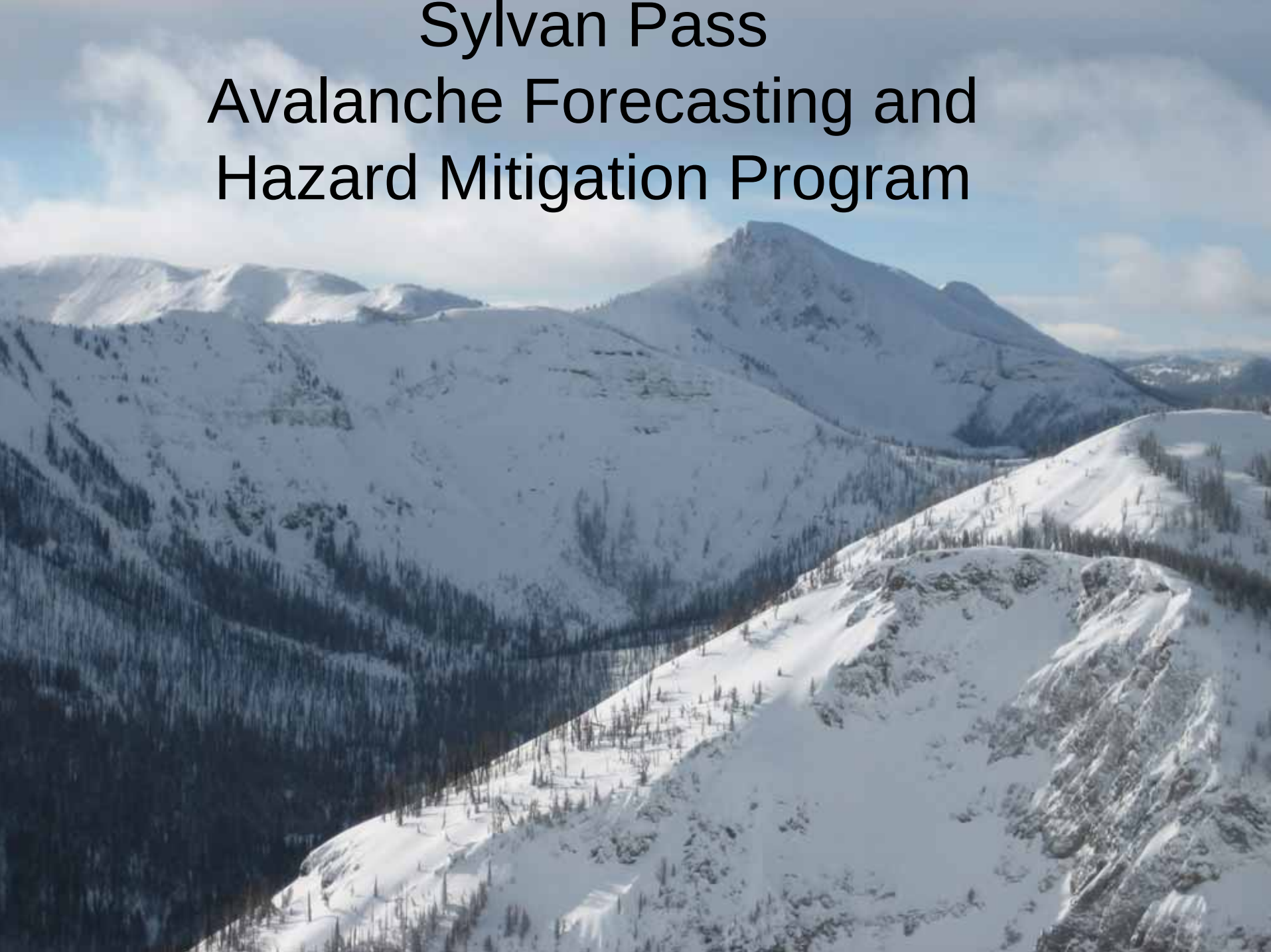
Sylvan Pass Avalanche Forecasting and Hazard Mitigation Program



Employee Safety

- Sylvan Pass Operational Profile established procedures for forecasting and mitigation activities.
- All employees involved in forecasting, hazard mitigation, and road grooming at Sylvan Pass are trained in avalanche awareness and rescue.
- All are equipped for avalanche rescue response.
- Forecasters and Assistants maintain more advanced levels of training and experience.

Avalanche Awareness and Rescue Training

Public Safety

- Commercial operators receive orientation on safe travel practices through Sylvan Pass.
- Visitors are contacted at East Entrance, Fishing Bridge Warming Hut and occasionally at Sylvan Pass.
- The Yellowstone website contains information on winter travel through Sylvan Pass.

