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Approaches to integrated Modelling

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Overview

- Integration goals
- Approaches

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Integration Goals

- Scrase & Sheate
- Brugnach & Pahl-Wostl
- Wesselink

Scrase & Sheate (2002)

Integrative Activities have specific goals

- Integrated environmental-economic modelling
- Integrated environmental management
- Integration among assessment tools
- Integration of assessment into governance
- Integrated information resources

Focus (contents, values, governance)

Learning (technical, social, conceptual)

Changes (goal, delivery, setting)

Scrase & Sheate (2002)

Integrative Activities have specific goals

70s : Environmental Impact Assessment

80s : Cost Benefit Analysis

Goal EIA und CBA: changes in contents of policy paradigm

90s : Integrated Assessment

Goal IA participatory policy making?

Brugnach & Pahl-Wostl (2005)

IA paradigm includes participation.

IA process goals und model attributes:

Prediction		Systems characteristics
Exploration	X	Role of uncertainty
Communication		Model properties
Learning		Model validation

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Brugnach & Pahl-Wostl (2005)

	System characteristics	Role of uncertainty	Model properties	Validation
Prediction	Abstractable	to be	Structured	Against observation
Exploration	Evoluti trajec			ent
Communi-cation	Systems complexity			nsights
Learning	Reflexive system	to be addressed	Under construction	Facilitation of learning

Assumption:
System is intrinsically complex

Wesselink (2007)

Studied integration in real policy processes.

(Flooding policy, spatial planning)

- Integration Expertise + Positions
- Argumentation + Negotiation

Wesselink (2007)

- Negotiation
  - Multi-interpretable goals help to merge positions
  - Local (non-generic) knowledge relevant
- Models relevant for
  - Introducing problem / solution options before
  - Legitimation afterwards

Goals integrated modelling

Scientific:

- Knowledge on feedback processes
- Resulting systems behaviour

Policy / decision support:

- Deliver boundary conditions to negotiations
- Moderate negotiations???
- Raise new issues, optimise solution design

Approaches

- Group Model Building
- Appropriate Modelling
- Agent Based Simulation

Group Model Building

- Systems theory approach
  - mental models
  - phenomenological
- Appropriate for learning and diagnosing, possibly preamble for negotiation
- Strategic political decision processes use scenario analyses and expert knowledge/views; models deliver boundary conditions
- Warning: ‘Negotiated knowledge‘

Appropriate Modelling / Scales

Approach for determining scales for Modelling (Booij, 2002)

Model results converge when refining resolution

No exact results required

Question: what scale?

Appropriate Modelling / Scales

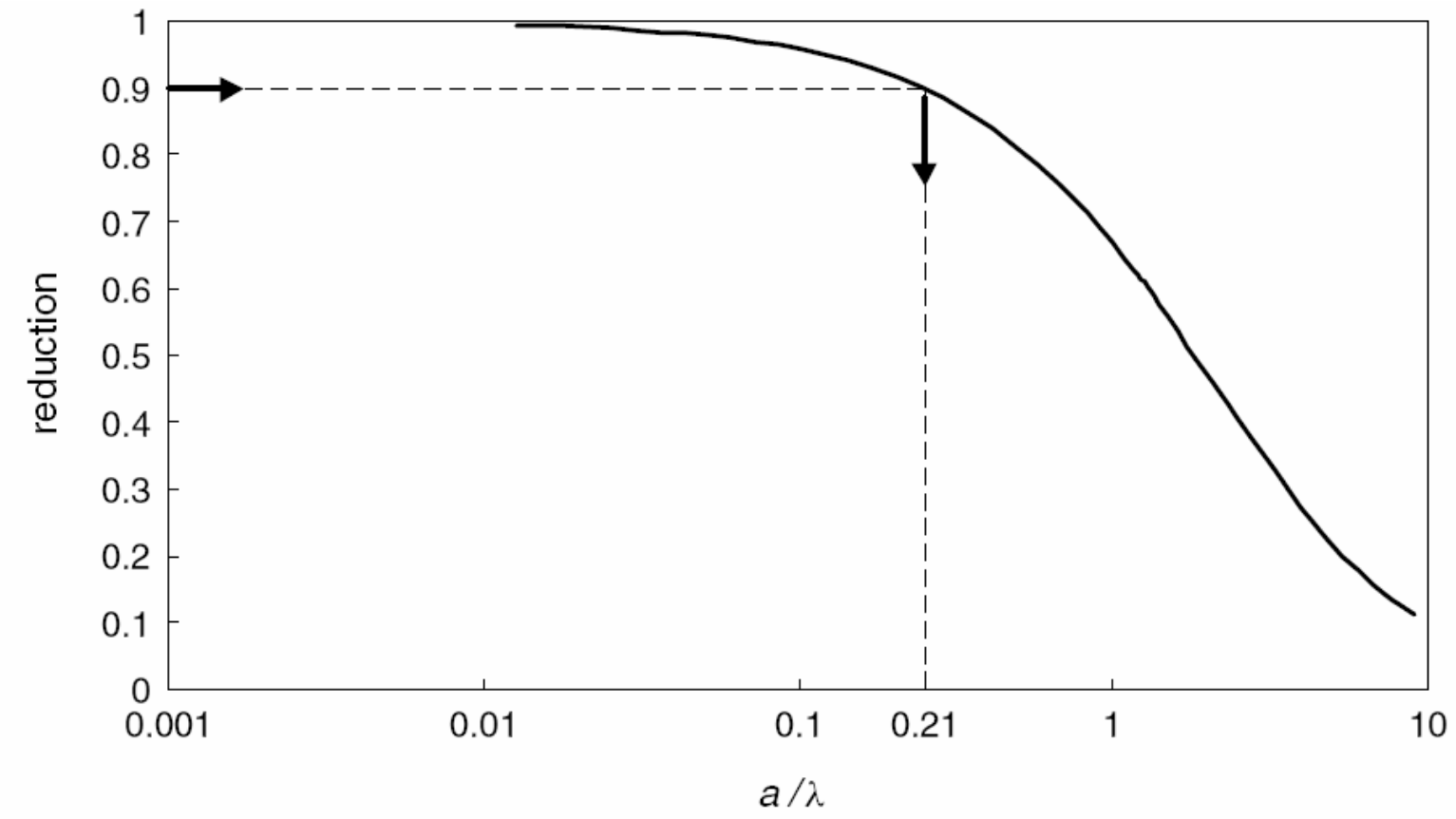
Goal: Choice spatio-temporal resolution for determining variables at river basin scale

