THESIS

PRACTICAL SNOW DEPTH SAMPLING AROUND SIX SNOW TELEMETRY (SNOTEL) STATIONS IN COLORADO AND WYOMING, UNITED STATES

Submitted by:

Amir Kashipazha

Department of Ecosystem Science and Sustainability

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Master's Committee:

Advisor: Steven Fassnacht

Stephanie Kampf
Melinda Laituri
Mazdak Arabi

ABSTRACT

PRACTICAL SNOW DEPTH SAMPLING AROUND SIX SNOW TELEMETRY (SNOTEL) STATIONS IN COLORADO AND WYOMING, UNITED STATES

Across the Western United States, the Natural Resources Conservation Service (NRCS) operates about 700 automated snowpack telemetry (SNOTEL) measurement stations. These stations measure snow depth (SD), snow water equivalent (SWE), air temperature and precipitation. To assess how representative the stations are of the surrounding 1 km^2 area, a set of approximately 200 snow depth measurement were taken using ten 1000-m transects sampled at 50-m intervals. This sampling was undertaken at the Dry Lake, Joe Wright, Lizard Head, Niwot, (in Colorado) South Brush Creek, and Togwotee Pass (in Wyoming) SNOTEL stations during the winters of 2008, 2009, and 2010. Various sampling patterns were employed at each sampling point, such as three depth measurements in a row parallel or perpendicular to a transect, and five in a row or five in a plus pattern. We used these patterns and various sub-sets of the 1 km^2 surrounding area to assess suitable and practical sampling strategies, to determine the minimum number of transects need for measuring the average SD of each station, to evaluate if each station represent the SD average of its 1km^2 area surrounding, and to investigate inter- and intra-annual variations of SD for each station. Statistical analysis used the least-significant-based analysis of variance with a 95 percent confidence level.

Statistical analyses showed snow depth averages of incorporated sampling methods were not significantly difference at the 95 percent confidence level. Therefore, any sampling method could be used for SD measurement based on sampling constraints. We recommend measuring three to five snow depths at each sampling spot and the distance between sampling spots should

be less than 200m. The minimum number of transects needed for each station was not the same and it depended upon the physiographic and vegetation heterogeneity of the area surrounding a station.

Snow depth varied within a $1km^2$ area surrounding of SNOTEL station and we did not find two sampling methods that had the same average SD. However, this did not mean that the average SD using a variety of sampling methods was significantly different at the 95 percent confidence level. A heterogeneous snowpack is caused variations in precipitation, wind patterns, solar radiation, etc. Physiographic and vegetation characteristics can be used as surrogates for these meteorological factors that vary at the small and large scale. The effect of these factors on snowpack heterogeneity is more likely greater when the distance of sampling spots is more than 1 km. The correlation between snowpack heterogeneity and the surrogate characteristics varied in spatially and temporally, and from location to location.

The Dry Lake, Joe Wright, Lizard Head, and Niwot SNOTEL stations represented the SD average of their 1 km^2 area surrounding while Lizard Head station represented the SD average of its 0.36 km^2 area surrounding, all at the 95 percent confidence level. However, the Togwotee Pass and South Brush Creek stations did not represented the SD average of their surrounding area. Whether a SNOTEL station does or does not represent the SD average of its surrounding area is related to the complexity of the terrain. For example, the area surrounding the Joe Wright station has complex terrain but represented the station SD while the South Brush Creek terrain was more homogeneous and did not represent station SD. The performance of the SD sensor at the SNOTEL station can be affected by the interaction of meteorology, physiography, vegetation, and possibly human influences, that can produce an highly varying snow pack under

and/or around a SD sensor and led to a lack of sensor representivity or sensor error. Due to potential SD sensor and sampling errors a reasonable amount of error for snow samples, such as 5-10% should be considered.

ACKNOWLEDGEMENTS

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CHAPTER 1: INTRODUCTION

Population growth, increased agriculture, industrial and commercial development have increased global demands on water resources exponentially (Chang *et al.* 2004). To address these demands it is necessary to develop a comprehensive understanding of availability of water resources and have accurate measurements of the hydrologic processes. For effective water resource management there is a need to adequately quantify the various components of a hydrological cycle across various different space and time scales.

Mountainous regions are important hydrologic and climatologic regions of the world (Viviroli *et al.* 2007), as they have a crucial role in water cycle and meteorological phenomena (Jong *et al.* 2005). Mountain river basins supply the water demand of 60 million people in the western United States (Bales *et al.* 2006). Nevertheless, our knowledge regarding the mountain regions is limited due to their complex topographic setting, strong climate gradients, limited monitoring station, and limited understanding of the spatial scaling and measurement (Bales *et al.* 2006).

Snow is the main fraction of precipitation in the mountainous regions. Seasonal snow cover area is an important component of a climate system. It controls the surface energy balance and the majority of runoff from these regions is derived from snow melt (Hua *et al.* 2008). The snowpack is considered a dynamic component of an ecosystem since its properties highly variable over time and space (Hua *et al.* 2008). These properties include snow water equivalent (SWE), snow depth (SD), snow density, and snow covered area (SCA). Estimation of these snow properties is necessary to understand the hydrologic responses in mountain regions. Moreover, to

better predict snow storage and detect trends in the variations of water resources more accurate snowpack information and the known error is essential (Chang *et al.* 2004).

Space-borne scanning data provide a wide spatial and temporal coverage that can be suitable for global snow measurements. Various satellite sensors have been used to map snow. Chang *et al.* (2004) used passive microwave imagery to study spatial and temporal variations of snow depth (SD), and suggested it is necessary to compare ground point SD measurement and satellite SD to understand uncertainties in point and areal SD. Dong *et al.* (2005 and 2007) incorporated passive microwave into land surface models to evaluate SWE in Canada. The passive microwave imagery provides highly temporal resolution of SWE (e.g. 1 – 3 repeat every day) with a reasonable spatial resolution (25 – 50 km) for a flat region (Dong *et al.* 2007). While, passive microwave imagery is suitable to provide global scale SWE maps, its application has limited utility in small areas and in a complex terrain such as mountain.

Moderate Resolution Imaging Spectroradiometer (MODIS) have been used to determine snow cover area (SCA) at a 500m resolution (e.g. Hua *et al.* 2008, Xiaobing *et al.* 2005, and Hall *et al.* 2002). Although, MODIS images provide a suitable snow cover area for a region, they do not provide SEW or SD.

Across the western U.S. temporal snowpack properties such as SWE and SD have been measured manually on the first of each month at snow course stations for almost 75 years (Serreze *et al.* 1999). Natural Resources Conservation Service (NRCS) is replacing these snow courses stations with automated Snowpack Telemetry Stations (SNOTEL). Besides SWE and SD these stations record air temperature and accumulated precipitation. The snow course and SNOTEL stations have been established based on site accessibility and protection from public

disturbance. Therefore, these stations may not represent spatial variation of snowpack in a large domain (Molotch and Bales 2005).

SNOTEL stations represent highly temporal snow properties (hourly to daily) of a single point ($10m^2$) (Serreze *et al.* 1999). Although these point data are accurate, the ability to predict or model the spatial variation of the surrounding snow pack is poor (Tarboton *et al.* 2000). Despite the knowledge that there is extreme spatial variability among snow properties, only a few point measurements are often available in a catchment of interest that may cover a large area. Thus a small number of SNOTEL station may not be representative of spatial patterns and/or spatial averages for the catchment of interest (Elder *et al.* 1991). In this regards, SNOTEL stations may not provide the quantitative spatial snowpack information needed for spatially distributed modeling. Consequently, there is a need to develop a more representative ground-based measurement to improve our ability to measure and estimate spatial snowpack properties with more accuracy and to assess if SNOTEL stations represent snow properties of their surrounding area.

Ground based snow measurements have been collected to better understand the distribution of snow (Elder *et al.* 1998, Winstral *et al.* 2002, Erxleben *et al.* 2002, Molotch and Bales 2005). Intensive snow surveys are usually limited to a small basin or a small area of a basin with limited topographic variation similar to that of SNOTEL stations, due to labor cost, accessibility, steep terrain, and avalanche hazards (Elder *et al.* 1998). Moreover, the optimal area of a spatial survey that correlates to a SNOTEL station is unknown. For example, SNOTEL SWE was up to 200 percent greater than the mean of the 16, 4, and 1 km^2 area surrounding six SNOTEL stations in the Rio Grande basin (Molotch and Bales, 2005). Therefore, it is necessary

to develop an appropriate sampling strategy and apply it in several areas surrounding SNOTEL stations such as 0.5, 1, 4, or 16 km^2 areas to determine if each SNOTEL station represents the SD and/or SWE of their surrounding area.

It is important to consider that the area which a SNOTEL station represent is likely not the entire area of interest such as a watershed. Therefore, it is necessary to incorporate ground based measurements and statistical techniques to interpolate snowpack properties across a basin. Several interpolation techniques have been incorporated for SD and SWE interpolation (Winstral *et al.* 2002, Erxleben *et al.* 2002, Molotch and Bales 2005, Hultstrand *et al.* 2006, and Fassnacht *et al.* 2003). However, prior to interpolate SWE we need to know if a specific SNOTEL station represents SWE across the area of interest.

Manual measurement of SWE and SD is practical to be measure in field. SWE is the mass of snow at a point, which is product of snow depth (SD) and depth-average density (Fassnacht *et al.* 2010) and both SWE and SD are measured at SNOTEL stations. Snow depth tends to be more variable than snow density (Logan 1973, Elder *et al.* 1991, and Fassnacht *et al.* 2010). Manual measurements of SD are more practical and easier than SWE or snow density since SD is measured using a depth probe while SWE requires the extraction of a snow core. Density can be measured in a snow pit using 10 cm increments samples, and while this is more accurate than extraction core (Fassnacht *et al.* 2010) it is more laborious. We can measure more SD samples compared to SWE or density. For instance, we collected approximately 1000 SD points in one sampling date around the Joe Wright SNOTEL station while we could not sample more than 5 snow pits to measure snow density in the same time. Therefore, measuring SD gives

us the capability to determine the distribution of snow over larger area which provides appropriate spatial data to evaluate a SNOTEL station performance.

The purpose of this research is to determine how well a SNOTEL station represents the snowpack characteristic of its surrounding area. The corresponding hypothesis is that a SNOTEL station represents snowpack properties of its 1 km^2 surrounding area where the station is located in the center. In order to test this hypothesis we conducted field snow measurements across the 1 km^2 area. Several analyses were undertaken to compare the field measured data to the SNOTEL station data to determine the suitable sampling strategy and optimum sampling number needed to represent SD over a 1 km^2 around a SNOTEL station.

CHAPTER 2: PRACTICAL SNOW DEPTH SAMPLING AROUND SIX SNOW TELEMETRY (SNOTEL) STATIONS IN COLORADO AND WYOMING, UNITED STATES

Materials and Methods

2-1 Introduction

Population growth, increased agriculture, industrial and commercial development have increased global demands on water resources exponentially (Chang *et al.* 2004). To address these demands it is necessary to develop a comprehensive understanding of availability of water resources and have accurate measurements of the hydrologic processes. For effective water resource management there is a need to adequately quantify the various components of a hydrological cycle across various different space and time scales.

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measured manually on the first of each month at snow course stations for almost 75 years (Serreze *et al.* 1999). Natural Resources Conservation Service (NRCS) is replacing these snow courses stations with automated Snowpack Telemetry Stations (SNOTEL). Besides SWE and SD these stations record air temperature and accumulated precipitation. These stations have been established based on site accessibility and protection from public disturbance, therefore; they may not represent spatial variation of snowpack in a large domain (Molotch and Bales 2005).

Despite the knowledge that there is extreme spatial variability among snow properties, only a few point measurements are often available in a catchment of interest that may cover a large area. Thus a small number of SNOTEL station may not be representative of spatial patterns and/or spatial averages for the catchment of interest (Elder *et al.* 1991). In this regards, snow SNOTEL stations may not provide the quantitative spatial snowpack information needed for spatially distributed modeling.

It is important to consider that the area which a SNOTEL station represent is likely not the entire area of interest such as a watershed. Therefore, it is necessary to incorporate ground based measurements and statistical techniques to interpolate snowpack properties across a basin. However, before using statistical methods for interpolation we need to know if a specific SNOTEL station represents snow properties of its surrounding area. Consequently, there is a need to develop a more representative ground-based measurement data to improve our ability to measure and estimate spatial snowpack properties with more accuracy and to assess if a specific SNOTEL station represents snow properties of its surrounding area.

In this research we conducted intensive ground base snow depth (SD) measurement in surrounding $1km^2$ of six SNOTEL stations to determine a practical sampling strategies for SD

measurement in surrounding 1km^2 of SNOTEL station regarding to the sampling constraint and to know if those stations represent SD average of their surrounding 1km^2.

2-2 Background

Snow is the main source of water in the mountainous regions and its properties vary in spatially and temporally (Hua *et al.* 2008). These properties include snow water equivalent (SWE), snow depth (SD), snow density, and snow covered area (SCA). Estimation of these snow properties is necessary to understand the hydrologic responses in mountain regions. Moreover, to better predict snow storage and detect trends in the variations of water resources more accurate snowpack information and the known error is essential (Chang *et al.* 2004). Nevertheless, our knowledge regarding the snowpack characteristics within mountain regions is restricted due to complex topographic setting, strong climate gradients, and inadequate number of monitoring station (Bales *et al.* 2006).

Space-borne scanning data provide a wide spatial and temporal coverage that can be suitable for global snow measurements. Various satellite sensors have been used to map snow. Chang *et al.* (2004) used passive microwave imagery to study spatial and temporal variations of snow depth (SD), and suggested it is necessary to compare ground point SD measurement and satellite SD to understand uncertainties in point and areal SD. Dong *et al.* (2005 and 2007) incorporated passive microwave into land surface models to evaluate SWE in Canada. The passive microwave imagery provides highly temporal resolution of SWE (e.g. 1 – 3 repeat every day) with a reasonable spatial resolution (25 – 50 km) for a flat region (Dong *et al.* 2007). Although, passive microwave imagery is suitable to provide global scale SWE maps, but its application has limited utility in small areas and in a complex terrain such as mountain.

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SNOTEL stations measure highly temporal snow properties (hourly to daily) of a single point ($10m^2$) (Serreze *et al.* 1999). Although these point data are accurate, the ability to predict or model the spatial variation of the surrounding snow pack is poor (Tarboton *et al.* 2000). Moreover, the optimal area of a spatial survey that correlates to a SNOTEL station is unknown. For example, SNOTEL SWE was up to 200 percent greater than the mean of the 16, 4, and 1 km^2 area surrounding six SNOTEL stations in the Rio Grande basin (Molotch and Bales, 2005). Therefore, it is necessary to develop an appropriate sampling strategy and apply it in several areas surrounding SNOTEL stations such as 0.5, 1, 4, or 16 km^2 areas to determine if each SNOTEL station represents the SD and/or SWE of their surrounding area.

Ground based snow measurements have been collected to better understand the distribution of snow (Elder *et al.* 1998, Winstral *et al.* 2002, Erxleben *et al.* 2002, Molotch and Bales 2005). Nonetheless, intensive snow surveys are usually limited to small basins or a small spatial area due to labor costs, accessibility, steep terrain, and avalanche hazards (Elder *et al.* 1991; Dozier *et al.* 2004). Therefore, there is a need to develop sampling methods to accurately estimate snowpack properties over an area in a reasonable time and with limited manpower (Elder *et al.* 1991). For instance, we can apply a spatial sampling in several areas surrounding SNOTEL stations such as 0.5, 1, 4, or 16 km^2 areas to determine if each SNOTEL station represents the SD and SWE of their surrounding area.

Manual measurement of SWE and SD is practical to be measure in field. SWE is the mass of snow at a point, which is product of snow depth (SD) and depth-average density (Fassnacht *et al.* 2010) and both SWE and SD are measured at SNOTEL stations. Snow depth tends to be more variable than snow density (Logan 1973, Elder *et al.* 1991, and Fassnacht *et al.* 2010). Manual measurements of SD are more practical and easier than SWE or snow density since SD is measured using a depth probe while SWE requires the extraction of a snow core. Density can be measured in a snow pit using 10 cm increments samples, and while this is more accurate than extraction core (Fassnacht *et al.* 2010) it is more laborious. We can measure more SD samples compared to SWE or density. For instance, we collected approximately 1000 SD points in one sampling date around the Joe Wright SNOTEL station while we could not sample more than 5 snow pits to measure snow density in the same time. Therefore, measuring SD gives us the capability to determine the distribution of snow over larger area.

The purpose of this research is to determine how well a SNOTEL station represents the snowpack characteristic of its surrounding area. We conducted intensive SD measurement of surrounding $1km^2$ areas of six stations due to high spatial distribution of SD to test the following hypothesis:

- SNOTEL station represents snow depth of their surrounding $1km^2$ at the 95 percent confidence level because interactions among climate and terrain do not lead to heterogynous snowpack at the $1km^2$.

- Sampling strategies effects snow depth average of surrounding $1km^2$ of SNOTEL station at the 95 percent confidence level due to various numbers of recorded data in each method.

2-2 Study area

Six SNOTEL stations in Colorado and Wyoming were studied (Table 2-1, Figure 2-1 and 2-2) during winter of 2008, 2009, and 2010 (Table 2-2). We sampled SD of 1 km^2 surrounding area of six SNOTEL stations approximately from 7am to 4pm Pacific Time (PST) for each sampling date. The area of the box was increased for Joe Wright, Niwot, and South Brush Creek since some of the sampling points were located outside of the 1 km^2 area.

Forested regions were the main land cover of surrounding $1km^2$ areas of the studies stations. More than 80 percent of these areas covered by evergreen, deciduous, mixed forest, and grassland. Evergreen forest was the dominant land cover of surrounding $1km^2$ of the studied station except for Dry Lake. Deciduous forest was the main land cover at Dry Lake. Canopy density within the surrounding $1km^2$ areas of the studies stations was high. More than 50 percent part of these areas was more than 50 percent, and it was highest at Niwot, Joe Wright, and South Brush Creek respectively.

Terrain varies for surrounding $1km^2$ area of each station. Joe Wright and Togwotee Pass have complex terrain. Approximately slope of 55% of the surrounding $1km^2$ of Joe Wright station is more than 20 percent and slope between 3 to 20 percent cover 53% of the surrounding $1km^2$ of Togwotee Pass. Terrain variation for surrounding $1km^2$ area of Dry Lake was lower than Joe Wright and Togwotee Pass but it was higher than the other 3 stations. Terrain does not vary much for surrounding $1km^2$ areas of Lizard Head, Niwot, and South Brush Creek station.

2-2 SNOTEL data

Snow depth data of SNOTEL stations were obtained from NRCS snow web site (http://www.wcc.nrcs.usda.gov/snow/) for each sampling date from 7am to 4pm (PST). Hourly snow depth from the SNOTEL stations during this time period was incorporated to compare SNOTEL stations versus field sampling snow depth. SNOTEL depth data are reported in 2.5 cm (1 inch) increments, so this was the precision of the data.

2-3 Geospatial data

The Digital Elevation Model (DEM) and land cover data were obtained from USDA Geospatial Data Gate Way web site (http://datagateway.nrcs.usda.gov/). Slope and aspect maps were created from the 30m resolution DEM. Canopy density was obtained from National Land Cover Database (NLCD 2001) website (http://www.mrlc.gov/). Spatial resolution of DEM, canopy density and land cover data were 30m.

2-4 Methods

2-4-1 Field Sampling

Intensive field surveys were conducted across the 1 km^2 areas uses ten 1000m long transects spaced 100m apart. The direction of transects depended up on the terrain and was either north-south or east-west. Each transect was sampled at a 50m interval and each 50m interval called a spot. The first spot was at the beginning of each transect, and GPS units were used to locate each spot along transects. The UTM coordinate and snow depths were recorded at each spot. Several sampling patterns were used to measure snow depth at each spot. These sampling

patterns were 1 point in the center of a spot (Figure 2-3 a), 3 points along a transect (Figure 2-3 b and c), 3 points perpendicular to a transect (Figure 2-3 d), 5 points in a plus (Figure 2-3 e), and five points along the transect (Figure 2-3 f). Table 2-3 explains the abbreviated names of these sampling patterns.

2-4-2 Data Analyses

Before initiating the statistical analysis, extreme values were removed. These were deemed to be artifacts of human activities, such as roads, snow banks, and snow mobile trails. The Q test (Skoog *et al.,* 1996) was incorporated to find these data. The Q test calculate differences between questionable result and its nearest neighbor (e.g. for minimum and maximum results) then evaluate if the questionable result can be reject with the indicated degree of confidence level (Skoog *et al.,* 1996). In addition, incomplete transects and transects that were not straight line were removed for statistical analysis.

The spacing between spots in each transect was increased from 50 to 100 to 200m. Then they were combined with sampling patterns. These combinations were called sampling methods (Table 2-3). SD averages from similar sampling patterns were compared. For example, we compared 3 points in a row where distances between each spot were 50, 100, and 200m (e.g. F050, F100, and F200). Besides, SD averages of different sampling patterns that have the same distances were compared. For example 1, 3 points in a row or perpendicular to transect, or 5 points in a row or plus that distance between each spot was 50m (e.g. C050, F050, A050, and P050).

Statistical Analysis Software version 9.2 (SAS. Inc., Chicago, IL) was used to analyze the data. The first step was to investigate which sampling strategy was suitable to estimate the average snow depth of one transect and if SD average a specific transect and the SNOTEL station were significantly different at the 95 percent confidence level (all were at this level). In this regard, the SD average for sampling methods of each transect were with one another and to the SD of the SNOTEL station compared. Next SD of transects were compared one another to determine the SD differences among them. Then SD averages of the 10 transects, 5 odd transects (1, 3, 5, 7, and 9), 5 even transects (2, 4, 6, 8, and 10), and 3 transects (1, 5, and 10) were compared to the SNOTEL station to determine the number of transects needed to measure SD average of the $1km^2$ area around each SNOTEL station.

The second step was to determine how a specific SNOTEL station represents snow depth over an area up to 1 km^2. Five subareas, specifically 200*200m, 400*400m, 600*600m, 800*800m, and 1000*1000m, were used with various sampling methods. SD averages of these sub-areas, or surrounding boxes, and were compared to SNOTEL station to determine if they were statistically different. Lastly, SD averages of surrounding boxes were compared one another to determine SD difference among them.

Since the larger surrounding boxes in step 2 included data from the smaller boxes (e.g. 800*800m included the 200*200m, 400*400m, and 600*600m surrounding boxes), snow depths of the smaller boxes affect the average snow depth of any larger box. To address this, data of the small surrounding boxes were removed from larger box. For example, sampling spots of the 800*800m were removed from 1000*100m, and the remaining data were the sampling spots located from 800m to 1000m away from the SNOTEL station. These areas were named

concentric boxes. Five concentric boxes around the SNOTEL station of 0-200m, 200-400m, 400-600m, 600-800m, and 800-1000m were used for step 3 of this research. SD averages of concentric boxes and SNOTEL station were compared to see if they are significantly different. Then, SD averages of concentric boxes were compared one another to determine SD difference among them.

The final step of this analysis was to compare inter and intra annual snow depth variations. For intra-annual, sampled SD collected during a specific year were compared. For inter-annual comparison the SD measurements collected on approximately the same date of each year were compared.

To compare the means of two groups or one group with a determined value, student-based T-test or a related non-parametric approach (the Mann-Whitney-Wilcoxon or MWW test) was used (Ott and Longnecker 2001). The criteria for choosing between the student based t-test (parametric) and MWW (non-parametric) was normality of each data set and independence of variances which were assessed based on quarantile-quarantile plots (QQ Plot) and residual versus fitted value plots (Ott and Longnecker 2001). To compare the means for three or more groups, when all pair comparisons were desired, Tukey-adjusted least significant difference (LSD) analysis of variance (ANOVA) or a related non-parametric approach, i.e., the Kruskal Wallis test, was used (Gliner *et al.* 2009, and Creswell 2011). Criteria and plots for ANOVA analyses were the same as student T-test. All statistical analyses were conducted using SAS 9.2. The significance level for all analyses was set 95 percent (alpha=0.05).

Table 2-1 Name and location of the studied SNOTEL stations. Data were obtained from the NRCS SNOTEL website (http://www.wcc.nrcs.usda.gov/snow/)

SNOTEL Name	Longitude	Latitude	Elevation	Minimum elevation of 1km^2	Maximum elevation of 1km^2	SNOTEL ID	Period of record (years)	Mean Max SWE (mm)
Dry Lake, CO	-106.781	40.534	2560	2475	2650	06J01S	30	580
Joe Wright, CO	-105.887	40.532	3085	3055	3326	05J37S	32	680
Lizard Head Pass, CO	-107.924	37.799	3109	3071	3160	07M29S	30	420
Niwot, CO	-105.544	40.035	3021	2924	3124	05J42S	30	350
South Brush Creek, WY	-106.502	41.329	2560	2521	2615	06H19S	30	340
Togwotee Pass, WY	-110.058	43.749	2920	2844	3031	10F09S	28	670

Table 2-2 sampling dates, numbers, and patterns for the SNOTEL stations

SNOTEL station	Sampling date	Sample number in each point		Sampling Shape		Number of transect	Number of set of points	
		3	5	Row	Star		Center	Total
Dry Lake	04/04/2008	*		*		7	137	411
	05/02/2008		*		*	10	197	985
	02/28/2009		*		*	9	174	870
	03/28/2009		*	*		10	197	985
Joe Wright	04/03/2008		*		*	6	31	155
	05/01/2008	*		*		10	204	612
	01/31/2009		*		*	8	147	735
	02/27/2009		*		*	8	162	810
	05/02/2009		*	*		10	198	990
	05/01/2010 05/02/2010		*	*		10	193	965
Lizard Head Pass	03/17/2008		*		*	10	150	750
NIWOT	04/07/2008	*		*		10	176	528
	05/05/2008	*		*		10	209	627
	03/06/2009	*		*		7	144	432
	04/03/2009		*	*		10	201	1005
South Brush Creek	04/05/2008	*		*		6	64	195
	03/01/2009		*		*	10	210	1050
	03/29/2009		*	*		10	204	1020
Togwotee Pass	03/17/2009		*		*	7	106	530

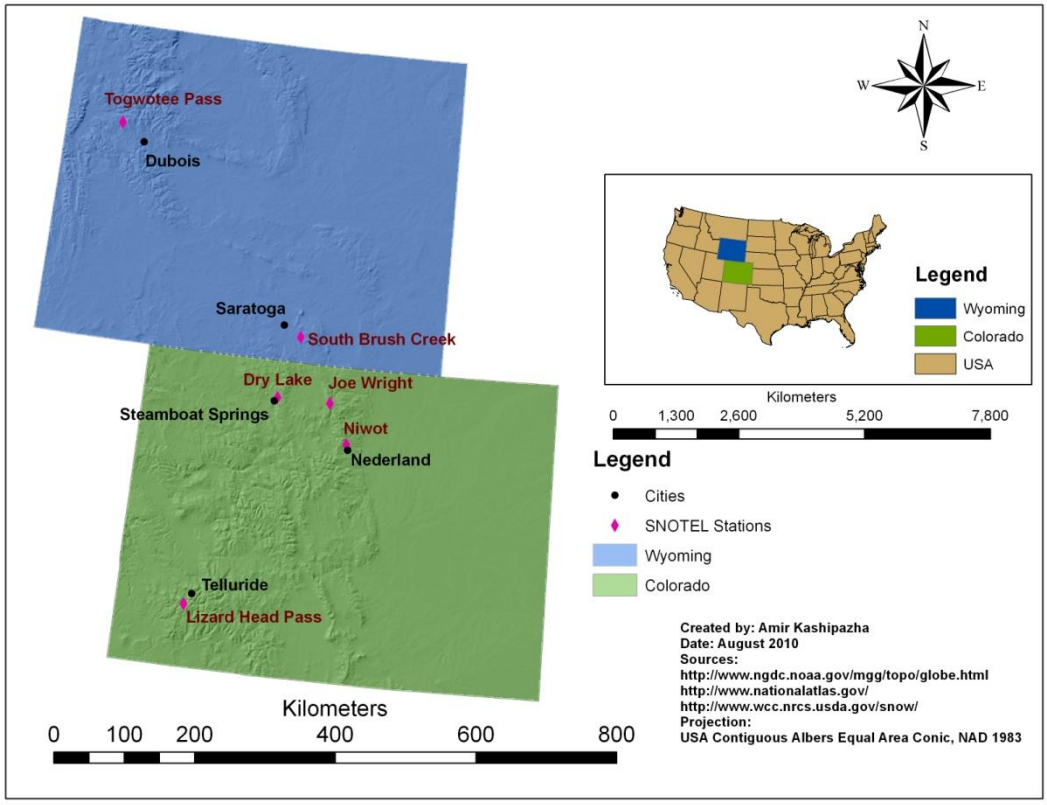

Figure 2-1 Location map of SNOTEL stations, data was taken from NRCS SNOTEL data website (http://www.wcc.nrcs.usda.gov/snow/, and http://www.nationalatlas.gov/)

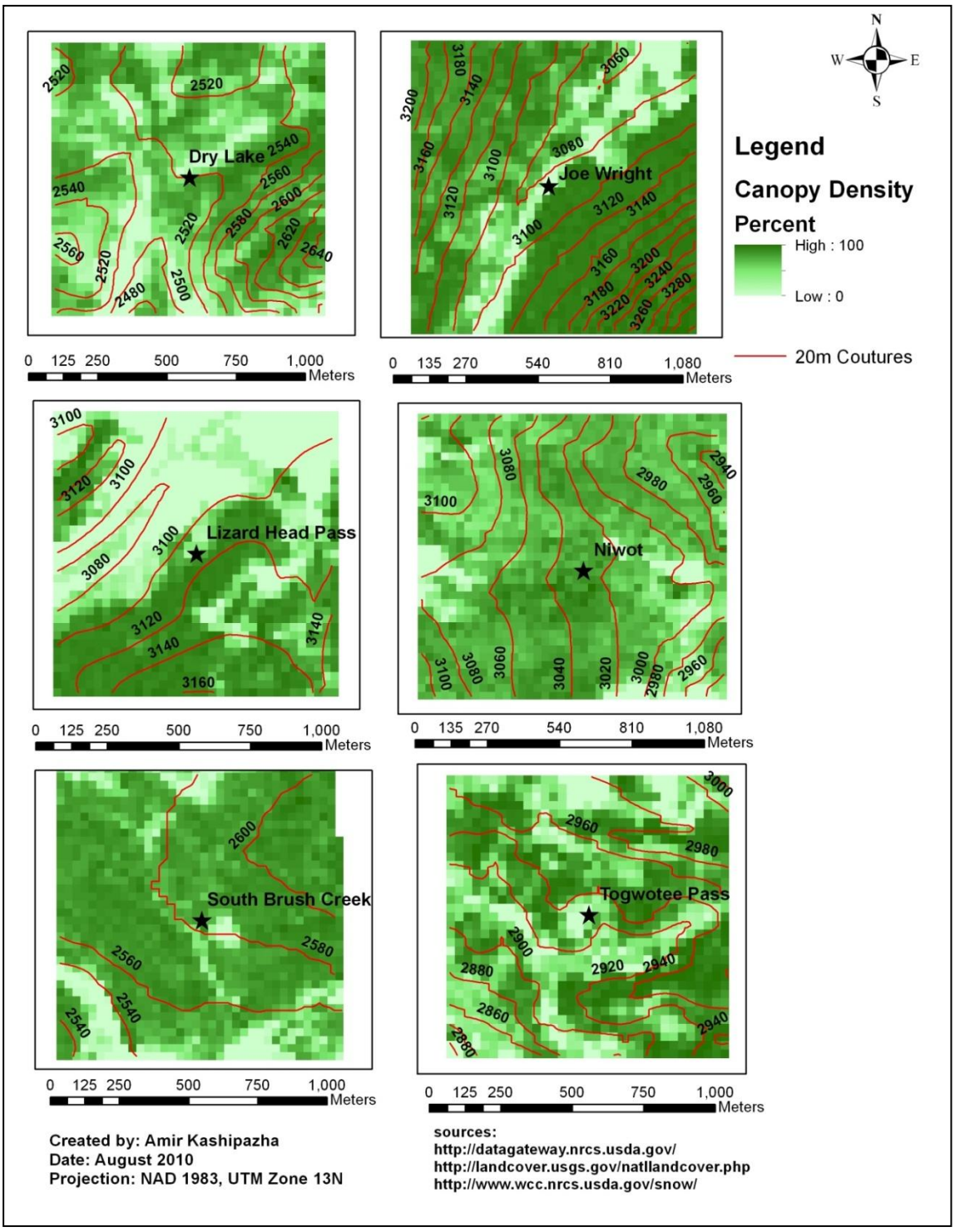

Figure 2-2 surrounding $1km^2$ area of the Studied SNOTE station, (http://www.epa.gov/mrlc/nlcd-2001.html and http://datagateway.nrcs.usda.gov/)

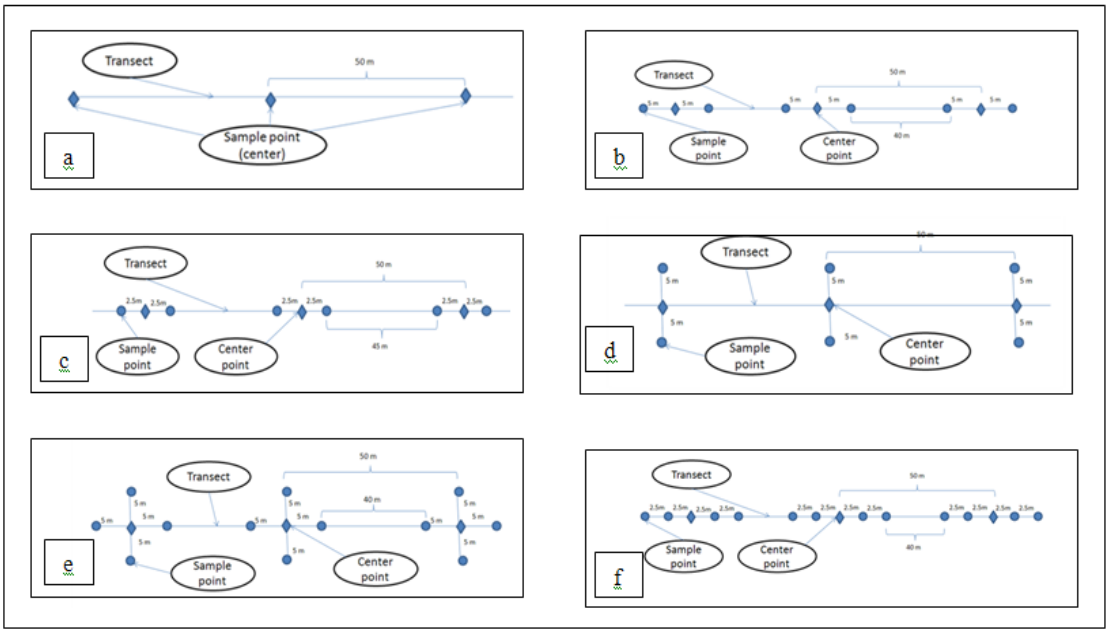

Figure 2-3 applied different sampling pattern in each spot, **2-9 a** one sample (C050, C100, C200) **2-9 b** three samples in a row with 5m distance (F050, F100, F200), **2-9 c** three samples in row with 2 or 3m distance (T050, T100, T200), **2-9 d** three samples perpendicular to transect (P050, P100, P200), **2-9 e** five samples in a star shape (A050, A100, A200), and **2-9 f** five samples in a row with 2.5m distance (A050, A100, A200)

CHAPTER 3: RESULTS

3-1 Effect of Sampling Method of SD Average of Specific Transect, Surrounding and Concentric Box

One hundred fifty two transects were analyzed. SD averages for some sampling methods of 5 transects of theses 152 transects were significantly different in regards to the other sampling methods of those transects. The observed differences were for 2 and 4 sampling methods of transect 6 and 7 on May/01/2008 at Joe Wright, 2 sampling methods of transect 6 on May/02/2009 at Joe Wright SNOTEL station, 2 sampling methods of transect 6 on Niwot on March/06/2009, and 2 sampling methods of transect 10 of South Brush Creek on March/01/2009. These observed differences were just for these sampling methods, but SD of these methods were not significantly different considering to the other sampling methods of those transects at the 95 percent confidence level.

Statistical analyses of surrounding and concentric boxes showed 2 sampling methods of 200*200m surrounding and 0-200m concentric box of Joe Wright SNOTEL station at February/27/2009 were significantly different at the 95% confidence level. But, other sampling methods of these boxes were not significantly different at the 95 percent confidence level.

Results of the statistical analyses of transects, surrounding and concentric boxes demonstrated SD averages various sampling methods were not significantly different at the 95 percent confidence level. In the other words, the sampling pattern and spacing does not affect SD of a specific transect, surrounding or a concentric box. In this reason, three sample in each spots with 50m spot distance (F050) sampling methods were used for rest of statistical analyses.

Because, this sampling method was available for all dates, it has the most data as compared to other sampling methods that were available such as one sample at the center of spot (C050), and there is not a significant difference in SD average of this sampling pattern with regards to the others in 95 percent confidence level.

3-2 SD of SNOTEL station versus transect and transect versus transect

Snow depth of SNOTEL stations was higher than transects except for 6 transects of Niwot station on May/05/2008. Nevertheless, it does not mean SD of SNOTEL stations and transects were significantly different at the 95 percent confidence level. The number of conducted transects were 36, 52, 37, 20, and 7 for Dry Lake, Joe Wright, Niwot, South Brush Creek, and Togwotee Pass and SD averages of 9, 19, 7, 9, and 6 of these transects were significantly different versus SNOTEL station at the 95 percent confidence level respectively (Table 3-1). It is important to notice significant SD different between SNOTEL station and a transect of one specific day were not consistent. For instance, SD averages of transect 1 of South Brush Creek SNOTEL at 50 and 100 spatial distance were significantly different on March/01/2009, while it was not significantly different for 200m spatial distance (Table 3-2). This inconsistency also was found for SD differences among transects. For example, SD averages of transects for Joe Wright station were not significantly different on May/01/2008 but significantly SD difference among transects were founded on May/02/2009 (Table 3-3). The only consistent SD differences were found for transect 9 and 10 of Dry Lake Station.

3-3 SD of SNOTEL station versus Surrounding and concentric boxes

SD of SNOTEL stations was higher than surrounding boxes except on May/05/2008 at Niwot station. Dry Lake SNOTEL represent SD average of its surrounding 1km^2 area at the 95 percent confidence level and one significant difference was found for the surrounding 0.04 1km^2 area of this station on 02/28/2009 (Table 3-4). Joe Wright station represented SD average of its surrounding 1km^2 area except on 05/01/2010. SD of the 1km^2 area of Joe Wright SNOTEL station at 2010 was measured on May/01 and May/02. Table 3-5 is the statistical analyses for measured SD of surrounding boxes of May/01 and May/02 versus SNOTEL station. In this reason we cannot conclude if SNOTEL station represented or did not represent SD of its 1 km^2 surrounding area at this date. To address this problem we conducted more analyses to validate these result using F050 sampling method (Table 3-5). Results showed Joe Wright station represented SD average on May/02 but it did not represented SD average on May/01. Since sampling accomplished on two dates, we cannot conclude if Joe Wright SNOTEL represented or not represented SD average it 1km^2 surrounding area, and recommend to sample SD in one date.

Statistical analyses showed Lizard Head SNOTEL represent SD averages of its surrounding 1km^2 area, however; sampling spots were not distributed in all parts of this area. In this reason, Lizard head station represented SD of its 0.36km^2 area. Niwot Station represented SD average of its surrounding area except on 03/06/2009.

South Brush Creek station did not represent SD average of its surrounding area except its 1km^2 surrounding area on 03/29/2009. It is important to notice although South Brush Creek represented SD of its 1km^2 surrounding area on 03/29/2009 but this station did not represented

SD of smaller surrounding boxes (Table 3-4). Togwotee Pass station did not represent its surrounding 0.64 km^2 at the 95 percent confidence level.

SD difference between sampling methods of surrounding areas versus SNOTEL stations were not consistent. For example, SD of Niwot station versus F050, C050, and C200 sampling methods on March/06/2009 were significantly different but it was not significantly different regarding to the other sampling methods of this date (Table 3-6). These inconsistencies also were founded among SD averages of surrounding boxes. For instance, SD averages of surrounding boxes of Joe Wright were not significantly different at the 95 percent confidence level on May/02/2009 but they were different on February/27/2009 (Table 3-7).

Statistical analyses of concentric boxes demonstrate SD of small surrounding boxes affected the larger boxes but these effects were not consistent for all station (Table 3-8). For instant, the number of differences increased for Dry Lake and Joe Wright but decreased for South Brush Creek station.

3-4 Number of transect need for each station

Number of transects were needed for each station was different. Additionally, number of transects were required to measure SD average of surrounding 1km^2 of one SNOTEL station were not equal at each date (Table 3-9). Results of this work showed minimum number of transect required were 4, 5, 3, 3 for Dry Lake, Joe Wright, Niwot, and south Brush Creek respectively.

3-5 inter and intra annual analyses

SD averages of Dry Lake, Joe Wright, Niwot, and South Brush Creek station were significantly different intra annually. SD averages of South Brush Creek station did not significantly different inter annual but SD averages of Dry Lake, Joe Wright, and Niwot were significantly at the 95 percent confidence level.

Table 3-1 statistical analyses of SD averages of transects versus SNOTEL stations for F050 sampling method at the 95 percent confidence level

SNOTEL station	Dates	1	2	3	4	5	6	7	8	9	10
Dry Lake	**04/04/2008**			M		M	M			↑	↑
	05/02/2008									↑	↑
	02/28/2009	↑								M	↑
	03/28/2009				↑					↑	↑
Joe Wright	**03/03/2008**	M			↑		↑	↑	M	M	M
	05/01/2008		↑					↑	↑		
	01/31/2009					M	M			↑	
	02/27/2009					M		M		↑	
	05/02/2009		↑	↑			↑	↑		↑	
	05/01/2010		↑		↑	↑	↑	↑	↑		
Niwot	**04/07/2008**										
	05/05/2008			↓					↓		
	03/06/2009			M	M	↑	↑		↑	↑	M
	04/03/2009						↑				
South Brush Creek	**03/01/2009**	↑		↑				↑	↑		↑
	03/29/2009				↑		↑		↑	↑	
Togwotee Pass	**03/17/2009**	M	M	↑	↑	↑	↑	↑	↑		M

Empty cell : no significant difference, M: missing data, N/A: not applicable

↓: significantly difference and SD of SNOTEL is lower ,↑: significantly difference and SD of SNOTEL is higher

Table 3-2 inconsistency of SD difference in transects of South Brush Creek Station at the 95 percent confidence level

Spacing / **Sampling pattern**		**1**			**2**			**3**			**4**			**5**		
		50	**100**	**200**	**50**	**100**	**200**	**50**	**100**	**200**	**50**	**100**	**200**	**50**	**100**	**200**
Mar/01/2009	**C**	↑	↑					↑		↑			↑			
	A	↑	↑					↑		↑			↑			
	F	↑	↑					↑		↑			↑			
	P	↑	↑					↑		↑	↑		↑			

Empty cell : no significant difference, M: missing data, N/A: not applicable

↓: significantly difference and SD of SNOTEL is lower ,↑: significantly difference and SD of SNOTEL is higher

Table 3-3 statistical analyses of transects versus transects of Joe Wright station for F050 sampling method on March/01/2009 and May/02/2009 at the 95 percent confidence level

	May/01/2008		May/02/2009	
	Mean ± STD (cm)[a]	**SID[b]**	**Mean ± STD (cm)**	**SID**
Transect 1	262.18 ± 20.20		162.10 ± 18.06	T3, T7
Transect 2	250.51 ± 21.94		156.87 ± 14.32	
Transect 3	170.27 ± 46.70		146.93 ± 22.14	T1, T8, T10
Transect 4	165.56 ± 34.28		154.70 ± 21.57	
Transect 5	167.68 ± 36.06		156.68 ± 20.92	
Transect 6	159.83 ± 24.86		150.68 ± 8.22	T8, T10
Transect 7	152.73 ± 32.29		144.77 ± 28.60	T1, T8, T10
Transect 8	157.32 ± 26.47		165.40 ± 36.78	T3, T6, T7, T9
Transect 9	165.77 ± 29.16		148.42 ± 20.33	T8, T10
Transect 10	167.56 ± 27.92		166.98 ± 27.40	T3, T6, T7, T9

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

T is transect

Table 3-4 statistical analyses of SD averages of surrounding boxes versus SNOTEL stations for F050 sampling method at the 95 percent confidence level

Station	Date	200*200m	400*400m	600*600m	800*800m	1000-1000m
Dry Lake	**04/04/2008**	M				
	05/02/2008					
	02/28/2009	↑				
	03/28/2009					
Joe Wright	**04/03/2008**		↑			M
	05/01/2008					
	01/31/2009	M				
	02/27/2009	↑				
	05/02/2009				↑	
	05/01/2010	↑		↑	↑	↑
Lizard Head	**03/17/2008**					
Niwot	**04/07/2008**					
	05/05/2008					
	03/06/2009	↑	↑	↑	↑	↑
	04/03/2009					
South Brush Creek	**04/05/2008**	↑	↑	↑	↑	M
	03/01/2009	↑	↑	↑	↑	↑
	03/29/2009	↑	↑	↑	↑	
Togwotee Pass	**03/17/2009**	↑	↑	↑	↑	M

Empty cell : no significant difference, M: missing data, N/A: not applicable

↓: significantly difference and SD of SNOTEL is lower ,↑: significantly difference and SD of SNOTEL is higher

Table 3-5 statistical analyses of measured SD at May/01/2010 and May/02/2010 versus Joe Wright SNOTEL station at 95 percent confidence level

SNOTEL Date	Field Data / Sampling Pattern	F050
May01	May01 and May02	*
May02	May01 and May02	
May01 and May02	May01 and May02	*
May01	May01	*
May02	May02	
May01	May01 and adjusted May02	*

* means significant difference, and empty cell means no significant difference

Table 3-6 inconsistency of SD difference in surrounding boxes of Niwot and South Brush Creek Station

Spacing / Sampling pattern		200*200m			400*400m			600*600m			800*800m			1000-1000m		
		50	100	200	50	100	200	50	100	200	50	100	200	50	100	200
Mar/06/2009 Niwot	**C**	↑	↑	N/A	↑			↑			↑		↑	↑		↑
	F	↑	↑	N/A	↑	↑		↑			↑	↑	↑	↑		
Mar/29/2009 South Brush Creek	**C**	↑	↑	N/A	↑	↑		↑	↑	↑	↑		↑			
	A	↑	↑	N/A	↑	↑		↑	↑		↑		↑			↑
	F	↑	↑	N/A	↑	↑		↑	↑		↑	↑	↑			
	T	↑	↑	N/A	↑	↑		↑	↑		↑		↑	↑		

Empty cell : no significant difference, M: missing data, N/A: not applicable

↓: significantly difference and SD of SNOTEL is lower ,↑: significantly difference and SD of SNOTEL is higher

Table 3-7 statistical analyses of surrounding boxes versus surrounding boxes of Joe Wright station on for F050 sampling method March/01/2009 and May/02/2009 at the 95 percent confidence level

	February/27/2009		**May/02/2009**	
	Mean ± STD (cm)[a]	**SID[b]**	**Mean ± STD (cm)**	**SID**
Box 200	111.08 ± 21.15	B600, B800, B1000	153.47 ± 30.03	
Box 400	129.58 ± 27.10	B1000	158.83 ± 25.82	
Box 600	141.51 ± 23.26	B200	154.90 ± 24.05	
Box 800	140.34 ± 21.82	B200	153.91 ± 24.70	
Box 1000	142.72 ± 23.56	B200, B400	155.56 ± 23.89	

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

B is the surrounding boxes

Table 3-8 statistical analyses of SD averages of consentric boxes versus SNOTEL stations for F050 sampling method at the 95 percent confidence level

Station	Date	0-200m	200-400m	400-600m	600-800m	800-1000m
Dry Lake	**04/04/2008**	M				
	05/02/2008					
	02/28/2009	↑				↑
	03/28/2009					
Joe Wright	**04/03/2008**		↑			M
	05/01/2008			↑	↑	
	01/31/2009	M				
	02/27/2009	↑				
	05/02/2009			↑	↑	
	05/01/2010	↑	↑	↑	↑	↑
Lizard Head	**03/17/2008**					
Niwot	**04/07/2008**					
	05/05/2008				↑	
	03/06/2009	↑	↑	↑	↑	
	04/03/2009					
Soth Brush Creek	**04/05/2008**	↑	↑	↑	↑	M
	03/01/2009	↑	↑		↑	
	03/29/2009	↑	↑			
Togwotee Pass	**03/17/2009**	↑	↑	↑	↑	M

Empty cell : no significant difference, M: missing data, N/A: not applicable

↓: significantly difference and SD of SNOTEL is lower ,↑: significantly difference and SD of SNOTEL is higher

Table 3-9 statistical analyses of SD average of 3, 5, and 10 transects versus SNOTEL station for F050 sampling method in 95 percent confidence level

	May/01/2008		**Jan/31/209**	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**
SNOTEL	182.37 ± 8.64		133.10 ± 1.31	
10 transects (all)	162.54 ± 30.57	odd, even, thr	127.60 ± 24.93[d]	
Transects 2, 4 , 6, 8, 10 (even)	178.79 ± 43.77	all, thr	132.75 ± 21.71[e]	odd
Transects 1, 3, 5, 7, 9 (odd)	183.59 ± 51.94	all, thr	122.44 ± 26.93[f]	even
Transects 1, 5, 10 (thr)	198.62 ± 52.95	all, odd, even	-	
	May/02/2009		May/01/2010	
	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	170.94 ± 2.41	odd	173.23 ± 2.88	All, even, odd, thr
10 transects (all)	155.56 ± 23.89		150.02 ± 23.58	SNOTEL
Transects 2, 4 , 6, 8, 10 (even)	159.11 ± 24.56	odd	148.37 ± 24.33	SNOTEL
Transects 1, 3, 5, 7, 9 (odd)	151.94 ± 22.75	SNOTEL, thr, even	151.76 ± 22.76	SNOTEL
Transects 1, 5, 10 (thr)	162.09 ± 22.54	odd	154.14 ± 23.22	SNOTEL

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

d transects 1, 2, 3, 4, 7, 8, 9, 10

e transects 2, 4, 8, and 10

f transects 1, 3, 7, and 9

CHAPTER 4: DISCUSSION

Intensive snow surveys are usually limited to small basins or a small spatial area due to labor costs, accessibility, steep terrain, and avalanche hazards (Elder *et al.* 1991; Dozier *et al.* 2004). Therefore, there is a need to develop sampling methods to accurately estimate snowpack properties over an area in a reasonable time and with limited manpower (Elder *et al.* 1991). We conducted intensive snow depth (SD) sampling in a $1km^2$ surrounding area around various SNOTEL stations to assess sampling strategies. Various sampling patterns were used to average local variability of a sampling spot, yet the SD averages of various sampling patterns of a particular transect were not significantly different. This means that the local SD of a sampling spot was not significantly different, and using various sampling patterns did not make a significant difference on SD averages for sampling methods of one transect.

The three spacings were used to study how SD average on one transect could be different statistically with incorporating different distances between sampling spots. Results showed SD averages of various sampling distances of a transect were not significantly different at the 95 percent confidence level. In addition to transects, results of statistical analyses for a particular surrounding and concentric box showed SD averages of various sampling methods of these boxes were not significantly different, except for the 200*200m box of Joe Wright SNOTEL station on February/27/2009.

Precipitation controls the spatial distribution of snow pack especially at a small scale like a $1km^2$ surrounding box (Elder *et al.*, 1991; Faria *et al.*, 2000; and Trujillo *et al.*, 2007). In this reason, SD was not significantly different within the $1km^2$ surrounding each SNOTEL station. Although, SD averages of transects, surrounding and concentric boxes not being significantly

different at the 95 percent confidence level, it does not imply that SD averages of various sampling methods were not different. No two sampling methods had the exact same average SD.

The differences were largest to smallest in the following order: transects, concentric boxes, and surrounding boxes. Snow accumulation and ablation processes are governed by topography, land cover (e.g. coniferous, deciduous, or open), and vegetation structure, as illustrated by canopy density (Davis *et al.*, 1997, Hardy *et al.*, 1997, Link and Marks, 1999, Faria *et al.*, 2000, and Musselman *et al.*, 2008). In alpine and open areas wind redistribution is a primary reason for the spatial heterogeneity of snow (Elder *et al.*, 1991; Winstral *et al.* 2002; Hiemstra *et al.* 2006). All these factors create a heterogeneous snowpack in a small region, such as a $1km^2$ area, or even at a sampling spot. For instance, the SD difference between two sampling methods of the transect 7 of Joe Wright station on the May/01/2008 was 36 cm, these inconsistent SD differences were also founded for other SNOTEL stations. Vegetation dissimilarity and physiographic variation was more within a $1km^2$ surrounding area compared to a transect (Figure 2-2), but SD variation among sampling methods of surrounding boxes was less. One reason SD differences were higher among sampling methods for one transect is the number of sampling spots. For instance, SD average on a North-East aspect of Joe Wright station was higher on average than all other aspects on May/02/2009 (Figure 4-3), but there were only two sampling spots on that aspect. This yielded a considerable increase in SD average for one transect since there are 21 sampling spots in a transect, while the number of sampling spots within a $1km^2$ area is usually more than 200. Since there are more points within a surrounding box, averaging minimize the extreme SD values.

In addition to the physiographic and vegetation structure, Musselman *et al.* (2008) found tree wells resulted in inconsistent snow accumulation under the canopy, with SD in open-spaces higher than SD on the south and north sides of tree wells; SD was higher on the north side of a tree trunks compared to the next to it. The results herein showed the significant SD differences were related to the sampling spacing not the sampling pattern, because SD average of sampling methods with similar pattern and various spacing were different. The differences were between the 50m and 200m spacing (data not shown). This implies that a 200m could be a spacing threshold for the distance between sampling spots around a SNOTEL station. Therefore, it is recommended to measure SD along a transect with distances of less than 200m between sampling spot. The sampling pattern is not important at the studied SNOTEL stations, and any sampling pattern could be used based on other measurement constraints. López-Moreno *et al.* (2011) did an intensive SD survey at a plot scale in the Spanish Pyrenees Mountains. They recommended that when spatial heterogeneity of snow is substantial the number of snow depth samples should be increased; a "true" snow depth estimation error would be less than 10% if five or more measurements were taken at a sampling spot. Results herein showed that three snow depth measurements in a sampling spot along a transect or around a box yielded an average error less than 5%.

Since time, safety, labor availability, and labor experience are very important factors for snow measurement, we recommend the use of a sampling method that is not time consuming and is simple with a reasonable spatial distribution and coverage, such as three measurements in each spot at a 100m distance if trying to obtain an average SD. It is important to choose a simple sampling method for SD measurement especially for people who are not familiar with snow

sampling so to reduce confusion. For example, less experienced samplers may not complete a transect or may record SD incorrectly. The Togwotee Pass sampling was five points 1m apart in a plus, yielding 21 points per spot, which was very labor intensive.

It is important to note that SD averages of the surrounding boxes were not different even with varying physiographic and vegetation structure (Figures 2-2 and 4-1). The effects of independent variables on snow depth may change over a few kilometers and it is not similar in various regions (Elder 1995 as cited by Molotch and Bales 2005). The largest distance between the farthest spots of this work at a site was less than 1.5km. This means that the independent variables made SD differences among sampling methods but due to the small spatial distances, these variables did not make considerable SD differences. However, the independent variables minimum number of transect needed to be estimate SD average over a $1km^2$ area around a SNOTEL station was not always the same for each station.

It is difficult to determine which factor control spatial distribution of snow (Molotch and Bales 2005). Because, the effect of physiographic and vegetation on snow depth is different inter and intra annually and it is complicate to determine which factor was responsible for SD distribution. Erxleben *et al.* (2002) found aspect and Molotch and Bales (2005) found elevation and solar radiation were the most important physiographic factor for snow distribution. Molotch and Bales (2005) also reported factors which effected the snow distribution were not same at different year. Blumberg (2012) studied the effect of physiographic and vegetation variables on SD of surrounding area of Joe Wright station and found SD had higher correlation on May-2009 with canopy density, elevation, sin of slope, and northness respectively, while it had higher

correlation with northness, eastness, maximum upwind slope, canopy density, and elevation respectively on May-2010. These

Transects 9 and 10 of Dry Lake station were consistently lower (significantly) than the SNOTEL station and other transects (data not shown). These two transects have a south, southwest, and west aspects and are covered mostly by low density deciduous forest and grasslands while the eight other transects have a north, northwest, or west aspect and are covered with denser evergreen and deciduous forest (Figure 4-1). Transects 9 and 10 thus get more solar radiation and had less snow depth (Figure 4-4). Although; the amount of solar radiations these two transect received were not significantly different than other transects at the 95 percent confidence level but it could be a reason of why SD was lower for transect 9 and 10. In addition snow may have been redistributed away from this area, or wind may have compacted snow in this area. Aspect is likely the main factor for the low SD of these transects (Figure 4-2). We dug 3 snow pits in the in the $1km^2$ surrounding area of this station on March/28/2009, and one of them located on transect ten. SWE of the snow pit of transect 10 was 40.5cm and SWE of the two other pits and SNOTEL station were 57, 53.4, and 56.4cm respectively. We can conclude that SWE over this part of the $1km^2$ of Dry Lake study area was lower. However; we cannot make a conclusion on SWE for other date since we did not have a snow pit near transect 9 or 10 on the other dates. Moreover, snow densities for the snow pit of transect 10, two other pits, and the SNOTEL station on March/28/2009 were 318, 352, 356, and 379 kg/m^3 respectively. It means that the low SWE and SD for the transect 9 and 10 was not related to the snow compaction since snow density of the snow pit on transect 10 was the lowest.

Joe Wright SNOTEL station represented SD average of its 1 km^2 area at the 95 percent confidence except on May/01/2010 (Tables 3-4). SD measurement of surrounding area of this station was accomplished at May/01 and May/02 of 2010. Additional analyses (Table 3-5) demonstrated Joe Wright SNOTEL did not represent SD average of its $1km^2$ surrounding area at these dates. Because SD was sampled in two dates and 7.3cm of SD depth decreased from May/01 to May/02. We do not know if Joe Wright SNOTEL station represented SD average of its 1 km^2 area in 95 percent confidence level on May/01 or May/02 of 2010. To avoid this problem, we recommend sampling SD on one sampling date. While this station did not represent SD average at the 95 percent confidence level on these dates it could represent SD average on a lower confidence level (e.g. 90 percent). SD of SNOTEL station on May/01 was 7.3cm higher than May/02. SD of averages of the F050 sampling method was 2.1cm higher on May/01. These differences could be the reason of SD difference between SNOTEL station and $1km^2$ surrounding area. May is a melting season at the Joe Wright and the snow pit we dug at these date showed wet snow with 0 C º temperatures. These indicate snow melt faster in the SNOTEL station or under SD sensor or snow melting was not simulations for SNOTEL site and the $1km^2$ area. In addition the difference could because of the SD sensor error.

