

Objective

- ▶ Simulating the dynamics of transformational adaptation at the level of a population by synthesizing literature of adaptation psychology and sociology in an agent-based model

Introduction

- ▶ Climate change, biodiversity decline, change in nitrogen cycle and many others widening issues have already a decisive impact on economic development and social stability
- ▶ All these evolutions, combined with the unprecedented connectivity and complexity of societies, are shaping a context in which crises are increasingly frequent, intense, and unpredictable
- ▶ Responses mainly irrelevant and counterproductive in long-term since worldviews of decision-makers not in line with global context
- ▶ Transformational adaptation are often required to change the decision context of actors, and thus enable to engage persistently in pathway to sustainability

Materials

- ▶ Factors of Change:
 - ▷ internal (values, worldviews)
 - ▷ external (social network, overall situation)
- ▶ Barriers to Adaptation:
 - ▷ psychological (unfavorable attitude)
 - ▷ social (unfavorable institutions)
 - ▷ technical (unfavorable facilities)
- ▶ Considering Transformational Options:
 - ▷ more likely in multi stressors context
 - ▷ first incremental adaptations, then transformational
- ▶ Adopting Transformational Options :
 - ▷ Theory of Planned Behavior [1] for capturing all motivational factors
 - ▷ Intention to adopt depends on attitude, subjective norm and perceived behavioral control

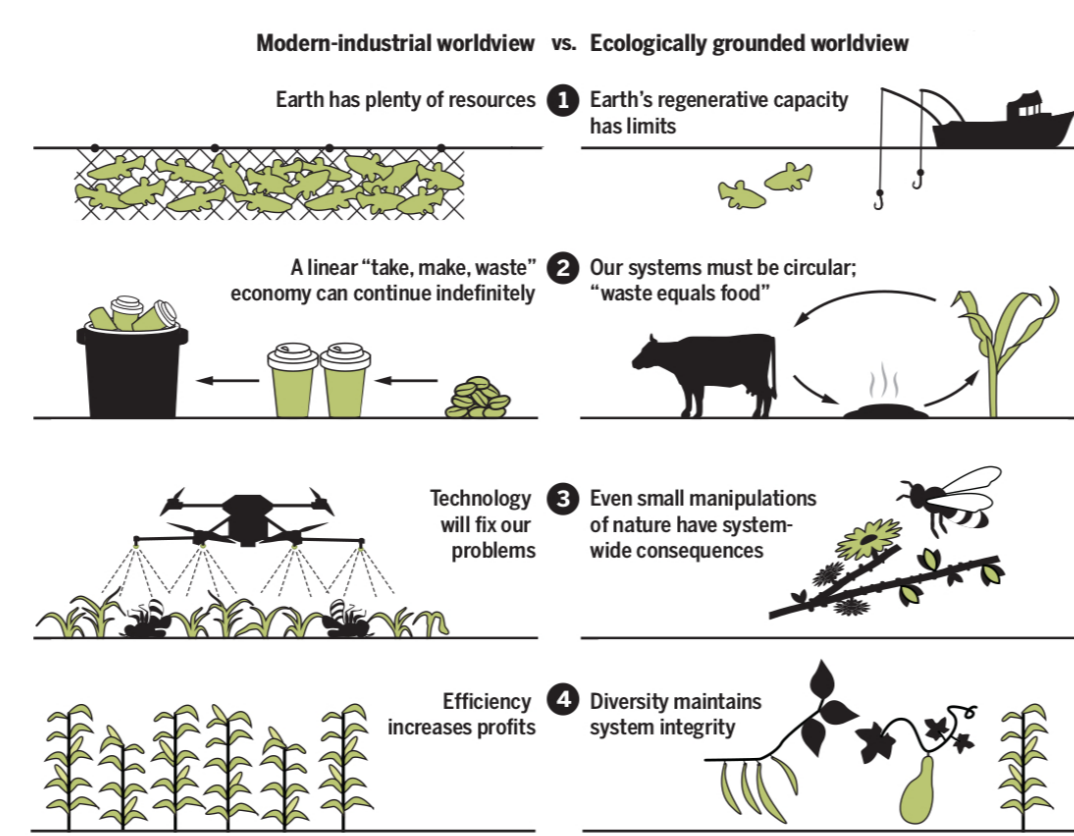


Figure 1: Example of psychological barrier in farming context [2]

