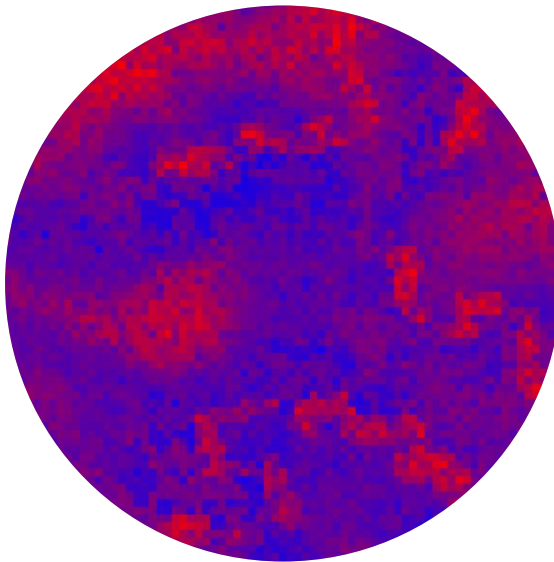


# Validation of ABM: can we do it?

21-01-2013, Arend Ligtenberg



# Outline

- Introduction
- Case 1: Validation of beliefs and preferences
- Case 2: Opinion dynamics
- Discussion



# Simulating LUCC:

## Complex (Adaptive) Systems

- Many elements
- Interact non-linearly
- Different spatial and temporal scales
- Non-closure
- System boundaries hard to define
- Path dependency
  
- Discover surprising behaviour (tipping points)



# The challenges

- Social processes
- Diversity in behaviour
- Diversity in knowledge amongst agents
- Making decisions in absence of complete information
- Adaptivity or non-stationarity
- What to observe?



# Why?

At least not for predicting

- **Explore** system behaviour
- See what knowledge is missing
- Test assumptions/hypotheses
- Try to **understand** a system



Perhaps guidelines for better management or design



# Case 1: Modelling interactive spatial planning using ABM

- Main driver LUCC: people
- Decision making process
- Allocation problem

- Multi-Actor
- Multi-Goal
- Decision rules



# Planning process / Study area

## Regional dialogue approach

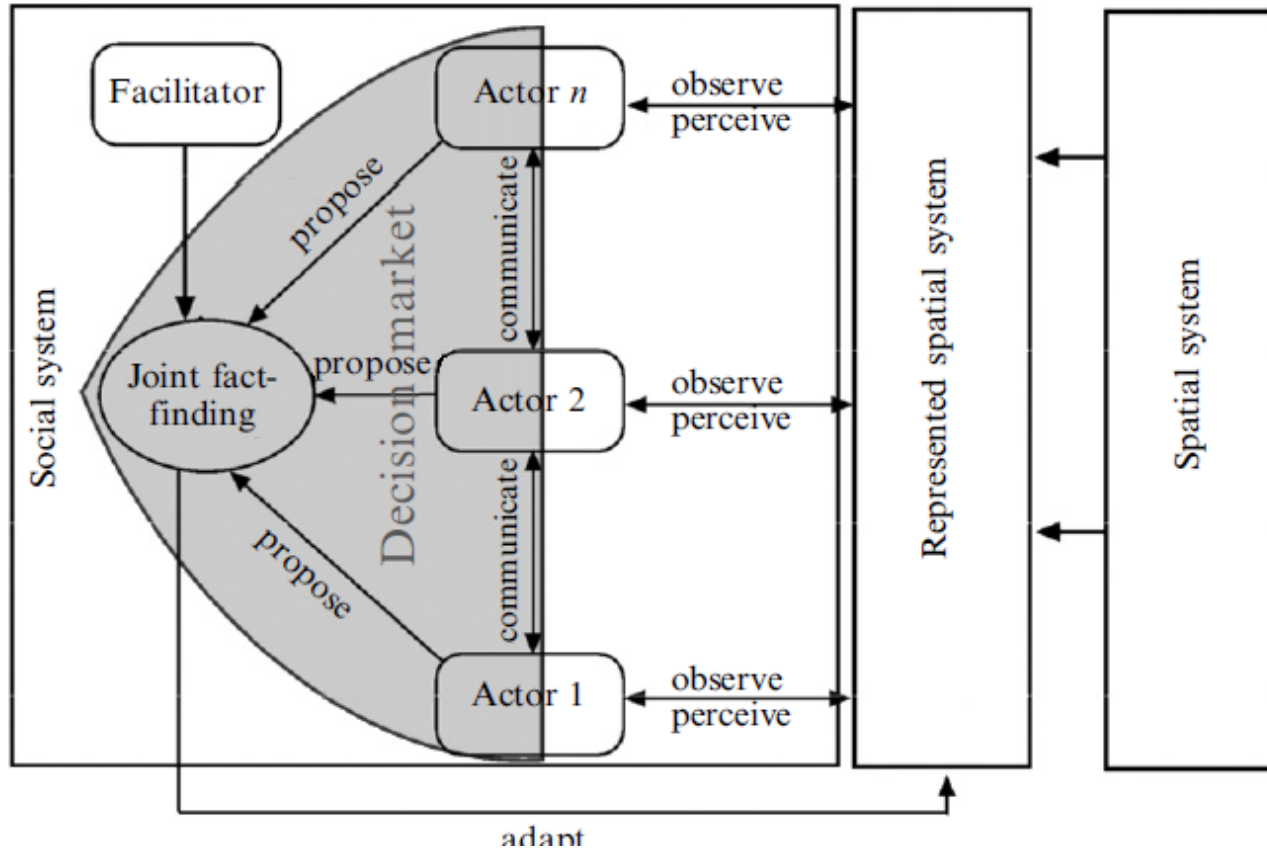
1. Socialisation
2. Externalisation
3. Internalisation
4. Combination



Fig. 1. The study area.



