Integrated assessment and modelling of agro-ecological practices on water flow at catchment level: what potential of the Maelia platform?

Laurene Casal, Hélène Tribouillois, Renaud Misslin, Julie J. Constantin, Magali Willaume, Olivier Therond

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INTERNATIONAL SOCIETY FOR ECOLOGICAL MODELLING

Adour-Garonne Catchment: what are the effects of agro-ecological practices?

BAG'AGES

Integrated assessment and modelling of agro-ecological practices on water flow at catchment level: what potential of the Maelia platform?

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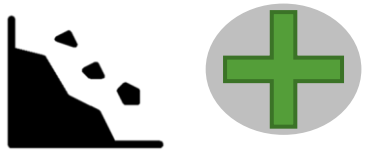
International Society for Ecological Modelling
Global Conference 2019
1-5 October 2019 Salzburg Austria

Territorial issues for the sustainability of agriculture

What are the effects of agro-ecological practices such as diversification and cover crop?

On Soil

On soil erosion



On organic matter

Soil cover

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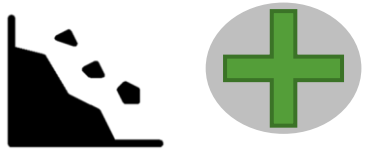

On organic matter

Carbone storage

Soil cover

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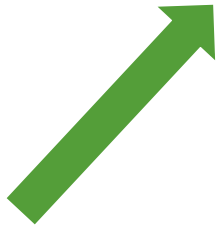
On water cycle

