A comparison of flash flood producing narrow cold frontal rain bands on November 16, 2006 and January 25, 2010 in northeast Pennsylvania and southern New York

Significant flash flooding occurred over portions of northeast Pennsylvania and southern New York on November 16th, 2006 and again on January 25th, 2010, in association with intense, eastward-moving, north-south oriented narrow cold frontal rain bands (NCFRs). In both cases, the flooding associated with these events was widespread, with the most damaging flooding occurring across the twin tiers of southern New York and northern Pennsylvania. Isolated severe wind gusts and a tornado occurred on November 16th, along with flash flooding resulting from rainfall totals of 3 to 4 inches in around 3 hours. No damaging winds were reported on January 25th, however rainfall totals of 2 to 3 inches in a few hours combined with snow melt to produce flooding and flash flooding. This study will examine the similarities and differences between these two events, with the goal of providing forecasters with insight into environments that produce these types of storms..

The large-scale flow patterns associated with the two events were quite similar. Both events featured highly amplified mid-level troughs moving slowly east across the Great Lakes and Ohio Valley. Strong surface cold fronts moved east across the central and northern Appalachian mountains. In addition, both events were associated with anomalously strong southerly low-level jets, and north-south plumes of anomalously high values of precipitable water.

A surface analysis of the two events indicated that a narrow band of heavy rain on the 16th occurred well downstream from the primary surface cold front, however, a band of pressure falls associated with weak surface trough may have served to focus the heavy rain. A band of heavy rain on the 25th appeared to occur along the primary surface cold front, in association with a maxima of surface pressure falls accompanying a weak low pressure wave moving north along the front. A cross-sectional analysis of equivalent potential temperature taken from east to west across the two rain bands indicated that both bands were associated with strong mid-level frontal zones. On November 16th, the mid-level frontal zone was co-located with the heavy rain band and was located downstream of the low-level front, resulting in more low-level instability and a stronger intrusion of dry air between 700 and 500 hPa, in the area where heavy rain developed. By contrast, on January 25th the surface and mid-level frontal zones were both co-located with the heavy rain. As a result, there appeared to be less low-level instability in the vicinity of the heavy rain band. In addition, the amount of mid-level drying was much less on the 25th.

The results of this study imply that heavy rain producing NCFRs have certain key features in common, which can be easily identified by looking at standardized anomaly plots. Specifically, strong low-level southerly wind components and north-

south plumes of anomalously high precipitable water values appear to be key features associated with flash flood producing NCFRs. However, differing meso-scale environments, including the structure of the associated frontal zones, can modulate the degree of flooding vs. wind damage that accompany these events.