# ABM



- Belief, Desires and Intentions Architecture (BDI)
- REPAST



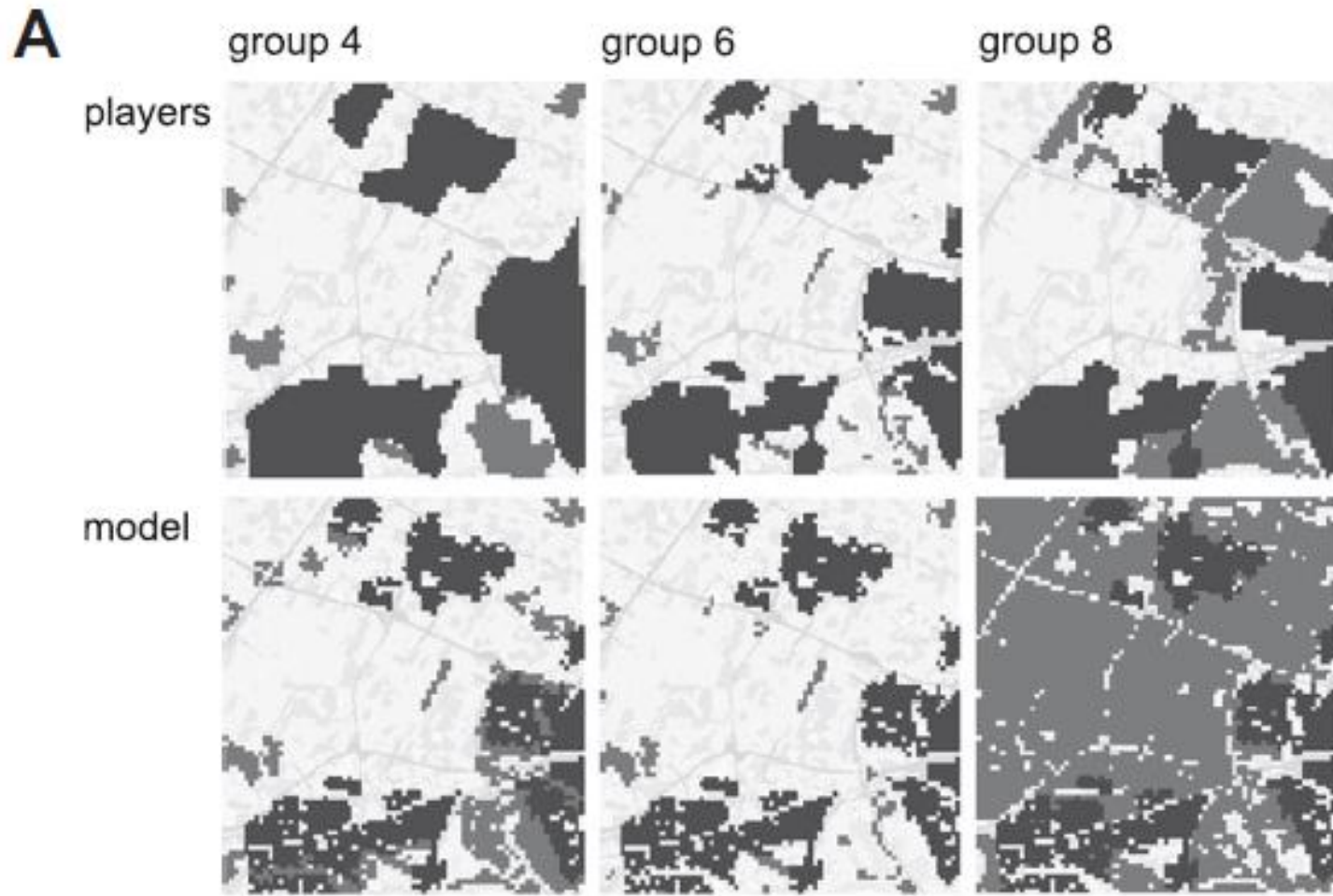
# Validation experiment

- 27 students
- 9 groups
- 3 roles (citizens, farmers, nature conservationist)
- Allocate 300 ha urban area
- Validating beliefs and preferences

