



Visite de l'Université Paris Créteil  
15 janvier 2026

# Développement expérimental pour la planification de l'éducation

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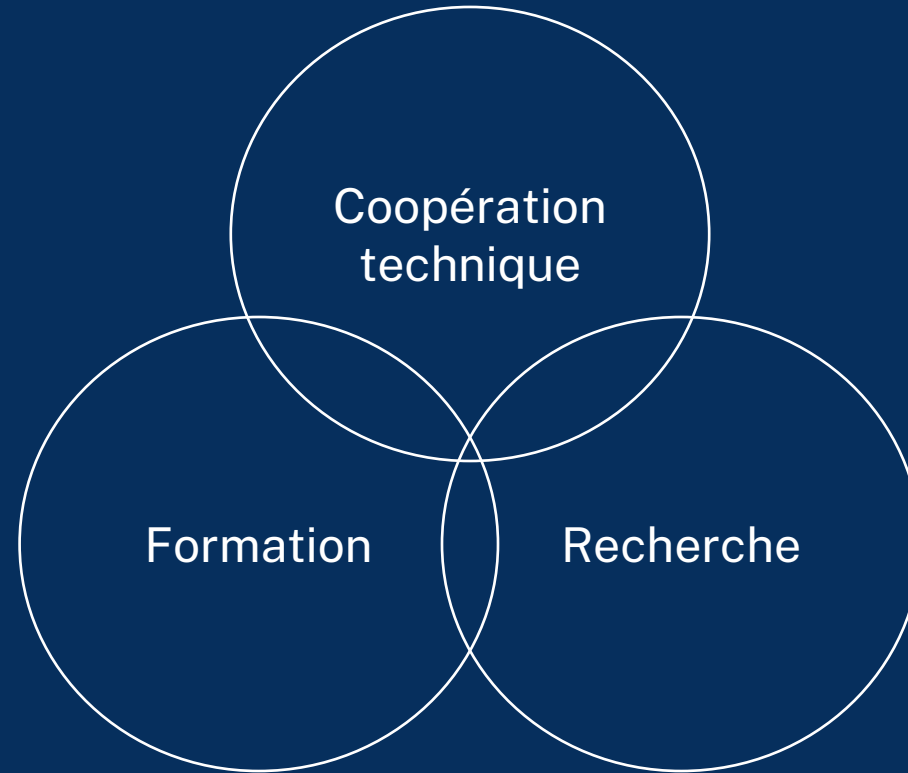
**Germán Vargas Mesa**

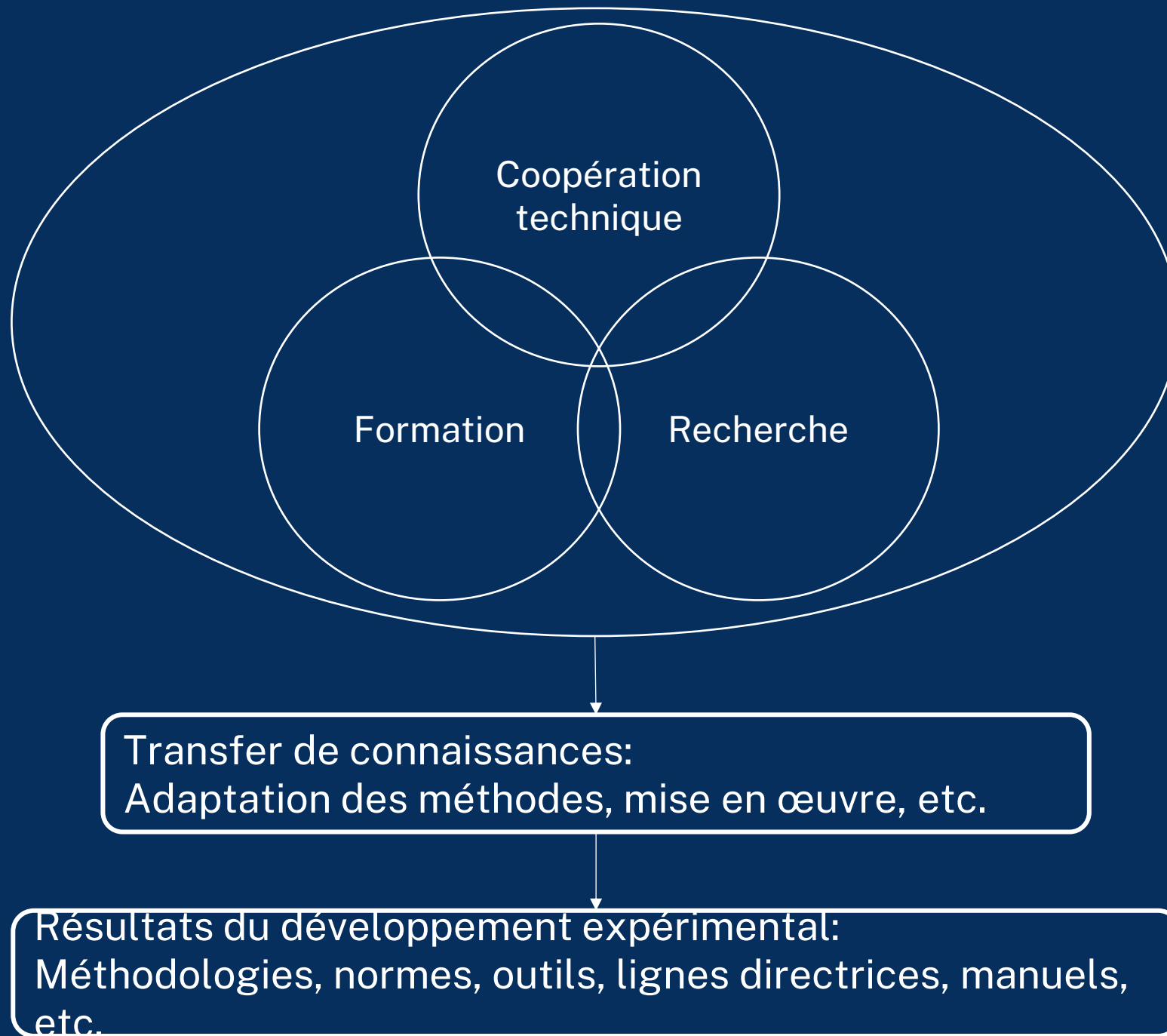
Spécialiste associé au programme

**Am Gagnon**

Spécialiste principal du programme







# La vision générale

## Conception de produits multifonctionnels

- Formation
- Recherche
- Coopération technique

## Approche collaborative et itérative

- États membres
- Collaborateurs et experts de l'IIPE
- Communautés de pratique

## Déploiement inclusif

- Normes ouvertes, logiciels, documentation
- Données allégées
- 100 % répliquable

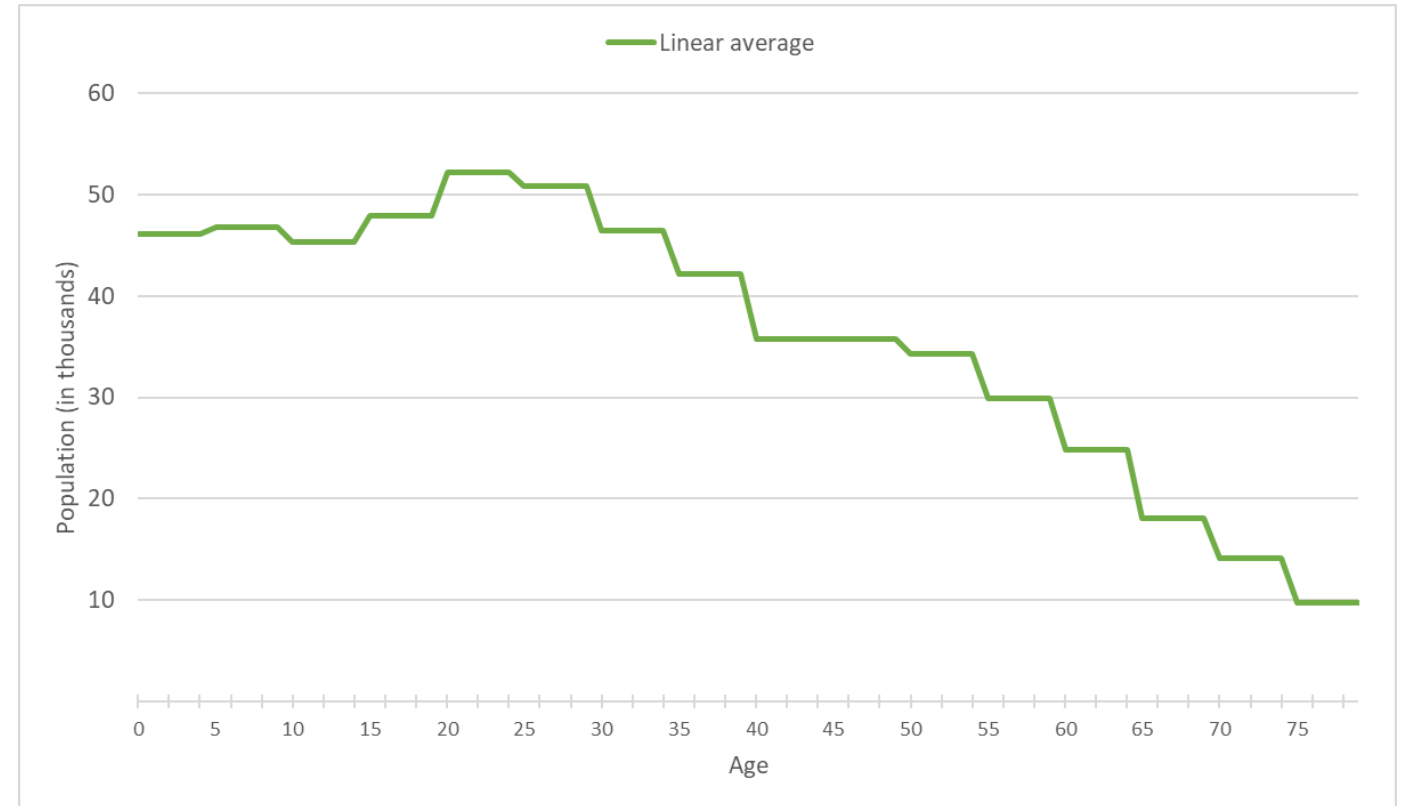
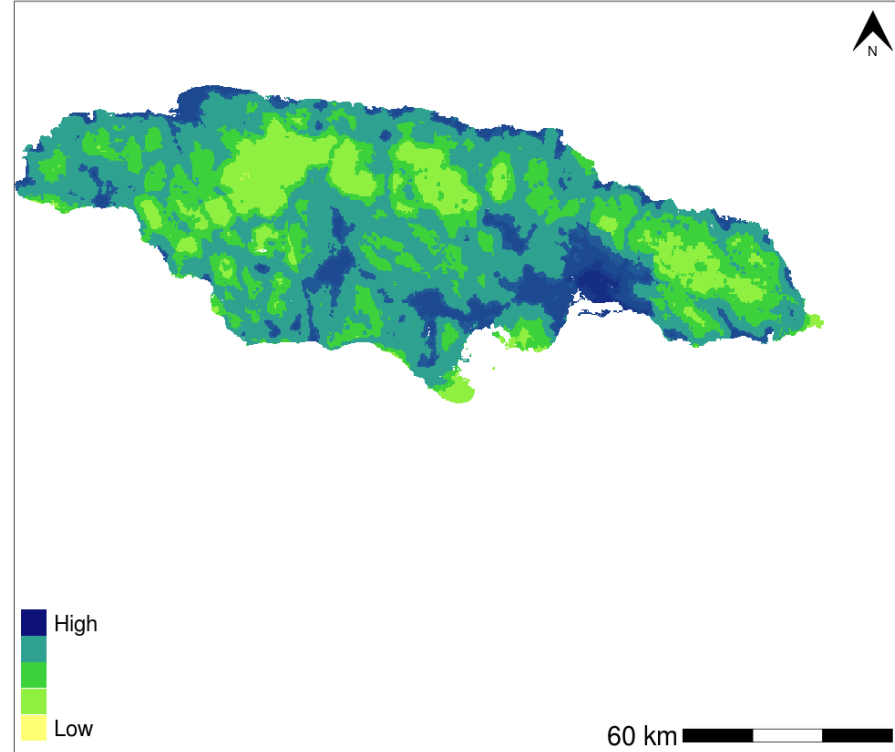


# Où vivent les enfants d'âge scolaire ?

Calcul des populations d'âge scolaire  
spécialisées à l'aide des multiplicateurs de  
Sprague

# Jamaica 100m Age structures

Estimated total number of people per grid-cell at a resolution of (3 arc seconds approximately 100m at the equator)



WorldPop ([www.worldpop.org](http://www.worldpop.org) – School of Geography and Environmental Science, University of Southampton; Department of Geography and Geosciences, University of Louisville; Département de Géographie, Université de Namur) and Center for International Earth Science Information Network (CIESIN), Columbia University (2018). Global High Resolution Population Denominators Project – Funded by the Bill and Melinda Gates Foundation (OPP1134076). <https://dx.doi.org/10.5258/SOTON/WP00646>

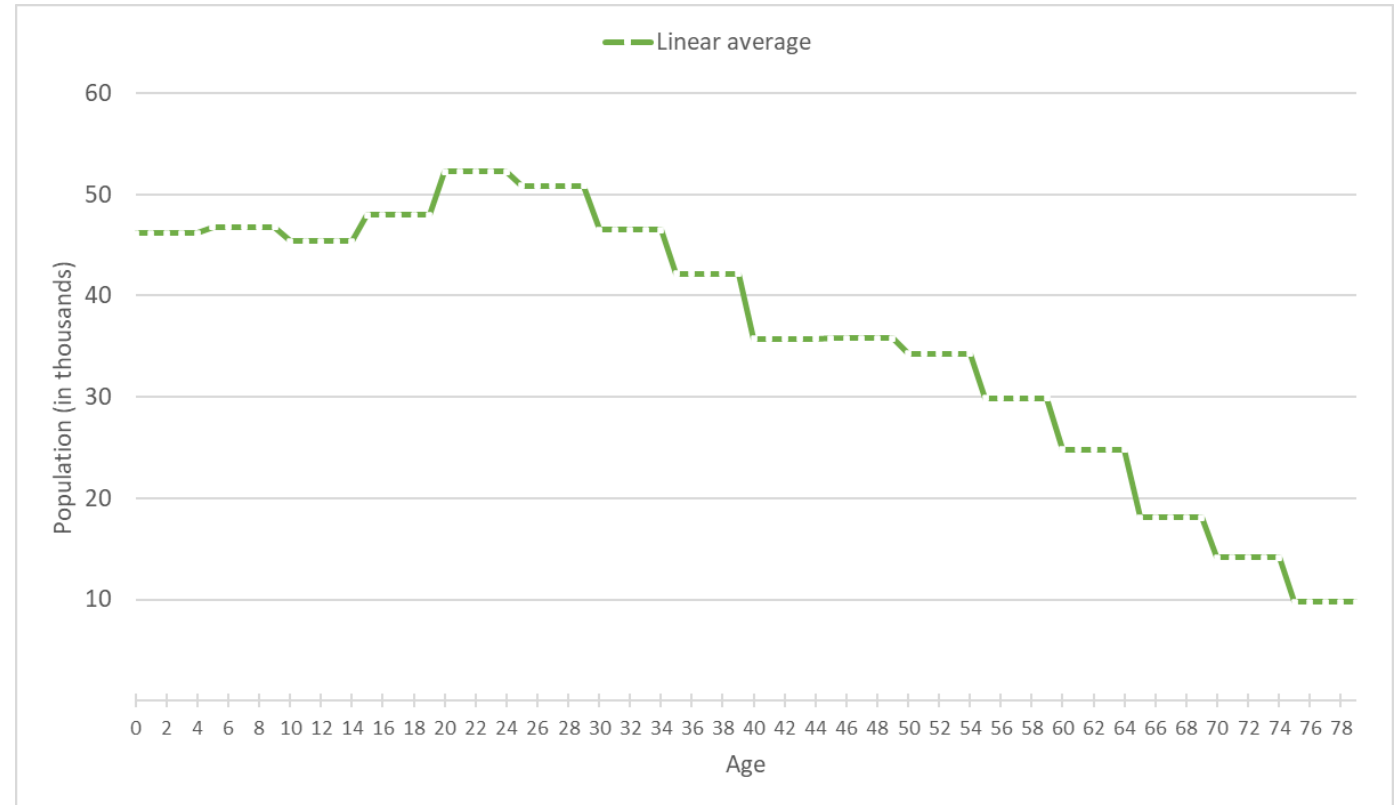
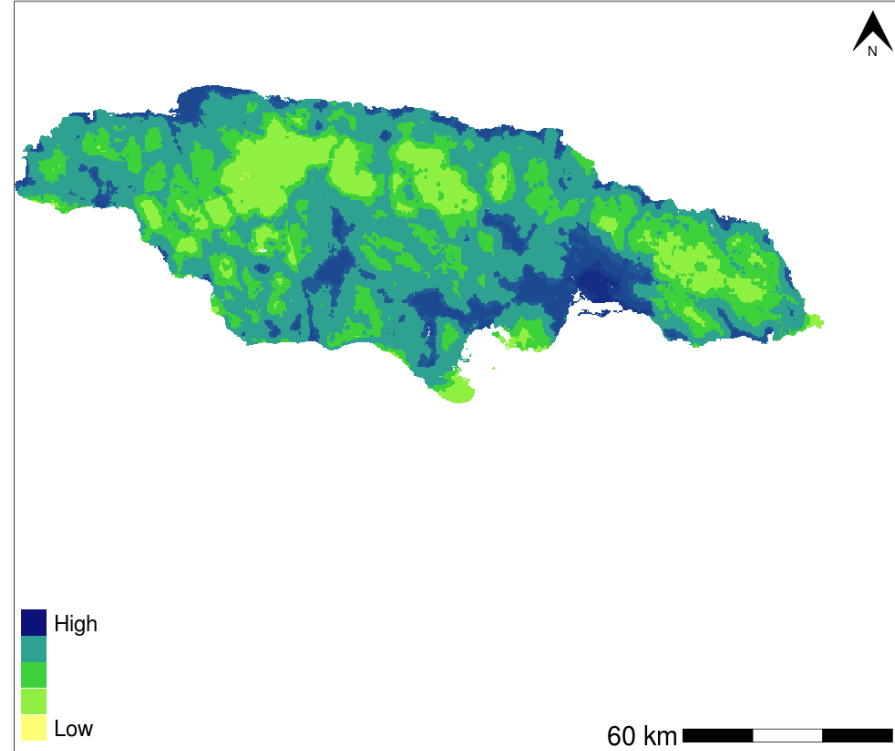
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Bondarenko M., Kerr D., Sorichetta A., and Tatem, A.J. 2020. Estimates of 2020 total number of people per grid square, adjusted to match the corresponding UNPD 2020 estimates and broken down by gender and age groupings, produced using Built-Settlement Growth Model (BSGM) outputs. WorldPop, University of Southampton, UK. doi:10.5258/SOTON/WP00698



