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An Agent-Based Model of the Amazonian Forest Colonisation and Oil Exploitation: the Oriente Study Case

William Chapotat, Lionel Houssou, Mehdi Saqalli, Benoit Gaudou, Emilie
Lerigoleur, Nicolas Maestripieri, Audren Bouadjio Boulic

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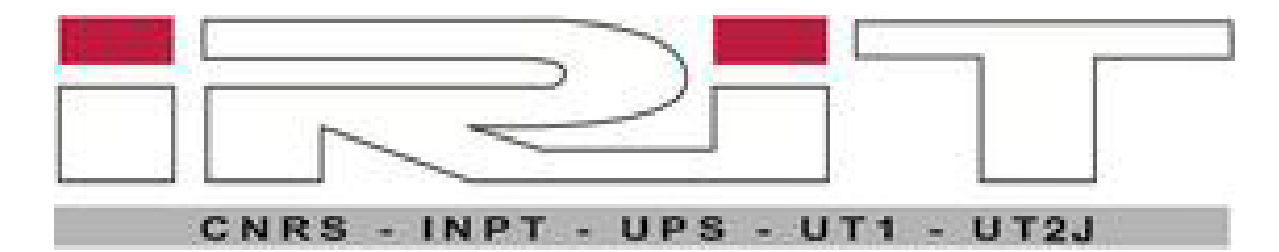
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An agent-based model of the Amazonian forest colonisation and oil exploitation : The Oriente study case

