FAO workshop – Santa Marta (Colombia), July 2024

Riskmaps for carbon credit certification

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Outline

1. Introduction
   - Improving certification methodologies
   - Allocating deforestation to projects
2. Methodology Verra for risk maps
   - VT0007 tool
   - Benchmark model
   - Alternative models and validation
   - Verra/UClark software
3. Software for modelling deforestation
   - Existing software
   - Limitations
4. Conclusion
   - A not so simple methodology
   - Need for an integrative tool : deforisk QGIS plugin

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Several criticisms

Several criticisms were addressed to previous REDD+ methodologies for carbon credit certification accusing them to oversell credits.

- **Non-additionnality** : Emissions reductions would have happened anyway. Inflated project-level baselines. Jurisdictional reference levels are reasonably good predictors of future trends.
- **Leakage** : The larger the area covered by a REDD+ initiative, the lower the leakage risk.
- **Reversal** : Jurisdictions are less likely than projects to have their forest carbon stocks decimated by a disturbance event.

Frances Seymour (WRI) : 4 Reasons Why a Jurisdictional Approach for REDD+ Crediting Is Superior to a Project-Based Approach.

New jurisdictional approach

Deforestation intensity

- Baseline activity data or Forest Reference Emission Level at the jurisdictional level
- Amount of deforestation.
- Deforestation “quantity” or “intensity”.

Spatial deforestation risk

- Map of the deforestation risk at the jurisdictional level.
- Spatial relative probability of deforestation.
- Deforestation “location”.

Risk map at the jurisdictional level

Objectives

- Identifying hot-spots/cold-spots of deforestation.
- Classifying forest pixels by risk of being deforested.
- One unique model for the whole jurisdiction (no methodological discrepancies between projects).
- Use this map to allocate deforestation (estimated for the jurisdiction) per project.

Figure – Map of the deforestation risk for Perou.
Green : low, Red/**Black** : high.

Allocating deforestation to projects

- Jurisdictional risk map : a map with class of deforestation risk.
- Obtaining a deforestation density map :
  Class of defor. risk $[1, 2, \ldots, l] \rightarrow$ Defor. density (ha/yr/pixel).
- Can be used to allocate deforestation per project.

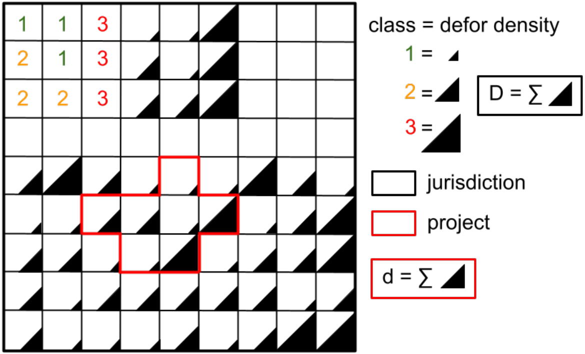

Figure – Allocating deforestation to projects within the jurisdiction.

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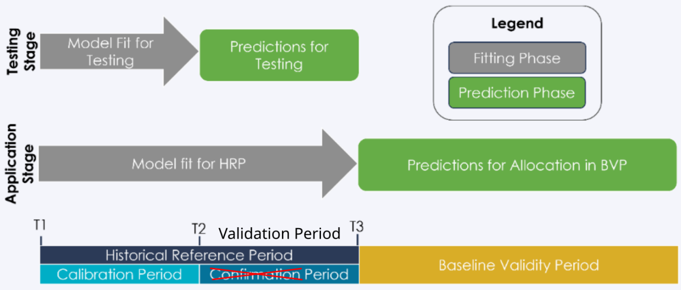
VT0007 tool

- Developed by Clark University (J. R. Eastman and R. G. Pontius Jr.) for Verra.
- **Aim** : Obtaining the best risk map possible at the jurisdictional level.

Basic steps

1. Use a reasonably good reference model to map the deforestation risk.
2. Let the user propose alternative maps from alternative models.
3. Validation step : check that alternative models are better than the benchmark model.
4. Use the best alternative map to allocate deforestation.

Modelling periods



- Three dates : t1, t2, t3.
- Four periods : calibration, validation, historical, (baseline validity period).
- Why different periods : model predictions must be compared with **independent data** (validation period).
- To forecast after t3, we want to use as much data as possible (historical period).

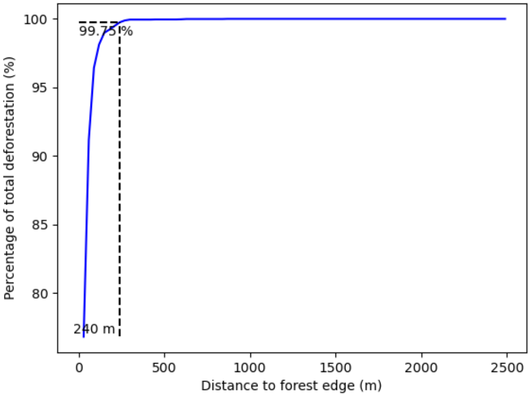
Benchmark model

- Benchmark model or reference model.
- A reasonably good deforestation model (better than a null model).
- Assuming a *decrease of deforestation with distance to forest edge* (commonly admitted).
- And a *different model between subjurisdictions* (regional variability).

