Merced Groundwater Subbasin
ITRC-METRIC and
Net Groundwater Use/Recharge

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2019

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Alternative to Well Metering

- For On-Farm Irrigation Management
  - Well flow and volume metering are important
    - Irrigation scheduling and well efficiency trending
- For GW Basin Sustainability Monitoring
  - Well flow and volume metering are misleading
  - Meters provide the GROSS amount pumped
  - They do not report how much groundwater was used

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Issues with existing groundwater policies

- Just having a policy does not mean it's a good one.
- New Mexico and Arizona limit gross GW pumping
  - Farmers improve efficiency…. and expand area or switch crops….. increasing consumption
  - Increased overdraft instead of solving the problem

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Water Rights and Groundwater

- Poor understanding of groundwater consumption…..as opposed to gross pumping

Consumption vs. Availability of water

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With GW Metering Example

- Surface Rights = 2.5 AF/A
- Sustainable Yield (net) = 0.5 AF/A
  - Assume IE = 80%
  - Pumping allotment = 0.5/0.8 = 0.625 AF/A
- Farmer can apply 3.125 AF/A
- This is wrong, because Surface Water is also not applied at 100% efficiency

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With GW Metering Example (cont.)

- If Farmer applies 3.125 AF/A at IE = 80%
- Crop will beneficially consume 3.125*0.8 = 2.5AF/A
- 0.625 AF/A will deep percolate and return to aquifer!!
- So the farmer did not receive their GW allotment, it was recycled back to the GW

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With GW Metering Example 2

- GSA Assumes IE = 80%
- Surface Rights = 2.5 AF/A
- Sustainable Yield (net) = 0.5 AF/A
  - Pumping allotment =
    [(2.5+0.5)/0.8]-2.5 = 1.25 AF/A
- Farmer can apply 2.5+1.25 = 3.75 AF/A
- What if farmers actual IE = 85%?
  - Applying 3.75 AF/A,
  - 0.6875 AF/A of groundwater would have been consumed,
  - **0.1875 AF/A more than sustainable…**

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NEW Concept Consumptive Rights

- Consumptive Right =

  Surface Right + Net Sustainable Yield

- Ignore Irrigation Efficiency

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Alternative to Metering GW Pumping

- Remote Sensing of actual consumption
- **Net to and from groundwater**
  - Surface deliveries, seepage, etc.
  - Precipitation
  - Compare to existing groundwater levels
- Use this as the basis for evaluating the potential future scenarios

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Net To and From Groundwater

- Local evaluation of NET groundwater consumption
- Can be evaluated on a parcel level
- Tool for water managers and groundwater modelers

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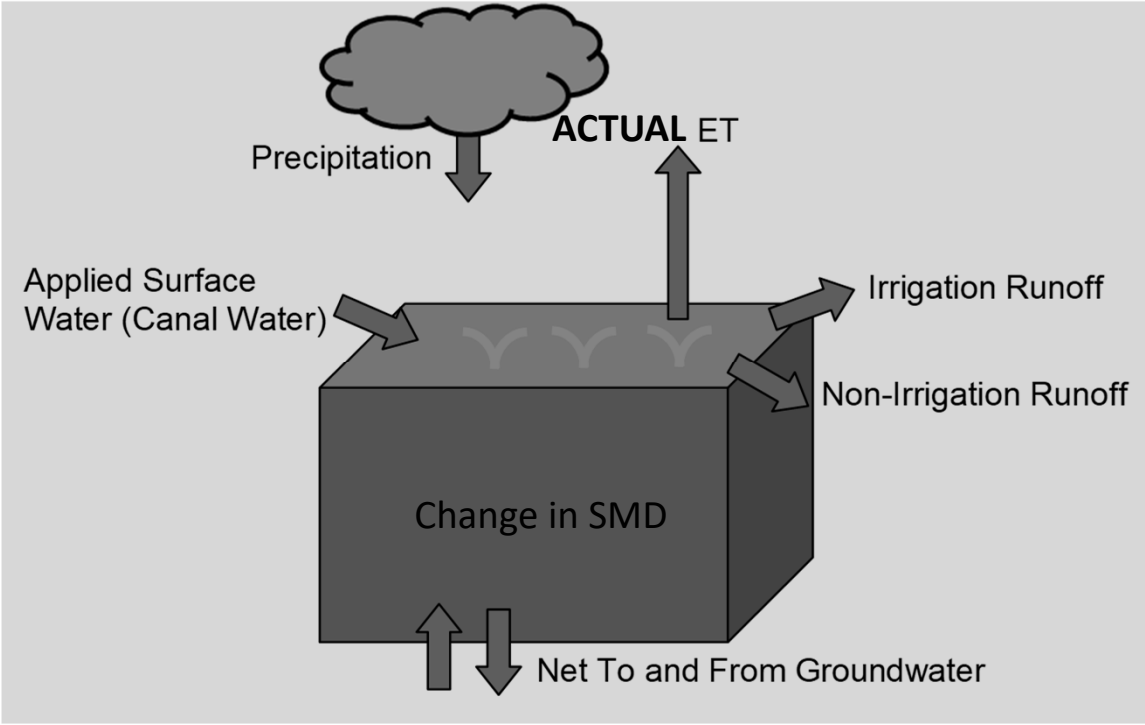
NET to/from aquifer



