AWOC Winter Weather Track FY11

Steamboat Valley and Park Range Upslope Snowstorms

IC4.3 Microclimate Exercise
Matthew Aleksa – NWS GJT
30 April 2011

Overview: The town of Steamboat Springs is located at the eastern end of the Upper Yampa River Valley at the base of the Park Range in northwest Colorado. Steamboat Springs has an elevation of roughly 6,700 ft, and is surrounded to the north, east and south by the Park Range, which sits between roughly 9,000 ft to 11,000 ft above sea level. The Upper Yampa River Valley extends about 115 miles to the west of Steamboat Springs to the Colorado-Utah border with an elevation around 6,300 ft. Vernal, Utah in northeast Utah, located in the Uintah Basin, is at an elevation of around 5,300 ft, 140 miles to the west of Steamboat Springs. This path is uninhibited by terrain, which allows certain wind flow regimes to enhance the snowfall in this region. The Tower SNOTEL site (Buffalo Pass), located 8 miles to the northeast of Steamboat Springs at an elevation of 10,500 ft, and often experiences some of the highest snowfall totals in the state. Figures 1 and 2 below show the spatial distribution between the town of Steamboat Springs, CO and Tower SNOTEL site.

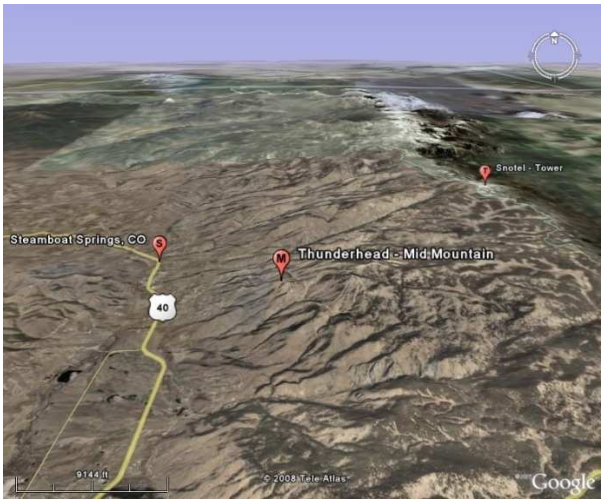

Figure 1 (left) is an aerial view looking north. Figure 2 (right) looks east and displays the topography and spatial distrubition of the sites. Marker "S" represents the town of Steamboat Springs, CO; "M" represents the mid-mountain site; "T" represents the Tower SNOTEL observation site. Images were taken using Google Earth.

Synoptic Setup: The Park Range, oriented from north to south in the northwest Colorado mountains, are generally favored for accumulating snowfall in a northwest synoptic flow regime. The Park Range curves around to the northwest and southwest of Steamboat Springs. Due to the open terrain to the west of Steamboat Springs, a westerly flow is favored for significant accumulating snowfall in the Steamboat Springs area. This westerly flow is typically seen on the back side of upper level low pressure systems as they track across the northern part of western

Colorado, as well as on the back side of cold fronts. If there is sufficient moisture, under a westerly flow regime, this moisture can be carried across the open, gently sloping terrain to the Steamboat Valley and up to the summit of the Park Range northeast of Steamboat Springs, allowing for enhanced and intense snowfall accumulations. The distance from Steamboat Springs at 6,700 ft to Tower SNOTEL at 10,500 ft is only 8 miles. A strong, westerly flow can produce significant snowfall accumulations due to enhanced orographic lift over this area. On average, Steamboat Springs receives about 160 inches of snow per year, while the Tower SNOTEL receives about 460 inches of snow per year. As explained earlier, this is largely due to a relief difference of 3,800 ft over 8 miles.

Long-term patterns are examined in order to determine the precipitation and temperature outlook for all four seasons, including the winter. A negative ENSO, or La Nina, can lead to above normal snowfall for the northern and central mountains in western Colorado, as this favors a more northerly storm track with low pressure systems tracking over northern Colorado.

Another scenario that can produce significant snowfall in the Steamboat Springs area and areas up valley is cold-air damming and overrunning precipitation. Cold air can become trapped in the Steamboat Valley when snow accumulates, leading to surface-based inversions due to snow cover. This cold air damming can lead to moisture overrunning the cold dome, leading to enhanced snowfall accumulations in Steamboat Springs due increased orographic lifting and potential increases due to the seeder-feeder mechanism.

Operational Impacts: MOS guidance and forecast models have difficulty handling the resolution of this enhanced snowfall and the fine-scale temperature variations in the Steamboat Springs valley. Since the Grand Junction WSR-88D radar is at 10,000 ft above sea level, the radar overshoots much of the precipitation that falls in this region. Satellite, spotter reports, and the SNOTEL observations are valuable to forecasters during these events to determine how much snow is falling and snowfall rates. When forecasting these events, forecasters rely heavily on local knowledge and experience.