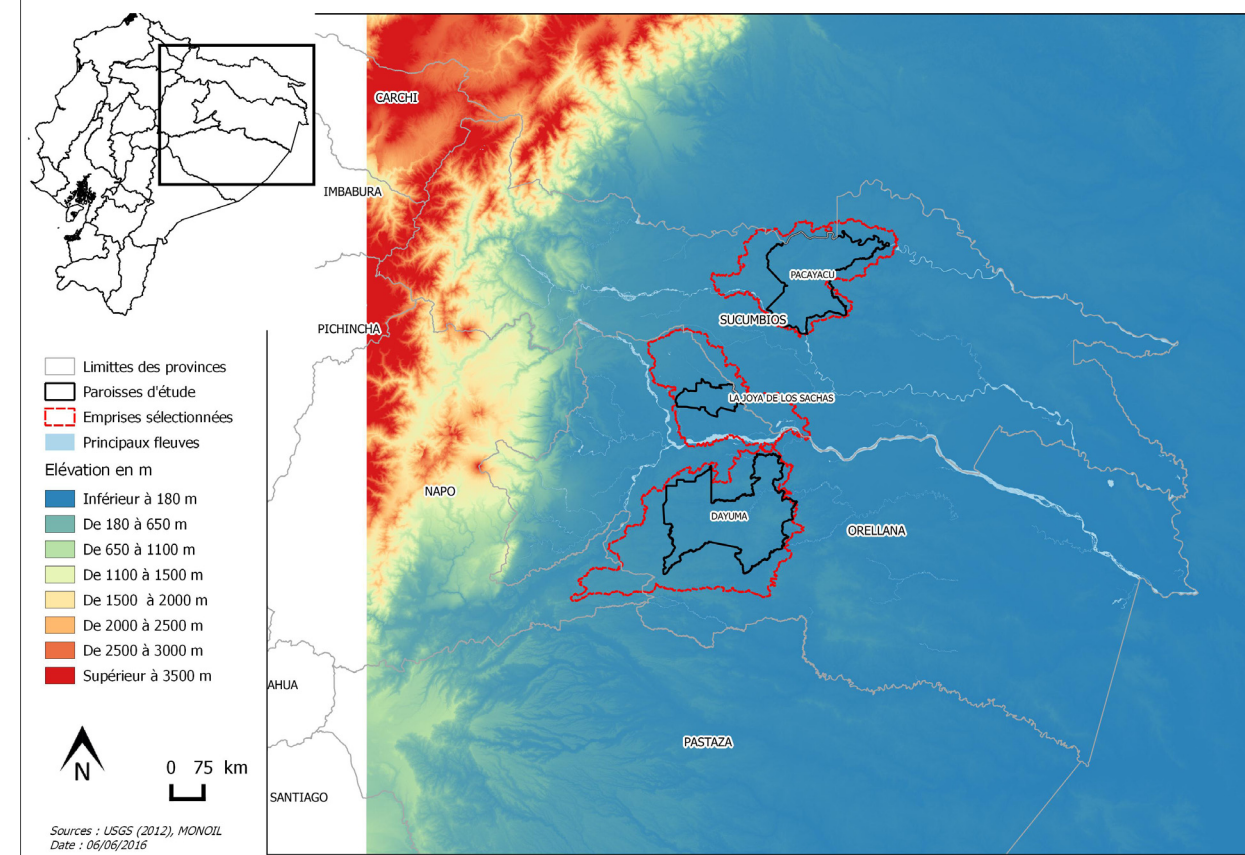


W. CHAPOTAT^(a), L. HOUSSOU^(a), M. SAQALLI^(a), B. GAUDOU^(b), E. LERIGOLEUR^(a), N. MAESTRIPIERI^(a), A. BOUADJIO - BOULIC^(b).

(a) UMR 5602 GEODE, CNRS, University of Toulouse 2 Jean Jaurès, Toulouse 31058, France
(b) UMR 5505 IRIT, CNRS, University of Toulouse 1 Capitole, Toulouse 31000, France



Context:



Sources : <http://www.monoil.ird.fr/photos>

Aim :