Criteria: reduction in Variance

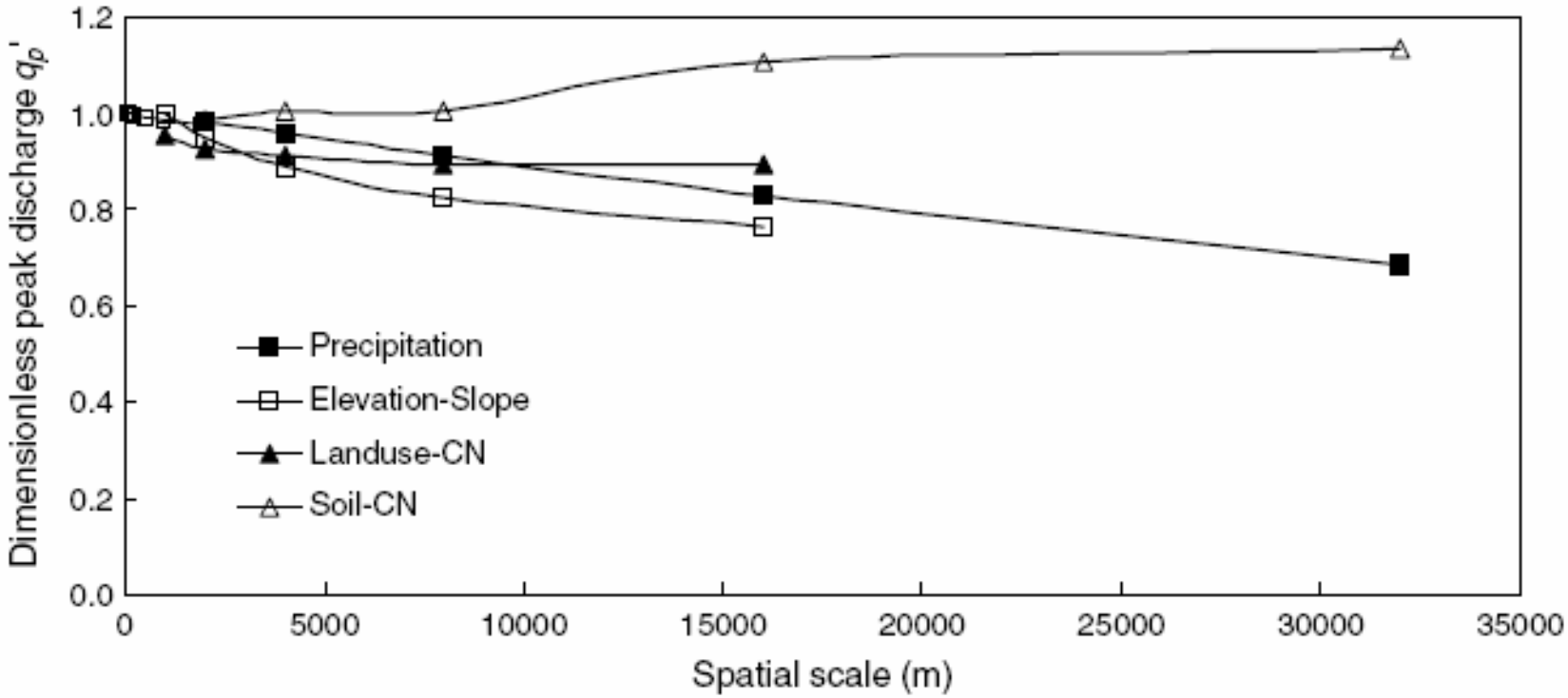
Method:

- Use correlation structure
- Integration using weights based on sensitivities

Appropriate Modelling / Scales



Appropriate Modelling / Scales



Sensitivities approximated using SCS approach

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Appropriate Modelling / Scales

Variable	Appropriate variable scale (km)	Weight (–)
Precipitation	19·9	0·39
Elevation	0·1	0·26
Soil	5·3	0·21
Land use	3·3	0·14
Integrated	9·5	1·00

Maximum daily discharge / Meuse:

- 10 km / ±100 sub-basins

Appropriate Modelling / Scales

Problem issues

- ‘Appropriate scale’ can be too small to be implemented → larger reductions in Variance
- Spatial correlations of Variables

Agent Based Simulation

Approach to represent coexistence society and environment

Taxonomy (Hare&Deadman, 2004)

- Cognition (no, fine tuning, strategies)
- Social interactions
  (no , local, global, group)
- Spatial explicit coupling
  society - environment

Agent Based Simulation

Example:

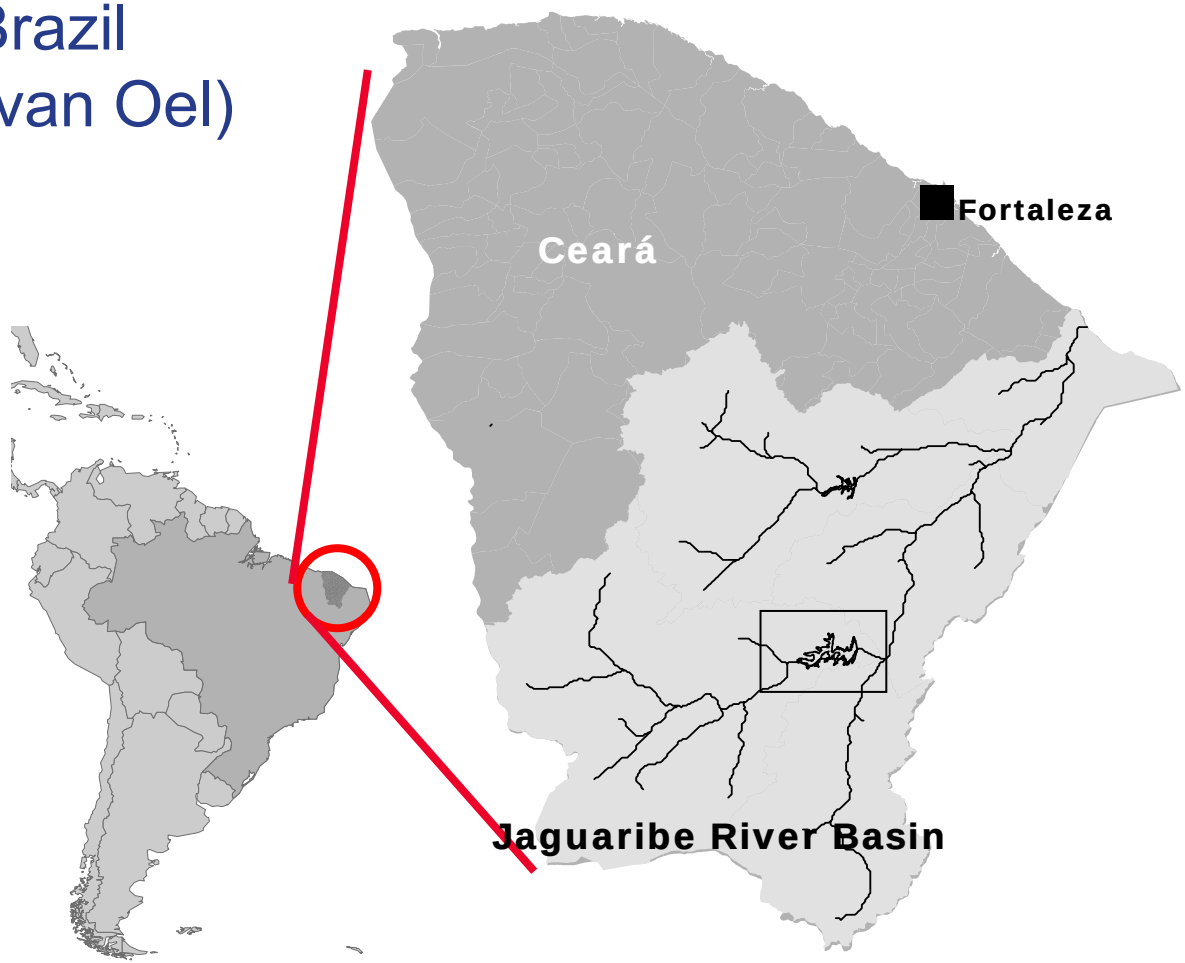
Use of variably available resources → Vulnerability, Semi-arid areas

- Reservoirs dampen variable availability
- Low availability dampens use?
  - Strategy to reduce usage
  - Effects of eg. prices
- Tool: Catchscape (CIRAD):
  Multi Agent Simulation