Figure – Subjurisdictions in Martinique (MTQ)

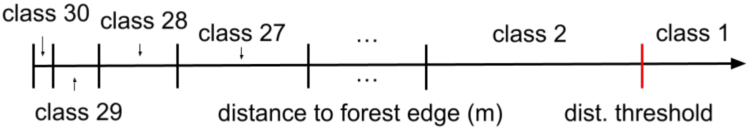
Distance threshold

- Identify the distance to forest edge below which **99.5%** of the deforestation occur.
- Use this distance to define the first class of risk (class 1).



From distance to risk class

- Distances below the threshold are transformed into classes of deforestation risk.
- A geometric series is used for that, ensuring that classes have a wider range for bigger distances.
- We define 29 additional classes of risk from 2 to 30 (class 1 has already been defined).

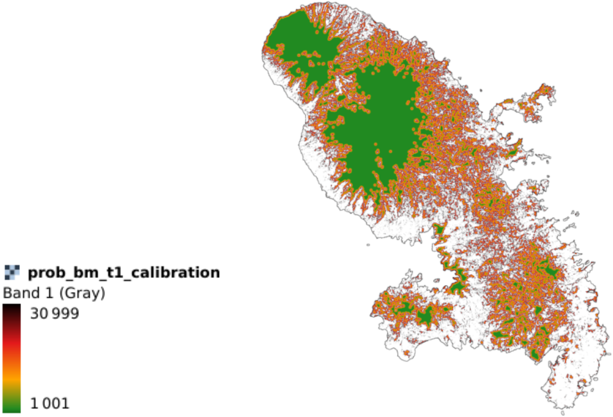


Classes from subjurisdictions

- Each subjurisdiction get a number from 1 to (potentially) 999.
- We combine classes derived from distance with subjurisdictions in the following way : **DD**SSS, with **DD** the distance class and SSS the subjurisdiction number.
- We obtain classes going from 01001 to potentially 30999 if there are 999 subjurisdictions.
- So for 10 subjurisdictions, we obtain ∼300 classes (but some distance classes might be missing).

Classes from subjurisdictions

- Following these steps, we obtain a map at the jurisdictional level where each forest pixel belongs to a given class of deforestation risk.
- Area in dark green : classes **1**SSS, beyond the deforestation threshold.



Deforestation density

- Each class i has an associated **deforestation probability** : $\theta_{m,i} = d_i/n_i$ (unitless), with d_i the number of deforested pixels during the period, and n_i the number of forest pixels at the beginning of the period.
- **Quantity adjustment** ρ : $\theta_{a,i} = \rho\theta_{m,i}$, so that total predicted deforestation = observed (or expected) deforestation. For the benchmark model for the calibration and historical periods, $\rho = 1$.
- **Deforestation density (in ha/yr per pixel)** computed as $\delta_i = \theta_{a,i} \times A/T$. A : pixel area (in ha), T : time-interval of the period (in yr).
- The deforestation density is used to predict the amount of deforestation for each pixel belonging to a given class of deforestation risk.

Deforestation density

Table – Deforestation rates for each class of deforestation risk (numbers truncated to three decimal digits).

cat	n_i	d_i	$\theta_{m,i}$	$\theta_{a,i}$	T	A	δ_i
1001	33433	0	0.0	0.0	10	0.09	0.0
1002	12965	0	0.0	0.0	10	0.09	0.0
1003	91686	19	2.072e-04	2.072e-04	10	0.09	1.865e-06
1004	82279	5	6.076e-05	6.076e-05	10	0.09	5.469e-07
2001	1373	0	0.0	0.0	10	0.09	0.0

Deforestation density (in ha/yr per pixel) computed as $\delta_i = \theta_{a,i} \times A/T$

Deforestation density

- The deforestation density is used to predict the amount of deforestation for each pixel belonging to a given class of deforestation risk.
- Can be used to allocate deforestation to projects within a jurisdiction.

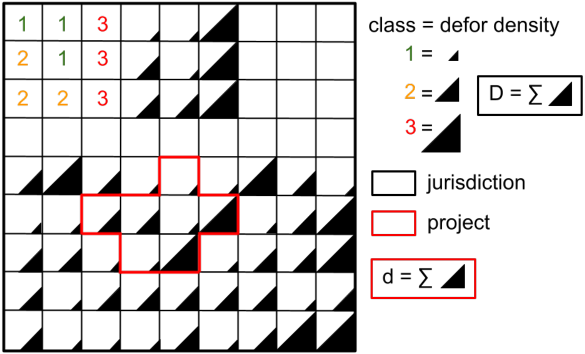


Figure – Allocating deforestation to projects within the jurisdiction

Alternative models

Validation procedure

Verra/UClark software

https://github.com/ClarkCGA/UDef-ARP/tree/v2.09

- User must provide fcc, distance to forest edge raster, subjurisdictional borders.
- Benchmark model.
- Validation.

Limitations

- Not tool to help prepare the data.
- No tool to develop the alternative model.
- Windows only.
- Require a computer with high RAM for large jurisdiction : all raster inputs are stored in RAM during processing. Therefore, large jurisdictions will require substantial RAM allocations (e.g., 64Gb).
- Several remarks :

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Existing software

- Dinamica EGO, CLUE, TerraSet (Clark U.).

Limitations

- All are not open source (transparency).
- Difficulty to reproduce the results (transparency, reproducibility).
- Large rasters on large jurisdiction ?
- No scripting : not well adapted to repeat computation.

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A not so simple methodology

Need for an integrative tool : the deforisk QGIS plugin

... Thank you for attention ...

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

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

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