SedAlp project (Alpine Space Programme): latest news and updatings

A good half of the SedAlp project's leght is spent: on this third newsletter you'll be informed about some of our studies and activities in specific pilot areas and we'll introduce you a new Alpine Space project, "WIKIAlps", which is promoting also SedAlp project's results.
The SedAlp partnership is a big chance to provide a better common understanding on sediment management in Alpine river basins and to develop together principals and strategies that are of value for practical implementation in each partner country or region. SedAlp partners gathered on 5th-7th March 2014 in the monastery of Benediktbeuern (Bavaria, Germany), for the third "Advisory Board Meeting". All delegates representing 14 project partners and subcontractors intensively discussed actions, activities, and outputs of the project and planned next and final steps of the project.
A very interesting excursion was organized by partner Bayerisches Landesamt für Umwelt during the meeting.
Project partners are now looking forward to next meeting, which will be in Padova (Padua- Italy) on 2-4th of September 2014.

Drone-made picture of project partners representatives during technical excursion near the confluence Hirshbach –Isaar torrent - 3rd Advisory Board meeting (Bavaria, Germany). Photo: Catholic University of Eichstätt-Ingolstadt.

Please follow the progress of SedAlp project on this newsletter and find interesting aspects of sediment-related topics in the Alps also on our website

www.sedalp.eu

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How much are glaciers relevant for bedload transport?

The key role of mountain glaciers on rivers' hydrological regime is well known, as well as their relevance for the very high suspended sediment transport measured in glacier-fed streams. In contrast, very few studies have tried to assess the extent to which glacier-melt flows and the overall current deglaciation occurring worldwide – including the European Alps – affect the transport of coarse sediment (gravel, cobbles and boulders) carried as bedload along the channel network.

The quantity of sediment moving annually as bedload is generally much smaller than that carried as suspended load. However, only the former has effects on the morphological evolution (i.e. on erosion, deposition, bedforms) of mountain and piedmont rivers. Therefore the understanding of how glacier dynamics influence bedload transport in mountain rivers will help predict the most likely river-bed changes to be expected in the near future along the channel network, and hence the most effective restoration and/or control measures to be implemented.

Within the Work-package 5 (WP5) of SedAlp project, the Autonomous Province of Bozen-Bolzano (Dept. of Hydraulic Engineering) and the Free University of Bozen-Bolzano (Faculty of Science and Technology, its subcontractor) are monitoring bedload transport in three mountain channels, two of them draining glacierized basins (the Saldur/Saldura and Sulden/Solda rivers) and one flowing in an unglacierized basin (the Strimm/Strimo Creek).

The latter represents a sort of "control site" where stream hydrology (and thus bedload transport events) is driven by snowmelt and precipitation events only. These basins are located in the upper Vinschgau/Venosta valley (NE Italy, near the border with Switzerland and Austria), and range in size from about 8 km^2 (Strimm) to 130 km^2 (Sulden).

Figure 1 - A portable "Bunte" bedload trap deployed in the upper Saldur river during intense glaciermelt flows in late August.

Figure 2 - The monitoring station in the Sulden river, where bedload sensors (one acoustic pipe and eight geophone plates) are mounted on the right side of a check-dam. The pipe is located on the concrete apron upstream of the geophones plates which were installed overhanging from the crest.

Water stage is measured continuously at 2-3 sections in each stream by using pressure transducers and ultrasonic sensors, and water discharge is determined by the salt dilution method.

Different systems are deployed in each channel to monitor bedload transport. In the Strimm creek, radiofrequency tags called PITs (Passive Integrated Transponders) inserted in natural clasts are used in conjunction with topographical/Lidar surveys, in collaboration with the CNR-IRPI Padova and the University of Milano-Bicocca.

In the Saldur River, the combination of stationary antennas for tracking PITs tag, portable "Bunte" bedload traps (Fig. 1) and an acoustic pipe sensor (manufactured in Japan) is utilized. These methods permit the continuous monitoring of bedload transport deriving from snowmelt flows (May to June), mixed snow-glacier melt (July-early August) and purely glaciermelt flows (late August-September).

