RAMMS::ROCKFALL

M. Christen[1], Y. Bühler[1], J. Glover[1], W. Gerber[2] und P. Bartelt[1]

[1] WSL Institute for Snow and Avalanche Research SLF, Davos, Switzerland

[2] Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Switzerland

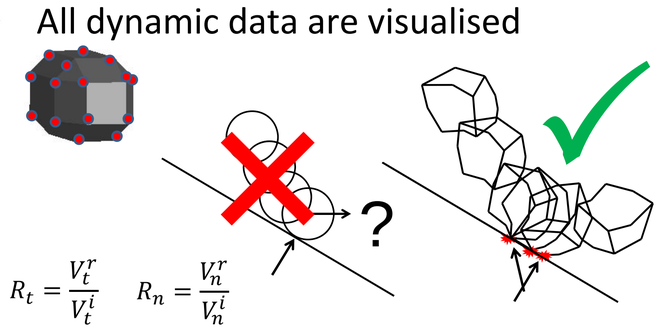
WHAT IS RAMMS::ROCKFALL?

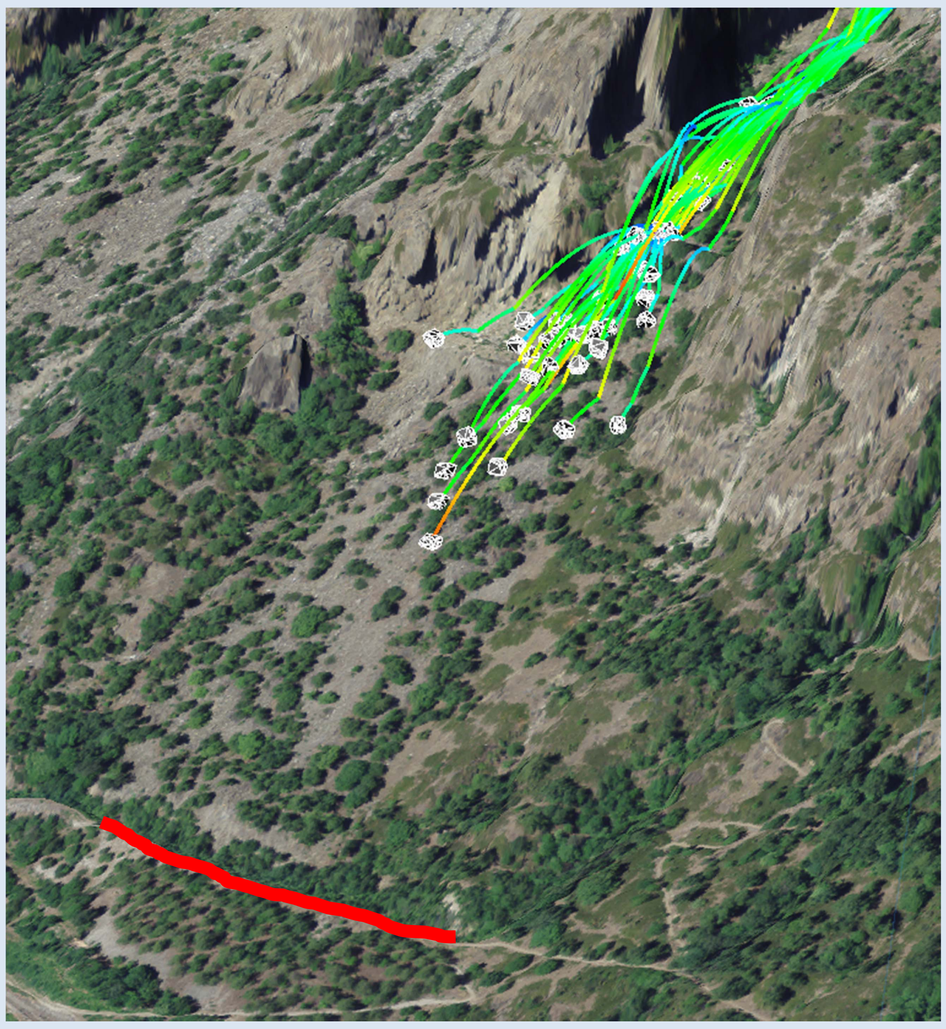
RAMMS::ROCKFALL is the new **Rockfall module in the RAMMS-Software** (**RA**pid **M**ass **M**ovement **S**ystem). In collaboration with the **ETH Zürich** we have developed a novel contact-algorithm to model the rockfalls in **3D**. The model accounts for real rock shapes, computing their runout trajectory over 3D terrain, including their jump heights, velocity, rotational velocity, total kinetic energy and contact-impact force. All possible modes of rockfall motion (jumping, rolling and sliding) are deterministically simulated. Dynamics of single trajectories can be individually inspected or multiple trajectories can be statistically analysed. The highly **user-friendly** interface does not require additional GIS-Software. Results are easily exported and visualised in 3D.

