Adventure, Tourism, Hospitality and Sports

Avalanche Forecasting for Large Mountain Areas

Presented By: Mike Wiegele

Assistance by Bill Mark

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Helicopter Skiing

Introduction

- As a practitioner who works and plays in the mountains I have to act responsibly to measure and manage the risk.

- My thoughts and actions are to follow the **5 step checklist concept**:
  - *A mental structured approach in a systematic and methodical system in order to determine the desired end result.*

Nature's Complexity & Chaos

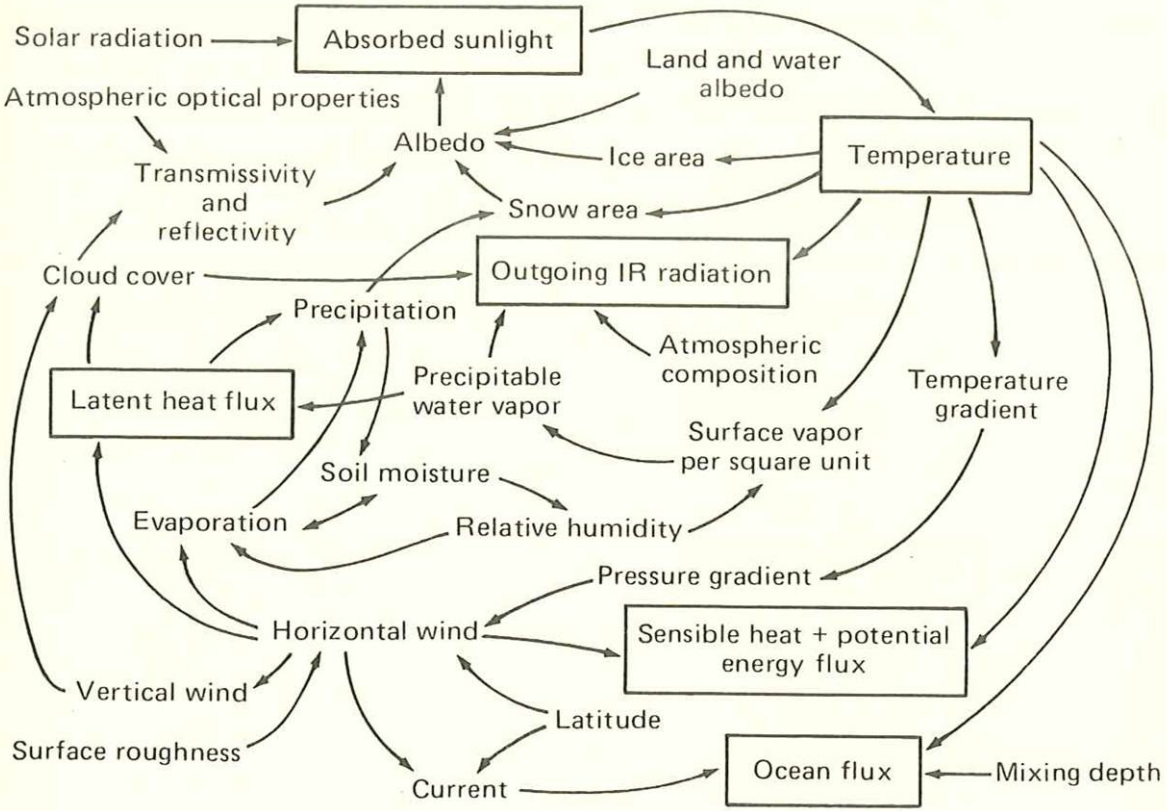

Figure 1.1. A model of the weather and climate machine illustrating its complex and intricate feedback mechanisms. The influence of several of the feedback processes are comparable in magnitude but opposite in direction. It is clear that variations in the energy input parameter at the top left may affect several of the meteorological parameters within the machine. From Kellogg and Schneider (1974).

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Our Goal

1. **Our organization:**
   - consists of experts in the field that have the highest current international safety standards
2. **The Law and legal liability:**
   - We must adhere to the Canadian law
   - We are responsible for people when we take them on high risk activities
   - **Duty of Care**

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Risk Management Plan for Loss Prevention

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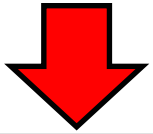
Warnings
Early detection
Prevention

