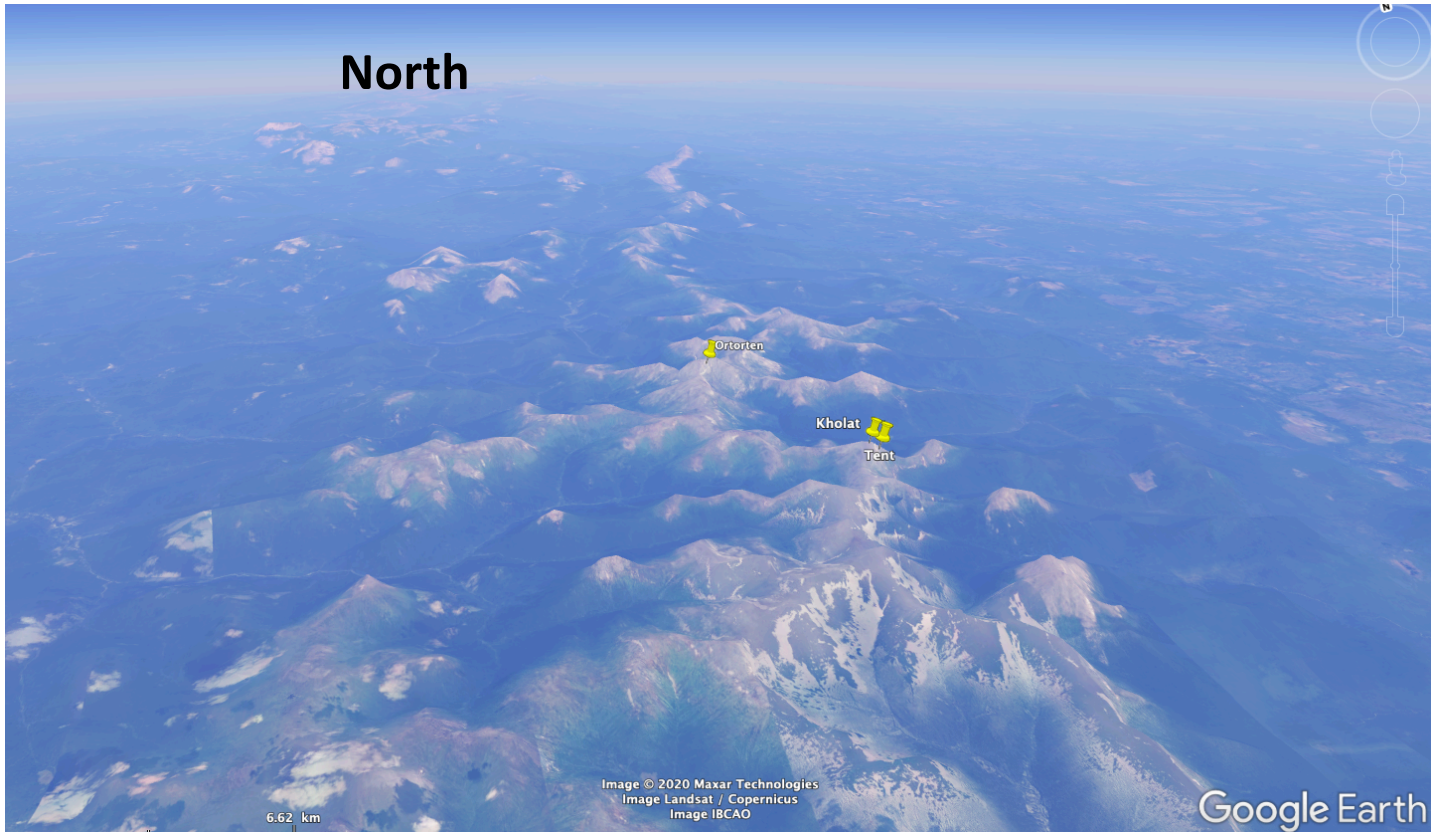
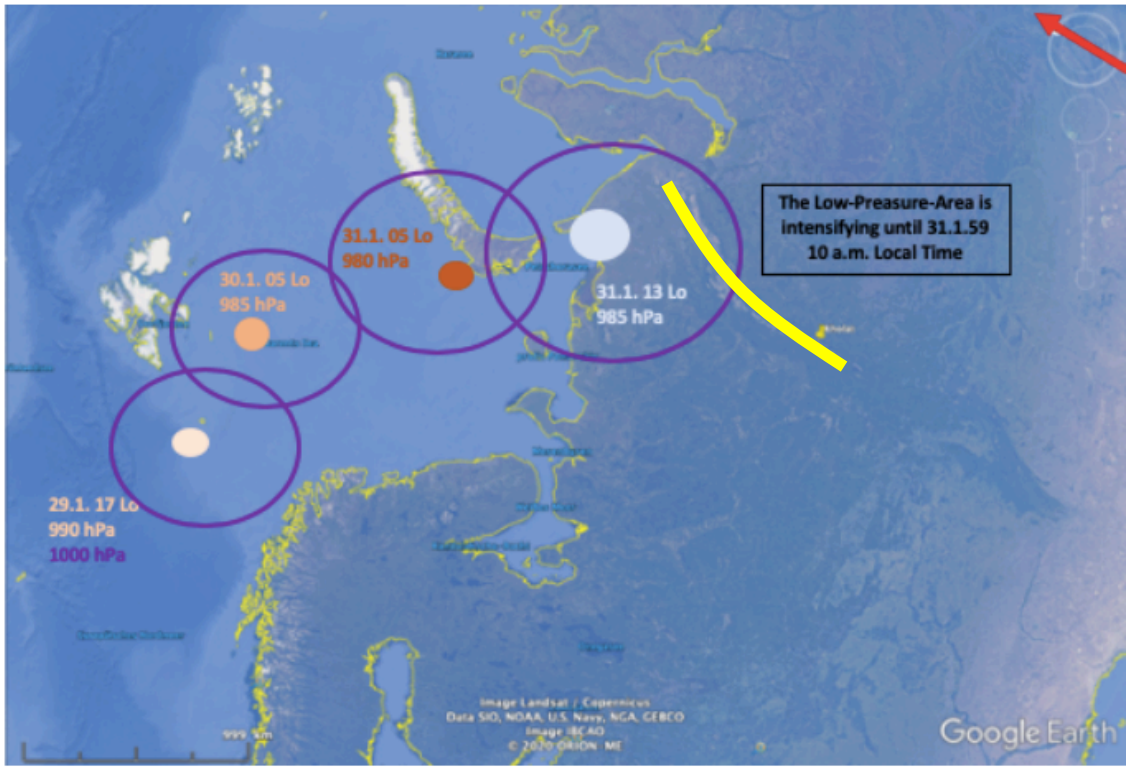
Dyatlov- Accident



The mountain range of Ural, stretches in a North-South direction and is 2 500 km long, with a maximum width of 50 km. Near the peak of Kholat the mountains are about 1200 m high and 20 km wide.

Weather-Situation:



On February 31, 1959 at 11 p.m. the Low-Pressure came under High-Pressure influence.

A Low-Pressure area approached the Urals from the Barents Sea.

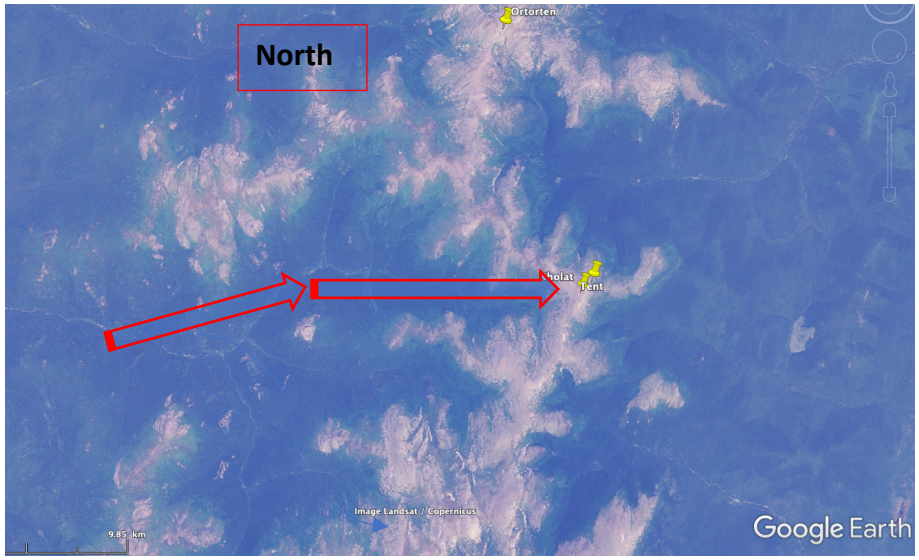
The yellow line marks the Ural mountain range.

Katabatic Wind:

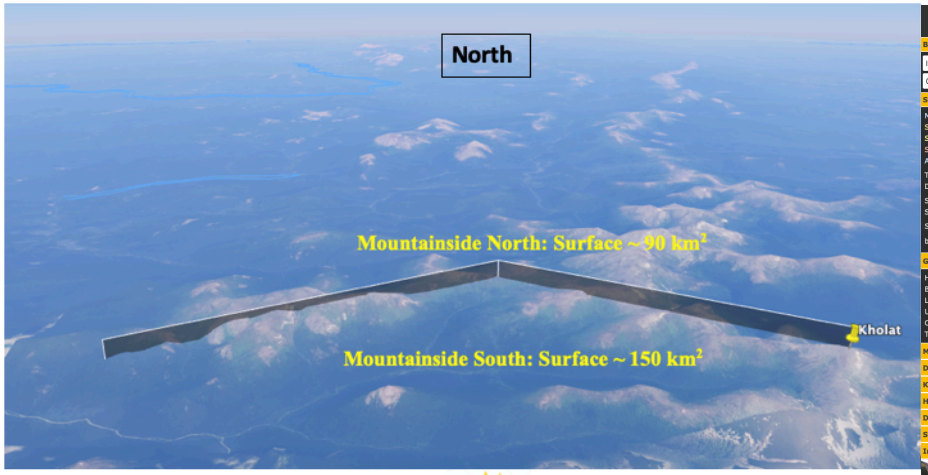
A "Katabatic-Wind" is a cold local downward wind that typically occurs suddenly. There are numerous examples of this phenomenon worldwide. For example, the cold air rises over a very cold surface - as such it is of a very high density.

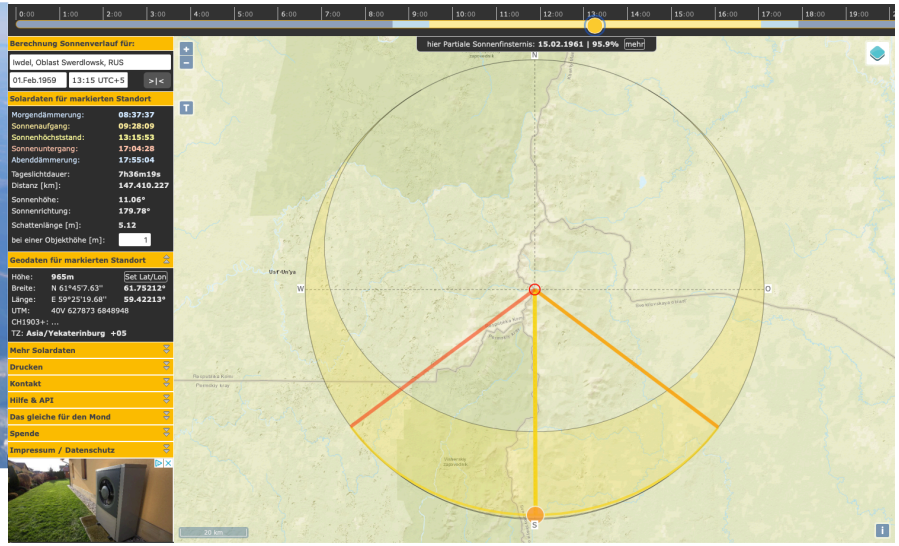
In the Norwegian Fjords it is known as "Elvegust" or "Sno".