Quality

On soil erosion

On organic matter



Soil cover

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On Soil

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Quality

Quantity

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Green water

Soil cover

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On water cycle

Quality

Quantity

Green water

BUT

Blue water

Soil cover

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On Soil

On soil erosion

On organic matter

On climate change

On water cycle

Quality

Quantity

Green water

BUT

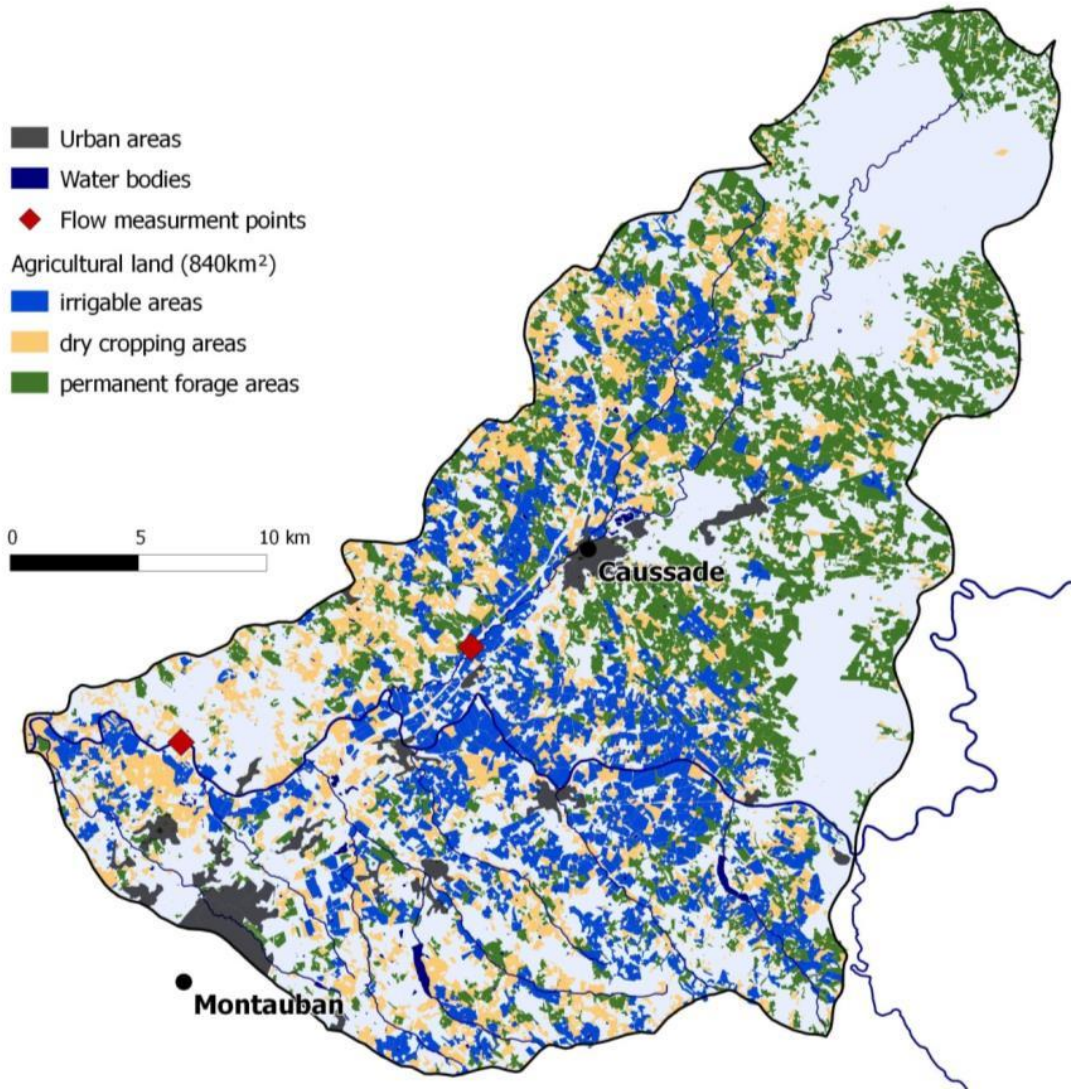
Blue water

What agricultural practices for what performance at the catchment scale?

What are the impacts of soil cover in a catchment affected by water shortages?

Study Site

Irrigated catchment of downstream Aveyron



Main issues

- **Water deficit**
- **Pollution**
- **Erosion**

840 km²,
40 000 ha UAA,
1150 farms
18 000 fields
≈ 34 % irrigated

Murgue 2014

MAELIA

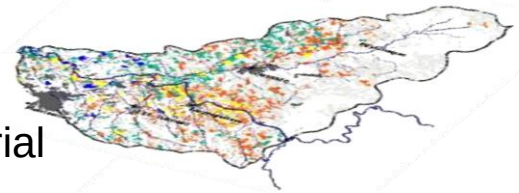
Modelling of socio-Agro-Ecological systems for Landscape Integrated Assessment

GIS
Description of system

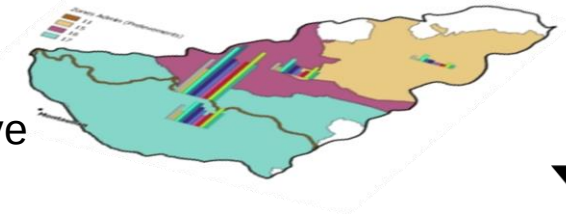
Soil map

Cropping system

Irrigation material



Administrative zones



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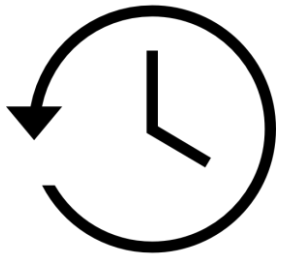
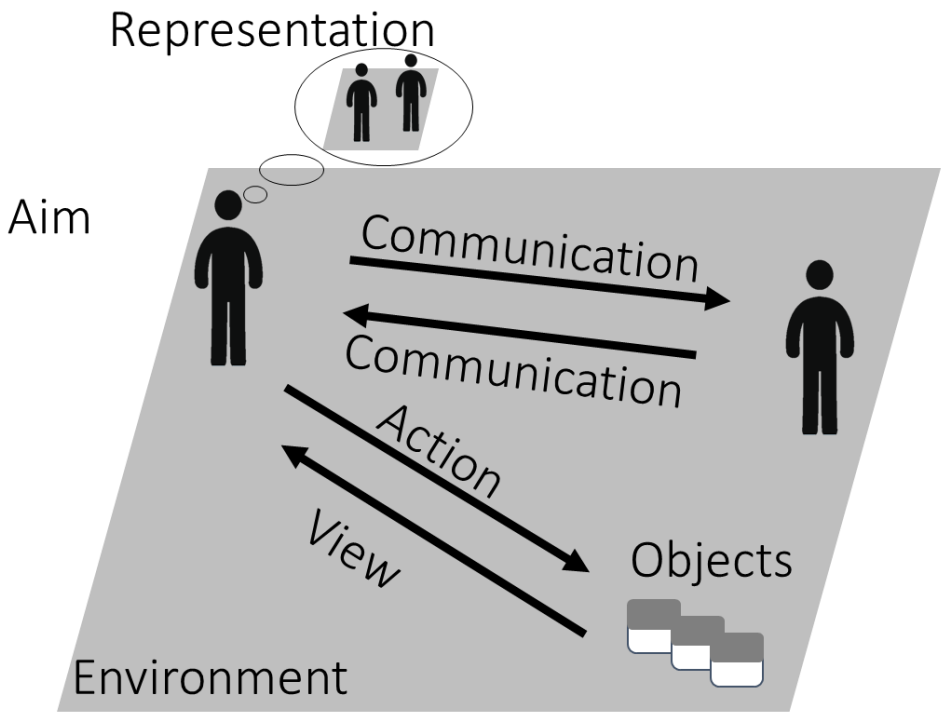


