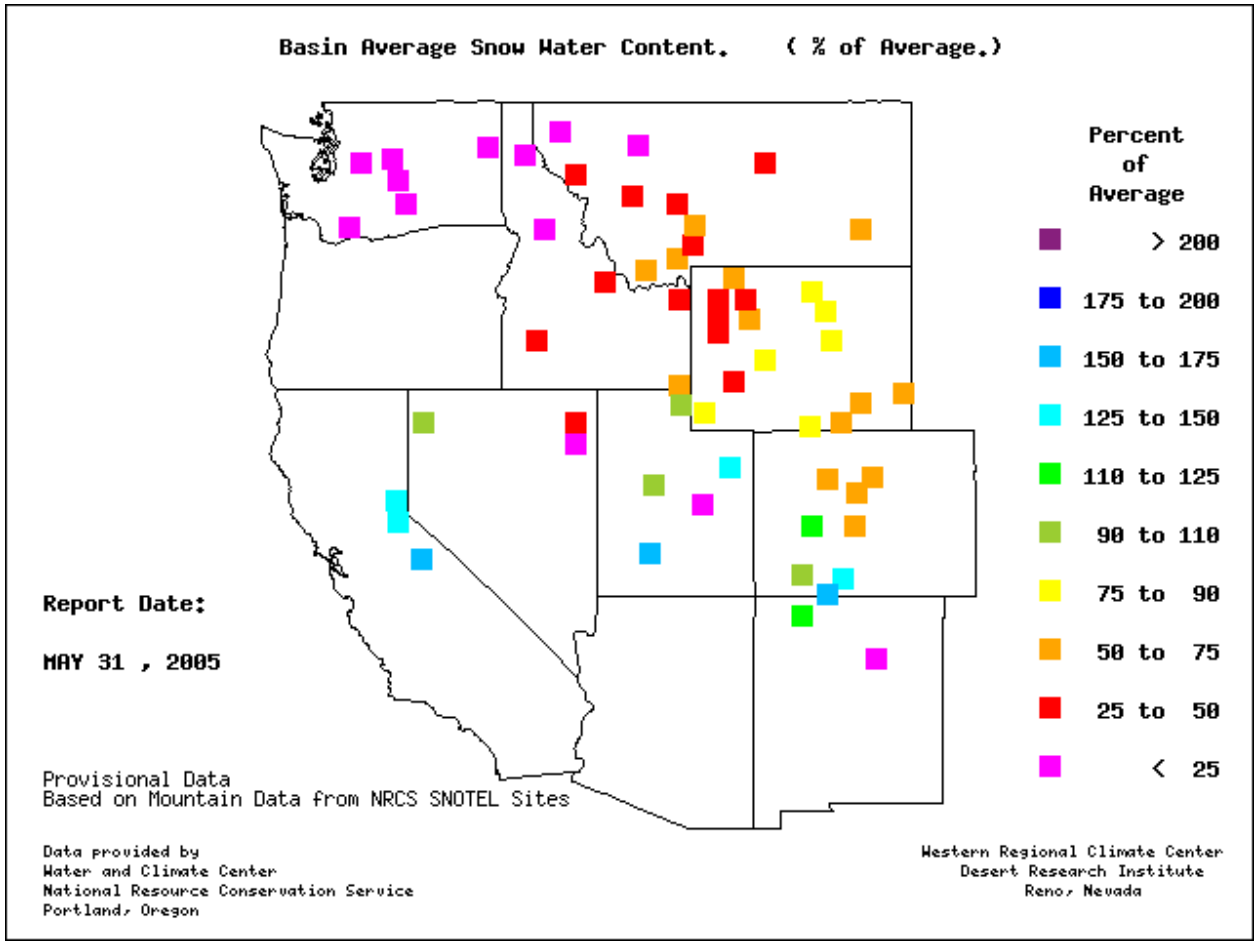
Northwest Weather and Avalanche Center



2004-2005 Annual Report

Report prepared by Mark Moore, Kenny Kramer and Garth Ferber

A partnership between the USDA Forest Service, Washington State Parks and Recreation Commission, Washington State Snowpark and Snowmobile Programs, Washington State Department of Transportation, National Weather Service, National Park Service, Pacific Northwest Ski Area Association, USDA-FS Fee-demo Program, County Title II RAC Program, Friends of the Avalanche Center and others.

United States Department of Agriculture

Forest Service Pacific Northwest Region

Cover Photo credits:

This graphic of snow water content courtesy WRCC (Western Region Climate Center) in the mountain west as of May 31, 2005 is indicative of the recent 2004-05 winter. Note that the remaining snowpack throughout much of the Northwest remains at or below 50% of average while those in Washington State appear in the purple or less than 25% of average. Meanwhile above average or well above average water contents persist in much of the Southwest where heavy snowfall pummeled the area for a good part of the winter.

Northwest Weather and Avalanche Center
2004-05 Annual Report

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NORTHWEST WEATHER AND AVALANCHE CENTER

A partnership between the USDA Forest Service, Washington State Parks and Recreation Commission, National Park Service, National Weather Service, Pacific Northwest Ski Area Association, Washington State Department of Transportation, Washington State Snowpark and Snowmobile Programs, USDA Forest Service Fee Demo programs, Title II RAC programs, Ski Schools, Friends of the Avalanche Center and others.

ANNUAL REPORT—2004-2005 SEASON

Report prepared by Mark Moore, Kenny Kramer and Garth Ferber in May 2005.

A Message From the Director – What a year! It's difficult to think of appropriate adjectives that describe the past winter, or non-winter as some would say, but dismal, abysmal and unreal come to mind as many areas in the Cascades and Olympics posted record low or near record-low snow depths. Although some early season snowfall and two early season fatalities indicated that winter's arrival was imminent in late Fall 2004, this was not to be the case even though special statements were issued on November 23-25 and daily forecasting began the following week on December 3. Large and persistent splits in the main westerly flow by early-mid December continued and expanded in January, ill omens for even worsening and strengthening splits or ridges to come. For much of the season during the normally maximum snow accumulation months of January, February and March, most Northwest mountain locations observed way too much in the form of dirt, rocks, ground and grasses while further to the south and east much of the Sierras, Wasatch and southern Rockies received record setting snowfall of a more positive variety. A weak El Niño was initially blamed on the unusual conditions, but in February and March the extreme conditions (continued drought in the Northwest and expansive flooding in the Southwest) were considered as inconsistent with a weak El Nino and other factors were considered (see the discussion below). For whatever reason, the announced drought like conditions in the Northwest did not abate until almost April and despite some late season recovery in late March through early May, the snowpack and water supply remained well below normal. As a result, the NWAC operated in a reduced forecasting mode for much of February and March, issuing intermittent forecasts whenever weakened storm remnants actually reached the area. This reduction helped to limit and conserve forecast expenditures and most effectively spend the gradually dwindling overall funding that the Center is receiving.

While 26 avalanche fatalities occurred in the US during this most unusual of winters (through mid-May), the lack of storms and snowfall helped limit both avalanche

involvements and fatalities locally. This is not to say that the Northwest did not have a weak and unstable snowpack at times—in fact, during much of the mid-winter drought months field snowpack observations indicated some of the weakest snowpack structure on record including a well developed depth hoar layer that in more normal years would have produced a very significant avalanche problem. However, owing to subsequent rain events and the evolution of the late winter and spring which produced rather cool and intermittently wet conditions for April and May, this fragile and potentially damaging snowpack was never able to achieve its true potential. At least we have some things to be thankful for with the past winter.

The continued high public usage of all NWAC products and services during this marginal winter (see below) attests to the value of the program and importance of our mission. Several million hits (2.67 million) on data and forecast products is up slightly from the record setting numbers achieved during the more normal winter of 2003-04, this despite the meager winter and a changeover to a new more graphical web site with new Internet address (www.nwac.us). Along with an increase in the educational efforts accomplished this year, this success reflects well on our dedicated staff of professional weather and avalanche forecasters and on the cooperators whose past support has helped make this avalanche safety program what it has become today. Unfortunately, in addition to the normal efforts to promote public safety through the daily forecasting and data network operations, an increasing amount of work continues to be dedicated toward maintaining program funding. Recent past funding efforts have been rewarded by expanded support from PNSAA, County Title II RAC and USFS Fee Demo programs over the past few years, and such increases have helped to plug holes and minimize program cutbacks. However, current and projected reductions and/or flat support levels from several federal and state agencies will continue to challenge the program, and such funding deficiencies may limit NWAC operations in the immediate future.—Mark Moore, NWAC Director

NWAC MISSION STATEMENT

Even during this past (being very generous) relatively light winter, NWAC staff and the NWAC program as a whole remain committed to a single mission: To reduce the impacts of adverse mountain weather and avalanches on recreation, industry and transportation in Washington and northern Oregon through data collection, forecasting and education. As in the past, this promotion of public safety been and is accomplished by providing cooperating agencies and the public with:

- Mountain Weather Data
- Mountain Weather Forecasts
- Avalanche Forecasts
- Education
- Applied Research and Technology

How to get NWAC mountain weather and avalanche forecast information:
http://www.nwac.us
206-526-6677 (Seattle Hotline)

503-808-2400 (Portland Hotline)

How to reach us for other information:
Northwest Weather and Avalanche Center
7600 Sandpoint Way NE
Seattle, WA 98115
206-526-6164 (office); 206-526-4666 (messages)
nwac.sew@noaa.gov

Note that a more complete version of this mission statement is available on our web site.

OPERATIONS SUMMARY

Forecast staff at the NWAC are employed by the USDA-Forest Service from mid September through mid-June. The following is a summary of the main NWAC tasks during the 3 distinct parts of our season:

Pre-Season (mid September to mid November):

- Attend and provide input and instruction at the International Snow Science Workshop or National Avalanche School.
- Finalize and initiate annual operating plan.
- Office preparation especially of forecasting and weather station computers.
- Weather data network installation, upgrades and repairs.
- Preliminary mountain weather forecasting for ski areas, WSDOT.

