National Operational Hydrologic Remote Sensing Center

National Weather Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce
Minneapolis, Minnesota

Overview of the Center's Web Site and Products

www.nohrsc.noaa.gov

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National Operational Hydrologic Remote Sensing Center

1 Introduction

The National Operational Hydrologic Remote Sensing Center (NOHRSC) ingests daily ground-based, airborne, and satellite snow observations from all available electronic sources for the coterminous U.S. These data are used along with estimates of snowpack characteristics generated by a physically-based snow model to generate the operational, daily NOAA National Snow Analyses (NSA) for the coterminous U.S. The NOHRSC snow model is an energy-and-mass-balance, spatially-uncoupled, vertically-distributed, multi-layer snow model run operationally at 1-km² spatial resolution and hourly temporal resolution for the nation. Ground-based and remotely-sensed snow observations are assimilated daily into the simulated snow-model state variables. NOHRSC NSA output products are distributed in a variety of interactive map, text discussion, alphanumeric, time-series, and gridded formats. NSA product formats include: (1) daily national and regional maps for nine snowpack characteristics, (2) seasonal, two-week, and 24 hour movie-loop animations for nine snowpack characteristics, (3) text summaries, (4) a suite of interactive maps, text, and time-series products, and (5) selected gridded snow products for the CONUS. The NSA provide information about snow water equivalent, snow depth, surface and profile snowpack temperatures, snowmelt, surface and blowing snow sublimation, snow-surface energy exchanges, precipitation, and weather forcings in multiple formats.

Most NOHRSC products are available from the NOHRSC web site. The following provides an overview of the NOHRSC web site, insight to web-site navigation, and a summary of the products available through the NOHRSC web site (www.nohrsc.noaa.gov).

For more information on the NOHRSC operations and snow modeling environment, see the following paper on the NOHRSC Technology page: NOHRSC Operations and the Simulation of Snow Cover Properties for the Coterminous U.S.: Western Snow Conference, 2001 April. Additionally, some users may find the listing of the NOHRSC Abbreviations and Acronyms at the top of the NOHRSC Technology page useful.

2 Home Page

The home page provides a NOHRSC site map and NWS news, organization, and search options across the top. The main menu is on the left and each menu item will be discussed in this overview. The three principle pages on the site are: (1) Snow Analyses, (2) Interactive Products, and (3) Airborne Snow Survey Program. These pages can be accessed from the side-bar menu or by depressing the appropriate picture box in the middle of the page. Below the picture boxes, a very brief National Snow Summary is given with more information provided on the Snow Analyses page.

