Wetting Front News

Soil and Water Management Research News

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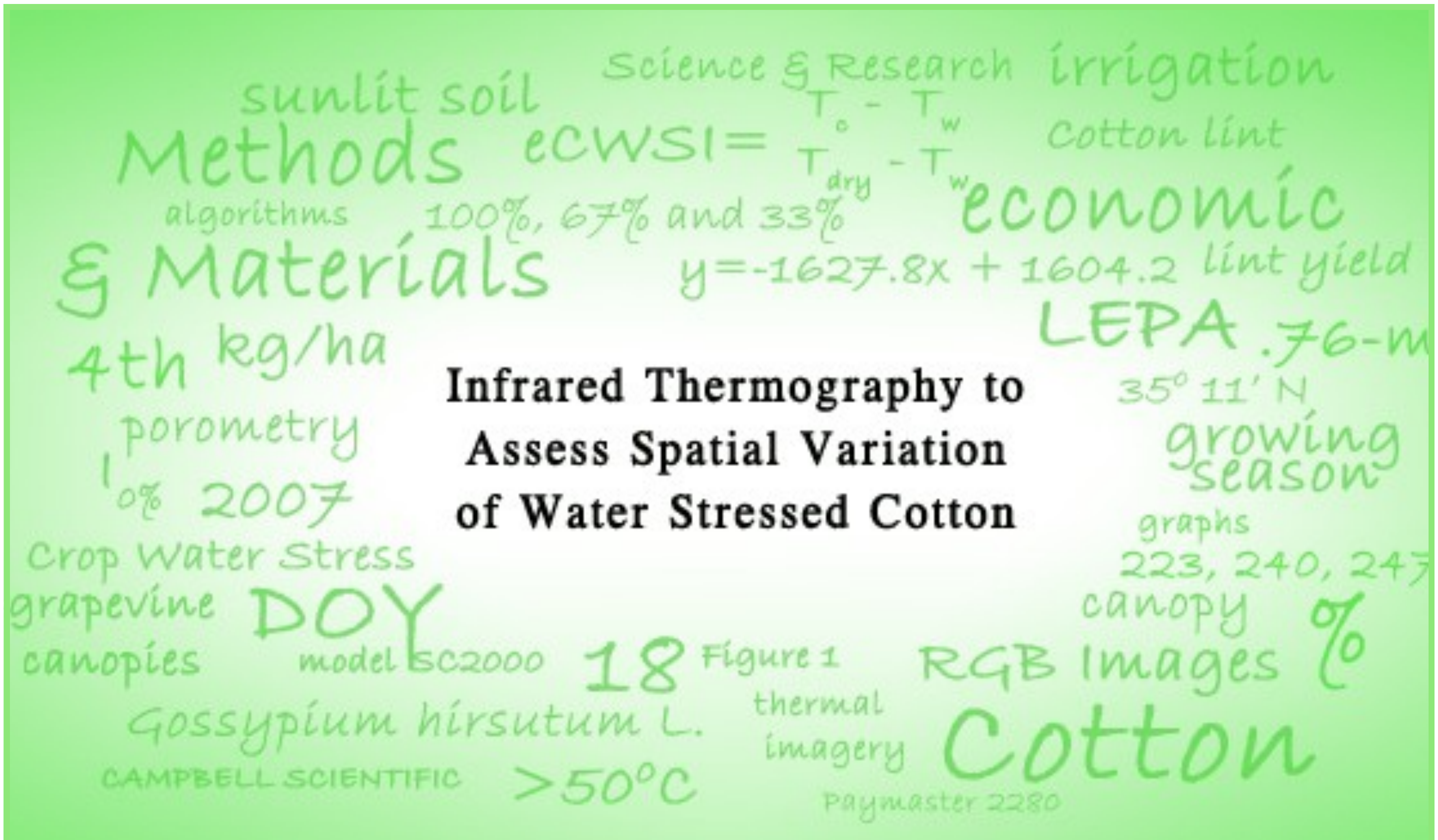
In This Issue



$$eCWSI = \frac{T_c - T_w}{T_{dry} - T_w}$$

Infrared Thermography to Assess Spatial Variation of Water Stressed Cotton

By Susan A. O'Shaughnessy & Steven R. Evett

Increasing costs and regulations on water pumped from existing ground-water aquifers is cause for producers in irrigated agriculture to look at new technologies for improving water savings and sustainability through irrigation management. The use of infrared thermography and digital imagery to investigate unapparent but important field conditions (poor drainage, non-uniform irrigation, soil variability, or biotic infestations) offers improved management for a producer to avoid yield declines or variability in crop status. This article focuses on the use of non-satellite infrared images to improve irrigation water management to enhance crop productivity.

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Background

Useful information on canopy water relations can be derived from infrared thermography, which provides spatio-temporal imagery and relational surface temperature measurements. Infrared thermography in agriculture has been used as a non-invasive versatile tool to investigate plant water status issues. Jones et al. (2002) performed field studies to assess the consistency and repeatability of using thermal imagery to measure stomatal conductance in grapevine canopies. They concluded that thermography allows for semi-automated analysis of large areas of canopy with much more effective replication than can be achieved with porometry. Möeller et al. (2007) used thermal and visible imagery to estimate the crop water status of irrigated wine grapes. Included in their methodology was the temperature of an artificial wet reference to estimate a wet baseline (i.e., a surrogate for a fully transpiring leaf) and maximum daily air temperature to estimate a dry baseline.

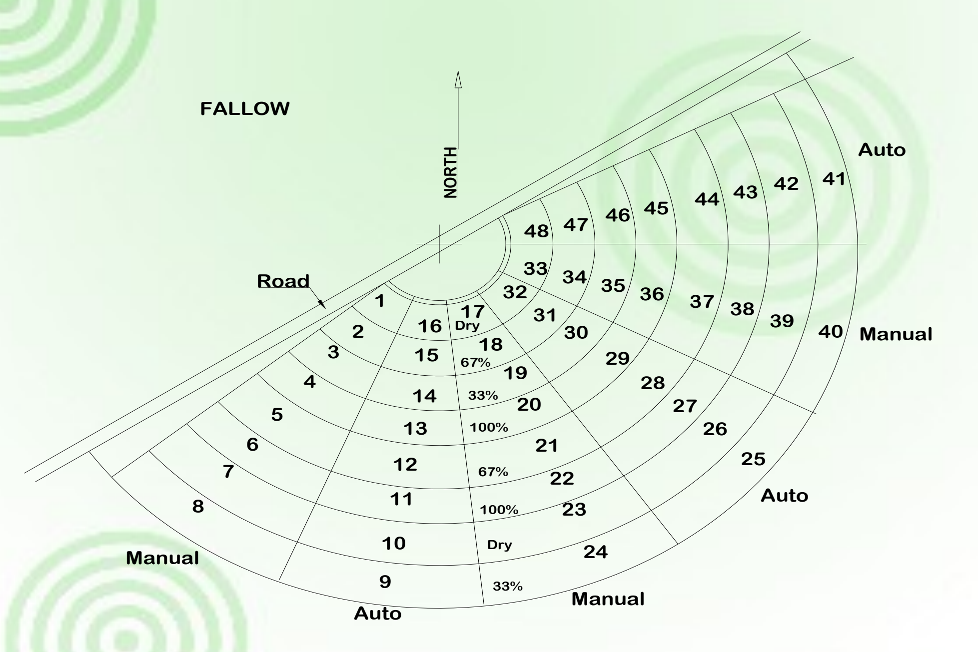


Figure 1. Three span center pivot system shown with 6 pie-sections. The three sections labeled "manual" were irrigated manually on a weekly decision interval at the levels of 100%, 67% and 33% of full replenishment of soil water to field capacity using low energy precision application (LEPA) drag socks. Automatic plots were irrigated when the center pivot received a signal based on plant canopy temperature feedback. Dryland plots (Dry) were also planted.