Niwot station represented SD average of its 1 km^2 area at the 95 percent confidence except on March/06/2009 (Tables 3-4). Table 3-4 shows the statistical analyses of the F050 sampling method and SNOTEL stations. Average SD of the F050 was 1 cm lower than other sampling methods at this date. SO we can conclude that Niwot station represented SD average of its 1 km^2 surrounding box. However, it represented SD at a confidence level lower than 95 percent which is reasonable. A standard error of 10 percent for snow sampling is acceptable

regarding the independent variables and sampling errors (Dickinson and Whiteley 1972), and the standard error for this work was 5 percent.

South Brush Creek SNOTEL station did not represented SD average of its surrounding boxes except for the 1000*1000m surrounding box on March/29/2009 (Table 3-4). But the 800-1000m concentric box of South Brush Creek station was not significantly different (Table 3-8). Thus it is possible that SD average for a larger area (e.g. $2km^2$) could represent a station while not representing smaller areas. Although, surrounding $1km^2$ area of South Brush Creek station is homogeneous (Figures 2-2 and 4-1), but it did not represent SD average of its surrounding boxes. But SD averages of surrounding boxes versus surrounding boxes of these stations were not significantly different at the 95 percent confidence level (data not shown). It means snow distributed homogenously in the $1km^2$ areas of this station, because of the homogeneity of $1km^2$ surrounding area of this station, therefore; selection of SNOTEL site for station establishment could not be wrong.

Unlike South Brush Creek SNOTEL the $1km^2$ surrounding area of the Togwotee Pass is not homogeneous (Figures 2-2 and 4-1). Nevertheless, results of this work showed physiographic variations do not enough reason to conclude if a SNOTEL station do not represent SD average of its $1km^2$ surrounding area. For example, physiographic variation is more in surrounding area of Joe Wright station compared to Togwotee Pass, but Joe Wright represented SD average of its surrounding area.

On noticeable result of this research was SD of SNOTEL stations were generally higher than SD surrounding boxes except for May/05/2008 at Niwot station (data not shown). It is important to know why SNOTEL stations over estimate SD averages of their surrounding area.

Molotch and Bales (2005) explained SNOTEL stations may not represent spatial variation of snowpack in a large domain because they established based on site accessibility and protection from public disturbance. In 2011, due to the unprecedented snowfall, the NRCS took snow cores with a federal sampler for calibrate the Joe Wright snow pillow SWE measurements. Therefore, one reason of why SD of SNOTEL station was higher than surrounding boxes could be SNOTEL stations locate in an area which does not represent SD average of the surrounding region. For example, Joe Wright SNOTEL locates close to a meadow and Togwotee Pass SNOTEL locates next to a treeless area and wind deposit snow on the SNOTEL station. Snow like other sediment tends to accumulate or erode when flow decelerate or accelerate (Elder *et al.,* 1991). The interaction of the terrain and wind led to inconsistent snow depth in a small scale like a sampling spot (Musselman *et al.*, 2008) or large scale such as $1km^2$ area (Elder *et al.,* 1991, Hiemstra *et al.* 2006). The effect of wind in snow accumulation and erosion could be seen in SD along a 50m transect next to Joe Wright SNOTEL (Figure 4-5). Snow tended to erode in the SNOTEL station site and accumulate from 25 to 40m of the station and SD of this transect was generally higher than SD of SNOTEL station. Personal observation showed wind direction is south to north at Joe Wright station, which caused deposit from road, snow plow activity, or intercepted snow deposit on the open pace next to this station.

Musselman *et al.* (2008) found tree trunk and land cover made inconsistent snow accumulation under canopy density and open-space. SNOTEL station hardware, neighboring trees, or open-space may generate varying snow accumulation patterns around a SNOTEL stations. This means that snow depth could vary in small scale like a sampling spot or a small distance from SNOTEL station. This could make a potential error for SD sensor to overestimate

or underestimate the snow depth. Rice and Bales (2010) designed an embedded-sensor network to measure SD of the area surrounding a SNOTEL station. They found that a network of 4 or 5 sensors place in an optimal location is sufficient to measure SD the $1km^2$ spatial mean within ±20 to ±25% error. Thus it is a good idea to increase the number of sensors within the study area. Neumann *et al.* (2006) found snow depth one fixed-measurement of snow depth did not statistically represent the SD of a particular area even for uniform snow cover. They also recommended using multiple automated point depth sensors is practical to decrease uncertainty of SD measurement by SD sensor for the region which manual snow survey is not practical.

Beyond using an embedded-sensor network, we also recommend measuring snow depth around each ultra-sonic depth sensor at the SNOTEL. We found snow depth difference within 3m surrounding area of the SD sensor at the Joe Wright station to be up to 40cm (Figures 4-6 and 4-7) but this was not consistent with direction. Thus snow depth variation in a small scale (sampling spot) can also be important to how a SNOTEL site represents SD of its surrounding area. For example, if SD sensor of Joe Wright Station was established anywhere in its 0 to 3m surrounding area of it, this station could possibly underestimate, estimate, or overestimate the SD average of the $1km^2$ surrounding area. In this regard, we recommend having more than one SD sensor at a SNOTEL station.

It is important to note that error in snow depth measurement by SD sensor is part of SD measurement and which made by several factors. Ryan *et al.* (2008a) found SD sensor measured SD accurately beneath the sensor, but the sensor underestimated the surrounding area. They also found several factors may affect SD sensor performance including snow crystal type, blowing or drifting snow, intense snowfall, wind speed, and uneven snow surface. It is difficult to know

what factor was responsible for the and how to alleviate the error (Ryan *et al.* 2008a and b), thus we need to consider a reasonable error (e.g. 5% or 10%) for snow measurement studies.

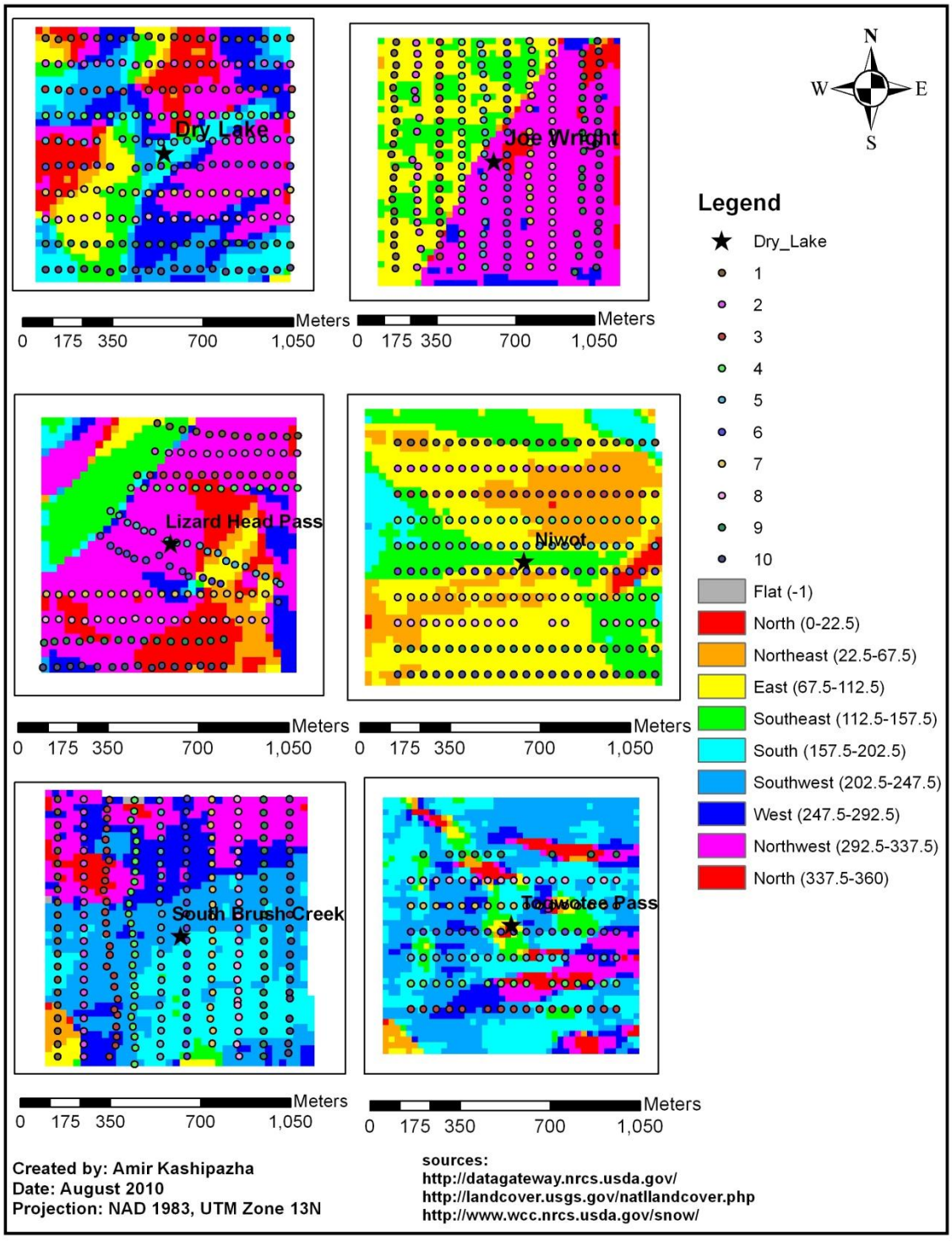

Figure 4-1 aspect distribution of the 1km^2 of studied SNOTEL station

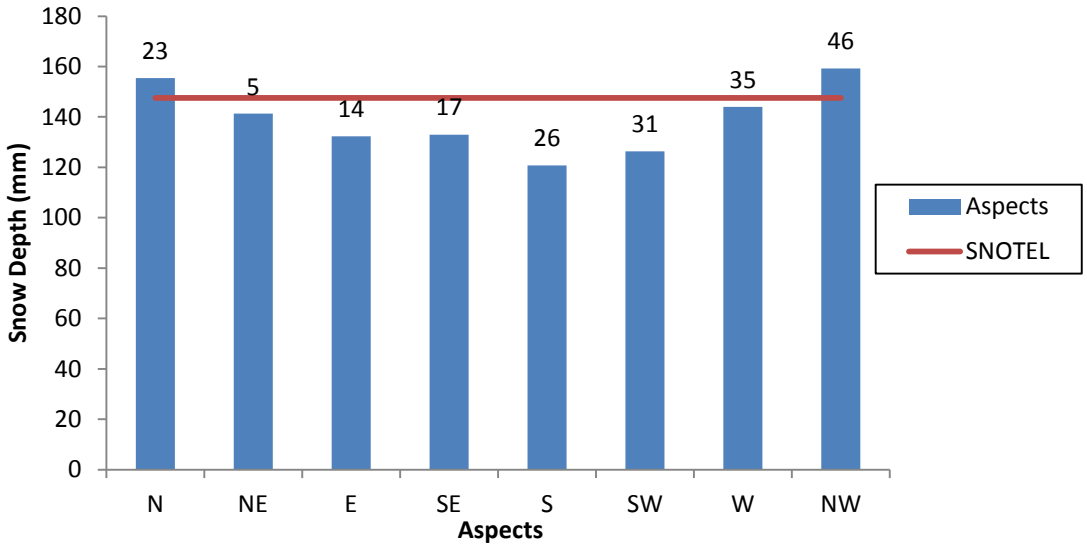

Figure 4-2 SD averages of main aspects for 1km^2 area of Dry Lake SNOTEL on March/28/2009 and number of sampling spots at each aspect

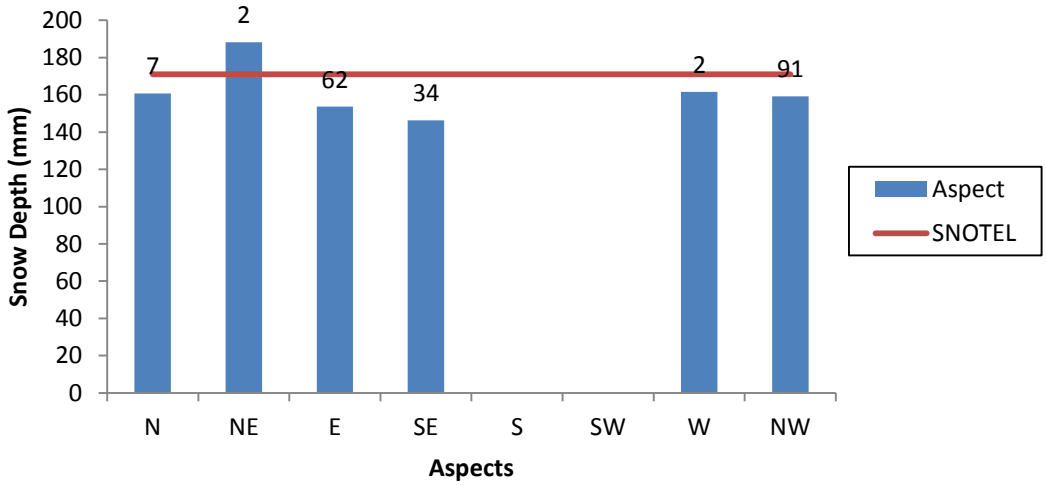

Figure 4-3 SD averages of main aspects for 1km^2 area of Joe Wright SNOTEL on May/02/2009 and number of sampling spots at each aspect

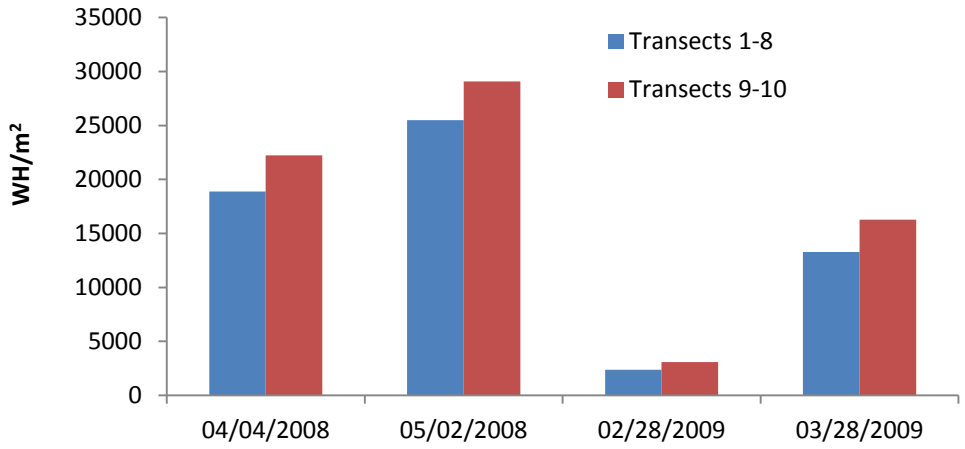

Figure 4-4 Daily solar radiation for transects 1 to 8 versus transects 9 to 10 of Dry Lake SNOTEL station

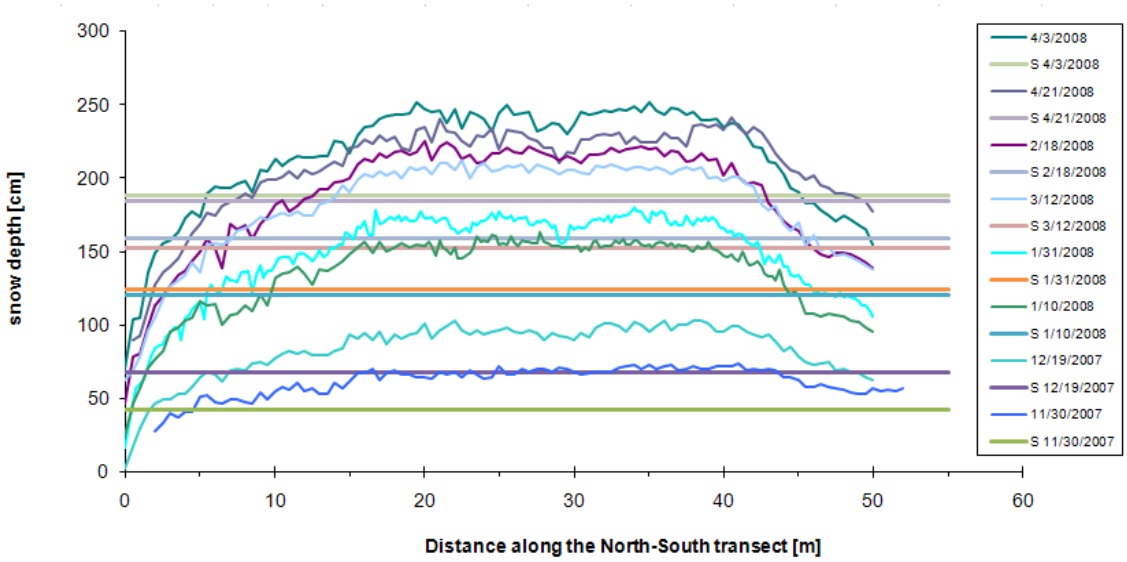

Figure 4-5 SD of a 50m transect next to the Joe Wright SNOTEL versus SD of this station (S stands for SNOTEL)

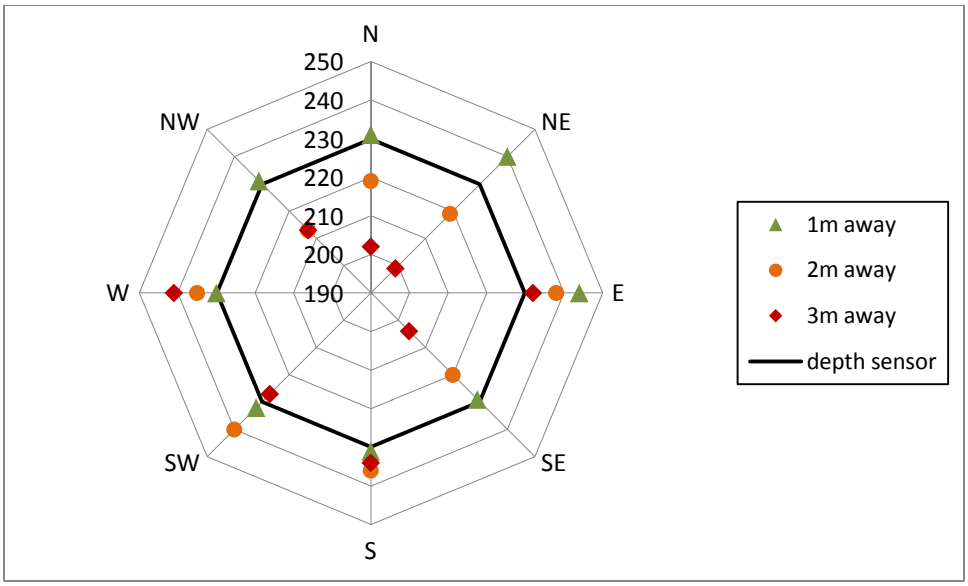

Figure 4-6 SD measurement in the adjacent of the SD sensor on June/02/2011

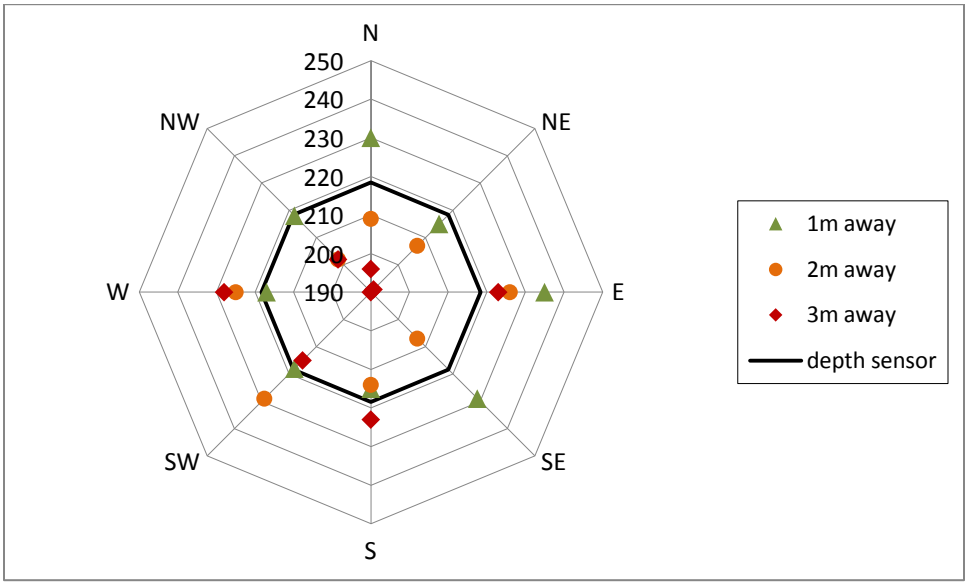

Figure 4-7 SD measurement in the adjacent of the SD sensor on June/04/2011

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

Results of statistical analyses showed SD averages of various sampling methods for a particular transect or surrounding box were mostly not significantly different at the 95 percent confidence level. Transects were used as a tool for SD measurement studies, and it is we recommended to incorporate an efficient sampling method to consider sampling constraints such as time, safety, labor, and sampler experience. For instance, 3 to 5 SD measurements at each spot at 100m intervals apparent to be a suitable method for SD sampling. It is essential to explore the physical characteristics of the area surrounding a SNOTEL station before SD sampling to know sources of differences to guide the selection of sampling strategies in particular sampling method and the number of transects needed.

Snow depth varied within the $1km^2$ surrounding area of the studied SNOTEL station due to the interaction of wind and solar radiation on snow influenced by physiographic and vegetation properties. The surrounding $1km^2$ area was not large enough to generate a snowpack with significant SD difference. Therefore, it is necessary to increase the study area to investigate how these environmental components modify snow properties spatially and temporally.

The interaction of the environmental factors in a small scale (6m distance) led to some SNOTEL stations overestimating SD compare to their surrounding area, yet it does not mean SD average of SNOTEL station versus $1km^2$ were significantly different. The reason likely a combination of location of a SNOTEL station with respect to its surroundings such as a tree, open-space, human artifacts (road), vegetation density, wind snow erosion and deposition, and possible errors of the SD sensor. It is complicated to determine which of these factors is responsible for the SNOTEL differences because even though all stations use the SD sensor each station established has been

in a unique location. Therefore, it is recommended to measure SD around the sensor. Furthermore, it is important to note that snow properties change spatially and temporally. Thus for snow studies should consider a level of error of 5 to 10 percent. To decrease the uncertainty, we recommend using multiple SD sensors rather than one, yet this may not be practical. Instead, measuring SD around a sensor, as we and NRCS did on June/2011, could be a practical way to calibrate the SD sensor or studying the SD sensor performance.

This research focused on SD variation in a $1km^2$ area surrounding SNOTEL stations in mostly forested environment. Future work at these and other stations could also consider wind, effects, such as in more open environments or areas and other physiographic drives, such as steep slope.

Field measurements provided insight into the SD variation of the $1km^2$ area, whether the studied SNOTEL station represented the SD average of their $1km^2$ surrounding area at a specific confidence level, and introduced practical SD sampling strategies. For future SD measurement around SNOTEL stations, these results insight for choosing a convenient sampling method. The selection of a sampling method depends on the purpose of the study, for example, interpolation of SD requires an intensive dataset. However, for a similar research, such intensive data collection is not necessary.

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Appendix A: Naming convention for sampling patterns with various spacing

Table A-1 Naming convention for sampling patterns with various spacing,

Abbreviated name	Explanation
C	One point for center of a spot
A	Average for five point in a spot, sampling could be in row or star
F	Average for three points in a row, distance of each points and center is 5m
P	Average for three point which are perpendicular to transect
T	Average for three points in row, distance of each point and center is 2 or 3m
050	Distance between each spot (m)
100	Distance between each spot (m)
200	Distance between each spot (m)
For example: C050 means one sample in the center of a spot and spacing between spots along transect is 50m	

Appendix B: Physiographic and land cover properties of surrounding 1km^2 of studied SNOTEL stations

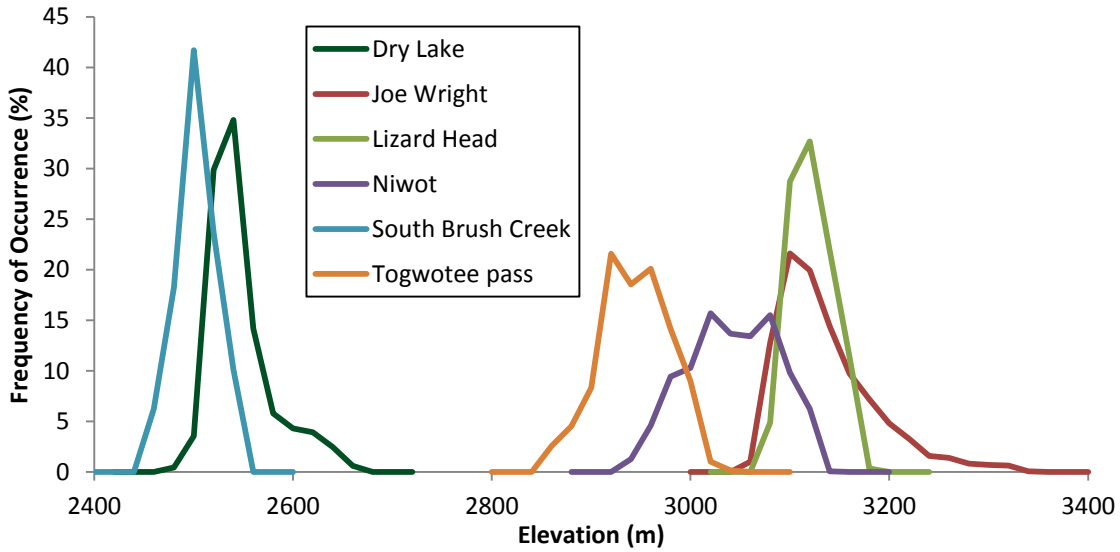

Figure B-1 Elevation distributions of the 1km^2 areas of surrounding SNOTEL stations, data were obtained from USDA Geospatial Data Gate Way web site (http://datagateway.nrcs.usda.gov/)

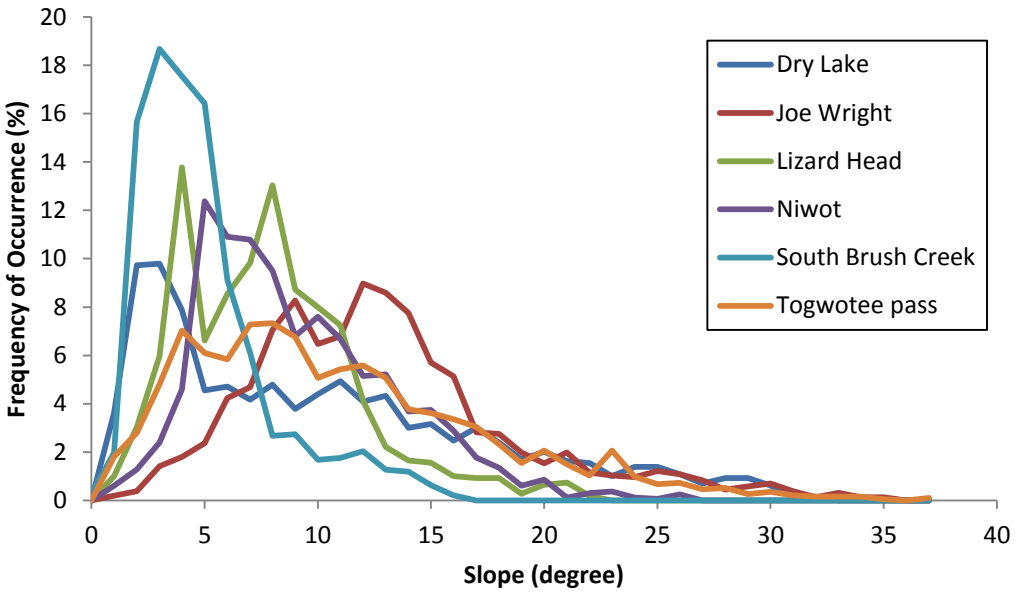

Figure B-2 Slope distributions of the 1km^2 areas of surrounding SNOTEL stations, Data were obtained from USDA Geospatial Data Gate Way web site (http://datagateway.nrcs.usda.gov/)

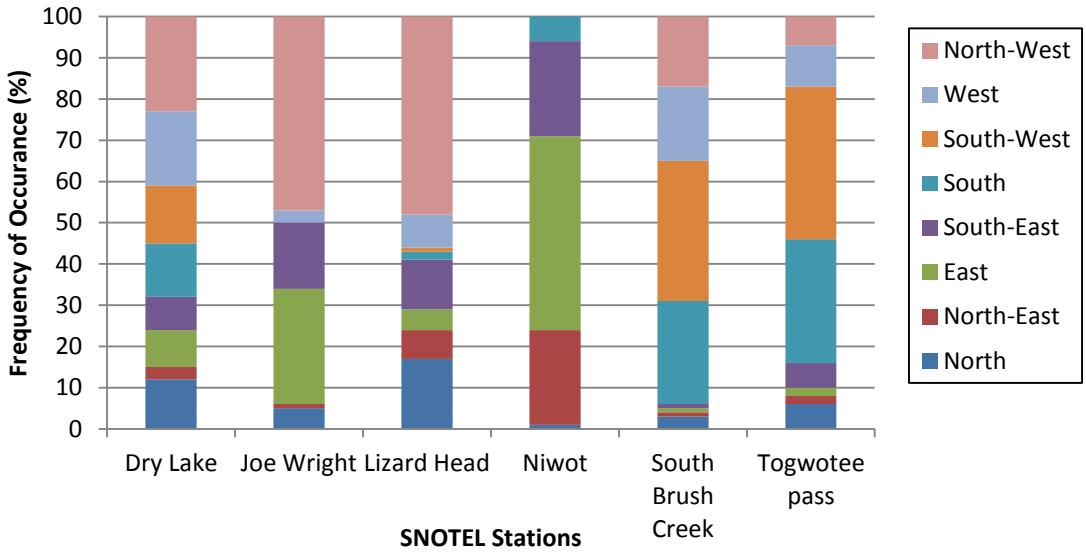

Figure B-3 aspect distributions of the 1km^2 areas of surrounding SNOTEL stations, data were obtained from USDA Geospatial Data Gate Way web site (http://datagateway.nrcs.usda.gov/)

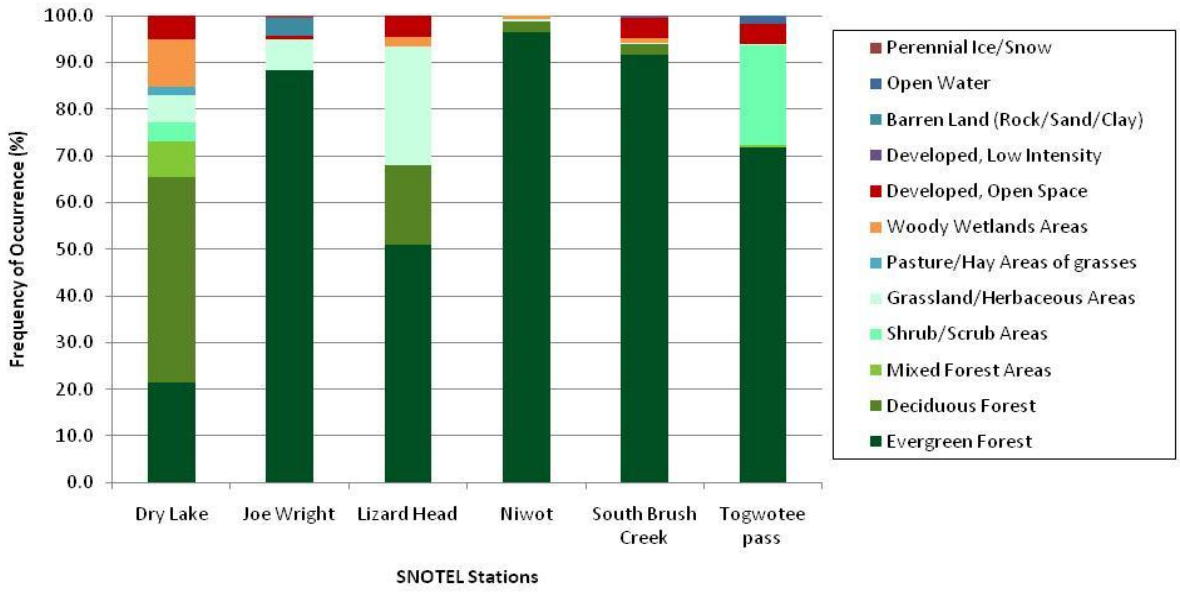

Figure B-4 land cover distributions of the 1km^2 areas of surrounding SNOTEL stations, data were obtained from USDA Geospatial Data Gate Way web site (http://datagateway.nrcs.usda.gov/)

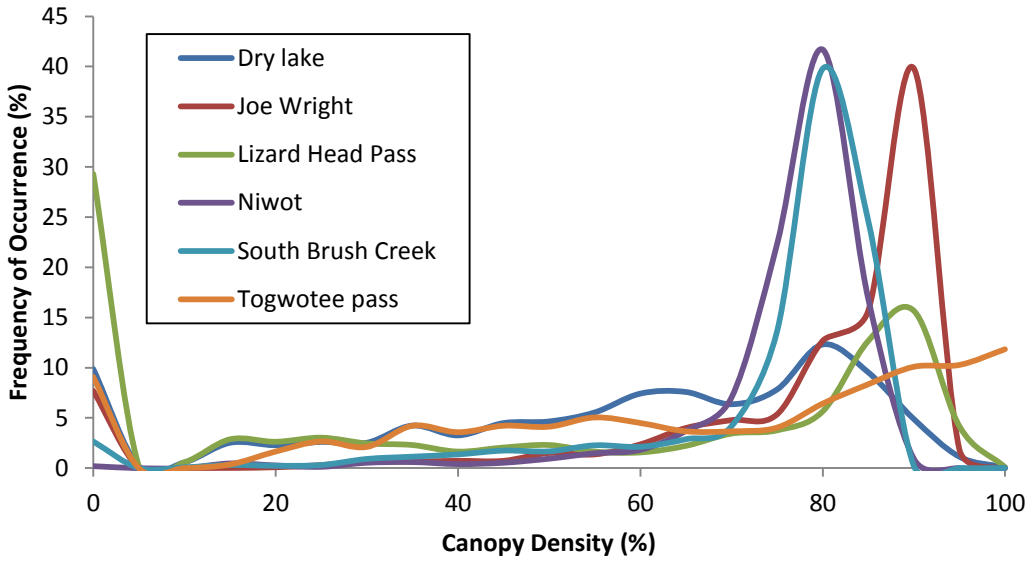

Figure B-5 canopy density distributions of the 1km^2 areas of surrounding SNOTEL stations, data were obtained from National Land Cover Database (http://www.epa.gov/mrlc/nlcd-2001.html)

Appendix C: Sampling strategies for SD measurement

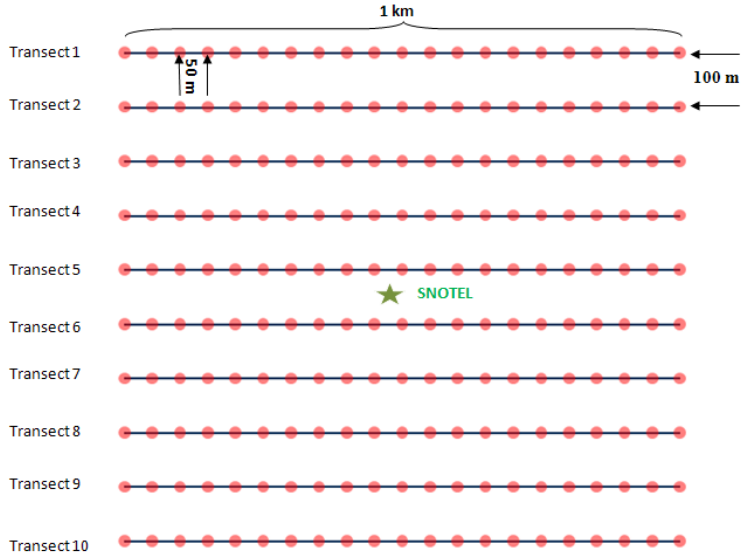

Figure C-1 Conducted transect in each SNOTEL station

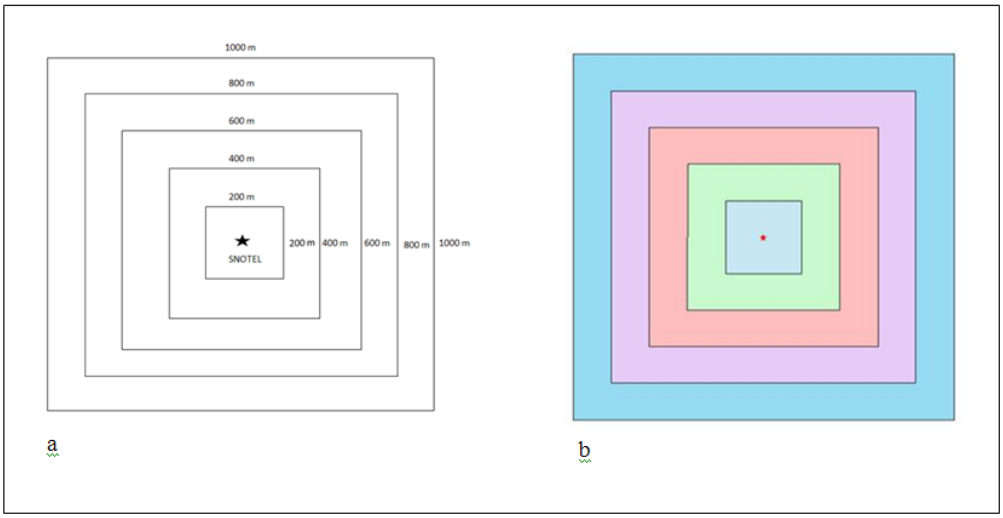

Figure C-2 surrounding boxes around SNTOEL station, **b** concentric boxes each color represent once concentric box