Winter Season (mid November to mid April):

- Provide daily mountain weather and avalanche consultations to ski areas, WSDOT crews and other cooperating agencies, starting at 3:30 am, 7 days a week.
- Prepare and disseminate twice daily public mountain weather forecasts (7 am) and daily avalanche forecasts (9 am) 7 days a week; provide updates and special statements as necessary.
- NWAC weather station repairs; ensure reliable and highest quality data on the web site.
- Gather first hand snow pack information and snow pack information from others; integrate into avalanche forecasts.
- Provide avalanche awareness presentations as requested.
- Prepare and update web site pages with accident reports & statistics, climatological snowdepth and other educational information.

Post Season (mid April to mid June):

- Continue to provide mountain weather and avalanche consultations as funding allows to cooperating agencies, such as WSDOT crews at Washington and Chinook passes.
- Issue special avalanche statements when necessary.
- NWAC weather station upgrades or repairs; continue to provide hourly weather data via web site.

- Prepare for annual meeting and issue annual report.
- Plan operations for next season.

INFORMATION EXCHANGE

INCOMING INFORMATION:

Through the winter NWAC forecasters rely on incoming information and data to make accurate assessments of current mountain weather and avalanche observations. This information comes from the following sources:

- **Observer Network**: The forecaster at the NWAC receives daily weather and avalanche observations via telephone from most ski areas, WSDOT crews at Stevens and Snoqualmie, and observers at Hurricane Ridge and Paradise on Mt Rainier.
- **Backcountry Observations**: The NWAC makes as much use as possible of available back country snow and avalanche observations via phone calls and messages, the new FOAC Snow pack Information Exchange, and sources on the Internet such as the Turns-All-Year.com web page.
- **NWAC Weather Stations:** The NWAC currently maintains or helps maintain 42 weather stations located at NPS, WSDOT and ski area sites at Hurricane Ridge in the Olympics and in many locations throughout the Cascade Mountains. These stations provide temperature, relative humidity, wind, precipitation and snowfall information automatically via phone and radio connections.
- **National Weather Service:** NWAC staff has access to all products and expertise of the Seattle WFO (Weather Forecast Office of the National Weather Service).

OUTGOING INFORMATION:

The NWAC distributes mountain weather and avalanche information via the following means:

- **Phone Consultations**: daily with most ski areas, DOT crews at Stevens and Snoqualmie Passes, and observers at Paradise.
- **Public Hotline Recordings**: in Seattle and Portland 5049 calls this season (see chart below), a number that continues to dwindle as the Internet accesses increase. Also, the mountain weather forecast recording—whose usage had dwindled to less than 100 for the season—was discontinued this year after being in existence for over 20 years.
- **Internet**: This season we had over 327,000 hits on the Mountain Weather Forecasts, 210,000 hits on the Avalanche Forecasts, 2,128,000 on the weather station data, with another 7+ million files served on the NWAC web site. As shown in Figure 1, weekly product access ranged up to 100,000-120,000 hits per week and peaked at around 160,000 (solely on data and forecast products). When viewing Figure 2 below, keep in mind that the NWAC web site became operational in 1996 for forecast access alone. Availability of and access to hourly weather data were added in 1998.
- **NOAA Seattle Weatherwire**: A total of five (5) Avalanche Warnings and/or Special Statements were sent to the media via the Weatherwire this season, well under the average of around 23/year.

- **Search and Rescue Assistance:** The NWAC provides weather and avalanche forecast assistance to County Search and Rescue teams every season.
- 16 years of **archived NWAC mountain weather station data** should be available this year from WRCC and are available upon request from the Avalanche Center.

Figure 1. Weekly forecast and data access on NWAC web site.

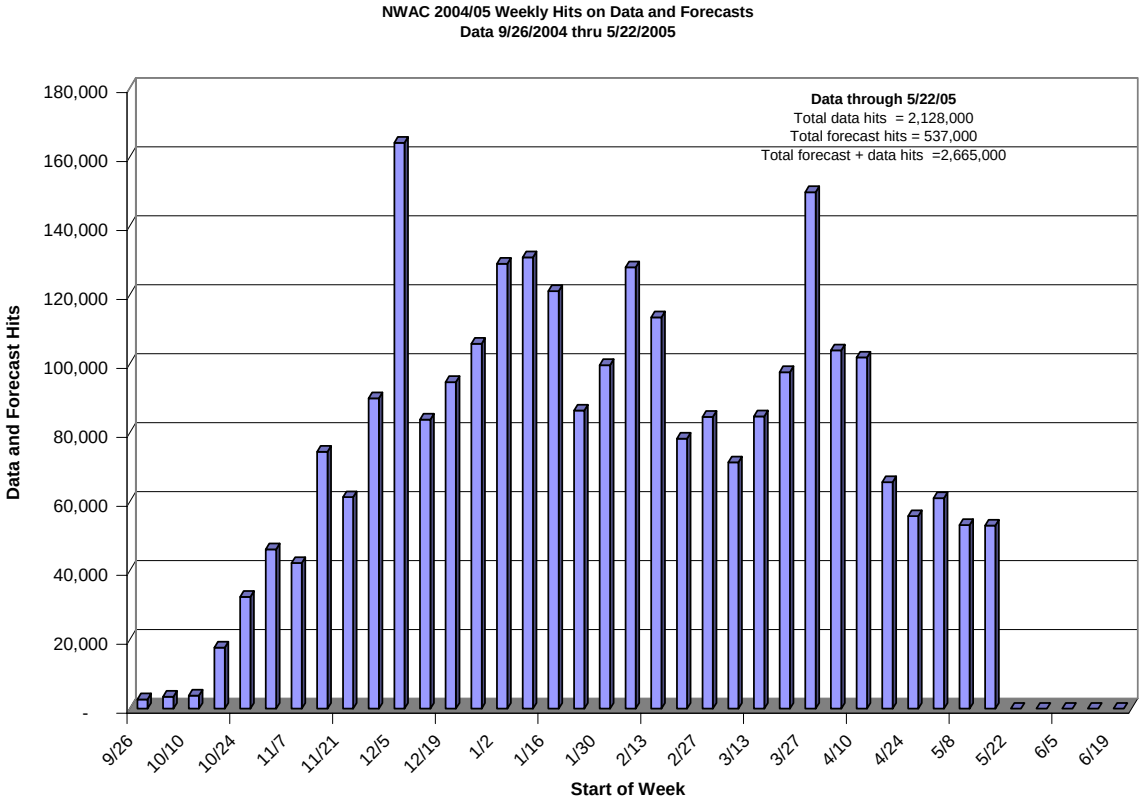
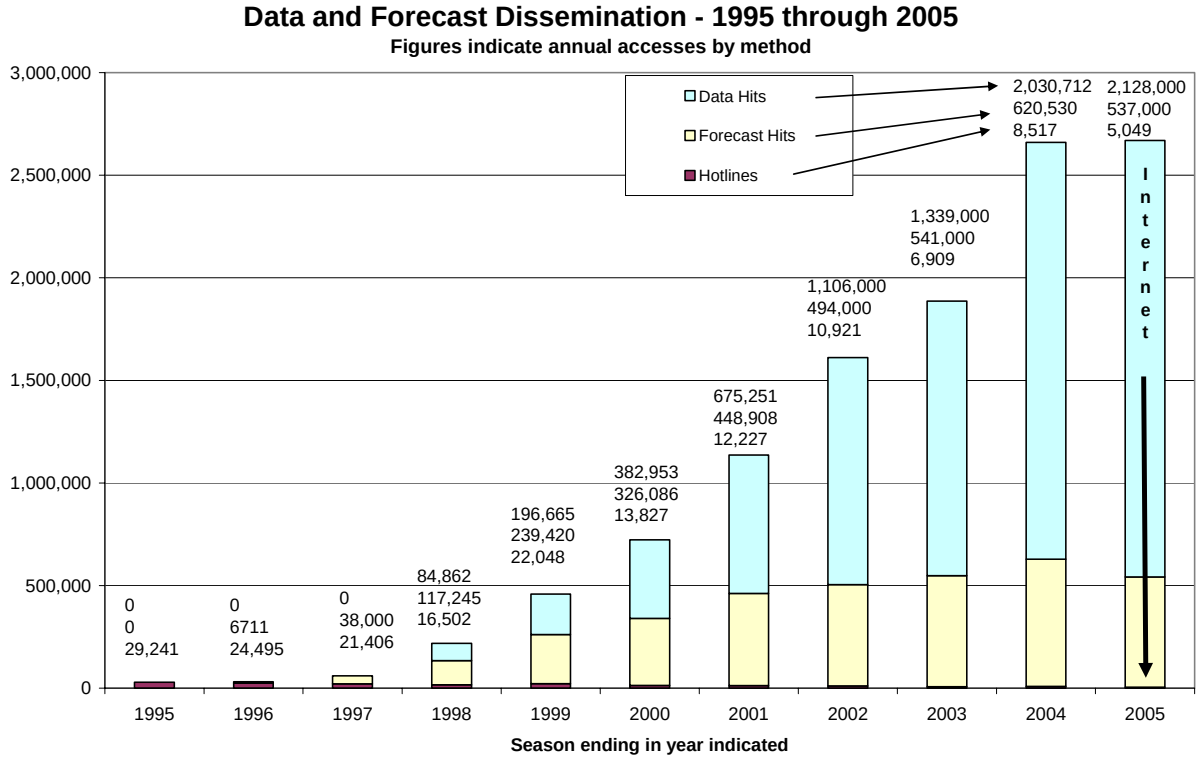


Figure 2. NWAC data and forecast dissemination over the past 11 years.



