

COMET Outreach Program Final Report

University: Humboldt State University, Arcata, CA

Name of University Researcher Preparing Report: Brad Finney

NWS Office: California-Nevada River Forecast Center

Name of NWS Researcher Preparing Report: Troy Nicolini

Project: Web-based instructional modules in hydrologic sciences for NWS hydrologists: Stage-Discharge relationships.

UCAR Award No.: S01-32799

Date: October 2002

SECTION 1: PROJECT OBJECTIVES AND ACCOMPLISHMENTS

The Hydrologic Services Division of the National Weather Service Office of Climate, Water, And Weather Services (NWS/OCWWS) has recognized the need for service training opportunities for NWS staff in the area of basic hydrologic science. This training program is to be managed by the Cooperative Program for Operational Meteorology, Education, and Training (COMET). The intent of this training is to remedy the deficiencies of individuals with little or no formal education in hydrology, and to augment formal training in hydrology which focused on other problems such as hydrologic design or watershed management.

The objective of this project was to develop a web-based instructional training module for the NWS Professional Development Series (PDS) in Hydrologic Forecasting. The training module addresses one of the six topic areas identified by the COMET program and NWS/HSD: Basic Stage-Discharge Relationships.

The training module consists of 10 goal oriented segments or lessons. The material included in each lesson was selected so that it can be covered in a 35 to 45 minute session. The lessons are designed to illustrate the hydrology topic in the context of the NWS hydrologist professional responsibilities. Each lesson begins with a brief review of previous lessons, a statement of learning objective for the current lesson, and an illustration of how this objective relates to common NWS hydrologist job responsibilities. The body of the lesson includes liberal use of photos and figures to illustrate points made within the text. The lessons conclude with a restatement of the lesson objective, a summary of new material presented in the lesson, self assessment questions to help the user determine whether continuing to the next lesson is appropriate, and a brief statement on what is contained in the next lesson.

The mode of presentation for the lessons is web based, so web browser interface concepts are utilized throughout the lessons. A menu bar is included to allow choosing a new lesson, joining a lesson at some intermediate point, or branching to supplementary material.

SECTION 2: SUMMARY OF UNIVERSITY/NWS EXCHANGES

All phases of the project activities were accomplished in collaboration with, and under the on-going review of NWS scientists to ensures that the training material matched the needs of the target audience. The selection of lesson objectives was made with input from NWS hydrologists and scientists. All hydrologic technical content was co-developed and reviewed

by NWS hydrologists. The lesson pacing, depth, and presentation look-and-feel issues was reviewed by NWS end users.

A close working relationship between the development team at Humboldt State University (HSU) and the NWS team was established at the project outset. Almost daily phone and email contact between the HSU and NWS team members occurred during the last four months of the project effort. Face-to-face team member meetings were also held to facilitate the exchange of ideas and assess project progress.

SECTION 3: PRESENTATIONS AND PUBLICATIONS

Other than the 7 hours of web based instructional material, none.

SECTION 4: SUMMARY OF BENEFITS AND PROBLEMS ENCOUNTERED

Section 4.1 — Academic Partner

Humboldt State University Environmental Resources Engineering professors gained valuable insight into the role of NWS hydrologists in flood forecasting. Significant new information was also gained on USGS procedures used to create rating curves and their associated shifts. The close interaction between HSU and NWS hydrologists during this project has resulted in an invitation for NWS hydrologists to give guest lectures in hydrology and water resources courses at HSU.

The primary problem encountered by HSU team members during this project were related to the antiquated Netscape version 4 web browser used by many NWS hydrologists. This browser has many bugs and non-standard features that makes developing cross-platform maintainable HTML code nearly impossible. This problem was resolved by negotiating with COMET and NWS staff to change the target web browser for the project from Netscape 4.7x to version 6 browsers. This allowed development of the training modules using modern, cross-platform, maintainable coding standards.

Section 4.2 — NWS Forecast Partner

This project involved the development of a training module on stage-discharge relationships to be used by NWS operational hydrologists. The benefits of the project are derived from the effectiveness of the training module in presenting the material, and from the importance of the material to forecasting operations.

Stage-discharge relationships, or rating curves, play a critical role in the flood forecast process because they enable the forecast to be converted from flow to stage. Stage is typically more meaningful to NWS clients because it directly implies the depth and impact of flooding. Unfortunately, rating curves are developed by agencies other than the NWS, and are frequently applied by NWS hydrologists without a basic understanding of the potentially significant uncertainties associated with their use. This can result in forecast errors that are larger than the cumulative error from the rest of the forecast process. The following examples illustrate how information presented in the training module mitigates this deficiency and results in improved forecasting operations:

1. The training module provides a thorough treatment of the basic concepts of stage-discharge relationships that are relevant to the mission of the NWS. This is important because stage-discharge relationships encompass a wide body of knowledge, only a small portion of which is useful for the operational hydrologist.
2. Connections are made between the main subject of the module and ancillary impacts on forecasting operations. For example, after the lesson on stage measurement is presented within the context of the rating curve development process, an additional

section is presented that illustrates how understanding the failure mechanisms in stage measurement can assist the operational hydrologist in detecting streamflow data errors in real-time.

3. The training module conveys in a very conceptual way the uncertainties associated with the use of stage-discharge relationships. For example, the impacts of physical characteristics of stream channels and streamflow conditions on stage-discharge relationship accuracy is explored. Guidelines are presented to enable the operational forecaster to assess the level of uncertainty associated with the use of a specific stage-discharge relationship for a particular forecasting problem. Connections are made between the assessed uncertainty and needed modifications to operational procedures.
5. The training module outlines the deficiencies in forecasting procedures that normally only become evident during extraordinarily large events. The module describes estimation methods for converting discharge to stage for streamflow conditions that are well beyond the limit of official stage-discharge relationships. Guidance is provided for the background work needed to prepare for these scenarios.
6. The training module provides an in-depth treatment of complex stage-discharge relationships that are critical to the NWS mission. Examples include those associated with streams for which rising and falling hydrographs produce different stages for the same flow, and stage-discharge relationships in tidally influenced environments.
7. The training module employs visual explanations of concepts using images specifically designed to be understandable to operational hydrologists and meaningful to the NWS mission.