3 NOHRSC Overview

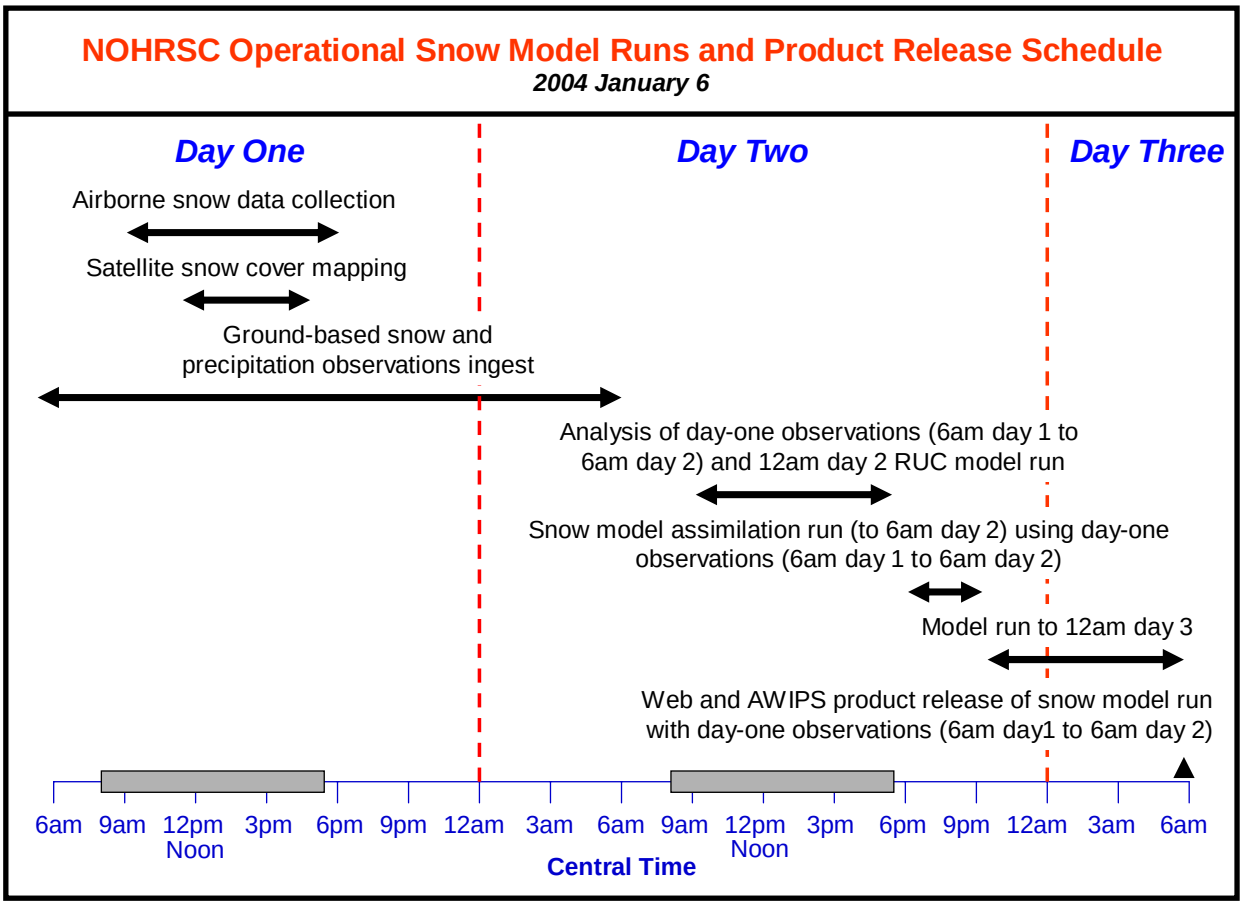
The current version of this document, in PDF format, is available directly from the NOHRSC home page side-bar menu and from the General Help Questions section of the help page.

4 Snow Analyses

The NOHRSC National and Regional Snow Analyses page provides a daily synoptic overview of snow conditions for the coterminous U.S. as well as for the 18 U.S. snow regions at a higher resolution. The Snow Analyses include maps are text descriptions of daily snow accumulation based on snow observations and modeled snowpack characteristics. They review both the meteorological observations of snowfall and snow on the ground as well as the snowfall and snow accumulation simulated by the NOHRSC snow model. Regions of the greatest, or most interesting, snow precipitation are highlighted in the analyses. The Snow Analyses also provide an explanation of the variance between the NOHRSC snow model state variables and observed snow conditions. The analyses review the regions across the country where observed snow data have been assimilated into the snow model state variables. Unique snow data observations such as airborne snow water equivalent measurements are reviewed in the text product during the course of operational airborne snow survey missions. Image maps of snow characteristics and other graphics summaries are hyper-linked in the analyses to highlight specific points of interest. The Snow Analyses are prepared each weekday by NOHRSC personnel.