2004-2005 WINTER WEATHER AND AVALANCHE SUMMARY

Heavy rainfall over the Thanksgiving Day weekend put a damper on any early start to winter, and after some avalanche activity mainly at higher elevations (summarized and forecast in several early season special avalanche statements issued just before the Thanksgiving Day weekend), the rainfall helped to stabilize or melt much of the low elevation snowpack. The NWAC began normal daily forecasting on December 3, 2004, several weeks later than average due to the overall persistent dry and mild conditions recurring during most of the fall. This start of regular forecasting in early December was prompted by a temporary beginning to winter when most areas received significant snowfall. Many west slope areas received 2 to 4 feet of snow from about the 4th through the 9th of December. However, this would prove to be an anomalous trend as warming with heavy rains returned later in December.

An informal discussion regarding the ominous Northwest weather pattern was held in early December at the NWS. At this meeting the Science and Operations Officer (SOO) Dr. Brad Colman suggested that the Pacific Northwest would be experiencing a weather pattern shift within about two weeks. Brad talked about the potential for an overall stable upper level ridge of high pressure to become established along the coast regions of the Pacific Northwest. He was exactly correct as within about two weeks we had significant rain followed by an extensive warm and dry period that extended into late December. Then with the exception of about a two

week cold period the Northwest indeed remained under the influence of the dominant upper ridge for a majority of the winter.

With the exception of moderate storm cycles in mid January, the second week of February and again in mid March, the Pacific Northwest continued to be dominated by the northern branch of a persistent split flow in the Pacific westerlies. This resulted in a ridge of high pressure off the Pacific Northwest coast and a strong southern branch flow that brought unusually heavy snowfall to the California Sierras throughout the winter months. In the Northwest, this highly abnormal winter weather pattern produced predominantly sunny and mild weather with mountain vistas reminiscent of mid-summertime conditions and temperatures in the lowlands frequently soaring into the upper sixties and seventies! Some comments on this unusual western weather pattern were prepared by Mark Moore in February and published in *The Avalanche Review*. Some excerpts follow—

WINTER WEATHER PATTERN COMMENTS

Whenever the winter weather is unusual in one place it's normally unusual in lots of places, since the patterns of ridges and troughs that encircle both hemispheres are all connected. And that connection extends all the way from the western US into the tropics and subtropics: enter El Niño. Although what atmospheric, oceanic or cosmic aberration is to blame for particularly unusual of nasty weather can be a hot topic, and El Niño often becomes the culprit, we must also take into account that a variety of cyclical or other long term weather factors may be acting to influence seasonal, annual or more long term weather patterns, including the Pacific Decadal Oscillation (PDO), Global Warming, the Madden-Julian Oscillation (MJO) etc. That said, for this short discussion we'll concentrate on El Niño and whether or not it is to blame.

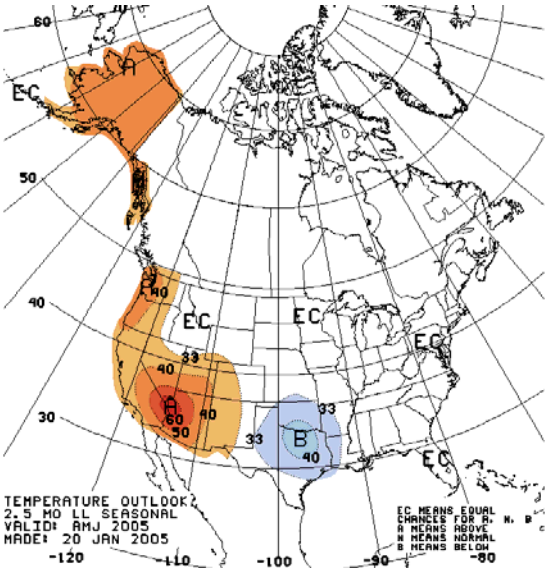
Although the atmospheric mechanisms and adjustments that result from this unusual or periodic eastward warming (El Niño) of the equatorial tropical Pacific can be unreliable or inconsistent, depending on the strength of the warming episode, these adjustments can nevertheless exert a significant though not easily forecast influence on winter weather in the US. As most of us have realized by the way our various snowpacks have evolved, or not evolved this winter, each region is being blessed with an unusual though very different snowpack from both the norm and from each other. And whenever we have these unusual snowpacks we have unusual snowpack conditions from which may stem some or perhaps even many of the avalanche incidents that have engulfed us so far this winter. Are such conditions attributable to what most professional climatologists term a weak warming event (see discussion below)? While some might argue that such conditions may be directly associated with El Niño, the official word from the Climate Prediction Center (http://www.cpc.ncep.noaa.gov/products/predictions/long_range/fxus05.html) on January 20th is that the current warm event should have only a limited influence on the remainder of the winter and that at least some of the unusual circulations observed thus far this year are not typical of El Niños:

> *This El Niño should have only a very limited influence on the US Climate for the remainder of the cool season. Central Pacific El Niños in the past such as in 1963-64, 1968-69 and 2002-03 have a much less reliable signal than basin-wide El Niños where warm SST's extend to the South American coast.*
>
> *The US temperature response to Central Pacific El Niños is usually colder than normal over the southeast with a slight tendency for wet conditions across the Southern US. Recent heavy precipitation in California in early January is the result of unusual circulation patterns in the North Pacific Ocean that are not typical of El Niños. Early January precipitation patterns observed in Florida and the Ohio Valley are opposite of the*

usual El Niño signals, further suggesting that conditions in the first half of January are due to unusual circulation patterns unrelated to El Niño.

During significant warm episode events, one of the effects of El Niño and the associated increased transfer of heat from certain equatorial regions toward the poles is to develop an abnormal and relatively strong southern branch of the jetstream in the eastern Pacific Ocean. To achieve this result, the Coriolis force from the rotating earth acts to deflect the unusually strong northward flow of upper level air from the equator toward the right, or toward the east in this context. This suptropical jetstream enhances westerly flow and moisture across much of the southern tier of the US, and intermittently tends to split the jetstream off the west coast. Such a split can and often does encourage development of a semi-persistent upper level ridge along either in the Gulf of Alaska or along the west coast, depending on the magnitude and eastward extent of the underlying tropical warming. The results of all of these atmospheric adjustments can result in periodic oscillations between the two preferred branches of the westerly flow—that is, between heavy precipitation and warming in the southern branch and colder and drier in the northern branch. And we all know what that swing can bring, and has brought to us this winter. In the southern Intermountain and southern Rockies, this has resulted in periods of heavy loading of that unstable bag of potato chips, while in the Northwest, and across the northern Intermountain and northern Rockies, an unusually cold, weak and shallow snowpack for the early part of the winter has been recently loaded and/or replaced by a much higher density snow (can you say 100%) and a rather warm, fuzzy, wet feeling.

How long will this unusualness persist? Although no definite projections are possible for such long terms (I personally feel uncomfortable with forecasts extending beyond a few minutes because of the Unusual Factor), during most recent winters in which a weak El Niño has been a factor, the effects of the warming episode have waned considerably during the latter part of the winter and spring. So the odds are that we're more likely than not to return to a more normal flow pattern by springtime. But once again the question is when exactly, and what's normal anyway, since in some areas of the west it seems like spring now? The National Weather Service long range forecasts for precipitation for most regions of the US tends toward equal chances (EC) or climatology in the spring, but a bias continues toward warmer than normal temperatures in the April-June time frame (see temperature outlook below and look on the web at http://www.cpc.ncep.noaa.gov/products/predictions/long_range/lead03/off_index.html to view the most current temperature and precipitation outlook.



But then what's normal except a series of unusual events averaged out over time? Unfortunately this can paint a pretty good picture about reliability of long term forecasts...especially during a weak event such as this winter is. Current teleconnections (global correlations of weather patterns) just don't have much predictability when you're dealing with a weak warm episode. Whatever weather association there is with this weak El Niño, it may persist for a few more weeks or as long as few more months. To quote the National Center for Environmental Prediction/Climate Prediction Center's ENSO Diagnostic Discussion issued on January 6, 2005

(http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/index.html links to the most recent ENSO discussion):

> *Based on the recent evolution of oceanic and atmospheric conditions and on a majority of the statistical and coupled model forecasts, it seems most likely that weak warm episode (El Niño) conditions will persist for at least the next three months. However, there is considerable uncertainty concerning future developments in the extreme eastern equatorial Pacific (the classical El Niño region).*

And how about the impacts of such continued warming?

> *Expected global impacts include drier-than-average conditions over portions of Indonesia (through early 2005), northern and northeastern Australia (through February 2005), and southeastern Africa (through March 2005). If the warming in the tropical Pacific strengthens and spreads eastward to the South American coast, then wetter-than-average conditions would be expected in coastal sections of Ecuador and northern Peru during March-April 2005, and drier-than-average conditions would be expected to develop in Northeast Brazil during February through April 2005. Expected US impacts during Northern Hemisphere winter include warmer- than-average conditions in the West and in the northern Plains, and cooler- and wetter-than-average conditions for portions of the South and Southeast.*

Unfortunately we have a rather limited database of such events from which to predict future weather. If we had 1000 of these events to study, or at least something more statistically significant, maybe we could start to draw more conclusive correlations. So wherever you are and whatever your weather is, enjoy it, because it just might continue or it might change to something really good! An excellent and more detailed expert assessment of the unusually wet weather in the Southwest US during late December and early-mid January is available by clicking here or entering the link below in your web browser: http://www.cpc.ncep.noaa.gov/products/expert_assessment/california_assessment_2005.pdf.

But back to the Northwest "winter" discussion/summary which we'll pick up again in mid-late March, after late January through early March produced a series of continuing split flows and little or no precipitation in most Northwest areas.

As quickly as the drought conditions developed early in the season, they vanished in late March. A significant pattern change occurred in late March finally bringing the long awaited winter weather that many had all but given up on. The ridge was dramatically replaced by a series of upper level low pressure systems in the eastern north Pacific generating significant precipitation at low freezing levels. From mid March until mid April steady snowfall began to build the nearly nonexistent snowpack. Most stations doubled to nearly tripled their snow depths from mid March through mid April! Paradise on Mt Rainier received over 125 inches of snowfall during that 30 day period contrasted to only 20 inches of snowfall the previous 40 days! NWAC forecasters experienced mid-winter powder conditions in the Crystal Mountain backcountry as late as April 14th following another very cold snowfall with temperatures in the low 20's!