Thermal imagery is a tool that enables detailed investigation of: (1) the temperature contribution of a specific material within an image, for example leaf temperature versus bloom or tassel temperature of a crop; (2) the frequency distribution of temperatures over a selected area, which can assist in estimating fraction of vegetation or discerning between sunlit and shaded samples; and (3) the reference temperatures for further use as thresholds to eliminate extraneous surfaces when analyzing large areas of canopy that may include some sky or soil.

At the Bushland USDA-ARS Conservation and Production Research Laboratory, we have been using thermal imagery to document the spatial variability of crop water status in irrigated cotton fields and have made use of an empirical crop water stress index to characterize in-field crop water stress.

Methods and Materials

Agronomy

Cotton (*Gossypium hirsutum* L.), variety Paymaster 2280[1] (Bollgard II® Roundup Ready®, Delta and Pine Land Co., Scott, Miss.) was planted on DOY 149 (May 29) in 2007. The crop was grown in eighteen row plots on beds spaced 0.76-m apart under a three span center pivot in Bushland, Tex. (35˚ 11' N, 102˚ 06' W, 1174 m above mean sea level). Manual irrigations were applied weekly to three designated pie sections, comprised of four treatment plots and two replicates (Fig. 1). Irrigation was applied at the levels of 33%, 67%, and 100% of full replenishment of soil water in the root zone to field capacity (treatments designated $I_{33\%}$, $I_{67\%}$ and $I_{100\%}$) based on neutron moisture meter readings and using low energy precision application (LEPA) drag socks. Dryland plots were also included as the fourth treatment ($I_{0\%}$). Irrigation treatments ran concentrically in the southeast half of the field, while the northwest half was planted to sorghum. The pie sections labeled "auto" were irrigated using algorithms for irrigation automation and control that use canopy temperature measurements (Fig. 1). The full irrigation level for automatic treatments was week-long peak cotton water use.

In situ measurements

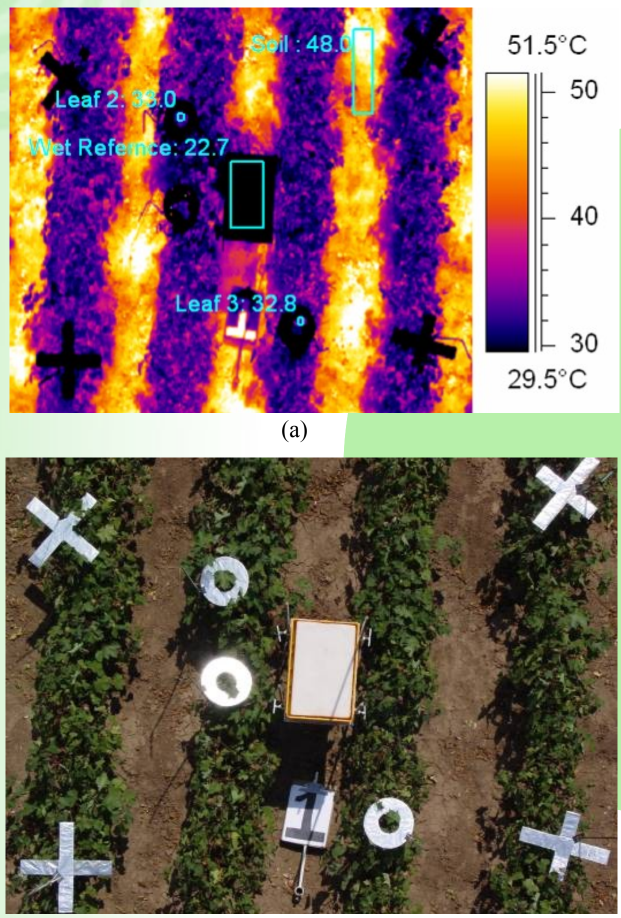
Ten leaf stem water potential samples were taken from each treatment plot on each of four sampling days near

[1]*Mention of trade names or commercial products in this article is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the U.S. Department of Agriculture.*

solar noon on days of year (DOY) 223 (Aug. 11), 240 (Aug. 28), 247 (Sept. 4) and 256 (Sept. 13) in plots 1-8 (Fig. 1). Leaves were excised with a razor blade, wrapped in aluminum foil, and placed in an ice chest until the petiole was inserted into the pressure chamber (PMS Instrument Company, Albany, Oreg.). All readings were performed within one hour of excision. This metric is an accepted method to characterize crop water stress (Turner, 1988).

Thermometric Image Analysis

Digital images were taken with a thermal infrared camera and corresponding software (model SC2000 and ThermaCAM Researcher Pro 2.8 software, FLIR Systems, Billerica, Maine) on DOY 223 (Aug. 11), 240 (Aug. 28), 247 (Sept. 4), and 256 (Sept. 13) near solar noon. Overlapping images were taken at the same time with an RGB digital camera (model DSC-S85, Sony Electronics, Inc., Oradell, N.J.) mounted alongside the thermal imager to aid in image analysis. Images were taken at a nadir view angle from a hydraulic platform, 7.0 m above the ground. For each thermometric image acquisition, cardboard crosses covered with aluminum foil were placed in the plant canopy to define the boundaries of interest. The crosses appeared as colder areas in the thermometric images and as bright areas in the RGB images. The scale to the right of the digital image (Fig. 2a) indicates that shaded soil temperatures are approximately 42ºC, sunlit soil is > 50ºC, average crop canopy temperature is approximately 32ºC, and the wet reference temperature is 22.7ºC. Canopy temperature for the CWSI was determined by measurement of individual leaves secured to cardboard circles that were also covered with aluminum foil for easy discrimination; the leaves were fully expanded and sunlit.



(a)

(b)

Figure 2. Images taken from 7.0 m above a dryland plot:

(a) thermal image showing average temperature of wet reference, soil, and individual leaves;

(b) RBG digital image with wet reference in the center furrow. Photo taken Sept 2007.

The extracted wet reference temperatures were average values of the unshaded areas. The digital photographs were used to improve digital analysis (Fig. 2b).

The empirical wet reference crop water stress index, eCWSI, was calculated as:

$$\text{eCWSI} = \frac{T_c - T_w}{T_{dry} - T_w} \quad [1]$$

where T_c was the temperature (°C) of the crop at the time of the thermometric image, T_w was the average temperature of a "wet reference" that acted as a substitute for the well-watered base line temperature, and T_{dry} was estimated by adding 5°C to the maximum dry bulb temperature recorded (Möller et al., 2006) for the specific field day. The wet reference was a 27 by 42 cm wet surface constructed from semi-permeable plastic foam blocks covered with white polyester felt resting in a basin filled with deionized water. The foam blocks and felt were submerged to re-wet them at least one min before readings were taken. Capillary action kept the fabric wetted for several minutes.