Appendix D: Sampling transects and spots

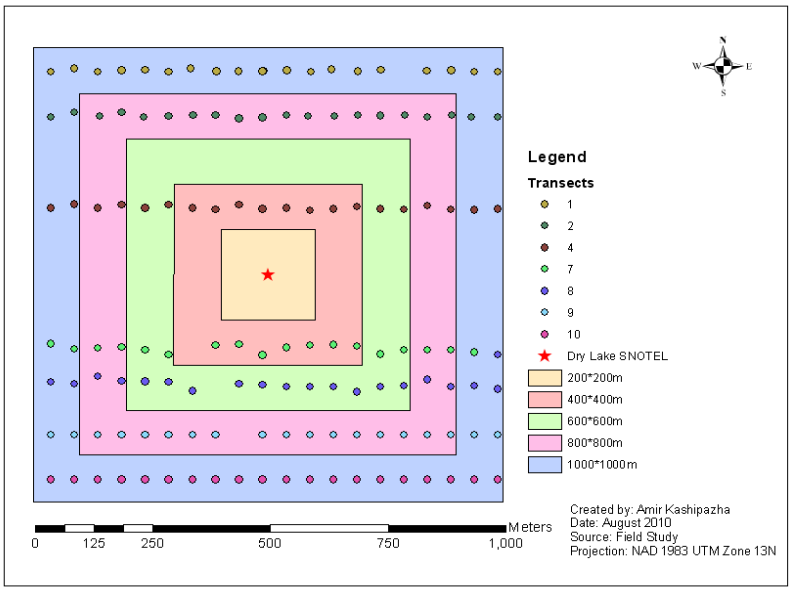

Figure D-1 Sampling spots at April/04/2008 of Dry Lake SNOTEL Station

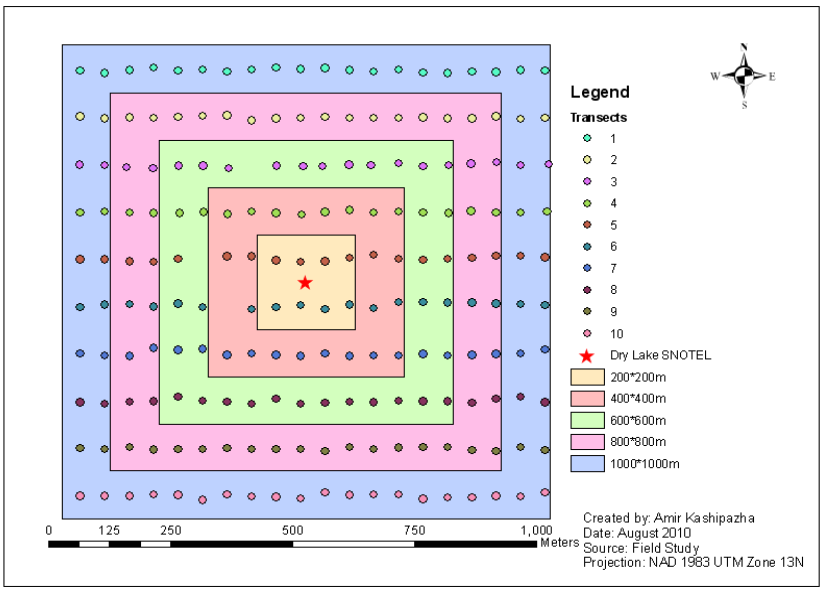

Figure D-2 Sampling spots at May/02/2008 of Dry Lake SNOTEL Station

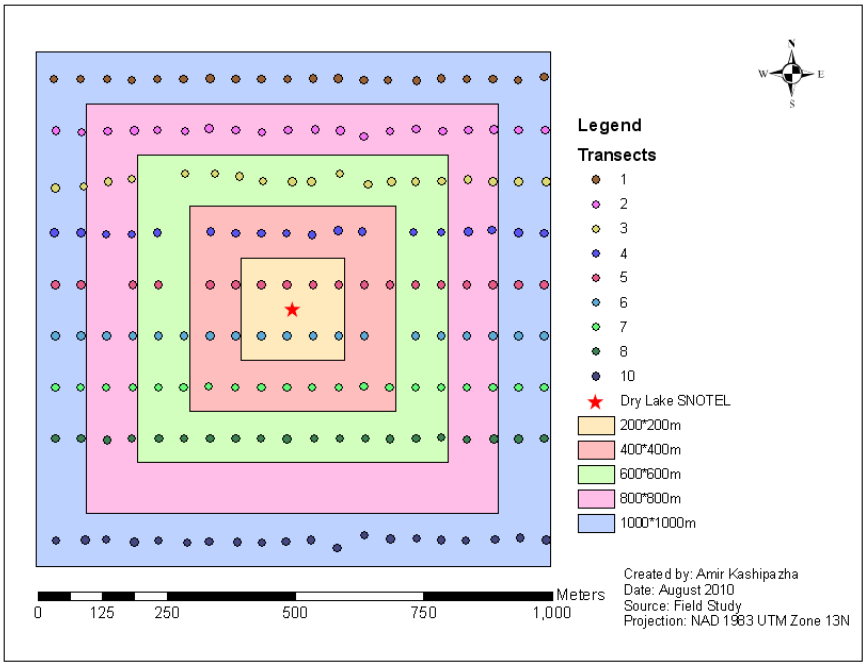

Figure D-3 Sampling spots at February/28/2009 of Dry Lake SNOTEL Station

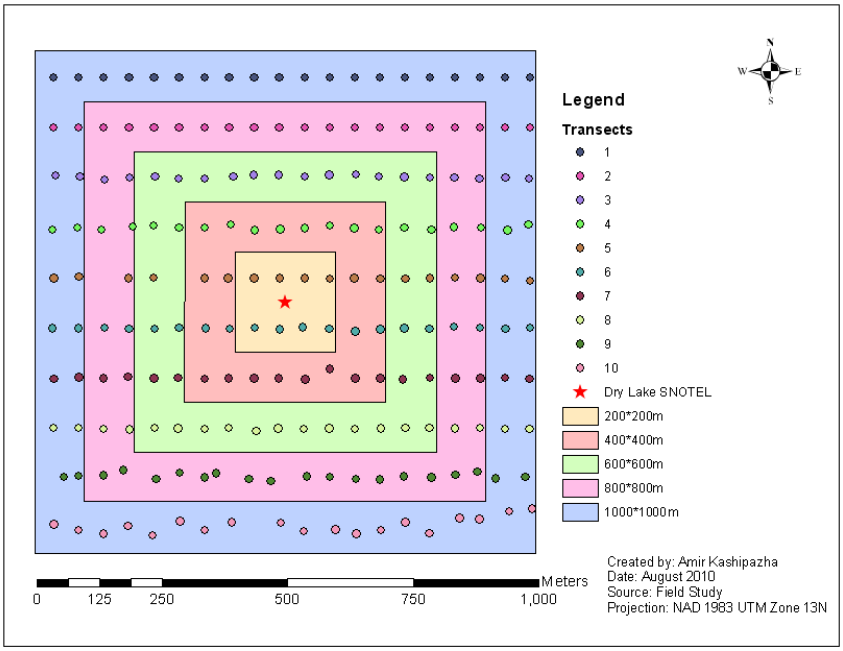

Figure D-4 Sampling spots at March/28/2009 of Dry Lake SNOTEL Station

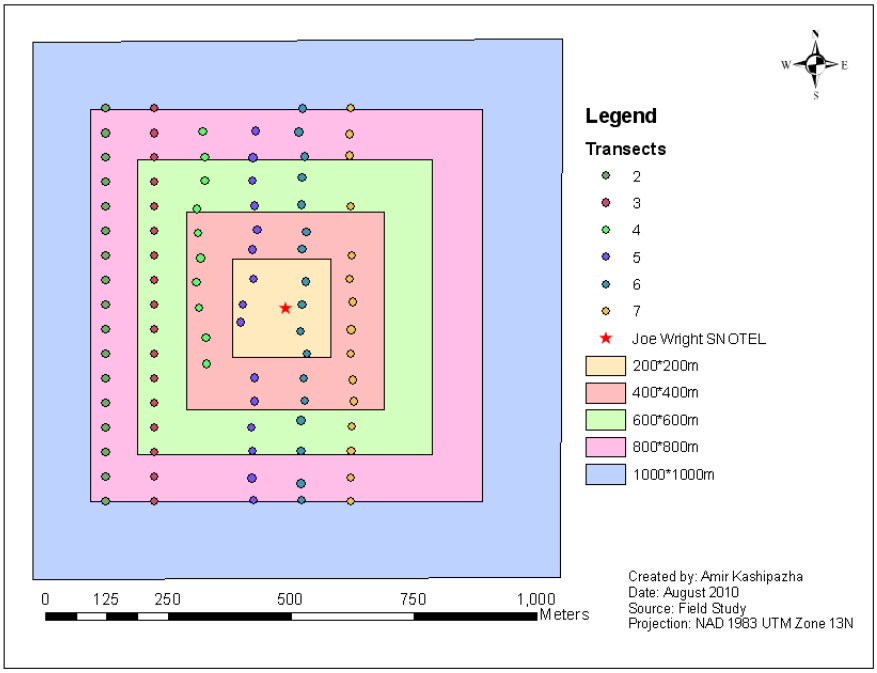

Figure D-5 Sampling spots at April/03/2008 for Joe Wright SNOTEL station

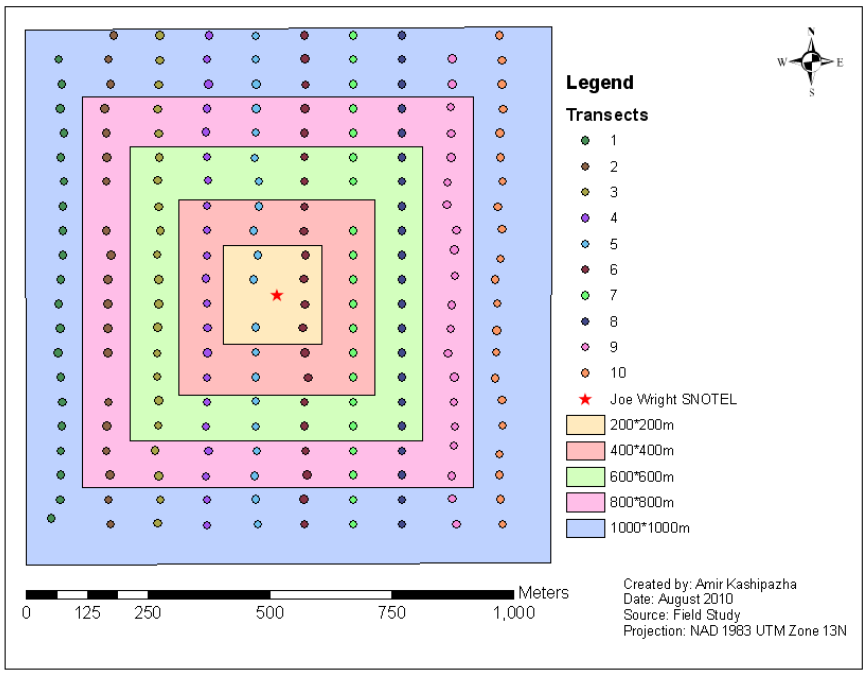

Figure D-6 Sampling spots at May/01/2008 for Joe Wright SNOTEL station

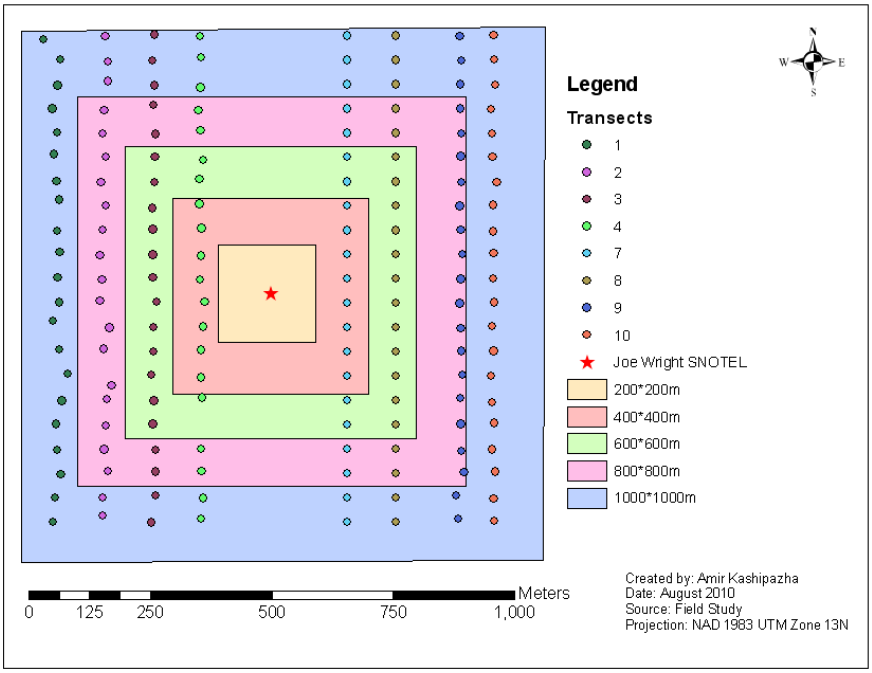

Figure D-7 Sampling spots at January/31/2009 for Joe Wright SNOTEL station

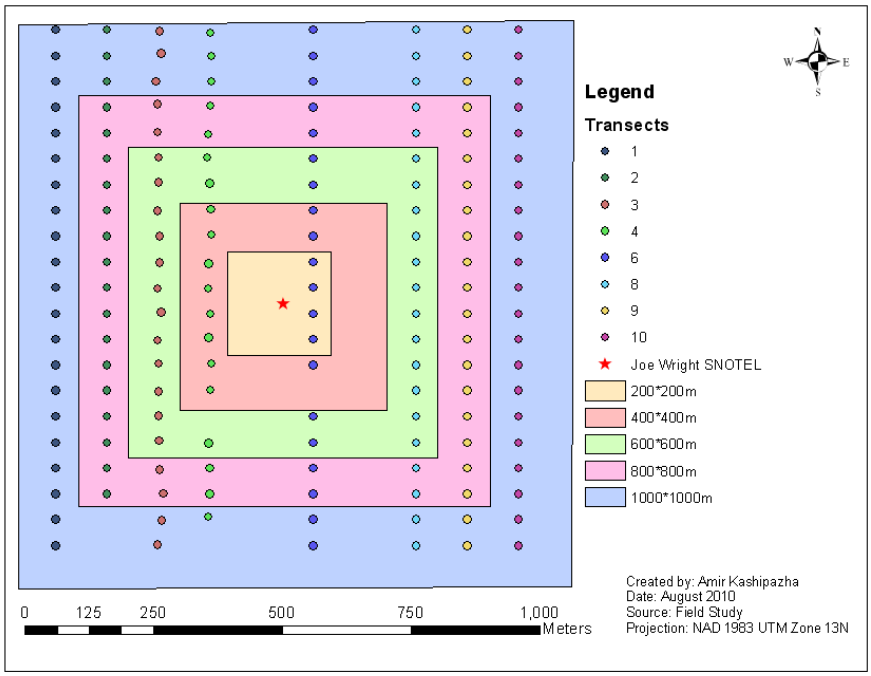

Figure D-8 Sampling spots at February/27/2009 for Joe Wright SNOTEL station

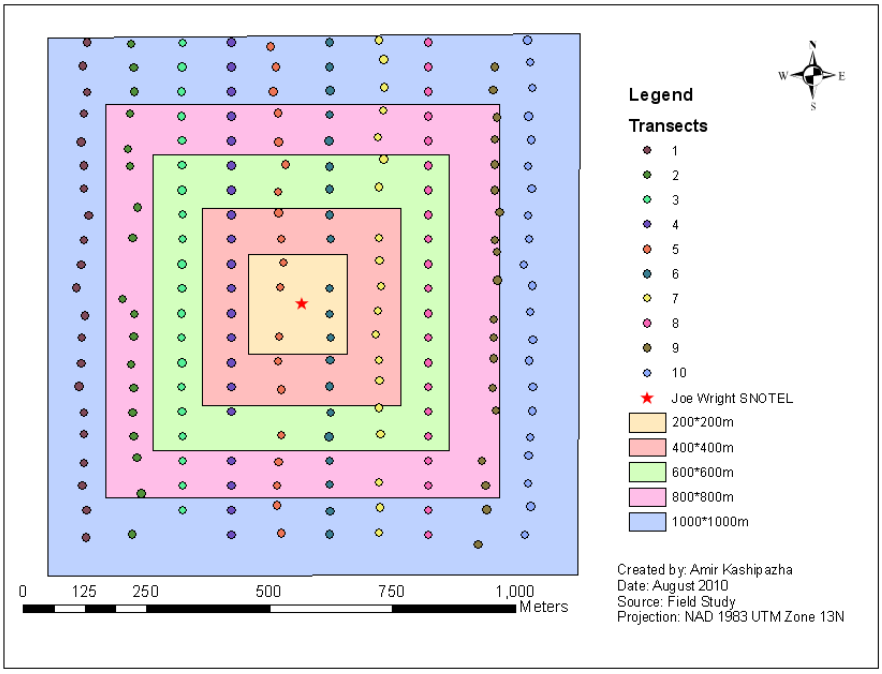

Figure D-9 Sampling spots at May/02/2009 for Joe Wright SNOTEL station

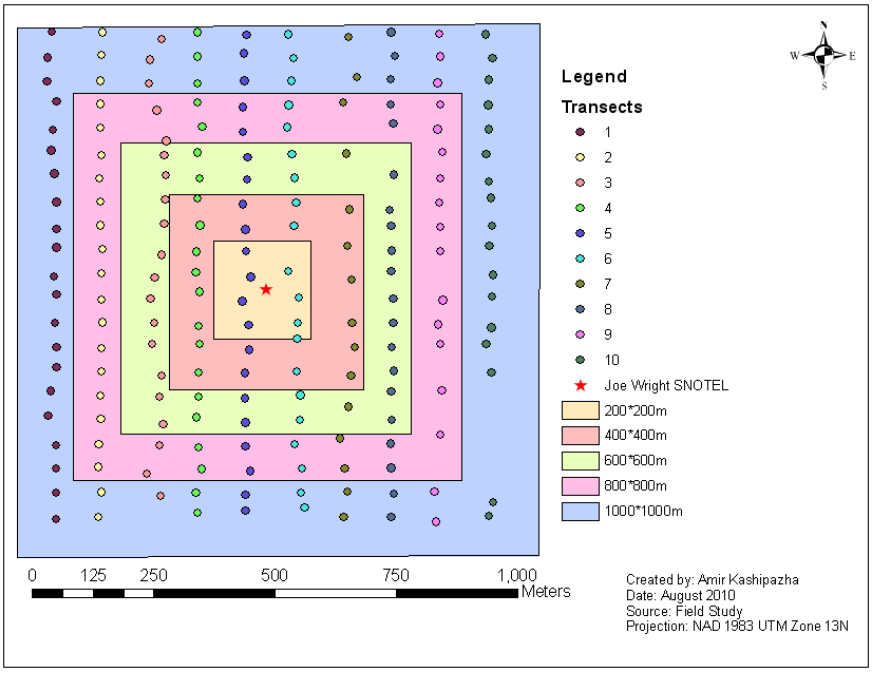

Figure D-10 Sampling spots at May/01/2010 for Joe Wright SNOTEL station

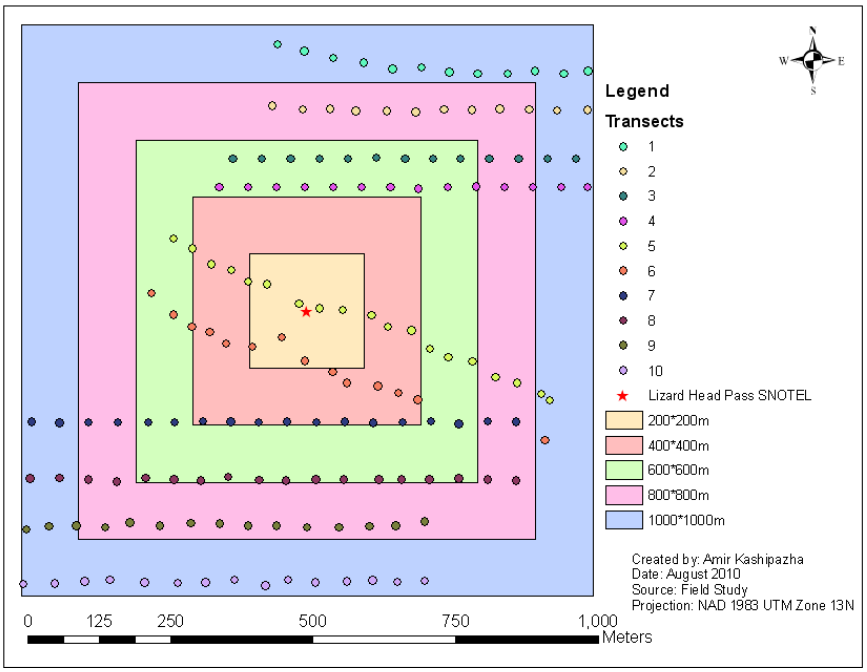

Figure D-11 Sampling spots at March/17/2008 for Lizard Head Pass SNOTEL station

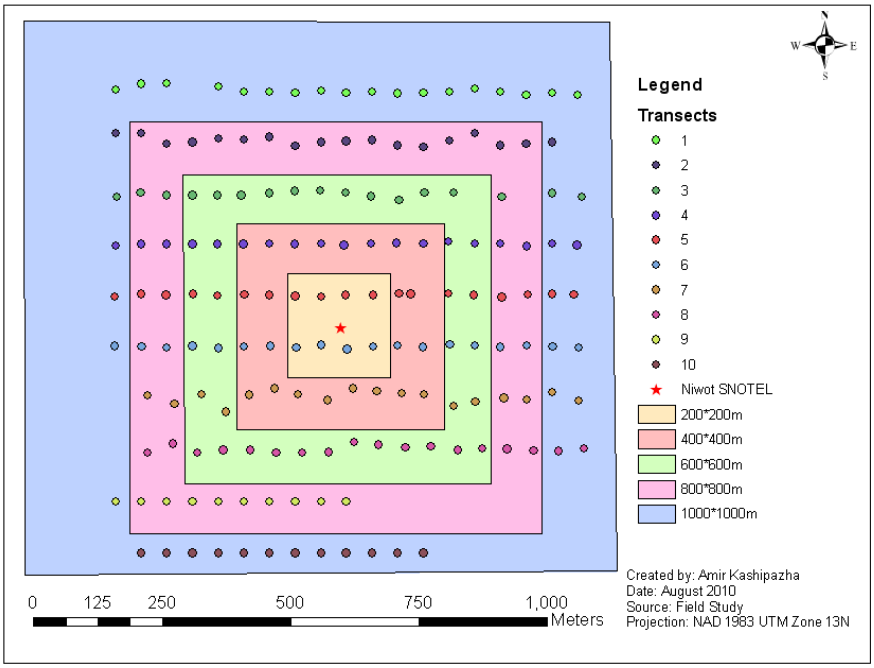

Figure D-12 Sampling spots at April/07/2008 for Niwot SNOTEL station

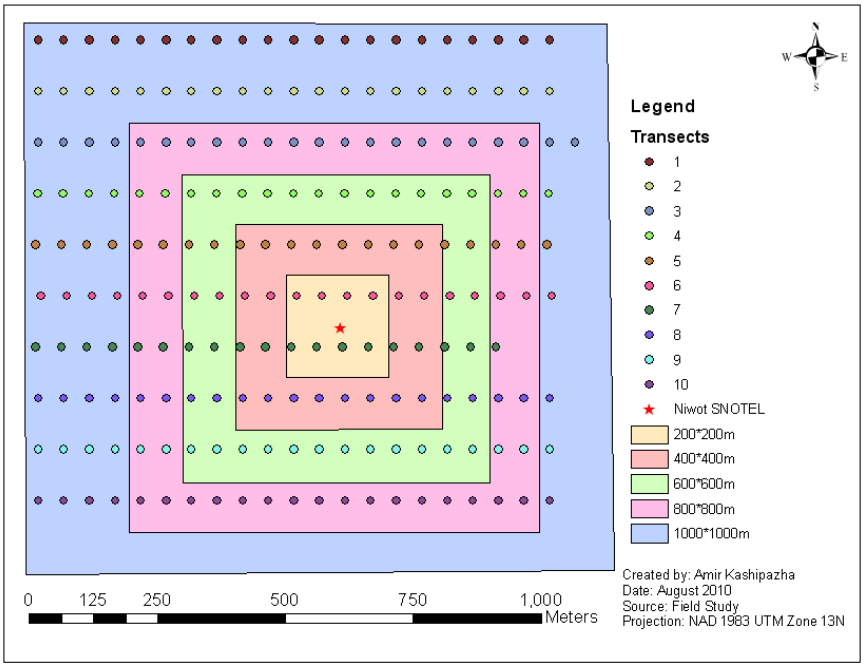

Figure D-13 Sampling spots at May/05/2008 for Niwot SNOTEL station

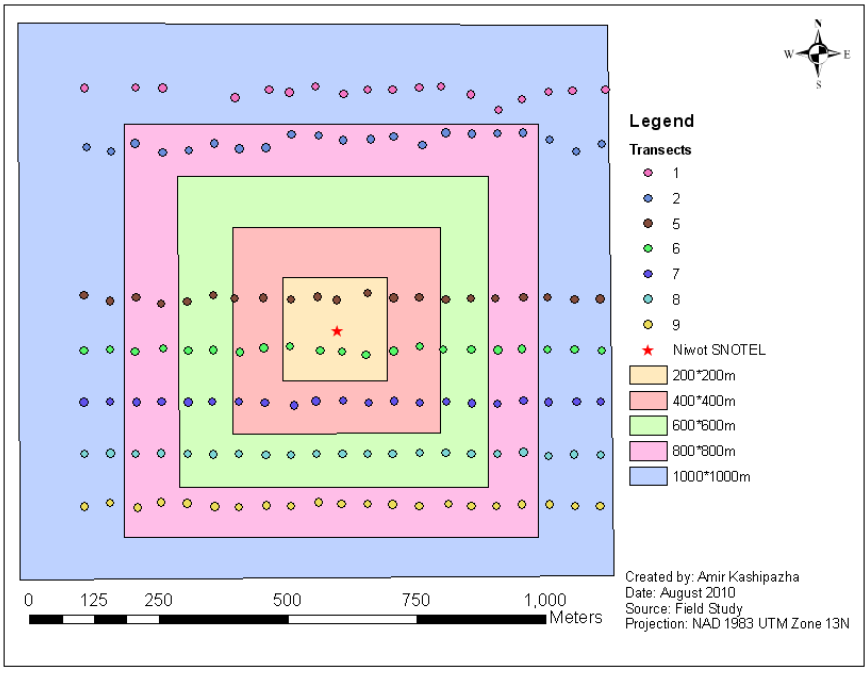

Figure D-14 Sampling spots at March/06/2009 for Niwot SNOTEL station

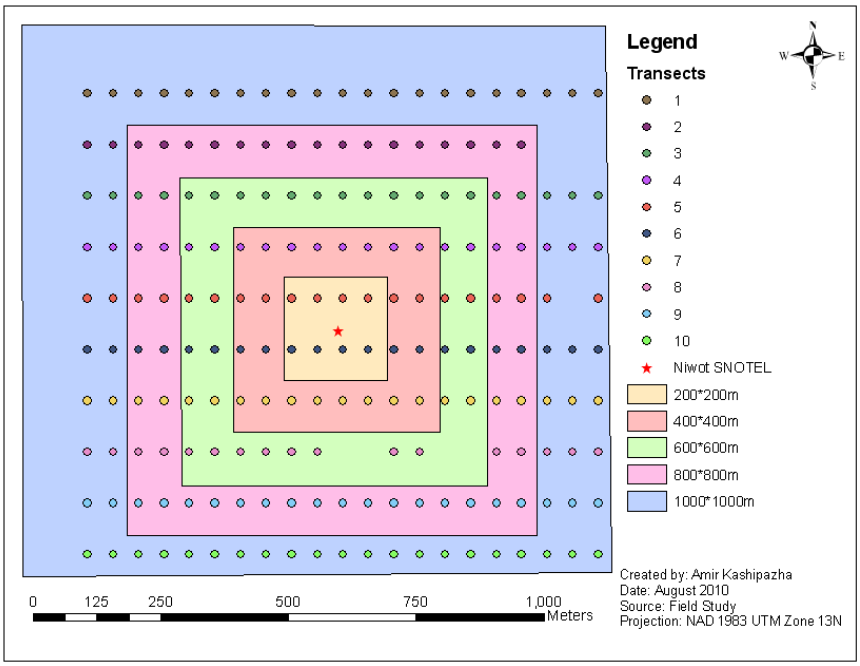

Figure D-15 Sampling spots at April/03/2009 for Niwot SNOTEL station

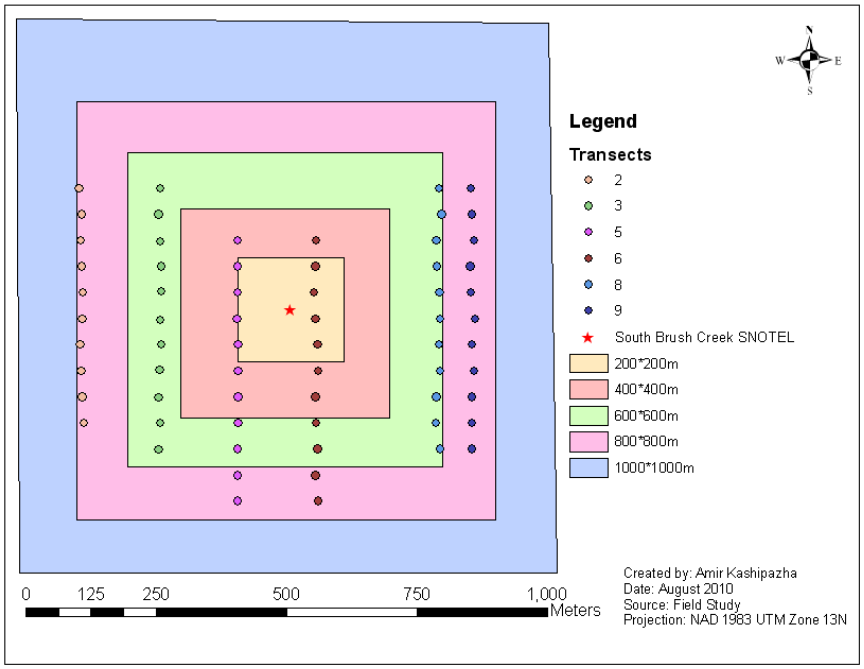

Figure D-16 Sampling spots at April/05/2008 for South Brush Creek SNOTEL station

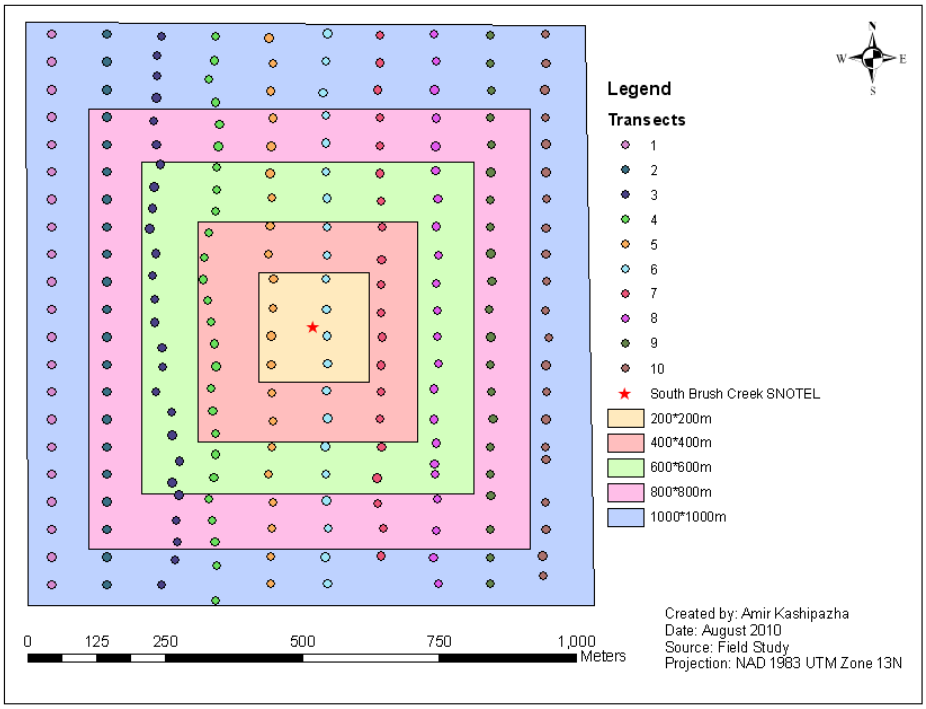

Figure D-17 Sampling spots at March/01/2009 for South Brush Creek SNOTEL station

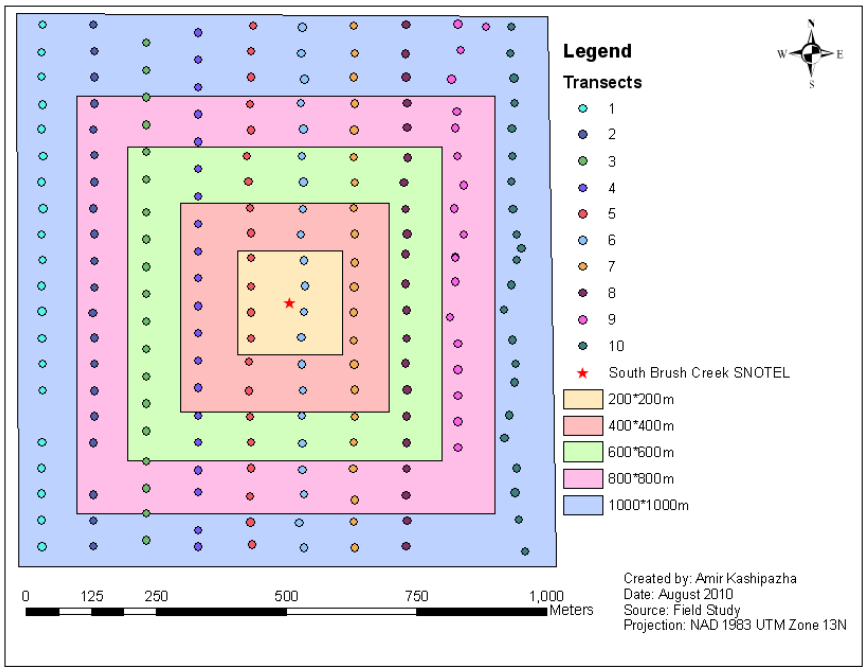

Figure D-18 Sampling spots at March/29/2009 for South Brush Creek SNOTEL station

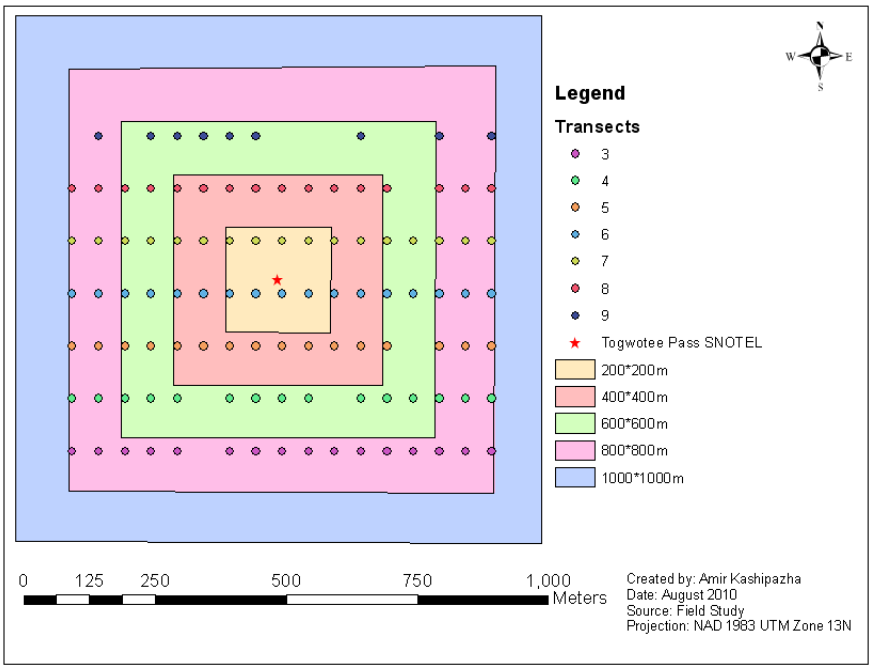

Figure D-19 Sampling spots at March/17/2009 for Togwotee Pass SNOTEL station

Appendix E: Dry Lake SNOTEL station statistical analyses results

Table E-1 snow depth of field measurement analyzing of transects versus snow depth of Dry Lake SNOTEL station for April/04/2008 in 5 percent confidence limit

	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	158.75 ± 1.34		158.75 ± 1.34		-	-	158.75 ± 1.34		-	-
C050[b]	153.95 ± 22.24		151.70 ± 18.79		-	-	167.55 ± 18.26		-	-
C100	152.10 ± 15.83		152.30 ± 19.84		-	-	167.70 ± 16.62		-	-
C200	147.40 ± 26.67		150.60 ± 17.92		-	-	161.00 ± 12.17		-	-
F050	152.46 ± 18.84		151.13 ± 16.25		-	-	167.80 ± 17.45		-	-
F100	149.83 ± 17.57		148.47 ± 16.09		-	-	164.08 ± 16.81		-	-
F200	143.27 ± 15.86		147.33 ± 15.11		-	-	158.00 ± 16.76		-	-
	Transect 6		**Transect 7**		**Transect 8**		**Transect 9**		**Transect 10**	
	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	-	-	158.75 ± 1.34		158.75 ± 1.34		158.75 ± 1.34		158.75 ± 1.34	
C050	-	-	163.39 ± 31.94		166.75 ± 17.79		144.37 ± 11.85	SNOTEL	134.35 ± 11.69	SNOTEL
C100	-	-	160.89 ± 40.81		165.09 ± 19.62		142.4 ± 9.14	SNOTEL	130.70 ± 15.30	SNOTEL
C200	-	-	164.40 ± 31.19		161.40 ± 15.73		149.00 ± 3.32		140.80 ± 13.44	SNOTEL
F050	-	-	161.43 ± 25.19		165.65 ± 16.99		143.23 ± 10.44	SNOTEL	132.78 ± 10.94	SNOTEL
F100	-	-	162.29 ± 21.59		165.03 ± 15.96		141.57 ± 11.13	SNOTEL	132.30 ± 12.66	SNOTEL
F200	-	-	167.93 ± 24.43		163.79 ± 15.21		147.80 ± 6.01	SNOTEL	138.00 ± 12.81	SNOTEL

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column mean there is no significant difference

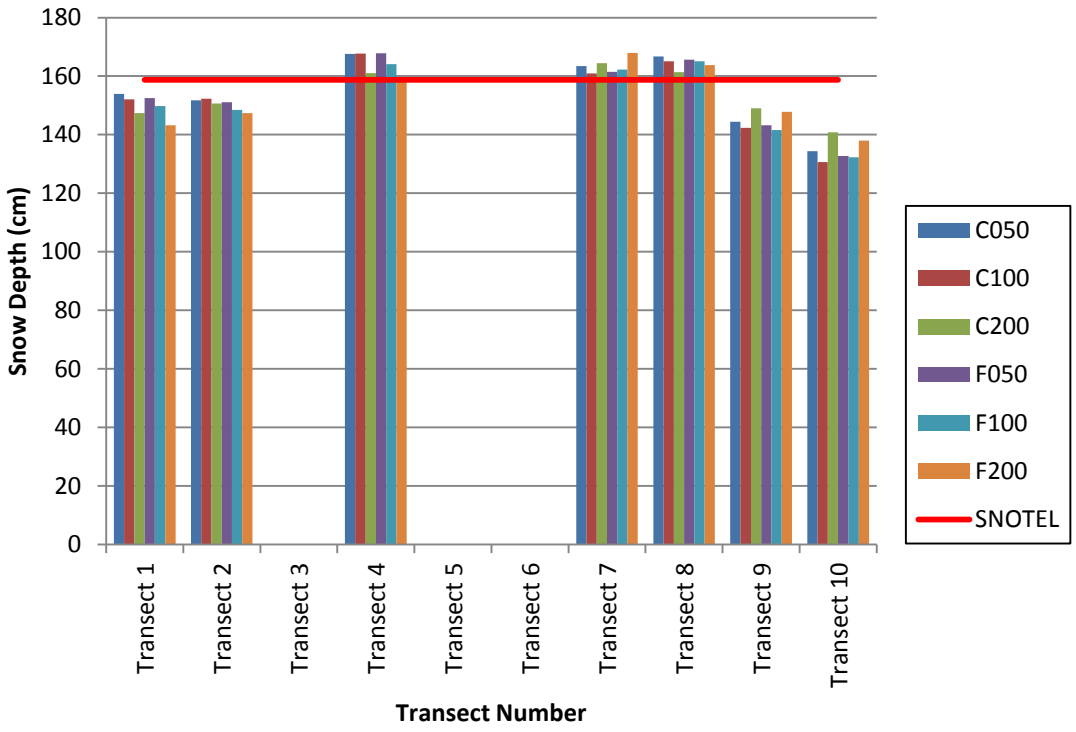

Figure E-1 snow depth field measurement of transects versus snow depth of Dry Lake SNOTEL station for April/04/2008 (Refer to Table A-1 for clarification of abbreviations)

Table E-2 snow depth field measurement analysis of surrounding boxes versus snow depth of Dry Lake SNOTEL for April/04/2008 in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	-	-	158.75 ± 1.34		158.75 ± 1.34		158.75 ± 1.34		158.75 ± 1.34	
C050[b]	-	-	163.13 ± 31.17		161.61 ± 25.25		158.20 ± 22.51		155.96 ± 22.15	
C100	-	-	165.67 ± 18.81		161.33 ± 19.41		157.45 ± 20.25		154.63 ± 19.77	
C200	-	-	169.25 ± 8.77		157.55 ± 17.75		159.04 ± 19.04		154.60 ± 18.31	
F050	-	-	164.38 ± 26.37		162.49 ± 21.69		157.68 ± 20.52		155.89 ± 20.73	
F100	-	-	165.56 ± 22.97		162.19 ± 18.59		156.82 ± 18.99		154.15 ± 19.14	
F200	-	-	174.42 ± 8.61		162.30 ± 14.66		159.58 ± 16.94		154.60 ± 16.95	

Table E-3 snow depth field measurement analysis of concentric boxes versus snow depth of Dry Lake SNOTEL for April/04/2008 in 95 percent confidence limit

	0-200m		200-400m		400-600m		600-800m		800-1000m	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	-	-	158.75 ± 1.34		158.75 ± 1.34		158.75 ± 1.34		158.75 ± 1.34	
C050[b]	-	-	163.13 ± 31.17		160.50 ± 20.64		152.96 ± 21.53		153.77 ± 22.30	
C100	-	-	165.67 ± 18.81		158.08 ± 20.03		154.54 ± 20.72		151.00 ± 18.76	
C200	-	-	169.25 ± 8.77		150.86 ± 18.52		160.31 ± 20.70		149.52 ± 16.44	
F050	-	-	164.38 ± 26.38		161.12 ± 18.10		154.30 ± 19.14		150.70 ± 19.03	
F100	-	-	165.56 ± 22.97		159.67 ± 15.12		152.80 ± 18.60		153.75 ± 20.91	
F200	-	-	174.42 ± 8.61		155.38 ± 12.94		157.28 ± 18.94		148.90 ± 15.42	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

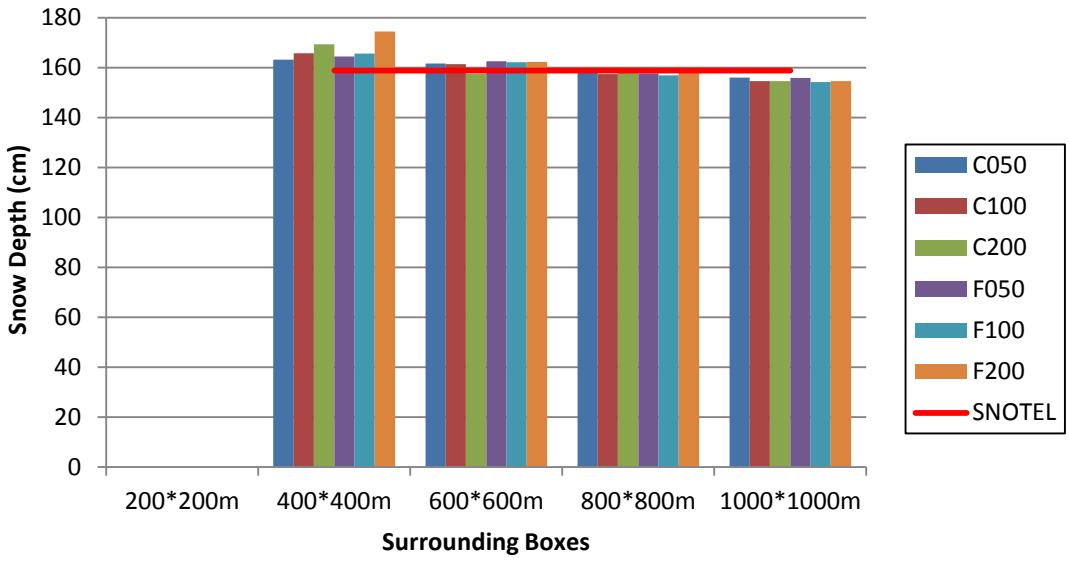

Figure E-2 snow depth field measurement analysis of surrounding boxes versus snow depth of Dry Lake SNOTEL for April/04/2008 (Refer to Table A-1 for clarification of abbreviations)

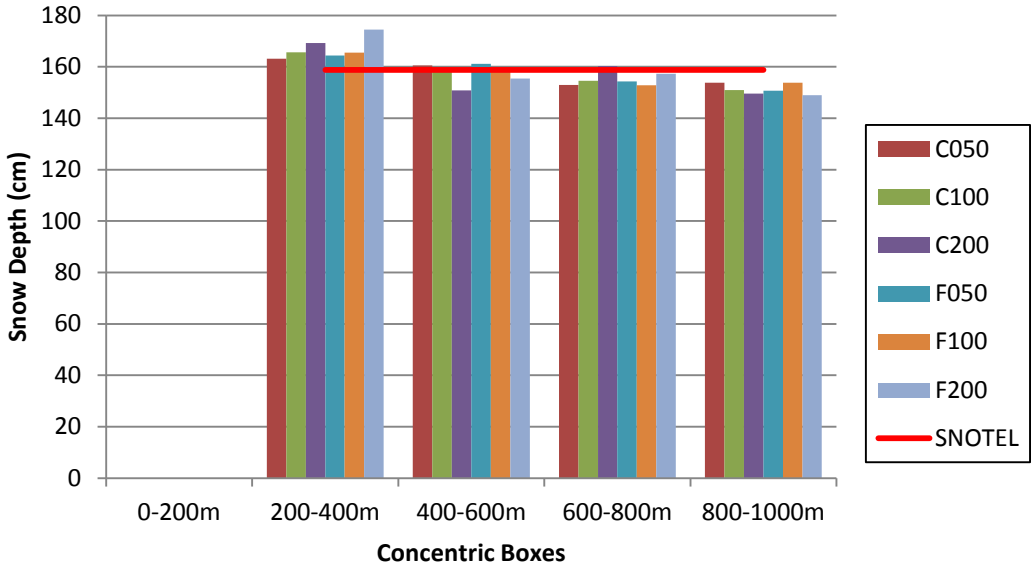

Figure E-3 snow depth field measurement analysis of Concentric boxes versus snow depth of Dry Lake SNOTEL for April/04/2008 (Refer to Table A-1 for clarification of abbreviations)

Table E-4 snow depth field measurement analyzing of transects versus snow depth of Dry Lake SNOTEL station for May/02/2008 in 95 percent confidence limit

	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	149.23 ± 1.61		149.23 ± 1.61		149.23 ± 1.61		149.23 ± 1.61		149.23 ± 1.61	
C050[b]	151.3 ± 20.31		145.35 ± 26.23		145.37 ± 23.64		146.55 ± 25.24		146.47 ± 22.28	
C100	147.80 ± 22.01		147.60 ± 25.77		145.50 ± 26.15		142.70 ± 30.59		139.60 ± 20.33	
C200	131.40 ± 8.08		145.20 ± 20.00		147.20 ± 32.58		126.20 ± 16.13		141.00 ± 14.88	
F050	151.07 ± 18.38		140.98 ± 21.79		146.18 ± 21.55		141.23 ± 22.34		145.24 ± 18.54	
F100	146.97 ± 17.72		142.87 ± 19.01		144.30 ± 23.57		138.70 ± 28.86		144.30 ± 18.86	
F200	136.53 ± 11.29		139.07 ± 12.58		141.93 ± 26.30		122.80 ± 13.51		145.73 ± 19.34	
	Transect 6		**Transect 7**		**Transect 8**		**Transect 9**		**Transect 10**	
	Mean ± STD (cm)	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	149.23 ± 1.61		149.23 ± 1.61		149.23 ± 1.61		149.23 ± 1.61		149.23 ± 1.61	
C050	155.68 ± 22.15		146.70 ± 32.45		139.60 ± 24.57		113.85 ± 15.49	SNOTEL	96.65 ± 18.61	SNOTEL
C100	150.44 ± 15.30		146.10 ± 33.68		137.80 ± 17.83		115.50 ± 14.45	SNOTEL	94.40 ± 24.05	SNOTEL
C200	150.20 ± 16.35		142.60 ± 26.05		134.40 ± 20.51		118.60 ± 15.45	SNOTEL	95.00 33.08	SNOTEL
F050	155.44 ± 18.41		147.78 ± 26.25		139.02 ± 23.97		111.23 ± 12.83	SNOTEL	97.03 ± 17.83	SNOTEL
F100	152.15 ± 12.77		146.57 ± 26.35		135.77 ± 21.43		113.67 ± 11.75	SNOTEL	94.33 ± 20.03	SNOTEL
F200	148.33 ± 14.32		144.40 ± 26.00		132.20 ± 23.33		111.33 ± 12.74	SNOTEL	98.20 ± 24.47	SNOTEL

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column mean there is no significant difference

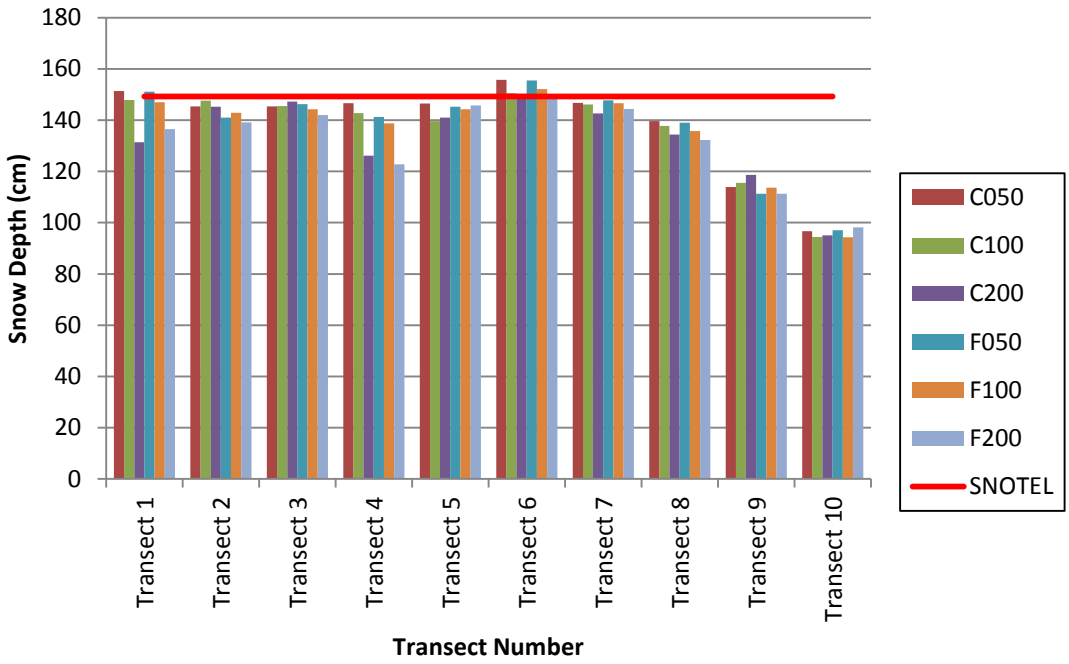

Figure E-4 snow depth field measurement analyzing of transects versus snow depth of Dry Lake SNOTEL station for May/02/2008 (Refer to Table A-1 for clarification of abbreviations)

Table E-5 snow depth field measurement analysis of surrounding boxes versus snow depth of Dry Lake SNOTEL for May/02/2008 in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	149.23 ± 1.61		149.23 ± 1.61		149.23 ± 1.61		149.23 ± 1.61		149.23 ± 1.61	
C050[b]	144.13 ± 21.94		148.52 ± 27.69		145.38 ± 26.20		141.08 ± 26.10		138.59 ± 29.04	
C100	134.00 ± 25.23		141.73 ± 28.10		141.11 ± 23.64		138.60 ± 23.66		136.61 ± 28.44	
C200	-		149.25 ± 21.60		141.22 ± 21.79		153.63 ± 17.70		133.18 ± 25.30	
F050	145.67 ± 16.95		146.97 ± 22.63		144.54 ± 22.98		139.46 ± 23.44		137.35 ± 26.76	
F100	141.92 ± 20.80		143.49 ± 21.94		141.51 ± 21.75		138.31 ± 21.98		135.80 ± 26.20	
F200	-	-	148.96 ± 21.75		138.74 ± 20.91		137.73 ± 21.94		132.05 ± 23.53	

Table E-6 snow depth field measurement analysis of concentric boxes versus snow depth of Dry Lake SNOTEL for May/02/2008 in 95 percent confidence limit

	0-200m		200-400m		400-600m		600-800m		800-1000m	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	149.23 ± 1.61		149.23 ± 1.61		149.23 ± 1.61		149.23 ± 1.61		149.23 ± 1.61	
C050[b]	144.13 ± 21.94		150.04 ± 29.71		142.82 ± 25.01		135.79 ± 25.20		134.28 ± 33.31	
C100	134.00 ± 25.23		144.55 ± 29.70		140.65 ± 20.43		135.46 ± 23.73		133.11 ± 35.41	
C200	-	-	150.00 ± 23.41		134.80 ± 20.77		138.14 ± 23.43		121.28 ± 26.67	SNOTEL
F050	145.67 ± 16.95		147.42 ± 24.62		142.55 ± 23.38		133.20 ± 22.65	SNOTEL	133.69 ± 31.55	
F100	141.92 ± 20.80		144.06 ± 23.30		140.03 ± 22.06		134.31 ± 21.99		131.40 ± 32.16	
F200	-	-	148.45 ± 22.56		130.57 ± 17.06		136.43 ± 23.94		121.96 ± 23.44	SNOTEL

a Values represent mean ± Standard Deviation

b Refer to Table 1-2 for clarification of abbreviation

c Significant difference, blank column means there is no significant difference

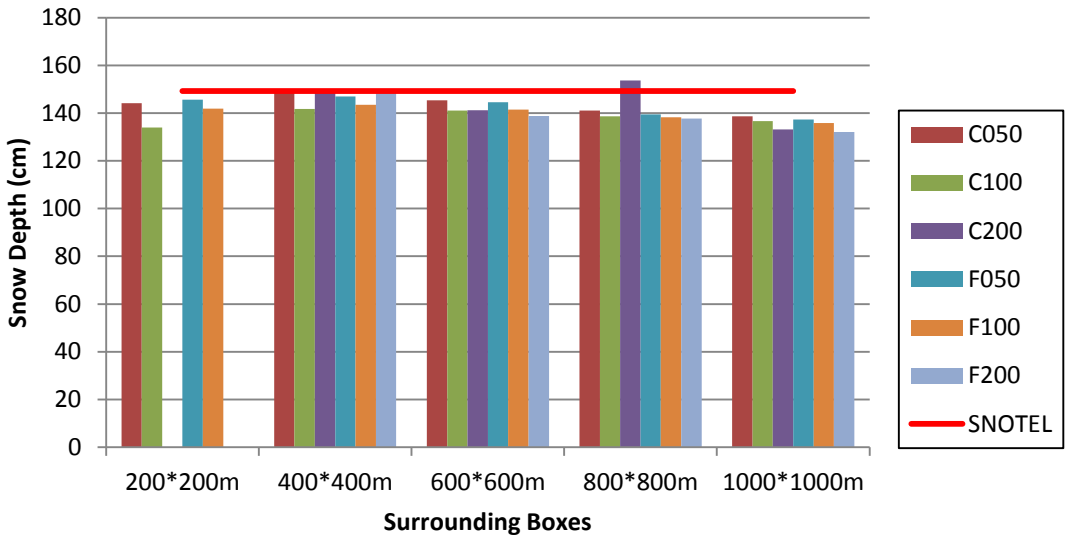

Figure E-5 snow depth field measurement analysis of the surrounding boxes versus snow depth of Dry Lake SNOTEL for May/02/2008 (Refer to Table A-1 for clarification of abbreviations)

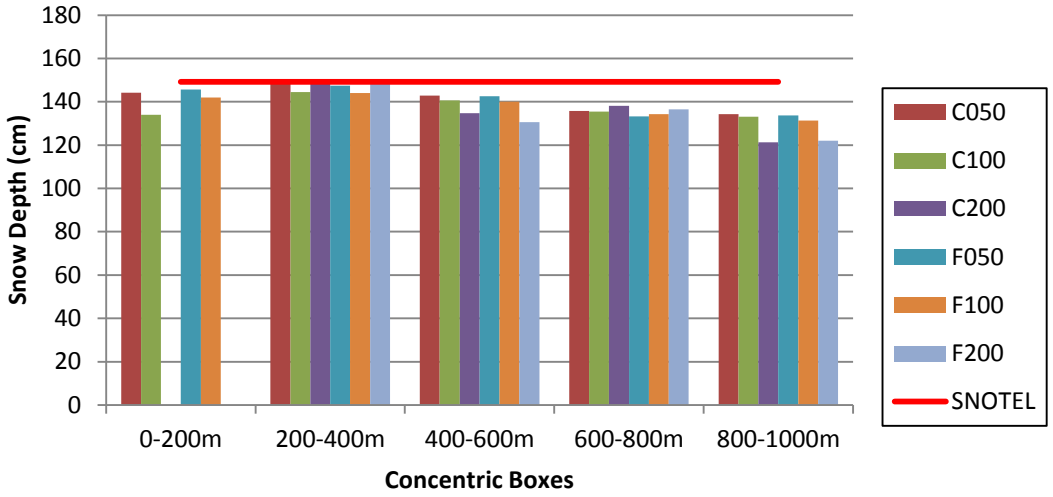

Figure E-6 snow depth field measurement analysis of the concentric boxes versus snow depth of Dry Lake SNOTEL for May/02/2008(Refer to Table A-1 for clarification of abbreviations)

Table E-7a snow depth field measurement analyzing of transects versus snow depth of Dry Lake SNOTEL station for February/28/2009 (Transects 1 to 5) in 95 percent confidence limit

	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	160.78 ± 2.41		160.78 ± 2.41		160.78 ± 2.41		160.78 ± 2.41		160.78 ± 2.41	
C050[b]	148.45 ± 17.82	SNOTEL	148.40 ± 17.61		164.00 ± 14.62		161.33 ± 23.64		148.89 ± 21.50	
C100	153.20 ± 9.92		147.60 17.54		161.56 ± 15.88		159.20 ± 23.04		149.89 ± 24.02	
C200	155.17 ± 12.43		143.50 ± 21.71	SNOTEL	158.00 ± 18.71		152.17 ± 15.61		155.17 ± 22.60	
A050	147.78 ± 12.87	SNOTEL	148.79 ± 15.06		160.56 ± 13.45		161.07 ± 19.78		146.48 ± 19.12	
A100	148.10 ± 4.31	SNOTEL	147.04 ± 15.70		160.47 ± 10.75		159.68 ± 20.67		148.91 ± 18.89	
A200	152.13 ± 12.90		142.67 ± 17.12	SNOTEL	161.32 ± 13.33		152.10 ± 16.49		150.50 ± 19.82	
F050	147.35 ± 14.13	SNOTEL	148.92 ± 17.07		160.28 ± 14.70		160.17 ± 21.41		147.02 ± 20.83	
F100	149.07 ± 10.08	SNOTEL	147.87 ± 19.60		158.74 ± 13.08		159.70 ± 20.80		148.81 ± 21.69	
F200	152.67 ± 15.27		141.89 ± 21.70	SNOTEL	158.47 ± 15.67		153.72 ± 14.88		151.06 ± 24.25	
P050	148.43 ± 14.80	SNOTEL	148.53 ± 14.41		161.98 ± 13.08		162.06 ± 20.87		146.74 ± 18.04	
P100	148.83 ± 6.55	SNOTEL	146.40 ± 12.78	SNOTEL	162.55 ± 10.39		159.50 ± 22.49		149.33 ± 17.89	
P200	152.61 ± 14.92		143.72 ± 15.08	SNOTEL	163.07 ± 12.33		150.50 ± 19.34		151.50 ± 16.30	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table E-7b snow depth field measurement analyzing of transects versus snow depth of Dry Lake SNOTEL station for February/28/2009 (Transects 6 to 10) in 95 percent confidence limit

	Transect 6		Transect 7		Transect 8		Transect 9		Transect 10	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	160.78 ± 2.41		160.78 ± 2.41		160.78 ± 2.41		-	-	160.78 ± 2.41	
C050[b]	161.11 ± 21.99		154.40 ± 21.45		150.35 ± 17.20		-	-	121.20 ± 16.48	SNOTEL
C100	162.00 ± 24.74		149.90 ± 22.67		152.40 ± 19.66		-	-	120.7 ± 18.56	SNOTEL
C200	165.50 ± 26.73		153.17 ± 19.75		152.00 21.28		-	-	128.17 ± 15.44	SNOTEL
A050	157.88 ± 19.76		152.61 ± 18.62		151.43 ± 15.24		-	-	122.38 ± 11.66	SNOTEL
A100	157.56 ± 19.28		148.84 ± 19.06		153.38 ± 17.53		-	-	121.62 ± 12.22	SNOTEL
A200	160.13 ± 24.17		151.27 ± 21.21		152.20 ± 20.34		-	-	124.57 ± 12.55	SNOTEL
F050	157.75 ± 21.15		155.30 ± 19.46		151.10 ± 16.12		-	-	123.50 ± 11.25	SNOTEL
F100	158.47 ± 21.31		150.27 ± 19.93		152.17 ± 19.41		-	-	123.27 ± 11.41	SNOTEL
F200	163.56 ± 25.31		151.61 ± 22.24		151.00 23.10		-	-	125.22 ± 12.07	SNOTEL
P050	159.09 ± 19.44		150.52 ± 18.84		151.40 ± 15.65		-	-	120.86 ± 13.65	SNOTEL
P100	158.14 ± 19.56		147.77 ± 19.42		154.27 ± 16.70		-	-	119.67 ± 15.20	SNOTEL
P200	158.50 ± 23.91		151.55 ± 19.64		153.33 ± 18.37		-	-	125.11 ± 14.32	SNOTEL

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

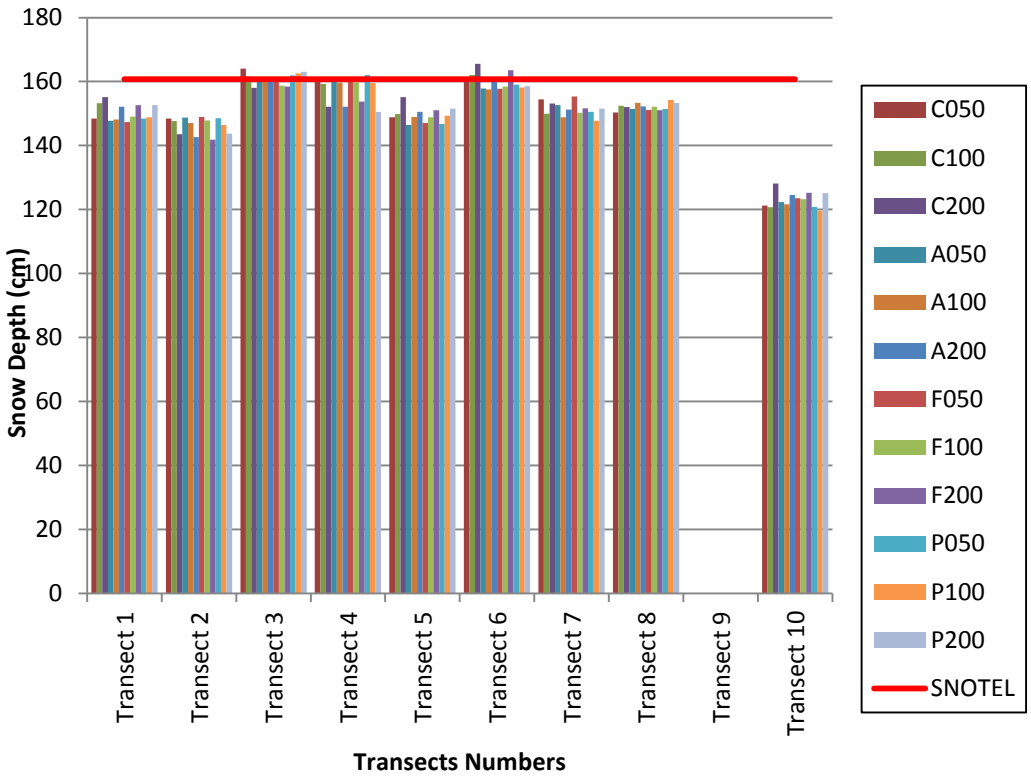

Figure E-7 snow depth field measurement analyzing of transects versus snow depth of Dry Lake SNOTEL station for February/28/2009 (Refer to Table A-1 for clarification of abbreviations)

Table E-8 snow depth field measurement analysis of surrounding boxes versus snow depth of Dry Lake SNOTEL for February/28/2009 in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	160.78 ± 2.41		160.78 ± 2.41		160.78 ± 2.41		160.78 ± 2.41		160.78 ± 2.41	
C050[b]	144.13 ± 18.80	SNOTEL	155.17 ± 22.44		154.10 ± 20.05		154.28 ± 20.14		150.67 ± 22.39	
C100	152.75 ± 13.40		155.17 ± 22.44		155.49 ± 21.97		153.59 ± 20.52		150.60 ± 22.50	
C200	-	-	164.50 ± 21.78		154.76 ± 20.34		153.63 ± 20.32		151.30 ± 20.78	
A050	140.88 ± 17.76	SNOTEL	146.41 ± 32.30		152.13 ± 17.71		153.27 ± 17.46		149.69 ± 19.45	
A100	146.50 ± 15.29		151.89 ± 19.64		154.14 ± 18.49		153.43 ± 17.01		149.39 ± 19.03	
A200	-	-	158.23 ± 18.91		150.95 ± 17.89		152.44 ± 17.49		149.43 ± 19.55	
F050	139.79 ± 19.57	SNOTEL	151.92 ± 21.34		152.14 ± 18.81		153.46 ± 18.56		149.97 ± 20.25	
F100	146.42 ± 15.10		151.92 ± 21.34		154.29 ± 19.84		153.67 ± 18.36		149.73 ± 20.12	
F200	-	-	161.83 ± 21.72		151.29 ± 20.71		153.12 ± 19.61		149.75 ± 21.17	
P050	143.04 ± 16.89	SNOTEL	152.94 ± 20.11		152.78 ± 18.14		153.42 ± 17.75		149.73 ± 20.13	
P100	148.67 ± 14.85		152.94 ± 20.11		154.44 ±18.75		153.24 ± 17.20		149.46 ± 19.71	
P200	-	-	156.71 ± 17.46		151.88 ± 16.51		152.16 ± 16.74		149.74 ± 19.08	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table E-9 snow depth field measurement analysis of concentric boxes versus snow depth of Dry Lake SNOTEL for February/28/2009 in 95 percent confidence limit

	0-200m		200-400m		400-600m		600-800m		800-1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	160.78 ± 2.41		160.78 ± 2.41		160.78 ± 2.41		160.78 ± 2.41		160.78 ± 2.41	
C050[b]	144.13 ± 18.80	SNOTEL	159.18 ± 22.68		153.24 ± 18.15		154.59 ± 20.56		145.04 ± 24.62	SNOTEL
C100	152.75 ± 13.40		161.08 ± 26.66		152.53 ± 20.39		150.11 ± 17.54		145.85 ± 24.91	
C200	-	-	171.67 ± 19.96		146.11 ± 15.28		151.70 ± 21.21		148.88 ± 21.38	
A050	140.88 ± 17.76	SNOTEL	155.89 ± 19.10		152.34 ± 16.24		155.23 ± 17.06		144.10 ± 21.16	
A100	146.50 ± 15.29		158.37 ± 20.93		153.08 ± 17.71		152.11 ± 14.24		142.99 ± 20.52	SNOTEL
A200	-	-	165.27 ± 14.43		144.49 ± 15.08	SNOTEL	154.98 ± 17.42		146.31 ± 21.38	SNOTEL
F050	139.79 ± 19.57	SNOTEL	156.33 ± 20.61		152.65 ± 16.66		155.72 ± 18.14		144.54 ± 21.67	SNOTEL
F100	146.42 ± 15.10		160.11 ± 22.21		153.70 ± 17.29		152.51 ± 15.72		143.47 ± 21.45	SNOTEL
F200	-	-	170.39 ± 16.36		147.59 ± 15.31	SNOTEL	156.23 ± 18.20		146.24 ± 22.53	
P050	143.04 ± 16.89	SNOTEL	156.55 ± 20.31		152.32 ± 16.79		152.63 ± 18.00		143.98 ± 22.29	SNOTEL
P100	148.67 ± 14.85		157.53 ± 22.67		152.28 ± 19.07		154.53 ± 17.23		143.46 ± 22.11	SNOTEL
P200	-	-	162.28 ± 14.96		141.93 ± 15.34		151.04 ± 14.10		147.23 ± 21.28	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

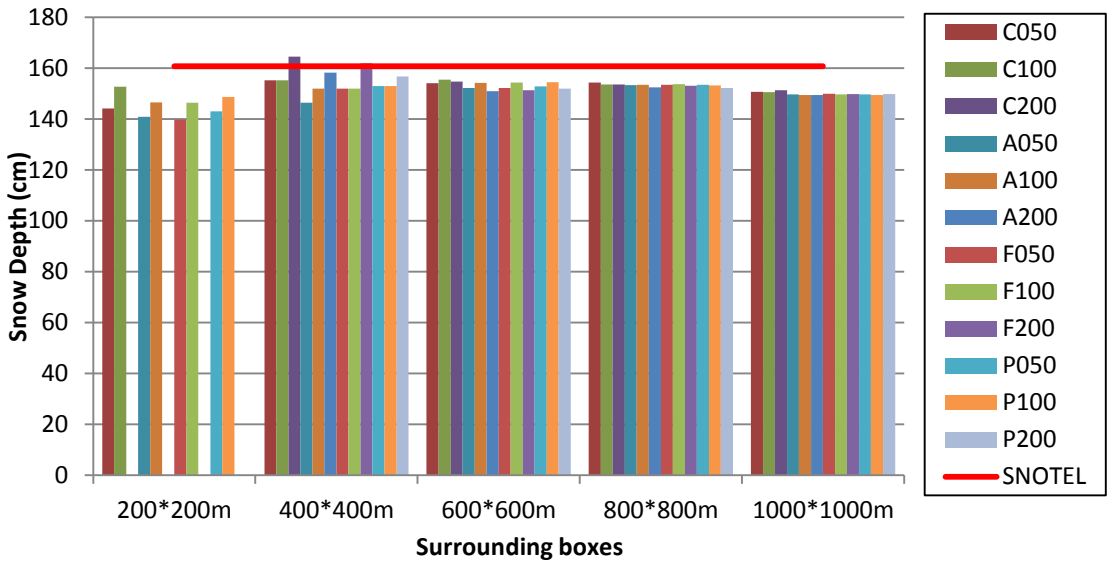

Figure E-8 snow depth field measurement analysis of surrounding boxes versus snow depth of Dry Lake SNOTEL for February/28/2009 (Refer to Table A-1 for clarification of abbreviations)

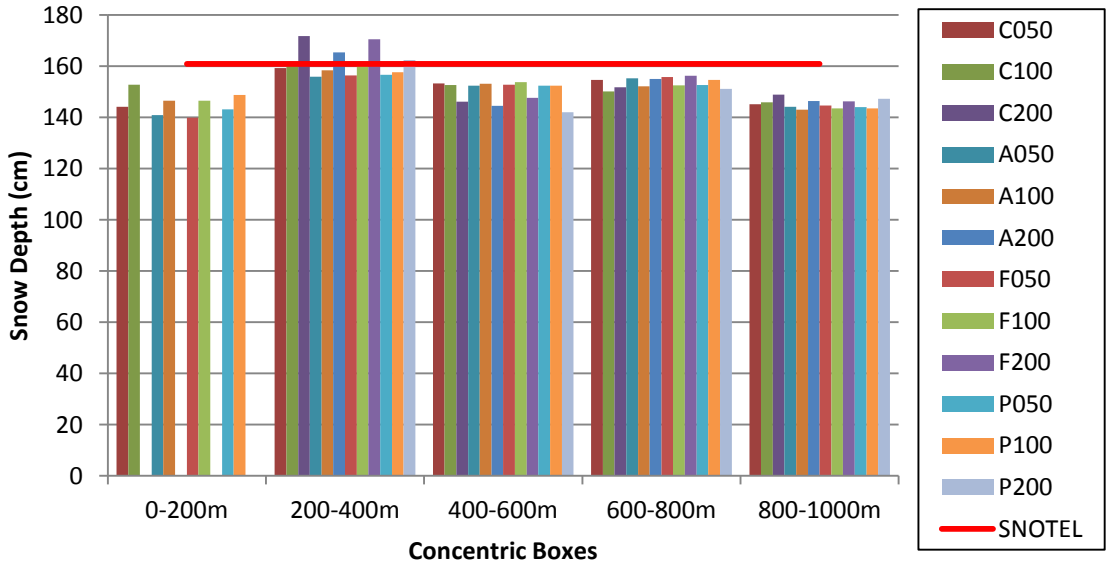

Figure E-9 snow depth field measurement analysis of donuts versus snow depth of Dry Lake SNOTEL for February/28/2009

Table E-10 a snow depth field measurement analyzing of transects versus snow depth of Dry Lake SNOTEL station for March/28/2009 (Transects 1 to 5) in 95 percent confidence limit

	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5	
	Mean ± STD (cm)	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	147.57 ± 0.80		147.57 ± 0.80		147.57 ± 0.80		147.57 ± 0.80		147.57 ± 0.80	
C050[b]	144.70 ± 20.69		147.89 ± 26.40		148.95 ± 20.47		130.10 ± 21.14	SNOTEL	144.44 ± 24.93	
C100	143.10 ± 25.97		141.11 ± 31.77		151.60 ± 18.88		121.40 ± 17.64	SNOTEL	143.89 ± 18.16	
C200	151.67 ± 8.52		144.83 ± 26.95		154.67 ± 20.54		124.00 ± 16.25	SNOTEL	146.83 ± 15.73	
A050	145.06 ± 17.98		143.63 ± 22.30		145.56 ± 20.49		132.35 ± 17.72	SNOTEL	143.92 ± 25.65	
A100	141.52 ± 21.52		137.69 ± 26.74		149.54 ± 19.23		127.64 ± 12.84	SNOTEL	149.16 ± 21.53	
A200	148.43 ± 11.37		143.40 ± 20.36		150.63 ± 18.64		123.47 ± 8.27	SNOTEL	152.93 ± 20.45	
F050	146.30 ±18.07		145.09 ± 21.38		144.45 ± 21.49		132.28 ± 17.60	SNOTEL	143.50 ± 26.68	
F100	142.97 ± 21.61		140.19 ±26.09		148.23 ± 21.63		128.37 ± 12.22	SNOTEL	147.96 ± 21.95	
F200	148.06 ± 8.89		145.00 ± 19.17		148.83 ± 19.50		125.56 ± 11.46	SNOTEL	151.39 ± 18.36	
T050	143.70 ± 18.64		143.60 ± 24.63		147.80 ± 19.71		131.67 ± 19.07	SNOTEL	144.52 ± 24.40	
T100	140.60 ± 22.79		136.34 ± 29.06		151.53 ± 17.07		124.84 ± 11.97	SNOTEL	148.59 ± 19.74	
T200	149.89 ± 12.63		142.28 ± 24.20		153.78 ± 18.74		121.56 ± 9.40	SNOTEL	152.44 ± 21.04	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column mean there is no significant difference

Table E-10 b snow depth field measurement analyzing of transects versus snow depth of Dry Lake SNOTEL station for March/28/2009 (Transects 6 to 10) in 95 percent confidence limit

	Transect 6		Transect 7		Transect 8		Transect 9		Transect 10	
	Mean ± STD (cm)	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	147.57 ± 0.80		147.57 ± 0.80		147.57 ± 0.80		147.57 ± 0.80		147.57 ± 0.80	
C050[b]	158.95 ± 32.63		157.95 ± 24.33		143.90 ± 27.45		130.40 ± 15.84	SNOTEL	110.79 ± 23.30	SNOTEL
C100	154.70 ± 33.82		150.50 ± 15.59		147.80 ± 29.72		125.10 ± 17.99	SNOTEL	108.11 ± 22.13	SNOTEL
C200	155.83 ± 40.53		155.00 ±26.40		144.83 ± 36.93		131.17 ± 23.40	SNOTEL	117.67 ± 24.01	SNOTEL
A050	162.29 ± 26.51		157.29 ± 25.15		145.00 ± 19.15		127.86 ± 13.04	SNOTEL	109.27 ± 20.95	SNOTEL
A100	159.44 ± 26.79		151.84 ± 21.49		145.64 ± 19.75		123.16 ± 14.92	SNOTEL	106.80 ± 22.51	SNOTEL
A200	160.63 ± 32.38		155.70 ± 30.15		143.83 ± 24.07		128.90 ± 17.53	SNOTEL	121.77 ± 15.89	SNOTEL
F050	162.07 ± 27.51		156.32 ± 25.68		144.40 ± 20.50		127.00 ± 14.19	SNOTEL	108.97 ± 20.40	SNOTEL
F100	159.17 ± 26.01		149.73 ± 21.59		144.40 ± 22.73		122.87 ± 16.85	SNOTEL	107.30 ± 22.83	SNOTEL
F200	162.56 ± 35.24		152.83 ± 30.96		143.56 ± 25.57		127.50 ± 19.31	SNOTEL	121.61 ± 18.72	SNOTEL
T050	161.40 ± 27.64		158.48 ± 24.50		145.23 ± 20.63		129.57 ± 13.48	SNOTEL	110.09 ± 22.52	SNOTEL
T100	158.14 ± 29.49		153.50 ± 19.81		147.60 ± 21.11		124.10 ± 14.53	SNOTEL	106.74 ± 22.27	SNOTEL
T200	157.11 ± 32.68		158.33 ± 28.46		144.45 ± 26.54		131.06 ± 17.24	SNOTEL	120.56 ± 17.86	SNOTEL

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column mean there is no significant difference