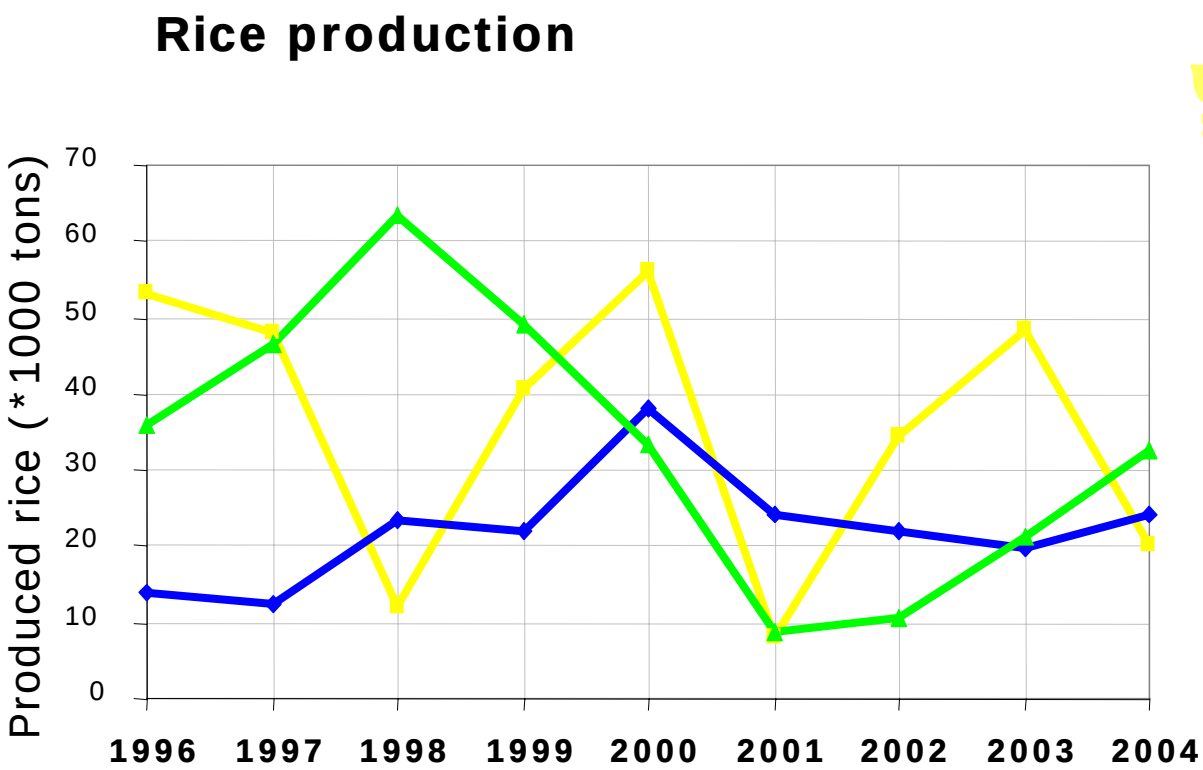
Agent Based Simulation

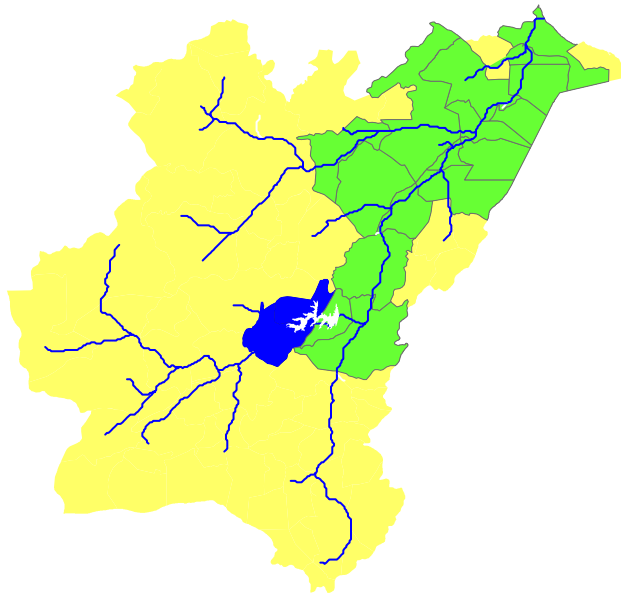
Analysis Northeast Brazil
(PhD-Project van Oel)

