Lomonosov Moscow State University
Faculty of geography
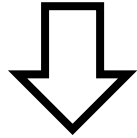Department of meteorology and climatology

Assessment of the use of reanalyses for the diagnosis of avalanche hazard in the Caucasus mountains

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Motivation

High population density in the Caucasus region causes an **increased avalanche danger for people and infrastructure**

Diagnosis and forecasting

Problems of existing methods:
- Methods that use numerical modeling and are suitable for forecasting **cannot cover the whole region**
- Methods for estimating avalanche hazard at the regional scale are usually used without numerical modeling, which **does not allow their use for forecasting**.
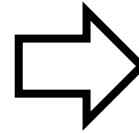
It is necessary **to use reanalysis and modeling data with a method working on a regional scale**.
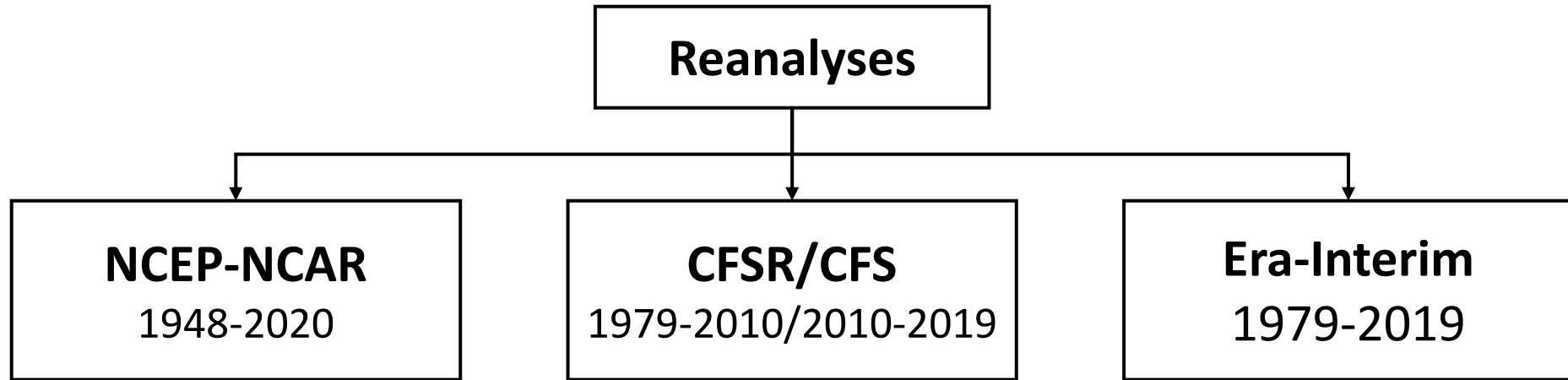The chosen method [Olejnikov, 2002] makes it possible to diagnose avalanche hazard based on the ratio of air temperature and precipitation during the cold period.

