**General description**

The model simulates the decision-making process of the water authorities and residents (hereafter “actors”), and its effect on the spatial distribution of socio-hydrological vulnerability in Mexico City.

The model operates at the scale of neighborhoods, which are defined based on census information related to geographical socio-economic and infrastructural attributes.

Each actor is represented by a set of agents that modify the attributes of the neighborhoods. The agents of water operators make investments in infrastructure systems in a selected set of neighborhoods, and these investments modify particular attributes of infrastructure systems that in turn influence the risk of infrastructure related failure and hydrological hazards. Residents on the other hand modify the attributes of their local neighborhood which in turn influence their sensitivity to the exposure to water scarcity, flooding and gastrointestinal diseases.

The decision making process of the actor is rooted on multi-criteria decision principles. Under this paradigm agents take decisions considering a set of criteria and criteria weights that represent the concepts that the actors consider of importance to solve water related vulnerability. The information to parametrize the decision-making process of the actors was elicited through a series of workshops with the actors themselves, that is with the residents and water operators. The information collected in these workshops was then translated into the analytical network model using a multi-criteria decision analysis techniques (MCDA).

The model also includes four simulation submodels: water supply, flooding, gastrointestinal diseases and subsidence.

**Agents**

For each model iteration, the criteria values are processed through four steps to take a decision: Normalize criteria, use limit matrix, obtain distance-to-ideal-point for each action and finally make an action. This decision dinamically updates the criteria values.

1. *Normalize criteria values*

Criteria values are normalized by applying a value function which is assigned to each alternative-criteria combination. The shape of the value functions are define based on the relationship between stimulus and action from psychophysical theory. We expect to modify them based on empirical information that will be collected in subsequent interactions with the actors (SACMEX and residents).

1. *Use limit matrix*

“analitic network processes theory”

1. *Obtain distance-to-ideal-point*

4. *Make a decision*

Sacmex: depending on policy type selected, sacmex takes distances to ideal points and decides wich alternative of action

**Submodels**

Piped water supply disruption:

This sub-model simulates independent stochastic realization of days in a week a neighborhood does not have access to **piped potable water**. The model represent a Poisson process with mean defined by a linear combination of altitude, the condition of the infrastructure, which meant to represent its propensity to fail, and the estimated average days without water at the municipal level, which was parametrized using data from a survey carried out at the municipality level. Altitude and infrastructure condition are parameters that down sale the risk to the scale of the neighborhood.

Flooding: this submodel simulates the number of flood event in a year, given the amount of precipitation observed in a neighborhood. These probabilities were derived from contingency tables and Bayes rule.

Gastrointestinal diseases: This model is compose of two linear spatial regression models that together simulates the expected number of incidence of gastrointestinal diseases in Mexico City, only. The first sub-model simulates incidences in the lowlands neighborhoods of the city, and the second in the highlands. In the case of the lowlands, the calculation of the regression depends on the spatial distribution of incidence in surrounding neighborhoods, and the number of flooding events per year. For the highlands, the regression does not need a spatial component and is influenced by the percentage of houses with sewer infrastructure, dirt floor and without toilets. There relationships were estimated empirically.

Andres: we need u to explain details

Subsidence: this sub-model represents in simple terms the increment in subsidence rate due to the increment of water extraction from aquifers. It is based on the fact that extraction of groundwater leads to compactation of soil particles in the lacustrine area of Mexico City, were more subsidence had been experienced over the last century. This is a simplification of a more physically based model currently in development.

Nata: hay que tener consistencia entre los términos usados en el diagrama y el texto

Nota: mostrar en el diagrama las diferentes escalas temporales y los loops

Nota: el diagrama debe incluir los 4 steps que están en esta descripción