



## **Drones application on snow and ice surveys in alpine areas**

Leonardo La Rocca (1), Luigi Bonetti (2), Matteo Fioletti (2), and Giovanni Peretti (2)

(1) Lombardy Region - civil protection, (2) ARPA Lombardia - Regional agency for environment protection of Lombardy

First results from Climate change are now clear in Europe, and in Italy in particular, with the natural disasters that damaged irreparably the territory and the habitat due to extreme meteorological events.

The Directive 2007/60/EC highlight that an “effective natural hazards prevention and mitigation that requires coordination between Member States above all on natural hazards prevention” is necessary.

A climate change adaptation strategy is identified on the basis of the guidelines of the European Community program 2007-2013. Following the directives provided in the financial instrument for civil protection "Union Civil Protection Mechanism" under Decision No. 1313/2013 / EU of the European Parliament and Council, a cross-cutting approach that takes into account a large number of implementation tools of EU policies is proposed as climate change adaptation strategy.

In last 7 years a network of trans-Alpine area's authorities was created between Italy and Switzerland to define an adaptive strategy on climate change effects on natural environment based on non structural remedies.

The Interreg IT – CH STRADA Project (STRategie di ADattamento al cambiamento climatico) was born to join all the non structural remedies to climate change effects caused by snow and avalanches, on mountain sources, extreme hydrological events and to manage all transnational hydrological resources, involving all stakeholders from Italy and Switzerland.

The STRADA project involved all civil protection authorities and all research centers in charge of snow, hydrology and civil protection. The Snow - meteorological center of the Regional Agency for Environment Protection (CNM of ARPA Lombardia) and the Civil Protection of Lombardy Region created a research team to develop tools for avalanche prediction and to observe and predict snow cover on Alpine area.

With this aim a lot of aerial photo using Drone as been performed in unusual landscape. Results of all surveys were really interesting on a scientific point of view.

All flight was performed by remote controlled aero models with high resolution camera. Aero models were able to take off and to ground on snow covered or icy surfaces since the specific aerodynamic configuration and specific engine used to.

All winter surveys were executed flying low to obtain a tridimensional reconstruction of an High resolution Digital Elevation Model (DEM) of snow cover and ice cover and on summer as been developed the DEM were snow amass in the maximum avalanche risk period. The difference between winter and summer DEM (difference between two point clouds) let to individuate the snow depth, and it was used as input data for the snow avalanche model for the Aprica site (Bergamo – Italy).