MTAC Meeting Notes from December 5, 2013

Introductions were made, and an attendance list was circulated. The following were present at the meeting:

Jim Bartolino (USGS)
Ernie Carlsen (Idaho Water Engineering)
Jason Fisher (USGS)
Sunny Healey (TNC Silver Creek)
Tom Hellen (Hailey)
Patti Lousen (self/Wood River Land Trust)
Pat McMahon (SVWSD)
Mike McVay (IDWR
Neeley Miller (IDWR)
Christian Petrich (SPF/Hailey)
Erick Powell (Brockway Engineering)
Larry Schoen (Blain County)
Jennifer Sukow (IDWR)
Dave Tuthill (Idaho Water Engineering)
Sean Vincent (IDWR)
Allan Wylie (IDWR)

Agenda Item 1 – Revised Design Objectives (Sean Vincent/Jim Bartolino)

Sean Vincent and Jim Bartolino briefly discussed the revised objectives with the MTAC.

Christian Petrich made the initial comment that the revised objectives are a huge improvement over the original objectives. He indicated that he likes that conjunctive administration is front and center. He added that he will do some additional review of the objectives and provide written comment.

Erik Powell said he found the revised objectives to be much better, but that he would like to review them further and may provide additional revisions.

Sean Vincent indicated that he would like the MTAC to provide him with additional comments so he can finalize the objectives prior to the February MTAC.

Agenda item 2 – Tributary Valley Flux (Jim Bartolino)

Jim Bartolino tried several approaches for determining the volumetric flux of tributary underflow. First, specification of a constant head boundary using groundwater levels measured in 2006 or 2012 was judged unrealistic and not defensible. Second, water-table gradients taken from water-level contours representing 2006 conditions (Skinner and others, 2007) incorporated interpolation errors inherent in the contouring process and scarce data in many tributary canyons. While water levels from drillers' logs are more plentiful, the wide variability of measurement dates are not directly comparable. The cross-sectional area of model cells in the tributaries are not representative because of errors inherent in discretization. It was therefore decided to estimate a cross-sectional area of the saturated thickness in tributary canyons from well and geophysical data and apply a Darcian analysis for flux. Jim described the process he used in ArcMap to determine the flux rates for the tributaries.

Ernie Carlsen commented that he was intrigued by some of the preliminary flux estimates in Jim's table.

Jim indicated these figures are preliminary estimates and he will have to verify. He added that he was surprised that the figures were a level of magnitude lower than the figures in his previous water budget. Jim indicated that he believes his current approach is the best approach and he is open to suggestions for improvement.

Erik Powell asked Jim what he used for his K values.

Jim indicated that he used 85 ft/d (for his K value) throughout his analysis. That figure represents the mean of the two geometric means (Thomasson and Theis methods) in the Bartolino and Adkins framework report (table 2).

Allan Wylie commented that moving forward we are going to have to shape the figures Jim presented seasonally/annually.

Jim indicated he has thought about that and thinks weather stations and snotel site data might help with that effort, but he said he was open to other suggestions.

Larry Schoen asked Jim where he is getting his precipitation data from.

Jim indicated that he is using values from StreamStats which uses a coverage of "Molnau, M., 1995, Mean annual precipitation, 1961-1990, University of Idaho Agricultural Engineering Department, State Climate Program, scale1:1,000,000"

Larry said that the airport weather data has got to be the best record of data. He indicated that he is frustrated that we cannot get access to that data. He said he would follow-up with his airport contact to see if we can eventually get access to that data.

Christian asked Jim to clarify what the 6% figure represents.

Jim said that the 6% represents the amounts of precipitation that falls and leaves the tributary through tributary underflow.

Erik made the comment that he would like to see how much these estimates impact the water budget.

Christian added that it would be helpful to see percentages associated with these estimates so the larger group could get a sense of the ranges.

Jim indicated that he agreed and that he will discuss those ranges in his design document.

Agenda Item 3 – New Model Boundaries (Jason Fisher)

Jason Fisher presented model boundaries for groundwater entering the model domain through source cells located in the major tributary canyons and beneath the valley floor at the confluence of the Big Wood River and the North Fork Big Wood River. Source cells were identified using horizontal polygons with a single polygon allocated to each of the 22 source areas. Specified flow boundaries are used to simulate the groundwater inflow. Attention was given to the estimated volumetric flux specified for each source area. Jason also presented model boundaries for groundwater leaving the aquifer beneath Silver Creek and Stanton Crossing. These boundaries are modeled using head-dependent flux boundary conditions.