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Remote Sensing of Actual ET_c

- Modified METRIC™ algorithm with LandSAT images
- IS NOT NDVI based ET estimation!!

- Basic Principle – Evaporative cooling

- Cooler fields have higher ET

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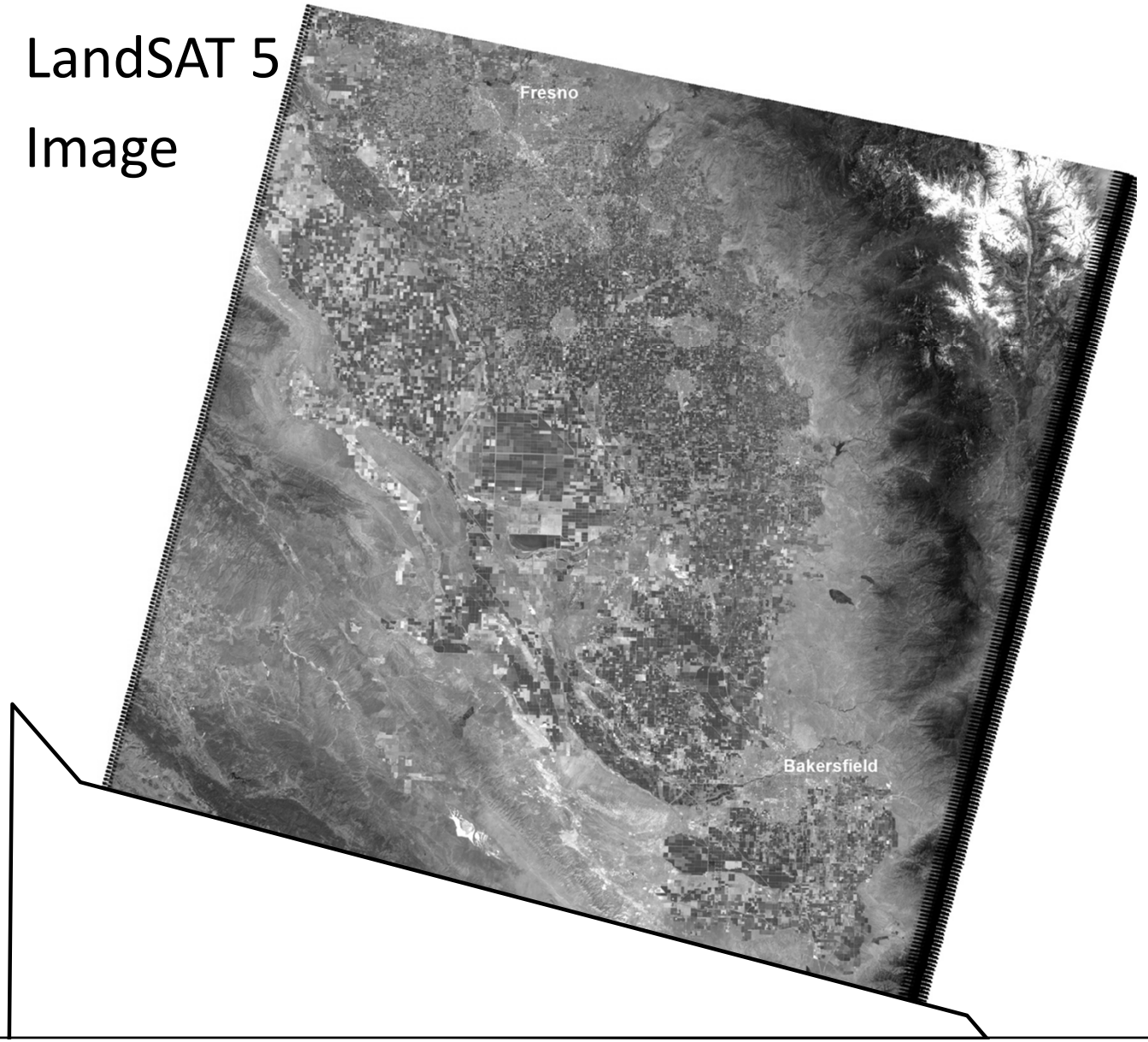
LandSAT 5 Image