Finally, the monitoring station in the Sulden River was installed in spring 2014 thanks to the integration with the "AQUASED" project, co-funded by the Province of Bolzano (Dept. of Research and Innovation) and by two private companies ("CISMA Srl" and "Mountain-eering Srl") with the scientific collaboration of the Universities of Bolzano and Trento and the logistical support by the Hydrographic Office and the Dept. of Hydraulic Engineering of the Province. The station is quite unique as it hosts both a Japanese acoustic pipe sensor and an array of geophones plates – similar to those used in the Austrian SedAlp monitoring sites – on the same check-dam (Fig. 2). Calibration of these sensors is carried out by collecting bedload samples using a "Bunte-like" portable trap operated from a crane mounted on a truck (Fig. 3).

Preliminary results from the Saldur river indicate tremendous seasonal variations in bedload dynamics (both in terms of transport rates and in the daily timing), whereas the first data collected in the Sulden River clearly shows how the relationship between water discharge and bedload rate is hugely variable even from one day to another. Overall, sediment supply (from glaciers as well as from hillslopes processes) appears to govern sediment fluxes in mountain rivers. But let's wait the progress of the project for some more quantitative results!

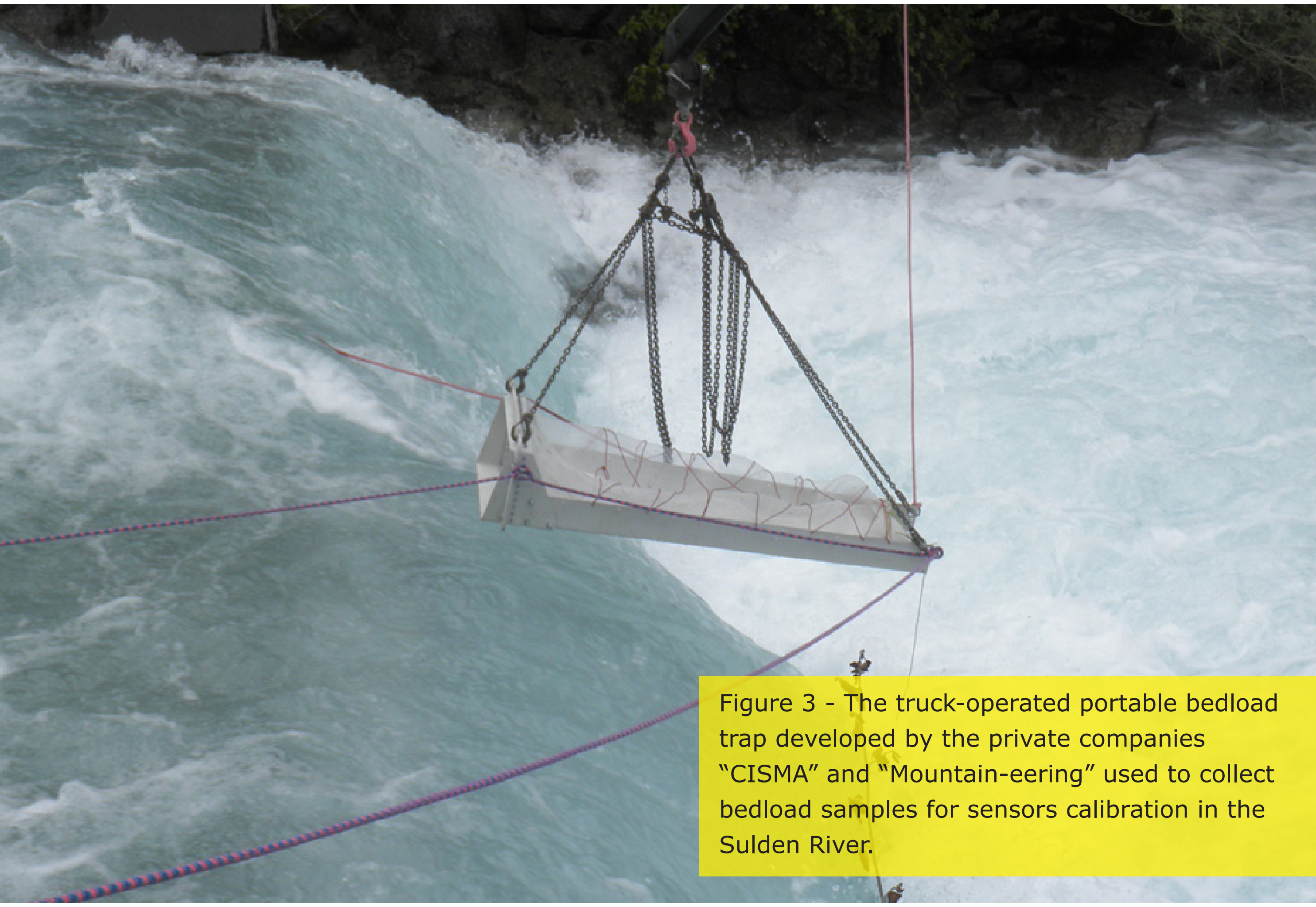

Figure 3 - The truck-operated portable bedload trap developed by the private companies "CISMA" and "Mountain-eering" used to collect bedload samples for sensors calibration in the Sulden River.

Basin-scale sediment dynamics: Maira Valley case study

In the frame of Workpackage 4 (WP4), an integrated approach encompassing sediment sources mapping and connectivity assessment, was carried out jointly by SedAlp partners CNR IRPI and Regione Piemonte in the Maira valley (NW Italy), study area of Regione Piemonte.

Preliminary activities focused on the analysis of available maps regarding instability and on the exploitation of regional historical archives. In order to identify and classify current sediment sources in the study area, different methods were used: multi-temporal photointerpretation, DEM-based morphometric analyses and detailed field surveys. Sediment sources of upper Maira valley were classified according to three main criteria: the first one takes into account the "state of activity" of sediment sources (active sources producing sediments on annual basis and quiescent sources, producing sediments on pluriannual basis). Sediment sources classified as "active" were then evaluated on the basis of the possibility for the sediments to reach or not the hydrographic network.

