ESCAPE

Exploring by Simulation Cities Awareness on Population Evacuation

Institut de Recherche pour le Développement FRANCE

MODEL AND SIMULATE EVACUATIONS INDUCED BY NATURAL DISASTERS AS A TOOL FOR DESIGNING EVACUATION PLANS

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4 partners: IRD / UMMISCO, Bondy, France; University of Rouen / LITIS, France; University of Rouen / IDEES, France.

CONTEXT

Populations are increasingly vulnerable to disastrous natural or technological events, as demographic and urban growth lead to greater expositions of goods and people. Large-scale evacuation strategies are efficient tools for mitigating this vulnerability. Nonetheless, risks incurred during an important displacement through an altered environment are high: refusal to evacuate, crashes, direct exposure to the source hazard, riots, emergency services failures ... In France, a policy called "Territoires à Risques importants d'Inondation" (TRI) has emerged to deal with floods, in a first step to deal with the most frequent natural disaster in this country. Nevertheless, local governments and emergency managers lack prospective tools to assist their understanding and planning of large-scale evacuations. ESCAPE aims at overcoming this major problem by the creation of an evacuation operational research system.

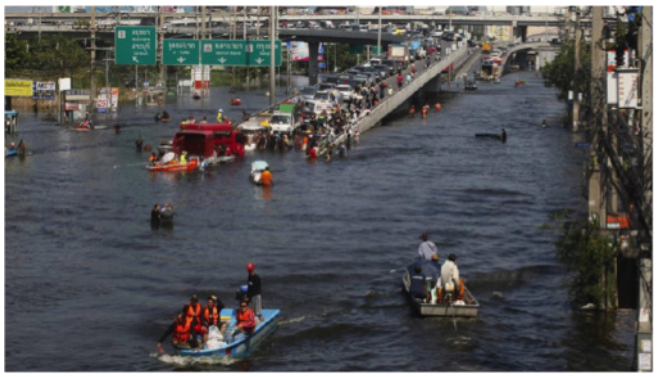



Figure 1: examples of situations where evacuation plans are needed

OBJECTIVES

General

The core of our project is the tight coupling between Geographical Information Systems, agent-based multi-scale modeling and computer simulation exploring tools. It will be deployed and validated on real case studies, so as to generate simulations realistic enough to allow their use by emergency managers for experimenting evacuation strategies.

By combining sources including territorial information (land occupation, transport networks, hazards expansion and intensity), demographic data (residential and transitional population numbers, age pyramid), a mobility and traffic management simulator (cars, bikes, pedestrians, public transport), and by providing different evacuation strategies (partial or complete, by waves or synchronous), we will provide measures on evacuation time of various crisis zones, and will make explicit local and global constraints on these times. For this, we need to explore at multiple space and time scales the emergence of collective behaviors that would detract from planned strategies, and to devise solutions to dampen the consequences of these behaviors on the evacuation times. The ESCAPE team will build demonstrators to allow productive interactions with emergency services and remain reality-grounded for the whole duration of the project. These prototypes will allow us to precisely identify the stakes at play in each case study and the needs of the various managers.

Specific

Develop software libraries and extensions for GAMA platform, dedicated to modeling and simulation of massive evacuations in areas at risk.

Implement and test demonstrators on 4 use cases:

a. Propagation of a toxic cloud in Rouen area (follow up of MOSAIIC);

b. Tsunami reaching coastal cities of Da Nang and Nha Trang (follow up of TsunEvac) or flood in Ho Chi Minh Ville;

