Climate change: Taking a Local Perspective to the Global Level

By Alan K. Betts, posted on February 27th, 2012 in Articles, Climate Consensus

https://earthzine.org/climate-change-taking-a-local-perspective-to-the-global-level/

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The rapid pace of climate change in northern latitudes presents society with many challenges and a few opportunities. I am writing from the perspective of Vermont in the northeastern United States, where I conduct research on local climate change[1,2,] give talks[3] and write for local newspapers[4]. In the past few decades in northern New England (45°N), the winter season, when small lakes are frozen, has been lessening by about seven days per decade1. This impacts local ecology, stream flow and human recreational activities like ice fishing. Similarly, ground freeze-up is coming later, and melt is happening earlier in the spring.

Figure 1. Author turning over a cover crop of winter rye on Jan. 2, 2012.

Figure 1 shows the author turning over a cover crop of winter rye on Jan. 2, 2012. In three of the past six years, ground freeze-up, which historically occurred by November, has been delayed into January.

Mean winter temperatures have been increasing by 0.5 degrees Celsius per decade — twice as fast as the annual mean. The minimum winter temperature extremes are increasing even faster. This shrinking of the winter season is being driven by the same climate processes that are driving the rapid melt of the Arctic sea-ice in summer.

Two positive feedbacks are important[2]. As winter snow and ice cover shrinks, the reduced reflection of sunlight is a positive feedback, the familiar snow-ice albedo feedback. Warmer temperatures, with more rain and less snow, as well as reduced snow and ice-cover give more surface evaporation, which increases both the water vapor and cloud feedbacks through the increase in the downward longwave flux. At northern latitudes over land, these processes are familiar to local communities. For example, temperatures plunge after a moderate snowfall, while the diurnal temperature range remains small when there is wet ground with a moist or cloudy atmosphere[2].

Earlier snow and ground melt in spring advance the date of leaf-out and the last spring frost, and the spring climate transitions[2]. In fall, there is a delay in the first frost and the freeze-up of ground and lakes, so the growing season is extended on both ends[1]. The local food movement is burgeoning and the rise in extreme minimum winter temperatures, which allows more crops to winter over in unheated greenhouses, has greatly expanded the availability of green crops in the winter farmers' markets in Vermont.

Rural communities in northern New England are familiar with these seasonal changes, and are adapting. In the process, they are developing a social understanding of the link between regional climate change and global climate change, as newspaper articles[5] map out and discuss ongoing changes in terms familiar to local audiences. Moreover, the state has broad public support as it moves ahead with adaptation planning[6], and the transformation toward a more efficient energy economy, based on renewable sources of energy[7].

In 2011, Vermont suffered two major floods. Heavy rain in April and May, combined with warm temperatures and the melting of an above-average snowpack led to extensive flooding on the rivers feeding Lake Champlain. The lake rose to a new record level and stayed above flood-stage for two months. In late August, tropical storm Irene dumped more than 150 millimeters of rain across central and southern Vermont, destroying roads and bridges and ultimately cutting off 13 towns. Rebuilding has taken months. These major floods have prompted a reassessment of the vulnerability to increasing precipitation extremes — which have occurred in the northeastern U.S. in recent decades, and are predicted for decades to come.

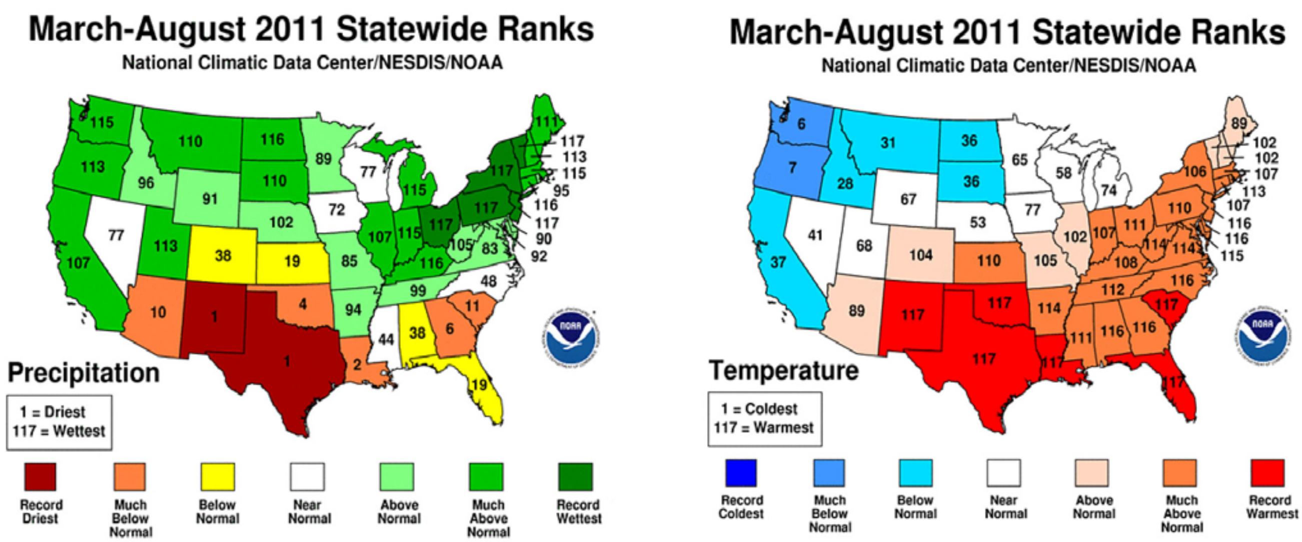

Figure 2. State-wide ranks for average March-August 2012 precipitation and temperature. Source: NOAA.

Figure 2 shows the statewide ranks for the average March to August 2011 precipitation (left) and temperature (right) for the U.S[8]. For precipitation, the states from Ohio to Vermont set new records for the highest precipitation in 117 years of data collection, while New Mexico and Texas set new records for the lowest precipitation. The southern U.S. set new high temperature records with the extended drought, while temperatures were much above normal for most of the eastern U.S. It is well known that precipitation rates increase with temperature because of the steep dependence of saturation water vapor mixing ratio on temperature. However, Figure 2 shows that over land storm-track patterns that are quasi-stationary play an important role in extreme precipitation events.

On the national scale in the U.S., entrenched political agendas are in denial about our responsibility for global climate change. However, in the northern New England states, communities are adapting to ongoing regional climate change, because the change in the seasons, as well as the increase in the frequency of extreme precipitation events, are readily apparent to state government and to citizens with connections and roots in the outdoors.

References

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His research is supported by NSF grant AGS05-29797.