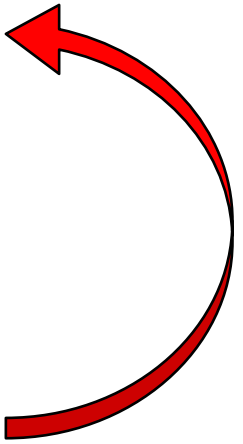
The 5 Step Checklist

5 steps stability rating system

1. Daily weather data
2. Graphs
3. Snow Profile observations
4. Field observations
5. Ski test and stability ratings



Ski terrain choice & use of guiding procedures



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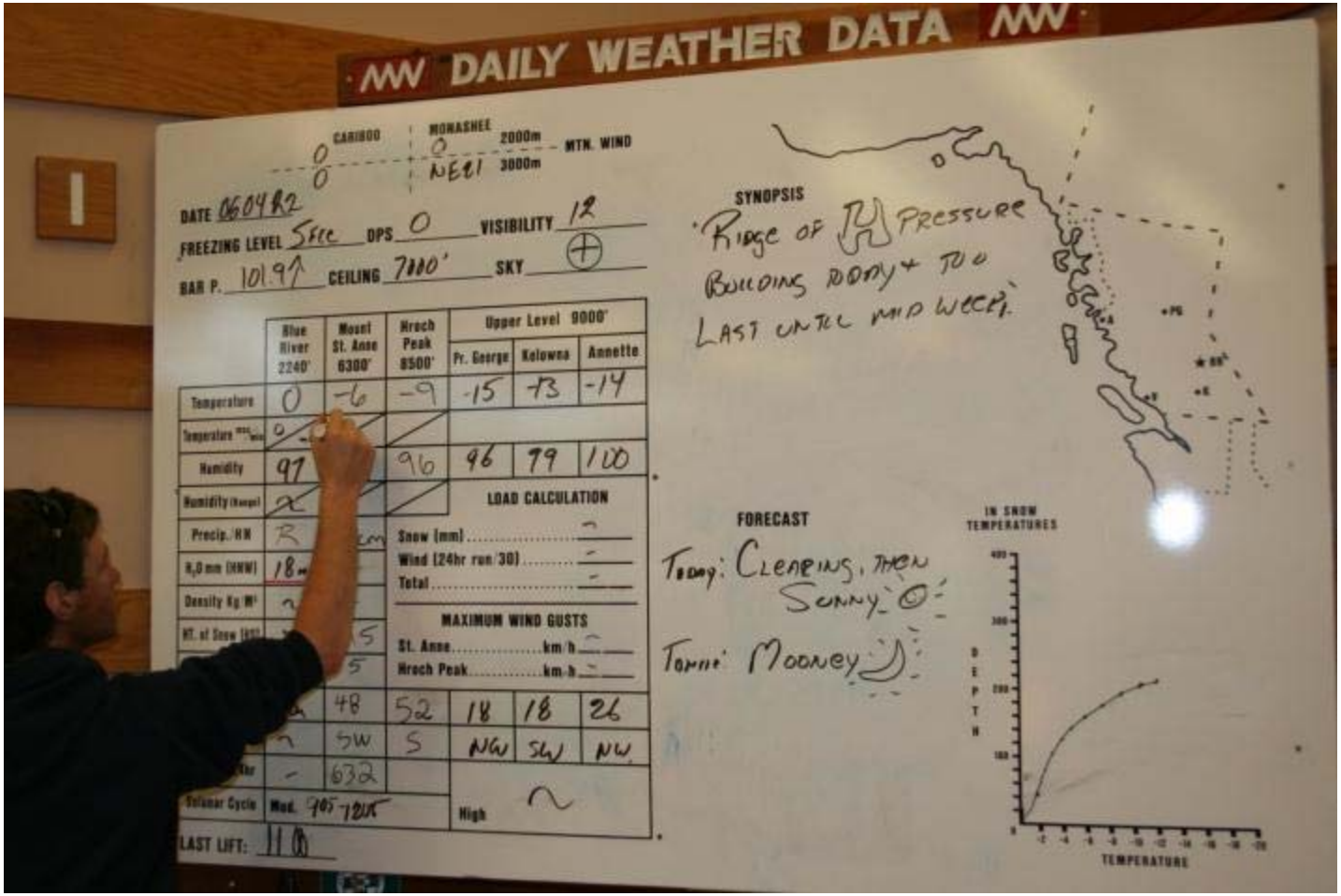
Step 1 Daily Weather Data



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	Cariboos	Monashees	
	s20	s26	2000m
	s46	s57	3000m

	mm/dd/yy				
Date:	3/12/2010	Time:	06.00	**WX F/caster:**	Jason
Freezing level:	sfc	DPS:	0	**Sky:**	⊕ overcast
Ceiling:	6600	Visibility:	16	**Bar P:**	100.6 ↓

	BlueRiver	St.Anne	Roche	Upper Level 9000'		
	2240'	6300'	8500'	PG	Kelowna	Annette
Temperature	-1	-6	-10	-15	-12	-18
Temp Range Max / Min	6 / -1	-6 / -9	-5 / -17			
Humidity	99	97	95	81	90	83
Hum Range High / Low	99 / 61	97 / 95	98 / 88			
Dew Point	-1					
Precip (HN)	trace	18	**HNW**		5.8	
H20mm (HNW)	~	5.8	**Ann WRun /30**		32	
Density kg/m^3	~	32	**Equals Load**		38	
HT. Snow (HS)	35	300	**Anne maxGust/DIR/h**	79	S	1226
Settlement	3	-11	**Roche maxGust/DIR/h**	82	SSW	1204
Wind in Knots				35	40	25
Wind Speed	Calm	38	13	64	73	46
Wind Direction	0	S	SSW	sw	sw	sw
Wind Run	~	964	782			
		Mod	1110-1410	High	0	
Last Lift:	1600	**Cycle Time:**	1500-1600			
Forecast Notes:						

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	2240'	6300'	8500'	PG	Kelowna	Annette
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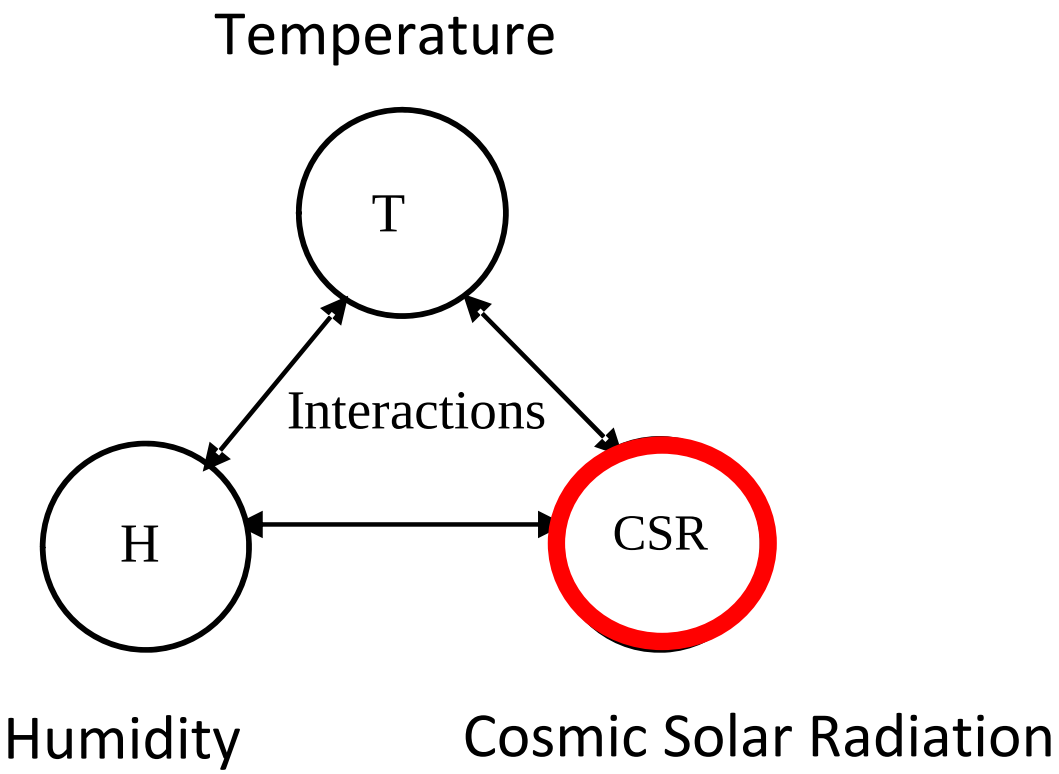
Forecast Notes:						