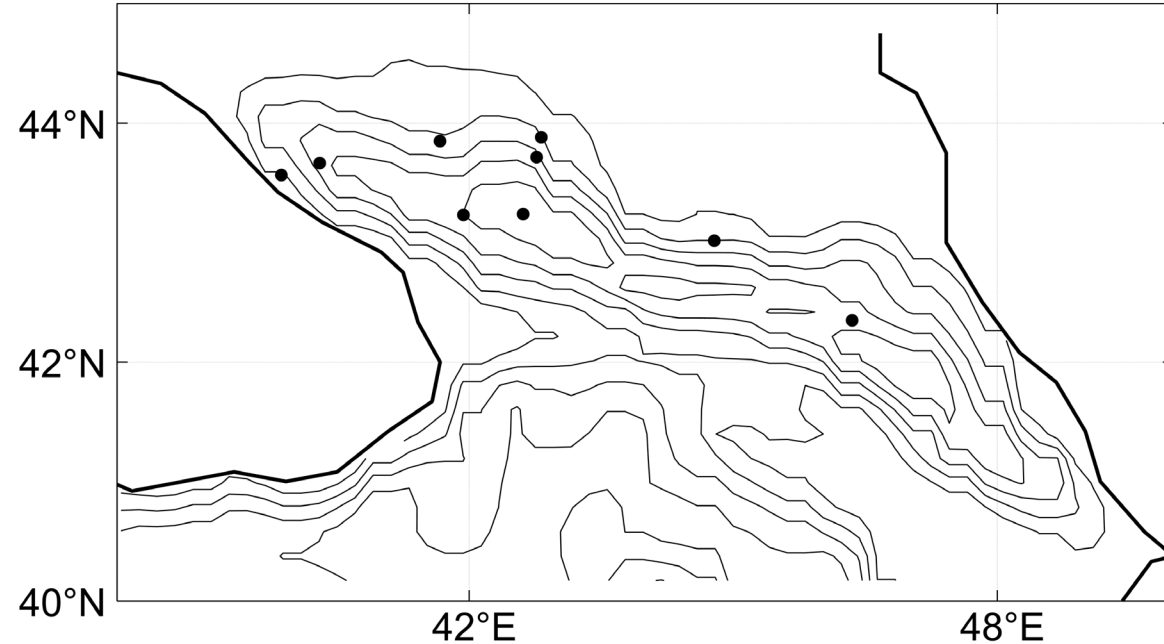| x \ t	А $t \geq \bar{t}+\delta$	Б $\bar{t} \leq t < \bar{t}+\delta$	В $\bar{t}-\delta \leq t < \bar{t}$	Г $t < \bar{t}-\delta$
① $x \leq \bar{x}-\delta$	1950/51			1948/49
② $x-\delta < x \leq \bar{x}$				
③ $\bar{x} < x \leq \bar{x}+\delta$				1953/54 1975/76
④ $x > \bar{x}+\delta$	1962/63		1955/56,1967/68, 1986/87	

□ 1   ▦ 2   ▨ 3   ■ 4

Winter avalanche hazard matrix [Olejnikov, 2002]
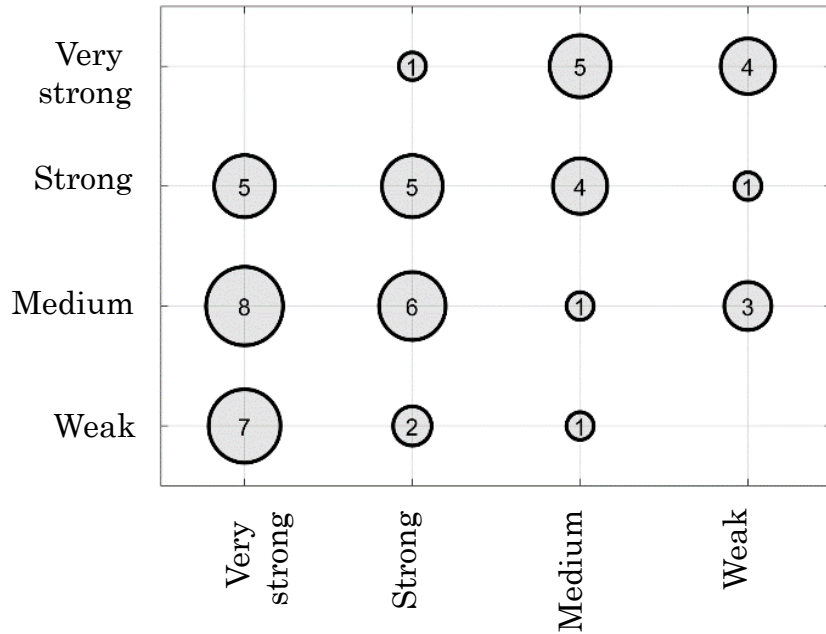
Materials and methods