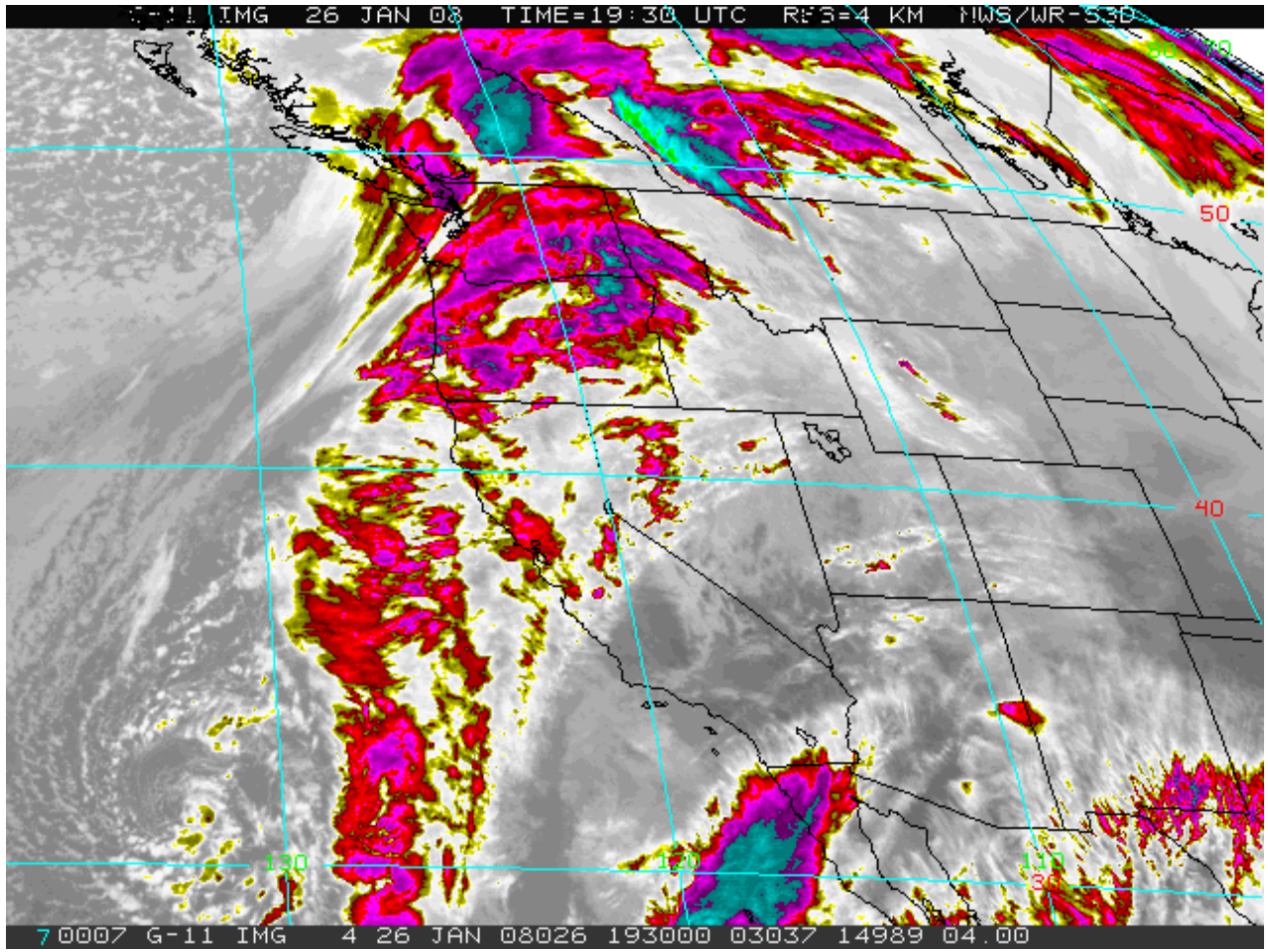
One of three Forecasters performs daily assessment and monitoring of conditions at Sylvan Pass and coordinates avalanche hazard mitigation, if needed.

- **Maura Longden** – 25 years as an avalanche professional.
- Former Professional Ski Patroller, International Mountain Guide, Backcountry Ski Guide, NPS Winter Ranger and Avalanche Specialist in Yellowstone, Yosemite, and Rocky Mountain. NPS Climbing & SAR Ranger

- **Kurt Speers** – 4 years Sylvan Pass forecasting & hazard mitigation experience. Advanced level avalanche training. Assistant Gunner & Helicopter Project Manager. Former Mt. Rainier & Denali NP Ranger. Mountaineering & winter SAR experience.

