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LittoWag : a serious game to explore adaptation scenarios in front of coastal risks

Julie Latune, Mariana Rios, Joana Line Guerreiro, Eva Perrier, Géraldine Abrami, Nils Ferrand
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Introduction

| | 1.5°C | 2.0°C | 3.0°C | 4.0°C | 5.0°C | SSP5-8.5 Low Confidence |
|--------------|--------------------------|-----------------------|-----------------------|--------------------------|--------------------------|-------------------------------|
| Closest SSPs | SSP1-2.6 | SSP1-2.6/SSP2-4.5 | SSP2-4.5/SSP3-7.0 | SSP3-7.0 | SSP5-8.5 | |
| Total (2050) | 0.18 (0.16-0.24) m | 0.20 (0.17-0.26) m | 0.21 (0.18-0.27) m | 0.22 (0.19-0.28) m | 0.25 (0.22-0.31) m | 0.24 (0.20-0.40) m |
| Total (2100) | 0.44 (0.34-0.59) m | 0.51 (0.40-0.69) m | 0.61 (0.50-0.81) m | 0.70 (0.58-0.92) m | 0.81 (0.69-1.05) m | 0.88 (0.63-1.60) m |

Table 1 Global mean sea level projections according five global warming levels. (IPCC, 2021)

→ In France, since the 2010 Xynthia storm which stroke the Atlantic coast, various new regulations emerged, such as national and regional strategies for integrated management of the coastline, State-Region contracts, or the Climate and Resilience law of August 2021.

→ To carry out adaptation of coastal areas, studies and reports emphasize the importance involving the inhabitants and citizens (Buchou 2019, Barone 2022) : it can foster efficiency, but it requires adequate tools and methodologies.

Serious games can engage participants about stressful topics, and smoothly grasp situations which are impossible or dangerous to reproduce in reality, or explore new scenarios in a safe framework.

→ Developed coastlines are increasingly vulnerable to sea level rise, marine submersion and erosion : in 2021 the IPCC reports sea level rise between 0.16 and 0.30 meters by 2050 (table 1), and more frequent and severe storms.

→ French coastlines and the Occitanie region seaside (from Rhône to Spain) is vulnerable. Since 1945, 2600 hectares of land are lost, and 25% of the coastlines eroded. The Occitan coast faces strong urbanization, started in 60s, and an erosion phenomenon of the sandy coast (figure 1).