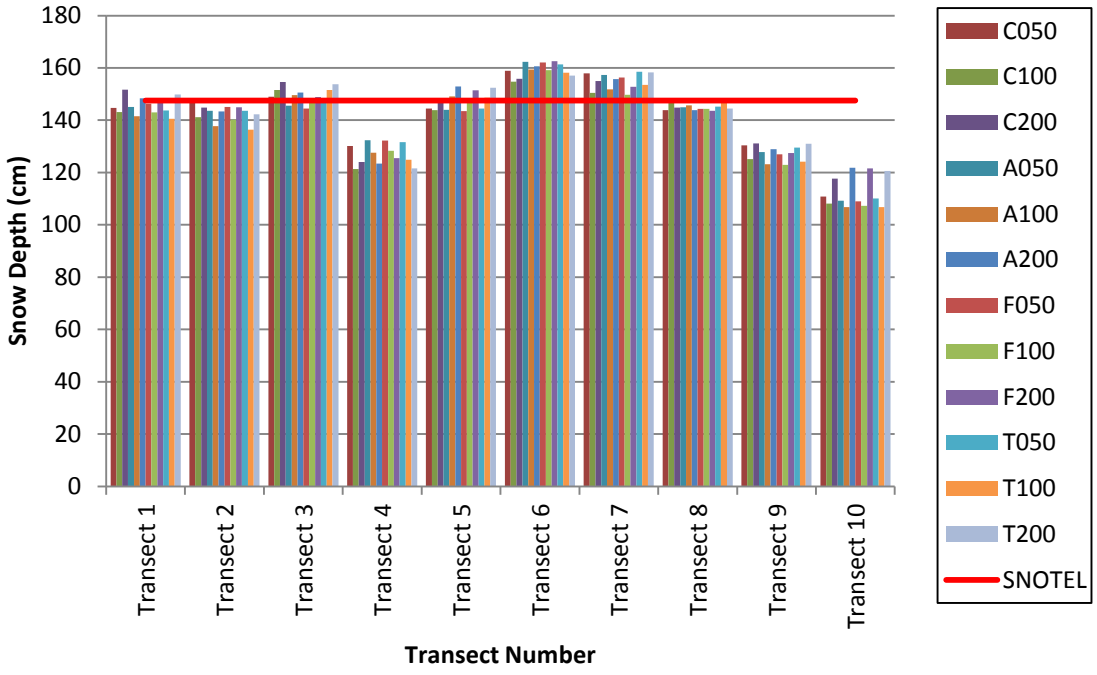

Figure E-10 snow depth field measurement analyzing of transects versus snow depth of Dry Lake SNOTEL station for March/28/2009 (Refer to Table A-1 for clarification of abbreviations)

Table E-11 snow depth field measurement analysis of surrounding boxes versus snow depth of Dry Lake SNOTEL for March/28/2009 in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	147.57 ± 0.80		147.57 ± 0.80		147.57 ± 0.80		147.57 ± 0.80		147.57 ± 0.80	
C050[b]	123.13 ±23.15	SNOTEL	138.75 ± 25.25		143.55 ± 26.37		143.66 ± 25.79		141.90 ± 27.19	
C100	121.25 ± 5.38	SNOTEL	137.69 ± 19.27		141.83 ± 23.86		140.54 ± 25.44		138.99 ± 26.91	
C200	-	-	143.50 ± 19.42		140.17 ± 23.02		141.47 ± 26.41		142.65 ± 26.96	
A050	125.48 ± 26.92	SNOTEL	139.94 ± 25.08		143.71 ± 24.29		142.90 ± 23.22		141.39 ± 25.11	
A100	127.55 ± 16.84		140.18 ± 20.31		143.91 ± 21.73		140.89 ± 22.64		139.59 ± 24.91	
A200	-	-	144.63 ± 24.78		140.56 ± 22.15		141.51 ± 23.40		142.97 ± 23.48	
F050	123.46 ± 28.49		139.50 ± 25.28		142.73 ±25.03		142.50 ± 23.67		141.21 ± 25.51	
F100	126.42 ± 16.50	SNOTEL	139.44 ± 18.52		142.67 ± 21.85		140.78 ± 22.84		139.48 ± 25.01	
F200	-	-	143.58 ± 22.39		139.07 ± 20.60		141.28 ± 23.24		142.87 ± 24.21	
T050	126.71 ± 23.57	SNOTEL	139.99 ±24.51		144.64 ± 24.20		143.56 ± 23.69		141.73 ± 25.47	
T100	126.59 ± 12.14		140.08 ± 19.90		144.46 ± 21.67		140.87 ± 23.14		139.50 ± 25.34	
T200	-	-	145.29 ± 24.75		141.91 ± 23.47		141.72 ± 24.53		142.96 ± 24.14	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table E-12 snow depth field measurement analysis of concentric boxes versus snow depth of Dry Lake SNOTEL for March/28/2009 in 95 percent confidence limit

	0-200m		400-400m		600-600m		800-800m		800-1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	147.57 ± 0.80		147.57 ± 0.80		147.57 ± 0.80		147.57 ± 0.80		147.57 ± 0.80	
C050[b]	123.13 ± 23.15	SNOTEL	143.96 ± 24.15		147.49 ± 26.93		143.80 ± 25.27		138.79 ± 29.43	
C100	121.25 ± 5.38	SNOTEL	143.17 ± 19.16		145.15 ± 27.01		138.81 ± 27.77		136.20 ± 29.56	
C200	-	-	151.50 ± 14.69		137.50 ± 26.27		143.14 ± 31.06		144.00 ± 28.00	
A050	125.48 ± 26.92	SNOTEL	144.77 ± 23.03		146.81 ± 23.49		141.86 ± 21.93		138.70 ± 28.12	
A100	127.55 ± 16.85		144.38 ± 20.19		146.90 ± 22.88		136.85 ± 23.61		137.26 ± 28.74	
A200	-	-	152.40 ± 23.49		137.30 ± 20.56		142.73 ± 25.73		144.64 ± 23.87	
F050	123.46 ± 28.49		144.85 ± 22.25		145.38 ± 24.83		142.21 ± 22.01		138.93 ± 28.52	
F100	126.42 ± 16.50	SNOTEL	143.78 ± 17.64		145.25 ± 24.36		138.27 ± 24.28		137.14 ± 28.71	
F200	-	-	150.50 ± 21.30		135.47 ± 19.48		144.12 ± 26.79		144.69 ± 25.58	
T050	126.71 ± 23.57	SNOTEL	144.42 ± 23.64		148.46 ± 23.57		142.16 ± 23.17		138.49 ± 28.24	
P100	126.59 ± 12.14		144.58 ± 20.28		147.97 ± 22.88		136.09 ± 24.56		137.03 ± 29.07	
P200	-	-	154.00 ± 21.94		139.20 ± 23.37		141.48 ± 26.72		144.38 ± 24.05	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

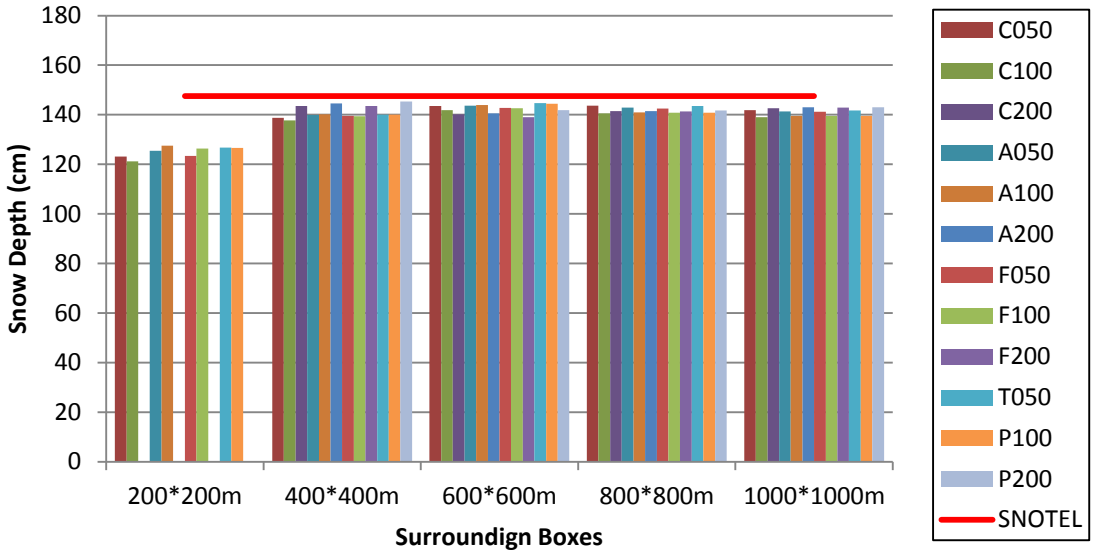

Figure E-11 snow depth field measurement analysis of surrounding boxes versus snow depth of Dry Lake SNOTEL for March/28/2009 (Refer to Table A-1 for clarification of abbreviations)

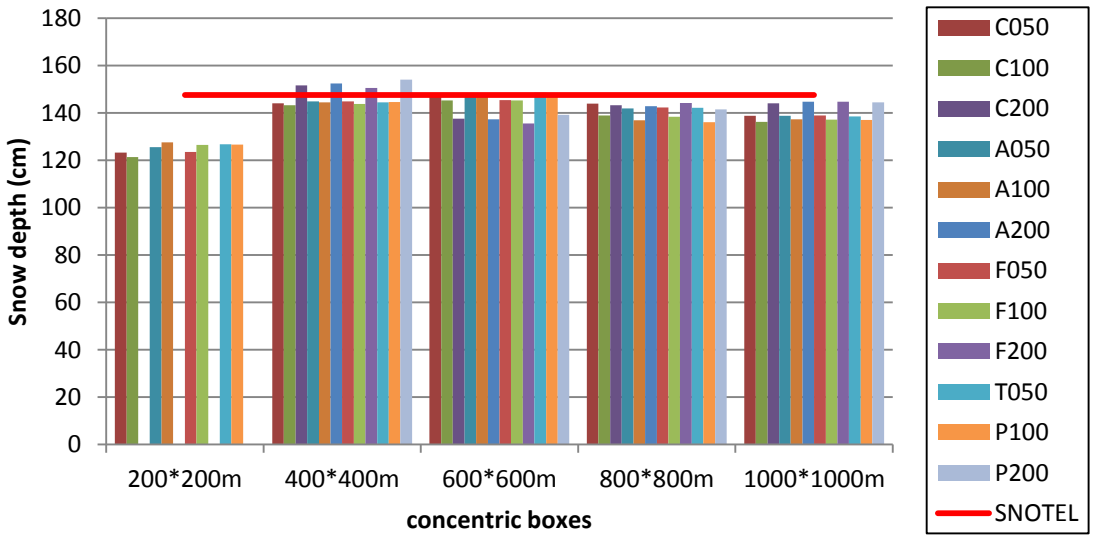

Figure E-12 snow depth field measurement analysis of concentric boxes versus snow depth of Dry Lake SNOTEL for March/28/2009(Refer to Table A-1 for clarification of abbreviations)

Table E-13 statistical analyses of transects versus transects of each specific day for Dry Lake SNOTEL station in 95 percent confidence limit

	4/4/2008		5/2/2008	
	Mean ± STD (cm)[a]	**SID[b]**	**Mean ± STD (cm)a**	**SIDb**
Transect 1	152.47 ± 18.85	T10	151.07 ± 18.38	T9, T10
Transect 2	151.13 ± 16.25	T4, T8, T9, T10	140.98 ± 21.79	T6, T9, T10
Transect 3	*****	*****	146.18 ± 21.55	T9, T10
Transect 4	167.80 ± 17.45	T1, T2, T9,T10	141.23 ± 22.34	T6, T9, T10
Transect 5	*****	*****	145.25 ± 18.54	T9, T10
Transect 6	*****	*****	155.44 ± 18.41	T2, T4, T8, T9, T10
Transect 7	161.43 ± 25.20	T4, T8, T9, T10	147.78 ± 26.25	T9, T10
Transect 8	165.65 ± 16.99	T1, T2, T9,T10	139.02 ± 23.97	T9, T10
Transect 9	143.23 ± 10.44	T4, T4,T8	111.23 ± 12.83	T1, T2, T3, T4, T5, T6, T7, T8, T10
Transect 10	132.78 ± 10.94	T1, T2, T4, T7,T10	97.03 ± 17.83	T1, T2, T3, T4, T5, T6, T7, T8, T9
	2/28/2009		**3/28/2009**	
	Mean ± STD (cm)	**SID**	**Mean ± STD (cm)**	**SID**
Transect 1	147.35 ± 14.13	T3, T10	146.30 ± 18.07	T4, T9, T10
Transect 2	148.92 ± 17.07	T3, T10	145.48 ± 20.89	T6, T9, T10
Transect 3	160.28 ± 14.70	T1, T2, T5, T10	144.45 ± 21.49	T6, T9, T10
Transect 4	160.17 ± 21.41	T1, T5, T10	132.28 ± 17.60	T1,T6, T7, T10
Transect 5	147.02 ± 20.83	T3,T4	143.50 ± 26.68	T6, T9, T10
Transect 6	157.75 ± 21.15	T10	162.07 ± 27.51	T1, T2, T3, T4, T5, T8, T9, T10
Transect 7	155.30 ± 19.46	T10	156.32 ± 25.68	T4, T9, T10
Transect 8	151.10 ± 16.12	T10	144.40 ± 20.50	T6, T9, T10
Transect 9	*****	*****	127.00 ± 14.19	T1, T2, T3, T5, T6, T7, T8, T10
Transect 10	123.50 ± 11.25	T1, T2, T3, T4, T5, T6, T7, T8	108.97 ± 20.40	T1, T2, T3, T4, T5, T6, T7, T8, T9

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

T is transect

Table E-14 statistical analyses of surrounding boxes versus surrounding boxes of each specific day for Dry Lake SNOTEL station in 95 percent confidence limit

	4/4/2008		5/2/2008		2/28/2009		3/28/2009	
	Mean ± STD (cm)[a]	**SID[b]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
200*200m	*****	*****	145.67 ± 16.95		139.79 ± 19.57		123.46 ± 28.49	B600, B800, B1000
400*400m	164.38 ± 26.38		146.97 ± 22.63	B[C] 1000	151.92 ± 21.34		139.50 ± 25.28	
600*600m	162.49 ± 21.69		144.54 ± 22.98	B1000	152.14 ± 18.81		142.73 ± 25.03	B200
800*800m	157.68 ± 20.52		139.46 ± 23.44		153.46 ± 18.56		142.50 ± 23.67	B200
1000*1000m	155.89 ± 20.73		137.35 ± 26.76	B400, B600	149.97 ± 20.25		141.21 ± 25.51	B200

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

c Surrounding boxes

Table E-15 statistical analyses of concentric boxes versus concentric boxes of each specific day for Dry Lake SNOTEL station in 95 percent confidence limit

	4/4/2008		5/2/2008		2/28/2009		3/28/2009	
	Mean ± STD (cm)[a]	**SID[b]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
0-200m	*****	*****	142.19 ± 14.91		139.79 ± 19.57		123.46 ± 28.49	CB400, CB600
200-400m	164.38 ± 26.38		147.42 ± 24.62	CB[c] 800, CB 1000	156.33 ± 20.61	CB800, CB1000	144.85 ± 22.25	CB200
400-600m	161.12 ± 18.10		142.55 ± 23.38		152.32 ± 16.79		145.38 ± 24.83	CB200
600-800m	154.30 ± 19.14		133.20 ± 22.65	CB400	155.72 ± 18.14	CB400,CB1000	142.21 ± 22.01	
800-1000m	153.75 ± 20.91		133.69 ± 31.55	CB400	144.54 ± 21.67	CB400, CB800	138.93 ± 28.52	

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

c Concentric Boxes

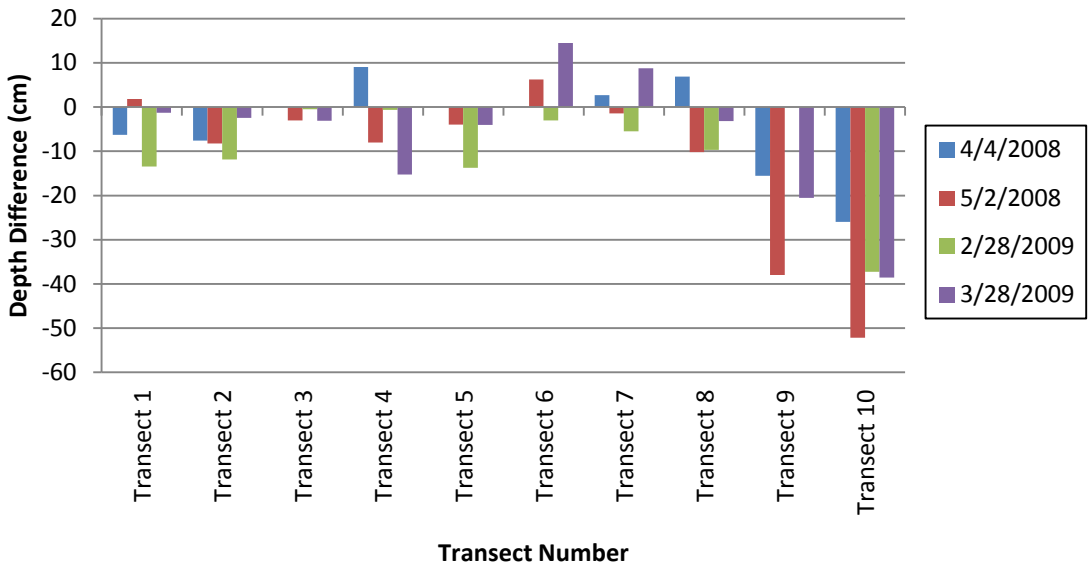

Figure E-13 SD difference between transects and SD of Dry lake SNOTEL station (F050 minus SNOTEL)

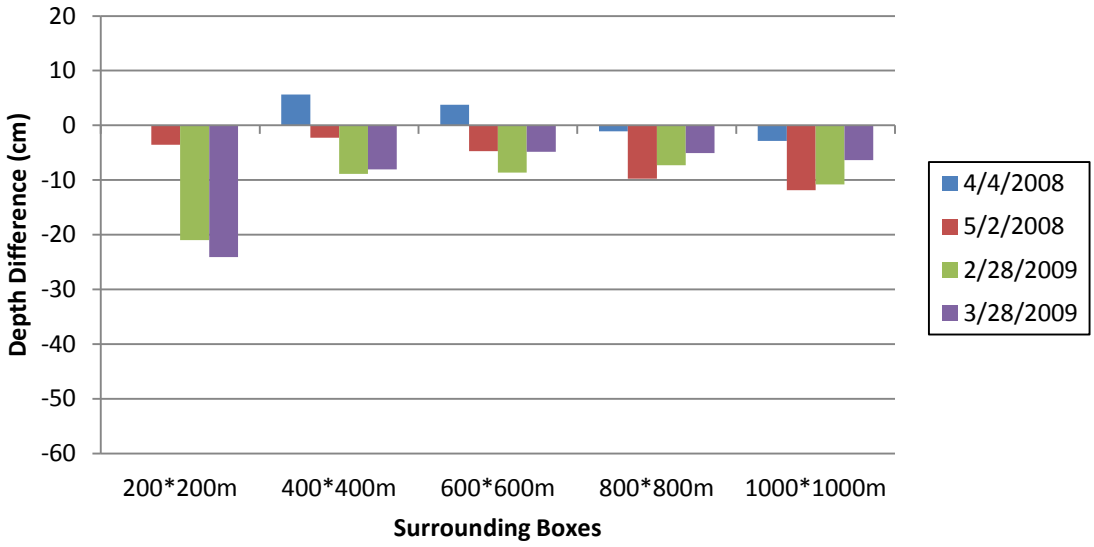

Figure E-14 SD difference between surrounding boxes and SD of Dry lake SNOTEL station (F050 minus SNOTEL)

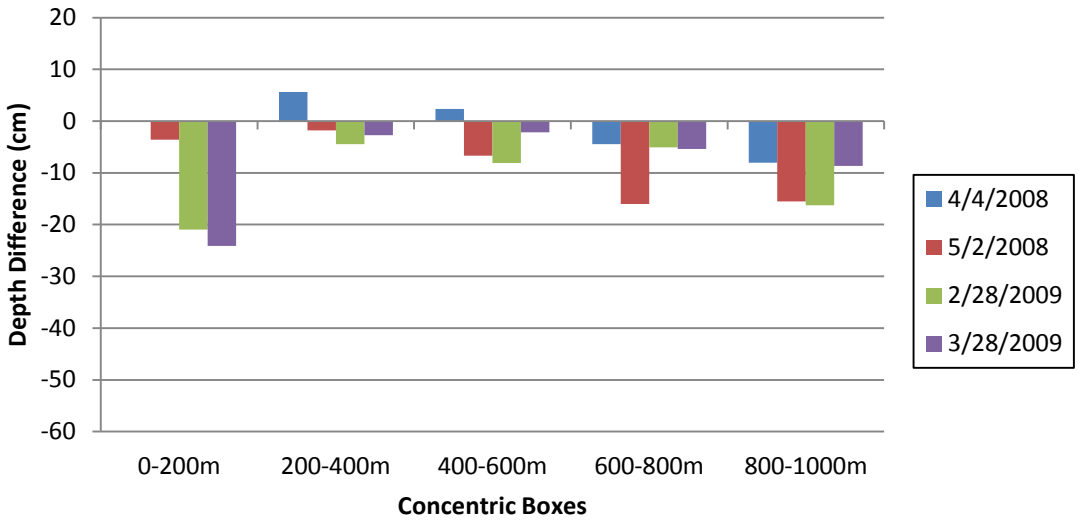

Figure E-15 SD difference between concentric boxes and SD of Dry lake SNOTEL station (F050 minus SNOTEL)

Table E-16 statistical analyses of SD averages of 3, 5, and 10 transects versus Dry Lake SNOTEL station in 95 percent confidence level

	May/02/2008		Feb/28/2009		Mar/28/2009	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	149.23 ± 1.61	thr	160.78 ± 2.41	thr	147.57 ± 0.80	
10 transects (all)	137.35 ± 26.76		149.97 ± 20.25[d]		141.21 ± 25.51	thr
Transects 2, 4 , 6, 8, 10 (even)	144.03 ± 22.31	thr	147.94 ± 21.75	thr	138.94 ± 27.50	
Transects 1, 3, 5, 7, 9 (odd)	140.19 ± 24.59	thr	-	thr	143.51 ± 23.23	thr
Transects 1, 5, 10 (thr)	130.88 ± 30.41	SNOTEL, even, odd	139.02 ± 19.16	SNOTEL, even, odd	132.97 ± 27.48	odd, all

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

d nine transects

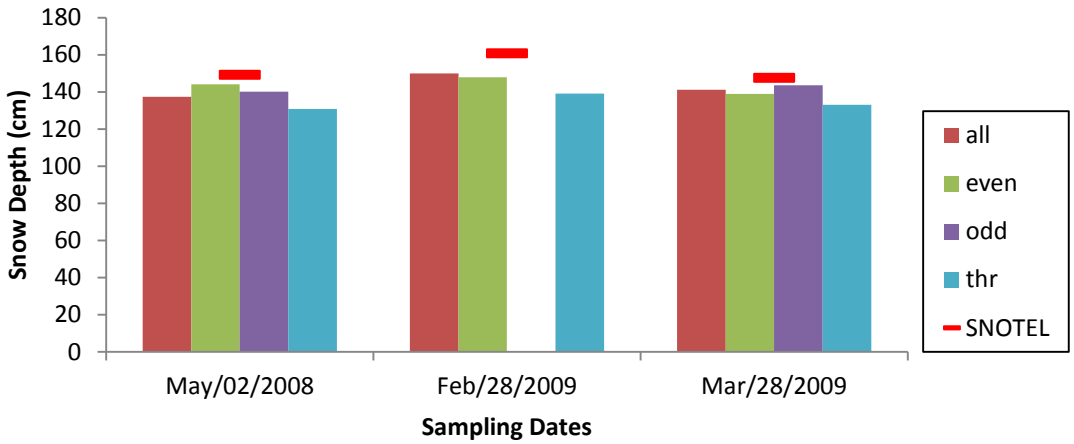

Figure E-16 SD averages of 3, 5, and 10 transects versus Dry Lake SNOTEL station (refer to column 1 of Table E-16 for definition)

Table E-17 statistical analyses of inter and intra annual for sampling dates of Dry Lake SNOTE in 95 percent confidence level

	04/04/2008 and 05/02/2008	
	Mean ± STD (cm)[a]	**SID[c]**
4/4/2008	153.50 ± 20.47	5/2/2008
5/2/2008	132.60 27.83	4/4/2008
	02/28/2009 and 03/28/2009	
	Mean ± STD (cm)	**SID**
2/28/2009	150.00 ± 20.25	3/28/2009
3/28/2009	142.80 ± 26.02	2/28/2009
	04/04/2008 and 03/28/2009	
	Mean ± STD (cm)	**SID**
4/4/2008	153.50 ± 20.47	3/28/2009
3/28/2009	137.50 ± 24.27	4/4/2008

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

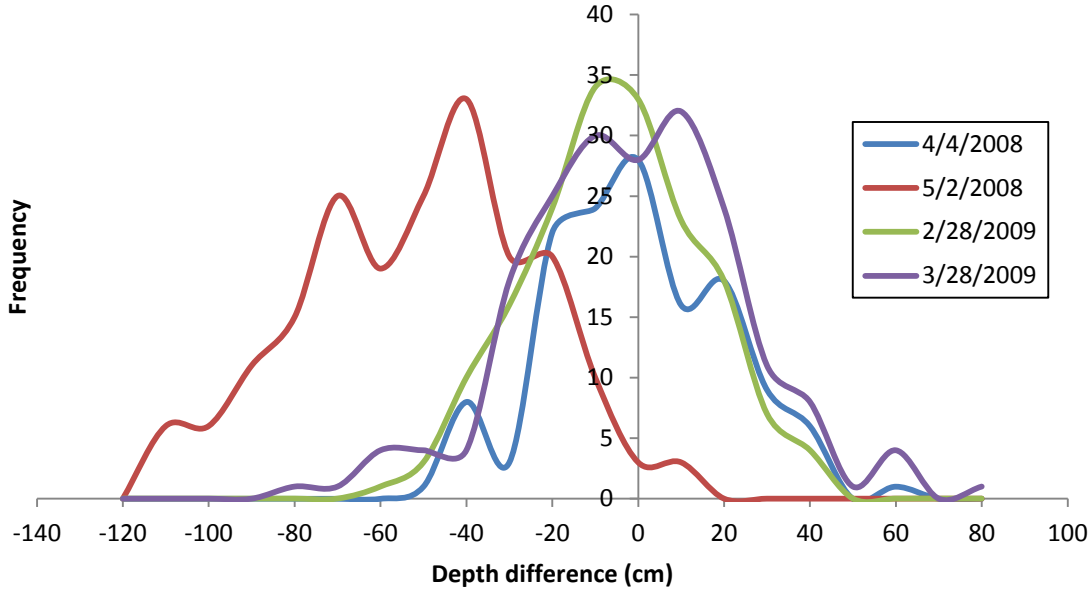

Figure E-17 SD difference between field sampling and Dry Lake SNOTEL station for different sampling date

Appendix F: Joe Wright SNOTEL station statistical analyses results

Table F-1 a snow depth of field measurement analyzing of transects versus snow depth of Joe Wright SNOTEL station for April/03/2008 in 95 percent confidence limit

	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5	
	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	*****		187.96 ± 0.00		187.96 ± 0.00		187.96 ± 0.00		187.96 ± 0.00	
C050[b]	*****		186.94 ± 28.49		189.24 ± 54.18		160.20 ± 34.93	SNOTEL	171.93 ± 36.58	
C100	*****		188.44 ± 35.35		188.11 ± 60.83		170.80 ± 23.23		185.57 ± 38.20	
C200	*****		198.60 ± 40.92		209.60 ± 46.38		*****		185.00 ± 49.77	
A050	*****		183.72 ± 31.69		188.22 ± 49.38		160.38 ± 24.97	SNOTEL	169.67 ± 30.66	
A100	*****		187.40 ± 37.51		185.47 ± 57.00		162.16 ± 24.41		176.57 ± 33.91	
A200	*****		198.96 ± 43.34		202.00 ± 40.25		*****		176.75 ± 41.83	
F050	*****		184.86 ± 29.88		188.61 ± 51.72		159.23 ± 27.78	SNOTEL	170.87 ± 31.18	
F100	*****		187.82 ± 34.68		185.96 ± 59.70		163.20 ± 24.62		179.24 ± 35.69	
F200	*****		197.87 ± 39.71		202.47 ± 45.76		*****		179.33 ± 42.60	
P050	*****		183.65 ± 32.42		188.18 ± 48.49		161.47 ± 24.53	SNOTEL	169.22 ± 32.19	
P100	*****		187.33 ± 39.64		185.85 ± 55.49		164.00 ± 23.23		176.90 ± 34.56	
P200	*****		199.93 ± 46.02		204.07 ± 36.45		*****		176.92 ± 44.26	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table F-1 b snow depth of field measurement analyzing of transects versus snow depth of Joe Wright SNOTEL station for April/03/2008 in 95 percent confidence limit

	Transect 6		Transect 7		Transect 8		Transect 9		Transect 10	
	Mean ± STD (cm)	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	187.96 ± 0.00		187.96 ± 0.00		*****		*****		*****	
C050	163.94 ± 26.05	SNOTEL	159.67 ± 24.55	SNOTEL	*****		*****		*****	
C100	162.22 ± 27.86	SNOTEL	158.56 ± 24.23	SNOTEL	*****		*****		*****	
C200	163.40 ± 25.56		152.00 ± 30.39	SNOTEL	*****		*****		*****	
A050	156.36 ± 22.96	SNOTEL	156.56 ± 20.11	SNOTEL	*****		*****		*****	
A100	154.38 ± 22.10	SNOTEL	158.58 ± 18.14	SNOTEL	*****		*****		*****	
A200	155.92 ± 24.86	SNOTEL	156.36 ± 24.21	SNOTEL	*****		*****		*****	
F050	159.27 ± 23.02	SNOTEL	157.11 ± 21.46	SNOTEL	*****		*****		*****	
F100	158.26 ± 24.14	SNOTEL	156.93 ± 22.56	SNOTEL	*****		*****		*****	
F200	154.87 ± 22.77	SNOTEL	151.67 ± 28.66	SNOTEL	*****		*****		*****	
P050	155.98 ± 25.12	SNOTEL	157.04 ± 21.71	SNOTEL	*****		*****		*****	
P100	153.11 ± 24.02	SNOTEL	160.22 ± 17.16	SNOTEL	*****		*****		*****	
P200	159.47 ± 27.32	SNOTEL	159.60 ± 24.05	SNOTEL	*****		*****		*****	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

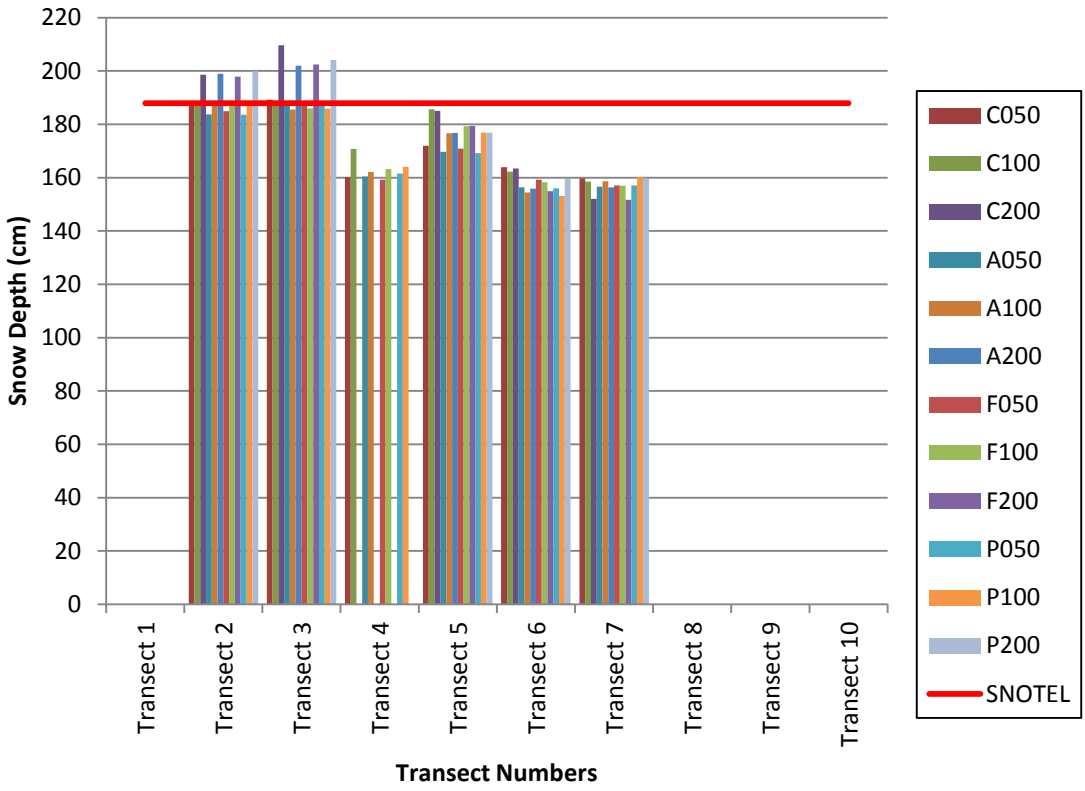

Figure F-1 snow depth field measurement of transects versus snow depth of Joe Wright SNOTEL station for April/03/2008(Refer to Table A-1 for clarification of abbreviations)

Table F-2 snow depth field measurement analysis of surrounding boxes versus snow depth of Joe Wright SNOTEL for April/03/2008 in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	187.96 ± 0.00		187.96 ± 0.00		187.96 ± 0.00		187.96 ± 0.00		*****	
C050[b]	182.86 ± 42.82		167.75 ± 31.96		171.11 ± 41.89		173.16 ± 36.89		*****	
C100	184.33 ± 62.52		171.57 ± 33.56		173.67 ± 44.03		175.60 ± 38.41		*****	
C200	*****		162.14 ± 42.38		180.07 ± 46.07		180.08 ± 40.64		*****	
A050	176.46 ± 41.11		160.81 ± 27.23	SNOTEL	167.52 ± 37.03		170.09 ± 33.93		*****	
A100	173.53 ± 54.28		160.40 ± 27.54	SNOTEL	166.98 ± 39.63		171.23 ± 36.28		*****	
A200	*****		156.89 ± 35.64	SNOTEL	174.66 ± 39.78		176.94 ± 37.52		*****	
F050	177.62 ± 45.71		164.02 ± 27.15	SNOTEL	168.99 ± 37.87		171.08 ± 34.60		*****	
F100	178.22 ± 52.06		165.12 ± 29.29		169.14 ± 41.20		172.32 ± 37.31		*****	
F200	*****		157.09 ± 37.09		175.07 ± 41.79		176.26 ± 38.71		*****	
P050	177.43 ± 37.73		159.92 ± 29.02	SNOTEL	167.25 ± 37.70		170.12 ± 34.39		*****	
P100	172.45 ± 59.93		159.41 ± 28.47	SNOTEL	167.05 ± 39.87		171.60 ± 36.40		*****	
P200	*****		158.43 ± 36.45	SNOTEL	176.05 ± 40.03		178.67 ± 37.69		*****	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table F-3 snow depth field measurement analysis of concentric boxes versus snow depth of Joe Wright SNOTEL for April/03/2008 in 95 percent confidence limit

	0-200m		200-400m		400-600m		600-800m		800-1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	187.96 ± 0.00		187.96 ± 0.00		187.96 ± 0.00		187.96 ± 0.00		*****	
C050[b]	182.86 ± 42.82		162.71 ± 26.88	SNOTEL	174.88 ± 51.24		176.03 ± 28.79		*****	
C100	184.33 ± 62.52		168.09 ± 24.90	SNOTEL	175.92 ± 54.49		178.10 ± 30.59		*****	
A050	176.46 ± 41.11		155.60 ± 19.48	SNOTEL	175.02 ± 45.01		173.68 ± 29.15		*****	
A100	173.53 ± 54.28		156.82 ± 18.19	SNOTEL	174.06 ± 49.76		176.70 ± 31.55		*****	
F050	177.62 ± 45.71		159.56 ± 22.01	SNOTEL	174.55 ± 47.09		174.01 ± 29.67		*****	
F100	178.22 ± 52.06		161.54 ± 22.53	SNOTEL	173.46 ± 52.06		176.41 ± 32.14		*****	
P050	177.43 ± 37.73		154.02 ± 19.07	SNOTEL	175.45 ± 44.72		174.14 ± 29.16		*****	
P100	172.45 ± 59.93		155.85 ± 16.45	SNOTEL	175.28 ± 49.23		177.46 ± 31.36		*****	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

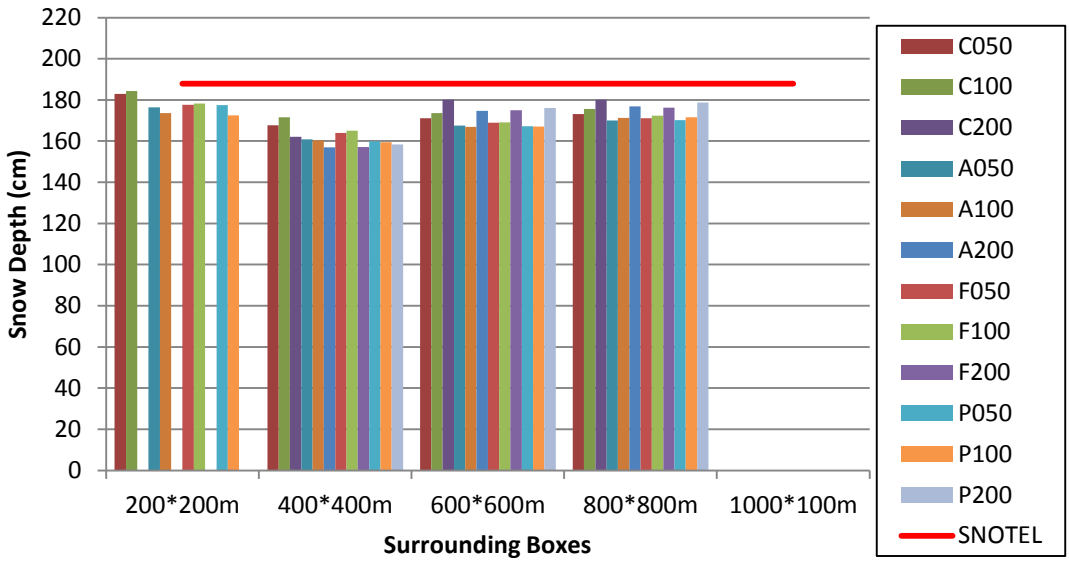

Figure F-2 snow depth field measurement analysis of surrounding boxes versus snow depth of Joe Wright SNOTEL for April/03/2008 (Refer to Table A-1 for clarification of abbreviations)

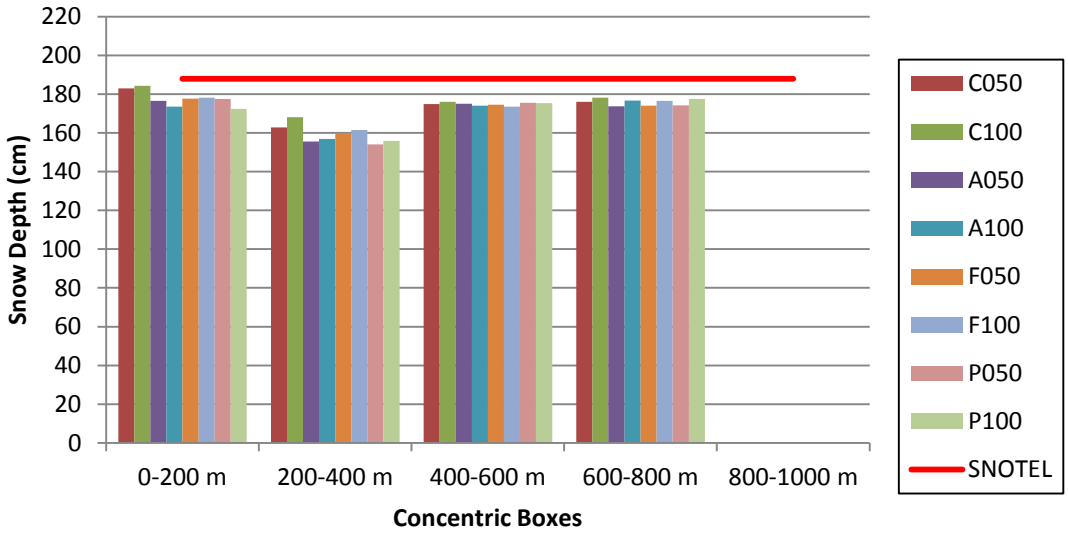

Figure F-3 snow depth field measurement analysis of Concentric boxes versus snow depth of Joe Wright SNOTEL for April/03/2008 (Refer to Table A-1 for clarification of abbreviations)

Table F-4 snow depth of field measurement analyzing of transects versus snow depth of Joe Wright SNOTEL station for May/01/2008 in 95 percent confidence limit

	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	182.37 ± 8.64		182.37 ± 8.64		182.37 ± 8.64		182.37 ± 8.64		182.37 ± 8.64	
C050[b]	161.40 ± 33.97		146.89 ± 24.49	SNOTEL	165.57 ± 55.24		169.05 ± 44.94		171.20 ± 41.20	
C100	157.90 ± 39.42		145.50 ± 31.58	SNOTEL	164.27 ± 51.45		173.91 ± 53.01		176.36 ± 51.50	
C200	165.67 ± 54.58		155.77 ± 18.21	SNOTEL	175.00 ± 68.35		155.17 ± 18.76		177.33 ± 34.54	
F050	162.18 ± 20.20		150.50 ± 19.88	SNOTEL	170.27 ± 46.70		152.33 ± 19.71		167.68 ± 36.06	
F100	160.50 ± 25.31		151.74 ± 22.41	SNOTEL	170.64 ± 49.00		165.56 ± 34.28		173.79 ± 44.14	
F200	165.00 ± 32.62		151.90 ± 27.19	SNOTEL	175.95 ± 66.13		167.42 ± 36.06		174.67 ± 31.06	
	Transect 6		**Transect 7**		**Transect 8**		**Transect 9**		**Transect 10**	
	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	182.37 ± 8.64		182.37 ± 8.64		182.37 ± 8.64		182.37 ± 8.64		182.37 ± 8.64	
C050	155.00 ± 41.53	C200	153.05 ± 35.53	SNOTEL,C200	155.81 ± 33.74		166.30 ± 31.89		169.24 ± 26.27	
C100	166.27 ± 52.01		167.73 ± 34.51		152.91 ± 39.71	SNOTEL	165.10 ± 13.36		165.00 ± 26.37	
C200	192.33 ± 55.83	C050	186.50 ± 35.88	C050	175.83 ± 34.33		169.00 ± 7.91		156.67 ± 31.33	
F050	159.83 ± 24.86		152.73 ± 32.29	SNOTEL,A200	157.32 ± 26.47	SNOTEL	165.77 ± 29.16		167.56 ± 27.92	
F100	166.03 ± 30.18		166.15 ± 32.88		157.48 ± 28.89	SNOTEL	165.77 ± 16.19		165.39 ± 21.60	
F200	179.67 ± 35.16		183.67 ± 35.49	A050	168.28 ± 29.03		167.87 ± 5.44		160.00 ± 24.80	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

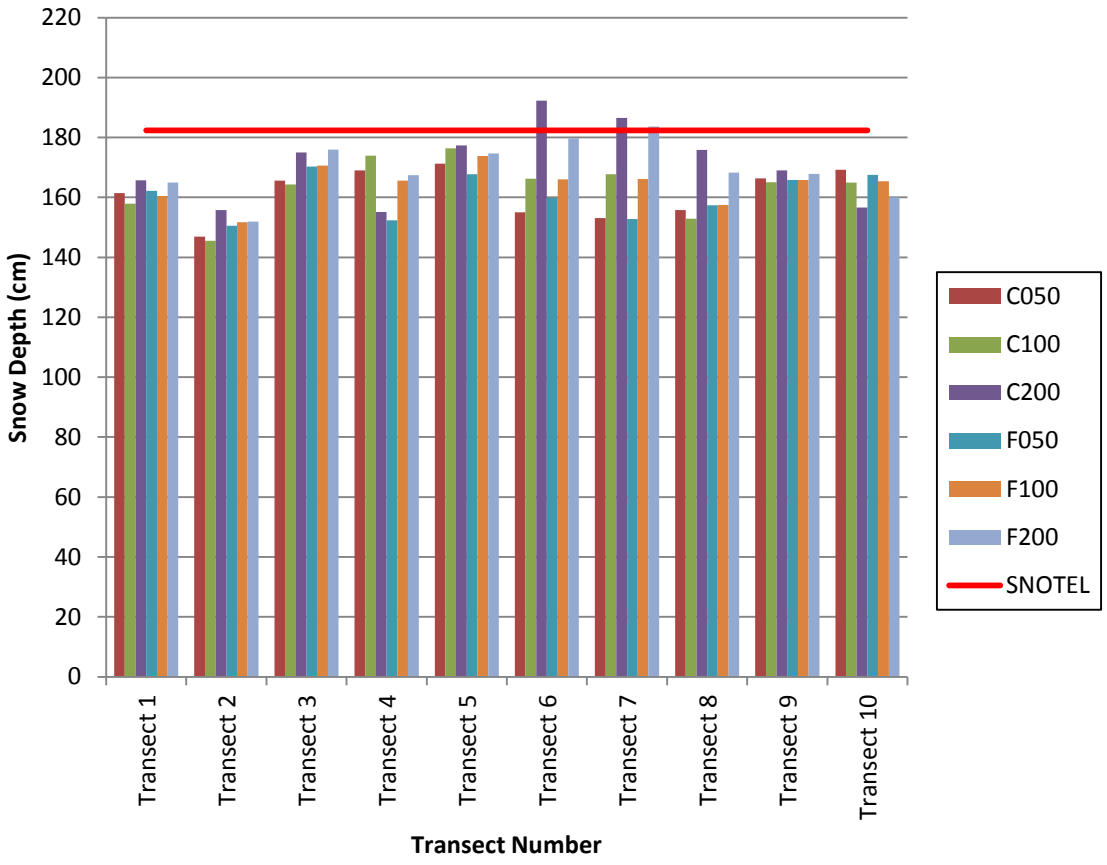

Figure F-4 snow depth field measurement of transects versus snow depth of Joe Wright SNOTEL station for May/01/2008 (Refer to Table A-1 for clarification of abbreviations)

Table F-5 snow depth field measurement analysis of surrounding boxes versus snow depth of Joe Wright SNOTEL for May/01/2008 in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	182.37 ± 8.64		182.37 ± 8.64		182.37 ± 8.64		182.37 ± 8.64		182.37 ± 8.64	
C050[b]	182.57 ± 60.49		174.77 ± 51.68		163.87 ± 43.04		159.74 ± 39.84	SNOTEL	161.91 ± 37.73	
C100	193.50 ± 80.39		190.44 ± 63.43		168.69 ± 49.18		165.67 ± 41.90		164.30 ± 40.19	
C200			200.50 ± 44.09		179.39 ± 36.86		173.34 ± 36.38		169.92 ± 40.57	
F050	185.48 ± 46.05		171.99 ± 39.91		162.79 ± 33.48		161.03 ± 29.87		162.54 ± 30.57	
F100	193.67 ± 62.13		182.94 ± 48.40		167.75 ± 37.32		165.98 ± 31.23		164.52 ± 31.52	
F200			192.96 ± 37.46		174.70 ± 32.39		170.22 ± 28.44		167.42 ± 33.30	

Table F-6 snow depth field measurement analysis of concentric boxes versus snow depth of Joe Wright SNOTEL for May/01/2008 in 95 percent confidence limit

	0-200m		200-400m		400-600m		600-800m		800-1000m	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	182.37 ± 8.64		182.37 ± 8.64		182.37 ± 8.64		182.37 ± 8.64		182.37 ± 8.64	
C050[b]	182.57 ± 60.49		172.39 ± 49.98		155.70 ± 33.63	SNOTEL	154.39 ± 34.92	SNOTEL	165.28 ± 34.17	
C100	193.50 ± 80.39		189.42 ± 60.98		151.30 ± 23.73	SNOTEL	161.63 ± 30.01	SNOTEL	162.34 ± 37.99	
C200	*****		208.17 ± 45.19		162.50 ± 18.49		165.57 ± 35.53		165.85 ± 45.41	
F050	185.48 ± 46.05		167.88 ± 38.02		155.88 ± 26.16	SNOTEL	158.75 ± 24.55	SNOTEL	164.88 ± 31.67	
F100	193.67 ± 62.13		179.36 ± 45.67		155.60 ± 19.15	SNOTEL	163.62 ± 20.99		162.43 ± 32.17	
F200	*****		198.67 ± 40.29		160.10 ± 18.90		164.45 ± 22.21		164.11 ± 38.59	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

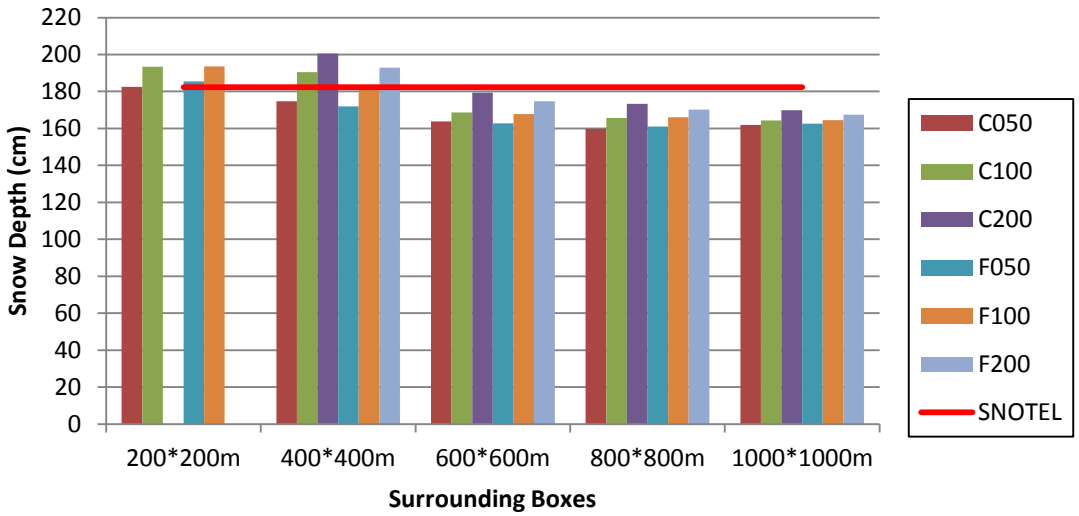

Figure F-5 snow depth field measurement analysis of surrounding boxes versus snow depth of Joe Wright SNOTEL for May/01/2008 (Refer to Table A-1 for clarification of abbreviations)

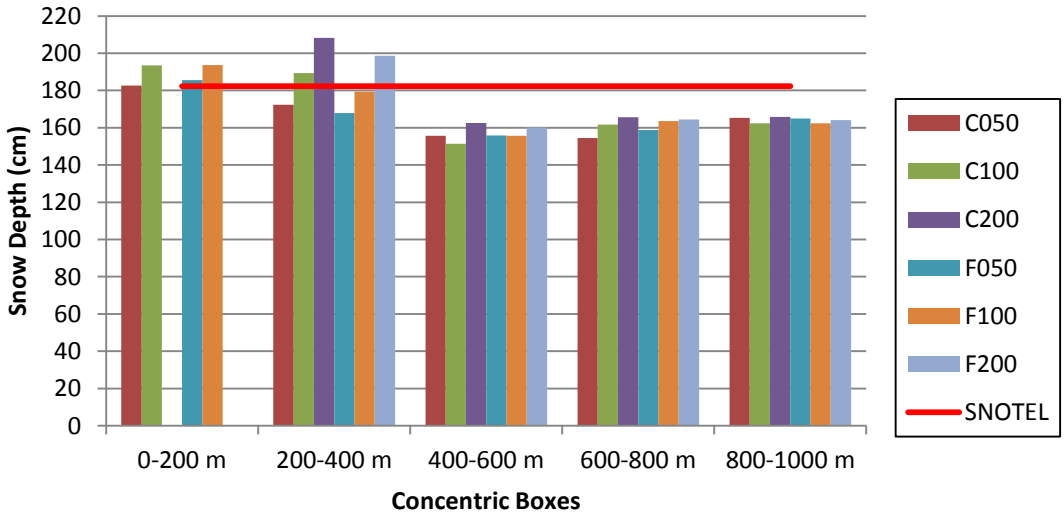

Figure F-6 snow depth field measurement analysis of Concentric boxes versus snow depth of Joe Wright SNOTEL for May/01/2008 (Refer to Table A-1 for clarification of abbreviations)

Table F-7 a snow depth of field measurement analyzing of transects versus snow depth of Joe Wright SNOTEL station for January/31/2009 in 95 percent confidence limit

	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	133.10 ± 1.31		133.10 ± 1.31		133.10 ± 1.31		133.10 ± 1.31		*****	
C050[b]	123.95 ± 32.73		135.09 ± 15.24		123.48 ± 28.12		127.80 ± 26.91		*****	
C100	122.91 ± 24.50		142.17 ± 12.99		124.09 ± 25.96		128.30 ± 30.01		*****	
C200	121.17 ± 31.13		145.14 ± 12.84		117.50 ± 28.65		128.80 ± 7.66		*****	
A050	128.77 ± 27.33		133.64 ± 14.57		123.60 ± 27.17		126.93 ± 17.99		*****	
A100	127.11 ± 30.76		138.93 ± 14.93		123.16 ± 26.82		129.60 ± 23.19		*****	
A200	121.37 ± 41.38		140.94 ± 17.35		118.67 ± 29.80		128.60 ± 8.62		*****	
F050	128.44 ± 30.87		134.74 ± 14.10		123.68 ± 27.34		125.67 ± 21.00		*****	
F100	128.91 ± 31.95		139.83 ± 13.49		125.91 ± 22.46		127.77 ± 23.00		*****	
F200	121.56 ± 42.33		142.19 ± 16.36		123.78 ± 27.28		124.74 ± 6.07		*****	
P050	127.49 ± 25.37		133.02 ± 15.54		123.48 ± 29.33		128.48 ± 19.43		*****	
P100	123.91 ± 26.84		139.11 ± 16.09		120.73 ± 32.58		131.00 ± 26.72		*****	
P200	121.11 ± 35.74		141.10 ± 16.72		113.17 ± 32.35		132.53 ± 13.61		*****	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table F-7 b snow depth of field measurement analyzing of transects versus snow depth of Joe Wright SNOTEL station for January/31/2009 in 95 percent confidence limit

	Transect 6		Transect 7		Transect 8		Transect 9		Transect 10	
	Mean ± STD (cm)	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	*****		133.10 ± 1.31		133.10 ± 1.31		133.10 ± 1.31		133.10 ± 1.31	
C050	*****		118.43 ± 38.62		142.57 ± 25.90		116.52 ± 15.82	SNOTEL	136.00 ± 27.94	
C100	*****		131.09 ± 48.90		144.09 ± 26.91		114.00 ± 17.17	SNOTEL	136.82 ± 30.03	
C200	*****		131.67 ± 66.21		160.33 ± 27.07	SNOTEL	115.00 ± 17.74	SNOTEL	129.33 ± 23.93	
A050	*****		117.10 ± 28.99		132.51 ± 19.58		118.22 ± 17.71	SNOTEL	134.29 ± 25.16	
A100	*****		125.56 ± 36.13		134.47 ± 21.54		123.15 ± 22.20		132.85 ± 25.34	
A200	*****		129.77 ± 49.64		144.47 ± 23.29		119.93 ± 15.73		123.83 ± 15.63	
F050	*****		119.19 ± 31.55		134.16 ± 19.40		118.44 ± 15.74	SNOTEL	136.00 ± 29.75	
F100	*****		128.48 ± 39.52		134.30 ± 20.86		121.36 ± 19.06		133.09 ± 29.59	
F200	*****		133.39 ± 52.12		145.06 ± 22.48		118.28 ± 16.17		124.00 ± 13.59	
P050	*****		115.44 ± 30.31		134.22 ± 22.29		117.43 ± 15.86	SNOTEL	133.14 ± 22.72	
P100	*****		124.48 ± 38.01		137.85 ± 23.53		121.88 ± 19.24		133.94 ± 23.48	
P200	*****		126.78 ± 52.79		149.17 ± 24.44		119.95 ± 15.63		125.50 ± 20.62	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

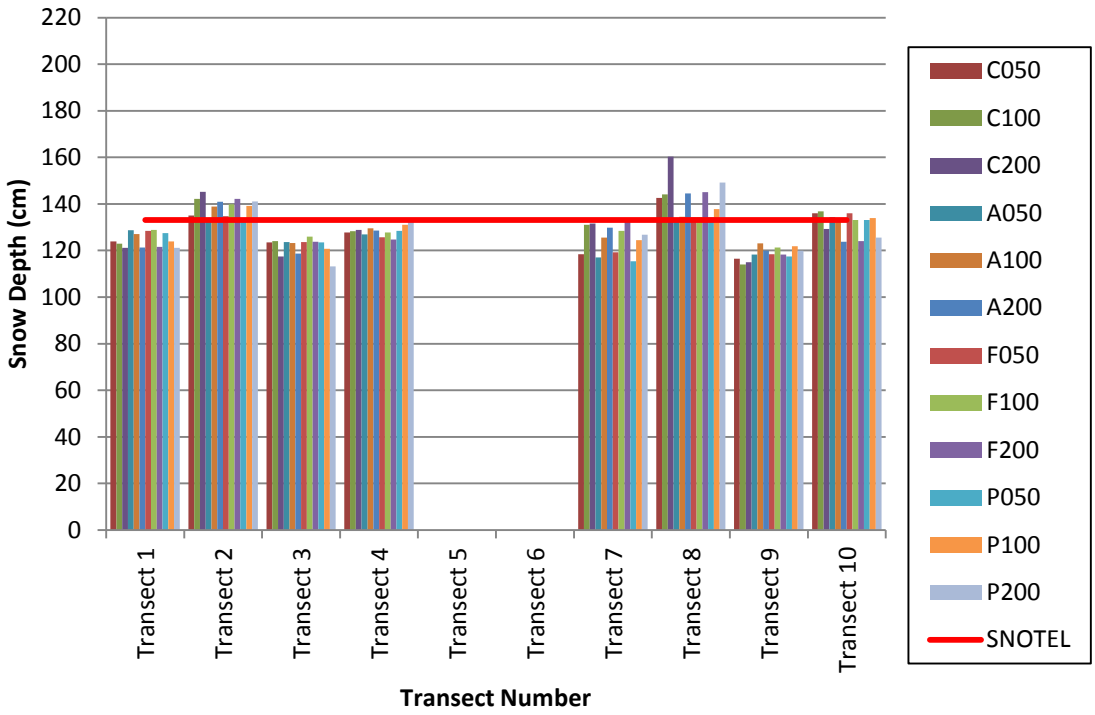

Figure F-7 snow depth field measurement of transects versus snow depth of Joe Wright SNOTEL station for January/31/2009 (Refer to Table A-1 for clarification of abbreviations)