Agenda Item 4 – Break

Agenda Item 5 – ET on Irrigated Lands (Mike McVay) ***working lunch***

Mike McVay began his presentation by revisiting a few important elements associated with remote ET Estimation and updating the MTAC on ET data availability:

Quick Recap on Remote ET Estimation

- Reference ET (ETr) is theoretical ET from an ideal crop of alfalfa.
  - Based on weather data.
- Crop Coefficient (Kc) is an adjustment to the ETr for non-alfalfa crops.
- Traditional Method of estimating ET involves multiplying crop data by weather data.
  - ET_{trad} = Kc x ETr.
- ET Fraction (ETrf) is the ratio of satellite image ET to ETr.
- METRIC uses the ET fraction, which serves the same mathematical purpose as Kc.
  - **$ET_{METRIC} = ETrf_{METRIC} \times ETr$**
- NDVI uses a relationship with METRIC to generate ETrf.
- NDVI uses the ETrf and ETr like METRIC.
  - **$ET_{NDVI} = ETrf_{NDVI} \times ETr$**

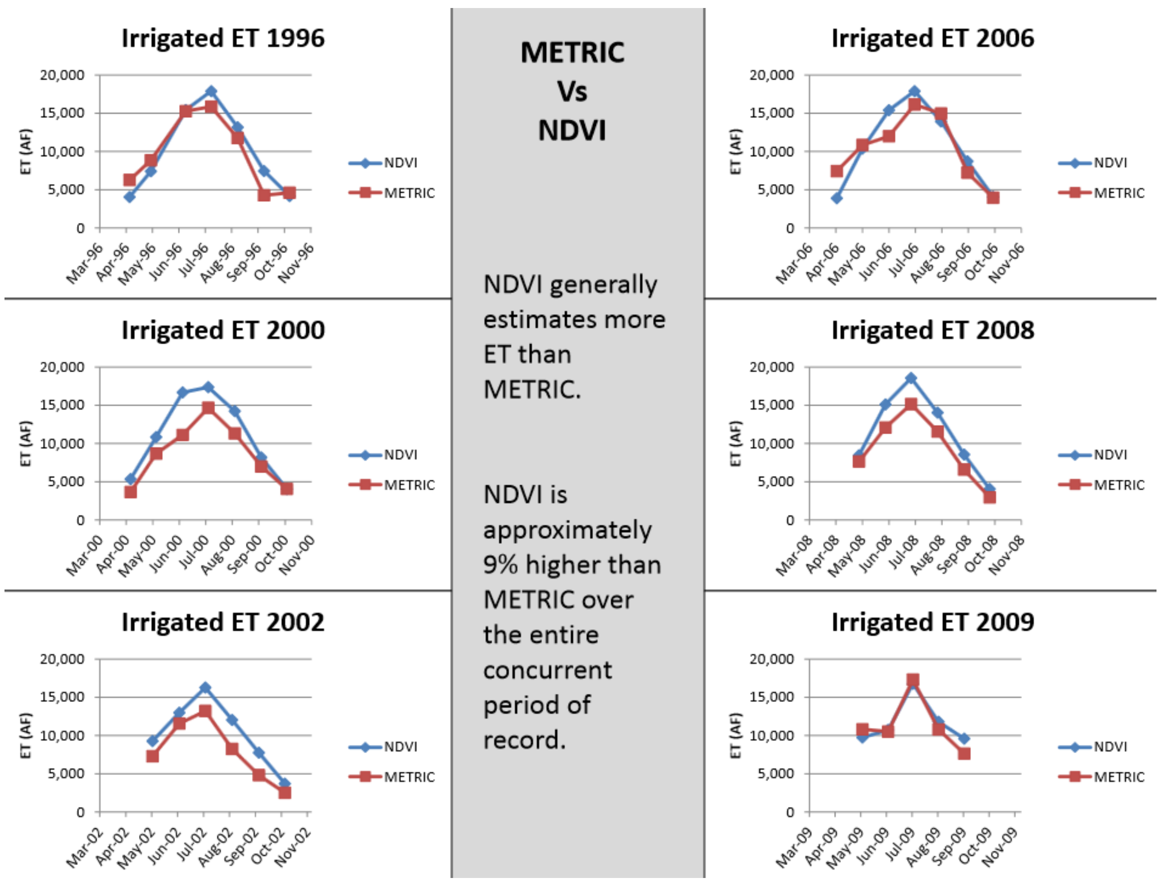
ET Data Availability

ET Estimate	Year	Available Data
NDVI	1995	July
METRIC	1996	All irrigation season
NDVI	1997	Sep and Oct
NDVI	1998	Aug-Oct
NDVI	1999	Jul-Oct
METRIC	2000	All irrigation season
NDVI	2001	Jun-Oct
METRIC and NDVI	2002	METRIC All season, Triangle only; NDVI May-Oct, all domain
