# GIS DATA MODEL

Douglas Scott[1]
Avalanche Mapping

ABSTRACT:  The intent of this poster presentation is to demonstrate the various GIS data layers used in the documentation and analysis of snow profiles and avalanche paths. These posters will present a flow chart defining the workflow of this data in a GIS. The historical avalanche path data is loaded in to a database that can relate the hard copy snowpit and weather data. These data layers can be displayed over other GIS base layers such as DEM, DRG, DOQ, soils/geology, and vegetation cover. Integration of realtime weather and snow profile data can be added to this for analysis. I will correlate these types of data and explain how they could be used in analysis to enhance predictions and provide more information. Digital data collection tools will be displayed that can load new data directly in to a GIS Database with little hand entry.

For many years the Swiss, Canadian and other snow scientist have been using GIS to monitor, document, and model avalanche occurrence, snow profiles, and weather. In the United States the use has been limited to only a few areas. The recent advances in technology and the lowering of overall cost have made it so that much can be done. This presentation will attempt to familiarize the viewer with the data types and applications.

Historical (legacy) data can be used as references in the GIS when the hand drawn avalanche paths are digitized and loaded in to a geodatabase.  Avalanche path data (consisting of avalanche archive records and photographs, avalanche mapping of starting zones, size, frequency and area extent of danger), snowpit, and weather data can be converted from hard copy to digital. The weather data is often in digital and can be linked or loaded to the avalanche and snowpit profile database as well.

The base data layers such as DRG (digital topo map) and DOQ (aerial photography) provide visual information and the ability to identify avalanche terrain. These can also help in referencing the topography of the avalanche areas. The DEM (digital elevation model) allows various terrain analyses: mean slope, minimum slope, maximum slope, mean aspect, and curvature.  When the avalanche path data is overlaid on the DEM it can be analyzed using the nearest neighbor model. This data type is becoming more readily available and at higher resolution (most of the US is now available at 10m and there is 2 meter data for some areas) and accuracy. Much of it is free from the USGS or the USDA as well as many state GIS data clearing houses.

Other important GIS data layers are the hydrography (rivers, streams and lakes), geology, vegetation, tree ring, buildings and roads. Hydrography data shows drainages where avalanches could be constructed by potential terrain traps. Vegetation and geologic layers and often combined with slope angles and curvature to help gauge friction parameters (destructive force) from the various sizes of the volume of the avalanche's release. Tree ring data can help document and predict the frequency and sizes of avalanches along their tracks. Building zoning and road data can define potential areas that will suffer destruction.

The analyst can use the GIS to combine this data with real time weather and snow data of the area by modern digital collection tools to assess risk and level of danger. The advent of pocket computers and mobile GIS/GPS software has made it possible to collect digital field data about avalanche paths and snow profiles. This data can be integrated with the historical avalanche database after it has been brought into the digital framework. Likewise it is possible to take the historical data into the field for a reference and create a new file for the latest occurrence. By collecting a new weather and  profile and give it a spatial position with a GPS point it possible to hyperlink snowpit profile graphs, photographs, and weather station locations to a specific spatial place. This is useful in viewing the changes to a particular place over a season and the ability to quickly call up past information.

Remote weather stations can send weather data every half hour by phone line or wireless transmission. Through the internet a weather program called Meteorologix can bring real time Doppler radar weather images directly into the GIS software view window. As well as digital collection by hand held computer from traditional weather and snow observation sites. With these

new tools it is possible to have this real time data quickly and it is easily joined with and compared to past years data.

Regional and local datasets can analyzed and then be used to create various map/computer outputs: Snow depth and cover stability, avalanche hazard/locater (atlas), frequency, damage, forecast, risk, and zoning maps. These can be useful for forecasting, control work, zoning plans and the need for mitigation structures.

In conclusion, there are many benefits to using GIS and digital data for avalanche and snow science. This poster session documented the various data types and their possible applications. It also demonstrated some of the new tools available for data collection and the way in which weather information can be delivered in real time. I am also looking to receive input from the community on what other data could be included or excluded.

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[1]Corresponding author address:
Douglas Scott
Boulder, Co  80305
Tel: 303-528-0461
Email: ddscott@avalanchemapping.org