

Strong Radiational Cooling in the Tygart Valley

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Overview

Radiational cooling in the Tygart Valley, located along the western slopes of the Appalachian Mountains, is a common occurrence during clear calm nights. This phenomenon is further exacerbated in the winter months when snow stays on the ground adding to the cooling of the lower atmosphere. Typically, when one thinks of locations in the U.S. with winter low temperatures reaching into the -10F to -20F range, they think of the northern plain states. However, Elkins, WV can be added to that list of cold spots.

Located in the northern third of the Tygart Valley, Elkins manages to get sub-zero low temperatures every winter and these have been recorded through the years beginning in the late 1800's. One occurrence of strong radiational cooling, January 9th – 10th 2011, had low temperatures in Elkins of -5F and -4F, respectively. The low temperatures had been in the mid teens above zero in the week leading up to the event. This brief document will further discuss the topography and atmospheric ingredients that cause this phenomenon and the January 9th – 10th event of 2011.

Topography

The Tygart Valley, located in Randolph County in West Virginia, is a mountain valley with a base elevation of just under 2000ft. Running parallel on either side of the valley are ridgelines that vary from about 3000ft to 4000ft. The valley wall running south to north along the western side of the valley is comprised of the Rich Mountain ridgeline and tops out around 3600ft. The wall on the eastern side of the valley is a little less structured, however, tops out higher with several peaks just above 4000ft. The Tygart Valley holds the Tygart Valley River which originates just a few miles south of Valley Head, WV. The Tygart Valley gently guides the river north as the slope of the valley is south to north. The valley and river drain north to Elkins, before turning west through the pass between the Rich Mountain ridgeline and the Laurel Mountain ridgeline.

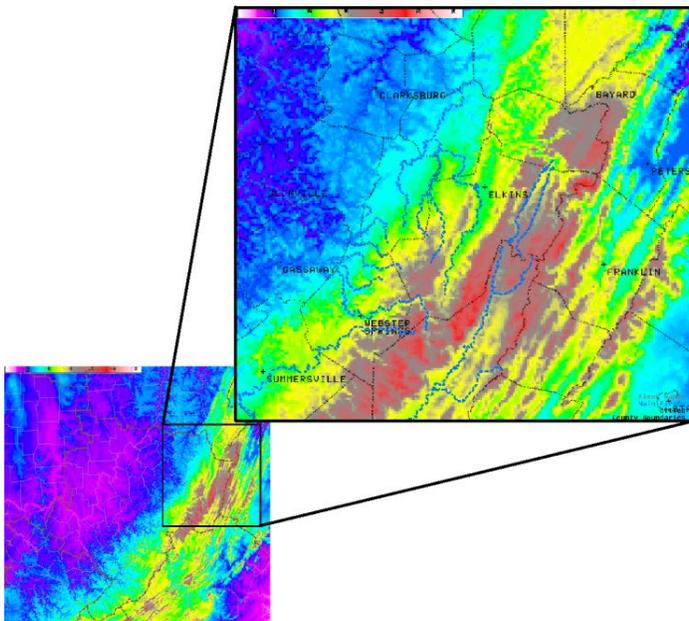


Figure 1: Topographic image of Tygart Valley with cities and rivers overlaid

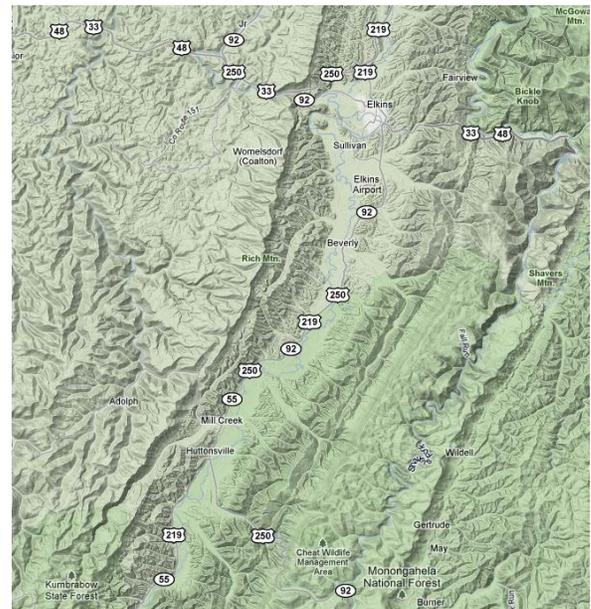


Figure 2: Alternate topographic map of Tygart Valley with roads and cities overlaid