Wikipedia - Example of an Ice-Shelf "Katabatic Wind".



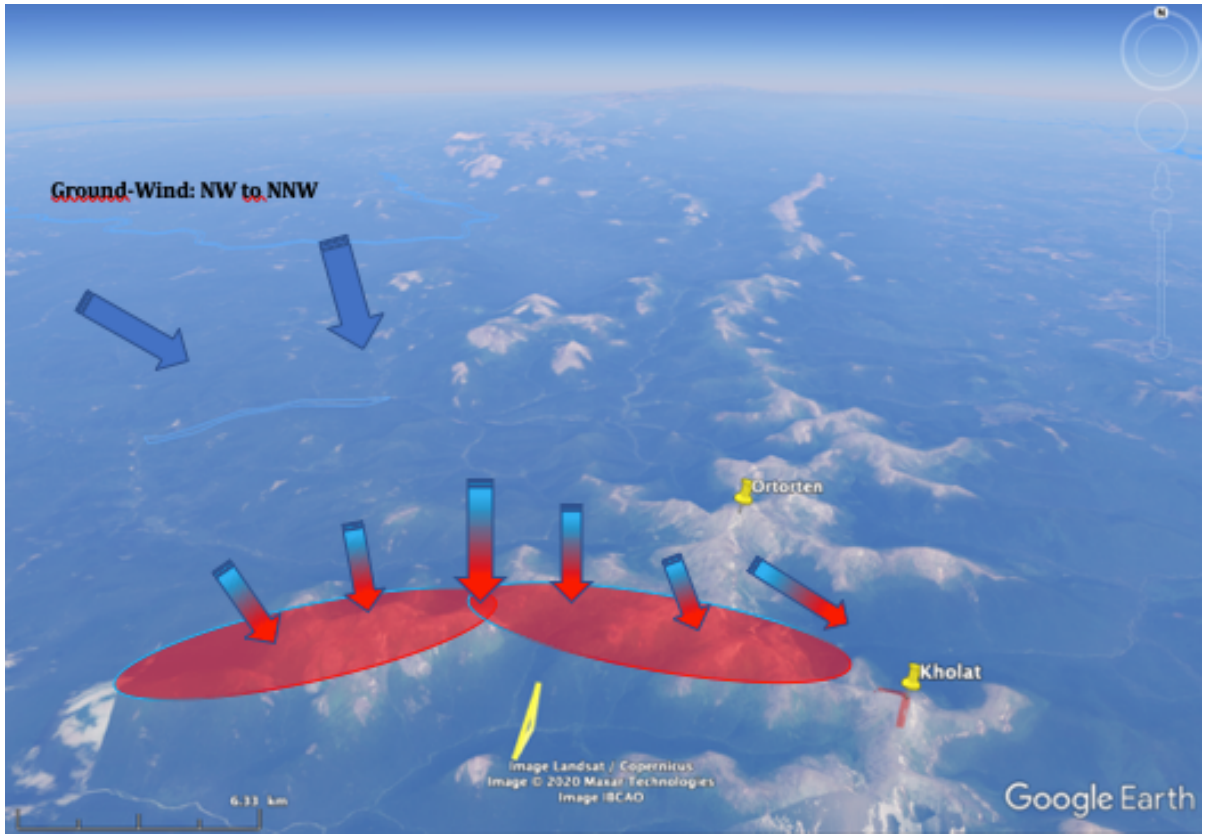
From the peak of "Kholat", an approximately 20 to 25 km long valley stretches in a western direction. This valley is furthermore limited to the north by a mountain range. Here, the northern side (90 km ^{2}) is not exposed to the sun from November to the beginning of February. Generally, all mountainsides facing north on this latitude are not illuminated by the sun.





Google-Earth-Pro.

https://www.sonnenverlauf.de/#/61.7521,59.4221,8.669999999999996/1959.02.01/13:15/1/3



The consequence of the hillsides facing north, are extremely cold air of high density - hence “heavy air”. The temperature usually falls from -25 ° C to </= -40 ° C.

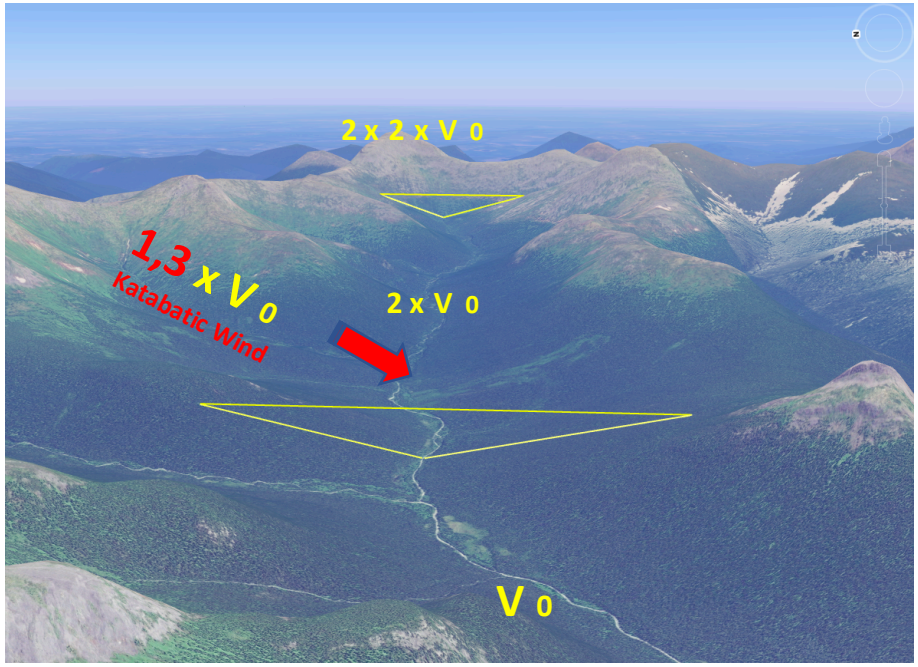
When this air mass flows from the Northern side into the West-Valley, it can create a "Katabatic Wind".

Wind-Profile:

When the cross-section of the western valley halves (see the narrowing on the triangles drawn in yellow), the wind speed doubles. Over Kholat, the wind speed doubles again because the wind is pressed against the upper air masses.

The supply of a "Katabatic Wind" additionally increases the wind speed.

N **S**



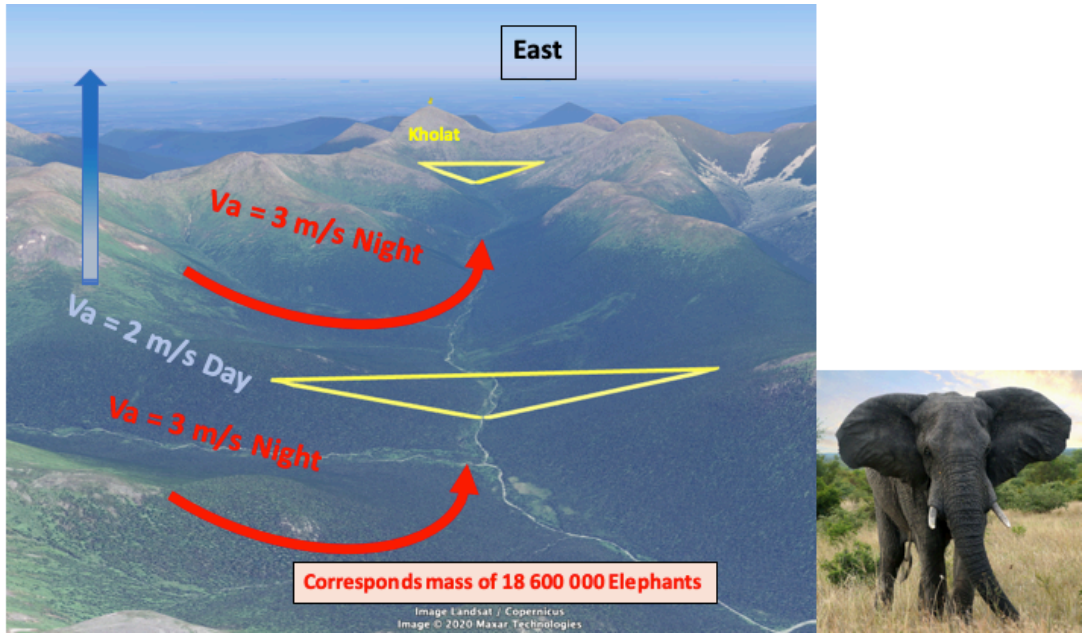
Google-Earth-Pro

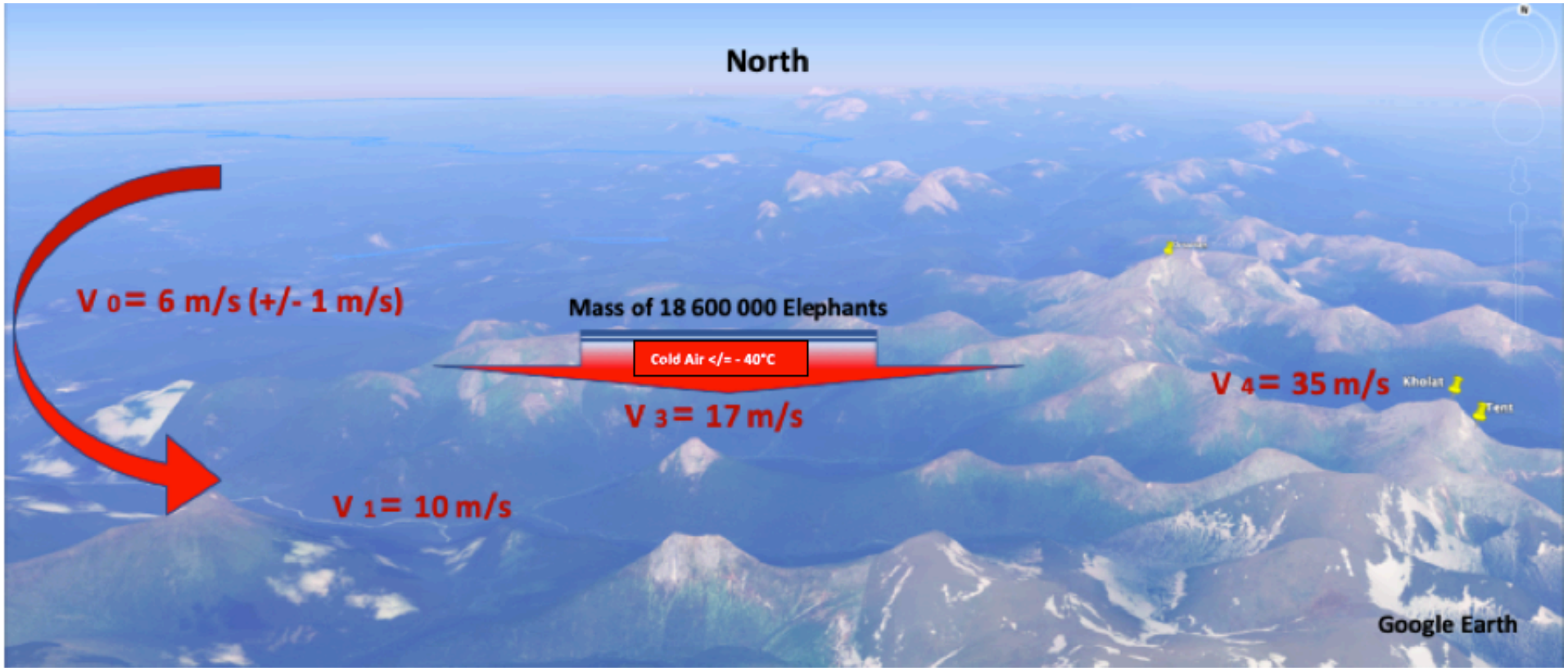
However, one must distinguish between two meteorological situations. During the day, a thermal lift is generated on the mountainside by solar radiation. This stops the "Katabatic Wind". Therefore, moderate wind speeds are measured on the eastern side of Kholat during the day (the position of Dyatlov's Tent), especially under a cloudless sky.