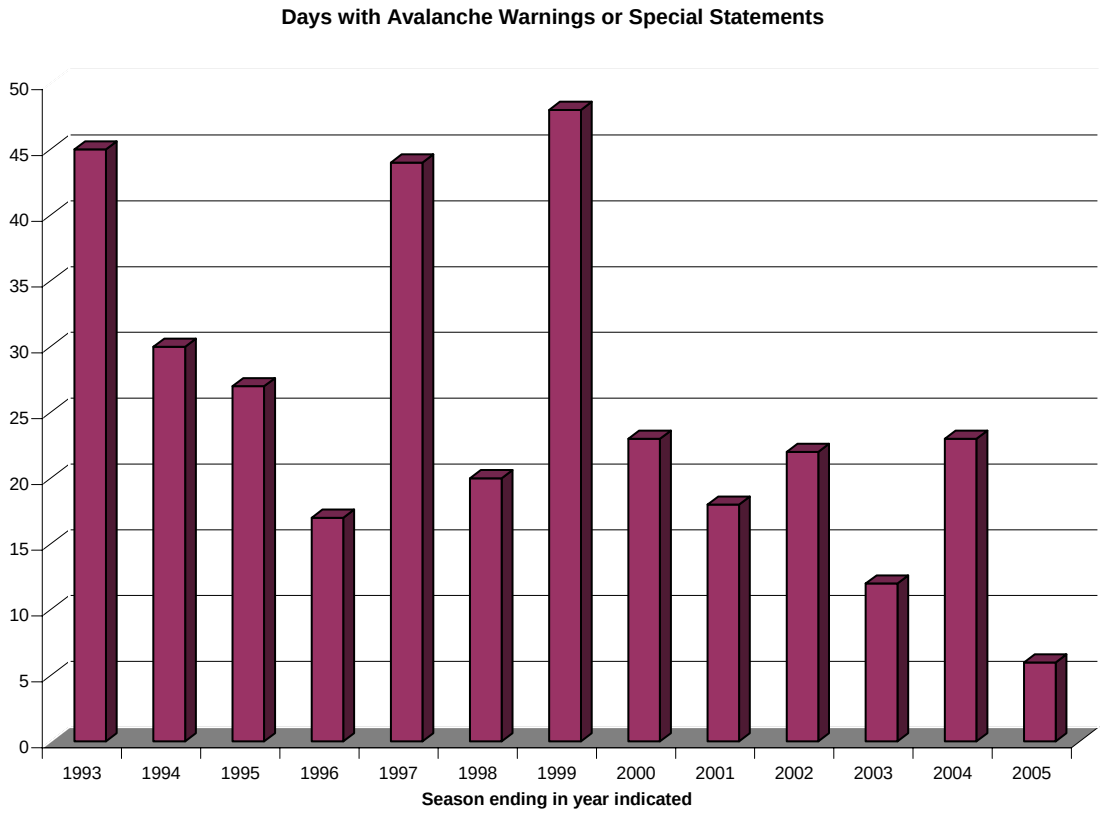
The late spring weather pattern in the Pacific Northwest was primarily influenced by continually reforming closed upper level low pressure systems over the region. These produced mostly unsettled showery weather with relatively low freezing levels. The lack of any period of extended high freezing levels so late in the spring punctuated the entirely unusual mountain weather season of 2004-05 in the Pacific Northwest.

Figure 3. Brittle skier-triggered wind slab from 1-13-05. Photo by Jon Andrews.

Despite the overall snowpack being at or near record low depths for much of the season, a period of very high avalanche danger developed near mid January resulting in an avalanche fatality at the closed Alpental Ski Area on January 12th, 2005. See details: http://www.nwac.us/documents/accidents/2004_2005/Alpental_01_12_05.htm. Along with an early season climbing related avalanche fatality on Mt Rainier in October, this brought the 2004-05 fatality total to two in the Northwest (see the Accidents summary below). The cold temperatures in early January and the shallow overall snow depths combined to create a very weak snow structure. Strong winds, moderate to heavy snowfall and warming late on the 11th and 12th of January led to unstable wind slabs deposited over a very weak snowpack. Besides the unfortunate fatality at Alpental, there were several close calls elsewhere in the Mt Baker ski area and backcountry, at Stevens Pass and Crystal Mountain. Figure 1 shows a triggered hard slab avalanche that was released at Stevens Pass on January 13th.

With summer-like weather returning for the bulk of the winter months from mid-January through late March, no additional avalanche warnings were issued. Only two late season special statements were issued and not until late May following a stormy period which saw water equivalents ranging from 6 to 8 inches over a two week period from about May 9th through the 22nd. These statements were issued primarily to warn climbers and skiers traveling to higher elevations on the volcanic peaks of the potential dangers. Indeed, there were several reports following the weekend of May 21-22 of both skiing and climbing parties changing their goals while out as a result of the perceived avalanche dangers. And on Sunday afternoon, the 23rd, several climbers venturing onto the shoulder of the North Sister near Bend, Oregon in the central Oregon Cascades triggered and were caught in a slide releasing within of just beneath the most recently deposited snow. Severe injuries were reported (including broken pelvis and ribs), but it is hoped that both victims suffering the most significant injuries will recover completely. While this incident occurred beyond the normal geographical range of NWAC forecast products, snowpack conditions may have been similar. In any case, it is hoped that the statements helped inform and prepare many of the areas springtime backcountry travelers, and helped them avoid additional avalanche incidents.

Figure 4. Days with Avalanche Warnings or Special Statements for the current and past seasons.



US AND NORTHWEST AVALANCHE ACCIDENT TRENDS

After an unusually high number of avalanche fatalities in Washington in 2003/04 (seven fatalities were the most in a season since five were claimed in the Northwest during the 1996/97 winter), only two fatalities occurred in 2004/05 through mid-May, 2005, and one of these was a very early season climbing fatality in October, 2004. While any fatalities are too many, it continues to be encouraging to see that the Northwest fatality total has not increased significantly over the past 30 years. In fact, the five year running mean of avalanche fatalities in the Northwest are running about a fatality less than they were in the early 1980's, a time when skiers were venturing beyond the boundaries of developed areas and into the back country in greatly increasing numbers. Overall the 26 avalanche fatalities nationwide (and 32 in North America, with six in BC) during this past season are slightly less than the 5-year running total of about 29 deaths per year in the US. Details on recent and past season avalanche accidents can be found at both www.nwac.us or at www.avalanche.org. Some key annual statistics are presented below.

Figure 5. Fatalities produced by natural disaster in Washington State, 1910-2003.

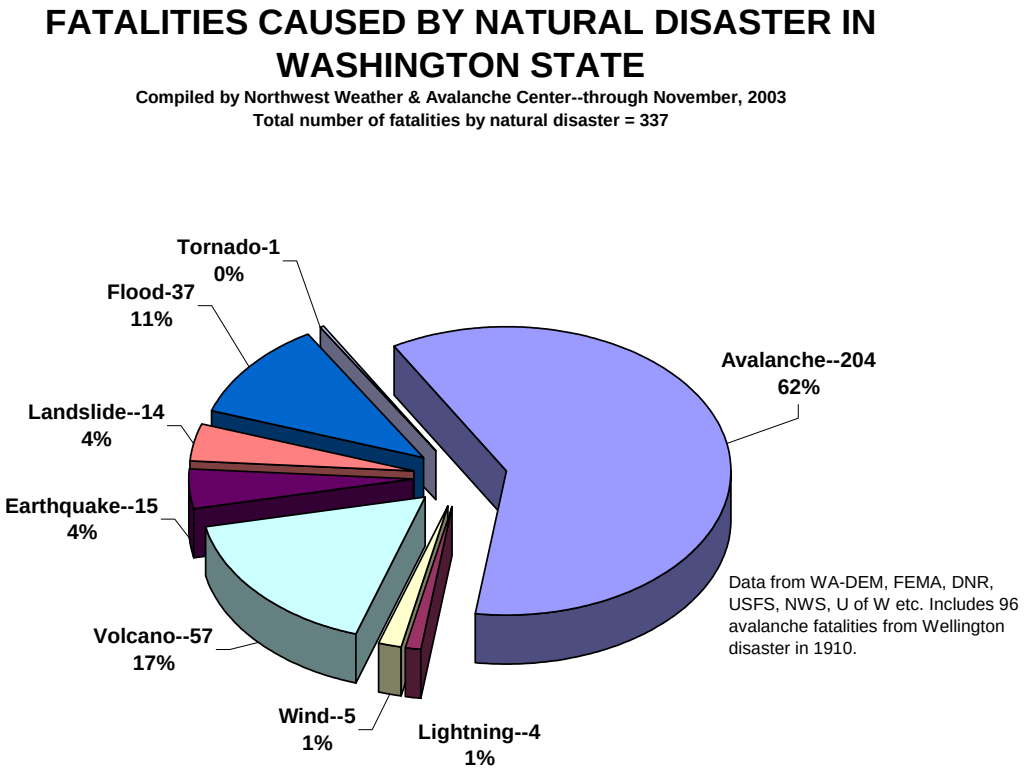


Figure 6. Annual US avalanche fatalities and 5-year moving average, 1950-2005.

