Importance of Accurate Snow Measurements

To: National Hydrologic Program Managers

From: Tom Carroll, National Operational Hydrologic Remote Sensing Center

The National Operational Hydrologic Remote Sensing Center (NOHRSC) uses all available data to make the best, near real-time estimate of snowpack properties for the CONUS. The products are used by the NWS and others in operational hydrologic forecasting. The NOHRSC assimilates daily ground-based snow water equivalent and snow depth observations into the NOHRSC energy-and-mass-balance snow model state variables. The NOHRSC snow model is re-initialized with the observed snow data and a variety of National Snow Analyses products are generated and distributed to NWS and non-NWS users (www.nohrsc.noaa.gov).

Figure 1 and Figure 2 depict poor quality observed snow water equivalent data that were, unfortunately, used in the NOHRSC snow data assimilation process resulting in comparatively poor snow model simulations.

Figure 1 shows an apparently reasonable snow water equivalent accumulation (dark blue dots) from less than 1 cm to 8 cm on January 5-7. The snow model apparently underestimated the 8 cm water equivalent observation. Consequently, the observed value of 8 cm was assimilated into the snow model. The time of assimilation is indicated by the green line at the top of the plot. After the assimilation, the modeled estimate was about 8 cm (dark blue line). The next observation indicates a water equivalent of zero. The following three observations indicate a water equivalent of about 1 cm while the modeled water equivalent remains unrealistically high at 8 cm. With the benefit of the January 8-12 snow water equivalent data, it seems clear that the 8 cm observation was in error and the resulting assimilation was ill advised.

Figure 2 depicts multiple daily observations of snow water equivalent (dark blue dots) that are unrealistic. The air temperatures during the period were below freezing and no melt occurred. Snow water equivalent does not behave in the erratic pattern indicated by the observations and red arrows.

The NOHRSC attempts to quality control all snow data before they are assimilated into the NOHRSC snow model. It is extremely difficult, and frequently impossible, to identify non-representative or blundered snow observations in real-time. Consequently, it is critically important that all NWS and non-NWS observers who make snow measurements to make the best, most representative, and highest quality snow measurements possible. Only in this way can the NOHRSC make the best estimate of snowpack properties using all available data that is, in turn, used operationally in the NWS hydrology program.

Many thanks for your punctilious attention to snow measurement detail.

Quality snow depth and snow water equivalent measurements are hugely important!

We rely heavily on your snow data!

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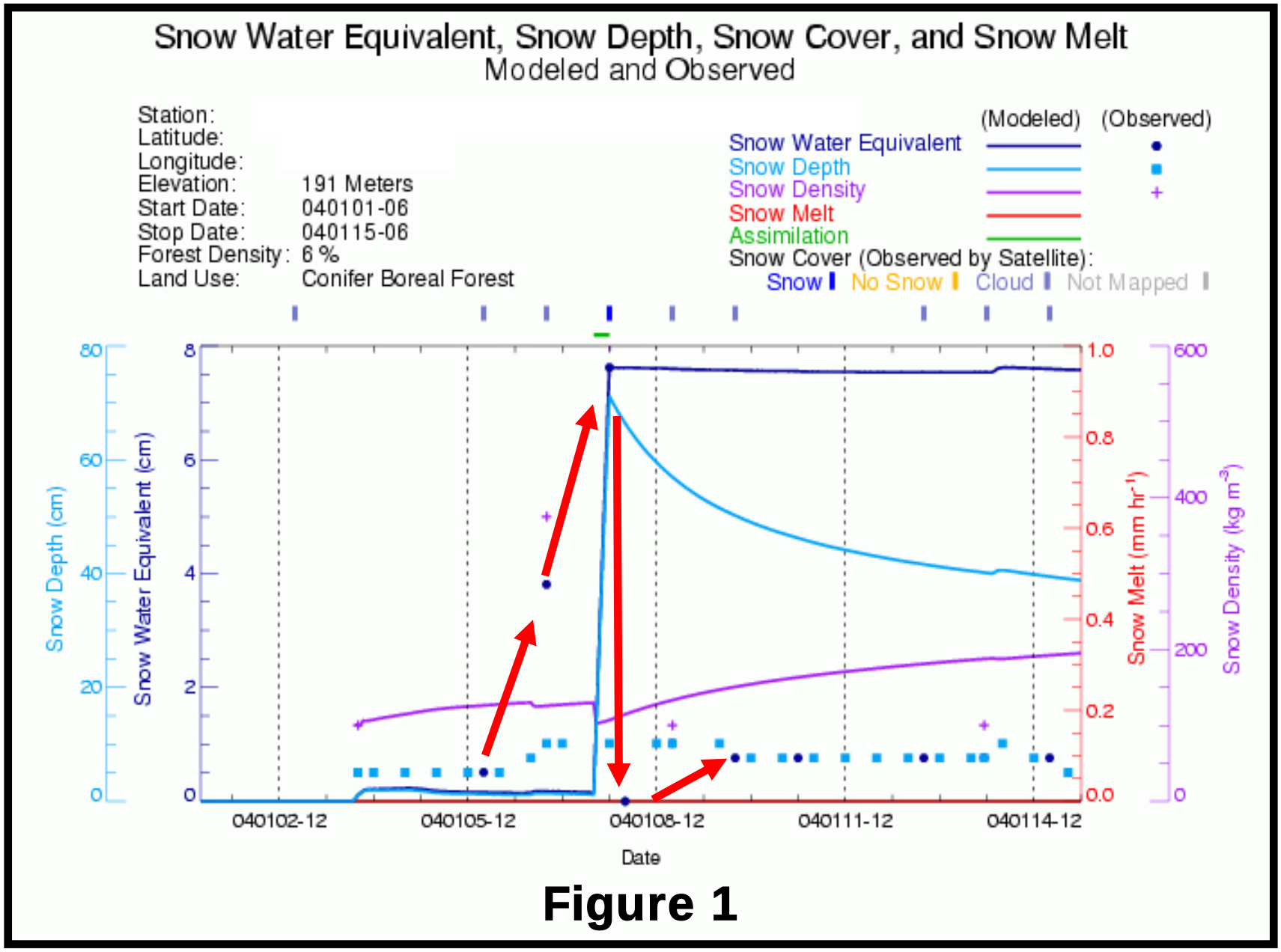

