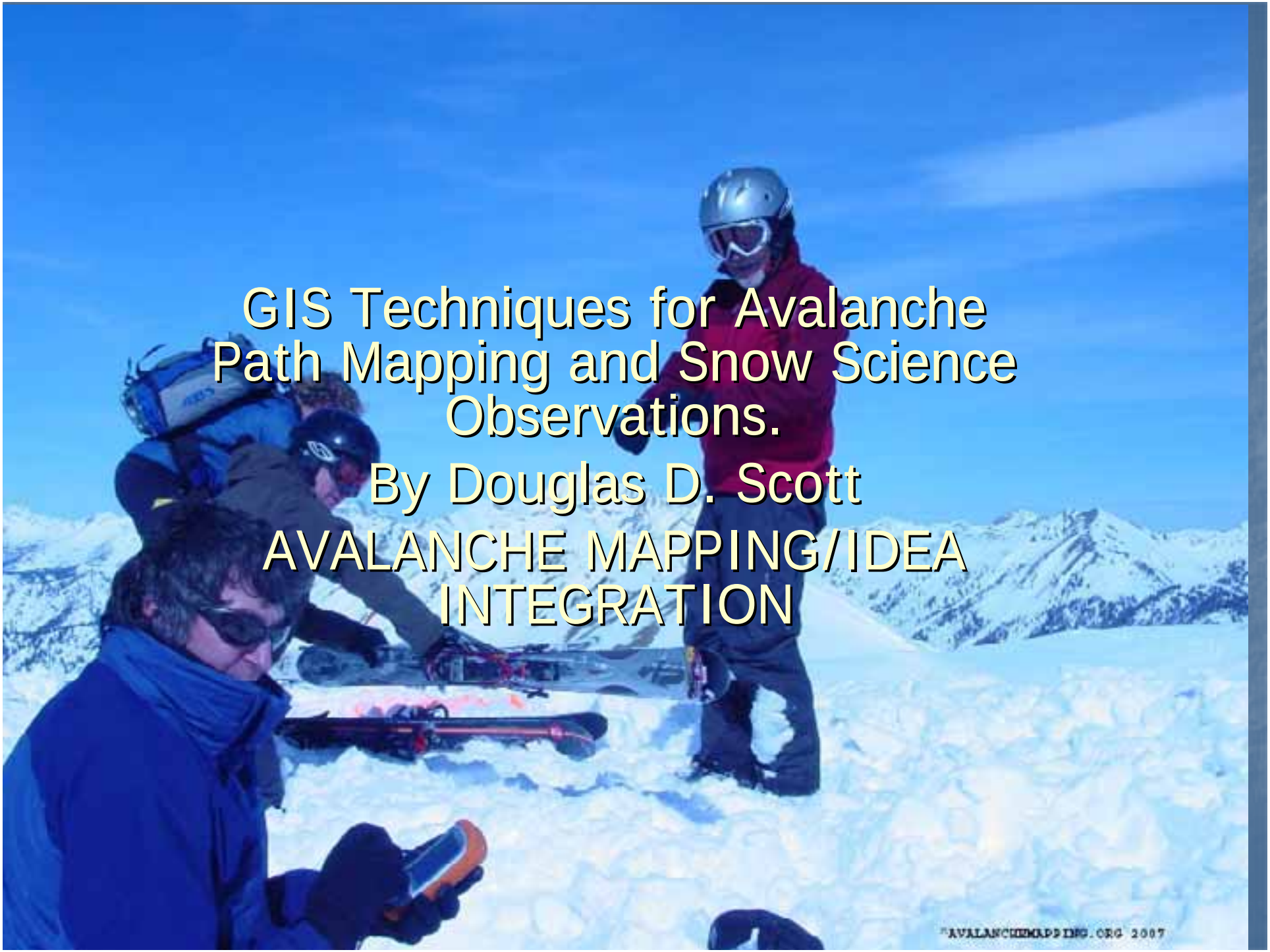
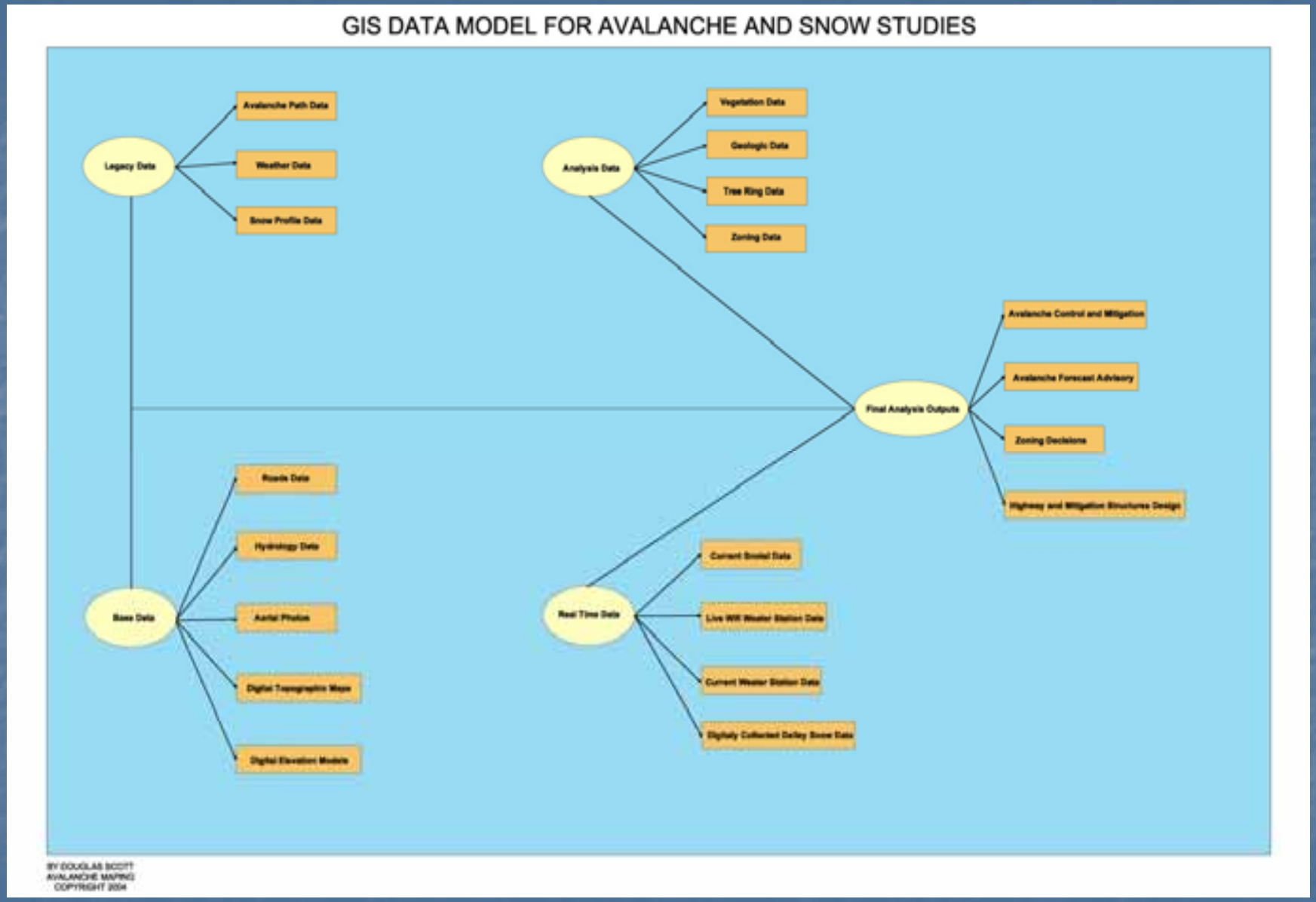

