Hybrid modeling of debris flows – Focusing on initial and boundary conditions

Elena Pummer[1]*, Berit Vosskämper[2], Anja Dufresne[3] and Julia Kowalski[4]

[1] *Department of Civil and Environmental Engineering, NTNU, S. P. Andersens veg 5, NO-7491, Trondheim, NORWAY*
[2] *Institute of Hydraulic Engineering and Water Resources Management, RWTH Aachen University, Mies-van-der-Rohe-Str.17, DE-52074, GERMANY*
[3] *Department of Engineering Geology and Hydrogeology, RWTH Aachen University, Lochnerstraße 4-20, DE-52056 Aachen, GERMANY*
[4] *Aachen Institute for Advanced Study in Computational Engineering Science, RWTH Aachen University, Schinkelstraße 2, DE-52056, GERMANY*
**Corresponding author, e-mail: elena.pummer@ntnu.no*

ABSTRACT

Debris flows are mixtures of water, sediments and debris that initiate on mountain sides, travel down a confined steep channel at high velocity, and may turn into natural disasters for communities and infrastructure. To prevent any destructive effect, precautionary measures are often employed, wherefore a fundamental understanding of the debris flow processes, e.g. velocity profiles, erosion and bulking, impact forces, etc., are needed. The relevant parameters of initiation and runout differ widely in characteristics. Thus, setting initial and boundary conditions for physical and numerical modeling is challenging. The aim of our investigation is hence to analyse velocity profiles and shear stresses of debris flows using variable but repeatable initial and boundary conditions. We built a Plexiglas flume, constructed like a seesaw that can tilt to either side. Each side is equipped with a sediment reservoir and the roughness of the flume base can be modified. Ultrasonic probes measure water levels, and high-speed cameras record the flow velocity distribution, using the Large-Scale Particle Image Velocimetry (LSPIV)-method. The results provide the basis for 2D depth-averaged numerical modeling using a Finite-Volume-method. Combining and hybridizing both, the physical and numerical model will lead to a better process understanding of these natural phenomena.