

### Better models are more effectively connected models

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#### ▶ To cite this version:

João Pedro Nunes, Charles Bielders, Frédéric Darboux, Peter Fiener, David Finger, et al.. Better models are more effectively connected models. European Geosciences Union General Assembly 2016, Apr 2016, Vienne, Austria. EGU, Geophysical Research Abstracts, 18, 2016, Geophysical Research Abstracts. hal-01731143

## HAL Id: hal-01731143 https://hal.science/hal-01731143

Submitted on 13 Mar 2018

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# Better models are more effectively connected models

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# **1. Incorporating connectivity in models**

<u>Hydrologic and geomorphologic connectivity</u>: 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.

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

<u>Modelling is a tool</u> 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.

<u>Connectivity can be represented in models</u> by:

- allowing it to emerge from model behaviour <u>explicit approach</u>
- parameterizing it inside model structures implicit approach

Explicit approach: high demands of data and computational resources. <u>Implicit approach</u>: high demands of knowledge on how to parameterize abstract "connectivity functions".

In practice, different models and modellers apply different



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



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# 2. Modellers' attitudes and approaches to connectivity

The attitudes and approaches of modellers to connectivity were assessed through a <u>community survey</u> .					The explicit and implicit spatially distributed representation of processes depends on this, but also on		Random rough Field edges, he Rills Gullies
Detailed online questionnaire <u>answered by 27</u> <u>modellers</u> .					The server of th		Vegetation pat LU pattern Snow patches
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)of spatial heterogeneity is related with <u>how well model</u> users understand their simulated system.							Grass strips, w Ponds, reserve Pipes, ditches Orientated rou
	Representation of connectivity in processes				Representation of spatial heterogeneity		
	Mode	el Type	<b>Explicit Processes</b>	Implicit Processes	Explicit Spatial Heterogeneity	Implicit Spa Heterogen	atial eity
	high DIS		Surface runoff Infiltration Vegetation growth	Vegetation dynamics feedbacks	Surface runoff Infiltration Vegetation growth	Infiltratio	n
	spatial resol	LUMPED		Channel flow (via pre- defined channel networks)	Explicitly in discretize rks) equations	ed Depends on the user understa the implicit c particularly	e model anding ontext well
	low LU		Water flux Overland flow	Infiltration Infiltration excess at shorter timescales	Meteorology Soil properties	(i.e. relates to parameteriza	model ation)

# **3. Connectivity modelling exercise**

<u>Multi-model application exercise</u> 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?

## <u>Semi-virtual catchment</u> 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.



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Figure 4: modelling exercise baseline catchment.













European Regional Development Fund