

Final Report Partners Project

University: Kean University

Name of University Researcher Preparing Report: Paul J. Croft

NWS Office: Philadelphia/Mount Holly (PHI)

Name of NWS Researcher Preparing Report: Alan M. Cope

Type of Project (Partners or Cooperative): Partners

Project Title: Distribution & Initiation of Summer Season

**Convection: Operational Verification, Examination, & Research
in New Jersey (DISSCOVER – NJ)**

UCAR Award No.: S07-66830

Date: January 2009

Section 1: Summary of Project Objectives

The project examined convective initiation patterns, total coverage, and the attendant synoptic fields, point observations, various indices, and derived operational products to better understand summer season convection in the New Jersey region. Both mapping and statistical compositing were prepared to depict the spatial characteristics and determine specific attributes associated with convection (e.g., timing, location, and severity) as well as any interactions with local features or flows. The intent was to better define and depict convective modes and morphology for use in operational forecasting based on prevailing flow and physiographic features. Results have provided distinctions that forecasters may use in operations to better depict the convective mode and 'threat' by location according to key flow features. There were also several instances in which no additional distinction could be made of the convective timing and distribution in the region. These

were helpful in identifying situations that require further investigation and research by other methods. Verification of the findings was also considered with regard to POP forecasts for select cases to determine what improvements might be gained from application of the real-time techniques applied. These indicated that a greater precision was possible in the prediction of initial cell activity, location, and coverage as well as later convective activity. Scientific interaction and exchange between the NWS and Kean University were increased and enhanced between partners and provided students with access to current NWS operational methods.

Section 2: Project Accomplishments and Findings

Summer season convective activity was classified as events (initiating after 15 UTC), contaminates (activity occurring between 12 and 15 UTC), and null days (no activity from 12 to 00 UTC). Project results indicated that the greatest amount of activity (event or contaminate) occurred with W and SW flows at 500mb and surface cold fronts and troughs. While event initiates had a similar location of origin to contaminate activity, they mostly developed outside NJ; and most of the resulting total activity occurred as isolated clusters or cells and had less "focus" or organization as compared to contaminates.

One hundred percent of events initiated in northwestern NJ during June, 65% in July, and 42% in August. In 65% of all events, initiation began in northwestern NJ and this "source region" diminished in significance as the summer season progressed. Initiation of events was observed to trend towards southern NJ as the summer season progressed with 57% of August initiates occurring in southern NJ. Total coverage event initiates showed a solid, intensifying progression from higher elevations to the coast. Activity was highly variable, but limited, in its "time-placement-coverage" versus contaminates that clustered; and event days had higher LI values than contaminates.

The contaminate activity for initial cells showed coverage to be farther to the southeast as compared with event initiates with many found in southern NJ and the nearby coastal regions – particularly for S and SW flows. Contaminate activity did not preclude further convective development and showed higher PWAT values than for event days. Cold front initiates were intense and widespread across northeastern

PA and northwestern NJ and showed a region of higher concentration across Chesapeake Bay & southern PA through MD.

The 500mb SW flow initiates, which share many of the same coverage patterns of the cold front initiates, indicated higher intensities in the northwestern region. Combinations of various upper air flow and surface features were to be investigated separately (e.g., cfropa for 500 mb flow from the NW, W, SW, et cetera). In ten observed cases of sea breeze initiation that were reviewed, the convection was weak and short lived, with no apparent influence on later convective activity. The initiation generally occurred when the sea breeze moved well inland. Sea breeze initiated convection was more common in July and August with only one event occurring in June. Sea breeze convective cases occurred with 500 mb flows from the W and SW.

This COMET project originally called for verification of operational forecast grids, including probability of precipitation (PoP), QPF, weather type, etc. However, the grid verification software was not available and therefore a limited verification evaluation was made based on the initial findings of the project. The 'point verification' suggested a tendency to over-forecast on low PoP days, e.g., to forecast 30% PoP on a day with 20% rainfall coverage, and conversely to under-forecast on high PoP days. The range of forecast PoP across the entire forecast area was never more than 30%. This suggests that forecasters are hesitant to discriminate between thunderstorm and no-thunderstorm areas, and tend to stay within the middle range of PoP. The verification study also suggested that the first-period forecast in certain cases could be updated during the morning, using meso-scale information, to increase PoPs in some areas and reduce them in others, to better discriminate between thunder and no-thunder areas.