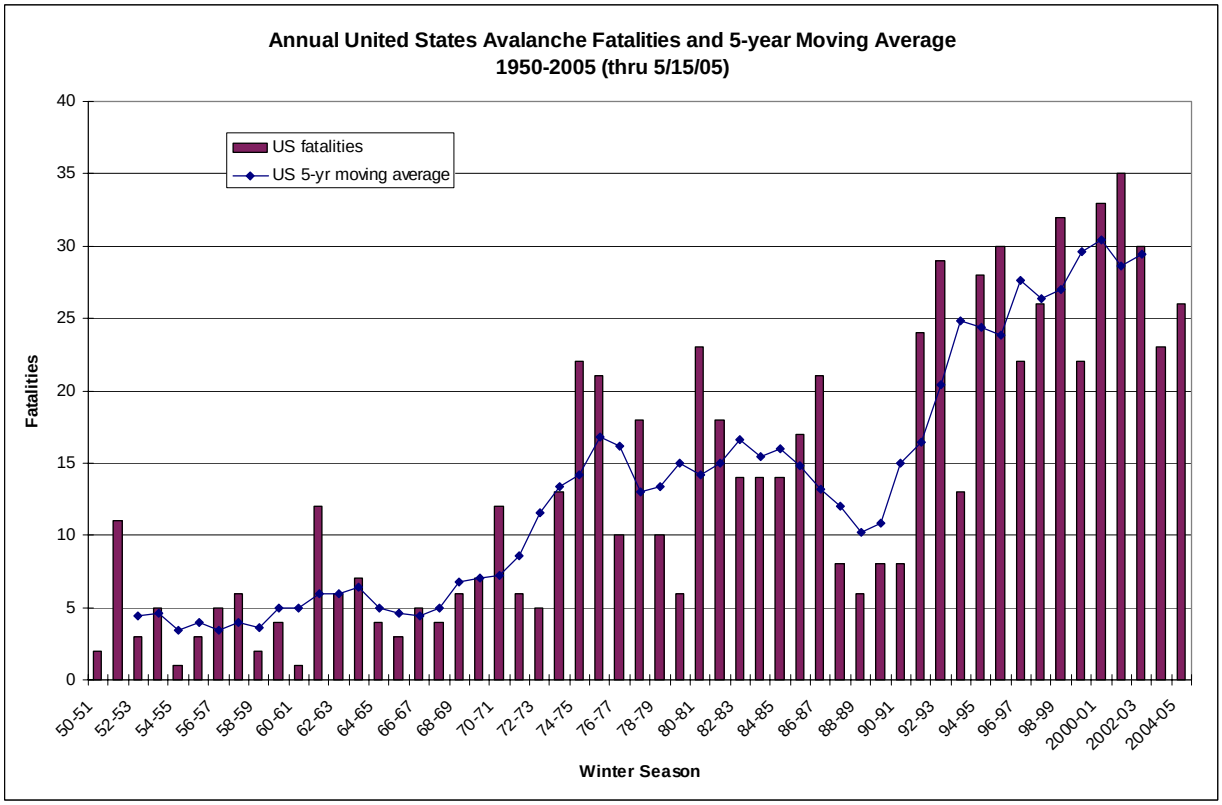


Figure 7. Annual US versus NW avalanche fatality chart (1976-2005)

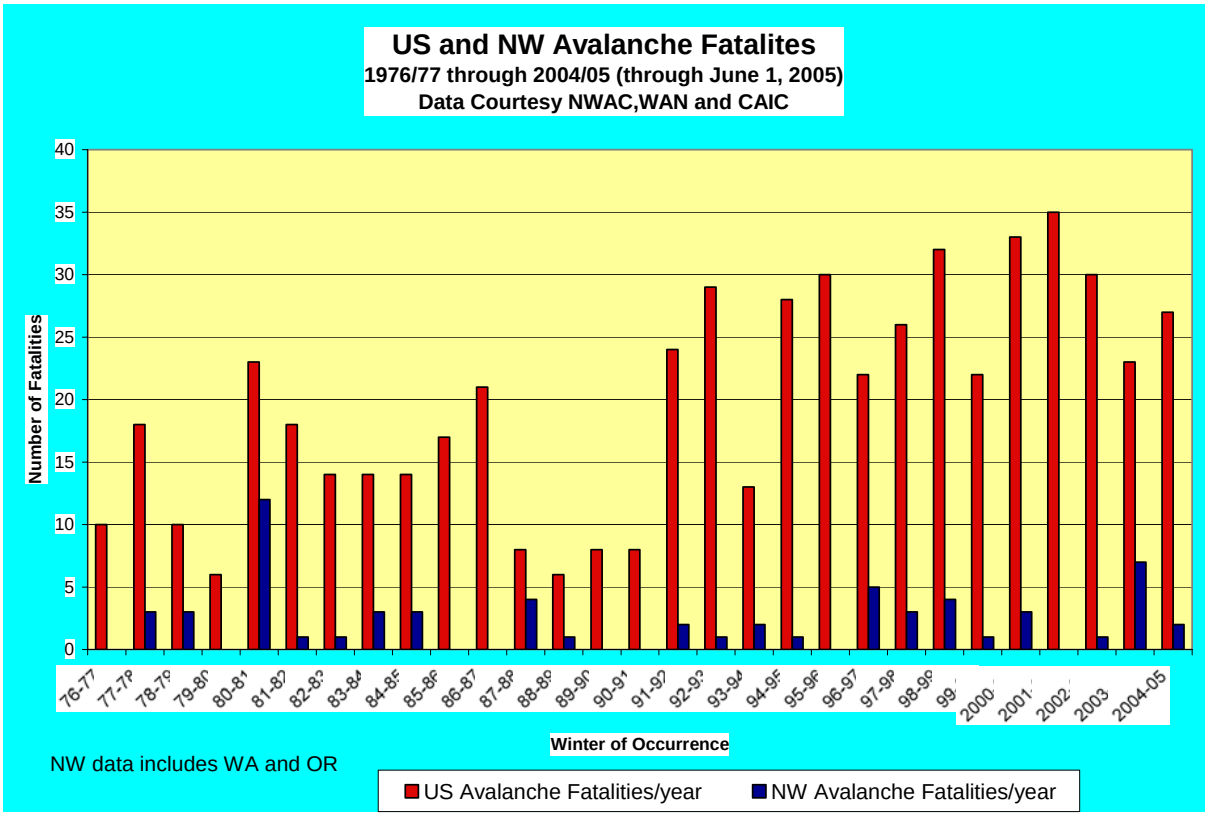
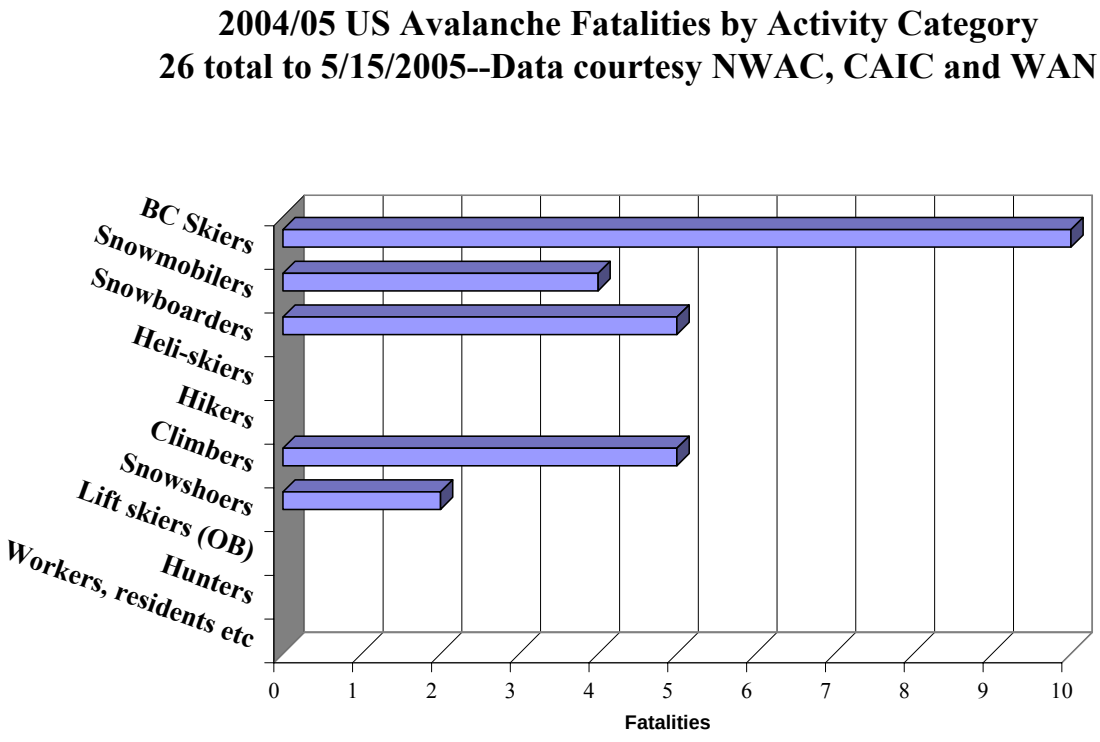


Figure 8. Annual US avalanche fatalities by category



2004-2005 SNOW PACK

Overall the snowpack started slow and remained well below normal during the 2004-05 season, as Pacific Northwest ski area operators are painfully aware. This was generally the worst winter for snowfall since the 1980-1981 and 1976-1977 seasons.

The storm cycle that was seen in early December caused a sharp increase in snow depths but this was followed by rain in late December. The moderate storm cycles in mid January and mid February are apparent as is the minor cycle in mid March. Finally the major storm cycle of late March to April caused snow depths to temporarily rise to about half of normal at many sites. But by 1 May that snow melted and consolidated all sites way remaining well normal especially at lower elevation sites such as Snoqualmie.

