CIVIL AND ENVIRONMENTAL ENGINEERING

DIATI - Monitoring of the Alpine environment and glaciers with geomatic techniques

Funded By	Dipartimento DIATI
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Context of the research activity	Alpine mountainous and cryosphere are key elements for the future. Climate change will impact Alpine environments more than the other areas, leading to a more frequent occurrence of natural hazards and the evidence of the vulnerability to extreme events and their monitoring will be increasingly crucial. Their complex systems need different and integrated techniques of measurement, different arising problems such as the difficulty in accessing with the classical methods and the large areas to cover.
Objectives	Integrated measurement techniques will be increasingly important will be increasingly important in environmental monitoring and the prevention of climate change risks, especially in the next future. The use of visible images and photogrammetric techniques is what we usually use applied to the alpine cryosphere, but the cloud coverage and the necessity to monitor the movements led to the use of active sensors. Synthetic Aperture Radar (SAR) technology has been increasingly utilized for glacier monitoring due to its ability to penetrate clouds and operate in all weather conditions, providing high-resolution images of the Earth's surface. The SAR satellites, for example the European Space Agency's Sentinel-1, provide high-resolution images for monitoring the glacier dynamics and this technology has been increasingly utilized for glacier monitoring due to its ability to penetrate clouds and operate in all weather conditions. Hence, the multifrequency SAR data can be used going towards monitor the snow parameters (e.g. snow liquid water content) thanks to the response of soil and snow to the microwave response. Moreover, the Interferometric Synthetic Aperture Radar (InSAR) allow the measurement of the displacement of surface deformation with millimetric precision so it can be used for risk prevention in mountainous areas, detect crevasses under snow bridge and glacier dynamics. Therefore, the deformation detected from the SAR can be useful for monitoring landslides and subsidence and other geological hazards. In the cryosphere applications the response of microwave energy is usually backscattered due to many factors such as penetration depth, presence of liquid water, surface roughness, slope and geometry (incident and azimuth angles). Segmentation and interpretation data is still under development and are quite complex. An integrated approach in Earth Observation (EO) between passive and active sensors for environmental monitoring especially to deal with the climate

	change hazards. Combining satellite and ground observations together with physical based and data driven models, to monitor the environment developing a new approach, and focusing on mountainous areas analyzing the dynamics of the processes. Moreover, deepen and understand if the classification algorithms are usable both on cryosphere and landslides and how to tackle the unsolved issued, such as speckle noise problems without reducing the special resolution, is still somet into research. As far as ground observations are concerned, test the use of low-cost GNSS instruments that can recently take advantage of the new signals from the Galileo constellation and the recent evolution of Precise Point Positioning. To complement ground monitoring, GNSS-engineered control units and cameras could be the ground systems to be tested and also brought to the field, with low power consumption. Climate change will impact Alpine environments more than the other areas, leading to a more frequent occurrence of natural hazards and the evidence of the vulnerability to extreme events and their monitoring will be increasingly crucial.

Skills and competencies for the development of the activity	Expertise from various Geomatics disciplines : knowledge of GNSS, photogrammetry, GIS, remote sensing, and related data processing. Experience on field measurement activities and ability to move in alpine terrain. Speak and write correct English; good written and oral communication skills; strong motivation and independence.