4.1 Timing of Observed Snow Data Assimilation and Product Release to AWIPS

It takes some length of time for snow and precipitation observations to be made, to encode the observations into SHEF, to send the data to AWIPS, to ingest the numerical weather prediction model Rapid Update Cycle (RUC20) data, to run the NOHRSC snow model with the RUC data, to analyze manually the snow model results along with the relevant snow and precipitation observations, to re-run the NOHRSC snow model to assimilate those snow observations into the snow model, and to release the updated results to the NOHRSC web site and to AWIPS. The snow model assimilation run essentially incorporates snow depth and water equivalent observations that we received during the 24 hour period (6am to 6am central time) of day one and day two (see figure below). We typically complete the generation and posting of a variety of assimilation-run products to our web site by 6am central time on day three. The SHEF and GRIB products released to AWIPS at approximately 6am on day three include the observed snow information that we received on day one and day two. The NOHRSC staff is available from 8am to 5:30pm weekdays to manage the care and feeding of the snow model and to produce and distribute the National Snow Analyses. The figure below gives the timing of the sequence of events from data ingest to product release.



4.2 Snow Analyses

The page defaults to a national map of snow regions and summarizes the national statistics to the right: automated snow model discussion, snow depth, and snow water equivalent. It defaults to the most recent date for which there are data. The region and date of the snow analyses is selectable.

4.2.1 Snow Analyses Maps and Seasonal, Two-weeks, and One-day Animations

Below the region and date pull-down menus are nine maps of snow characteristics for the region (default is U.S.): snow water equivalent, snow depth, mean snowpack temperature, 24 hour snow water equivalent change, snow precipitation, snowmelt, blowing snow sublimation, surface sublimation, and non-snow precipitation. Clicking on any of the nine maps gives an enlarged version. Below each map are three buttons titled: animate–season, two-weeks, and one-day. The season animate function gives a pop-up window that loops the daily snow products since October 1. The two-week and one-day animate function provide similar pop-up window that loops the hourly snow products. The map images that provide the animation may take a bit of time to load over slow internet connections and will display synchronously with the date/time indicator ONLY after all of the images have been loaded on the local machine.

4.2.2 Weather Summary

Below the nine maps is a weather summary text discussion for the region giving salient information and links for the region.

4.2.3 Station Snow Reports

Below the weather summary is a table of the 10 highest snowfall reports for the region. Below the snowfall reports are links to pipe-delimited records that give *all* of the station snowfall reports, snow water equivalent reports, and snow depth reports for the last 24 hours. These data are not currently quality controlled and are posted to our web site as we receive them directly from AWIPS; use with caution.

4.2.4 Model Assimilation

Below the snow reports is a brief text discussion of the office activity associated with snow model assimilation of snow depth and/or snow water equivalent station observations.

4.2.5 NOHRSC Airborne Snow Survey Program

This section provides a text discussion of any planned or recently completed airborne snow survey mission in the selected snow region.

4.3 Regional Snow Analyses

The above information is also provided at a higher resolution for each of the 18 snow regions selectable on the U.S. map or from the region and date pull-down menus. Unfortunately, snow analyses are not available for Alaska at this time.

5 Interactive Products

The NOHRSC Interactive Snow Information summary gives the end-user the flexibility to produce tailored graphic summaries suited to individual needs and requirements. The graphic maps from the Interactive Snow Information summary can be queried in either metric or English units. The page can be configured for Internet Explorer or Netscape.

Clicking on the Interactive Products button on the side-bar menu gives the Interactive Snow Information page. The upper side-bar menu provides buttons to go to: NOHRSC home, the Snow Analyses pages, quick queries for time-series and text snow products (for users who know their station or basin ids), and interactive help.

5.1 Interactive Help

The interactive help page provides information on: (1) navigation, display, and querying the interactive map server, (2) map products and text discussion products, (3) the Airborne Snow Survey Program, and (4) general help.

5.2 Default Settings

The interactive snow information page defaults to: (1) full U.S. map, (2) physical element equals snow water equivalent, (3) date equals most recent date and hour for which data are available, (4) zoom in selected (across top), (5) overlays equal states and stations (with labels), and (6) map preferences (lower side-bar menu) equals English units (can be changed to metric units), background image (DEM), high-contrast color palette for snow depth and water equivalent products (optional: if selected, recommend that background DEM is turned off), 512 pixels map width and height, JavaScript on, Smoothing off, session Cookies off. All of the above options are described on the interactive help page. The scale for the selected physical element is given to the right of the map (or below if selected and refreshed). Unfortunately, we need to use a non-linear scale for the entire country. We do not have the ability to recalculate the scale on-the-fly for each zoom level. We have, however, added shallow snow depth and shallow snow water equivalent maps that can be selected from the physical elements list. The corner latitude and longitude coordinates are given on the map borders along with the east/west and north/south distances.

