Recent Research on Predicting and Measuring Water Use

University of Idaho
John C. Tracy, Director
Bryce Contor, Research Scientist
Idaho Water Resources Research Institute
Rick Allen, Research Professor
Biological and Agricultural Engineering

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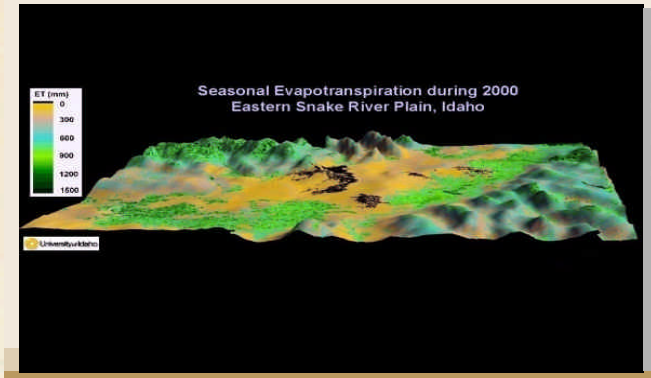
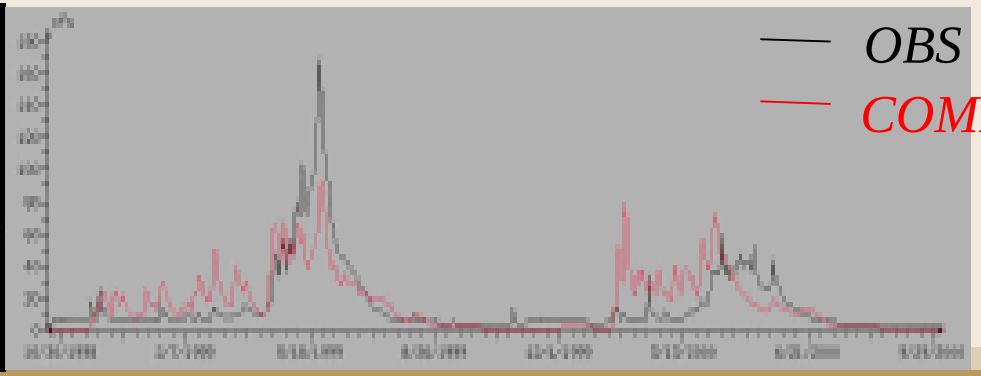
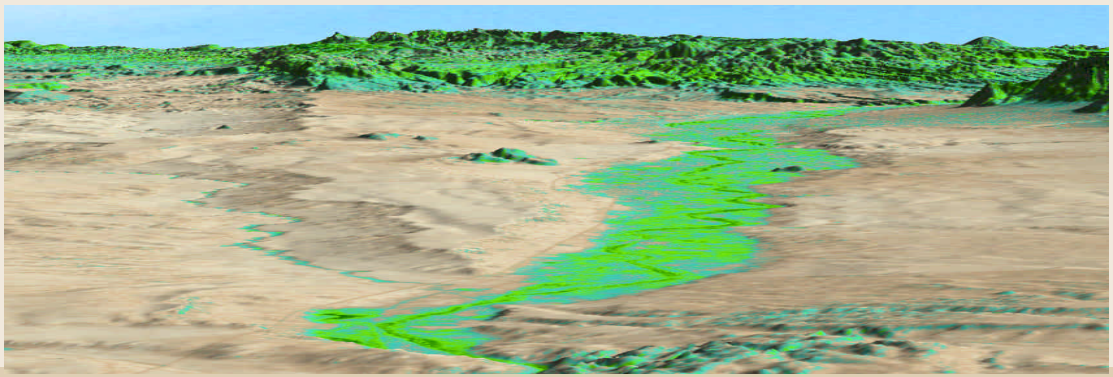




Purpose:

Provide two examples of on-going research at the University of Idaho that are attempting to better:

- Predict future demands for water; and
- Estimate actual use of water.



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Deriving ***Economic Demand*** for Irrigation Water

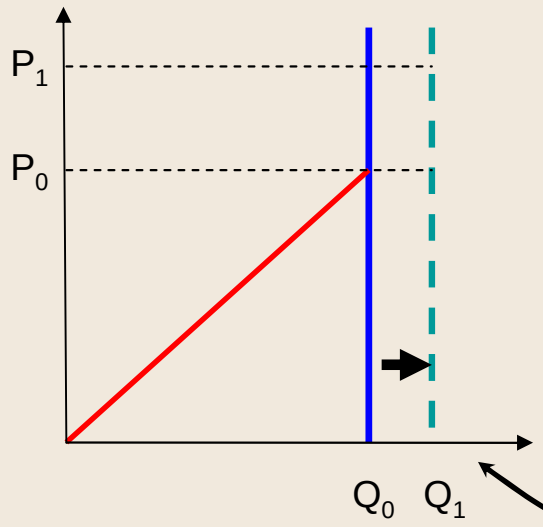
Bryce Contor, Research Scientist
Idaho Water Resources Research Institute