Agent based System

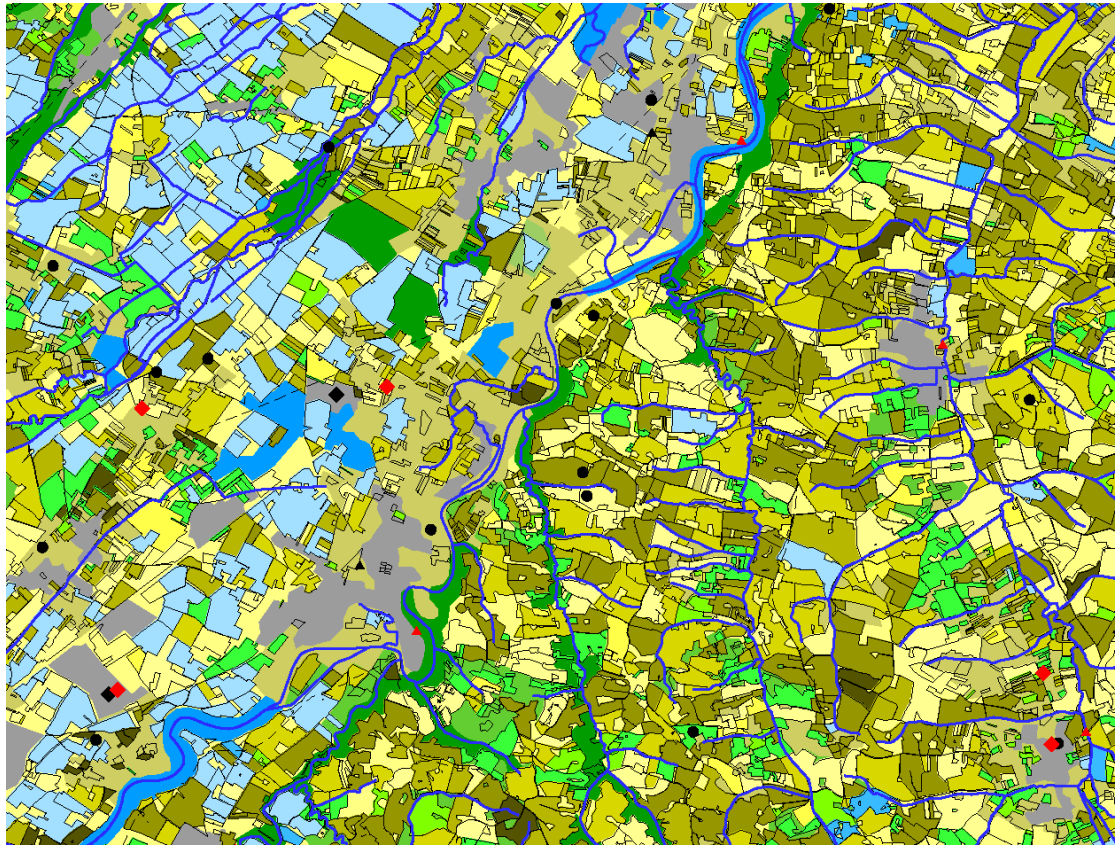


Dynamics

MAELIA

Modelling of socio-Agro-Ecological systems for Landscape Integrated Assessment

High resolution (plot)



