Geophysical Research Abstracts
Vol. 21, EGU2019-10386, 2019
EGU General Assembly 2019

Gravity currents interacting with a bottom triangular obstacle

Claudia Adduce, Maria Chiara De Falco, and Maria Rita Maggi
University Roma Tre, Department of Engineering, Rome, Italy (claudia.adduce@uniroma3.it)

Gravity currents are flows produced by a density difference between two fluids. When the density difference is due to the presence of suspended sediments a turbidity current occurs. These kind of flows often form during flooding events, when sediments are entrained from the river bed and transported toward a lake or a reservoir. In order to avoid the reduction of the reservoir storage capability, bottom mounted barriers/obstacles are often used. The interaction between an obstacle and a gravity current can cause important changes in the structure of the incoming current and surrounding flow. In order to investigate the processes occurring between a dense current and an ambient fluid, due to the presence of the obstacle, several laboratory experiments were performed at the Hydraulics laboratory of the University Roma Tre.
Gravity currents were produced by the lock-release technique in a tank divided in two volumes filled with fluids at different density, i.e. the dense fluid in the lock and the ambient fluid in the rest of the tank, and separated by a vertical sliding gate. As soon as the gate was removed, the two fluids interacted developing a dense gravity current propagating along the bottom of the tank and entraining the ambient fluid flowing in the opposite direction. A bottom triangular obstacle was placed in the middle of the tank. The relevant dimensionless parameter varied during the runs was the aspect ratio between the initial water depth of the dense fluid in the lock and the obstacle height. All the experiments were also performed without the obstacle to have references cases. The dense lock fluid was dyed for visualizations purposes and all the experiments were recorded by a camera. An image analysis technique was used to evaluate the instantaneous density fields of the gravity currents.
When the gravity current interacted with the obstacle, a portion of the fluid flowed over the obstacle while the rest of it was reflected back. The gravity current's dynamics was strongly affected by the aspect ratio. Experiments with smaller aspect ratios were more affected by the presence of the obstacle, because the amount of fluid flowing over the obstacle was small. Consequently, the mass loss caused a large reduction of the gravity current velocity. Both the bulk and the instantaneous entrainment parameters were evaluated. Despite the formation of a macro vortex, when the gravity current flowed over the obstacle, the bulk entrainment parameter at the end of the experiment was not affected by the presence of the obstacle. The percentage of the overflow, depending on the aspect ratio, was evaluated and compared with previous findings in the literature and a good agreement was found.