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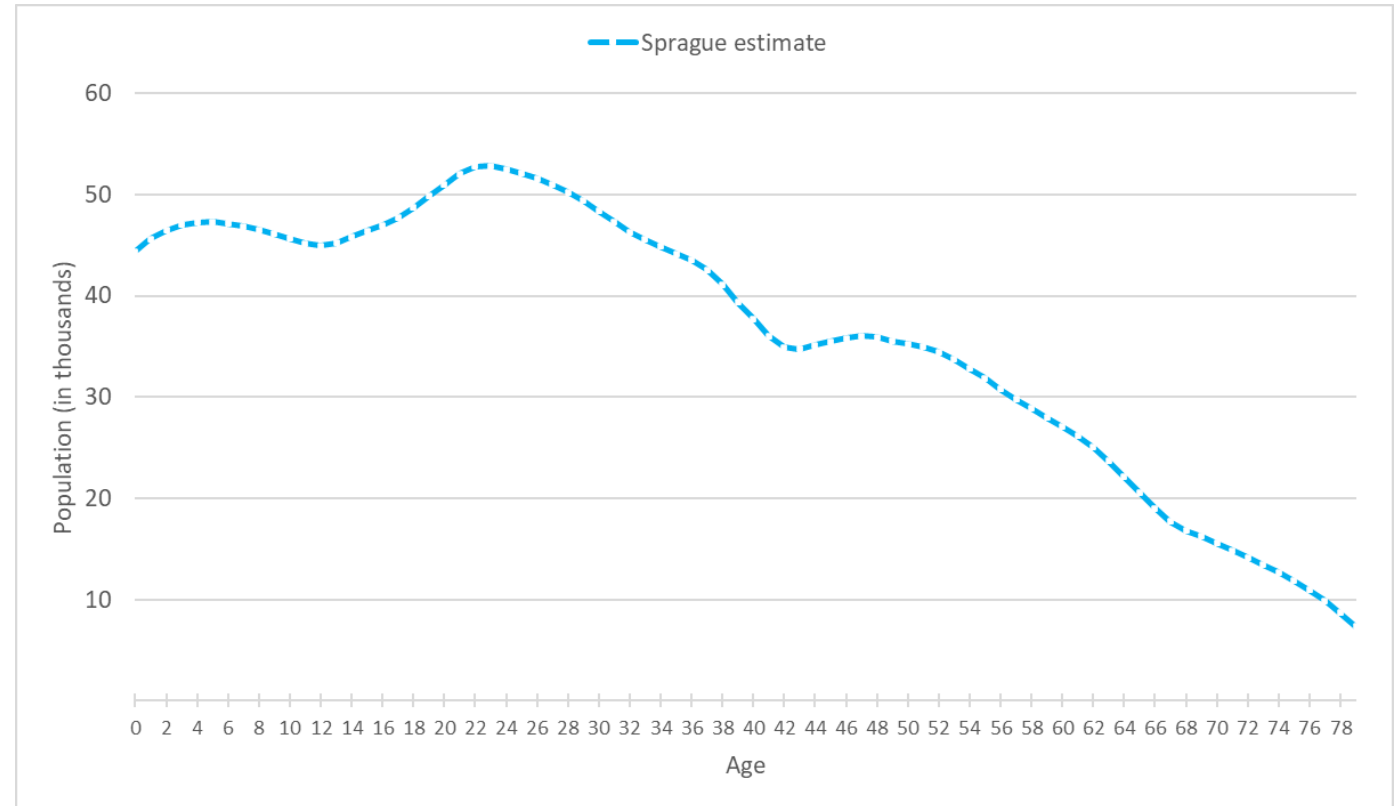
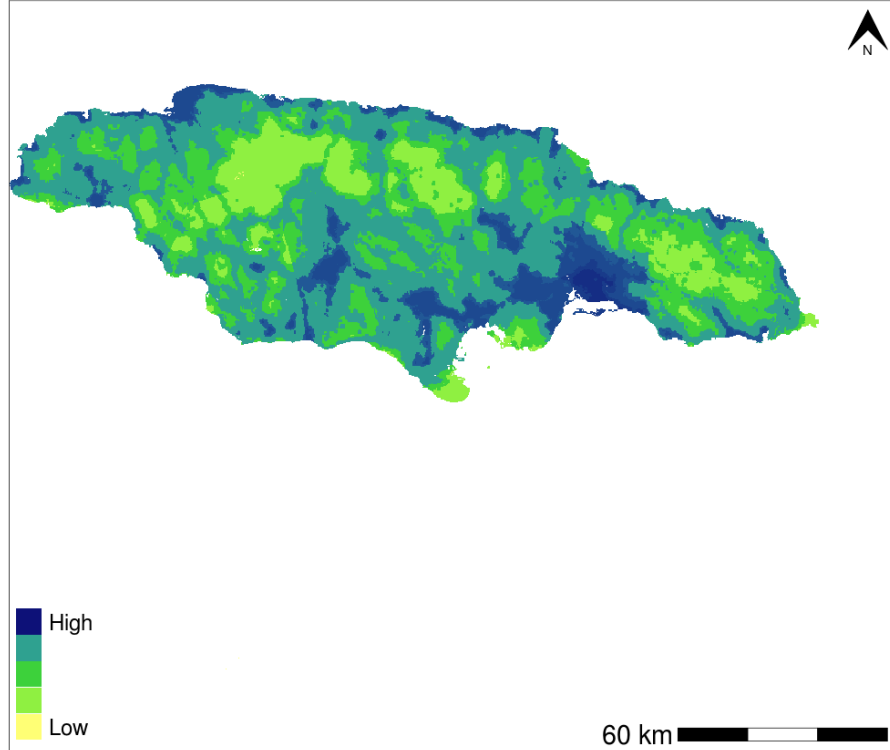
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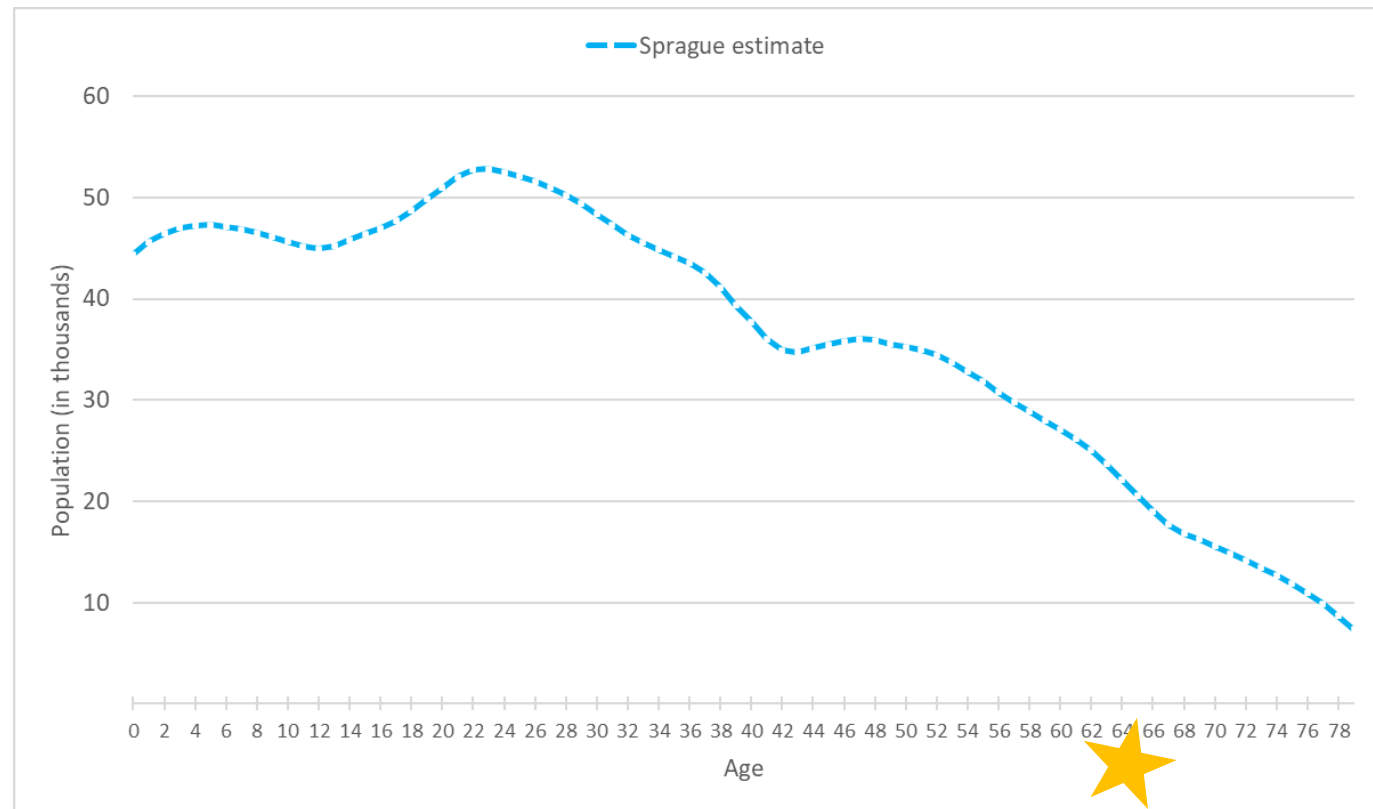
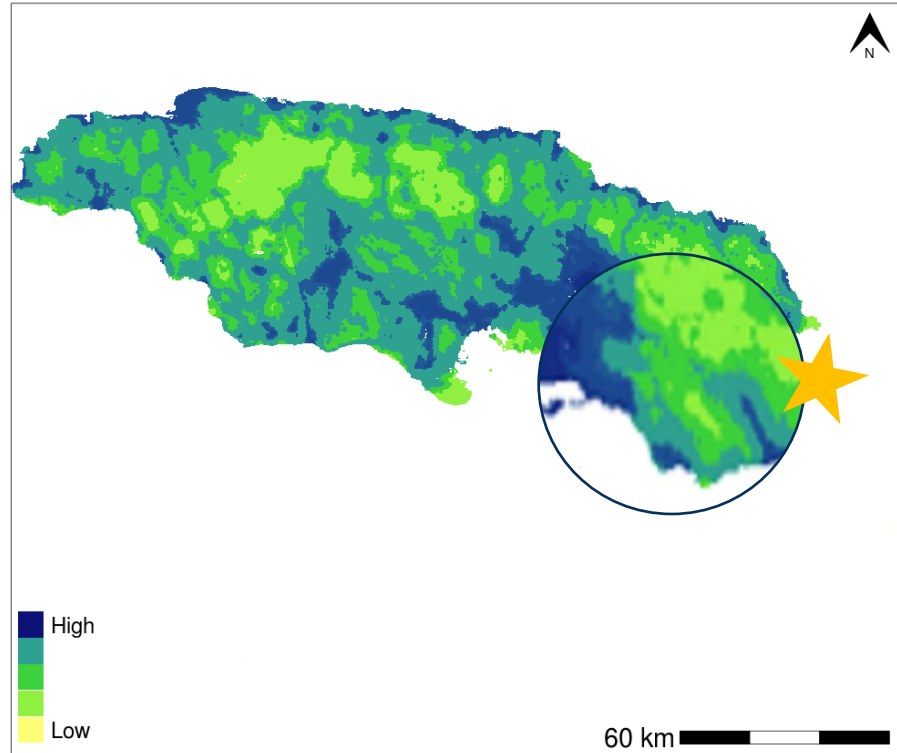
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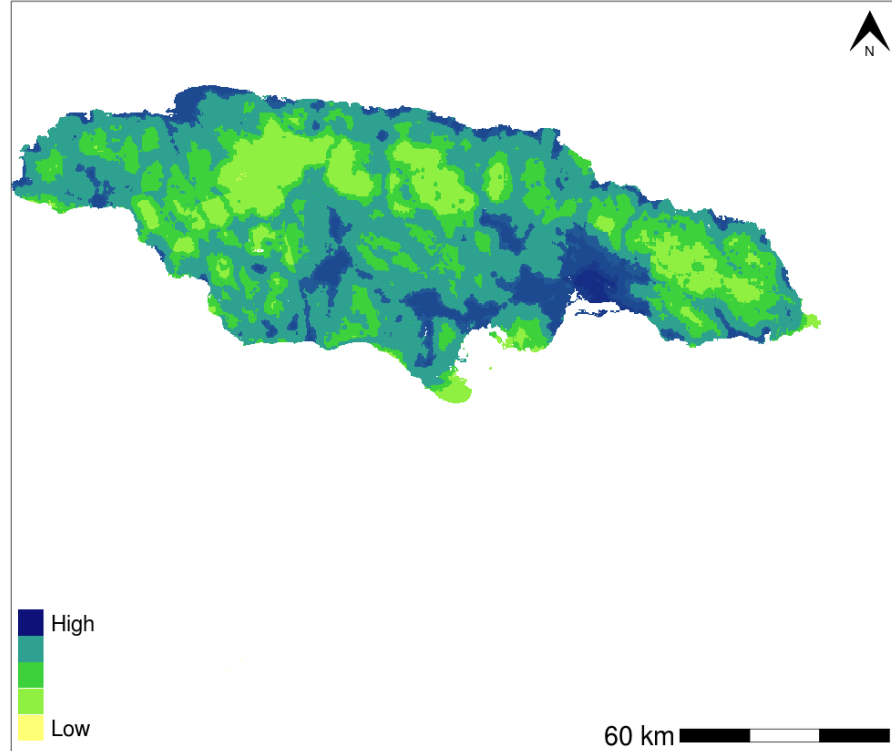
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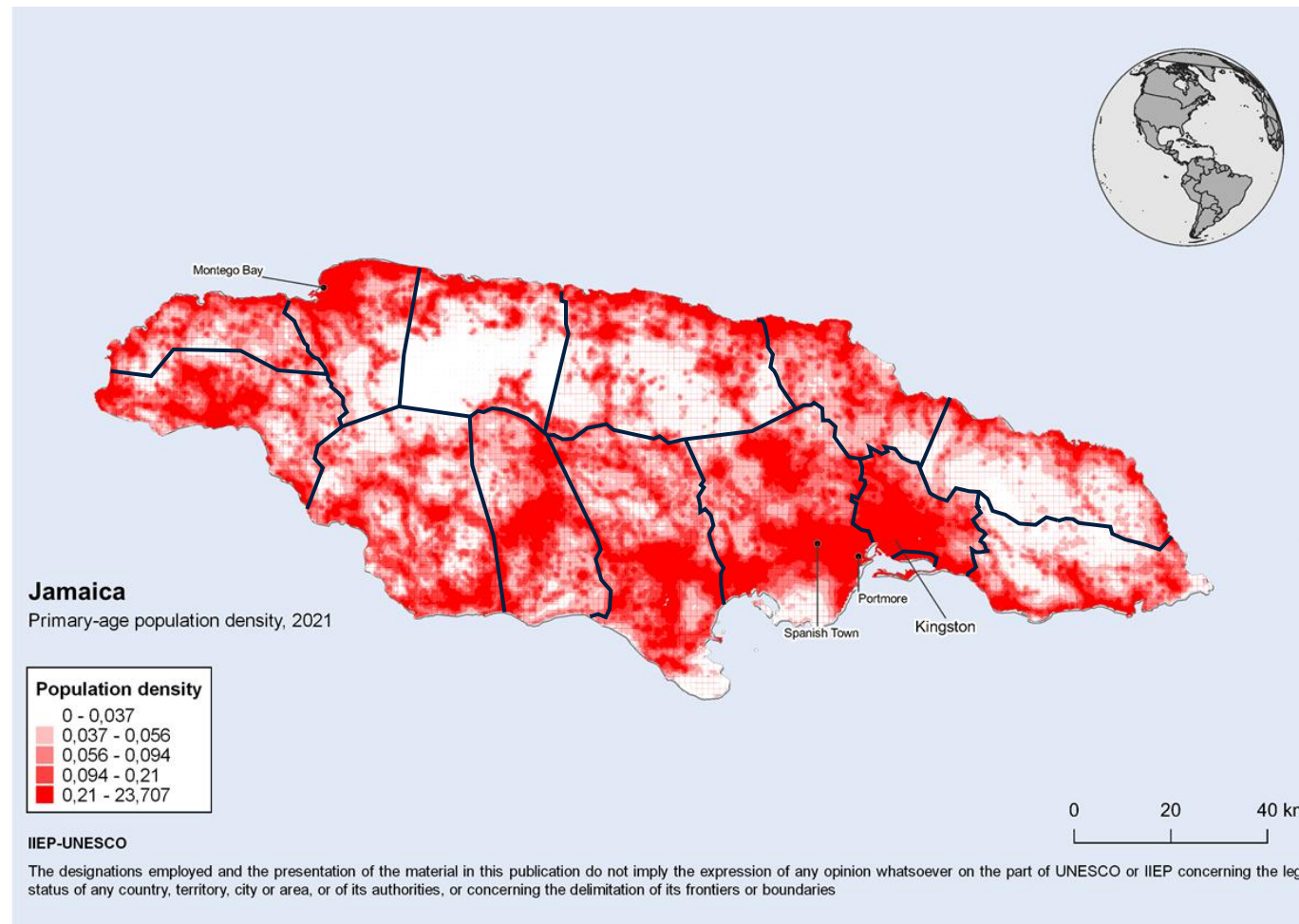
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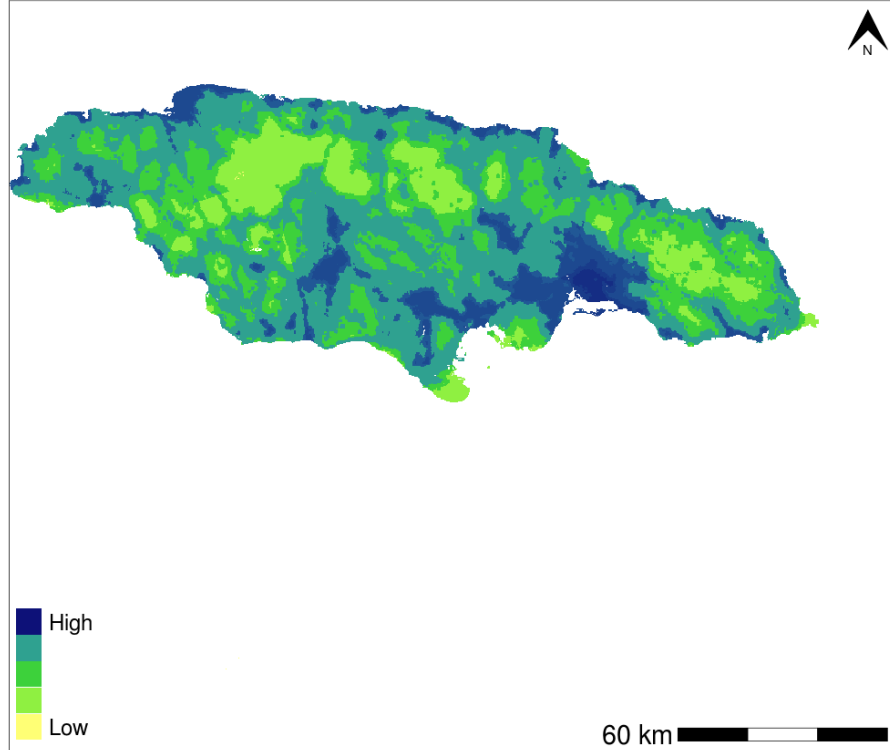
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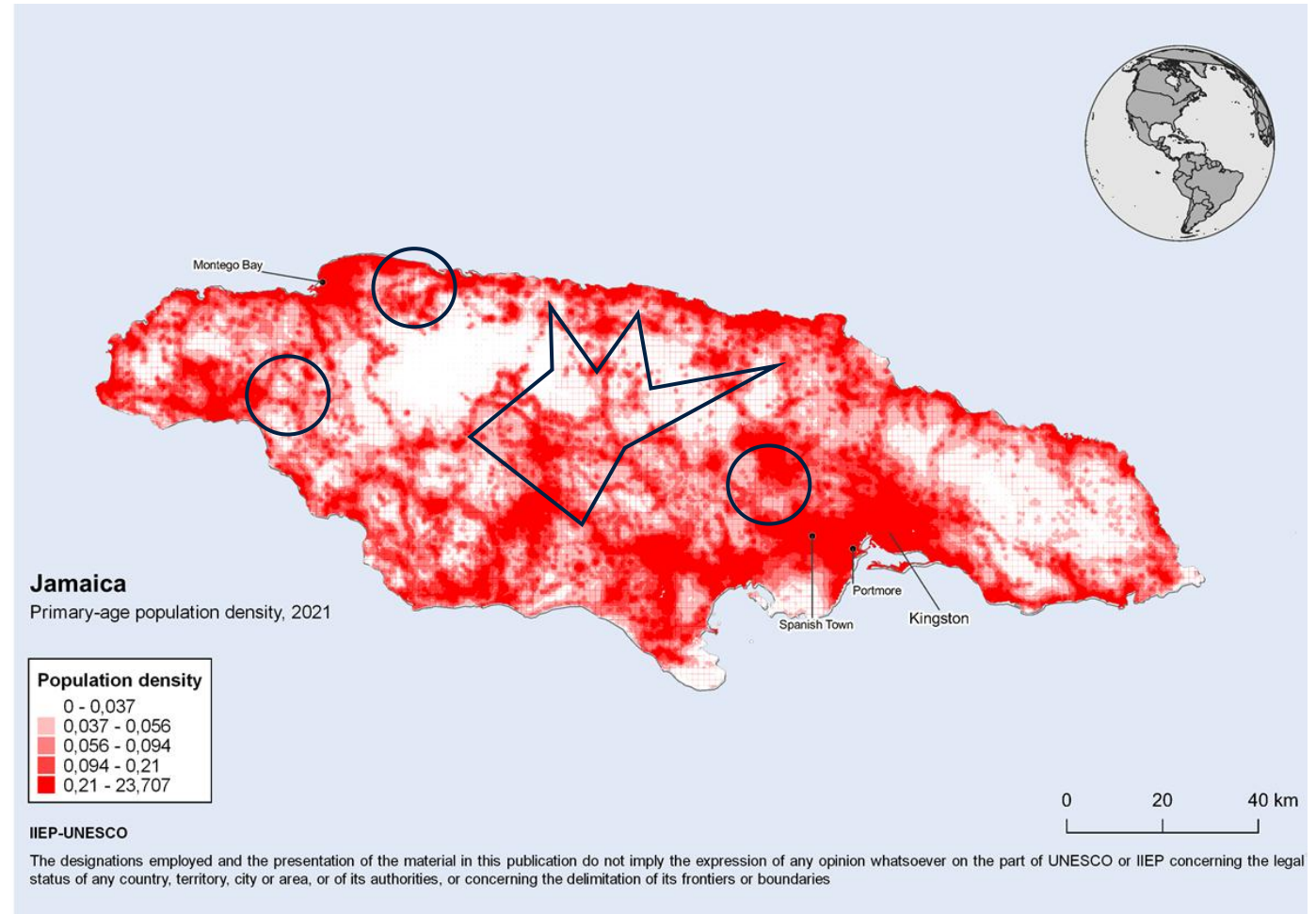
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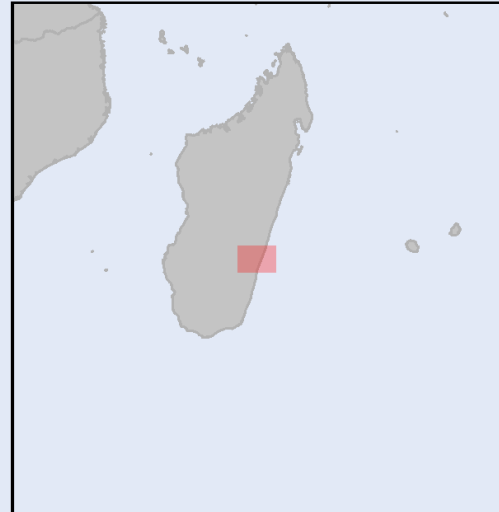
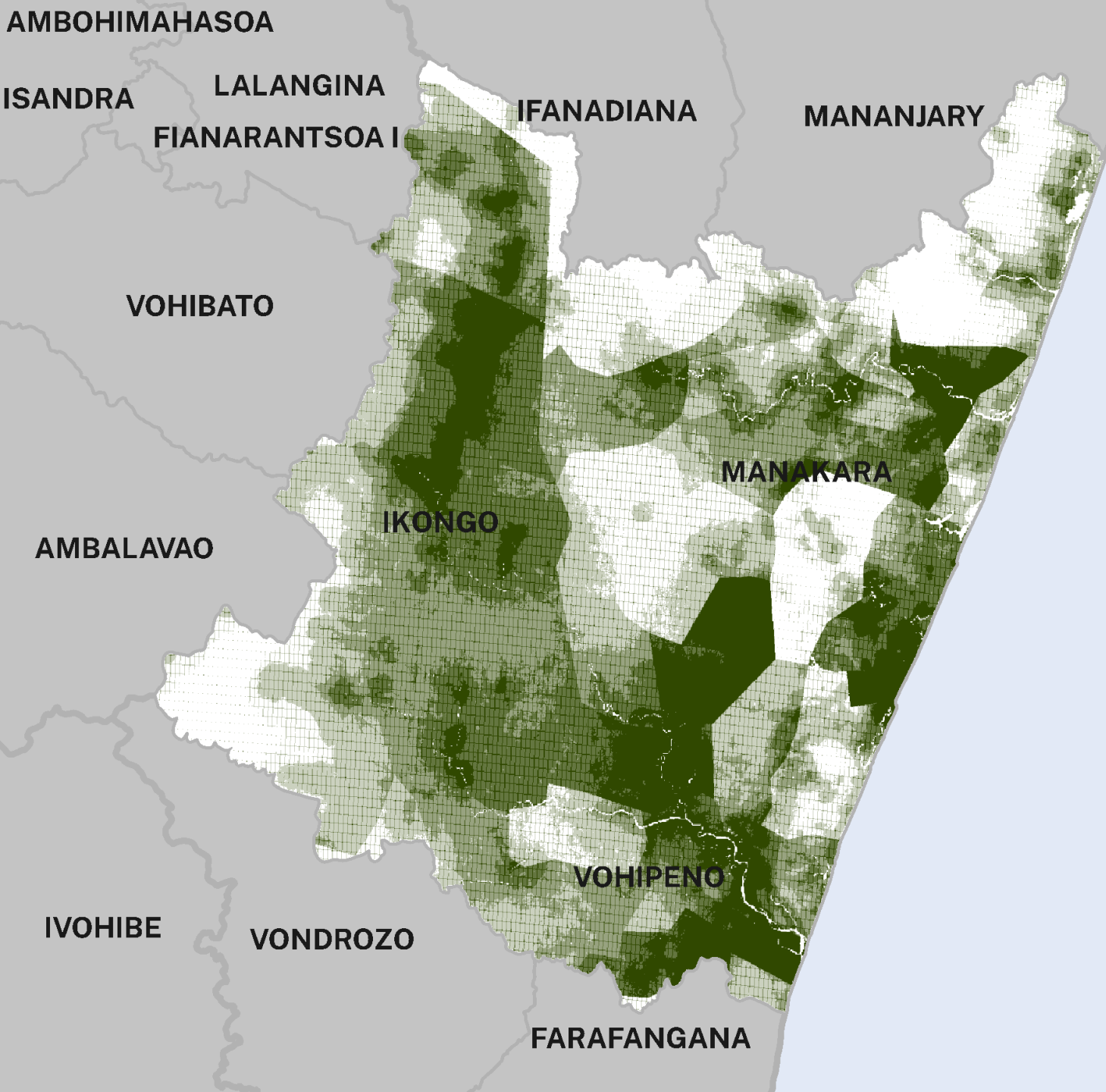


