D.2.3 GIS plugin achievement allowing to run the model for NBS suitability mapping

Pascal Breil

Contents

Warning

- The current version 0.5.4 of the plugin has been registered with the APP to protect its intellectual property. Due to its use of open-source libraries with contaminating effects it is an open version written in Python 3 and licensed under the reference number:
- IDDN.FR.001.530008.000.S.A.2020.000.10000.

- Any version of the plugin modified for specific needs must refer to the original.

- The current version 0.5.4 of the plugin has undergone several stability tests. A French and English dictionary is included. The working language is determined by the keyboard type (AZERTY or QUERTY). Not all fields have yet been translated correctly, and English texts are sometimes present in the French language.

- The aim of the training course is to make the plugin available to design offices and operational departments, so that a group of testers can benefit from feedback. Through a series of requested improvements, this will enable the plugin to be finalized for open availability by 2025.

- The IRIP model implementation is presented in the following part of this document.

- The names of directories where data is stored must not contain accents, as some libraries called by IRIP do not handle this correctly.

***If you have any questions about using the IRIP model, or about how to join the testers' group, please send a message to** pascal.breil@inrae.fr.*

What is the relationship between intense runoff and stormwater management in peri-urban environments?

Peri-urban areas are often subject to rapid urbanization, with stormwater runoff overloading the sewerage systems of dense urban areas located downstream. The difficulty and high cost of increasing the capacity of these networks means that management solutions have to be found for the urban periphery, which mixes rural and urban areas. This implies a new way of managing the areas to be built. To do this, we need to understand how intense, and potentially damaging, runoff is organized in these mixed spaces. This means knowing where and how to act with nature-based solutions. It also enables us to define which areas need to be preserved to manage runoff and conserve this resource in an evolving climate with more intense rainfall within longer periods of drought.

Where can I find the IRIP model plugin and the test dataset?

You'll find it all under the ATENAS directory D.5.2: Presentation of ATENAS material

- IRIP_model_training_data&QGISPlugin, direct link: IRIP_Model_training_data_and_QGISplugin.7z
- IRIP model tutorial, direct link: IRIP model tutorial_.pdf
- IRIP short tutorial, direct link: IRIP_short_tutorial.pdf

Understanding the three IRIP maps

The IRIP model can be used to locate the trigger zones for intense runoff, erosion and accumulation processes, both liquid and solid. This is because the model uses slope failures as upstream process indicators. Consequently, it does not indicate the propagation zones of erosion or accumulation hazards. This point is illustrated in Figure 1, which shows a water body with steep banks. IRIP accumulation scores >=4 are shown in blue, and erosive transfer scores >=3 in green. Note the continuity of the accumulation zones feeding the water body from upstream (left of figure) and around the water body. IRIP does not model the water surface. For erosive transfer, we observe the erosion start line below the road that closes off the water body. IRIP does not model the propagation of mudflows. The IRIP model provides a good representation of hazard initiation zones, where preventive actions can be developed.

Figure 1: Water body or accumulation zone detected by the IRIP model. 5m raster mesh.

Example of a preventive application with NBS based on IRIP maps

Rural runoff to urbanized areas

The choice of NBS locations to reduce the effect of intense runoff, whether rural or urban, can be based on risk analysis. This involves cross-referencing landscape features that are vulnerable to intense runoff. The Yzeron watershed, which includes part of the city of Lyon, is a good example of this. Figure 2 shows a road bordering a field that is conducive to runoff accumulation. This runoff is collected by a ditch which discharges into a combined sewer system. This situation has two consequences: the risk of flooding homes and the loss of a resource that is evacuated by the sewer system. The solution may be to build a buffer zone in a depression, upstream of the road, to store and infiltrate this resource. This is a low-cost solution that does not necessarily freeze agricultural use if the slopes of the depression are gentle enough.

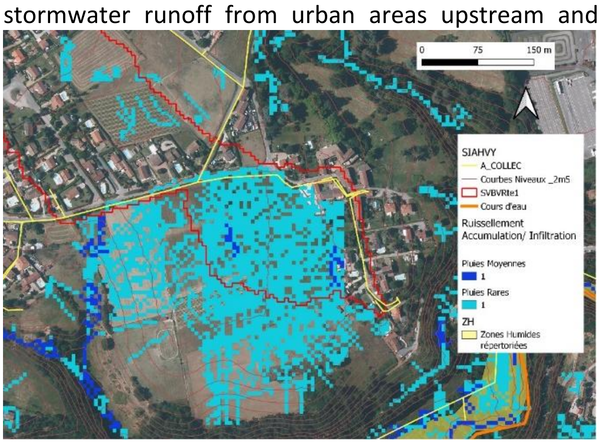

Figure 2: IRIP accumulation scores (3= light blue; 4-5 = dark blue).

Directing urban runoff to rural storage areas

Urban runoff captured by a combined sewer system is sent to a WWTP via a combined sewer system, with possible overflows, urban flooding and impact on receiving watercourses along the way. The massive inflow of stormwater to a biological WWTP is also a dysfunctional factor, generating direct discharges without treatment, via a bypass or discharges that are insufficiently treated. One solution is to disconnect stormwater runoff from urban areas upstream and send it to a stormwater network to be created. In order to avoid massive, one-off inflows of water into small streams, the stormwater outfall ends up in a system consisting of a stormwater basin, sometimes supplemented by a planted filter, whose purified water flows into a watercourse. As the effect of runoff is to rapidly evacuate the resource towards natural outlets, to the detriment of infiltration, we explore here the possibility of directing urban runoff towards rural accumulation areas conducive to infiltration.