NDVI	2003	May-Sep
NDVI	2004	Apr, Jul, Oct
NDVI	2005	All irrigation season
METRIC	2006	All irrigation season
NDVI	2007	All irrigation season
METRIC	2008	All irrigation season
METRIC	2009	All irrigation season
METRIC	2010	Not done yet, due in 2013

METRIC is our best estimate of ET, but it is not available for all months (or not available in time for calibration). Mike indicated that we can use a relationship between NDVI and

METRIC to estimate ET from NDVI images (NDVI is substantially quicker). In order to use satellite-derived data for all months in the calibration period two processes must be completed:

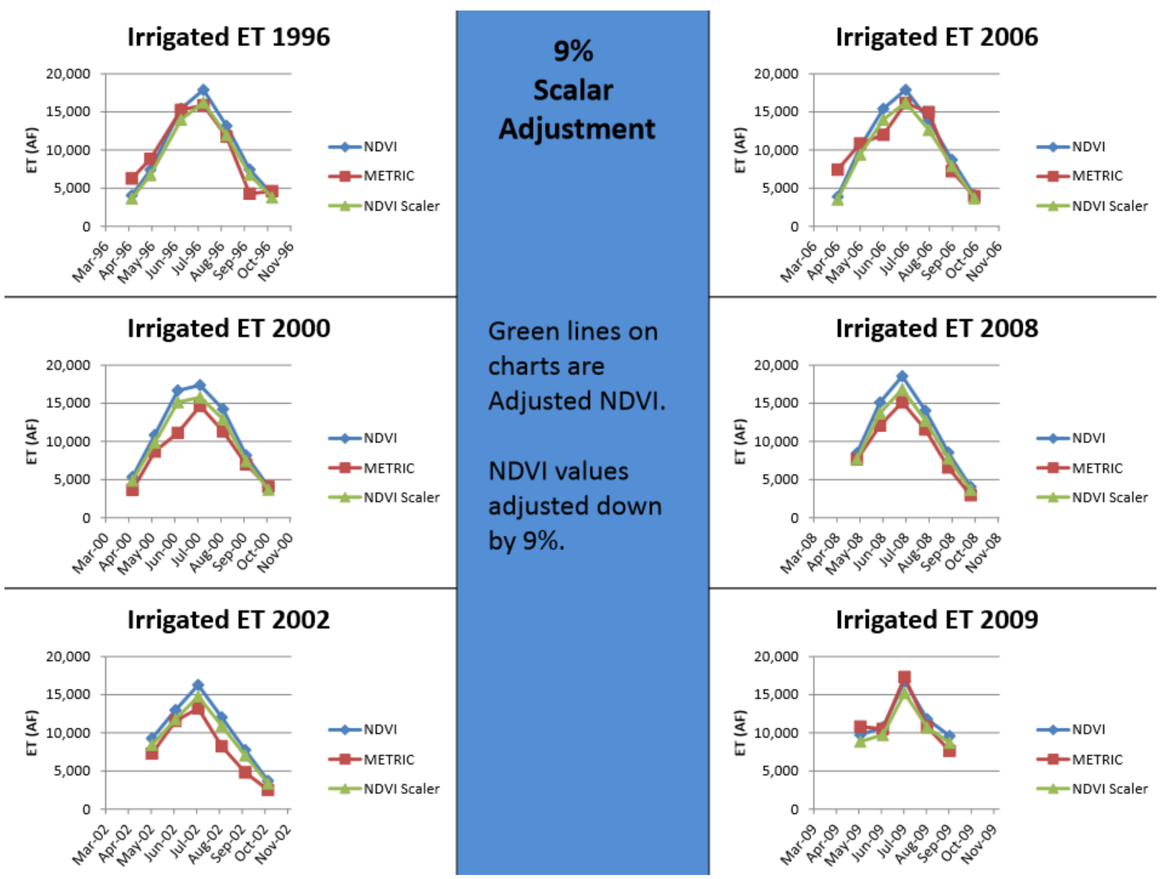
1. <u>Compare NDVI to METRIC.</u> Compare years with both METRIC and NDVI estimates to investigate the relationship between the methods. a) Are the methods producing comparable estimates? b) Is there a bias to the NDVI estimates? c) Correct any bias.
2. <u>Interpolate or Estimate years with no Satellite data.</u> Some months are too cloudy to produce either METRIC or NDVI estimates. a) Use Reference ET (ETr) from weather data for date of interest. b) Interpolate ET fraction (ETrf) from neighboring months with ET estimates. c) Calculated ET using actual weather data and interpolated ETrf.



