Seasonal changes in stream bank stability under different vegetation cover

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INTRODUCTION: The hydrological processes associated with slope stability are complex, especially because their transient effects. Additionally, mechanical processes are also influences by the type of vegetation covering bank slopes.

OBJECTIVE: Investigation of coupled **hydrological and mechanical influence of vegetation** on stream bank behaviour, accounting for both seasonal time scale and different vegetation type (**grass/natural vegetation**, **shrubs** and **trees)**.

METHOD:

- Long-term **hydrogeological monitoring** of stream banks: soil moisture conditions - ϑ (TDR); ground *WL* (DIVER) and *WL* in the stream (ULTRASONIC); soil shear strength - τ (FIELD INSPECTION VANE TESTER)
- Stream bank stability modeling (BSTEM)

RESULTS - MONITORING

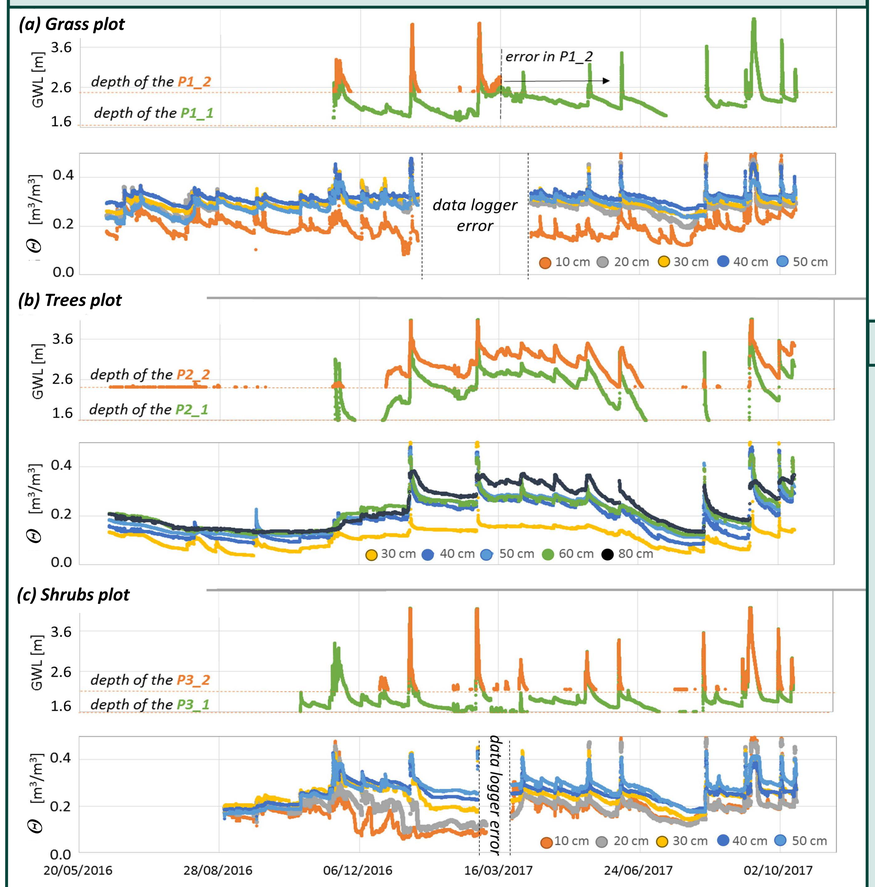

Figure 3. Hydrological monitoring results: fluctuation of ground water level (GWL) above the riverbed and soil water content (Θ) at four depths within the grass plot (a), the trees plot (b) and the shrubs plot (c).

SITE:

The Morsa catchment covers about 690 km², drains into the Oslo Fjord. It has relatively high proportion of agricultural land – 103 km² in total) with very productive soils. The catchment area of the Hobølelva River is 333 km².

Figure 1: The Hobøl River, Norway (photos: T.Kerkhof & D.Krzeminska)

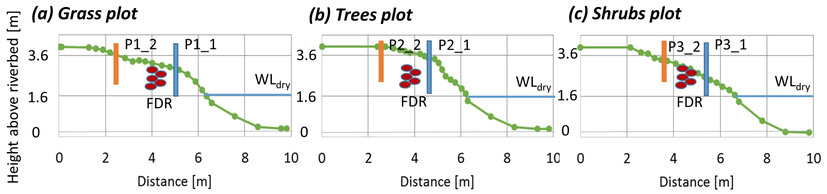

Figure 2. The stream bank profiles with location of monitoring equipment. Depth of the FDR sensor is not scaled