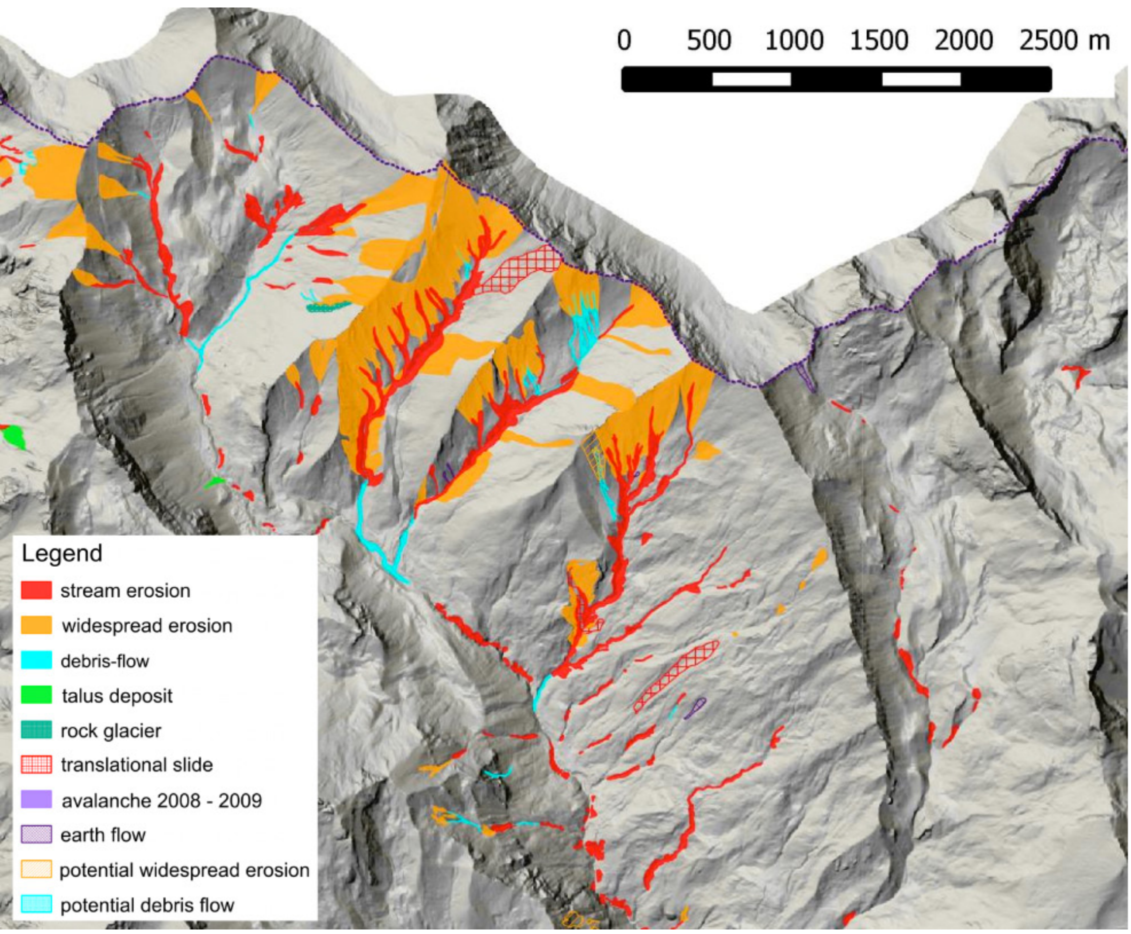

Figure 4 - Example of sediment sources classification map in the upper part of Mollasco basin (tributary of Maira river- NW Italy).

Finally, active sources, were defined as unstable area directly providing sediments to the streams unlike potential sources that could supply sediments to the streams only in the occasion of major heavy rains.

In order to quantitatively evaluate the potential connection between sediment sources and the channel network and to share a common tool of SedAlp partnership, the stand-alone software, SedInConnect 1.0, was applied to the Maira valley and to some selected sub-basins (Maurin, Unerzio, Preit and Mollasco) to compute the Connectivity Index (IC). This tool was recently developed by CNR IRPI in the frame of the project.. IC computation follows the approach proposed by Cavalli et al. (2013), refining the connectivity index originally developed by Borselli et al. (2008).

The input data were a 5m resolution LiDAR DTM and a weighting factor (W) expressing the impedance to sediment transfer across the catchment. A local measure of topographic surface roughness was used as W. The roughness index was calculated as the standard deviation of the residual topography at a scale of few meters (Cavalli et al. 2008) with a moving window approach (3x3 windows size in this case) and after a normalization procedure was used as input in SedInConnect 1.0.

Then the IC was computed in the Maira Valley and selected subbasins, using the main hydrographic network as target. The choice of modeling sediment coupling-decoupling between sediment sources and hydrographic network stems from the need to address a main sediment management issue: what is the probability that sediment eroded from the hillslopes will attain the channel network?

Results of the IC computation for a selected watershed are shown in the figure 5.

The connectivity values were classified into 4 classes (low, medium-low, medium high, high) by analyzing the distribution of IC values within each basin with the Natural Breaks algorithm (Jenks, 1967), an approach that minimizes the variance within the class and maximizes the variance between classes.

The IC has proven to be very useful in understanding which areas of the catchments might effectively be connected with the drainage network.

In the Maira valley, different patterns of sediment connectivity are clearly highlighted in the IC map. The results are consistent with the morphological setting of the valley: in high altitude areas, where the glacial morphology is prevalent, sub-basins are poorly connected with streams whereas a higher connectivity characterizes sediment sources located downstream of glacier thresholds or in areas where fluvial morphology prevails.

In conclusion, the possibility to relate a quantitative estimate of sediment connectivity to sediment sources databases can improve hazard and risk assessment in order to mitigate the effects of dangerous phenomena like debris flows. With an integrated approach, which encompasses sediment sources mapping and connectivity assessment as in the Maira study case, it is indeed possible not only to evaluate the general availability of sediment but also to estimate the potential for this sediment to reach specific targets.

