Integrating Deep Learning to GIS Modelling
An Efficient Approach to Predict Sediment Discharge at Water Treatment Plant Under Different Land-Use Scenarios

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Background
➢ In karstic environment, erosion and runoff can lead to excessive transfer of sediments in raw water
➢ Excessive sediment supply can be highly disruptive
• Additional water treatment
• Temporary shut down of water treatment plant

Scientific questions?
• Can we predict the variability of the sediment discharge induced by heavy rainfall at a water treatment plant?
• Impacts of different land-use scenarios?

Study site
Radicatel catchment (106 km²)
Normandy, France

Method
➢ Coupled modelling approach
• WaterSed (Landemaine, 2016): Raster-based distributed model
• WaterSed outputs are extracted at connected sinkholes and used as inputs in the DNN
• Deep Neural Network
• WaterSed outputs are used as inputs in the DNN
• 41 neurons; 3 hidden layers; activation function = ReLU

Land-use Scenarios
➢ $S_{base}$: Land Cover 2016 + existing erosion control measures
➢ $S_{grass}$: 33% of grasslands ploughed-up
➢ $S_{engi}$: 161 fascines + 13.1 ha of grass strips
➢ $S_{farm}$: +15% infiltration on 50% of the cultivated plots

Our modelling results suggest that adoption of best farming practices on catchment can significantly decrease sediment discharge at sinkholes and thus, reduce impacts at water treatment plant (up to 61%)

Fig: (A) Predicted sediment discharge at the water treatment plant (Radicatel, Normandy, France), by the coupled model (GIS-DNN) on five designed storm project and four land-use scenarios; (B) Simulated flow paths on the baseline scenario; (C) Simulated flow paths when considering best farming practices on 50% of the plots for which the capacity infiltration has been increased by +15%.

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