

## Dispersion of tracers in the stable atmosphere of a valley opening onto a plain

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The purpose of the present study is to quantify the impact of a valley-wind system on the transport of passive tracers in the stably-stratified atmosphere of a valley dynamically decoupled from the atmosphere above. The simple configuration of an idealized Alpine-type valley opening onto a plain is considered, for two values of the initial buoyancy frequency and of the valley steepness. The valley-wind system consists of thermally-driven down-slope flows which induce a pressure difference between the valley interior and the plain, thereby triggering a down-valley flow. A steady-state regime is eventually reached, at the beginning of which passive tracers are emitted at the valley floor and at different heights above it. The tracer emitted at the valley floor is fully mixed below the height of the maximum speed of the down-valley flow, which behaves like a jet, and remains decoupled from the tracers emitted above. The down-valley wind increases linearly in the along-valley direction  $y$  so that, from the conservation of the tracer flux, the tracer concentration decays as  $1/y$ . A simple theoretical model is proposed to account for the down-valley wind and tracer behaviors. The tracer emitted at the valley floor also displays marked oscillations, which are induced by internal gravity waves emitted by a hydraulic-jump process when the down-slope winds reach the valley floor. The amplitude of the oscillations can be as high as 50% of their mean value, implying that averaged values in an urbanized valley may disguise high instantaneous – and potentially harmful – values.

Reference: Quimbayo-Duarte J., C. Staquet, C. Chemel, G. Arduini. Dispersion of tracers in the stable atmosphere of a valley opening onto a plain. Accepted for publication in Boundary Layer Meteorology.