Field Forecasting—a short summary—

As becomes increasingly obvious from field application of weather forecasts, forecast updating or "field forecasting" is an integral and important part of weather forecasting and snow safety. We define field forecasting as the process of using our knowledge and awareness of weather and it's interaction with local terrain to ascertain an updated mountain weather forecast. This ability to effectively generate such a forecast greatly enhances our safe travel in mountainous terrain.

As shown in Figure 1, the field forecasting process involves several steps:

1) Being aware of the broad scale weather patterns (the current general forecast and the flow at upper levels);

2) Applying knowledge of local effects to the expected wind, temperature and moisture fields;

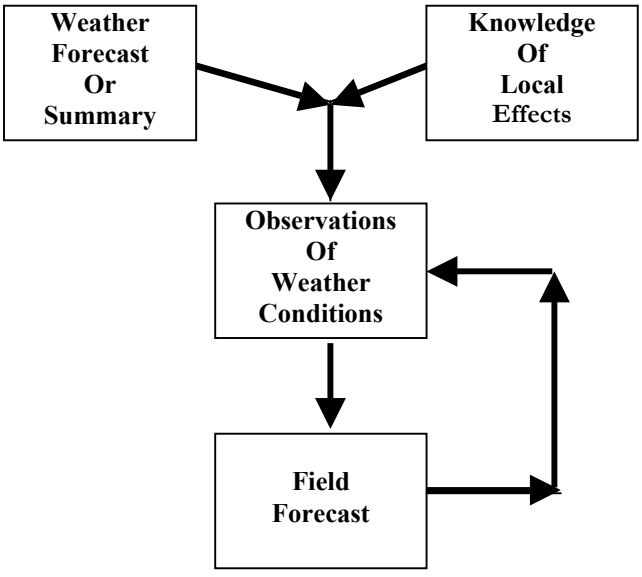
3) Observing the weather conditions;

4) Preparing a field forecast consistent with the (changing) observations;

5) Continually updating the forecast through an iterative process of further observations and subsequent forecast refinements;

6) Using this feedback to arrive at a working knowledge of not only the current weather and snowpack, but how these should evolve in the immediate future.

Figure 1. Components of a **Field Weather Forecast**



When we try to apply our mental picture of the atmosphere and the observations that comprise it to reality in the mountains—the field forecast—we'll want to remember a couple of key points:

Weather observations are influenced by local terrain to varying degrees. This means that a good knowledge of local effects is necessary to correctly interpret and apply our observations. And no matter how reliable or good the forecast that we start with is, we'll have to remember to constantly update our assessment of the weather and come

up with our own local forecast update. That is, if we're not good local weather forecasters and correctly interpret the effects of local weather on the snow pack, we'll be surprised by local avalanches.

This feedback process is best accomplished through observations and compilation of updated information that helps to keep our view of the weather and snowpack current. While **most observations are influenced by local terrain to some degree**, some are more strongly affected than others. Our major weather parameters of interest and the degree to which they are normally affected by terrain follow:

- **Most: Temperature, Wind, Precipitation**
- **Less: Sky Conditions**
- **Least: Barometric Pressure Changes**

This means that a good working knowledge of local effects is necessary in order to correctly interpret observations, especially those most affected by terrain. However, at least we can normally use those parameters that are least affected by topography (sky conditions and atmospheric pressure) to infer what should be unfolding with the parameters of most concern—temperature, wind and precipitation. We can use a barometer or altimeter to infer changing weather (lowering barometer or rising altimeter portends worsening weather, while rising barometer or lowering altimeter leads to better weather), and if we can glimpse the sky, higher cloud motions and cloud types can give clues to upper level wind directions and related weather trends.

There are a variety of signs that can be used to help anticipate changing weather conditions. These signs range from those heralding an approaching storm to signs about the storm itself to what should happen after the storm passes. Being aware of such signs is what really constitutes the basics of Field Forecasting. The following outline summarizes some of the storm and/or general weather clues that are helpful to us in the forecasting process.

SOME GENERAL WEATHER CLUES

- **Signs of an approaching storm**
  - Cap or lens clouds
  - Solid layer of cirrus on horizon
  - Halo around sun or moon
  - Clouds lowering and thickening
  - Winds backing (e.g., SW→ S →SE) and increasing with time
  - Puffy cumulus forming (moisture is being lifted)
  - Falling surface pressures

- **Signs of a warm front**
  - Dull leaden sky
  - Gradual increase in precipitation
  - Steady light to moderate precipitation
  - Slow fall of a barometer (altimeter slowly rises)
  - Passage usually unremarkable
  - Type of precipitation may change (i.e., snow to rain)
  - Pressure may fall more slowly
  - Temperatures may rise, but often not, in the mountains
  - Wind directions may vary dramatically with elevation (surface pressure gradient versus free air winds at 850 and 700mb levels—about 5000 and 9000 ft., respectively)

- **Signs of a cold front**
  - Continuing pressure falls
  - Increasing precipitation
  - Front often accompanied by heavy precipitation, and precipitation may be in bands of shower parallel to the front
  - Hail, lightning and strong winds may occur with the front, with possibly dramatic changes in wind speed and direction (e.g., changing from east to west winds); be aware of different wind loading patterns from pressure gradient driven winds common near passes versus free winds more likely at higher ridgelines.
  - Rapid rise in pressure (altimeter lowers) when front passes
  - Temperatures usually begin to fall, but not always—temperatures may actually rise with a cold frontal passage when cold continental air is being replaced by cooler air following the cold front
  - Marked decrease in precipitation immediately after front
  - Showery (off and on) precipitation after front

- **More storms?**
  - Pressure stops rising or begins to fall

- Increasingly steady precipitation (showers with a following trough have been overrun by increasing moisture ahead of the next front)
- Solid deck of high clouds visible through breaks

♦ **Improving weather!**

- Pressure rises for more than 12 hours
- Showers tapering off
- Or sharp maximum in showers followed by rapid decrease
- Temperatures drop to -10°C (14°F) or lower (strong cold dry northerly flow moving in aloft and at surface)
- Only wispy clouds or no clouds visible through breaks
- Watch out for surface hoar developing overnight if skies continue fair; be aware of surface crusts forming on sun-exposed terrain if temperatures warm. Note that dramatic changes in snow structure may develop on sun-exposed versus sun-shaded terrain.

♦ **Continued fair weather**

- Cloud free sky
- Wispy cirrus from north or northwest
- Steady or gradually rising pressure for several days
- Low clouds burning off every day to clear skies
- Watch out for developing surface hoar during clear nights; try to track where this weak layer may be destroyed or buried intact. Significant small-scale variations in snow pack stability are often the result of uneven and localized survival and ensuing burial of surface hoar.

It should be noted that in this discussion of field forecasting, both the general orientation of the mountain range to the upper level flow and the specifics of the underlying topography in question (passes, ridges, large topographic barriers, etc) have major effects on the time-wise changes of wind, precipitation and temperature fields with any given storm. For instance, the evolution of wind direction (both at higher elevations ridgelines and near lower passes) with a given storm will be considerably different for an east-west oriented mountain range than if the same storm impacted a north-south running range. **Finally, many thanks to my colleague—Rich Marriott—one of the founders of the Avalanche Center and one of the best TV weather forecasters I know, for helping develop much of the information presented here.**