Ground based remote sensing

Sixteen infrared thermometers (Exergen model IRT/c.5, Watertown, Mass.) with a 5:1 field of view were mounted on masts attached to the center pivot arm, with two sensors facing into each treatment plot pointed towards the canopy at an oblique angle. One sensor was mounted at the outside edge of each plot and one sensor on the inside edge so that the sensors were aimed nearly towards each other from opposite sides of the plot, thus reducing sun angle effects. Data from these sensors were measured and recorded every 10 seconds and averaged and stored for each minute. A temperature and humidity sensor (model HMP45C, Campbell Scientific, Logan, Utah) was mounted at the end of the pivot arm and wired to a data logger (model CR10X, Campbell Scientific, Logan, Utah). Data were sampled every 10 seconds and averaged and stored every minute.

Calculations:

Equation 1 was used to calculate the eCWSI for each of these plots using data extracted from the thermal images (canopy and wet reference temperature) on the four sampling days and regressed against stem leaf water potential measurements.

Average seasonal eCWSI values for each of the 48 plots were calculated from data measured on the days the pivot moved using the scaled canopy temperature determined for 12:00 pm, CST, as T_c, measured by the IRTs on the pivot arm using the one-time-of-day measurements corresponding to each treatment block and the scaling method reported by Peters and Evett (2004). Maximum daily air temperature, T_{dry}, was calculated from data collected by the HMP45C sensor, and daily wet reference temperature was estimated by subtracting 10°C from T_{dry}, where 10.2°C was the average of the wet reference temperatures extracted from the thermal images for this growing season.

Preliminary results

Simple linear regression of the calculated empirical CWSI, using data extracted from thermal imagery, against leaf water potential measurements demonstrated a linear relationship, indicating that low stem leaf water potential values were associated with high empirical crop water stress indices (Fig. 3).

These results prompted an investigation to use the empirical stress index to characterize spatial variability of crop water status for all treatment plots under the center pivot. The average seasonal empirical CWSI explained 86% of the variation in cotton yields for each of the twenty-four manually irrigated treatment plots, and 80% of the variation in the automatically irrigated treatment plots (Figs. 4a and 4b). Although there appeared to be less variation from the effects of water stress on cotton yield among the manually irrigated plots, the range in yields for both types of irrigated plots was similar. The linear relationship between lint yield and the seasonal mean eCWSI was similar to the lint yield relationships reported by Reginato (1983), LY = -1957(CWSI) + 1763, and Howell et al. (1984), LY = -1907(CWSI) + 1794, for conventional row cotton with 1.0 m spacing, where LY is lint yield and CWSI was calculated using the empirical method by Idso et al. (1981).

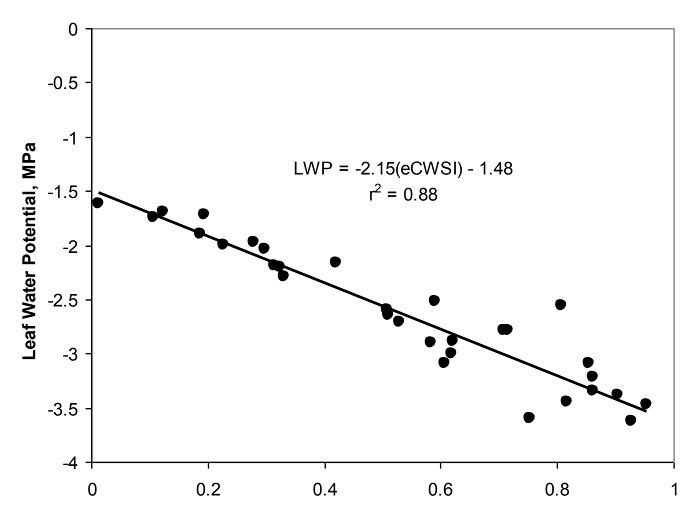
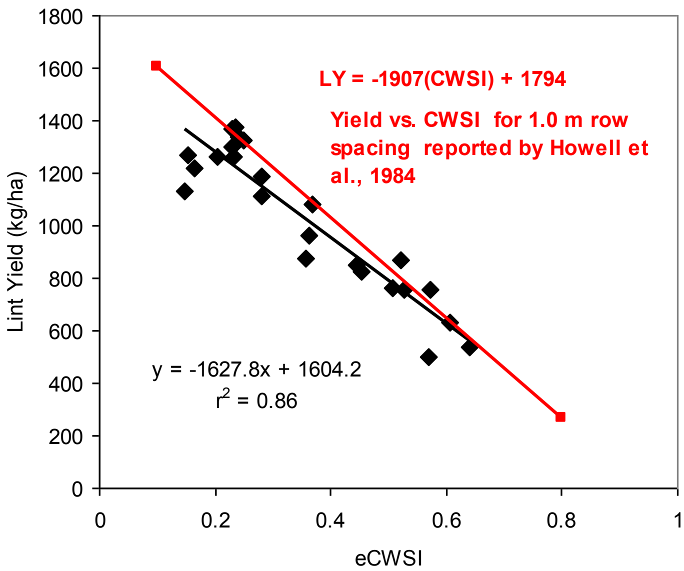
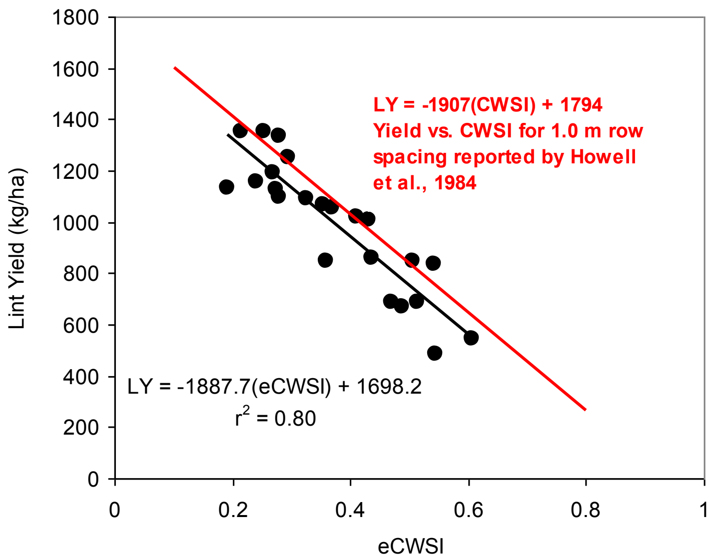


Figure 3.

Figure 3. (Left) Plot showing the negative relationship between leaf water potential and the empirical crop water stress index using an artificial wet reference. Temperature and in situ measurements were made at mid-day during the 2007 growing season. (Pictured above) pressure chamber for measuring stem leaf water potential.



(a)



(b)

Figure 4. There exists a negative correlation between eCWSI and cotton lint yields across the four irrigation treatments in (a) manually irrigated plots; (b) automatically irrigated plots.

Acknowledgements. The authors appreciate the dedicated work performed by Brice Ruthardt, Biological Science Technician, and Chad Ford, Agricultural Science Technician, USDA-ARS, Bushland, TX and funding for this project from the Ogallala Aquifer Program, a consortium between USDA-Agricultural Research Service, Kansas State University, Texas AgriLife Research, Texas AgriLife Extension Service, Texas Tech University, and West Texas A&M University.

IMPACT

The empirical CWSI presented in this article requires minimal supplementary inputs to provide information on crop water status within a field and to predict crop yields for cotton. It is easier to use than the CWSI developed by earlier researchers and thus is amenable to automation. These early results demonstrated the potential positive impact of infrared thermography and remote canopy temperature sensing on farm management and their end-use as a tool for crop water stress monitoring and yield prediction. Infrared thermography could be used to scan an entire pivot field independent of pivot movement. Methods are needed to digitally convert field infrared imagery to make use of this technology as a tool for irrigation scheduling and site specific delivery of water. As thermal imagers become more affordable, automated digital analysis of field imagery taken at different times of the day and converted to useful and easily accessible data can provide decision support information to a producer and a means for improved irrigation and time management. Further studies are needed to evaluate the consistency of the eCWSI's usefulness during different growing seasons.