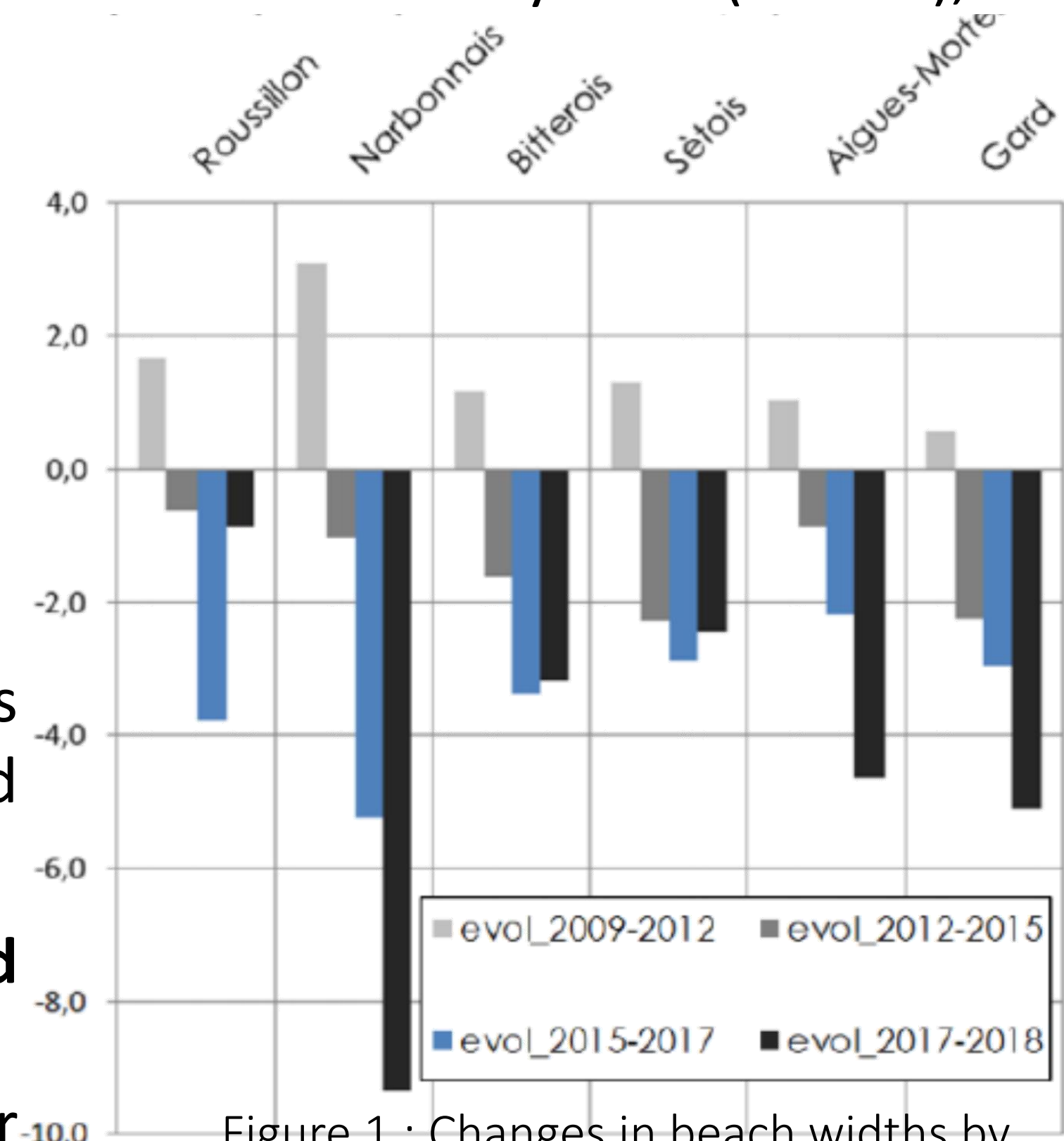


Figure 1: Changes in beach widths by coastal unit over several periods (data per m/year) (EID Méditerranée, 2020)

Steps Material and methods

Creation of the model

CreaWag method (Wat-A-Game subset) : 5 stages involved in creating a model and putting it into action:

- (i) framing (identification of the issues, their measurement, the intention of the model, the context of use, and the participants);
- (ii) construction of the conceptual model (space, issues, players, resources, activities);
- (iii) making the model dynamic by building a game (defining the territory, selecting roles, actions per role, resources, running a first round);
- (iv) finalising the game (resources dynamics);
- (v) calibrating the model parameters (to highlight the dilemmas, tensions, risks, induced effects and system constraints). (Ferrand et al., 2009)

Participatory simulation workshops

→ What is tracked:

- (i) choices and arguments concerning the coastline management options (i.e. civil engineering, nature solution bases, other techniques, monitoring) (Céréma 2020)
- (ii) the land use they want to transform.
- (iii) Analysis of learning dimensions: Change is expected among citizens, which can be cognitive, relational and / or normative.

Participatory simulations and role-playing games can enable such exploration and learning (Deen Han et al., 2018, Baird et al., 2014). We assess this by:

- pre-post questionnaires
- observation of the game session
- debriefing (fig 4) (ComMod, 2020).

