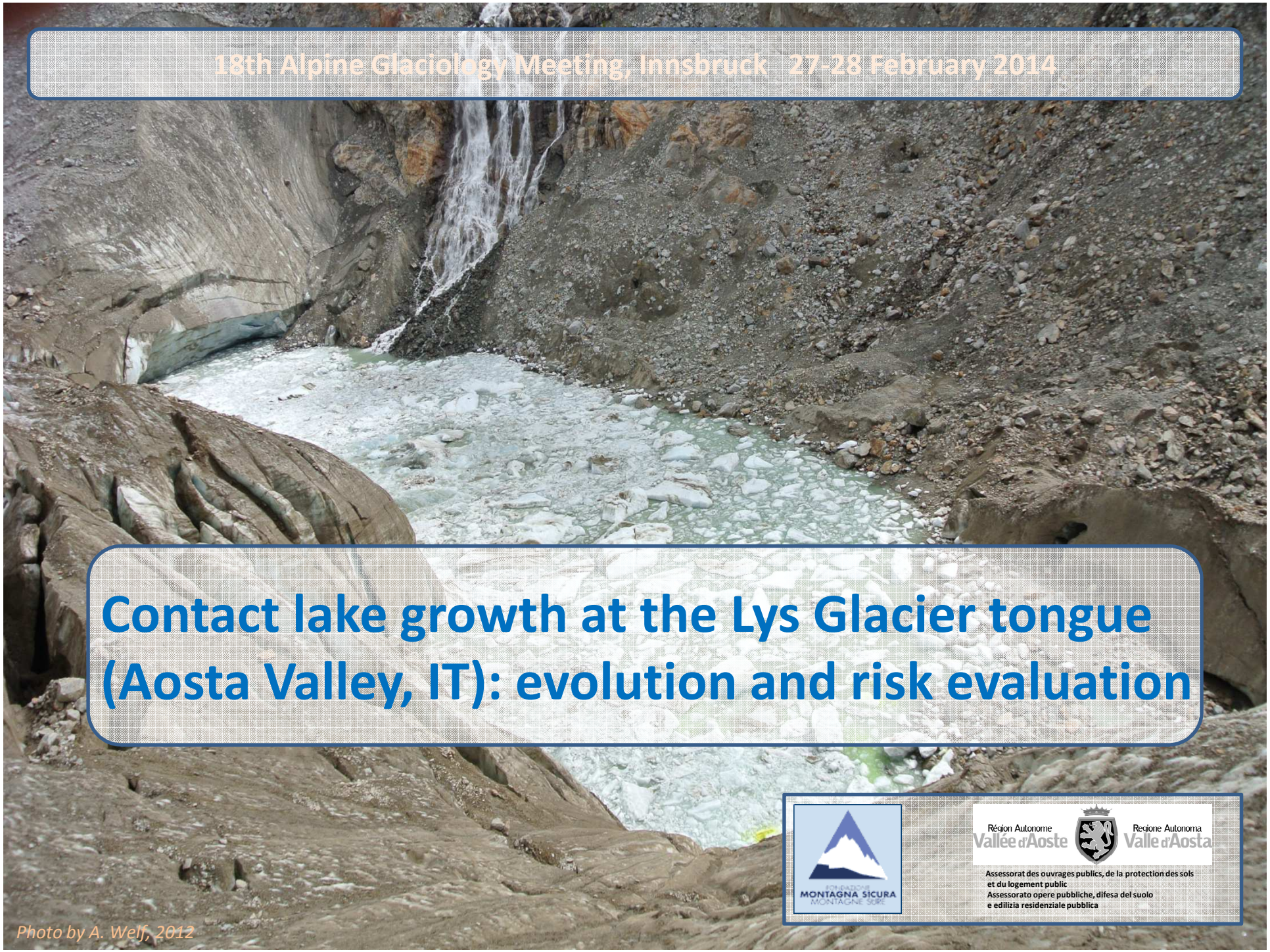

18th Alpine Glaciology Meeting, Innsbruck 27-28 February 2014

Contact lake growth at the Lys Glacier tongue (Aosta Valley, IT): evolution and risk evaluation

FONDAZIONE MONTAGNA SICURA MONTAGNE SÛRE

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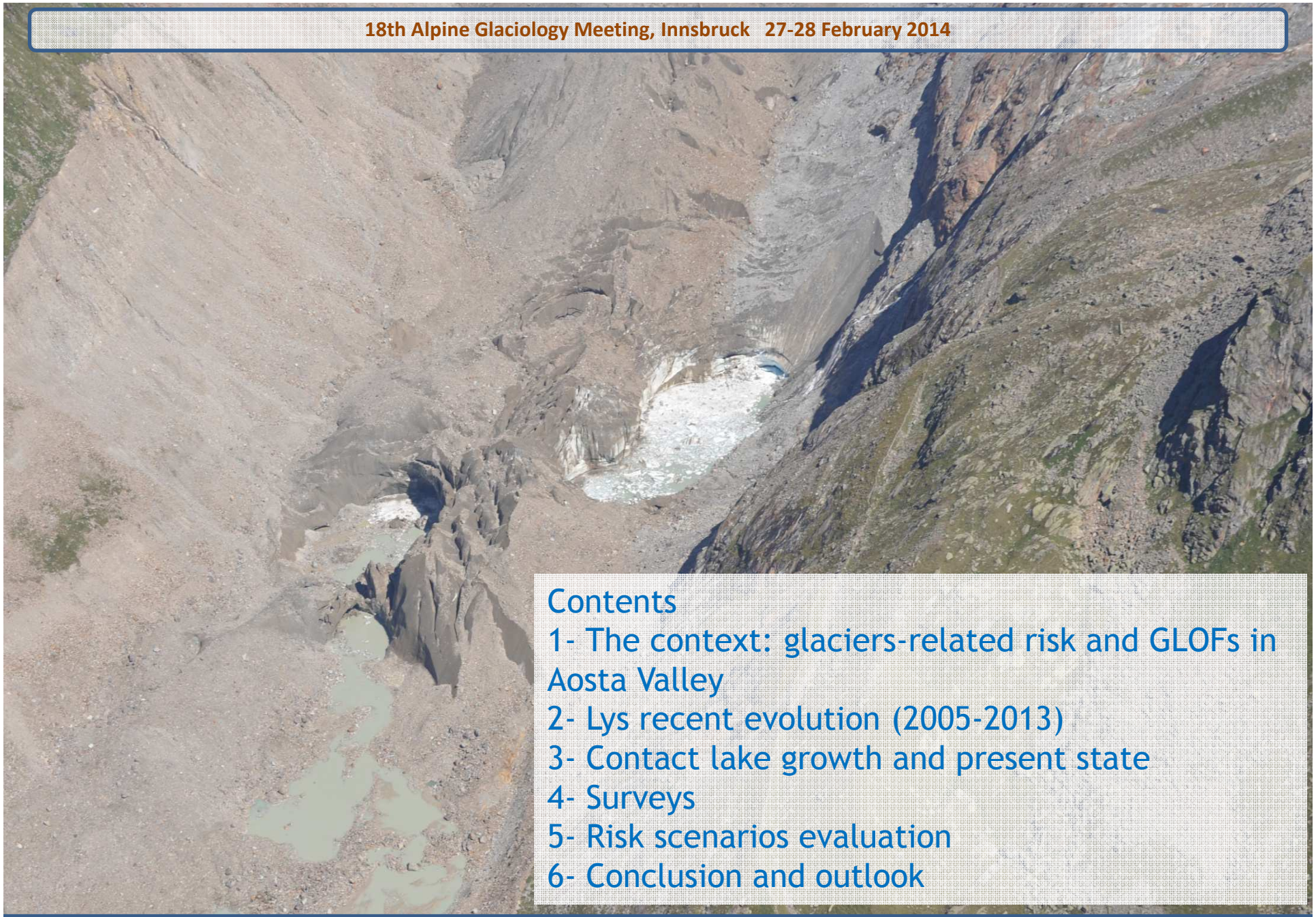
Photo by A. Welf, 2012



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Glaciers hazards

Types

Hanging glaciers icefalls

Glaciers breakdowns

Glacial lakes ouburst floods

1- Context

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Glacial lakes ouburst floods

1- Context

Tête Rousse Glacier, 1892. Cavity resulting from an outburst flood; catastrophic flood propagated downstream and killed 175 people. In 2009-2010 a new growing cavity was detected by means of geophysics and prevention measures were taken to empty the cavity and avoid risk (from C. Vincent, in GlaRiskAlp Alcotra project)

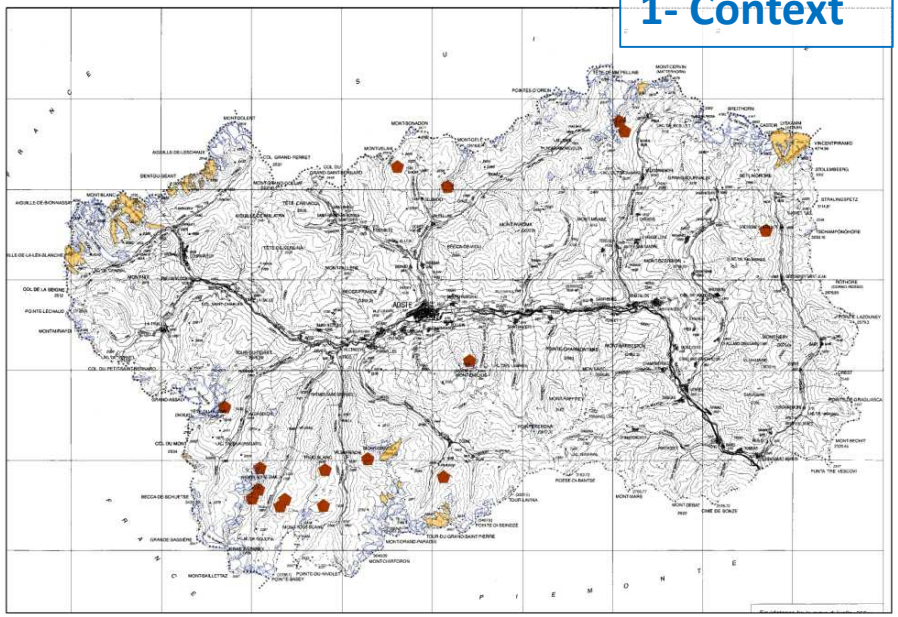
"Lago effimero" Belvedere Glacier (from G. Mortara - CNR-IRPI) 2002

