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# Better models are more effectively connected models

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## 1. Incorporating connectivity in models

**Hydrologic and geomorphologic connectivity:** processes and pathways which link sources (e.g. rainfall, snow and ice melt, springs, eroded areas and barren lands) to accumulation areas (e.g. foot slopes, streams, aquifers, reservoirs), and respective spatial variations.

**Process-based understanding of connectivity** is crucial to help managers understand their systems and adopt adequate measures for flood prevention, pollution mitigation or soil protection.

**Modelling is a tool** to understand and predict fluxes within a catchment. Models should therefore be able to reproduce the connectivity of water and sediment fluxes within catchments. For this, a high level of spatial and temporal detail is desirable, but limited by computational and data constraints.

Connectivity can be represented in models by:

- allowing it to emerge from model behaviour – **explicit approach**
- parameterizing it inside model structures – **implicit approach**

**Explicit approach:** high demands of data and computational resources.  
**Implicit approach:** high demands of knowledge on how to parameterize abstract “connectivity functions”.

In practice, different models and modellers apply different combinations of modelling approaches (Fig. 1).

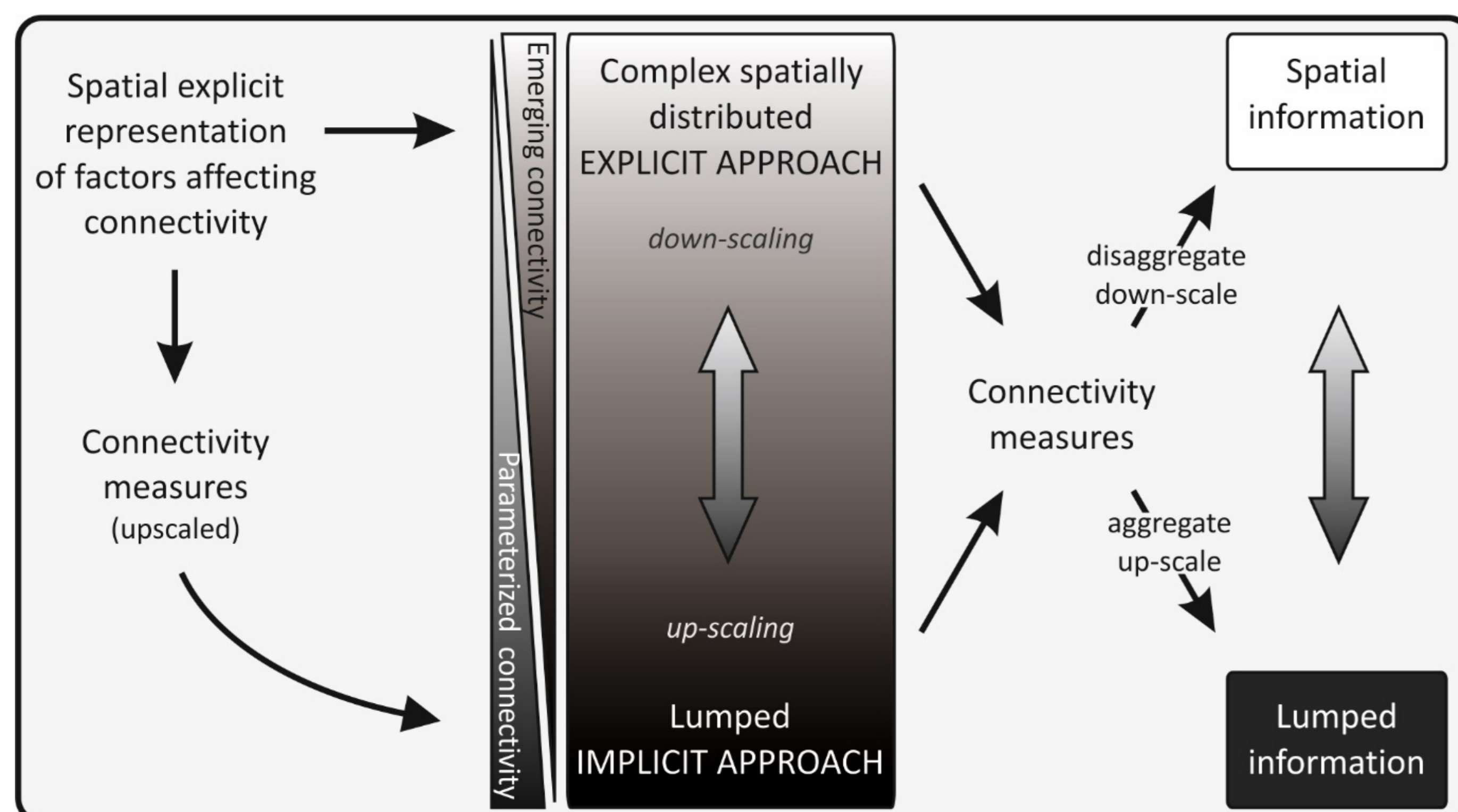


Figure 1: relationship between explicit and implicit modelling approaches for connectivity with information availability

## 2. Modellers' attitudes and approaches to connectivity

The attitudes and approaches of modellers to connectivity were assessed through a **community survey**.