After sunset, the thermal wind stops and now the slope cools down. Now cold air flows down the hillside.

By late evening this down wind takes the extremely cold air from the North-Side.

The North-Side with its 90 km² area flows down the slope at around >/=3 m/s. This is an unimaginably large mass and corresponds to that of 18 600 000 elephants per night. This cold air is furthermore accelerated by the Bernoulli-Effect and collapses over the Kholat to the east.





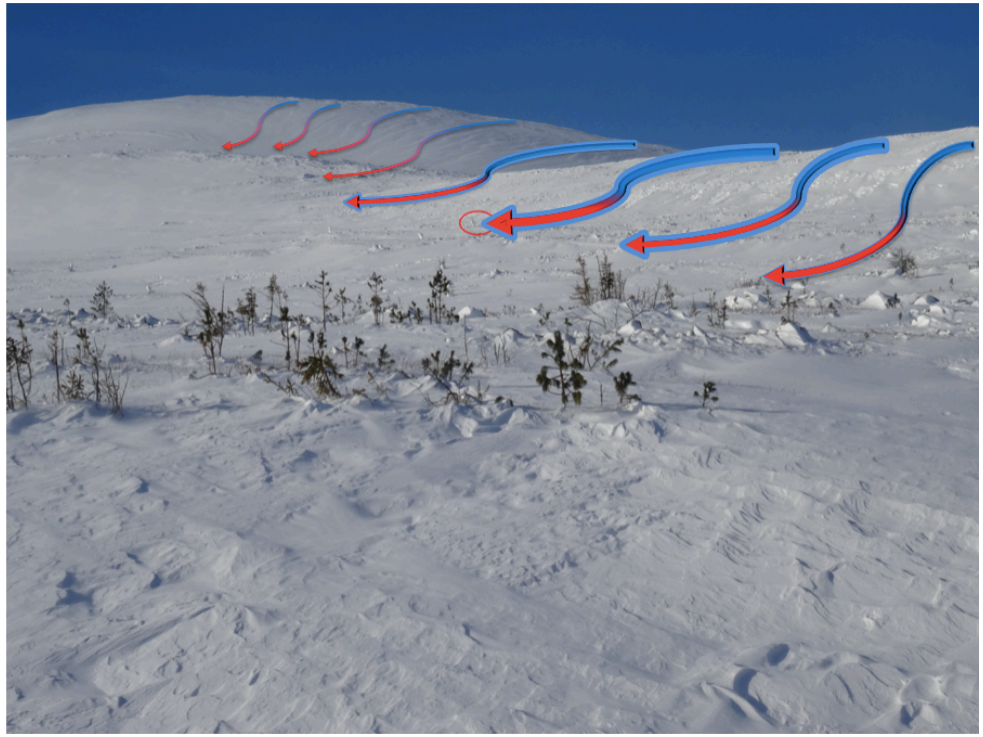
Schematic representation of the wind increase after sunset in the late evening.

Each attentive reader has seen snow accumulations at the edges of shady forest or inside the northern sides of valleys. This is especially familiar in northern Europe after a cold winter. The ground in such spots is deeply frozen and since earth is a poor conductor of heat, these cold conditions can prevail for a long time. Even in April when flowers are blooming and butterflies are fluttering, the ground can stay exceptionally frozen in such places.

1. Phase

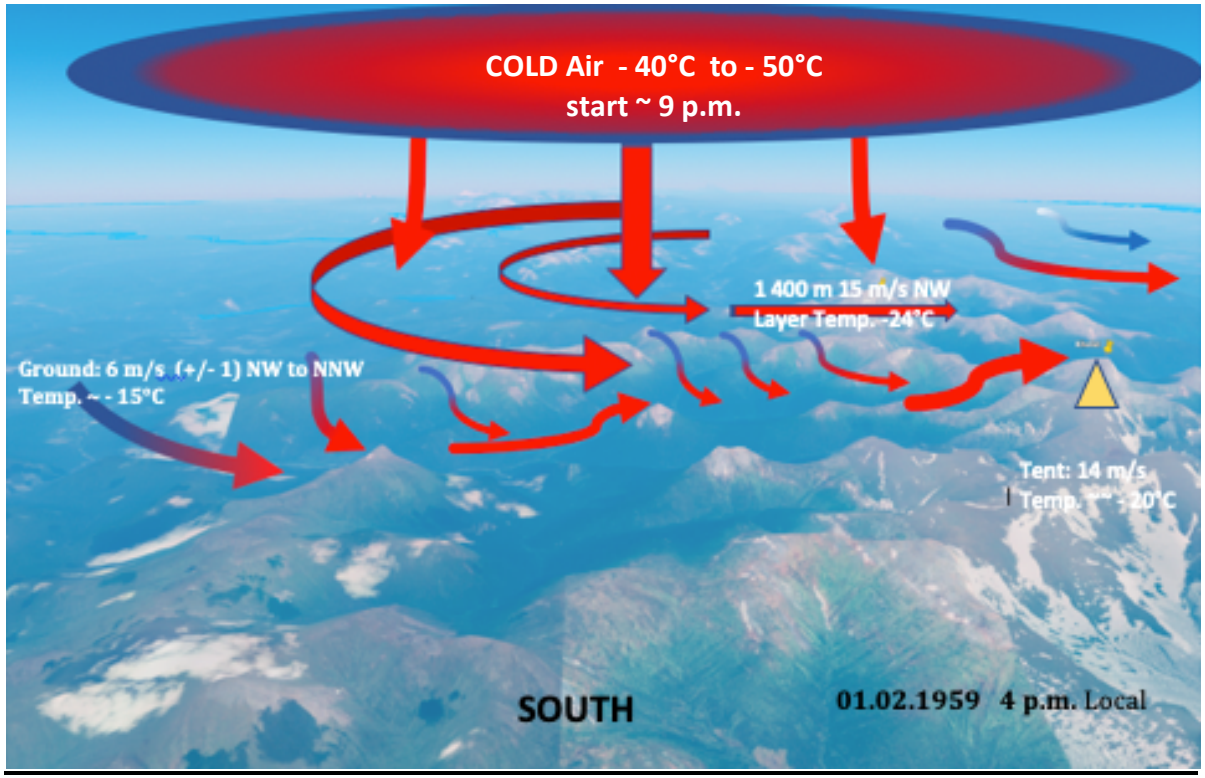
February 1, 1959 - 11:00 a.m. to 4:00 p.m. (local time).

The wind was blowing moderately from NW to NNW with 6 m/s (+/- 1) in the plane of Northern Ural.
This was measured by several weather stations.



The wind was ~ 14 m/s at a height of 1000 m on the "Kholat" and the temperature was about ~ - 20 ° C.
The group was well acquainted with these conditions and it did not pose any particular challenge.

February 1, 1959 - 4:00 p.m. to 7:00 p.m. (local time).

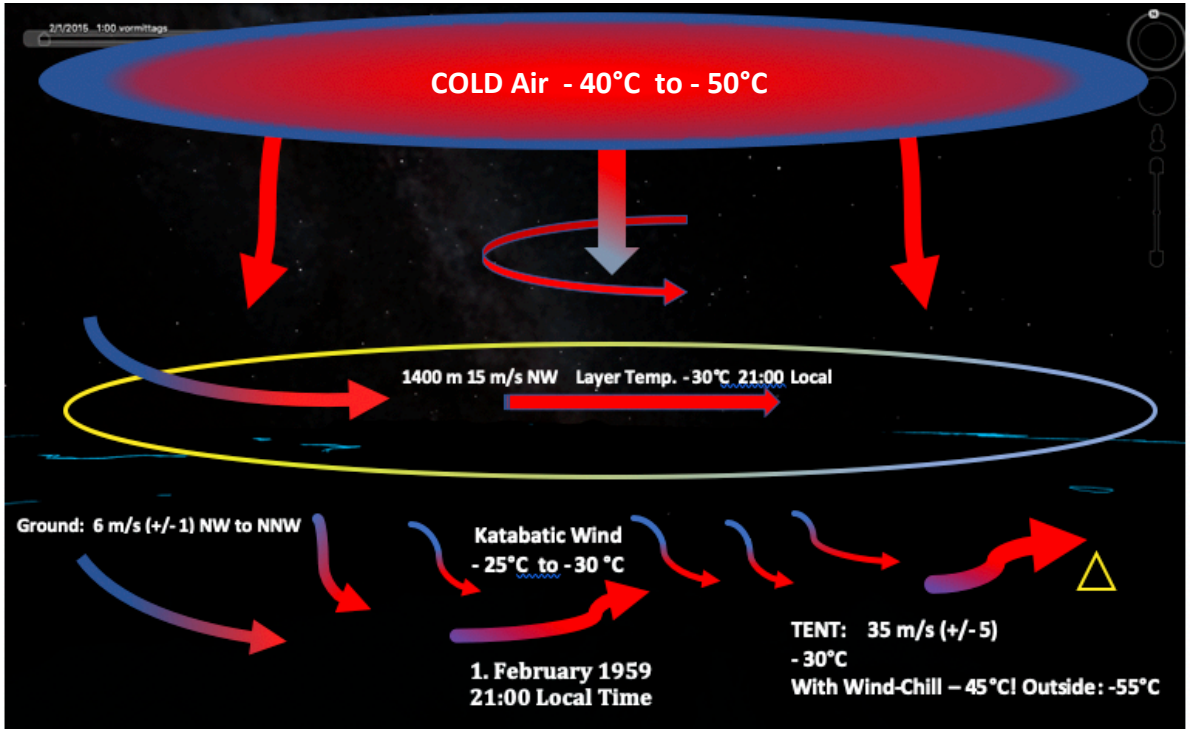


Google-Earth-Pro

For professional hikers, who are on the path during winter with a tent, it is well known that a human body emits ~ 45 watts in the tent. One can therefore assume that the 9 hikers radiated about 400 watts of heat. This can produce a temperature increase in the tent of about +15°C – that is, if the tent is in perfect condition. The "Inuit" people heat their igloos with body heat only and oil lamps! But their igloos are perfectly sealed.
The "Katabatic-Wind" has not yet begun.

2. Phase

February 1, 1959 - 7:00 p.m. to 11:00 p.m. (local time).



Google-Earth-Pro

The "Katabatic Wind" started with full force after 7 p.m.. The wind speed suddenly increased to 30 m/s (+/- 5 m/s). The temperature fell to -25 ° C.
Around 9 p.m., the "Katabatic Wind" was 35 m/s (+/- 5 m/s) with strong, incalculable gusts and the air temperature was - 30 ° C. The "Cold-Air" from high above initiated slowly at 11 p.m.

