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# Malaria risk mapping in cross-border area between French Guiana and Brazil

## Supporting malaria elimination plans

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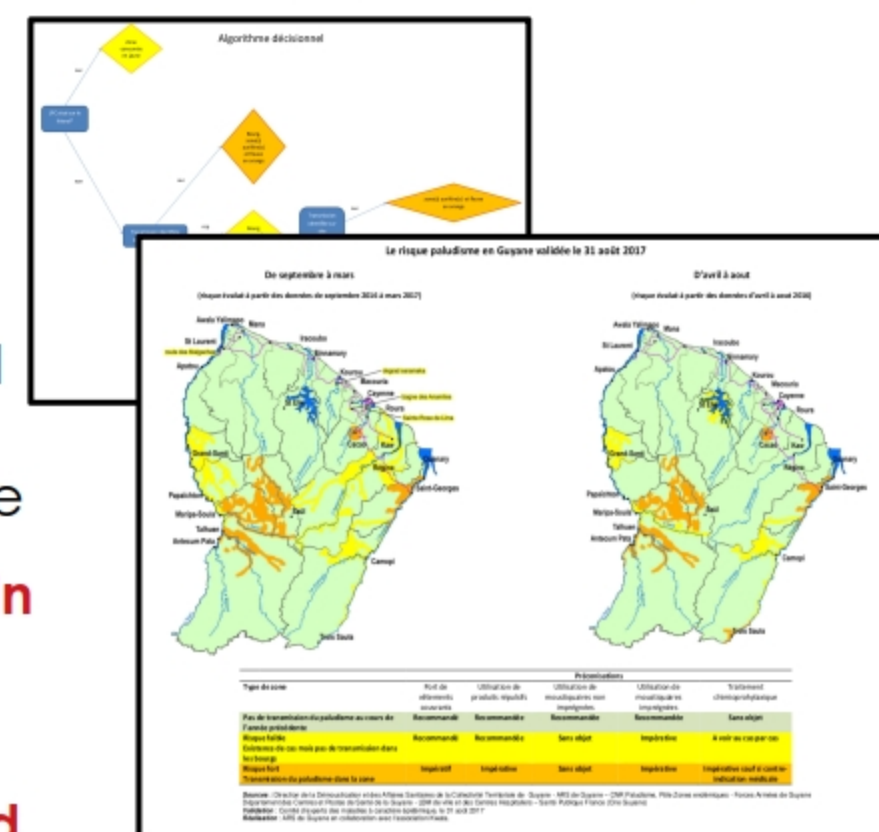
## Background

- Brazil and French Guiana reaffirmed the **objective of malaria elimination** (new elimination plan in Brazil, planning elimination of *P. falciparum* and *P. vivax* up to 2030 and 2035, respectively MOH, 2022)
- Modelling/learning approaches based on past reported cases are promising Schincariol et al., 2020
- In cross-border areas, the **high spatial resolution and dynamic risk mapping based (notably) on remote sensing data would help targeting control and elimination actions** in space and time independently of the international limits
- Risk mapping and knowledge formalization are used in Public Health

"Cross-border malaria [is] a major obstacle for malaria elimination" Wangdi et al., 2015