Inner water reservoirs are usually difficult to detect, unless they are known from previous events: forecasting of outburst floods from these cavities is therefore difficult or impossible especially at a regional scale

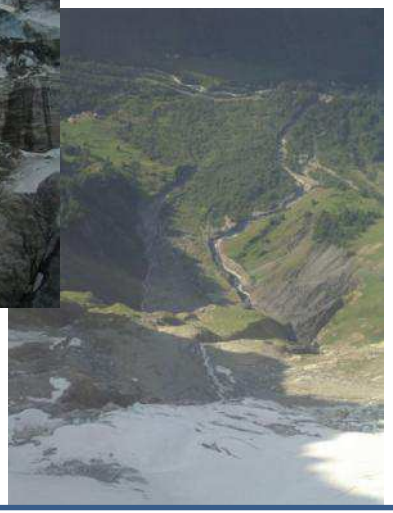
1- Context

Glacial risk in Aost

- About 200 glaciers in a 3200 sq km surface
- several glaciers are nearby inhabited areas (touristic settlements) or infrastructures;
- many basins have snow-glacial water supply – effect of glaciers on flood or debris flow dynamics
- rapid recent glaciers evolution due to climate warming



Glacial risk monitoring plan set up by Fondazione Montagna sicura on behalf of R.A.V.A. Geological service



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1- Context

Glacial risk monitoring plan in Aosta Valley

Basic

-Inventory of glaciers hazards, both on historical and geomorphological data
-Geodatabase storing data and images about glaciers hazard
-Crossing hazard data with vulnerability analysis
-Detailed report for « dangerous » glaciers identified

Updating

-Yearly photographic survey by helicopter, covering all glaciers of the Region
-Qualitative analysis of glaciers evolution by comparing images
-Identification of potentially dangerous glaciers from image analysis
-Update of the inventory
-Monitoring of specific cases

Specific cases

-Grandes Jorasses hanging glaciers;
-Brenva basin hanging glaciers
-Lys glacial lake
-Planpincieux glacier

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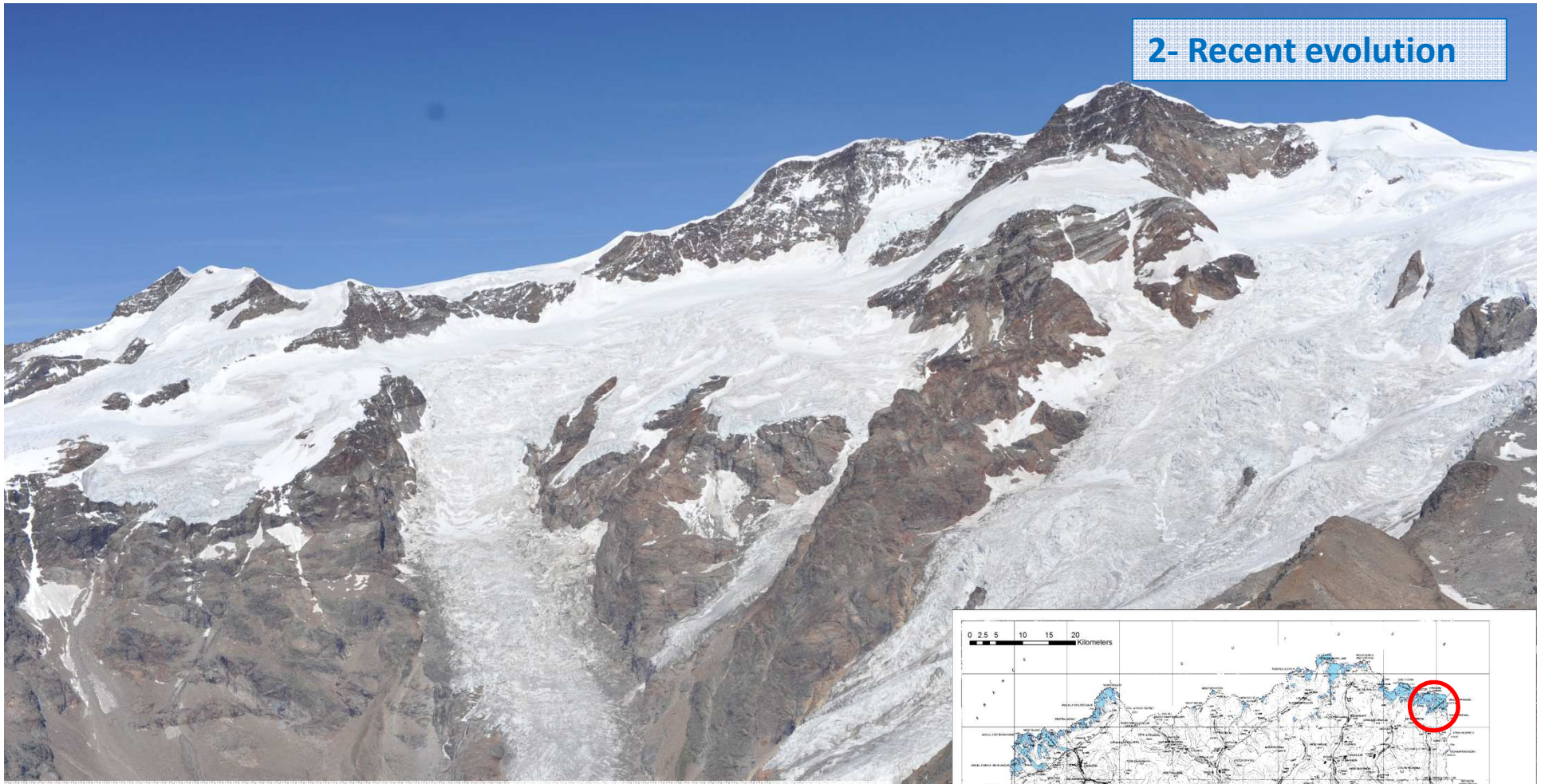
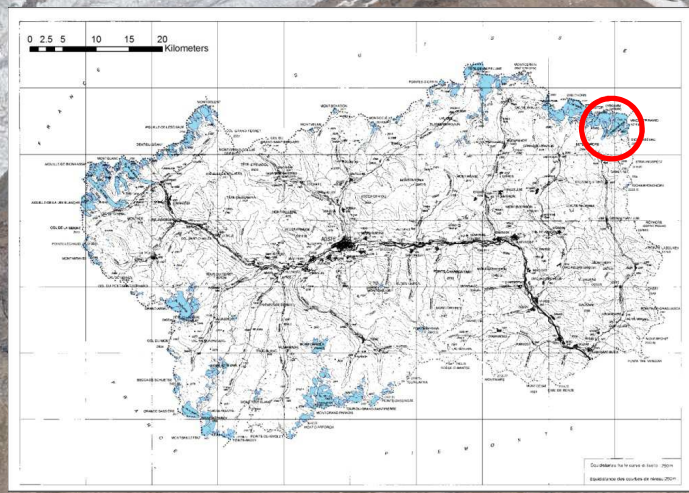
2- Recent evolution





Lys Glacier

- 2nd glacier extent in Aosta Valley (ca. 10 km2)
- Glacier tongue detachment from the upper zone in 2007
- Increasing debris cover and shrinking of the glacier tongue