5.3 Interactive Options

It is possible to select any one of a variety of physical elements (e.g., snow water equivalent, snow depth, mean snowpack temperature, 24 hour change in water equivalent or depth, etc.). A variety of map overlays are also selectable from the side-bar menu. The map overlays selected from the side-bar menu have no impact on the query function described below. The date and hour of the map image can be selected.

5.3.1 Deviation From Normal Snow Depth Maps

One of the selectable physical elements is the Monthly Depth Normal that gives the average snow depth (1961-1990) for a specific month (e.g., October, November, December, January, February, March, or April). The monthly normal snow depth products were provided by the National Climatic Data Center from the NCDC 1961-1990 Climate Atlas for the U.S. based on data from 5525 stations used in the NCDC U.S. Snow Climatology (TD-9641M). The NCDC monthly depth normal gridded maps are used with the daily NSA snow depth map to generate a Daily Depth Minus Normal map also available as a selectable physical element.

5.3.2 Plotted Snow Water Equivalent and Snow Depth Observation Values

The end-user can select from the physical element pull-down menu a national map that gives the observed value of the snow water equivalent or snow depth from the more than 10,000 stations that report snow observations to the NOHRSC. Daily, 2-day, or 3-day maps can be

selected. The values are color coded by range; the user can pan and zoom the maps to the area of interest.

5.3.3 Snowfall Maps

The end-user can select from the physical element pull-down menu a national map that gives the observed values of daily, 2-day, or 3-day snowfall. The values are color coded by range; the user can pan and zoom the maps to the area of interest.

5.4 Cursor Mode

Above the map it is possible to select one of four cursor modes: (1) pan, (2) zoom in, (3) zoom out, and (4) query. It is possible to select the zoom factor from the pull-down menu on the upper right of the map. These functions are fully described on the interactive help (navigation) page. A number of map overlay elements are progressively disclosed as the user zooms in further (e.g., stations, cities, flight lines). For example, more than 18,000 stations are eventually revealed as the map is zoomed in further.

5.4.1 Query Mode

The NOHRSC station or basin time-series plots consist of a series of x-y graphic plots that use data from the selected reporting station or basin for the selected period-of-record. The plots include line graphs of NOHRSC snow model output and point indicators for a variety of observed hydrometeorological variables. The default is the station time-series. When the query button is selected from above the map, it is possible to generate time-series plots from the NOHRSC database for the point or area selected from the pull-down menu. With the query mode and station time-series selected, the user can move the curser to a specific station on the map and left-click the mouse. A second browser is spawned that gives multiple time-series of modeled and observed information for that station. The station time-series plots include graphs of modeled and/or observed snow water equivalent, snow depth, snow cover, snowmelt, snow surface temperature, mean snowpack temperature, air temperature, snow and non-snow precipitation, sublimation/condensation, various weather forcings, and snow surface energy exchanges. Upon first access, the default dates are the last two weeks and units are English; either can be changed and refreshed. If “cookies are on” the changed date and units will remain for future station queries. Details of the query function are given on the interactive help (querying) page.

5.4.1.1 Alphanumeric Data and Products

Alphanumeric summaries for selected NSA physical elements are available for RFC hydrologic forecast basins on a basin-by-basin basis. Summaries giving mean areal estimates of the selected physical element for RFC hydrologic forecast basins can be grouped by NWS River Forecast Center, by NWS County Warning Area, by USGS Hydrologic Unit Code, by state, or by county. Alphanumeric summaries are available for snow water equivalent, snow depth, and areal extent of snow cover derived from the snow model. The summaries include the basin id, date, minimum and maximum elevation in the basin, basin name (if available), and

the mean, standard deviation, minimum, and maximum pixel values of the selected physical element for the basin. If the RFCs have provided elevation zone information for specific basins, the same information is available for each elevation zone. The end-user can select the physical element, the date, and the units (English or metric) for the report.