Table F-8 snow depth field measurement analysis of surrounding boxes versus snow depth of Joe Wright SNOTEL for January/31/2009 in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	*****		133.10 ± 1.31		133.10 ± 1.31		133.10 ± 1.31		133.10 ± 1.31	
C050[b]	*****		130.49 ± 30.14		126.91 ± 25.82		125.41 ± 21.44		126.92 ± 23.27	
C100	*****		139.63 ± 39.65		127.98 ± 30.80		128.95 ± 23.98		129.46 ± 25.27	
C200	*****		148.30 ± 46.63		132.71 ± 38.27		132.10 ± 27.44		128.70 ± 27.93	
A050	*****		133.25 ± 39.87		128.70 ± 32.61		127.27 ± 26.34		128.02 ± 28.13	
A100	*****		145.38 ± 50.51		131.83 ± 39.75		130.74 ± 30.34		130.59 ± 29.18	
A200	*****		155.50 ± 55.46		134.45 ± 50.23		131.96 ± 35.76		131.46 ± 32.62	
F050	*****		131.94 ± 32.00		127.16 ± 26.25		125.79 ± 22.01		127.60 ± 24.93	
F100	*****		140.75 ± 42.20		129.49 ± 31.31		129.26 ± 24.36		130.09 ± 25.58	
F200	*****		146.75 ± 51.72		132.88 ± 39.19		132.42 ± 28.33		129.49 ± 28.09	
P050	*****		129.96 ± 32.26		127.26 ± 28.32		125.65 ± 23.39		126.61 ± 23.68	
P100	*****		140.42 ± 41.85		127.75 ± 33.97		129.23 ± 26.79		129.20 ± 26.37	
P200	*****		152.25 ± 45.76		133.12 ± 42.20		131.73 ± 29.98		128.84 ± 29.28	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table F-9 snow depth field measurement analysis of concentric boxes versus snow depth of Joe Wright SNOTEL for January/31/2009 in 95 percent confidence limit

	0-200m		200-400m		400-600m		600-800m		800-1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	*****		133.10 ± 1.31		133.10 ± 1.31		133.10 ± 1.31		133.10 ± 1.31	
C050[b]	*****		133.25 ± 39.87		126.35 ± 28.62		125.88 ± 18.50		129.00 ± 30.46	
C100	*****		145.38 ± 50.51		124.60 ± 32.34		129.71 ± 18.11		130.41 ± 28.15	
C200	*****		155.50 ± 55.46		122.43 ± 46.95		129.67 ± 15.88		131.00 ± 30.17	
A050	*****		130.49 ± 30.14		125.06 ± 23.61		123.95 ± 16.22		128.88 ± 25.47	
A100	*****		139.63 ± 39.65		121.77 ± 24.21		129.88 ± 15.53		130.05 ± 26.96	
A200	*****		148.30 ± 46.63		123.80 ± 33.15		131.53 ± 13.17		125.58 ± 28.58	
F050	*****		131.94 ± 32.00		124.69 ± 22.93		124.46 ± 17.07		129.94 ± 28.27	
F100	*****		140.75 ± 42.20		123.49 ± 23.21		129.04 ± 15.79		131.05 ± 27.18	
F200	*****		146.75 ± 51.72		124.95 ± 31.95		132.00 ± 14.42		126.79 ± 28.17	
P050	*****		129.96 ± 32.26		125.87 ± 26.52		124.08 ± 17.44		127.87 ± 24.17	
P100	*****		140.42 ± 41.85		121.00 ± 28.23		130.65 ± 18.10		129.17 ± 26.22	
P200	*****		152.25 ± 45.76		122.19 ± 39.22		130.45 ± 13.24		126.19 ± 28.98	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

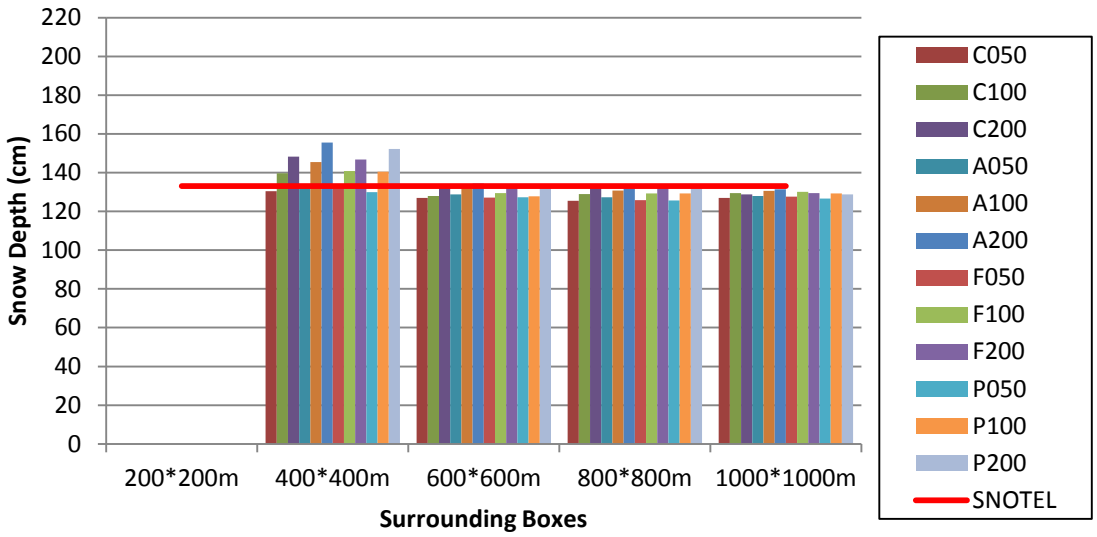

Figure F-8 snow depth field measurement analysis of surrounding boxes versus snow depth of Joe Wright SNOTEL for January/31/2009 (Refer to Table A-1 for clarification of abbreviations)

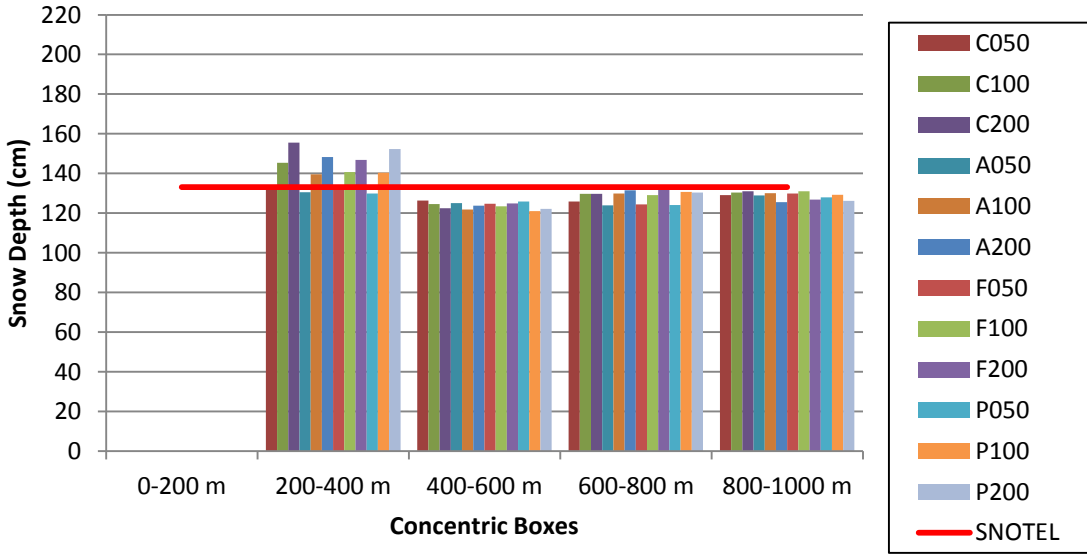

Figure F-9 snow depth field measurement analysis of Concentric boxes versus snow depth of Joe Wright SNOTEL for January/31/2009 (Refer to Table A-1 for clarification of abbreviations)

Table F-10 a snow depth of field measurement analyzing of transects versus snow depth of Joe Wright SNOTEL station for February/27/2009 in 95 percent confidence limit

	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	152.91 ± 3.93		152.91 ± 3.93		152.91 ± 3.93		152.91 ± 3.93		*****	
C050[b]	153.05 ± 21.38		140.84 ± 26.22		146.38 ± 32.60		141.05 ± 32.03		*****	
C100	158.36 ± 18.40		152.10 ± 21.18		150.73 ± 34.52		135.60 ± 37.32		*****	
C200	159.50 ± 21.72		145.00 ± 24.69		136.00 ± 33.22		145.60 ± 25.13		*****	
A050	148.22 ± 17.27		139.45 ± 23.22		139.55 ± 27.88		133.38 ± 22.51		*****	
A100	151.93 ± 18.89		146.20 ± 21.33		142.20 ± 29.97		127.42 ± 25.26	SNOTEL	*****	
A200	154.27 ± 24.73		139.36 ± 24.87		127.73 ± 31.13		134.16 ± 15.40		*****	
F050	151.55 ± 21.99		138.11 ± 20.86		141.84 ± 30.41		136.81 ± 24.34		*****	
F100	156.52 ± 21.72		144.37 ± 21.24		145.88 ± 29.20		130.00 ± 27.01	SNOTEL	*****	
F200	162.45 ± 27.67		137.47 ± 24.58		131.11 ± 26.49		135.40 ± 19.22		*****	
P050	146.50 ± 14.36		141.26 ± 26.89		139.54 ± 27.56		132.51 ± 25.13	SNOTEL	*****	
P100	149.49 ± 17.35		150.00 ± 21.86		141.37 ± 32.15		127.57 ± 28.87	SNOTEL	*****	
P200	147.83 ± 21.56		143.13 ± 25.44		127.11 ± 35.95		136.73 ± 17.44		*****	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table F-10 b snow depth of field measurement analyzing of transects versus snow depth of Joe Wright SNOTEL station for February/27/2009 in 95 percent confidence limit

	Transect 6		Transect 7		Transect 8		Transect 9		Transect 10	
	Mean ± STD (cm)	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	152.91 ± 3.93		*****		152.91 ± 3.93		152.91 ± 3.93		152.91 ± 3.93	
C050	143.15 ± 31.16		*****		147.19 ± 21.44		136.67 ± 18.50	SNOTEL	154.29 ± 29.03	
C100	146.90 ± 37.40		*****		142.73 ± 20.17		136.18 ± 17.44	SNOTEL	153.64 ± 31.92	
C200	149.83 ± 45.93		*****		147.17 ± 17.68		132.67 ± 12.86	SNOTEL	144.33 ± 30.08	
A050	139.31 ± 24.55		*****		146.26 ± 15.80		134.81 ± 17.60	SNOTEL	147.60 ± 25.91	
A100	143.92 ± 26.07		*****		144.35 ± 16.68		134.11 ± 15.09	SNOTEL	145.93 ± 28.83	
A200	144.37 ± 33.44		*****		148.77 ± 13.41		131.50 ± 12.94	SNOTEL	137.17 ± 25.40	
F050	137.25 ± 25.07		*****		149.90 ± 17.18		135.43 ± 16.80	SNOTEL	149.63 ± 26.20	
F100	141.80 ± 22.87		*****		148.73 ± 18.31		135.42 ± 15.57	SNOTEL	145.57 ± 27.03	
F200	140.28 ± 28.76		*****		152.11 ± 17.51		131.50 ± 12.03	SNOTEL	137.61 ± 23.40	
P050	142.65 ± 28.95		*****		142.92 ± 18.12		134.81 ± 18.79	SNOTEL	147.79 ± 27.52	
P100	147.03 ± 33.72		*****		139.42 ± 17.70		133.49 ± 14.96	SNOTEL	148.85 ± 31.78	
P200	150.28 ± 42.47		*****		144.89 ± 13.50		131.89 ± 12.57	SNOTEL	139.11 ± 28.82	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

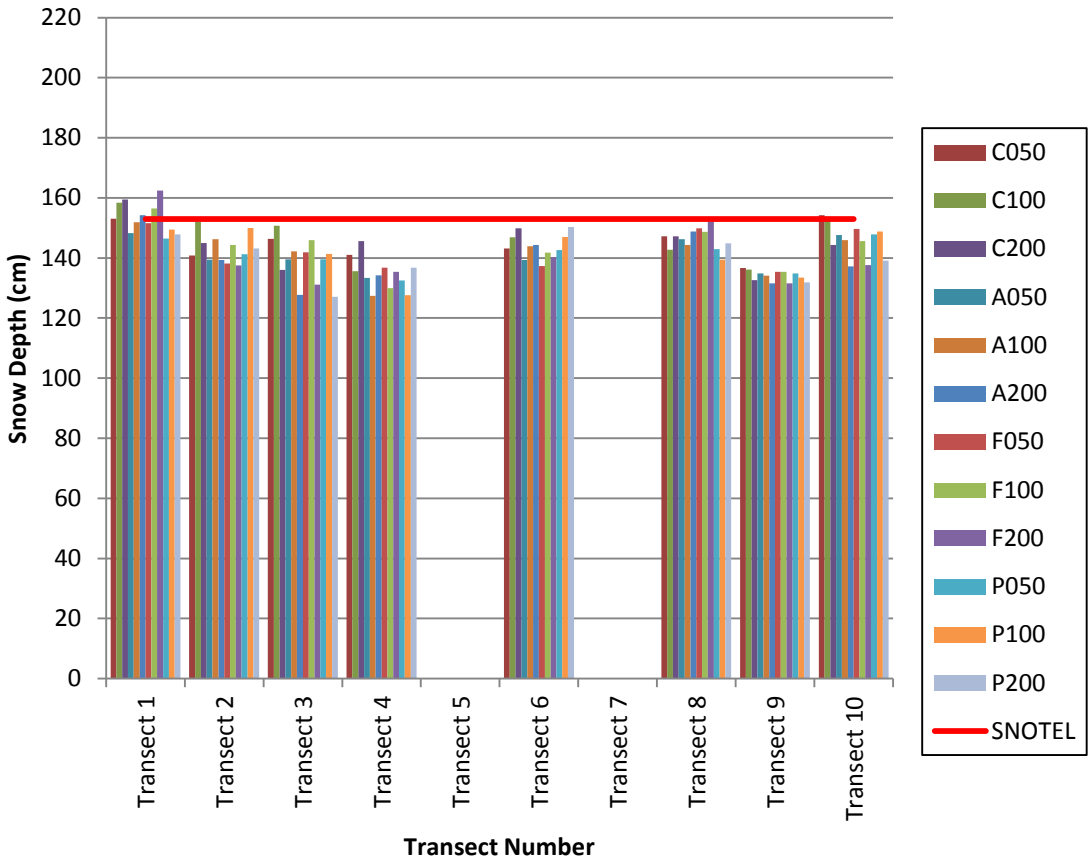

Figure F-10 snow depth field measurement of transects versus snow depth of Joe Wright SNOTEL station for February/27/2009 (Refer to Table A-1 for clarification of abbreviations)

Table F-11 snow depth field measurement analysis of surrounding boxes versus snow depth of Joe Wright SNOTEL for February/27/2009 in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	152.91 ± 3.93		152.91 ± 3.93		152.91 ± 3.93		152.91 ± 3.93		152.91 ± 3.93	
C050[b]	125.50 ± 11.68	SNOTEL	137.53 ± 28.64		145.24 ± 25.19		143.29 ± 26.92		145.43 ± 26.93	
C100	*****		131.29 ± 36.46		139.57 ± 27.20		145.70 ± 29.83		147.11 ± 28.21	
C200	*****		149.00 ± 23.41	SNOTEL	143.58 ± 21.74		148.67 ± 27.69		145.00 ± 27.14	
A050	119.40 ± 11.04	SNOTEL, P050	128.81 ± 20.93	SNOTEL	139.94 ± 20.38		139.31 ± 21.06		141.17 ± 22.32	
A100	*****		127.60 ± 27.38	SNOTEL	138.20 ± 21.64		141.11 ± 22.69		142.11 ± 23.46	
A200	*****		137.95 ± 17.81		140.02 ± 14.83		142.63 ± 21.36		139.79 ± 23.68	
F050	111.08 ± 21.15	SNOTEL	129.58 ± 27.10		141.51 ± 23.26		140.34 ± 21.82		142.72 ± 23.56	
F100	*****		126.86 ± 27.96		139.52 ± 23.10		142.24 ± 23.03		143.71 ± 23.53	
F200	*****		138.50 ± 16.84	SNOTEL	141.11 ± 17.65		142.37 ± 21.01		141.19 ± 23.70	
P050	129.75 ± 16.33	SNOTEL,A050	130.96 ± 21.88		140.15 ± 21.27		139.61 ± 23.59		141.05 ± 23.84	
P100	*****		129.57 ± 30.85	SNOTEL	137.33 ± 23.15		141.52 ± 25.61		142.17 ± 25.78	
P200	*****		141.09 ± 24.49		140.11 ± 17.02		144.90 ± 24.96		140.13 ± 25.87	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table F-12 snow depth field measurement analysis of concentric boxes versus snow depth of Joe Wright SNOTEL for February/27/2009 in 95 percent confidence limit

	0-200m		200-400m		400-600m		600-800m		800-1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	152.91 ± 3.93		152.91 ± 3.93		152.91 ± 3.93		152.91 ± 3.93		152.91 ± 3.93	
C050[b]	125.50 ± 11.68	SNOTEL	141.91 ± 32.07		148.97 ± 22.92		141.42 ± 28.62		148.35 ± 26.87	
C100	*****		*****		143.19 ± 22.52		151.58 ± 31.60		148.84 ± 26.36	
C200	*****		*****		140.88 ± 21.96		153.75 ± 32.77		141.00 ± 26.58	
A050	119.40 ± 11.04	SNOTEL, P050	132.24 ± 22.99		145.33 ± 18.08		138.71 ± 21.88		143.71 ± 23.86	
A100	*****		*****		142.84 ± 17.65		143.91 ± 23.78		143.33 ± 24.62	
A200	*****		*****		141.05 ± 14.35		145.25 ± 26.81		136.69 ± 26.13	
F050	111.08 ± 21.15	SNOTEL	136.30 ± 26.59		147.28 ± 19.05		139.22 ± 20.53		145.96 ± 25.54	
F100	*****		*****		145.06 ± 19.03		144.85 ± 23.15		145.52 ± 24.32	
F200	*****		*****		142.42 ± 19.03		143.64 ± 24.65		139.89 ± 26.78	
P050	129.75 ± 16.33	SNOTEL, A050	131.39 ± 24.28	SNOTEL	144.59 ± 19.82		139.10 ± 25.84		143.01 ± 24.22	
P100	*****		*****		140.73 ± 19.10		145.53 ± 27.66		142.98 ± 26.31	
P200	*****		*****		139.63 ± 14.04		149.69 ± 31.04		134.93 ± 26.40	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

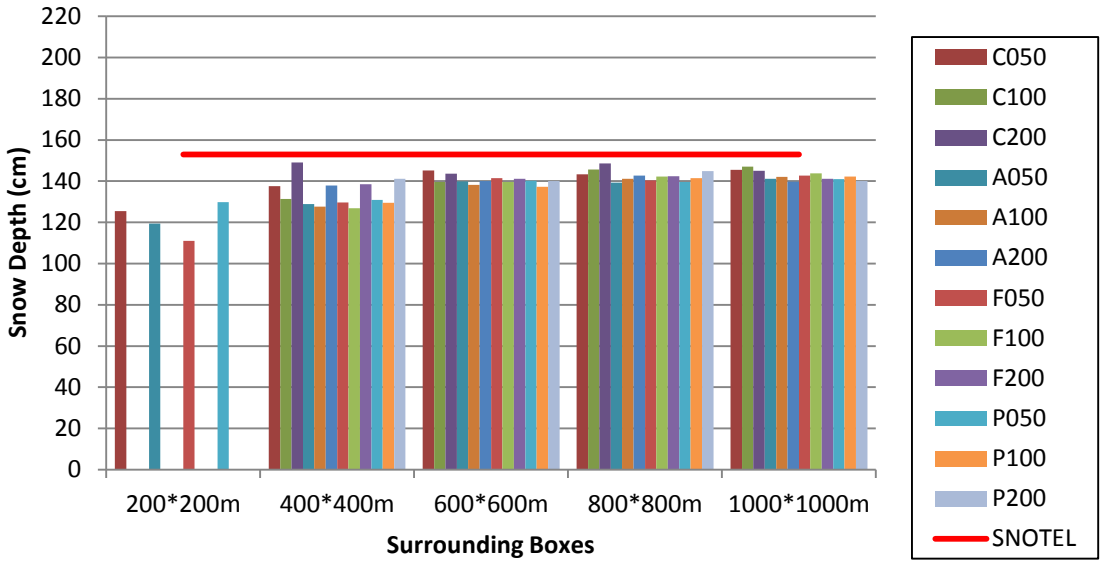

Figure F-11 snow depth field measurement analysis of surrounding boxes versus snow depth of Joe Wright SNOTEL for February/27/2009 (Refer to Table A-1 for clarification of abbreviations)

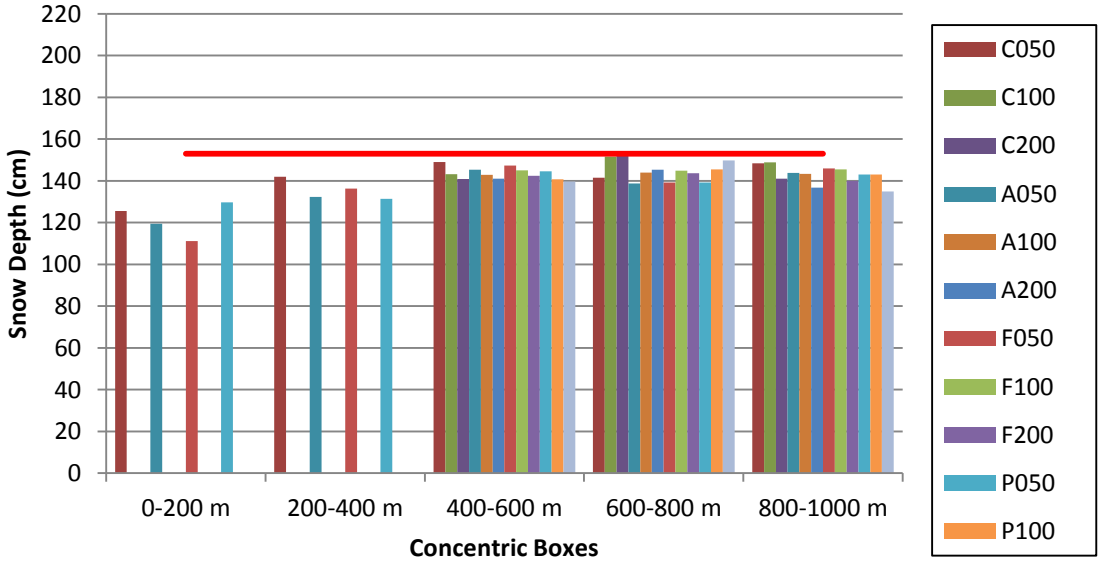

Figure F-12 snow depth field measurement analysis of Concentric boxes versus snow depth of Joe Wright SNOTEL for February/27/2009 (Refer to Table A-1 for clarification of abbreviations)

Table F-13 a snow depth of field measurement analyzing of transects versus snow depth of Joe Wright SNOTEL station for May/02/2009 in 95 percent confidence limit

	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	170.94 ± 2.41		170.94 ± 2.41		170.94 ± 2.41		170.94 ± 2.41		170.94 ± 2.41	
C050[b]	162.33 ± 24.88		153.22 ± 23.74	SNOTEL	147.45 ± 30.69	SNOTEL	155.90 ± 31.08		162.16 ± 26.72	
C100	163.82 ± 27.56		152.09 ± 21.58	SNOTEL	143.90 ± 36.70	SNOTEL	156.80 ± 29.67		165.64 ± 23.38	
C200	172.50 ± 17.90		160.00 ± 17.03		135.80 ± 38.21	SNOTEL	170.40 ± 29.77		165.67 ± 23.79	
A050	164.04 ± 19.18		156.83 ± 14.45	SNOTEL	145.91 ± 22.79	SNOTEL	154.49 ± 22.09		158.05 ± 23.94	
A100	168.38 ± 20.88		155.44 ± 9.79	SNOTEL	144.20 ± 26.29	SNOTEL	153.42 ± 19.63		162.02 ± 24.25	
A200	174.50 ± 24.09		156.03 ± 10.88		138.00 ± 26.21	SNOTEL	157.80 ± 10.79		157.43 ± 19.32	
F050	162.10 ± 18.06		156.87 ± 14.32	SNOTEL	146.93 ± 22.14	SNOTEL	154.70 ± 21.57		156.68 ± 20.92	
F100	164.46 ± 19.72		154.15 ± 10.60	SNOTEL	144.60 ± 24.77	SNOTEL	152.03 ± 16.77		159.64 ± 20.82	
F200	170.72 ± 19.71		155.11 ± 11.33		139.93 ± 25.14	SNOTEL	151.60 ± 8.01		155.83 ± 16.85	
T050	165.41 ± 22.01		155.59 ± 17.65	SNOTEL	145.40 ± 26.17	SNOTEL	154.75 ± 26.41		160.79 ± 27.40	
T100	170.79 ± 23.07		155.61 ± 12.22	SNOTEL	143.70 ± 31.43	SNOTEL	155.93 ± 25.55		165.61 ± 26.70	
T200	177.61 ± 26.22		158.28 ± 13.51		135.33 ± 31.21	SNOTEL	168.20 ± 20.41		161.78 ± 23.54	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table F-13 b snow depth of field measurement analyzing of transects versus snow depth of Joe Wright SNOTEL station for May/02/2009 in 95 percent confidence limit

	Transect 6		Transect 7		Transect 8		Transect 9		Transect 10	
	Mean ± STD (cm)	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	170.94 ± 2.41		170.94 ± 2.41		170.94 ± 2.41		170.94 ± 2.41		170.94 ± 2.41	
C050	151.90 ± 12.39	SNOTEL	135.05 ± 35.45	SNOTEL	163.38 ± 45.69		148.63 ± 25.85	SNOTEL	170.14 ± 32.45	
C100	149.91 ± 9.13	SNOTEL	142.00 ± 39.14	SNOTEL	148.64 ± 39.06		152.44 ± 20.40	SNOTEL	157.55 ± 21.53	
C200	152.83 ± 5.64	SNOTEL	152.50 ± 46.53		139.00 ± 45.25		161.00 ± 18.92		148.50 ± 26.37	
A050	147.91 ± 10.28	SNOTEL	145.00 ± 26.20	SNOTEL	164.11 ± 35.89		147.02 ± 21.71	SNOTEL	167.79 ± 25.37	
A100	151.27 ± 11.07	SNOTEL	149.09 ± 27.03		154.51 ± 31.00		151.29 ± 13.94	SNOTEL	157.96 ± 18.31	
A200	156.00 ± 6.09	SNOTEL	156.37 ± 33.61		148.00 ± 36.62		156.50 ± 14.47		153.27 ± 19.57	
F050	150.68 ± 8.22	SNOTEL	144.77 ± 28.60	SNOTEL	165.40 ± 36.78		148.42 ± 20.33	SNOTEL	166.98 ± 27.40	
F100	151.39 ± 8.86	SNOTEL	148.49 ± 30.72		156.06 ± 29.68		151.93 ± 14.43	SNOTEL	155.94 ± 21.50	
F200	153.89 ± 9.24	SNOTEL	155.22 ± 39.08		150.06 ± 35.36		158.67 ± 13.47		150.22 ± 24.63	
T050	146.47 ± 15.18	SNOTEL, T200	141.91 ± 27.23	SNOTEL	162.59 ± 38.59		146.16 ± 24.50	SNOTEL	169.38 ± 25.37	
T100	150.70 ± 14.40	SNOTEL	147.33 ± 28.14		151.00 ± 35.04		151.04 ± 15.73	SNOTEL	159.85 ± 15.42	
T200	157.06 ± 7.07	SNOTEL, T050	156.22 ± 32.65		142.95 ± 40.81		155.84 ± 17.35		154.72 ± 16.70	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

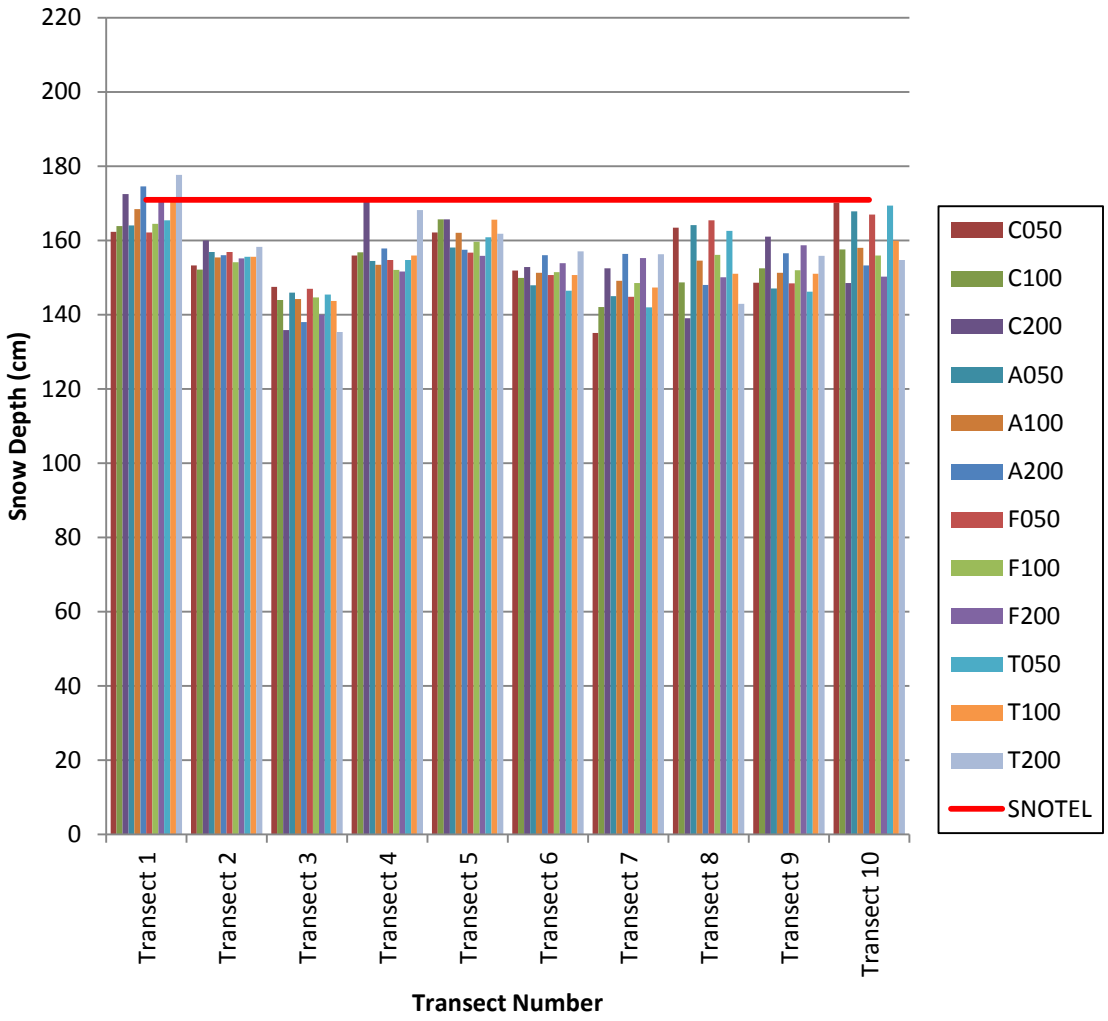

Figure F-13 snow depth field measurement of transects versus snow depth of Joe Wright SNOTEL station for May/02/2009 (Refer to Table A-1 for clarification of abbreviations)

Table F-14 snow depth field measurement analysis of surrounding boxes versus snow depth of Joe Wright SNOTEL for May/02/2009 in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	170.94 ± 2.41		170.94 ± 2.41		170.94 ± 2.41		170.94 ± 2.41		170.94 ± 2.41	
C050[b]	151.33 ± 22.84		162.48 ± 29.92		154.37 ± 29.83		152.42 ± 31.72	SNOTEL	155.29 ± 31.02	
C100	160.25 ± 23.30		165.25 ± 30.34		152.40 ± 30.40		150.94 ± 27.61	SNOTEL	153.35 ± 28.12	SNOTEL
C200	-		179.25 ± 31.16		157.00 ± 38.18		153.43 ± 31.13		155.73 ± 29.76	
A050	152.37 ± 34.61		156.98 ± 27.27		153.53 ± 24.95		152.81 ± 25.07	SNOTEL	155.33 ± 24.13	
A100	164.65 ± 36.38		160.76 ± 27.32		153.01 ± 24.92		153.22 ± 20.82	SNOTEL	154.94 ± 21.47	
A200	-		165.68 ± 23.02		154.76 ± 26.46		153.39 ± 21.70		155.62 ± 22.47	
F050	153.78 ± 26.87		158.83 ± 25.82		154.90 ± 24.05		153.91 ± 24.70	SNOTEL	155.56 ± 23.89	
F100	162.25 ± 29.76		160.31 ± 25.67		153.25 ± 23.55		152.87 ± 19.98	SNOTEL	154.01 ± 20.87	SNOTEL
F200	-		162.75 ± 26.32		153.37 ± 26.27	SNOTEL	152.84 ± 21.67		154.26 ± 22.43	
T050	150.61 ± 38.44		156.97 ± 30.75		152.43 ± 28.05		151.57 ± 27.89	SNOTEL	155.08 ± 26.89	
T100	165.59 ± 38.89		162.71 ± 30.49		152.57 ± 28.42		152.81 ± 23.88	SNOTEL	155.33 ± 24.30	
T200	-		173.13 ± 23.38		156.90 ± 31.11		153.94 ± 25.44		157.01 ± 25.51	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table F-15 snow depth field measurement analysis of concentric boxes versus snow depth of Joe Wright SNOTEL for May/02/2009 in 95 percent confidence limit

	0-200m		200-400m		400-600m		600-800m		800-1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	170.94 ± 2.41		170.94 ± 2.41		170.94 ± 2.41		170.94 ± 2.41		170.94 ± 2.41	
C050[b]	151.33 ± 22.84		165.39 ± 31.28		148.18 ± 28.62	SNOTEL	149.90 ± 34.12	SNOTEL	159.61 ± 29.61	
C100	160.25 ± 23.30		166.92 ± 33.09		141.58 ± 26.61	SNOTEL	149.04 ± 23.96	SNOTEL	156.75 ± 28.79	
C200	*****		186.83 ± 32.90		137.22 ± 33.63	SNOTEL	148.77 ± 18.89	SNOTEL	158.38 ± 28.47	
A050	152.37 ± 34.61		158.18 ± 25.83		150.89 ± 23.05	SNOTEL	151.88 ± 25.42	SNOTEL	159.13 ± 22.27	
A100	164.65 ± 36.38		159.47 ± 25.49		146.48 ± 21.26	SNOTEL	153.50 ± 14.33		157.35 ± 22.36	
A200	*****		170.70 ± 24.28		145.07 ± 26.68	SNOTEL	151.58 ± 14.09	SNOTEL	158.19 ± 23.50	
F050	153.78 ± 26.87		160.15 ± 25.99		151.90 ± 22.50	SNOTEL	152.63 ± 25.69	SNOTEL	158.06 ± 22.54	
F100	162.25 ± 29.76		159.67 ± 25.59		147.30 ± 20.43	SNOTEL	152.38 ± 14.50	SNOTEL	155.61 ± 22.20	
F200	*****		167.61 ± 28.92		145.04 ± 24.65	SNOTEL	152.15 ± 14.61		155.90 ± 23.60	
T050	150.61 ± 38.44		158.62 ± 29.22		148.97 ± 25.68	SNOTEL	150.47 ± 27.91	SNOTEL	160.37 ± 24.55	
T100	165.59 ± 38.89		161.75 ± 29.18		144.04 ± 24.14	SNOTEL	153.12 ± 16.76	SNOTEL	158.89 ± 24.73	
T200	*****		179.17 ± 23.75		142.48 ± 30.98	SNOTEL	150.08 ± 15.65	SNOTEL	160.55 ± 25.62	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

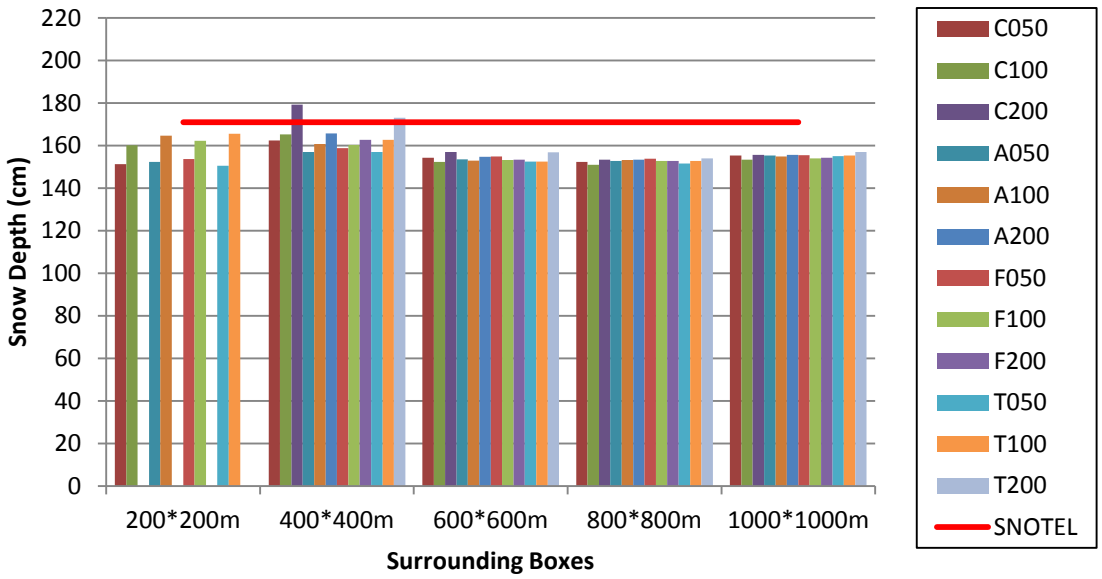

Figure F-14 snow depth field measurement analysis of surrounding boxes versus snow depth of Joe Wright SNOTEL for May/02/2009 (Refer to Table A-1 for clarification of abbreviations)

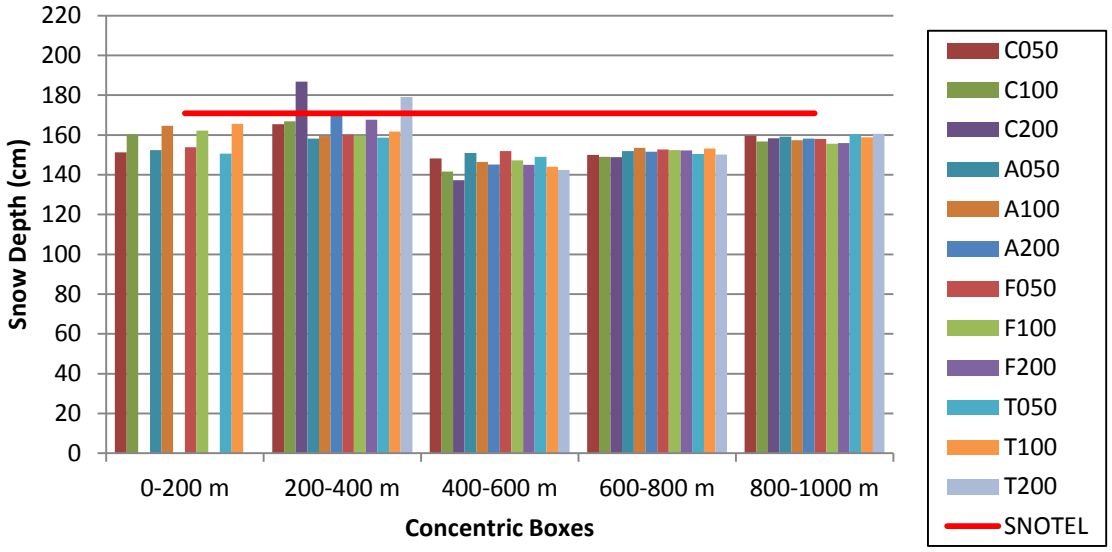

Figure F-15 snow depth field measurement analysis of Concentric boxes versus snow depth of Joe Wright SNOTEL for May/02/2009 (Refer to Table A-1 for clarification of abbreviations)

Table F-16 a snow depth of field measurement analyzing of transects versus snow depth of Joe Wright SNOTEL station for May/01/2010 in 95 percent confidence limit

	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	173.23 ± 2.88		173.23 ± 2.88		173.23 ± 2.88		173.23 ± 2.88		173.23 ± 2.88	
C050[b]	153.76 ± 23.85	SNOTEL	152.00 ± 15.41	SNOTEL	159.60 ± 27.54		133.24 ± 36.07	SNOTEL	145.38 ± 23.31	SNOTEL
C100	151.45 ± 22.72	SNOTEL	150.45 ± 18.00	SNOTEL	164.10 ± 23.83		141.73 ± 30.83	SNOTEL	145.55 ± 27.83	SNOTEL
C200	147.67 ± 22.49	SNOTEL	160.33 ± 14.11		168.40 ± 26.18		135.67 ± 23.52	SNOTEL	140.83 ± 29.01	SNOTEL
A050	160.58 ± 18.69		152.25 ± 14.57	SNOTEL	158.59 ± 27.91		135.60 ± 25.72	SNOTEL	139.96 ± 20.71	SNOTEL
A100	162.93 ± 19.85		149.27 ± 17.14	SNOTEL	161.96 ± 23.16		140.75 ± 19.74	SNOTEL	140.71 ± 23.33	SNOTEL
A200	163.83 ± 14.41		155.90 ± 13.05	SNOTEL	164.60 ± 26.02		139.03 ± 21.72	SNOTEL	139.67 ± 22.74	SNOTEL
F050	160.24 ± 17.38		150.10 ± 15.23	SNOTEL	156.45 ± 25.36		135.90 ± 26.97	SNOTEL	140.36 ± 21.53	SNOTEL
F100	161.91 ± 17.99		147.39 ± 18.11	SNOTEL	157.90 ± 20.76		140.15 ± 24.89	SNOTEL	142.57 ± 25.46	SNOTEL
F200	161.50 ± 15.28		152.06 ± 11.64	SNOTEL	159.13 ± 22.73		138.11 ± 22.21	SNOTEL	142.33 ± 25.02	SNOTEL
T050	158.65 ± 21.99		154.32 ± 15.01	SNOTEL	161.07 ± 30.86		134.51 ± 27.99	SNOTEL	141.36 ± 20.72	SNOTEL
T100	160.12 ± 22.91		151.55 ± 17.84	SNOTEL	166.73 ± 26.39		141.67 ± 19.11	SNOTEL	140.45 ± 22.57	SNOTEL
T200	160.78 ± 18.13		161.22 ± 12.61		171.33 ± 30.65		138.83 ± 22.50	SNOTEL	137.39 ± 22.43	SNOTEL

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table F-16 b snow depth of field measurement analyzing of transects versus snow depth of Joe Wright SNOTEL station for May/01/2010 in 95 percent confidence limit

	Transect 6		Transect 7		Transect 8		Transect 9		Transect 10	
	Mean ± STD (cm)	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	173.23 ± 2.88		173.23 ± 2.88		173.23 ± 2.88		173.23 ± 2.88		173.23 ± 2.88	
C050	145.55 ± 36.17	SNOTEL	151.00 ± 24.42	SNOTEL	148.25 ± 27.87	SNOTEL	149.47 ± 28.06		164.29 ± 35.04	
C100	147.55 ± 41.17		164.71 ± 21.94		145.73 ± 28.30	SNOTEL	154.86 ± 32.04		166.33 ± 39.32	
C200	151.00 ± 46.78		164.67 ± 32.08		142.33 ± 29.60	SNOTEL	155.40 ± 38.22		157.00 ± 36.15	
A050	143.85 ± 27.18	SNOTEL	152.59 ± 11.80	SNOTEL	151.71 ± 18.62	SNOTEL	150.65 ± 29.50		165.41 ± 23.95	
A100	143.45 ± 30.65	SNOTEL	155.03 ± 8.80	SNOTEL	149.47 ± 17.10	SNOTEL	157.31 ± 35.74		164.71 ± 27.66	
A200	148.30 ± 37.00		152.67 ± 14.46		150.17 ± 15.95	SNOTEL	154.84 ± 43.44		160.37 ± 18.63	
F050	145.03 ± 29.18	SNOTEL	151.18 ± 15.28	SNOTEL	150.00 ± 16.89	SNOTEL	150.35 ± 28.15		163.63 ± 24.58	
F100	142.82 ± 33.64	SNOTEL	155.00 ± 6.27	SNOTEL	147.64 ± 14.37	SNOTEL	156.29 ± 32.99		161.41 ± 28.14	
F200	150.45 ± 43.84		157.67 ± 7.31		148.50 ± 12.44	SNOTEL	155.67 ± 40.33		156.22 ± 19.11	
T050	143.23 ± 30.32	SNOTEL	153.47 ± 13.52	SNOTEL	152.27 ± 24.56	SNOTEL	150.55 ± 30.65		166.82 ± 26.76	
T100	145.46 ± 35.70		158.29 ± 16.99		150.06 ± 25.17	SNOTEL	157.52 ± 37.44		168.56 ± 29.86	
T200	147.06 ± 37.78		151.67 ± 26.46	SNOTEL	149.22 ± 26.99	SNOTEL	154.20 ± 45.25		163.39 ± 22.22	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

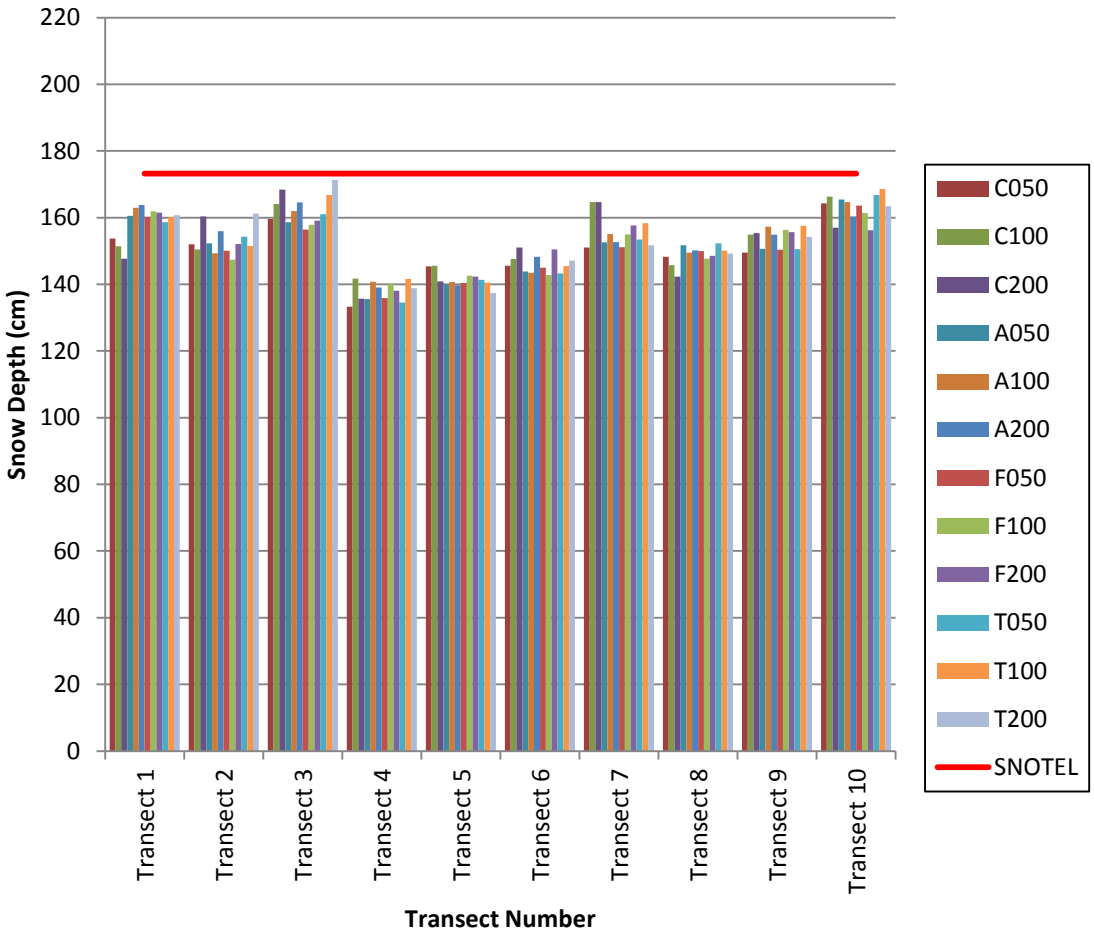

Figure F-16 snow depth field measurement of transects versus snow depth of Joe Wright SNOTEL station for May/01/2010 (Refer to Table A-1 for clarification of abbreviations)

Table F-17 snow depth field measurement analysis of surrounding boxes versus snow depth of Joe Wright SNOTEL for May/01/2010 in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	173.23 ± 2.88		173.23 ± 2.88		173.23 ± 2.88		173.23 ± 2.88		173.23 ± 2.88	
C050[b]	159.14 ± 29.80		150.03 ± 36.75	SNOTEL	147.27 ± 30.41	SNOTEL	145.75 ± 28.79	SNOTEL	149.94 ± 28.88	SNOTEL
C100	176.50 ± 28.87		158.87 ± 35.12		149.88 ± 31.75	SNOTEL	148.11 ± 28.13	SNOTEL	152.34 ± 29.26	SNOTEL
C200	-		147.29 ± 39.54	SNOTEL	147.06 ± 34.84	SNOTEL	145.79 ± 29.07	SNOTEL	151.31 ± 29.95	SNOTEL
A050	146.11 ± 27.35		146.44 ± 28.26	SNOTEL	145.59 ± 26.25	SNOTEL	146.48 ± 24.54	SNOTEL	150.78 ± 23.80	SNOTEL
A100	154.90 ± 32.96		148.05 ± 27.64	SNOTEL	146.39 ± 25.13	SNOTEL	146.45 ± 23.61	SNOTEL	151.93 ± 23.77	SNOTEL
A200	-		139.60 ± 31.87	SNOTEL	145.91 ± 28.90	SNOTEL	146.18 ± 26.27	SNOTEL	152.71 ± 24.17	SNOTEL
F050	143.72 ± 29.93	SNOTEL	146.81 ± 30.46		144.75 ± 26.52	SNOTEL	145.54 ± 24.44	SNOTEL	150.02 ± 23.58	SNOTEL
F100	151.17 ± 37.72		147.82 ± 31.30	SNOTEL	145.22 ± 26.23	SNOTEL	145.51 ± 24.22	SNOTEL	150.69 ± 23.84	SNOTEL
F200	-		141.05 ± 36.12	SNOTEL	145.63 ± 29.43	SNOTEL	145.79 ± 26.13	SNOTEL	151.67 ± 24.03	SNOTEL
T050	152.86 ± 29.63		147.28 ± 29.97	SNOTEL	146.98 ± 28.03	SNOTEL	147.17 ± 26.32	SNOTEL	151.27 ± 26.14	SNOTEL
T100	165.83 ± 34.06		151.89 ± 29.39		148.72 ± 27.95	SNOTEL	147.94 ± 25.80	SNOTEL	153.31 ± 26.46	SNOTEL
T200	-		140.71 ± 32.41	SNOTEL	146.58 ± 31.97	SNOTEL	146.44 ± 28.52	SNOTEL	153.27 ± 27.27	SNOTEL

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table F-18 snow depth field measurement analysis of concentric boxes versus snow depth of Joe Wright SNOTEL for May/01/2010 in 95 percent confidence limit

	0-200m		200-400m		400-600m		600-800m		800-1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	173.23 ± 2.88		173.23 ± 2.88		173.23 ± 2.88		173.23 ± 2.88		173.23 ± 2.88	
C050[b]	159.14 ± 29.80		147.14 ± 38.87	SNOTEL	145.11 ± 24.67	SNOTEL	143.78 ± 26.71	SNOTEL	156.39 ± 28.00	SNOTEL
C100	176.50 ± 28.87		152.45 ± 36.15		142.39 ± 27.41	SNOTEL	145.57 ± 22.39	SNOTEL	157.86 ± 30.11	
C200	*****		144.40 ± 46.78		146.89 ± 33.21	SNOTEL	144.08 ± 20.35	SNOTEL	157.04 ± 30.31	
A050	146.11 ± 27.35		146.55 ± 29.18	SNOTEL	144.92 ± 24.94	SNOTEL	147.64 ± 22.34	SNOTEL	157.41 ± 21.10	
A100	154.90 ± 32.96		145.56 ± 26.80	SNOTEL	145.00 ± 23.56	SNOTEL	146.53 ± 21.81	SNOTEL	159.07 ± 22.28	
A200	*****		142.84 ± 34.80		150.82 ± 27.25		146.53 ± 23.54	SNOTEL	159.47 ± 20.08	
F050	143.72 ± 29.93	SNOTEL	147.79 ± 31.26	SNOTEL	143.14 ± 23.28	SNOTEL	146.57 ± 21.67	SNOTEL	156.91 ± 20.50	SNOTEL
F100	151.17 ± 37.72		146.61 ± 30.64		143.06 ± 21.84	SNOTEL	145.91 ± 21.58	SNOTEL	157.43 ± 21.80	
F200	*****		144.87 ± 35.87		149.18 ± 24.76	SNOTEL	146.00 ± 22.24	SNOTEL	157.78 ± 20.36	
T050	152.86 ± 29.63		145.50 ± 30.54	SNOTEL	146.76 ± 26.83	SNOTEL	147.42 ± 24.20	SNOTEL	157.57 ± 24.74	
T100	165.83 ± 34.06		146.82 ± 27.49		146.07 ± 27.26	SNOTEL	146.83 ± 22.91	SNOTEL	160.30 ± 25.97	
T200	*****		141.33 ± 39.17		151.15 ± 32.78		146.25 ± 24.57	SNOTEL	160.36 ± 24.43	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

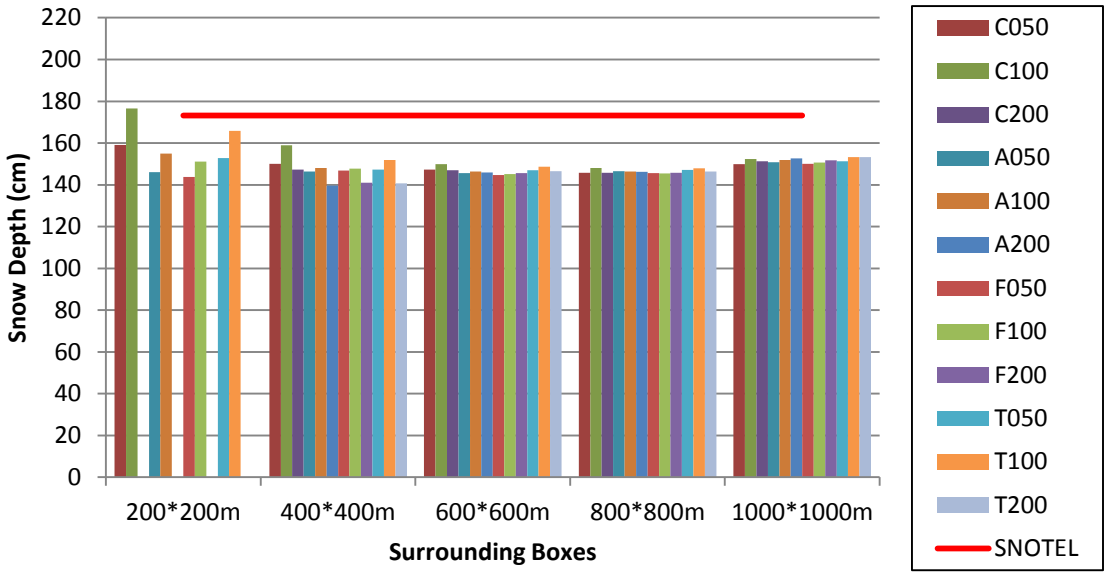

Figure F-17 snow depth field measurement analysis of surrounding boxes versus snow depth of Joe Wright SNOTEL for May/01/2010 (Refer to Table A-1 for clarification of abbreviations)

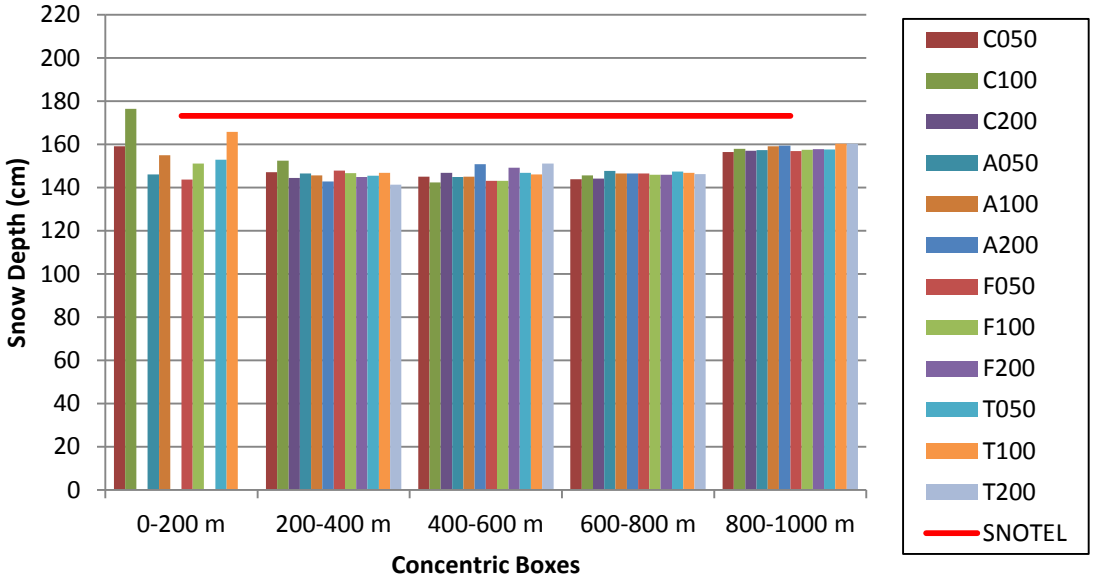

Figure F-18 snow depth field measurement analysis of Concentric boxes versus snow depth of Joe Wright SNOTEL for May/01/2010 (Refer to Table A-1 for clarification of abbreviations)

