

LittoSIM-GEN: exploiting GAMA features to simulate a serious game of flooding risk management

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Abstract

LittoSIM-GEN is a generic participatory simulation model composed of three agent-based models that allow playing a multirole serious game of flooding risk management. The central component of LittoSIM-GEN is the *manager* model where submersion events are calculated and displayed on a multidistrict study area. The *player* model offers a set of land use and coastal defense actions to distant playing teams (usually four) to manage their districts and mitigate the unpredictable flooding damage. The last model is the *leader*, which represents a state risk agency that supervises the game and pushes players towards collaborative and alternative strategies.

The model creates a virtual environment for decision makers, urban planners, and risk managers to deal with different scenarios that they may confront in real world situations. Such experiences promote risk culture and raise awareness of the workshop participants who share their feedback and discuss their learning during the debriefing debate. Game animators use automatic and manual data collection, pre- and post-surveys, and a set of graphical indicators to report and assess the results of workshops.

To implement such a realistic ludic game with relevant outcomes, LittoSIM-GEN makes use of multiple features of the GAMA platform, a modeling environment for developing agent-based simulations:

- *Reading and writing text files*: besides exporting results as textual data for further analysis, the model reads multiple hierarchical configuration files during the initialization phase. This allows loading diverse territorial archetypes with different parameters, which makes LittoSIM-GEN a generic and dynamic model.
- *Processing geospatial data*: loading and accessing vector and raster files is a simple task in GAMA. LittoSIM-GEN uses this feature to create a realistic environment by using empirical data, such as administrative boundaries, elevation models, and land cover databases.
- *Using ergonomic interfaces*: GAMA allows developing user-friendly graphical interfaces to handle player actions. LittoSIM-GEN players can use tablets to make the game more playful.
- *Implementing large-scale models*: agent-based models developed with GAMA can go up to millions of agents with the possibility of executing parallel processes to speed up calculus. LittoSIM-GEN uses large spatial grids to represent the territories and simulate inundations gradually.
- *Connecting to the network*: participants can play LittoSIM-GEN as a remote game through GAMA primitives that allow serializing data and communicating over the network using shared messaging brokers such as Apache ActiveMQ.
- *Accessing the system command*: GAMA can access the system prompt to execute any command or external program. This feature allows LittoSIM-GEN to use LISFLOOD-FP model to calculate the real extent of a submersion based on data of the study area.
- *Displaying graphical outputs*: during the game, multiple real-time indicators and dynamic graphs show the current state of the territory. GAMA can visualize any relevant information on graphical displays, as well as saving these data to different output files (textual, vector, raster).

Improving LittoSIM-GEN depends highly on future enhancements of the GAMA platform, particularly:

- Portability of GAMA applications to allow the execution of models out of the platform.
- Dynamic graphical components to handle more user interactions, such as built-in buttons and text boxes.

Additional material

GitHub repository: https://github.com/LittoSim/LittoSim_model