COGEAR

MODULE 3:

Geotechnical investigations in the Matter valley (soil slopes)

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Task 3b.3.2

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Summary

This report summarizes preliminary investigations of soil deposits in the Matter valley with respect to potential earthquake-triggered landslides. Data sets used include the 1:200'000 Geotechnical Map of Switzerland (De Quervain et al., 1965), DTM-AV elevation data (Swisstopo), and aerial imagery (Swissphoto), in addition to limited field observations. A Google Earth database was constructed to allow easy viewing and exchange of these basic data, which could aid any future efforts for more detailed investigation. Findings in this report are preliminary and based mostly on coarse-scale mapping, so should be used with caution and only as a first guide for future work.

Soil deposits in the Matter valley

The geotechnical map outlines four main soil deposits in the study area of the Matter valley (roughly between Stalden and Täsch). These are:

- Sand and Silt with Clay – often blocky and mixed with moraine deposits
- Gravel and Sand deposits related to the current fluvial system
- Gravels with Blocks from steep streams
- Blocky colluvium – rockfall talus and block deposits from slope failures

Blocky hillslope deposits are common on the eastern wall of the Matter valley, while the western wall is mostly intact bedrock with talus and debris flow fans at the mouth of steep gullies. Blocky slope deposits are typically steep, and frequently associated with deep-seated gravitation slope movements (e.g. Täschgufer). These are commonly the most steeply inclined of all sediment deposits in the Matter valley, but because of the large block size, coherent landslides may be uncommon. However, block falls and block movements are to be expected during an earthquake. Block size can often be quite large – up to meters scale – as for example in the steep slopes above Grächen.

Young fluvial sediment occurs preferentially in the valley bottom adjacent to the current Mattervispa river, and terraces can be seen in some locations (e.g. near Breitmatten). Talus and debris fans are important geomorphic features along the main valley, fed by debris flows, rockfall, and snow avalanches, and reworked by steep streams. Deposits in these categories are characteristically more gently inclined, and these materials are not analyzed further in the context of earthquake-triggered landslides.

The deposits thought to be most interesting for soil landslide studies are those in the category of Sand and Silt with Clay. Such deposits are commonly glacial in origin, often composed of moraine sediment and till. Composition is therefore highly variable, in some areas more blocky deposits prevail, while in others fine-grained sediment dominates. The geotechnical map distinguishes more fine-grained variants of these deposits (clayey silt from e.g. lakes), however no such units are mapped in our study area. Certain deposits of this type have been identified though from drilling logs at Grächen (Eichenberger et al., 2010), and are discussed further in detailed studies of the Grächen test site.

Geodata compilation

Relevant geodata were assembled and compiled in a Google Earth database. These include the 1:200'000 geotechnical map of Switzerland (De Quervain et al., 1965), DTM-AV elevation data (Swisstopo), and aerial imagery (Swissphoto). A portion of the geotechnical map was scanned and geo-referenced in Google Earth (Figure 1). Elevation data were processed for slope inclination, and a map produced highlighting slope angles relevant for soil landslides (Figure 2). Sand and Silt with Clay deposits identified as of interest for this project were digitized in Google Earth as polygons (Figure 3). The combined data set allows easy comparison between slope angle and mapped soil deposits, which can help in identifying steep soil slopes that may be relevant for analysis of earthquake-triggered landslides. It is important to stress that soil deposits were mapped a very coarse scale (1:200'000), so represent only a rough first estimate – any future analyses should first include detailed local mapping. Figures 3 and 4 show example images from the Google Earth database, both for the entire study area and a detail of the Grächen / St. Niklaus / Embd region, respectively.

The assembled geodata can be downloaded from:
http://www.rockslide.ethz.ch/data/Geotech_Soil_Mattertal.kmz

Preliminary analysis

Steep soil slope deposits in the Matter valley are not common. Most typically, Sand and Silt with Clay deposits form slopes with inclination less than or around 20 degrees (Figures 3 and 4). Some exceptions, however, can be identified – for example:

- South of Stalden above the roadways leading into the Matter and Saas valleys
- The area around the town of Embd
- A small but steep scarp just east of the Grächen town center
- Slopes adjacent to and east of the villages of Randa and Täsch

These slopes and deposits are first candidates for further analysis of potential earthquake-induced soil landslides. The deposit materials and slope morphologies should be investigated in detail as the first step of any future work.

