Social Data Sharing with Avalanche Lab: What if you could crowd source your avalanche forecast?

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1. INTRODUCTION

The first version of Avalanche Lab was released in November 2011. It had a fairly simple goal: to replace the traditional field notebook with an electronic alternative. It could record and display snow pit and avalanche data, but the format was still based on what could be done on paper.

Development for the 2012/2013 version of Avalanche Lab started with a much bigger goal: make the best use possible of a smart phone to aid a human in avalanche hazard evaluation and decision making. An additional part of the goal was to not present information in ways that could contribute to poor decision making. For planning purposes the software was divided into three areas, collecting data, visualizing and viewing, and sharing observations.

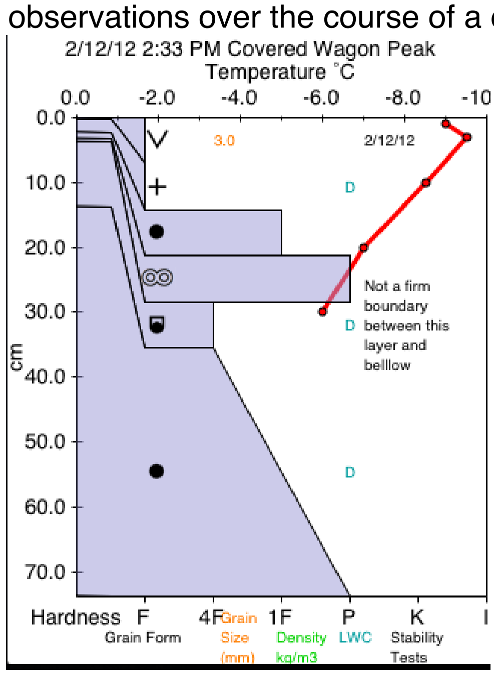
2. DATA COLLECTION

The initial version of Avalanche Lab had two different types of observations, snow pits and avalanche observations, each with a separate form for data entry. There were lots of options for what to enter, but not very much guidance for what was important to collect. For the new version there is only one type of observation, but within the observation there are seven different forms that a user must select from when creating a new observations. The forms are broken into two main groups, Snow and Avalanche. There are four forms for snow observations: “Quick Observation”, “Quick Pit”, “Full Pit”, and “Weather Observation.” There are three forms for avalanche observations: “Basic Report”, “More Info”, and “Full Investigation”. With the larger number of forms it was possible to reduce the number of elements in each form, which should help the user make better decisions about what data to collect.

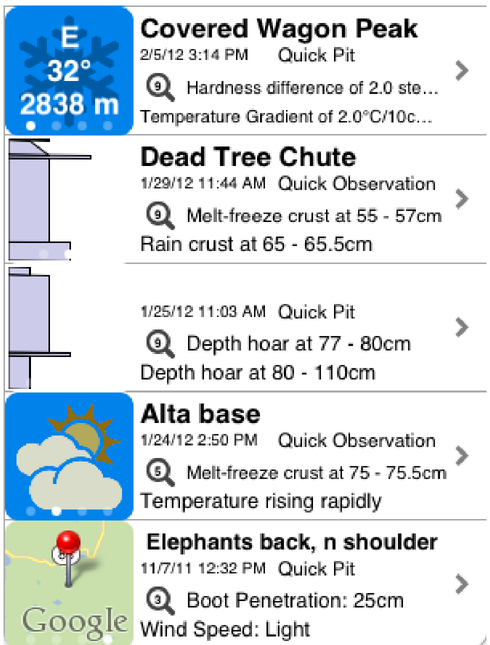
The structure of the software allows for new observation forms to be added as trends in data collection change. Forms under consideration for future versions include a hazard assessment form, and a form for reporting on ski conditions. There is also the possibility of creating custom forms on an as needed basis for research projects.

3. VIEWING AND VISUALIZATION

The initial version of Avalanche Lab introduced a new format for presenting snow profiles designed to present as much information as possible on the limited space of an iPhone screen. The initial version was developed around the use case of doing several long observations over the course of a day.



After conducting post-season interviews with users, it became clear that the mobile snow profile format was part of the solution, but many users felt that they still could not view their data as quickly as they could in a note book. For users involved in mechanized guiding, their workflow was so different from that which avalanche lab was designed that it was hardly useful.

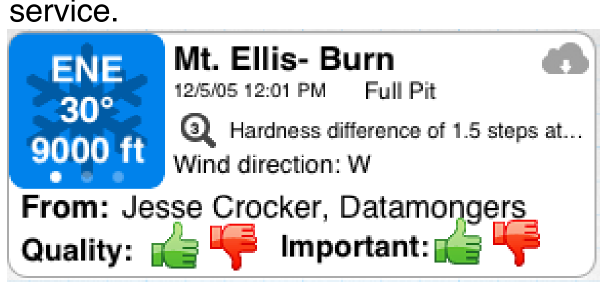


What was needed was a way to view the relevant parts of many observations at once without having to drill down through a series of menus. The initial solution to that problem was to generate a series of graphical previews for each observation, including a location summary, a weather summary, a mini snow pit diagram, and a micro-map. Even with the graphical previews there was still a lot of information that could only be viewed by drilling down into the observation.

