

Spatial agent-based modelling

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Limitations of field-based modelling

- 1) Assumes phenomena to be spatially unbounded and continuous



Modelling glacier budgets:

- A glacier is bounded in space

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Limitations of field-based modelling

- 1) Assumes phenomena to be spatially unbounded and continuous



Modelling ship movement:

- A ship is bounded in space..
- It is mobile...

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Limitations of field-based modelling

- 2) Assumes one time transfer function for all locations ($Z_{t-1} = f(Z_t)$)



Land use / cover over time

- Depends on farmer decisions
- Many different farmers..

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Limitations of field-based modelling

- 3) Assumes flow of material or information to occur as a 2D field



Water resources modelling

- Reservoirs..
- Irrigation canals..
- Decision makers..

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Limitations of field-based modelling

- 3) Assumes flow of material or information to occur as a 2D field



Modelling decision making

- Flow of information along a social network..
- Only partly spatial..

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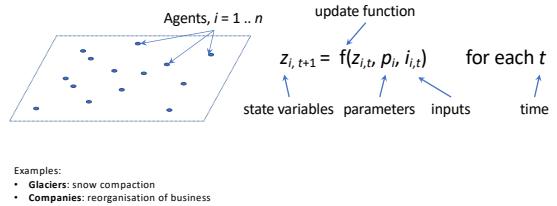
Spatial agent-based modelling

- Spatially bounded agents
- Mobile agents or agents with evolving geometry
- Interacting agents
- Agents interacting with continuous fields
- Other transfer functions
 - Decision making agents

In ecology referred to as *individual based modelling*
Related: *discrete particle simulation*

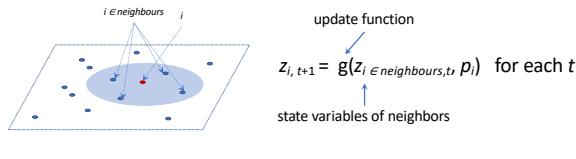
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Local processes



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Neighbourhood effects

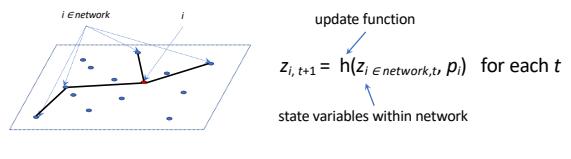


Examples:

- Shops: adjust goods offered to goods offered by other shops
- House prices: neighbourhood house prices affecting price of house
- Animals: swarm behaviour (copy behaviour from neighbouring animals)

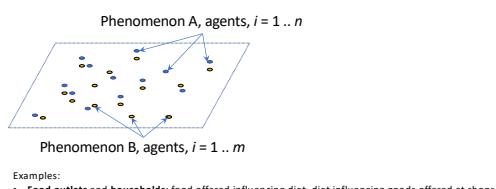
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Network effects



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Multiple phenomena (or agent groups)

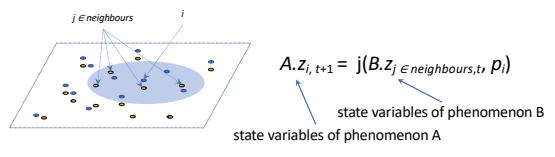


Examples:

- Food outlets and households: food offered influencing diet, diet influencing goods offered at shops
- Predators and prey: food web
- Individual plants and individual seeds: ecological model

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Effects between phenomena

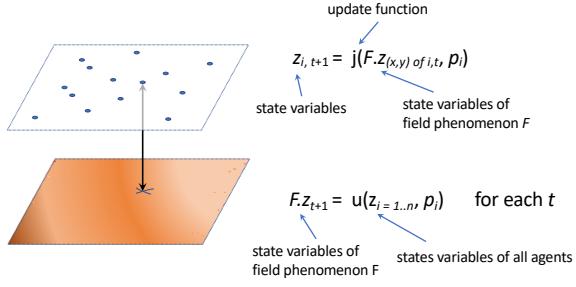


Examples:

- Food outlets and households: food offered influencing diet, diet influencing goods offered at shops
- Predators and prey: predators consuming prey in their neighbourhood
- Water managers and farmers: stakeholder interaction in a water management simulation

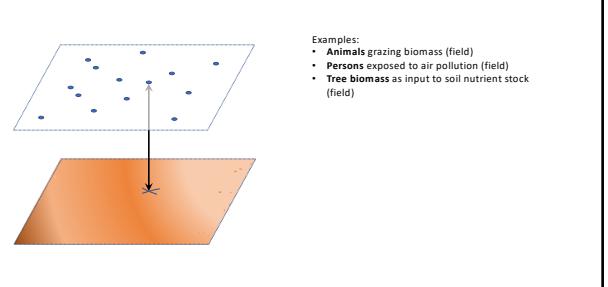
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Interaction with fields



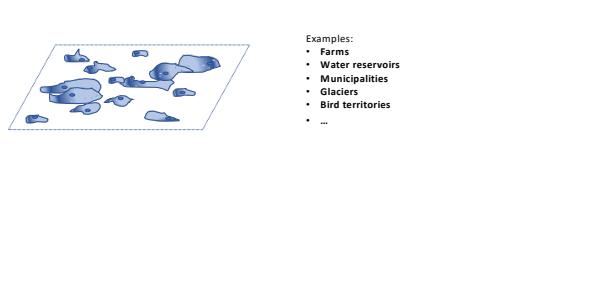
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Interaction with fields



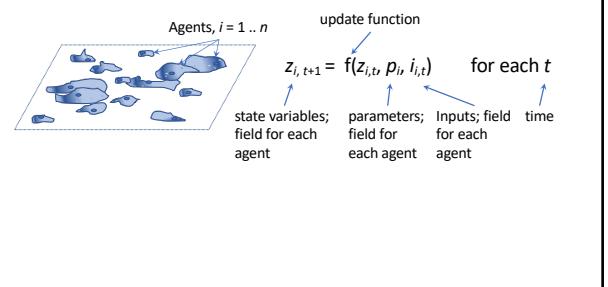
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Field-agents



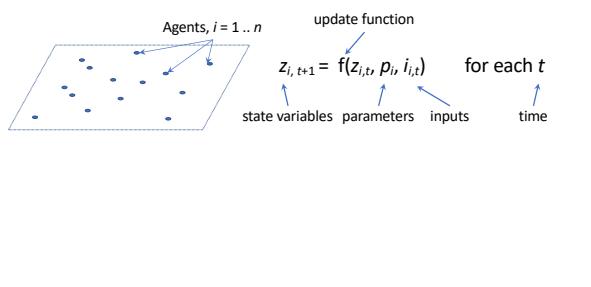
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Field-agents



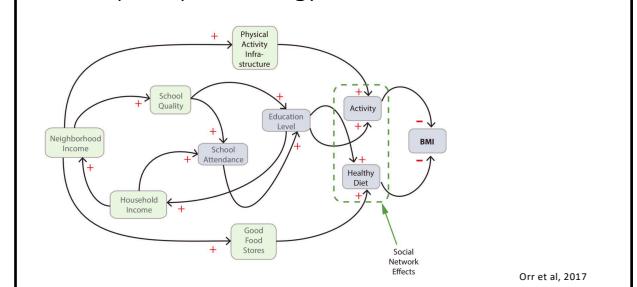
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Mobile agents



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Example: epidemiology



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Software tools

Object oriented programming based, often Java

- GAMA
- Repast
- ..

Dedicated scripting language based

- NetLogo

Spatially from the ground up, field-agents, Python

- Campo