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Terrestrial laser survey on dune-bedded overbank deposits from the 2006 eruption of Tungurahua volcano, Ecuador.

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The deposits of the 2006 pyroclastic density currents (PDCs) at Tungurahua are organized as 1) massive, coarse-grained deposits confined to valleys of the drainage network and 2) cross-stratified, ash-dominated overbank deposits from dilute PDCs. These overbank deposits are exceptionally well preserved and show dune bedforms shaping the surface of the outcrops. In order to gain insights into the depositional mechanisms of the latter, we combined a terrestrial laser scanner (TLS) survey with a ground penetrating radar (GPR) dense network of profiles. TLS provides a dense data cloud (measurements at c.a. 5 cm step) with centimetric precision.

Previous eye-witness observation of the overbank deposits permitted a qualitative description. Ashy deposits are organized as spatially isolated and limited “ash bodies”, most of them with the shape of a sedimentary wedge, i.e. a sharp increase in thickness at the upstream end, gently vanishing in the downstream direction. Dune bedforms shape the surface of the sedimentary wedges. Their crest orientation permit to reconstruct the parental flows’ direction. A decrease in their dimensions follows the downstream direction (from 1.6 m to 0.1 m in thickness and ca. 15 m to 2 m in length). Moreover, the outer shape of the dune bedforms is observed to evolve downstream. Steep sided, transverse bedforms are the exclusive type found at the upstream end, but outcrop all over the ash bodies. Lunate shapes (barchanoidal crests concave upstream) outcrop exclusively in middle parts. Two-dimensional dune bedforms, very wide but short and organized in recurrent trains are only present on outer edges of the deposition zones, where the parental flows are believed to have spread.

We scanned the surface of three of the main ash bodies containing dune bedforms. The dataset ensures the full preservation of the geomorphological information about the deposits. As numerical data, it can be used to retrieve the qualitatively-observed evolutions, and quantify them. We attempt to pick crests of the dune bedforms automatically, measure slope angles and dimensions and derive a Fourier analysis of the evolution of the (wave)lengths and amplitude. Setting limit parameters, we also try to group the dune bedforms according to their outer shape, and derive the conclusions previously addressed qualitatively.