WHAT IS NEW?

Rigid Body Contact Model

- The rock is modelled as a rigid-body
- Rock shape: A convex hull is produced from arbitrary set of vertices or predefined rock shapes and geometric form (Rock Builder)
- Precise rock-terrain contact detection
- Variability is initiated by initial release conditions (i.e. rock shape, and release orientation) and **NOT** by varying the impact condition (restitution coefficient)
- All dynamic data are visualised

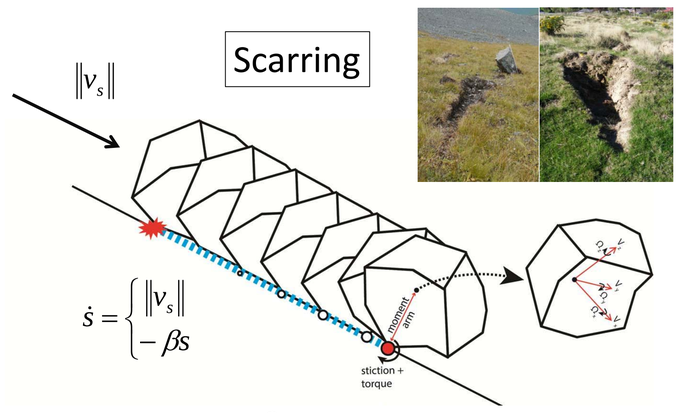




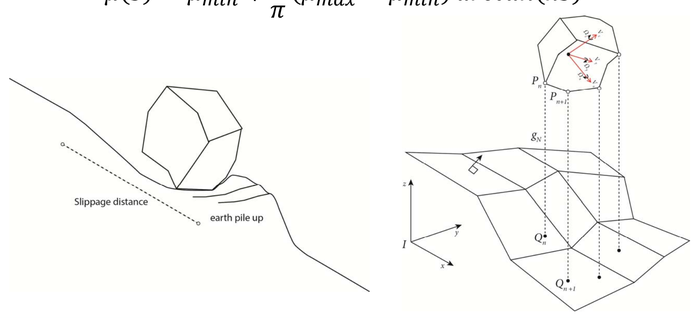
CONTACT - MODEL

Slippage Model

- Contact occurs not only over a single point → Line-Scar
- Friction is **not** constant during the entire contact period.
- Friction leads to stiction of contacts generating moments and torques → defines jump heights and rotations
- Models terrain scarring