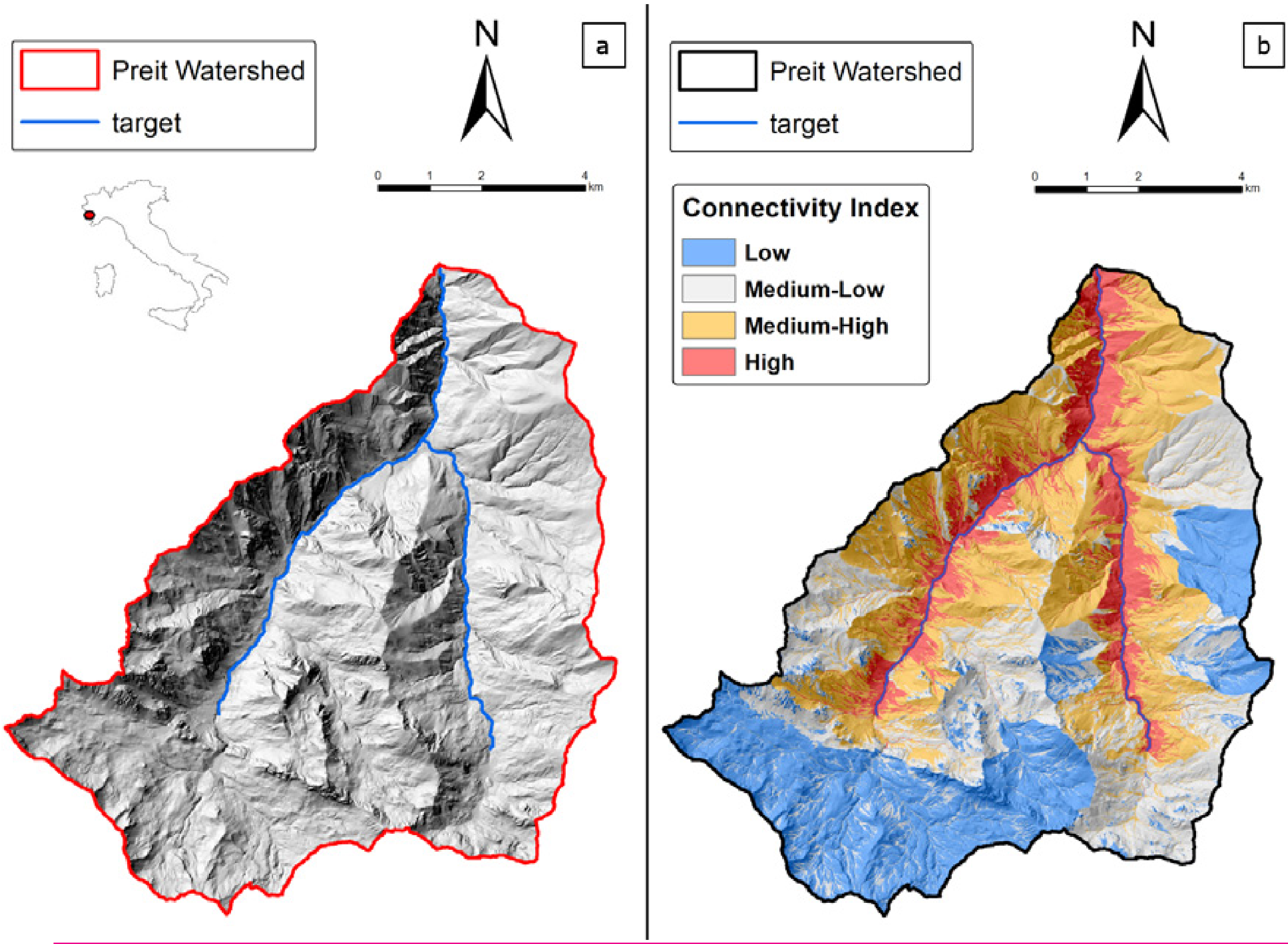

Figure 5 - The connectivity index has been applied to the Preit catchment (a) a sub-basin of the Maira river (NW Italy). The main channel network has been selected as the target of the connectivity assessment. Results (b) show that areas where glacial morphology are predominant manifest low values of the index, while areas characterized by fluvial morphology generally show higher values of the index. Noteworthy is the hanging valley in the upper part of the basin, which seems to have an important degree of decoupling with the rest of the watershed. This valley is actually characterized by very low drainage density and very important karstic features along with evident glacial morphologies.