GIS Techniques for Avalanche Path Mapping and Snow Science Observations.
By Douglas D. Scott
AVALANCHE MAPPING/IDEA INTEGRATION

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. Until recently almost all avalanche and snowpit data observations were recorded on hard copy and or did not have a spatial component. With the current advances in technology this has become affordable and reasonable to implement. This paper presents the techniques for building avalanche atlas maps, sourced from newly collected and legacy data. This will also present the integration of a digital snowpit profile program for the pocket pc with ArcPad and GPS for the collection of snowpit observation data that has a spatial reference. These advances will make it possible to bring observations and data into a GIS for referencing, modeling, and sharing. 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. Digital data collection tools will be displayed that can load new data directly in to a GIS Database with little hand entry.


GIS DATA MODEL FOR AVALANCHE AND SNOW STUDIES
Legacy Data
Avalanche Path Data
Weather Data
Snow Profile Data
Analysis Data
Vegetation Data
Geologic Data
Tree Ring Data
Zoning Data
Final Analysis Outputs
Avalanche Control and Mitigation
Avalanche Forecast Advisory
Zoning Decisions
Highway and Mitigation Structures Design
Base Data
Roads Data
Hydrology Data
Aerial Photos
Digital Topographic Maps
Digital Elevation Models
Real Time Data
Current Snotel Data
Live Wifi Weater Station Data
Current Weater Station Data
Digitally Collected Valley Snow Data
BY DOUGLAS SCOTT
AVALANCHE MAPPING
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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.


NORTH CASCADES HIGHWAY

SR-20

AVALANCHE

ATLAS

Prepared for
Washington State Highway Commission
Department of Highways
and in cooperation with
U. S. Department of Transportation
Federal Highway Administration