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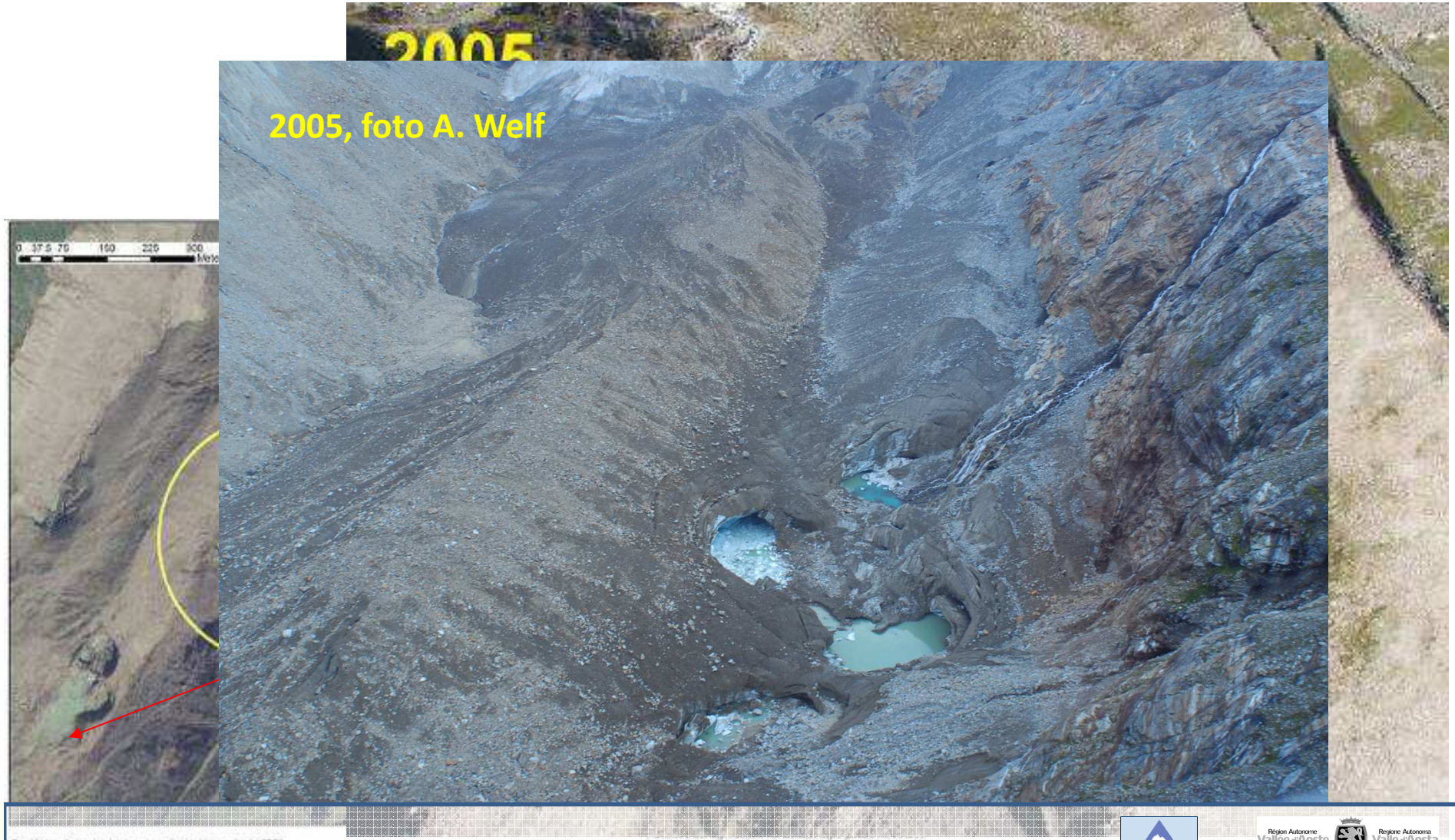
Lys Glacier tongue

2- Recent evolution

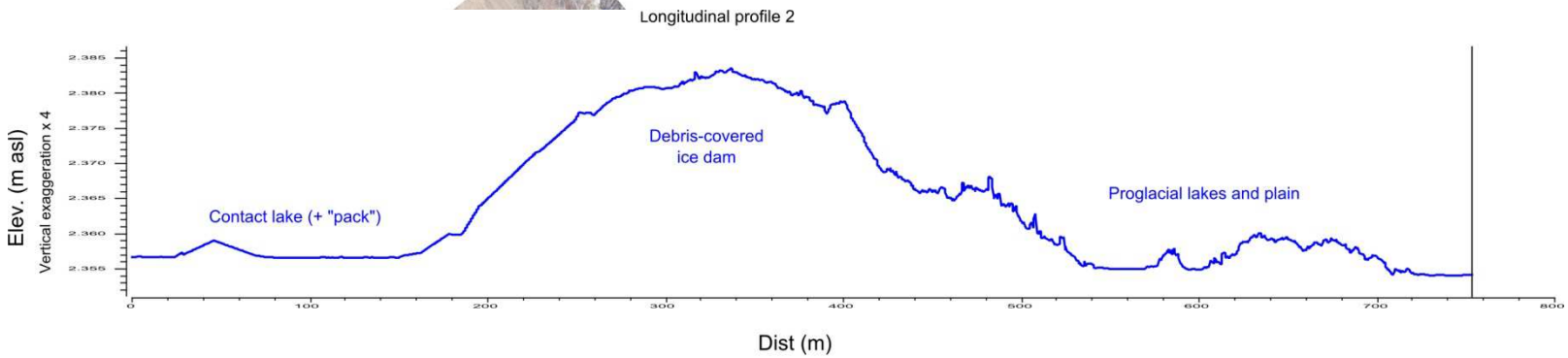
Recent evolution: Collapse cavities growing because of ice melting

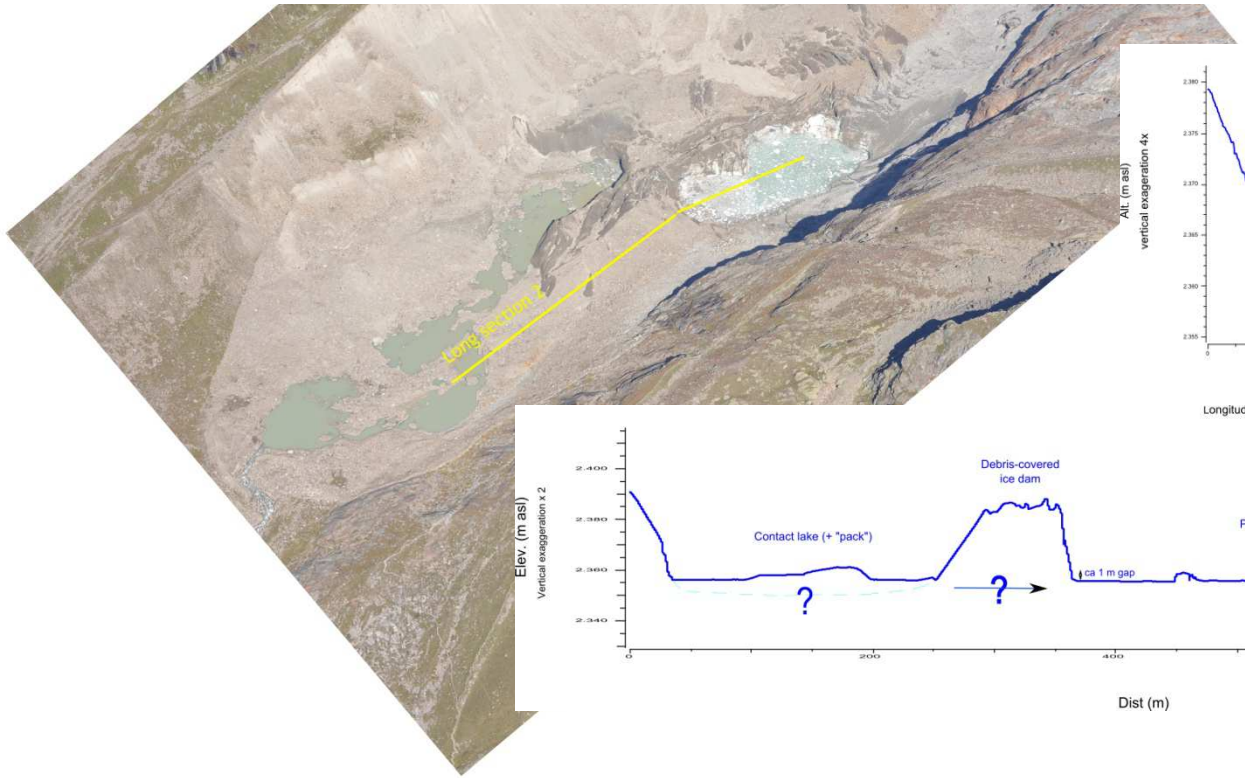


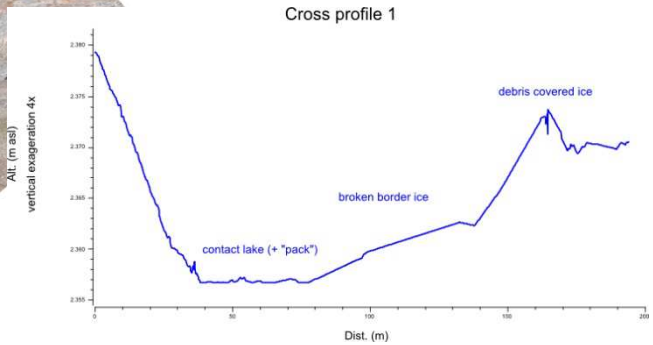
Recent evolution: Collapse cavities growing from ice melting