Steeper slopes in the Sand and Silt with Clay soil category are often young glacial deposits (moraines) located high in tributary catchments, for example on the eastern wall above Randa and Täsch, or adjacent to the Riedgletscher tongue above St. Niklaus. Some of these deposits are known to contain interstitial ice and many are actively creeping, creating a well-studied and respected hazard from debris flows in tributary channels that can reach the main valley floor (e.g. Graf and McArdell, 2005). Similar considerations could be relevant for earthquake-induced landsliding, where the greatest hazard might not be related to the primary landslide event itself but to potential triggering of debris flows that could reach the valley floor and nearby settlements.

References

Eichenberger, J., Ferrari A., Schurmann, C., and Laloui, L. (2010). Overview of existing data in the Matter valley (soil slopes) – COGEAR Deliverable No.: 3b.3.1.1.

Graf, C., and McArdell, B.W. (2005). Die Murgangbeobachtungsstation Randa. WSL. http://www.wsl.ch/info/mitarbeitende/grafc/download/Randa_Dorfbach

De Quervain, F., Frey, D., Hofmänner, F., and Jenny, V. (1965). Geotechnishe Karte der Schweiz, Zweite Auflage. Geotechnishen Kommission, Massstab 1:200'000.

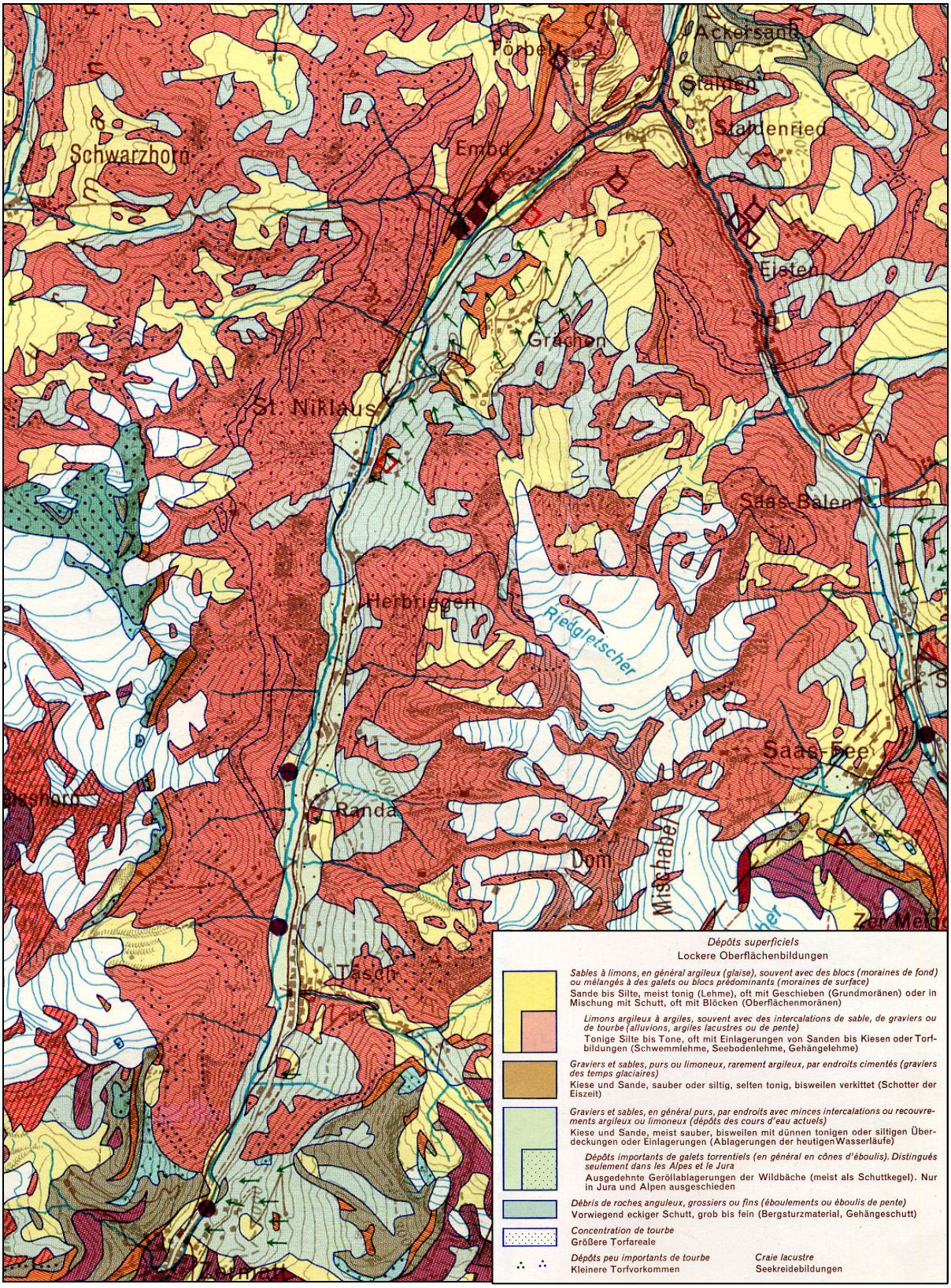

Figure 1: Scanned excerpt from the Geotechnical Map of Switzerland (De Quervain et al., 1965) for the Matter valley, with legend showing relevant soil and slope deposits.