Water

Contributory Factors



- Cosmic Solar Radiation is a major player

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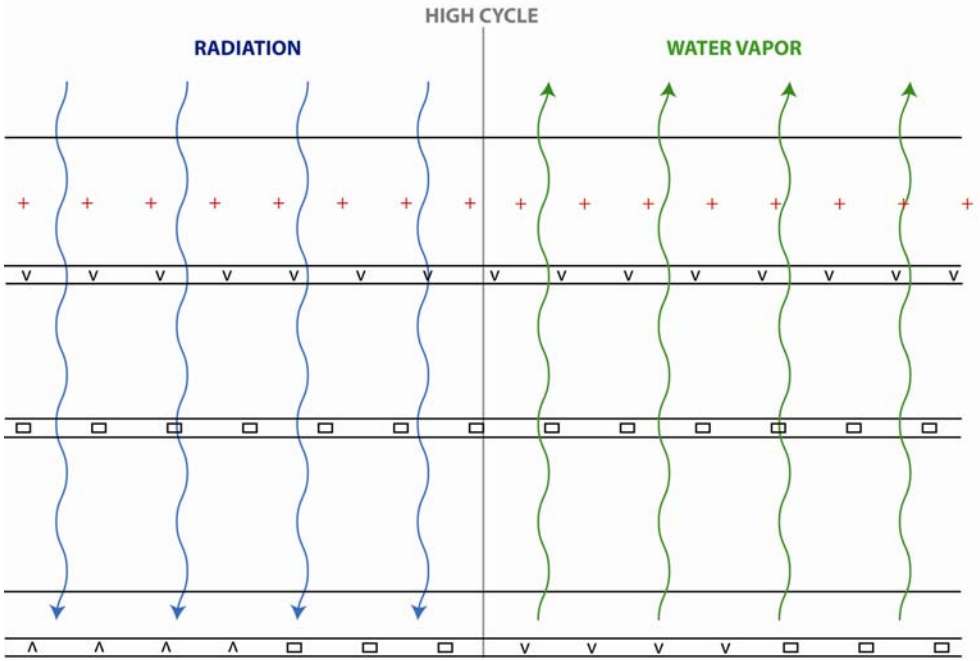
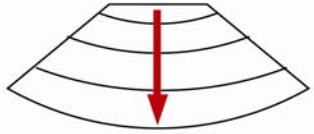
Cosmic Solar-Lunar Radiation

- Inflow of cosmic and solar radiation occurs in the high cycle related to the tidal chart
- The universal system works in a well-organized and perfect manner
- Cosmic rays are a stream of penetrating high speed atomic nuclei that enters the Earth's atmosphere
- Energy is transmitted as electronic fields of waves or moving particles and is invisible

COSMIC SOLAR RADIATION



A snow layer may lift during atmospheric pressure during high cycle. Snowpack is now saturated with water vapor causing downward tension.



The water vapor then returns to the surface, deteriorating the strength of the snow layers and ice, causing tension and creeping of snowpack - more so in high cycles - increasing the probability of snow pack failure and for natural of skier interference avalanches

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Observations

- We have observed worldwide that most avalanches, ice falls and fatalities occur during high cycle