To reproduce the environmental and socioeconomic impacts of colonization and oil exploitation on the Oriente (Ecuadorian Amazon)

Integrating :

- colonization & oil exploitation impacts
- microeconomics behaviors of the population
- public policies & goods' prices

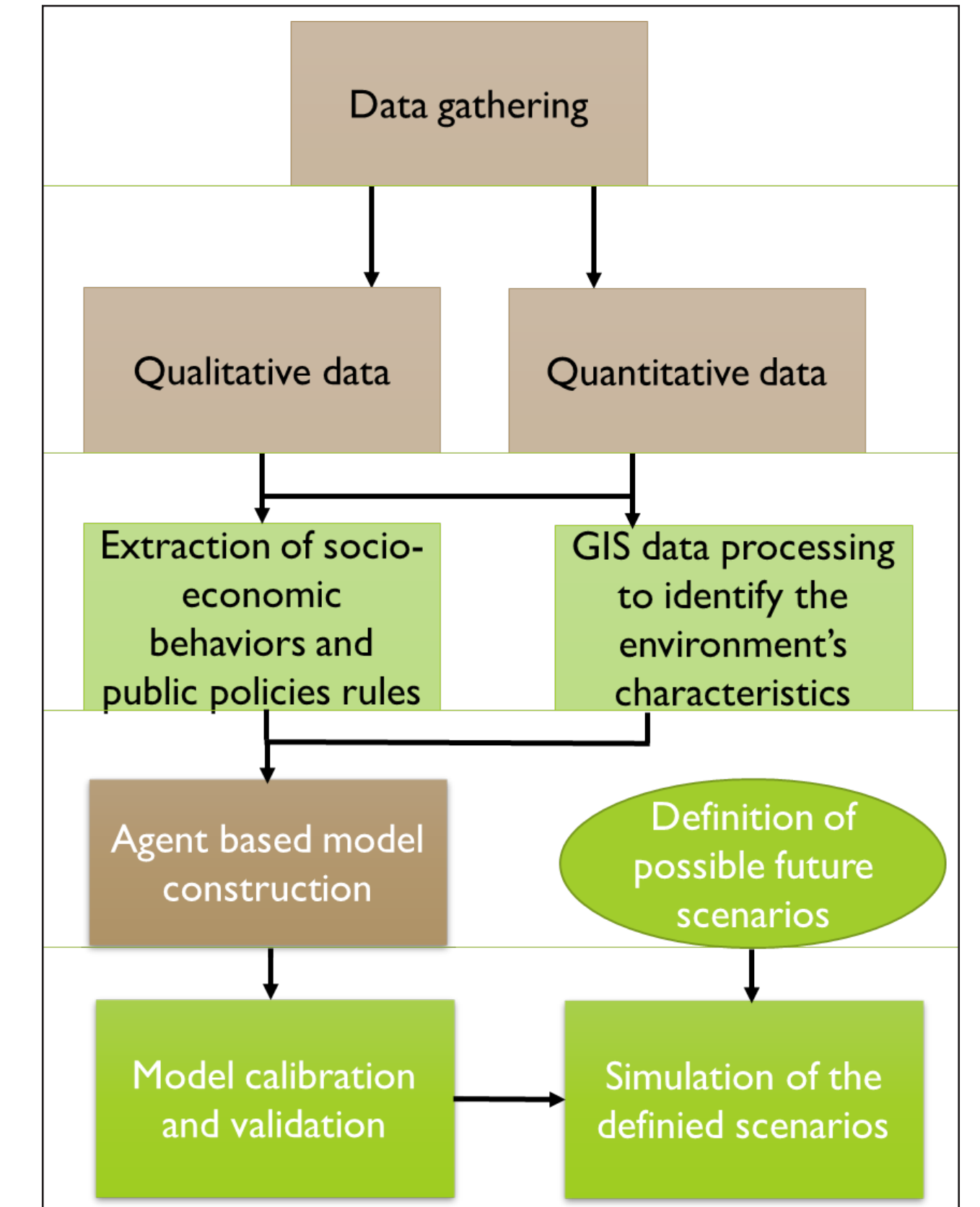
To simulate the possible futures of this territory by the means of a scenario based exploration tool

