SCHWEIZERISCHE GEOMORPHOLOGISCHE GESELLSCHAFT

SOCIETE SUISSE DE GEOMORPHOLOGIE

Excursion of the young geomorphologists (SGmS)

Ticino, a multi-disciplinary excursion

6-8 September 2019

The excursion took place in the Basodino area, located in the Valle Bavona, in the upper part of the Canton Ticino. This area is important for the hydroelectric energy production. Indeed many dams, connected between each other are located in the catchments and transport the water downward to the Lake Maggiore.

The excursion started on the 6th of September: we had dinner and spent the night at the hotel Albergo Posta in Bignasco. On the 7th of September, we moved to the CAS Capanna Basodino (1856 m a.s.l.) to start the excursion following the Glaciological Trail of the Basodino. This trail allows observing the main characteristics of the Basodino glacier and discover its evolution (Fig. 1).

The Basodino glacier takes its name from the Basodino pick (3272 m a.s.l.). In 2008, because of the glacial retreat, the glacier was divided in two parts: the Basodino glacier in the southern part and the Cavergno glacier to the north. The Basodino glacier has a small accumulation zone without a glacier tongue, it is temperate (temperature around 0°C, with water presence) and presents few steep portions, with crevasses but without seracs.

It is possible to reconstruct the past climate until 10.000-12.000 ybp because the earlier traces have been deleted from the last glaciation (Dryas). After the Dryas glacier retreat, the humus started to form in the areas external to the main moraines. In the internal part, the glacier had about ten fluctuations.

During the Holocene Optimum (4000-5000 ybc), a very long and intense warm stage, the glacier was probably smaller than nowadays and the lower limit reached an elevation of 3000 m a.s.l.

After the end of the Little Ice Age (1850), when it had the last maximal extension, the glacier started to retreat and vegetation and animals started to colonize the area inside the LIA moraines. During two stages (1915-1939 and 1965-1985), the glacier had some advances that formed new moraines in the Cavergno glacier forefield. These moraines are not visible in the Basodino part because of the minor material availability and due to the greater debris dispersion along the slope.
After the LIA, the air temperature increased by 2°C, especially after the 80s. The cause is mainly connected to the human impact. The actual climate is of alpine type, with long snow cover (from November to June) and short summer. Precipitation is abundant (2200 mm/y) because of humid air masses coming from south, west and north.

The glacier retreat is monitored through the measurement of the front position and the evaluation of the mass balance (winter snow cover and summer melting). Since the end of the LIA the glacier had a retreat of 1400 m and a total loss in volume of 75 % (0.167 $km^{3.}$ in 1850, 0.072 km^3 in 1973 and 0.040 km^3 in 2010).
From 1990 to 2010, the equilibrium line moved from 2800 to 3000 m a.s.l. With a mean thickness of 21 m, the glacier is destined to fragment in small portions in the next twenty years.

From a geological point of view, the Basodino region is on the northern part of the Lepontine Dome on the boundary between three nappes: Antigorio, Lebendun and Maggia, composed of gneiss, granitic gneiss, pretriassic schists and paragneiss. The area includes also metasedimentary rocks (metaconglomerates, calcschists and marbles).

Following the Glaciological Trail, we crossed a karstic area, characterized by marbles subjected to chemical erosion because of the carbon dioxide present in the water. In this area, we observed small valleys with steep slopes, asymmetric sinkholes and karren-lapiés (Valle di Caralina). The best example of karstic process we could observe is the Acqua del Pavone cave, where the waters flowing down from the Cavergno glacier disappear (Fig. 2).

Gone back to the CAS Capanna Basodino, we spent the night with delicious Ticino meals.

On the 8th of September, because of the bad weather, we stayed around the Lago Bianco (Fig. 3), describing the activities carried out by the SUPSI in the area of the Lago Nero (Fig. 4). Here, hydrological and permafrost researches are led inside the International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems. The overall aim of integrated monitoring is to determine and predict the state and change of terrestrial and freshwater ecosystems in a long-term perspective with respect to the impact of air pollutants, especially nitrogen and sulphur. This monitoring refers to the simultaneous measurement of physical, chemical and biological properties of an ecosystem over time and across compartments at the same location.