by

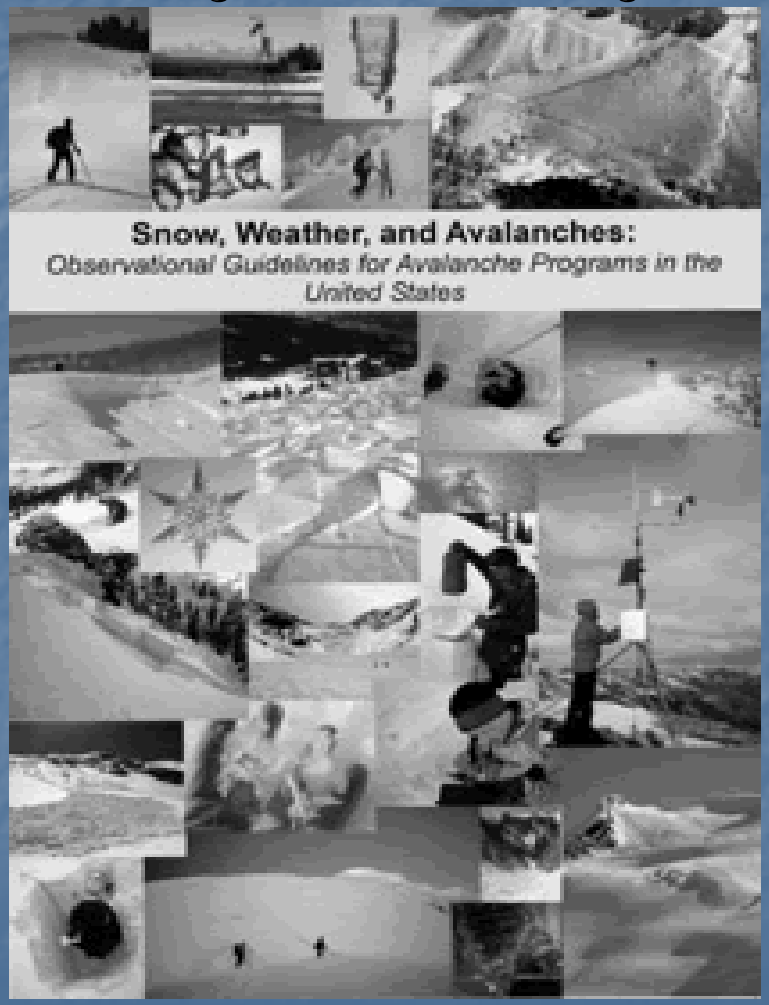
Geophysics Program and Department
of Civil Engineering
University of Washington
Seattle, Washington

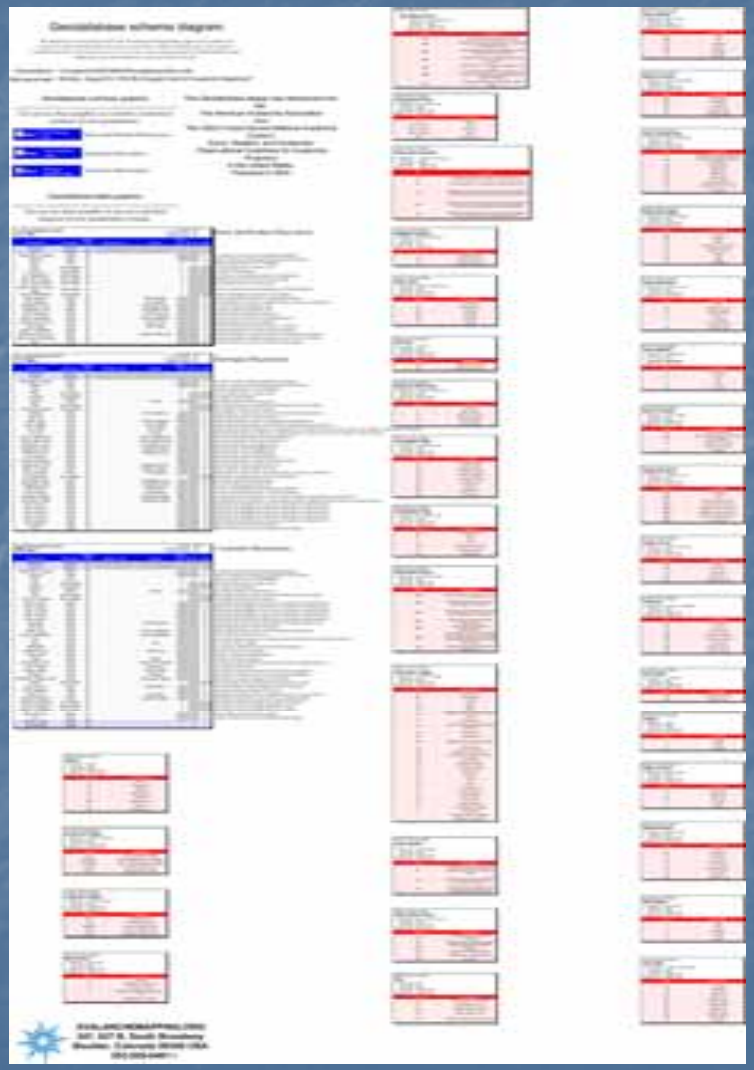
June 1971

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 2004 United States Observational Guidelines were used as the template for the GIS geodatabase design.



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 snow profile and giving 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.



Trimble
Trimble
GeoXT
GeoXT
Using ArcGIS and ArcPad to map historic avalanche paths and collect realtime snow and avalanche data.
© DOUGLAS SCOTT
AVALANCHE MAPPING
2005

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

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 paper 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.

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