USE OF SUPPORTING DATA

for ET Estimates

SOURCES OF SUPPORT DATA

- Today, your main source of data may be the Internet and digital copies of publications from the library
- For me, the main source has been reprints and miscellaneous publications that I collected over a half century in my work because I was not stationed near a university library
- I subscribed to several engineering and agronomy journals and Irrigation Science
- A common practice before the Internet was to request a reprint of articles of interest from the authors, or request a copies from the USDA National Agricultural Library
- Many publications were mailed to me by authors that knew of my work and interests

BACKGROUND & EXAMPLES

- I retired first from ARS-USDA in 1987 and from CSU in 1993
- I was involved in several water-related projects from 1989 to 2011
- Three projects in which supporting data were very helpful in supporting my ET estimates or in verifying ET calculations will be described briefly
- These are:
  - ET estimates for the Nebraska vs. Wyoming lawsuit
  - Estimating ET and evaporation from Hoover Dam to Mexico
  - Estimating ET, irrigation efficiency and return flow from the Imperial Irrigation District (IID) in California

NEBRASKA vs. WYOMING

- Nebraska filed the suit in 1986
- Wyoming filed counter claims in 1987
- The case was settled out of court in2001 the day before trial was to begin
- In brief, Nebraska claimed that Wyoming was consuming more water from the North Platte River than it was entitled to under the North Platte Decree as apportioned in 1945
- The apparent main basis for the suit was that crop yields in Wyoming had increased substantially, therefore the assumption was that more water was being consumed
- The 1945 Decree, supplemented in 1953, was modified in 2001 with later revisions of some Exhibits

Background

- Numerous publications in the early 1960s indicated that crop yields could be increased substantially by adding a deficient nutrient like zinc, phosphorus or nitrogen with little or only a slight increase in water consumed
- Much of the irrigated land along the North Platte River in Wyoming was irrigated hay
- There were some other crops like corn and grain crops

Examples of Supporting Data

- First, agricultural statistics indicated that the use of nitrogen fertilizer in Wyoming began increasing in the 1980s—a five-fold increase
- A study of hybrid corn yields using hybrids released from the late 1950s to the 1990s showed that corn yields increased depending on the year the hybrid was released
- Increasing corn yields in Wyoming paralleled the increase in hybrids based on the year the hybrid was released
- These and other data that I used, I believe, played a significant role in refuting the claims that water consumption must have increased as yields increased
- ET was estimated using traditional methods with some short term Bowen ratio & eddy covariance measurements

ESTIMATING WATER CONSUMPTION– HOOVER DAM to MEXICO

- The USBR is required by law to account for consumption of water from the Colorado River from Hoover Dam to Mexico
- ET and evaporation estimates were needed
- Originally, the USBR planned to use a water balance model based on ET estimates made with the Blaney-Criddle equation
- A visit to all the weather stations from Hoover Dam to Mexico indicated many stations were poorly sited, next to bldgs, & other obstructions

Approach I Used to Estimate ET

- Daily weather data from CIMIS and AZMET
- Crop coefficients were mainly from FAO 56 for about 40 cropping & vegetation groups
- Crop and phreatophyte ET estimates verified using reported crop and phreatophyte data
- Free water evaporation estimates for each of the four reaches between dams were made using the Penman-Monteith equation
- The resulting system is known as the Lower Colorado River Accounting System (LCRAS)

Supporting Data Used

- Reported measured crop ET and salt cedar ET data from the literature & unpublished reports
- Measured ET from phreatophytes (salt cedar) based on Bowen ratio measurements
- Reported phreatophyte green-up & decline dates
- Surface water temperatures based on limnology studies on reservoirs
- Water temperature data from below dams and at the pumping station to the Arizona were used to support estimated surface water temperatures and for calculating horizontal energy advection

Results

- Initially, daily crop coefficients for each crop and vegetation group was provided to the USBR
- Later, I think the USBR developed monthly coefficients from the daily coefficients
- Estimates of total ET for each of the four reaches were compared with measured depletions and diversion to the All American Canal (Imperial Irrigation District)
- To my knowledge, the LCRAS system is still being used

ASSESSMENT of WATER USE by the IMPERIAL IRRIGATION DISTRICT (IID)

- An assessment first began in 1993 when the USBR organized a team of five to study use of water diverted from the Colorado River
- The study was supported by IID and the Metropolitan Water District (MWD)
- The team prepared a draft report of phase I and presented it to the IID in January 1994
- IID reneged on proceeding with phase II

Assessment Continued

- I was asked by the USBR to do an independent assessment of water use by the IID
- My first report was completed in 1995
- It was updated by Jensen and Ivan Walter in 1997 using a FORTRAN program to facilitate calculations
- Daily CIMIS and AZMET weather data were used
- ET estimates were verified as done with LCRAS
- Supporting data were published ET data and ET data in unpublished reports

Summary of Results

- Colorado River diversions and delivery to IID had increased about 400,000 ac-ft per year from 1987 to 1997 to 3.1 million ac-ft
- Tailwater and estimated leach water increased
- Net inflow to the Salton Sea increased about 20% from 1987 to 1990 & from 1994 to 2001
- The level of the Salton Sea increased reflecting the effects of the higher flows
- Why the increased diversions? My opinion

Current Status

- In 2003, an historic 75-year Quantitative Settlement Agreement (QSA) was signed by the parties involved
- The QSA included the transfer a large share of Colorado River water to urban use from water diverted to IID which would reduce the flow to the Salton Sea
- The QSA specified 80,000 ac-ft/yr to go to San Diego
- In 2009, a lower court invalidated the QSA because it required California to write a blank check to offset environmental projects such as restoring the Salton Sea
- On December 7, 2011 the State appeals court upheld part of the QSA reversing the lower court's ruling

Summary

- These brief examples illustrate that various data can support ET estimates or verify the ET estimates that were made
- My ET estimates , I believe, have impacted decisions that were made
- Conclusion—make the best of information available to you (example)