Kean University students also collected, mapped, and began to prepare an archived dataset for the period 2000-2005 (in addition to the 2006, 2007, and 2008 data) for development of a conceptual model and verification/testing. This is planned for the winter/spring of 2009 to provide information towards the implementation of an operational conceptual model that may be used in forecaster training. A COMET Partners proposal (Forecast Implementation & Testing:

Summer Season Convective Initiation Techniques) has been submitted for consideration of this work. Students also prepared composite field mapping for null, event, and contaminate cases to generate checklist guidance for operations. This is presently in progress in anticipation of funding of the new project. An examination of severe versus non-severe was also initiated as an aid to forecasters in determining risks during the summer season. Each of these will serve the purpose of developing a checklist for convective activity which can be used to create a conceptual model for real-time application and testing. In a related activity, the NWS and KU partners collaborated on several aspects of a Weather & Environmental Hazards Symposium on Kean University campus (November 2008) designed to raise awareness, educate, and highlight research of practical significance to the public and other sectors. The one day meeting was attended by professional audiences, the general public, K-12 students & teachers, and Kean University students, staff, faculty, and alumni.

The project accomplishments met the scientific outcomes through the determination of the attributes of convective initiation according to flow regime and variability; the impact (or lack) of (impact) with regard to ongoing convection and the overall attributes of convection (in terms of distribution and null cases); and distinguished convective distribution (timing, location) with forecast fields and verification.

The project accomplishments met related outcomes by delivery of a variety of abstracts for conferences; publication of preprints and other technical materials; presentations at conferences (and scientific and other audiences); manuscript and proposal development; and increased and enhanced exchanges between the partner institutions.

Section 3: Benefits and Lessons Learned: Operational Partner Perspective

From the NWS point of view, one of the most important benefits of this COMET Partner's Project has been the high level of interaction between the office and the Kean University Department of Geology & Meteorology. Dr. Croft visited NWS Mount Holly numerous times during the course of the project to review progress and plan the next steps. Al Cope also visited Kean University on several occasions and

gave a presentation on winter weather forecasting in the NWS to Dr. Crofts Physical Meteorology class. Several students from other universities, who were serving as summer volunteers at the NWS, were able to participate in the project. These students helped map the radar outlines of convection during summer 2007 and 2008.

NWS Mount Holly held its annual spring workshop in April 2008, at which Dr. Croft and Mr. Cope presented the findings from the project. A majority of the office staff was present for the workshop. The results suggest that afternoon thunderstorm initiation is favored in certain parts of the forecast area, e.g., in northwest New Jersey during the early part of the summer, and in southern New Jersey later in the summer. The verification results indicate that there are opportunities on some days to refine and better focus the short-term convective weather forecast for the local area, based on the evolving meso-scale situation. Staff provided valuable feedback and comments with regard to operational application of the results. These ideas were applied and further investigated in forecast operations during summer 2008.

Section 4: Benefits and Lessons Learned: University Partner Perspective

Students had an opportunity to work on an operations-based research project and direct interaction with NWS personnel. Skills from their coursework were useful to project work and will assist their career and professional development. A substantial data archive was developed and will provide for comparison with in-house WRF modeling (e.g., see the website: <http://hurri.kean.edu/nwpmode1>) and other data to improve depiction of the convective environment. The work completed was also part of the Honors Seminar coursework students were enrolled in as well as Independent Study and other Kean University student-research programs. These included emphasis on writing for publication. Results and findings have been displayed in the hallway and formed the basis of discussions in synoptic laboratory sessions and other classes in which map discussions and assessments were completed.

The NWS provided guest speakers for lecture and results were also presented during the pre-summer workshop at the PHI NWS office.

Leveraging of the project has been accomplished through the Kean University Students Partnering with Faculty Program. This allowed for student work on project activities in advance and in concert with those hired for analytic work and archival data collection. Students involved in the project have presented their results to the Kean University Student Chapter of the AMS/NWA, the College-wide meeting of the College of Natural, Applied, and Health Sciences, and contributed to both oral and poster presentations of the research.

Section 5: Publications and Presentations

Presentations of the work were made by Croft (National Weather Association Conference, October 2007 in Reno, NV; American Meteorological Society Annual Meeting, January 2008 in New Orleans, LA; the Northeastern Storms Conference, March 2008 in Springfield, MA) and Cope (Northeast Regional Operational Workshop, November in Albany, NY). The latest results were given at the October 2008 NWA Conference in Louisville, KY. A preprint of the work was published as part of the American Meteorological Society 2008 annual meetings and a manuscript continues in preparation. Results were presented at the NWS spring workshop (PHI office) by the investigators (April 2008).

Section 6: Summary of University/Operational Partner Interactions and Roles

The two main participants in this COMET project were Dr. Paul J. Croft of Kean University and Mr. Al Cope of the NWS Mount Holly, NJ office. Dr. Croft prepared the original proposal with input from Mr. Cope. Data for the project, including radar maps, synoptic weather charts, sounding data, etc., were collected by students in the Kean University Department of Geology and Meteorology under the supervision of Dr. Croft. Radar maps for summer 2007 and 2008 were prepared by summer volunteer students at NWS Holly, using the local archive and computer workstation, under the supervision of Mr. Cope. Students at Kean University also prepared radar composite charts for the various synoptic patterns. Analysis of the results was done by Dr. Croft and Mr. Cope. Written and oral presentations were prepared and given by Dr. Croft, and an oral presentation was given by Mr. Cope.