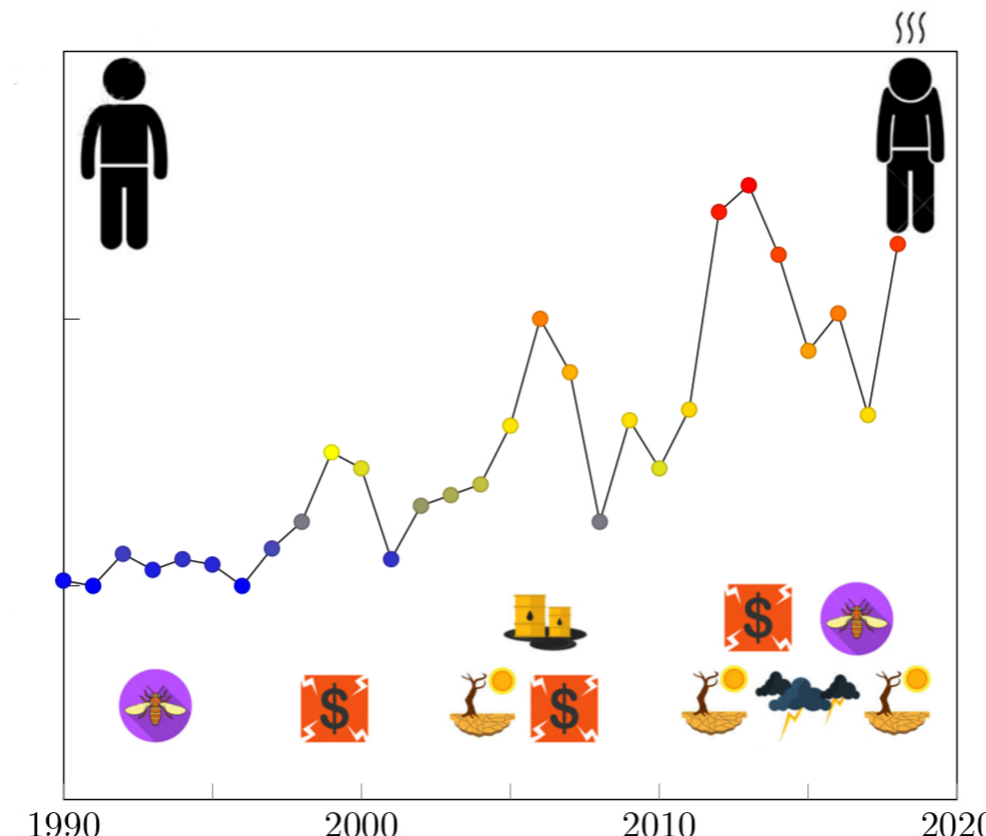


Figure 2: Illustration of increasing need for change in farming context

Methods

Implementation of process of transformational adaptation in an agent-based model.

- ▶ Proposed Process:
 1. habitual routine :
 - ▶ evaluation through current worldview and social group
 2. perturbation :
 - ▶ change of environment and social influences
 3. possible responses :
 - ▶ search informations
 - ▶ consider alternative from neighbor
 4. when considering
 - ▶ evaluation through both worldviews and social groups
 5. adoption and internalization
 - ▶ new behavior, worldview and social group
 - ▶ return to habitual routine
- ▶ Cognitive Elements:
 - ▷ Value : Reference for evaluating a practice, for considering alternatives and for searching informations. Constant during the simulation.
 - ▷ Worldview : bounds attitude of agent. Two types of worldview possibles : one based on beliefs oriented toward resilience (worldview R), one based on beliefs toward narrow efficiency (worldview E).

Mathematical Section

Cognitive functions

- ▶ Attitude:
$$\text{Att}(\text{practice}) = \begin{cases} 0.5 \times \text{value}(\text{practice}) + 0.5 & \text{if worldview R} \\ 0.5 \times \text{value}(\text{practice}) & \text{if worldview E} \end{cases} \quad (1)$$
- ▶ Subjective Norm:
$$\text{Sn}(\text{practice}) = \begin{cases} \text{mean of Att}(\text{practice}) \text{ of similar neighbors} \\ 0.5 & \text{if no similar neighbor} \end{cases} \quad (2)$$
- ▶ Perceived Behavioral Control:
$$\text{Pbc}(\text{practice}) = 1 - \text{Impact} * (1 - \text{Level of resilience of the practice}) \quad (3)$$
- ▶ Evaluation:
$$\text{E}(\text{practice}) = \begin{cases} 1/3 * (\text{Att}(\text{practice}) + \text{Sn}(\text{practice}) + \text{Pbc}(\text{practice})) \\ 1/2 * (\text{Att}(\text{practice}) + \text{Sn}(\text{practice})) & \text{if no info on pbc} \end{cases} \quad (4)$$

Response to perturbation

if $\text{E}(\text{current practice}) < \text{value}$, then search information and consider (5)

if $\left\{ \begin{array}{l} \text{PBC}(\text{current practice}) < \text{value} \\ \text{alternative in local network} \end{array} \right\}$ then consider (6)