Table F-19 statistical analyses of transects versus transects of each specific sampling date for Joe Wright SNOTEL station in 95 percent confidence level

	April/03/2008		**May/01/2008**		**January/31/2009**	
	Mean ± STD (cm)[a]	**SID[b]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
Transect 1	*****	*****	162.18 ± 20.20		128.44 ± 30.87	
Transect 2	184.86 ± 29.88	T6, T7	155.77 ± 18.21		134.74 ± 14.10	T7, T9
Transect 3	188.61 ± 51.72	T4, T6, T7	170.27 ± 46.70		123.68 ± 27.34	
Transect 4	159.23 ± 27.78	T3	165.56 ± 34.28		125.67 ± 21.00	
Transect 5	170.87 ± 31.18		167.68 ± 36.06		*****	*****
Transect 6	159.27 ± 23.02	T2, T3	159.83 ± 24.86		*****	*****
Transect 7	157.11 ± 21.46	T2, T3	152.73 ± 32.29		119.19 ± 31.55	T2, T10
Transect 8	*****	*****	157.32 ± 26.47		134.16 ± 19.40	T9
Transect 9	*****	*****	165.77 ± 29.16		118.44 ± 15.74	T2,T8, T10
Transect 10	*****	*****	167.56 ± 27.92		136.00 ± 29.75	T7, T9
	February/27/2009		**May/02/2009**		**May/01/2010**	
	Mean ± STD (cm)	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
Transect 1	151.49 ± 21.44	T4, T9	162.10 ± 18.06	T3, T7	160.24 ± 17.38	T4, T5, T6
Transect 2	138.11 ± 20.86		156.87 ± 14.32		150.10 ± 15.23	T4
Transect 3	141.84 ± 30.41		146.93 ± 22.14	T1, T8, T10	156.45 ± 25.36	T4, T5
Transect 4	136.81 ± 24.34		154.70 ± 21.57		135.90 ± 26.97	T1, T2, T3, T7, T8, T10
Transect 5	*****	*****	156.68 ± 20.92		140.36 ± 21.53	T1, T3, T10
Transect 6	137.25 ± 25.07	T9	150.68 ± 8.22	T8, T10	145.03 ± 29.18	T1
Transect 7	*****	*****	144.77 ± 28.60	T1, T8, T10	151.18 ± 15.28	T4
Transect 8	149.90 ± 17.18	T9	165.40 ± 36.78	T3, T6, T7, T9	150.00 ± 16.89	T4, T10
Transect 9	135.43 ± 16.80	T1, T8, T10	148.42 ± 20.33	T8, T10	150.35 ± 28.15	
Transect 10	149.63 ± 26.20	T9	166.98 ± 27.40	T3, T6, T7, T9	163.63 ± 24.58	T4, T5, T6

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

T is transect

Table F-20 statistical analyses of surrounding boxes versus surrounding boxes of each specific sampling date for Joe Wright SNOTEL station in 95 percent confidence level

	April/03/2008		**May/01/2008**		**January/31/2009**	
	Mean ± STD (cm)[a]	**SID[b]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
Box 200	177.62 ± 45.71		185.48 ± 46.05	B800	*****	*****
Box 400	164.02 ± 27.15		171.99 ± 39.91		131.94 ± 32.00	
Box 600	168.99 ± 37.87		162.79 ± 33.48		127.16 ± 26.25	
Box 800	171.08 ± 34.60		161.03 ± 29.87	B200	125.79 ± 22.01	
Box 1000	*****	*****	162.54 ± 30.57		127.60 ± 24.93	
	February/27/2009		**May/02/2009**		**May/01/2010**	
	Mean ± STD (cm)[a]	**SID[b]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
Box 200	111.08 ± 21.15	B600, B800, B1000	153.47 ± 30.03		143.72 ± 29.93	
Box 400	129.58 ± 27.10	B1000	158.83 ± 25.82		146.81 ± 30.46	
Box 600	141.51 ± 23.26	B200	154.90 ± 24.05		144.75 ± 26.52	
Box 800	140.34 ± 21.82	B200	153.91 ± 24.70		145.54 ± 24.44	
Box 1000	142.72 ± 23.56	B200, B400	155.56 ± 23.89		150.02 ± 23.58	

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

B is the surrounding boxes

Table F-21 statistical analyses of concentric boxes versus concentric boxes of each specific sampling date for Joe Wright SNOTEL station in 95 percent confidence level

	April/03/2008		May/01/2008		January/31/2009	
	Mean ± STD (cm)[a]	**SID[b]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
Concentric box 200	177.43 ± 37.73		185.48 ± 46.05	B600, B800	*****	*****
Concentric box 400	159.56 ± 22.01		167.88 ± 38.02		131.94 ± 32.00	
Concentric box 600	174.55 ± 47.09		155.88 ± 26.16		124.69 ± 22.93	
Concentric box 800	174.01 ± 29.67		158.75 ± 24.55		124.46 ± 17.07	
Concentric box 1000	*****	*****	164.88 ± 31.67		129.94 ± 28.27	
	February/27/2009		**May/02/2009**		**May/01/2010**	
	Mean ± STD (cm)[a]	**SID[b]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
Concentric box 200	111.08 ± 21.15	CB600, CB800, CB1000	153.78 ± 26.87		143.72 ± 29.93	
Concentric box 400	136.30 ± 26.59		157.35 ± 22.79		147.79 ± 31.26	
Concentric box 600	147.28 ± 19.05	CB200	151.90 ± 22.50		143.14 ± 23.28	CB800, CB1000
Concentric box 800	139.22 ± 20.53	CB200	152.63 ± 25.69		152.65 ± 21.55	CB600
Concentric box 1000	145.96 ± 25.54	CB200	158.06 ± 22.54		156.91 ± 20.50	CB600

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

CB is the surrounding boxes

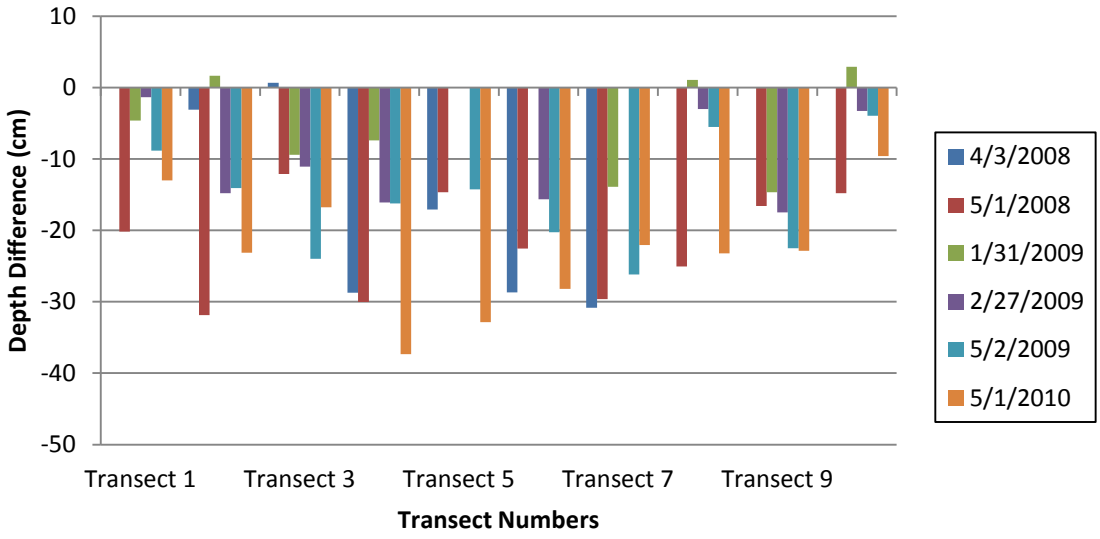

Figure F-19 SD difference between transects and Joe Wright SNOTEL station in each sampling date (F050 minus SNOTEL)

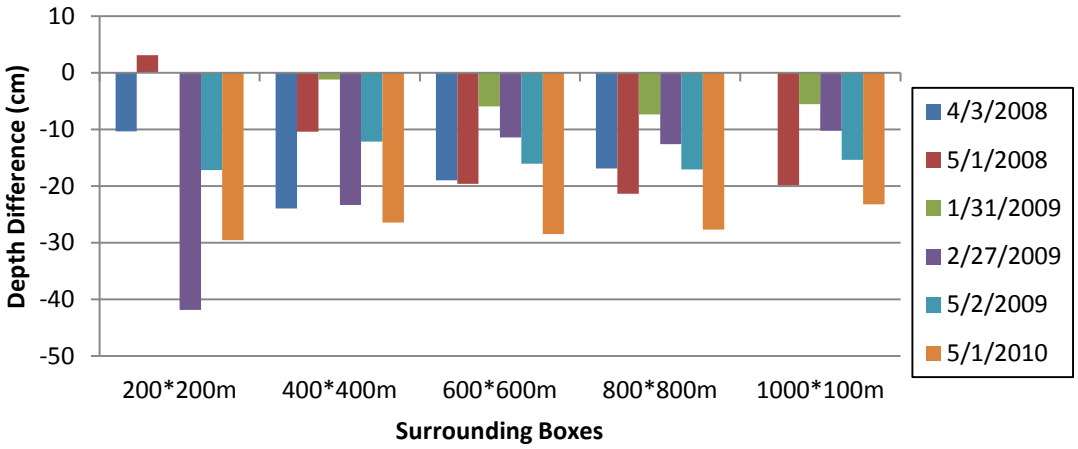

Figure F-20 SD difference between surrounding boxes and Joe Wright SNOTEL station in each sampling date (F050 minus SNOTEL)

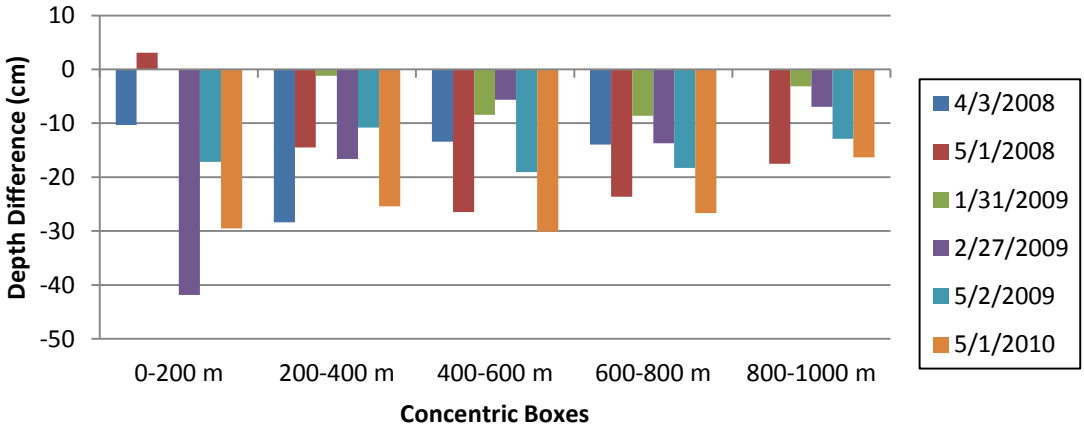

Figure F-21 SD difference between concentric boxes and Joe Wright SNOTEL station in each sampling date (F050 minus SNOTEL)

Table F-22 statistical analyses of SD average of 3, 5, and 10 transects versus SD of Joe Wright SNOTEL station in 95 percent confidence level

	May/01/2008		**Jan/31/209**		**Feb/272009**	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	182.37 ± 8.64		133.10 ± 1.31		152.91 ± 3.93	
10 transects (all)	162.54 ± 30.57	odd, even, thr	127.60 ± 24.93[d]		142.72 ± 23.56[g]	
Transects 2, 4 , 6, 8, 10 (even)	178.79 ± 43.77	all, thr	132.75 ± 21.71[e]	odd	142.59 ± 23.32	
Transects 1, 3, 5, 7, 9 (odd)	183.59 ± 51.94	all, thr	122.44 ± 26.93[f]	even	-	
Transects 1, 5, 10 (thr)	198.62 ± 52.95	all, odd, even	-		146.27 ± 24.73[h]	
	May/02/2009		**May/01/2010**			
	Mean ± STD (cm)	**SID**	**Mean ± STD (cm)**	**SID**		
SNOTEL	170.94 ± 2.41	odd	173.23 ± 2.88	All, even, odd, thr		
10 transects (all)	155.56 ± 23.89		150.02 ± 23.58	SNOTEL		
Transects 2, 4 , 6, 8, 10 (even)	159.11 ± 24.56	odd	148.37 ± 24.33	SNOTEL		
Transects 1, 3, 5, 7, 9 (odd)	151.94 ± 22.75	SNOTEL, thr, even	151.76 ± 22.76	SNOTEL		
Transects 1, 5, 10 (thr)	162.09 ± 22.54	odd	154.14 ± 23.22	SNOTEL		

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

d transects 1, 2, 3, 4, 7, 8, 9, 10

e transects 2, 4, 8, and 10

f transects 1, 3, 7, and 9

g transects 1, 2, 3, 4, 6 , 8, 9, and 10

h transect 1, 6, and 10

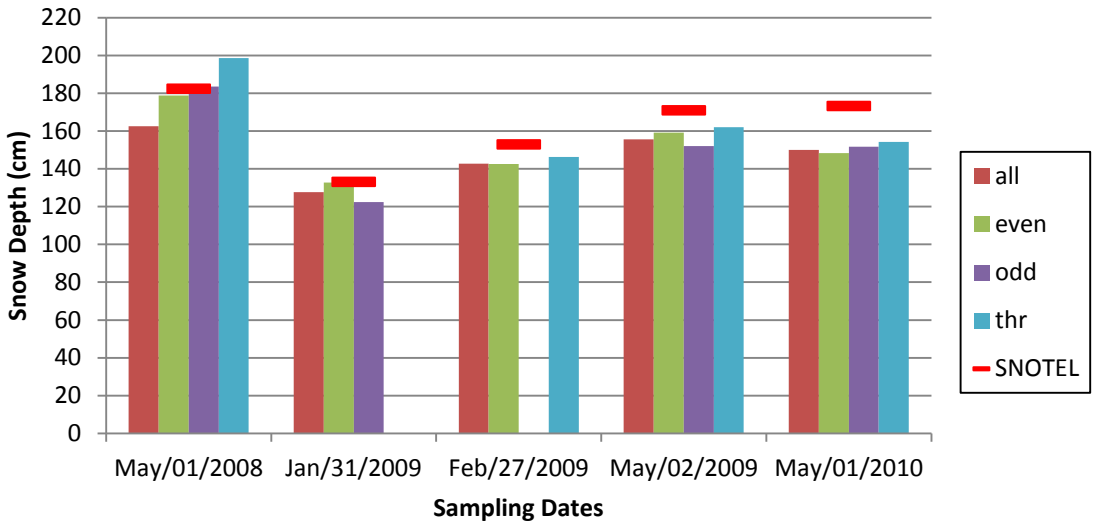

Figure F-22 SD average of 3, 5, and 10 transects versus SD of Joe Wright SNOTEL station (refer to column 1 of Table F-22 for definition)

Table F-23 statistical analyses of inter and intra annual for sampling dates of Joe Wright SNOTEL in 95 percent confidence level

	04/03/2008 versus 5/1/2008	
	Mean ± STD (cm)[a]	**SID[c]**
4/3/2008	171.10 ± 34.59	5/1/2008
5/1/2008	162.10 ± 33.39	4/3/2008
	1/312009, and 2/27/2009, versus 5/2/2009	
	Mean ± STD (cm)[a]	**SID[c]**
1/31/2009	128.80 ± 23.73	2/27/2009, 5/2/2009
2/27/2009	143.48 ± 23.32	1/31/2009, 5/2/2009
5/2/2009	157.57 ± 24.76	1/31/2009, 2/27/2009
	5/1/2008, and 5/2/2009, versus 5/1/2010	
	Mean ± STD (cm)[a]	**SID[c]**
5/1/2008	162.54 ± 30.57	5/2/2009, 5/1/2010
5/2/2009	155.56 ± 23.89	5/1/2008, 5/1/2010
5/1/2010	150.02 ± 23.58	5/1/2008, 5/2/2009

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

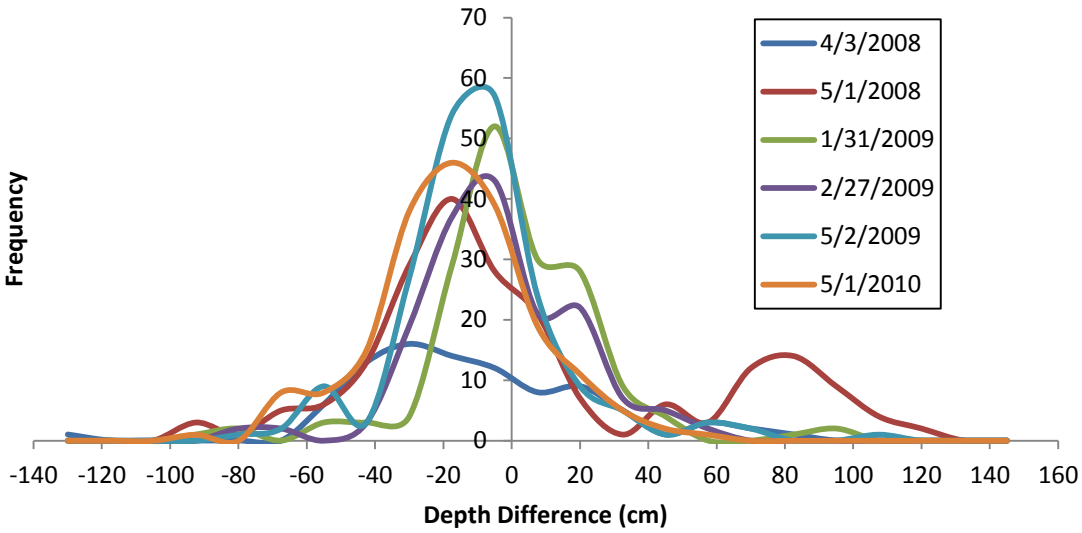

Figure F-23 frequency of the SD difference between field sampling and SD of the Joe Wright SNOTEL station for each sampling date

Appendix G: Lizard Head SNOTEL station statistical analyses results

Table G-1 snow depth field measurement analysis of surrounding boxes versus snow depth of Lizard Head SNOTEL for April/05/2008 in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	164.08 ± 1.78		164.08 ± 1.78		164.08 ± 1.78		164.08 ± 1.78		164.08 ± 1.78	
C050[b]	142.57 ± 33.56		157.38 ± 27.56		161.45 ± 22.42		159.02 ± 21.48		159.89 ± 22.01	
C100	161.67 ± 43.62		162.71 ± 24.40		163.92 ± 20.75		161.87 ± 20.54		160.85 ± 20.97	
C200	*****		159.71 ± 25.82		160.80 ± 19.62		158.48 ± 20.57		159.38 ± 22.23	
A050	140.40 ± 29.63		155.45 ± 24.27		159.98 ± 20.46		157.90 ± 19.99		158.80 ± 20.15	
A100	158.27 ± 38.80		159.49 ± 20.54		161.78 ± 18.90		160.05 ± 19.36		159.48 ± 19.18	
A200	*****		154.86 ± 19.75		159.12 ± 16.01		157.05 ± 18.22		158.95 ± 20.27	
F050	138.67 ± 30.24		156.36 ± 24.55		160.68 ± 20.46		158.16 ± 20.18		159.15 ± 20.34	
F100	160.22 ± 37.92		161.50 ± 21.09		163.22 ± 18.67		160.84 ± 19.40		160.06 ± 19.28	
F200	*****		157.19 ± 22.54		160.88 ± 16.80		158.23 ± 19.03		159.89 ± 21.01	
P050	142.86 ± 31.44		155.18 ± 25.76		159.77 ± 21.38		158.02 ± 20.52		158.82 ± 21.01	
P100	157.44 ± 41.48		158.55 ± 21.47		161.05 ± 19.69		159.88 ± 19.76		159.35 ± 20.24	
P200	*****		154.14 ± 19.17		157.92 ± 16.30		156.35 ± 18.14		158.16 ± 20.81	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table G-2 snow depth field measurement analysis of concentric boxes versus snow depth of Lizard Head SNOTEL for April/05/2008 in 95 percent confidence limit

	0-200m		200-400m		400-600m		600-800m		800-1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	164.08 ± 1.78		164.08 ± 1.78		164.08 ± 1.78		164.08 ± 1.78		164.08 ± 1.78	
C050[b]	142.57 ± 33.56		162.09 ± 24.39		164.26 ± 17.88		154.22 ± 18.86		162.07 ± 23.40	
C100	161.67 ± 43.62		163.00 ± 19.82		164.65 ± 18.75		157.67 ± 20.00		158.39 ± 22.25	
C200	*****		163.83 ± 25.65		161.38 ± 16.58		153.33 ± 22.87		161.00 ± 25.60	
A050	140.40 ± 29.63		160.24 ± 20.86		163.10 ± 16.97		153.81 ± 18.63		161.05 ± 20.61	
A100	158.27 ± 38.80		159.82 ± 15.71		163.17 ± 18.16		156.51 ± 20.37		158.10 ± 19.11	
A200	*****		158.70 ± 18.55		161.42 ± 13.95		152.44 ± 22.78		162.40 ± 23.78	
F050	138.67 ± 30.24		161.98 ± 20.12		163.66 ± 16.76		153.19 ± 18.91		161.64 ± 20.76	
F100	160.22 ± 37.92		161.85 ± 17.02		164.26 ± 17.45		155.94 ± 20.50		158.22 ± 19.30	
F200	*****		161.39 ± 21.49		162.87 ± 13.43		152.33 ± 23.26		162.90 ± 24.56	
P050	142.86 ± 31.44		159.11 ± 23.15		162.94 ± 17.37		154.56 ± 18.51		160.80 ± 22.33	
P100	157.44 ± 41.48		158.85 ± 15.95		162.58 ± 18.86		157.46 ± 20.24		158.09 ± 21.74	
P200	*****		157.72 ± 18.26		159.95 ± 14.97		152.85 ± 22.38		161.44 ± 25.26	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

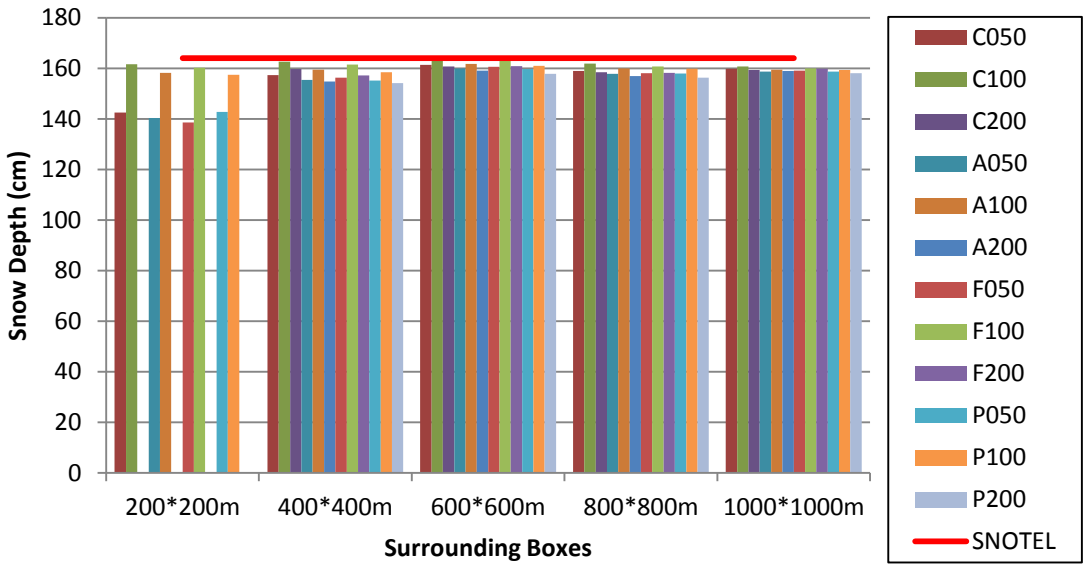

Figure G-1 snow depth field measurement analysis of surrounding boxes versus snow depth of Lizard Head SNOTEL for April/05/2008 (Refer to Table A-1 for clarification of abbreviations)

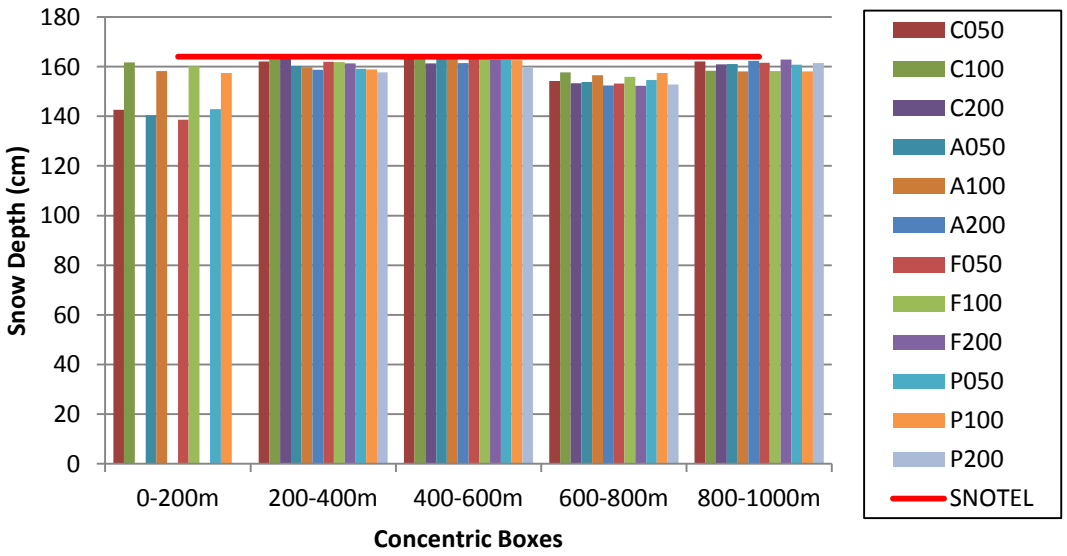

Figure G-2 snow depth field measurement analysis of Concentric boxes versus snow depth of Lizard Head SNOTEL for April/05/2008 (Refer to Table A-1 for clarification of abbreviations)

Table G-3 statistical analyses of surrounding boxes versus surrounding boxes of April/05/2008 for Lizard Head SNOTEL station in 95 percent confidence level

	Mean ± STD (cm)[a]	SID[b]
200*200m	140.17 ± 32.84	B600, B800, b1000
400*400m	156.36 ± 24.55	
600*600m	160.68 ± 20.46	B200
800*800m	158.16 ± 20.18	B200
1000*1000m	159.15 ± 20.34	B200

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

B is surrounding box

Table G-4 statistical analyses of concentric boxes versus concentric boxes of April/05/2008 for Lizard Head SNOTEL station in 95 percent confidence level

	Mean ± STD (cm)[a]	SID[b]
0-200m	140.17 ± 32.84	CB400, CB600, CB1000
200-400m	161.98 ± 20.12	CB200
400-600m	163.66 ± 16.76	CB200, CB800
600-800m	153.19 ± 18.91	CB600
800-1000m	161.64 ± 20.76	CB200

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

CB is concentric box

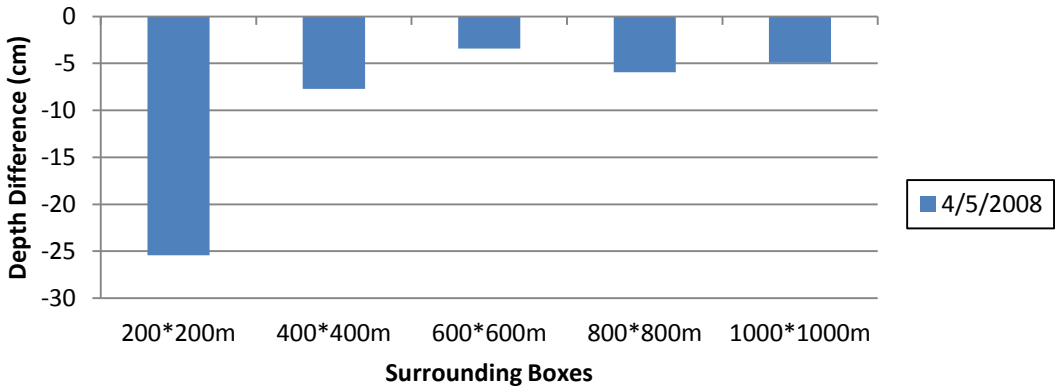

Figure G-3 SD difference between surrounding boxes and Lizard Head SNOTEL station (F050 minus SNOTEL)

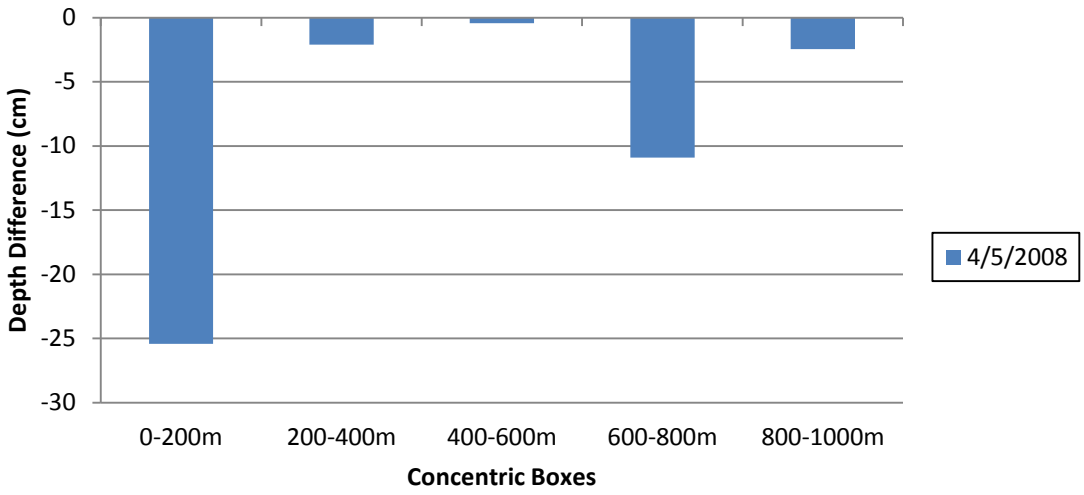

Figure G-4 SD difference between surrounding boxes and Lizard Head SNOTEL station (F050 minus SNOTEL)

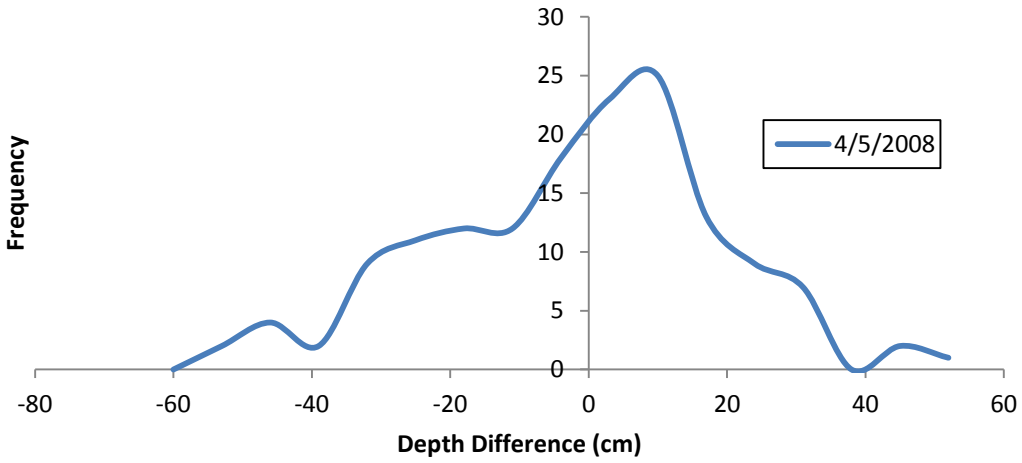

Figure G-5 frequency of the SD difference between field sampling and SD of the Lizard Head SNOTEL station for March/17/2009

Appendix H: Niwot SNOTEL station statistical analyses results

Table H-1 snow depth of field measurement analyzing of transects versus snow depth of Niwot SNOTEL station for April/07/2008 in 95 percent confidence limit

	Transect 1		**Transect 2**		**Transect 3**		**Transect 4**		**Transect 5**	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	125.73 ± 2.74		125.73 ± 2.74		125.73 ± 2.74		125.73 ± 2.74		125.73 ± 2.74	
C050[b]	114.00 ± 21.63		121.72 ± 15.90		122.35 ± 19.20		108.00 ± 32.93		125.16 ± 35.41	
C100	113.00 ± 14.12		125.11 ± 17.90		121.50 ± 24.78		103.90 ± 33.75		128.80 ± 30.17	
C200	114.33 ± 11.06		121.20 ± 19.07		125.33 ± 27.38		106.67 ± 47.11		122.00 ± 51.33	
F050	114.98 ± 17.95		121.68 ± 10.25		121.47 ± 12.87		109.37 ± 28.44		119.11 ± 34.02	
F100	117.40 ± 19.10		122.93 ± 11.55		119.92 ± 15.69		107.80 ± 30.56		121.67 ± 27.51	
F200	118.00 ± 18.23		121.67 ± 10.36		120.39 ± 17.71		102.39 ± 42.00		112.50 ± 45.42	
	Transect 6		Transect 7		Transect 8		Transect 9		Transect 10	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	125.73 ± 2.74		125.73 ± 2.74		125.73 ± 2.74		125.73 ± 2.74		125.73 ± 2.74	
C050[b]	123.11 ± 36.90		125.44 ± 40.52		112.44 ± 22.41		121.33 ± 9.74		118.75 ± 12.21	
C100	110.80 ± 40.61		137.33 ± 40.45		106.33 ± 27.89	SNOTEL	123.56 ± 12.63		117.83 ± 14.86	
C200	110.00 ± 41.47		142.60 ± 44.68		103.40 ± 13.54	SNOTEL	121.20 ± 7.69		124.00 ± 20.30	
F050	118.26 ± 34.74		119.28 ± 27.63		111.65 ± 17.10		119.94 ± 6.83		120.03 ± 9.69	
F100	111.97 ± 43.68		131.96 ± 24.82		108.59 ± 21.56		120.89 ± 8.48		120.22 ± 9.43	
F200	113.94 ± 49.23		125.93 ± 24.77		110.87 ± 15.29		121.13 ± 5.34		121.11 ± 14.24	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

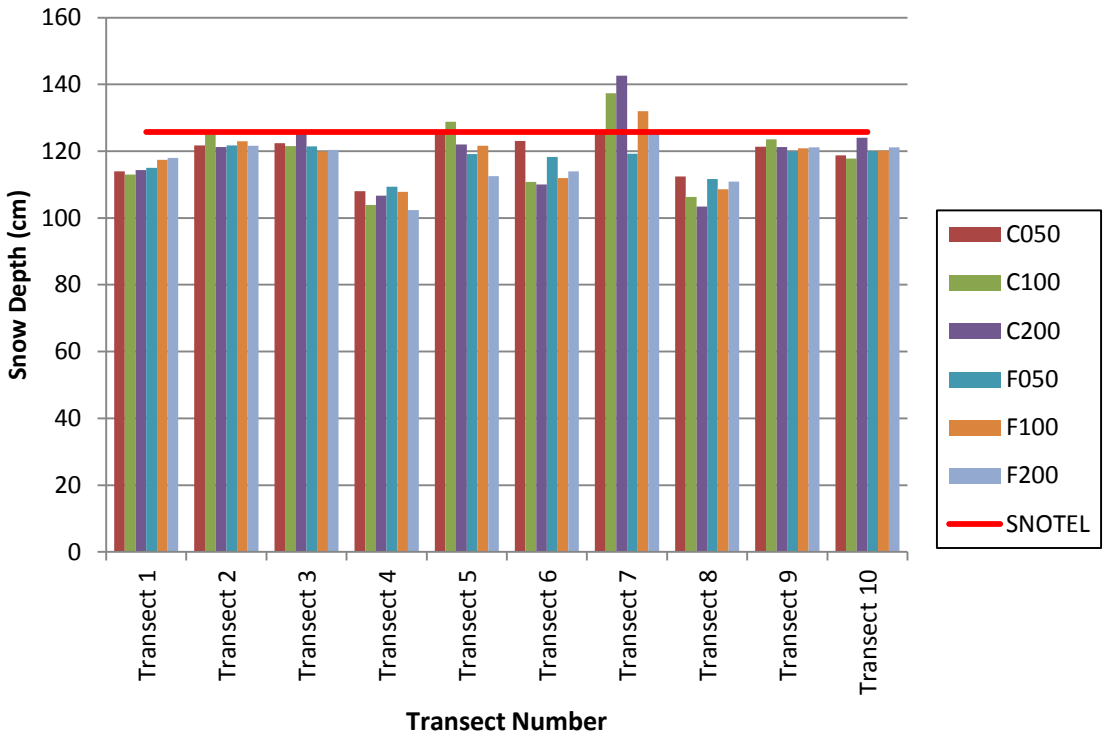

Figure H-1 snow depth field measurement of transects versus snow depth of Niwot SNOTEL station for April/07/2008 (Refer to Table A-1 for clarification of abbreviations)

Table H-2 snow depth field measurement analysis of surrounding boxes versus snow depth of Niwot SNOTEL for April/07/2008 in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	125.73 ± 2.74		125.73 ± 2.74		125.73 ± 2.74		125.73 ± 2.74		125.73 ± 2.74	
C050[b]	129.25 ± 17.47		123.47 ± 25.41		121.76 ± 27.29		121.71 ± 25.75		119.22 ± 27.27	
C100	136.50 ± 17.82		121.06 ± 26.01		120.34 ± 30.79		120.31 ± 26.79		118.61 ± 28.63	
C200	*****		110.00 ± 18.75		121.94 ± 26.30		120.22 ± 29.47		118.57 ± 32.35	
F050	125.67 ± 17.46		122.26 ± 23.72		120.16 ± 21.80		119.40 ± 20.23		117.44 ± 22.64	
F100	137.00 ± 14.27		120.27 ± 22.08		119.82 ± 22.78		119.50 ± 20.42		118.09 ± 24.31	
F200	*****		108.08 ± 20.06		119.07 ± 21.30		117.78 ± 22.71		116.31 ± 28.13	

Table H-3 snow depth field measurement analysis of concentric boxes versus snow depth of Niwot SNOTEL for April/07/2008 in 95 percent confidence limit

	0-200m		200-400m		400-600m		600-800m		800-1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	125.73 ± 2.74		125.73 ± 2.74		125.73 ± 2.74		125.73 ± 2.74		125.73 ± 2.74	
C050[b]	129.25 ± 17.47		121.54 ± 27.61		120.36 ± 28.99		121.64 ± 23.90		112.78 ± 30.21	
C100	136.50 ± 17.82		115.92 ± 26.84		119.74 ± 35.02		120.26 ± 21.08		114.86 ± 32.54	
C200	*****		103.83 ± 13.14		131.50 ± 28.38		118.00 ± 34.02		116.05 ± 36.91	
F050	125.67 ± 17.46		121.13 ± 25.70		118.43 ± 20.23		118.45 ± 18.19		112.34 ± 27.52	
F100	137.00 ± 14.27		114.69 ± 21.77		119.44 ± 23.95		119.07 ± 17.31		114.99 ± 31.47	
F200	*****		101.67 ± 18.13		127.87 ± 18.72		116.12 ± 25.12		114.08 ± 35.36	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

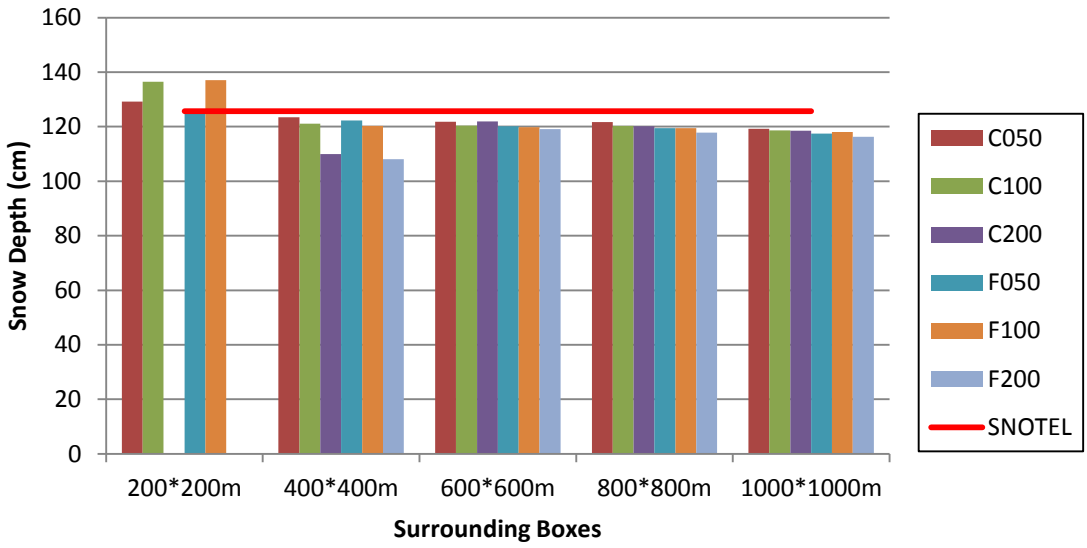

Figure H-2 snow depth field measurement analysis of surrounding boxes versus snow depth of Niwot SNOTEL for April/07/2008 (Refer to Table A-1 for clarification of abbreviations)

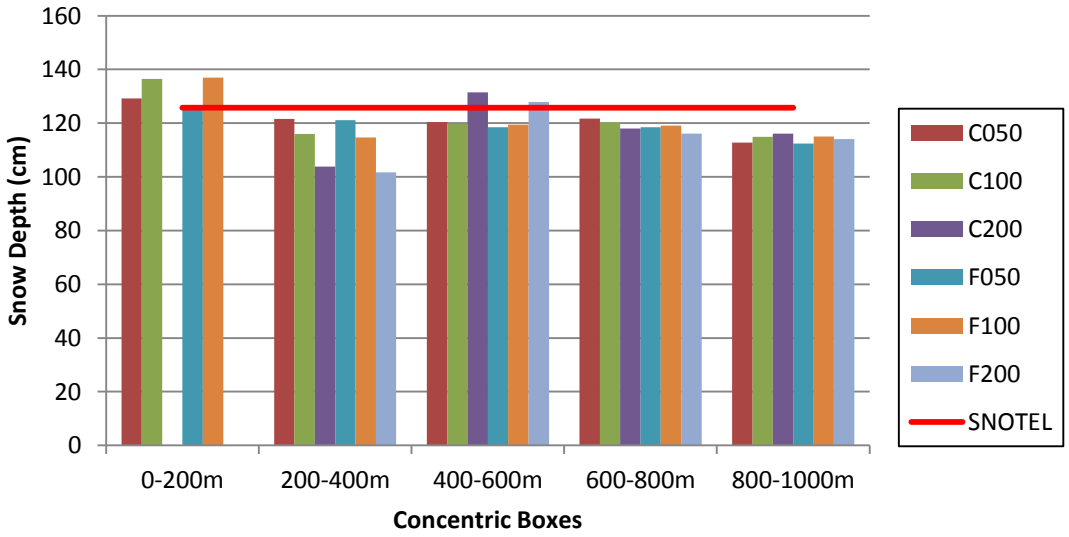

Figure H-3 snow depth field measurement analysis of Concentric boxes versus snow depth of Niwot SNOTEL for April/07/2008 (Refer to Table A-1 for clarification of abbreviations)

Table H-4 snow depth of field measurement analyzing of transects versus snow depth of Niwot SNOTEL station for May/05/2008 in 95 percent confidence limit

	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	73.91 ± 1.87		73.91 ± 1.87		73.91 ± 1.87		73.91 ± 1.87		73.91 ± 1.87	
C050[b]	80.38 ± 35.69		67.95 ± 25.00		87.50 ± 14.56	SNOTEL	68.00 ± 26.47		74.71 ± 31.15	
C100	77.09 ± 47.04		67.64 ± 26.12		85.82 ± 14.16	SNOTEL	61.00 ± 19.14		76.82 ± 26.70	
C200	64.17 ± 30.22		69.17 ± 29.22		79.33 ± 16.13		54.67 ± 21.16		76.83 ± 22.48	
F050	72.89 ± 24.13		69.48 ± 16.20		88.36 ± 11.85	SNOTEL	75.22 ± 22.88		77.19 ± 29.15	
F100	68.12 ± 28.91		70.24 ± 19.69		86.97 ± 13.67	SNOTEL	71.79 ± 24.05		81.64 ± 26.27	
F200	65.45 ± 23.42		64.94 ± 23.37		81.67 ± 14.67		66.17 ± 31.98		85.95 ± 15.62	

	Transect 6		Transect 7		Transect 8		Transect 9		Transect 10	
	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	73.91 ± 1.87		73.91 ± 1.87		73.91 ± 1.87		73.91 ± 1.87		73.91 ± 1.87	
C050	63.19 ± 37.32		82.42 ± 21.05		78.86 ± 18.69		89.19 ± 21.40	SNOTEL	86.00 ± 24.04	
C100	71.27 ± 38.99		88.60 ± 24.31		74.64 ± 22.41		92.91 ± 16.07	SNOTEL	88.45 ± 31.93	
C200	69.33 ± 27.97		99.80 ± 18.73	SNOTEL	74.00 ± 24.57		93.67 ± 20.00	SNOTEL	86.33 ± 43.55	
F050	66.92 ± 34.71		91.72 ± 19.47	SNOTEL	82.40 ± 18.25		87.41 ± 21.67		86.37 ± 19.24	
F100	76.55 ± 35.63		95.07 ± 19.98	SNOTEL	79.91 ± 23.93		90.09 ± 13.08	SNOTEL	84.54 ± 24.02	
F200	70.45 ± 30.22		102.40 ± 16.65	SNOTEL	80.78 ± 27.41		93.45 ± 12.98	SNOTEL	85.94 ± 32.25	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

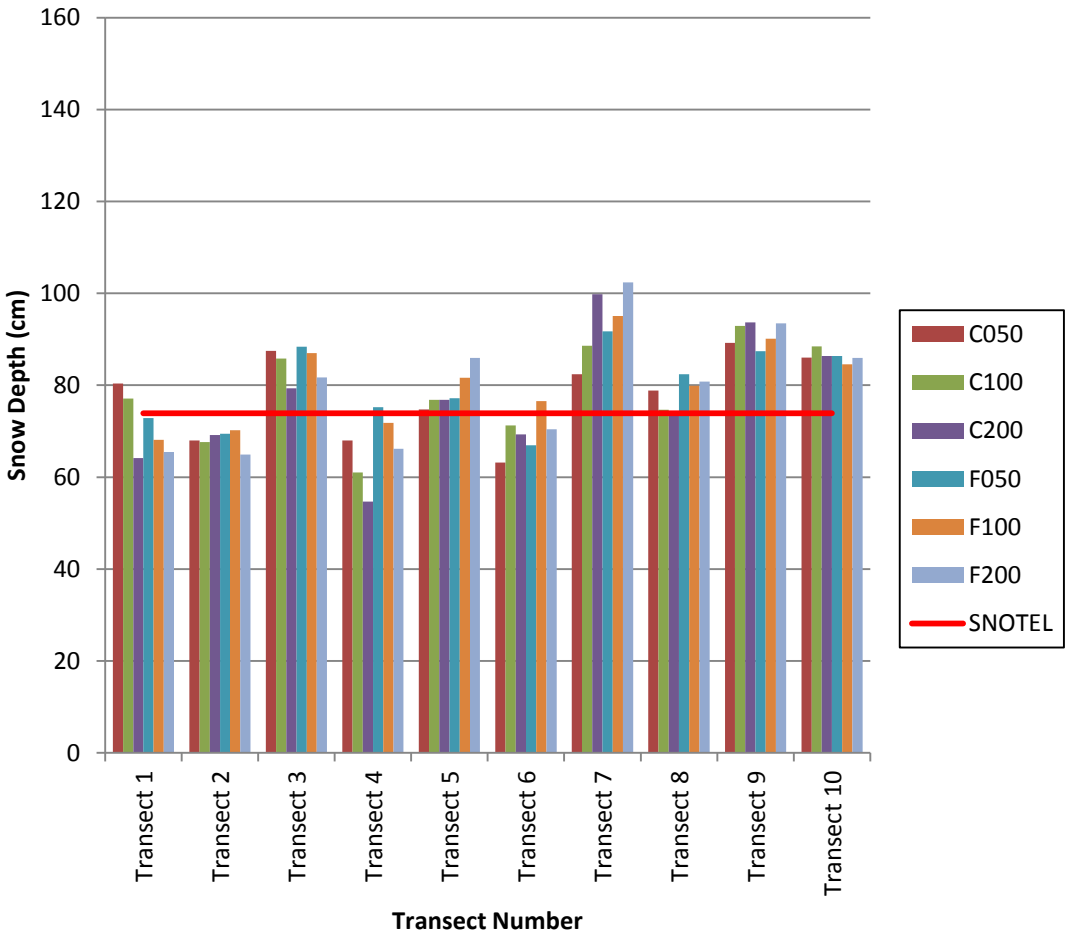

Figure H-4 snow depth field measurement of transects versus snow depth of Niwot SNOTEL station for May/05/2008 (Refer to Table A-1 for clarification of abbreviations)

Table H-5 snow depth field measurement analysis of surrounding boxes versus snow depth of Niwot SNOTEL for May/05/2008 in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	73.91 ± 1.87		73.91 ± 1.87		73.91 ± 1.87		73.91 ± 1.87		73.91 ± 1.87	
C050[b]	78.63 ± 15.68		82.94 ± 24.65		81.36 ± 23.20		83.76 ± 21.29		77.82 ± 27.29	
C100	78.25 ± 20.79		90.13 ± 22.02	SNOTEL	85.50 ± 19.34		86.36 ± 19.90		78.33 ± 28.95	
C200	*****		88.13 ± 13.74		82.78 ± 18.38		87.09 ± 18.66		76.34 ± 27.63	
F050	84.13 ± 12.72		85.95 ± 20.63		84.04 ± 20.69		85.41 ± 18.79		79.72 ± 23.57	
F100	80.75 ± 17.36		92.00 ± 20.00	SNOTEL	88.41 ± 15.76	SNOTEL	88.68 ± 17.03	SNOTEL	80.36 ± 24.33	
F200	*****		90.21 ± 8.45		88.67 ± 10.06		92.18 ± 12.69	SNOTEL	79.33 ± 25.15	

Table H-6 snow depth field measurement analysis of concentric boxes versus snow depth of Niwot SNOTEL for May/05/2008 in 95 percent confidence limit

	0-200m		200-400m		400-600m		600-800m		800-1000m	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	73.91 ± 1.87		73.91 ± 1.87		73.91 ± 1.87		73.91 ± 1.87		73.91 ± 1.87	
C050[b]	78.63 ± 15.68		84.38 ± 27.13		80.10 ± 22.20		86.89 ± 18.25	SNOTEL	68.63 ± 32.65	
C100	78.25 ± 20.79		94.08 ± 21.79	SNOTEL	81.80 ± 16.55		87.46 ± 20.91	SNOTEL	66.91 ± 35.53	
C200	*****		86.33 ± 13.26		78.50 ± 21.10		92.64 ± 18.17	SNOTEL	63.59 ± 31.24	
F050	84.13 ± 12.72		86.56 ± 22.87		82.52 ± 20.87		87.21 ± 15.98	SNOTEL	70.91 ± 27.35	
F100	80.75 ± 17.36		95.75 ± 20.05	SNOTEL	85.53 ± 11.05		89.04 ± 18.82	SNOTEL	68.52 ± 28.17	
F200	*****		90.50 ± 8.83		87.44 ± 11.48		96.69 ± 14.58	SNOTEL	64.11 ± 27.85	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

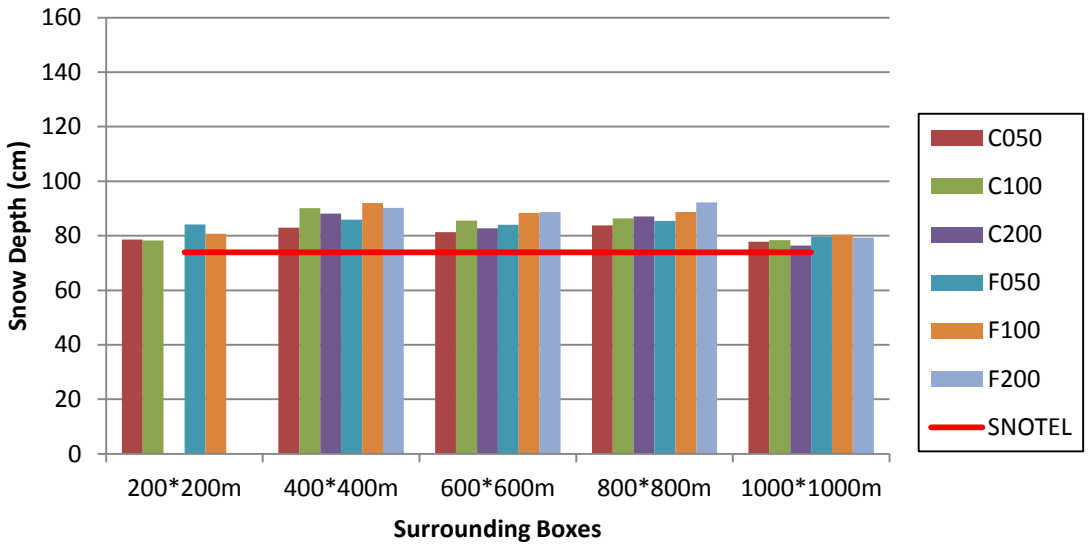

Figure H-5 snow depth field measurement analysis of surrounding boxes versus snow depth of Niwot SNOTEL for May/05/2008 (Refer to Table A-1 for clarification of abbreviations)

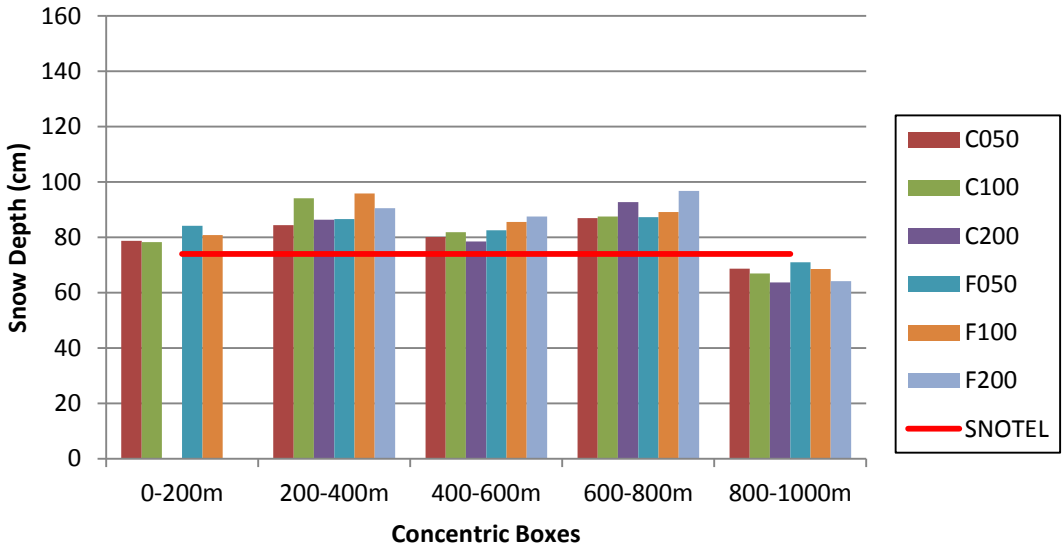

Figure H-6 snow depth field measurement analysis of Concentric boxes versus snow depth of Niwot SNOTEL for May/05/2008 (Refer to Table A-1 for clarification of abbreviations)

Table H-7 snow depth of field measurement analyzing of transects versus snow depth of Niwot SNOTEL station for March/06/2009 in 95 percent confidence limit

	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	70.87 ± 0.80		70.87 ± 0.80		*****		*****		70.87 ± 0.80	
C050[b]	52.39 ± 24.38		60.24 ± 13.77	SNOTEL	*****		*****		41.38 ± 22.94	SNOTEL
C100	48.70 ± 31.87	SNOTEL	58.73 ± 10.57	SNOTEL	*****		*****		44.09 ± 18.38	SNOTEL
C200	43.33 ± 34.43	SNOTEL	57.00 ± 9.63	SNOTEL	*****		*****		34.50 ± 19.50	SNOTEL
F050	56.28 ± 22.14		63.81 ± 7.79		*****		*****		47.19 ± 21.03	SNOTEL
F100	50.90 ± 22.03		62.21 ± 6.45	SNOTEL	*****		*****		48.45 ± 17.51	SNOTEL
F200	49.83 ± 25.53		60.67 ± 5.45	SNOTEL	*****		*****		42.33 ± 22.28	SNOTEL
	Transect 6		**Transect 7**		**Transect 8**		**Transect 9**		**Transect 10**	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	70.87 ± 0.80		70.87 ± 0.80		70.87 ± 0.80		70.87 ± 0.80		*****	
C050[b]	58.90 ± 31.17	SNOTEL, C200	66.76 ± 25.43		54.67 ± 19.47	SNOTEL	61.95 ± 16.71		*****	
C100	74.36 ± 25.77		66.73 ± 33.54		60.18 ± 10.25		61.27 ± 20.75		*****	
C200	86.50 ± 30.00	C050	55.50 ± 27.76		60.33 ± 12.32		57.17 ± 19.03		*****	
F050	47.29 ± 22.74	SNOTEL	62.00 ± 28.19		54.67 ± 19.47	SNOTEL	58.71 ± 11.47	SNOTEL	*****	
F100	61.00 ± 22.94		62.24 ± 22.92		58.97 ± 9.94		59.57 ± 8.02		*****	
F200	73.84 ± 21.37		54.84 ± 12.80		57.11 ± 11.74		59.06 ± 10.29		*****	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