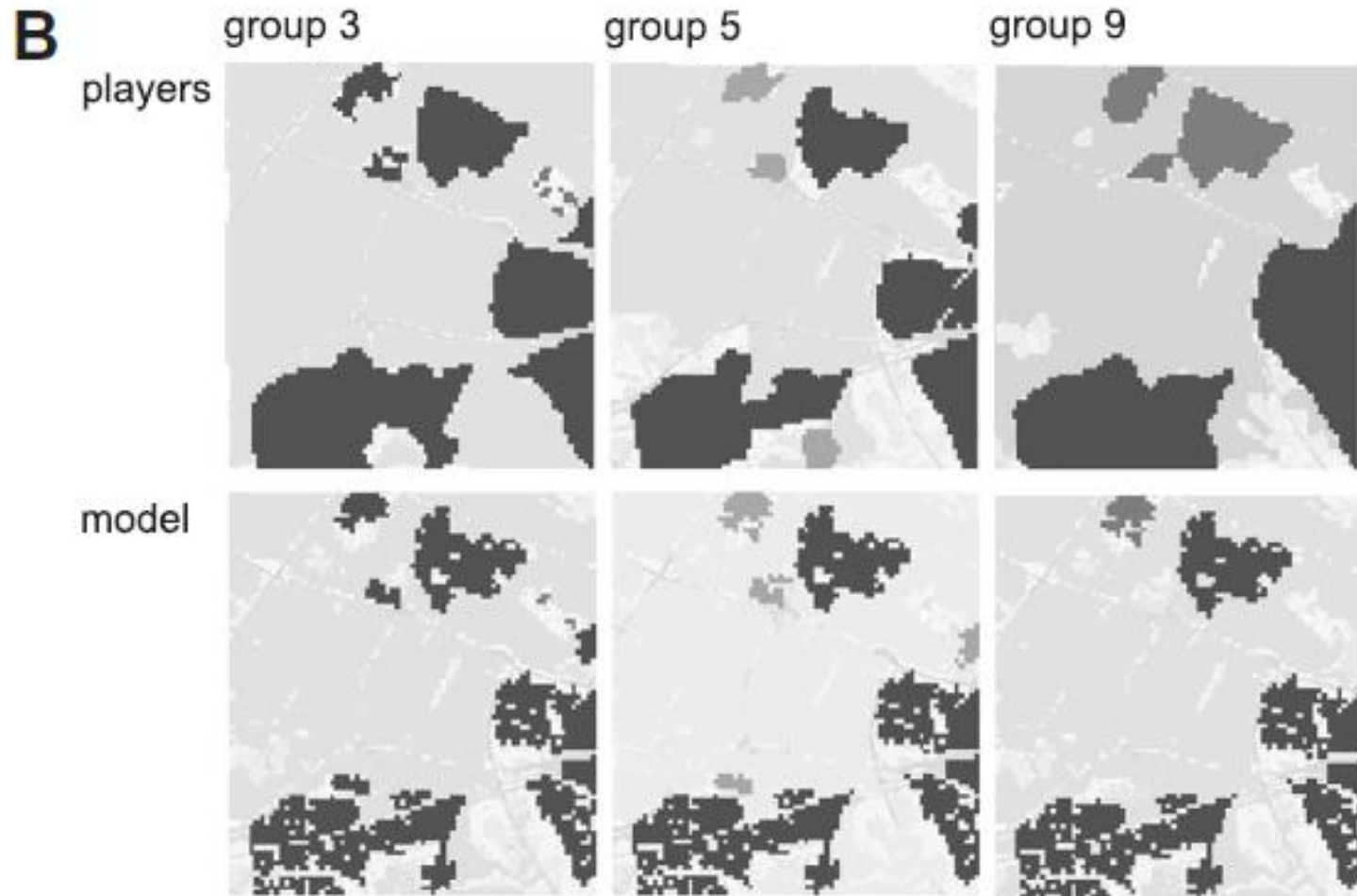
Role	Desires
Citizens' organization	New urban development around existing urban areas Near forest and nature
Farmers' organization	New urban development preferably located around existing urban areas Not near existing agricultural land Not near small villages
Nature-conservationists	New urban development not near nature areas As little new urban development as possible around "historic" villages



