J22.6 UNDERGRADUATE FORECASTING AND NOWCASTING FOR A MAJOR URBAN PUBLIC UTILITY

Brian J. Cerruti, Steven G. Decker *, and Louis A. Bowers
Rutgers, the State University of New Jersey, New Brunswick, NJ

Wayne K. Wittman
PSEG Services Corporation, Newark, NJ

John Carlson
Public Service Electric and Gas Company, Newark, NJ

1. INTRODUCTION

Public Service Electric and Gas Company (PSE&G) is the largest public utility in New Jersey, providing services to several urban areas, including Newark, New Brunswick, Trenton, and Camden, and encompassing 2.1 million electric and 1.7 million gas customers (Public Service Enterprise Group 2009). The weather can have a dramatic impact on energy demands given the dense population it supplies. As such, Rutgers University and PSE&G have developed a cooperative relationship to provide detailed daily weather forecasts to help PSE&G prepare for adverse weather. Most importantly, Rutgers forecasters provide PSE&G officials with "weather alerts" specifically tailored to PSE&G's needs and concerns. In return, PSE&G provides Rutgers undergraduates who participate in the program with the unique opportunity to earn real world experience forecasting for a high profile utilities company. Forecasters must deal with deadline-driven work, intra-forecaster cooperation, and all of the diverse weather situations New Jersey has to offer, and many earn academic credit through the Cooperative Education Program at the Rutgers University School of Environmental and Biological Sciences (CoopEd).

2. ORIGINS OF THE RELATIONSHIP

The Rutgers/PSE&G relationship began in 2003 when a Rutgers Institute of Marine and Coastal Sciences (IMCS) graduate student was looking for funding opportunities. PSE&G presented one such opportunity, and by the fall semester of that year, PSE&G was providing a weather forecasting grant with that student as the Program Manager and an IMCS faculty member as the Program Director. The Program Manager's roles included overseeing the undergraduate forecasters, maintaining verification statistics, and corresponding with PSE&G about the program on a regular basis. The Program Director recruited undergraduate forecasters and served as advisor for the graduate student and undergraduate students participating in CoopEd. The grant called for daily forecasts for electric operations in a Today, Tonight, Tomorrow, and 3–5-Day Extended Forecast format, with the targeted variables being temperature, wind, and precipitation type and amounts. Additionally, a seven-day gas forecast was issued daily targeting wind, relative humidity, cloud cover, temperature, and precipitation type for every three hours of the seven-day period.

A new Manager of Distribution Operations for PSE&G in the winter of 2004 would undertake a more involved relationship with the Program Manager to closely monitor and prepare PSE&G operations for adverse weather. They decided to discontinue the gas portion of the forecasting, but place more emphasis on the electric forecasting. This added emphasis culminated in "weather alert" criteria being developed to help PSE&G prepare more efficiently for different adverse weather. With encouragement from the Emerging Technology and Transfer group at PSE&G, the development of a Plant Damage Model was incorporated into the grant. This tool was expected to further aid PSE&G in storm preparation. This project became part of the graduate student's Master's thesis, and that student stayed on as Program Manager following graduation. Bowers et al. (2005) relate more information on the early history of this project.

* *Corresponding author address:* Steven G. Decker, Rutgers Univ., Dept. of Environmental Sci., 14 College Farm Rd., New Brunswick, NJ 08901; e-mail: decker@envsci.rutgers.edu

In the summer of 2007, the Program Manager moved on from his IMCS position, leaving a vacancy. One of the undergraduate forecasters at the time, then a senior in the Rutgers Undergraduate Program in Meteorology, was asked to fill in, and accepted the position for the remainder of the fall 2007 semester. At the end of the year, the Program Director left, leading to the transition of the program to the Rutgers Department of Environmental Sciences (DES), where a DES faculty member served as the new Program Director. The Program Manager entered the Rutgers University Graduate Program in Atmospheric Science in July 2008, where he is working to upgrade the previous Plant Damage Model while continuing to carry out Program Manager duties. It is anticipated that upon graduation, a new master's level graduate student will join Rutgers to fill the Program Manager role and carry out research of interest to both Rutgers and PSE&G.

3. DAILY OPERATIONS

3.1 Forecasting and Consulting

Forecasts are entered a minimum of once per day by 0700 LT (local time) for each of the four PSE&G service territories pictured in Figure 1. Additional forecasts are issued to address adverse weather as needed. Update times are made to coincide with PSE&G daily operations, specifically, two hours prior to shift changes. Major shift changes occur at 0700 LT (normal forecast; 0700 LT), 1500 LT (1300 LT update), and 2300 LT (2100 LT update). Additional workforce operations may necessitate updates at 1700 and 1900 LT. During severe or extreme weather conditions such as tropical cyclones, large-scale severe weather outbreaks, and intense nor'easters when weather alerts are in effect, conference calls are hosted by the PSE&G Manager of Distribution Operations to address manpower and safety concerns. During these calls, the Program Manager gives a 30-second oral forecast overview and is on hand to answer any questions from the division managers or other personnel.