Figure 1

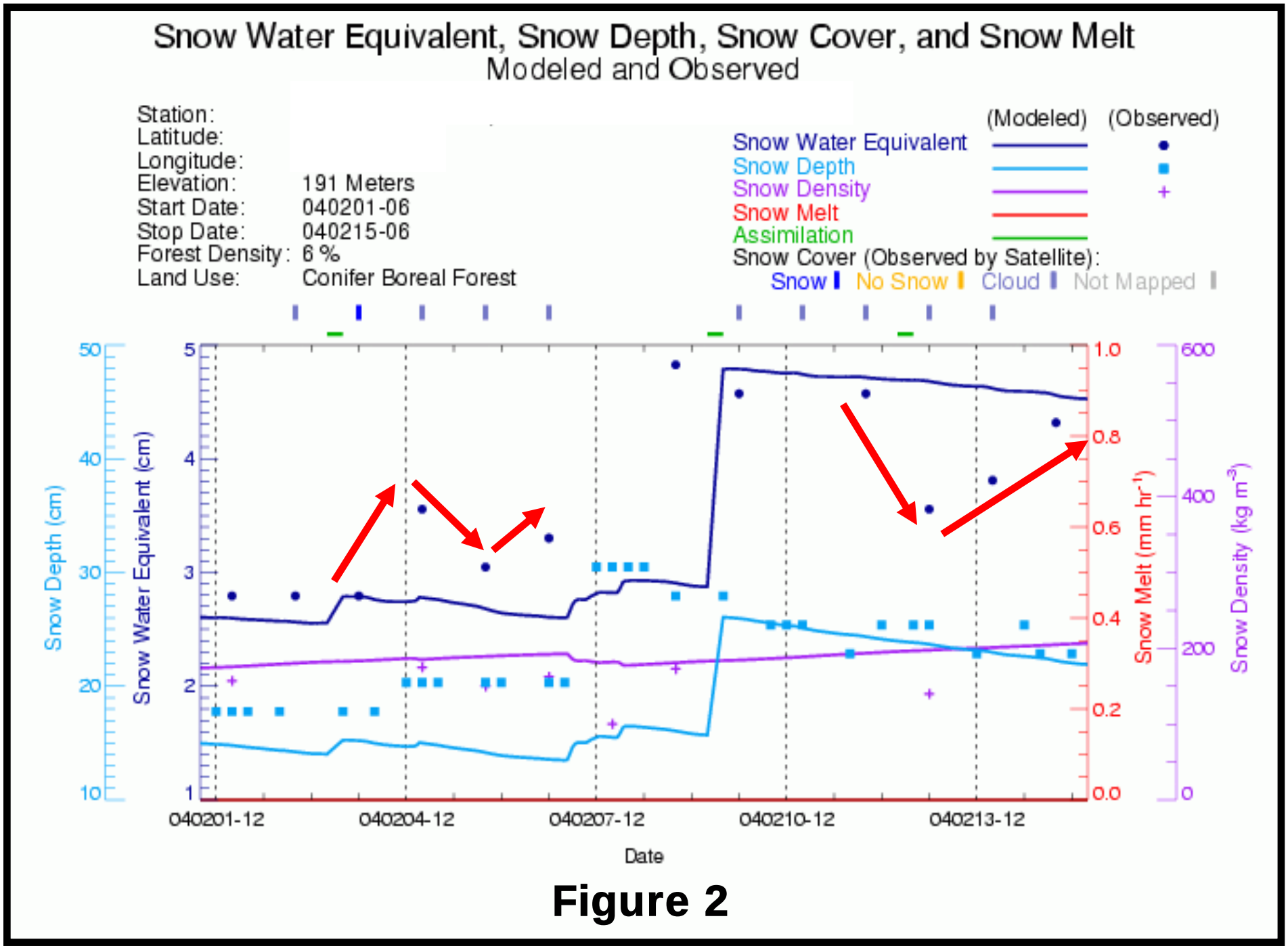
Snow Water Equivalent, Snow Depth, Snow Cover, and Snow Melt
Modeled and Observed
Station:
Latitude:
Longitude:
Elevation: 191 Meters
Start Date: 040201-06
Stop Date: 040215-06
Forest Density: 6 %
Land Use: Conifer Boreal Forest
(Modeled) (Observed)
Snow Water Equivalent
Snow Depth
Snow Density
Snow Melt
Assimilation
Snow Cover (Observed by Satellite):
Snow No Snow Cloud Not Mapped
Snow Depth (cm)
Snow Water Equivalent (cm)
Snow Melt (mm hr-1)
Snow Density (kg m-3)
040201-12
040204-12
040207-12
040210-12
040213-12
Date

Figure 2