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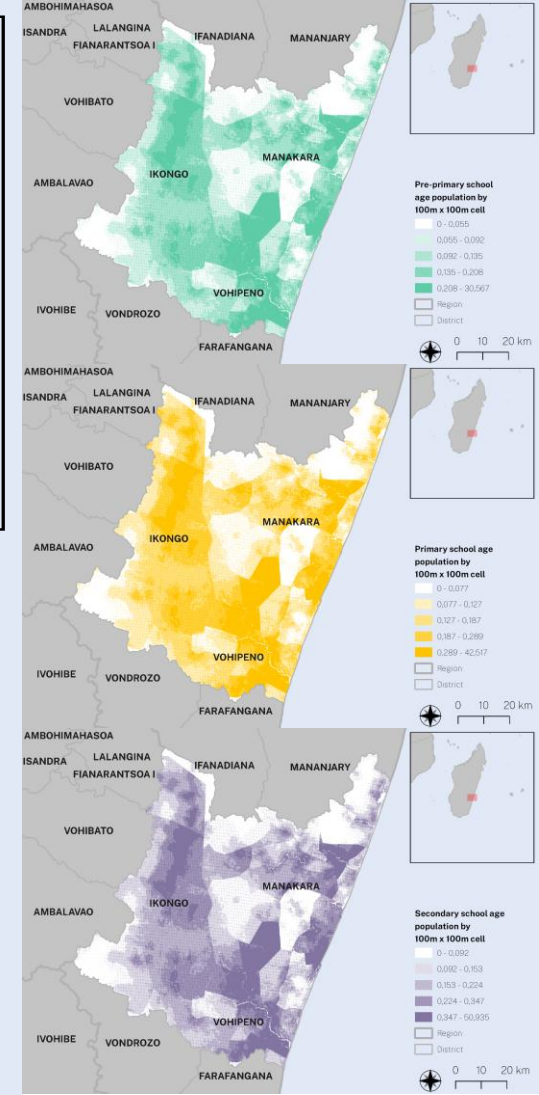
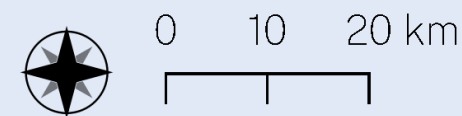
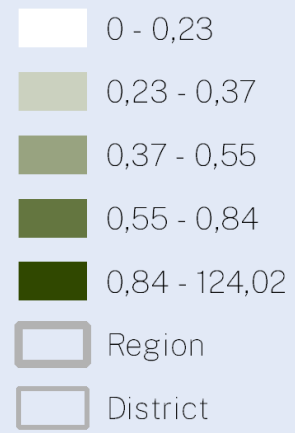
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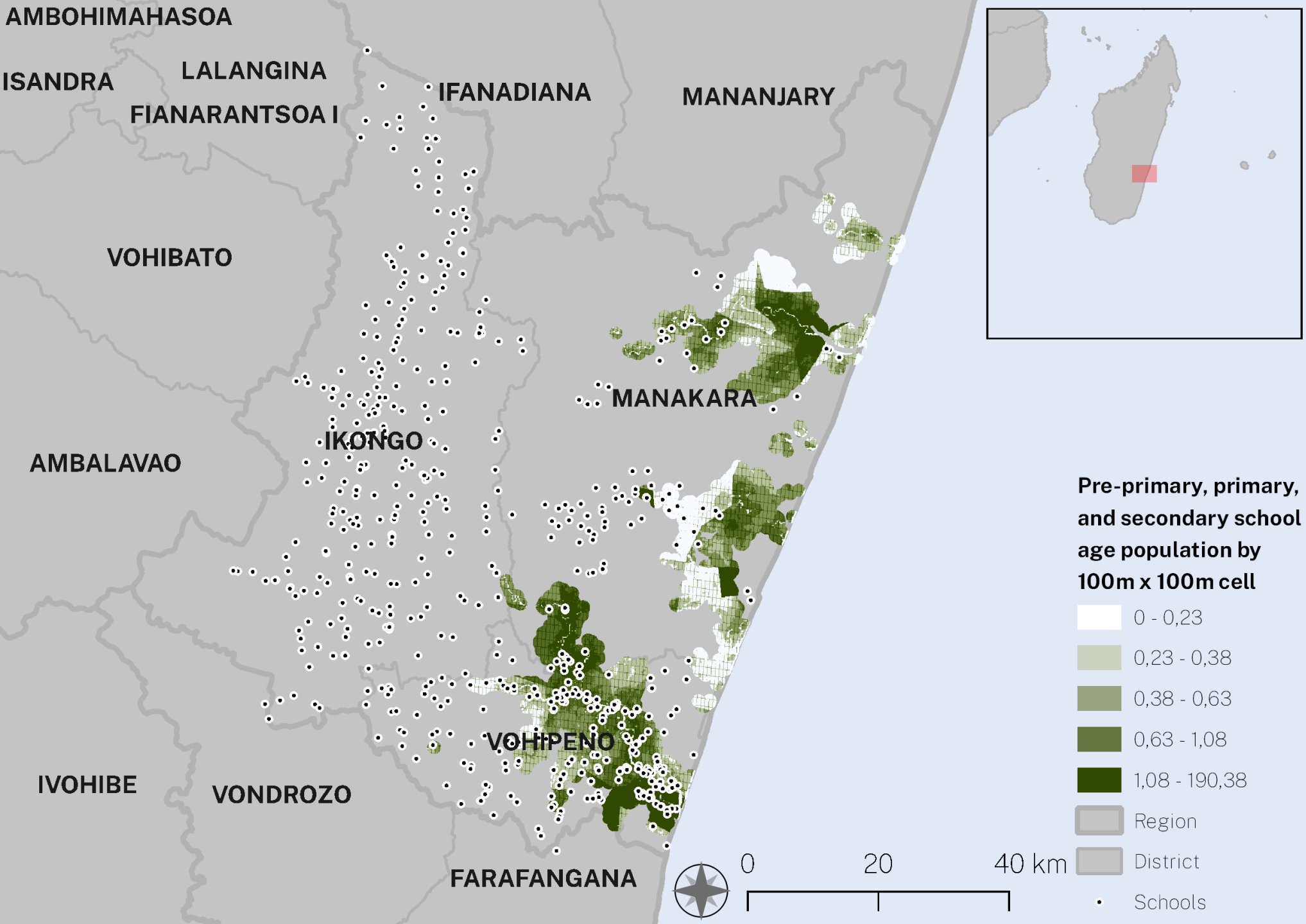
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**Pre-primary, primary, and secondary school age population by 100m x 100m cell**