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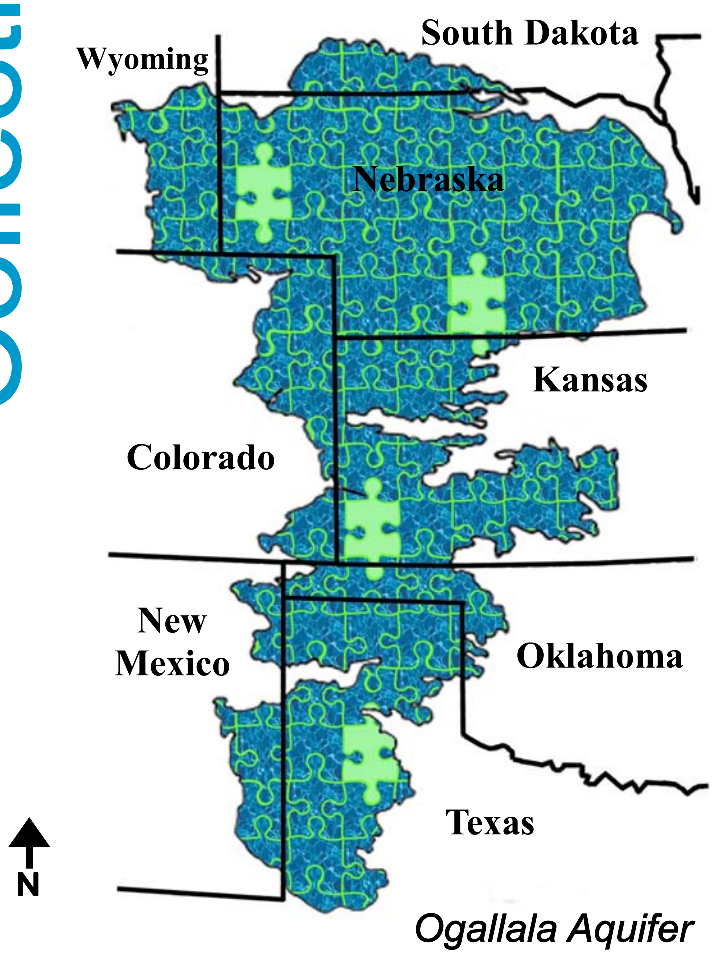
Collecting All The Pieces For The Model



Calibrating Northern Texas High Plains Groundwater Model

by Jairo E. Hernandez, Prasanna H. Gowda, Terry A. Howell, and Thomas H. Marek

In the Northern High Plains of Texas, irrigated crop production accounts for a major portion of groundwater withdrawals from the Ogallala aquifer. The concern is that diminishing groundwater supplies will severely reduce regional crop and animal production, which in turn would impact the regional economy. The objective of this study was to develop and calibrate a groundwater model for a 4-county area (Dallam, Sherman, Hartley, and Moore counties) in the Northwest region of the Texas High Plains. This study is a major component of a comprehensive regional analysis of groundwater depletion in the Ogallala aquifer region with the purpose of understanding short- and long-term effects of existing and alternative land use scenarios on groundwater changes. A comprehensive Geographic Information System (GIS) database was developed for this purpose. Hydrologic simulations were done using MODFLOW-2000 model. The model was calibrated satisfactorily for predevelopment time (before 1950), understanding this period as the time when groundwater was not exploited extensively for irrigation. Predevelopment historical groundwater levels in the 4-county study area ranged from 955 to 1,405 meters above mean sea level (MSL) and simulated levels ranged from 930 to 1,410 meters above MSL and reproduced groundwater levels for the 1950s with a correlation coefficient of 0.9. Results are expected to be useful to develop and evaluate strategies to conserve groundwater in the Ogallala aquifer beneath Northern High Plains of Texas and improve regional water planning. Preliminary results indicated that simulated groundwater levels closely followed trends in the observed historical groundwater levels of the Ogallala aquifer in the study area. Future modeling efforts should include model calibration for post-irrigation development years and evaluation of the effect of change in land use and other cultural practices on sustainability of the aquifer life within the study region.

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Introduction

The Ogallala aquifer (or also named the High Plains aquifer) is one of the largest and most productive groundwater resources in the world and underlies an area of about 45 million hectare in the central U.S. covering parts of Texas, New Mexico, Oklahoma, Kansas, Colorado, Wyoming, Nebraska, and South Dakota. About 66 million m^3 (17.5 billion gallon) of water are withdrawn per day from this aquifer to meet agricultural and urban water demand (Maupin and Barber, 2005). The aquifer area is a remnant of a vast plain formed by sediments that were deposited by streams flowing eastward from the ancestral Rocky Mountains (Reilly et al., 2008). The Ogallala aquifer consists mainly of hydraulically connected geologic units of late Tertiary and Quaternary ages from a heterogeneous sequence of clays, silts, sands, and gravels (Gutentag et al., 1984).

In the Northern High Plains of Texas, groundwater from the Ogallala aquifer is the main source of agricultural and public-water supplies that has sustained economic development in the region for more than a century. Irrigated crop production for grain, fiber, forage, and silage accounts for a major portion (89% - Marek et al., 2004) of groundwater withdrawals from the aquifer and the regional economy is heavily dependent on Ogallala's water. It is now known that the Ogallala aquifer is an exhaustible resource. Therefore, it is essential to avoid any adverse impacts on the regional economy due to the extensive future withdrawal of the limited groundwater.

The Area

This study was conducted on the 4-county area in the Northern High Plains of Texas (Fig. 1). It shares a border with the Oklahoma Panhandle to the north and New Mexico to the west, and it occupies an area of 12,196 squared kilometers (1.22 Mha). About 52% of total crop land (478,000 ha) in the study area is under irrigation, and corn is the major crop in the region. In 2008, the study area produced about 30% of the total corn production (74.2 million bushel) in Texas (NASS, 2008), and this region has one of greatest U.S. county-wide corn grain yield at 13.2 metric ton per hectare (210 bushel per acre) due primarily to the region's corn being all irrigated. Groundwater exploitation in the study area is mainly for row crop production following livestock and municipal uses (TWDB, 2006). About 96% of the water from wells is for irrigation, 3% for livestock, and the rest is for municipal, manufacturing, mining and electric power generation

