

# Snow Hydrology Breakout Sessions

## *National Hydrologic Program Manager's Conference* New Orleans, Louisiana

2004 December 9

Rob Hartman (HIC, CNRFC) and Tom Carroll (NOHRSC) moderated two snow hydrology breakout sessions at the National Hydrologic Program Manager's Conference on December 9, 2004. Summarized below are the salient observations and issues raised at each of the two sessions followed by comments by Hartman and Carroll. This document has been forwarded to all NWS Hydrologic Program Managers, all HICs, all DOHs, all regional HSD Chiefs, the Chief of OCWWS/HSD, the Director of the Office of Hydrologic Development, and is posted on the conference web page.

### **Session 1**

Scribe: Mark Walton

1. Observation: Biggest challenges in the East are the atypical events with the models (i.e. 1996 floods with high winds and humidity). How do you get a handle on sublimation of snowpack? Daily modeled sublimation estimates are now provided in map, gridded, SHEF, and time-series formats from the NOHRSC snow model.
2. Observation: It is important to get PNS snow data into SHEF and sent to AWIPS.
3. Action item: Have LSR create stranger reports or develop some sort of software that creates a lat/long with every snow report and sends the data as a stranger report in SHEF.

Comment: Jeff Zimmerman should investigate the prospect of modifying the LSR to accommodate lat/long information. (Carroll)

4. Action item: The NOHRSC should send an email with examples of bad/poor snow data to WFOs and stress the need for good consistent snow measurements.

Comment: The NOHRSC has sent examples of non-representative snow water equivalent measurements to all hydrologic program managers and to OCWWS/OS7 to emphasize the importance of high quality snow observations. The intent is for the HPMs and others to use the material to further educate those most in need on the importance of quality snow measurements. (Carroll)

5. Action item: Have NOHRSC send list of data sites to all WFOs to cross check for accuracy of metadata. (see item 5 in session 2 below)

Comment: The NOHRSC will create a web page that gives the station IDs, by CWA, for which the NOHRSC has metadata and is able to process information when received at the NOHRSC in

SHEF. Additionally, a page of "lost" station IDs (i.e., no metadata available) will be created. Each hydrology program manager should review both pages to ensure that: (1) the NOHRSC has all of the expected stations IDs for a given CWA, and (2) that none of the "lost" stations are his/her responsibility. The station ID pages should be complete by early January. I'll notify all HPMs when they are available. (Carroll)

6. Observation: In order for the data to make it into the NOHRSC snow model, snow observations need to be shipped, in SHEF, to AWIPS by noon (Central Time) because the NOHRSC model runs overnight. NOHRSC products are typically distributed at 5-6am local time the following day.

7. Action item: WFOs need to make sure NWSLI station metadata are current and correct. Have NOHRSC flag suspect sites and send to WFOs.

Comment: Each hydrology program manager needs to ensure that the metadata for all reporting stations for his/her CWA are current and correct—particularly the latitude/longitude information. The NOHRSC has no way of knowing if the lat/long metadata are blundered and, consequently, no ability flag suspect reporting stations. (Carroll)

8. Action item: All WFOs (and all other observers) should be taking snow depth readings with SWE measurements.

Comment: The NWS has modified the snow data collection policy to include the following: (1) snow water equivalent should NEVER be estimated from tables or by dividing snow depth by 10 (see NWS Manual 10-1311), and (2) snow depth measurements should always be made and reported at the same time snow water equivalent measurements are made (see NWS Manual 10-1311 and Federal Meteorology Handbook No. 1). (Carroll)

## **Session 2**

Scribe: Jay Breidenbach

1. Timing of Seasonal Peak Flow Forecasts - Customers continue to ask for a product which gives some information on the timing of seasonal peak flow resulting from snowmelt. As the season progresses, customers also want to know whether or not streams have already peaked. What is the probability of a higher seasonal peak than what has already been observed?

Comment: As AHPS is implemented, RFCs will have an enhanced ability to generate peak and timing information for snowmelt watersheds through ESP. This same modeling approach allows for subsequent peak assessment. ESP products which deal specifically with the magnitude and timing of snowmelt peaks are not a part of the AHPS baseline, however, they are easily generated. Customer requirements for such information need to be made known to the RFCs. RFCs and WFOs should collaborate to ensure that NWS customers are well served. (Hartman)

2. Low Elevation Snow Water Equivalent - This continues to be an important issue with most winter flood episodes in the intermountain region originating from rain on low elevation snow. Are there other sources of observed SWE data which could be used to help evaluate the low elevation snow

pack and to determine whether or not snow model states are close to reality? New snow courses? New SNOTEL? Gamma Flight Lines? Other?