Detailed online questionnaire answered by **27 modellers**.

The explicit and implicit representation of processes and features **depends on the spatial resolution** of the model type (Fig. 1). This can be linked with the scale at which each representation approach is possible (Fig. 2)

The explicit and implicit **spatially distributed representation of processes** depends on this, but also on model users.

I.e. the implicit representation of spatial heterogeneity is related with **how well model users understand their simulated system**.

Model Type	Representation of connectivity in processes		Representation of spatial heterogeneity	
	Explicit Processes	Implicit Processes	Explicit Spatial Heterogeneity	Implicit Spatial Heterogeneity
high <b>DISTRIBUTED</b>	Surface runoff Infiltration Vegetation growth	Vegetation dynamics, feedbacks  Channel flow (via pre-defined channel networks)	Surface runoff Infiltration Vegetation growth <b>Explicitly in discretized equations</b>	<b>Infiltration</b>  <b>Depends on the model user understanding the implicit context particularly well (i.e. relates to model parameterization)</b>
low <b>LUMPED</b>	Water flux Overland flow	Infiltration Infiltration excess at shorter timescales	Meteorology Soil properties	

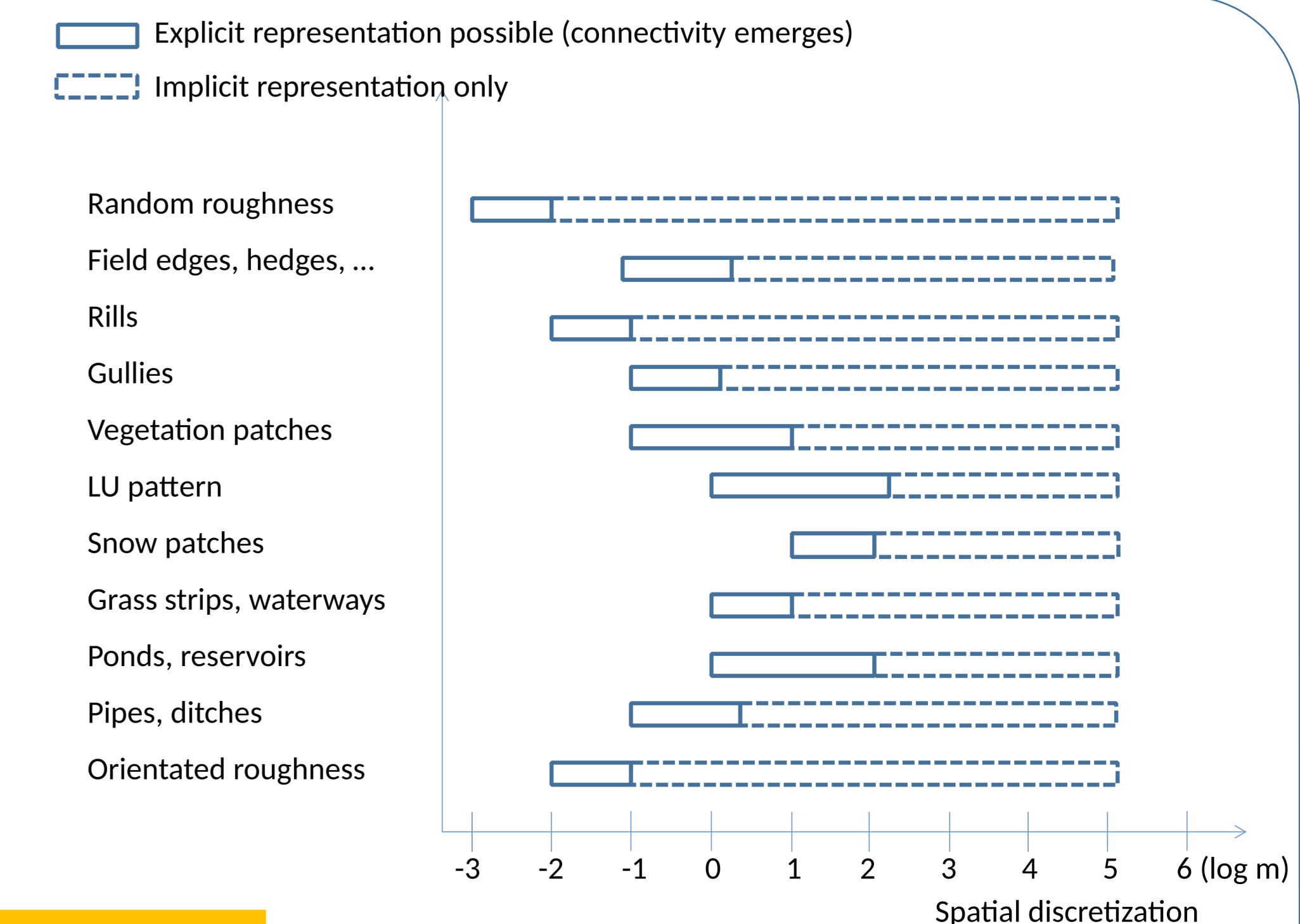


Figure 3: possibility of explicit or implicit representation of different features according to the level of spatial discretization.