5.4.1.2 Time-series Plots of Modeled and Observed Data

The time-series plots give both modeled and observed data for the station. Station-specific information is provided in the upper left of the time-series plots and includes: station id and name, latitude/longitude, elevation, start and stop date for the time-series, forest density, and land use. The color-coded legend on the upper right describes the variables plotted. Assimilation (green line) indicates the point in time at which the NOHRSC staff assimilated snow depth or snow water equivalent observations for the region around the station into the snow model states. Snow cover (observed by satellite) is indicated by the colored tick-marks above the first time-series plot. Even if the modeled data and the observed data were perfect, the user should **not** expect the modeled and observed data to agree in all cases. The station data should be representative of a point; the modeled data should be representative of the 1-km^2 pixel in which the station falls. Both might be perfectly correct but not equal. Other time-series options from the pull-down menu are described on the interactive help (querying) page.

5.4.1.3 Time-series Quick Query

From the menu on the left it is possible to select a quick query for the RFC forecast basin time-series information. The user must select an RFC in which the basin resides; a listing of the SHEF IDs for all basins will be revealed; the user can then select the forecast basin by SHEF ID to obtain the time-series information. The user can also enter the station SHEF ID (if known) for a quick query of the time-series information for the selected station.

5.4.1.4 Text Product Quick Query

The user can select text products giving mean areal (and other statistics) snow water equivalent, snow depth, and snow cover for all RFC basins in either the selected: RFC, state, USGS Hydrologic Unit Code, NWS Country Warning Areas, or counties. After the geographic area is selected the data will be reported. It is possible to change the physical element, the date and hour to report the data, and the units (English or metric). These text products can also be retrieved directly from the main interactive snow information page by selecting query and basins by RFC, state, HUC, CWA, or counties.

5.4.1.5 Snow Depth Daily Climatology

The user can plot current year modeled and observed snow water equivalent and snow depth from over 5,000 climate stations along with the historic snow depth observations (1960 to last year) by the following process. On the Interactive Snow Information page, select from the left side-bar menu “climate points” and the associated filled square label. At the top center of the page select “query.” From the pull-down menu to the right of the “query”

button, select “station climatology”. Move the cursor to the climate station (filled square) of choice and click to see the current and historic snow depth record. Select up to four years from the left to high-light historic snow observations (1960 to last year).

6 Snow Forecasts, Today’s Weather, and U.S. Snow Climatology

These links connect to other NOAA web sites that give: (1) one-day, two-day, and three-day snowfall probability forecasts for equal-to-or-greater-than 4, 8, or 12 inches of snowfall, (2) today’s weather, and (3) a summary of U.S. snow climatology.

7 Airborne Snow Survey Program

The NOHRSC maintains two snow survey aircraft to make airborne snow water equivalent measurements across a network of over 2200 flight lines covering portions of 31 states (including Alaska) and 8 Canadian provinces. Salient information about the Airborne Snow Survey Program is given on the page including information on: snow survey schedule, airborne photography, flight line index, flight line maps, and airborne snow data. For more information, see the Airborne Snow Survey Program User's Guide: 2001 March 1 on the NOHRSC Technology web page.

7.1 Airborne Flight Line Maps and Airborne Flight Line Index

It is possible to click on Flight Line Maps and retrieve a U.S. map with all of the airborne flight line locations but with no labels. Check at least the following map overlays: flight lines and the labels button to the right of the flight line map overlay box. Select zoom in at the top of the page. Move curser to region of interest and left click to zoom in (perhaps several times depending on zoom level setting). Eventually the flight line labels will be disclosed. Zoom in further for clarity. The Airborne Flight Line Index is available in ascii format from the airborne page and contains a summary of the total flight line database and includes: flight line id, basin name, NWS region, RFC, WFO, and latitude/longitude/elevation of the flight line mid-point.