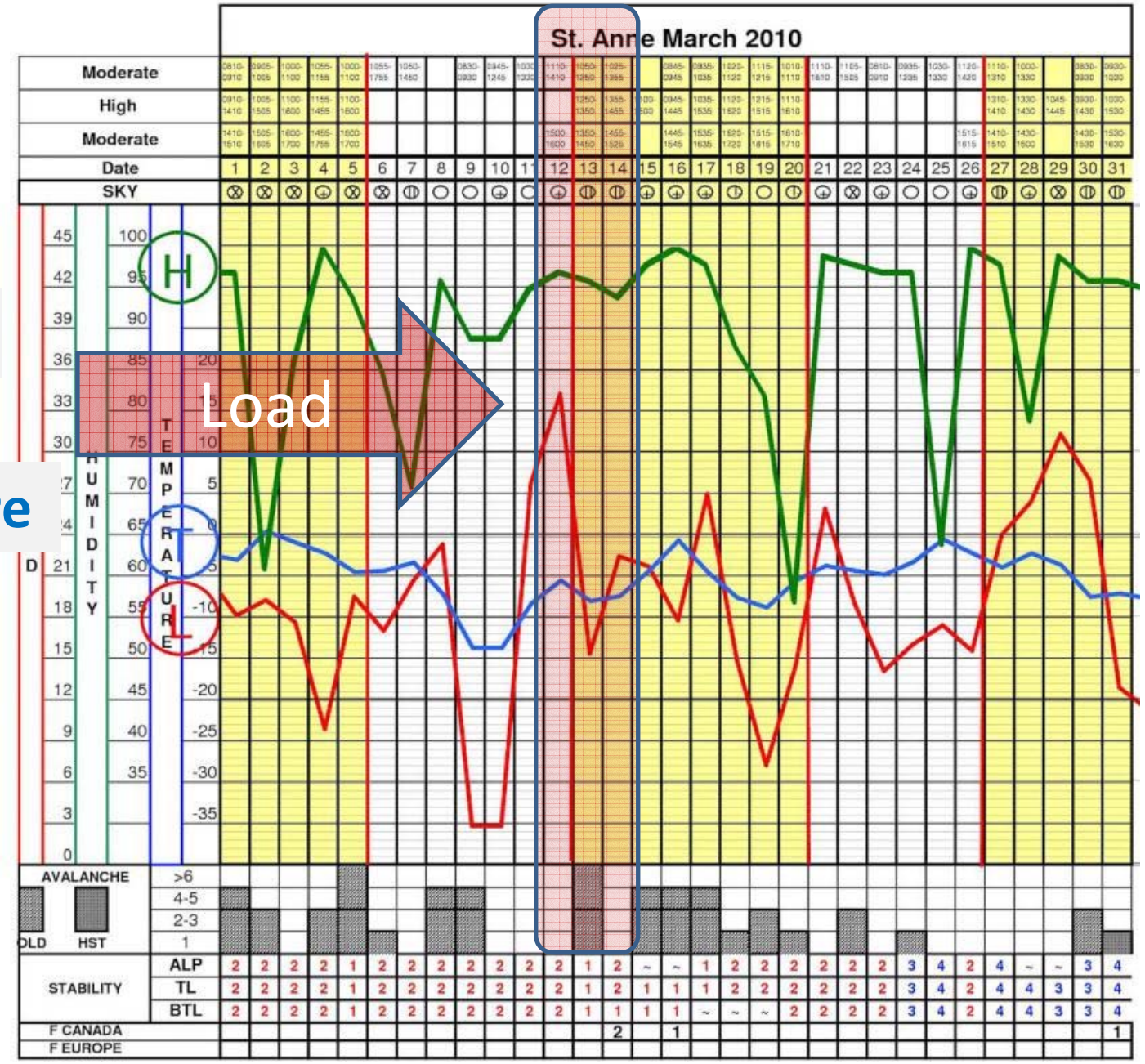
Step 2

Graphs

Humidity

Temperature

Load

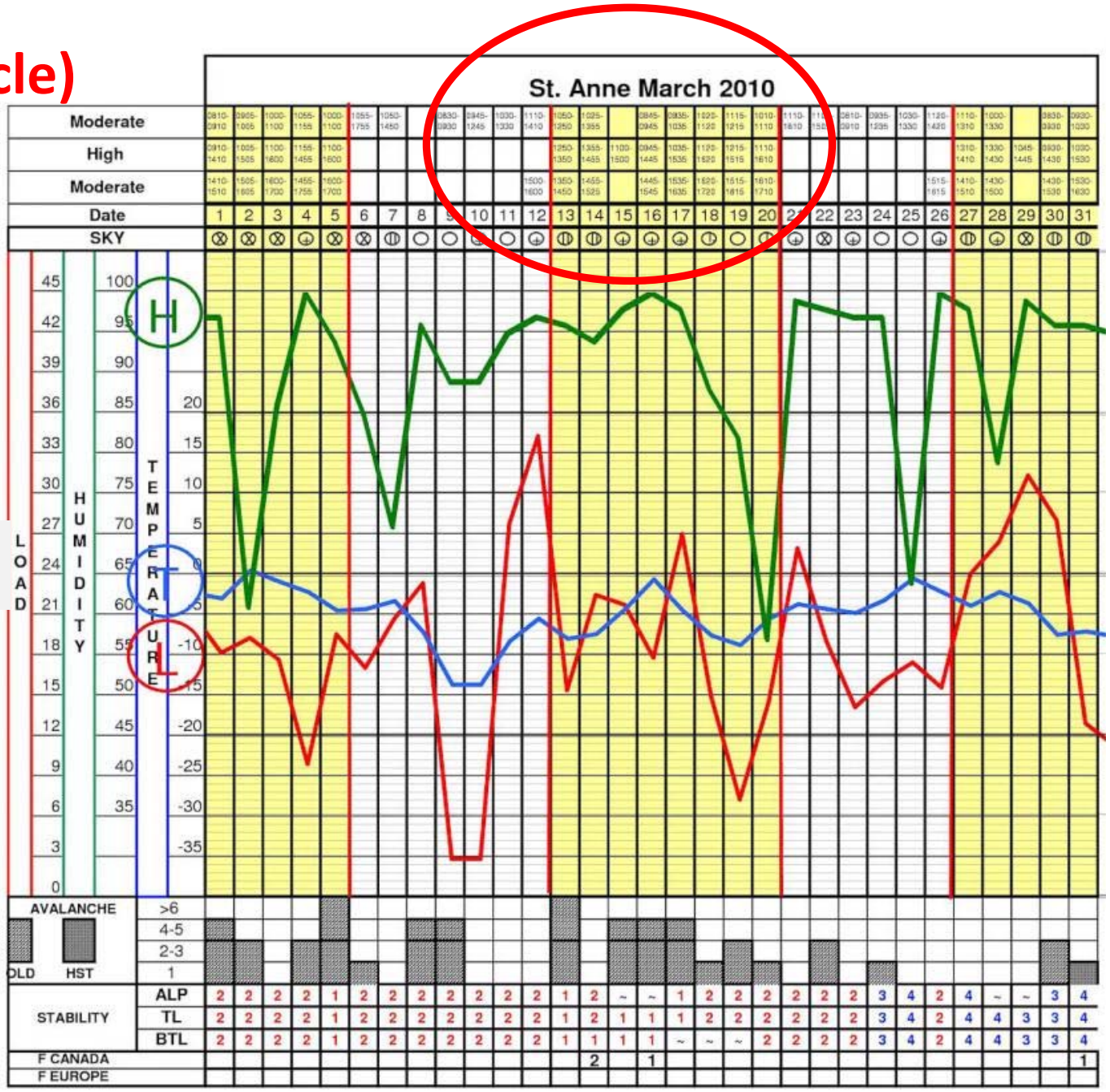


CSR (high cycle)