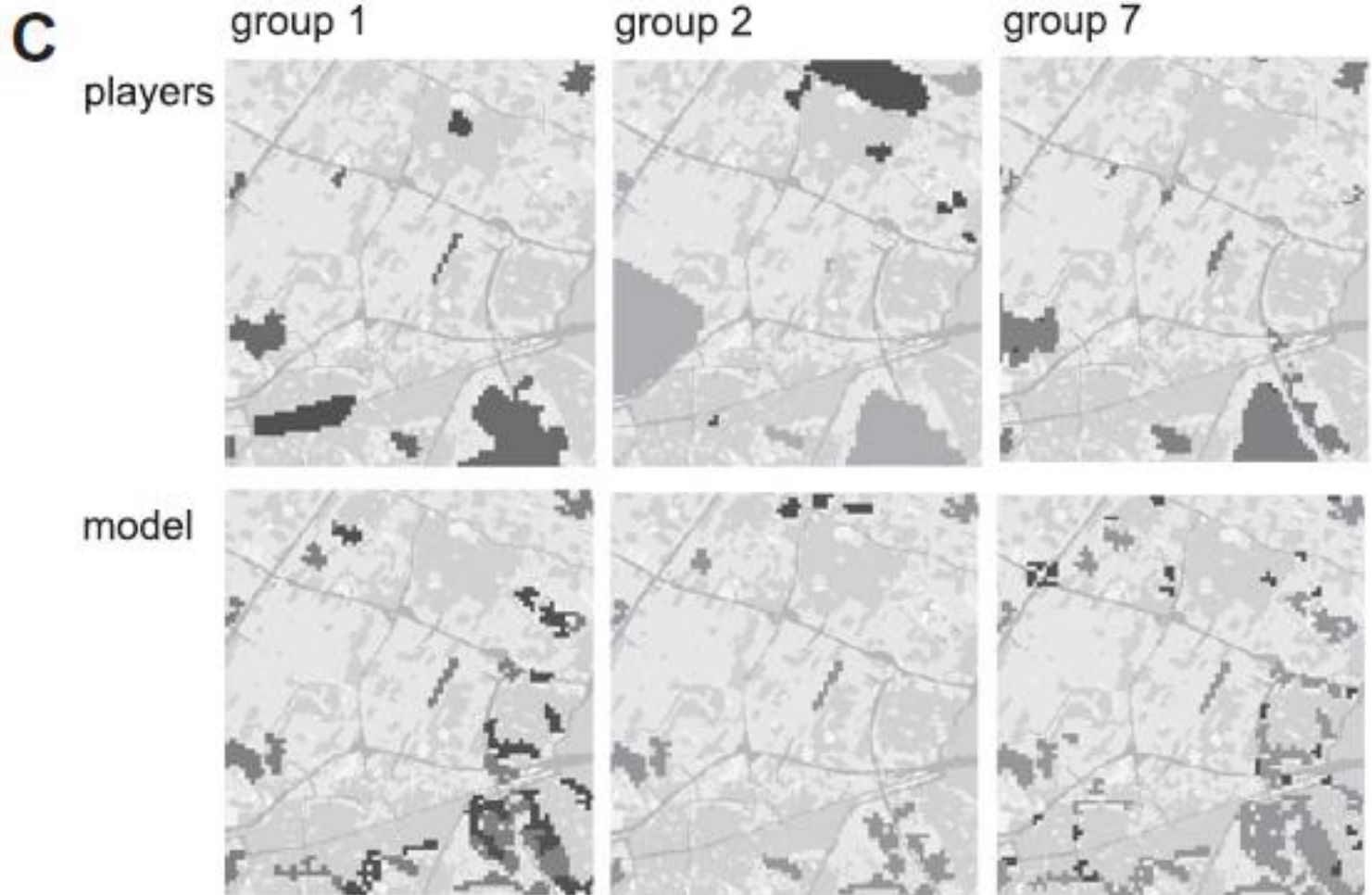
# Results: beliefs 1



# Results: beliefs 2



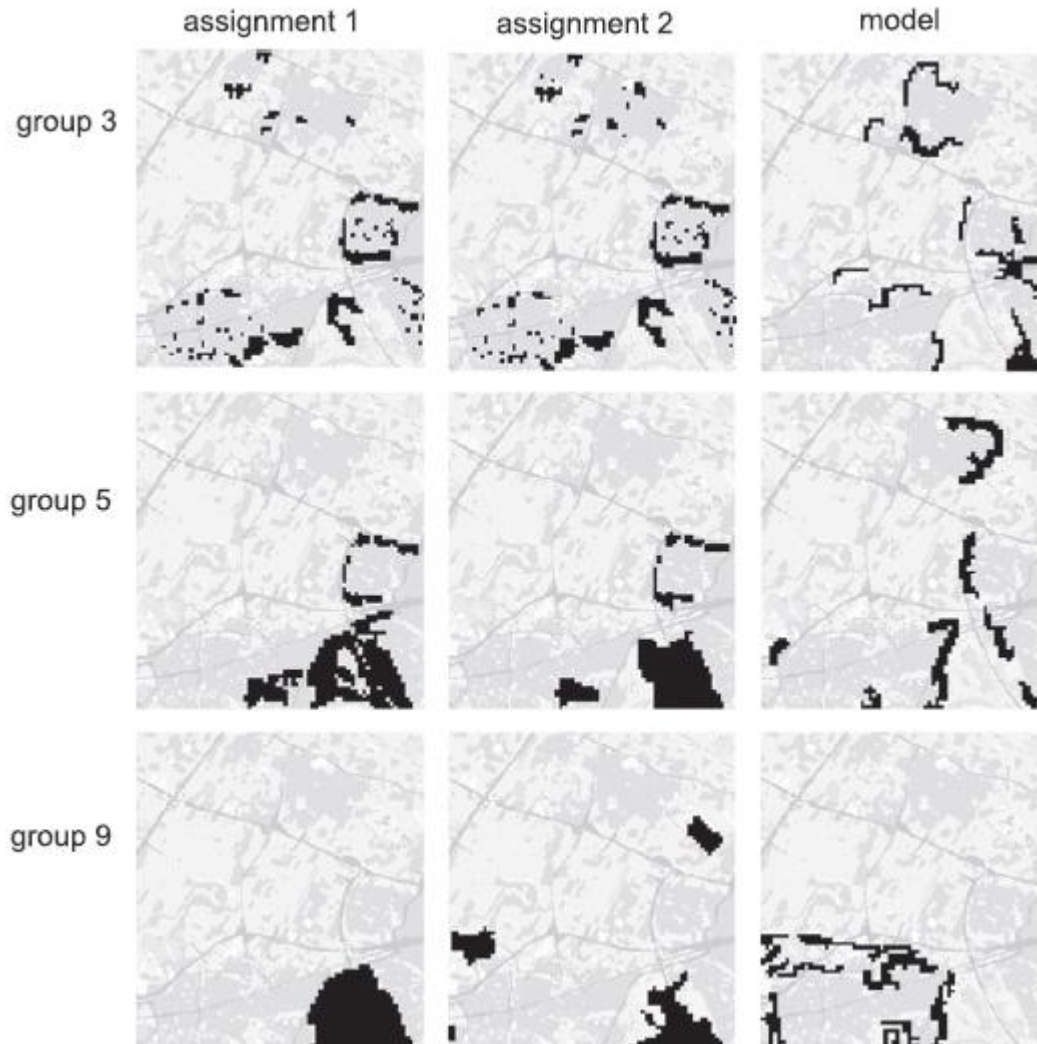
# Results: beliefs 3



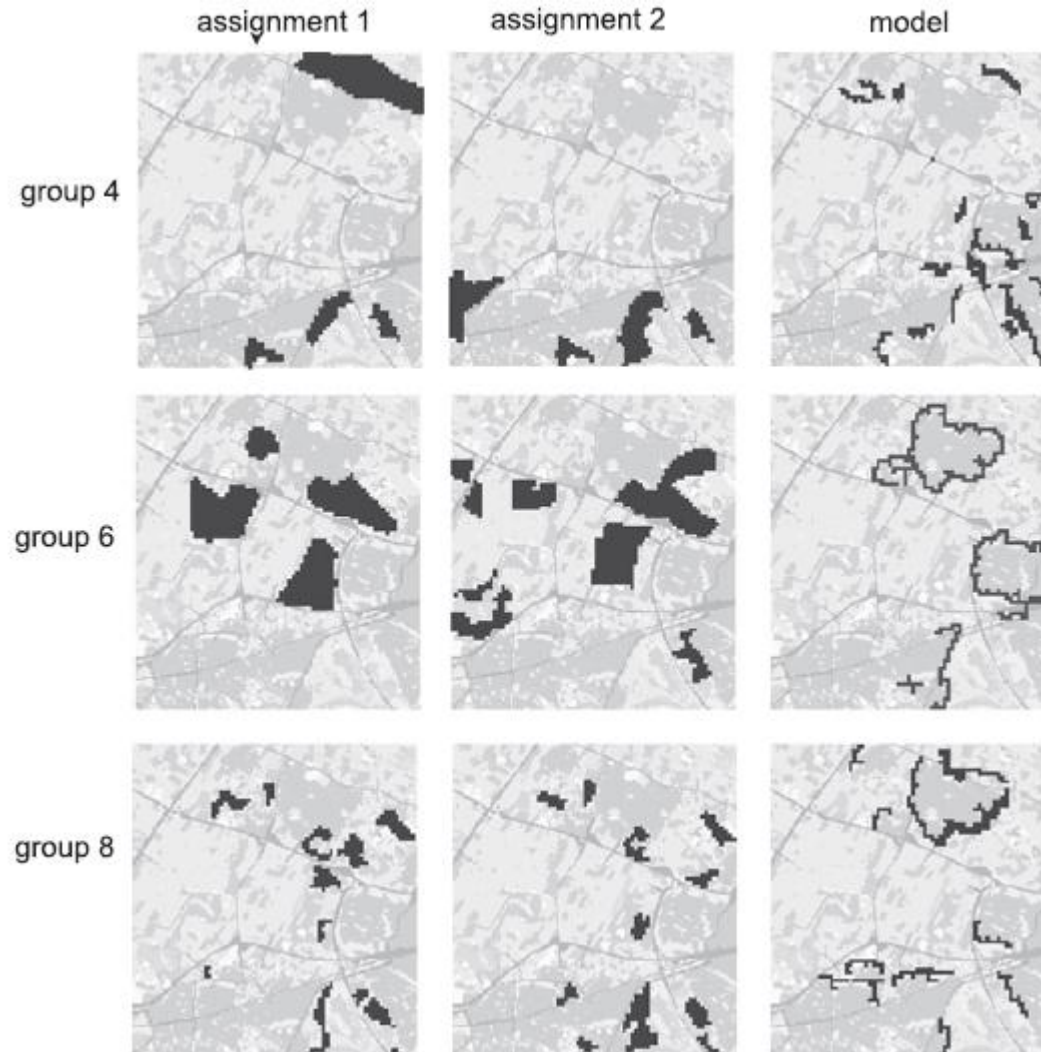
Land use	Urban			Forest/nature		
	4	6	8	4	6	8
Pasture (1)						X
Cereal (5)						X
Glasshouses (8)						
Orchards (9)						
Dec. forest (11)				X	X	X
Con. forest (12)				X	X	
Nature (14)				X	X	
Bare ground in nature (15)						
Water (16)				X		
Urban (18)	X	X	X			
Rural build-up (19)						X
Dec. forest in build-up area (20)				X		
Con. forest in build-up area (21)						
Forest in dense urban area (22)						
Pasture in dense urban area (23)				X		X
Bare ground in rural build-up (24)						X
Main infrastructure (25)						
Agriculture (30)						X



# Results: preferences 1



# Results: preferences 2



# Conclusions

- Differences in generalisation
- Semantics depends on location
- Beliefs defined within topological context
- Humans use additional clues perceived through various channels
- Mismatch between processes and spatial scale





# Case 2: non rationality

- Mutual influence (coalition versus extremism)
- Dynamics of opinion or negotiation
- Trust & Reputation
- Cooperation & Conflicts
  
- Main driver for most land use changes
- Away from utility thinking
- Satisficing rather than optimising