This night, the tent was statically hit by the mass of an elephant every 5 seconds. A wind of more than 20 m/s falls cylindrical and partly chaotic from the slope. The wind additionaly impacted the tent from the valley side.

TENT:

I now come to a section that at first may seem unimportant to the reader - but it is exactly the opposite. The results are astonishing. This section is the key to understanding the disaster. It concerns the tent of the Dyatlov group. I have been studying the disaster for several years and have read almost all the forums, but no one has ever qualitatively described the influence the tent had on the disaster. Pages after pages were written about the snow conditions, possible snow boards and avalanches, but never about the tent.

I therefore did three days of experiments showing the physical conditions of the tent in the "Dyatlov-Disaster". For this I used my own tent, which can fit 2 adults and 2 children.

Tent width 255, length 200 and height 125 (cm)

This commercial tent consists of a separate inner tent with a 6-sided ground floor and an outer tent. The inner tent is completely enclosed. The waterproofed outer shelter is placed over the inner tent and attached to the ground. Air circulation from the environment is possible. I put plastic material mats around the outer tent, since tents stand in snow during winter and this also protects the ground area from wind.

On the days of the measurement, during Janunar 2021, it was windless. The measured data in the tent and outside were taken from 6 calibrated thermometers. In the diagram below, only the temperature inside the tent was plotted, corrected with the outside temperature. The measurement is therefore independent of the outside temperature.

Ten tea lights were chosen for the experiment (diameter 6 cm and height 2 cm). Burning time 8 h, 9 h, 10 h. Power ~ 40 watts per light.

There were 2 tea light stoves with 4 candles each. The metal stove had 2 lights. The ovens were self-constructed, since the commercially available tea stoves are less effective. It is not important to run this experiment with open candles, but this method better corresponds to the heat emission from a human body. When using the fan, the danger of blowing out the candles was also reduced.

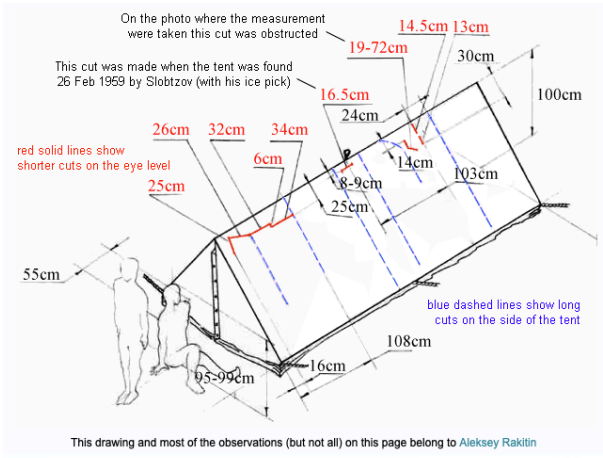
The fan had 40 watts of power and 3 working levels, where the highest rotation level was chosen for the experiment. The fan stood about 1m away from the tent opening. The wing diameter was 30 cm with an air flow of maximum 3-5 m/s.

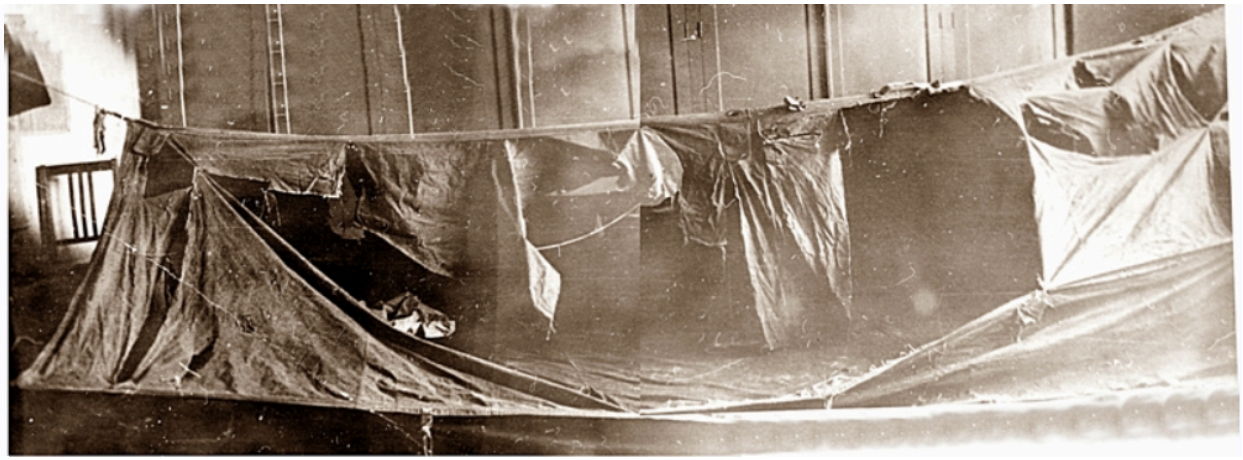
DATA TENT:

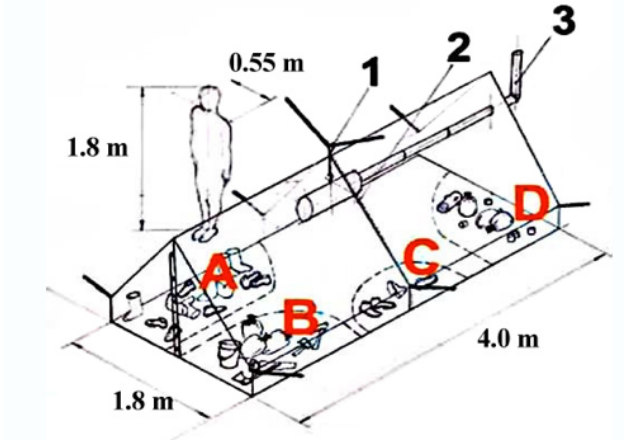
Area floor A = 3,94 m^2
Area of inner tent without floor: A = 9 m^2
Inner tent volume: V = 3,4 m^3
Ratio A/V = 9/3,4 = 2,65

DATA "Dyatlov-Tent":

Area floor A = 7,2 m^2
Area of tent without floor: A = 13,3 m^2
Tent volume: V = 4,3 m^3
Volume people + equipment: V ~0,8 m^3
Air volume tent: 3,5 m^3
Ratio A/V = 13,2/3,5 = 3,8







https://dyatlovpass.com/1959-search?flp=1#the-tent

The two tents have practically the same volume. Only the surfaces and materials are different. This is however insignificant with regard to the test results.

The "Dyatlov tent" was designed and optimised for the group.

Energy calculators for the required heat output (watts) in order to heat a tent, reasonably confirm that these tents need about 400 watts.

https://www.imowell.de/Bedarfsrechner
https://albrecht-services.de/heizung_berechnung.html

An adult person has a surface area of about 1.8 m^2. Without clothing, a person has a heat transfer coefficient of 10 watts/ m^2 K. With clothing, this value is reduced to 1/4. The heat emission then corresponds approximately to that of a tea light.

10 tea lights correspond to ~ 9 people in winter clothing. Thus, around 400 watts.

Experimental procedure:

The 10 tea lights were lit and the temperature in the tent was measured at short intervals at different points and heights. The result corresponds to the blue temperature curve in the diagram at a height of 40 cm (page 22). After about 8 hours, the first tea lights went out.
My measurements show that within 1-2 hours the tent temperature can rise by 10-12 °C, due to 400 watts. Presumably the temperature in the tent could be increased to +15°C after 10 h.

(In principle, the "Dyatlov tent" had been correctly dimensioned. Small inner volume with a practical sleeping arrangement. Unfavourable for an long tent is the ratio of the outer surface of the tent divided by the inner volume).

The same test was performed a day later, but now the holes in the tent were simulated.

A 1 = 0,062 m² ~ 0.7 % **A 2 = 0,124 m² ~ 1,40 %**

I was surprised myself how big a hole of only 0.7% looks on the tent.

Results:

The tent entrance was opened after 2 hours to the value A1 = 0.062 m² (1 sheet DIN A4). About 15 minutes later, the temperature fell. Then it increased again.
After 4 hours, the tent entrance was opened to A2 = 0.124 m² (2 sheets of A4). Again, the temperature dropped but it did not rise again. Therefore, I assume that with about A = 0.09 m² = 1% (1.5 sheets of DIN A4) of defective tent area, a balance would occur, with a constant +5°C temperature loss.
These values also apply to the "Dyatlov tent" with a tendency to a slightly higher temperature loss due to the poorer surface/volume ratio.
I suspect that the Dyatlov tent had about 1.5 to maximum 2 sheets of A4 damage. If there had been more damage, major repairs would necessarily have been carried out immediately, even if there had been no

wind. The problem was that the group could not know the absolute temperature loss because they did not have thermometers outside or inside, like I did.

"...We know, there was at least one hole in the tent and Dyatlov's jacket was found hidden inside."
(Dyatlovpass.com)

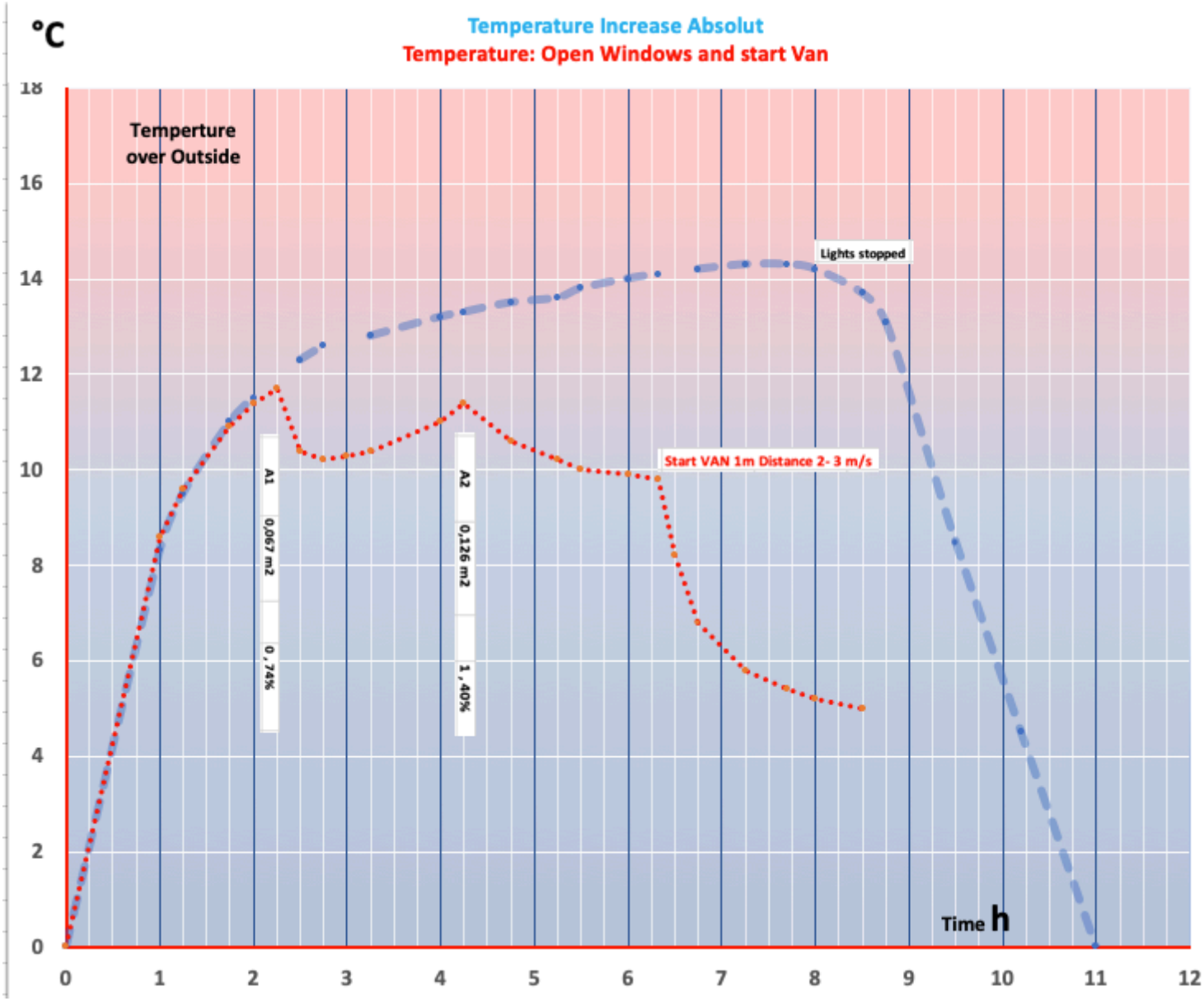
Next, the wind was simulated in my experiment. As can be seen in the picture above, I used a small room fan of 40 watts. The wind speed was around 4 m/s = 15 km/h. The fan was positioned at the height of the opening - at 1m distance with the tent opening still A2 = 0.124 m^2 (1.4%).
Immediately the temperature in the tent fell drastically by ~10°C and even with a 1% opening, the temperature would have dropped by 10°C.

