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Permafrost Map of the Eastern Ticino Alps

Scapozza Cristian*, Mari Stefano**, Valenti Giorgio***, Strozzi Tazio****, Gex Pierre*****, Fontana Georgia*, Müller Guy*, Lambiel Christophe*, Delaloye Reynald** & Reynard Emmanuel*

*Institut de Géographie, Université de Lausanne, Anthropole, CH-1015 Lausanne (Cristian.Scapozza@unil.ch)
**Département des Géosciences, Géographie, Université de Fribourg, Chemin du Musée 4, CH-1700 Fribourg
***Sezione Forestale Cantonale, Viale Franscini 17, CH-6500 Bellinzona
****GAMMA Remote Sensing, Worbstrasse 225, CH-3073 Gümlingen
*****Institut de Géophysique, Université de Lausanne, Amphipôle, CH-1015 Lausanne

The permafrost distribution and characteristics in the Southern Swiss Alps are poorly known because of lack of research dedicated to this morphoclimatic context of the Alps during the last decades. In spite of the interest for the cryosphere reactions to climate warming, only few scientific studies were carried out until now in the periglacial belt of the Ticino Alps. Within the framework of geomorphological and geophysical investigations on the Lateglacial and Holocene glacier/permafrost evolution in the Southern Swiss Alps (see Scapozza & Reynard 2007; Scapozza 2008; Scapozza et al. 2008), a regional model based on an inventory of 75 rockglaciers was developed to simulate the permafrost distribution in the Eastern Alps of the Canton Ticino (Fig. 1). The model used is based on the assumption that the permafrost distribution at the regional scale depends mainly on altitude and orientation (topoclimatic parameters) and that the minimal altitude of active/inactive rockglaciers can be used as an indicator of the lower limit of discontinuous permafrost. The model was calibrated by thermal and geophysical prospecting, in order to asses the permafrost distribution at the local scale. Moreover, several sites were equipped for long-term studies. At the moment, in the Eastern Ticino Alps (Fig. 1), the followings studies are carried out:

- Geomorphological mapping and geophysical prospecting and monitoring in the Sceru Valley. The geophysical prospecting was carried out with frequency-domain electromagnetic lateral mapping and 2D resistivity profiling (Geonics EM-16R and EM-31), direct-current (DC) resistivity soundings, self-potential measurements, and thermal prospecting (miniature ground temperature data loggers and spring temperatures) (Scapozza 2008; Scapozza et al. 2008). On the Piancabella rockglacier and on the Gana Rossa talus slope, a ground- surface temperature and self-potential monitoring network was set up.
- Geomorphological mapping, direct-current (DC) resistivity soundings, ground-surface temperatures and real-time kinematic (RTK) GPS monitoring for studying the dynamics of creeping permafrost in the Northern side of the Cima di Gana Bianca, particularly on the Stabbio di Largario rockglacier (Valenti 2006; Müller, in prep.).
- ERS InSAR (space-borne synthetic aperture radar interferometry) signatures inventory to estimate both magnitude and spatial pattern of slope motion in the periglacial belt of the Ticino Alps, in particular in the Gothard region and in the Blenio Valley.

In the next years, the study and the equipment of others sites for permafrost research and monitoring is planned in the Val Bedretto region and in the Greina region. The goal is to better known the cryosphere reaction to recent climate warming in order to assess and quantify the processes related with permafrost degradation in high mountain environments.