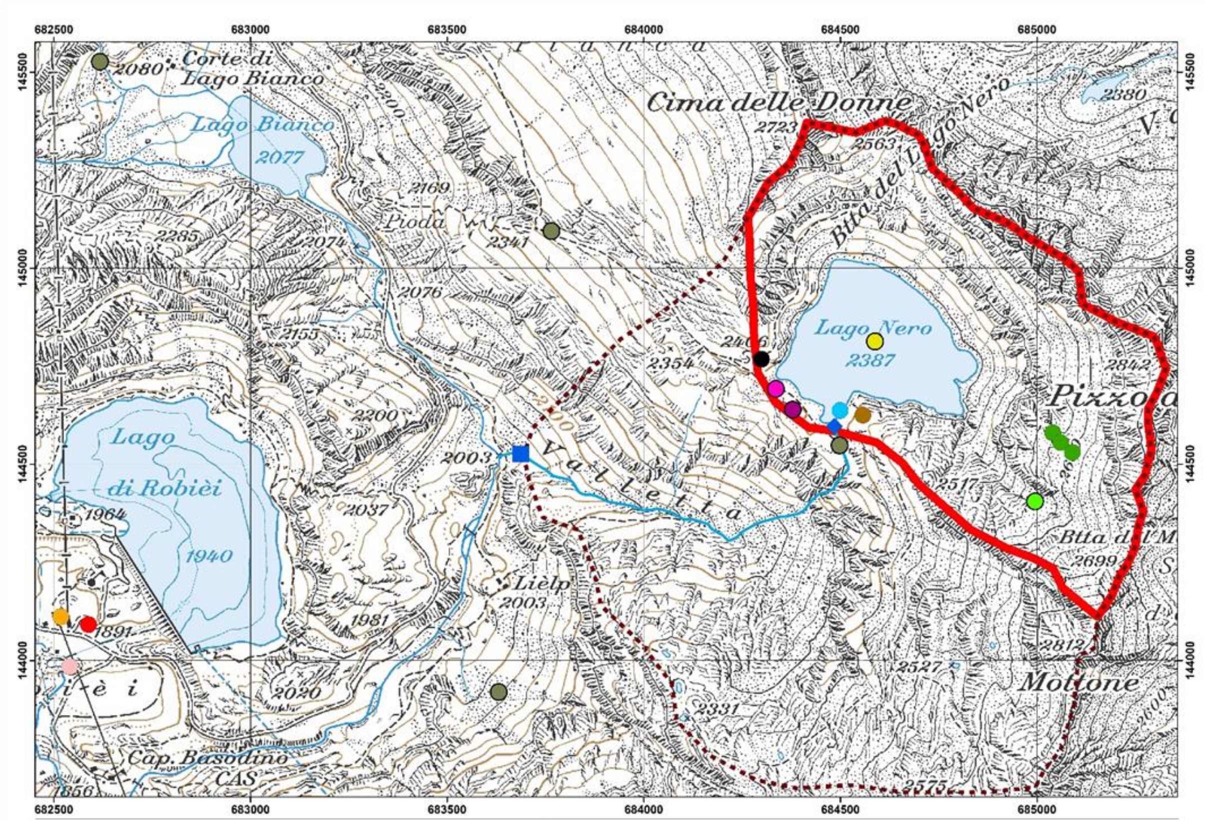
The Lago Nero is located in the northern part of the Val Bavona and it is an oligotrophic, soft-water lake. Thanks to its remote localization, that minimizes direct anthropogenic impacts as well as its ecosystem sensitivity to atmospheric temperature rise and atmospheric pollutants. Water samples were collected manually or using am auto-sampler to increase sampling frequency during the snowmelt period and concentrations of key chemical parameters have been measured since 2014.

In the southeastern part of the catchment of the Lago Nero there is a rock glacier with the front reaching 2560 m a.s.l. Here the mean annual air and the ground surface temperatures have been recorded since 2015. Furthermore, chemical analysis of the water coming from the rock glacier are performed with the aim to compare the data with the water analysis of the Lago Nero. The results show that the rock glacier outflow includes higher amounts of ammonia and sulphate compared to the water of the Lago Nero. This could be connected to the prolonged contact between ground ice in the rock glacier and rock debris, allowing the ionic enrichment of water, and to the enhanced melting of ground ice, related to the recent severe warming, that is nowadays releasing "legacy" pollutants that have been stored in the cryosphere for several decades.

Fig. 1. Lago del Zözz and Basodino Glacier.

Fig. 2. Karstic cave Acqua del Pavone and river flowing down.

Fig. 3. Lago Bianco and dam of Lago dei Cavagnöö.



Monitoring points

- Riale Lago Nero - Station and water sampling
- Riale Valletta - Station and water sampling
- Lake level measurement
- Soil chemistry / Soil temperature measurement
- Air temperature measurement + vegetation
- Microbial parameters
- Pelagic parameters
- Robiei meteorological station
- NO2 Passive sampler
- Wet deposition sampling point
- Rock glacier spring temperature measurement
- Rock glacier surface temperature measurement
- Summer precipitation sampling
- Time lapse photo camera

Fig. 4. Map of the catchment of Lago Nero. In red the Lago Nero catchment, in dotted red the extended catchment.