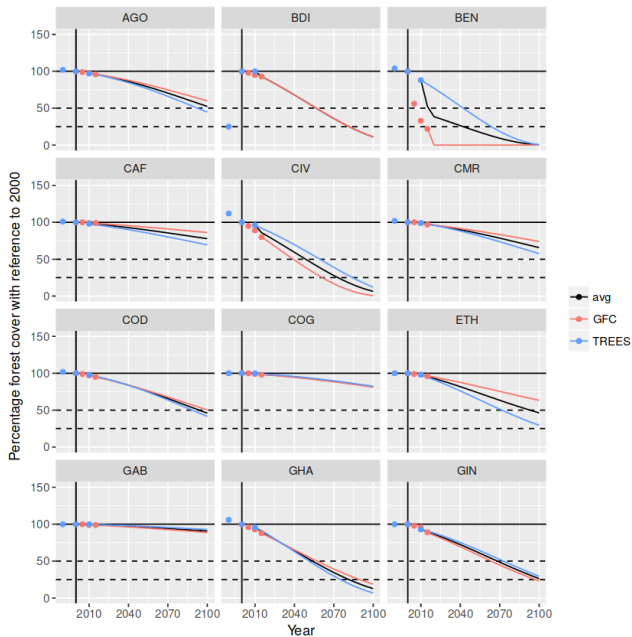
# Model

- The fate of African tropical forests
- Associated to demographic explosion
- $\log D = \beta_0 + \beta_1 \log F + \beta_2 \log P$
- Data on deforestation :
  1. JRC : 1990-2000-2010
  2. GFC :  
2000-2005-2010-2015
- Projection of forest cover in 2050, 2100



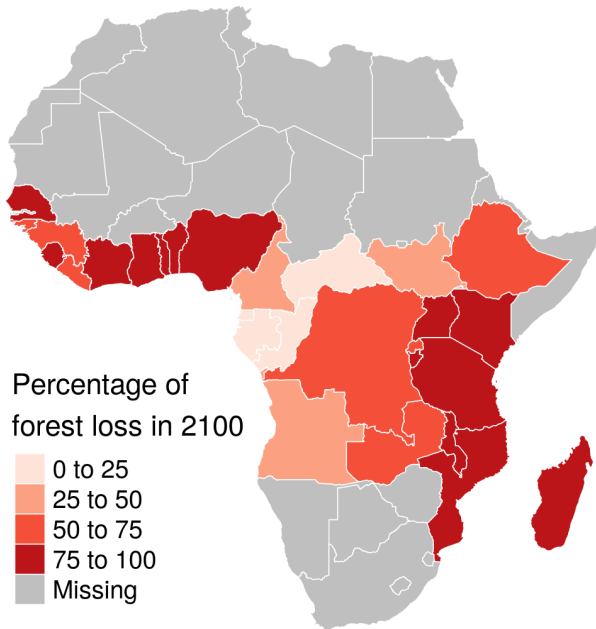
## Results

# Model averaging per country





## Percentage of forest loss 21st century



Reflexion

# Reflexion

- Scientific articles
- Integration of Roadless data on deforestation ?
- Use of the results for future deforestation scenario in Africa
- Predictions in percentage of forest loss :  $\sim$  independent of forest definition

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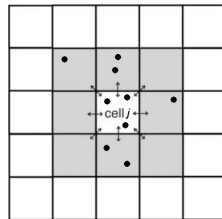
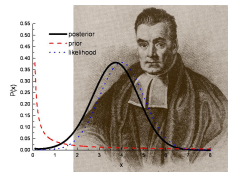
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Functionality

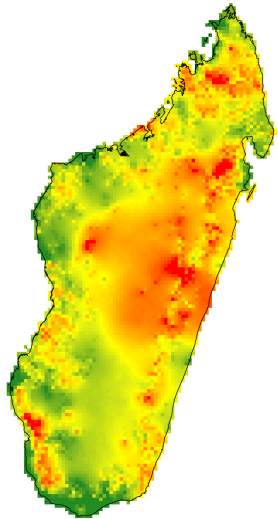
# forestatrisk Python module specifications

- Spatial probability of deforestation
- $\text{logit}(\theta_i) = f(\text{spatial factors}_i) + \rho_j$
- Factors : accessibility (dist. towns, roads, villages), landscape (dist. forest edge), land-tenure (protected areas)
- $\rho_j$  : spatial random effect
- $\{<\a href="https://github.com/ghislainv/forestatrisk">https://github.com/ghislainv/forestatrisk\}$