Garth Taylor, Professor
Department of Agricultural Economics

Engineering Economics Approach to Sizing and Pricing Water Supply Projects

(An oversimplified explanation)

We assume we can charge this price



We think we have to provide this quantity

We have assumed

1) Vertical demand curve
2) Horizontal shift in demand
3) Users will pay the calculated project water price

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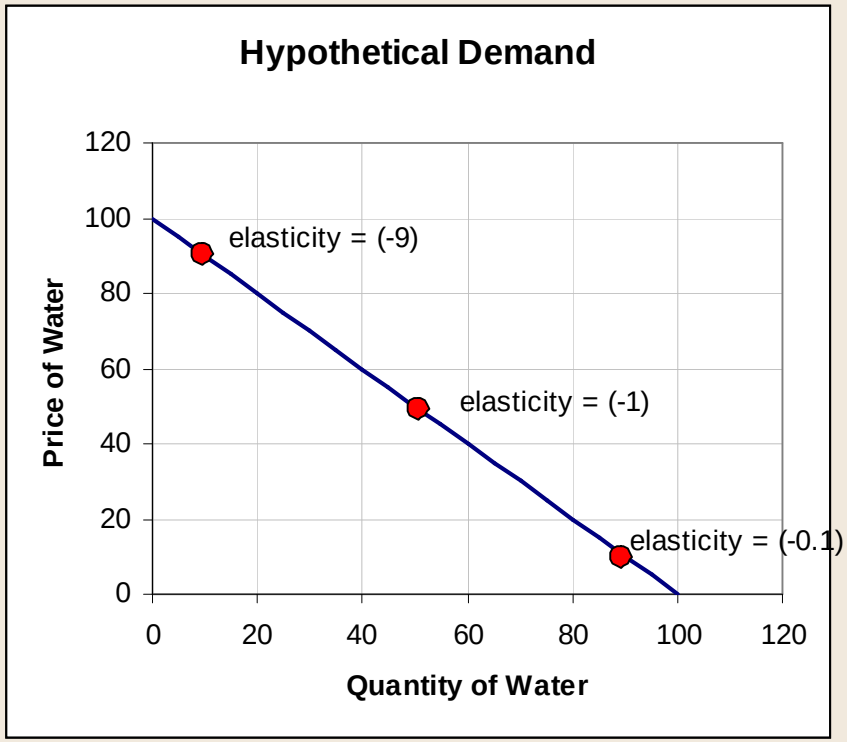
Understanding Price Elasticity



- ***Price elasticity***: percentage change in willingness-to-pay for water, for a given percentage change in price of water.
- $\frac{dQ}{dP} \times \frac{P}{Q}$

Elasticity is typically negative:

E < -2.0 is elastic; E = -1.0 is "unitary elasticity"; E > -0.1 is inelastic

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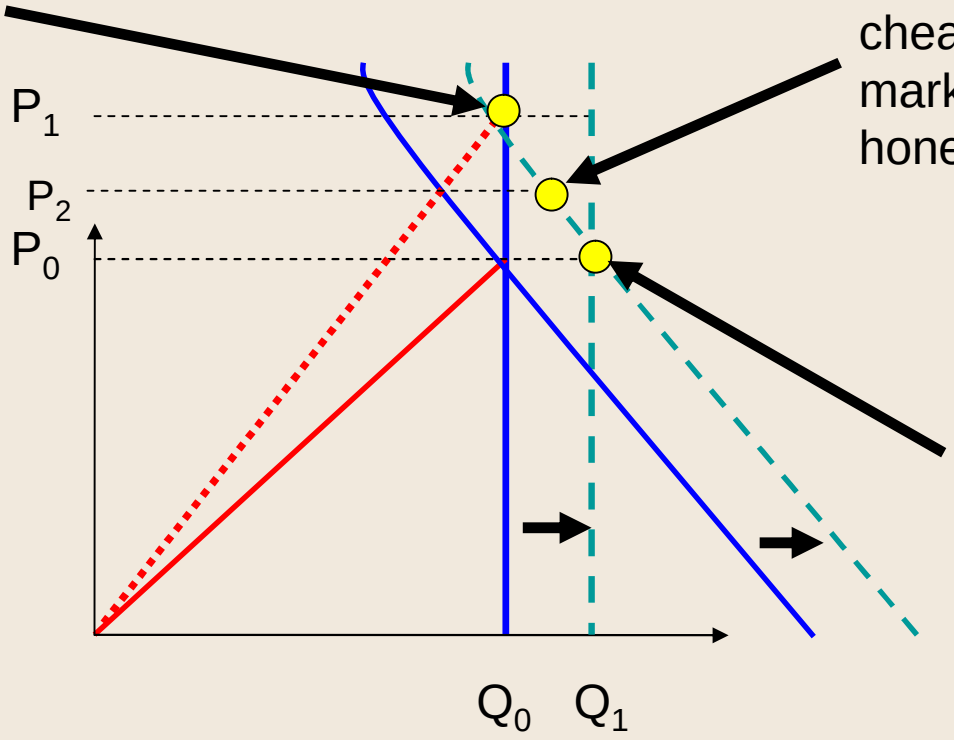
Economics Approach to Sizing and Pricing Water Supply Projects