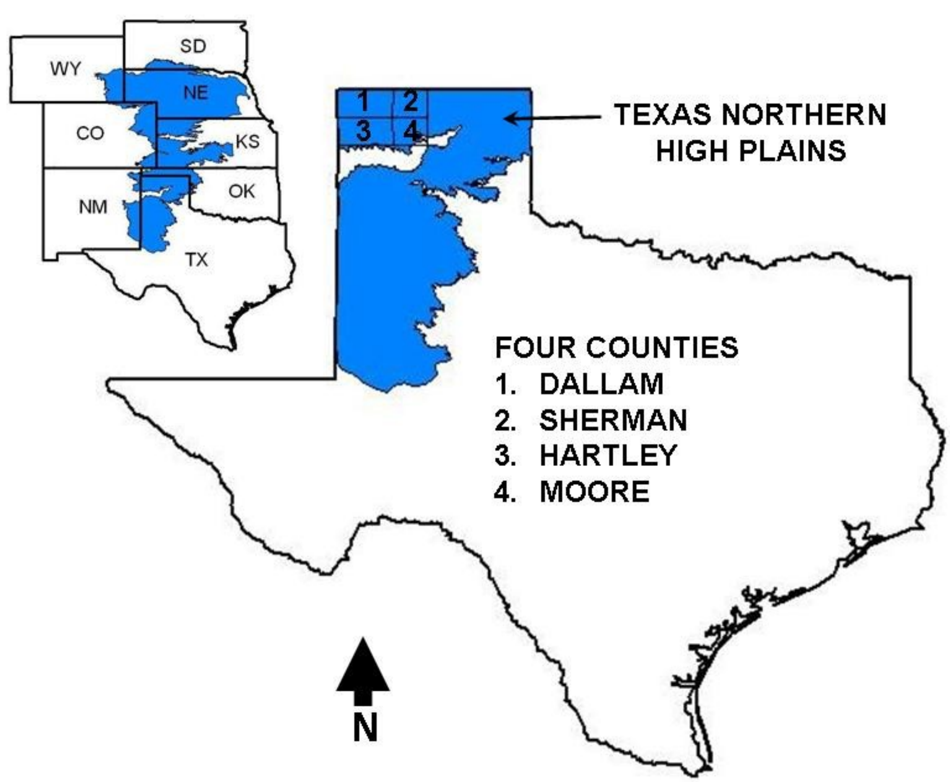

Figure 1. Four county area of the Ogallala aquifer region.

The 4-county study area has an arid to semi-arid climate. Surface water availability is limited to late summer season. Annual precipitation varies from 381 mm in the western edge to 483 mm in the east end of the study area. Potential evaporation from free water surface ranges from 2,200 to 2,400 mm per year exceeding precipitation and leaving little amounts of water for recharge to the groundwater system. There is no presence of major reservoirs in the study area and all waterways are non-perennial streams. Consequently, the vast majority of the area's water supply is extracted primarily from the Ogallala aquifer.

The Ogallala formation in the study area overlies Permian, Triassic, and Cretaceous strata and consists primarily of heterogeneous sequences of coarse-grained sand and gravel in the lower part, grading upward into fine clay, silt, and sand (NPGCD, 2008). Ogallala aquifer is considered as an unconfined aquifer with a predominant flow direction from west to east. No fractured rock zones and faults were identified in the study area. Some hydraulic continuity occurs between the Ogallala formation and the two underlying local aquifers, Rita Blanca and Dockum aquifers.

The Model

Data sources included the United States Geological Survey (USGS), United States Department of Agriculture (USDA), Texas Water Development Board (TWDB), and the North Plains Groundwater Conservation District (NPGCD). Most spatial and non-spatial input data for the study area came from previous regional groundwater studies. Hydrogeology in the form of Geographic Information System (GIS) files were used to define the aquifer base and the saturated thickness, creating a one layer aquifer. Base of the Ogallala aquifer in the study area varies in elevation from about 900 m above mean sea level (MSL) on the eastern limit of Sherman and Moore Counties to about 1,300 m above MSL in the northwest corner of Dallam County. Saturated thickness of the Ogallala aquifer in the 4-county area (Hallmark, 2008) ranged from 15 to 140 m with an average of 50 m and depth to water ranged from 15 to 137 m.

Spatial variability in the easiness with which water can move (hydraulic conductivity) and the capacity to release water from storage (specific yield) were input into the model using the USGS (2008) spatial data. Hydraulic conductivity (between 8 and 120 m per day) and specific yield (from 2.5 to 27.5%) are highly variable in the study area, and they do not follow any particular spatial tendency due to the dependency on sediment types, which vary widely both horizontally and vertically (Gutentag et al., 1984).

No wells were added to the model for the predevelopment period. Historical groundwater levels from observation wells and aquifer delineation (Gutentag et al., 1984) were the base for defining predevelopment groundwater levels. These historical groundwater levels were considered as the target levels to evaluate performance for this study when evaluating predevelopment time.

The hydrologic simulations were done using MODFLOW-2000 (Harbaugh et al., 2000), a computer program that solves the three-dimensional groundwater flow equation through a porous media using a finite-difference method. A Visual MODFLOW Pro 4.3 (SWS, 2008) interface was used to facilitate data input and results analysis. A conceptual model has been created to represent the actual aquifer system to assess the effects of future groundwater exploitation for water levels in the Ogallala aquifer.

Historically, groundwater in the study area was not exploited extensively until the mid 20th century, even though some wells have reported records since 1919. It is evident that the aquifer was underexploited in terms of development during that period of time, especially for irrigation in the 4-county study area. An assumption for this modeling study was that the aquifer system had steady-state flow during this period of time, which is known as predevelopment time. During wet seasons, groundwater discharged naturally by seepage to streams and springs. Discharges diminished during the dry time and natural groundwater levels remained almost constant until the next season, repeating the cycle. According to this assumption, during the first half of the 20th century, the aquifer can be considered as behaving naturally, obtaining recharge from precipitation and withdrawing water by means of evapotranspiration (ET) from plants, stream leakage, and spring discharges; therefore, keeping groundwater levels stable.

Data for geological characterization of the conceptual model were obtained from the USGS and updated with published reports on hydrogeology, topography, vegetation, soils, hydrography, climate and additional information available for the region. Calibration of the model to verify the performance of the conceptual model, included computer simulations under different scenarios to match historical conditions by means of parameter modification and conceptual model adjustment. Although the object of interest for modeling groundwater hydraulics was the Ogallala aquifer in the 4-county study area, model

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boundaries were defined beyond these political boundaries to reduce inaccuracies in the study area boundary.

A computer model was created for the study area based on a 400 x 400 m pixel. Each pixel had internal, uniform characteristics for computing purposes. Therefore, each and every cell in the grid had its own parameter values, which were used for defining aquifer characterization over time, and as a consequence, they changed through time. The aquifer was divided into ten layers to make the computational process more efficient.

Based on the historical information, springs were added to the study area with the purpose of recreating predevelopment conditions. Data on springs for modeling during the predevelopment time were obtained from Brune (1975). In Dallam County, one moderately large spring found in the 15th century (0.28 to 1.0 cubic meters per second) had become a medium-size spring (0.1 to 0.03 cubic meters per second) by 1973. In Hartley County, a small spring in the 15th century (0.003 to 0.0003 cubic meters per second) was reported as a “former spring” by 1973, meaning that it disappeared (stopped flowing). A medium size spring reported in Oldham County was classified as a small spring by 1973. There are no major springs currently in the 4-county study area.

Precipitation over the study area is a key element for recharge evaluation. Soil types and the effect of ET over the recharge areas were evaluated. However, ET was not computed separately because the water table was much deeper than plant root zones, and it was assumed that they were unable to extract groundwater. Instead, it was considered that ET effects above the recharge areas were included in computations by assuming that recharge was a percentage of precipitation. From here on, the term recharge should be interpreted as net recharge that includes evaporation from the soil surface and transpiration from plants. Recharge was applied to the uppermost active layer of the model in all cases.

Pumping for irrigation purposes is the primary mechanism used for aquifer discharge as precipitation is the main mechanism for recharge, the latter representing a small proportion because of the effects of evaporation from the soil and transpiration from plants. A detailed study of the region by Luckey and Becker (1999) recommended annual recharge rates of 16 to 24 mm for sand dune areas in Dallam and Hartley Counties and 1.6 to 2.1 mm for low permeability soils in Sherman and Moore Counties. More recent groundwater modeling studies (Dutton, 2004; Dutton et al., 2001) of the Ogallala “n” model showed the necessity for increasing annual recharge rates in some areas on Dallam and Hartley Counties up to 10 mm and on Sherman County up to 4 mm.