The undergraduate forecasters are responsible for making forecasts for each of the four service territories by 0700 LT, making sure to update the forecasting website and issue alerts as required. Each forecaster is responsible for a single day per week, where the "day" runs from 0700 to 0700 LT. Should severe weather develop upstream, the forecaster is responsible for monitoring and tracking the weather, and issuing any pertinent alerts to PSE&G.

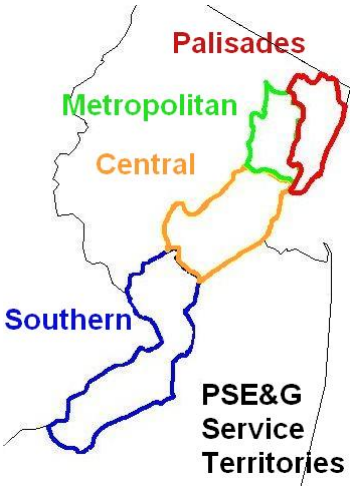

FIG. 1. A map of much of New Jersey showing the four PSE&G service territories.

3.2 Weather Alerts

In order to more effectively communicate weather-related potential damage and disruption to PSE&G officials, "weather alerts" were developed by the Program Manager and the PSE&G Manager of Distribution Operations with the help of several PSE&G engineers and Division Managers in the fall of 2004. The forecasters use the alert criteria as "red flags" when preparing a forecast, issuing alerts when the criteria has the potential to be met. This potential is conveyed with a forecast confidence level (low, medium, or high), provided with every alert, to address the uncertainty with each scenario. The alerts are sent as an email directly to the PSE&G Division Managers' smartphones.

The PSE&G staff use these alerts to prepare their workforce to be in the right place at the right time to ensure any damage to the PSE&G physical plant is fixed as soon as possible. This combined with other efficient PSE&G programs and operations has helped to make PSE&G a six-time winner of PA Consulting's ReliabilityOne Award for the Mid-Atlantic Region and winner of the 2005 and 2006 National ReliabilityOne Awards as the most reliable utility service in the nation.

4. COOPERATIVE EDUCATION CREDIT

A fundamental extension of the Rutgers/PSE&G relationship for undergraduates is CoopEd. CoopEd provides undergraduates in the forecasting program the opportunity to earn college credits towards their degree in the form of a traditional work-study program.

Additionally, the program offers college students with invaluable experience, real-world settings and deadlines, and the ability to directly apply classroom lessons on the fly. These opportunities often lead to improved confidence, a higher degree of understanding how the atmosphere works, and the ability to explain complicated situations to non-meteorologists.

Most importantly, the forecaster gains responsibility and accountability through CoopEd by setting out to accomplish goals they set at the beginning of the semester. When the semester is over, they critically review their forecasts, procedures, and outcomes to evaluate their performance. Typically, the student writes a synthesis paper or makes an oral presentation detailing their experience and lessons learned. This also serves to continue the program by spreading awareness via making the papers available, or holding the presentations as part of meetings other undergraduates attend.

5. OTHER ACTIVITIES

5.1 Plant Damage Model

Part of the original grant to IMCS in the fall of 2003 called for the Program Manager to develop a tool the forecasters could use to communicate the risk to the physical plant of PSE&G. The result was the Plant Damage Model, a reference table that predicts the number of damage report phone calls PSE&G would receive based on weather forecasts of wind gusts, precipitation type and amounts, and lightning activity for each of the four service territories. Phone calls were used because the volume of phone calls is related to the amount of damage received. However, because it is much more useful for PSE&G to receive estimates of physical plant damage, and not inferred damage, a policy change was made in PSE&G based on this original work to more carefully observe and record storm damage. Thanks to these efforts, a more complete record of weather-related plant damage is available to the current Program Manager for further investigation. Analysis of this new data is ongoing so that the Plant Damage Model may be improved. This effort forms part of the Program Manager's master's thesis research.

5.2 Numerical Modeling

High-resolution models were originally used at Rutgers University to investigate sea-breeze circulation interactions along the New Jersey shore. The ARW and NMM cores of the WRF model were utilized to run two 12-km nested domains over the Mid-Atlantic, and two more nested domains were used with the ARW core at 6 km and 1.3 km over the New Jersey Shore, which happened to also cover the PSE&G service territories. The model output was also used for offshore weather forecasting to support underwater glider operations by IMCS and the Woods Hole Oceanographic Institution.

Earlier forecast teams relied heavily on this high-resolution output to predict wind gusts and precipitation amounts, allowing them to consistently outpace the other resources PSE&G uses for workload preparation. More recently, the WRF model is additionally run at 36 km with a nested domain of 12 km over the PSE&G area, with planned expansions to 4 and 1.3 km.

Future plans include tying the WRF model run into the Plant Damage Model, producing a MOS-like text tabular output. This information will be used to help PSE&G more adequately prepare for daily operations.

REFERENCES

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