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## 1. Introduction

Since the fall of 2004, the Plymouth State University (PSU) meteorology program and Public Service of New Hampshire (PSNH), a major electric utility, have participated in a partnership to investigate ways in which PSNH could make better operational decisions when faced with possible weather related power outages. The primary goal of the partnership was to identify forecastable meteorological features that contributed to major outages (100 or more areas without power) and then develop a tool to bring the results of the research into day-to-day operations. In Phase I, Michael Nahmias (undergraduate student at PSU) developed an 8-year climatology of weather events that caused major outages (Nahmias and Hoffman, 2005). The results of this research identified four main weather systems that cause major outages: winter storms; wind storms; thunderstorms; and heat waves. For each type of weather system there were several common characteristics that were identified. For example, 90% of winter storm outages occurred when the temperature was between 28 and 34 °F. In Phase II of the project (completed by June 2006), the main objective was to use the results from Phase I and integrate them with actual meteorological data to provide a web based application that would serve PSNH as a tool for identifying conditions that may cause outages ahead of time. Content for this tool would be specific to the needs of PSNH and conform mainly to the New Hampshire and New England region.

PSU and PSNH worked closely together to develop the content of the web site. The web site contains five main sections: 1) links to real-time meteorological observations; 2) links to forecast weather data; 3) a decision making tool; 4) a reference section; and 5) the results of the climatological research. In each of the following sections there will be a brief description of the content of the section as well as a screen capture to show the layout of the web site.

The layout of the web site (Fig. 1) is designed so that you can click either in the left menu bar to navigate the site or to click graphic buttons in the main frame. In the left navigation bar, a sub menu appears and remains in the frame until you move on to another part of the web site. This allows the user multiple ways to navigate the site which was important to the PSNH personnel.

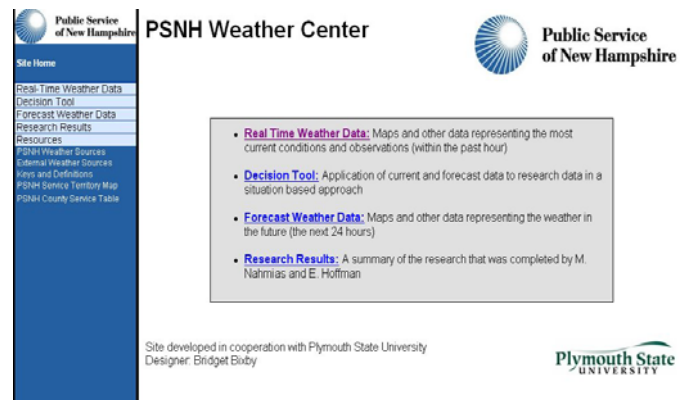


Figure 1. Screen capture of front page of the web site.

## 2. Real Time Weather Data

The real-time section contains links to weather maps and images of current conditions around NH and New England, as well as some national and global resources. This section was included so that PSNH personnel can easily keep up with rapidly changing conditions as they occur. This section contains four types of weather maps: plain data maps; color graphic maps; precipitation (radar); and cloud images (see Fig. 2 for screen capture). The terms used to describe the maps in this section are not those that would have been chosen by meteorologists. However, it was important to the PSNH personnel that the terms be intuitive to the users of the data. For example: “color graphic” maps was originally called “contour maps”, but the alternate wording was more intuitive to the PSNH staff responsible for making operational decisions.

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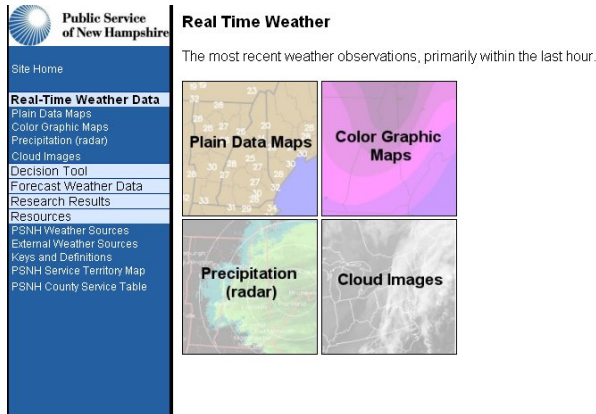


Figure 2. Screen capture of Real Time Weather section.

### 3. Forecast Weather Data

The forecast section contains maps from various model sources with forecasts for conditions out to 48 hours (see Fig. 3 for a screen capture). A user of the site can look at graphical forecasts from several sources including the regional NAM model output, global GFS output and forecasts prepared by the National Weather Service at both the local forecast offices and at the National Centers for Environmental Prediction (NCEP). During the course of building the web site we found out that the PSNH personnel really like the hourly point forecast meteograms available from the NWS offices in Gray, ME (KGYX) and Taunton, MA (KBOX). In order to easily use these forecasts we developed a clickable map of the PSNH service territory which links to the appropriate meteogram.