# Opinion dynamics

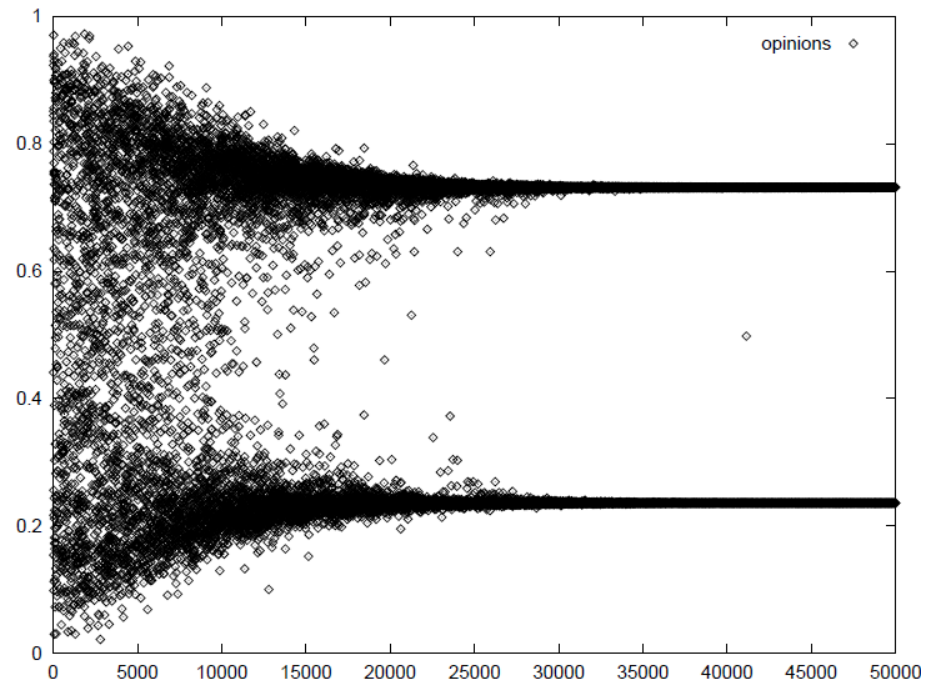
- Deffuant-Weisburg model:

$$X_{i(t+1)} = X_{it} + \mu * (X_{jt} - X_{it})$$

$$X_{j(t+1)} = X_{jt} + \mu * (X_{it} - X_{jt})$$

Only iff  $|x_{it} - x_{jt}| < d$

- Problem non spatial!