All this data is however insignificant in relation to the Dyatlov accident. Because, the fan produces a mild breeze which is similar to what is created in a living room for a pleasant climate.

On "Kholat", during the night of February 1 1959, there were wind speeds of at least 20 m/s to 35 m/s. That is 5 to 10 times higher.

It should be clear to every reader that the tent with holes now offered absolutely no protection.

The combination of holes in the tent and wind was and is deadly.


°C
Temperature Increase Absolut
Temperature: Open Windows and start Van
Temperture over Outside
Lights stopped
Start VAN 1m Distance 2- 3 m/s
A1
0,067 m2
0 , 74%
A2
0,126 m2
1 , 40%
Time h
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
8
9
10
11
12

Two days after the end of my tests, a wind of only 10 m/s appeared. The wind came from the houses in the background and all of the fixing anchors were ripped out of the ground – this even if the 2-metre-high door kept most of the wind out. The outer tent had come loose and blew away.The inner tent stayed in the courtyard because there was still a heavy table inside, weighing about 5 kg.

The attentive reader would have noticed that the tent would normally have flown away from the gate and into the courtyard. But here a vortex was created that reversed the wind direction and pushed the tent against the gate and lifted it. Simply put - this exact effect is also described at the "Kholat". From a certain wind speed onwards, a vortex is created behind a mountain ridge, which flowed against the tent from the valley side.

Wind-Chill-Effect

https://www.youtube.com/watch?v=fbZjcKl3Z6o

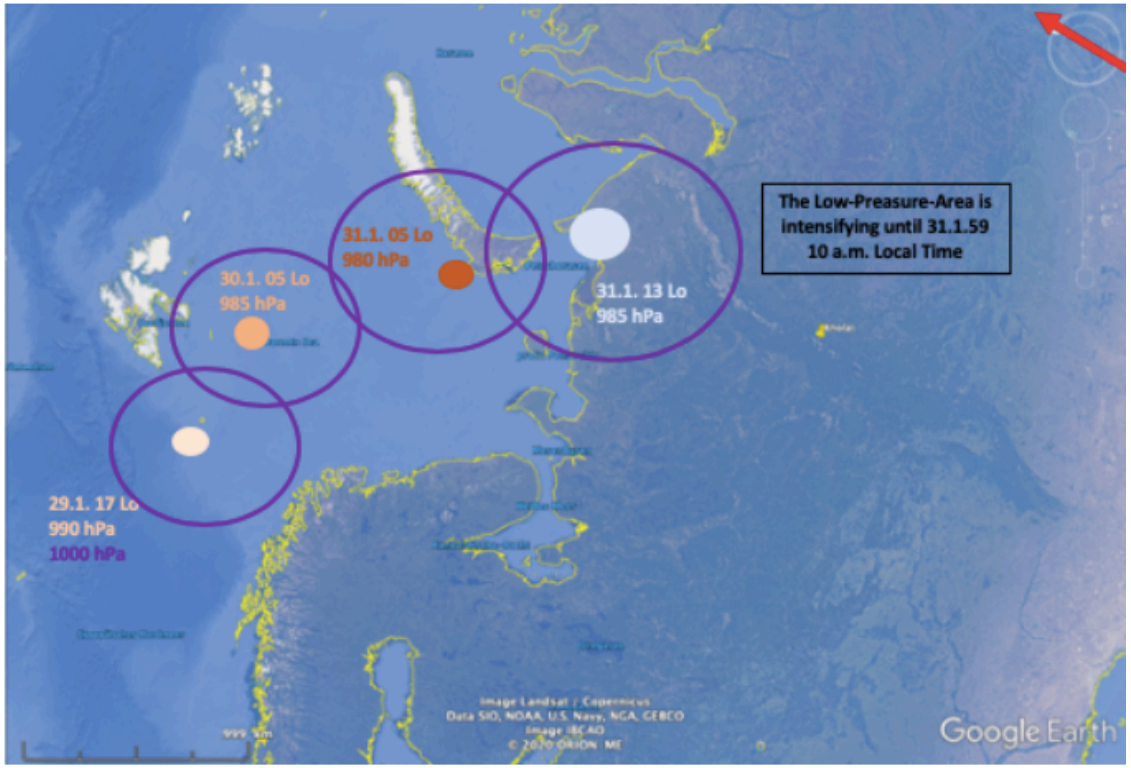
1. **Dyatlov-Tent: Volume around 4 m^3. Subtract the volume of people and equipment ~ 0,8 m^3. This results in 3,5 m^3 free volume.**
2. **Tent area around 13,3 m^2.**
3. **The condition of the tent was not good, as people reported ongoing repairs during the tour. Dyatlov even stuffed his pullover into a hole. The group certainly underestimated the effect of the wind, as they mainly stayed in valleys sheltered from the wind before 1.2.59.**
4. **It thinks that there were < 1 % holes in the tent. The entrances were closed with wooden toggles and were creped. 2 tents were stitched together.**
5. **One tea light generates ~ 40 Watt. One person in the winter conditions gives off just as much heat (otherwise 3-4-times normally). 9 people therefore generate ~ 400 Watt.**
6. **The tent temperature would have increased by +15°C compared to the outside temperature in an ideal case (no wind, no holes).**
7. **Presumably the group assumed outside temperatures of maximum – 20 °C (+/- 5°C) and wind speeds of around 15 m/s (+/- 5 m/s).**
8. **Using films from the internet and the film by Dr. Borzenkov (35 m/s), I have estimated how often a tent wall or a tent flutters in a strong wind. A large tent flutters ~ 2 times per second and a smaller tent around 3-4 times per second. The air inside the tent vibrates in the Infrasound Range!**
9. **In one hour, that is ~ 15 000 fluttering movements. A completely conservative estimate is that about 150 m^3 (more likely up to 300 m^3) are circulated through the holes (openings) of the tent, i.e. transported out.**
10. **The possible maximum profit through body heat of +15°C is of course no longer available, as my experiments shows.**

11. **The fluttering also creates a "Wind-Chill-Effect" in the tent. I estimate this to be around >/= 50% of the normal value of the wind-chill effect. The increased wind speed, with gusts and vortexes, allowed the fluttering of the tent walls to also increase the holes in the tent uncontrollably.**
12. **There were 2 stages in the weather development leading up to the disaster.**
13. **Phase 2 from 7 p.m.-locally a previously not calculated "Katabatic-Wind", with wind speeds and gusts of about 35 m/s (+/- 5m/s) and with temperatures of about - 25°C to -30°C. The wind speed is not impossible, because 35 m/s was measured by Dr. Borzenkov himself on 27.01.2015. All expeditions reported a sudden drop in temperature overnight. R. Holmgren also reported -43 °C on 1.2.2019.**
14. **Phase 3 started around 10 to 11 p.m.-local with the breakthrough of vertical Cold Air with temperatures -35°C to -50 °C - see below.**
15. **By 7 p.m. at the latest, the group should have been understood that survival in the tent would not be possible under these circumstances (Wind-Chill -38°C). However, many indications (which I will not discuss here) suggest that the group did not leave the tent before 9 p.m. At that time the Wind-Chill was inside -45°C and outside - 60°C. The group lost a lot of vitality as a result from 7 p.m. to 9 p.m.**
16. **Due to group dynamics, in view of a possible near death, psychological effects also occurred in the group. Consciousness narrowing, limited attention, the inability to process stimuli, lethargy and disorientation were the result. This resulted in partly senseless, illogical actions and flight reactions, which can occur within minutes. In the meantime, "normal actions" of some group members certainly occurred in parallel as well.**
17. **https://icd.who.int/browse10/2016/en#/F40-F48**
    Especially F43.0

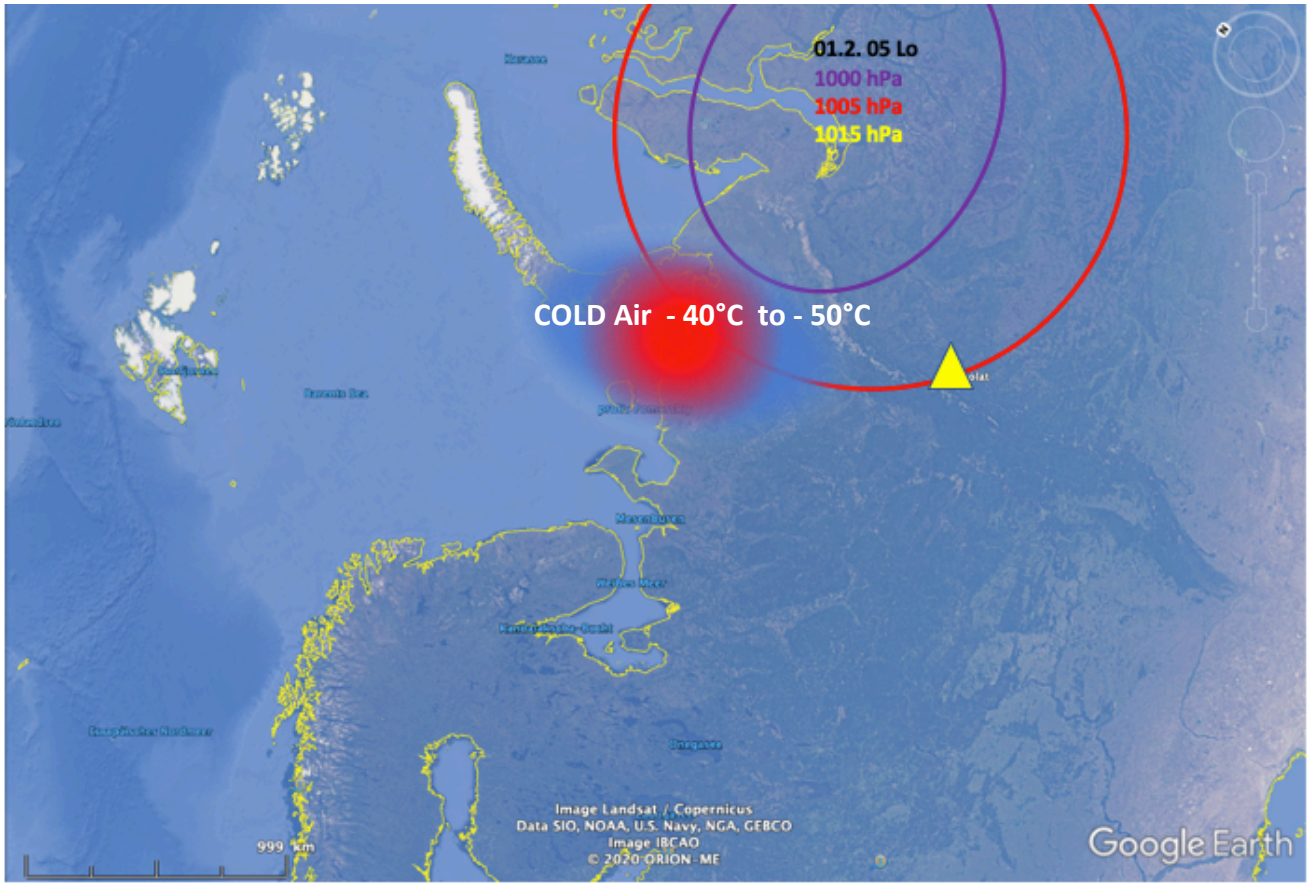
    The general behaviour of the group when leaving the tent is still hard to understand and one of the biggest mysteries.