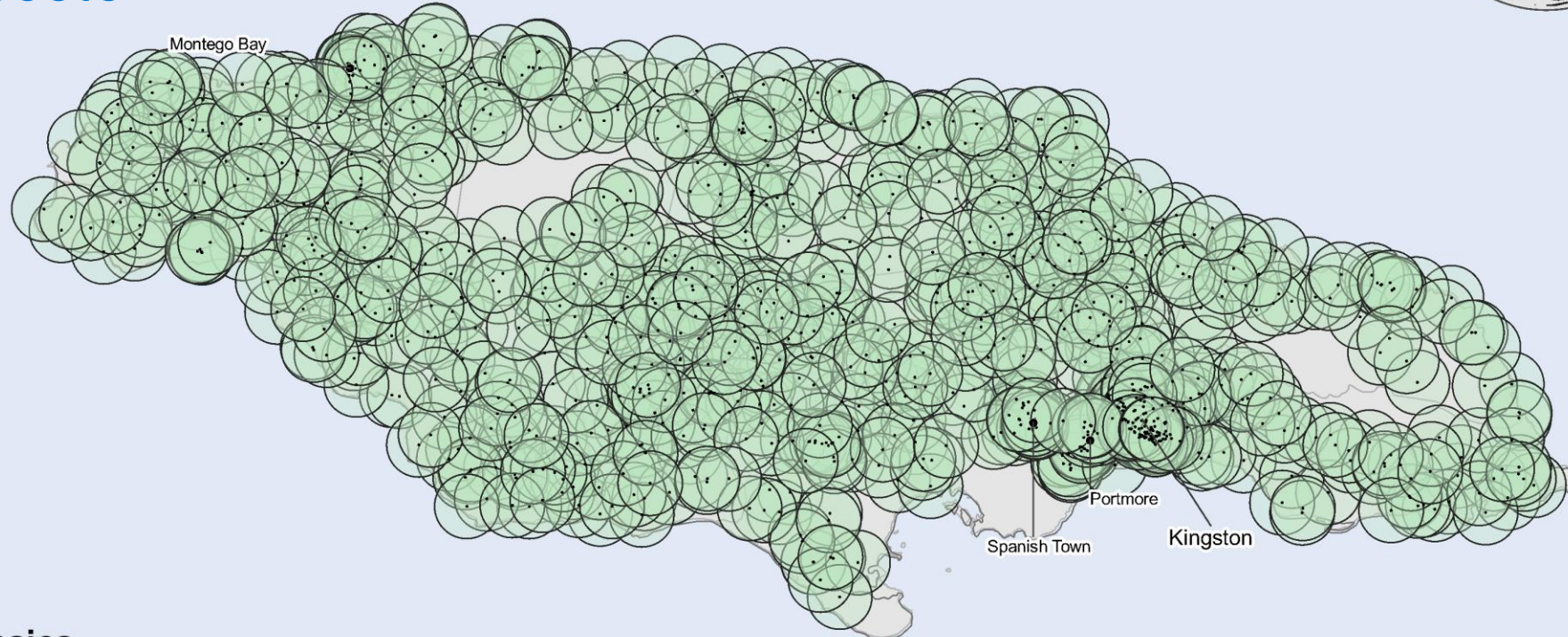




# Qui est (réellement) couvert par le système scolaire ?

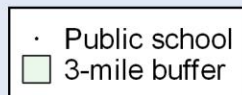
Calcul des zones desservies à l'aide d'isochrones

99,5 % de la population en âge d'aller à l'école primaire vit dans un rayon de 3 miles autour d'une école



## Jamaica

Primary school location, and 3-mile buffer, 2021

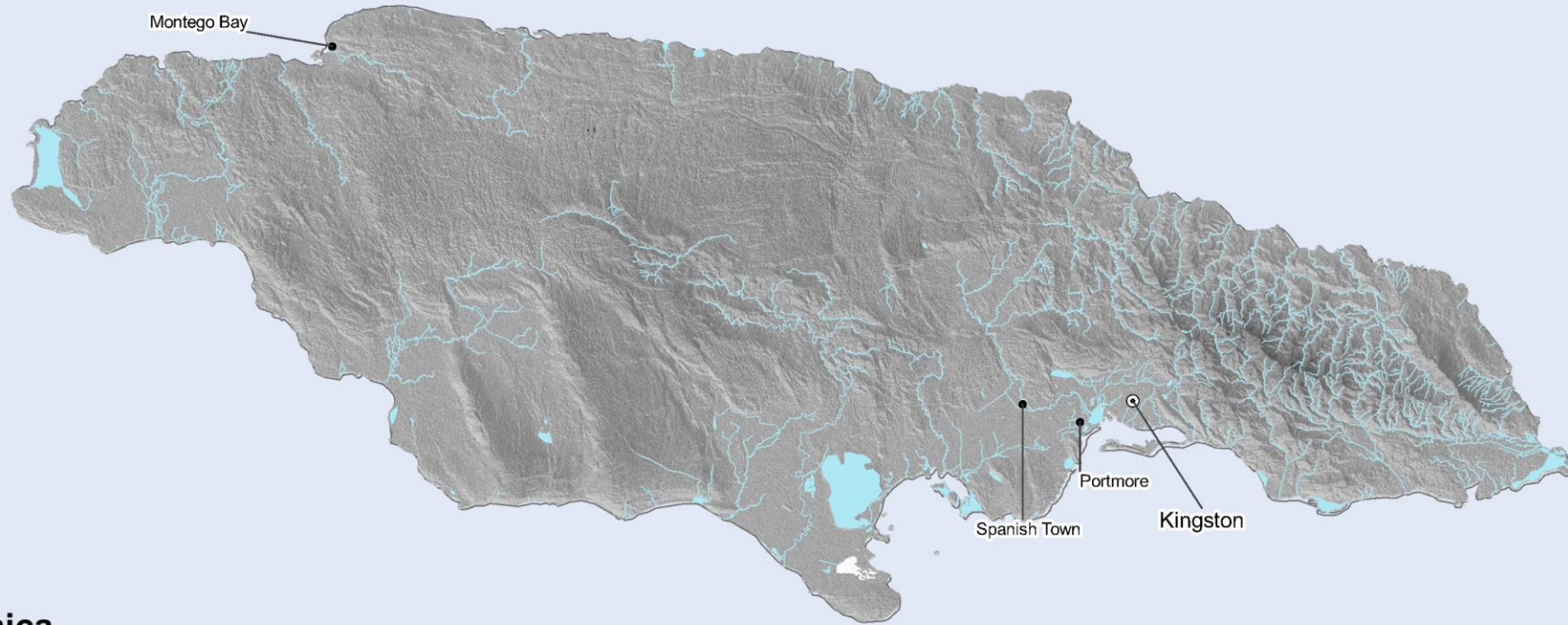


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... un adulte moyen parcourt cette distance en 45 à 60 minutes





## Jamaica

Elevation map and waterways

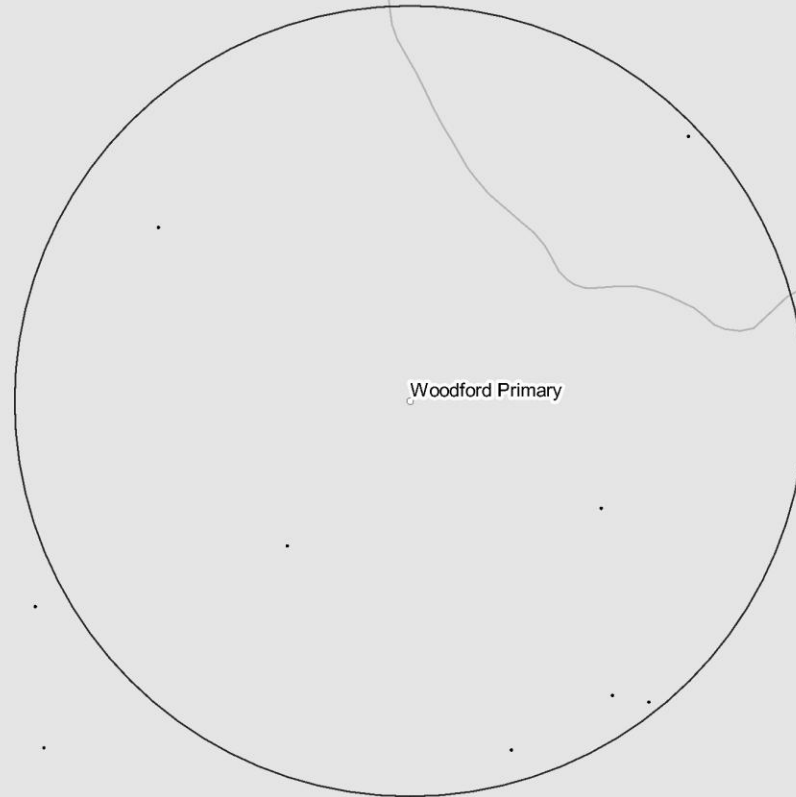
— Waterways



### IIEP-UNESCO

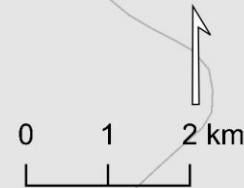
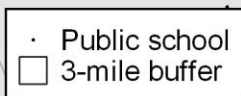
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# Woodford Primary School



## Jamaica

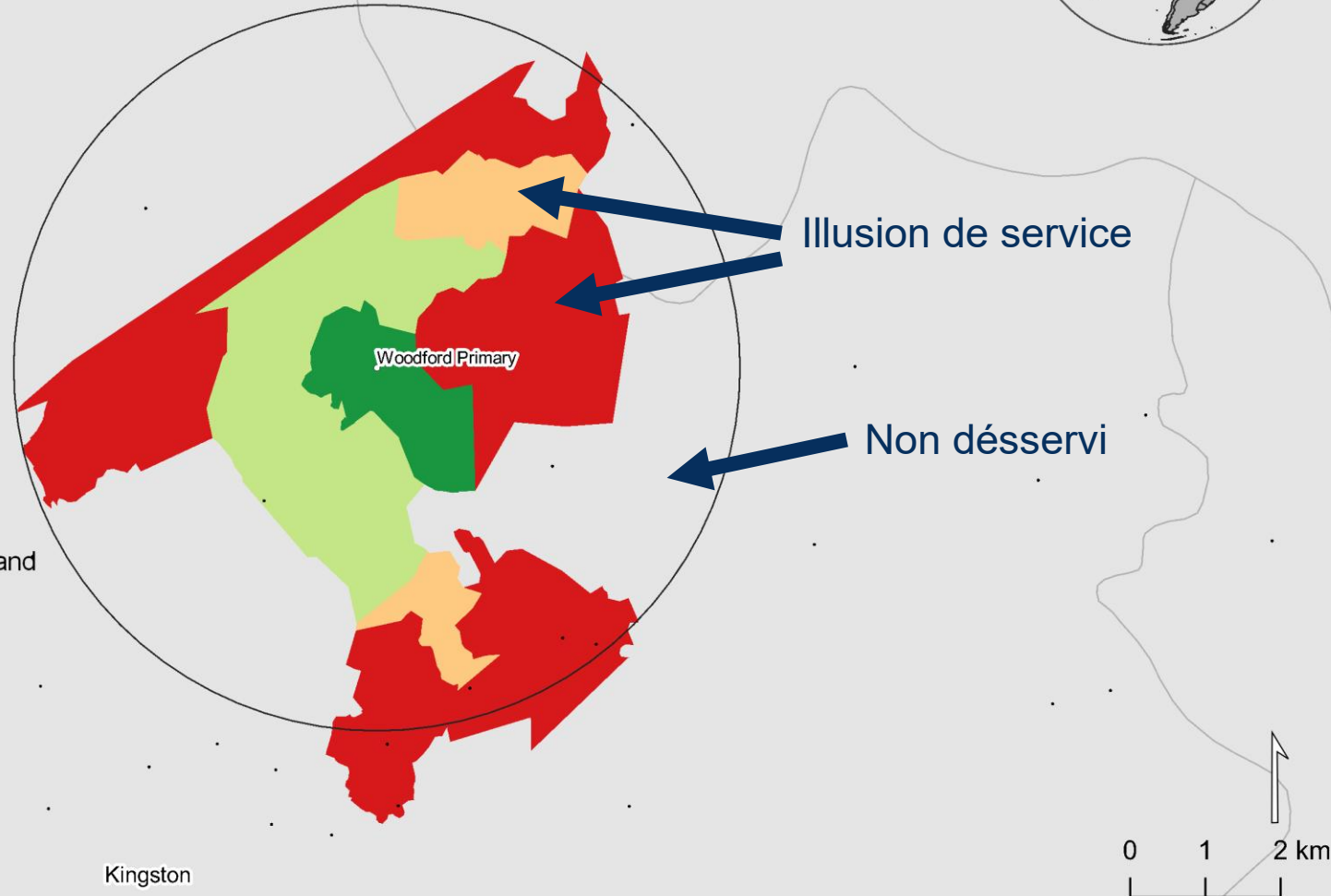
Woodford Primary location, and 3-mile buffer, 2021



## IIEP-UNESCO

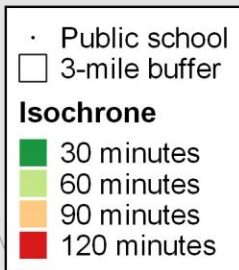
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# Woodford Primary School



## Jamaica

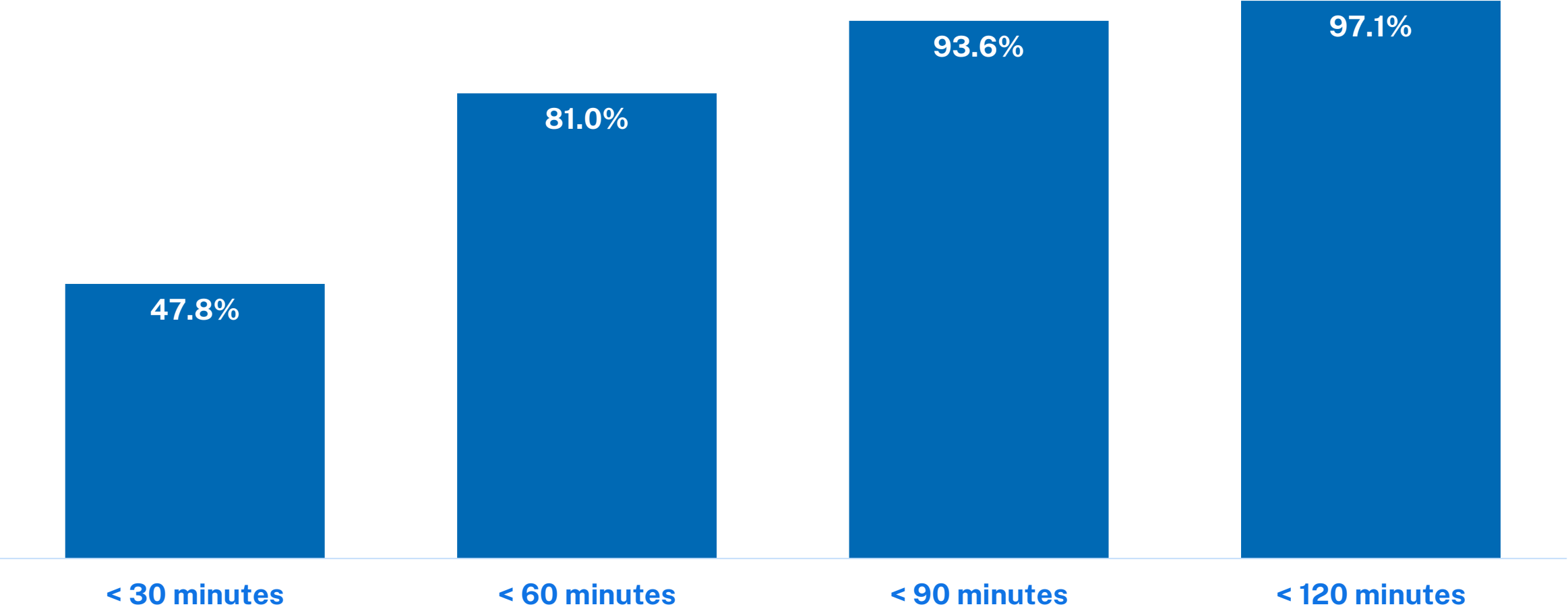
Woodford Primary location, 3-mile buffer, and isochrone-based catchment area, 2021

