P1.27 DEVELOPMENT OF A TURFGRASS IRRIGATION MANAGEMENT SYSTEM FOR NORTH CAROLINA

Mark S. Brooks*, Ryan P. Boyles, Charles Peacock†, Dan Bowman†, Jenifer Reynolds†, and David Zahn†
State Climate Office of North Carolina
† Department of Crop Science
North Carolina State University, Raleigh, NC 27695-7236

1. INTRODUCTION

Water supply issues are becoming significant economic and social concerns for many states, including North Carolina. Drought conditions in North Carolina during 2007 were the worst since modern weather records began in 1895. Exceptional drought conditions also existed throughout parts of 2008. Drought is exacerbated by increasing population and increasing demands for water. Long-term weather predictions offer little guidance in what the future holds. This is compelling municipalities to develop long-range water conservation strategies.

Information on turf water use and turf species crop coefficients has been collated from a number of scientific studies and assimilated into a model on irrigation management, which was developed by the Department of Crop Science and the State Climate Office of North Carolina (SCO) at NC State University.

The Turf Irrigation Management System (TIMS) was jointly launched in June 2007 by the Department of Crop Science and the State Climate Office at NC State University. TIMS is an irrigation decision-support tool, accessible to anyone via the Internet. It provides users with guidance for irrigation management of turf areas. Users provide their location, turfgrass species, soil type, and recent irrigation amounts. Based on recent daily temperatures, precipitation, and estimated evapotranspiration rates, a recommended irrigation amount is provided. The simple interface to TIMS gives everyone, from the dedicated turf professional to the homeowner, help in making irrigation management decisions.

1.1 *CRONOS Database*

The SCO previously developed and maintains a digital database called CRONOS** (Climate Retrieval and Observation Network of the Southeast). CRONOS archives high-quality observations from several environmental observing networks. These networks include the NC Environment and Climate Observing Network (ECONet), a mesonet operated by the SCO, and several other networks maintained by a variety of federal and state agencies. Weather and climate information used in TIMS is retrieved from CRONOS.

2. METHODOLOGY

The development of TIMS included an evaluation of evapotranspiration (ET) models, how they needed to be integrated with turf water use, information about irrigation systems management, and generalized soils information.

A website‡ was developed that interviews the user. First, the user is prompted for their location, turf species and soil type. A personal login account is created for first-time users. Recent irrigation amounts are optional inputs. Second, the nearest hourly weather station is automatically determined and hourly weather data for the past several days is retrieved from CRONOS. Stations include ASOS, AWOS and the ECONet.

After the user enters all required inputs, the website uses the FAO Penman-Montieth ET equation (Allen, et al., 1998) at the respective weather station. Most weather stations do not measure solar radiation, which is required for this equation. Therefore, solar radiation is estimated using the Hargreaves method.

TIMS also considers multi-sensor precipitation estimates (MPE) in determining recent precipitation amounts. MPE are gage-corrected RADAR estimates of precipitation, provided by the National Centers for Environmental Prediction and the River Forecast Centers. The annual root

* *Corresponding author address:* Mark S. Brooks, North Carolina State University, State Climate Office, Raleigh, NC 27695-7236;
e-mail: mark_brooks@ncsu.edu

** CRONOS:
http://www.nc-climate.ncsu.edu/cronos/

‡ Turf Irrigation Management System (TIMS):
http://www.turffiles.ncsu.edu/tims/

mean square error over North Carolina for a 24-hour period is 0.023 inches (Boyles, et al., 2006), which affords sufficient accuracy for TIMS.

Based on recent weather conditions, including precipitation and ET estimates, and known crop irrigation demands, the suggested amount of irrigation is calculated. Results are given in minutes of irrigation, or volume of water, necessary to keep the user's turf alive and healthy.

3. BENEFITS

TIMS is a resource for helping homeowners conserve water. As of January 7, 2009, there were 2,017 accounts using this decision support tool. Our estimation is that after a few weeks of use, users will save at least 25% of normal irrigation. Additionally, the amount of over-watering will decrease thereby reducing silt-runoff, which is one of the most tenacious environmental concerns of North Carolina's water systems. These benefits help mitigate water resource concerns from using potable water supplies in irrigation and potential economic hardships to the turf industry.

4. LOOKING AHEAD

In rural areas, observed rainfall data are sparse. Data from the Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) can be used in helping determine the amount of actual rainfall nearest the user. CoCoRaHS is a unique, non-profit, community-based network of volunteers of all ages and backgrounds working together to measure and map precipitation (rain, hail and snow). By using low-cost measurement tools, stressing training and education, and utilizing an interactive website, high quality data are provided for natural resource, education and research applications. CoCoRaHS currently operates in many states across the country. There are over 350 observers in North Carolina. Precipitation data from CoCoRaHS may help the TIMS website estimate precipitation near the user, where perhaps even the user is a CoCoRaHS observer. Although CoCoRaHS is not an operational dataset and must be used with care, it is a valuable resource for precipitation data. Appropriate use of CoCoRaHS data will be determined and implemented.

While MPE are good, a next generation of radar-based precipitation estimates is currently being developed at the National Severe Storms Laboratory. This 2nd generation quantitative precipitation estimate (called Q2) is expected to improve local precipitation estimation by increasing spatial resolution (1 km resolution as compared to 5 km with MPE) and by providing bias correction at individual grid points (as compared with regional bias correction used in MPE). However, Q2 will not include the human quality control that current MPE products use, and therefore will not have the value-added accuracy that human scientists provide. Q2 has been made available to SCO for evaluation, but it is not yet known if Q2 would be better than MPE over North Carolina. A study is being conducted to evaluate Q2 over North Carolina for products like TIMS. The results of such a study will have an impact on TIMS and other applied climatology applications where precipitation estimates are used.

Data from the National Digital Forecast Database (NDFD) will be used to predict turf irrigation demand in the proceeding 1-3 days. NDFD consists of gridded forecasts of major weather parameters. Forecast data are currently available at a resolution of 5km. The probability of precipitation is available every 12 hours and the volume of precipitation is available every 6 hours. According to the National Weather Service's NDFD website, the brier error for probability of precipitation ranges from 0-0.12 in North Carolina for May through October. By utilizing NDFD, TIMS will consider the precipitation forecast at specific points in making irrigation recommendations. It may help conserve more water when precipitation is likely to occur in the next 1-3 days. Turf managers and homeowners may be able to forgo (some) irrigation if rain is likely at their specific location.

To aid in future turf and climatology research, a database is being developed to archive evapotranspiration means and extremes across North Carolina. No historical database of ET means and extremes is known by the authors to exist. Such a resource would be valuable in providing a historical comparison with current conditions.

Finally, TIMS currently only works for North Carolina. However, with some modifications and appropriate funding, it can be adapted to other geographies. North Carolina is a demonstration region; plans are being developed to expand TIMS coverage across the Southeast.

5. REFERENCES

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Acknowledgements: This work is sponsored by grants from the Center for Turfgrass Environmental Research and Education at NC State University, and with in-kind matching from the North Carolina Agricultural Research Service. Weather data sources include the National Oceanic and Atmospheric Administration, National Centers for Environmental Prediction, and the National Weather Service River Forecast Centers. A special thanks is given to the National Weather Service Forecast Office in Raleigh, NC, for continuing to provide the SCO with a real-time metar data feed.