- irrigation dominant water user
- problems in dry years

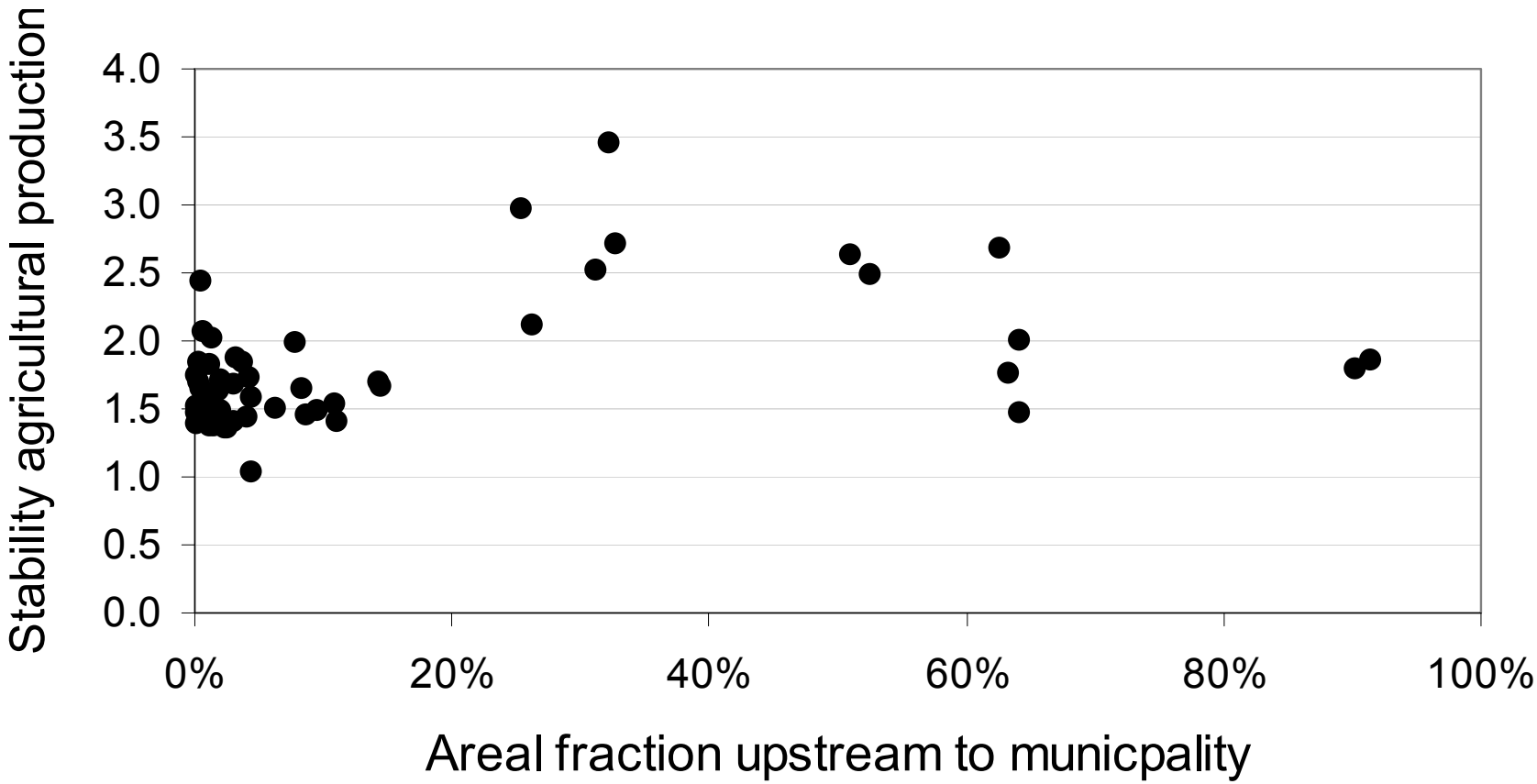


Agent Based Simulation

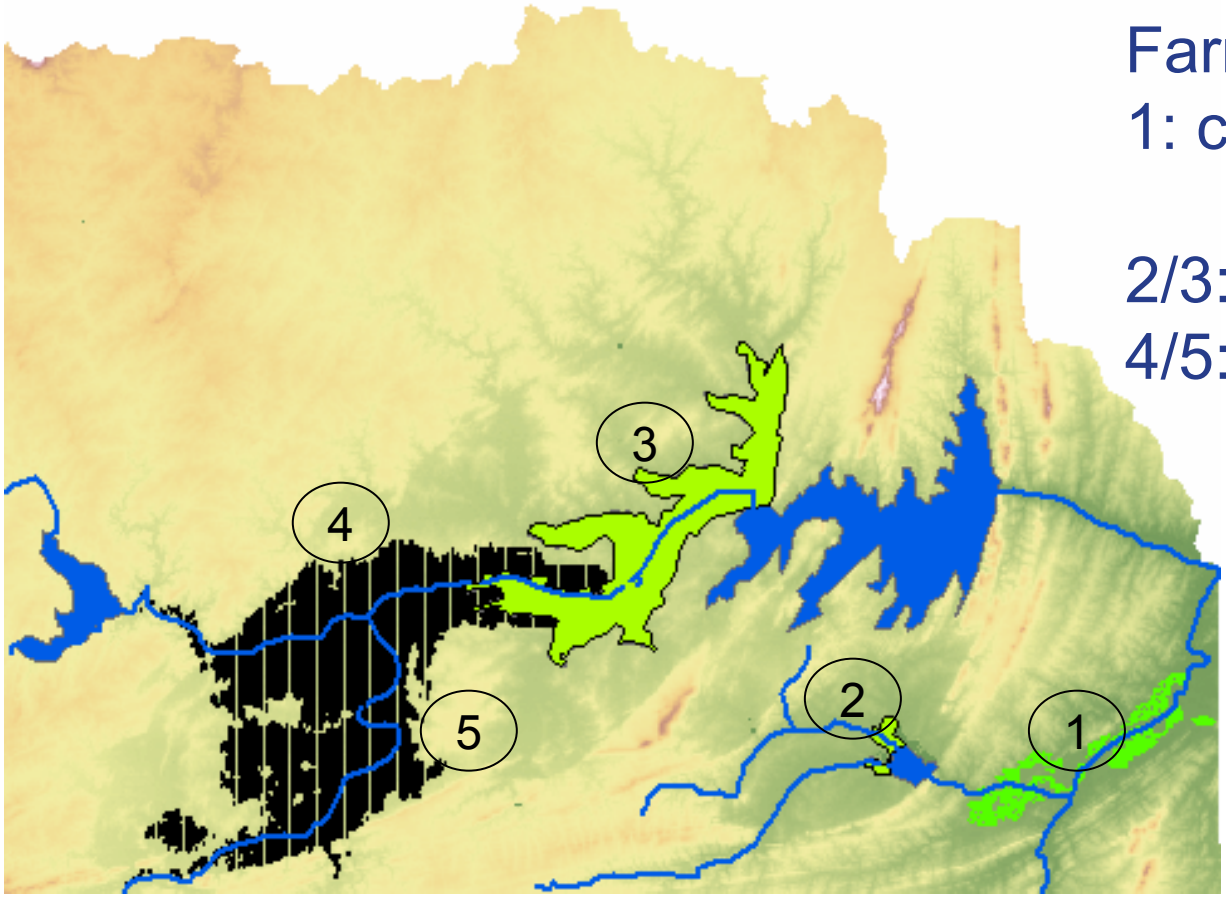




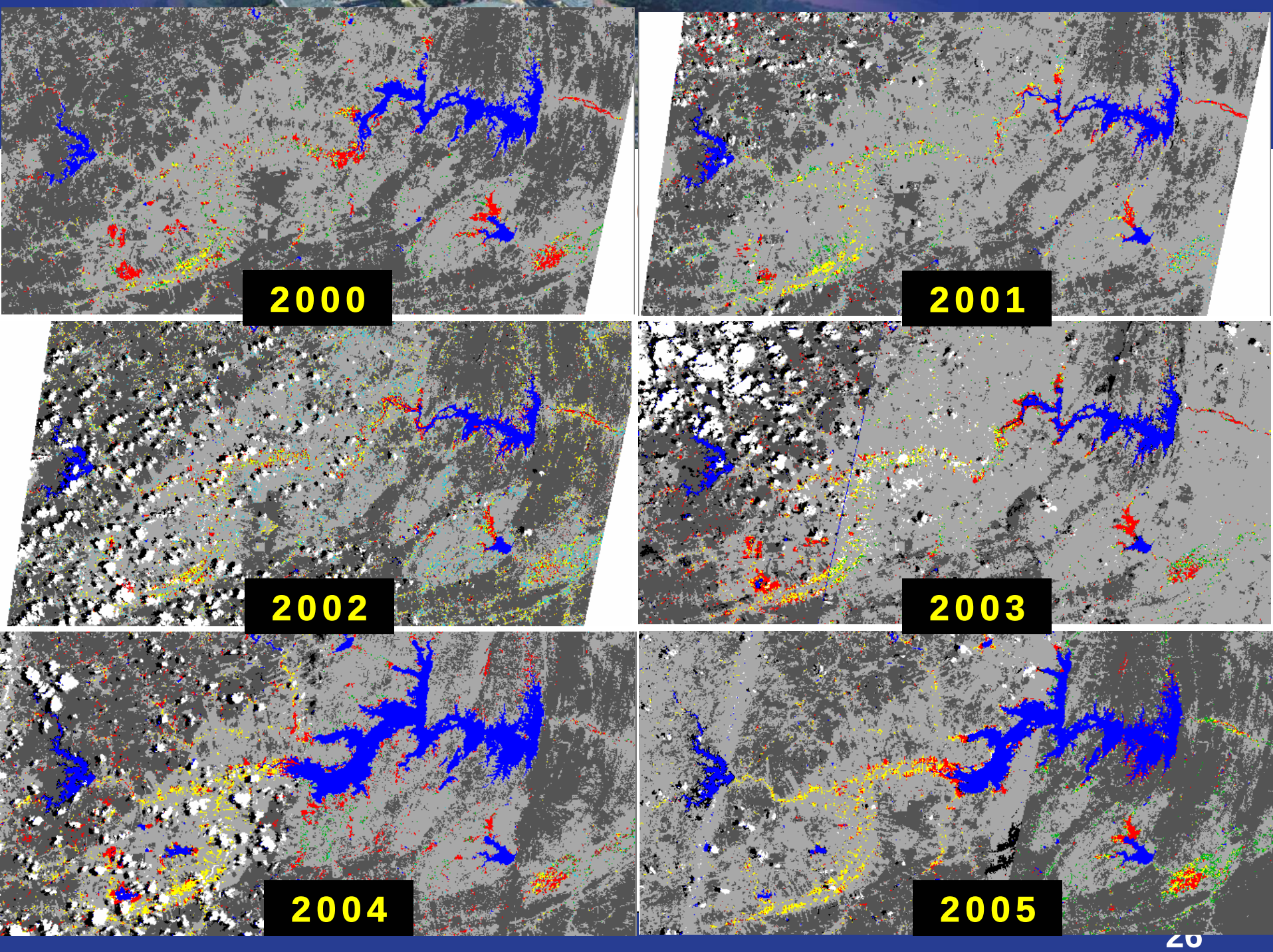
Agent Based Simulation



Agent Based Simulation



Farmers rationality:
1: controlled irrigation schemes
2/3: reservoir flood plains
4/5: alluvial aquifer, access to river, local sources