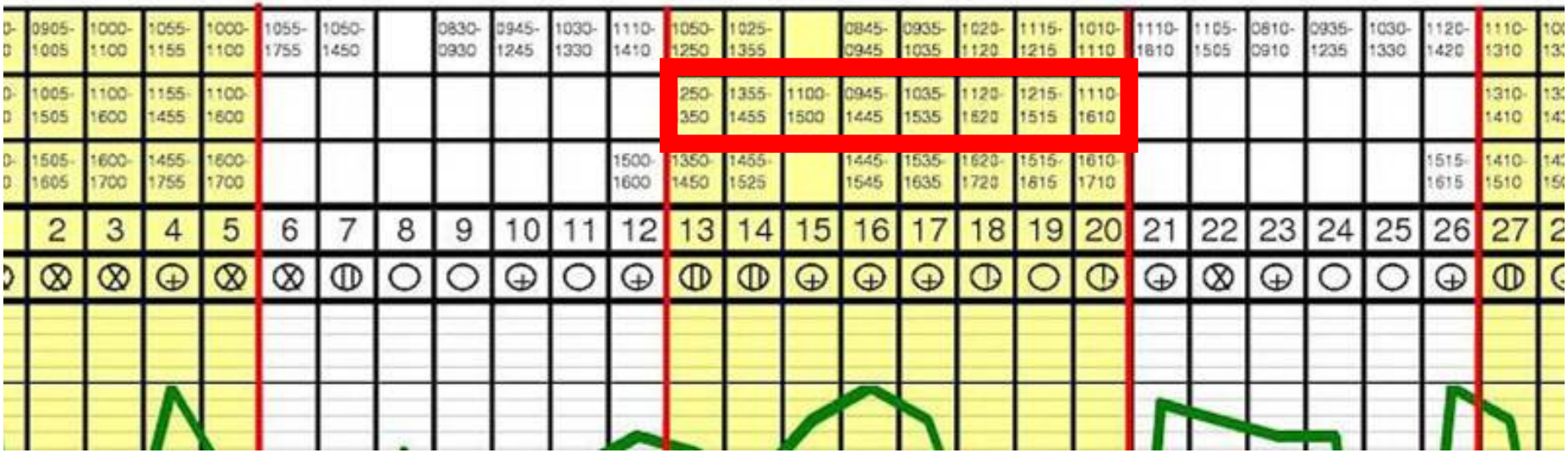
Humidity

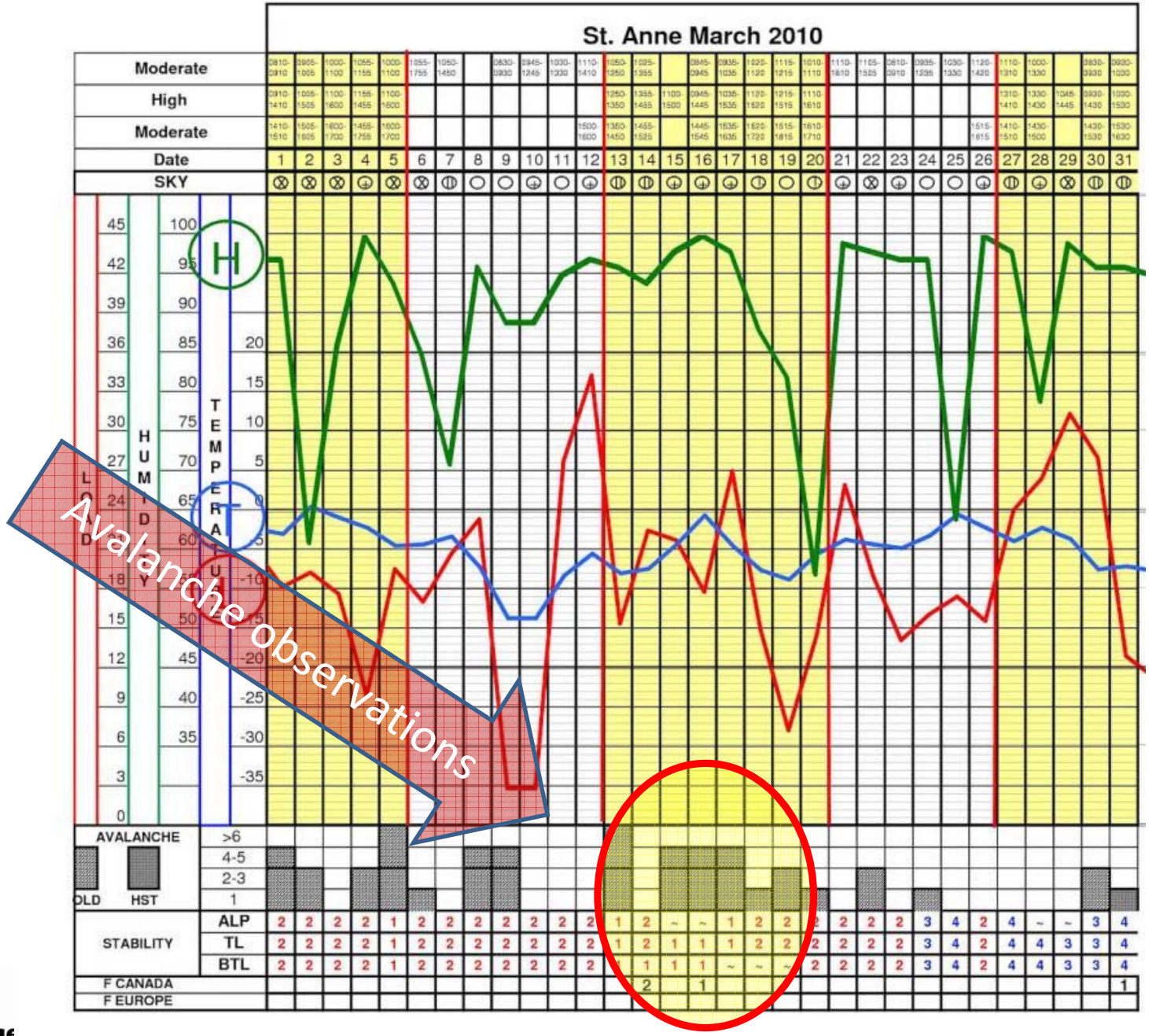
Temperature

Load



St. Anne March 2010





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Step 3 Snow Pack Profiles

"If you don't dig, you don't know"