The computer model was extended beyond the political boundary to reach the western Ogallala aquifer borderline in order to make the model more robust. The aquifer borderline and partial borderlines located to the north were assimilated to a no-flow boundary. A general dependent flow boundary corresponded to a cell that transmitted flow to or from an external source proportionally to the head difference between the cell and the head assigned to the external source. For the eastern model boundary, a general head dependent flow was defined using different heads and distances to the external source depending upon the nearness to historic water table elevations. Criterion applied to define distances from the study area boundary to the general head dependent source was three times the average depth of the aquifer in the boundary area. Once the conceptual model was defined, model calibration was required to verify that output from the model corresponded to situations that matched the historical natural aquifer behavior. For calibrating the model for predevelopment time, a steady-state simulation was set to keep all boundary conditions constant through time.

Groundwater levels for predevelopment time were reproduced satisfactorily by simulating the groundwater levels in the Ogallala aquifer in the 1950s, with a correlation coefficient of 0.9 (Fig. 2). Predevelopment historical groundwater levels ranged from 955 to 1,405 m above MSL and simulated levels ranged from 930 to 1,410 m above MSL in the 4-county study area (Fig. 3). When comparing historical data to simulated groundwater levels, areas of over-prediction were located in the northern part of Sherman County and in the northeast corner of Dallam County. Areas of under-prediction of groundwater levels were located throughout Moore County and the eastern part of Hartley County. Coarser contour lines were observed for simulated groundwater levels due to more detailed information used for this study than for the historic levels. The anomaly in the Hartley-Moore County boundary was generated because the aquifer base was more elevated in this part of the study region than in the surrounding area .

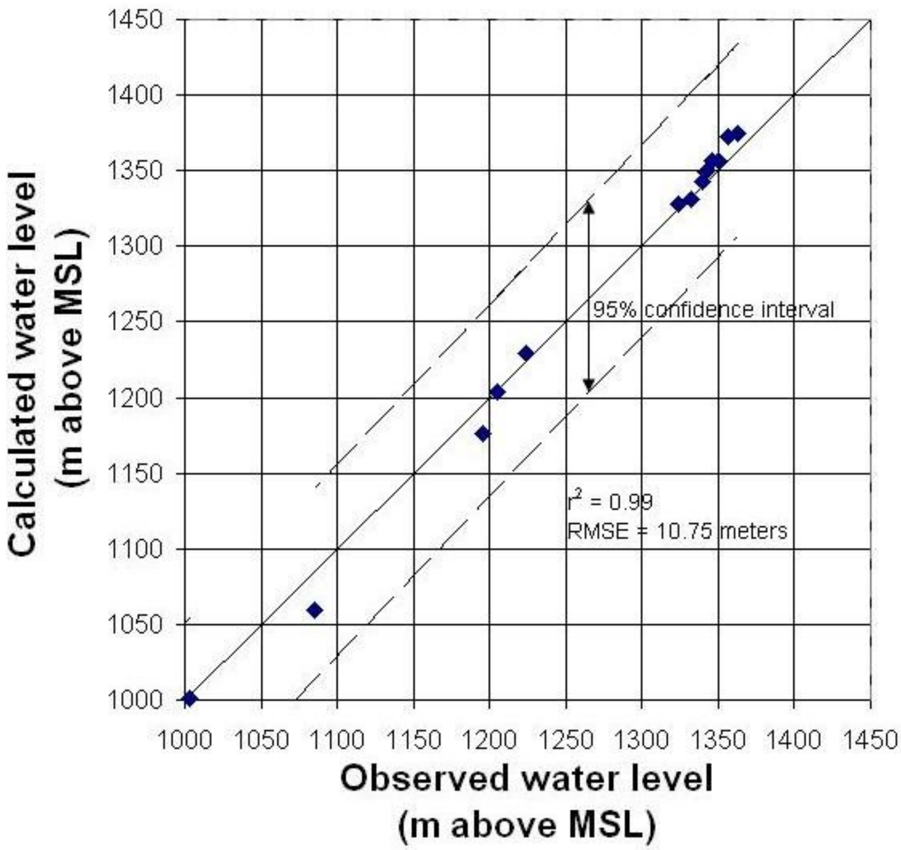


Figure 2. Observed vs. calculated groundwater levels for 1939

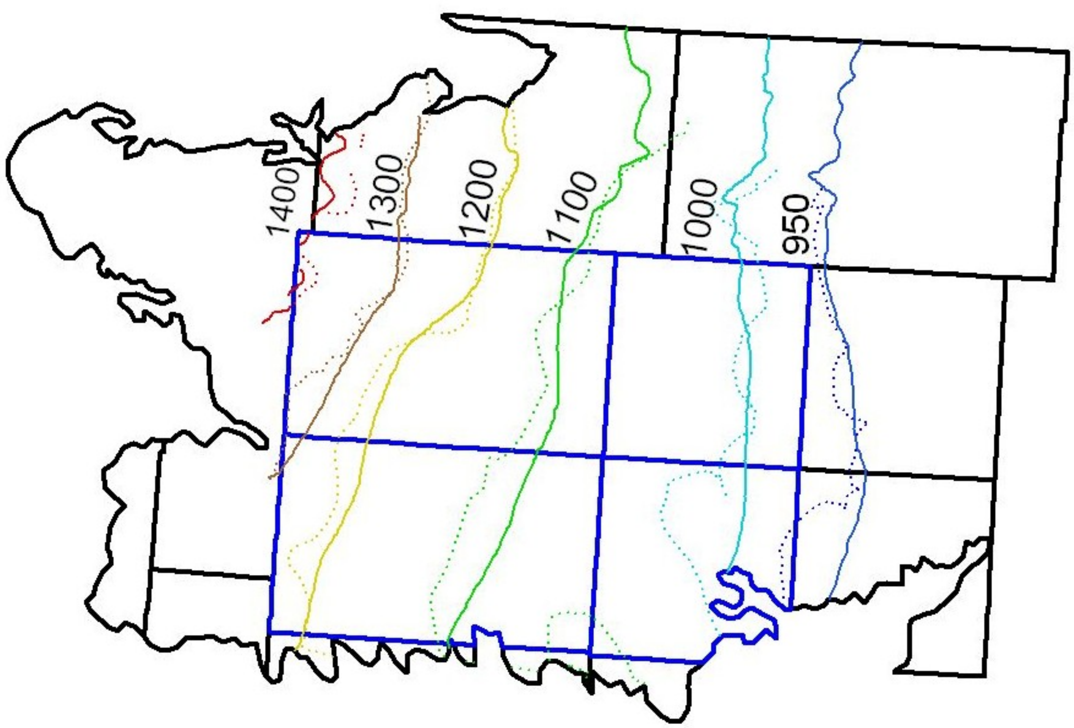
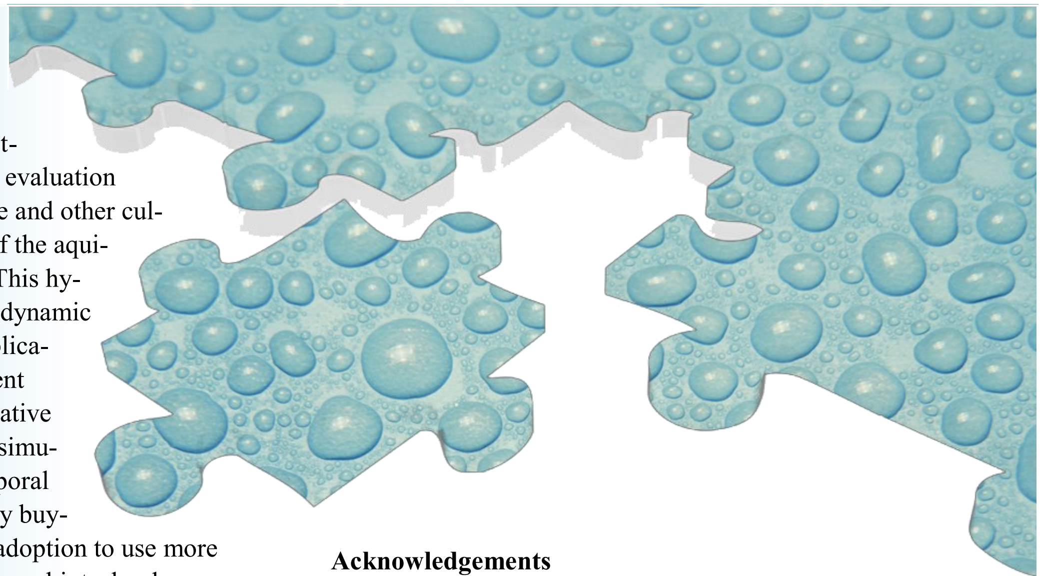