Dynamics

Ecological processes

Crop model : AqYield

Hydrological model : SWAT ®

Decision-making processes

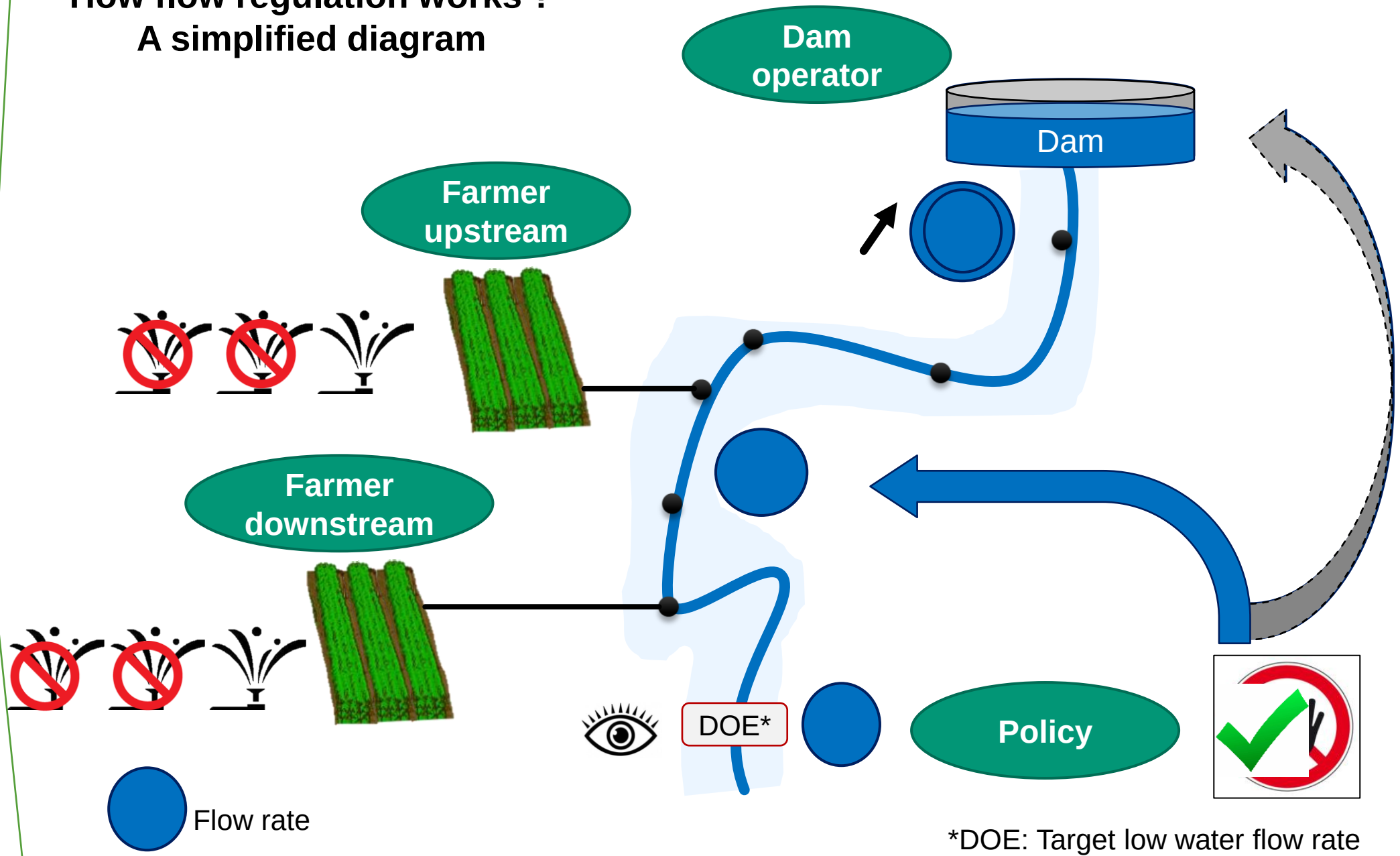
Farmer

Stakeholders

Water policy

MAELIA coordinator: **Olivier Therond, INRA**
Olivier.therond@inra.fr

How flow regulation works ?
A simplified diagram



*DOE: Target low water flow rate

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Modelling of socio-Agro-Ecological systems for Landscape Integrated Assessment