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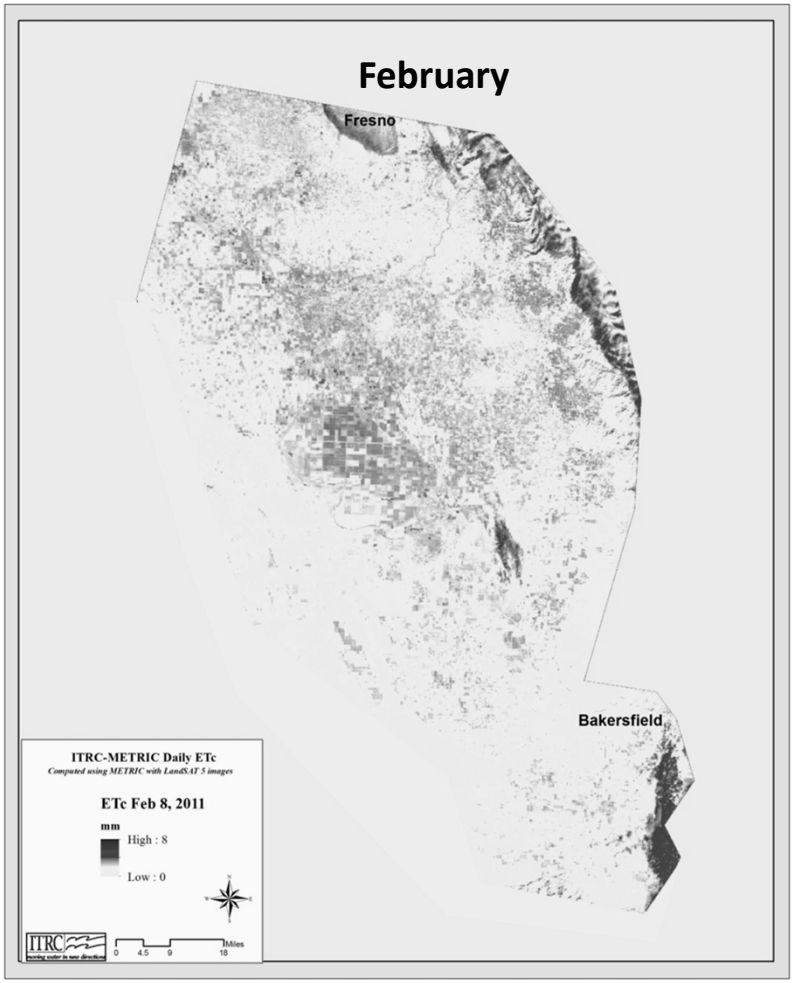
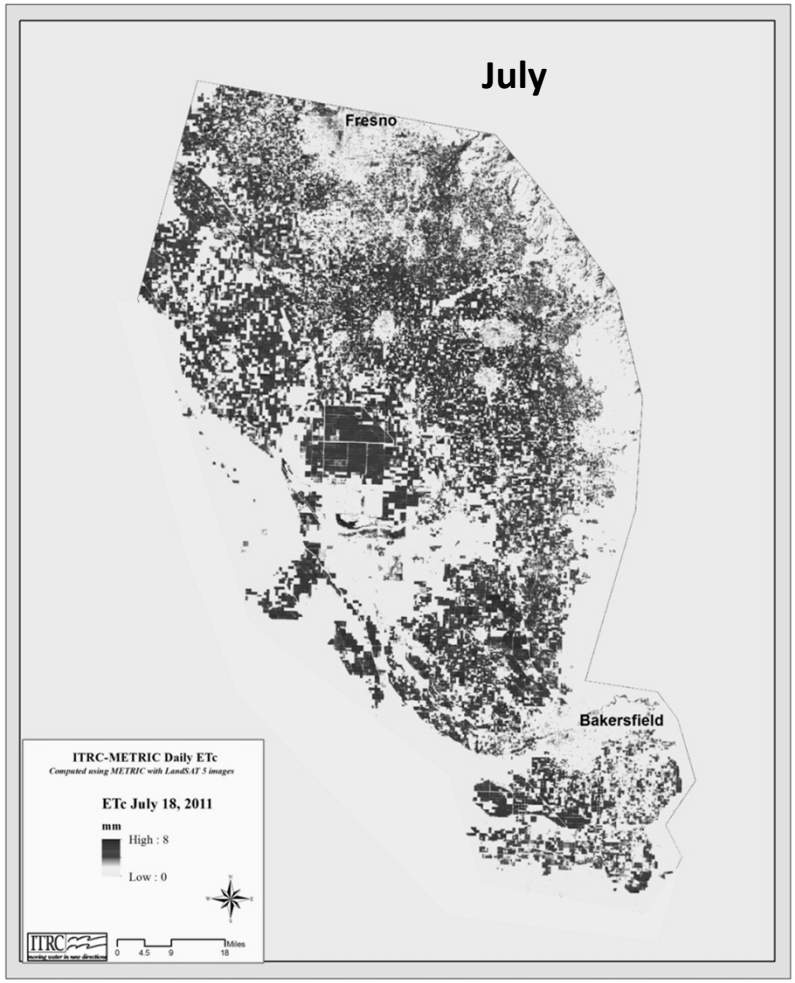
Instantaneous ETc images