If we tax the price we don't need new supply



If we build a smaller, cheaper project the market clears at an honest price

If we subsidize the price we can use the planned volume

The engineering plan will not result in a sustainable economic plan

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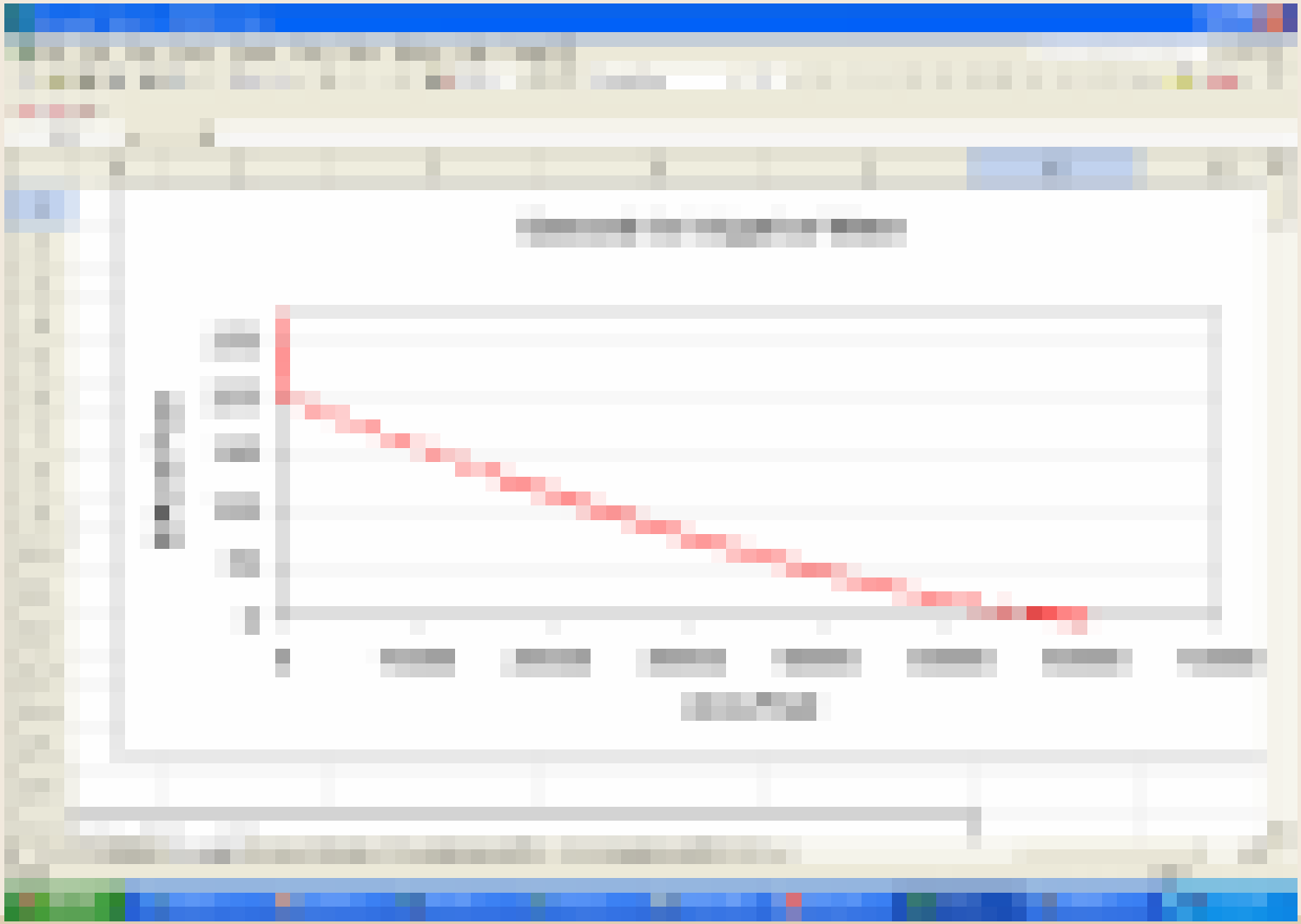
New Tool: Irrigation Demand Calculator