Figure 9. Current versus climatological snowdepth--Mt Baker

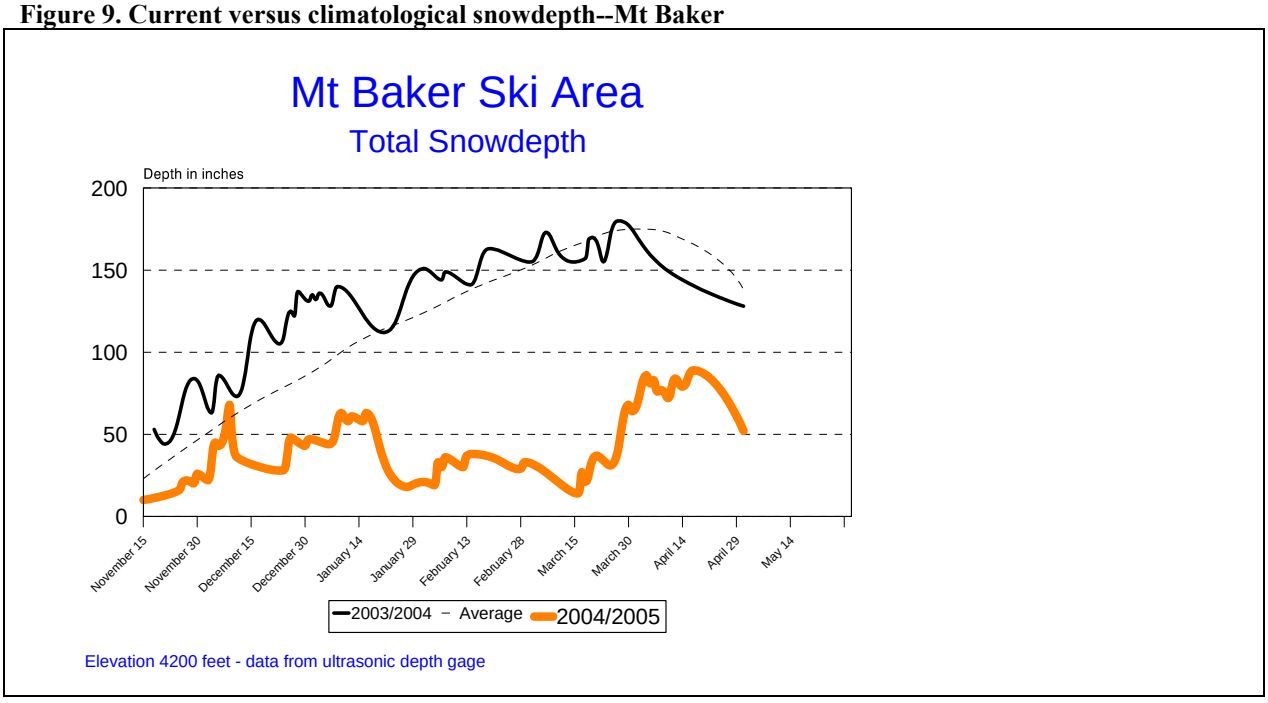


Figure 10. Current versus climatological snowdepth--Timberline Lodge

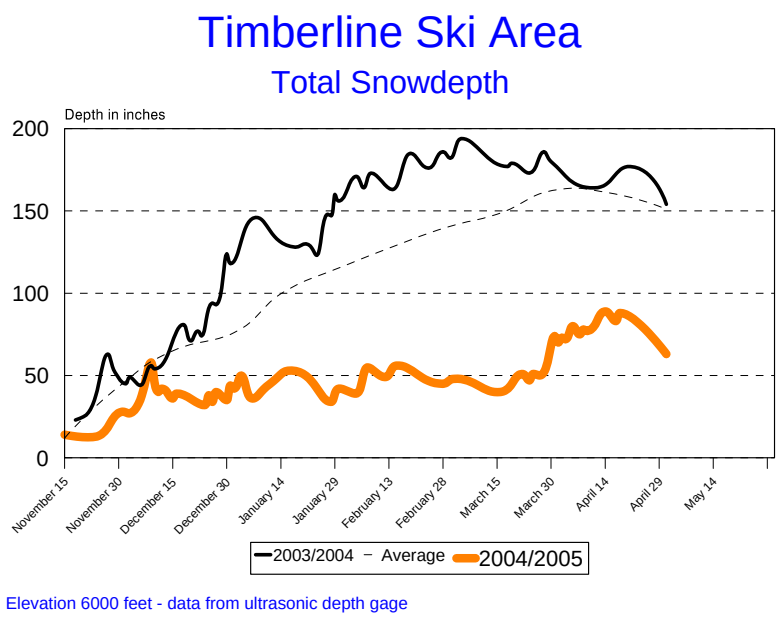
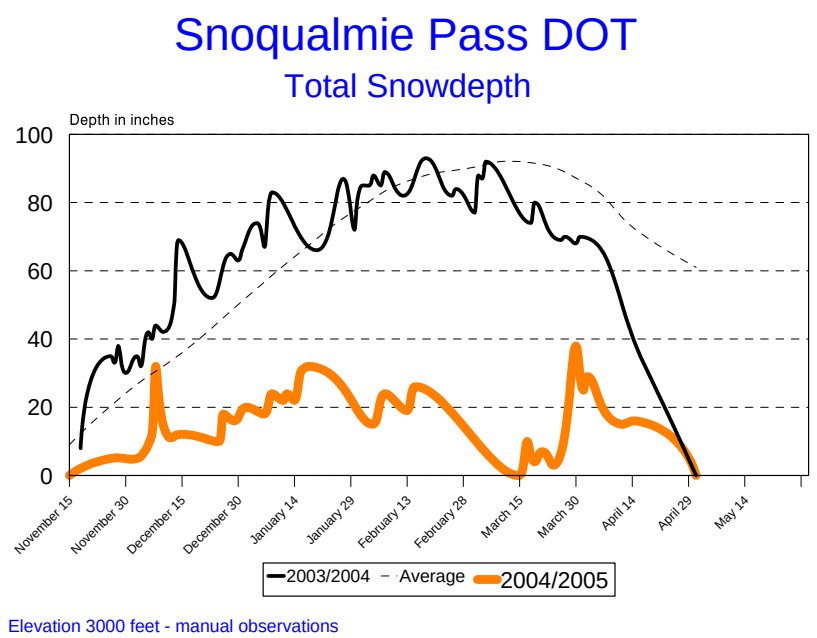


Figure 11. Current versus climatological snowdepth--Snoqualmie Pass



While some Northwest winters on record are noted for overall low snowdepths throughout the season, others gain notoriety by being unusually dry or warm during either the early or late part of the season. The following summary was prepared from a brief review of NWAC (Northwest Weather and Avalanche Center— www.nwac.us) snowpack statistics, and the snowdepth graphics available on www.skimountaineer.com. The table below indicates the years of interest for overall lowest snow packs (from the 1920's or 30's onward) and/or the time of winter these

snowdepths were unusually low (for those years that experienced low totals for only part of the season).

Winter season	Reason for Ranking	Ranking	Comments
2004/05	Overall	1	Split flow or ridge dominates for much of winter; partial recovery in late March and April
1976/77	Overall	2	Huge ridge, little or no precipitation; some recovery in March/April
1980/81	Overall	3	Flatter ridge, periods of warm rain; some recovery in March/April
1989/90	Overall	4	Especially dry in southern Washington and Oregon
2001/02 1999/2000 1975/76 1939/40	Bad early season	Tied for 5	Some of the lowest snow totals early in the season; better snowpack recovery in Jan-Mar
1995/96 1991/92 1971/72 1940/41 1933/34	Bad late season	Tied for 5	Better early season snowfall; bad or terrible ending to winter

Further Note: This compilation is neither exhaustive nor necessarily definitive. Other winters that may be close or should be included as honorable mentions are: 1962/63, 1941/42, 1933/34 and 1929/30).

EDUCATION

Avalanche awareness presentations, using a slide show or Power Point, are offered by NWAC staff and FOAC volunteers on request. Full Level I, II and III avalanche classes are provided by private companies. The table below lists avalanche awareness presentations that were presented by the NWAC during the 2004-2005 season, reaching an audience of over 2800 (NWAC educational efforts reached ~1600 in FY04). During the past five years these educational efforts have connected with over 10,000 (10,344) individuals.

Table 1. Educational presentations by NWAC and FOAC.

DATE(S)	GROUP	AUDIENCE SIZE	LOCATION	SPEAKER
1 Oct	ISSW	700	Jackson, WY	Moore
4 Oct – 25 Jan	BPA	996	Various WA, OR, ID, MT, WY locations	Emetaz
5 Oct	NWS Media Workshop	45	Seattle, WA	Ferber
6 Oct	NWS Media Workshop	35	Seattle, WA	Ferber
23 Oct	WSSA Snowmobile Show	15	Puyallup, WA	Ferber
24 Oct	WSSA Snowmobile Show	15	Puyallup, WA	Kramer
30 Nov	REI	30	Hillsboro, OR	Emetaz
2 Dec	Mountaineers	38	Everett, WA	White
7 Dec	XC Ski Club	26	Ellensburg, WA	White
14 Dec	One World Outing Club	20	Seattle, WA	Ferber
4 Jan	Mountaineers	40	Olympia, WA	Emetaz
8 Jan	REI	100	Mt Hood, OR	Emetaz
11 Jan	US Forest Service	35	White Pass, WA	Moore, Kramer
12 Jan	US Forest Service	55	Lake Wenatchee, WA	Moore, Kramer
12 Jan	REI	35	Portland, OR	Emetaz
15 Jan	Staff	25	Holden Village, WA	Emetaz
15 Jan	NW Avalanche Institute	21	Crystal Mountain, WA	Moore
16 Jan	NW Avalanche Institute	21	Crystal Mountain, WA	Moore
18 Jan	Bushwackers	40	Seattle, WA	Emetaz
19 Jan	Whitman College	30	Walla Walla, WA	White
20 Jan	Mountaineers	35	Everett, WA	White
24 Jan	Boy Scouts	35	Kent, WA	White
25 Jan	REI	35	Tualatin, OR	Emetaz
29 Jan	NW Avalanche Institute	25	Crystal Mountain, WA	Moore
30 Jan	NW Avalanche Institute	25	Crystal Mountain, WA	Moore
29, 30 Jan	Portland Mountain Rescue	30	Mt Hood, OR	Emetaz
1 Feb	Mt Rainier NPS	100	Longmire, WA	Ferber, Casson
7 Feb	Bellevue CC	10	Bellevue, WA	White
9 Feb	Snowmobile Club	40	Seattle, WA	White
11 Mar	CWU	15	Snoqualmie Pass, WA	Moore
16 Mar	Mountaineers	45	Tacoma, WA	Moore, Emetaz
27 Mar	Turns-All-Year	25	Seattle, WA	Ferber
12 Apr	Mountaineers	30	Tacoma, WA	Emetaz
21 Apr	Mountaineers	41	Everett, WA	White
29 Apr	Mountaineers	45	Everett, WA	White
		Total = 2858		

Table 2. Attendees at NWAC educational presentations by year, 2001-2005.