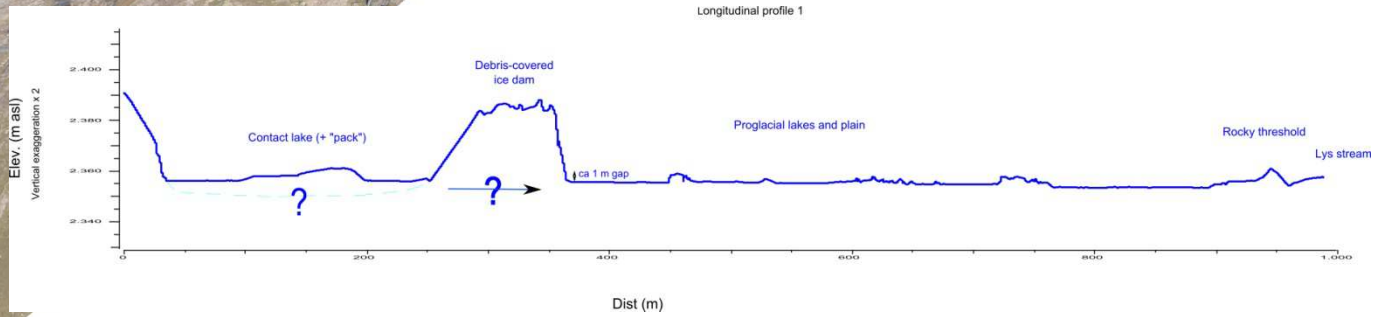
2- Recent evolution

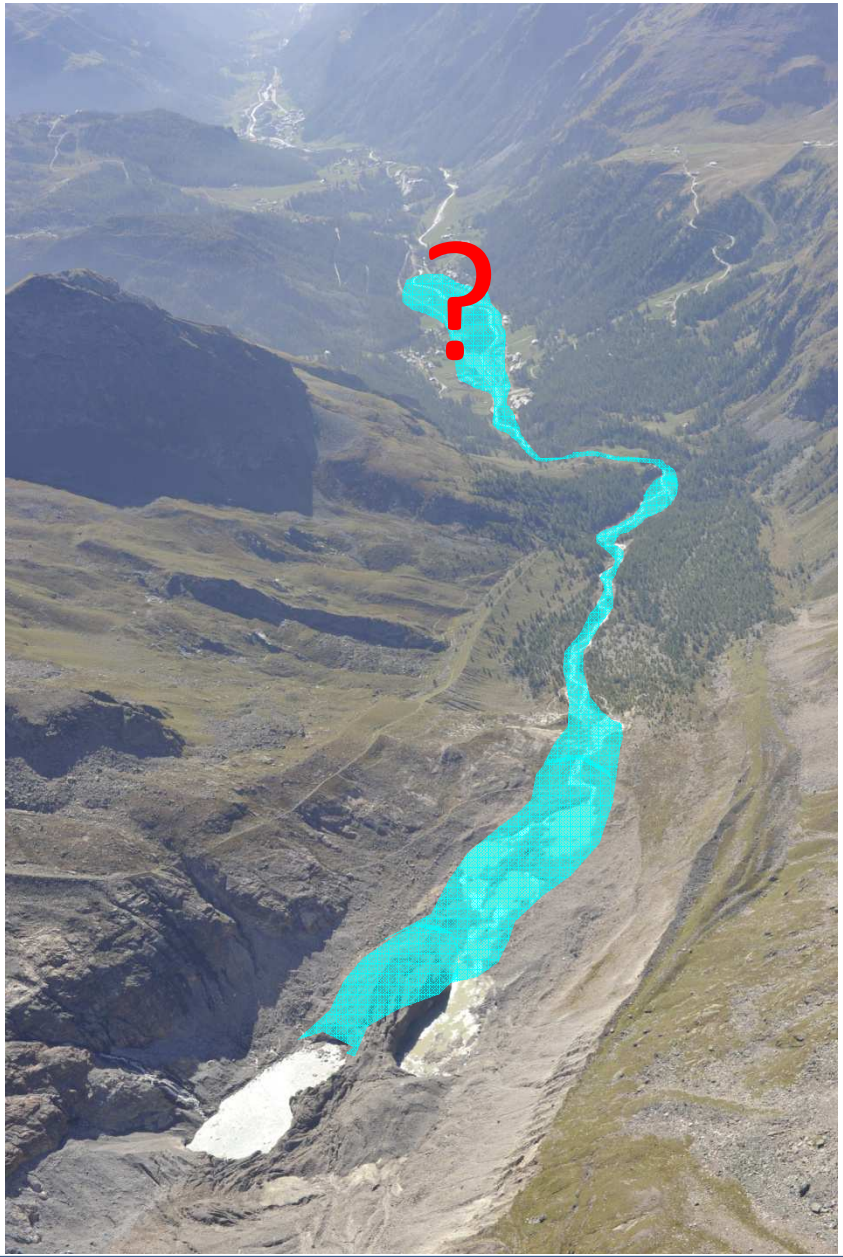
3- Present state











Concern: can this lake generate an ouburst flood and endanger inhabited areas downvalley?

- What water volume can accumulate?
- What volume volume could be released?
- Is a “dam break” outburst possible?

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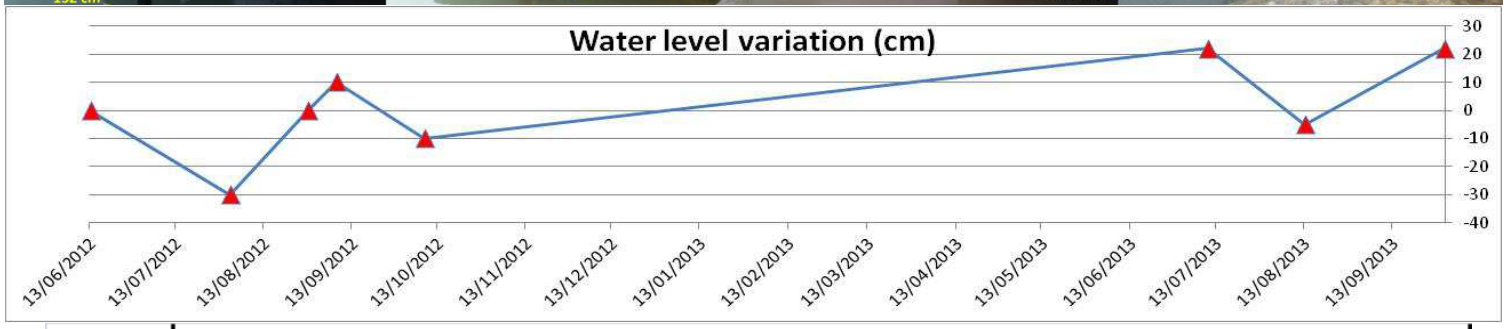
Water level measurement

4- Surveys



	Date/emerging from water level (cm)							
Stake	13/06/2012	01/08/2012	28/08/2012	07/09/2012	08/10/2012	10/07/2013	13/08/2013	01/10/2013
1	100	130						
2	115	> 130	> 130	120	> 130	120	-	
3					132	110	115	137