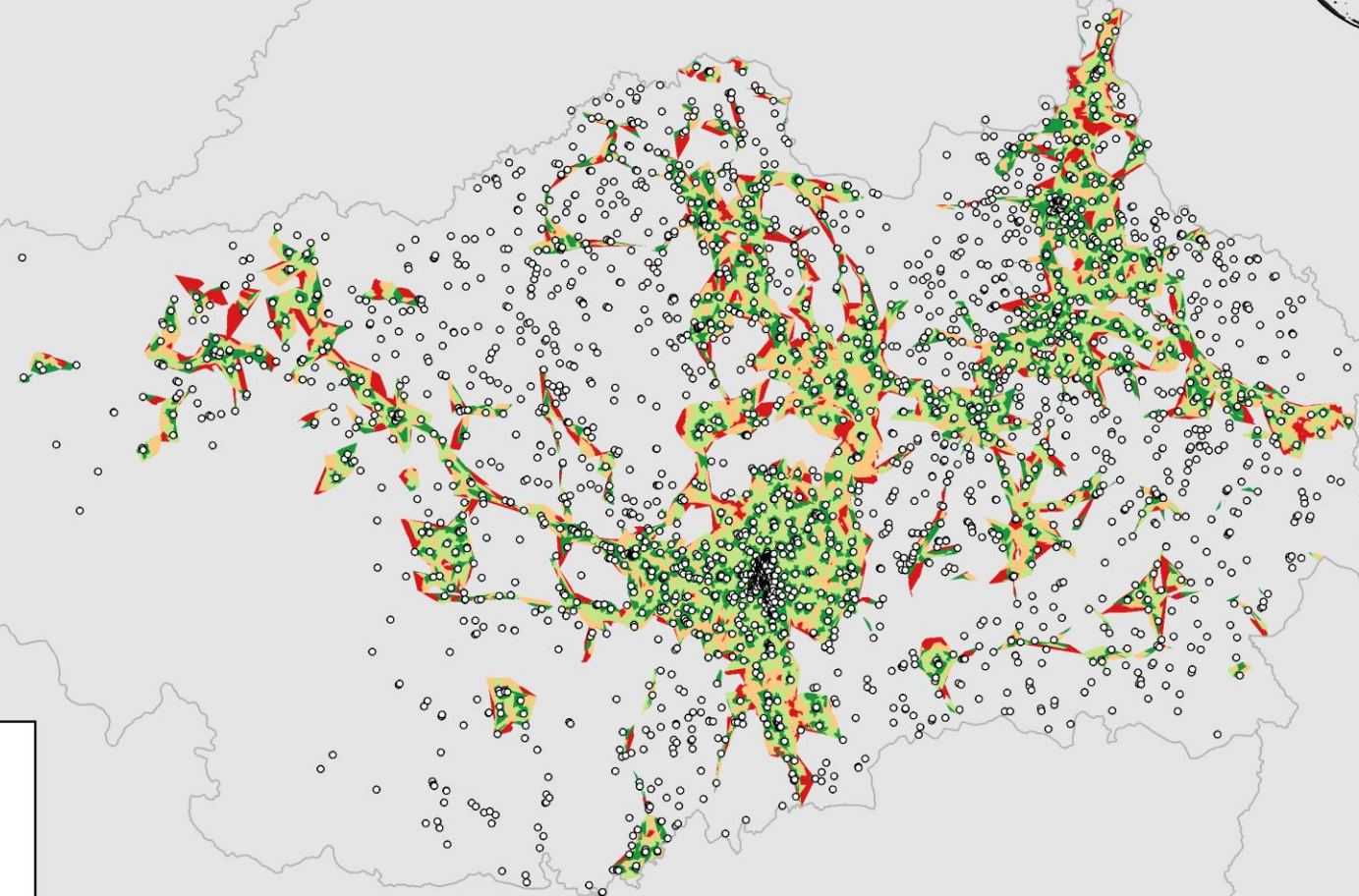
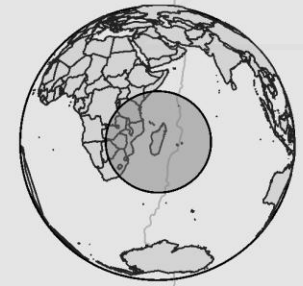


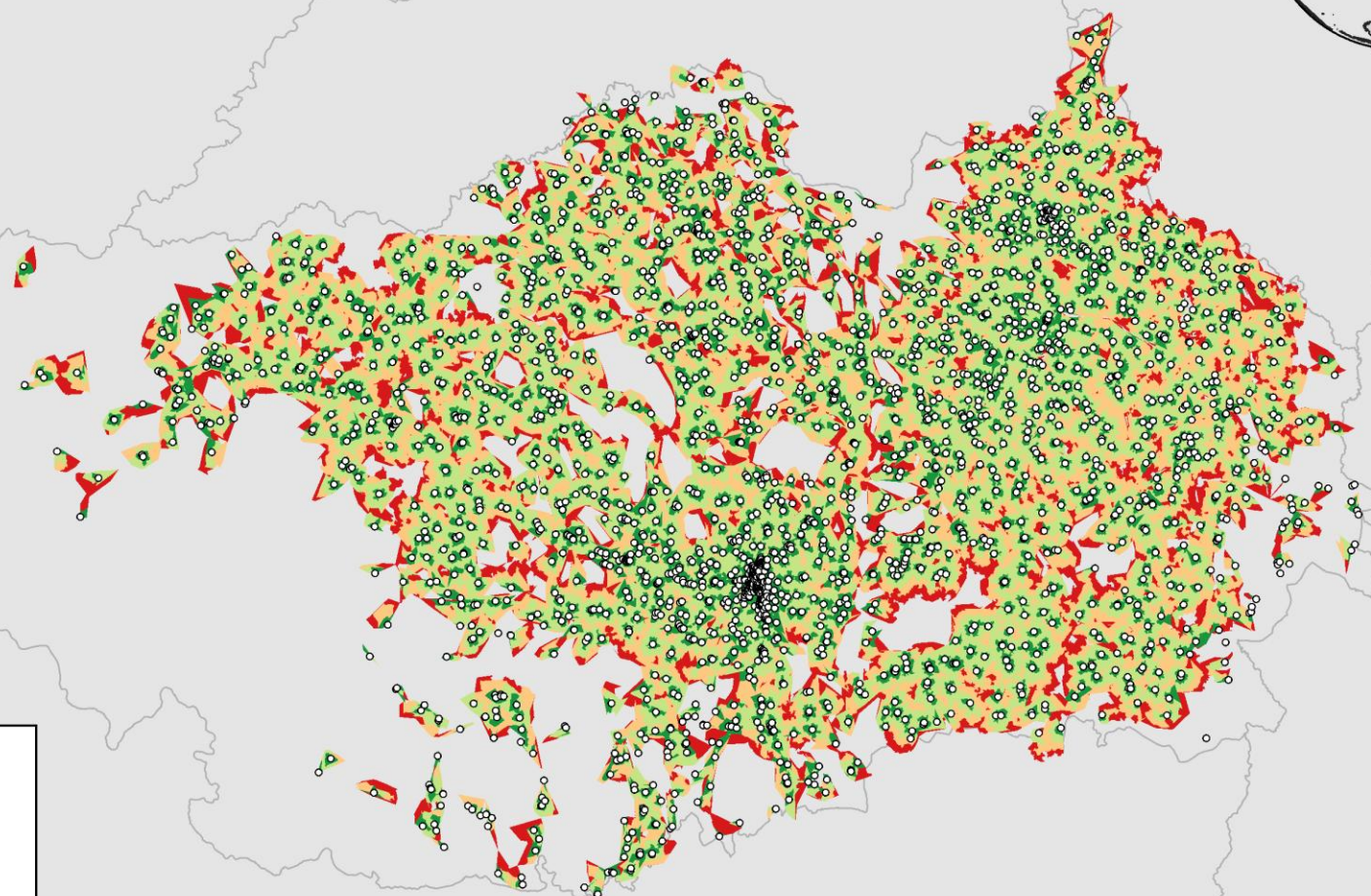
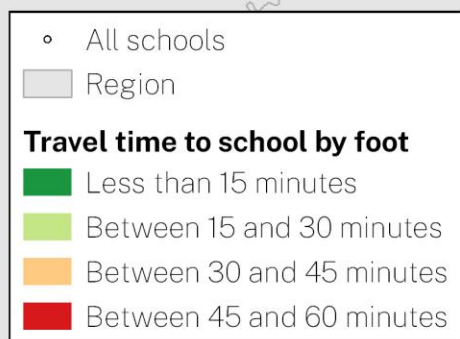
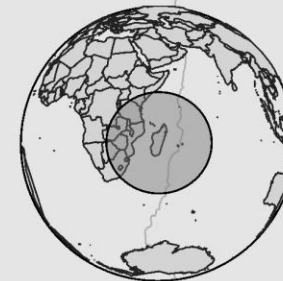
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# L'accès effectif à l'école en Jamaïque, population en âge de fréquenter l'école primaire







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# Où devraient être situées les écoles ?

Analyse multicritères de décision

# Introduction au modèle ADM



L'utilisation de données nationales ou gratuites de source ouverte permet de cartographier différents aléas naturels et risques potentiels sur le système éducatif, en particulier sur les établissements d'enseignement.

La méthodologie est construite **en deux parties**. Premièrement, il évalue **l'exposition des écoles existantes à différents risques** ; dans ce cas les risques d'aléas naturels.

Le deuxième modèle est créé à l'aide d'une **analyse des critères d'adéquation**. Des critères dans différentes catégories sont choisis pour fonder l'adéquation du site et reçoivent un score d'adéquation (entre 1 et 4).

En procédant à une analyse d'adéquation, il permet de pondérer les critères et de les personnaliser en fonction du contexte. Le résultat est une carte d'adéquation qui affiche les emplacements plus ou moins adaptés à la construction ou au déplacement des établissements d'enseignement.

# Aléas naturels

Rasters (ou vecteurs rasterisés)