Two main steps :

- Retrospective simulation to replicate the past colonization of the environment and its effects on the environment
- Simulate the actual and possible future situation with the social structuration of agents and their difficulties to deal with oil contamination

To use the results obtained as decision-support tools

Method :



Construction of the MONOIL model

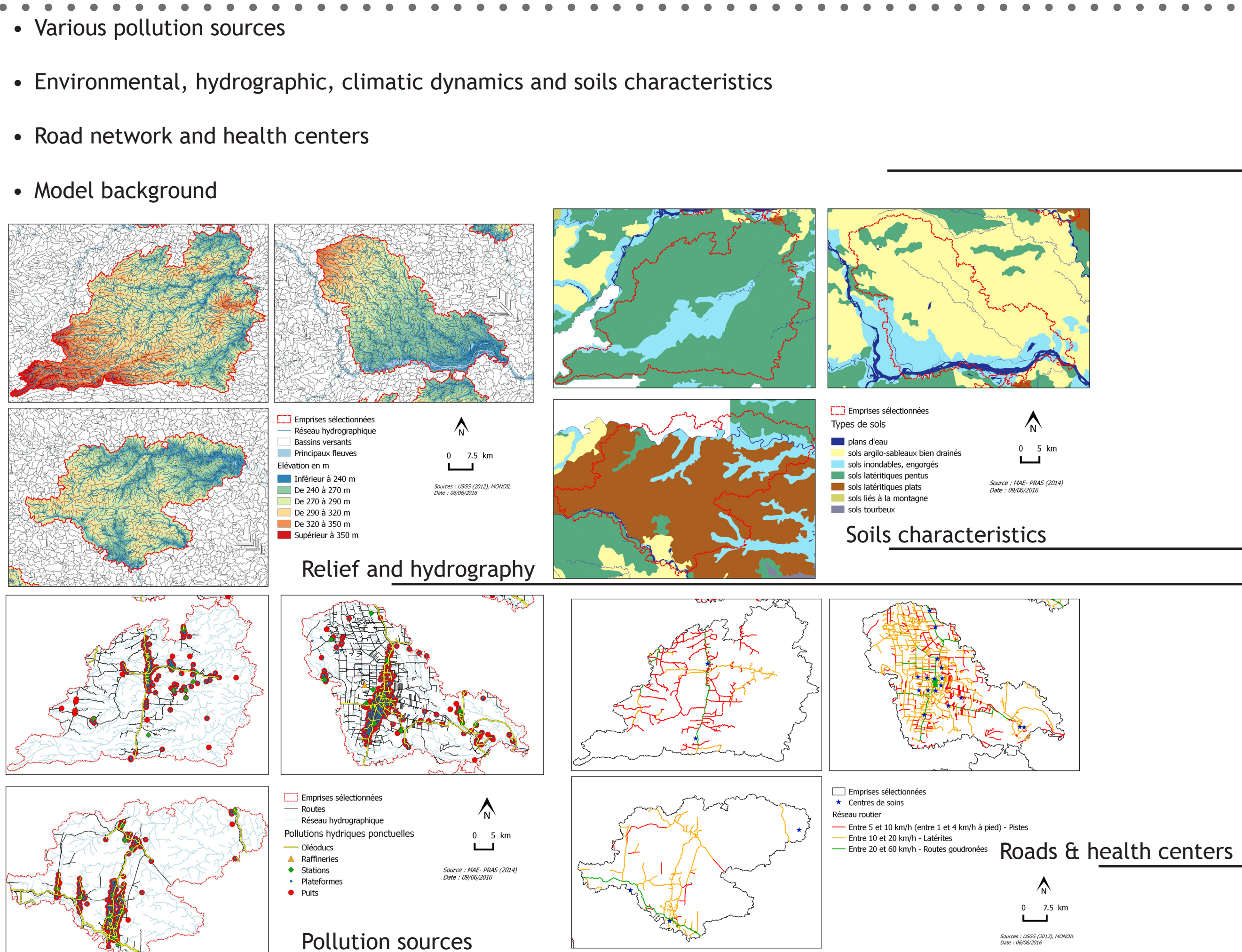
Modules created :