Cold-Air-Drop:

Weather-Situation:



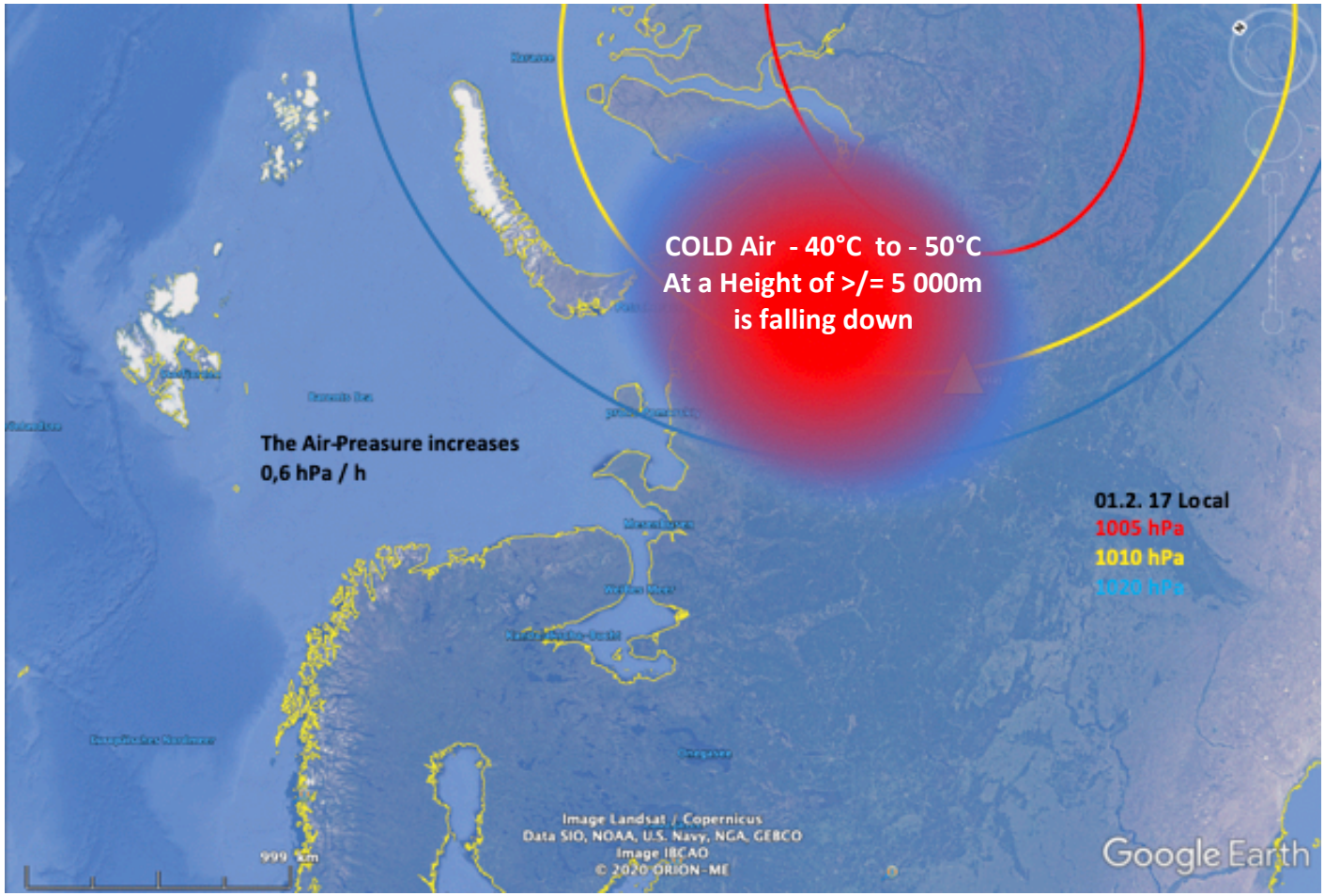
On January 31, 1959 at 11 p.m. the Low-Pressure came under High-Pressure influence.



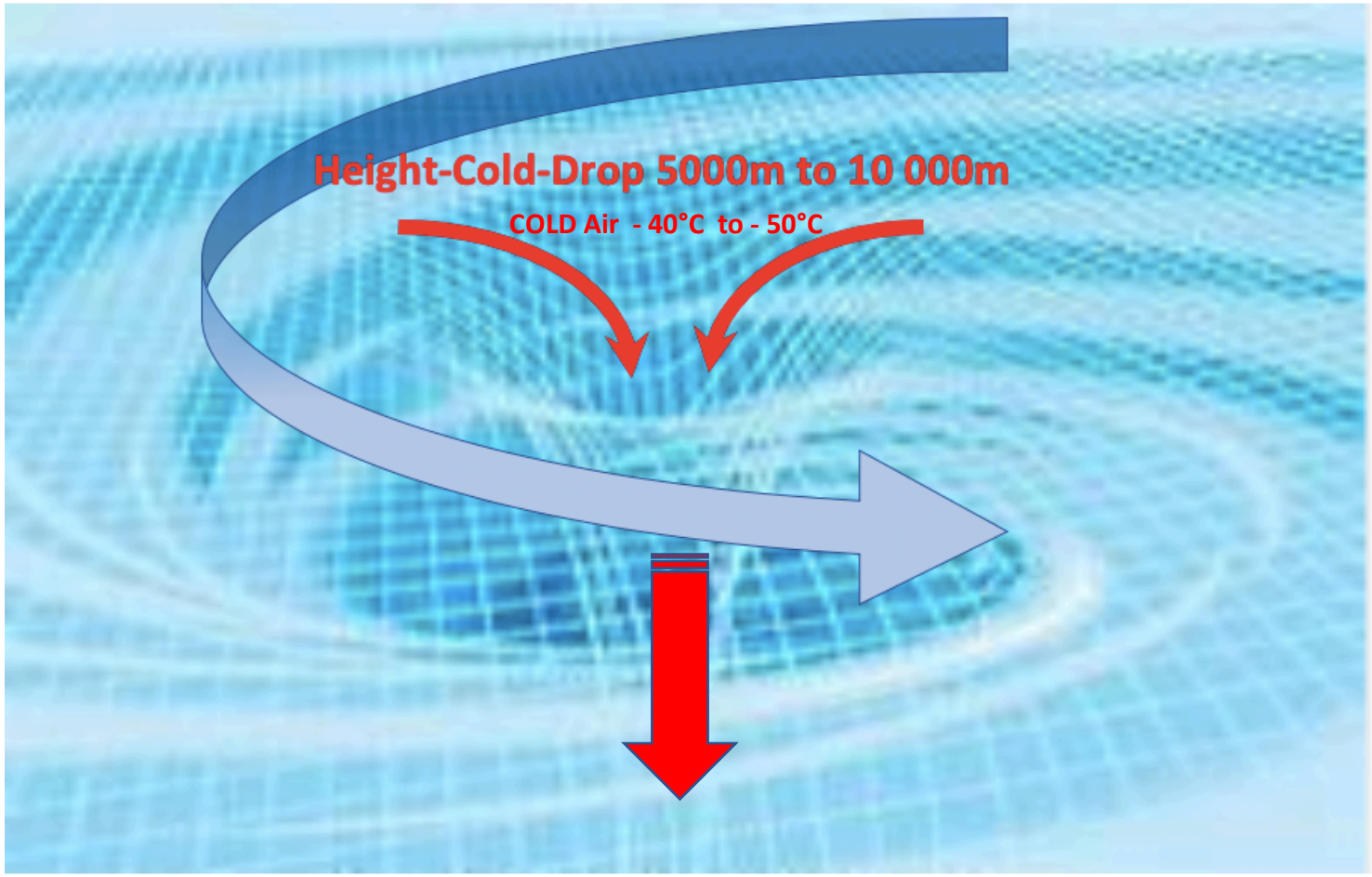
Very cold air (Cold-Drop) suddenly sank from a great altitude (5 000m to 10 000m) at 01.02.59, 05 a.m. This cold air in that high atmospheric altitude originally came from Northern Siberia.

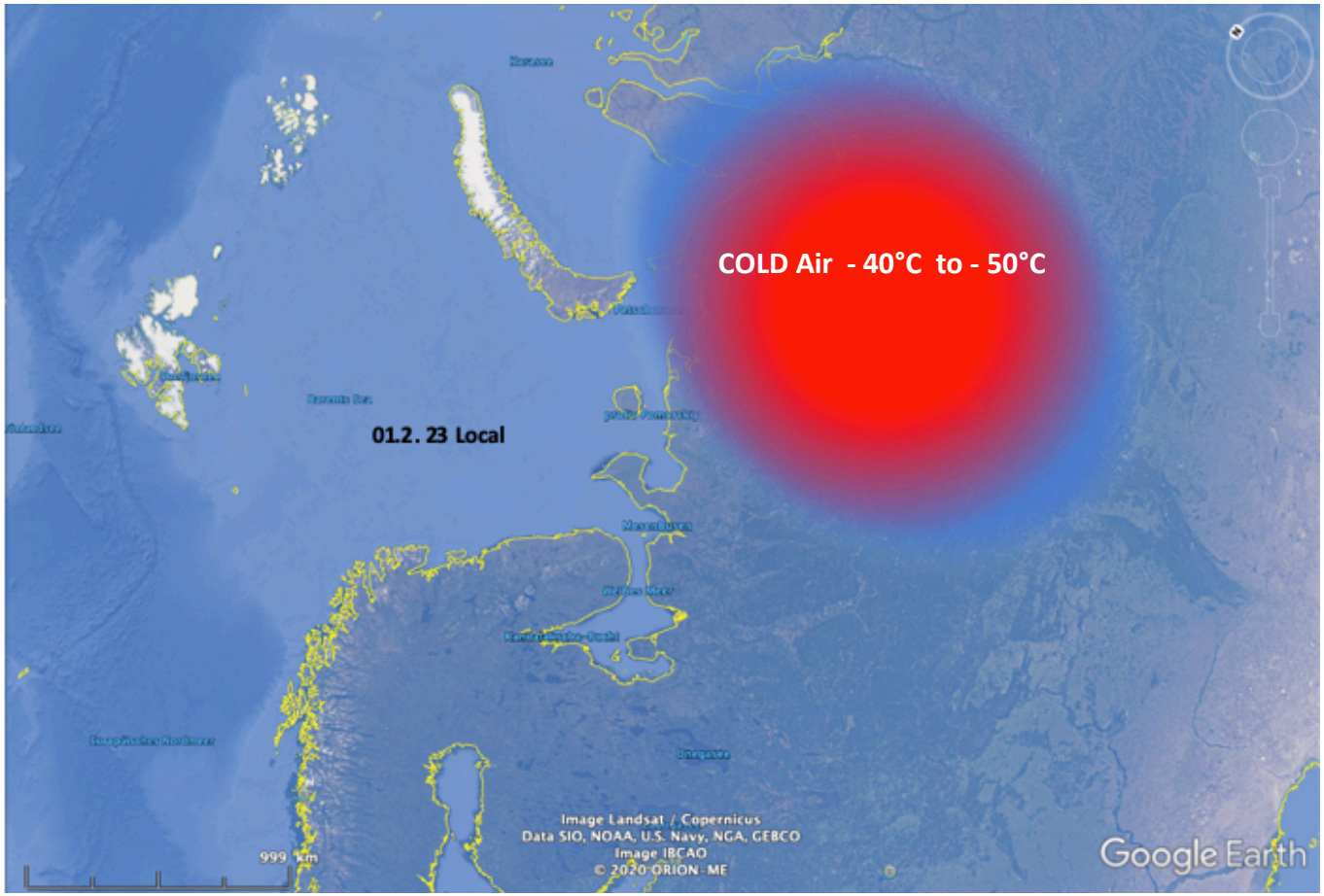
The yellow triangle marks the position of the tent.