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Irrigation Demand Calculator

The calculator builds on the Martin-Suppalla production function to allow estimation of irrigation demand from *very basic, obtainable* data

- Irrigated acres
- Depth of irrigation for full yield
- Evapotranspiration at full yield
- Yield at full irrigation
- Dryland yield*
- Crop price

Includes CLIMATE CHANGE Worksheet!

* Can be estimated from effective precipitation

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Sample Application of Demand Calculator

- "Status Quo" condition, hypothetical irrigation district with today's commodity prices
- Same district with commodity prices typical of just a few years ago.
- Same district with Climate Change
  - ET increased 10%
  - Precipitation increased 3%

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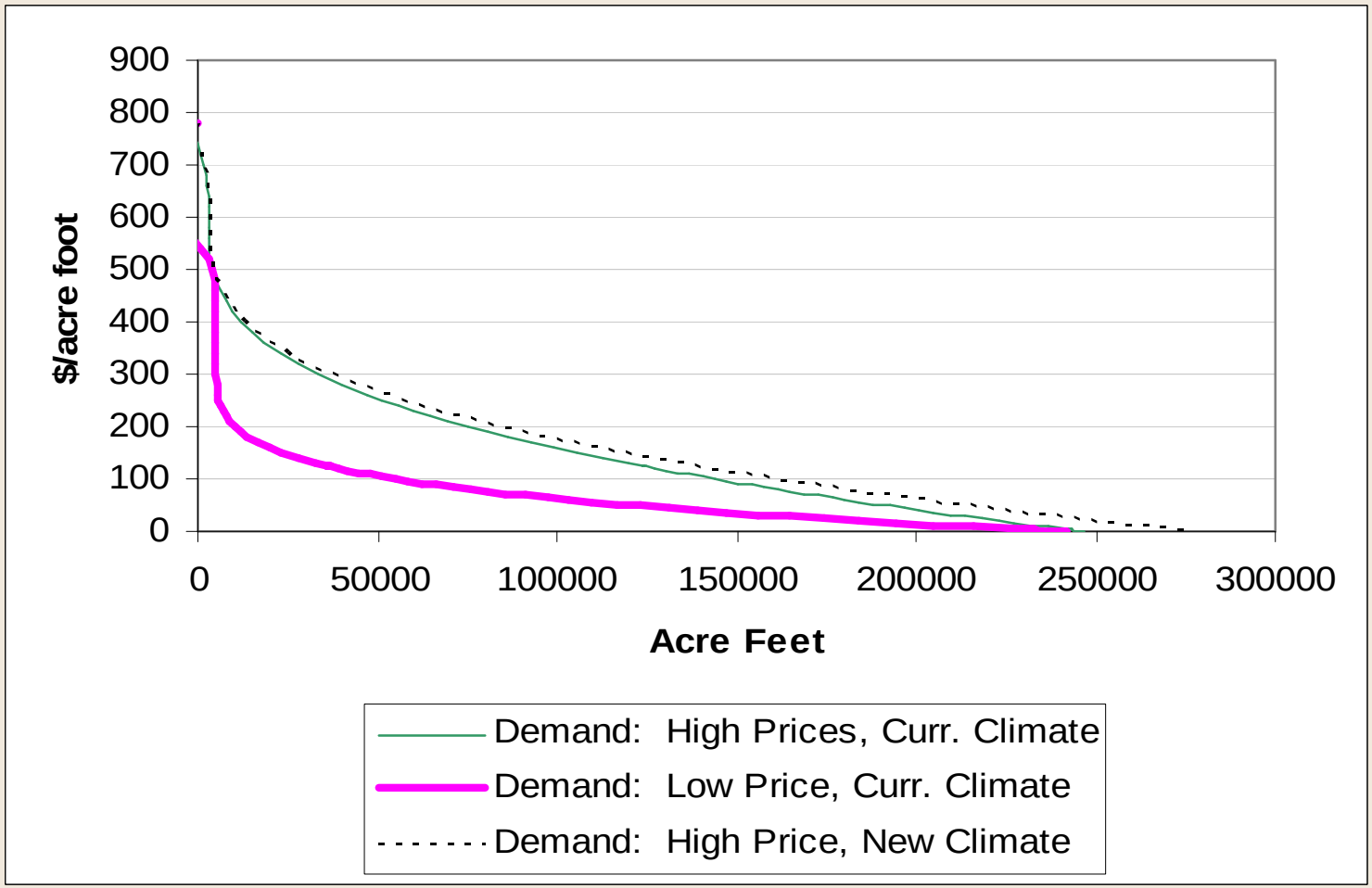
Sample Application of Demand Calculator