Steps of the project :

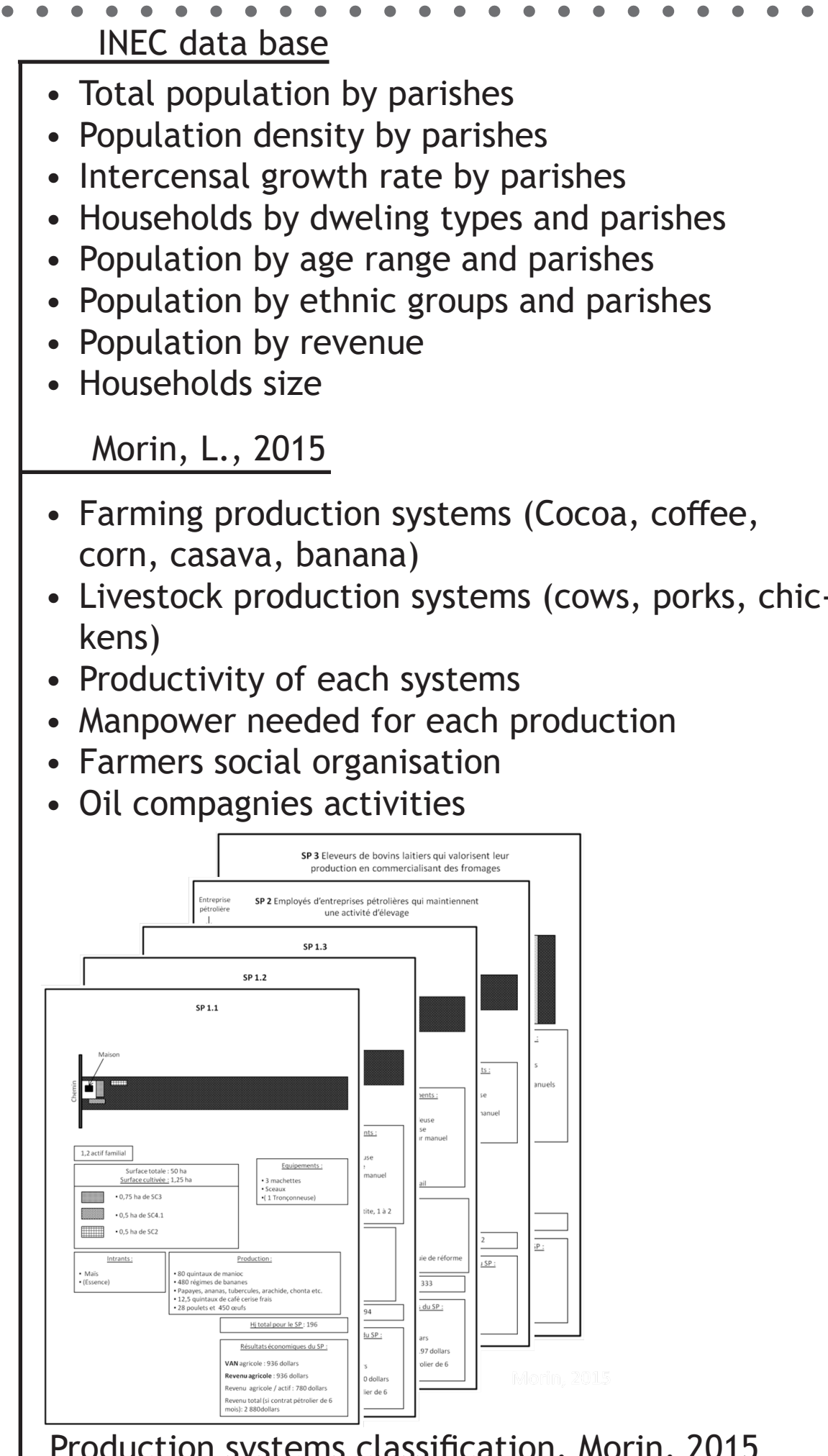
Data processing

- Building a meaningful GIS dataset for feeding the model
- Creation of watersheds and rivers
- Demarcation of the study areas (Parish of Dayuma, Pacayacu, La joya de los sachas) using the DEM (Digital Elevation Model) including the upperstream watersheds
- Selection of rainfall data for each study site (Hijmans, et al. 2005)
- Classification of the pollutions sources according to their effect area and persistence on the environment
- Calculation of pollutions accidents' periodicity and volume variability
- Processing demographics data
- Definition of soils characteristics of our study areas using USDA (United State Department of Agriculture) data
- Computation of the fertility and flooding indices of our study areas' soils