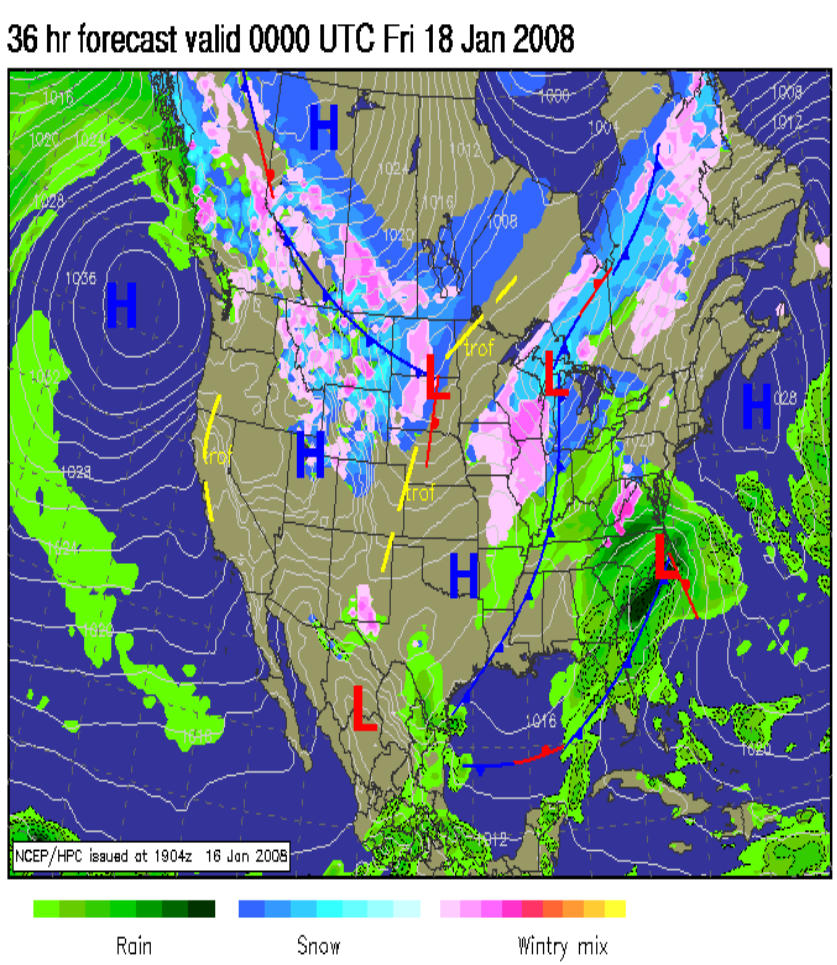
- **Rich Baerwald –** 28 years of experience as an avalanche professional and mountaineer.
- 18 years as Big Sky Ski Resort Avalanche Forecaster, control operations leader and lead artillery gunner.
- NPS Winter Ranger and Avalanche Specialist in Yellowstone and Yosemite NP. Climbing Ranger in Grand Teton and Rocky Mountain NP.

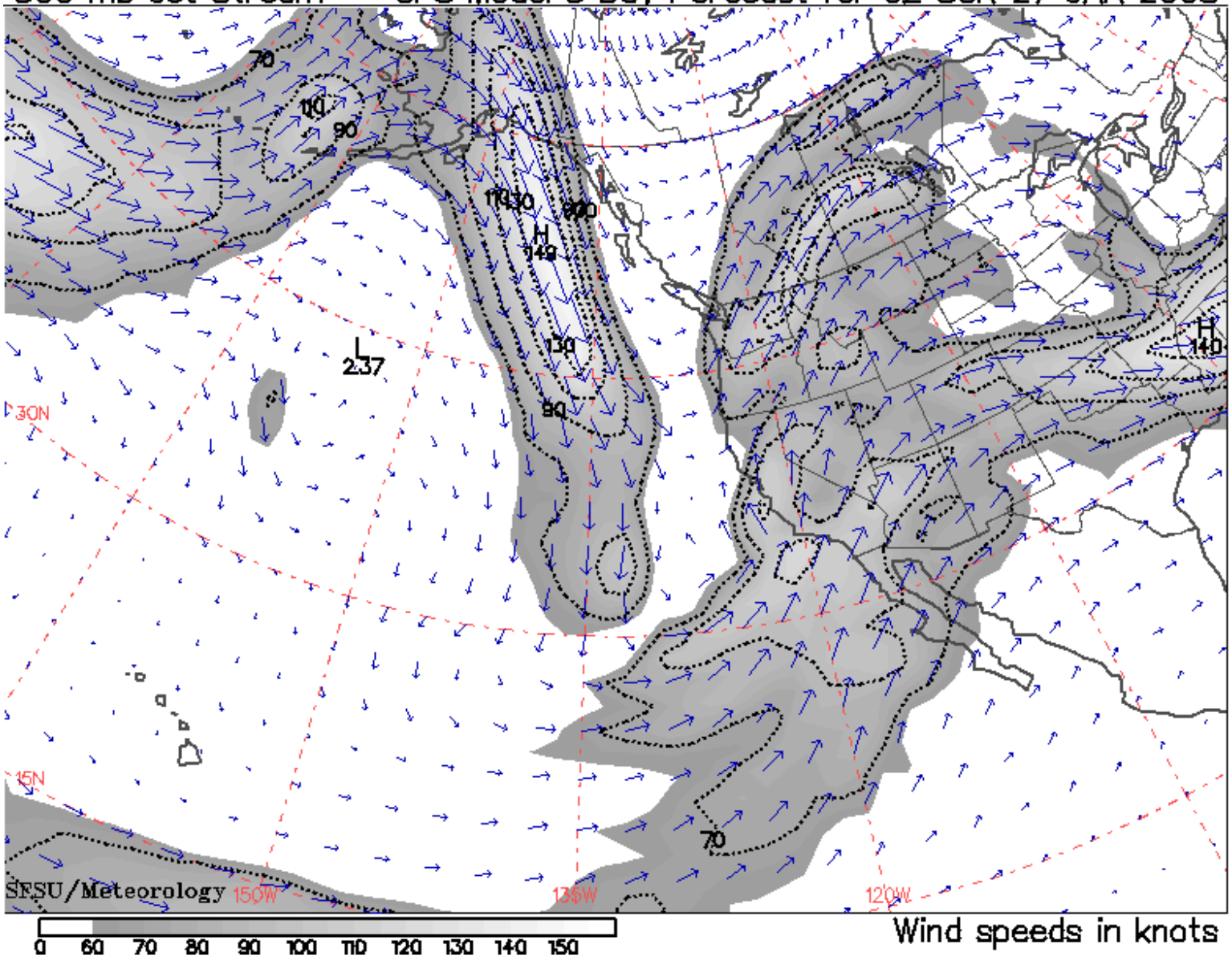
Our day begins and ends with weather forecasting