Tremblement de terre

Tsunamis

Inondations

Climat extrême

Glissement de terrain

Volcan

Scores  
normalisés

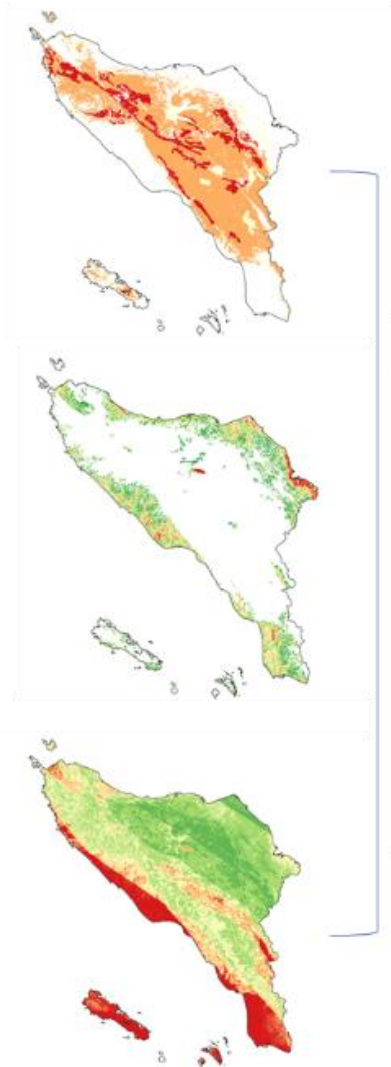
**Danger naturel  
et exposition**

*Exemple avec  
l'Indonésie*

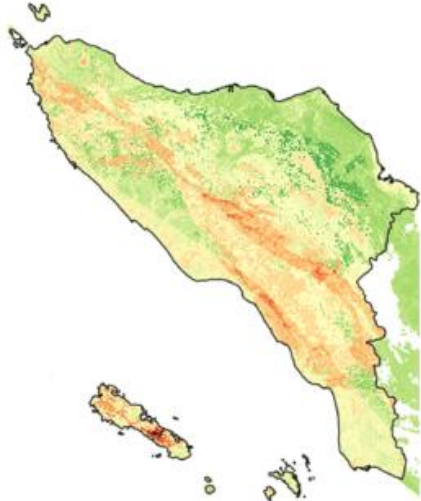
*Catégorie*

*Composants*

## Couches d'aléas naturels



Couches d'aléas naturels combinés pour créer un indice composite

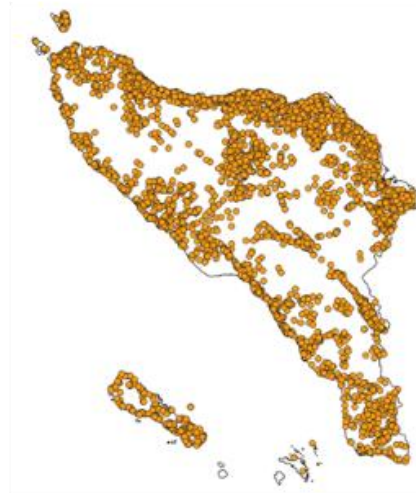


## Zone d'analyse et points d'exposition

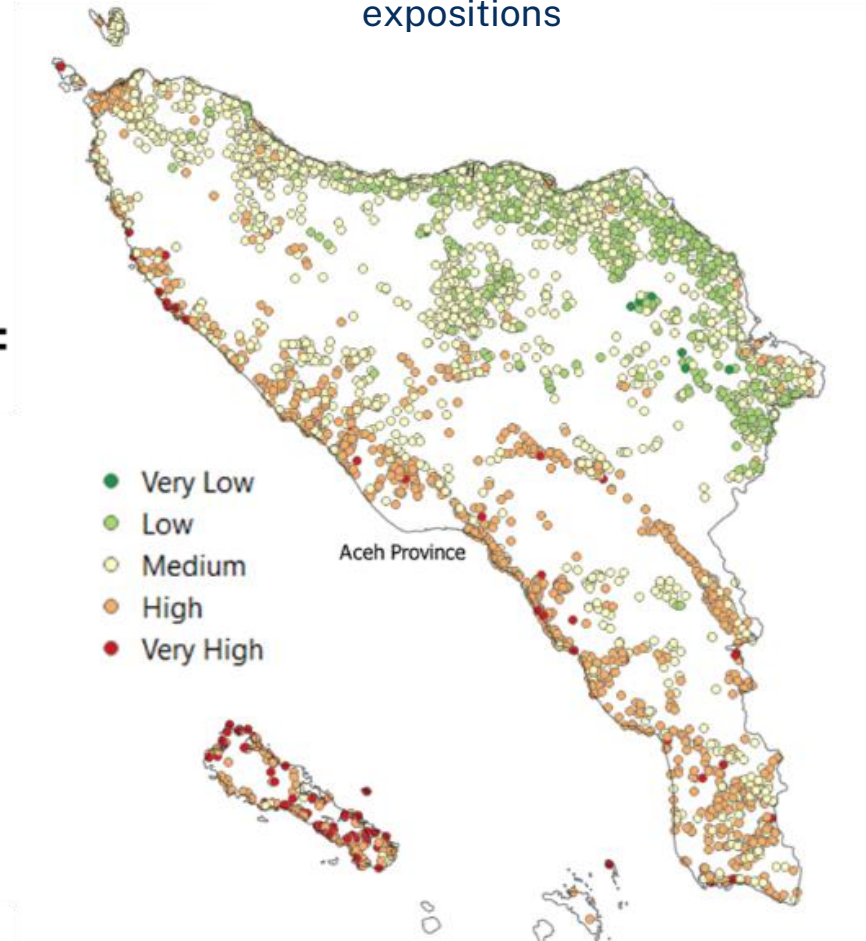


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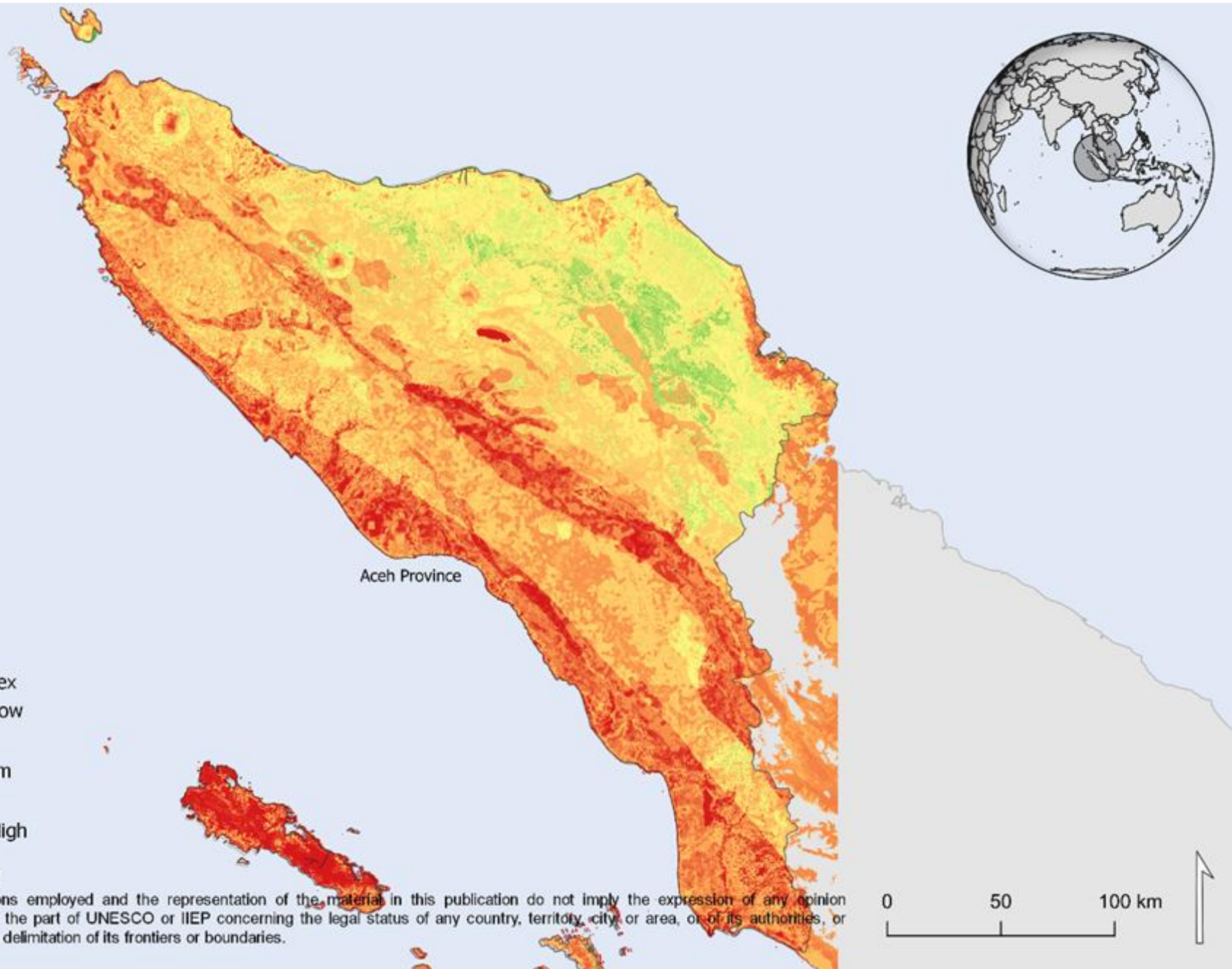


## Écoles et leurs expositions





unesco

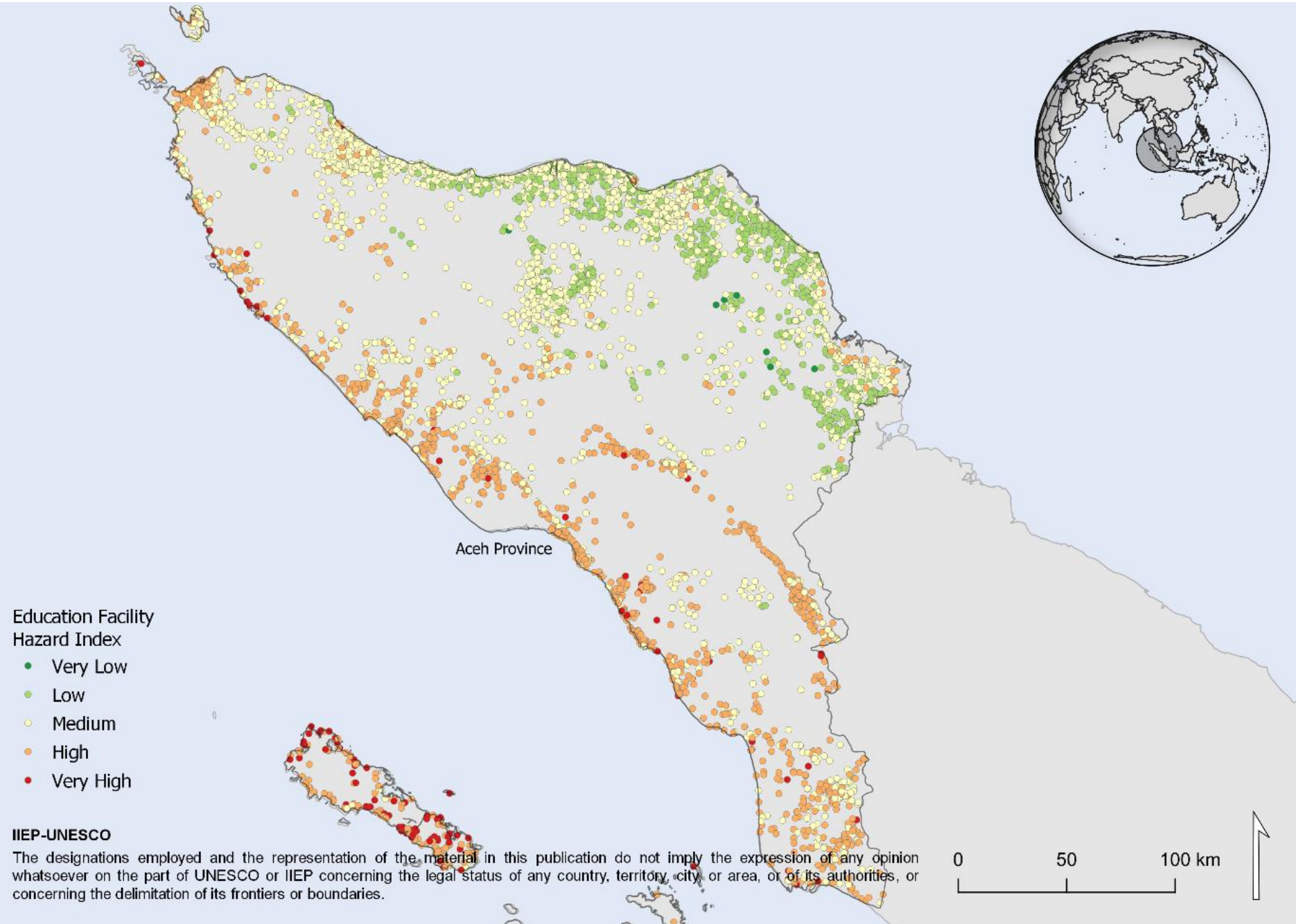


- Hazard Index
- Very Low
  - Low
  - Medium
  - High
  - Very High

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0 50 100 km

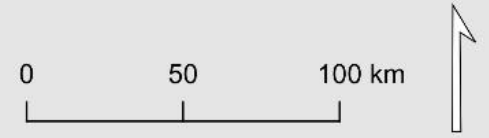




Education Facility  
Hazard Index

- Very Low
- Low
- Medium
- High
- Very High

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## Environnement et risque d'aléas

- Évaluation des risques multirisques, calculée dans la partie A, pour afficher le niveau de risque
- Risque de pente, pour assurer la sécurité du bâtiment et le risque de danger
- Perturbation de la végétation, pour minimiser la perturbation des arbres et des forêts pour construire/construire un site d'éducation

## Aléas économiques/ Infrastructure

- Proximité de la route principale, pour s'assurer que les écoles ne sont pas situées trop près des routes principales pour le bruit et la sécurité.
- Risques d'inondations fluviales et soudaines (impacts minimes sur les bassins versants), pour garantir que le site ne sera pas situé dans une zone inondable.

## Aléas sociaux

- Densité de la population, pour s'assurer que les écoles seront situées dans des zones peuplées pour la convivialité et l'accessibilité par la population.
- Les établissements d'enseignement existants, pour s'assurer que les nouveaux établissements d'enseignement construits sont espacés entre les établissements d'enseignement existants pour une utilisation optimale.

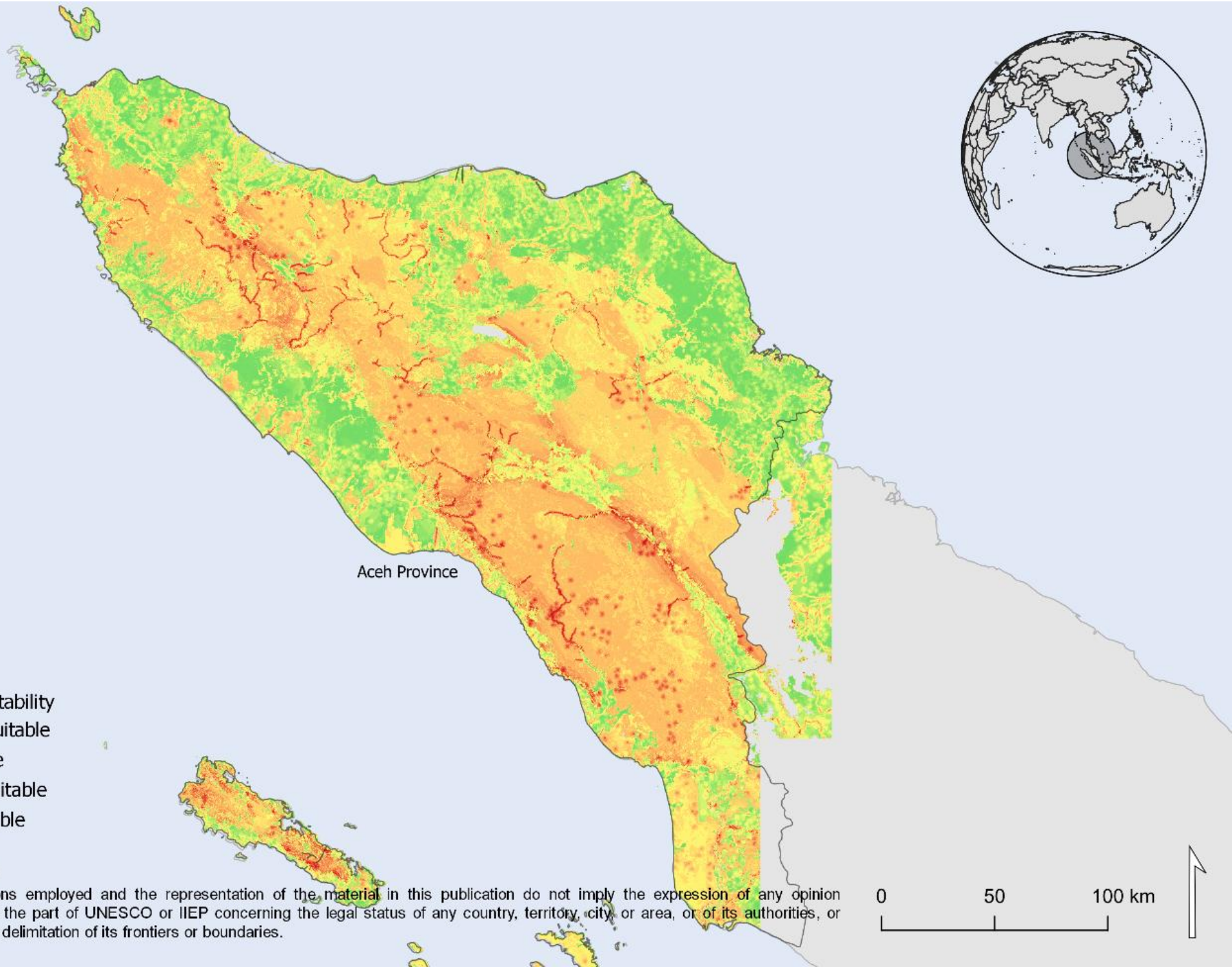


# Notes des critères – Catégorie Environnement (exemple)

| Catégorie     | Critère  | Score | Pertinence          |
|---------------|--|-------|---------------------|
| Environnement | <b>Indice de risques multiples, tel que calculé dans la partie A</b> |       |                     |
|               | 0 – 0.25   | 1     | Plus pertinente     |
|               | 0.25 – 0.5   | 2     | Pertinente          |
|               | 0.5 – 0.75   | 3     | Moins pertinente    |
|               | 0.75 – 1   | 4     | Le moins pertinente |
|               | <b>Pente</b>   |       |                     |
|               | 0  | 1     | Plus pertinente     |
|               | 1 – 10   | 2     | Pertinente          |
|               | 10 – 20  | 3     | Moins pertinente    |
|               | > 20   | 4     | Le moins pertinente |
|               | <b>Perturbation des arbres, forêt primaire</b>                       |       |                     |
|               | Aucun défrichage nécessaire (0 score)                                | 1     | Plus pertinente     |
|               | Défrichage de la forêt primaire nécessaire                           | 4     | Le moins pertinente |

# Options de pondération

| <b>Catégorie</b>            | <b>Critère</b>                 | <b>Pondération</b> |
|-----------------------------|--------------------------------|--------------------|
| Environnement               | Indice de risques multiples    | 0.3                |
|                             | Pente                          | 0.2                |
|                             | Superficie forestière primaire | 0.5                |
| Infrastructures et économie | Réseau routier                 | 0.3                |
|                             | Rivières et plans d'eau        | 0.7                |
| Social                      | Densité de population          | 0.4                |
|                             | Emplacements des écoles        | 0.6                |