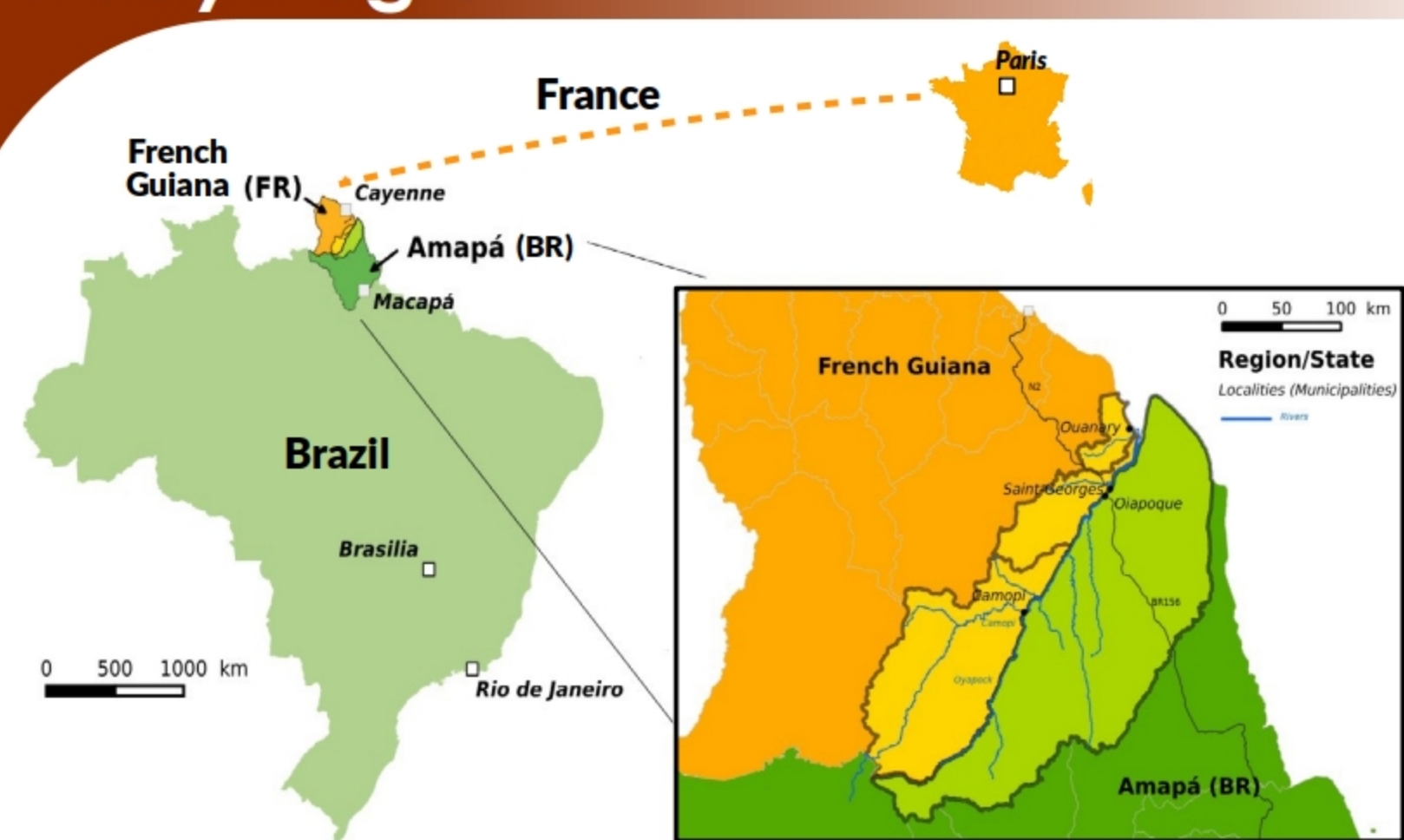
- Pre-elimination phase means **very few cases** and potentially high impacts of control actions (**non-stationarity**) making such approaches inoperative
- Remotely sensed risk mapping is **not/rarely used in Public Health practice**

- knowledge and processing chains **should be formalized and standardized**, and **use of qualified data and indicators should be enhanced**, to ensure greater objectivity and reproducibility