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- For more information contact:

  Bryce Contor, Research Scientist,
  IWRRI University of Idaho

  Visit http://www.iwrri.uidaho.edu
  Follow links to Reports, then Boise

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Satellite-based Evapotranspiration by Energy Balance for Water Management

--with weather-based calibration

Rick Allen -- University of Idaho, Kimberly, Idaho

J. Kjaersgaard, M. Garcia and R. Trezza – University of Idaho
M. Tasumi, Univ. Miyazaki, Japan
Tony Morse, W. Kramber – Idaho Dept. Water Resources
Wim Bastiaanssen – WaterWatch
James Wright -- USDA-ARS

Estimating ET using satellite imagery

- Surface Energy Balance Algorithm for Land

  Dr. Wim Bastiaanssen,
  WaterWatch, *The Netherlands*
  – beginning in 1990
  – SEBAL is commercially applied in the U.S.A. by SEBAL-North America

- Mapping EvapoTranspiration with high Resolution and Internalized Calibration

Allen and Tasumi,
University of Idaho, *Kimberly*
– beginning in 2000
– rooted in SEBAL[2000]

METRIC[tm] is energy-balance-based ET mapping tied down and partly calibrated using ground-based *reference ET* (from weather data)

METRIC[tm] is designed to work well in advective conditions of the western U.S.

Why Quantify ET at the basin scale?

- Net Depletion from Ground-water Pumping *(if unmeasured)*
- Manage and transfer Water Rights
- Evaluate ET 'with' and 'without' Irrigation
- Close water balance for a watershed to better compute unmeasured recharge or discharge
- Determine "Actual" ET for Developing better Crop Coefficient Curves

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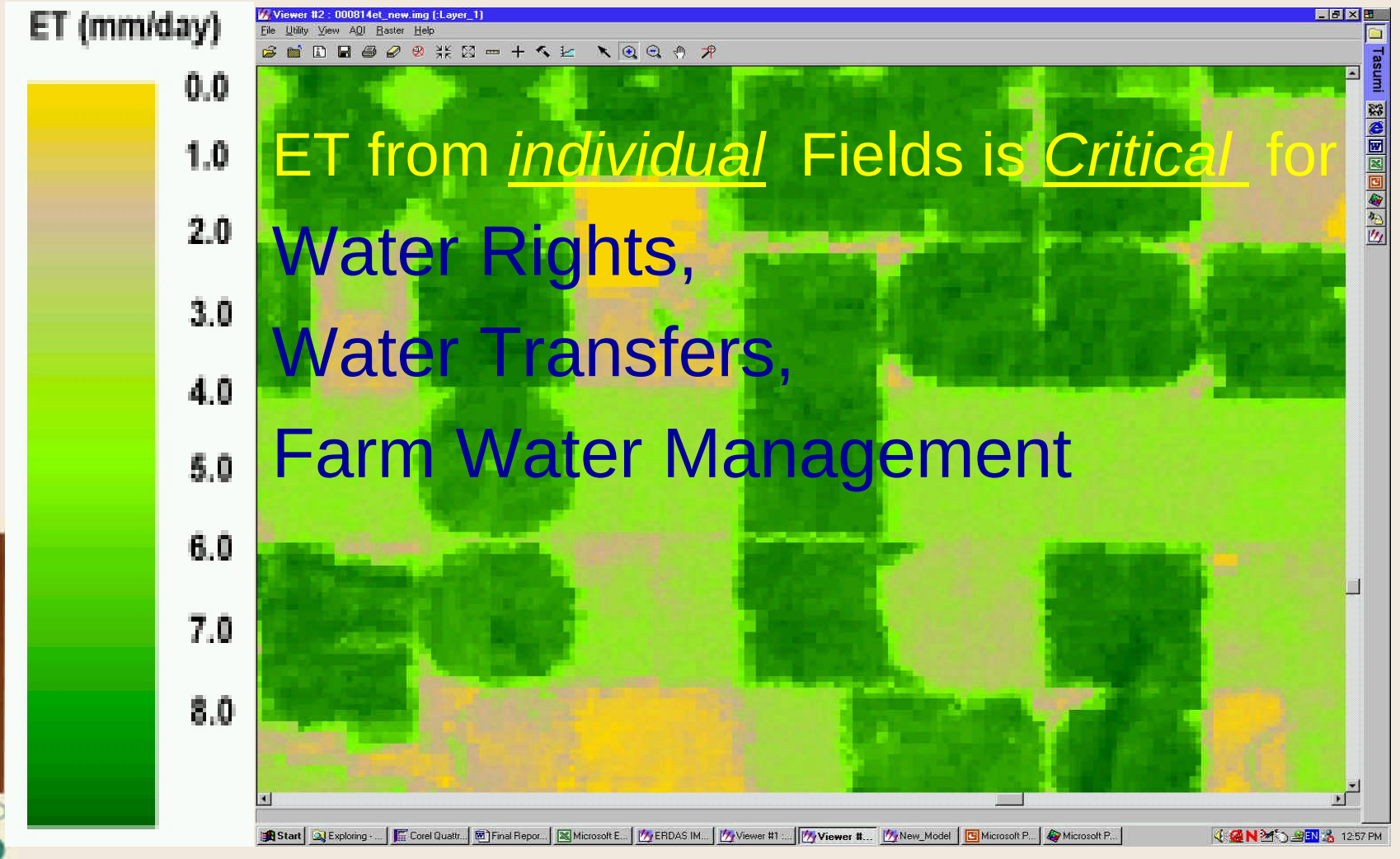
Why use High Resolution Imagery?