Biophysical module



Agents module



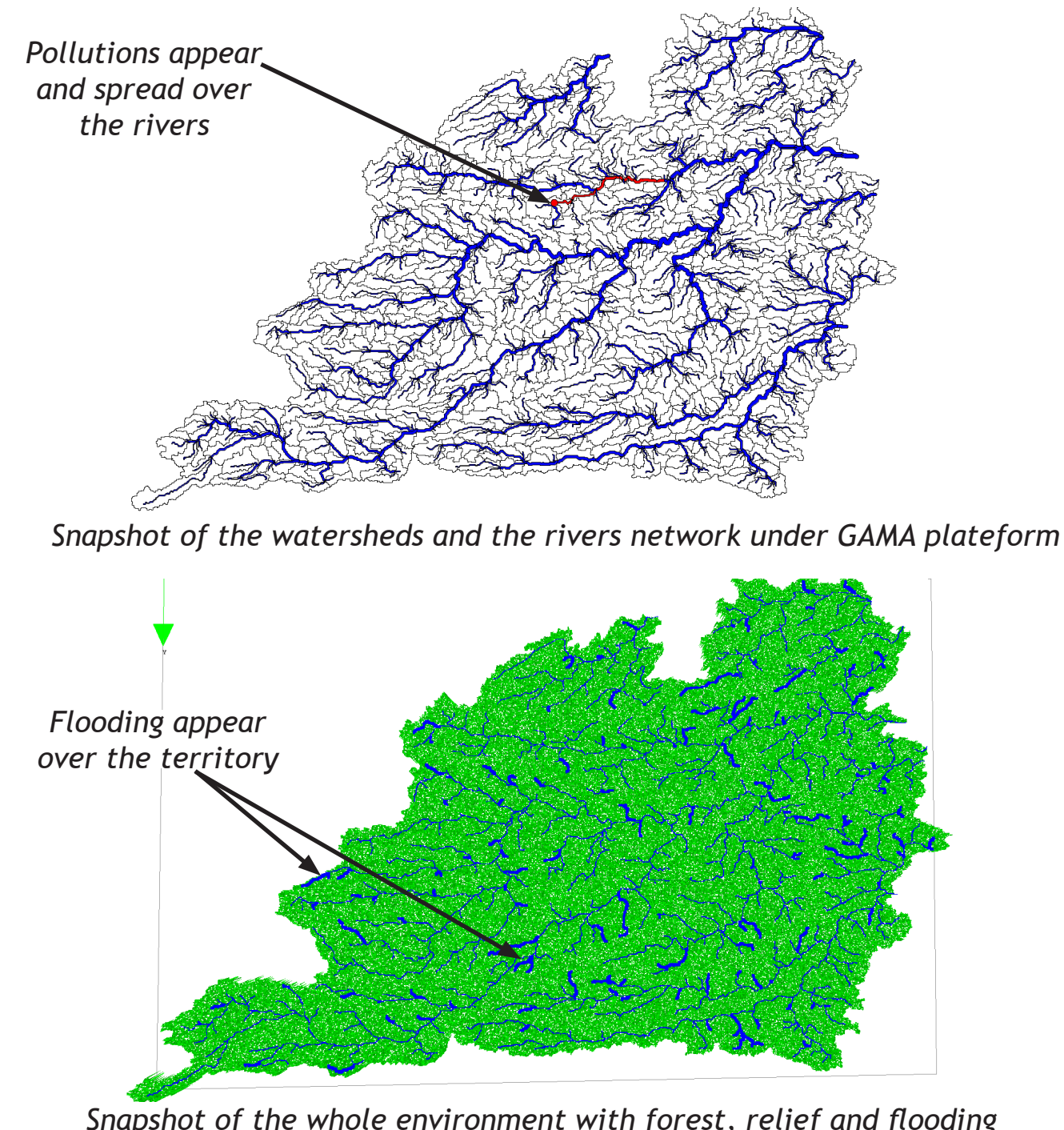