Figure 2: explicit and implicit representation of process connectivity and spatial heterogeneity according to model type (from lumped to spatially distributed).

## 3. Connectivity modelling exercise

**Multi-model application exercise** to determine:

- What can models teach us about connectivity?
- How can we link simulated connectivity with model structure?
- How do model results compare with connectivity indices calculated from landscape structure?

**Semi-virtual catchment approach:**

- use a real landscape, create scenarios with different spatial complexity;
- run models for each scenario, analyse how changes to spatial complexity translate into changes to hydrographs and to functional connectivity (water and sediment flows);
- compare model results with structural connectivity indices calculated from the landscape, assess their performance and suggest improvements;
- link spatially-distributed model to model structures.

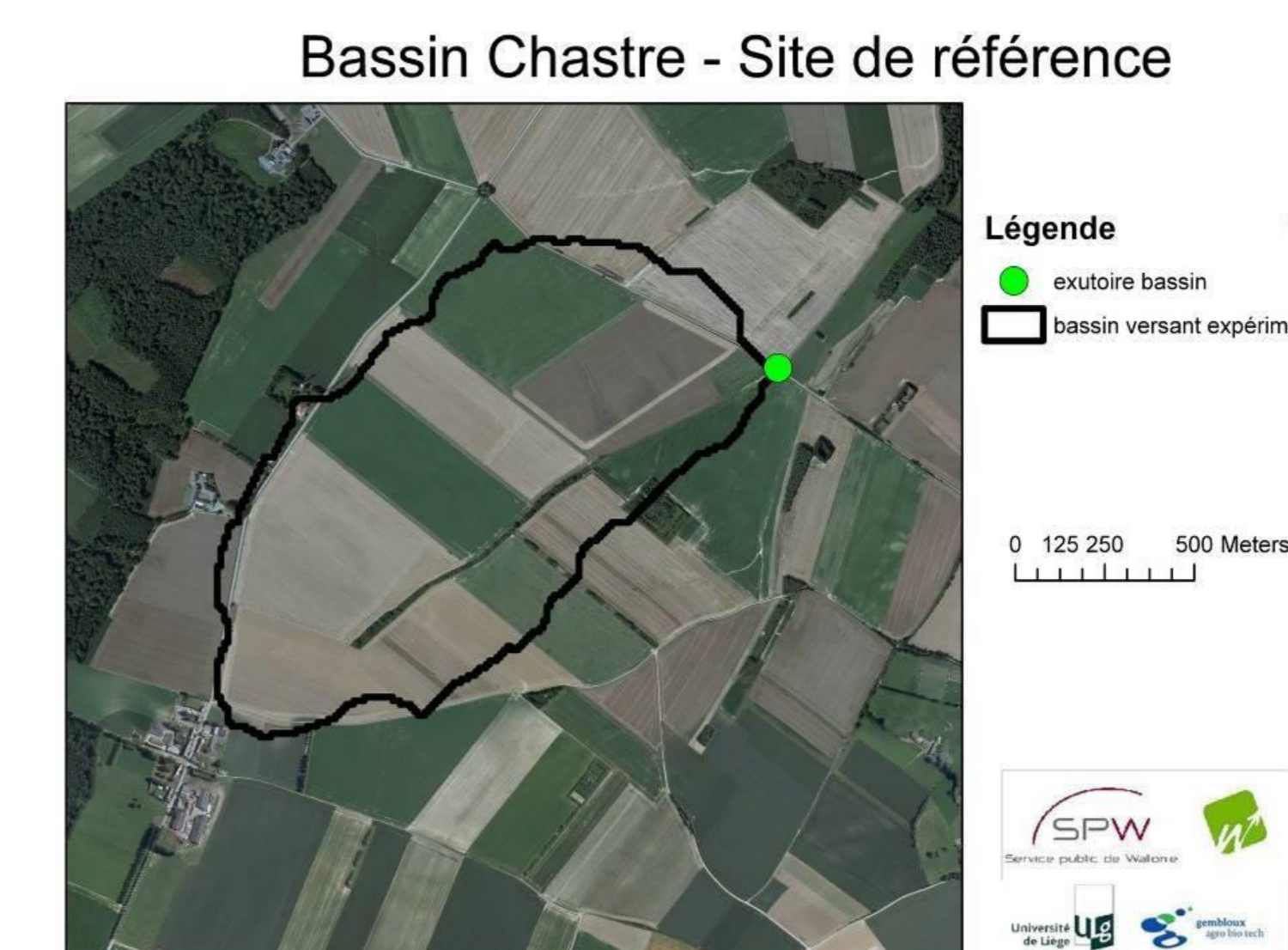


Figure 4: modelling exercise baseline catchment.

**Baseline catchment:** Chastre, Loam belt of central Belgium (Fig. 4)

**Spatial complexity scenarios – change connectivity features in Chastre:**

- tillage orientation
- land-use patchiness
- field size and boundaries
- ditch networks
- grass buffer strips
- roads and artificial channels

**First workshop:** late June in Wageningen, NL.

**INTERESTED IN COLLABORATING? CONTACT US!**  
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