Slope instabilities occurred at high elevation in the Italian Alps in 2016:

Regional landscape fragility and meteorological situation

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Earth’s 2016 surface temperatures were the warmest since modern recordkeeping began in 1880, according to NASA and NOAA, i.e. the third year in a row to set a new record.

On the whole Northern Italy, the year 2016 was again among the hottest in the last centuries, although less exceptional than the yrs 2014 and 2015: in almost all the long time series (more than 2 centuries) the year is located between the 4th and the 6th place, with average anomalies ranging mostly between +0.7 and +1.5 °C.

[Climatic situation diagram and charts]

[http://www.isac.cnr.it/~climstor/climate/latest_year_TMM_met.html]
Climatic situation

Total annual precipitation was quite in the mean values (-3% for the whole Italy); however, some notable monthly and local anomalies of opposite sign have been registered, such as the droughts of January, late summer and December, which was extraordinary in the North-East, and the floods of the end of November in the North-West.

Monthly precipitation anomalies in 2016 (SMI, 2017)

Torino (NW Italy)

Rovereto (NE Italy)
Spatial distribution of the 2016 natural instability events above 1500 m a.s.l. in the Italian Alps

total: 31 slope instability events
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Spatial distribution of the 2016 natural instability events above 1500 m a.s.l. in the Italian Alps

Italian Alps 2016 (ca. 52.000 km²):

26 Rock/blockfalls

Central Mont Blanc Massif (ca. 330 km²):

44 Rock/blockfalls/yr

(average 2009-2015, from 100 to 45.000 m³), Ravanel et al., 2016
Types of processes

The Piccola Croda Rossa rock-fall/avalanche
August, 19th
2850 m a.s.l.
600,000-700,000 m³

Ice in the rock fractures

Photo: Geological Office of the Bolzano Province
Types of processes

The Sperone della Brenva rockfalls
September, 28-29th
3650 m a.s.l.
10.000-35.000 m³

Ice in the rock fractures

Photo: Catasto Dissesti Regionale SCT – Valle d’Aosta
Types of processes

The Monte Pelmo debris flow
August, 19th
2200 m a.s.l.

Firn in the source area, under debris

Photos: Soccorso Alpino e Speleologico Veneto
Types of processes

The Triolet Glacier ice-avalanche
July, 25th
about 3000 m a.s.l.

Photo: Rifugio Dalmazzi hut keeper
Types of processes

The Grand Croux GLOF
August, 14th
2700 m a.s.l.
50,000-70,000 m$^3$ (source: FMS)

Photo: www.meteogiuliacci.it
A few comments about data mining

- Regional heterogeneity in data collection, filing, distribution
- Focus on inhabited areas and infrastructures
A few comments about data mining

Action CensiCro – «PermaDataRoc» Project

Ravanel et al., EGU 2016 - High morphogenic activity in the permafrost-affected rock walls of the Mont Blanc massif during the 2015 summer heat wave
A few comments about data mining

New tools:

https://cervinia.panomax.com/matterhorn,
11/08/2016 h. 11.20


Hall X5 at board number X5.217. Author in attendance on Wednesday, 26 Apr 2017, 17:30-19:00
Processes distribution on APIM (*PermaNet Project*)
Processes distribution on APIM (PermaNet Project)
Processes distribution on APIM (*PermaNet Project*)
Seasonal distribution of events

Northern Italy 2016

31 slope instabilities, including different process types and rainfall-triggered events

Northern Italy 1997-2013

(Paranunzio et al., 2016)

41 rock-falls/avalanches, not triggered by precipitation
Regional landscape fragility
Conclusions - 1

Despite technological advances and increased awareness of the effects of CC on natural instability, in particular in high-altitude environments and in particular after the hot summer 2003, in Italy the systematic documentation of natural instability events on the whole territory is still not considered a priority.

In 2004 we presented at this same venue geomorphological processes triggered by the hot summer 2003. After almost 15 years, we still don’t have statistically reliable data about the spatial and temporal trends of occurrence of natural instability processes, especially at high altitudes, despite many evidences that these are among the most sensitive areas to climate change.

In this context, scientific institutions still maintain a leading role in documenting environmental changes taking place as a result of climate change, and in maintaining the awareness of the authorities and of the public on these topics.
Conclusions - 2

The analysis of the case studies presented here are in agreement with the findings of previous studies (Paranunzio et al., 2016), and in particular:

- Rock-falls/avalanches are the dominant instability process at high altitude in the Italian Alps;
- Temperature plays a key role for the initiation of slope instabilities;
- The slope instability events concentrate in the NW and NE parts of the chain, while the central Italian Alps show little activity;
- Slope instability events in the NW and NE Alpine sectors have different characteristics of occurrence that may correspond to different processes leading to instability, even if in several cases rainfall is the trigger:
  - in the NE a crucial role may be played, on the one hand, by snow melt, on the other hand by the degradation of a cryosphere which is no longer in balance with the current climatic conditions;
  - in the NW, in addition to snow melt, the dynamics of the active layer of permafrost seems to play a crucial role, jointly with slope changes due to deglaciation.

The study presented here is part of a wider ongoing study focusing on slope instability processes at high altitude in the Italian Alps in the 2000-2016 period (see also Paranunzio et al. at EGU 2017)
Thanks for your attention

For additional information:

geoclimalp.irpi.cnr.it

www.nimbus.it