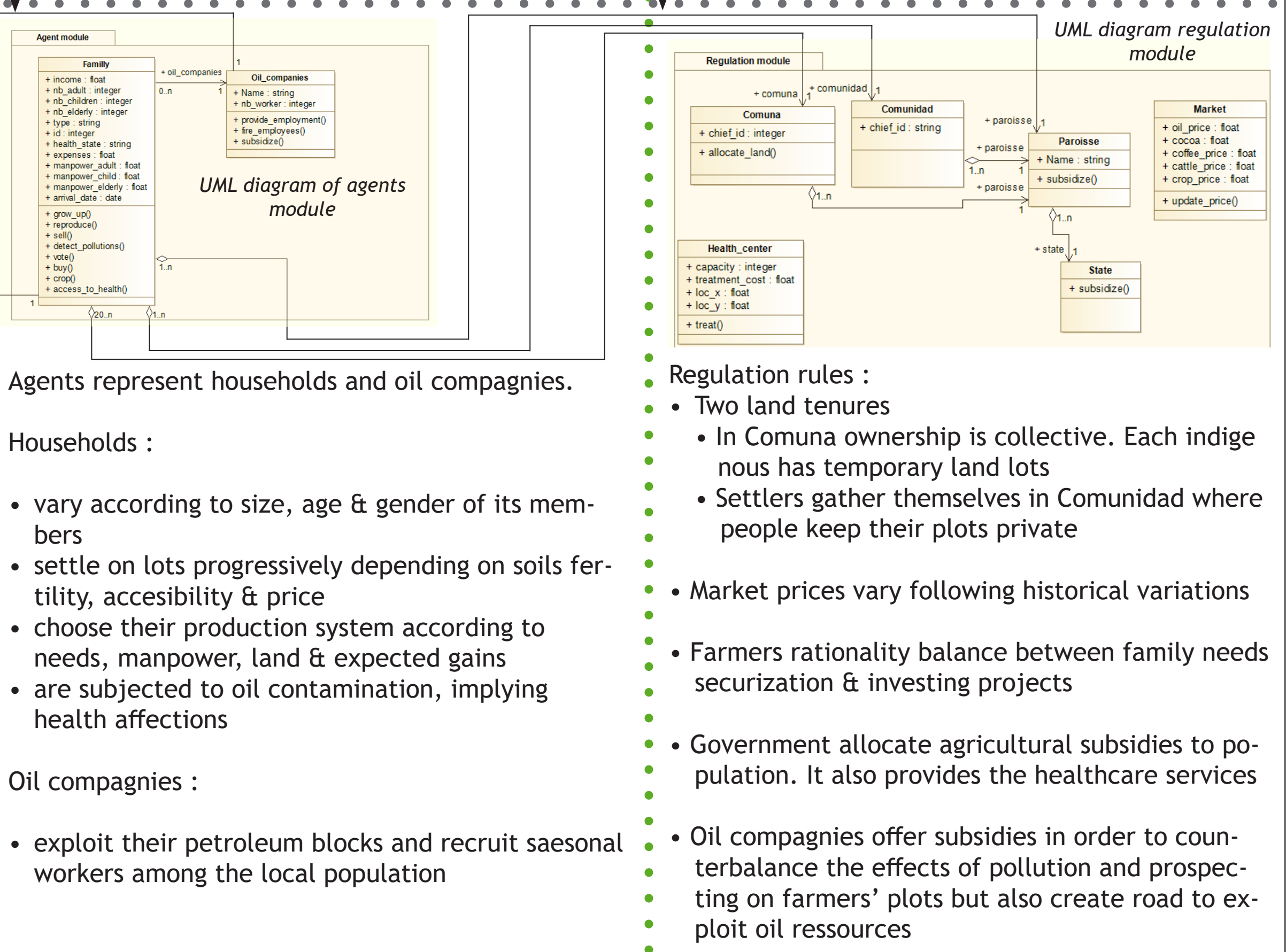
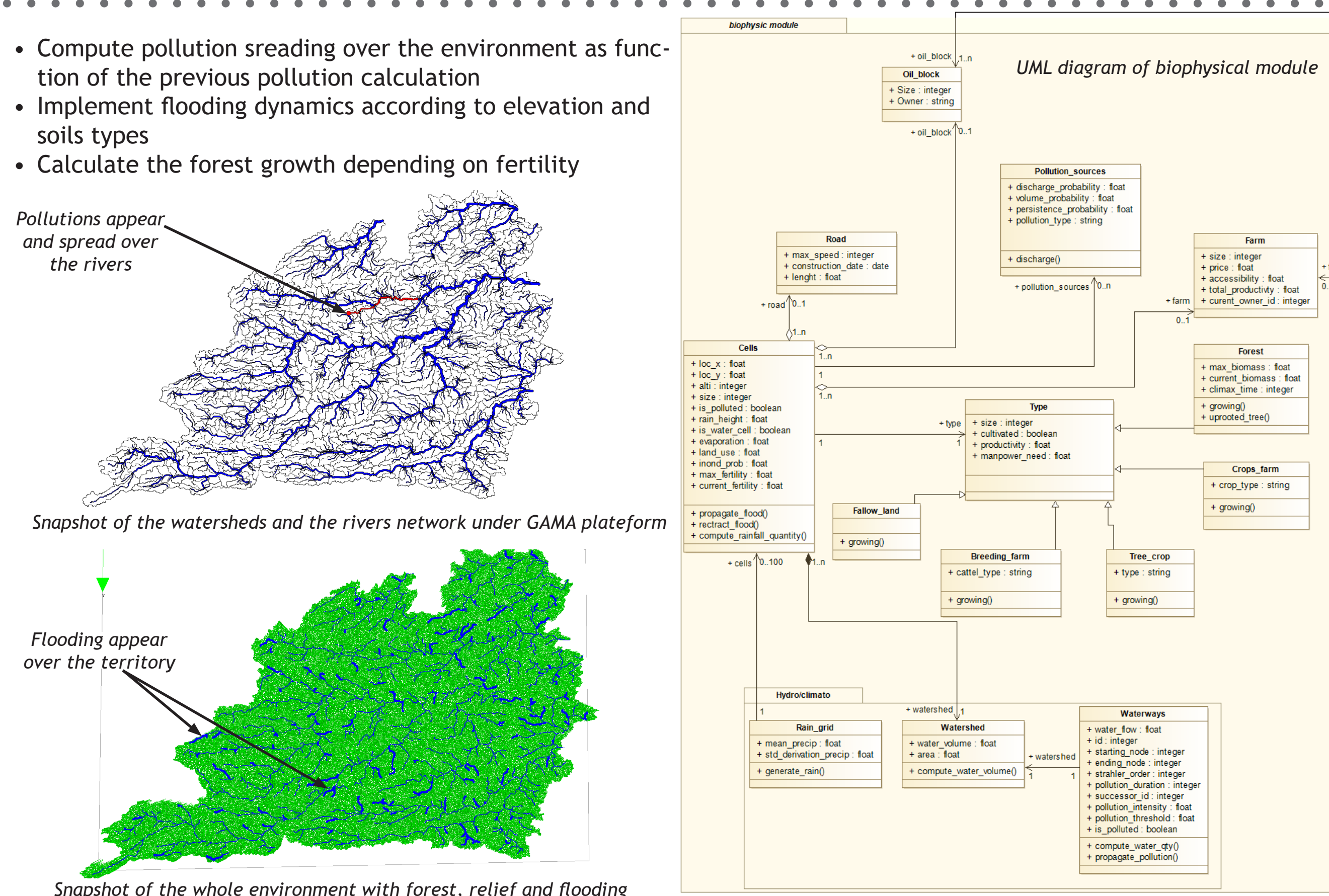
Regulation module