→ Workshop organisation:

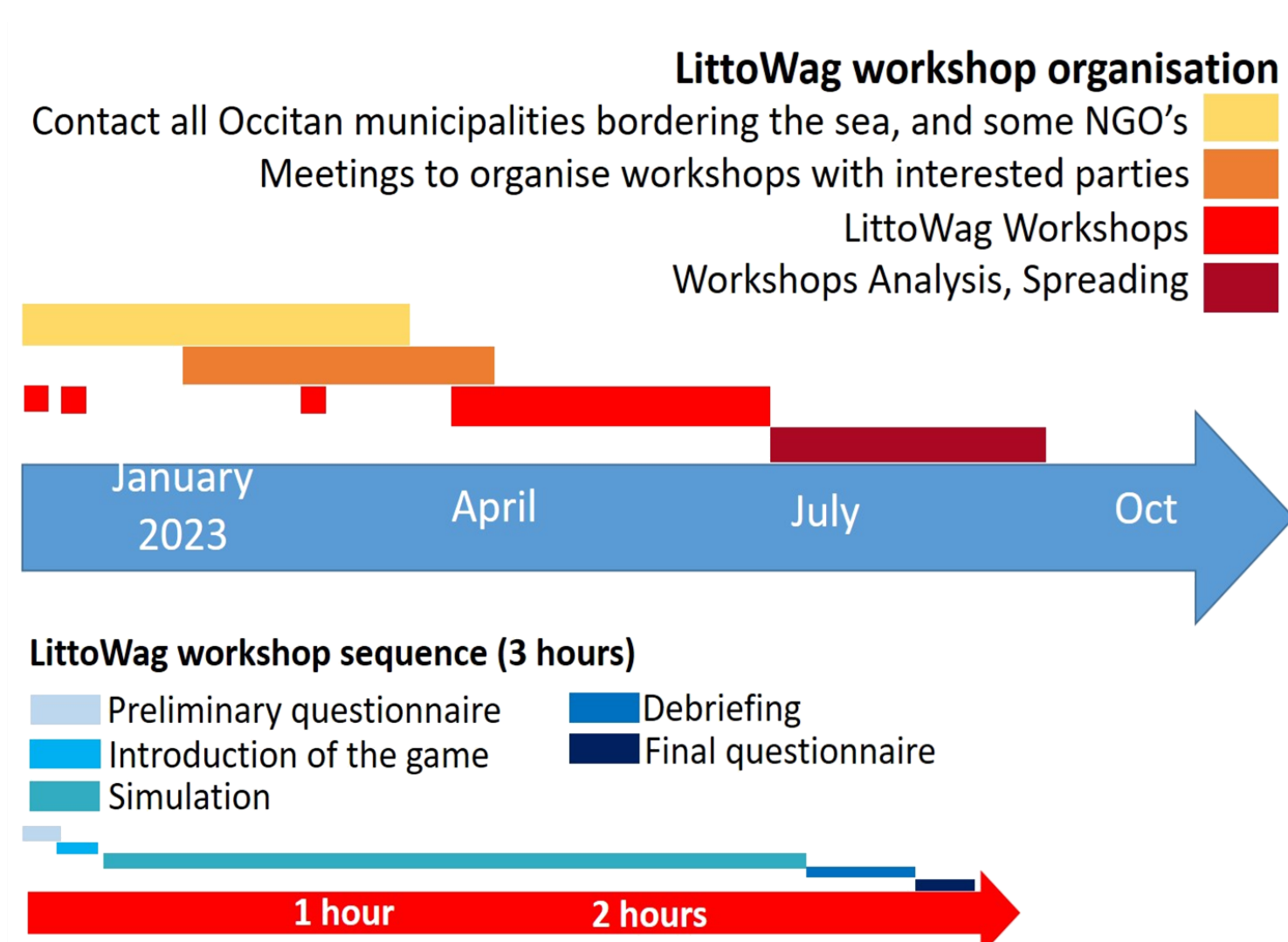


Figure 5: LITTOWAG workshops

Results: The LITTOWAG game

Getting the Occitanie citizens to consider their coastlines adaptation in front of marine erosion and submersion.

7 sliders monitor the area's ability to maintain its uses:

- . Touristical,
- . Agricultural,
- . Accommodation of residents,
- . Well being of resident,
- . Public services,
- . Natural areas,
- . Territorial budget.

