

# OPALE: a Framework for Assessing the Eco-functionalities of Landscapes

D. Trévisan<sup>1,2</sup>, P. Taillandier<sup>3,4,5</sup>, B. Sarrazin<sup>6</sup>, D. Etienne<sup>7</sup>, N. Ayari<sup>3</sup>, C. Petiqueux<sup>8</sup>, P. Quetin<sup>1</sup>, C. Janin<sup>9</sup>

<sup>1</sup> INRAE UMR Carrtel

<sup>2</sup> INRAE UMR iEES

<sup>3</sup> INRAE UR MIAT

<sup>4</sup> IRD UMI UMMISCO

<sup>5</sup> Univerity Thuylol JEAJ WARM

<sup>6</sup> ISARA, Agroecology and Environment research unit

<sup>7</sup> Univ. Savoie Mont Blanc UMR Carrtel

<sup>8</sup> ENSSA Bordeaux Aquitaine

<sup>9</sup> Univ. Grenoble Alpes UMR Pacte

dominique.trevisan@inrae.fr

## Keywords

agricultural systems, decision rules, agricultural landscapes, crop management, hydrological processes

## Abstract

Ecohydrological processes are of primary importance in agricultural landscapes where fluxes of water are driven by vegetation, whether cultivated in fields or grasslands or present in semi-natural habitats and interstitial areas (open channels, riparian borders, inter-ranks of perennial crops) surrounding the cultivated parcels. Human practices are a key lever of the composition and properties of vegetation in landscape agroecosystems.

In order to better understand their impact, we propose a suite of Gama and Matlab programs coupled in a single OPALE-gui (Operational Assessment of Landscapes Eco-functionalities) that aims at (i) representing landscape organization in relation with the functioning and decision rules of annual crops or breeding systems, (ii) evaluating water movements and trajectories from biomass and hydrological exchanges, and (iii) analyzing the transfer dynamics of nutrients, suspended matter or fecal bacteria based on particle tracking methods. More precisely, the tool includes a set of libraries about:

- the distribution of the farmland part of the landscape, allowing to spatially allocate crops into farm fields and the related farming practices (inputs, soil tillage, fodder management...) following time schedules (Land Use and Land Cover Change model, LULCC);
- the modeling of water movements within previous simulated landscapes, considering surface, sub-surface and deep flows (Water Movements Within Landscapes model, WMWL);
- the evaluation of –inert and living– solute and suspended matter transfers related to water movements, including N, P, *E. Coli* (EC) and Suspended Matter (SM);
- the construction of output normalized indicators of landscape function in order to assess its regulation service.

OPALE allows to better understand the underlying processes that drive exchanges and sink-source effects operating at the landscape scale, including a landscape transfer function and a delivery ratio for the global assessment of landscapes. It was tested in three agricultural contexts and biophysical situations. Water flows and flows of associated matters were compared to data recorded at the catchment outlet, and showed the efficiency of the algorithms developed in the generic OPALE libraries.