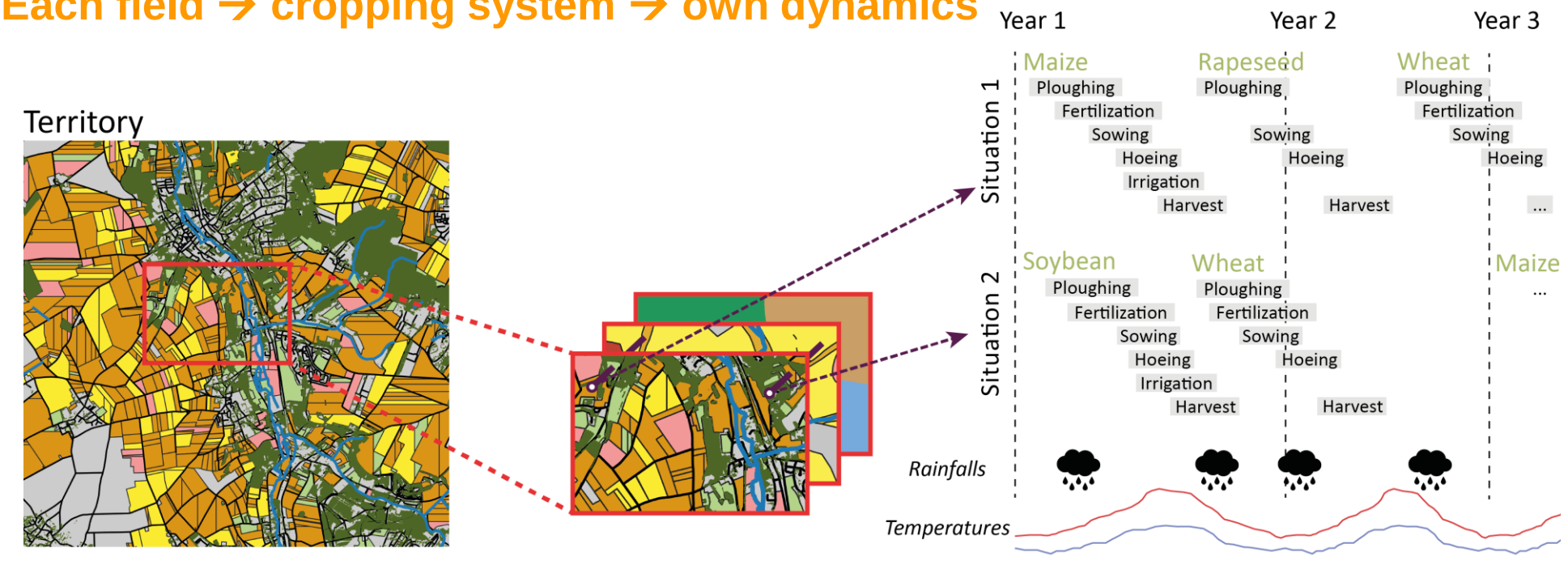
- **Decision Making**

Decision rules for triggering of technical operations :

Heuristic decision rules (nested IF THEN rules)

→ IF soil humidity < 0.8 & temperature >25C THEN harvest

- **Each field → cropping system → own dynamics**



Set of scenarios

Benchmarck

- Simulation of farm practices
- The Maelia platform is able to reproduce the behaviour of the stakeholders

Murgue, 2014; Allain, 2018

Set of scenarios

Benchmarck

Maximizing irrigation efficiency

- BaU (current practices) + irrigation according to the plant's needs

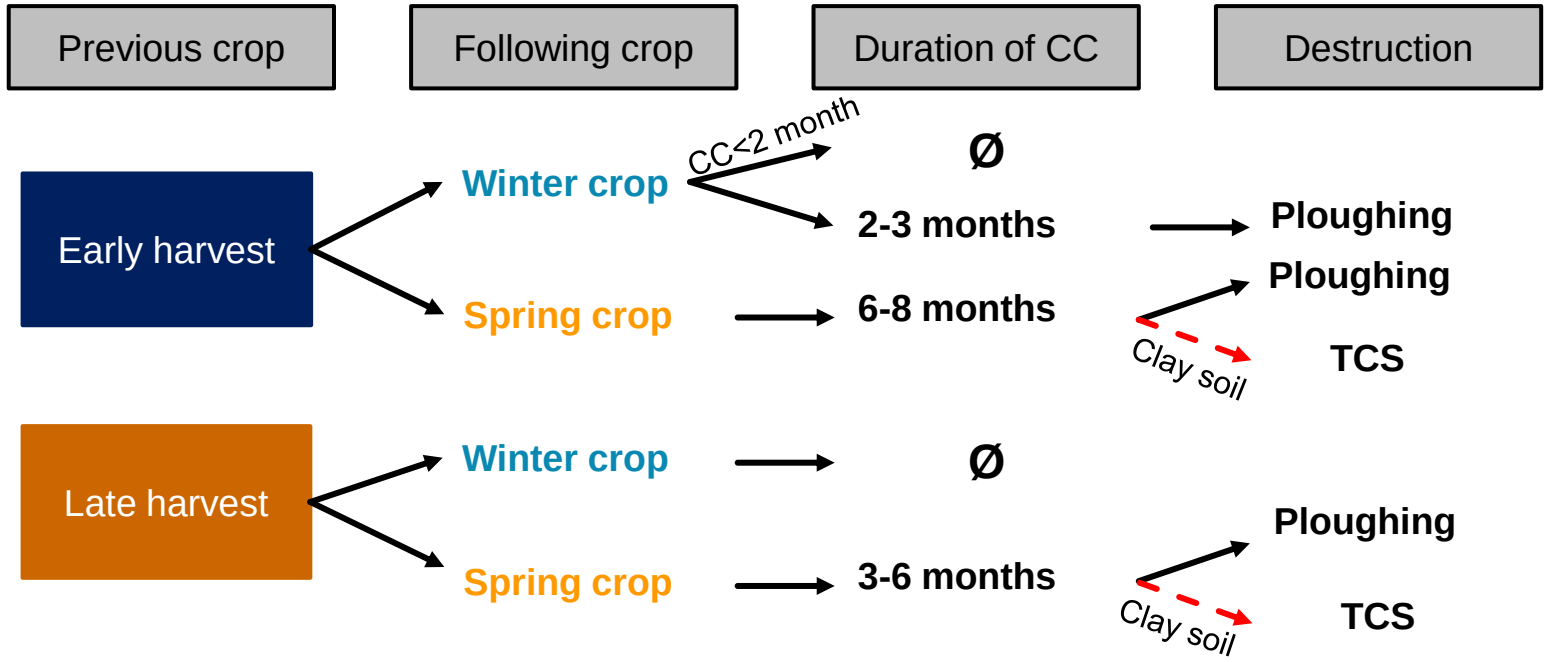
Set of scenarios

Benchmarck

Maximizing irrigation efficiency

Cover crop (CC)