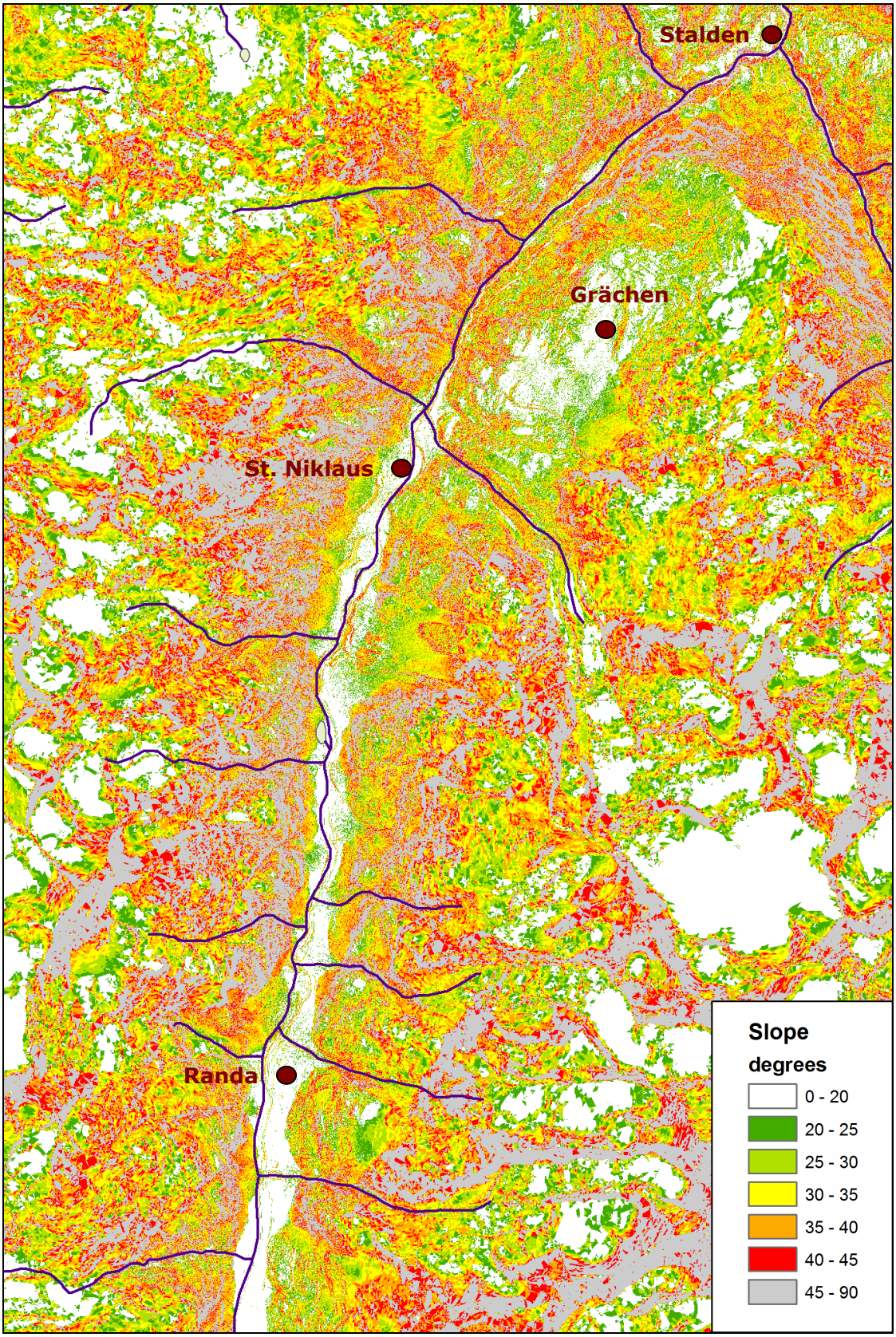

Figure 2: Slope map generated for the Matter valley from DTM elevation data of Swisstopo. Also shown are the main river channels in bold lines.