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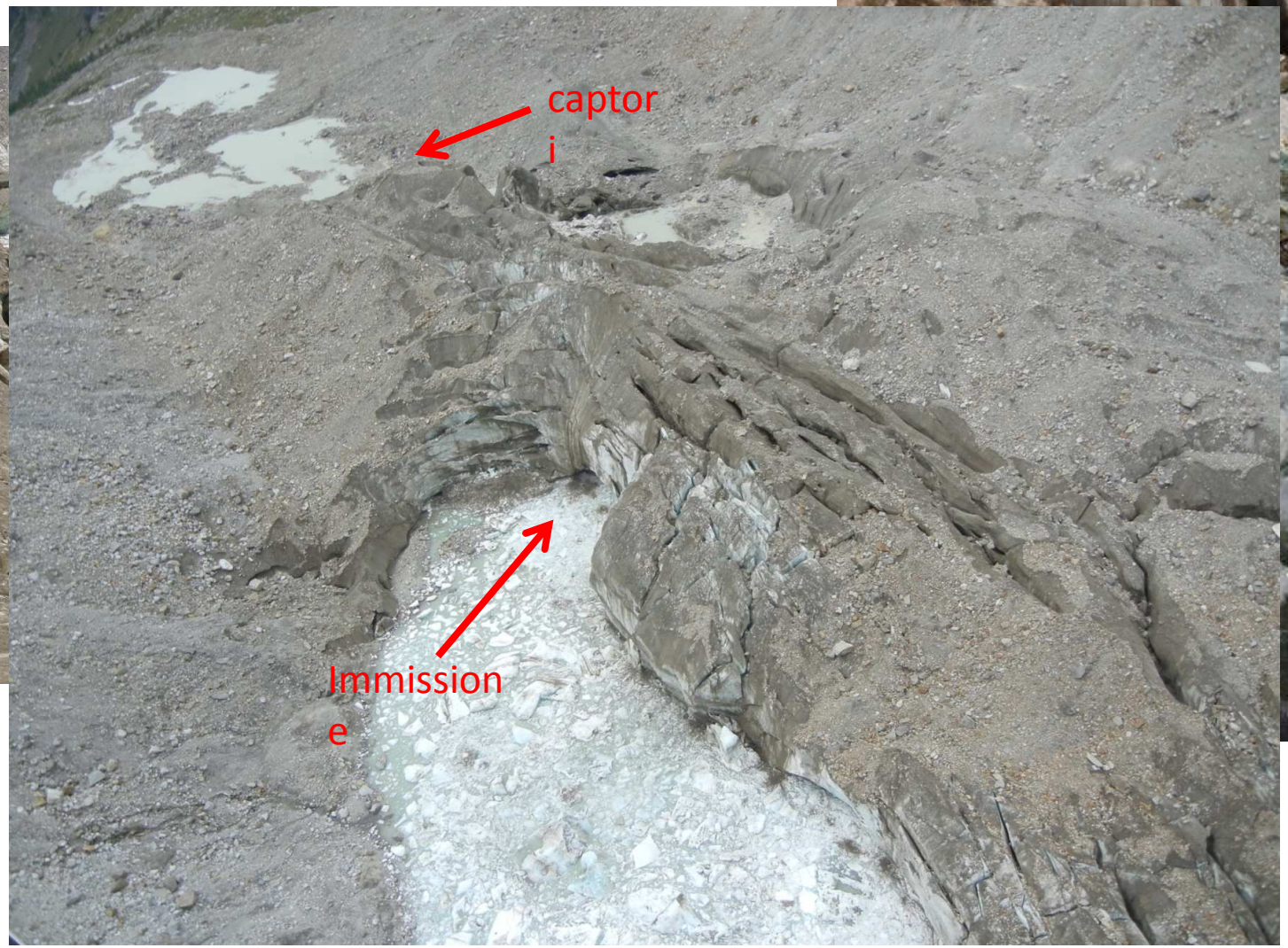
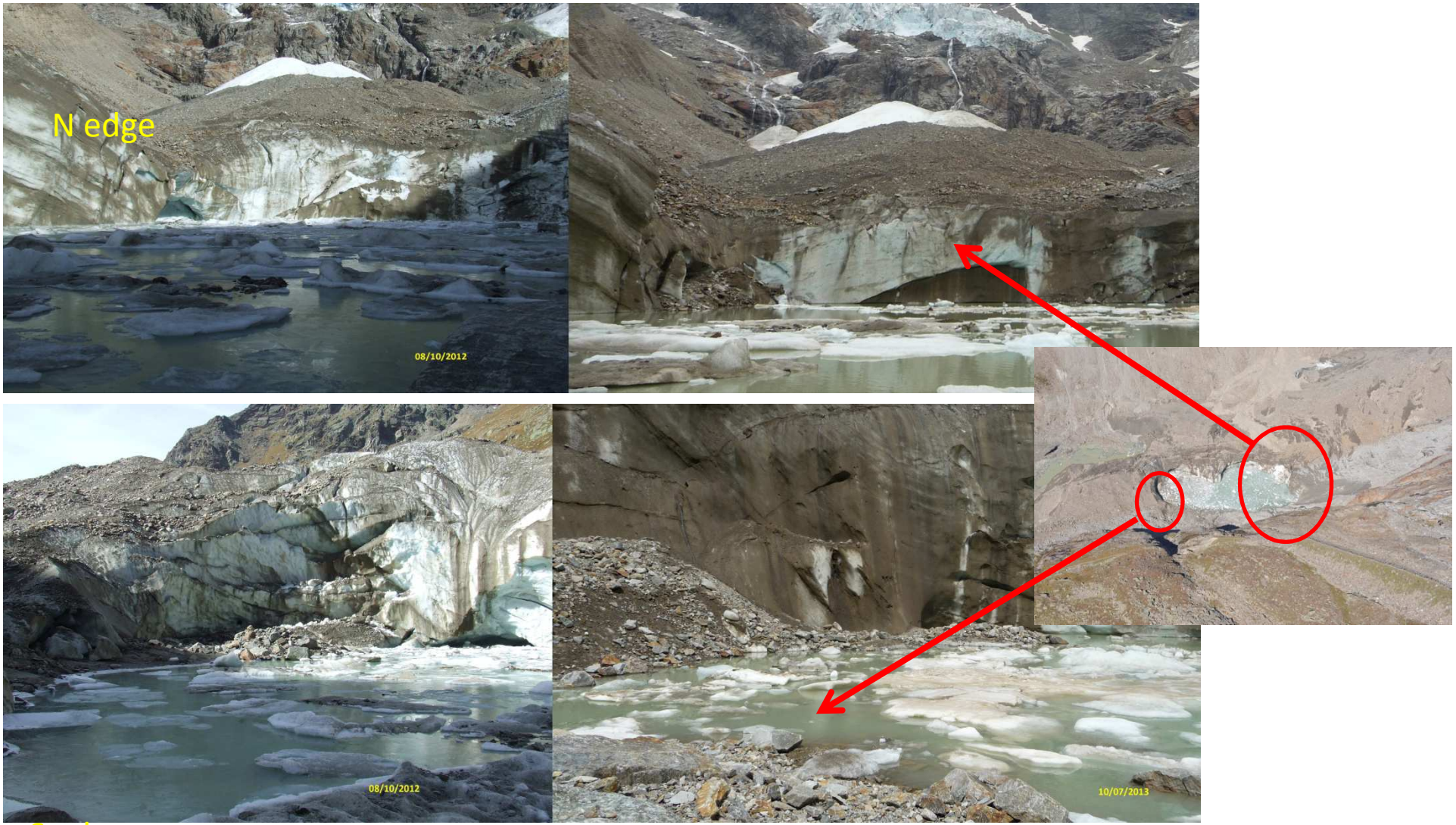
Tracer surveys

4- Surveys



Geomorphological evolution of the border

4- Surveys



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4- Surveys

Geomorphological evolution of the border

-Thermal erosion
-Calving

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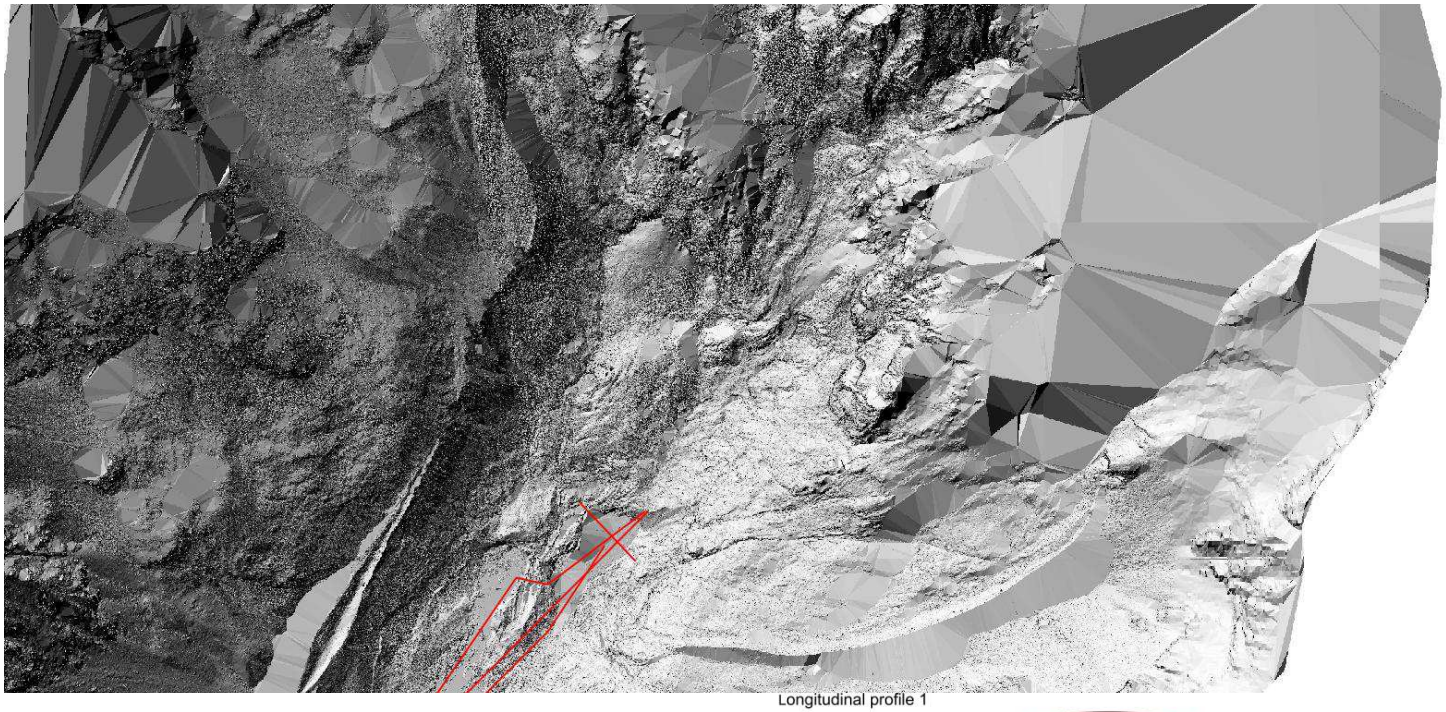
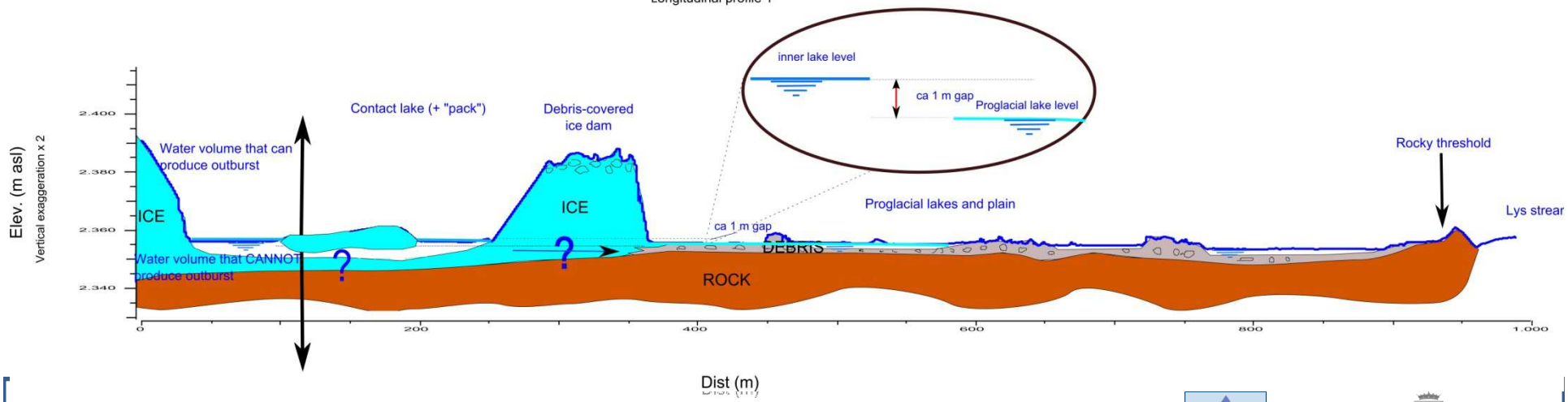
Topographic surveys and LIDAR (dsm)