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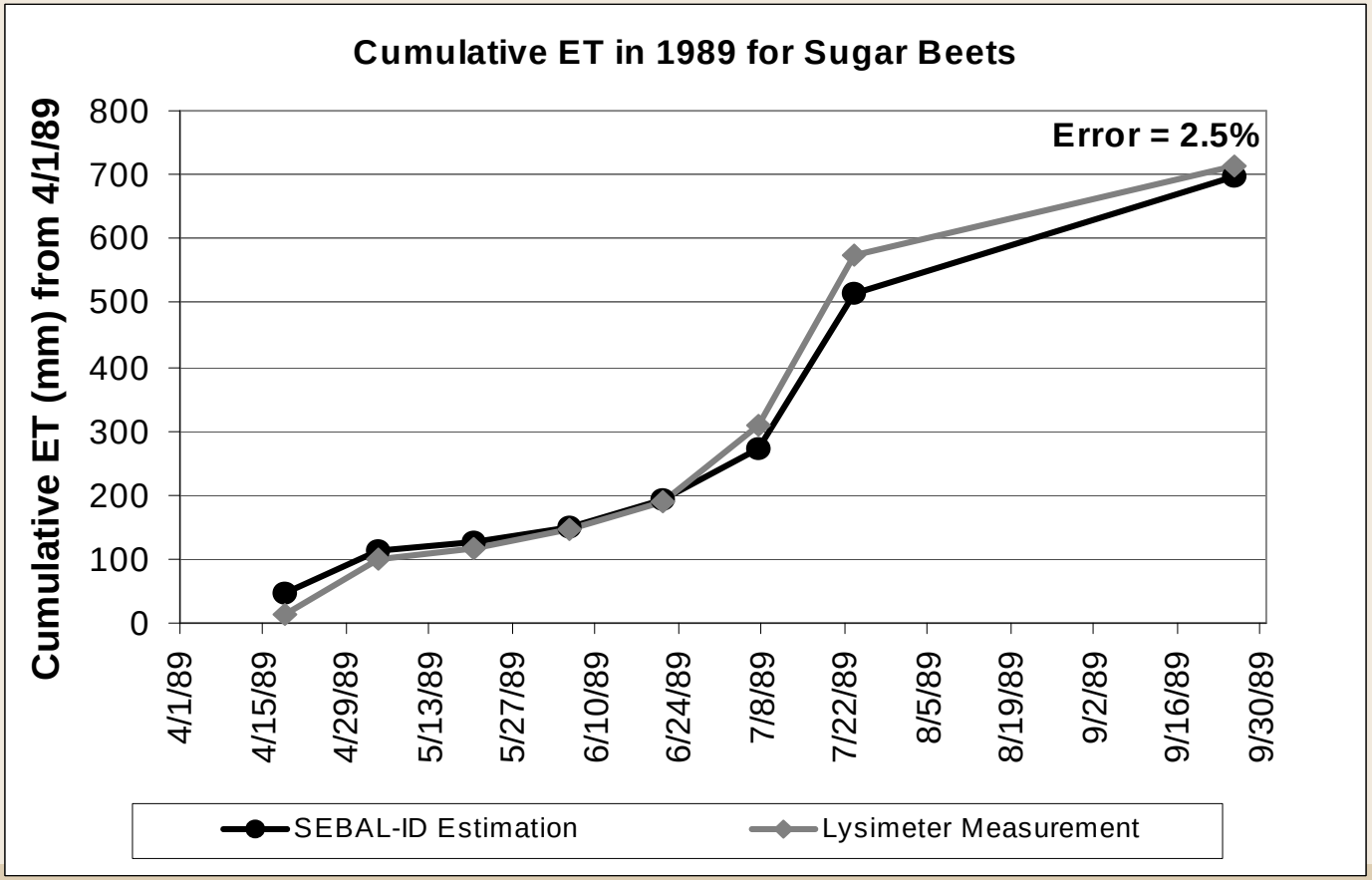
Comparison of METRIC estimates with Lysimeter Measurements