Year	2001	2002	2003	2004	2005
Attendees	1,800	2,600	1,486	1,600	2,858
TOTAL					**10,344**

Also during the past year, the FOAC, the US Forest Service and the NWAC teamed up to produce and print 10,000 new Snow Avalanche Information Reference cards in late 2004. Along with new snowmobile avalanche safety brochure procured in 2003 and new avalanche information brochures purchased in fiscal year 2004, these new more colorful snow safety cards are supplied free of charge and are available on request.

2004-2005 WEATHER STATION CHANGES AND IMPROVEMENTS

After significant preparation for an updated weather station at **Washington Pass** last spring and early summer, further preliminary work was accomplished at **Washington Pass** to prepare for a new and improved weather station planned for installation in the late summer or fall of 2005. In collaboration with the WSDOT, radio-frequency communications was established between the site at Washington Pass and a radio site on Flag Mountain above Mazama. This will allow for two-way communications with the dataloggers at the sites, something we heretofore have not had. In addition to an updated precipitation site equipped with an ETI all-season precipitation gage, NWAC and WSDOT are planning to jointly install a new wind site located about 1000 feet above the pass on a knoll below Cutthroat Ridge (see Figure 11). This exposed wind site will also support temperature and relative humidity and help determine avalanche conditions on the many adjacent starting zones.

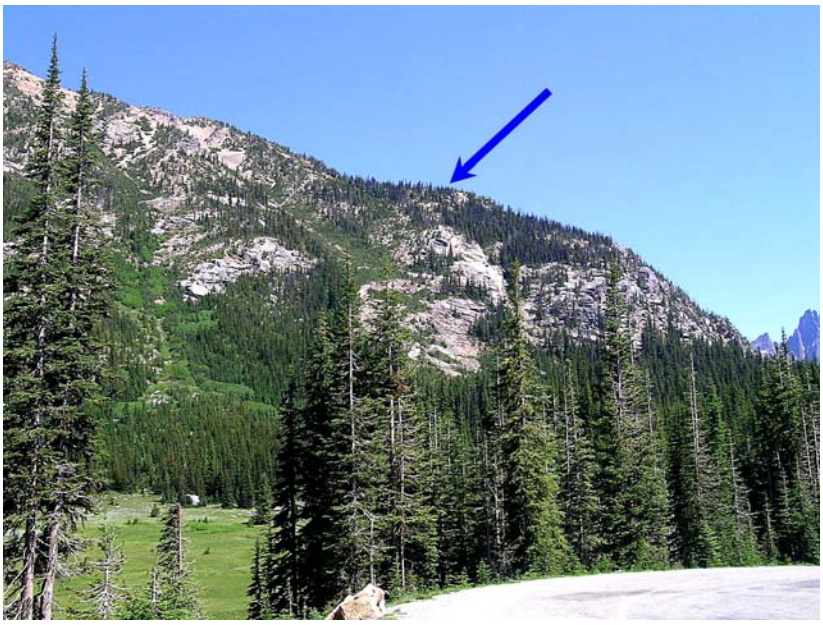


Figure 12. Planned new wind site above Washington Pass

At **Crystal Mountain Ski Area** we replaced the CR10X datalogger in late October to solve a difficulty connecting with the logger. This temporarily relieved the problem. However a power problem continued to plague the system, requiring another trip to replace an ailing battery back-up. Plans to replace the battery and install a UPS system were completed in the late fall. In addition to this work, a back up spread spectrum radio system is to be installed this spring to access remote weather equipment at Chinook Pass and Sunrise in the event the phone line is lost to Sunrise (which has already occurred twice this season). Later in the winter the backup radio equipment was installed at the top of Crystal, however, no contact with Chinook Pass stations has been achieved.

At **Timberline** on Mt Hood, a replacement Judd II acoustic snowdepth sensor and cable was mailed to mountain manager Bill Brett in late January. Bill replaced the failing instrument and

cable and returned it for repair. This has been a great relationship as relatively easy repair work can be accomplished while saving the NWAC a tremendous amount of travel time and money.

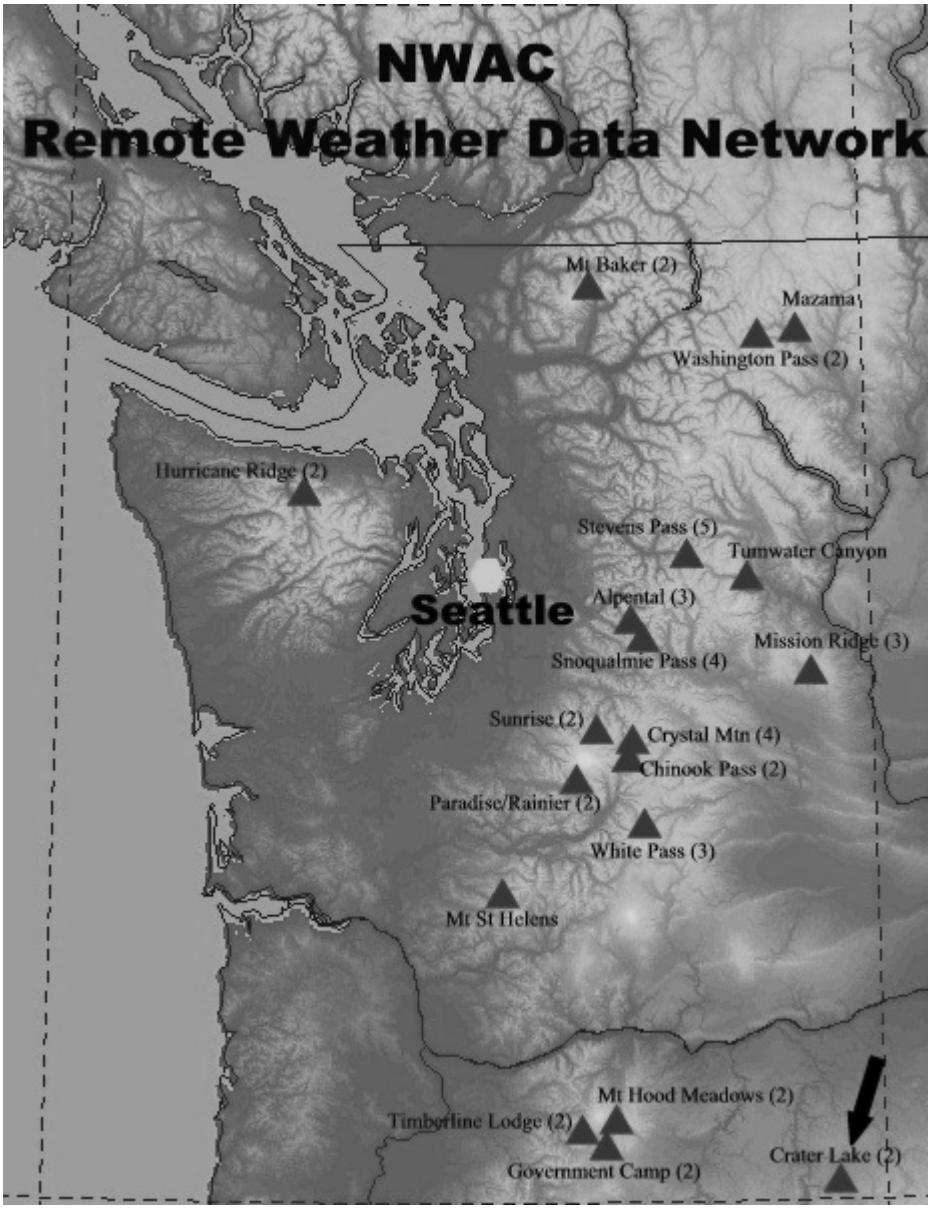
At the top of **White Pass Ski Area** a new CR10X datalogger was installed to replace a failed older model CR10. Preliminary work was also done to install a new base station to replace the base temperature that we had lost contact with due to ongoing land line problems. This new base station was installed at the base of **White Pass Ski Area** late in the fall. This station includes a CR10 logger and CS500 air temperature-relative humidity sensor. The ski area provided us with a phone line to access this station and we are now receiving data and assimilating this new information into our White Pass weather page.

A correction factor has been applied to the original wind speed sensors on Pig Tail Peak to adjust for the off angle wind speed acceleration of the site. This has resulted in lowering the wind speed output by roughly 25% and should prove more realistic during strong west wind events (although significant wind acceleration does indeed occur during northwest through southwest wind episodes, the site has probably recorded higher than actual speeds during previous years).

A new site was installed in the summer and early fall at **Sunrise on Mt Rainier** for Mt Rainier National Park. This site is an addition to the parks efforts to collect long term climatological weather data**.** The new station was installed about 500 feet above the base station on an exposed knob location and features unheated wind speed and direction as well as air temperature and relative humidity. The site is accessed via a FreeWave spread spectrum radio-frequency link to the base area. Located at 6900 ft this new site is now the highest elevation weather station for NWAC in Washington State.

Below is a map showing weather stations maintained or partly maintained by the NWAC.

Figure 13. Map of the mountain weather stations managed and maintained or partly maintained by NWAC staff.



FUTURE PLANS

- We plan to undertake a **trial job share** during the 2005-2006 with one full time position being shared between Garth and Knox Williams (formerly Director of the Colorado Avalanche Information Center).
- Convert **Washington Pass** weather station from a satellite system to a Campbell datalogger / radio access system working with North Central WSDOT crew.
- As much as possible, ensure that a reliable radio link is available to allow for hourly access of **Chinook Pass Base station** throughout the next winter season. This may involve having a back-up base station at the top of Crystal Mountain, and/or using the

Sunrise Knob site as a repeater. Both options will be worked to achieve the optimal solution.