Figure 3. Simulated (dotted lines) and Historical Water Levels for Predevelopment in meters above MSL

Future Work

Future modeling efforts will include model calibration for post-irrigation development years and evaluation of the effect of change in land use and other cultural practices on sustainability of the aquifer life within the study region. This hydraulic model will be linked to a dynamic economic model to allow the application of different water management policies to the study area. Alternative water conservation polices to be simulated include permanent and temporal conversion to dry-land farming by buying out water rights; technology adoption to use more water efficient irrigation technology; biotechnology to adopt more water efficient crop varieties; and a mandatory water use restriction.



Acknowledgements

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Research Center Showcases Studies

Small Grains Field Day

Small Grains Field Days was hosted by Texas AgriLife Research, Texas AgriLife Extension Service, USDA-ARS and West Texas A&M University on May 21, 2009. Area farmers, crop advisors, consultants and research personnel were invited to hear and see current studies on wheat varieties, management of irrigation systems and scientific advancement of precision agriculture center pivot systems. Agricultural Engineer, Susan O'Shaughnessy (pictured left) talks about the wireless IRT unit while two visitors get a closer looks at the IRT board. Visitors observed new technology in irrigation application discussed by Agriculture Engineer, Paul Colaizzi. The wheat variety studies conducted through AgriLife Research has been renowned for the successful varieties it has produced through out the years.

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2009 CIRE Conference
Consortium for Irrigation Research and Education

The Texas CIRE (Consortium for Irrigation Research and Education) met at Bushland at the USDA-ARS Conservation and Production Research Laboratory (CPRL) on May 27th with presentations on important regional issues. On May 28th, they toured area facilities including a visit to the Texas Wheat Producers Board, a tour of CPRL irrigation research, and a local CAFO, dairy, cotton gin, flour mill, and a SDI field on a nearby farm. On May 29th, the group met at the Amarillo Texas AgriLife Research and Extension Center to discuss future collaborations and opportunities for funding.

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MEETINGS & PRESENTATIONS

Steve Evett participated in the ARS Information Technology Steering Committee meeting, December 11-12, 2008 at Beltsville, MD.

Steve Evett, Robert Schwartz and Jourdan Bell attended the Western Regional Research Project W-1188 meeting, “Characterizing Mass and Energy Transport at Different Scales”, at the BioSphere III site near Tucson, AZ, January 5-7, 2009, where they presented a report on work they had done to meet, in part, the objectives: 1) To develop an improved understanding of the fundamental soil physical properties and processes governing mass and energy transport, and the biogeochemical interactions these mediate, and 2) To develop and evaluate instrumentation and methods of analysis for characterizing mass and energy transport in soils at different scales.

January 14, 2009 the SWMRU scientific staff attended the High Plains Irrigation Conference in Amarillo, TX. Paul Colaizzi, Steve Evett, and Susan O’Shaughnessy made presentations.

Paul Colaizzi presented “Comparison of grain sorghum, soybean, and cotton production under spray, LEPA, and SDI” at the Central Plains Irrigation Conference, in Colby, KS, February 24-25, 2009/

The scientific staff of the research unit attended the Ogallala Aquifer Program Workshop in Garden City, KS, on March 10-12, 2009.

Steve Evett attended a research meeting concerning the Bushland Evapotranspiration and Agricultural Remote Sensing Experiment 2008 (BEAREX08) at Utah State University, Logan, UT, on April 27-28, 2009.

On May 2-8, 2009, Steve Evett participated as the irrigation and water resources expert on a team organized by the U.S. Forest Service Office of International Programs to advise USAID in Egypt on use of treated wastewaters to irrigate tree crops. The team held meetings with the Ministry of Agriculture and Land Reclamation, that ministry’s Soil, Water and Environment Research Institute (SWERI), the Ministry of Water Resources and Irrigation, and USAID. They visited afforestation projects and research sites in Ismailia and Luxor. Steve also visited Dr. Taha El-Maghraby of SWERI who completed a six-month visiting scientist stint with Steve at Bushland in February 2009.

Terry Howell attended the Western Great Plains Sustainability Conference, Denver, CO February 11-13, 2009.

Robert Schwartz presented an invited seminar at the Dept. Soil & Crop Sciences, Texas A&M University, College Station, TX, February 25, 2009 entitled "Dependence of Soil Dielectric Properties on Mineralogy: Implications for Soil Water Content Sensing".

February 24-25, 2009, the Central Plains Irrigation Conference in Colby, KS was attended by Paul Colaizzi and Terry Howell. Paul Coaizzi had a presentation and paper; and T.A. Howell had a paper “Global Climatic Change Effects on Irrigation Requirements for the Central Great Plains” presented by Dr. Rob Aiken, KSU, Colby, KS.

March 2-6, 2009, Crop Production in the 21st Century: Global Climate Change, Environmental Risks and Water Scarcity Symposium, Haifa Israel Terry Howell had an invited presented “Advanced Irrigation Engineering: Precision and Precise” with a paper.

March 2-6, 2009, Prasanna Gowda was invited to the World Bank Headquarters, Agriculture and Rural Development Week, Agriculture in a changing world. P. Gowda authored “Remote sensing based ET algorithms for regional ET mapping”

March 10-12, 2009, Ogallala Aquifer Program Workshop in Garden City, KS was attended by Terry Howell, Steve Evett, Judy Tolk, Louis Baumhardt, Robert Schwartz, Paul Colaizzi, Prasanna Gowda, Jairo Hernandez, Steve Brauer, Susan O’Shaughnessy & Nolan Clark

April 14-15, 2009 A SPA On-Site SPA Review, research overviews were presented by each SWMRU and REMM Scientists.

May 1, 2009, Prasanna Gowda hosted the visit by Prof. Xiangming Xiao, Director of the Center for Spatial Analysis, College of Atmospheric and Geographic Sciences, Univ. of Oklahoma, Norman, OK.