- Add cover crop according to the decision tree



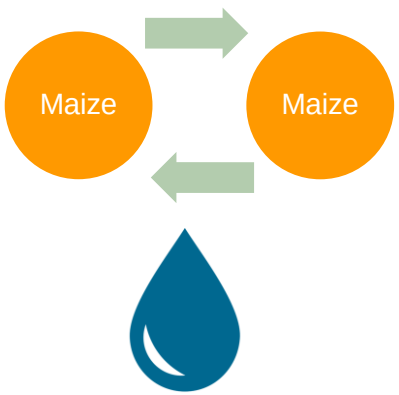
Set of scenarios

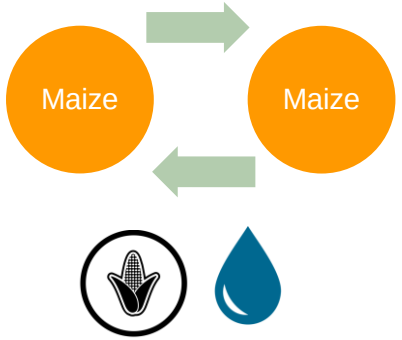
Benchmarck

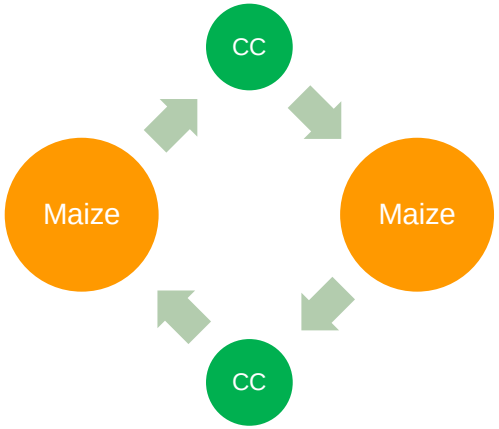
Maximizing irrigation efficiency

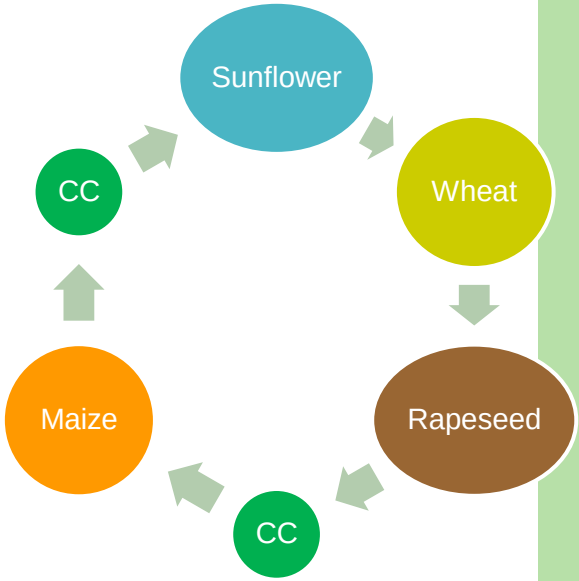
Cover crop (CC)

