

## Heatwave dynamics in the Northeast US

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A critical societal impact of a changing climate will be likely increases in extreme temperatures and an increasing trend in extreme temperatures is already observed, consistent with the projections. Heat waves are one of the leading natural hazards for the US in terms of human mortality, accounting for more than 20,000 deaths between 1936 and 1975. In order to confidently assess possible future changes to extreme temperature events, we need to understand the current range of dynamics. Here we consider heat waves in the Northeast US, defined based on daily temperatures for 14 representative stations that had good reporting for the 30-year period 1979-2008. Using the heat wave definition of 90F (32.2C) for at least three consecutive days, there are 504 days in the 30-year period that had a heat wave at at least one station in the region. One of our stations, Blue Hill Observatory, has the longest continuously-reporting record in the US and is therefore useful for looking at longer term trends. As expected, all events are associated with a high pressure system. However, the position, strength, and structure of the high pressure system varies dramatically. In fact, during a heat wave the 1000hPa wind over the Northeast can be coming from any quarter; that is, heat waves are observed with a SW, NW, NE, and SE local flow. The majority of the events have a flow from the southwest, as expected from the "classic" picture, but at least three other patterns occur with regularity. The range of events are explored both in terms of the thermodynamic equation at 925hPa, to look in the near-surface layer at the relative importance of horizontal temperature advection and subsidence, as well as at the terms of the surface energy budget, especially the relative importance of radiative and flux terms. In the range of heat wave circulations, the key distinction appears to be between horizontal advection events, like the classic case of flow from the southwest, where temperature advection is strong but the vertical velocity is near zero, as compared to events where the flow is from the north and horizontal advection appears to be negligible or event slightly negative but subsidence is very strong. Trends in maximum temperature and the number of heat waves are increasing in both the 30-year period and in the secular Blue Hill record. We also examined the link between summer daily temperatures and energy use in the Northeast and show a close correspondence. As peak energy summer use is already close to capacity in the region, further increases in high temperature days will like provoke serious capacity problems even in the next five to ten years.