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WP6 activities: A physical scale model to investigate torrential filter structures

Within SedAlp work-package 6 (WP6), physical scale model experiments are carried out in the hydraulic laboratory of the Institute of Mountain Risk Engineering at the University of Life Sciences in Vienna (Austria), in order to optimize torrent protection structures.

Two different types of check dams are investigated: a screen-dam with inclined vertical beams is compared with a beam-dam with horizontal beams (Fig. 6). The experiments should evaluate the variation of sediment transport of these structures, including the influence of coarse woody debris. Therefore the distance between the steel elements can be adjusted to show their ability to filter sediment. The physical scale of the experiments is 1:30. All experimental runs are Froude scaled. Both dams are tested in elongated and pear-shaped sediment retention basins in order to investigate the shape effect of the deposition area. Both different geometries are shown in figure 7. The inclination of the basin is 5 %.

Figure 6 - Screen-dam with inclined vertical beams and beam-dam with horizontal beams.

Figure 7 - Elongated and pear-shaped deposition basin.

First the hydraulic effect of the structures is investigated by measuring the flow field and the back-water effects of the protection measures; then driftwood is added to show the influence of log jams on the hydraulic properties of the different structures.

Experiments with fluvial bedload transport are made for a systematic comparison of the two check dams. First a typical hydrograph for an extreme flood (HQ_{150}) with unlimited sediment supply is modelled. Therefore a typical torrential sediment mixture with a wide grain-size distribution is used. The sediment is fed by a conveyor belt according the transport capacity of the upstream reach. A total sediment volume of 1.05 m^3 is needed for each run. Then the deposition is scanned with a 2-D laser-scan device mounted on a rail above the basin, in order to analyze the deposition pattern and the deposited volume. Afterwards a flood with a lower reoccurrence period (HQ_5) without sediment transport from upstream is modelled to investigate the ability of the protection structure for self-emptying. Then the basin is scanned again to quantify the volume change in the deposition basin.

Experiments with logs are made to investigate the influence of driftwood on the deposition behavior. The hydro- and sedigraphs are the same as described above, but different log diameters and lengths are added upstream the basin. After scanning the surface the driftwood is removed carefully to model the cleaning of a log jam. An example of a log jam can be seen in figure 8. Then the more frequent flood without sediment and wood from upstream is modelled to show the self-emptying behavior of the basins.

Figure 8 – Example of a log jams caused by the added driftwood for both types of dams.

Particle-size distribution and characterization: the Venosta valley (NE Italy) study case

Sediment and large wood management in mountain watersheds, headwater systems and river basins must be based on the analysis and assessment of sediment regime-fluxes-dynamics at different spatial and temporal scale, as well as the interactions with existing and planned man-made structures. The activities of SedAlp work-package 7 (WP7) focuses on the integration of methodological approaches across scales and will provide guidelines for policy development in the context of sediment and large wood management.

During the last 24 months all the project partners started and developed important studies that permit to better define these management approaches. One of the most important key factors, looking at the sediment management, is the particle size characterization of the surface and subsurface sediment, that permit to better consider and analyze the sediment dynamics.

A particle-size characterization of surfaces and sub-surfaces sediment, in the Adige River (NE Italy) and in the main tributaries in the Venosta Valley in 12 different locations, within the main river network, were carried out by Autonomous Province of Bolzano. The goal has been achieved by sampling sediment in several river reaches as shown in figure 9 (yellow numerated circles).