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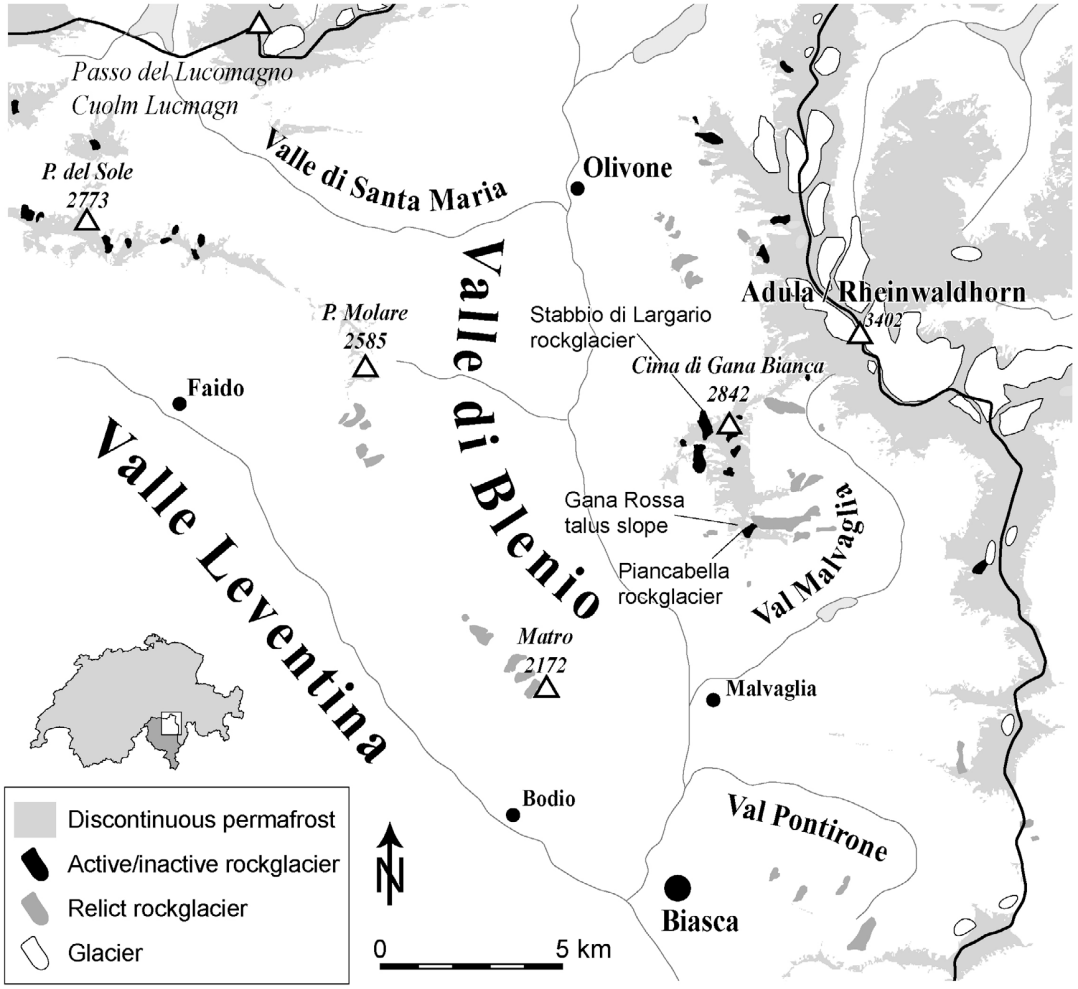

Figure 1. Permafrost and rockglaciers distribution in the Eastern Ticino Alps.

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Conceptualising sediment cascades to enhance dynamic geomorphological mapping

Theler David*, Bardou Eric**, Reynard Emmanuel*

*Institut de Géographie, Université de Lausanne, Quartier Dorigny, CH-1015 Lausanne (david.theler@unil.ch)
**Bureau IDEALP Ingénieurs Sàrl, Rue de la Marjorie 8, CH-1950 Sion

Research focusing on geomorphological mapping often concerns the establishment of landforms inventories at large scales. The main disadvantage of the maps produced is their static character. In fact, available geomorphological legend systems are not always sufficient for mapping alpine environments with high geomorphological activity. A good example is illustrated by torrential systems where dynamic processes like channelised debris flows occur and where landforms associated to these processes may change very fast in time and space scales. Assessing sediment volumes that supply debris flow channels is one of the key parameters to mitigate disasters on places geomorphologically concerned by fluvial processes (Zimmermann et al. 1997). Data derived through GIS spatial analysis based on high accuracy digital elevation models (slopes, aspect, hydrographic network and delineation of subwatersheds) might be of high interest for mapping dynamic geomorphological processes as shown by an attempt done for Bruchi torrential system in the Swiss Alps (Theler et al. in press). This paper proposes to use GIS tools coupled with a qualitative conceptualisation of the system, what should open new opportunities for geomorphological mapping. An example is presented for a torrential system in the Swiss Alps.

The different parts of the system are conceptualised in order to depict the sediment transfers on a mountain flank (Fig. 1,