



## Effect of inflow channel aspect ratio on the plunging dynamics of an unconfined hyperpycnal plume over a sloping bed

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Hyperpycnal (denser) river inflows into lakes bring sediments, nutrients, oxygen and contaminants, which are crucial for the water quality. Due to the higher densities of hyperpycnal inflows, they abruptly descend toward the lake bottom upon entering the lake, a process called plunging, and subsequently continue flowing along the lake bottom as a gravity-driven underflow. This plunging is accompanied by mixing and entrainment of ambient lake waters, which causes dilution of the initial density excess of the river inflow. The mixing is parameterized by the plunging mixing coefficient  $E_p$  and is of critical importance as it conditions the fate and final destination of the contaminants carried by the river inflows. A recently proposed conceptual model (Thorez et al. 2024) for the plunging into an unconfined lake configuration highlights the importance of the lateral slumping motion of the river plume and secondary flow cells on each side of the plume with respect to the plunging mixing.

This study builds on previous research that suggests that  $E_p$  is affected by the geometry of the river mouth. We investigate with Particle Image Velocimetry (PIV) in laboratory experiments how the width-to-depth ratio at the river mouth ( $W_0H^{-1}$ ) influences the plume hydrodynamics and  $E_p$ . Four different ratios,  $W_0H^{-1} = 5.4, 9, 13.5$  and  $27$ , were investigated in a configuration that mimics the Rhône inflow into Lake Geneva. The laboratory experiments were performed in the Coriolis platform at LEGI (Laboratoire des Ecoulements Géophysiques et Industriels) at a scale of 1:60 that allows minimal scaling effect.

The distance of the plunge location from the river mouth,  $x_p$ , and the corresponding depth,  $h_p$ , were found to decrease with the aspect ratio. In addition, the size of the secondary flow cells on each side of the slumping river plume decreased with aspect ratio which tentatively explains the observed variations in  $E_p$ .