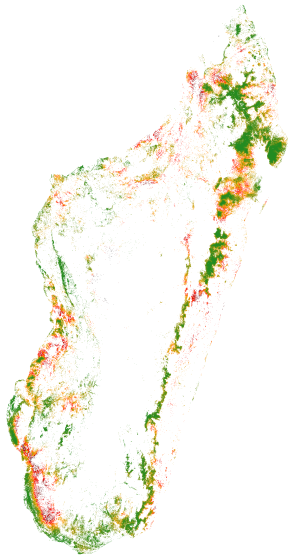
## Spatial random effects

- Hotspots of deforestation
- Not explained by the fixed env. factors



# Spatial probability of deforestation

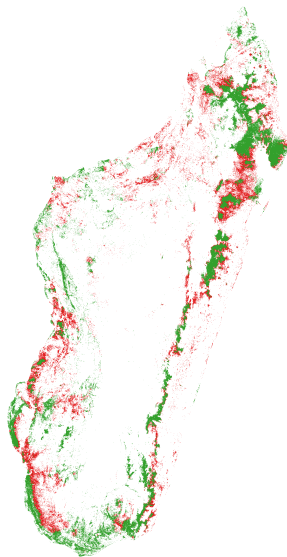
- Computed at 30 m resolution
- Greener : lower probability
- Darker red : higher probability





# Future forest cover

- green : residual forest in 2050
- red : deforested area  
2010-2050



## Improvements

# Improvements

- Python 2.7 and Python 3.x compatible
- Spatial random effects limited to country border
- Set of new functions for model validation
- Can be used from R with reticulate



Model performance

## Model performance

model	deviance	perc
null	27629	0
nsre	25365	8
icar	19279	30
full	0	100

TODO : Add map of differences

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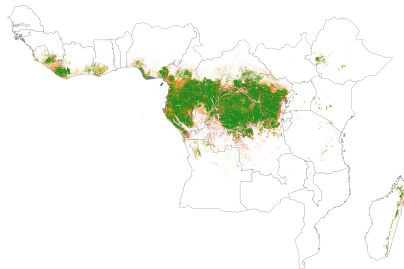
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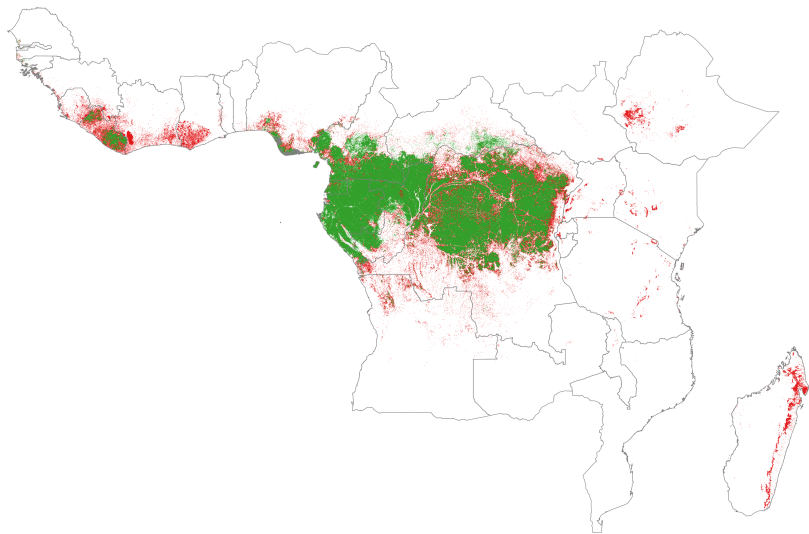
Extending at the tropical scale

# Africa

- Map of deforestation probability in 2015
- Future forest cover in 2050, 2100

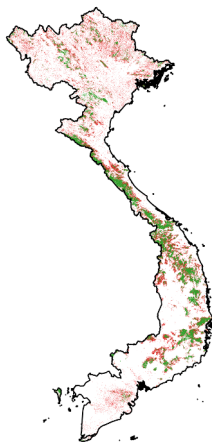






# Asia

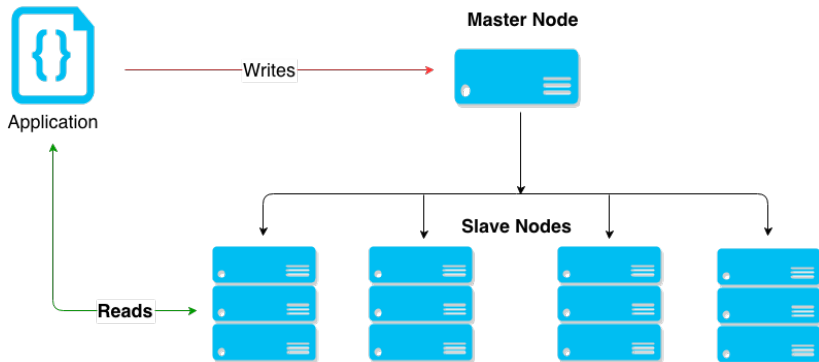
- 11 countries in tropical Asia
- Including MMR, THA, KHM, LAO, VNM (ReCaREDD focus countries)
- Ex. Vietnam in 2050 (half current deforestation rate)



Computational challenge

# Computational challenge

- Use of Google Cloud Computing
- Cluster of small machines with some cores
- Parallelization : one country per machine



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# Perspectives

1. Finalize the deforestation-demography study
2. Consolidate the code for the `forestatrisk` Python module and publish a methodological paper
3. Update the spatial prediction for Africa taking into account the demography
4. Extend projection to South America and publish the pantropical future forest cover map in 2050

... Thank you for attention ...