For the sake of clarity, the "Cold Air Drop" is drawn here as a red-blue ellipse.



At about 5:00 p.m. the Cold-Air is near the "Kholat".


Height-Cold-Drop 5000m to 10 000m
COLD Air - 40°C to - 50°C

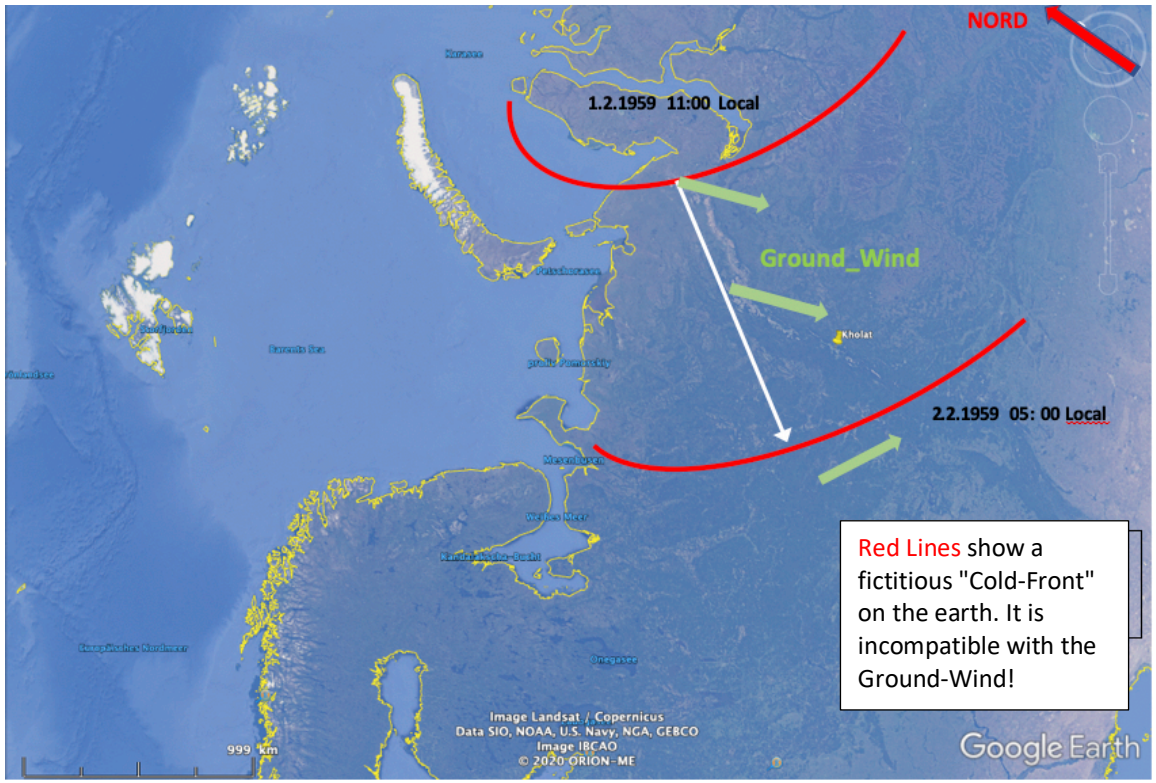


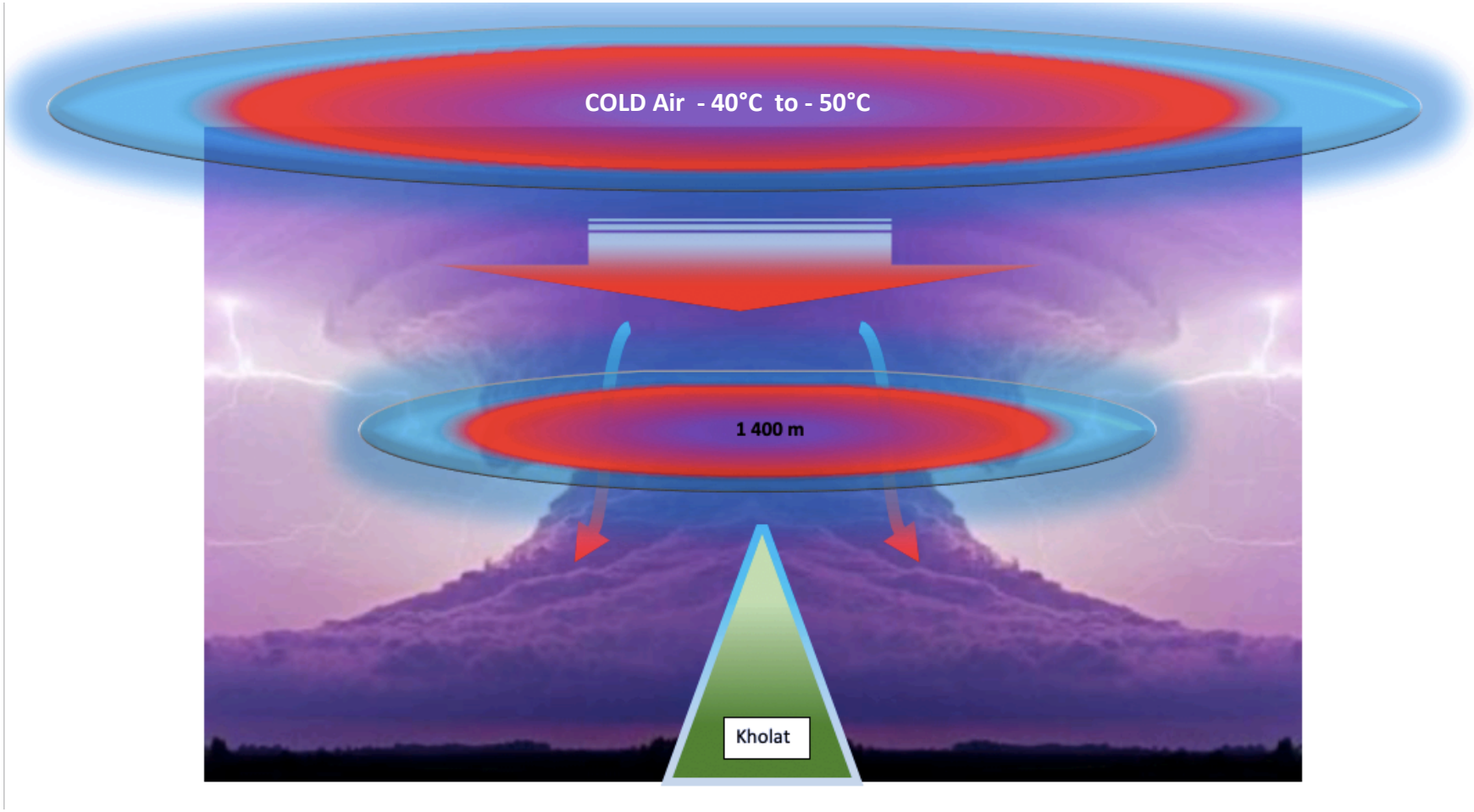
Under the increasing influence of high pressure, more and more cold air sinks from the height. At the same time, the cold air area is expanding towards the South-West.

Cold air ingress from above and its horizontal movement gives the impression of a Cold Front on the ground but they are fundamentally different.

The exact evaluation of the wind of all-weather stations for the period from 29.1.1959 to 4.2.1959 clearly shows that the ground wind would have been transverse to a ground "Cold-Air". The thesis of some commentators in some forums that a "Cold-Air-Front" on the ground from the north would have come to the "Kholat" at 55 km/h is absolute unacceptable.

Still other commentators in Russian forums agree completely with my analysis.





For the sake of clarity, a picture is shown here to demonstrate the vertical character of the Altitude-Layers.

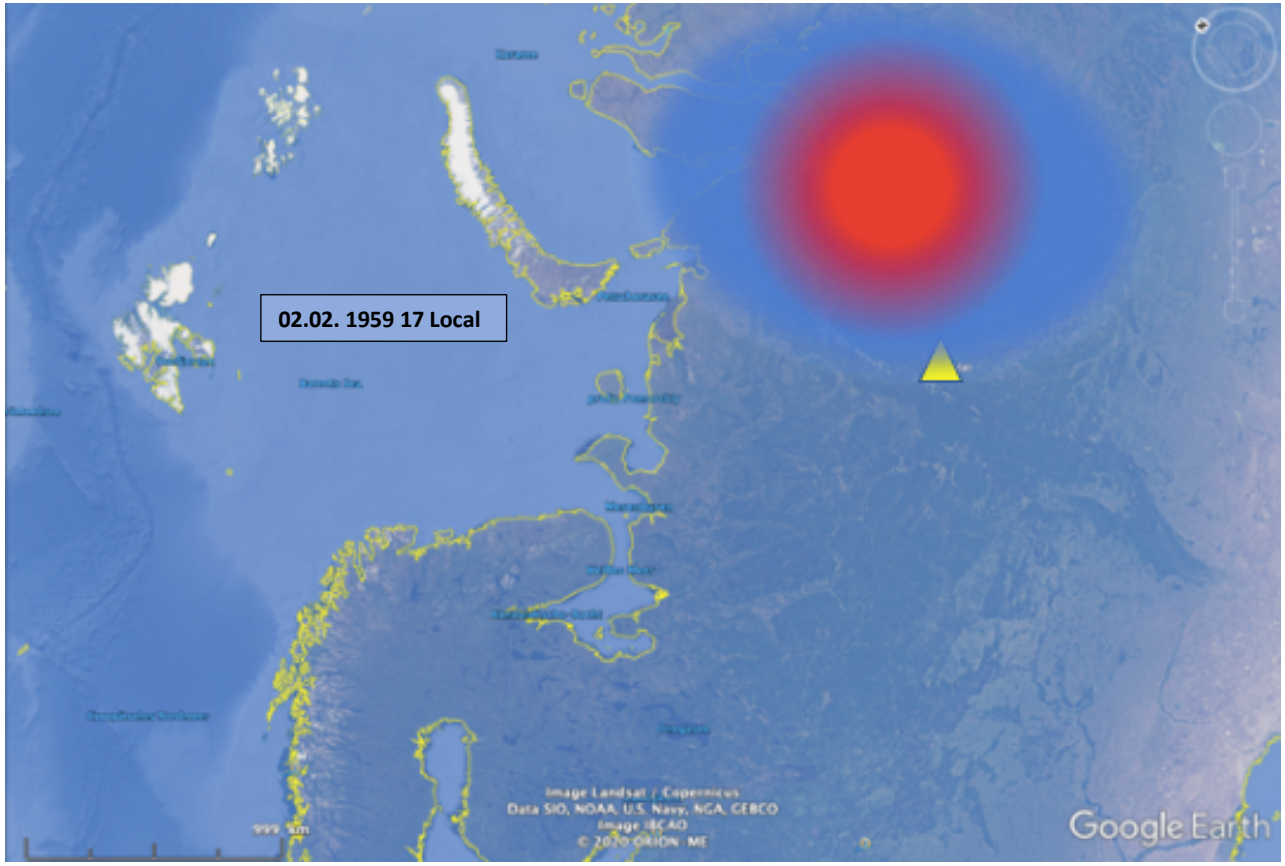
The sinking "Cold Air" is cloudless because it contains practically no humidity.