To determine areas suitable for runoff interception we need to use the IRIP accumulation layer and extract accumulation levels 3, 4 and 5. In figure 4, the dark blue areas represent accumulation locations >=3. We focus (Fig4) on an accumulation zone (orange zone) located below an urbanized area in the commune of Brindas.

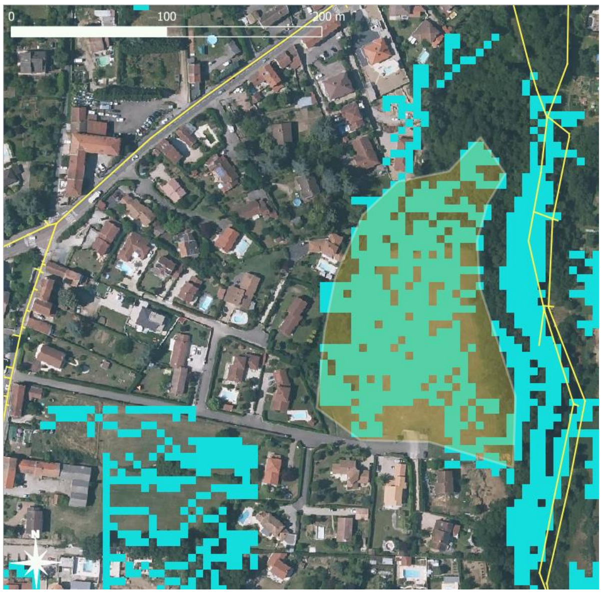

Figure 4- Municipality of Brindas, mapping of IRIP accumulation zones >=3

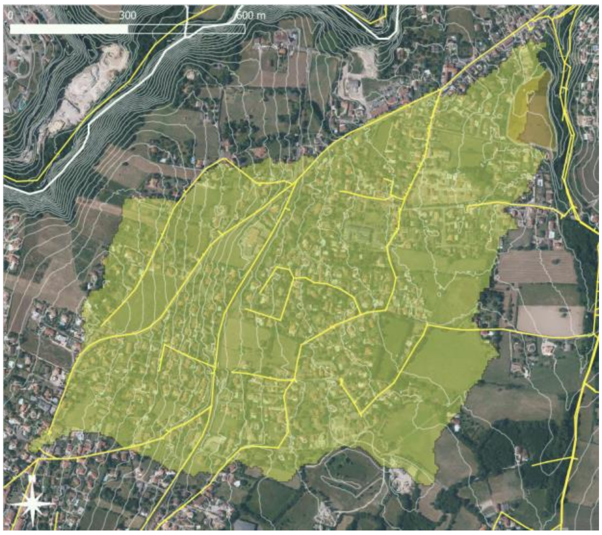

Figure 5- Topographic catchment area that can potentially be drained by the IRIP accumulation zone.

Natural runoff follows the topography and is intercepted by the sewer network (Fig5. Yellow lines). The corresponding topographic catchment area is urbanized (Fig5. Yellow zone). As a result, a large area of the watershed is not captured by the downstream accumulation zone. It is captured by the network, resulting in a loss of local resources.

In this situation, it is possible to disconnect the stormwater network from the combined network. The orange zone is an accumulation area of around 1.4 hectares which drains an area (in green) of 0.85 km2, 77% of which is urbanized. One possible action would be to divert the stormwater runoff currently flowing into the combined sewer system back to this orange accumulation zone. This could contribute to the formation of a potential wetland (to be verified if no control vegetation already exists), which would have additional ecological benefits. This can be achieved by creating channels or trenches to direct runoff from the stormwater network towards the accumulation zone. Storage areas can be created by working the topography. This temporary storage process encourages infiltration to help recharge the water table. According to ESDAC data, to be considered as orders of magnitude, in the first 30 cm of soil, infiltration speed exceeds 27 mm/h and water storage capacity is 132 mm.

The commune of Brindas has fairly continuous accumulation zones (Fig6), but most of them are located on concave slopes at the edge of valleys or on plateaux.

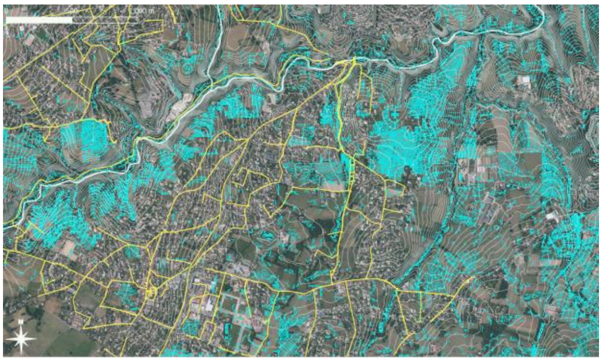

Figure 6- location of IRIP accumulation zones in the commuen of Brindas (France).

These areas are ideal for infiltration, provided runoff is managed by contour cultivation, for example.

In the upstream Yzeron watershed, areas of production, transfer and accumulation >=3, excluding urbanized areas, account for 29% of the surface area. Urbanized areas cover 18.5%. The remaining 52.5% corresponds to rural areas that are not very conducive to runoff and therefore to infiltration and recharge. However, the subsoil, made up of granite and gneiss, has little capacity for infiltration, except at the level of geological faults. Runoff surfaces can make a significant contribution to local water resources.

In relation to this case study, situations downstream of urban areas should be automatically sought throughout the Yzeron watershed, as they offer the dual advantage of limiting the malfunctioning of the wastewater network and preserving local water resources.