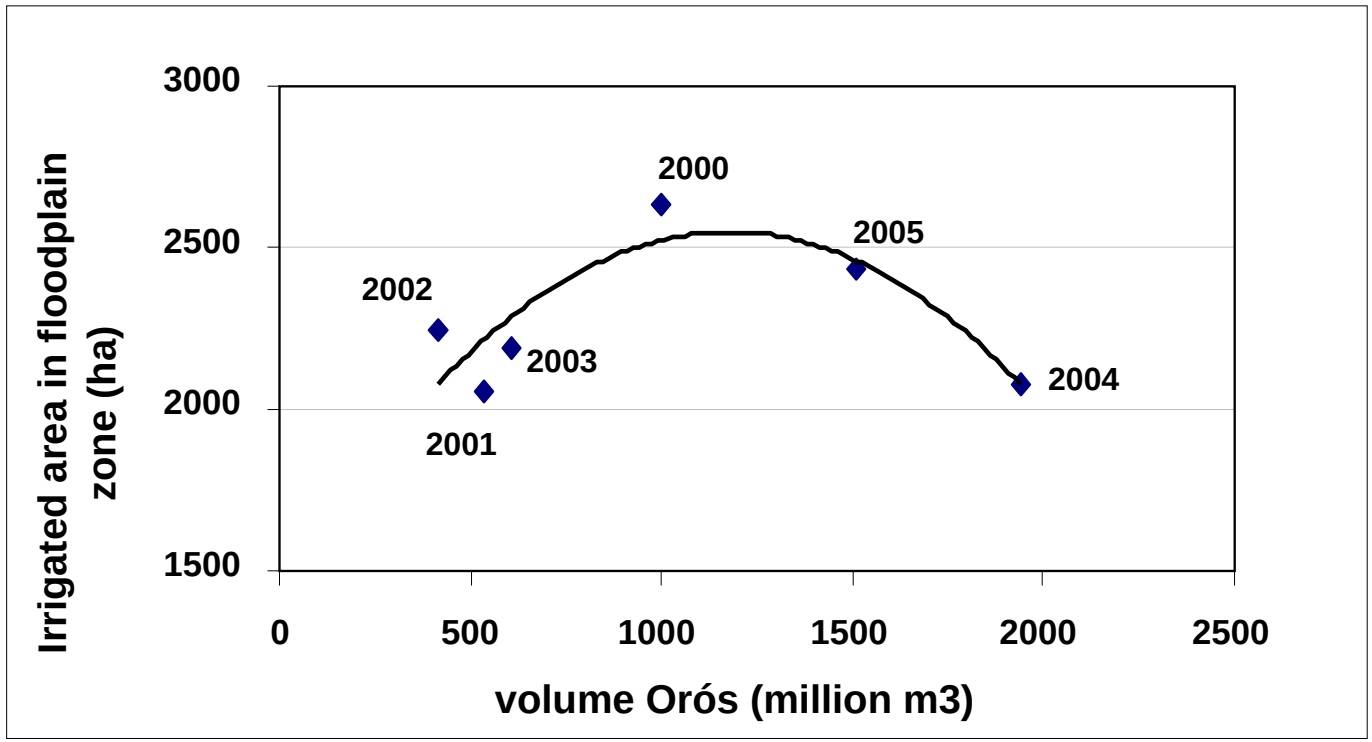

2000
2001
2002
2003
2004
2005

Agent Based Simulation

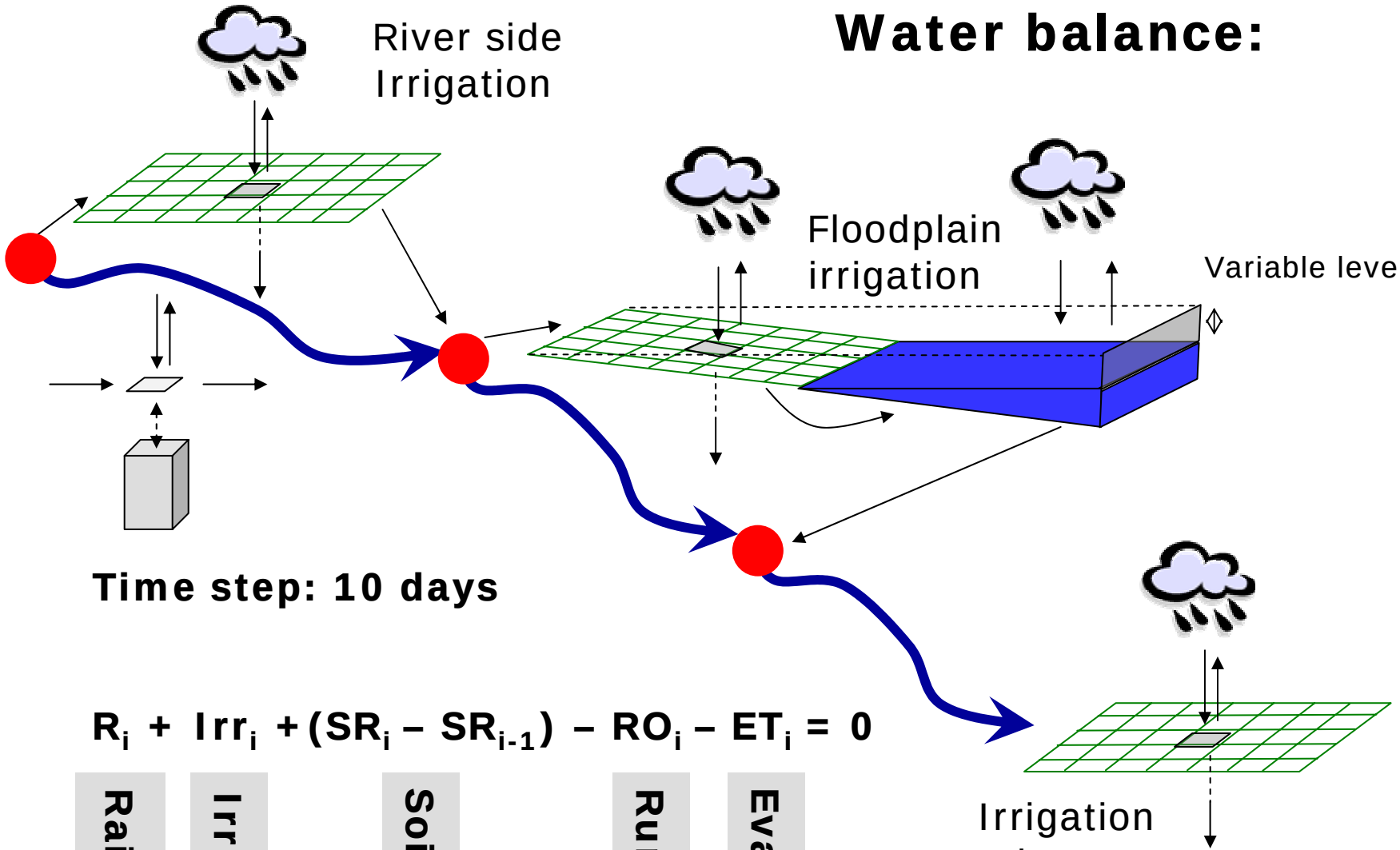
Disaggregated:

Description resource use decisions farmers

Aggregated:



Water balance:



Time step: 10 days

$$R_i + Irr_i + (SR_i - SR_{i-1}) - RO_i - ET_i = 0$$

- R_i — Rain
- Irr_i — Irrigation
- $SR_i - SR_{i-1}$ — Soil water
- RO_i — Run off
- ET_i — Evaporation