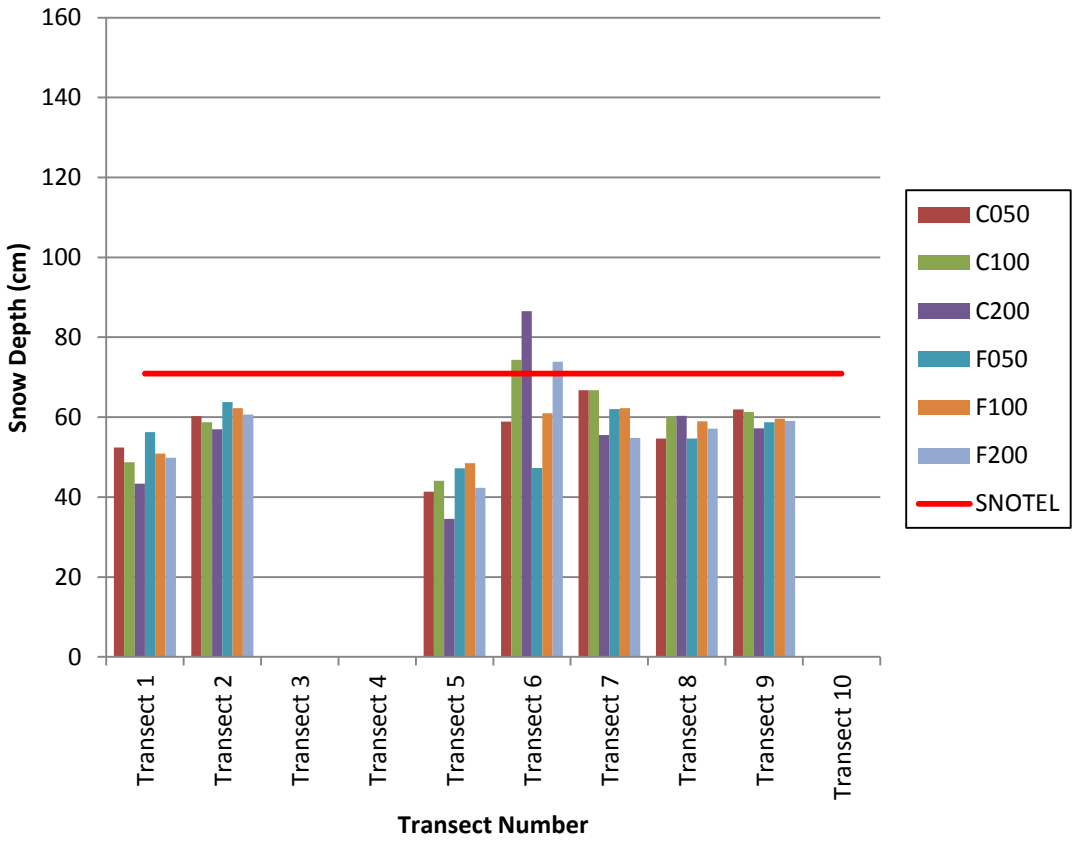

Figure H-7 snow depth field measurement of transects versus snow depth of Niwot SNOTEL station for March/06/2009 (Refer to Table A-1 for clarification of abbreviations)

Table H-8 snow depth field measurement analysis of surrounding boxes versus snow depth of Niwot SNOTEL for March/06/2009 in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	70.87 ± 0.80		70.87 ± 0.80		70.87 ± 0.80		70.87 ± 0.80		70.87 ± 0.80	
C050[b]	52.63 ± 15.29	SNOTEL	53.33 ± 18.02	SNOTEL	53.98 ± 21.19	SNOTEL	55.64 ± 20.64	SNOTEL	56.70 ± 23.41	SNOTEL
C100	59.25 ± 14.31	SNOTEL	59.75 ± 14.63		60.58 ± 18.49		59.25 ± 19.66		59.29 ± 24.14	
C200	*****		63.17 ± 19.49		58.08 ± 16.18		54.63 ± 18.94	SNOTEL	56.33 ± 26.44	SNOTEL
F050	52.63 ± 5.36	SNOTEL	54.65 ± 13.64	SNOTEL	54.11 ± 14.91	SNOTEL	55.55 ± 15.58	SNOTEL	56.13 ± 17.26	SNOTEL
F100	54.67 ± 6.24	SNOTEL	58.47 ± 7.37	SNOTEL	59.36 ± 10.79		58.07 ± 15.04	SNOTEL	57.71 ± 17.14	
F200	*****		60.89 ± 8.70		58.25 ± 9.44		54.24 ± 14.84	SNOTEL	56.81 ± 18.24	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table H-9 snow depth field measurement analysis of concentric boxes versus snow depth of Niwot SNOTEL for March/06/2009 in 95 percent confidence limit

	0-200m		200-400m		400-600m		600-800m		800-1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	70.87 ± 0.80		70.87 ± 0.80		70.87 ± 0.80		70.87 ± 0.80		70.87 ± 0.80	
C050[b]	52.63 ± 15.29	SNOTEL	53.69 ± 19.71	SNOTEL	54.63 ± 24.33	SNOTEL	57.29 ± 20.16	SNOTEL	58.83 ± 28.28	
C100	59.25 ± 14.31	SNOTEL	60.00 ± 15.76		61.42 ± 22.35		57.92 ± 21.08		59.36 ± 30.76	
C200	*****		64.25 ± 22.71		53.00 ± 11.59		51.17 ± 21.49	SNOTEL	58.61 ± 34.51	
F050	52.63 ± 5.36	SNOTEL	55.67 ± 16.39	SNOTEL	53.57 ± 16.36	SNOTEL	56.98 ± 16.25	SNOTEL	57.31 ± 20.33	
F100	54.67 ± 6.24	SNOTEL	60.38 ± 7.50		60.25 ± 13.69		56.78 ± 18.50	SNOTEL	57.10 ± 20.52	
F200	*****		62.92 ± 8.86		55.61 ± 10.17		50.22 ± 18.33	SNOTEL	60.24 ± 21.97	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

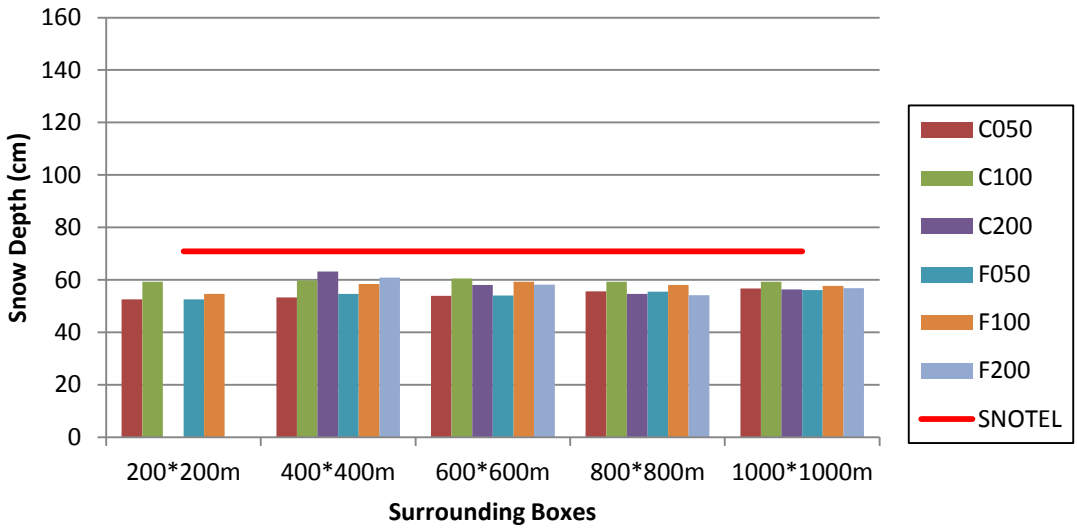

Figure H-8 snow depth field measurement analysis of surrounding boxes versus snow depth of Niwot SNOTEL for March/06/2009 (Refer to Table A-1 for clarification of abbreviations)

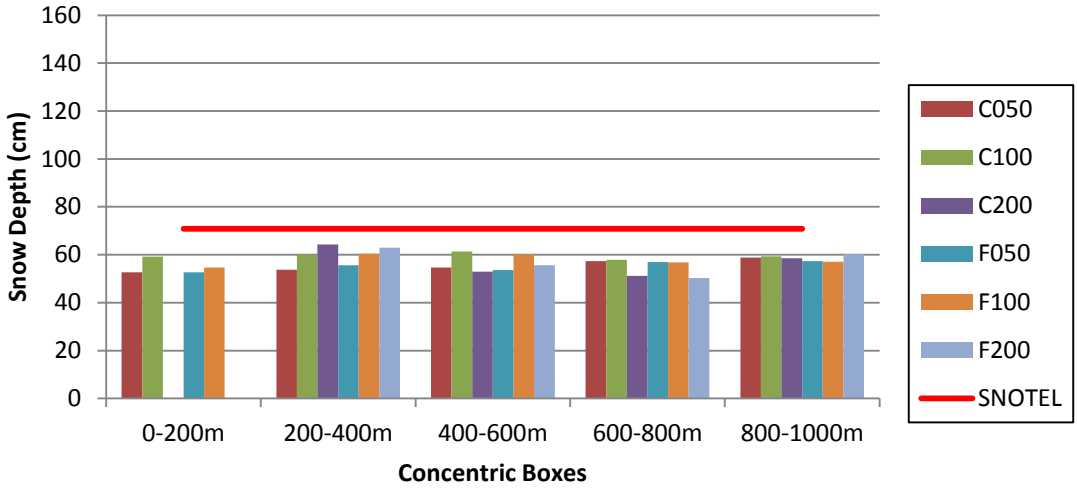

Figure H-9 snow depth field measurement analysis of Concentric boxes versus snow depth of Niwot SNOTEL for March/06/2009(Refer to Table A-1 for clarification of abbreviations)

Table H-10 a snow depth of field measurement analyzing of transects versus snow depth of Niwot SNOTEL station for April/03/2009 in 95 percent confidence limit

	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	84.58 ± 2.09		84.58 ± 2.09		84.58 ± 2.09		84.58 ± 2.09		84.58 ± 2.09	
C050[b]	85.95 ± 27.68		72.56 ± 20.50		68.90 ± 24.22		78.90 ± 15.10		77.60 ± 30.51	
C100	94.82 ± 21.58		68.67 ± 26.58		72.00 ± 19.25		79.55 ± 17.63		72.18 ± 27.95	
C200	92.00 ± 25.84		66.20 ± 19.58		69.17 ± 24.81		81.33 ± 15.64		79.83 ± 35.34	
A050	85.73 ± 25.26		72.31 ± 17.66		71.76 ± 23.11		81.21 ± 12.51		75.70 ± 24.09	
A100	94.80 ± 21.20		68.82 ± 22.66		73.96 ± 19.42		81.84 ± 13.98		72.96 ± 22.56	
A200	92.53 ± 26.03		68.12 ± 13.65		68.67 ± 21.35		81.80 ± 13.90		75.37 ± 28.84	
F050	85.21 ± 25.92		72.24 ± 17.22		71.60 ± 23.27		80.02 ± 11.37		75.90 ± 24.58	
F100	93.39 ± 21.05		68.52 ± 22.44		74.24 ± 20.30		80.67 ± 13.23		73.06 ± 24.92	
F200	91.61 ± 25.79		68.67 ± 11.43		67.89 ± 20.67		80.61 ± 12.84		74.95 ± 31.97	
T050	86.33 ± 25.95		72.46 ± 19.58		70.97 ± 23.68		81.64 ± 13.29		76.13 ± 26.11	
T100	96.21 ± 21.48		69.07 ± 24.61		73.03 ± 18.86		82.24 ± 13.58		72.61 ± 22.65	
T200	93.28 ± 26.23		66.93 ± 17.99		69.61 ± 22.95		82.84 ± 12.67		77.28 ± 28.94	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table H-10 b snow depth of field measurement analyzing of transects versus snow depth of Niwot SNOTEL station for April/03/2009 in 95 percent confidence limit

	Transect 6		Transect 7		Transect 8		Transect 9		Transect 10	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	84.58 ± 2.09		84.58 ± 2.09		84.58 ± 2.09		84.58 ± 2.09		84.58 ± 2.09	
C050[b]	60.86 ± 35.01	SNOTEL	78.10 ± 22.27		76.59 ± 10.57	SNOTEL	71.95 ± 21.10		69.38 ± 27.18	
C100	67.36 ± 38.55		66.64 ± 21.04	SNOTEL	80.44 ± 12.10		70.18 ± 21.71		64.00 ± 27.14	SNOTEL
C200	77.83 ± 41.06		63.33 ± 19.12	SNOTEL	80.33 ± 14.21		75.33 ± 20.18		54.17 ± 32.82	SNOTEL
A050	60.84 ± 23.37	SNOTEL	79.09 ± 18.20		78.91 ± 7.03		74.25 ± 15.92		70.74 ± 19.21	
A100	67.33 ± 20.63		75.73 ± 19.53		78.13 ± 8.86		74.04 ± 19.33		66.73 ± 21.22	
A200	62.00 ± 26.09		70.27 ± 24.51		77.27 ± 8.58		79.53 ± 11.97		59.97 ± 26.95	SNOTEL
F050	60.11 ± 22.89	SNOTEL	77.52 ± 16.61		79.24 ± 7.61		73.97 ± 16.72		73.19 ± 20.47	
F100	64.67 ± 21.21		73.30 ± 17.24		79.56 ± 9.98		74.48 ± 20.12		69.46 ± 21.17	
F200	62.00 ± 26.30		67.50 ± 20.03		78.95 ± 10.61		79.22 ± 13.75		64.00 ± 27.05	
T050	61.57 ± 26.62	SNOTEL	80.32 ± 20.99		77.80 ± 7.25		73.76 ± 16.85		67.84 ± 23.19	
T100	70.00 ± 24.99		75.12 ± 23.22		77.48 ± 8.60		72.30 ± 19.02		63.09 ± 24.35	SNOTEL
T200	67.28 ± 32.67		70.72 ± 30.37		76.61 ± 8.28		78.44 ± 12.85		54.00 ± 29.21	SNOTEL

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

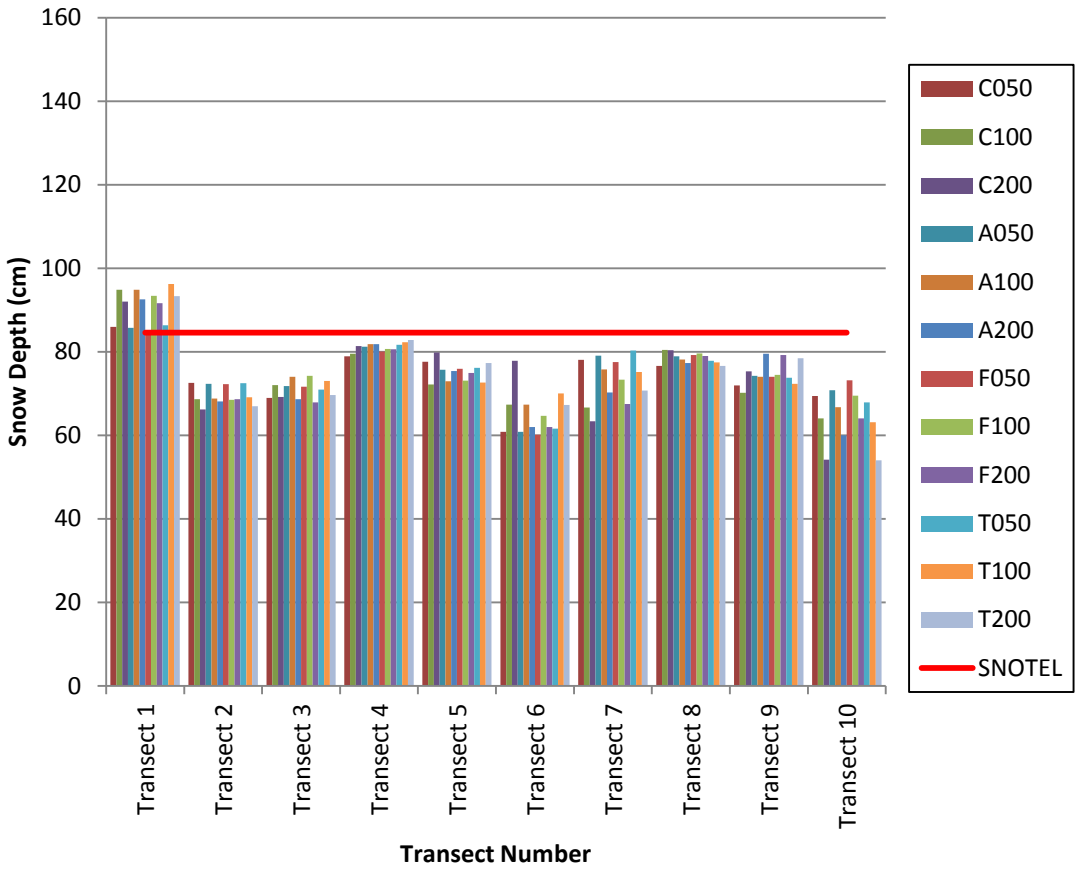

Figure H-10 snow depth field measurement of transects versus snow depth of Niwot SNOTEL station for April/03/2009 (Refer to Table A-1 for clarification of abbreviations)

Table H-11 snow depth field measurement analysis of surrounding boxes versus snow depth of Niwot SNOTEL for April/03/2009 in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	84.58 ± 2.09		84.58 ± 2.09		84.58 ± 2.09		84.58 ± 2.09		84.58 ± 2.09	
C050[b]	69.25 ± 33.41		78.88 ± 28.80		76.29 ± 24.60		74.10 ± 23.76		74.03 ± 24.97	
C100	66.00 ± 32.95		79.13 ± 27.98		78.38 ± 21.84		73.31 ± 23.39		73.55 ± 25.00	
C200	*****		85.00 ± 28.50		82.22 ± 22.94		73.94 ± 24.29		74.08 ± 26.39	
A050	77.83 ± 11.00		77.52 ± 17.77		76.03 ± 18.82		75.02 ± 18.37		75.01 ± 20.26	
A100	73.25 ± 8.37		76.49 ± 14.13		77.89 ± 14.24		75.33 ± 17.20		75.51 ± 20.25	
A200	*****		77.45 ± 16.92		76.62 ± 16.66		72.34 ± 18.68		73.64 ± 21.90	
F050	76.92 ± 13.54		77.31 ± 17.87		76.27 ± 18.85		74.62 ± 18.54		74.85 ± 20.27	
F100	72.08 ± 13.07		76.90 ± 14.88		78.28 ± 14.82		75.00 ± 18.42		75.18 ± 20.37	
F200	*****		79.42 ± 17.10		78.09 ± 16.88		72.32 ± 19.92		73.62 ± 21.60	
T050	75.88 ± 15.88		78.18 ± 20.83		75.87 ± 20.30		75.12 ± 19.81		74.85 ± 22.04	
T100	72.00 ± 13.40		76.96 ± 17.78		77.66 ± 15.72		74.98 ± 17.88		75.19 ± 21.75	
T200	*****		78.00 ± 20.64		77.02 ± 18.64		72.89 ± 19.62		73.81 ± 24.13	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table H-12 snow depth field measurement analysis of concentric boxes versus snow depth of Niwot SNOTEL for April/03/2009 in 95 percent confidence limit

	0-200m		200-400m		400-600m		600-800m		800-1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	84.58 ± 2.09		84.58 ± 2.09		84.58 ± 2.09		84.58 ± 2.09		84.58 ± 2.09	
C050[b]	69.25 ± 33.41		82.08 ± 27.12		74.00 ± 20.30		71.43 ± 22.63		73.94 ± 26.94	
C100	66.00 ± 32.95		83.50 ± 26.22		77.72 ± 15.31		67.14 ± 24.11	SNOTEL	73.89 ± 27.38	
C200	*****		86.67 ± 33.03		80.00 ± 18.71		63.29 ± 22.40	SNOTEL	74.26 ± 29.16	
A050	77.83 ± 11.00		77.42 ± 19.72		74.71 ± 19.86		73.80 ± 17.90		75.00 ± 23.08	
A100	73.25 ± 8.37		77.57 ± 15.76		79.13 ± 14.62		72.22 ± 20.06		75.76 ± 24.12	
A200	*****		77.67 ± 19.48		75.96 ± 17.34		66.83 ± 20.28	SNOTEL	75.19 ± 25.47	
F050	76.92 ± 13.54		77.44 ± 19.36		75.35 ± 19.88		72.60 ± 18.13		75.22 ± 22.86	
F100	72.08 ± 13.07		78.50 ± 15.62		79.52 ± 15.08		71.01 ± 21.64		75.42 ± 23.06	
F200	*****		78.72 ± 19.97		77.03 ± 17.56		64.90 ± 21.64	SNOTEL	75.16 ± 23.73	
T050	75.88 ± 15.88		78.95 ± 22.48		73.82 ± 19.89		74.21 ± 19.34		74.43 ± 25.32	
T100	72.00 ± 13.40		78.61 ± 19.24		78.28 ± 14.14		71.74 ± 20.01		75.47 ± 26.49	
T200	*****		79.61 ± 23.23		76.24 ± 17.98		67.57 ± 20.24	SNOTEL	74.91 ± 28.93	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

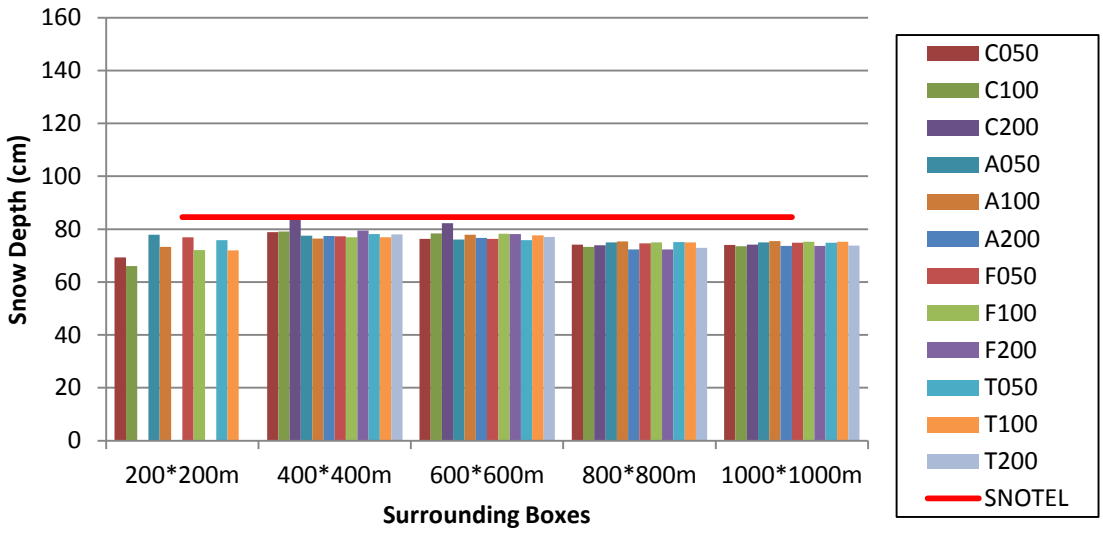

Figure H-11 snow depth field measurement analysis of surrounding boxes versus snow depth of Niwot SNOTEL for April/03/2009 (Refer to Table A-1 for clarification of abbreviations)

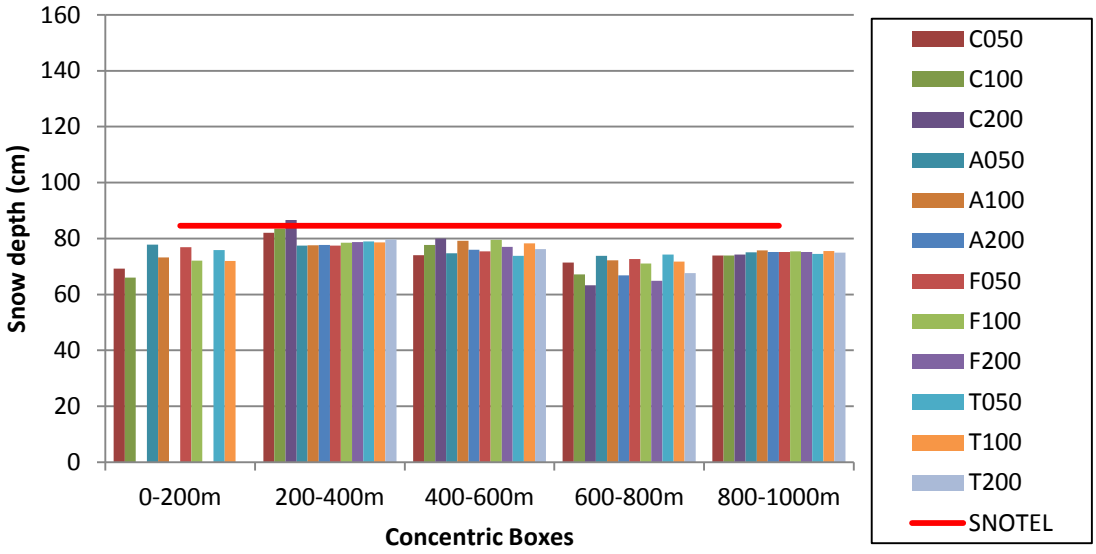

Figure H-12 snow depth field measurement analysis of Concentric boxes versus snow depth of Niwot SNOTEL for April/03/2009 (Refer to Table A-1 for clarification of abbreviations)

Table H-13 statistical analyses of transects versus transects of each specific sampling date for Niwot SNOTEL station in 95 percent confidence level

	4/7/2008		5/5/2008		3/6/2009		4/3/2009	
	Mean ± STD (cm)[a]	**SID[b]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
Transect 1	114.98 ± 17.95		72.89 ± 24.13	T3, T7, T9	54.26 ± 17.57		85.21 ± 25.92	T2, T3, T6, T10
Transect 2	121.68 ± 10.25		69.48 ± 16.20	T3, T7, T9, T10	62.17 ± 8.32	T5, T6	72.24 ± 17.22	T1
Transect 3	121.47 ± 12.87		88.36 ± 11.85	T1, T2, T4	*****	*****	71.60 ± 23.27	T1
Transect 4	109.37 ± 28.44		75.22 ± 22.88	T7	*****	*****	80.02 ± 11.37	T6
Transect 5	119.11 ± 34.02		77.19 ± 29.15	T7	44.75 ± 18.20	T2, T7, T8, T9	75.90 ± 24.58	T6
Transect 6	118.26 ± 34.74		66.92 ± 34.71	T3, T7, T8, T9, T10	51.70 ± 25.34	T2, T7	60.11 ± 22.89	T1, T4, T5, T7, T8, T9, T10
Transect 7	119.28 ± 27.63		91.72 ± 19.47	T1, T2, T4, T6, T8	63.84 ± 17.94	T5, T6	77.52 ± 16.61	T6
Transect 8	111.65 ± 17.10		82.40 ± 18.25	T6	56.22 ± 13.72	T5	79.24 ± 7.61	T6
Transect 9	119.94 ± 6.83		87.41 ± 21.67	T1, T2, T4	59.73 ± 6.34	T5	73.97 ± 16.72	T6
Transect 10	120.03 ± 9.69		86.37 ± 19.24	T2, T6	*****	*****	73.19 ± 20.47	T1, T6

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

T is transect

Table H-14 statistical analyses of surrounding boxes versus surrounding boxes of each specific sampling date for Niwot SNOTEL station in 95 percent confidence level

	4/7/2008		5/5/2008		3/6/2009		4/3/2009	
	Mean ± STD (cm)[a]	SID[b]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
200*200m	125.67 ± 17.46		84.13 ± 12.72		52.63 ± 5.36		76.92 ± 13.54	
400*400m	122.26 ± 23.72		85.95 ± 20.63		54.65 ± 13.64		77.31 ± 17.87	
600*600m	120.16 ± 21.80		84.04 ± 20.69		54.11 ± 14.91		76.27 ± 18.85	
800*800m	119.40 ± 20.23		85.41 ± 18.79	B1000	55.55 ± 15.58		74.62 ± 18.54	
1000*1000m	117.44 ± 22.64		79.72 ± 23.57	B800	56.13 ± 17.26		74.85 ± 20.27	

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

B is surrounding box

Table H-15 statistical analyses of concentric boxes versus concentric boxes of each specific sampling date for Niwot SNOTEL station in 95 percent confidence level

	4/7/2008		5/5/2008		3/6/2009		4/3/2009	
	Mean ± STD (cm)[a]	SID[b]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
0-200m	125.67 ± 17.46		84.13 ± 12.72		52.63 ± 5.36		76.92 ± 13.54	
200-400m	121.13 ± 25.70		86.56 ± 22.87	CB1000	55.67 ± 16.39		77.44 ± 19.36	
400-600m	118.43 ± 20.23		82.52 ± 20.87	CB1000	53.57 ± 16.36		75.35 ± 19.88	
600-800m	118.45 ± 18.19		87.21 ± 15.98	CB1000	56.98 ± 16.25		72.60 ± 18.13	
800-1000m	112.34 ± 27.52		70.91 ± 27.35	CB400, CB600, CB800	57.31 ± 20.33		75.22 ± 22.86	

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

CB is concentric box

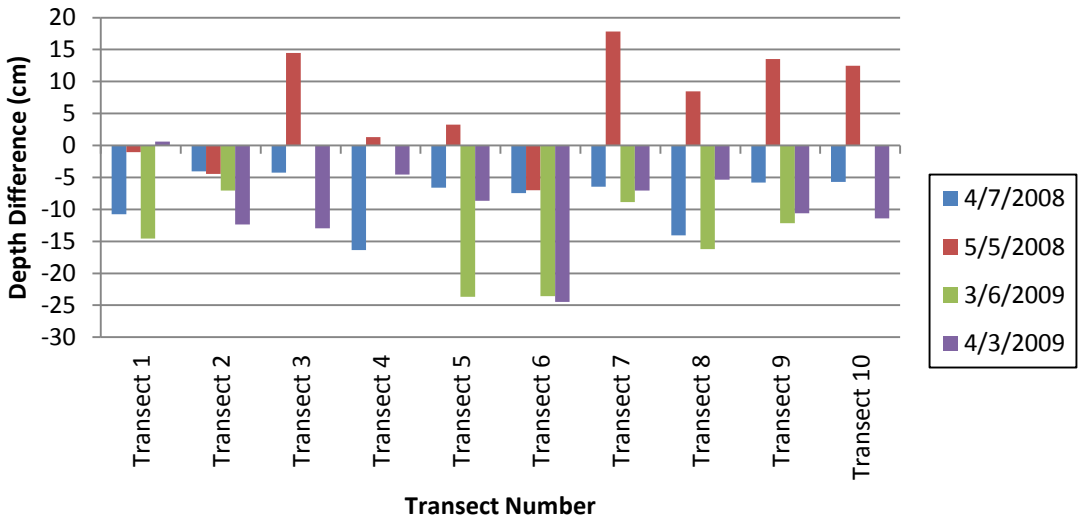

Figure H-13 SD difference between transects and Niwot SNOTEL station in each sampling date (F050 minus SNOTEL)

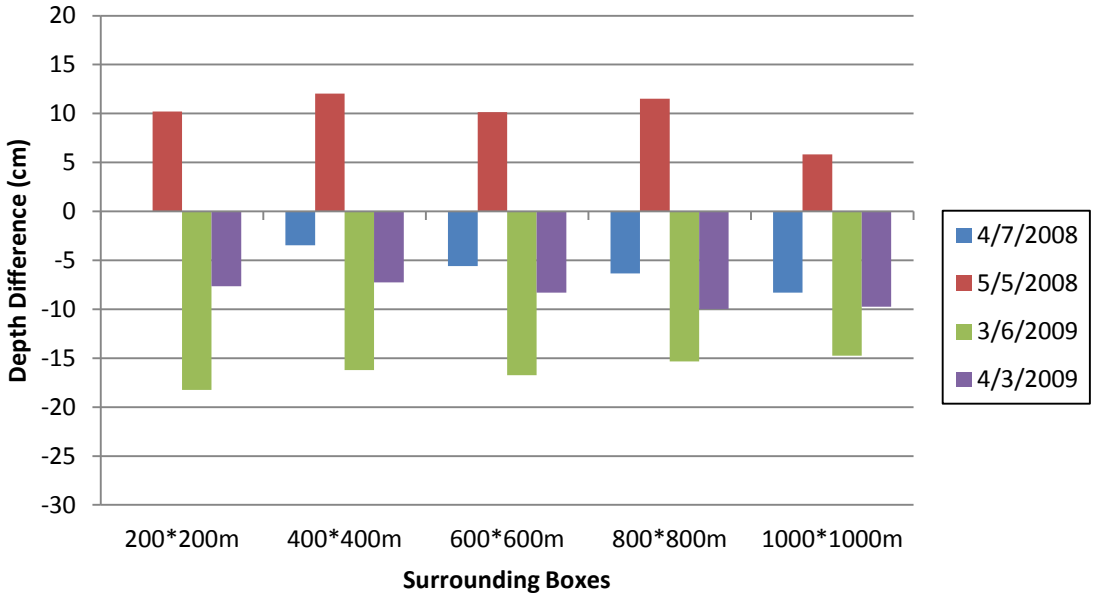

Figure H-14 SD difference between surrounding boxes and Niwot SNOTEL station in each sampling date (F050 minus SNOTEL)

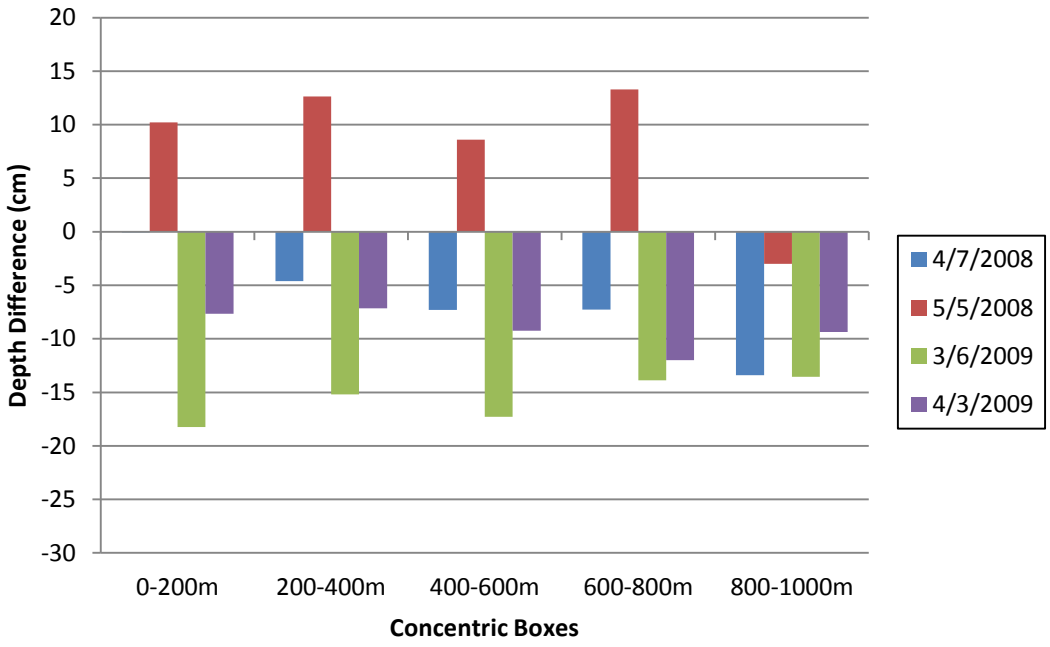

Figure H-15 SD difference between concentric boxes and Niwot SNOTEL station in each sampling date (F050 minus SNOTEL)

Table H-16 statistical analyses of SD averages of 3, 5, and 10 transect versus SD of Niwot SNOTEL station in 95 percent confidence level

	April/07/2008		May/05/2008		April/03/2009	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	125.73 ± 2.74		73.91 ± 1.87		84.58 ± 2.09	
10 transects (all)	117.44 ± 22.64		79.72 ± 23.57		74.85 ± 20.27	
Transects 2, 4 , 6, 8, 10 (even)	115.88 ± 23.29		76.08 ± 23.95	odd	72.72 ± 18.33	
Transects 1, 3, 5, 7, 9 (odd)	118.93 ± 22.02		83.40 ± 22.71	even	76.85 ± 21.83	
Transects 1, 5, 10 (thr)	117.82 ± 23.97		78.81 ± 24.77		78.13 ± 23.94	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

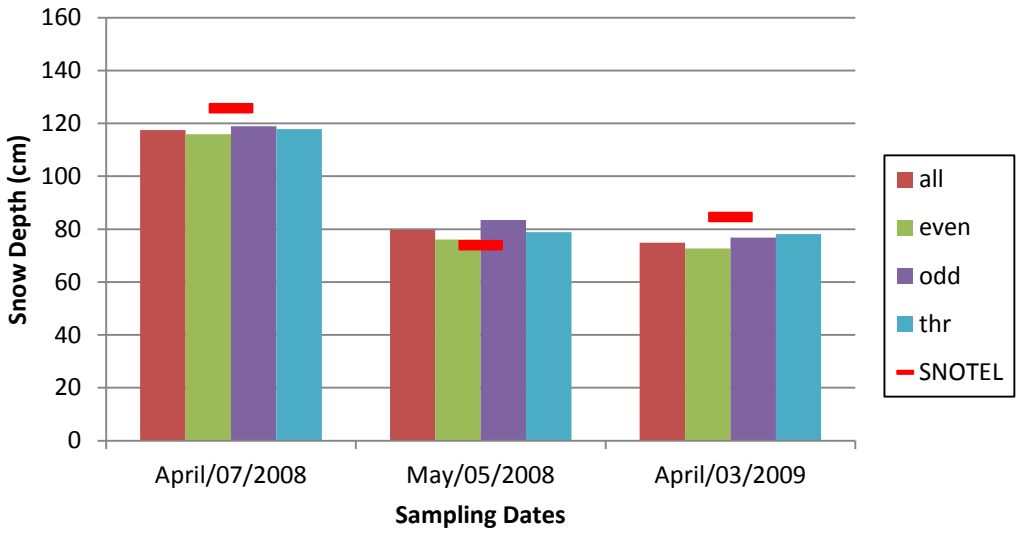

Figure H-16 SD averages of 3, 5, and 10 transect versus SD of Niwot SNOTEL station (Refer to column 1 of Table H-16 for definitions)

Table H-17 statistical analyses of inter and intra annual for sampling dates of Niwot SNOTEL in 95 percent confidence level

	2008 versus 2008	
	Mean ± STD (cm)[a]	**SID[b]**
4/7/2008	117.40 ± 22.64	5/5/2008
5/5/2008	79.72 ± 23.15	4/7/2008
	2009 versus 2009	
	Mean ± STD (cm)	**SID**
3/6/2009	56.13 ± 17.25	4/3/2009
4/3/2009	74.81 ± 20.83	3/6/2009
	2008 versus 2009	
	Mean ± STD (cm)	**SID**
4/7/2008	117.40 ± 22.64	4/3/2009
4/3/2009	74.85 ± 20.26	4/7/2008

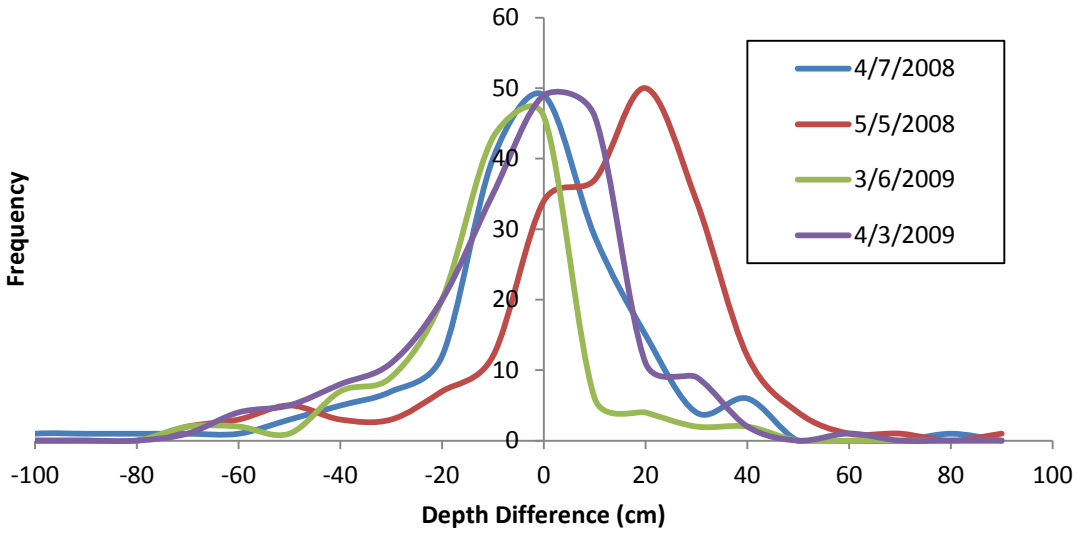

Figure H-17 frequency of the SD difference between field sampling and SD of the Niwot SNOTEL station for each sampling date

Appendix I: South Brush Creek SNOTEL station statistical analyses results

Table I-1 snow depth field measurement analysis of surrounding boxes versus snow depth of South Brush Creek SNOTEL for April/05/2008 in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	115.82 ± 3.43		115.82 ± 3.43		115.82 ± 3.43		115.82 ± 3.43		*****	
C050[b]	89.25 ± 10.69	SNOTEL	89.21 ± 23.54	SNOTEL	96.33 ± 22.84	SNOTEL	97.09 ± 20.06	SNOTEL	*****	
C100	*****		92.38 ± 10.54	SNOTEL	96.05 ± 19.30	SNOTEL	96.80 ± 18.08	SNOTEL	*****	
F050	90.75 ± 3.82	SNOTEL	87.67 ± 21.01	SNOTEL	95.74 ± 19.05	SNOTEL	96.87 ± 16.48	SNOTEL	*****	
F100	*****		90.58 ± 5.95	SNOTEL	95.36 ± 15.05	SNOTEL	96.54 ± 13.72	SNOTEL	*****	

Table I-2 snow depth field measurement analysis of concentric boxes versus snow depth of South Brush Creek SNOTEL for April/05/2008 in 95 percent confidence limit

	0-200m		200-400m		400-600m		600-800m		800-1000m	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	115.82 ± 3.43		115.82 ± 3.43		115.82 ± 3.43		115.82 ± 3.43		*****	
C050[b]	89.25 ± 10.69	SNOTEL	89.20 ± 27.61	SNOTEL	100.15 ± 21.96	SNOTEL	98.32 ± 14.90	SNOTEL	*****	
C100	*****		96.00 ± 9.57		98.14 ± 23.00	SNOTEL	98.08 ± 16.48	SNOTEL	*****	
F050	90.75 ± 3.82	SNOTEL	86.43 ± 25.04	SNOTEL	100.09 ± 16.75	SNOTEL	98.68 ± 11.35	SNOTEL	*****	
F100	*****		91.45 ± 6.61	SNOTEL	98.09 ± 18.03	SNOTEL	98.54 ± 11.39	SNOTEL	*****	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

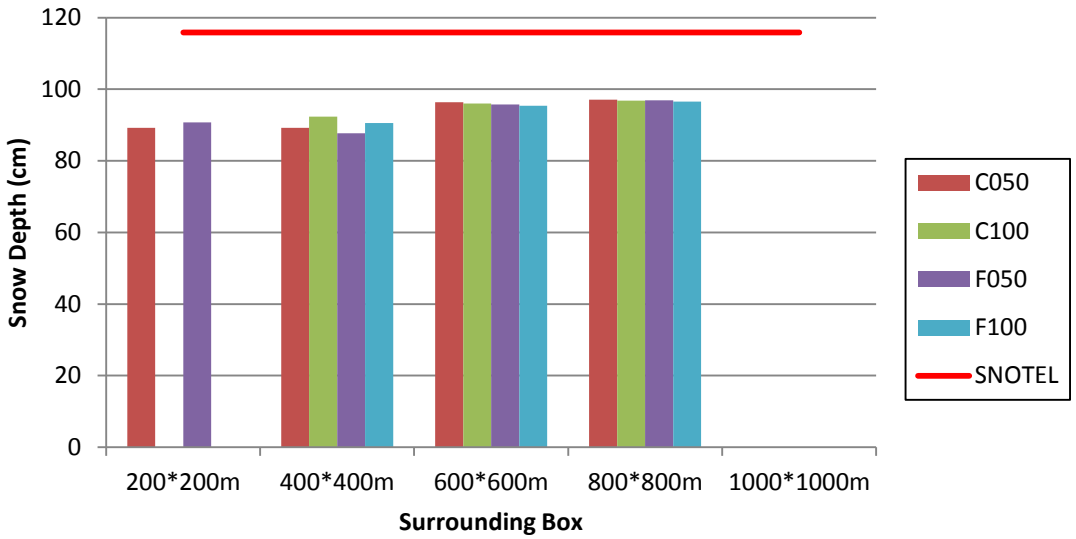

Figure I-1 snow depth field measurement analysis of surrounding boxes versus snow depth of South Brush Creek SNOTEL for April/05/2008 (Refer to Table A-1 for clarification of abbreviations)

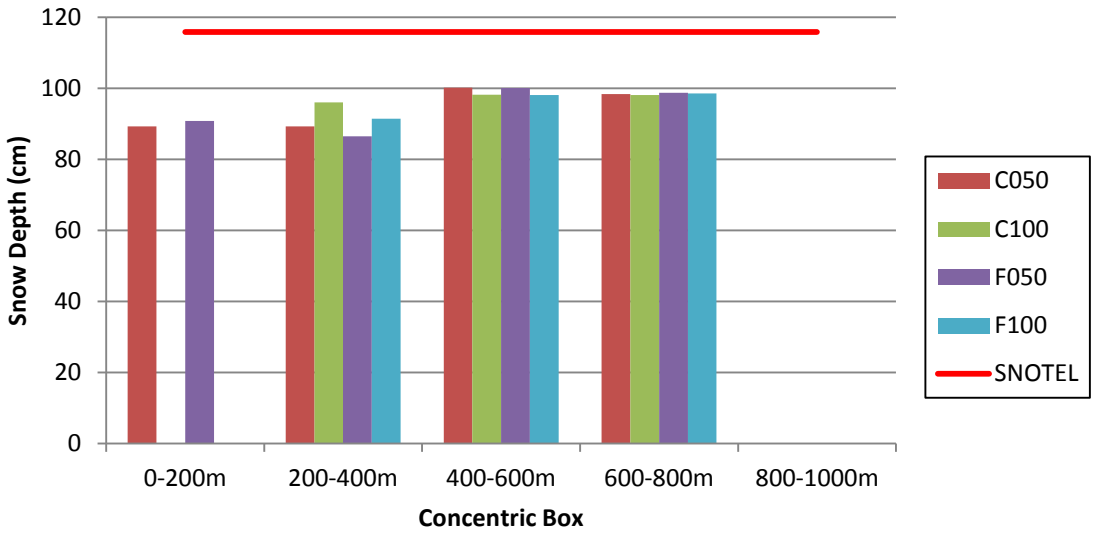

Figure I-2 snow depth field measurement analysis of concentric boxes versus snow depth of South Brush Creek SNOTEL for April/05/2008 (Refer to Table A-1 for clarification of abbreviations)

Table I-3 a snow depth of field measurement analyzing of transects versus snow depth of South Brush Creek SNOTEL station for March/01/2009 in 95 percent confidence limit

	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	92.46 ± 2.14		92.46 ± 2.14		92.46 ± 2.14		92.46 ± 2.14		92.46 ± 2.14	
C050[b]	78.38 ± 13.79	SNOTEL	88.52 ± 15.03		85.58 ± 10.85	SNOTEL	87.50 ± 11.32		84.05 ± 18.76	
C100	76.60 ± 13.00	SNOTEL	83.80 ± 15.98		87.18 ± 10.48		87.73 ± 7.40		88.18 ± 16.84	
C200	83.86 ± 10.46		91.71 ± 15.17		80.00 ± 7.90	SNOTEL	80.71 ± 7.20	SNOTEL	80.43 ± 26.48	
A050	79.87 ± 12.73	SNOTEL	86.25 ± 11.62		84.86 ± 8.77	SNOTEL	86.09 ± 10.27		83.78 ± 13.97	
A100	78.74 ± 10.52	SNOTEL	83.72 ± 12.96		86.76 ± 7.02		86.16 ± 7.08		85.58 ± 13.77	
A200	84.26 ± 12.30		88.00 ± 11.33		78.97 ± 8.82	SNOTEL	79.43 ± 8.40	SNOTEL	80.86 ± 20.15	
F050	80.38 ± 12.48	SNOTEL	87.17 ± 12.30		85.21 ± 9.02	SNOTEL	87.41 ± 10.22		84.21 ± 12.63	
F100	80.13 ± 10.95	SNOTEL	84.13 ± 12.92		87.09 ± 6.98		86.61 ± 6.91		85.36 ± 12.50	
F200	83.76 ± 12.76		90.00 ± 11.57		79.24 ± 8.83	SNOTEL	81.00 ± 7.05	SNOTEL	81.43 ± 18.21	
P050	78.86 ± 13.59	SNOTEL	86.08 ± 12.12		84.76 ± 8.93	SNOTEL	85.24 ± 11.23	SNOTEL	83.44 ± 16.84	
P100	76.64 ± 11.18	SNOTEL	83.33 ± 14.05		86.58 ± 7.74		86.24 ± 7.76		86.66 ± 15.91	
P200	84.62 ± 11.34		87.24 ± 12.69		79.05 ± 8.74	SNOTEL	78.28 ± 10.96	SNOTEL	80.14 ± 24.16	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table I-3 b snow depth of field measurement analyzing of transects versus snow depth of South Brush Creek SNOTEL station for March/01/2009 in 95 percent confidence limit

	Transect 6		Transect 7		Transect 8		Transect 9		Transect 10	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	92.46 ± 2.14		92.46 ± 2.14		92.46 ± 2.14		92.46 ± 2.14		92.46 ± 2.14	
C050[b]	87.48 ± 14.65		76.65 ± 10.67	SNOTEL	78.23 ± 12.36	SNOTEL	87.14 ± 15.27		82.95 ± 13.77	SNOTEL
C100	91.64 ± 13.73		77.27 ± 10.90	SNOTEL	77.27 ± 14.23	SNOTEL	82.36 ± 8.63		82.09 ± 8.75	SNOTEL
C200	96.43 ± 13.26		75.00 ± 11.19	SNOTEL	79.14 ± 10.51	SNOTEL	92.00 ± 19.24		91.00 ± 9.47	
A050	86.30 ± 12.78		77.54 ± 9.72	SNOTEL	78.78 ± 9.01	SNOTEL	87.53 ± 11.48		83.42 ± 10.95	SNOTEL
A100	89.95 ± 12.39		77.58 ± 10.08	SNOTEL	76.53 ± 10.87	SNOTEL	84.11 ± 7.16		83.98 ± 11.25	
A200	92.97 ± 11.81		78.23 ± 9.81	SNOTEL	77.97 ± 9.82	SNOTEL	87.89 ± 15.29		89.46 ± 4.29	
F050	85.51 ± 12.86		76.97 ± 9.81	SNOTEL	79.58 ± 8.11	SNOTEL	86.75 ± 10.14		83.48 ± 10.39	SNOTEL
F100	89.67 ± 12.77		77.45 ± 11.15	SNOTEL	78.00 ± 10.03	SNOTEL	84.24 ± 6.11		83.15 ± 8.70	SNOTEL
F200	93.00 ± 12.37		79.83 ± 10.98	SNOTEL	78.24 ± 10.41	SNOTEL	89.71 ± 12.09		86.76 ± 5.22	
P050	87.48 ± 13.92		77.82 ± 11.40	SNOTEL	77.80 ± 10.83	SNOTEL	88.19 ± 14.13		83.21 ± 12.94	SNOTEL,P200
P100	90.79 ± 12.49		77.61 ± 10.67	SNOTEL	75.30 ± 12.96	SNOTEL	83.39 ± 8.95		84.18 ± 13.46	
P200	94.10 ± 12.62		75.56 ± 9.25	SNOTEL	78.10 ± 9.30	SNOTEL	87.43 ± 19.88		92.67 ± 5.07	P050

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

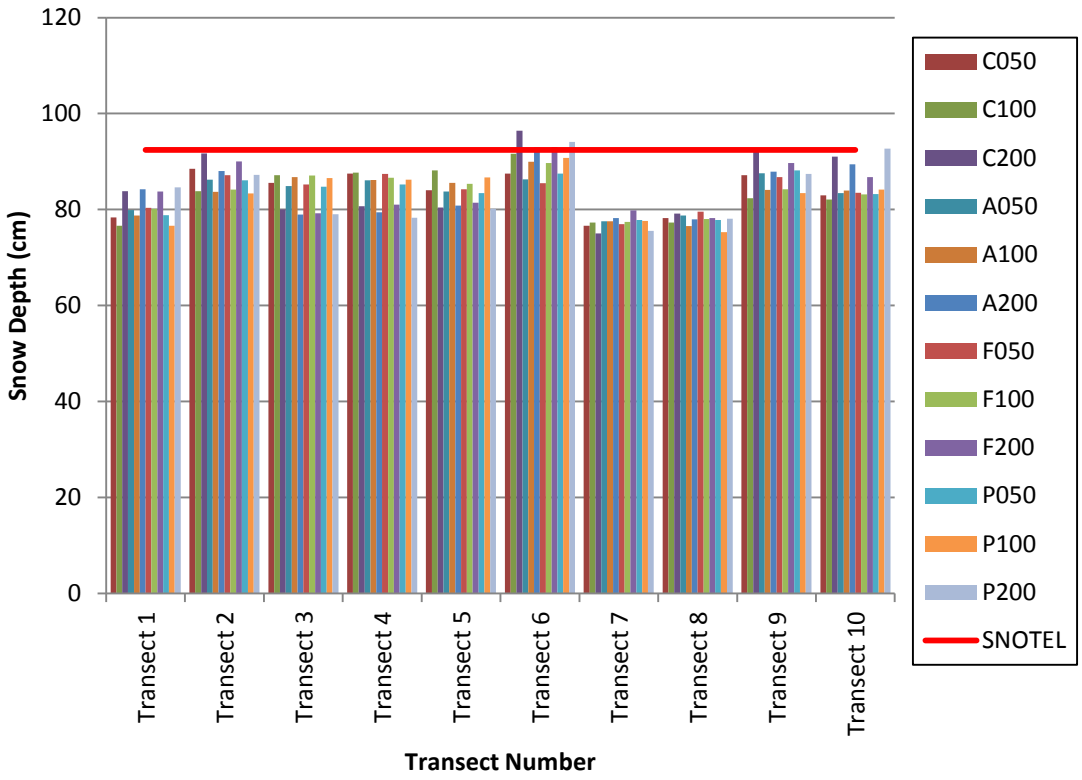

Figure I-3 snow depth field measurement of transects versus snow depth of South Brush Creek SNOTEL station for March/01/2009 (Refer to Table A-1 for clarification of abbreviations)

Table I-4 snow depth field measurement analysis of surrounding boxes versus snow depth of South Brush Creek SNOTEL for March/01/2009 in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	92.46 ± 2.14		92.46 ± 2.14		92.46 ± 2.14		92.46 ± 2.14		92.46 ± 2.14	
C050[b]	80.13 ± 10.76	SNOTEL	79.44 ± 12.10	SNOTEL	82.51 ± 13.44	SNOTEL	83.28 ± 12.76	SNOTEL	83.79 ± 14.08	SNOTEL
C100	75.25 ± 10.40	SNOTEL	82.25 ± 10.61	SNOTEL	83.03 ± 11.55	SNOTEL	82.79 ± 11.00	SNOTEL	83.47 ± 12.82	SNOTEL
C200	*****		77.38 ± 12.15	SNOTEL	79.94 ± 12.59	SNOTEL	82.13 ± 12.24	SNOTEL	85.17 ± 14.93	
A050	79.18 ± 11.51	SNOTEL	80.58 ± 9.30	SNOTEL	82.47 ± 10.83	SNOTEL	83.05 ± 10.53	SNOTEL	83.54 ± 11.42	SNOTEL
A100	78.65 ± 14.14	SNOTEL	83.06 ± 9.68	SNOTEL	83.11 ± 10.04	SNOTEL	82.73 ± 10.20	SNOTEL	83.35 ± 10.92	SNOTEL
A200	*****		78.70 ± 11.70	SNOTEL	79.07 ± 12.28	SNOTEL	81.20 ± 10.75	SNOTEL	83.88 ± 12.28	SNOTEL
F050	81.84 ± 10.90	SNOTEL	81.51 ± 9.65	SNOTEL	83.16 ± 10.83	SNOTEL	83.53 ± 10.64	SNOTEL	83.80 ± 11.14	SNOTEL
F100	79.42 ± 13.25	SNOTEL	83.83 ± 9.17	SNOTEL	83.72 ± 10.03	SNOTEL	83.11 ± 10.28	SNOTEL	83.61 ± 10.45	SNOTEL
F200	*****		79.46 ± 11.30	SNOTEL	80.50 ± 11.95	SNOTEL	82.82 ± 10.96	SNOTEL	84.36 ± 11.79	
P050	76.84 ± 11.99	SNOTEL	79.26 ± 10.40	SNOTEL	81.79 ± 12.12	SNOTEL	82.65 ± 11.44	SNOTEL	83.37 ± 12.90	SNOTEL
P100	76.75 ± 13.96	SNOTEL	82.02 ± 10.88	SNOTEL	82.46 ± 10.69	SNOTEL	82.38 ± 10.53	SNOTEL	83.13 ± 12.26	SNOTEL
P200	*****		77.50 ± 12.69	SNOTEL	77.93 ± 13.38	SNOTEL	79.88 ± 11.50	SNOTEL	83.84 ± 14.05	SNOTEL

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table I-5 snow depth field measurement analysis of concentric boxes versus snow depth of South Brush Creek SNOTEL for March/01/2009 in 95 percent confidence limit

	0-200m		200-400m		400-600m		600-800m		800-1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	92.46 ± 2.14		92.46 ± 2.14		92.46 ± 2.14		92.46 ± 2.14		92.46 ± 2.14	
C050[b]	80.13 ± 10.76	SNOTEL	79.23 ± 12.67	SNOTEL	84.82 ± 14.07		84.33 ± 11.79	SNOTEL	84.63 ± 16.07	
C100	75.25 ± 10.40	SNOTEL	84.58 ± 10.00		83.65 ± 12.50		82.48 ± 10.43	SNOTEL	84.42 ± 15.09	
C200	*****		79.17 ± 11.96	SNOTEL	82.00 ± 13.19		83.91 ± 11.93	SNOTEL	89.38 ± 17.35	
A050	79.18 ± 11.51	SNOTEL	81.01 ± 8.74	SNOTEL	83.90 ± 11.76	SNOTEL	83.84 ± 10.13	SNOTEL	84.35 ± 12.79	
A100	78.65 ± 14.14	SNOTEL	84.53 ± 7.99		83.14 ± 10.56		82.23 ± 10.58	SNOTEL	84.22 ± 11.92	
A200	*****		81.40 ± 10.31	SNOTEL	79.36 ± 13.36	SNOTEL	82.95 ± 9.23	SNOTEL	87.59 ± 13.44	
F050	81.84 ± 10.90	SNOTEL	81.41 ± 9.47	SNOTEL	84.41 ± 11.59		84.02 ± 10.46	SNOTEL	84.24 ± 11.96	
F100	79.42 ± 13.25	SNOTEL	85.31 ± 7.57		83.63 ± 10.90		82.28 ± 10.73	SNOTEL	84.32 ± 10.76	
F200	*****		82.22 ± 10.53	SNOTEL	81.33 ± 13.00	SNOTEL	84.73 ± 9.95		86.48 ± 12.73	
P050	76.84 ± 11.99	SNOTEL	80.01 ± 10.00	SNOTEL	83.70 ± 13.07	SNOTEL	83.82 ± 10.44	SNOTEL	84.54 ± 15.01	
P100	76.75 ± 13.96	SNOTEL	83.78 ± 9.73	SNOTEL	82.82 ± 10.80	SNOTEL	82.26 ± 10.51	SNOTEL	84.19 ± 14.41	
P200	*****		79.83 ± 11.25	SNOTEL	78.27 ± 14.58	SNOTEL	81.49 ± 9.73	SNOTEL	89.29 ± 15.55	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