METRIC is our best option. It appears that NDVI tends to estimate more ET than METRIC. Given this information, we need to decide how to use the NDVI. There are four things we can do, each with increasing manipulation of data:

1. Use NDVI directly. It is another method of estimating ET that we are using.
2. Scalar Adjustment of all NDVI data. NDVI values tend to estimate more ET than does METRIC. Since METRIC is our best estimate, we should try to fit NDVI to METRIC.
3. Month Specific Adjustment. Try to bring NDVI more in line with METRIC by adjusting with monthly averages. Months that have bigger differences on average, are adjusted more.
4. Month Specific Adjustment by Drought Index. Some months show variable differences from METRIC depending on precipitation. For example, NDVI estimates in spring months tend to be higher in dry years and lower in wet years.

Mike indicated that because there is limited data associated with monthly specific adjustments to NDVI he is proposing a scalar adjustment of 9% applied to all NDVI data.



Mike indicated we have several months we need to interpolate or somehow estimated:

Year	Missing Months
1995	Apr, May, Jun, Aug, Sep
1997	Apr, May, Jun, Jul, Aug
1998	Apr, May, Jun, Jul
1999	Apr, May, Jun
2001	Apr, May
2002	Correlate All-Season-METRIC (Triangle) to All-Domain-NDVI
2003	Apr, Oct
2004	May, Jun, Aug, Sep

Mike discussed the process he plans to use to interpolate ET:

How to Interpolate ET

Remember METRIC uses an ET fraction multiplied by the weather conditions.

$$ET = ETrf \times ETr$$

Interpolate to months without estimates, use weather data from the year/month we want and a ratio of the ETrf's that we know.

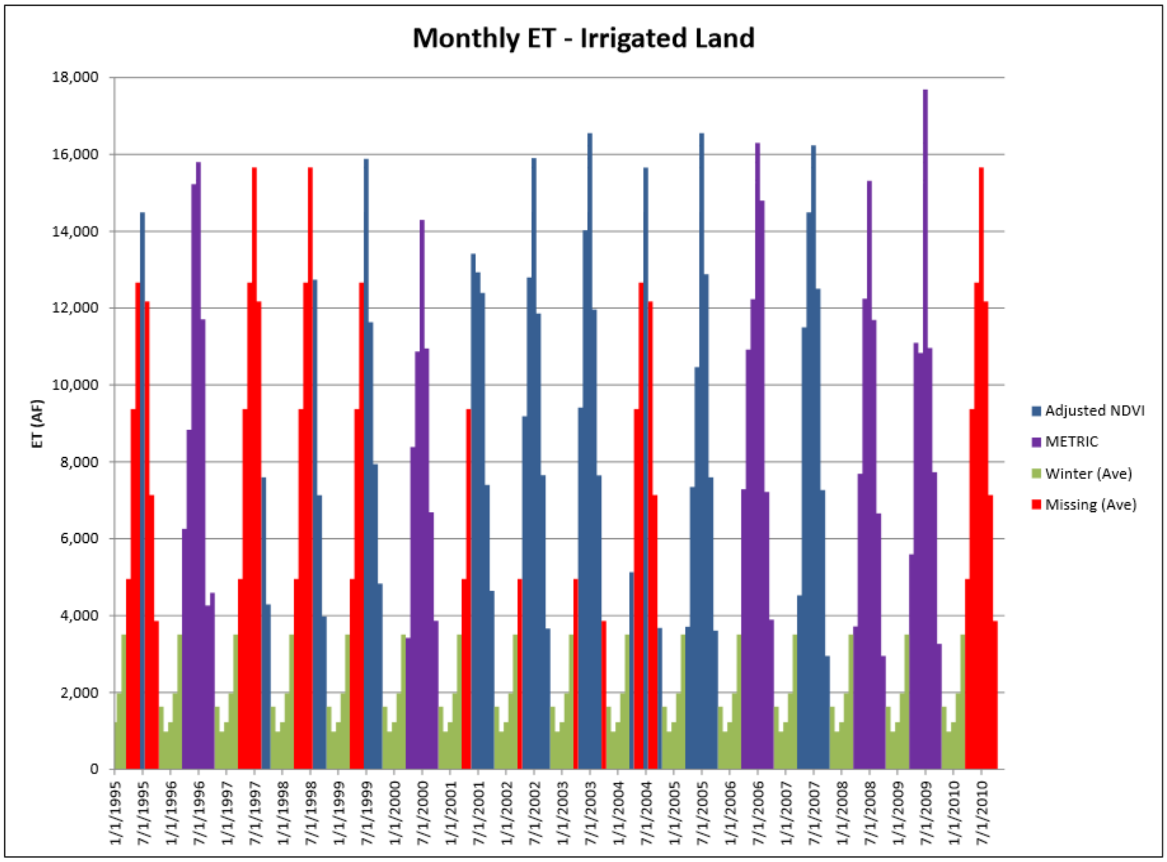
For example: Find **ET May 2001** given METRIC for June 2001 and all of 2000.