Seasonal ET - 1989



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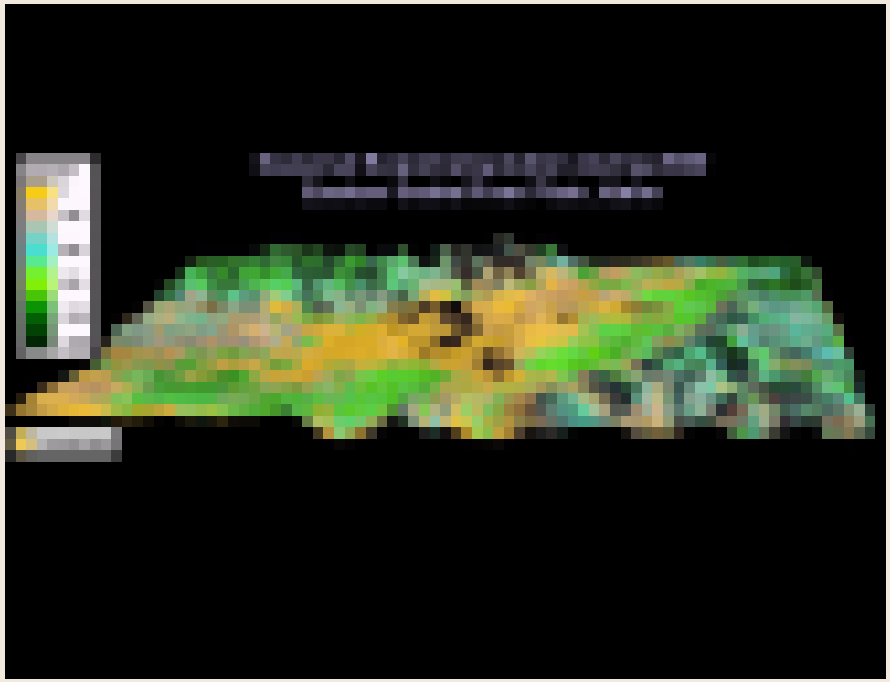
Example Applications of ET Maps

Irrigation Project Performance -- Idaho



Goal:

Use satellite based estimates of ET to evaluate impact of efficiency improvements to irrigation system for the Twin Falls Canal Company.

Improvements can be quantified as ratio of ET to canal diversions plus precipitation.

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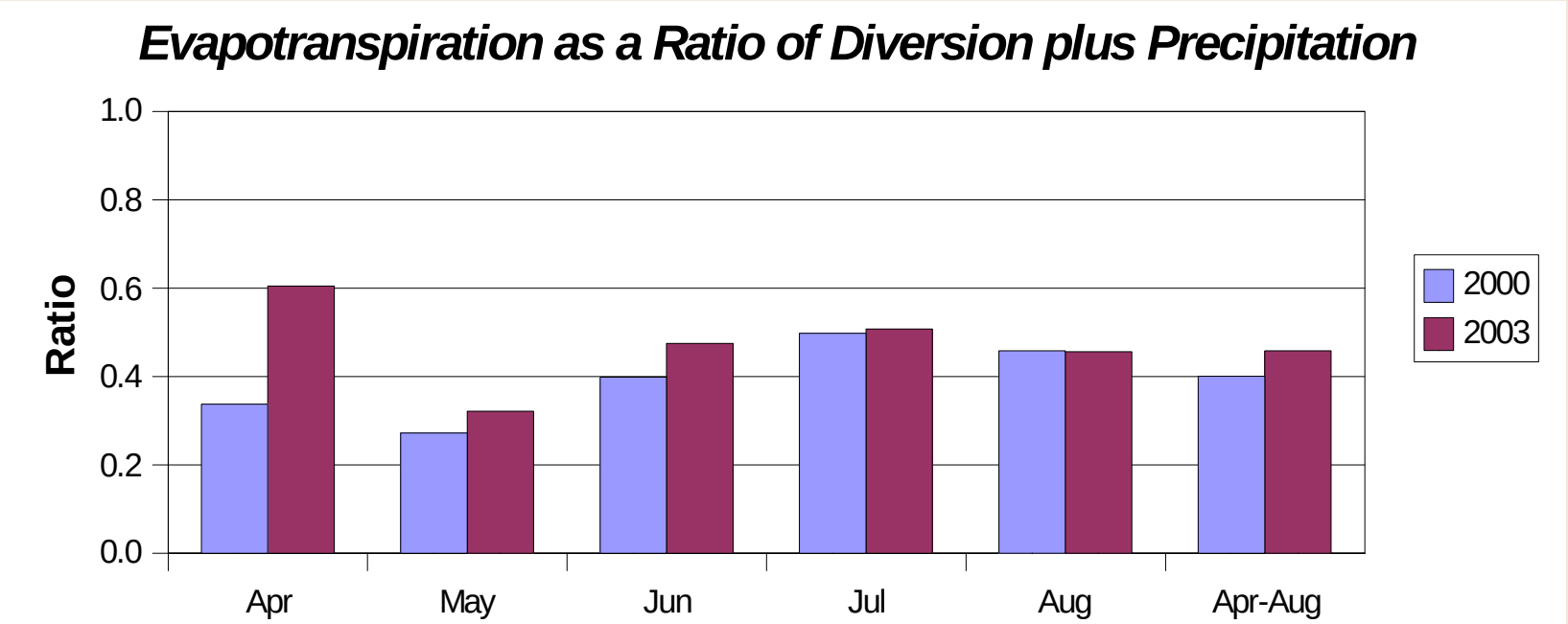
Irrigation Project Performance -- Idaho