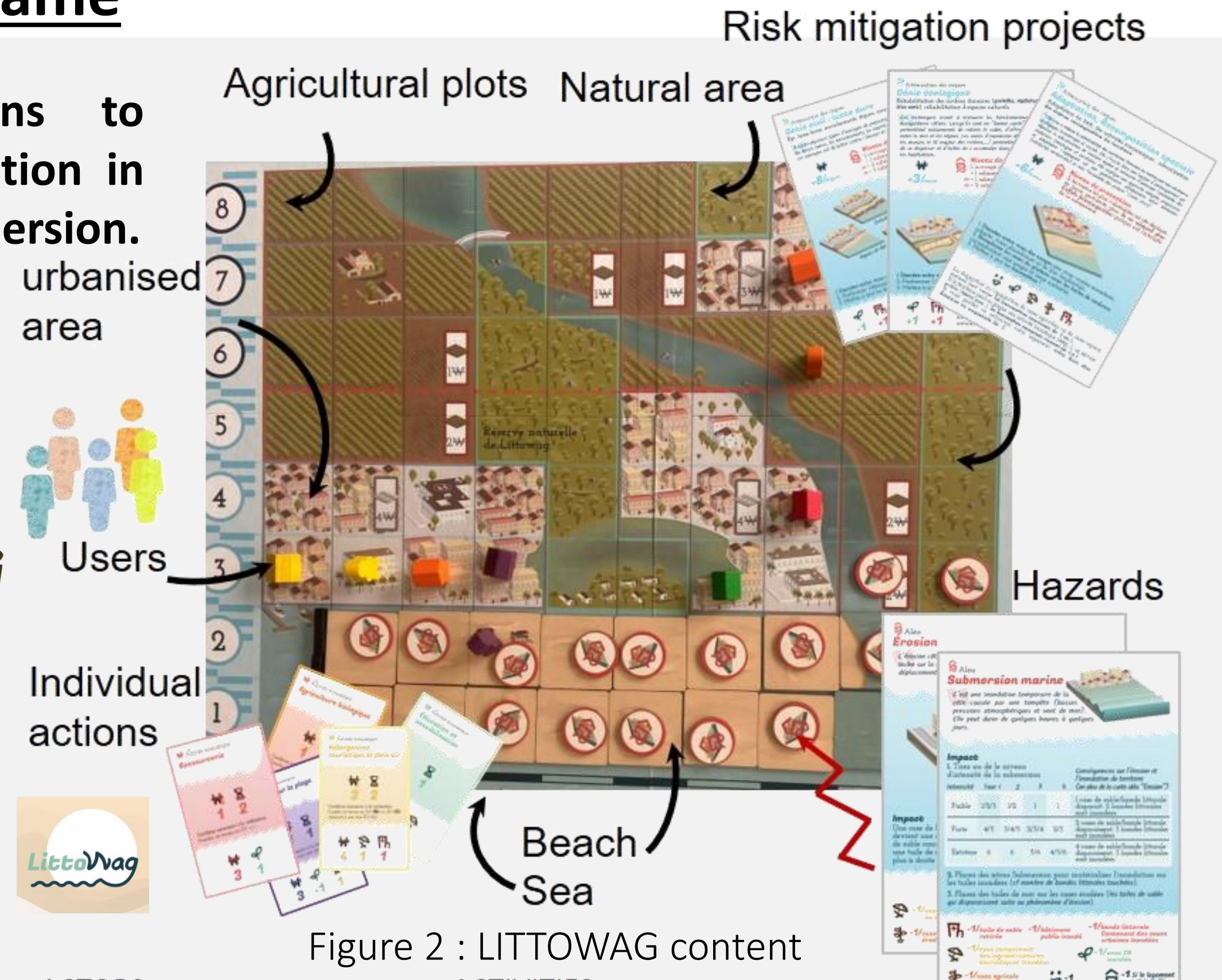


Figure 2: LITTOWAG content ACTIVITIES

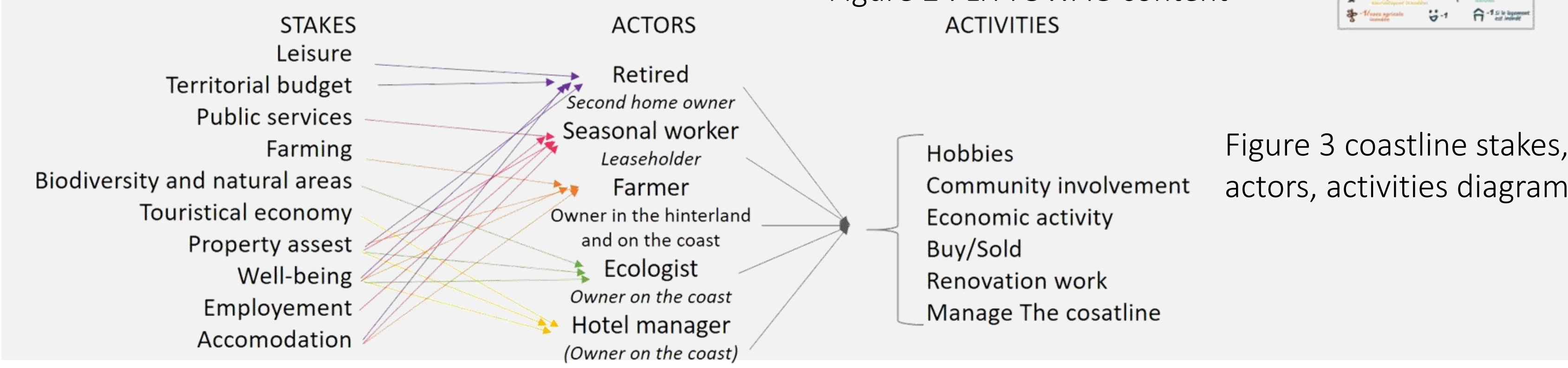


Figure 3: coastline stakes, actors, activities diagram

> Ecological engineering actions are preferred to manage coastline risks (7 workshops)