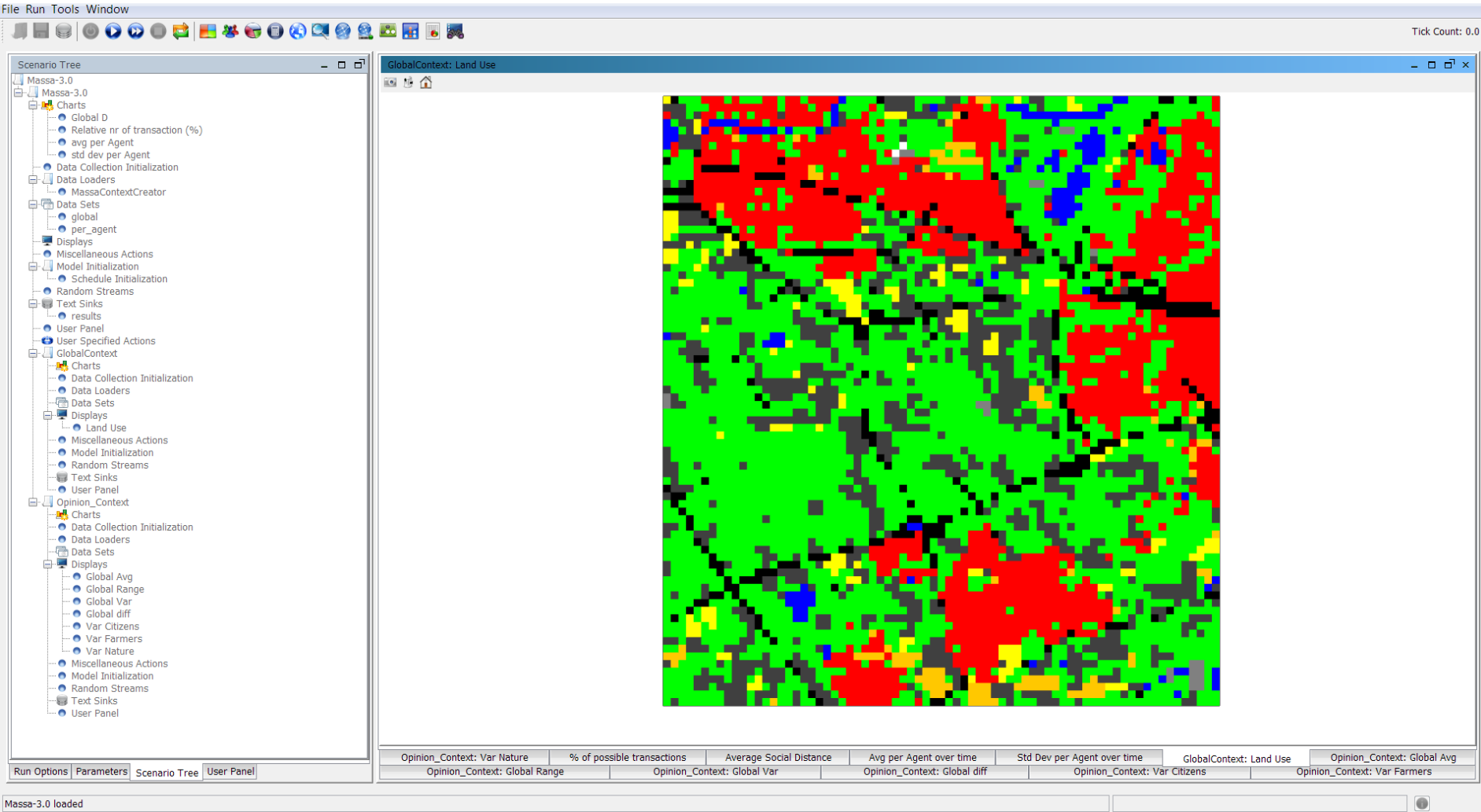


$d = 0.2$  ;  $\mu = 0.5$  and  $N = 1000$

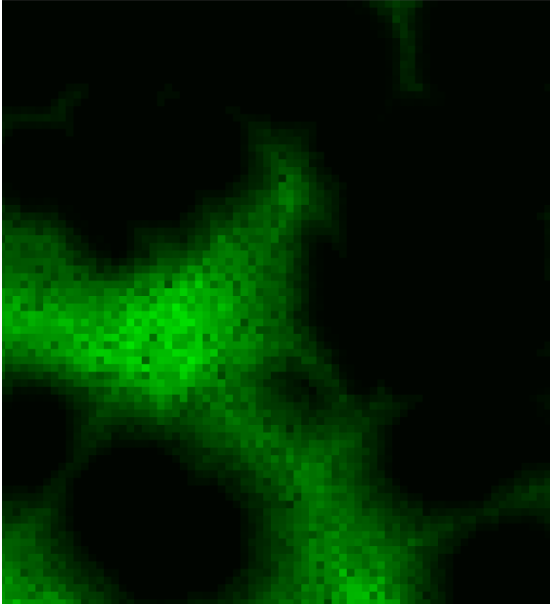
Source Deffuant et. Al. 2000



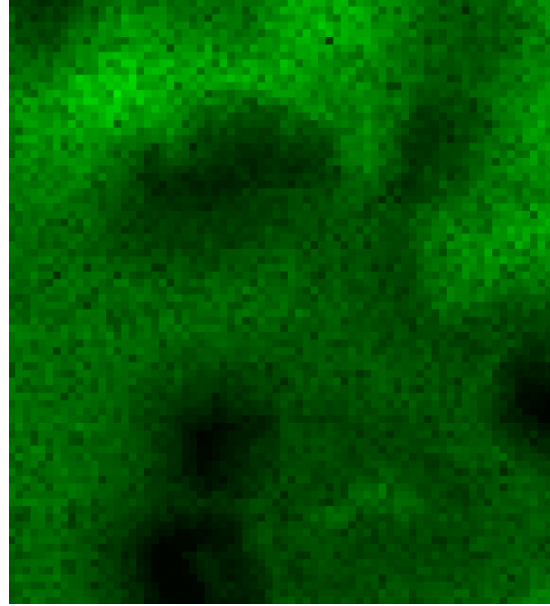
# Multi-actor land use planning



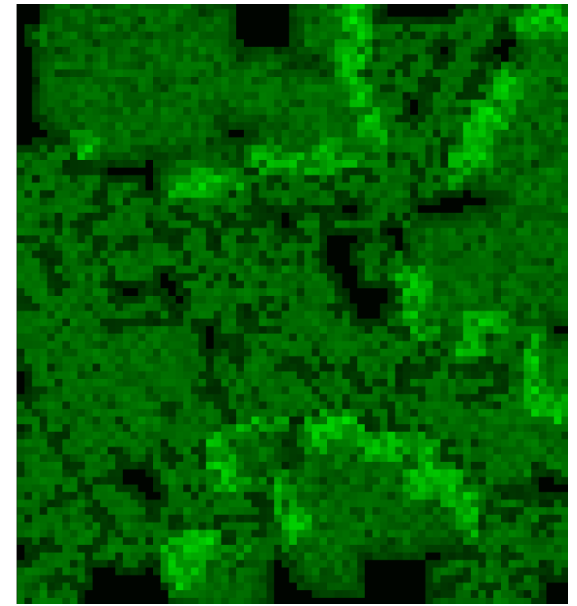
# Preferences



Nature



Farmers

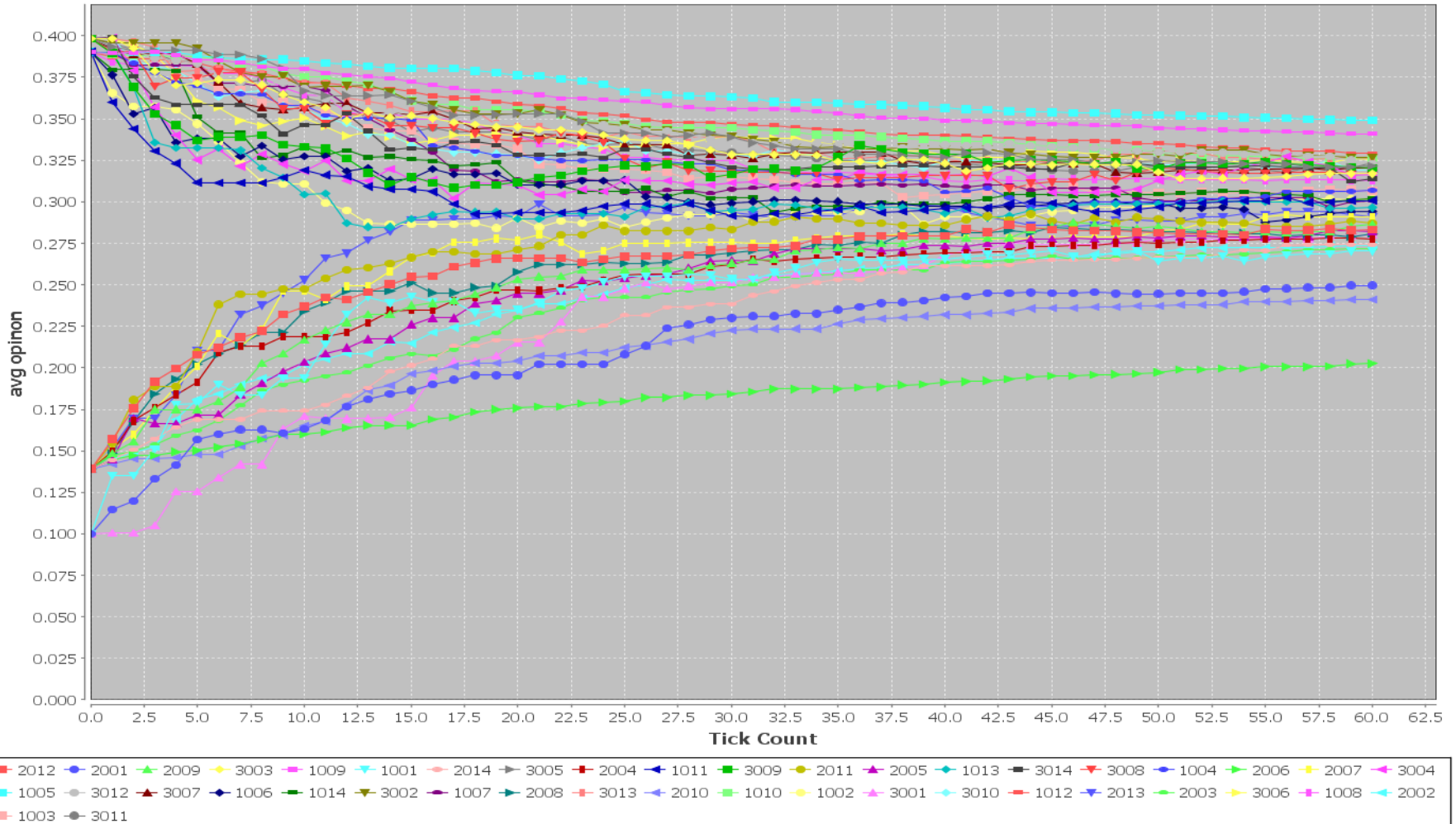