4- Surveys



0.1 m DSM realized from LIDAR survey by ISENET – Politechnic of Turin Spin-off)



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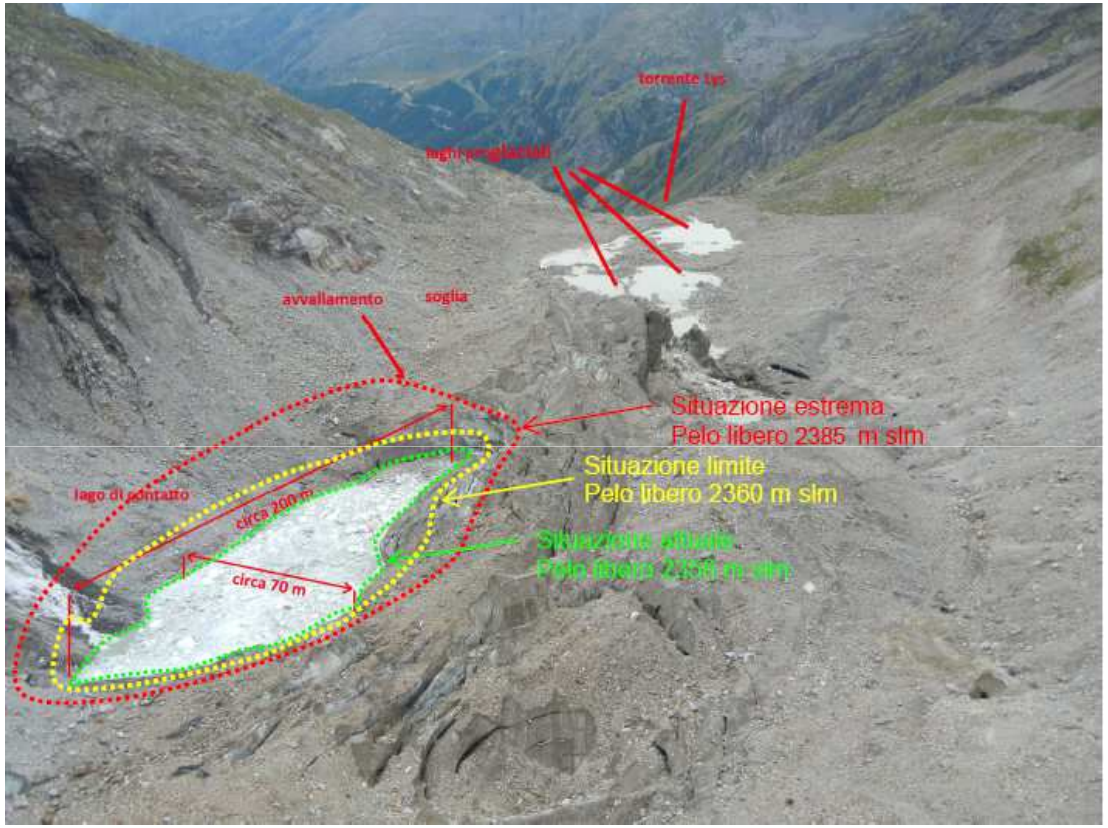
5- Risk evaluation



Simulation using dam break techniques (by Aosta Valley autonomous region)

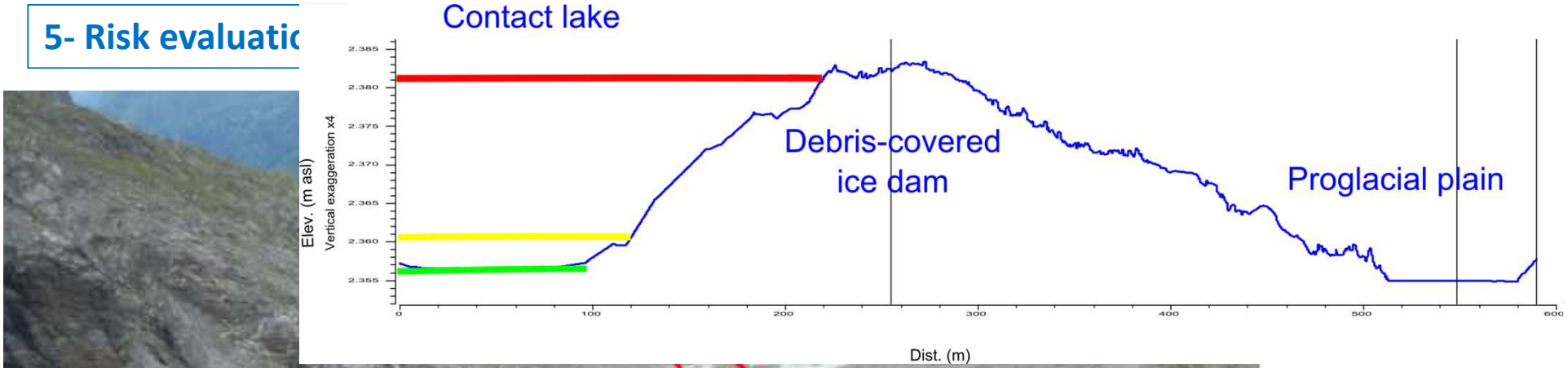
3 scenarios – water volume

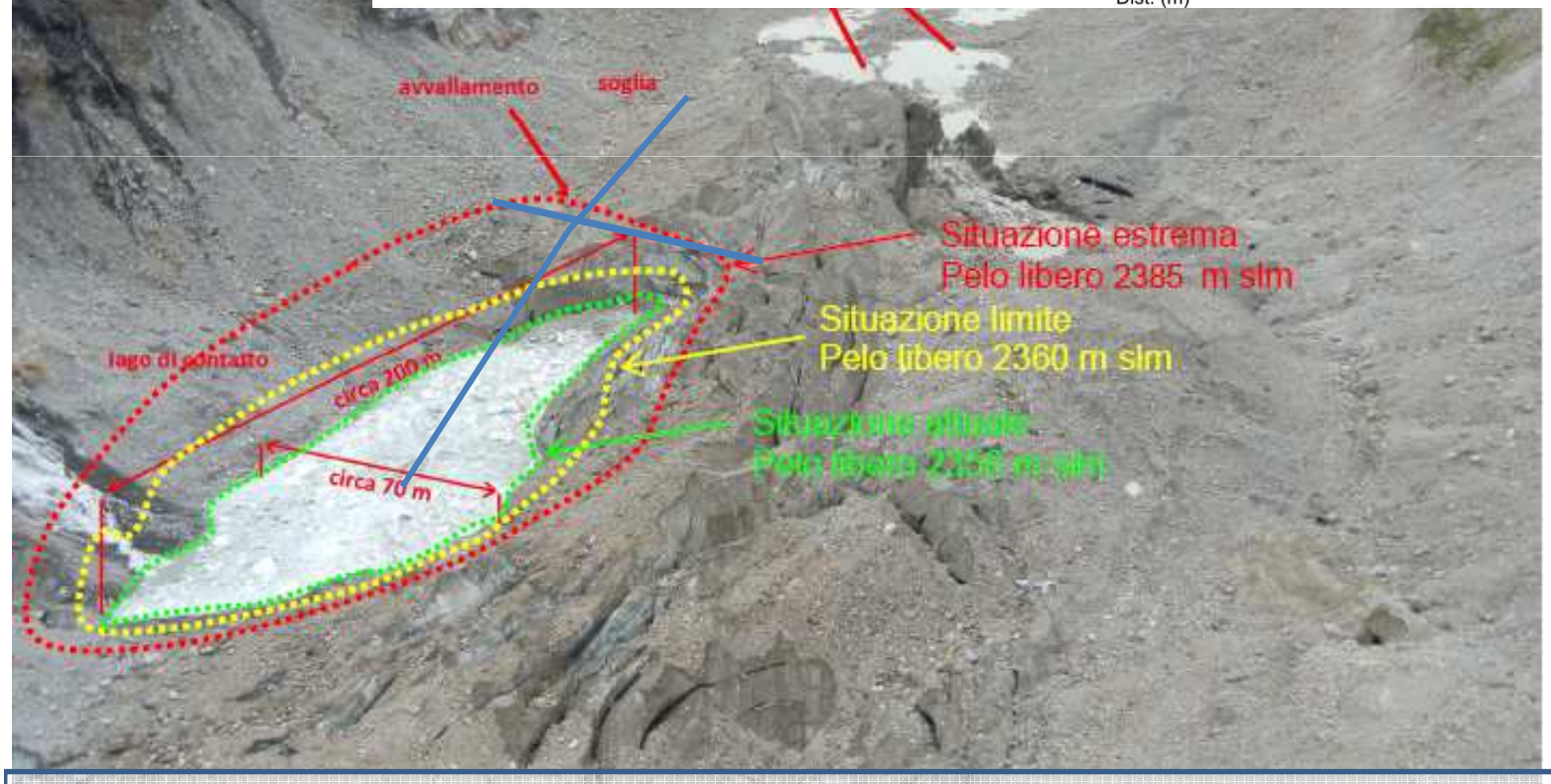
-**Present state**

- **Extreme volume**: max. potential volume according to present topographic condition

- **backward analysis**: max. water volume that can be contained in the riverbed (exceeding can produce a flood that can endanger inhabited areas)