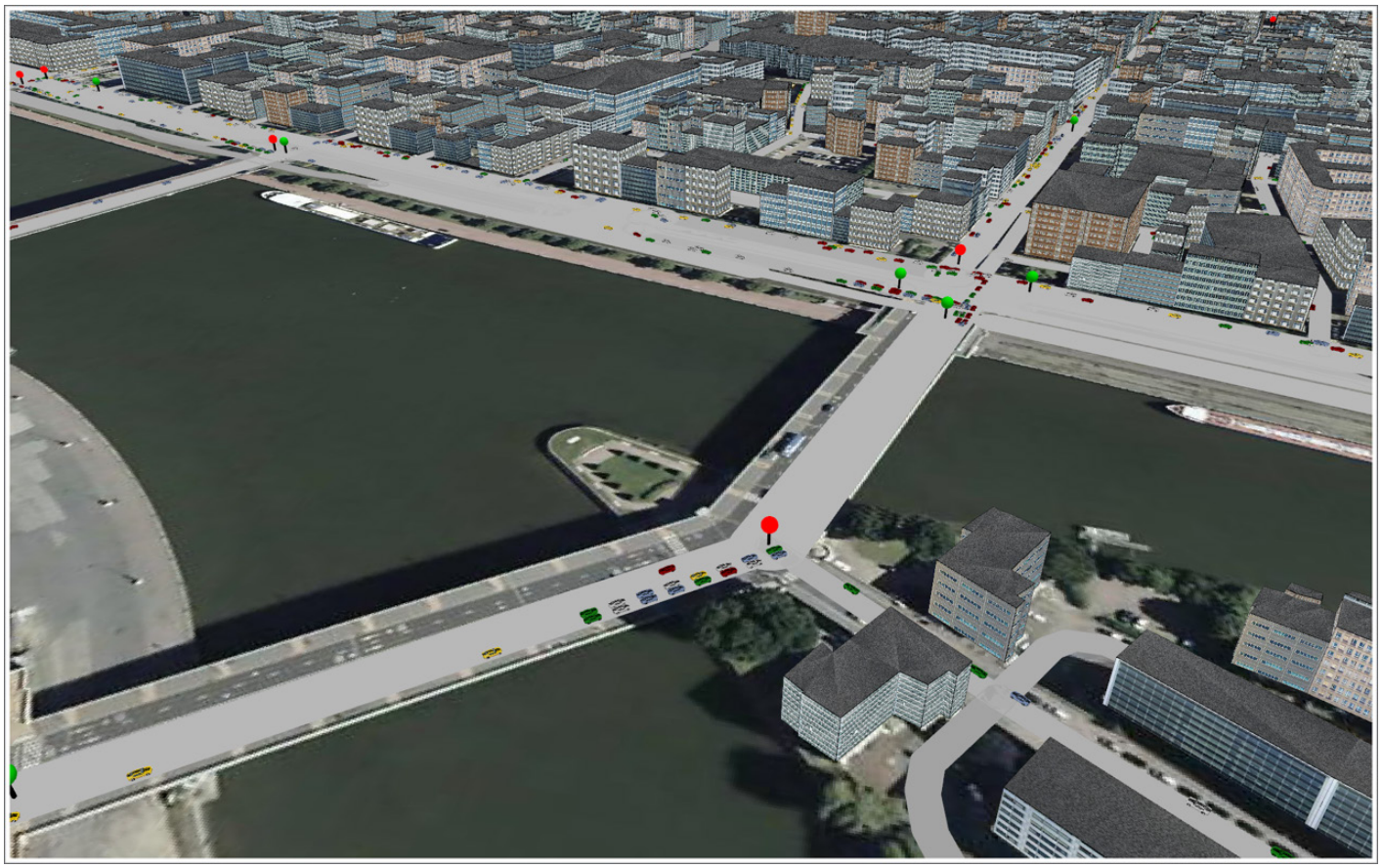
c. Floods in several towns in the south of France;

d. Cyclone on the coast of Andhra Pradesh and Odisha (India).

FOCUS ON GAMA

GAMA (http://gama-platform.org) is a modeling and simulation development environment for building spatially explicit agent-based simulations.

• Multiple application domains: use GAMA in any application domain.
• High-level and Intuitive Agent-based language: write models easily using GAML, a high-level and intuitive agent-based language.
• GIS and Data-Driven models: instantiate agents from any dataset, including GIS data, and execute large-scale simulations (up to millions of agents).
• Declarative user interface: declare interfaces supporting deep inspections on agents, user-controlled action panels, multi-layer 2D/3D displays & agent aspects.



SPECIFIC CHALLENGES

In most of the existing models, the population is considered as homogeneous. Here we aim at coping with heterogeneous populations. The main bottlenecks identified are as follows:

• Take into account the diversity of individual profiles, and existing inter-individual networks;
• Cope with the impact of this heterogeneity on mobility, flows and information dissemination;
• Cope with transportation heterogeneity and its impact on evacuation plans;
• Take into account the spatial distribution of individuals at alert time;
• Upscaling: large scale simulation processing and emerging properties and dynamics.

EXPECTED RESULTS

The main expected results are as follows:

• Tools to help in designing evacuation plans, with participation of the general public based on simulations;
• Insight into individuals behavior in a crisis, and identification of stress inducing socio-spatial features;
• Lessons learned from the actual management of the evacuation process during a realistic simulation, inducing a more efficient allocation of tasks and use of available resources;
• Free and open access to software libraries produced by ESCAPE will democratize the use of simulation in evacuation plans design.