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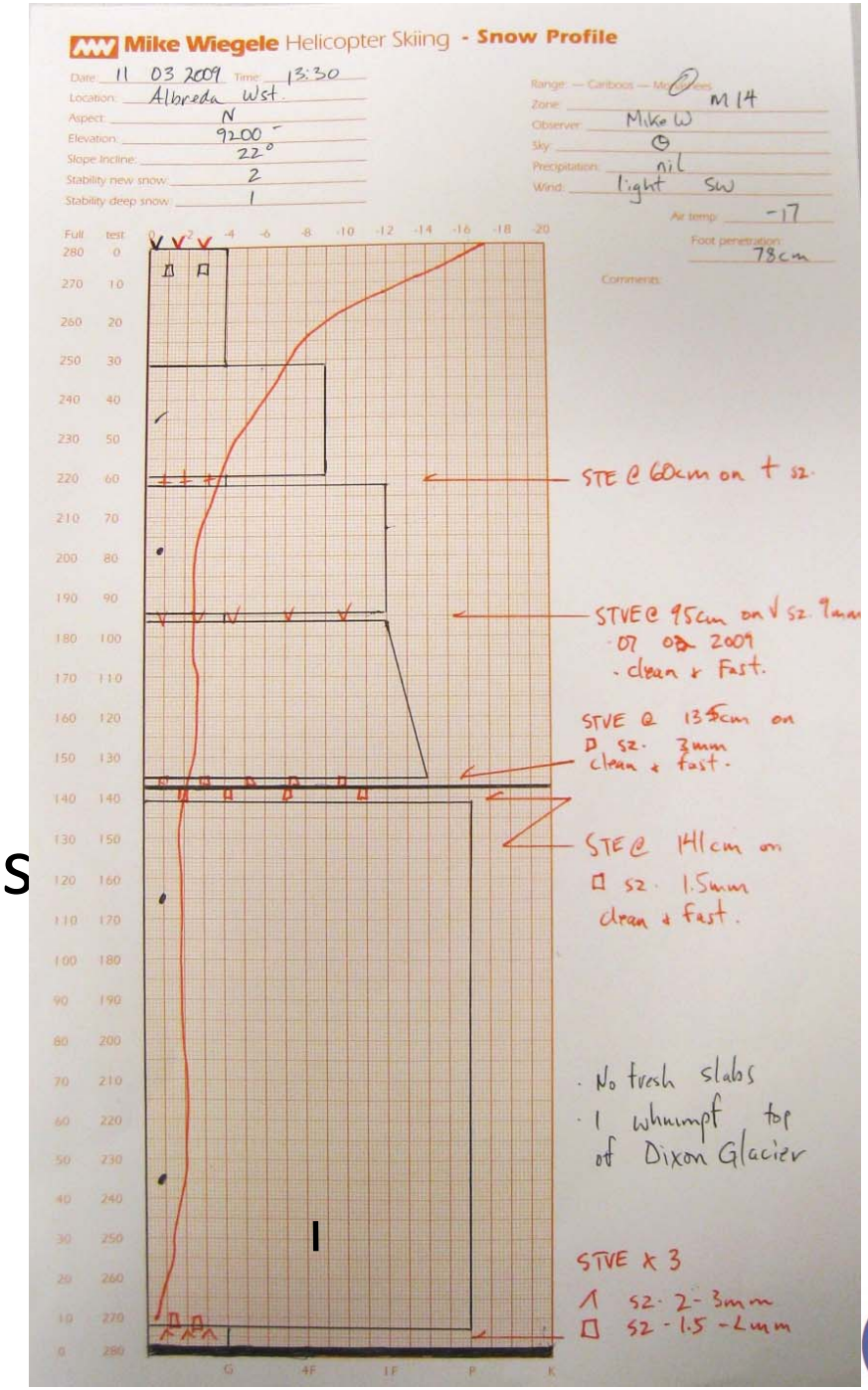
Major Gliding Layers

- Depth hoar (Λ)
- Surface hoar (V)
- Facets (□)
- Ice (____)
- New snow crystals (powder) (+)



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Shovel shear test

- Most reliable and effective method for measuring stability and ratings

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Classification of Shear Test Ratings

From 1-7

Very Easy	Easy	Easy Moderate	Moderate	Moderate Hard	Hard	Very Hard
VE	E	EM	M	MH	H	VH
1	2	3	4	5	6	7

- When the stability rating indicates a 4 (moderate) rating you must substantiate your findings with 3 to 5 tests
- Recent observed natural avalanches overrules all other tests
- **Fair ratings** are commonly used in the industry and are misleading and have created a false sense of security