5- Risk evaluatic





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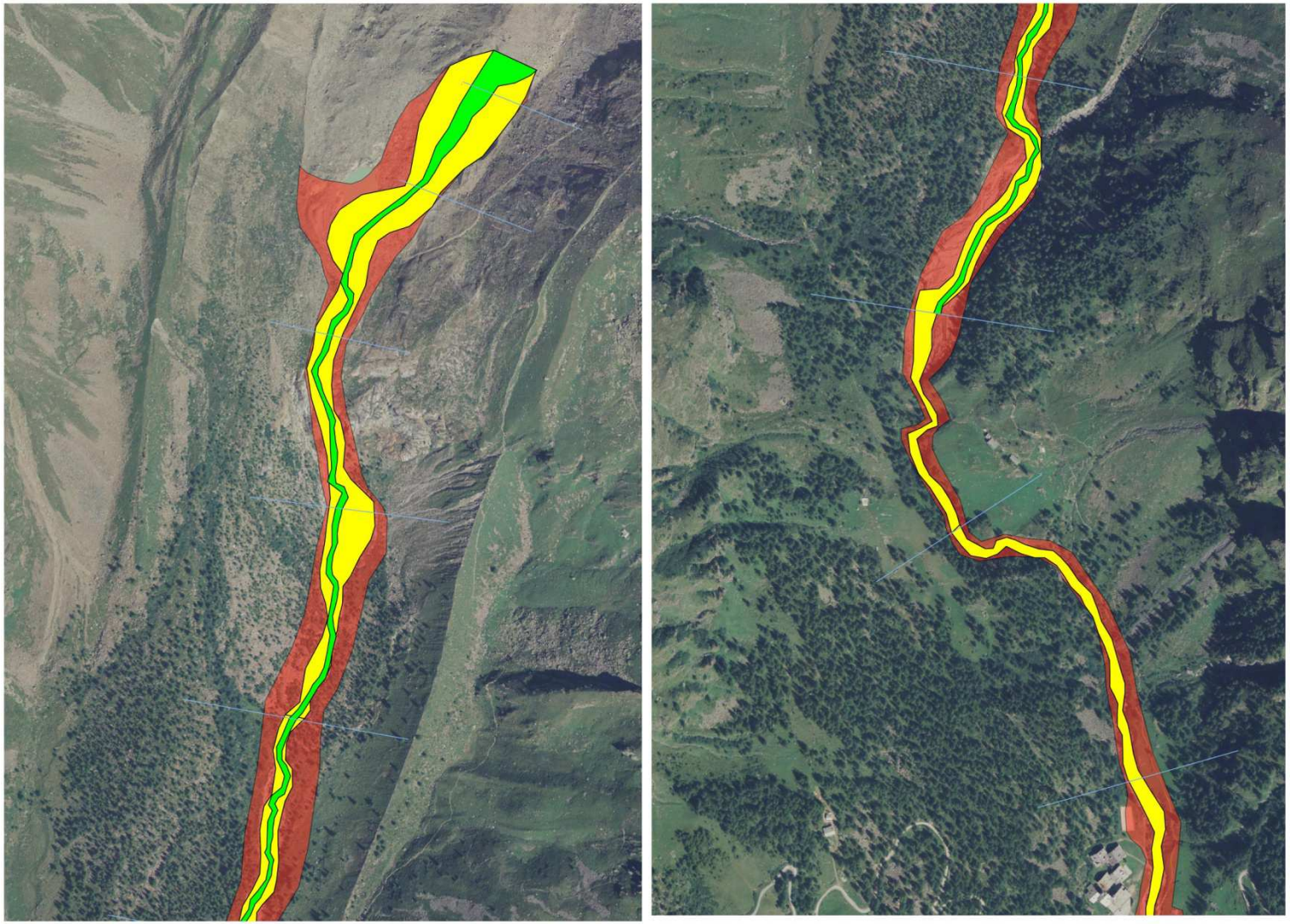
5- Risk evaluation



Present state

Extreme volume

Backward analysis

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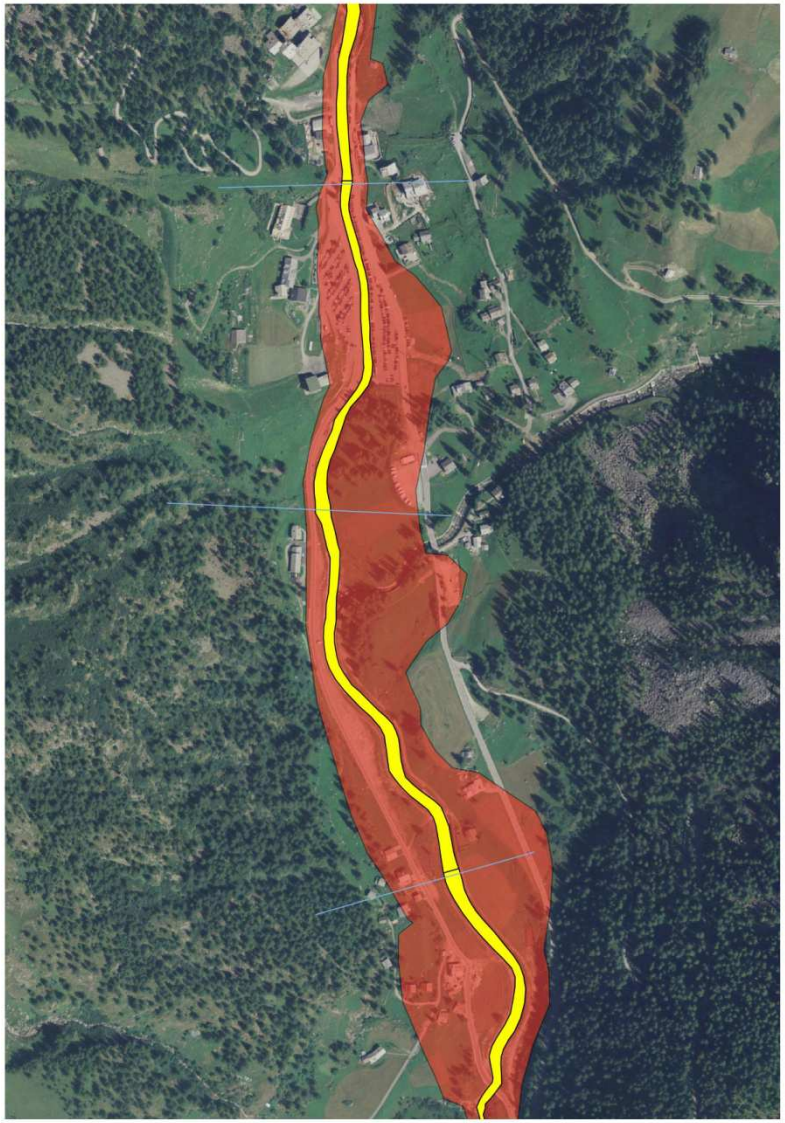
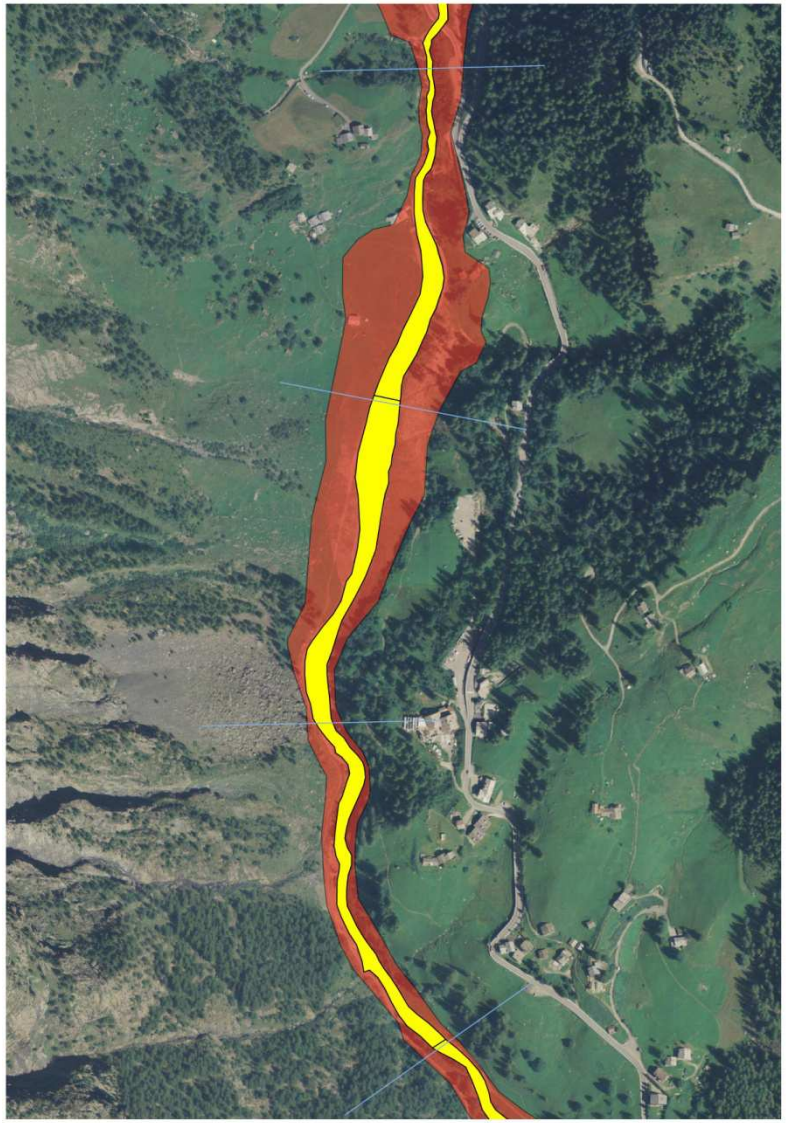
5- Risk evaluation