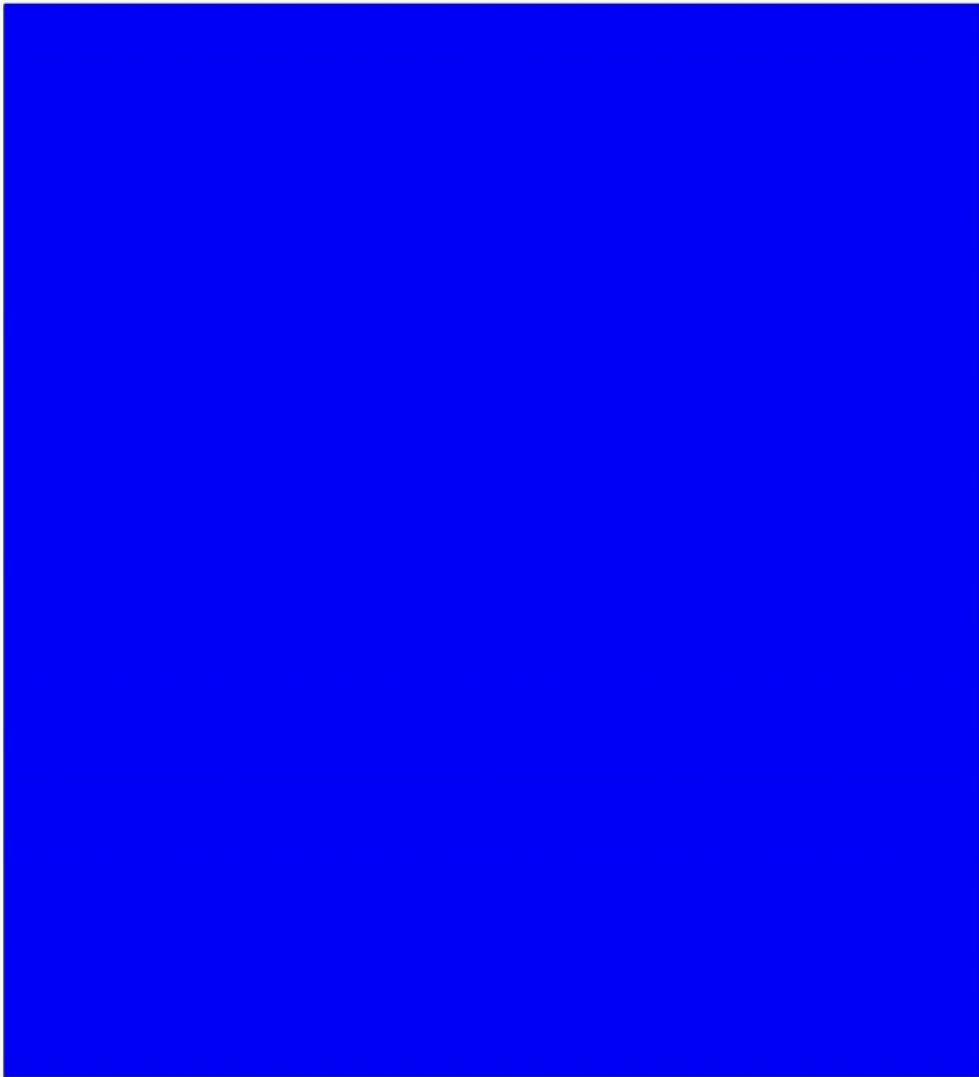
Citizens



# Development of opinions

**Avg per Agent over time**





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# Remarks

- The observation problem
- What to validate
  - Patterns?
  - Processes?
  - Both?
- Need alternative definitions for validation
  
- Gaming?



# Thank you

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