



A large scale flume for hydro-environmental studies

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The understanding of key hydrologic processes such as, water erosion, rill network development or agrochemical transport, requires controlled experiments at the appropriate scale. This is the reason for experimentation at flume scale in hydro-environmental research, used for many decades in this field. This communication presents a research infrastructure, recently completed in its first stage, consisting of a large flume for studying soil water erosion, sediment transport, and environmental processes such as the transport of different substances (salts, fertilizers, herbicides, carbon, ...) rather dissolved or absorbed with the sediment. It is located at the Institute for Sustainable Agriculture (CSIC) in Córdoba, Spain. The flume is 0.6 m deep, 12 m long, and 6 m wide. It may be divided longitudinally into three channels (6 m long, 1 m wide). The slope of the flume can be regulated from 0 % to 20 %. The device allows studying free surface flows over movable beds with different conditions of sediment transport by supplying clear or sediment-laden water from its head system. The head system consists of three triangular weirs for accurate measurement of water flow, three stilling tanks at the entrance of the flume, and three vibratory hoppers for applying sediments at pre-set rates. The water can be re-circulated, the maximum inflow is then about 30 l s⁻¹, or evacuated, then the inflow is limited to about 20 l s⁻¹.

The infrastructure is within a shelter with an area of 400 m² and height 8.7 m. The area of the shelter allows in-door mechanical preparation of soil and sediments. The height of the shelter will allow the installation of the rainfall simulator and a light rail crane in a second stage, not started yet. Several experiments have been planned at IAS-CSIC already, particularly investigation of the water erosion and sediment transport processes in concentrated flows under different soil conditions, as well as hydrodynamics aspects of suspended and bed-load transport in unsteady free surface flow. For this purpose, two complementary systems may be installed for specific purposes: a drainage system lying on the bottom of the flume that allows suctioning drainage water or inducing a perched water table in the soil, and in the future a rainfall simulator. When the experimental flume operates on rainfall simulator mode, the flume may be further divided transversally, thus the number of subplots may be up to 6. Surface and subsurface water flows may be collected separately at the outlet of each of the 6 plots.

The flume is designed to allow installation of different scientific instruments to monitor variables of interest for each experiment, such as TDR for measuring soil water content; tensiometers for measuring soil water potential; suction cups to extract soil solution; point gages to measure the water depth along the flume; LIDAR to determine micro-topographic changes; high-speed high-resolution digital cameras to record water surface flow and to track the motion of sediment particles; Laser Doppler Anemometer to determine velocity profiles in the surface flow; automatic water samplers; etc...

This research facility has been finalized in January 2013. It was initially supported by 32 researchers belonging to 6 institutes of CSIC and 5 universities of Spain. However, the aim is to put it to the service of any researcher interested in the facility, in order to transform this laboratory into a nodal point in hydrologic and hydro-environmental studies in Europe. This communication is one of the first steps in helping to include this facility into our tool box for hydrologic and environmental studies with multidisciplinary teams.