ARS-Guyane, Kwata, 2017

## Study Region



## Objectives

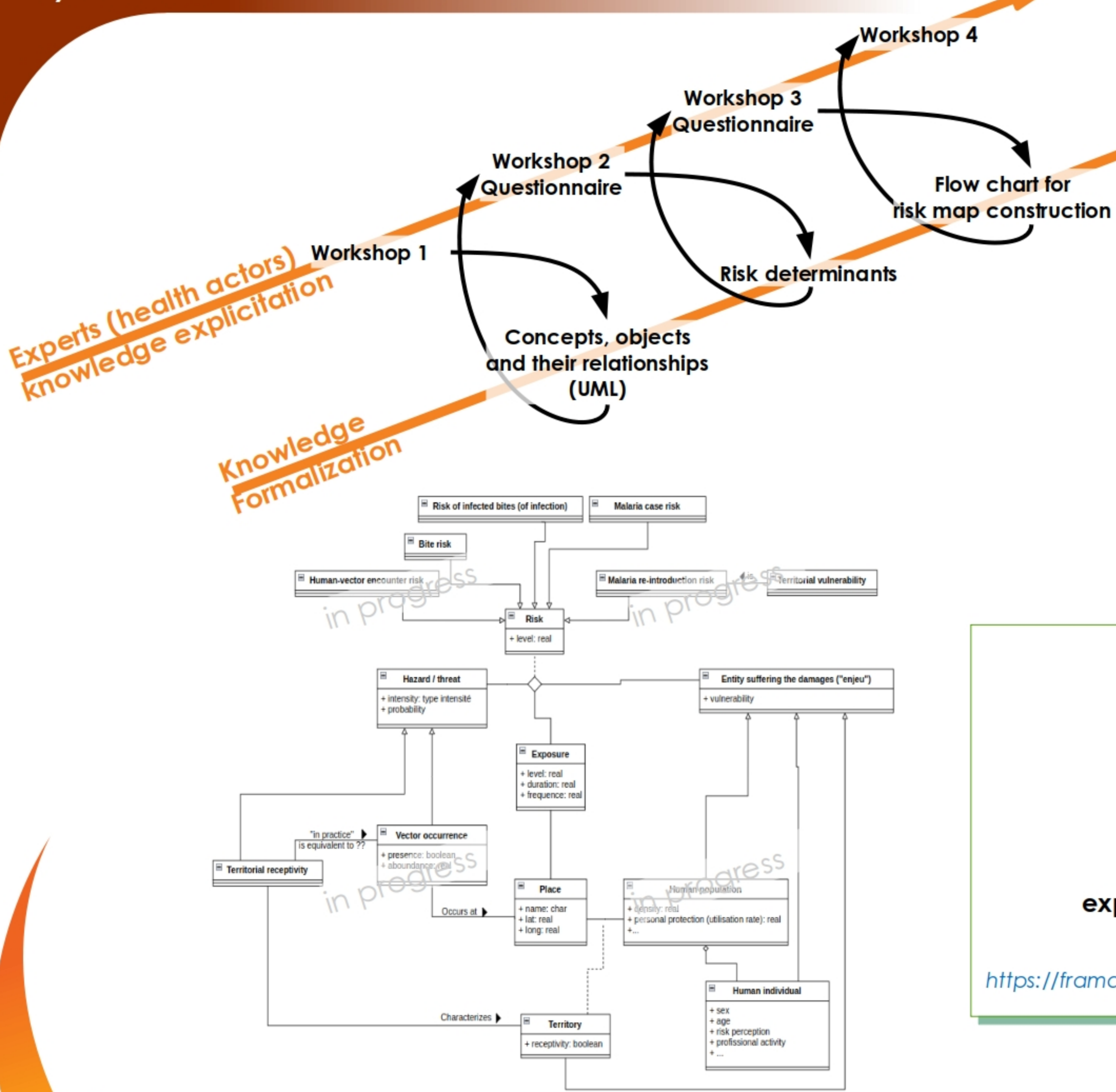
Mapping of malaria risks for an actual use in public health and based on remotely sensed (RS) data, for supporting:

- Targeting of control/elimination actions
  - Prevention/prevision of malaria reintroduction
- (NB: the idea is to support, in partnership! not substitute to current Public health approach!)