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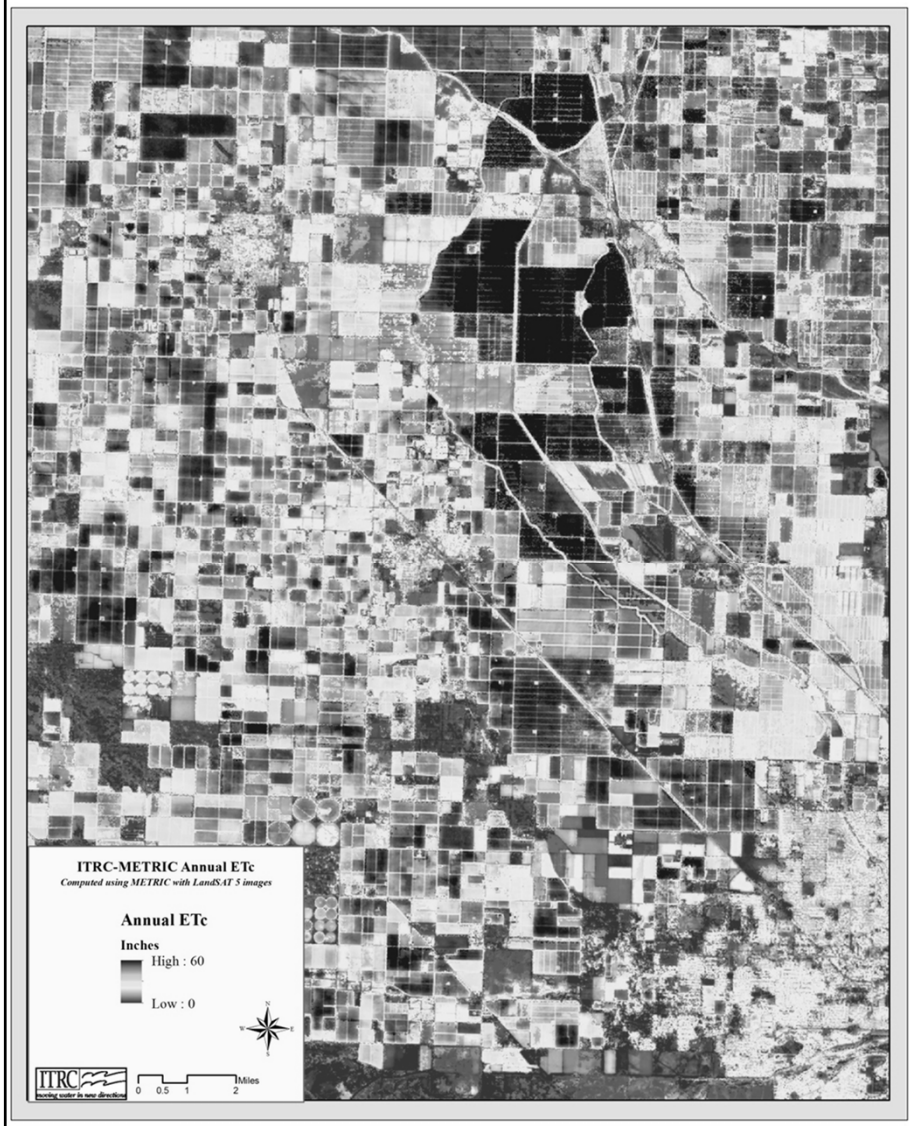
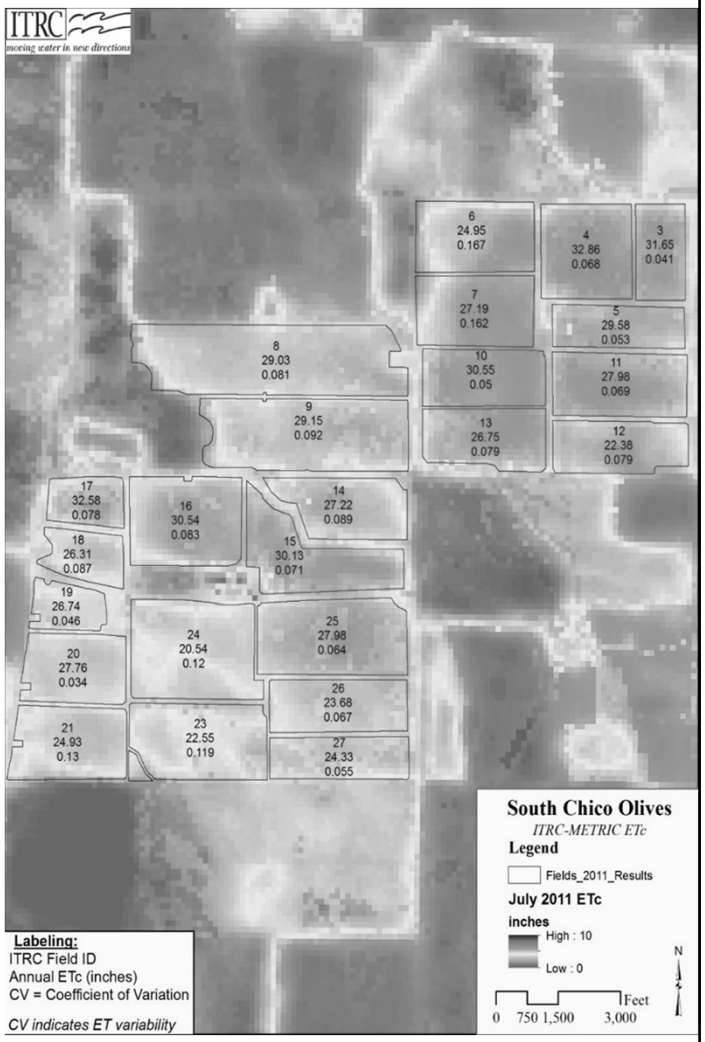