Inger Ludwig (www.bude31-helgoland.de)

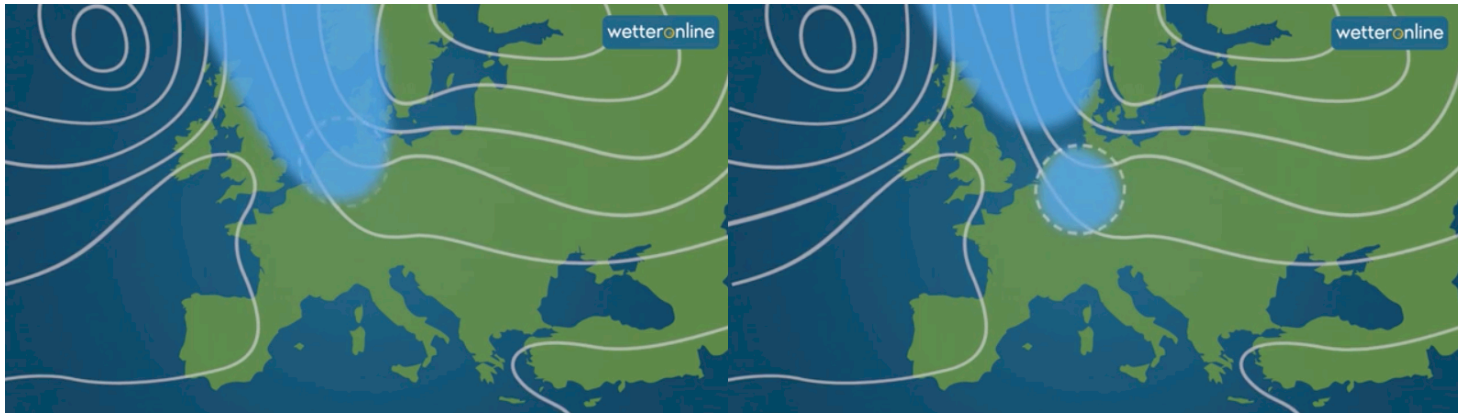
"Helgoland" in the North Sea, which is an island belonging to Germany. Here you can see a catastrophic development, similar to the situation on 1/2 February at "Kholat".

Here too, is an extremely "Cold-Fall-Wind" from above.

This natural event (100 km to 300 km) completely destroyed a campsite.



At 02.02.1959 around 5 p.m., the high-pressure influence weakens and the original Low-Pressure area from the Barents Sea dissolves.



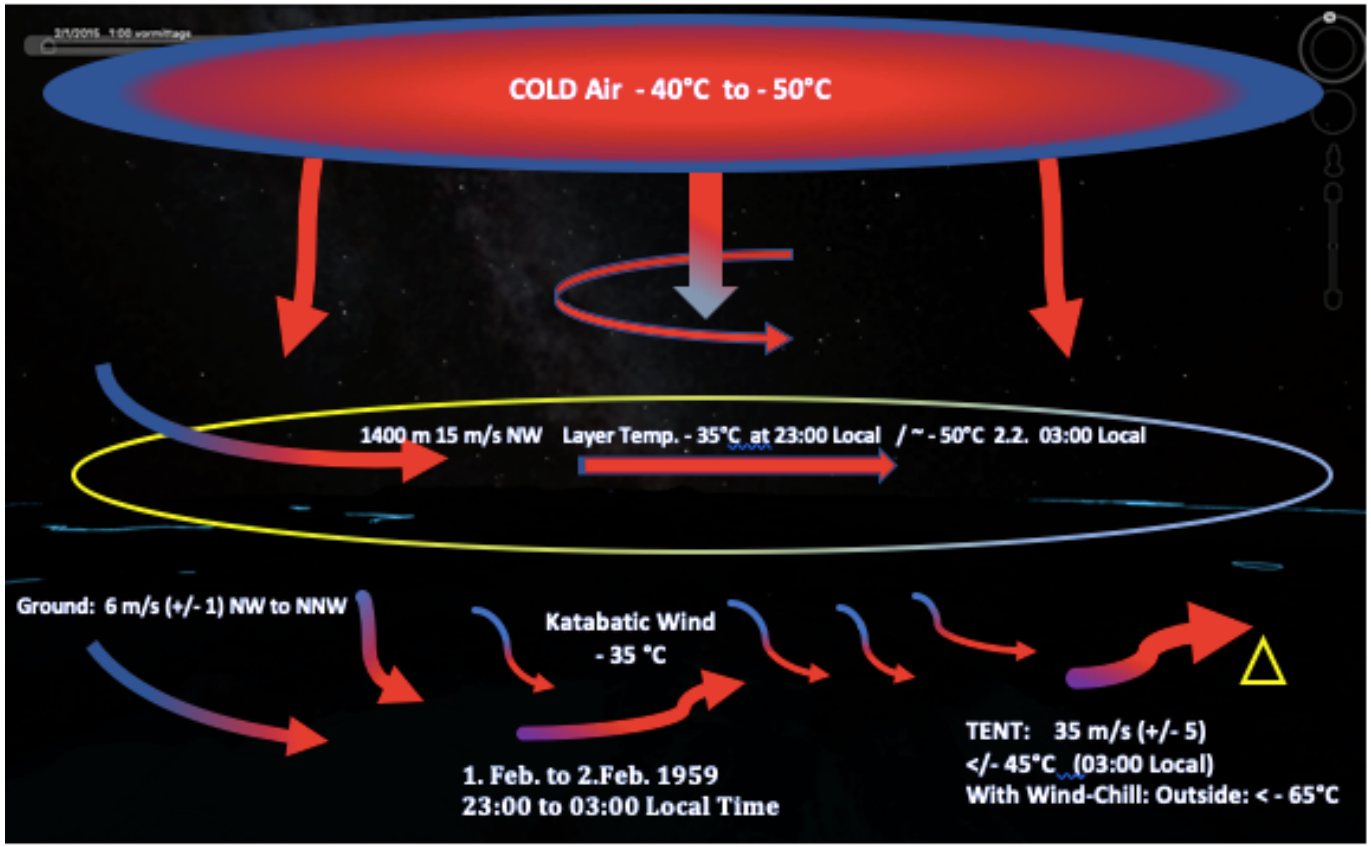
https://www.wetteronline.de/wetter-videos/2018-05-15-kt

"Cold-Air-Drop" is created by a "Cut-Off-Process" or by an aging "Low-Pressure-Area". This last process was decisive for the Dyatlov accident. For meteorologists, "Cold-High-Altitude-Air" suddenly arriving under high pressure is always a problem.

There is a saying in English-speaking countries: *«Cut-off low, forecasters woe».*

3. Phase

1. Februar 1959 11:00 p.m. to 2.Februar 03:00 a.m. Local-Time.



Google-Earth-Pro

In "Nyaksymvol/Burmantovo" -28.8°C was measured, in the night of 1/2 February, at an altitude of 170 m with practically no wind. This confirms my data as the air warms as it descends and the falling vertical cold air has no horizontal component.

The disaster had consequently *3 important nature problems*.

The "Katabatic Wind ", the "Acute-Stress-Reaction" and the "Cold-Air-Drop" from altitude.

In addition, there were *2 human factors*.

The choice of the campsite and the bad condition of the tent and late start to the valley.

Would it have been possible to survive the disaster?

TENT in perfect condition

	°C	°C	°C	°C	°C	°C	°C	°C	°C
m/s	-10	-15	-20	-25	-30	-35	-40	-45	-50
15	5	0	-5	-10	-15	-20	-25	-30	-35
20	5	0	-5	-10	-15	-20	-25	-30	-35
25	5	0	-5	-10	-15	-20	-25	-30	-35
30	5	0	-5	-10	-15	-20	-25	-30	-35
35	5	0	-5	-10	-15	-20	-25	-30	-35
40	5	0	-5	-10	-15	-20	-25	-30	-35
45	5	0	-5	-10	-15	-20	-25	-30	-35

TENT not in perfect condition. 50% Wind-Chill only!

	°C	°C	°C	°C	°C	°C	°C	°C	°C
m/s	-10	-15	-20	-25	-30	-35	-40	-45	-50
15	-15	-20	-28	-34	-40				
20	-16	-22	-29	-35	-41				
25	-17	-23	-30	-36	-42				
30	-17	-23	-30	-37	-42				
35	-18	-25	-32	-38	-43				
40	-25	-32	-38	-39	-45				
45									

Table 1 + 2

On 1.2.59 it was decided to choose the campsite high on the "Kholat" to continue the way to the "Otorten" the next day.

https://dyatlovpass.com/dyatlov-group-diary

31.Januar 1959
...Had a surprisingly good overnight, air is warm and dry, though it's -18°C to -24°C.
... Wind is western, warm, piercing, with speed like the draft from airplanes at take-off. Firn, open spaces.

There are social psychological studies that describe group processes. Reference is made to the phenomenon of "risky shift".
It describes the phenomenon or the thesis that groups, especially homogeneous groups (like friends) make riskier decisions and stick to made wrong decisions longer.
Perhaps a smaller group would have camped in the valley?
But I do not want to have discussions on this topic here in the abstract. There is a topic in my detailed report.

1. I am sure that the group assumed the following weather conditions in the night from 1/2.2.1959 15 m/s +/- 5 m/s and 20°C +/- 5°C. Looking at the tables, we can see that under this premise the group chose the location (ignoring the danger of holes in the tent) in view of the further journey to the Otorten. (Small black frame in table 1).

2. Considering the possible changes for the worse in the weather, the tolerance limit is still ok. Up to 35 m/s and -30°C could still be tolerated, with a perfect tent (Big black frame in table 1).

3. Where was the group's fundamental mistake? The group underestimated the holes in the tent. The holes dramatically changed the conditions. Furthermore, the late start to the valley was also catastrophic.

4. Theoretically, if the group had decided to leave for the valley immediately at 7 p.m., there would have been enough life energy left to take warm clothes and tools.
In the valley, they could have dug themselves into the snow and start a fire at the same time.
The cold blast that came into the valley after 11 p.m. could possibly have been survived, for some.
Starting off for the valley at 9 p.m. was absolutely deadly under these conditions. They died at the latest around 3 a.m.
Wherever they were and whatever clothes they wore.

4. Even without the vertical "Cold-Air-Blast" from altitude, the "Katabatic Wind" with the defects of the tent and the late start at 9 p.m. would probably have been deadly for some or all.

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