May 3-5, 2009 Terry Howell attended the Future of Water for Food Conference, Univ. of Nebraska-Lincoln, NE

May 17-21, 2009 ASCE Environmental Water Resources Institute 2009 World Environmental & Water Resources Congress, Kansas City, KS the following presentations were made.

P.H. Gowda, T.A. Howell, and K.S. Copeland. Co-authored “Mapping ET at high resolution in an advective semi-arid environment with airborne multispectral imagery” authored by J.L. Chavez.

P.H. Gowda, and T.A. Howell co-authored “Independent comparisons among calibration and output of energy balance components estimated by the METRIC procedure” authored by J.H. Kjaersgaard..

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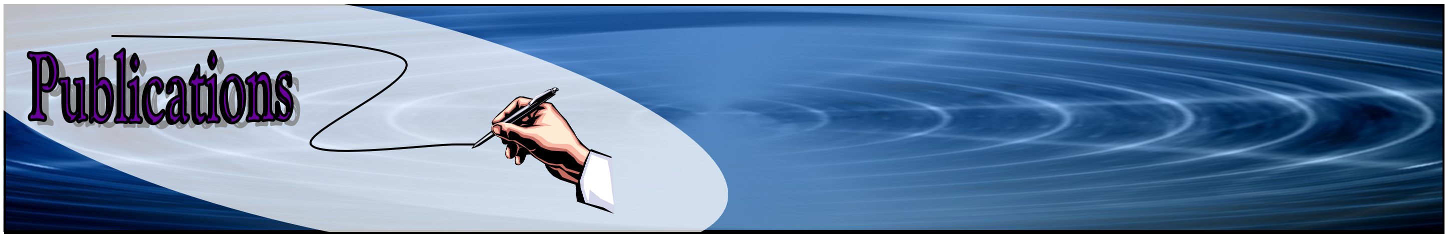

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P.H. Gowda co-authored "Application of remote sensing based tillage mapping technique to evaluate water quality impacts of tillage management decisions in Upper White River Basin", authored by S. Singh.

May 21, 2009 Small Grains Field Day in Bushland, TX, hosted by Texas AgriLife Research, Texas AgriLife Extension Service, USDA-Agricultural Research Service and West Texas A&M University. Presentations given by Paul Colaizzi, Steve Evett and Susan O'Shaughnessy; Judy Tolk served as a committee planning member.

May 21-25, EWRI Conference in Kansas City, Paul Colaizzi chaired the On-Farm Irrigation Systems Committee, and established a new Task Committee, "Envisioning the Next Generation of Irrigation Advisory Programs."

Ogallala Aquifer

Funded by USDA ARS Research Initiative

Check out the official website at:
http://ogallala.tamu.edu/

May 27-29, 2009 the Consortium for Irrigation Research and Education meeting was held at Bushland, TX. Paul Colaizzi, Judy Tolk, Steve Evett, Karen Copeland, Terry Howell, and O'Shaughnessy all precipitated in the research tour for the visitors.

February 25, 2009, Susan O'Shaughnessy was interviewed for the radio program, CREET Beat, regarding Precision Irrigation Management.

Paul Colaizzi, Steve Evett, Jairo Hernandez and Judy Tolk participated in the Career Expo, hosted by WTAMU in Canyon, TX, March 5, 2009.

Judy Tolk attended the Red and Canadian River Basins Advisory Committee Meeting, Texas Clean Rivers Program March 24, 2009, Amarillo, TX.

On April 7, 2009, Dr. Gerard Kluitenberg of Kansas State University presented the seminar "Groundwater Consumption by Phreatophytes in Mid-Continent Stream-Aquifer Systems" to the CPRL staff and visitors.

Susan O'Shaughnessy visited with students at the Part-time Job Fair, WTAMU, Canyon, TX on April 22, 2009.

(Pictured above) Here Dr. El-Maghraby (right) is learning from Mr. Brice Ruthardt (left) how to calibrate a weighing lysimeter by conducting a calibration of the reference grass lysimeter at Bushland using the test masses visible in the foreground.

In February, 2009. Dr. Taha El-Magrahby of the Soil, Water and Environment Research Institute, Giza, Egypt, completed a six-month stay as a visiting scientist studying crop water use and soil water content measurement systems with Steve Evett. Dr. El-Magrahby has already attracted funding from the Arab League to study water use and irrigation management of tree crops irrigated using treated wastewater.

Continued on next page

WISE (Women In Science Endeavors)

Science Rocks!

WISE (Women In Science Endeavors) a community event held each fall, where middle school girls from Amarillo, Canyon, and the surrounding areas come to a hands on workshop designed to peek their interest in pursuing math and/or science related careers. This program has been ongoing in Amarillo for over 15 years. Theme for the event was "Science Rocks". Presenters are responsible for 4 sessions (one session presented four times), each included 12-14 girls.

(pictured above) Jourdan Bell, Biological Science Technician, presents "Fun with Soil Physics" to the girls by processing soil samples to determine physical properties of soil and learn about their importance in agriculture.

Susan O'Shaughnessy, Agricultural Engineer presented " Exploring Alternative Sources and Uses of Electrical Energy" by making batteries from lemons and building a solar powered grasshopper (pictured left).

April 29, 2009 students from the WTAMU agriculture class toured CPRL research facility guided by Judy Tolk.

June 9, 2009, CPRL employees were invited to the Seminar: Some Results of Evapotranspiration Measured by Three Weighing Lysimeters in La Mancha, Spain presented by Dr. Ramón López-Urrea.

June 2, 2009, the Radiation Safety Training was conducted by Paul Colaizzi, for CPRL employees at Bushland, TX.

June 19, 2009 the seminar, "Past, Present, and Future of Livestock Grazing in the Northern Chihuahuan Desert" was presented to all CPRL employees, part of the SPA Scientific Seminar Series.

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ARS determining yield results

Lint yields require a ginning process. Samples from the station are taken to the Texas AgriLife Center's cotton gin in Lubbock to be processed.

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New Pair of Eyes Arrives on Station

Photographs by Karen Copeland

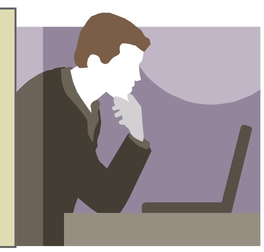
Pictured left the owl is estimated at 4-5 weeks old, (center) 6 weeks (right) and 10 weeks.

Meet “Junior”, the only offspring of a pair of great horned owls nesting on the station. Of course, we really don’t know if Junior is a he or a she. Karen Copeland, soil scientist and nature photographer, kept a watchful eye on the nest and once there was evidence of fluffy white feathers, she was sure of the arrival. At the time of photo on left, the owlet was perching near the nest while the parents were still feeding it. Now the owlet seen in right photo is nearly full grown, and has been seen in the main tree row.

Personnel News

Terry Howell received the Fellow award for 2008, given by the American Society of Civil Engineers and the Editor’s Citation of Excellence for Associate Editor, *Soil Science of America Journal* for 2008

Soil Scientist, Louis Baumhardt, will be out of the office til September while he is recovering at home from a recent motorcycle accident. He will continue to check email messages. We all wish Louis a speedy recovery.



WTAMU Student, Tatum Aldridge, has been employed as a Biological Science Aide Intern to assist in research projects on irrigation, specifically on deficit subsurface drip irrigation (SCI) of cotton. Interns assist full time Biological Science Technicians in all aspects of research from preparing plots, collecting and entering data, irrigation, collecting and processing plants samples.

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All issues will be sent by email or available on the website www.cprl.ars.usda.gov

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