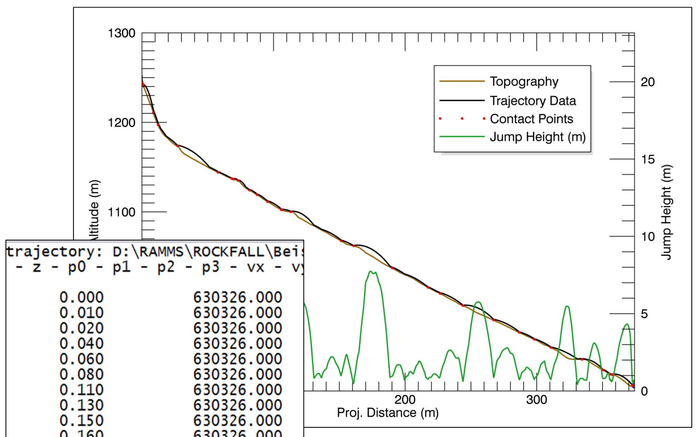


$$\mu(s) = \mu_{min} + \frac{2}{\pi}(\mu_{max} - \mu_{min})\, arctan(\kappa s)$$



TRAJECTORIES

Analysis of single trajectories



All dynamic data (up to 100 Hz) can be visualised and exported.

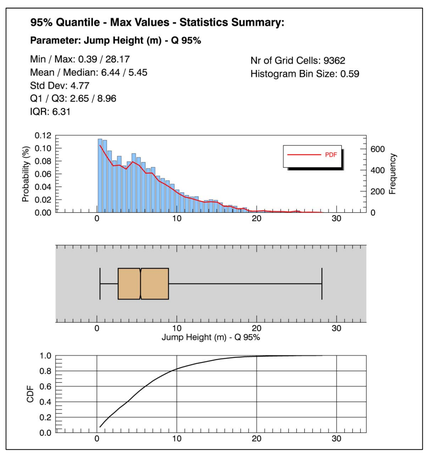
- Kin. Energy
- Jump heights
- 3D-Rotations
- Velocity
- Impact force
- Friction

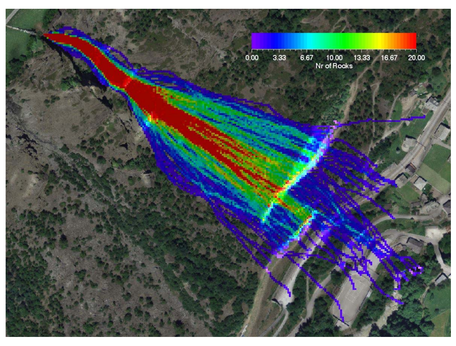
STATISTICS

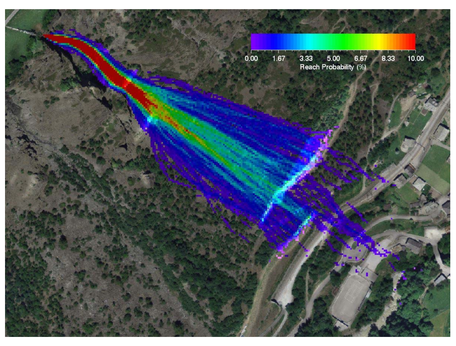
Statistical analysis

- Mean
- Median
- 90% Quantile
- 95% Quantile
- Max

- Nr of Rocks per cell
- Nr of deposited rocks
- Reach potential (%)



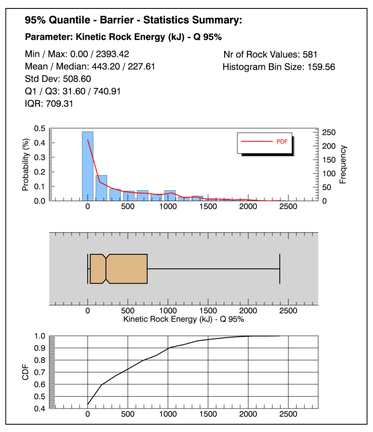




ROCKFALL BARRIERS

Statistical analysis along drawn in barrier structures (e.g. red line in centre image)

- Mean
- Median
- 90% Quantile
- 95% Quantile
- Max



CONTACT - REFERENCES

Dipl. Eng. ETH Marc Christen, christen@slf.ch

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