6B.5 DEVELOPMENT OF A SMART SEARCH SYSTEM FOR CLIMATE SERVICES

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1. INTRODUCTION

Climate services will always face the great challenge of translating a client's needs into delivering a product that facilitates their weather-sensitive decision making. No one product is a panacea for all clients. However, many requests for climate data have similarities in what is ultimately provided. After all, all climate services rely on the historical record of observations.

The value of timely weather and climate information to some users, especially a grower, is undeniably important. The State Climate Office of North Carolina (SCO) at NC State University works closely with researchers and extension scientists to develop climate-based, agricultural decision support tools. Data for these tools come from the Climate Retrieval and Observations Network of the Southeast (CRONOS**), a digital database of high-resolution surface weather observations. Launched in 2003, CRONOS continues to serve as the preferred source of climate data for many clients in North Carolina.

The SCO's data and decision support tools are currently disseminated via the web, e-mail, and telephone interaction with clients (Figure 1). However, many people in rural parts of North Carolina do not have Internet access and could benefit from climate services.

This need compelled the development of a text messaging service that will enable anyone with a text messaging capable mobile phone to interface with CRONOS and basic climate products (Figure 2). Called Smart Search, the system attempts to be smart in how it translates a client's request for data. The program is still under development but, when deployed, will also be accessible on the web where users can enter their data request in a single text box (Figure 3).

2. BACKGROUND

As the relationship between climatology and economically sensitive industries becomes more understood, valuable decision support tools become possible and necessary.

Farmers and agricultural scientists have always known that weather affects crop health and yield. Much research is being done to reveal the specific effects of these influences. While still a developing area, a wealth of knowledge has been produced for some crops, the results of which identify specific environmental thresholds for maturity rate and disease development.

Agricultural decision support tools can help a grower identify the opportune window of time to apply a fungicide or realize their crop's level of maturity for harvesting. The challenge for an extension scientist then becomes how to package and deliver this information to the grower, where it can affect crop yield and market value.

In 2005, work began on an automated peanut disease advisory system. Using published algorithms (Cu and Phipps 1993; Langston, Phipps, and Stipes 2002), an automated decision support tool for peanut growers was developed at the SCO. Two diseases in particular can decimate a peanut crop: Peanut leaf spot and Sclerotinia Blight. Favorable environmental conditions are known for these diseases. During the growing season (May-October), the SCO distributes daily e-mails for select locations in North Carolina to help growers identify favorable conditions for disease development. When the conditions reach a particular threshold at a particular location, the grower is advised to apply an appropriate fungicide. Preliminary estimates suggest that 1-2 sprays were saved in 2005, which equates to about $2 million in savings for growers.

In 2008, work began on a frost/freeze advisory system for strawberry growers in the Southeast. Strawberry plants are especially vulnerable during bud break. A website is being developed that will calculate the level of frost/freeze risk for strawberries at a given point.

The authors, and colleagues at the SCO, are also working on several other climate-based decision support systems for lettuce, cucurbits,

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tobacco, blueberry, blackberry, turf, and precipitation alert tools for construction.

One significant disadvantage is that these tools are only available to clients with regular access to the Internet. The lack of Internet usage in rural areas of North Carolina is a stark reality. Statistics collected in 2000 by the National Telecommunications and Information Administration reveal that only 35 percent of North Carolina households have Internet access. Nationally, only 41 percent have Internet access.

Clients without Internet access are also not likely to have it in their vehicles, on their tractors, or in the field where they may spend most of their days. Having access to data and tools via mobile phones will enable clients to make decisions such as when and what to spray while they are in the field, looking at their crop.

3. METHODOLOGY

Smart Search is designed to be flexible in that it requires only three pieces of information from the user – location, date/time, and desired type of data. The order in which these are provided in the input string has no consequence. Extraneous string tokens, not matching any of the three required inputs, are ignored.

A nominal amount of language processing is required to parse the user's request and formalize the logic to craft a response. Because only certain types of queries are expected (all weather or ag related at this time), this task is not as monumental as it may seem. All software was written in PHP. Specific keywords match with data manipulation methods in a MySQL table. When a message is received, software parses and validates the message, then responds appropriately (Table 1).

Software already exists to get or calculate most of the requested data, but there is no single entry point or common gateway by which to go through for queries of all types. This software is being written and tested.

Interaction via the webpage asks the user for feedback about how well the information matched their question (Figure 4). Feedback for each request via the webpage is being recorded for future analysis and improvement.

4. IMPACTS

The impact of this tool, quite literally, is putting climate services and CRONOS data into the hands of North Carolina growers and citizens. Never before has such timely information been so easily accessible by those we serve.

Statistics on usage will be archived for evaluation and understanding of usage patterns. A survey will be sent to users after individual periods of activity to evaluate the strengths and weaknesses of the product. Future surveys and evaluations will attempt to quantify the economic value of the services delivered. The results of these economic/social perspective questions will be used in other studies to illustrate the value of climate data/products in decision making.

5. LOOKING AHEAD

The authors recognize that no technology is likely to replace the experience, intuition and knowledge of a human. The technology presented herein is meant to supplement and strengthen already existing climate services.

Future projects could be launched that would enable other, non-website delivered climate services. For example, a dial-in speech-recognition telephone system could be developed to deliver climate services to anyone with a telephone.