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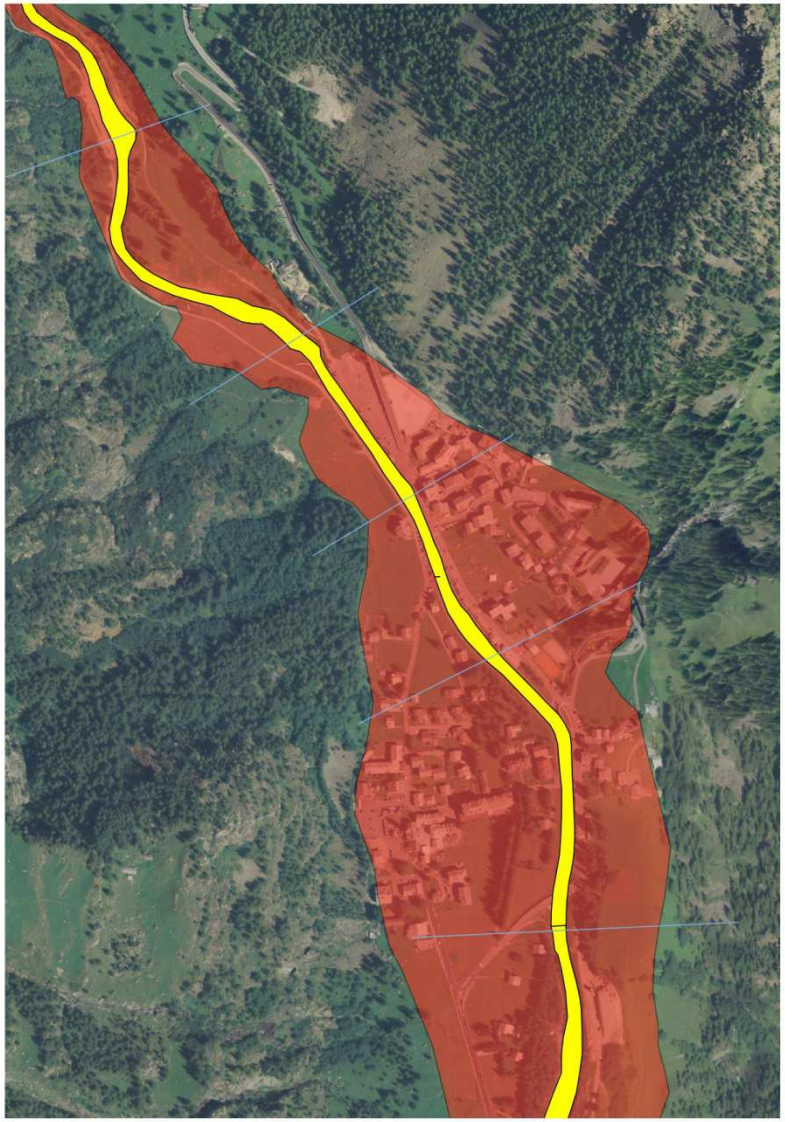
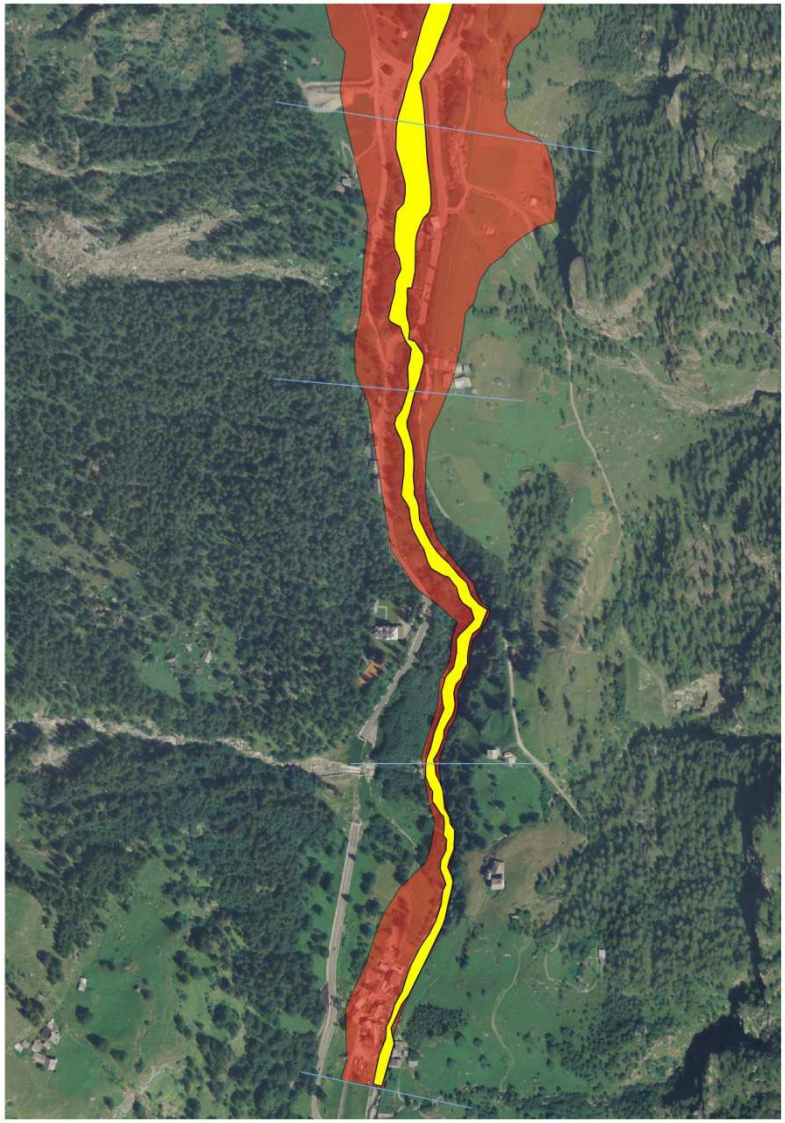
5- Risk evaluation





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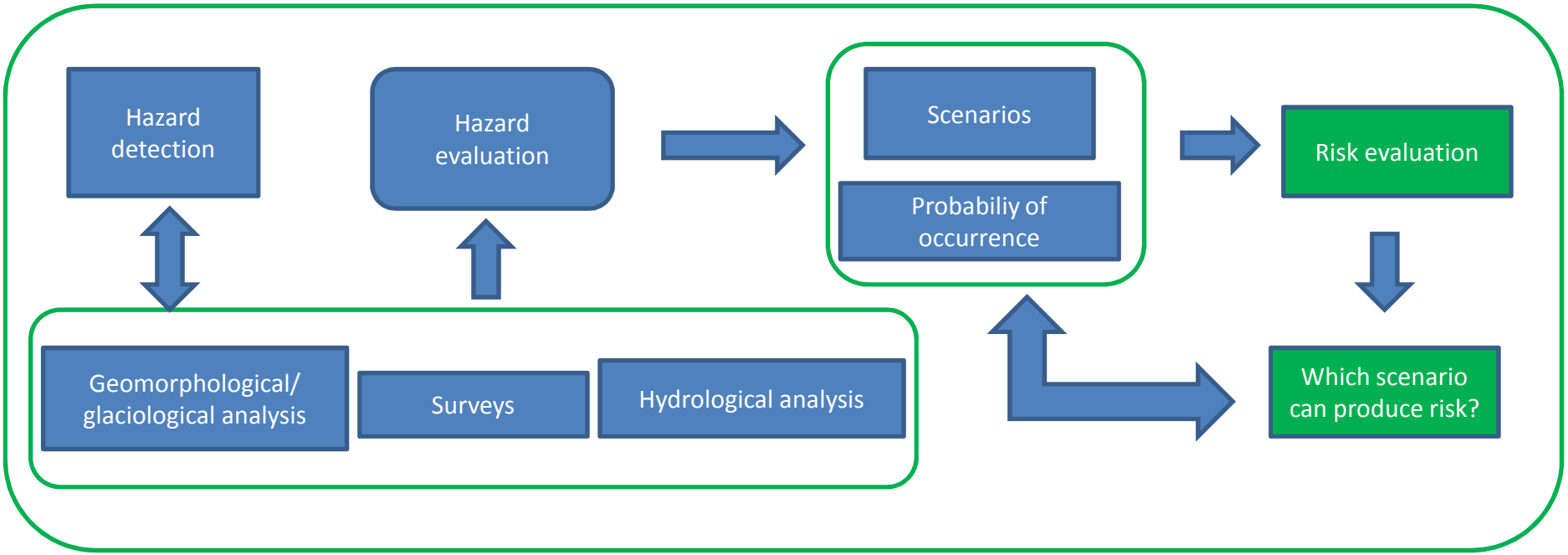
5- Risk evaluation

- At the present state the lake **is drained** (no level increase in spite of continuous inflow). It will be likely the same in the future evolution because of glacier melting and channel widening;
- very wide and flat proglacial plain;
- extreme volume level can be unlikely reached, as the ice dam will be progressive eroded or melted .

At the present state, a low danger level can be assessed.



6- Conclusion and outlook

- At the present state a low danger level can be assessed, because of drainage, gradual shrinking of ice dam and topographic condition ;

- Rapid evolution of the site and vulnerabilities downstream need to keep on qualitative monitoring in order to detect in advance arise of potential danger (e.g waves from icefalls in the lake);

- integration of different kind of surveys, analysis and skillness (glaciogical and topographic data + danger analysis + flood simulation) in an example of good practice that can be used in similar cases