ITRC-METRIC Annual ETc
Computed using METRIC with LandSAT 5 images
Annual ETc
Inches
High : 60
Low : 0
N
W
E
S
ITRC
moving water in new directions
0 0.5 1 2
Miles


ITRC
moving water in new directions
6
24.95
0.167
4
32.86
0.068
3
31.65
0.041
7
27.19
0.162
5
29.58
0.053
8
29.03
0.081
10
30.55
0.05
11
27.98
0.069
9
29.15
0.092
13
26.75
0.079
12
22.38
0.079
17
32.58
0.078
16
30.54
0.083
14
27.22
0.089
18
26.31
0.087
15
30.13
0.071
19
26.74
0.046
24
20.54
0.12
25
27.98
0.064
20
27.76
0.034
26
23.68
0.067
21
24.93
0.13
23
22.55
0,119
27
24.33
0.055
Labeling:
ITRC Field ID
Annual ETc (inches)
CV = Coefficient of Variation
CV indicates ET variability
South Chico Olives
ITRC-METRIC ETc
Legend
Fields_2011_Results
July 2011 ETc
inches
High : 10
Low : 0
N
0 750 1,500 3,000
Feet

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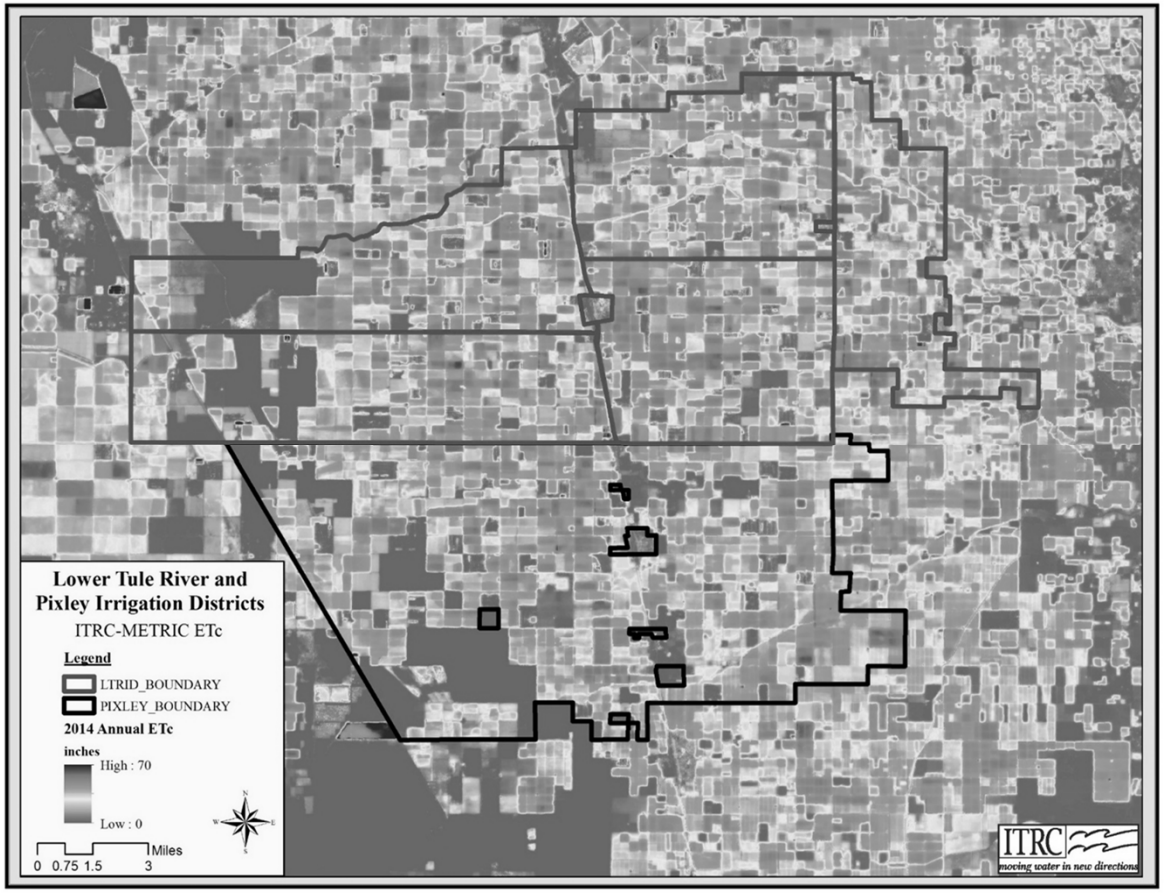
ITRC-METRIC – Remote Sensing of Actual Evapotranspiration