- Complete the **Sunrise, Mt Rainier National Park** site by installing an all-season precipitation gage at the base site.
- Begin installation at **Camp Muir, Mt Rainier National Park** of a new FreeWave spread spectrum radio accessed site.
- Continue to make improvements and/or repair to weather stations such as **Mazama, Mt St Helens** and **Ski Bowl Ski Area**.
- Install a new Cascade east slope weather station, most likely near **Lake Wenatchee**. A late spring meeting brought together potential cooperators and staff from Chelan County Fire District Nine, Lake Wenatchee State Park, USDA-Forest Service Lake Wenatchee Ranger District, National Weather Service Spokane Weather Forecast Office and the NWAC. All agreed that a site near or between the Chelan County Fire District Office (CCFD) and the Administrative Headquarters for Lake Wenatchee State Park (LWSP) would be suitable and plans are underway to obtain any necessary environmental approval for the weather station infrastructure (concrete base, AC power etc). It is hoped that the site will be a reality by this next fall, and it is believed that staff from CCFD and LWSP will be available on a regular basis to clear the planned automatic 24-hour snow stake after snowfall, as well as assist with installation and monitoring of the weather station during the winter.
- Retrieve extra **White Pass Ski Area** wind site instruments.

NWAC BUDGET AND FUNDING

Despite increasing funding challenges to maintain current and expected NWAC forecast and data service responsibilities, the NWAC and its administering agency, the USDA-Forest Service continue to recognize and greatly appreciate the continuing contributions and commitment of all cooperators in supporting Avalanche Center operations. While all state and federal agencies are faced with at times uncertain and declining budgets, and this will result in difficult budget decisions in the years ahead, please be assured that the Forest Service and NWAC staff will do all that is possible to ensure future normal operation of the Avalanche Center. As a result, we hope that our long and mutually beneficial relationship will continue well into the future. Please note that the NWAC has just concluded making presentations for several Title II grants and is receiving some capital equipment support from the Friends of the Avalanche Center in the form of a new field laptop computer. We are optimistic that these and other funding efforts will be fruitful in providing necessary monies to support a full and normal program in FY06 and beyond.

When viewing the budget projections for FY05 and FY06 shown below, please note the additional following information:

- Unanticipated donation carryover from prior seasons, lower than anticipated premium pay (OT, hazard), and less travel for FY04 combined to allow the one-time donation carryover (of about $28,000) shown for Fiscal Year 2005 (FY05).
- Flat support levels are expected to continue from the Forest Service and Washington State for the foreseeable future.

- After a significant decline in support levels during FY05 when Crater Lake NP ended its contributions to the program due to decreased overall funding of the Park, a further substantial decrease in National Park Service support is anticipated in FY06 when another long term partner (Mt. Rainier NP) is expected to drop its support—once again due to a declining funding at the Park level and a need to fund payroll and other required fixed costs.
- A very poor snow season in FY05 and associated reduction in forecast operation during some of the winter allowed for slightly lower than anticipated salary expenditures. This was primarily achieved through less premium pay (down about 25%), some leave without pay, and the fact that some forecasters were able to work and charge salaries to other Forest Service programs. Such savings produced a one-time reduction in overall salary compensation of about 10%. During more normal winters this reduction is not expected.
- In FY06, NWAC expected to receive approximately $20,000 from USDA-FS fee-demo programs and another $10,000 from Title II/RAC programs.
- Unemployment and Medical costs for forecast staff should remain at $0.
- Salaries are projected to increase at approximately +3%/year.
- FOAC is expected to contribute $5,000 toward capital equipment in FY06.
- All normal forecast and data services will be provided for as long as funding allows (this all or nothing program operation has been previously agreed upon with cooperators as the best way to meet future monetary shortages)

In order to achieve continued operation of the Center in FY06 and no additional sources of revenue:

- Capital equipment expenditures will remain flat.
- Travel and communication costs will remain flat.
- Unless shortfall is recovered, overall program operation will be reduced by the amount of anticipated shortfall.
- This will result in shorter forecast seasons, with mid-late season forecast operation curtailed by approximately 1 month for each $25,000 of shortfall (or two weeks for each $12,500 of shortfall).
- These ramifications will be discussed at the annual cooperator meeting.

Table 3. NWAC Budget--Sources of Funding for FY05 and FY06; Total Direct and Indirect Funding Summary

NWAC Budget—Sources of Funding

Funding Source		FY05 [projected]	FY06 [projected]
Federal		**$140,329**	**$119,762**
	USDA-Forest Service	$75,000	$75,000
	National Park Service	$17,000	$8,755
	USDA-FS Fee Demo	$20,000	$20,000
	USDA-FS Carryover	$28,329	$7,252
Washington State		**$99,000**	**$99,000**
	Parks and Recreation Commission (includes State General Fund $)	$79,000	$79,000
	Department of Transportation	$10,000	$10,000
	DOT spring forecasting	$0	$0
	Snowpark Program	$4,000	$4,000
	Snowmobile Program	$6,000	$6,000
County		**$10,000**	**$10,000**
	*Title II/Resource Advisory Comm.	$10,000	$10,000
Private		**$16,541**	**$20,000**
	PNSAA	$15,000	$15,000
	FOAC	$3,500	$5,000
	Other private	$1,541	$???
TOTAL FUNDING		**$269,370**	**$240,007**
Estimated In-Kind Support		**$171,096**	**$171,093**
[Indirect support]	USDA-FS (~30& of direct cont)	$22,500	$22,500
	WSDOT (obs + equip support)	$20,806	$21,430
	NPS (obs + equip support)	$5,145	$1,649
	NWS (office costs + product access etc)	$60,510	$62,325
	PNSAA (obs, power, phone etc)	$6,905	$7,112
	All (one time cost for data support)	$55,230	$56,887
GRAND TOTAL [DIRECT + INDIRECT]		**$440,466**	**$411,910**

*** Additional funds have been requested for FY06 but are not known currently**

Figure 14. NWAC—Projected FY05 Expenses

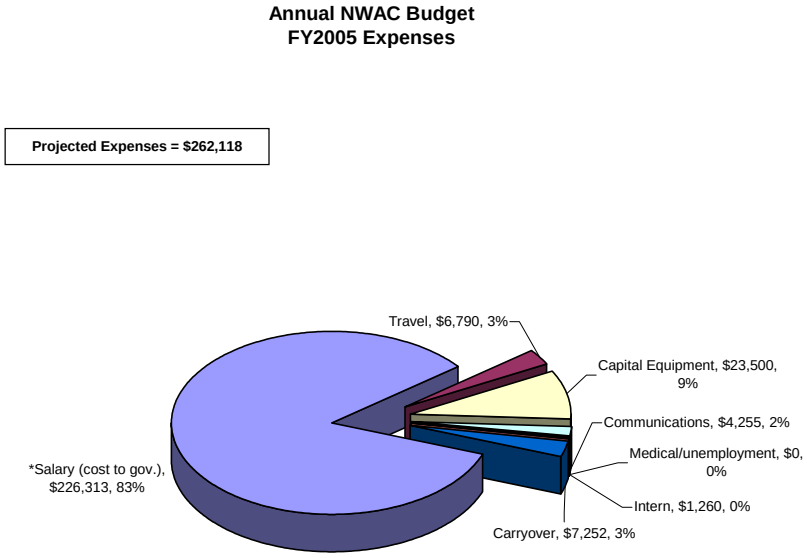
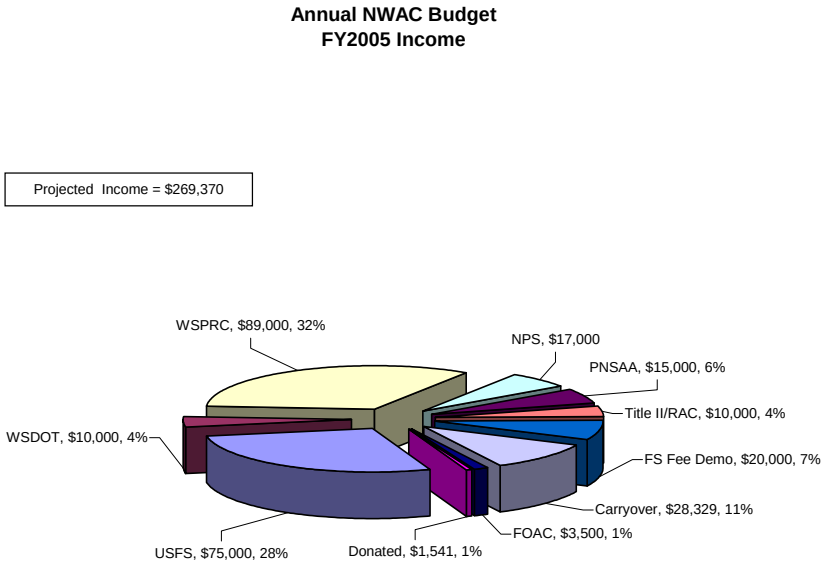


Figure 15. NWAC—Projected FY05 Income



NWAC STAFF

- **Mark Moore** – Director and forecaster at the NWAC since 1977. Focal point for budgeting, avalanche accident information, web site management and development, computer and weather station management. Old weather station guru.

- **Kenny Kramer** – Forecaster at the NWAC since 1990. Focal point for AWIPS (Automatic Weather Information Processing system) maps and macros, Resource Advisory Committee proposals.

- **Garth Ferber** – Forecaster at the NWAC since 1993. Focal point for weather station programs and data, forecast products, FOAC Snow pack Information Exchange.

- **Jerry Casson** – Intern at the NWAC during the 2004-2005 season. Jerry will be attending graduate school at the University of Washington starting in the fall of 2005 and it is hoped that he will be accepted in to the SCEP program (Student Career Employment Program) through the US Forest Service in the fall of this year. If accepted, participation in the SCEP program will allow Jerry to more active in NWAC forecasting during the 2006-07 season.