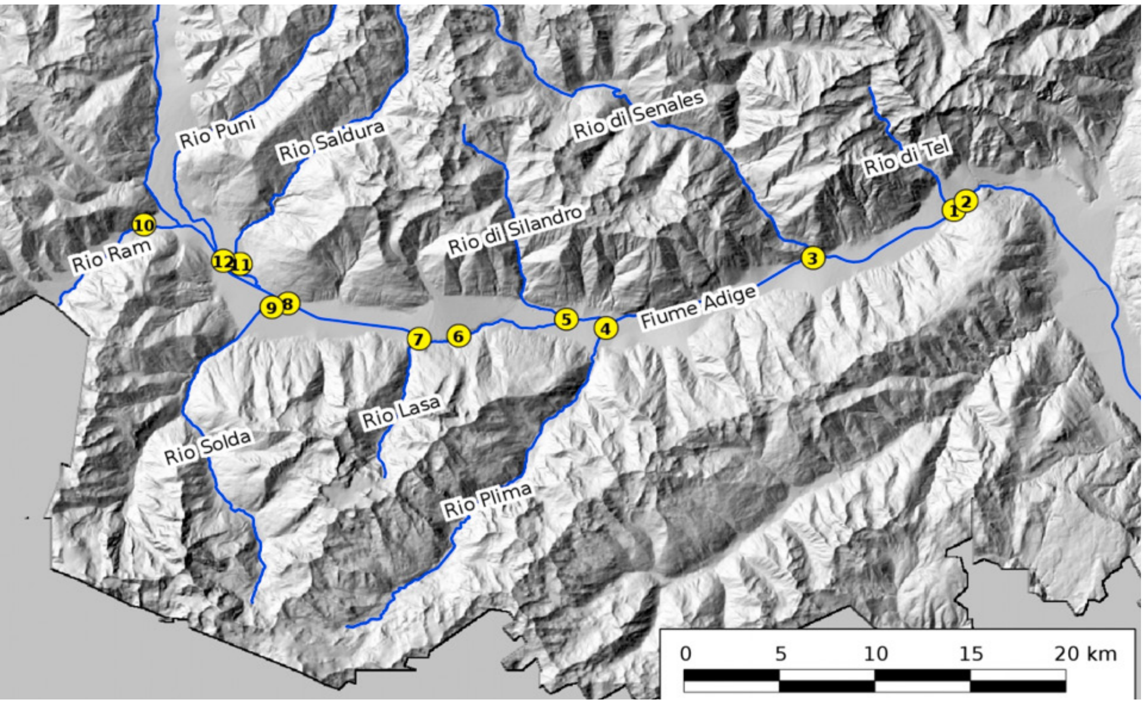


Figure 9 – Sampling locations in Venosta Valley (NE Italy).

The 12 sampling points have been chosen considering the local flow conditions, in order to guarantee the safety operators and results reliability.

Surface sampling has been performed by applying the "pebble count method", counting sediments along several transects and analyzing the collected data. The "pebble count method" consists in sampling particles in a wide and approximately even-spaced increments of at least the size of the bigger sediments. The sampling area covers large stream reach, in order to collect a large number of cobbles. The sampled particles sizes, are comparable with particle sizes obtained from the volumetric samples (sediment extraction in a defined vertical transect). The total number of counted particles is large enough to obtain reliable sediment particle size characterization (n>400). Cobbles, have been collected by moving along transect, by moving upstream or downstream the creek. The length of the measured reach has been chosen at the beginning of the measure as 7-10 times the channel width.

The sub-surface sediments have been sampled adopting the "volumetric sampling method" followed by lab measurements. Data have been analyzed by simple statistical methods: the mean value and the standard deviation are evaluated starting from the raw collected data, in term of diameters classes (Wentworth scale). Cumulative passing percentage evaluation allows for the estimation of specific percentiles diameters: D_{16}, D_{50}, D_{84}, D_{90} and D_{95}. Finally the best fit distribution (Log-normal) has been estimated using the method of moments.

WIKIAlps
A WIKI for capitalising on spatial-development projects

WIKIAlps is an Alpine Space Programme (ASP) project that aims to capitalise on selected projects on spatial development issues carried out in the Alpine Space Programming period 2007-2013, concentrating on projects in the two thematic fields of "Inclusive growth" and "Resource efficiency and ecosystem management". The overall aim of the WIKIAlps project is to facilitate a balanced and shared territorial development in the Alpine Space by overcoming national borders.
The results of former Alpine Space projects, dealing with spatial-development issues, provide innovative solutions for existing challenges in spatial development in the Alpine Space. In order to increase the visibility of these results, the WIKIAlps project approaches their capitalisation from three different perspectives:

