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Experiments on Gravity Currents

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We describe the results of a series of experiments on gravity currents in which we explore the mixing and dynamics of the flow, for both two-dimensional channelized currents and axisymmetric currents spreading from a local source. We find that there is a considerable amount of dilution of the current as the fluid ahead of the current, rises up over the head of the current, and partially mixes into the flow. For channelized currents, this has implications for the evolution of the flow from the initial constant speed phase of the flow to the nearly self-similar phase once the original fluid is all mixed with ambient fluid; it also influences the near self-similar evolution of an axisymmetric current as this mixes with the ambient fluid.

In both cases, we find that the current is vertically and laterally stratified in both velocity and density, and that this has a major impact on the dynamics of the current : the head of the current includes a dominant circulation whereby current fluid in the central part of the head, reaches the front of the flow, rises and mixes with the ambient fluid originally ahead of the current and which is displaced up and over the head.

The experiments are used to develop models of the mixing and the self-similar evolution of the flow. The models will be compared with the experimental results, including a description of the mixing within the flow. The implications of the results for the dynamics of turbidity currents, ash flow propagation and the hazardous release of dense gases will be discussed.

References :

Sher D and Woods AW, 2015, Entrainment, stratification and self-similarity, *J Fluid Mech.*, 784, 130-162

Samasiri, P and Woods, AW, 2015, Mixing in axisymmetric gravity currents. *J. Fluid Mech.* 782.