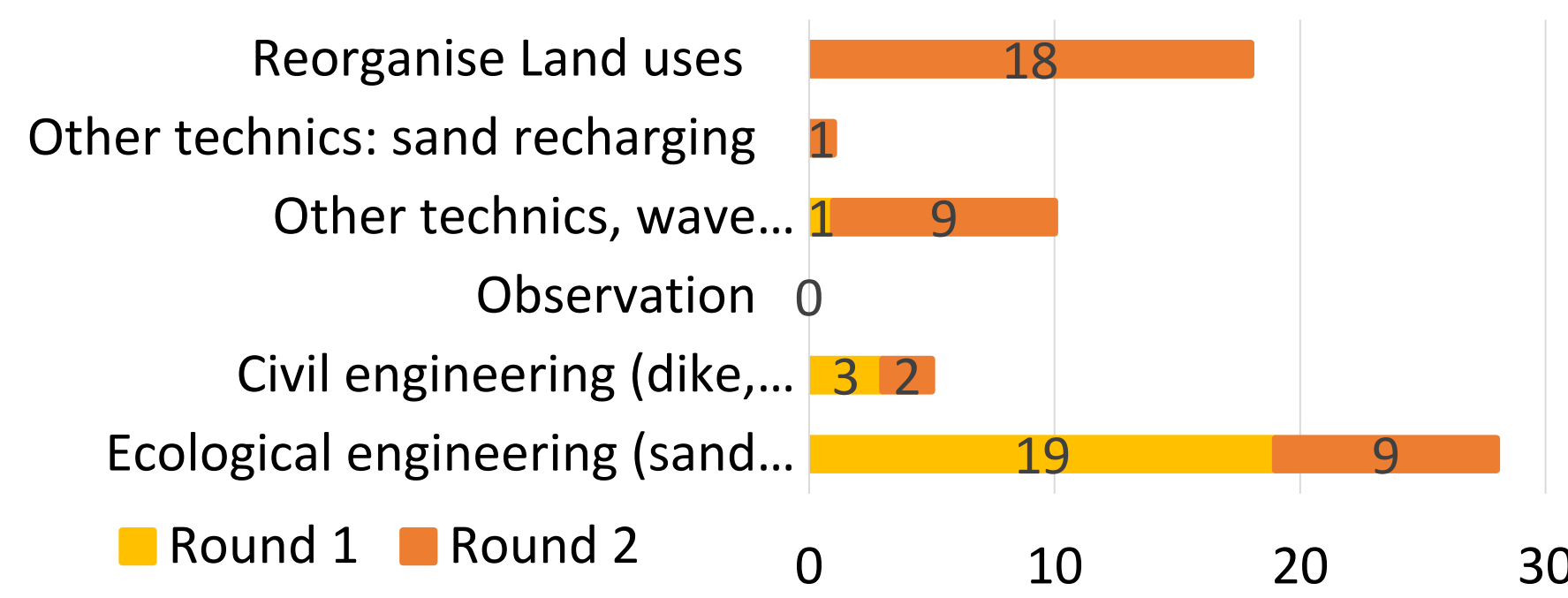


Figure 6: Number of actions chosen by category of coastline risk management solution

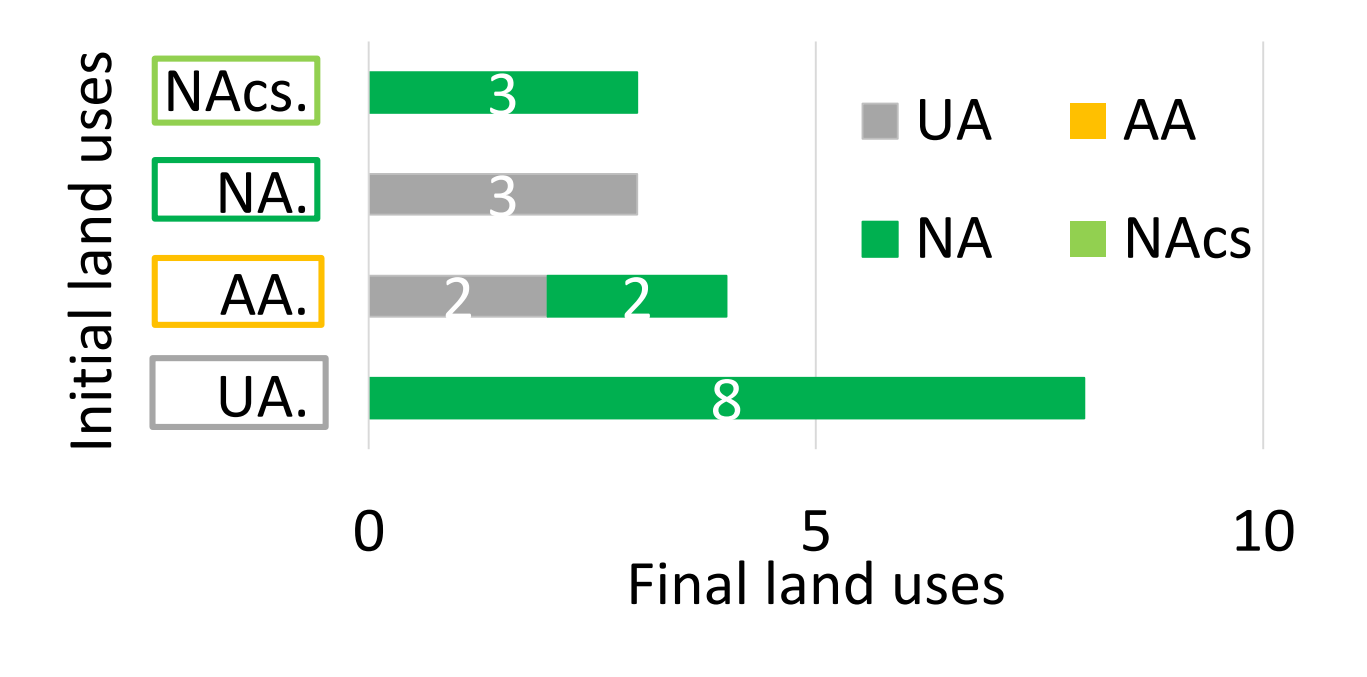


Figure 7: land use changes

> More cognitive learning (28 participants)

| Learning | Nb of participants | Verbatims « what you learnt, what impressed you » |
|------------|--------------------|--|
| Cognitive | 17 | "I learned more about actions to limit erosion and submersion. I better understand the societal issues relating to the coastline." |
| Normative | 12 | « Regular climatic hazards » |
| Relational | 8 | "The value of dialogue with the public and those affected." |