4. DATA SHARING

The first version of avalanche lab included what could be called manual data sharing. Observations could be exported in several formats and saved to a computer or emailed. It was possible to share observations with other users, but it was not up to the standards of our modern social networking world.

This winter's version started with a goal for how data sharing should work. A user should be able to get out their iPad and see a list of all observations that might be of interest to them, sorted by importance. When they get to the trailhead they should be able to pull out their phone and quickly pull up a list of relevant observations in their immediate area. When they are out touring (assuming there is cell phone service) they should automatically get notifications of critical information, such as nearby avalanches larger than class 2. When they record an observation, sharing it should take no more than 10 seconds. If they do not have data service in their touring area the observation should be saved and shared as soon as they get service.



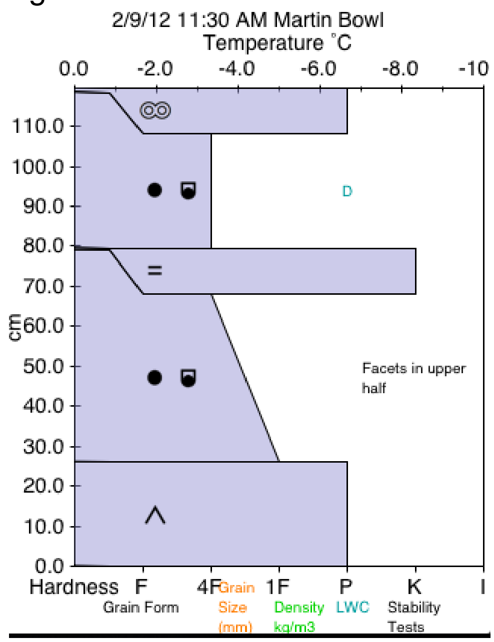
In heavily used areas this type of data sharing has the potential to generate large quantities of data, of which the user may have a hard time assessing the importance and accuracy. To address this problem Avalanche Lab relies on crowd sourcing. When a user views an observation from the data sharing service they are presented with two options for rating the observation, Quality and Importance. Each can be rated thumbs up or thumbs down. Users are not able to see how other users have rated an observation before rating to discourage group-think. It is also not possible to rate an observation from the main observation browser, because a user should not be able to rate an observation without having spent at least a few seconds looking at it.

The quality and importance ratings are used in different ways. The importance rating is used in sorting of observations in the browser, the more important an observation is, the higher up in the list it will appear. The effects of the quality score are more subtle. Instead of directly impacting the sorting of observations, the quality scores add up over time to generate a quality score for the observer, and these observer scores are a factor in sorting observations in the browser. The goal of the observer score is that observations by highly respected observers should automatically show up higher in the browser. Users are also able to see their own observer score to let them know what the crowd thinks of their abilities. Not including the importance scores as a factor in the observer score is intentional, doing so would discourage users from posting high quality, but low importance observations.

There is another use case to address besides the heavily used areas that generate lots of observations, and many sets of eyes reviewing them. Some places just don't have a crowd, and for those places a different strategy for sorting observations is needed.

5. A METHOD FOR AUTOMATIC SUMMARIZING AND RANKING OF OBSERVATION

During the course of development the problems of quickly viewing observations and knowing which shared observations a user needs to see converged on a single solution. What was needed was an algorithm for automatic summarization and ranking of observations. The process of designing the algorithm stated with the acknowledgement that it would not be possible to always come up with right answer. The most important information within an observation changes on a day to day basis as conditions change, but it ought to be possible to come up with the right answer most of the time.



The initial step in developing the algorithm was to break each observation down into individual pieces of information that seemed to be relevant. The observations that generated the above diagram broke down to the following pieces of information(known internally as crumbs)

- Rain crust at 79-79.5cm
- Melt-freeze crust at 118.5-119.5cm
- Temperature rising rapidly
- Depth hoar at 0-26cm
- Hardness difference of 2 steps at 118cm
- Hardness difference of 3 steps at 79cm
- Wind speed: light
- New snow in 24 hours: 0cm

Once an observation was broken down into crumbs, each crumb was assigned tags to assist in classification.

The melt-freeze crust in the above diagram received the following tags:

- Persistent weak layer
- Hardness difference of more than 1 step
- Shallow weak layer
- Thin weak layer

A human triggered avalanche might contain the follow tags:

- Human triggered avalanche
- Avalanche type SS
- Avalanche Class 3
- People Caught
- People Injured
- Sliding surface old snow

The current list of tags contains 186 items, but is expected to expand. Each tag was then assigned a score based on how much information it contained relating to possible snowpack instability. Scores range from 0 to 5, with 0 indicating that the information contains no information about snowpack instability, and 5 indicating high information content. The key difference between the crumbs and the tags is that crumbs do not have to contain information about snowpack instability, but the tags all have to do with instability. Once all of the tags have been assigned, a total score is generated by summing the score of the unique tags for each observation. Unique tags were used to avoid skewing the scores very high in areas with very poor snowpacks. If there are 5 persistent weak layers of the same type in the snowpack it did not seem to help the scoring to add a point for each of those layers.

To generate a summary of the observation each crumb is assigned a score of the sum of it's tag scores. The top two scoring crumbs are shown in the observation browser to provide a quick summary. There is also a link in the observation browser to quickly view a list of all the crumbs for the observations sorted by score.