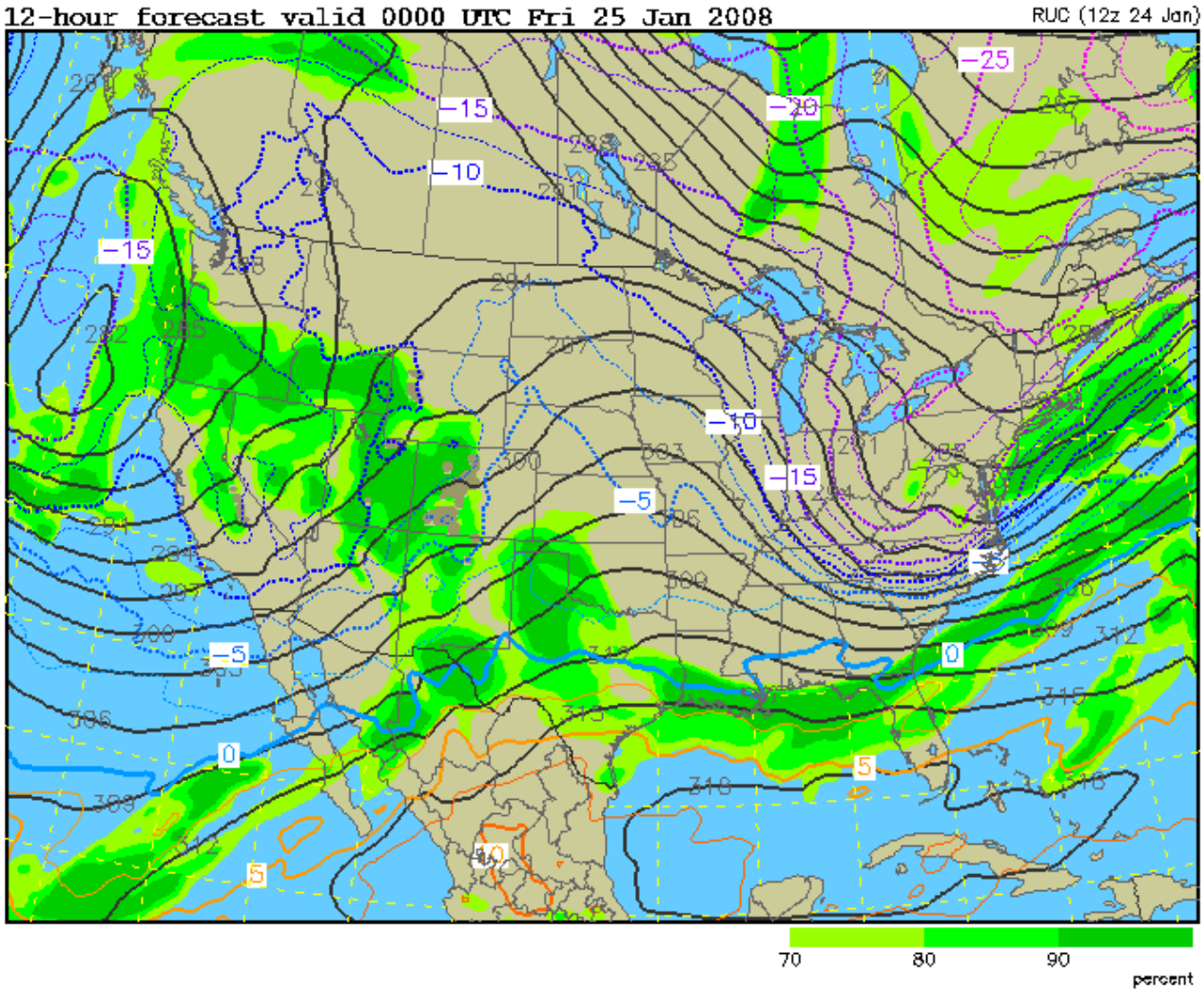
Weather Forecasting

- Key component of avalanche forecasting.
- Identify weather patterns that effect forecast area
- Important in predicting the effects of new snow and wind on the snowpack.
- Temperature changes, wind loading, and increased water content can be predicted.
- Is instability increasing due to weather factors?