Agent Based Simulation

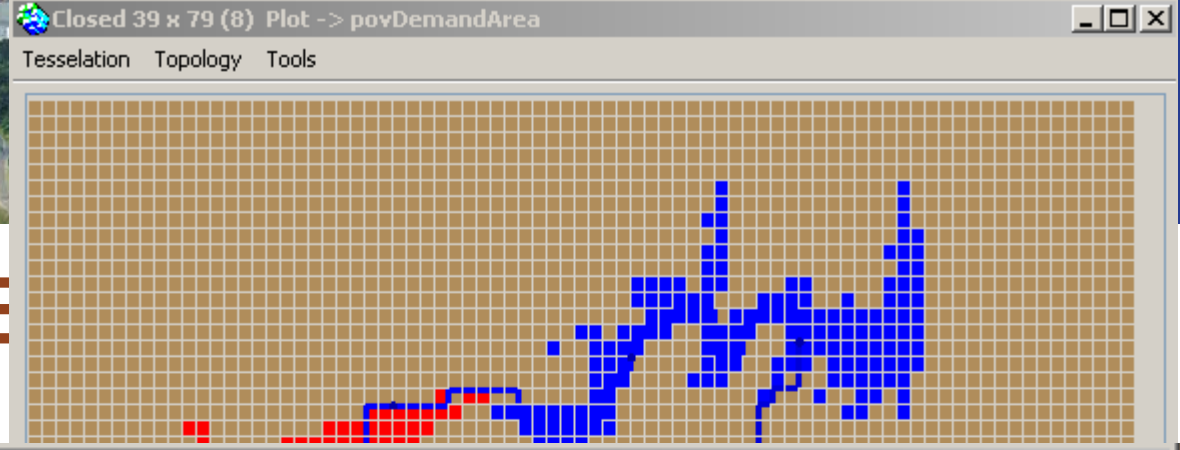
Aggregated:

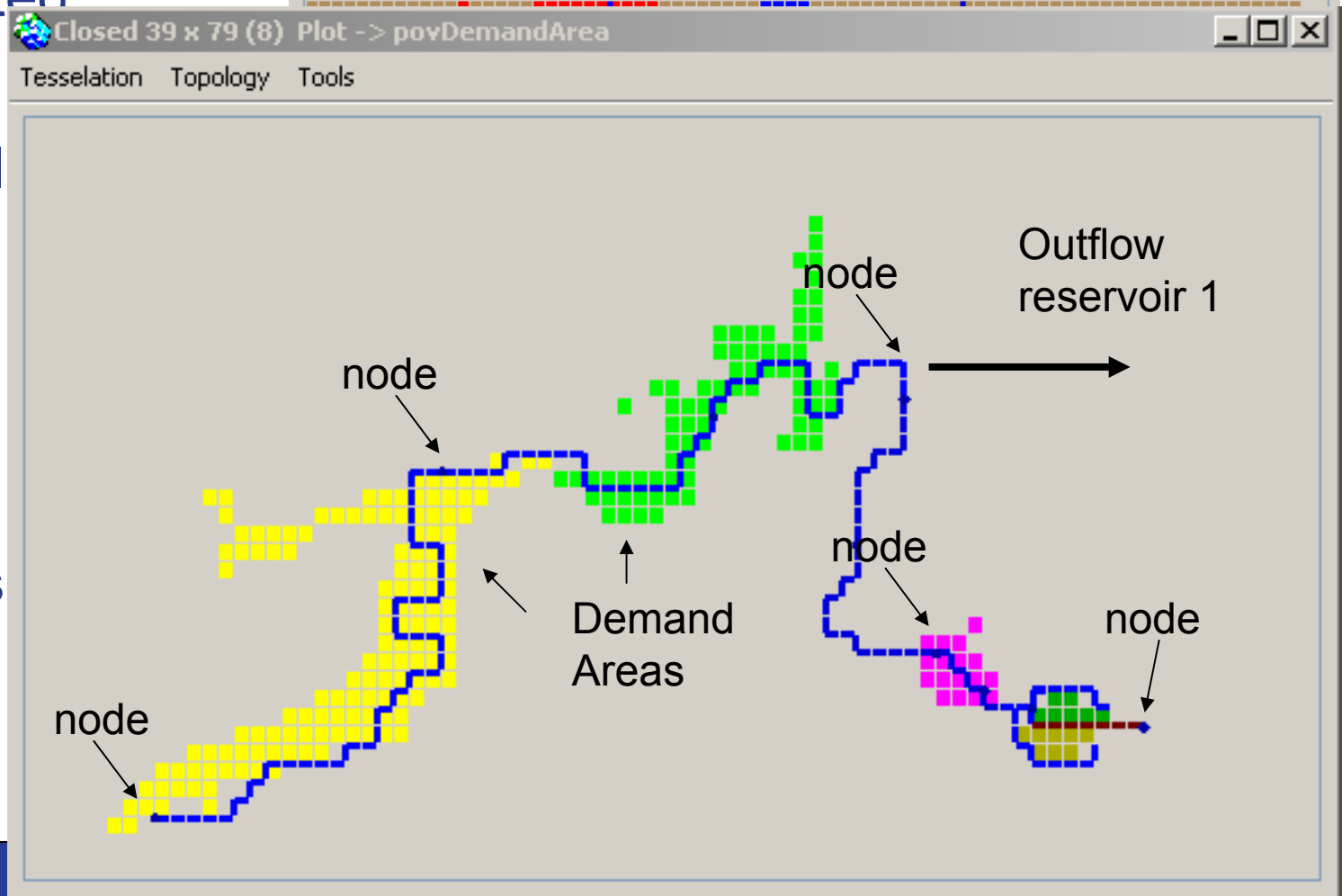
- Use within sub-basin significantly important
- Reservoir yield $Q_{90:}$ - 20%
- Effect variability in use fully dampened by reservoir

Agent E

Disaggregated:

- Regional vulnerabil
- Explain spatial patterns
- Impacts in scenarios





Approaches

Conclusion

- Roles of models in policy making are overemphasized in integrated-modelling-relative to policy-analysis-literature
- Models aiming at learning / issue raising may be simple, bear major uncertainty
- Appropriate modelling considerations may help in defining scales / model complexity
- Agent-based simulation may help to deepen understanding of resource use