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Applied Surface Water

- Irrigation District delivery records by account
- Converted to deliveries by parcel/group of fields
- Result is surface water applied spatially over the region
- Generally not all parcels are accounted for in records
- Spread water out over the area by using a 1 mile grid (or smaller if possible) after water is incorporated into a parcels map

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NET to/from GW

1. Evaluate precipitation, surface applications, ET to update the SMD.
2. If at the end of the month, surface applications and precip exceed ET
   - **Deep Percolation (NET To GW)**
3. If ET is greater than surface applications
   - **Pumping (NET From GW)**

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Simplified Monthly Example

- ET is 6”
- Surface deliveries = 5”
- Runoff = 0”

- Net GW Pumping = 6”- 5”- 0” **= 1”**

- *Grower may have pumped 5”, but 4” would be lost to deep percolation (either surface or GW) back to aquifer. The net GW used is 1”*
- *It is a bit more complicated because we incorporate soil moisture change from the beginning of the month as well but this is the basic premise.*

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PRELIMINARY NTFGW Results

- Light to Dark Blue = Net TO GW
- Beige and Brown = Net FROM GW

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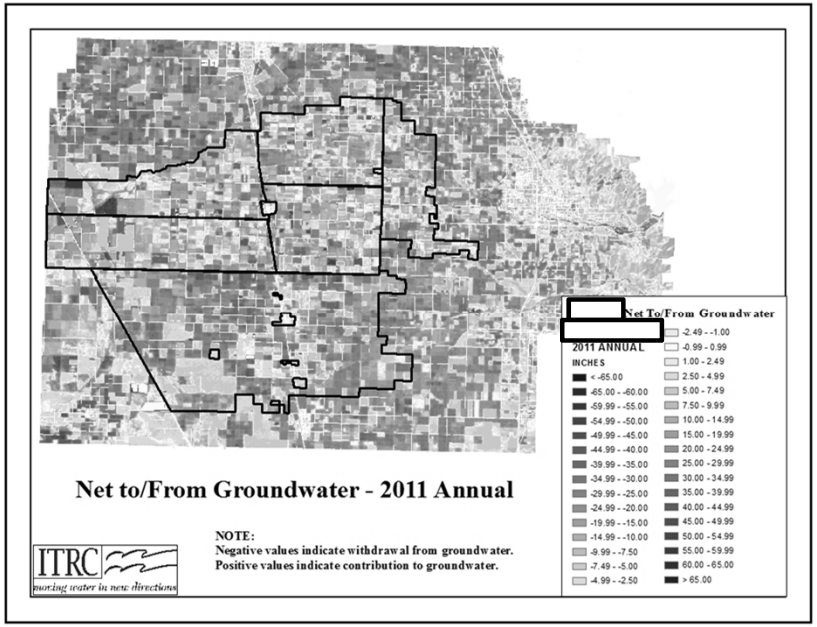
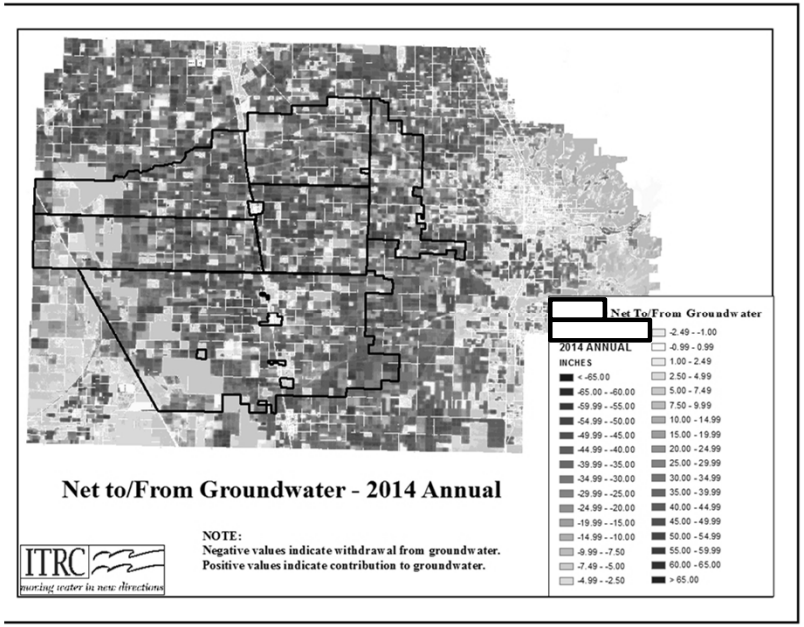
2011