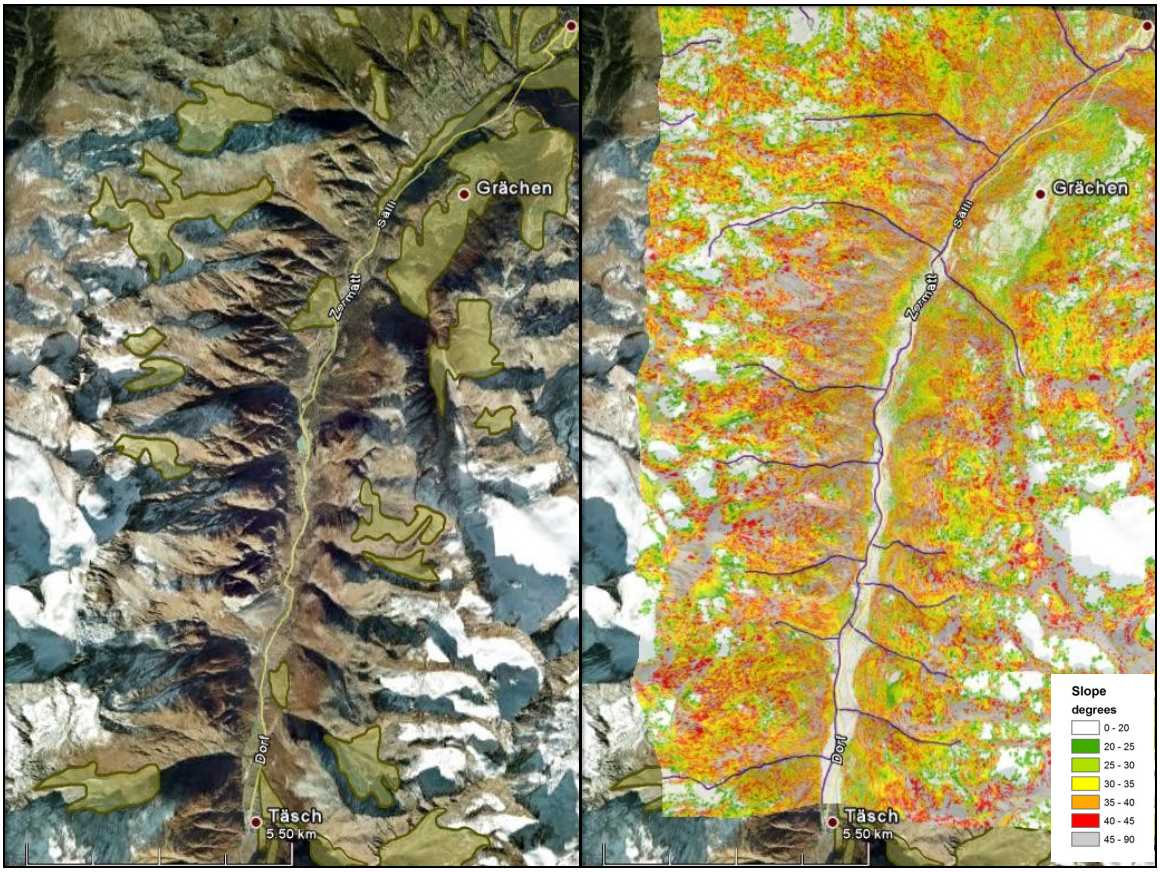

Figure 3: Excerpt from the Google Earth database showing digitized Sand and Silt with Clay soil deposits in the study area (left), together with overlain slope map (right). Toggling between the maps, it is