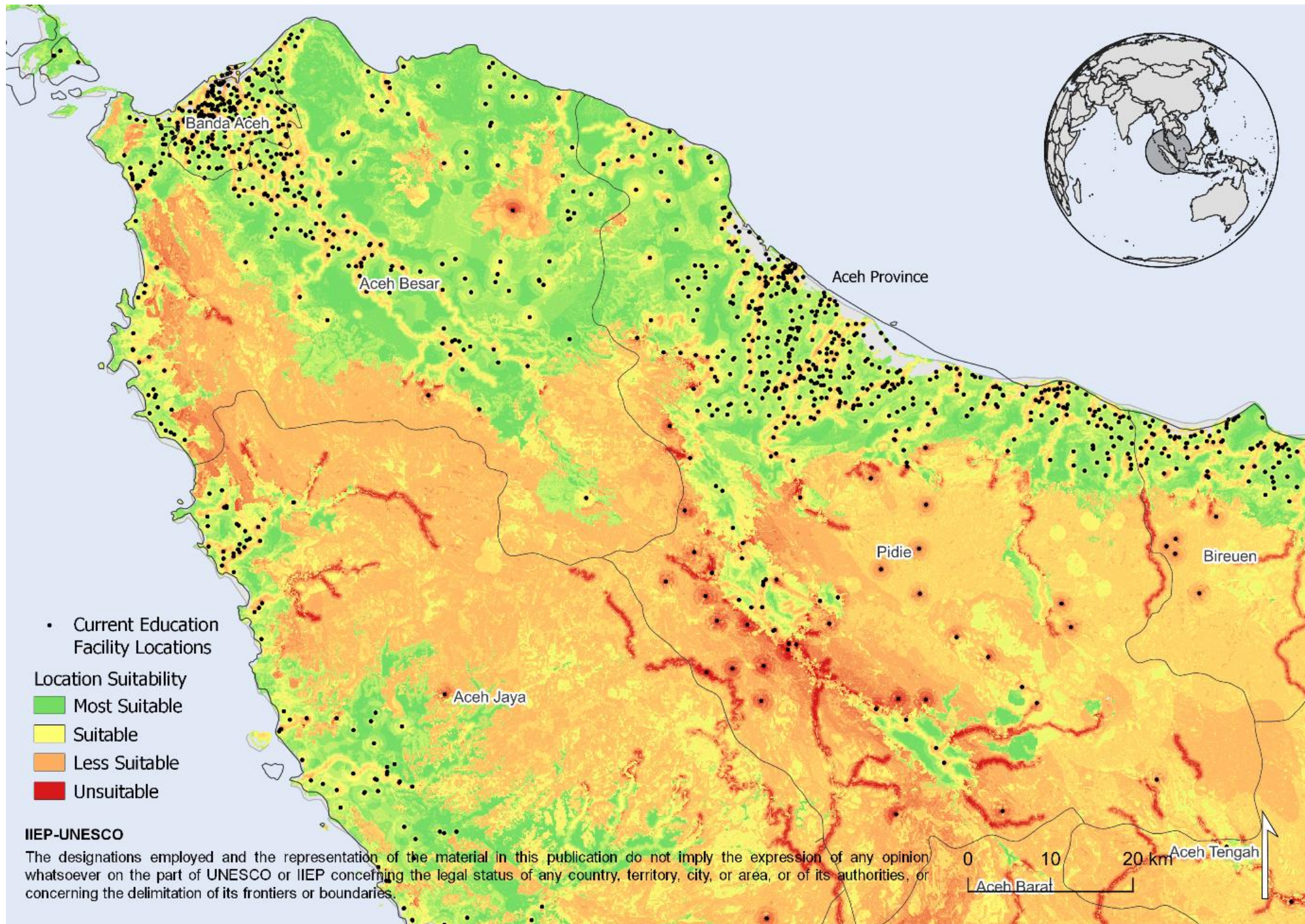
Location Suitability

-  Most Suitable
-  Suitable
-  Less Suitable
-  Unsuitable

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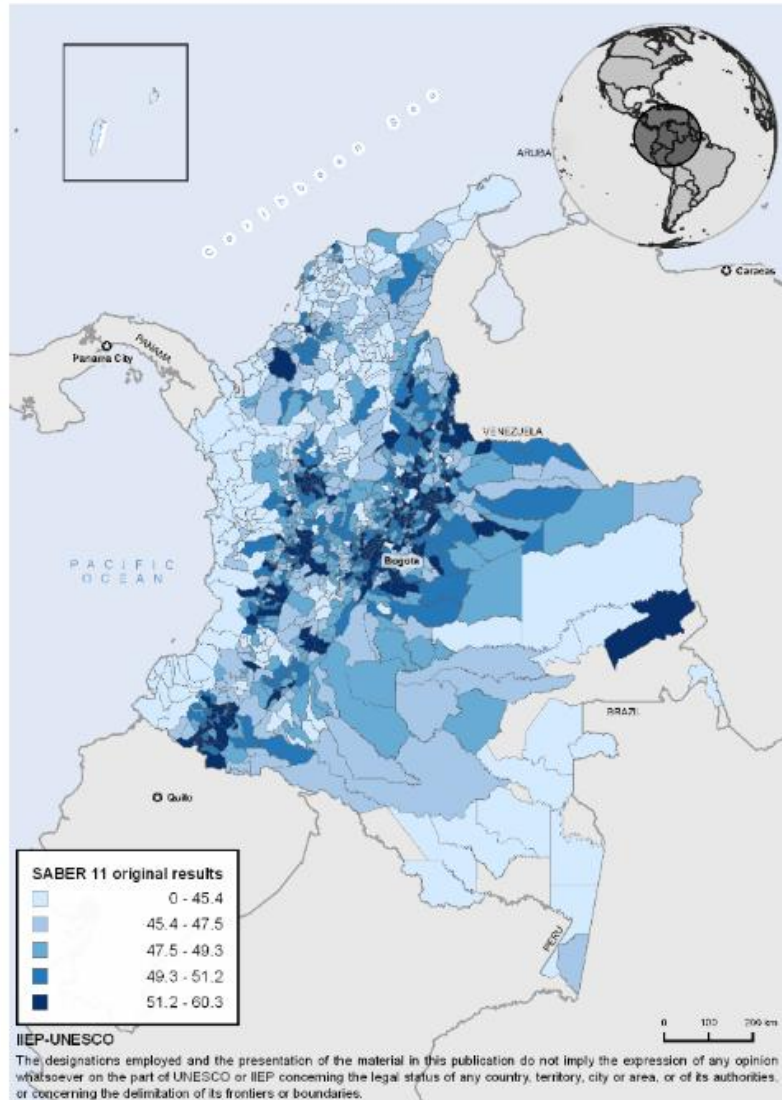


# Toutes les relations ne sont pas aussi efficaces partout

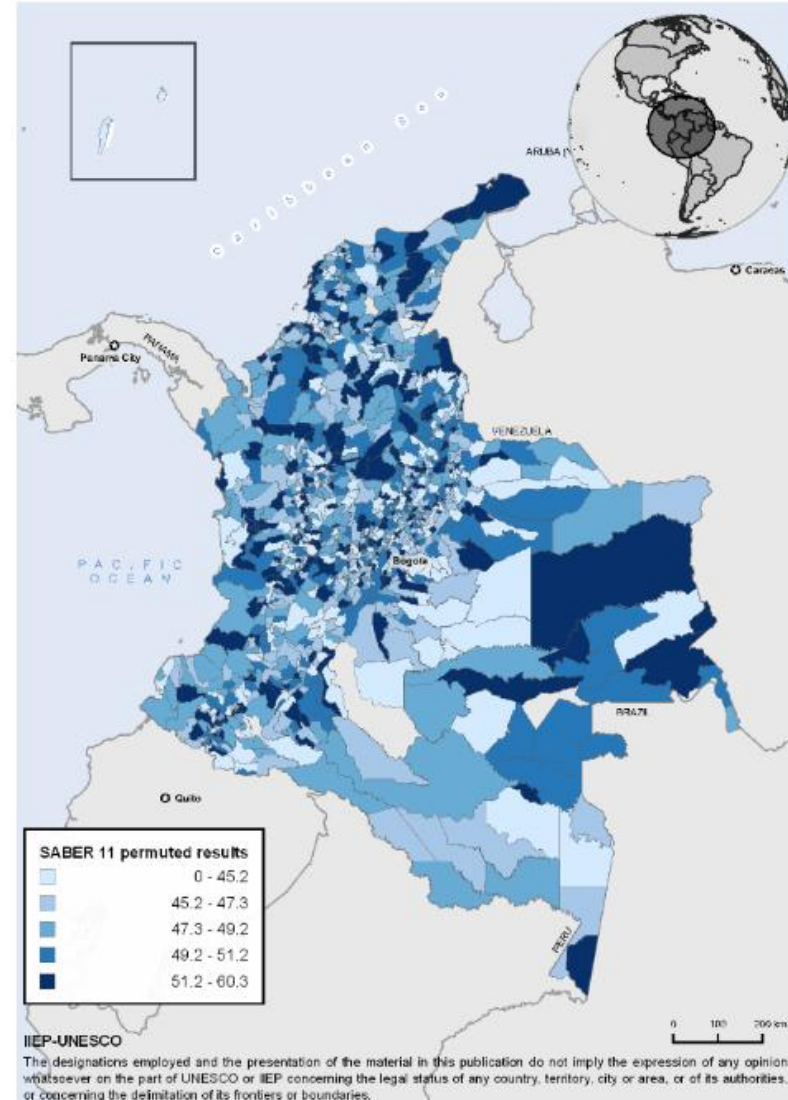
Régressions pondérées géographiquement

# Constat 1 : Les variables ne sont pas distribuées aléatoirement sur le territoire

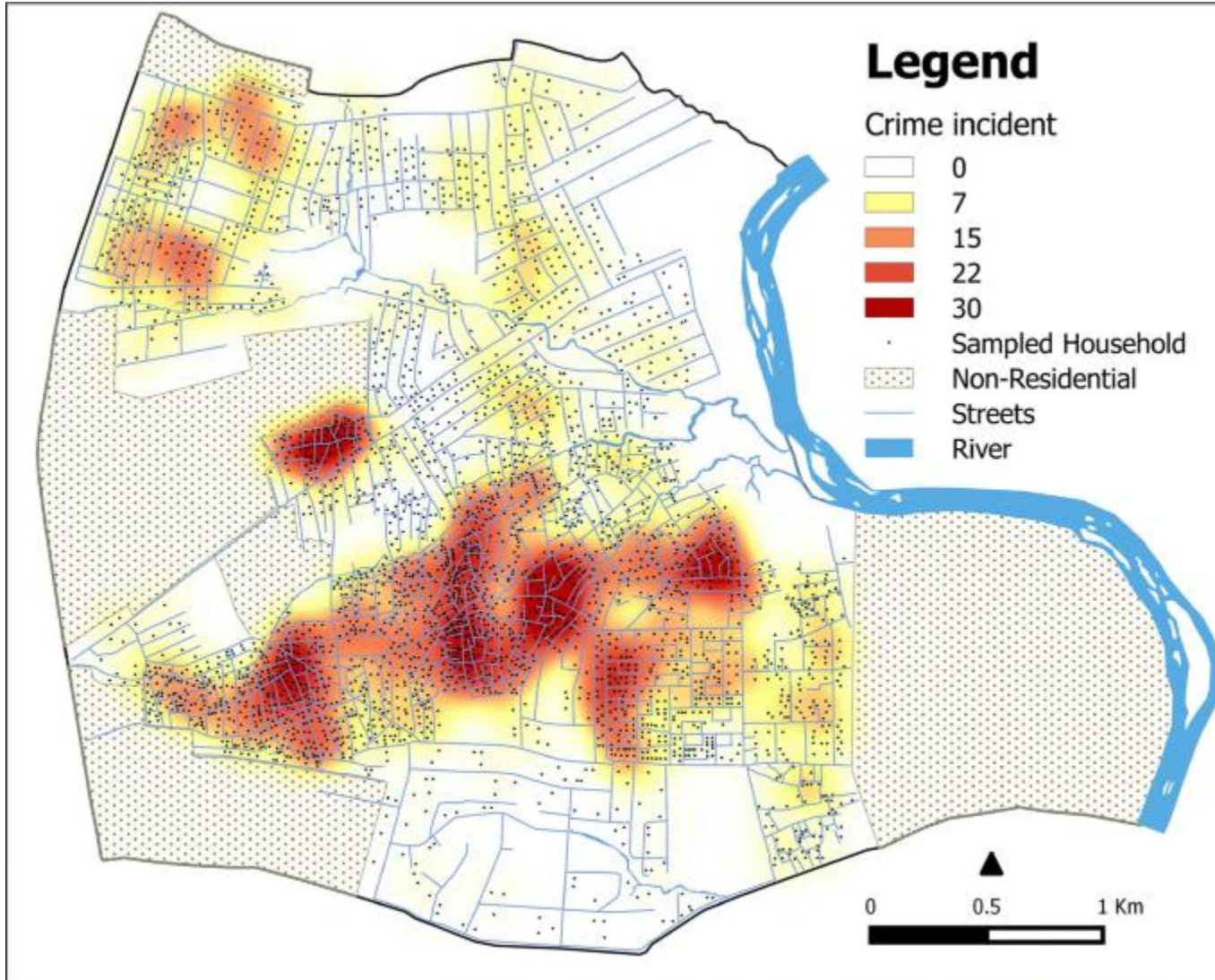
## Distribution réelle



## Distribution aléatoire



**Constat 2 :** Souvent, les chances de quelque chose ne dépendent pas seulement des caractéristiques de la personne ou du lieu, mais aussi de celles des « voisins ».



### Exemple: Criminalité

Umar, F., Johnson, S.D. & Cheshire, J.A.  
Assessing the Spatial Concentration of Urban  
Crime: An Insight from Nigeria. *J Quant  
Criminol* 37, 605–624 (2021).  
<https://doi.org/10.1007/s10940-019-09448-3>

# Constat 3 : Les mécanismes derrière les résultats observés pourraient ne pas être les mêmes dans l'espace

Les élèves abandonnent-ils le système scolaire pour les mêmes raisons, quel que soit leur lieu de résidence ? Ou existe-t-il des mécanismes différents selon leur AREF, voire leur lieu de résidence ?

Pas forcément !

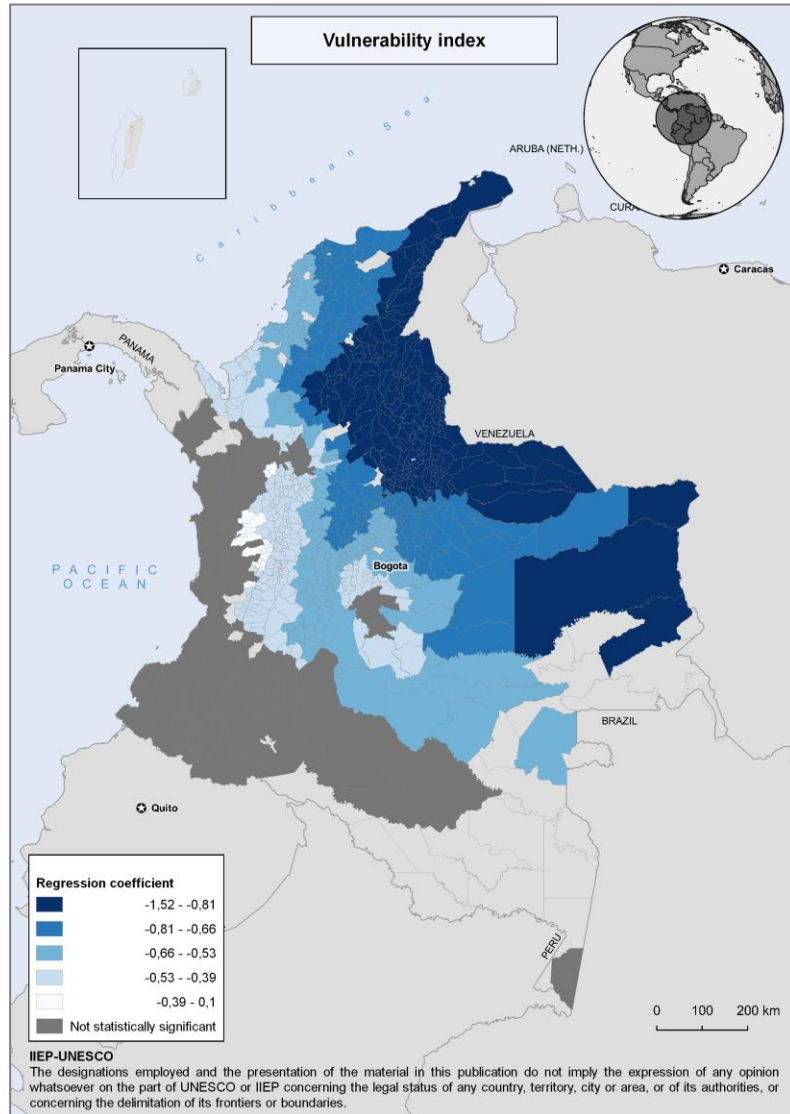
C'est pourtant l'hypothèse sous-jacente à la plupart des modèles économétriques.



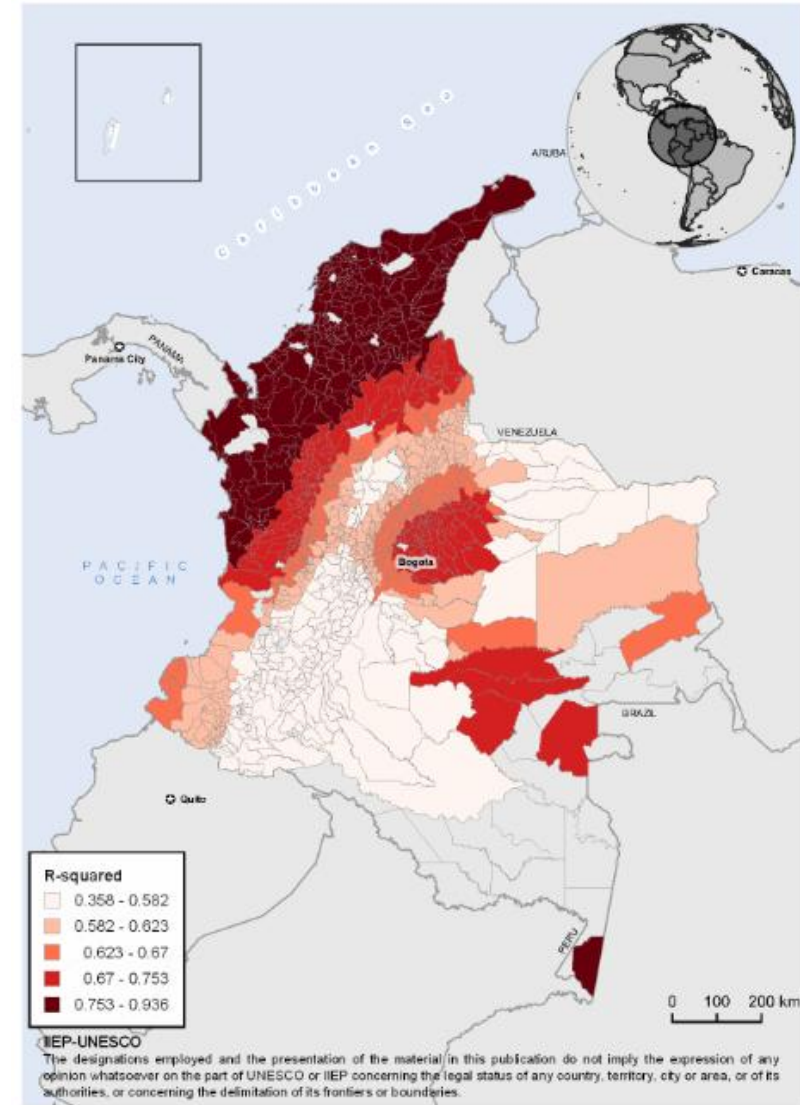
| Variable          | e_s11_to_1              |
|-------------------|-------------------------|
| <i>Vulnerabil</i> | -0.647***<br>(0.0808)   |
| <i>G_IGA_tota</i> | 0.069***<br>(0.0091)    |
| <i>TransAlimE</i> | -0.0002***<br>(0.00004) |
| <i>GC_indrura</i> | 1.366***<br>(0.4869)    |
| <i>Threat</i>     | 0.120*<br>(0.0572)      |
| <i>Poverty</i>    | 0.041***<br>(0.0075)    |
| <i>SISBENIPC</i>  | -17.7***<br>(3.8705)    |
| <i>MurderRate</i> | -0.011***<br>(0.0028)   |
| <i>Lack_Respo</i> | -0.053<br>(0.0717)      |
| <i>ProxyGDP</i>   | 0.322**<br>(0.1292)     |
| <i>HS_Cover_7</i> | 0.005<br>(0.0038)       |
| <i>HS_Cover_1</i> | -0.005*<br>(0.0034)     |
| <i>TransEducP</i> | 5.273<br>(1.0909)       |
| <i>GC_discapi</i> | 0.0002<br>(0.0014)      |
| (Intercept)       | 45.64***<br>(0.9592)    |
| Observations      | 1,070                   |
| R-squared         | 0.4969                  |