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Atmospheric Ingredients

As mentioned previously, optimal conditions for strong radiational cooling in the Tygart Valley are clear, calm nights with snow on the ground during the long nights of winter. Clear sky conditions mean no clouds are around to inhibit longwave radiation emitted from the earth's surface to escape into the atmosphere. Very light or calm winds greatly diminish the possibility of the mixing the near surface atmosphere, keeping the cold air firmly in place just above the ground. Snow cover helps to reflect incoming radiation while continuing to emit longwave radiation during the nighttime hours. As the radiational cooling continues through the long nights of winter, the colder and denser air continues to drain down-valley with the coldest temperatures felt at the drainage point of the valley. In the case of the Tygart Valley, Elkins is located near the drainage point of the valley.

2011 January 9th – 10th

The low temperatures recorded at KEKN (Elkins ASOS) leading up to the 9th and 10th were in the low to mid teens above zero with no snow cover reported. During the morning of January 7th, a vigorous cold front sweep across West Virginia bringing with it colder temperatures and a fresh coating of snow. From January 6th – 9th a total of 7.2 inches of snow fell and on the 9th a snow depth of 6 inches was reported at Elkins-Randolph County Airport. By the evening of the 9th, a 1030mb surface high pressure system had settled in, with light winds and clear skies reported throughout the lower Great Lakes through West Virginia (Fig. 3). Optimal conditions were in place for strong radiational cooling in area and specifically within the Tygart Valley. As indicated in Table 1, the low temperatures reported at KEKN on the 9th and 10th were extremely lower than average.

LOCAL CLIMATOLOGICAL DATA
 STATION: ELKINS WV
 MONTH: JANUARY
 YEAR: 2011

DY	MAX	MIN	AVG	DEP	WTR	SNW	DPTH
5	34	16	25	-4	0.00	0.0	0
6	30	15	23	-6	0.01	1.7	0
7	28	18	23	-6	0.06	1.5	3
8	24	12	18	-11	0.05	3.7	5
9	20	-5	8	-21	T	0.3	6
10	24	-4	10	-19	0.00	0.0	6

Table 1: Climate data for KEKN Jan 5th – 10th

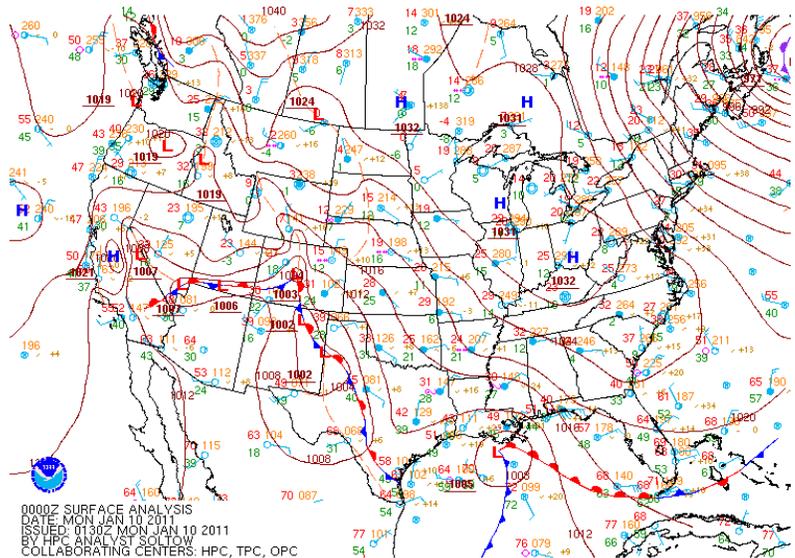


Figure 3: HPC surface analysis from January 10th 2011