Results: avalanche hazard by reanalysis
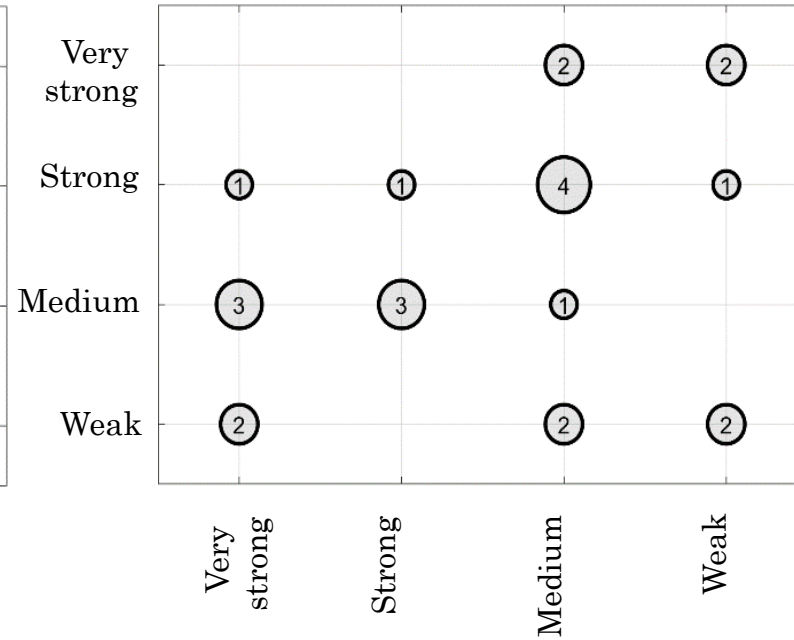
Results: atmospheric parameters
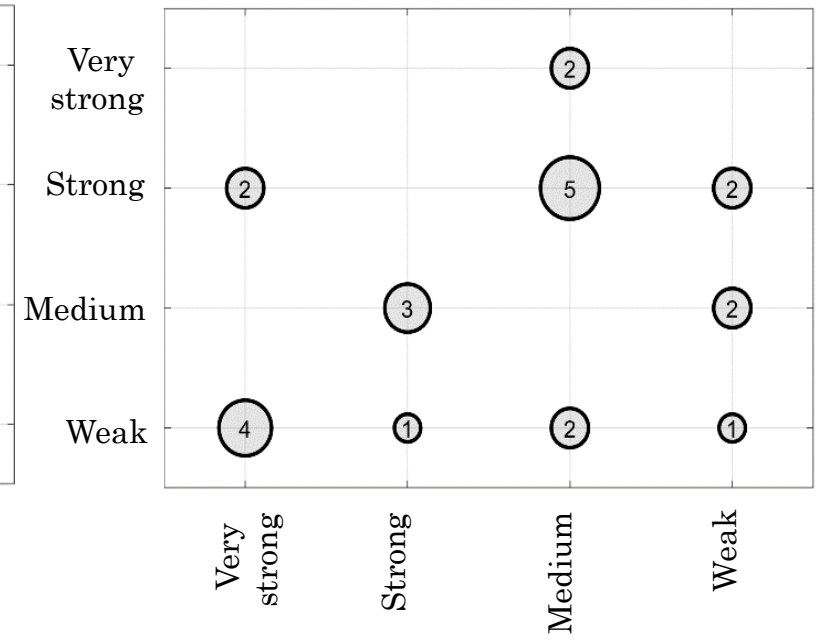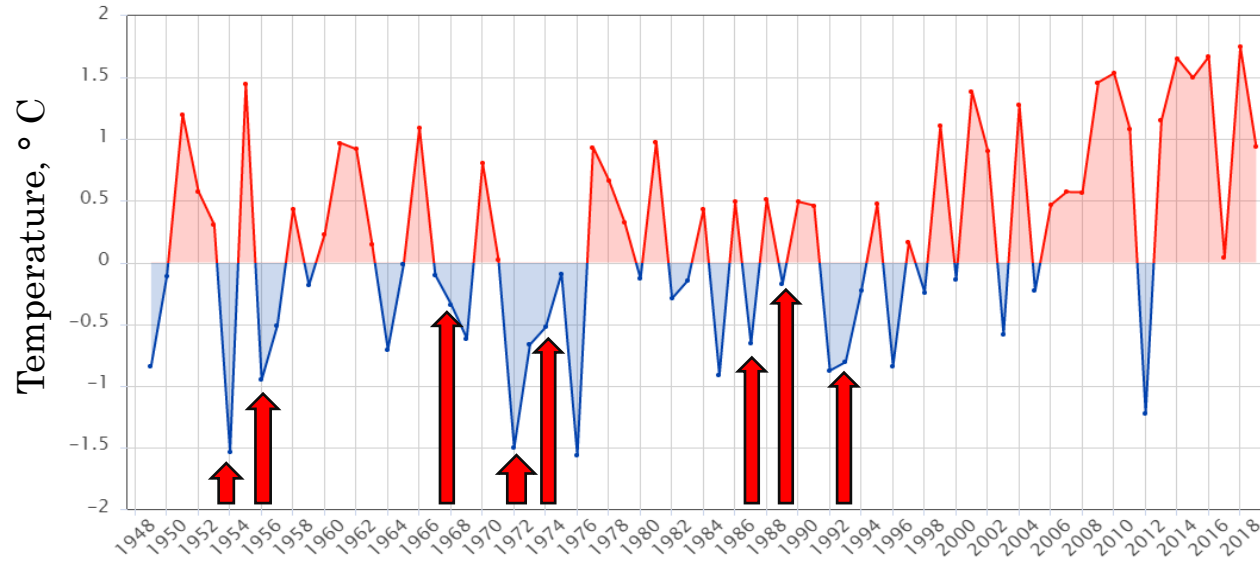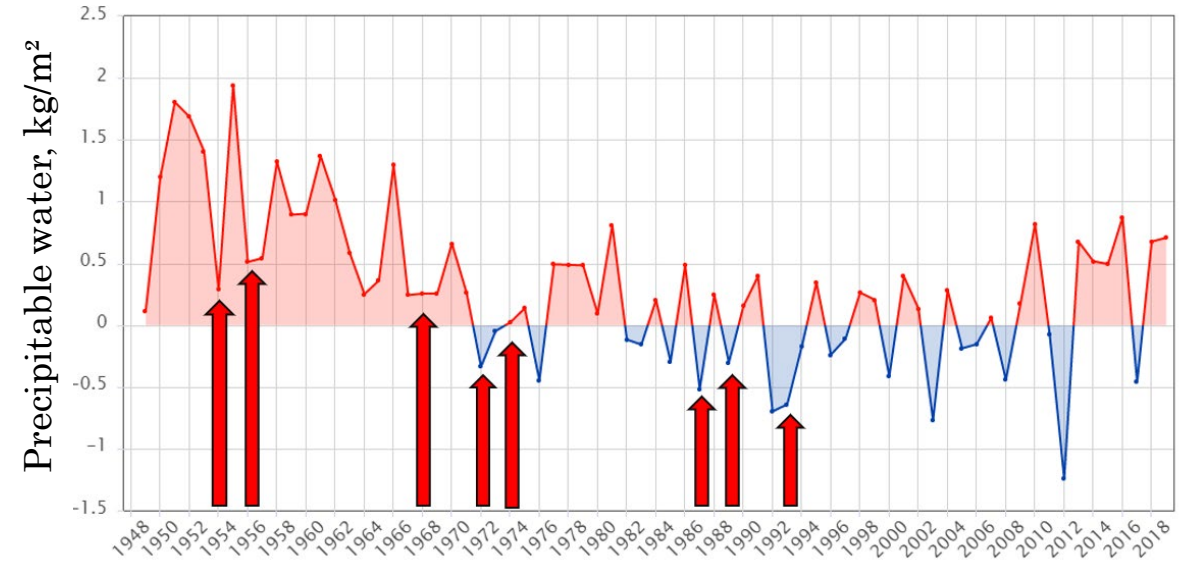

Winters with a **large number of catastrophic avalanches** were associated exclusively with the **negative temperature anomaly** at heights of 850, 700 and 500 hPa, and in all cases, the **negative moisture anomaly** coincided.

Conclusions

1. Reanalyses reproduce the avalanche hazard assessment in the Caucasus Mountains with acceptable accuracy. The absence of large deviations was noted in the NCEP-NCAR reanalysis.

2. Decrease in the number of winters with conditions for extreme avalanches has been observed over the past 20 years due to an increase in the frequency of warm winters and a shift in the maximum precipitation from winter months to March.

3. The key factor in the increased avalanche danger in the Central Caucasus is the effect of temperature, not precipitation.