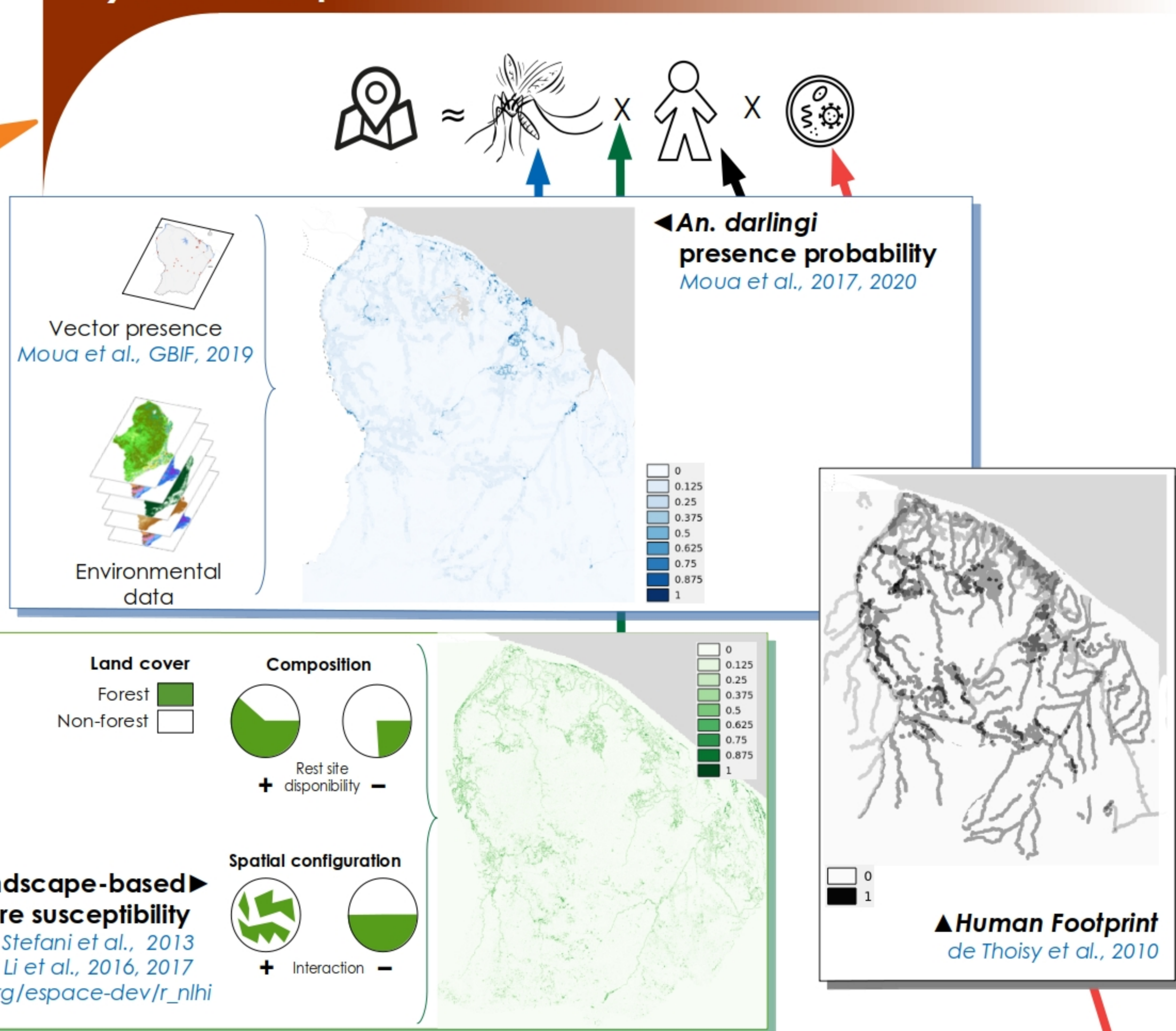
## Method

- 1) Elaboration of conceptual models of risks
  - Co-constructed by 1) researchers in RS and data/model sciences and 2) public health actors
  - Adopting international standards (WHO recommendations on risk stratification: vocabulary; strata definition)
- 2) Implementation of the models based on objective, qualified and up to date data and indicators