# RPG: Une régression par observation, en considérant ses caractéristiques et celles des « voisins » (y compris la distance)

## Coefficients de régression



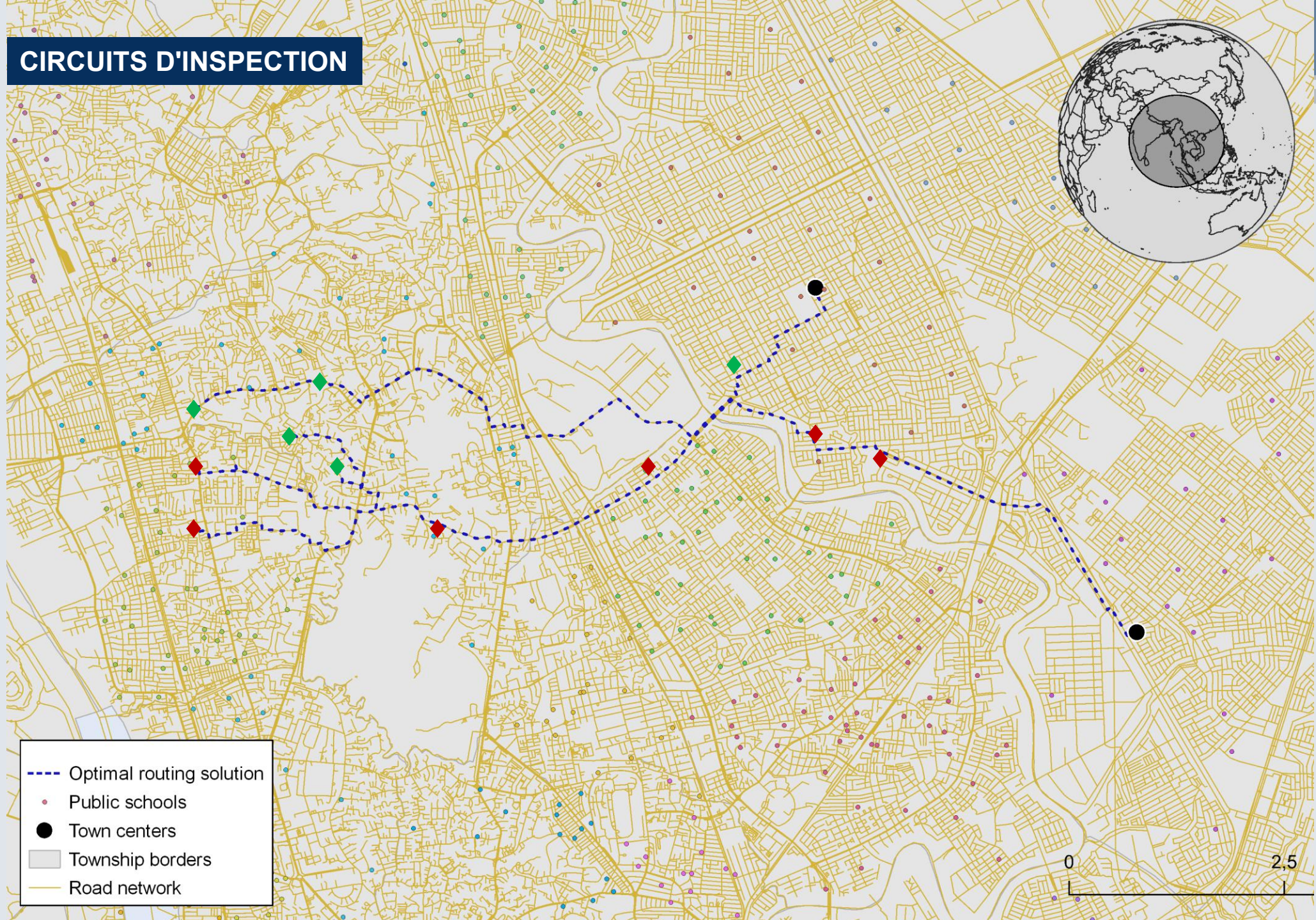
## Adéquation de l'ajustement



# Autres idées

Autres pistes de travail potentielles pour l'avenir

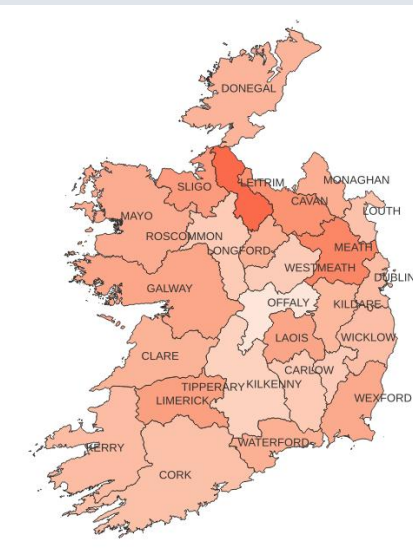
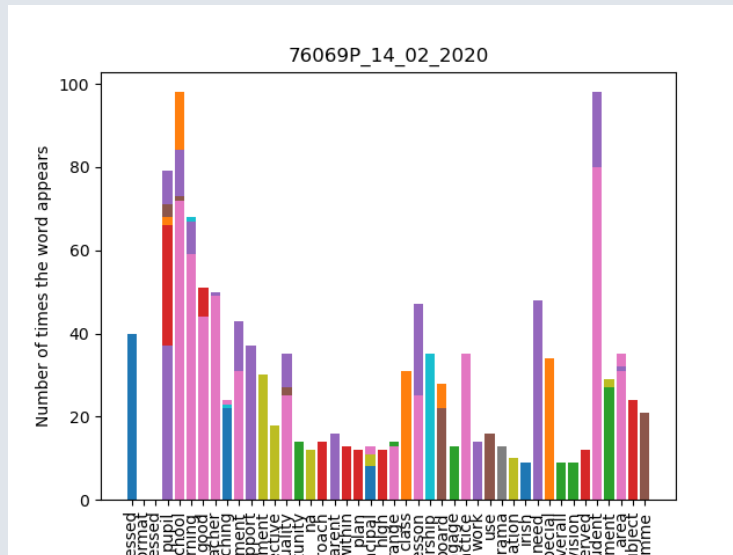
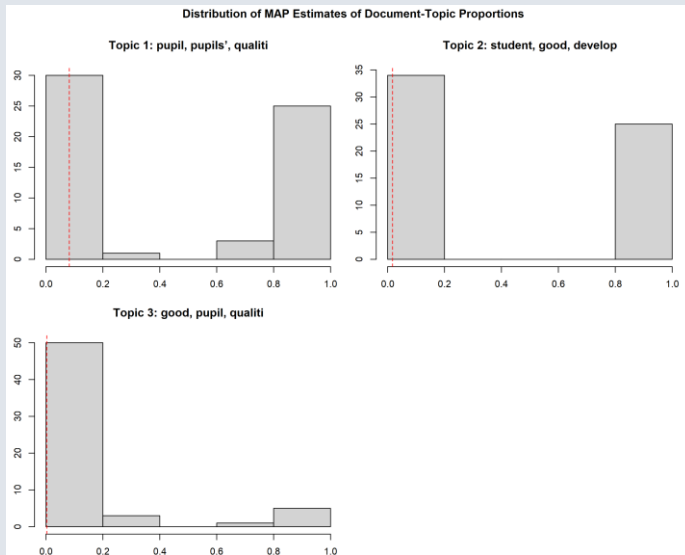
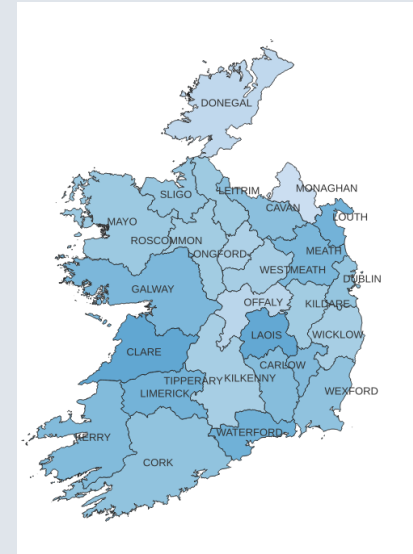
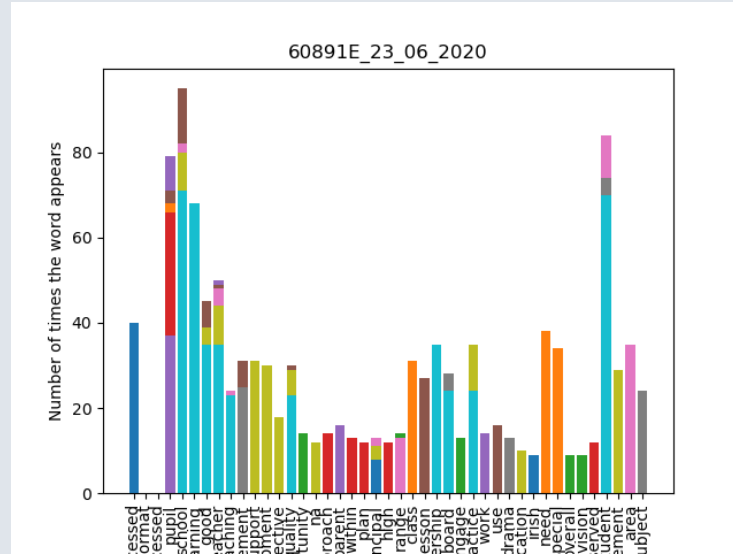
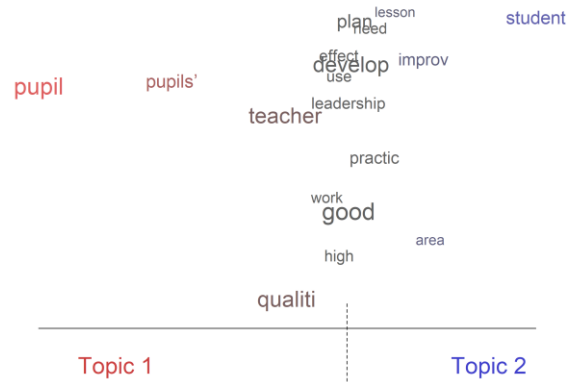
# CIRCUITS D'INSPECTION



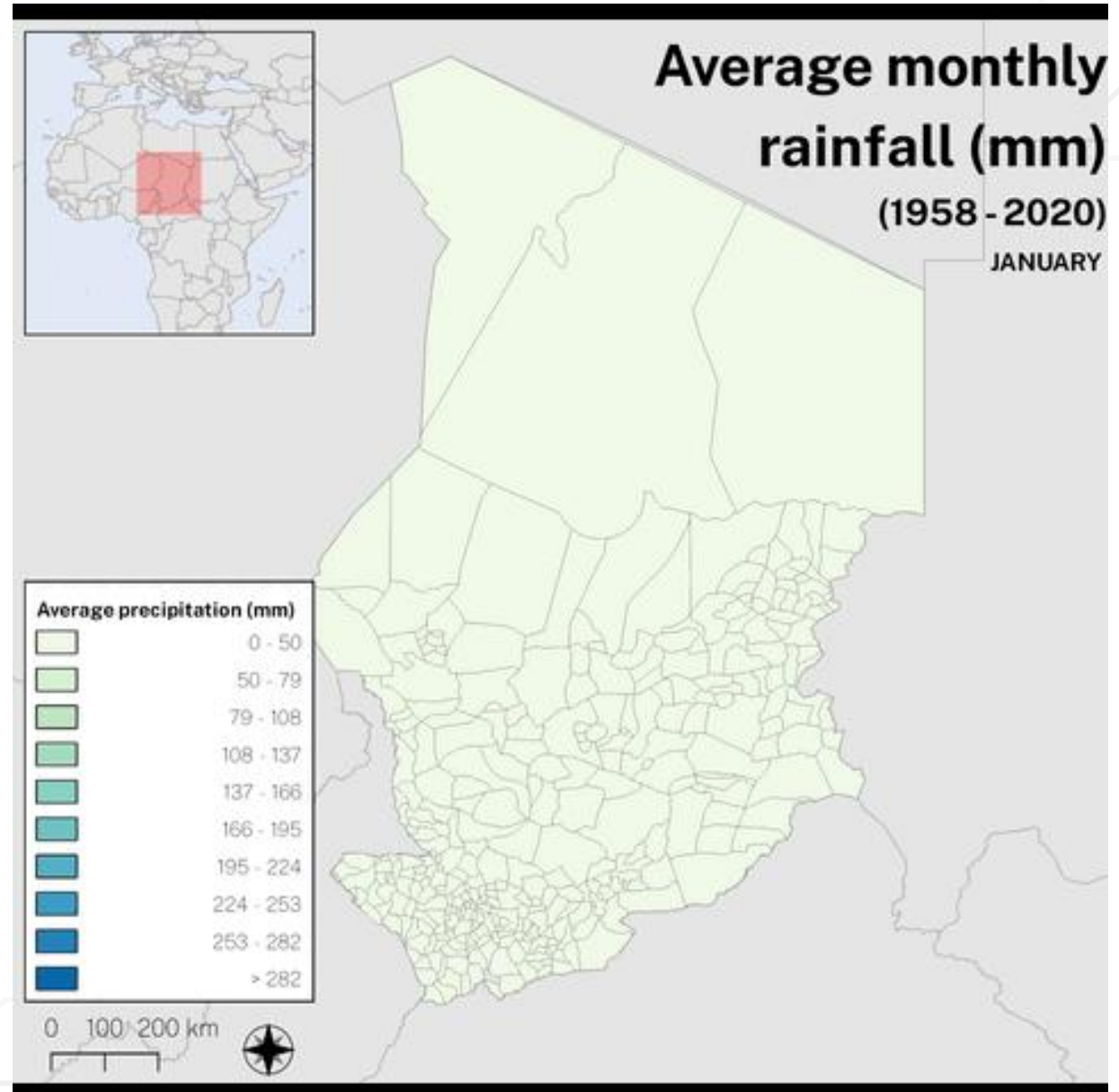
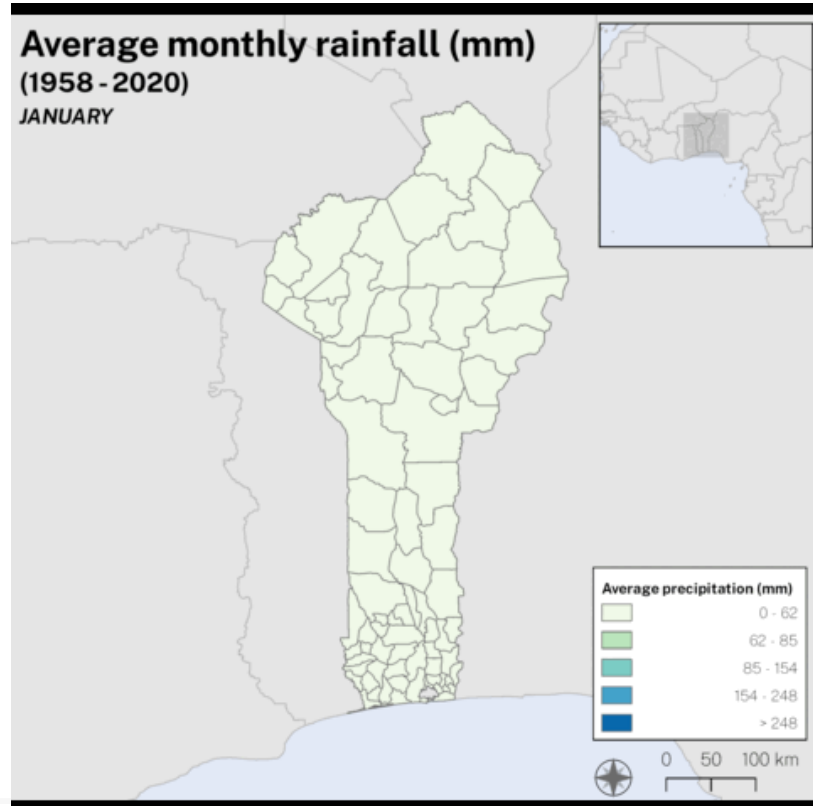
- Optimal routing solution
- Public schools
- Town centers
- Township borders
- Road network



# RAPPORTS D'INSPECTION



# CALENDRIERS SCOLAIRES



# Questions



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