Adoption of the alternative

if $\text{E}(\text{current practice}) < \text{E}(\text{alternative practice})$, then adoption (7)

Results

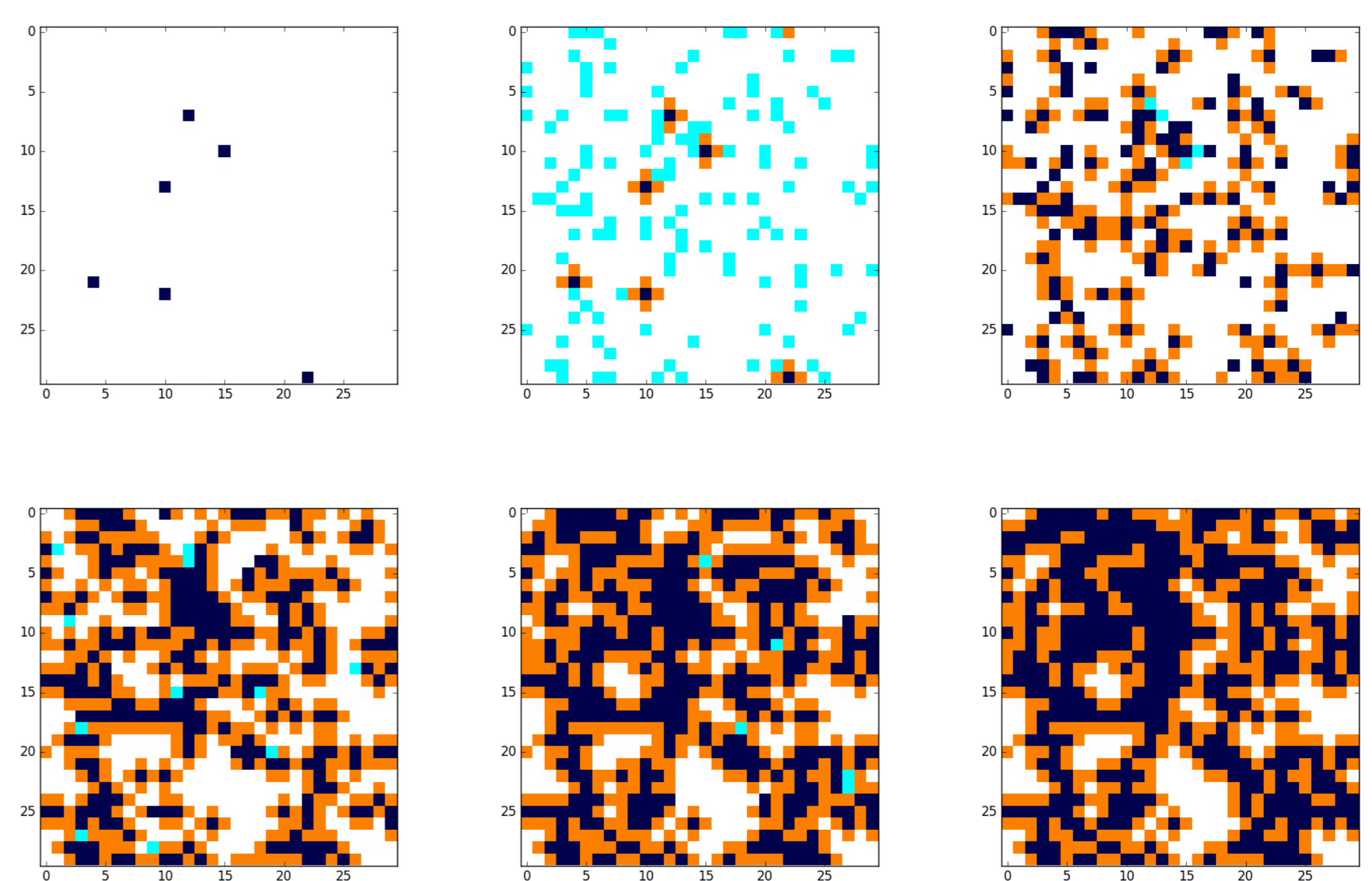


Figure 3: Maps of the population where each pixel represents an agent. Shock triggered on the first map. White : no adoption, orange : considered, light blue : informed, dark blue : adopted.

Conclusion

- ▶ Adopters are first the ones with high value, then the ones in high difficulty
- ▶ Some agents do not adopt because of low value or no access to information

References

- [1] Icek Ajzen. The theory of planned behavior. *Organizational behavior and human decision processes*, 50(2):179–211, 1991.
- [2] Elise Amel, Christie Manning, Britain Scott, and Susan Koger. Beyond the roots of human inaction: Fostering collective effort toward ecosystem conservation. *Science*, 356(6335):275–279, 2017.

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