- Definition of rules from MSc & Phd thesis and experts' opinion :
 - Agricultural policies,
 - Oil producer policies,
 - Political and social structuration,
 - Public and private subsidies system,
 - Market prices,
 - Healthcare system.
- Readings
- *Eties & Mettetal, 1985*
 - *Bilsborrow et al., 2006*
 - *Engelman, 2011*
 - *Juteau, 2012*
 - *Paichard, 2012*
 - *Dumont, 2013*
 - *Wasserstrom & Southgate, 2013*
 - *Morin, 2015*
 - *Boyon, 2015*

Model building and implementation

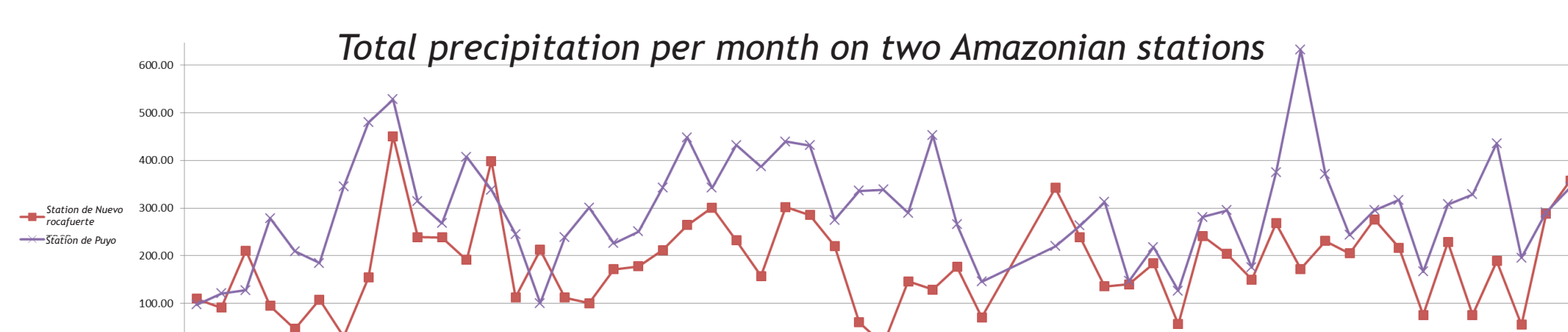
Conception of the model entities using UML language.

- Implementation of the elevation using the DEM
- Implementation of the rainfall, watersheds and rivers. Computation of the water flow
- Implementation of the flooding dynamics
- Implementation of pollutions and their spreading over rivers and soils
- Implementation of the agents dynamics
- Implementation of the model rules



Model calibration

- Using external data to calibrate the environment and the agents behaviors :
- GIS land use data (GAD, Gobierno Autonomo Descentralizado & PRAS, Programa de Reparacion Ambiente y Social)
- Perception based map of pollution (Maestriperieri & Saqalli, 2015)
- USGS (United State Geological Survey) precipitation data
- Pollution data (MONOIL project, work in progress)



Perspectives :

- A field mission is scheduled in October. During this mission we will discuss about our model with experts and MONOIL project actors :
 - Does the model look like they expect ?
 - Does the dynamics of the model fit with the reality ?
- It will also be an opportunity to define Oriente future development scenarios with the project stakeholders :
- survey local population and project stakeholders on the future of the territory
- create with them plausible future scenarios
- simulate these scenarios to help stakeholders in decision making process
- This work is still on progress until the end of October 2016.
- We also hope funding to lead a thesis on «migrations retrospective and prospective modelling over the colonisation of Amazonian forest : the ecuadorian case».