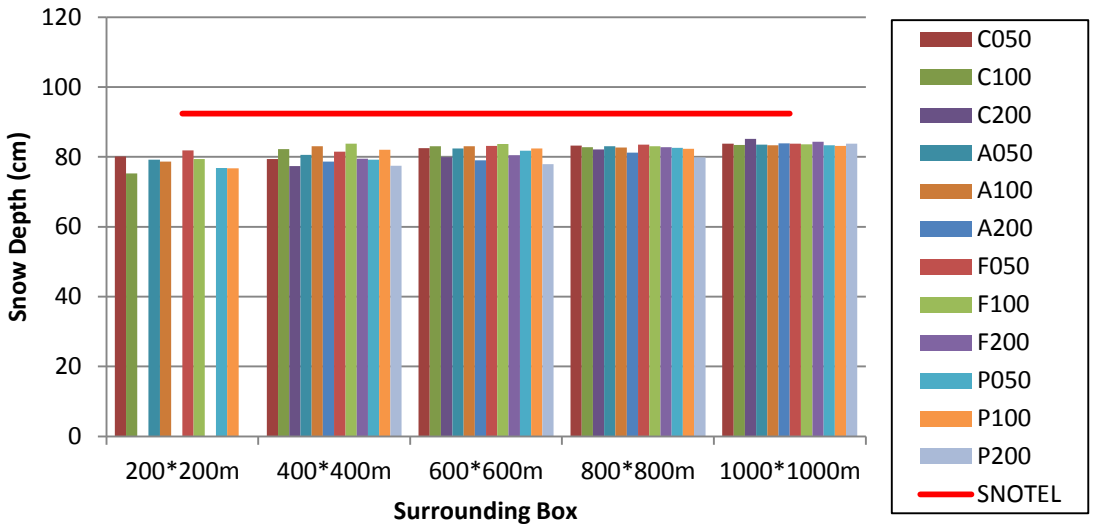

Figure I-4 snow depth field measurement analysis of surrounding boxes versus snow depth of South Brush Creek SNOTEL for March/01/2009 (Refer to Table A-1 for clarification of abbreviations)

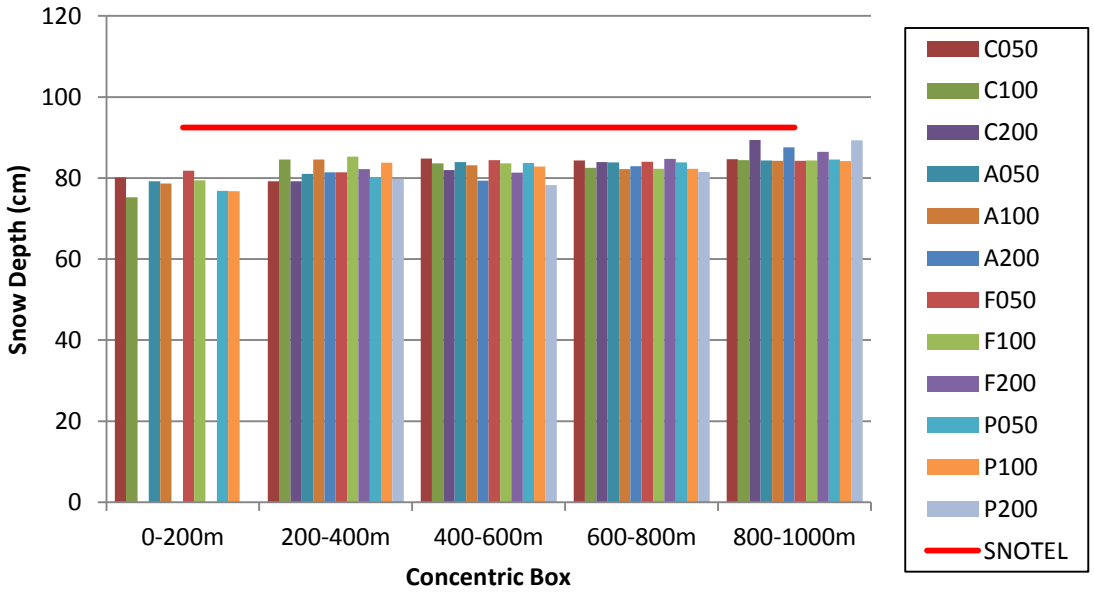

Figure I-5 snow depth field measurement analysis of concentric boxes versus snow depth of South Brush Creek SNOTEL for March/01/2009 (Refer to Table A-1 for clarification of abbreviations)

Table I-6 a snow depth of field measurement analyzing of transects versus snow depth of South Brush Creek SNOTEL station for March/29/2009 in 95 percent confidence limit

	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	96.52 ± 2.39		96.52 ± 2.39		96.52 ± 2.39		96.52 ± 2.39		96.52 ± 2.39	
C050[b]	91.65 ± 13.44		94.35 ± 23.94		89.63 ± 12.92		84.25 ± 17.98	SNOTEL	84.05 ± 18.76	
C100	93.09 ± 12.93		94.18 ± 20.83		90.40 ± 9.51		86.40 ± 16.44		84.00 ± 21.21	
C200	94.00 ± 14.95		84.17 ± 13.17		93.80 ± 11.56		82.50 ± 16.99		86.00 ± 27.64	
A050	87.34 ± 15.78		87.76 ± 19.36		92.38 ± 14.35		84.70 ± 15.78		83.78 ± 13.97	
A100	88.38 ± 16.46		87.42 ± 15.90		90.54 ± 13.76		86.02 ± 13.28		82.69 ± 16.04	
A200	91.20 ± 14.73		80.17 ± 8.61		91.20 ± 19.87		81.33 ± 16.38		84.43 ± 19.72	
F050	87.35 ± 16.84		87.77 ± 20.09		92.89 ± 15.38		84.10 ± 16.56	SNOTEL	84.21 ± 12.63	
F100	91.18 ± 16.97		85.40 ± 15.74		90.50 ± 13.80		85.17 ± 12.97		83.09 ± 14.66	
F200	96.28 ± 15.41		77.89 ± 11.95		91.47 ± 19.51		81.45 ± 15.11		84.44 ± 18.09	
T050	88.77 ± 15.80		89.95 ± 20.88		90.95 ± 13.02		85.15 ± 16.08		83.44 ± 16.84	SNOTEL
T100	87.15 ± 17.16		91.70 ± 18.84		90.53 ± 12.20		87.00 ± 14.60		82.73 ± 18.90	
T200	87.06 ± 18.31		83.78 ± 9.92		91.80 ± 17.41		81.61 ± 18.65		84.94 ± 23.59	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table I-6 b snow depth of field measurement analyzing of transects versus snow depth of South Brush Creek SNOTEL station for March/29/2009 in 95 percent confidence limit

	Transect 6		Transect 7		Transect 8		Transect 9		Transect 10	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	96.52 ± 2.39		96.52 ± 2.39		96.52 ± 2.39		96.52 ± 2.39		96.52 ± 2.39	
C050[b]	87.48 ± 14.65		86.95 ± 20.18		84.48 ± 10.77	SNOTEL	81.00 ± 18.33	SNOTEL	87.32 ± 17.11	
C100	92.00 ± 13.41		87.00 ± 19.80		87.18 ± 12.71	SNOTEL	80.70 ± 18.60	SNOTEL	89.55 ± 19.17	
C200	88.83 ± 14.91		92.50 ± 20.37		90.00 ± 12.23		79.17 ± 23.74	SNOTEL	81.67 ± 20.79	
A050	86.30 ± 12.78	SNOTEL	85.82 ± 16.81		88.59 ± 9.28	SNOTEL	82.05 ± 14.12	SNOTEL	85.26 ± 15.15	
A100	90.82 ± 11.13		87.95 ± 19.00		88.69 ± 8.68		83.46 ± 14.35		87.35 ± 16.85	
A200	88.13 ± 11.10		96.27 ± 13.70		92.07 ± 6.21		80.10 ± 16.26	SNOTEL	81.30 ± 19.65	
F050	85.51 ± 12.86	SNOTEL	84.98 ± 15.42		88.71 ± 9.50	SNOTEL	82.46 ± 14.13	SNOTEL	84.12 ± 15.77	
F100	90.27 ± 11.83		86.79 ± 17.35		88.15 ± 8.68	SNOTEL	83.73 ± 14.18		85.67 ± 17.87	
F200	86.78 ± 11.55		93.94 ± 12.80		91.06 ± 5.31		80.89 ± 15.96		79.17 ± 21.20	SNOTEL
T050	87.48 ± 13.92		87.03 ± 19.46		87.10 ± 8.51	SNOTEL	81.30 ± 15.36	SNOTEL	87.09 ± 15.31	
T100	91.76 ± 11.43		88.79 ± 21.08		88.73 ± 8.89		82.27 ± 15.74	SNOTEL	89.76 ± 16.75	
T200	89.72 ± 12.19		97.33 ± 17.88		92.39 ± 6.82		79.00 ± 18.77	SNOTEL	83.56 ± 18.42	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

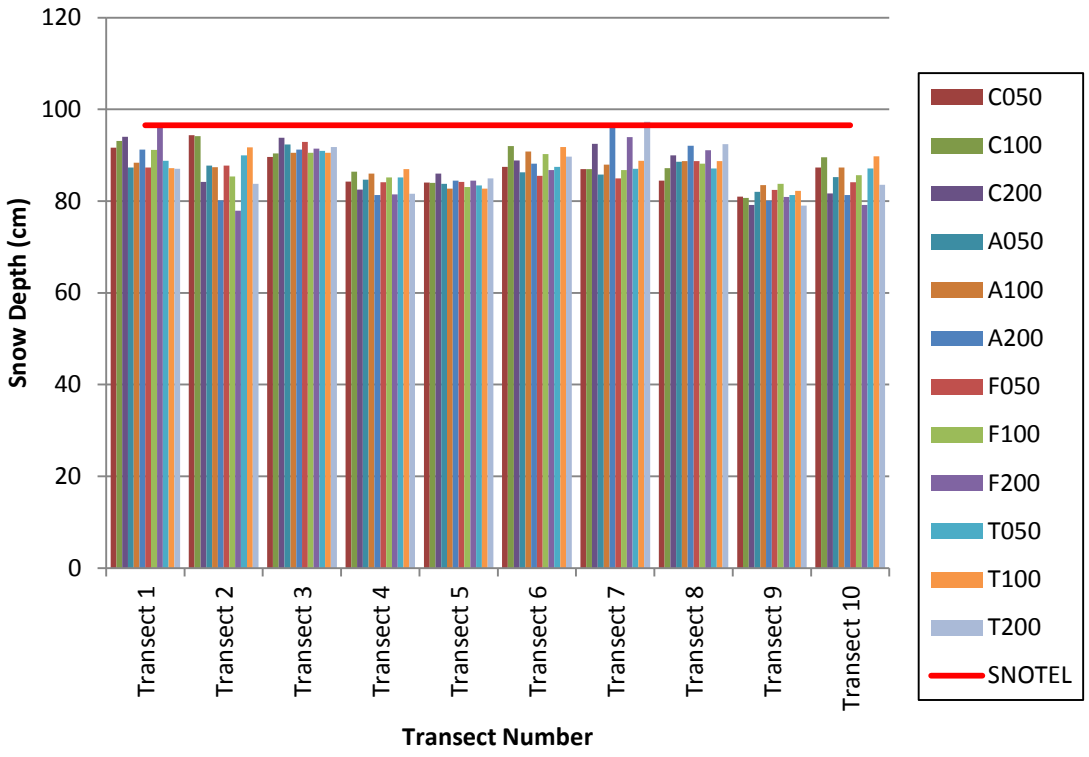

Figure I-6 snow depth field measurement of transects versus snow depth of South Brush Creek SNOTEL station for March/29/2009 (Refer to Table A-1 for clarification of abbreviations)

Table I-7 snow depth field measurement analysis of surrounding boxes versus snow depth of South Brush Creek SNOTEL for March/29/2009 in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	96.52 ± 2.39		96.52 ± 2.39		96.52 ± 2.39		96.52 ± 2.39		96.52 ± 2.39	
C050[b]	80.13 ± 10.76	SNOTEL	81.13 ± 14.87	SNOTEL	84.84 ± 15.46	SNOTEL	85.73 ± 17.70	SNOTEL	87.11 ± 17.23	
C100	75.25 ± 10.40	SNOTEL	81.87 ± 15.17	SNOTEL	85.86 ± 13.02	SNOTEL	87.03 ± 16.39		88.52 ± 16.70	
C200	*****		87.00 ± 7.58		86.18 ± 9.82	SNOTEL	84.39 ± 16.23	SNOTEL	87.15 ± 17.71	
A050	79.18 ± 11.51	SNOTEL	81.24 ± 12.76	SNOTEL	85.89 ± 13.42	SNOTEL	85.71 ± 14.73	SNOTEL	86.37 ± 14.83	
A100	78.65 ± 14.14	SNOTEL	82.13 ± 14.62	SNOTEL	86.67 ± 12.25	SNOTEL	86.64 ± 13.41		87.35 ± 14.43	
A200	*****		87.08 ± 8.26		88.35 ± 9.04		84.79 ± 13.35	SNOTEL	86.54 ± 15.07	SNOTEL
F050	81.84 ± 10.90	SNOTEL	81.72 ± 12.94	SNOTEL	85.61 ± 13.66	SNOTEL	85.68 ± 14.84	SNOTEL	86.17 ± 15.06	
F100	79.42 ± 13.25	SNOTEL	82.67 ± 13.84	SNOTEL	86.17 ± 11.88	SNOTEL	85.89 ± 13.02	SNOTEL	87.01 ± 14.31	
F200	*****		86.79 ± 9.85		87.22 ± 9.92		83.81 ± 13.17	SNOTEL	86.25 ± 15.33	
T050	76.84 ± 11.99	SNOTEL	80.72 ± 13.30	SNOTEL	85.83 ± 13.96	SNOTEL	85.74 ± 15.76	SNOTEL	86.82 ± 15.73	SNOTEL
T100	76.75 ± 13.96	SNOTEL	81.51 ± 15.37	SNOTEL	86.90 ± 12.67	SNOTEL	87.52 ± 14.82		88.08 ± 15.65	
T200	*****		87.33 ± 6.62		88.76 ± 8.27		85.63 ± 14.69	SNOTEL	87.04 ± 16.41	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table I-8 snow depth field measurement analysis of concentric boxes versus snow depth of South Brush Creek SNOTEL for March/29/2009 in 95 percent confidence limit

	0-200m		200-400m		400-600m		600-800m		800-1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	96.52 ± 2.39		96.52 ± 2.39		96.52 ± 2.39		96.52 ± 2.39		96.52 ± 2.39	
C050[b]	80.13 ± 10.76	SNOTEL	81.48 ± 16.26	SNOTEL	87.79 ± 15.45	SNOTEL	86.85 ± 20.29		89.29 ± 16.33	
C100	75.25 ± 10.40	SNOTEL	84.27 ± 16.31	SNOTEL	88.85 ± 10.57		88.56 ± 20.11		90.58 ± 17.09	
C200	*****		89.83 ± 5.81		85.44 ± 11.89		82.21 ± 21.91	SNOTEL	90.21 ± 19.04	
A050	79.18 ± 11.51	SNOTEL	81.96 ± 13.34	SNOTEL	89.59 ± 12.92		85.47 ± 16.38		87.43 ± 15.02	
A100	78.65 ± 14.14	SNOTEL	83.40 ± 15.25	SNOTEL	90.08 ± 9.08		86.59 ± 15.03		88.33 ± 15.83	
A200	*****		87.20 ± 8.80		89.49 ± 10.04		80.46 ± 16.55	SNOTEL	88.49 ± 16.80	
F050	81.84 ± 10.90	SNOTEL	81.68 ± 13.80	SNOTEL	88.69 ± 13.59		85.78 ± 16.35		86.94 ± 15.46	
F100	79.42 ± 13.25	SNOTEL	83.85 ± 14.49	SNOTEL	88.80 ± 9.72		85.52 ± 14.58		88.55 ± 15.94	
F200	*****		86.50 ± 10.76		87.59 ± 10.57	SNOTEL	79.67 ± 15.66	SNOTEL	88.95 ± 17.26	
T050	76.84 ± 11.99	SNOTEL	82.07 ± 13.72	SNOTEL	89.90 ± 13.27		85.62 ± 17.93		88.54 ± 15.62	
T100	76.75 ± 13.96	SNOTEL	83.24 ± 16.12	SNOTEL	90.95 ± 8.54		88.32 ± 17.44		88.85 ± 16.87	
T200	*****		88.78 ± 6.20		90.04 ± 9.72		81.83 ± 19.63	SNOTEL	88.60 ± 18.28	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

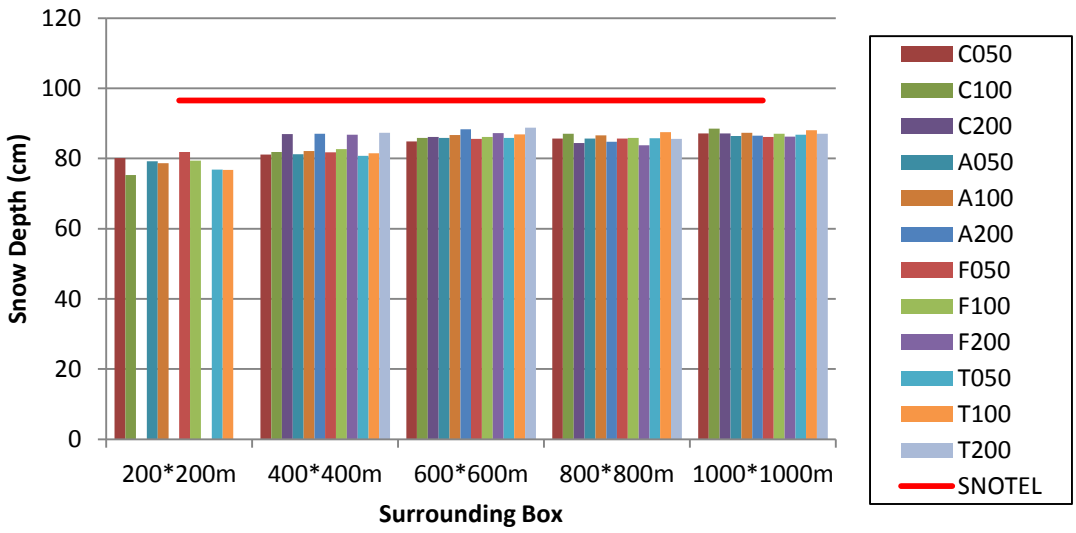

Figure I-7 snow depth field measurement analysis of surrounding boxes versus snow depth of South Brush Creek SNOTEL for March/29/2009 (Refer to Table A-1 for clarification of abbreviations)

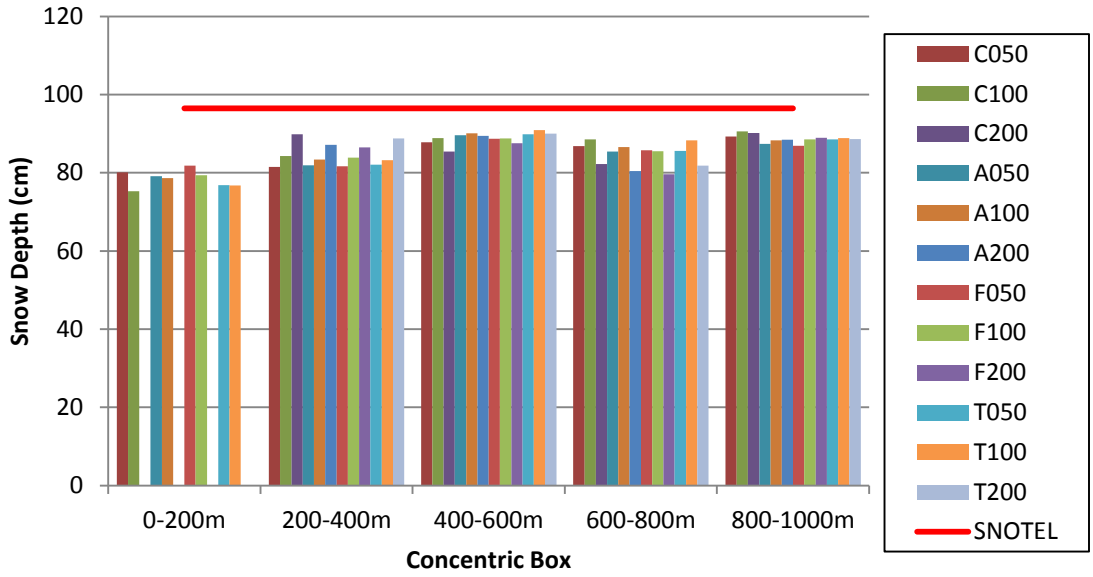

Figure I-8 snow depth field measurement analysis of Concentric boxes versus snow depth of South Brush Creek SNOTEL for March/29/2009 (Refer to Table A-1 for clarification of abbreviations)

Table I-9 statistical analyses of transects versus transects of each specific sampling date for South Brush Creek SNOTEL station in 95 percent confidence level

	4/5/2008		3/1/2009		3/29/2009	
	Mean ± STD (cm)[a]	**SID[b]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
Transect 1	*****	*****	80.38 ± 12.48	T2, T4	87.35 ± 16.84	
Transect 2	*****	*****	87.17 ± 12.30	T1, T7, T8	87.77 ± 20.09	
Transect 3	*****	*****	85.21 ± 9.02	T7	92.89 ± 15.38	T9
Transect 4	*****	*****	87.41 ± 10.22	T1, T7, T8	84.10 ± 16.56	
Transect 5	*****	*****	84.21 ± 12.63	T7	84.21 ± 12.63	
Transect 6	*****	*****	85.51 ± 12.86	T7	85.51 ± 12.86	
Transect 7	*****	*****	76.97 ± 9.81	T2, T3, T4, T5, T6, T9	84.98 ± 15.42	
Transect 8	*****	*****	79.58 ± 8.11	T2, T4, T9	88.71 ± 9.50	
Transect 9	*****	*****	86.75 ± 10.14	T7, T8	82.46 ± 14.13	T3
Transect 10	*****	*****	83.48 ± 10.39		84.12 ± 15.77	

T is transect

Table I-10 statistical analyses of surrounding boxes versus surrounding boxes of each specific sampling date for South Brush Creek SNOTEL station in 95 percent confidence level

	4/5/2008		3/1/2009		3/29/2009	
	Mean ± STD (cm)[a]	**SID[b]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
200*200m	90.75 ± 3.82		81.84 ± 10.90		81.84 ± 10.90	
400*400m	87.67 ± 21.01		81.51 ± 9.65		81.72 ± 12.94	
600*600m	95.74 ± 19.05		83.16 ± 10.83		85.61 ± 13.66	
800*800m	96.87 ± 16.48		83.53 ± 10.64		85.68 ± 14.84	
1000*1000m	*****	*****	83.80 ± 11.14		86.17 ± 15.06	

B is surrounding box

Table I-11 statistical analyses of concentric boxes versus concentric boxes of each specific sampling date for South Brush Creek SNOTEL station in 95 percent confidence level

	4/5/2008		3/1/2009		3/29/2009	
	Mean ± STD (cm)[a]	**SID[b]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
0-200m	90.75 ± 3.82		81.84 ± 10.90		81.84 ± 10.90	
200-400m	86.43 ± 25.04	CB600, CB800	81.41 ± 9.47		81.68 ± 13.80	
400-600m	100.09 ± 16.75	CB400	84.41 ± 11.59		88.69 ± 13.59	
600-800m	98.68 ± 11.35	CB400	84.02 ± 10.46		85.78 ± 16.35	
800-1000m	*****	*****	84.24 ± 11.96		86.94 ± 15.46	

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

CB is concentric box

Figure I-9 SD difference between transects and South Brush Creek SNOTEL station in each sampling date (F050 minus SNOTEL)

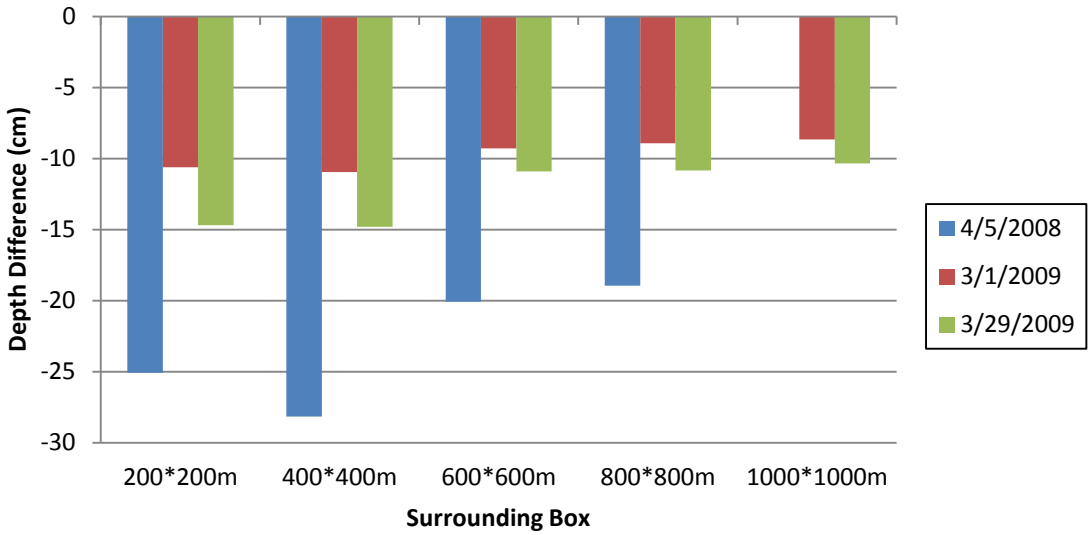

Figure I-10 SD difference between surrounding boxes and South Brush Creek station in each sampling date (F050 minus SNOTEL)

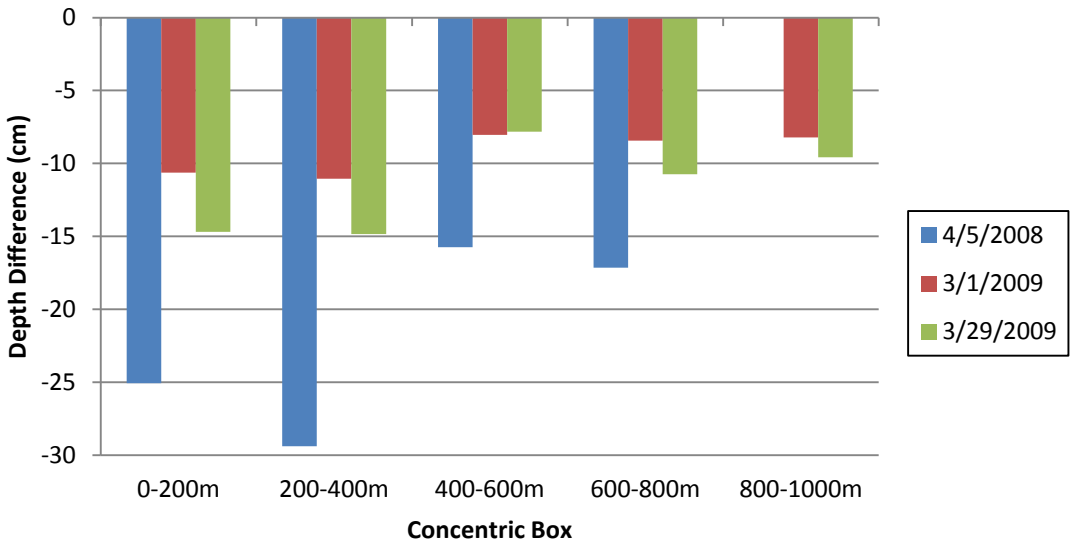

Figure I-11 SD difference between concentric boxes and South Brush Creek SNOTEL station in each sampling date (F050 minus SNOTEL)

Table I-12 Statistical analyses of average SD of 3, 5, and 10 transects versus SD of South Brush Creek SNOTEL station in 95 percent confidence level

	3/01/2009		Mar/29/2009	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**
SNOTEL	92.46 ± 2.14	all, even, odd, thr	96.52 ± 2.39	all, even, odd, thr
10 transects (all)	83.80 ± 11.14	SNOTEL	86.17 ± 15.06	SNOTEL
Transects 2, 4 , 6, 8, 10 (even)	84.71 ± 11.05	SNOTEL	86.03 ± 15.13	SNOTEL
Transects 1, 3, 5, 7, 9 (odd)	82.87 ± 11.20	SNOTEL	86.32 ± 15.05	SNOTEL
Transects 1, 5, 10 (thr)	82.69 ± 11.80	SNOTEL	85.17 ± 14.99	SNOTEL

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

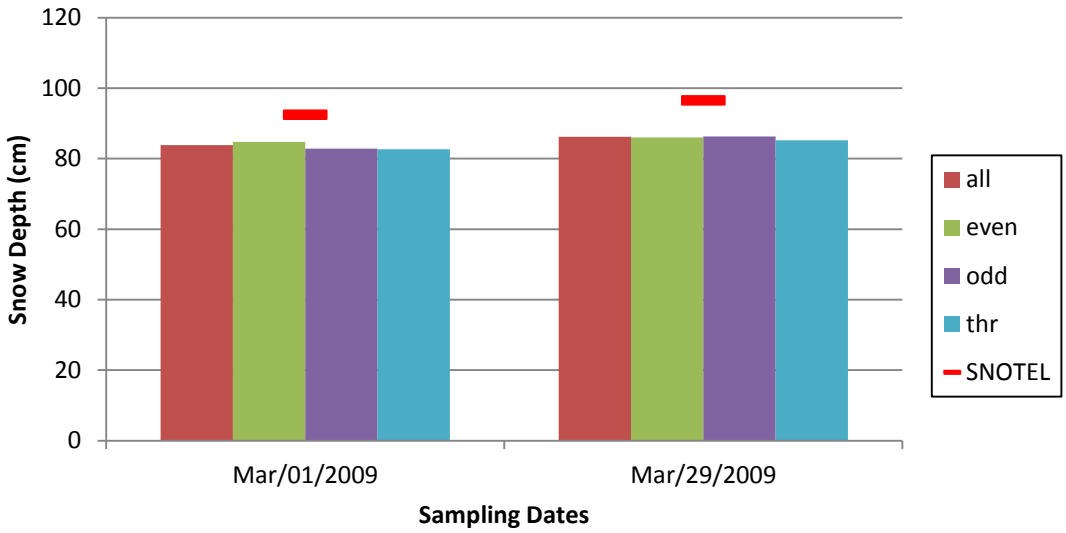

Figure I-12 average SD of 3, 5, and 10 transects versus SD of South Brush Creek SNOTEL station (Refer to column 1 of Table I-12 for definitions)

Table I-13 statistical analyses of intra annual for sampling dates of South Brush Creek SNOTEL in 95 percent confidence level

	2009 versus 2009	
	Mean ± STD (cm)[a]	**SID[b]**
3/1/2009	83.79 ± 11.14	
3/29/2009	86.16 ± 15.06	
	2008 versus 2009	
4/5/2008	96.87 ± 16.47	3/29/2009
3/29/2009	86.89 ± 14.47	4/5/2008

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

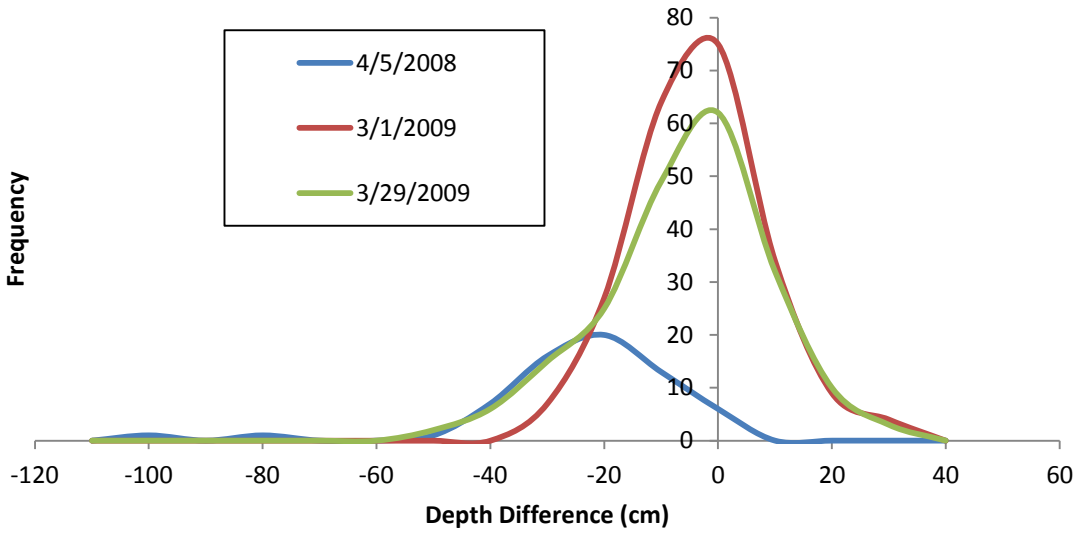

Figure I-13 frequency of the SD difference between field sampling and SD of the South Brush Creek SNOTEL station for each sampling date

Appendix J: Togwotee Pass SNOTEL station statistical analyses results

Table J-1 a snow depth of field measurement analyzing of transects versus snow depth of Togwotee Pass SNOTEL station for March/17/2009in 95 percent confidence limit

	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	*****		*****		205.99 ± 0.80		205.99 ± 0.80		205.99 ± 0.80	
C050[b]	*****		*****		179.25 ± 37.98	SNOTEL	170.93 ± 32.11	SNOTEL	144.06 ± 53.09	SNOTEL
C100	*****		*****		183.22 ± 39.43		166.00 ± 41.67	SNOTEL	146.33 ± 58.43	SNOTEL
C200	*****		*****		186.80 ± 15.61		173.80 ± 26.77	SNOTEL	141.00 ± 47.90	SNOTEL
A050	*****		*****		181.30 ± 26.38	SNOTEL	165.75 ± 22.54	SNOTEL	142.49 ± 45.87	SNOTEL
A100	*****		*****		181.73 ± 28.69		158.53 ± 27.20	SNOTEL	147.18 ± 47.65	SNOTEL
A200	*****		*****		179.28 ± 22.59		162.56 ± 14.04	SNOTEL	146.32 ± 45.98	SNOTEL
F050	*****		*****		181.86 ± 26.80	SNOTEL	166.13 ± 28.51	SNOTEL	142.58 ± 46.53	SNOTEL
F100	*****		*****		183.11 ± 28.63		153.54 ± 32.42	SNOTEL	145.52 ± 49.80	SNOTEL
F200	*****		*****		183.60 ± 16.54		156.20 ± 10.16	SNOTEL	144.13 ± 46.82	SNOTEL
P050	*****		*****		180.06 ± 31.04	SNOTEL	167.09 ± 24.36	SNOTEL	142.92 ± 49.22	SNOTEL
P100	*****		*****		180.85 ± 32.89		166.00 ± 29.36	SNOTEL	148.55 ± 49.04	SNOTEL
P200	*****		*****		177.47 ± 28.49		172.67 ± 24.04	SNOTEL	146.73 ± 45.52	SNOTEL

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table J-1 b snow depth of field measurement analyzing of transects versus snow depth of Togwotee Pass SNOTEL station for March/17/2009in 95 percent confidence limit

	Transect 6		Transect 7		Transect 8		Transect 9		Transect 10	
	Mean ± STD (cm)[a]	SID[c]	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID	Mean ± STD (cm)	SID
SNOTEL	205.99 ± 0.80		205.99 ± 0.80		205.99 ± 0.80		205.99 ± 0.80		*****	
C050[b]	187.12 ± 37.72		178.59 ± 16.69	SNOTEL	178.69 ± 30.59	SNOTEL	192.67 ± 49.53		*****	
C100	184.33 ± 24.47		176.56 ± 19.26	SNOTEL	177.11 ± 35.97	SNOTEL	195.50 ± 59.07		*****	
C200	187.00 ± 25.83		172.60 ± 21.98		174.80 ± 43.83		*****		*****	
A050	174.73 ± 24.91	SNOTEL	170.75 ± 34.63	SNOTEL	171.53 ± 26.53	SNOTEL	189.64 ± 34.36		*****	
A100	175.64 ± 25.24	SNOTEL	169.27 ± 44.18	SNOTEL	170.04 ± 32.27	SNOTEL	199.30 ± 29.06		*****	
A200	178.24 ± 31.64		186.32 ± 37.91		167.92 ± 40.76	SNOTEL	*****		*****	
F050	176.02 ± 27.24	SNOTEL	173.55 ± 25.92	SNOTEL	174.04 ± 25.59	SNOTEL	189.19 ± 38.03		*****	
F100	177.07 ± 22.18	SNOTEL	170.89 ± 31.04	SNOTEL	171.41 ± 30.08	SNOTEL	192.50 ± 39.04		*****	
F200	176.33 ± 28.50		181.60 ± 32.89		171.13 ± 38.30	SNOTEL	*****		*****	
P050	177.57 ± 27.54	SNOTEL	170.57 ± 35.90	SNOTEL	171.40 ± 31.33	SNOTEL	191.11 ± 35.46		*****	
P100	177.11 ± 29.19	SNOTEL	170.07 ± 46.77	SNOTEL	171.04 ± 37.88	SNOTEL	204.84 ± 28.30		*****	
P200	183.07 ± 33.45		186.47 ± 37.10		167.00 ± 45.83	SNOTEL	*****		*****	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

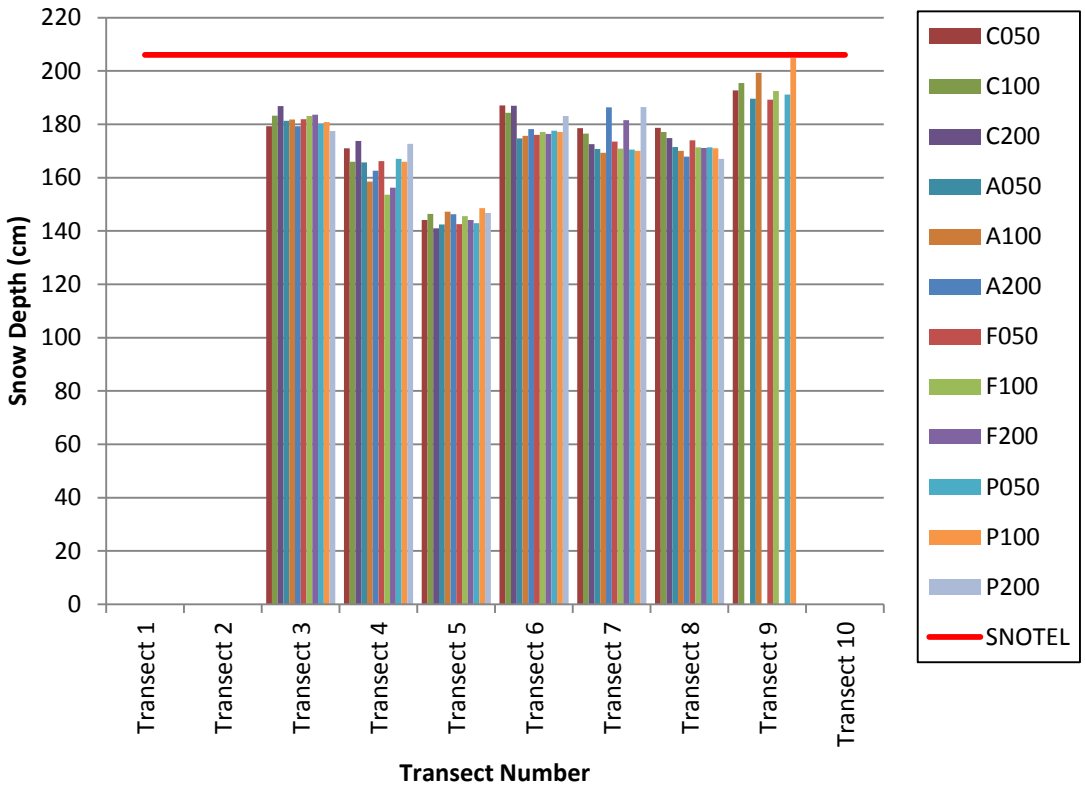

Figure J-1 snow depth field measurement of transects versus snow depth of Togwotee Pass SNOTEL station for March/17/2009 (Refer to Table A-1 for clarification of abbreviations)

Table J-2 snow depth field measurement analysis of surrounding boxes versus snow depth of Togwotee Pass SNOTEL for March/17/2009in 95 percent confidence limit

	200*200m		400*400m		600*600m		800*800m		1000*1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	205.99 ± 0.80		205.99 ± 0.80		205.99 ± 0.80		205.99 ± 0.80		*****	
C050[b]	184.63 ± 16.78	SNOTEL	159.75 ± 40.44	SNOTEL	170.50 ± 40.62	SNOTEL	174.97 ± 39.14	SNOTEL	*****	
C100	175.75 ± 13.84	SNOTEL	163.75 ± 42.02	SNOTEL	171.45 ± 43.86	SNOTEL	174.00 ± 40.44	SNOTEL	*****	
C200	*****		166.00 ± 32.55	SNOTEL	173.50 ± 38.93	SNOTEL	175.72 ± 34.79	SNOTEL	*****	
A050	184.93 ± 20.17	SNOTEL	158.08 ± 36.71	SNOTEL	164.53 ± 36.96	SNOTEL	169.73 ± 33.32	SNOTEL	*****	
A100	172.40 ± 19.74	SNOTEL	160.16 ± 33.99	SNOTEL	163.40 ± 39.55	SNOTEL	169.48 ± 35.90	SNOTEL	*****	
A200	*****		166.13 ± 30.63	SNOTEL	168.15 ± 34.67	SNOTEL	172.29 ± 33.70	SNOTEL	*****	
F050	186.33 ± 17.60	SNOTEL	159.57 ± 37.28	SNOTEL	165.91 ± 37.57	SNOTEL	170.88 ± 33.45	SNOTEL	*****	
F100	173.50 ± 13.58	SNOTEL	159.06 ± 35.18	SNOTEL	163.02 ± 39.23	SNOTEL	168.95 ± 35.04	SNOTEL	*****	
F200	*****		163.29 ± 33.05	SNOTEL	165.13 ± 36.28	SNOTEL	171.07 ± 32.25	SNOTEL	*****	
P050	183.42 ± 23.63	SNOTEL	157.14 ± 39.34	SNOTEL	165.13 ± 39.34	SNOTEL	170.33 ± 35.87	SNOTEL	*****	
P100	172.42 ± 27.45	SNOTEL	162.46 ± 37.00	SNOTEL	166.46 ± 41.98	SNOTEL	171.51 ± 38.42	SNOTEL	*****	
P200	*****		168.92 ± 29.41	SNOTEL	172.96 ± 35.35	SNOTEL	174.66 ± 36.03	SNOTEL	*****	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

Table J-3 snow depth field measurement analysis of concentric boxes versus snow depth of Togwotee Pass SNOTEL for March/17/2009in 95 percent confidence limit

	0-200m		200-400m		400-600m		600-800m		800-1000m	
	Mean ± STD (cm)[a]	**SID[c]**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**	**Mean ± STD (cm)**	**SID**
SNOTEL	205.99 ± 0.80		205.99 ± 0.80		205.99 ± 0.80		205.99 ± 0.80		*****	
C050[b]	184.63 ± 16.78	SNOTEL	151.46 ± 42.80	SNOTEL	181.97 ± 38.19		181.27 ± 36.47	SNOTEL	*****	
C100	175.75 ± 13.84	SNOTEL	159.75 ± 47.81	SNOTEL	179.67 ± 45.71		177.04 ± 36.58	SNOTEL	*****	
C200	*****		159.17 ± 35.16	SNOTEL	181.00 ± 45.39		177.94 ± 31.23	SNOTEL	*****	
A050	184.93 ± 20.17	SNOTEL	149.13 ± 36.85	SNOTEL	171.41 ± 36.59	SNOTEL	177.06 ± 26.04	SNOTEL	*****	
A100	172.40 ± 19.74	SNOTEL	156.08 ± 37.37	SNOTEL	166.85 ± 45.71		176.72 ± 30.16	SNOTEL	*****	
A200	*****		158.57 ± 32.11	SNOTEL	170.18 ± 40.35	SNOTEL	176.44 ± 33.29	SNOTEL	*****	
F050	186.33 ± 17.60	SNOTEL	150.65 ± 38.04	SNOTEL	172.67 ± 37.31	SNOTEL	177.88 ± 25.37	SNOTEL	*****	
F100	173.50 ± 13.58	SNOTEL	154.25 ± 39.20	SNOTEL	167.24 ± 43.98	SNOTEL	176.03 ± 28.43	SNOTEL	*****	
F200	*****		156.39 ± 36.02	SNOTEL	166.96 ± 41.49	SNOTEL	177.02 ± 27.52	SNOTEL	*****	
P050	183.42 ± 23.63	SNOTEL	148.37 ± 39.94	SNOTEL	173.67 ± 38.15	SNOTEL	177.64 ± 29.22	SNOTEL	*****	
P100	172.42 ± 27.45	SNOTEL	159.14 ± 40.17	SNOTEL	170.73 ± 47.66	SNOTEL	177.53 ± 33.49	SNOTEL	*****	
P200	*****		160.95 ± 29.75	SNOTEL	177.00 ± 42.15		176.35 ± 37.77	SNOTEL	*****	

a Values represent mean ± Standard Deviation

b Refer to Table A-1 for clarification of abbreviations

c Significant difference, blank column means there is no significant difference

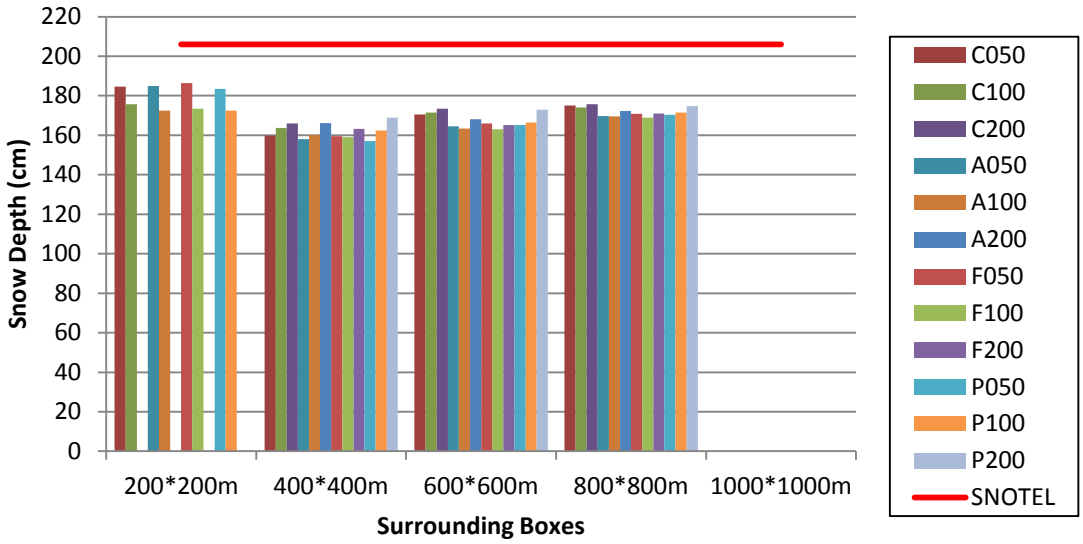

Figure J-2 snow depth field measurement analysis of surrounding boxes versus snow depth of Togwotee Pass SNOTEL for March/17/2009 (Refer to Table A-1 for clarification of abbreviations)

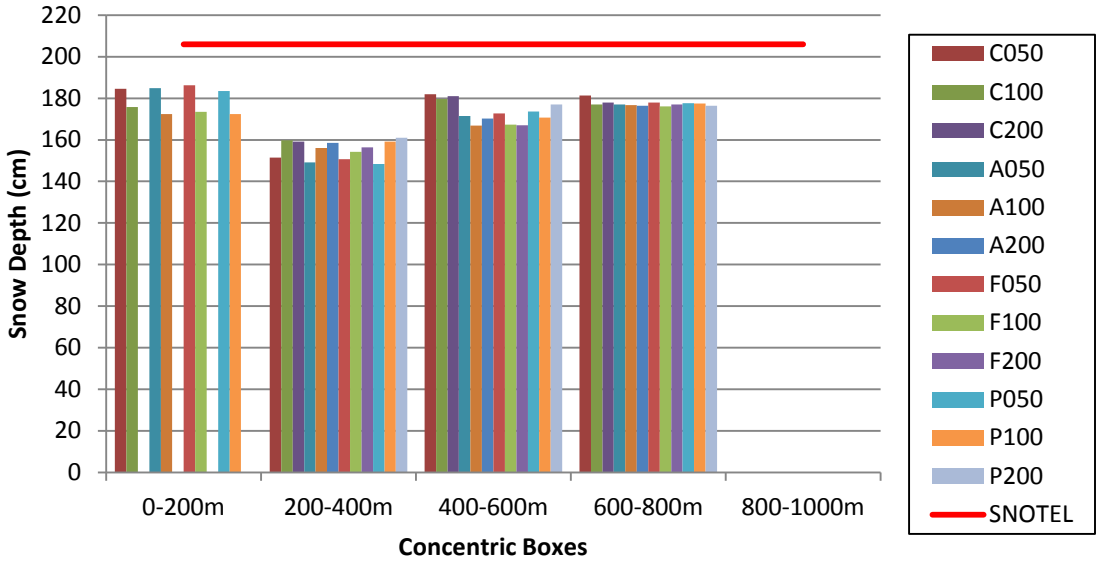

Figure J-3 snow depth field measurement analysis of Concentric boxes versus snow depth of Togwotee Pass SNOTEL for March/17/2009 (Refer to Table A-1 for clarification of abbreviations)

Table J-4 statistical analyses of transects versus transects of March/17/2009 sampling date for Togwotee Pass SNOTEL station in 95 percent confidence level

	Mean ± STD (cm)[a]	**SID[b]**
Transect 1	*****	*****
Transect 2	*****	*****
Transect 3	181.86 ± 26.80	T5
Transect 4	166.13 ± 28.51	T5
Transect 5	142.58 ± 46.53	T3, T4, T6, T7, T8, T9
Transect 6	176.02 ± 27.24	T5
Transect 7	173.55 ± 25.92	T5
Transect 8	174.04 ± 25.59	T5
Transect 9	189.19 ± 38.03	T5
Transect 10	*****	*****

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

T is transect

Table J-5 statistical analyses of surrounding boxes versus surrounding boxes of March/17/2009 for Togwotee Pass SNOTEL station in 95 percent confidence level

	Mean ± STD (cm)[a]	**SID[b]**
200*200m	186.33 ± 17.60	
400*400m	159.57 ± 37.28	
600*600m	165.91 ± 37.57	
800*800m	170.88 ± 33.45	
1000*1000m	*****	*****

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

Table J-6 statistical analyses of concentric boxes versus concentric boxes of March/17/2009 for Togwotee Pass SNOTEL station in 95 percent confidence level

	Mean ± STD (cm)[a]	SID[b]
0-200m	186.33 ± 17.60	CB400[c]
200-400m	150.65 ± 38.04	CB200, CB600, CB600
400-600m	172.67 ± 37.31	CB400
600-800m	177.88 ± 25.37	CB400
800-1000m	*****	*****

a Values represent mean ± Standard Deviation

b Significant difference, blank column mean there is no significant difference

CB is a concentric box

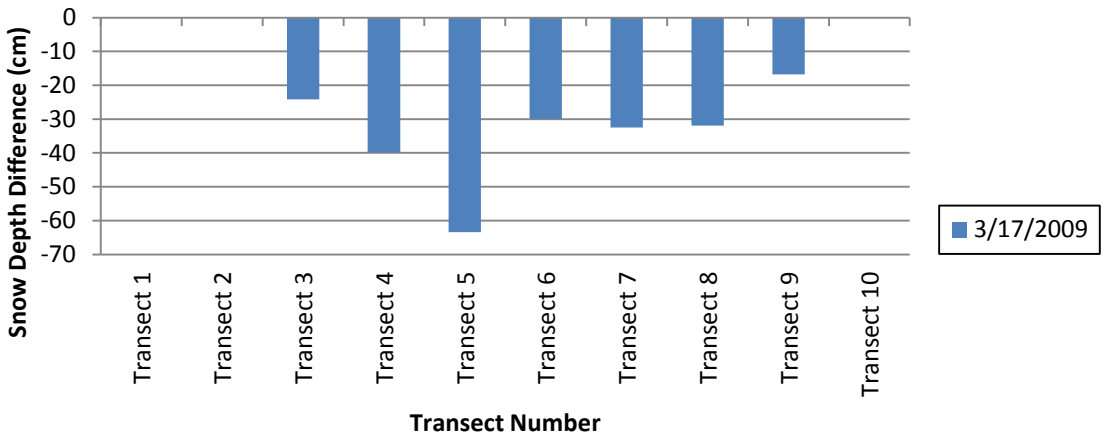

Figure J-4 SD difference between transects and Togwotee Pass SNOTEL station in March/17/2009 (F050 minus SNOTEL)

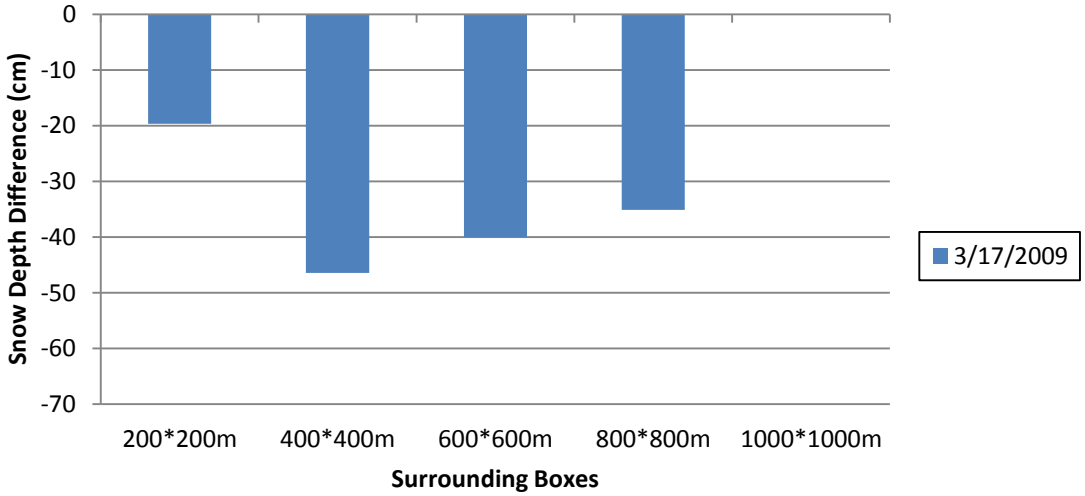

Figure J-5 SD difference between surrounding boxes and Joe Togwotee Pass station in March/17/2009 (F050 minus SNOTEL)

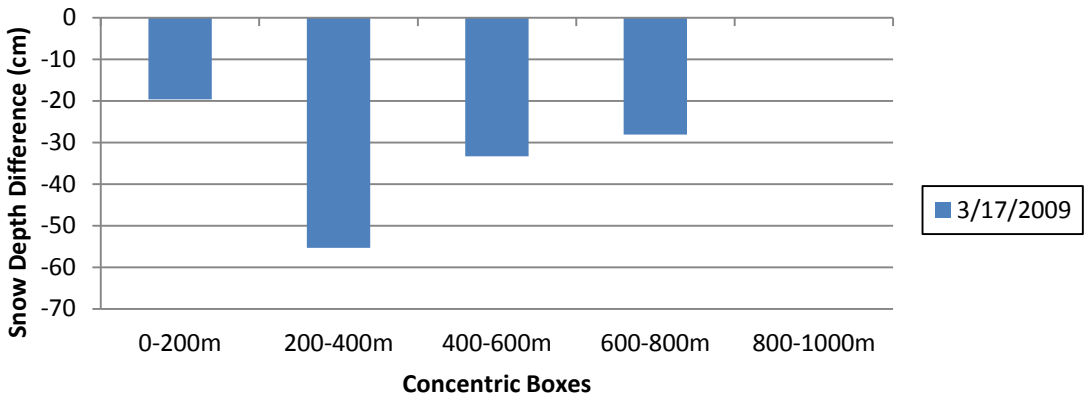

Figure J-6 SD difference between concentric boxes and Togwotee Pass SNOTEL station in March/17/2009 (F050 minus SNOTEL)

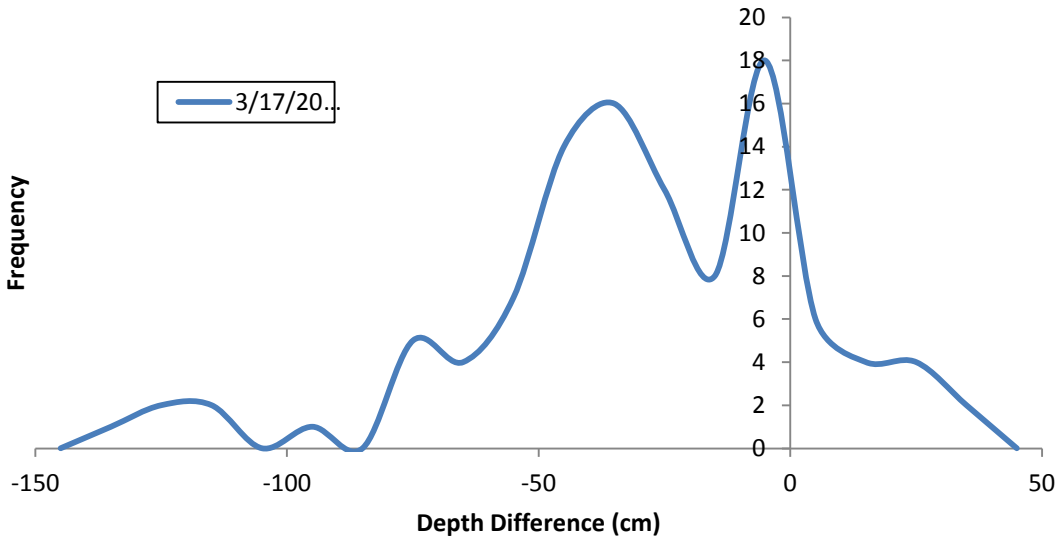

Figure J-7 frequency of the SD difference between field sampling and SD of the Togwotee Pass SNOTEL station for March/17/2009