7.2 Airborne Snow Survey Data and Snow Water Equivalent Maps

Data for each snow survey can be accessed from the Airborne Program page by selecting a “Snow Survey Name”. Each survey page gives a text summary of the survey, access to photos taken by the pilots, a running status map of flight lines flown and lines yet to be flown, and a table giving: Date, States Flown, Survey Status Map, Flight Line Data in SHEF, SWE Image (map of airborne data imposed on SNODAS modeled estimates of snow water equivalent), Discussion, and Used in Assimilation indicator. The SWE Image map indicates the value of the airborne measurement by the color between the two lines representing each flight line. The color contour map represents the modeled snow water equivalent *before* assimilation of the airborne data into the SNODAS model.

8 NOHRSC GIS Data Sets

Available GIS data sets include ESRI shape files that give the vector polygons of the RFC river forecast basins. Each RFC produces their respective shape file basin data sets and ships it to the NOHRSC for our use in generating products. Also included on the page are shape files that describe the 13 RFC perimeter vectors and a shape file that gives the NOHRSC airborne flight line network. All are available for download by the end-user.

9 SHEF Products and Archive

The NWS distributes a variety of hydrometeorological data in Standard Hydrologic Exchange Format (SHEF) that is a human/machine readable text file. The NOHRSC distributes modeled estimates (by forecast basin) of: (1) mean areal snow water equivalent, (2) areal extent of snow cover, (3) snowpack thickness, (4) blowing snow sublimation rate, (5) snowmelt rate, (6) snowpack average temperature, (7) snowpack sublimation rate, and (8) rain plus melt rate. See NOHRSC SHEF Products and Your SHEFPARM File link on the NOHRSC Technology page under the Operational Product Generation section for information required to modify the RFC SHEFPARM file to receive the above SHEF products. We produce and ship the SHEF products to AWIPS automatically each day at approximately 6:00 am central time for each of the 12 RFCs in the coterminous U.S. The NOHRSC SHEF products also include modeled estimates by elevation zone within each RFC basin if the RFC has provided to us the elevation break-points for each sub-basin of interest.

9.1 Observation Stations by WFO

The top of the SHEF Archive page has a link to monthly tables that gives reporting stations for each WFO. Each table contains the reporting station id and station name followed by 10 reported variables and the number of observations for each variable that the NOHRSC has received during the month. The table provides a summary, by WFO, of the reporting station ids in the NOHRSC database for which we have latitude and longitude information that, in turn, allows us to use the data reported by the stations in the NOHRSC snow modeling environment. Frequently, the latitude and longitude information for a reporting station is in error. WFOs should periodically verify that their station latitude/longitude information is correct in all appropriate databases.

9.2 Stations with Unknown Metadata

We frequently receive data in SHEF from reporting stations for which we have no metadata. We are unable to use that data because we do not know the location at which the observations were made. The top of the SHEF Archive page has a link to a listing of all stations from which we have received data during the water year but for which we have no location information. These data, reported in SHEF over AWIPS, fall unceremoniously on the NOHRSC floor. WFOs should periodically check the reporting stations with unknown metadata and provide accurate location information to the NOHRSC if available.

10 NOHRSC Technology

The NOHRSC Technology page gives a variety of reports, document, papers, and PowerPoint presentations that describe various aspects of the Center's activities, products, and data sets.

11 Staff, Links, Site Help, and Please Send Us Comments

We hold these pages to be self-evident.

12 Gridded National Snow Analyses Products

The NOHRSC snow model either ingests or generates the variables given in Table 1 below at hourly and 1-km^2 resolutions for the coterminous U.S. Additionally, the NOHRSC generates daily surface temperature products of average daily temperature and freezing and thawing degree-days cumulative since October 1 for the coterminous U.S. at 1-km^2 (Table 2). The NOHRSC daily, 1-km^2, CONUS, gridded products (Table 3) are permanently archived and available from both the National Snow and Ice Data Center (NSIDC) in Boulder, Colorado, and the NOAA National Climatic Data Center (NCDC) in Asheville, North Carolina. NSIDC and NCDC have developed an on-line distribution system whereby any end users can access and select any of the available gridded products (Table 3) for their required spatial and temporal domain. Selected gridded NOHRSC products starting October 1, 2003, to the present are available now from both NSIDC and NCDC.