Table 2 Categories of learning according to the number of participants in the workshops.

Uses of the model

The uses of a model/game depend on who is involved in its design (Etienne, 2014). It can reveal a shared problem among participants (Salliou et al. 2021). Being concerned by the problem is a prerequisite (i) to collective action (Callon, 1986) and (ii) to use the game, and the simulation in order to learn more about the system.

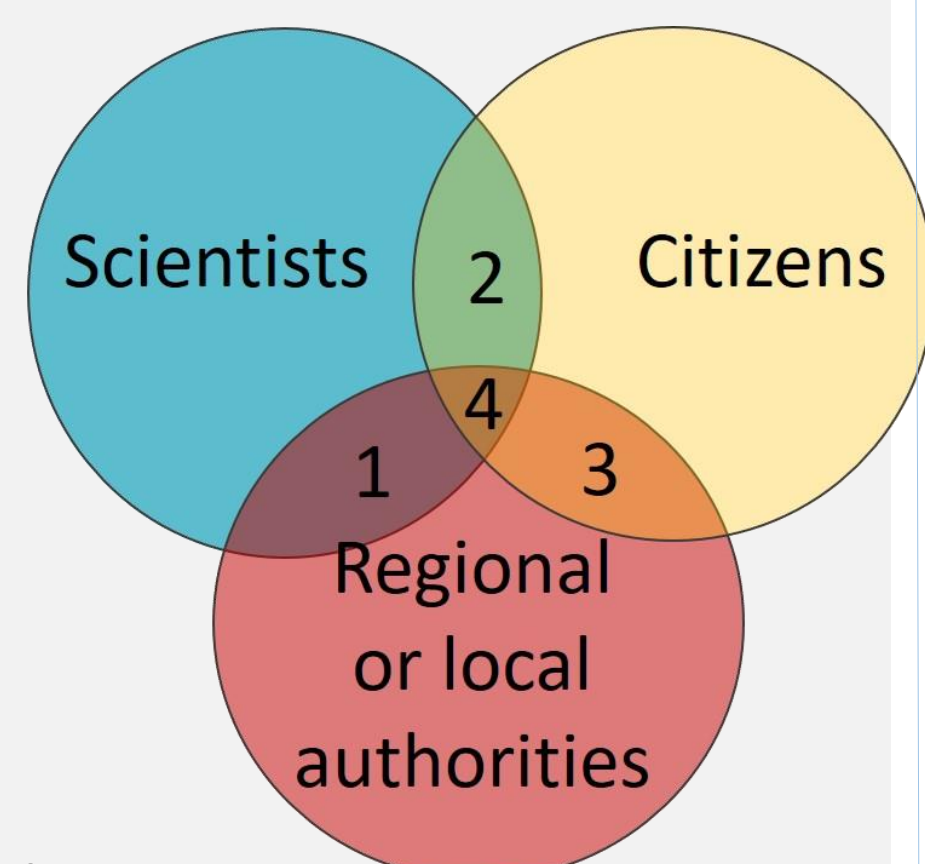


Figure 9 Model users according to problem sharing (adapted from Salliou et al. 2021)

Different uses of LittoWag respond to different issues depending on the stakeholders involved (figure 9):

- 1- A toolbox enabling those responsible for the integrated coastal management strategies to involve citizens (Occitanian regional authorities).
- 2- Reflect on the adaptation of the coastline (Occitanian coastal citizens).
- 4- Contribute to the definition of the local coastline management strategy (Local authorities of the Aude coast).

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