KNOW ETrf for June 2001, June 2000, May 2000 ($ETrf_{jun01}$, $ETrf_{jun00}$, $ETrf_{may00}$)
KNOW ETr for all months (ETr_{may00}, ETr_{jun00}, ETr_{may01}, ETr_{jun01})

1. Calculate ETrf from ET for May 2000, June 2000 and June 2001. ETrf = ET/ETr
2. Calculate ratio of $ETrf_{jun01}$ to $ETrf_{jun00}$. Ratio = 90% (not true ratio, only example).
3. Assume ETrf for all of 2001 is 90% of 2000 ETrf.
4. Therefore, assume May 2001 ETrf = 0.90 x May 2000 ETrf.
5. Calculate May 2001 ET as: $\mathbf{ET_{may01} = (0.9 \times ETrf_{may00}) \times ETr_{may01}}$

Mike indicated that next he plans to, 1) evaluate ET on non-irrigated and semi-irrigated lands, 2) make adjustments to NDVI for other land uses, 3) interpolate/estimate missing months for all land uses, and 4) finish computation of winter ET using previously presented methodology.

Mike concluded his presentation by showing a chart illustrating current state of ET processing (winter ET and missing months of irrigation season ET are averages):



Agenda Item 6 – Model Processing Design Document (Jason Fisher)

Jason Fisher discussed the status of the model processing design document. The design document is included with the R package and is referred to as a *package vignette*. The package vignette explains steps taken to pre- and post-process the groundwater flow model. R code embedded in the vignette is run when the vignette is built, and all data analysis output (tables, figures, etc.) is created on the fly and inserted into the final document.

Agenda Item 7 – Next Steps for Model Construction (Allan Wylie)

Once the model becomes fully functional calibration will commence. The calibration process consists of adjusting model parameters to improve the match between model output and field observations. Our field observations include: gains in the Big Wood River, Silver Creek, and Willow Creek, water levels in wells, and underflow out of the model. The gaging stations on the Big Wood River include near Ketchum (4/2011-present), at Hailey (7/1951-present), at Stanton Crossing (9/1996-present). There is one station on Silver Creek at Sportsman Access (10/1974-9/2006 and 10/2007-present) and one station on Willow Creek (6/2006-present). Jennifer conducted a regression analysis that allows us to fill in the missing data for the near Ketchum gage. Unfortunately most of the wells don't have many measurements during the calibration period.
Adjustable model parameters include anything the modelers think should be adjusted. In the case of the Wood River model, these parameters include: Hydraulic conductivity, specific yield, riverbed conductance, drain conductance, ET by irrigation entity, tributary inflow by tributary valley, and canal seepage by irrigation entity. All of the above parameters will be adjusted by Parameter ESTimation software (PEST). PEST is the industry standard software package for parameter estimation and uncertainty analysis of complex environmental models. PEST compares model output with field observations and adjusts model parameters within allowable ranges to minimize the difference between model output and field observations.

Agenda Item 8 – Announcements, Action Items, Next Meeting (Jim Bartolino)

The committee agreed the next meeting should be held at the Community Campus in Hailey, Idaho on Thursday February 6, 2014 from 10am until 3pm.