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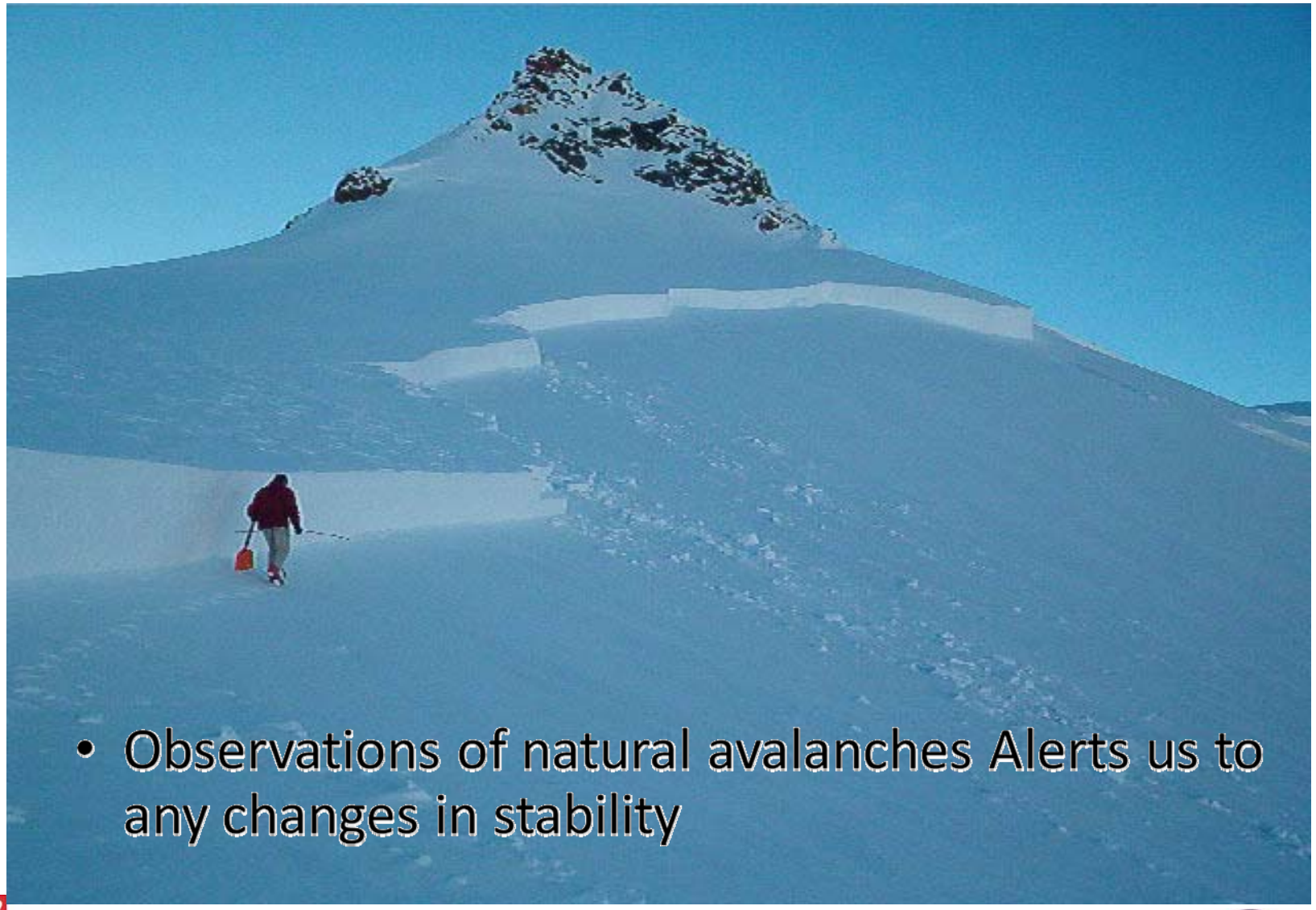
Step 4 Field Observations



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Step 4 Field Observations

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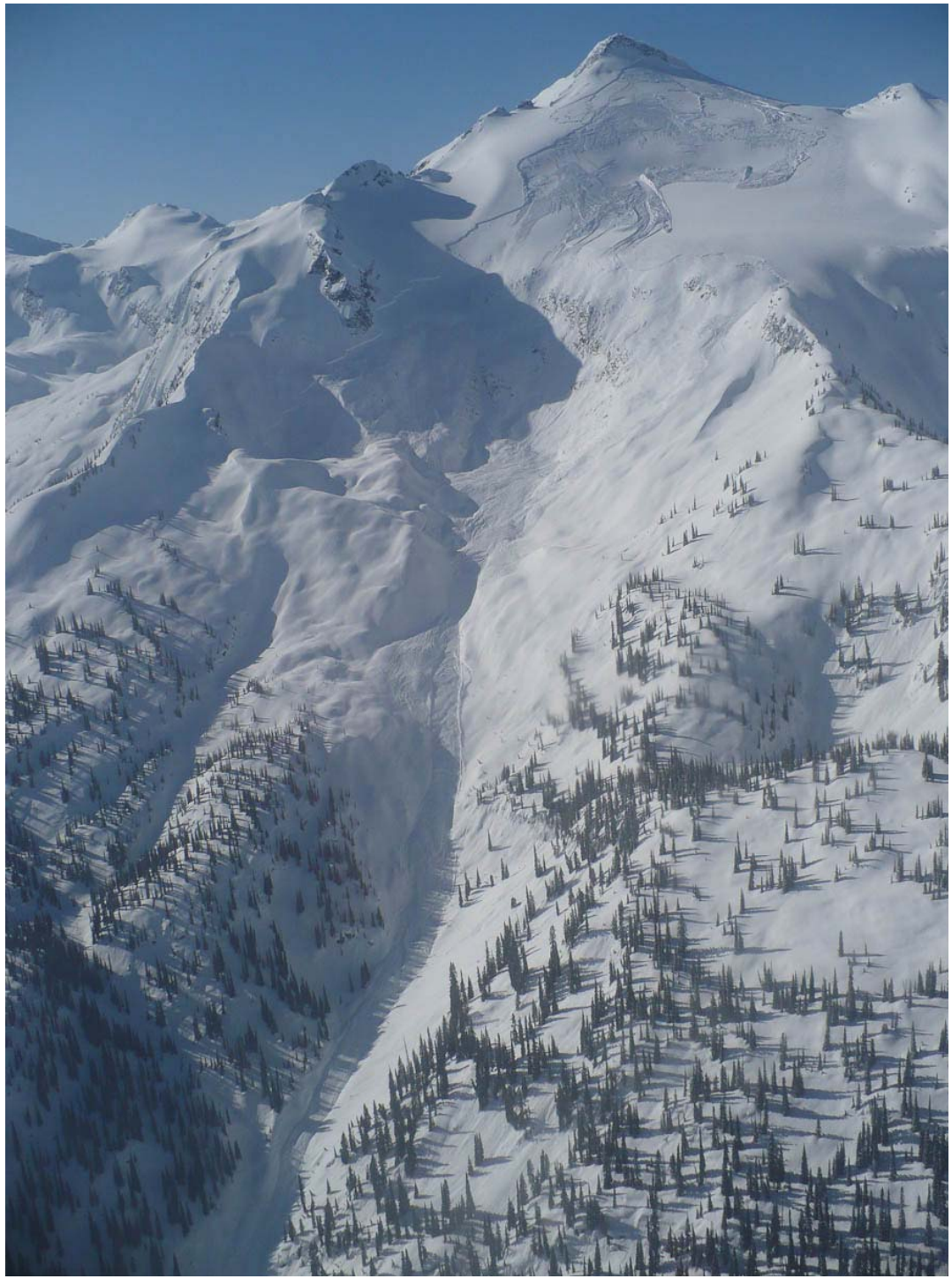
Step 4 Field Observations

