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# Quantifying the effects of material properties on analog models of critical taper wedges

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Analogue models are inherently handmade and reflect their creator's shaping character. For example, sieving style in combination with grain geometry and distribution have been claimed to influence bulk material properties and the outcome of analogue experiments. Few studies exist that quantify these effects and here we aim at investigating the impact of bulk properties of granular materials on the structural development of convergent brittle wedges in analogue experiments. In a systematic fashion, natural sands as well as glass beads of different grain size and size distribution were sieved by different persons from different heights and the resulting bulk density was measured. A series of analogue experiments in both the push and pull setup were performed. The differences in the outcome of experiments were analyzed based on sidewall pictures and 3D laserscanning of the surface. A new high-resolution approach to measuring surface slope automatically is introduced and applied to the evaluation of images and profiles. This procedure is compared to manual methods of determining surface slope. The effect of sidewall friction was quantified by measuring lateral changes in surface slope. The resulting dataset is used to identify the main differences between pushed and pulled wedge experiments in the light of critical taper theory. The bulk density of granular material was found to be highly dependent on sieve height. Sieve heights of less than 50 cm produced a bulk density that was up to 10% less than the maximum bulk density; an effect equally shown for different people sieving the material. Glass beads were found to produce a more regular structure of in-sequence-thrusts in both, space and time, than sands while displaying less variability. Surface slope was found to be highly transient for pushed wedge experiments, whereas it reached and attained a stable value in pulled experiments. Pushed wedges are inferred to develop into a supercritical state because they exceed the
theoretical critical surface slope by 5-15°. Since bulk density effects shear strength, different sieving styles could potentially alter the results of analogue models and must be taken into consideration when filling in material. Results from this study also show that only wedges in the pull setup are accurately described by critical taper theory.