300 mb Jet Stream
GFS Model 3 Day Forecast for 6Z SUN 27 JAN 2008
70
110
90
110
130
90
H
149
130
90
L
237
H
140
30N
15N
70
SFSU/Meteorology
150W
135W
120W
0 60 70 80 90 100 110 120 130 140 150
Wind speeds in knots

700 mb Heights (dm) / Temperature (°C) / Humidity (%)



Remote Automated Weather Stations

- **Forecasters utilize remote weather and snowtel sites to track weather influences on avalanche formation.**
- **Most useful stations are placed near avalanche forecasting area.**
- **Stations provide hourly updated information.**
- **Rapid temperature changes.**
- **Wind speed and direction.**
- **Water content of new snow.**
- **Total depth of snowpack.**

Morning Condition Assessment

Indicators

Road Conditions for Oversnow Travel

Evaluating Current Conditions at the Pass

1 Forecaster & 1 Assistant each day.

Teamwork, communication & safe travel practices

- Weather – wind, 24-hour snowfall, temp.
- Signs of snowpack Instability
- Visibility
- Changes since last observation
- Road conditions for oversnow travel


Observe slide paths from
various vantage points

Weather Factors

- Recent strong winds
- Recent heavy snow or rain
- Water content exceeding 1.0” since last mission
- Sudden warming (+12 to 15•F over 12 hrs)
- Recently wind loaded slopes
- Localized areas of convexity, especially with thin snowpack and rocks underneath

Loading

- Snow or rain in the last 48 hours
- 1 inch per hour of snowfall for 6 hours or more
- Amplified by terrain features
- Amplified by high winds

Snow Transport

Snow Study & Field Work


Snowpack Observations

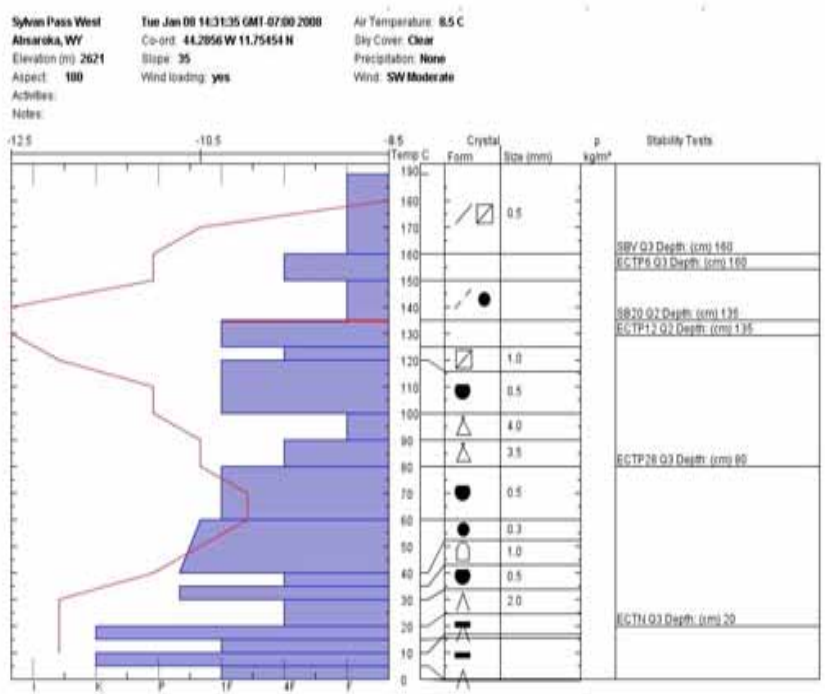

• Study Slopes
• Fracture Line Profiles
• Starting Zones
• Representative Slopes
• Safe Locations!

Slope Angle, Elevation and Aspect

Snowpack Structure and Stability

Stability Tests

Documentation



Open or Close?

Sylvan Pass Re-Opening

How long will the road closure be in effect?