Additionally, other geographies and decision support tools could be integrated into Smart Search thereby providing greater value. Ultimately, this Smart Search system may be a valuable supplement and tool in a national climate service.

Future development and projects will only be possible with appropriate funding. Until sustained funding is identified, continued development on the Smart Search system will proceed slowly.

6. REFERENCES

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Langston, D.B., P.M. Phipps, R.J. Stipes, 2002. An algorithm for predicting outbreaks of Sclertonia blight of peanut and improving the timing of fungicide sprays. *Plant Dis.*, **86**, 118-126.

National Telecommunications and Information Administration. Web page http://www.ntia.doc.gov/ntiahome/fttn00/charts00.html. Accessed March 13, 2007.

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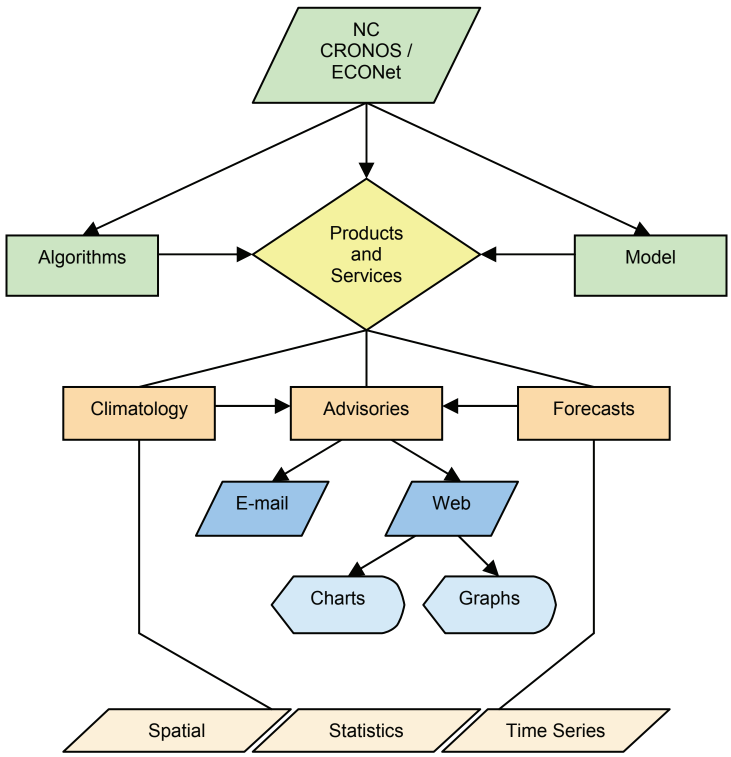

Figure 1. The State Climate Office of North Carolina's agricultural products and services are driven by a culmination of sources and needs. Climatology and forecast products feed real-time products, such as advisories. Advisories assist the client in making weather- and climate-based time sensitive decisions.

Figure 2. Smart Search is accessible via any text-message capable cellular telephone. Shown here is an example of a text message to be sent to Smart Search.

Figure 3. Smart Search will also be accessible via a webpage, where users can enter their request in a single text box.

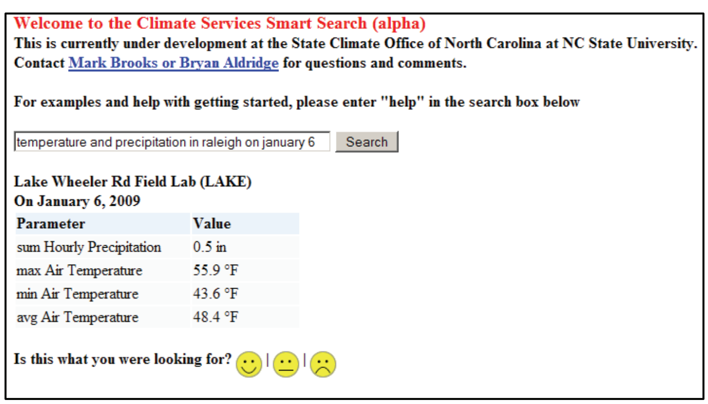

Figure 4. Results for the user's input query are formatted for easy reading. Feedback is requested from the user indicating that the results are what the user wanted, not quite what the user wanted, or not at all what the user wanted. These feedback results are archived for future analysis to help make the program smarter.

SMS message received from user	SMS message sent to user in response
Blackberry chill at Lewiston	Lewiston, NC (LEWS) has 811 blackberry chill units as of Feb 6, 2007, 4:00pm.
Peanut hours at Clinton	Clinton, NC (CLIN) has 21 favorable leaf spot hours, 33 favorable Sclerotinia hours. Spraying is not yet advised.
Weather at KRDU on September 5, 2002 at 8pm	Raleigh, NC (KRDU) weather on Sept 5, 2002 at 8pm: temperature=67 F, dewpoint=60 F, winds=3.4 mph from the NNE, no precip, hazy.
Weather at 1005 Capability Drive, Raleigh, nc on April 1, 2004	Raleigh, NC (LAKE) weather on Apr 1, 1999: high/low: 58/43 F, 0.12 in. precip
Weather in Salisbury, NC on November 22 2003	Salisbury, NC (SALI) weather on Nov 22, 2003: high/low: 76/33, no precip.
help	*Help dialogue with examples of how to use the service.*

Table 1. Results for the user's input query are formatted for easy reading. Shown here are example inputs and corresponding outputs.