Comment: The NOHRSC simulates snow water equivalent using all available ground-based, airborne, and satellite snow observations that are assimilated into snow model state variables forced by numerical weather prediction model fields. The NOHRSC produces a "delta" map daily that indicates the degree to which the modeled snow states deviate from observed snow water equivalent or snow depth. This delta field is used to re-initialize the snow model and, consequently, assimilate the observed data into the modeled state variables. Airborne gamma radiation flight lines can be added to specific basins of interest upon request. Once established, airborne flight lines can be flown to make airborne snow water equivalent measurements upon request. (Carroll)

There are really two problems here. First, is the RFC snow model (SNOW17) properly reflecting the current conditions? Second, if it is not, upon which basis can/should it be adjusted. This is less of a problem for areas where the snowpack is relatively deep and seasonally persistent. For lower elevations, where the snowpack is intermittent and where historical observations are sparse and of lower quality, this can be very problematic. A first step would be to increase awareness through revealing the SNOW17 model states for both low and higher elevation bands. When the snow model shows, for example, zero snow at lower elevations when that is obviously not the case, a change may be in order. Watershed estimates available from the NOHRSC should be considered as a reasonable place to start, but the impacts on simulated streamflow in the near and long term need to be assessed and understood. (Hartman)

3. Usefulness of additional SWE observations - It was pointed out that calibration issues with the Sacramento Soil Moisture Accounting Model make it difficult to incorporate observations of SWE equivalent without a long period of record. How long does the record need to be? Are there better ways to incorporate SWE data with shorter, or no period of record?

Comment: Current snow model updating techniques (used by RFCs in the West) cannot utilize observations that have no historical record. From a statistical perspective, approximately 20 years of data are needed to estimate stable coefficients. As the number of years diminishes, so does the confidence placed on coefficients and resulting estimates. Estimates based on 5 or fewer years of data should generally not be made unless you're very desperate. There is, however, hope. If a retrospective analysis (modeled with data assimilation, i.e. Snow Data Assimilation System (SNODAS)) of the gridded SWE can be estimated for the past ~30 years, then current estimates (which use the same processing techniques and include ad-hoc observations) can be related to current model states for updating purposes. (Hartman)

4. SNOW17 Model States - WFO's need a way to graphically display snow model states. Graphs of other SAC SMA model states may also be important. This may give the WFO hydrologist a better understanding of how the models will handle a given snowmelt situation.

Comment: The NOHRSC web site provides a summary of the NOHRSC energy-and-mass-balance snow model states in map, gridded, time-series, and SHEF (basin-by-basin) format. (Carroll)

The CBRFC web site currently provides access to simulated SWE for all of their watersheds. The other WR RFCs are interested in pursuing this as well. Maps depicting RFC simulated snow states is something that would be clearly useful. (Hartman)

5. Missing IDs - It was suggested that a map of missing IDs be posted which shows location and ID of stations which used to transmit snow information. This map should be broken down by WFO and sent to the hydrology mail list.

Comment: A map of missing station IDs cannot be created because the metadata (i.e., the latitude/longitude information) are missing. The NOHRSC will create a web page that gives the station IDs, by CWA, for which the NOHRSC has metadata and is able to process information when received at the NOHRSC in SHEF. Additionally, a page of "lost" station IDs (i.e., no metadata available) will also be created. Each hydrologic program manager should review both pages to ensure that: (1) the NOHRSC has all of the expected stations IDs for a given CWA, and (2) that none of the "lost" stations are his/her responsibility. The station ID pages should be complete by early January. I'll notify the HPMs when they are available. (Carroll)

6. Back Country Observations - It was noted that there are lots of back country observations of snow depth, snow density, and temperature. This data source should be investigated further for possible use in SNODAS and verification.

Comment: The NOHRSC makes every effort to ingest and process available data from over 40 mesonets across the country. If a hydrology program manager is aware of a "backcountry observation" network that could provide data for use in SNODAS processing and verification, he/she should: (1) create and post valid station IDs for all reporting stations into the NWSLI, and (2) ensure that the data get reported in near real-time and shipped in SHEF to AWIPS. Only in that way can the backcountry observations be ingested and processed by SNODAS. (Carroll)

Again, a retrospective analysis of SNODAS will allow for objective use of this information in the SNOW17 updating process. (Hartman)

7. Comparison of NOHRSC National Snow Analyses products to SNOW17 models results - Currently there is no way to intercompare the two products. Independent verification of both estimates would also be useful.

Comment: Currently, the NOHRSC sends daily snow water equivalent data in SHEF to all CONUS RFCs. RFCs can easily compare the snow water equivalent states from SNOW17 and from SNODAS. An intercomparison would certainly show differences between the two estimates of snow water equivalent derived using very different estimation procedures. What then? (Carroll)

The RFCs have not been provided with the tools to do this in an efficient manner. Additionally, the RFCs may not be motivated to develop the comparisons. It may be more appropriate for the RFCs to send simulated model states to the NOHRSC, or to OHD, for comparison and analysis. (Hartman)

8. Bookmarking NOHRSC pages – Is it possible on the NOHRSC interactive snow information page to set the geographic extent, specify the required map overlays, select the physical element of choice, etc and save the settings and URL for future use that will return snow data for the most recent date while using the previously defined map settings?

Comment: Yes. From the NOHRSC help menu, click on “interactive map server”, click on “navigation”, click on “How can I make a bookmark for a map that always shows the current date?” The following instructions are revealed:

The date information is stored within the URL of the interactive map page (as well as in the "link to image" image URL). If the date is not specified, the page will default to the most recent date.

\* So, to do this, you should remove the string "&dy=YYYY.....dh=HH", which specifies the year, month, day, and hour, from the URL. After doing so, you should have a bookmark to a page (or image) that shows the most recent date. (Carroll)

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