- **Until avalanche hazard has decreased or been mitigated.**
- **Until signs indicate increased stability.**
- **Until visibility improves, allowing forecasters to make an evaluation.**
- **Until road grooming can be safely conducted through the avalanche zones.**
- **The Forecaster will make the determination to re-open based on current and predicted conditions.**

Communication and Documentation

- **Conditions are reported to Yellowstone Communications Center. Changes in road status result in e-mail notifications.**
- **Daily 3 p.m. forecasters briefing for Sylvan Pass staff.**
- **Forecaster prepares daily avalanche discussion following the briefing. Weather forecast is updated.**
- **Discussions are posted for review by all staff working at Sylvan Pass.**
- **Forecasters complete documentation of avalanche hazard mitigation missions, natural avalanche occurrences, snow observations.**

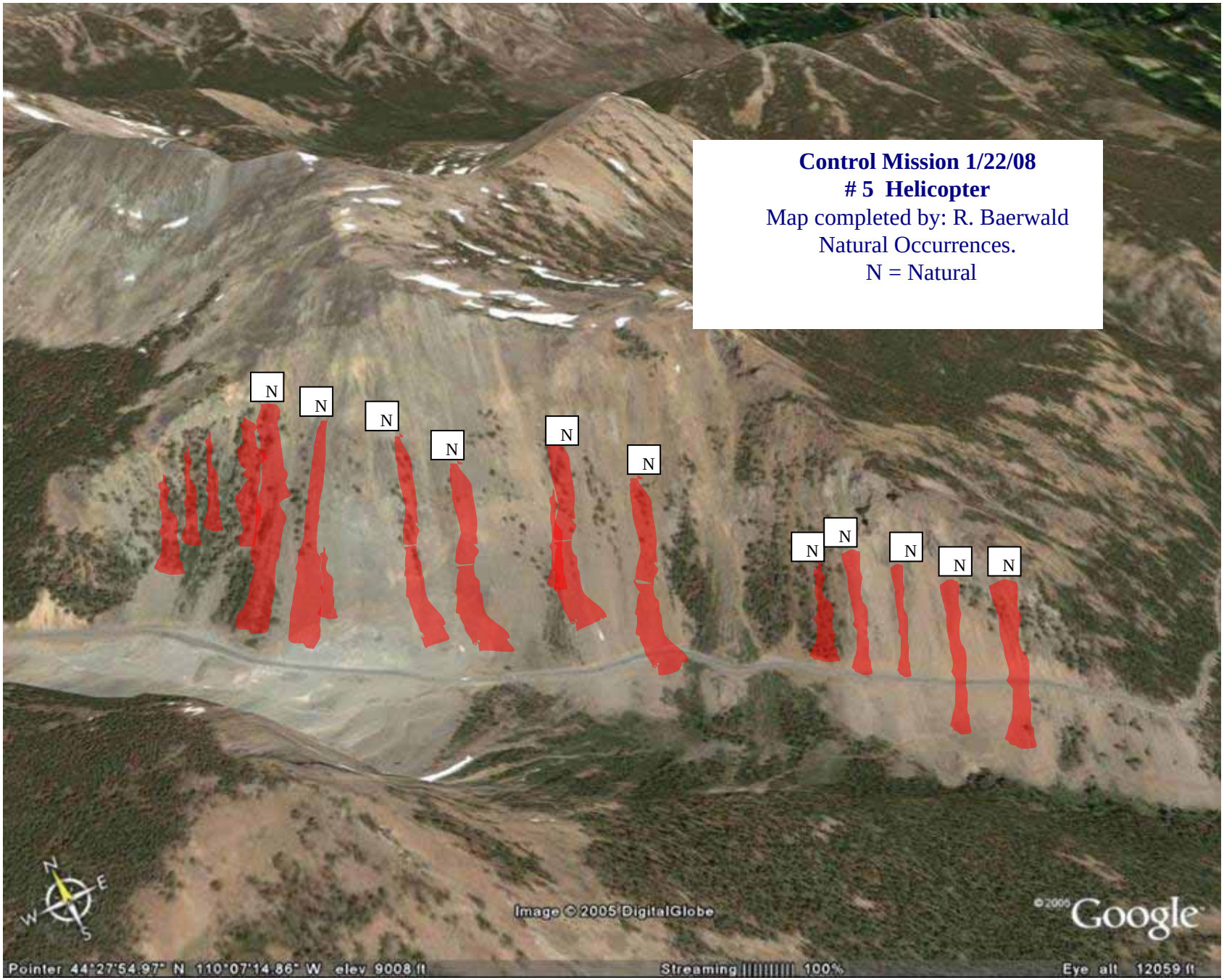
WEATHER AND AVALANCHE DISCUSSION
Sylvan Pass
Wednesday – January 9, 2008:

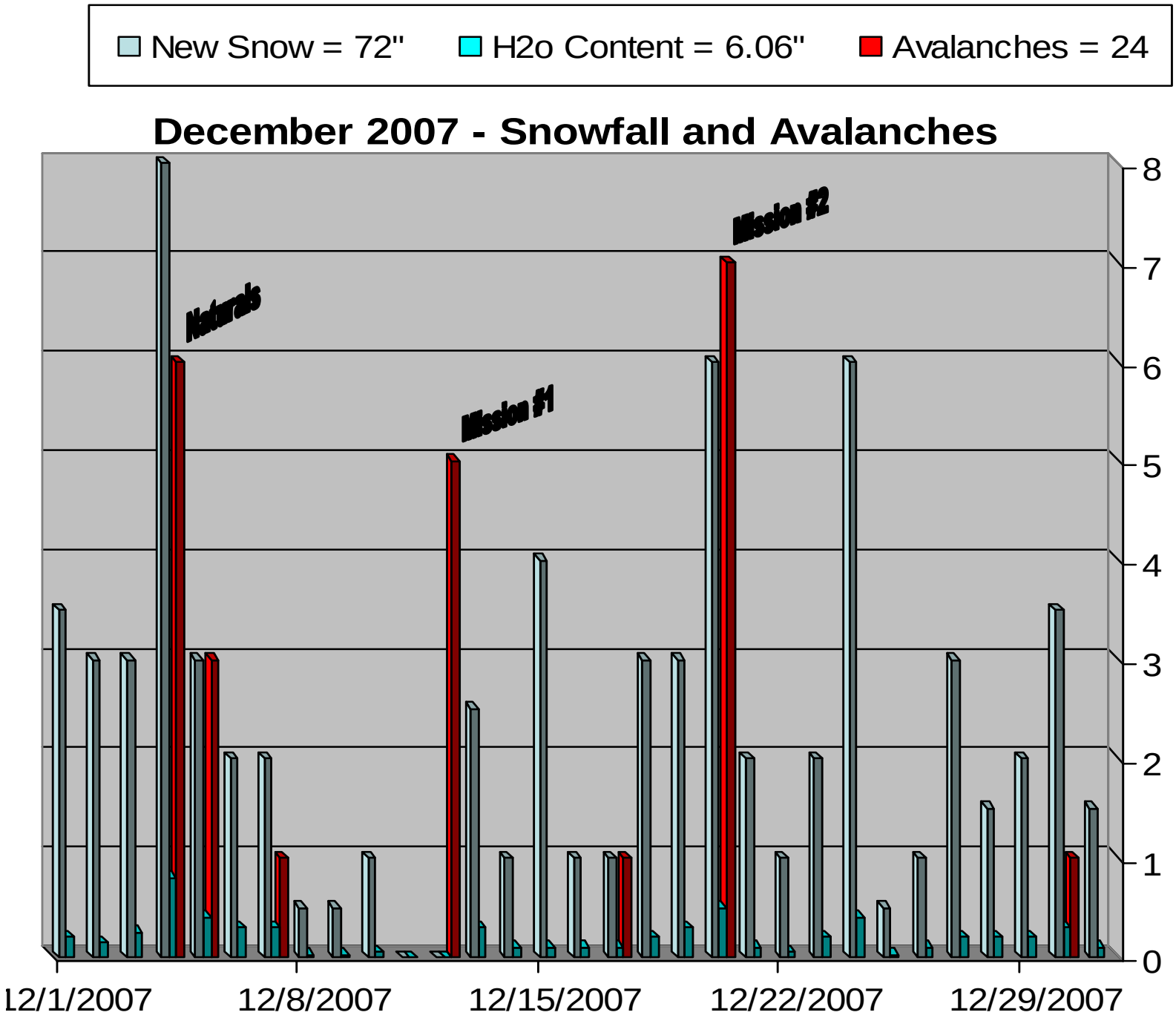
Discussion:

- The East Entrance Road is CLOSED to oversnow travel.
- The Sylvan Lake snotel site received 8” of new snow overnight and an additional 4” in 2 hours between the hours of 830am and 1030am. The new snow total is now 22-24” with 1.20” of water content since the last howitzer mission on 01/01/08.
- The howitzer mission on the 1st resulted in a deep slab avalanche with failure at, or just above the ground in shot #15. In the 1/7/08 and 1/8/08 data pits, a layer of faceted snow 45-55cm under the surface is our most significant weakness in the upper snowpack. With the recent snow and wind it will combine to create unstable conditions here at Sylvan Pass

Observations:

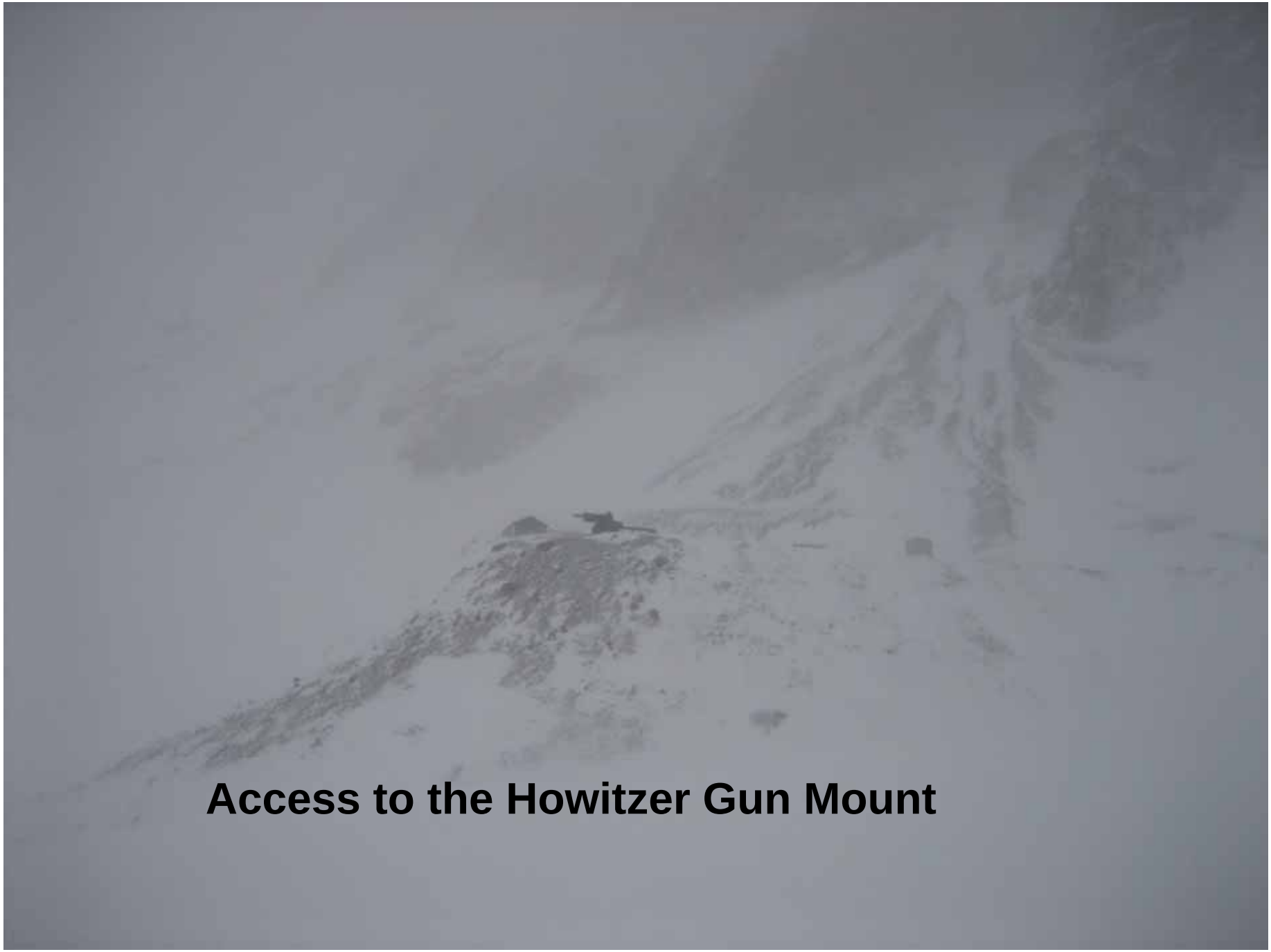
- Today’s rapid accumulation of new snow combined with wind has resulted in an elevated avalanche hazard at Sylvan Pass. During the morning forecast evaluation numerous natural avalanches were observed occurring on all aspects. 8-12” deep loose snow sluffs were starting on steep slopes, moving quickly and building up energy as these avalanches traveled. The potential for larger slab avalanches exists and avalanche hazard mitigation will be conducted to reduce the current and potential hazard.
- Observed numerous cornice failures from the top of Hoyt Peak. One on the West ridge of Topnotch and another on the NE side of Avalanche Peak. Both resulted in slab avalanches that ran full track. This is a good reminder that cornices above the gun mount remain suspect and could drop at any time.


Control Mission 1/22/08
5 Helicopter
Map completed by: R. Baerwald
Natural Occurrences.
N = Natural
N
N
N
N
N
N
N
N
N
N
N
Image © 2005 DigitalGlobe
©2005 Google
Pointer 44°27'54.97" N 110°07'14.86" W elev 9008 ft
Streaming 100%
Eye alt 12059 ft


New Snow = 72"
H2o Content = 6.06"
Avalanches = 24
December 2007 - Snowfall and Avalanches
Naturals
Mission #1
Mission #2
8
7
6
5
4
3
2
1
0
12/1/2007
12/8/2007
12/15/2007
12/22/2007
12/29/2007

Regional Coordination

- Regional Avalanche Forecast Centers provide general condition reports and advisories.
- Sylvan Pass forecasters contribute site specific observations to centers.
- Information sharing with other snow safety professionals accomplished through training and conference attendance, field work, web-sites and publications.



Access to the Howitzer Gun Mount

M101 Howitzer

Howitzer Operations

- Replaced 102 Howitzer this year
- Less preparation time
- Operates well in cold temperatures
- Direct or Indirect Fire
- Can be utilized during inclement weather


Helicopter Dispensed
Explosives Missions


N977CH


wind deposited snow
4-6' Crown Face
Shot #15
Elev. 9500'
Debris on roadway dimension = 200 yards wide x 15-20 deep
Elev 8500'


200 yards wide
15-20 feet deep


Road Grooming Operations

Re-assess Conditions