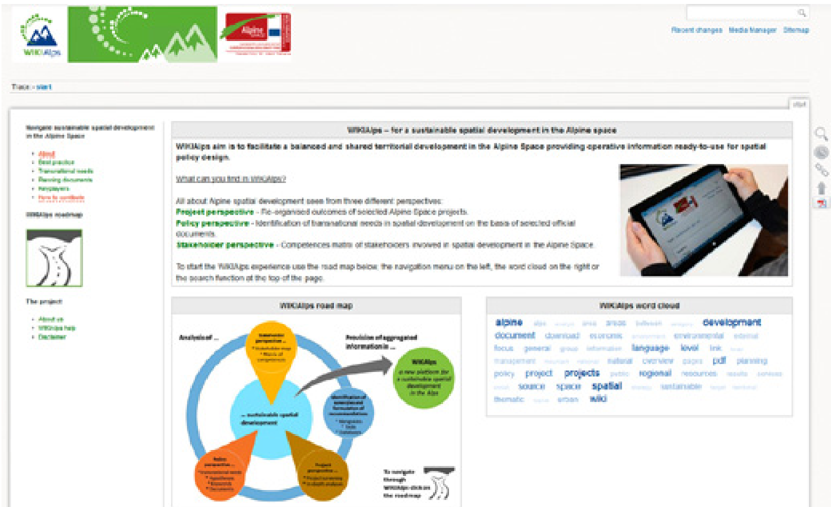
- From the project-level perspective, by screening all the 28 projects in the two thematic fields being followed by an in-depth analysis of at least eight selected projects.

- From the policy-level perspective analysing transnational, national and regional spatial planning documents, in order to identify transnational needs.
- From the stakeholder-level perspective, by mapping the active and identifying the missing stakeholders in the sphere of spatial development in the Alpine Space in a matrix of competences.

The main expected results of the project are:

- A "wiki" that reorganises the outcomes of selected projects, provides easy-to-use informations for spatial policy design and serves as a discussion platform on spatial development.
- Miniguides to include project findings immediately and practically in spatial development.
- And finally practical recommendations about the methodology used and how to integrate transnational issues in spatial policy planning.

WIKIAlps, the project's wiki, is accessible at **www.wikialps.eu** providing already a fair amount of informations, such as the screening of the SedAlp project. The wiki development is an ongoing process, built upon the contributions of many motivated authors, so please feel free to register an account and share your knowledge!
More information on the project is available at **www.wikialps-project.eu** and project partners can be contacted at info@wikialps.eu.



For more informations about SedAlp project and partnership please visit the SedAlp website www.sedalp.eu
and the Facebook page!

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Austria

- Bundesministerium für Land und Forstwirtschaft, Umwelt und Wasserwirtschaft (Lead partner)
- Amt der Tiroler Landesregierung
- Amt der Kärntner Landesregierung
- Universität für Bodenkultur Wien (BOKU)

France

- Centre National de la Recherche Scientifique (CNRS)
- Institut national de recherche en sciences et technologies pour l'environnement et l'agriculture (Irstea)

Germany

- Bayerisches Landesamt für Umwelt (LfU)

Italy

- Agenzia Regionale per la Prevenzione e Protezione Ambientale del Veneto
- Consiglio Nazionale delle Ricerche (CNR – IRPI)
- Provincia Autonoma di Bolzano/Autonome Provinz Bozen
- Regione Piemonte
- Università di Padova

Slovenia

- Inštituit za vode Republike Slovenije
- Univerza v Ljubljani

Project observers

- Agence de l'Eau Rhône-Méditerranée-Corse
- Agenzia Regionale per la Protezione dell'Ambiente della Valle d'Aosta
- Austrian Hydro Power
- Autorità di bacino del fiume Po
- Autorità di bacino del fiume Adige
- Bundesamt für Umwelt (BAFU)
- Enel Produzione SpA
- Enel Produzione SpA – UBI Hydro Piemonte
- Enel Green Power SpA
- Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft (WSL)
- Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA)
- Maira SpA
- Municipality of Kamnik
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- Ricerca sul Sistema Energetico
- SEL AG/SpA
- Stand Montafon
- Verbund - Austria Hydro Power
- Vorarlberger Illwerke AG

SedAlp – **Sed**iment management in **Alp**ine basins:
integrating sediment continuum, risk mitigation and hydropower

The project is co-funded by the European Regional Development Fund

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