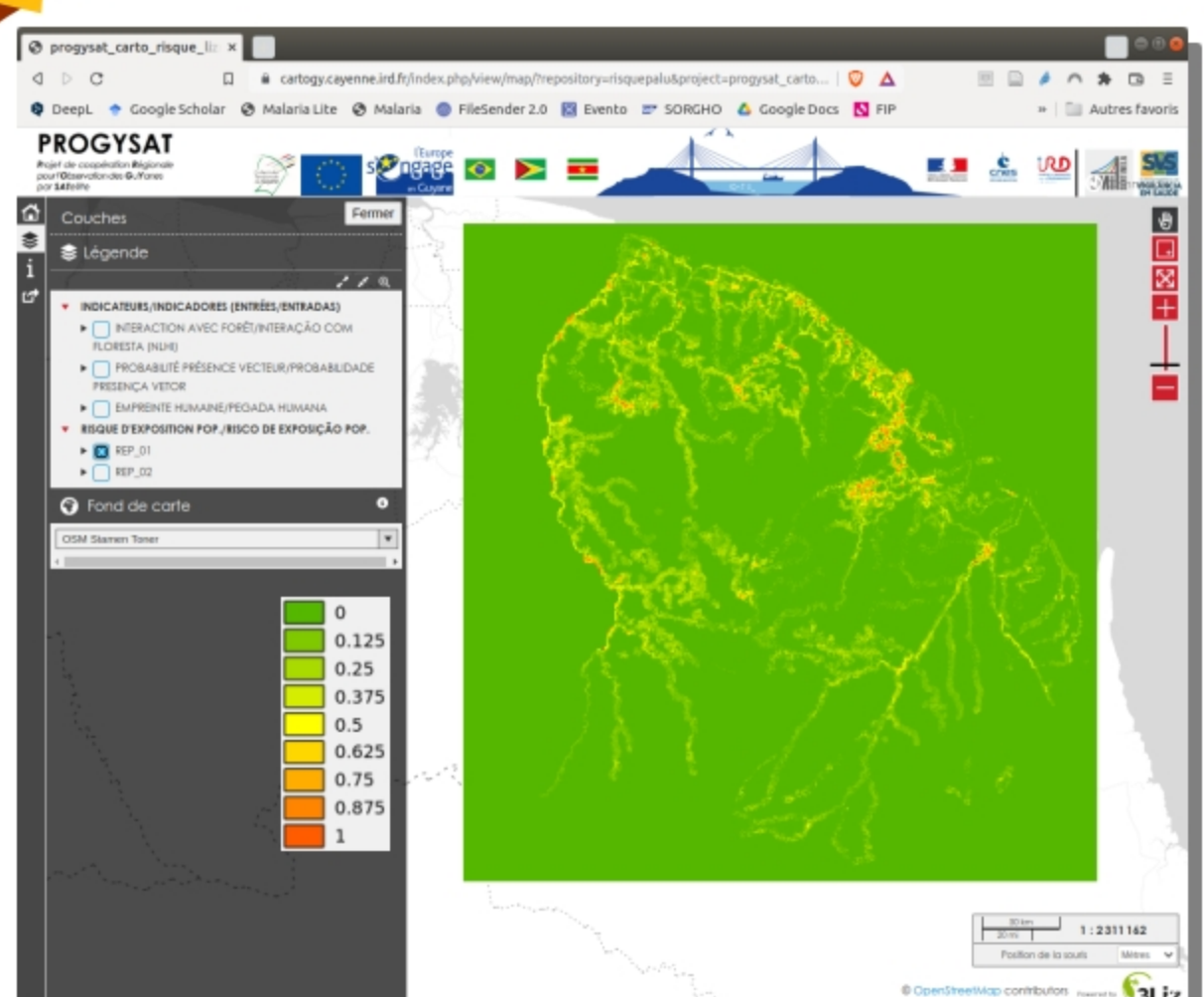
## 1) Risk model co-construction



## 2) Indicator production

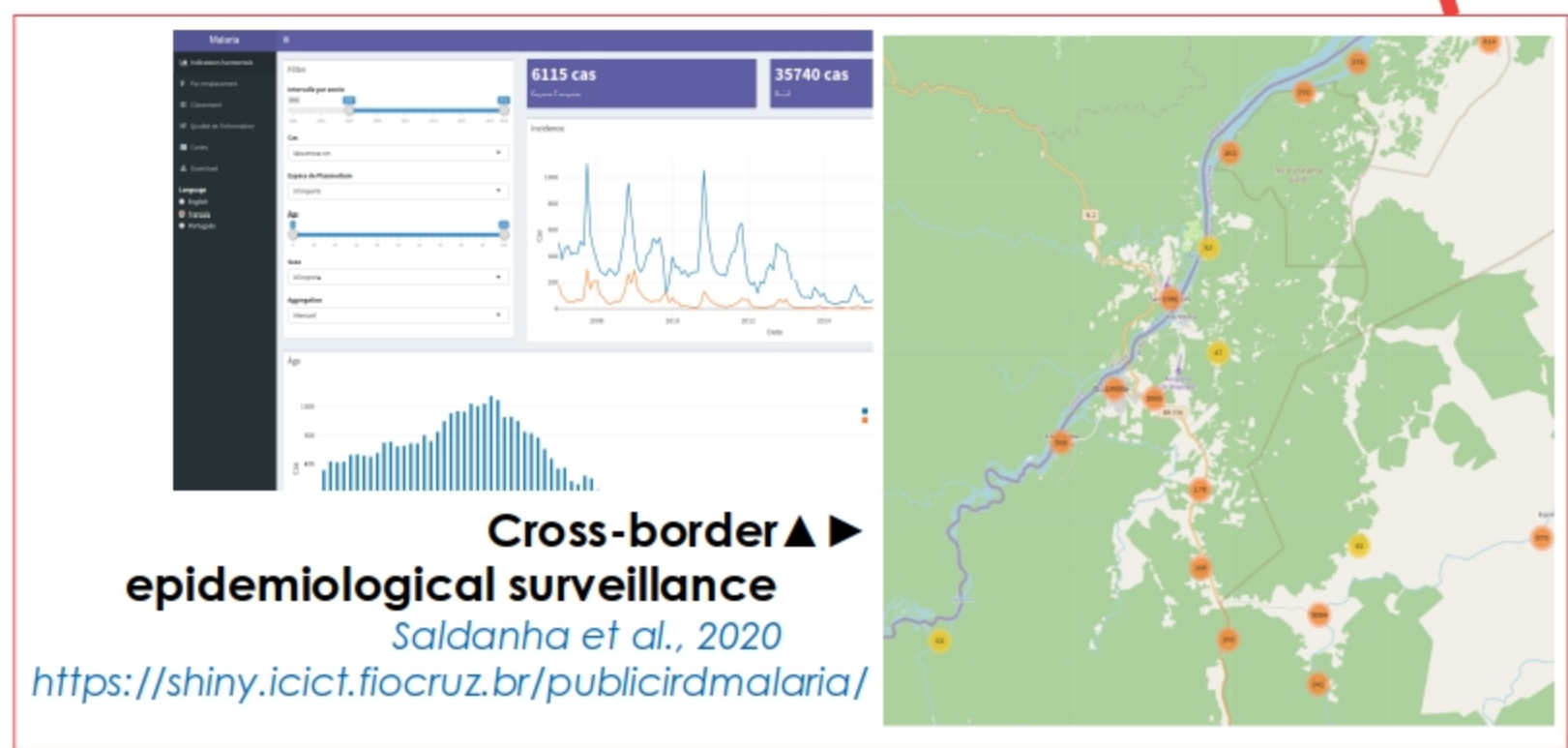


## Preliminary results & Perspectives



- Specification of the indicator aggregation method based on the formalized knowledge
  - aggregation operator: + or x or + and x
  - Indicator weights
- Result evaluation (Workshop 4; capacity of predict case occurrence, based on historical data)
- Result dissemination & promotion intended to researchers, public health actors and general public

«Risk (in population) of exposure to the main malaria vector (An. Darlingi) (Prototype/Proof of concept) [https://cartoguy.cayenne.ird.fr/index.php/view/map/?repository=risquepalu&project=progysat\\_carto\\_risque\\_lizmap](https://cartoguy.cayenne.ird.fr/index.php/view/map/?repository=risquepalu&project=progysat_carto_risque_lizmap)



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MOH (2022) Elimina Malaria Brasil - Plano Nacional de Eliminação da Malaria. MOH. ISBN 978-65-5993-185-9; Wangdi et al. (2015) Cross-border malaria: A major obstacle for malaria elimination. Adv. Parasitol. 2015, 89, 79–107; Moua et al. (2019) A database of Anopheles (Diptera, Culicidae): historical presence records in French Guiana and in the state of Amapá, in South America. GBIF. DOI: 10.15468/4n0lu; Moua et al. (2020) Distribution of the Habitat Suitability of the Main Malaria Vector in French Guiana Using Maximum Entropy Modeling. Journal of Medical Entomology. DOI: 10.1093/jme/tjw199; Moua et al. (2020) Connecting the effect of sampling bias in species distribution modeling - A new method in the case of a low number of presence data. Ecological Informatics. 