CONCLUSIONS

Monitoring: **There are differences in hydrogeological trend between areas:**

- **The timing of observed *GWL* peaks, in response to precipitations, is 10 the same in all three test plots.**
- ***GWL* within the trees plot stayed at a higher level for a longer period than at the two other plots.**
- **There were visible differences in the *Θ* trends within 0-30 cm subsoil, corresponding to the root depth and root water uptake**
- **no failure of the slope was observed - stream banks are stable**

Modeling **– Monitored stream banks are stable in current conditions.**

- **Vegetated buffer zones has mostly mechanical effect on slope stability.**
- **The area with the trees is the most 5 stable and shows the highest capacity to accommodate potential shear stress.**
- **The type of the vegetation used for reinforcing the stream bank slope should depends on slope angle: for gentle angles the grass cover is sufficient treatment, while trees cover is necessary to protect steeper slopes.**

RESULTS - MODELING

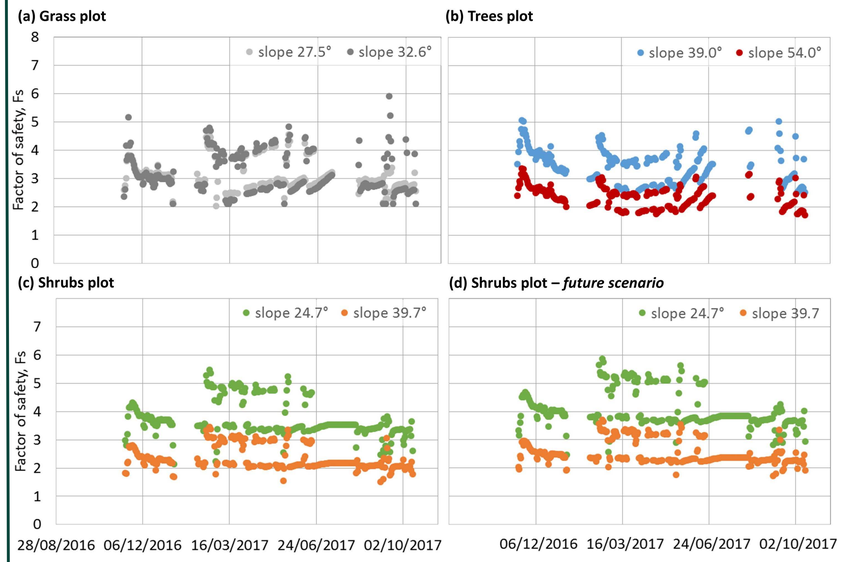

Figure 4. Factor of safety versus time for the three plots (a, b, c,) and for the "future scenario" of the shrubs plot with a fully developed root system (d). Different colors emphasize different slope angles.

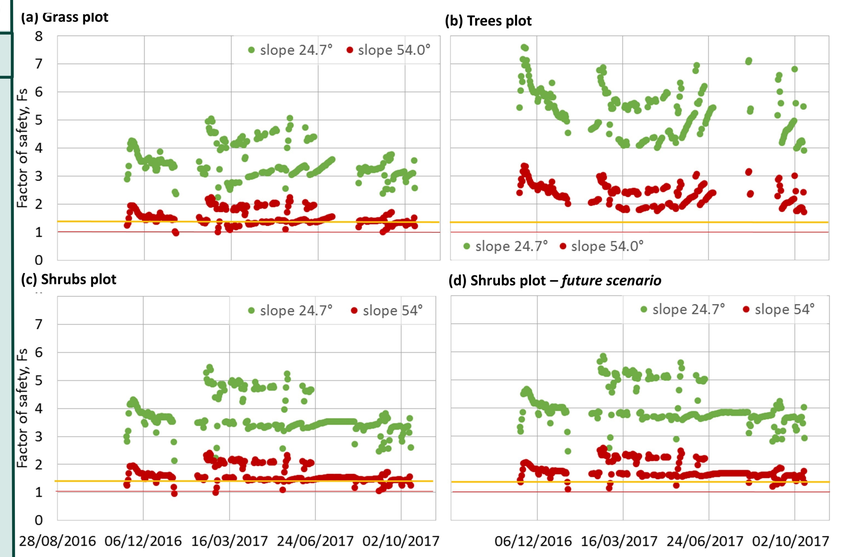

Figure 5. Factor of safety versus time for the three plots (a, b, c) and a future scenario of the shrubs plot (d) simulated with the minimum (24.7°) and maximum (54.0°) slope angle. The threshold lines are indicated to the graphs: red - Fs=1, 'unstable slope' and yellow - Fs=1.3, 'conditionally stable slope'

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