Twin Falls Canal Company, Idaho



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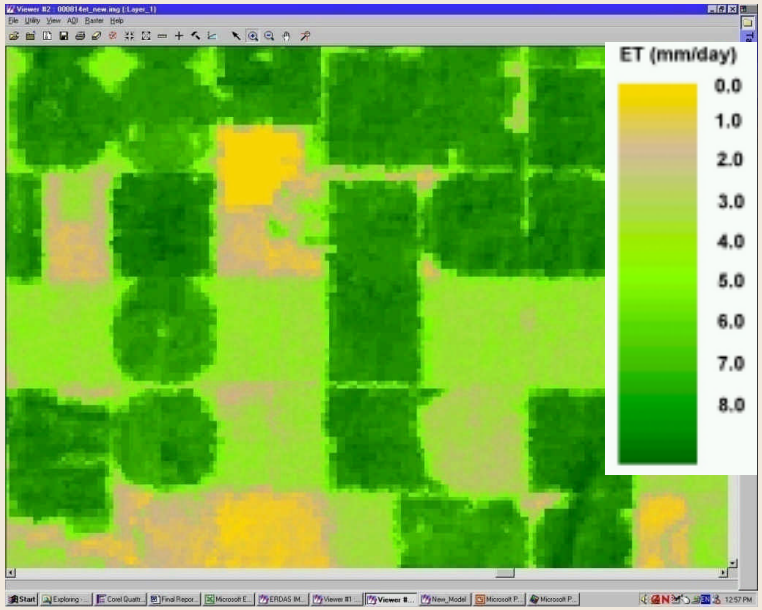
Requirements for SEBAL or METRIC^{tm}

- Satellite images with **<u>Thermal Band</u>**
  - Higher resolution (Landsat) is needed for field scale maps



- Good quality weather data if local calibration is desirable
- **Experienced, thinking human at the controls**
  (determination of ET conditions at calibration pixels)

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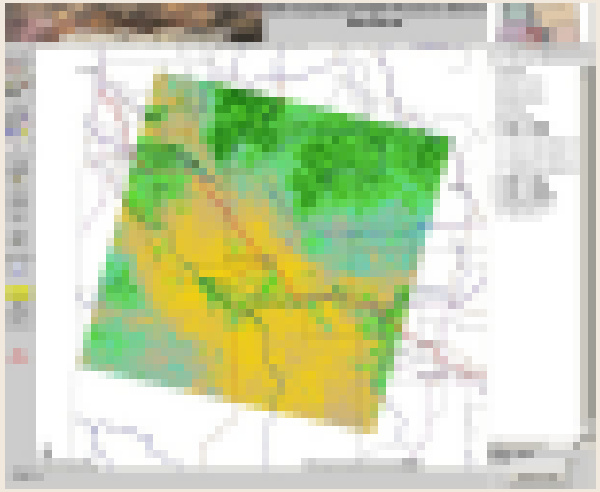
More information at:

- www.kimberly.uidaho.edu/water/ (METRIC^{tm})
- www.waterwatch.nl
- www.sebal.us (SEBAL^{tm})
- http://maps.idwr.idaho.gov/et/



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