Natural observations override snow profile observations



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Step 5

Stability Rating and Ski Tests

Every turn is a ski test

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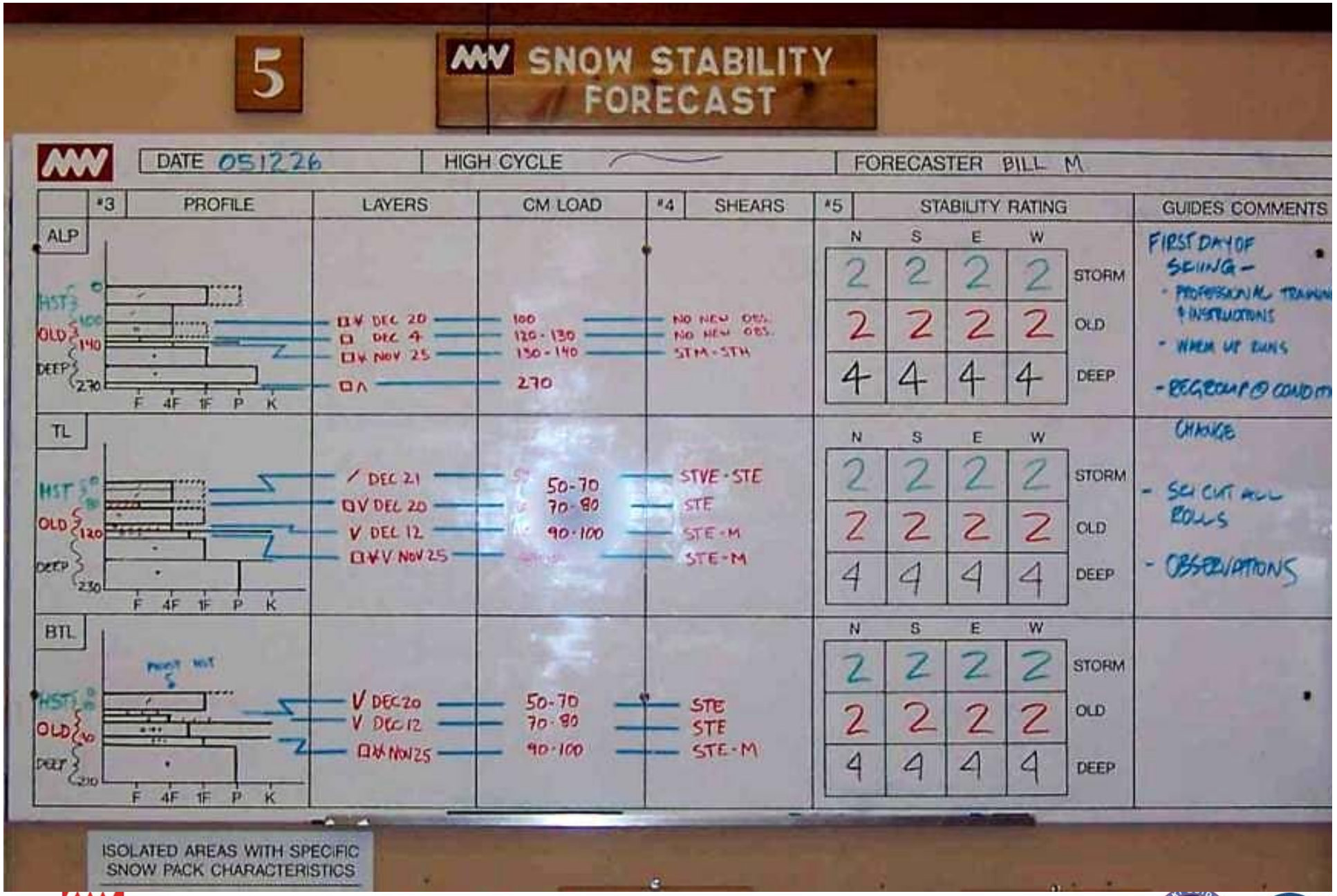

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Step 5 Stability Rating

- We then rate aspects and elevations

ALP (7,500 – 11,600 ft)				
N	S	E	W	
				Storm
				Old
				Deep

TL (6,500 – 7,500 ft)				
N	S	E	W	
				Storm
				Old
				Deep

BTL (2,230 – 6,500 ft)				
N	S	E	W	
				Storm
				Old
				Deep

- This allows us to focus on details of terrain and assists in our terrain choice and guiding procedures

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7 Stage Stability Rating

Very Easy	Easy	Easy Moderate	Moderate	Moderate Hard	Hard	Very Hard
1	2	3	4	5	6	7
Very Poor	Poor	Poor-Moderate	Moderate	Moderate-Good	Good	Very Good

- Focus on most important middle ground
- Where decision making is most difficult
- Where we spend most of our winter
- Better assists us in **terrain** selection and **guiding** procedure

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Stability Rating Values

Conventional Stability Rating
5 Steps

1	2	3	4	5	6	7
VP	Poor	Poor –Mod	Mod	Mod - good	Good	VG

VP	Poor	Fair	Good	VG
1	2	3	4	5

- ***Fair*** rating is too wide for **practitioners** in the field
- We spend a large proportion of winter in ***Fair***
- We need to better refine ***Fair*** for practitioners
- Divide ***Fair*** into 3 sections

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7 stage stability rating

1	2	3	4	5	6	7
VP	Poor	Poor –Fair	Fair	Fair - good	Good	VG

- We ***strongly encourage*** you to try dividing ***Fair*** into 3 parts
- Use the 7 stage stability rating

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Conclusion

- By using the system every day, we can maintain consistent and better choices

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