3.3 A UNIVERSITY CURRICULUM IN SURFACE TRANSPORTATION METEOROLOGY

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1. INTRODUCTION

After years of struggling for recognition, the surface transportation weather industry is gaining support within mainstream elements of the atmospheric sciences community. This support is highlighted by the involvement of the Office of the Federal Coordinator for Meteorology in convening two symposia on weather information involving the surface transportation community over the past two years. With a push at the federal level to establish a coordinated movement to enhance public safety with better planning based upon appropriate application of surface weather information, the potential for dramatic growth in the surface transportation weather industry is substantial. Unfortunately, the academic community has yet to embrace this potential to any widespread degree. Much of this can be traced to a historical lack of demand for trained personnel by the surface transportation weather community and to the lack of a well-defined set of research goals.

While meetings and workshops can alleviate some of these issues, only through education and training programs that commit to cross-discipline instruction will an inherent long-term level of communication be established between the cultures of meteorology and surface transportation. In turn, a more responsive research program can be achieved where specific needs of surface transportation weather can be addressed. The latter will foster greater academic interest and result in broader interest within the meteorology community.

2. CATALYST FOR GROWTH

Operational meteorological support for the surface transportation industry has existed for the past two decades; however, until recently this support has been slow to evolve and expand. The lack of growth has resulted from the lack of understanding within the maintenance industry of capabilities afforded by the meteorological community. During the mid 1990s a significant change in meteorology presence began with the growth in use of environmental sensor stations (ESS), often referred to as Road Weather Information Systems (RWIS). This change brought a new set of demands upon the atmospheric sciences community to assist in better utilization of this technology. Unfortunately, the lack of access to this observation data set and/or the inability to incorporate this data set with other atmospheric observations often precluded its use in more sophisticated forecasting schemas.

During the latter half of the 1990s, two major research programs funded by the Federal Highway Administration (FHWA) resulted in a significant advancement in the use of observational data and mesoscale weather prediction models to support operational maintenance decision-making in surface transportation. One of these programs, the Advanced Transportation Weather Information System (ATWIS) at the University of North Dakota, created a framework that closely integrated the high-resolution numerical model output from mesoscale atmospheric models with the experience of professional meteorologists to produce tailored weather forecasts to support surface transportation.

The expansion in the adoption of ESS technologies and the demonstrated benefit of numerical forecasting coupled to the human forecaster has resulted in a greater expectation in weather support services by state Department's of Transportation (DOT). The formation of multi-state user groups, such as AURORA, which are formed to better utilize ESS technologies, accentuate the growing awareness of the importance of meteorology to the maintenance decision maker.

3. TRAINING CHALLENGE

The present-day surface transportation meteorologist combines the traditional synoptic scale weather forecasting skills with an awareness of how weather conditions affect the surface transportation operational environment. This operational environment includes the present and future conditions of the road pavement and the associated roadway. The latter encompasses the surface area adjacent to the pavement as well as the layer of atmosphere immediately above the pavement surface in which surface vehicles travel. The skill of a meteorologist to integrate their weather forecasting skills with the transportation environment has in the past largely been determined by their ability to adapt and learn through on the job training. While this on the job training is typical in most areas involving operational weather forecasting, having previous exposure to training in the subject area is most desirable as it expedites the learning process and provides a higher degree of comprehension of training within the operational environment. An example often cited is operational aviation weather forecasting. While having mastered the skills needed to perform

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synoptic scale weather forecasting are important, understanding the relationship of atmospheric conditions leading to clear air turbulence or the presence of supercooled liquid water to the impact on aircraft of varying size and performance capabilities is important for the forecaster to understand. For the past 20 years numerous university atmospheric sciences programs have included aviation meteorology as part of their curriculum. The knowledge gained through the aviation meteorology coursework has enabled meteorology students to develop the necessary background in understanding of aviation for them to advance quickly in the operational aviation weather forecasting system. This same advancement could be achieved with a surface transportation meteorology curriculum.

4. SURFACE TRANSPORTATION CURRICULUM

For a surface transportation meteorology curriculum to be successful, it must provide a comprehensive treatment of the important routine and critical weather related topics encountered by the surface transportation professional and by the users of the surface transportation system. As in the case of aviation meteorology, this will often times require developing a thorough understanding of the logical and physical structure of the transportation system.

In the spring of 2001 the University of North Dakota department of atmospheric sciences developed a proposal to form a surface transportation meteorology academic program. This was in response to increasing inquiries to the department requesting graduates possessing knowledge and/or experience in operational surface transportation weather forecasting. Instructional expertise for the program comes from university research efforts over the past decade in advanced forecasting technology development and research associated with ATWIS in advanced surface transportation meteorology. During the fall 2001 semester, approval is expected from the University curriculum committee to offer two senior level undergraduate courses and one graduate level course. The first undergraduate course is scheduled to be offered during the spring 2002 semester.

The first course, Surface Transportation Meteorology I (AtSc 430), will focus on the fundamentals of the surface transportation system with a specific focus on maintenance operations. Topics will include:

- the configuration, siting, and data management/quality control of ESS (RWIS),
- fundamentals of surface transportation weather forecasting,
- overview of winter road maintenance methods; anti-ice treatment, snow removal, etc., and
- applications of geographical information systems technologies in a weather and road maintenance environment.

The first course will serve as a prerequisite for the second course. In the subsequent course, Surface Transportation Meteorology II (AtSc 431), a more in-depth exploration of surface transportation meteorology is covered. This course is designed to prepare students for immediate transition into an operational surface transportation meteorology career. Topics included in this course are:

- application of mesoscale weather prediction models,
- pavement temperature modeling,
- forecasts verification methods, and
- introduction to methods of maintenance decision-making.

The final course in the surface transportation meteorology curriculum is a graduate level course, Advanced Surface Transportation Meteorology (AtSc 540), designed to address weather research topics in contemporary surface transportation. While this will result in a course structure that will likely vary from year to year, the initial course offerings will focus on the following topics:

- maintenance decision support systems construction,
- applications of artificial intelligence methods, and
- investigation of land surface effects; advanced mesoscale weather prediction modeling.

5. SUMMARY

The growing awareness within the surface transportation industry of the value of appropriate, timely, and accurate weather information is providing a significant opportunity for today's atmospheric sciences student. However, without an adequate and appropriate education that addresses the specific issues within surface transportation that rely upon weather information, tomorrow's weather service providers may lack the ability to respond quickly to the opportunities that are emerging. Further, much of the advancement that will be made in the coming decade in surface transportation meteorology will require focused research programs. The efforts at the University of North Dakota department of atmospheric sciences to establish a comprehensive curriculum in surface transportation meteorology are directed at fostering growth of this area of specialization.