Rotation diversification

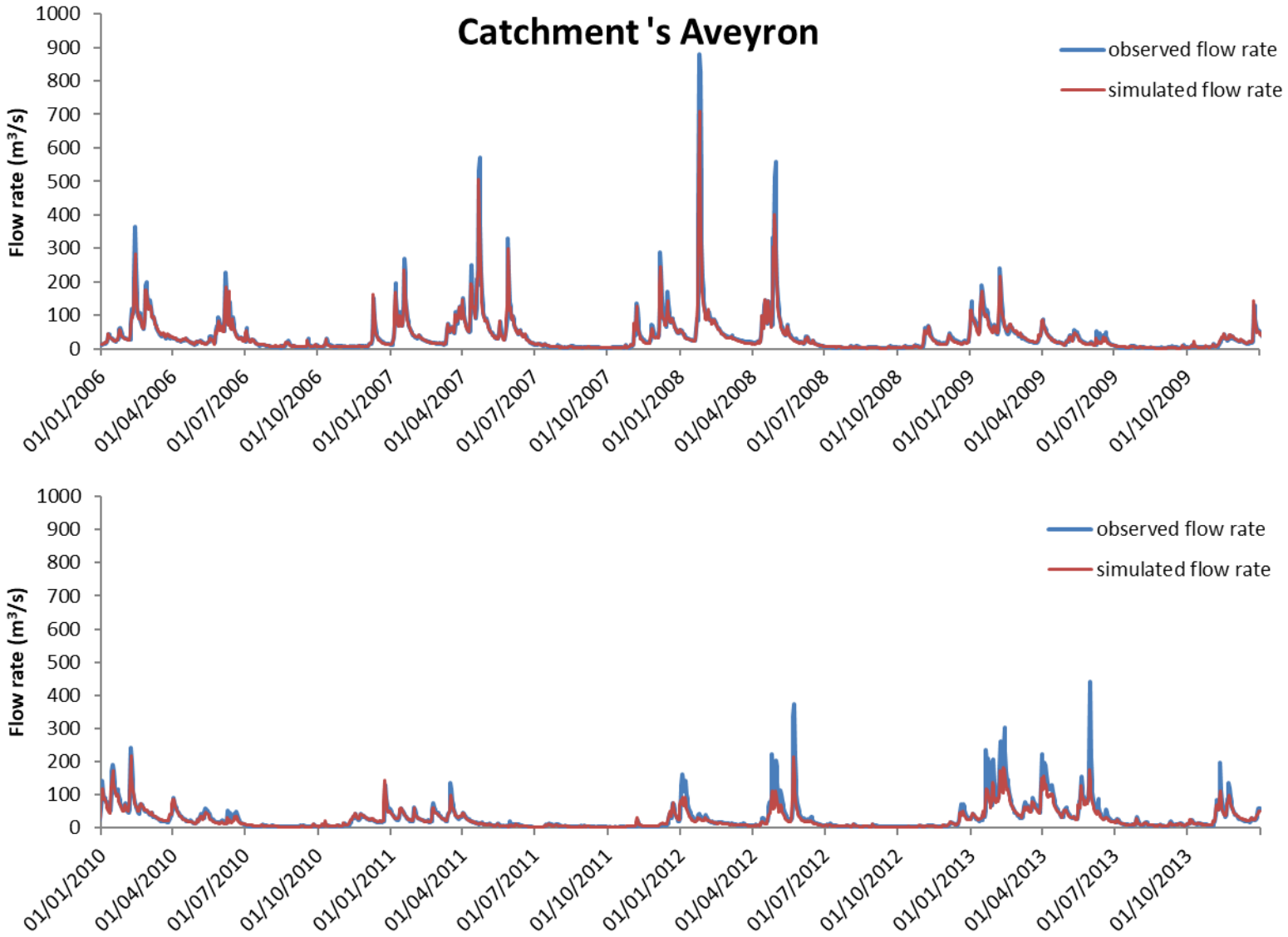




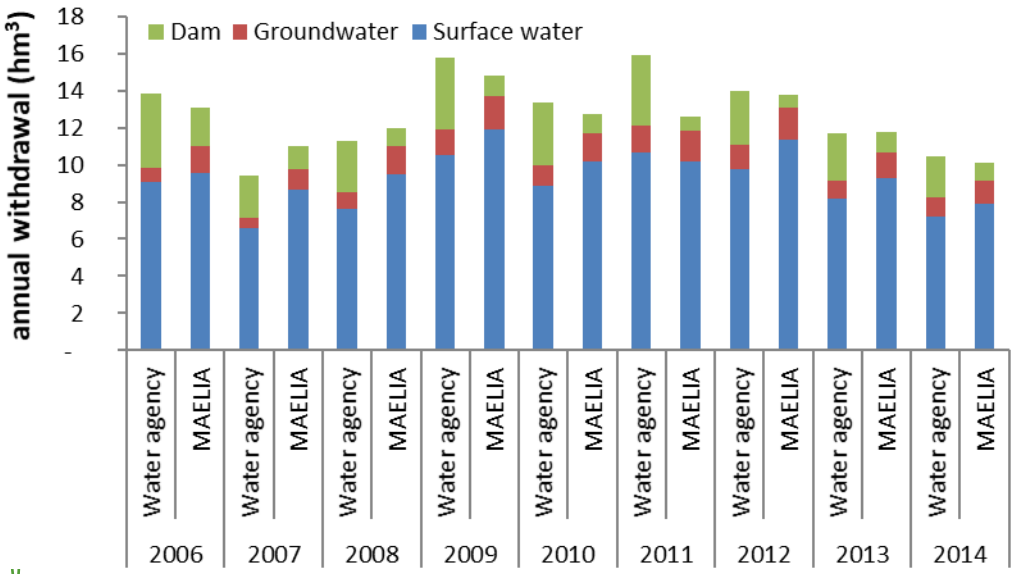


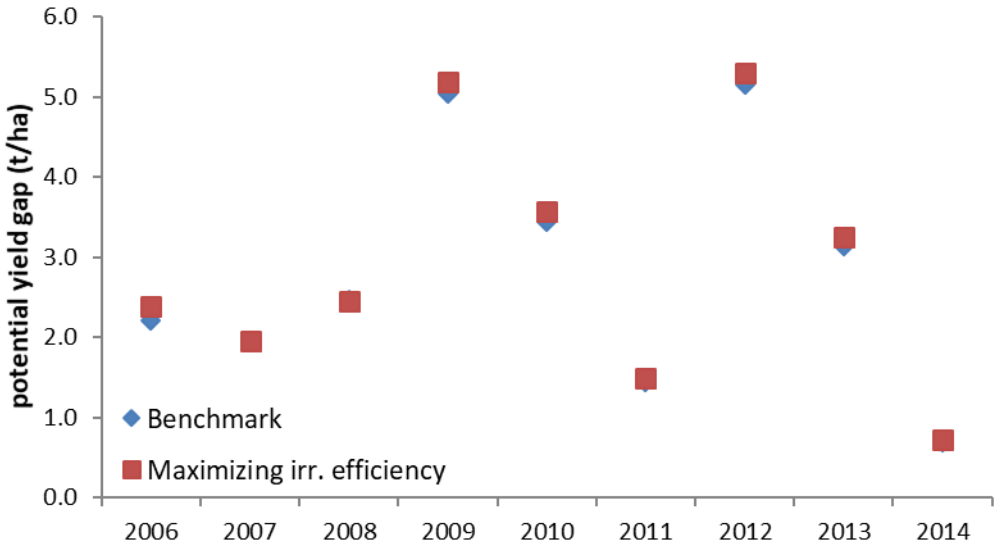


Analysed outputs : hydrological impacts of agricultural practices



Outputs of Agricultural syst. : practices, yields, economics





Outputs resolution & type

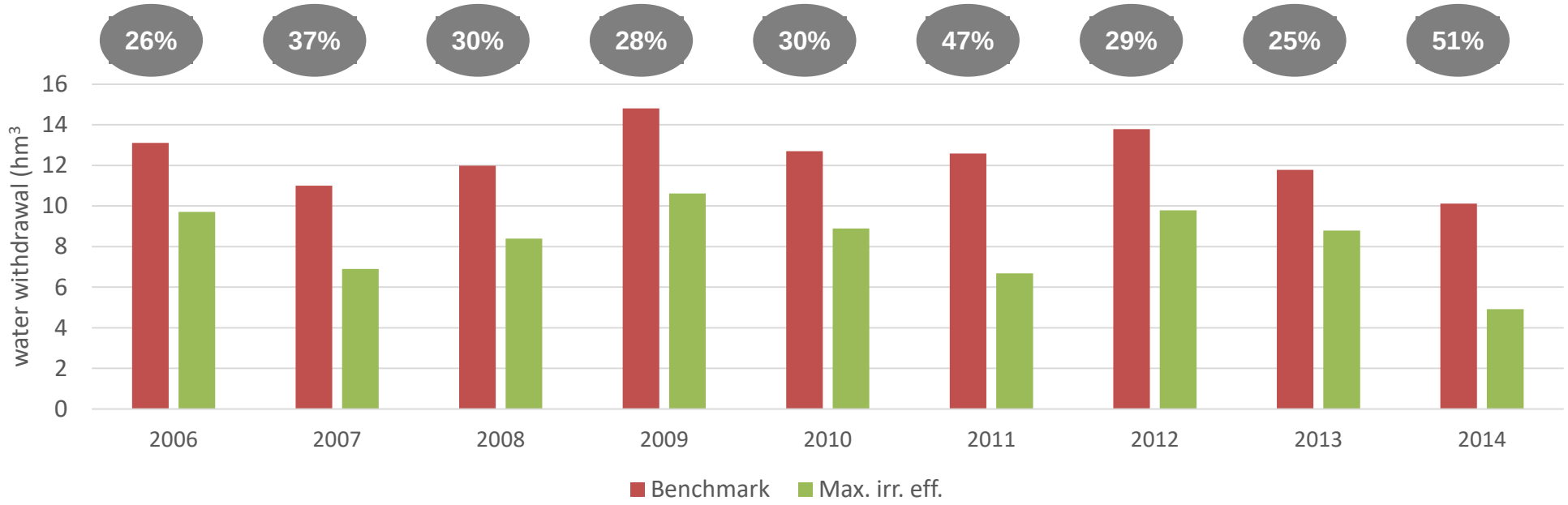
Increasing size

- Plant
- Field
- Farm
- Soil type
- Subcatchment
- Catchment

- Plant need
- Yield
- Economic
- Release
- Water Withdrawal
- Flow rate

- Plant characteristic
- Technical operations

Scenario : Irrigation optimisation



Difference of water withdrawal between Benchmark & maximizing irrigation efficiency scenarios

34% Potential gain on total withdrawals through maximizing irrigation efficiency

Project perspectives

- **Co-design of scenarios with experts**

- **Simulation for assessment on**
  - water
  - soil and CC issues

- **Water agency issue :**

Should agro-ecological practices in deficit catchment be supported?

Thanks you for your attention

http://maelia-platform.inra.fr

Conclusion perspectives of MAELIA toward an Integrated Assessment and Modelling of agricultural landscape