In addition, the NOHRSC has the ability to generate and to ship automatically, in near real-time, 1-km^2, hourly or daily gridded products for all of the snow model and cumulative surface temperature variables summarized below for use in special projects (Tables 1 and 2). The NOHRSC will limit the volume of gridded data shipped directly to end users to avoid overloading the available, and limited, Internet bandwidth. Additionally, the NOHRSC can only generate and ship gridded products directly in near real-time. We do not currently have the capability to archive or to regenerate past gridded products for use at a later date. The hourly or daily gridded products can be shipped, in near real-time, directly by the NOHRSC for the following geographic domains: coterminous U.S., River Forecast Center, County Warning Area, or state.

Table 1: Snow Model Input and Output Variables	
Driving Data	***Diagnostic Variables***
Surface zonal wind	Blowing snow sublimation rate
Surface meridional wind	Latent heat flux
Surface air temperature	Melt rate
Surface relative humidity	Net long wave radiation flux
Snow precipitation	Net solar radiation flux
Non-snow precipitation	Sensible heat flux
Solar radiation	Snowpack sublimation rate
State Variables	Snowpack surface temperature
Snow water equivalent	
Snowpack internal energy	
Snowpack thickness	
Snowpack average temperature	
Snowpack unfrozen fraction	

Table 2: U.S. Surface Temperature Products
Average daily temperature
Cumulative freezing degree days (since October 1)
Cumulative thawing degree days (since October 1)

Table 3: Daily NOHRSC Products Archived at and Available from NSIDC in Boulder, Colorado, and NCDC in Asheville, North Carolina	
Physical Element	***Remarks***
Snow precipitation	24-hour total, 6Z-6Z
Non-snow precipitation	24-hour total, 6Z-6Z
Snow water equivalent	snapshot, 6Z
Snowpack thickness	snapshot, 6Z
Blowing snow sublimation	total of 24 “per-hour” sublimation rates, 6Z-6Z
Snowpack sublimation	total of 24 “per-hour” sublimation rates, 6Z-6Z
Average snowpack temperature	Average of the 24 hourly vertically averaged snowpack temperatures
Melt	total of 24 “per-hour” melt rates out of bottom of the snowpack, 6Z-6Z

12.1 How to Obtain Gridded NOHRSC Products from NSIDC and NCDC.

NSIDC maintains a web-based data query and download capability for the NOHRSC gridded data identified in Table 3. A description of the NOHRSC products available from NSIDC and the process to obtain the NOHRSC gridded products from NSIDC are given on the NOHRSC Technology page under How to Obtain Gridded NOHRSC Products from NSIDC.

To request NOHRSC gridded products from NCDC, contact:

Climate Services Branch
National Climatic Data Center
Room 468
151 Patton Avenue
Asheville, NC 28801-5001
Phone: 828-271-4800
FAX: 828-271-4876
e-mail: ncdc.info@noaa.gov

13 NOHRSC Products on AWIPS

Daily NOHRSC GRIB products of snow water equivalent, snow cover, and snow cover by elevation are available for the coterminous U.S. on AWIPS D-2D. Additionally, mean areal estimates of various snowpack properties are distributed by basin, in SHEF, over AWIPS daily (see section 9).

14 NOHRSC CD-ROMs

The NOHRSC has been publishing CD-ROMs annually since 1990 through 2003 that contain most of the image and alphanumeric products generated each year. NOHRSC CD-ROMs are available upon request. NOHRSC web products since 2003 are available on the NOHRSC web site. Gridded products since 2003 are available directly from NSIDC and NCDC.

15 Contact Information

All questions, suggestions for improvement, and requests for additional information or gridded products and data sets should be addressed to:

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