57. DOI: 10.1016/j.ecoinf.2020.101086; Stefani et al. (2013) Land cover, land use and malaria in the Amazon: a systematic literature review of studies using remotely sensed data. Malaria Journal. 12, 192. DOI: 10.1186/1475-2875-12-192; Li et al. (2017) Regionalization of a Landscape-Based Hazard Index of Malaria Transmission: An Example of the State of Amapá, Brazil. Data. 2, 37. DOI: 10.3390/data2040037; Li et al. (2016) Mapping a Knowledge-Based Malaria Hazard Index to Landscape Using Remote Sensing: Application to the Cross-Border Area between French Guiana and Brazil. Remote Sensing. 8, 319. DOI: 10.3390/rs8040319; de Thois et al. (2010) Rapid evaluation of threats to biodiversity: human footprint score and large vertebrate species responses in French Guiana. Biodiversity and Conservation. 19, 1567–1584. DOI: 10.1007/s10531-010-9787-z; Saldanha et al. (2020) Contributing to Elimination of Cross-Border Malaria Through a Standardized Solution for Case Surveillance, Data Sharing, and Data Interpretation: Development of a Cross-Border Monitoring System. JMIR Public Health and Surveillance. 6. DOI: 10.2196/15409; Schincariol et al. (2021) Forecasting cross-border malaria case number: towards an early warning system to support malaria elimination plans. In ITSE'2021. Presented at the 7th International conference on Time Series and Forecasting, Spain.