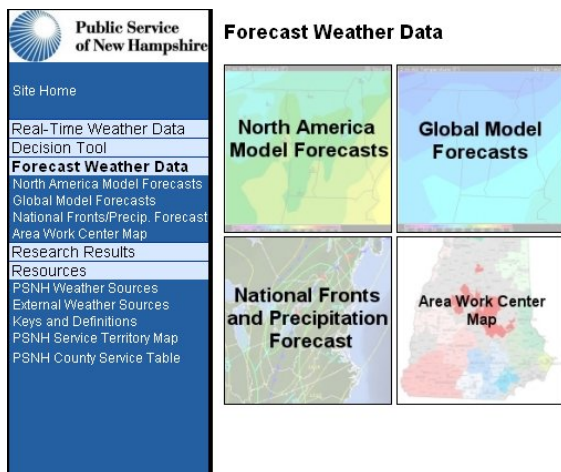


Figure 3. Screen capture from Forecast Weather data section.

### 4. Decision Tool

In the decision making tool, real-time and forecast weather data are combined with the results of the Phase I research into an interactive tool which leads the user through a decision tree. The user is prompted to answer questions about the forecast weather situation in relation to the criteria for each weather event (see Fig. 4). At the terminal end of each branch of the decision tree, a categorical likelihood of a major outage is given (likely, possible, and unlikely) and the relevant course of actions for the PSNH personnel is displayed.

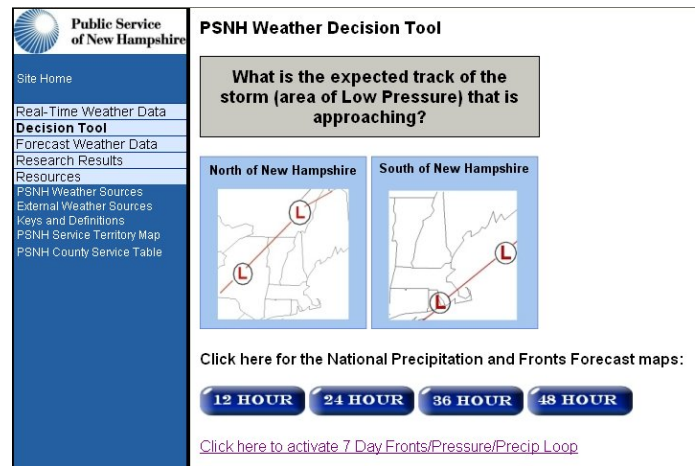


Figure 4. Screen capture from the Decision tool section.

### 5. References and Research Results.

The references section contains definitions, keys, and general information that may be helpful to PSNH users and assist them with understanding all of the maps, meteorological data, and vocabulary that are provided in the website. Lastly, the results section provides a short recap of the Phase I research as a reference for the user. Figures 5 is the screen captures from the research results section.

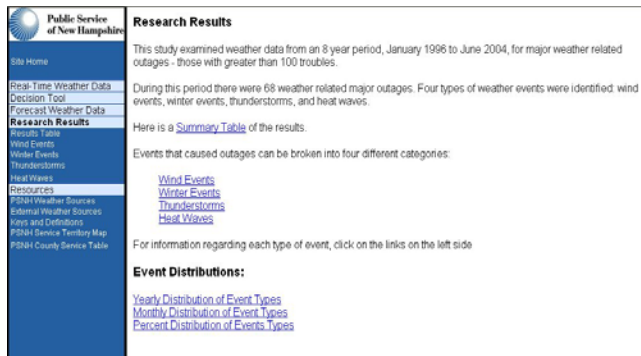


Figure 6. Screen capture from the Research Results section.

## 6. Future work.

This web tool was integrated into the internal PSNH web site over the summer months of 2006 and will be implemented into their operations during this winter season. PSNH will be evaluating the usefulness of the tool and perhaps make suggestions of how to improve the tool in the future. In addition, the application of the original research results will be evaluated to see if further research is needed to

understand the types of weather that cause power outages in New Hampshire.

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## References

Nahmias, M. and E.G. Hoffman, 2005: A climatological study of electric power outages in New Hampshire. *16<sup>th</sup> Symposium on Global Climate Change*, American Meteorological Society, San Diego, CA, January 10-14 2005, in combined preprint CD-ROM from the 85<sup>th</sup> AMS Annual Meeting.