possible to identify certain steep soil deposits that may be relevant for earthquake-triggered landslide analysis.

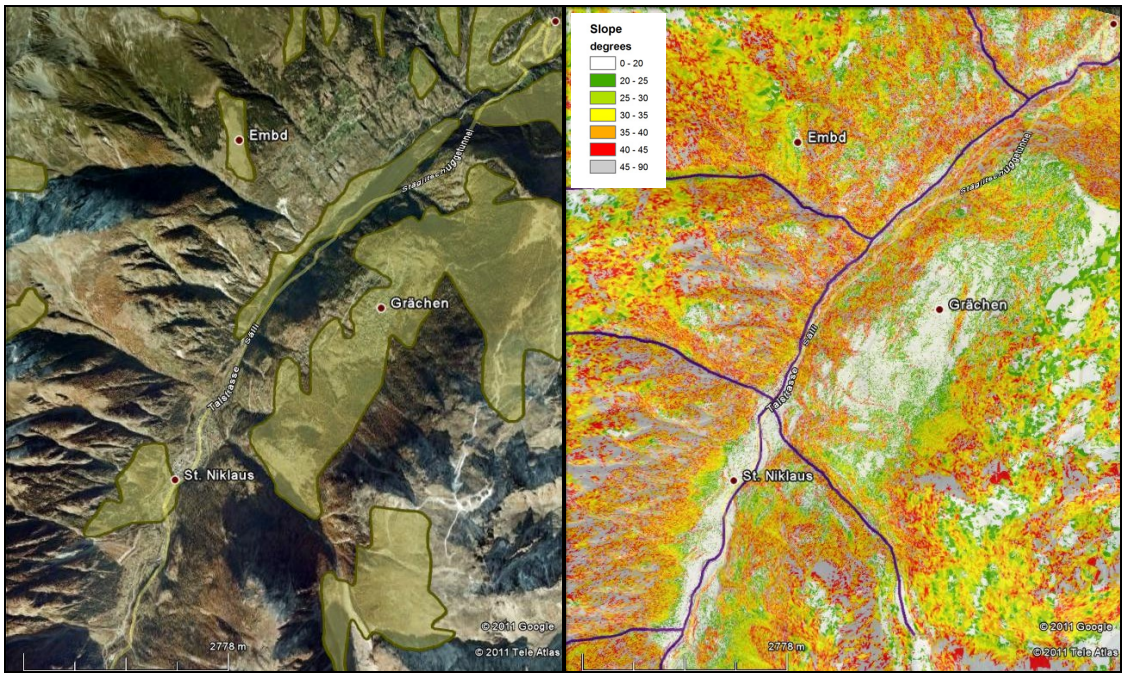

Figure 4: Detail of deposits and inclination for the area of St. Niklaus / Grächen / Embd.