Piping and subsurface heterogeneity: A scale model

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**Regional scale model**

The first scale at which modelling is possible is the regional scale. Here the locations of ditches relative to the river and levees precondition **regional hydraulic gradients**. These determine where the seepage through **upbursting** of the top layer occurs, creating a **concentrated seepage outflow point**. Since such potential locations are fixed this predetermines the associated discharge and potential for piping to occur. Potential upburst and piping locations are thus fixed to the **position of channel belts** as they determine **regional flow paths**.

**Process scale experiment**

In a **laboratory setting**, several sand samples were mixed and subjected to a hydraulic head difference between an inflow filter on one side and a **single exit point on the top** of the experiment. As the top of the experiment was see-through the progress of the pipe could be monitored visually (left). The results of this experiment are used to calibrate a digital model (right). **See the QR code for an animated version**

**Process scale modelling**

A hydraulic flow field is calculated in the model based on the gradient between the entry surface for flow on the left hand side to the outflow point in the top of the model at three quarters of the length of the model. Per modelling step the **capacity for erosion is calculated** (beige area) and the field is updated for the next modelling step. Using this method critical gradients and potential erosional paths for the piping process relative to the stochastic build up of the subsurface can be determined. **See the QR code for an animated version.**

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