Field measurements in an alpine catchment to evaluate impact of the ongoing climate change on the future sediment yield

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INTRODUCTION

The number of extreme weather events seems to increase steadily all over the world due to climate change and global warming (Sass et al, 2015). Beside a growing appearance of droughts in many countries, intense rain occurrences are getting more frequent too (IPCC, 2014). Particularly in mountainous areas little brooks can transform very fast into torrential rivers. They are able to cause damage that easily runs into millions of euros and also more importantly they can lead to human loss (Sass et al, 2015).

Such an event occurred in the municipality Oberwölz, the smallest town of the province Styria in Austria, in July 2011 causing massive damage. This was the reason for the start of the project ClimCatch in the year 2012 with the goal to predict the amount of the transported sediment in the following decades by investigating the behavior of mountain creeks under the viewpoint of the ongoing climate change. The project area is in the catchment of the torrent Schöttlbach and its tributaries (Krumeggerbach, Salchauerbach, Schmiedbognerbach, etc.).

The project is financed by the Austrian Climate and Energy Fund and is executed by the Institute of Geography and Regional Science, the Wegener Center for Climate and Global Change from University of Graz, as well as the Institute of Hydraulic Engineering and Water Resources Management from Graz University of Technology (TU Graz) (Sass et al, 2014).

METHODOLOGY AND DATA COLLECTION

Three meteorological stations have been installed in the catchment to measure the current hydrological conditions like temperature, rain, wind and snow. Precipitation calculations have been performed for the estimation of future weather events (Schneider et al, 2014). They are based on regional climate model EU-FP6 ENSEMBLES using the IPCC A1B greenhouse gas emission scenario. Through the combination of this actual measured data with the model it is possible to evaluate the amount and the intensity of upcoming extreme precipitation events.

The main goal of the project is the investigation of the existing sediment cascades and the correlation of the sediment movement with the discharge of the torrent. For that purpose three gauges have been installed. Two of them are pressure probes, which are located at the upper side of the investigation area. The third one is located at the outlet of the catchment and measures the water depth and velocity with radar technology as well as temperature, turbidity and conductivity. All stations were calibrated using magnetic inductive measurements in addition to salt tracer flow measurements.

To achieve further knowledge of the characteristics of the transported sediments, line pebble counting, automated grain size determination using photographs and sieving on-site were performed. Three Helley Smith Sampler, which were built at TU Graz, were used to get information of the transported sediment amount by the Schöttlbach and its tributaries. Based on several measurements with two small Helley Smith Sampler the daily sediment loads at certain discharges were calculated. These results, as well as basket samplers, were used as calibration factors for the Sediment impact sensors (SIS), developed and manufactured at University of Graz and TU Graz. They were placed at several spots in the Schöttlbach and its tributaries, as shown in figure 1.

These sensors are assembled from high resolution pile sensors which are stuck on a metal plate and mounted on a non-movable object in the river bed. Depending on the impacts they emit specific voltage pulses, which are stored on data loggers.

Figure 1: A Sediment Impact Sensor in the Salchauerbach

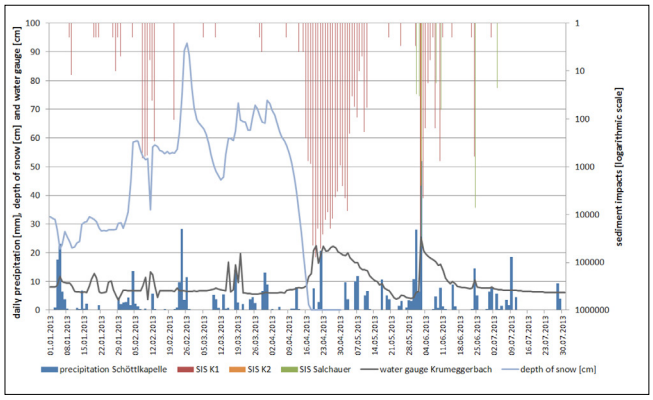

Figure 2: Example for a measured sediment load (Sass et al, 2014)

As an example figure 2 shows the monitoring of the sediment load in the river Schöttlbach and its tributaries over seven months.
In the end the measured data of precipitation and discharge will be correlated and linked with the incurring sediment yield, detected as described above. Based on the investigated climate change scenarios the future sediment volume can be predicted via the assumed rainfall events.

CONCLUSION

All measurements and simulations help to improve the understanding of the behavior of the system and gather information to estimate the future trends of the sediment balance in alpine catchments. The final contribution will present results derived in the project ClimCatch.

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KEYWORDS

sediment balance; Laser Scanning; tracer; sediment transport calculation; monitoring

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