2014



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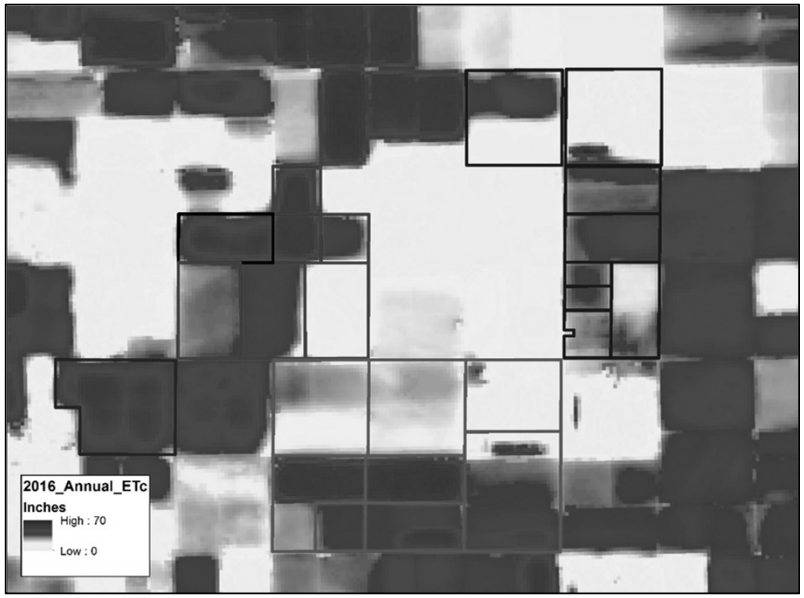
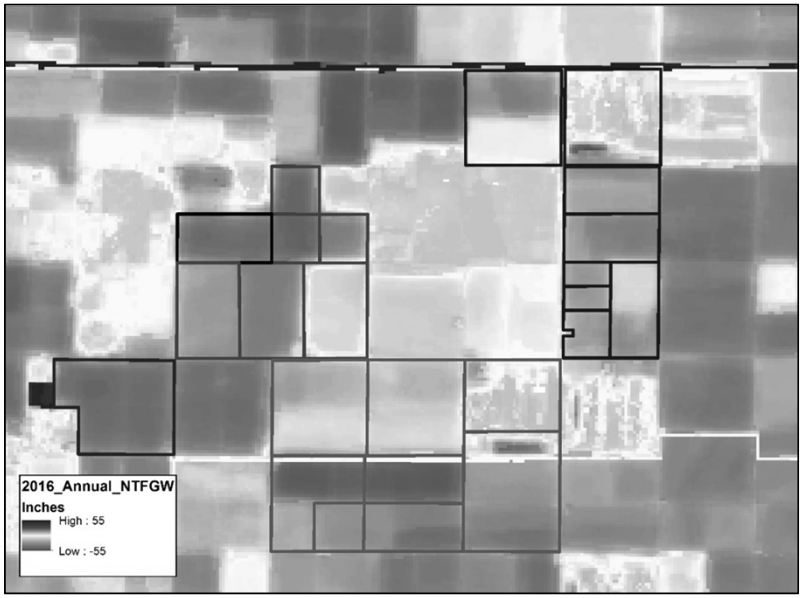
Tracking NTFGW on a Farm Basis

ITRC-METRIC ETc



NTFGW



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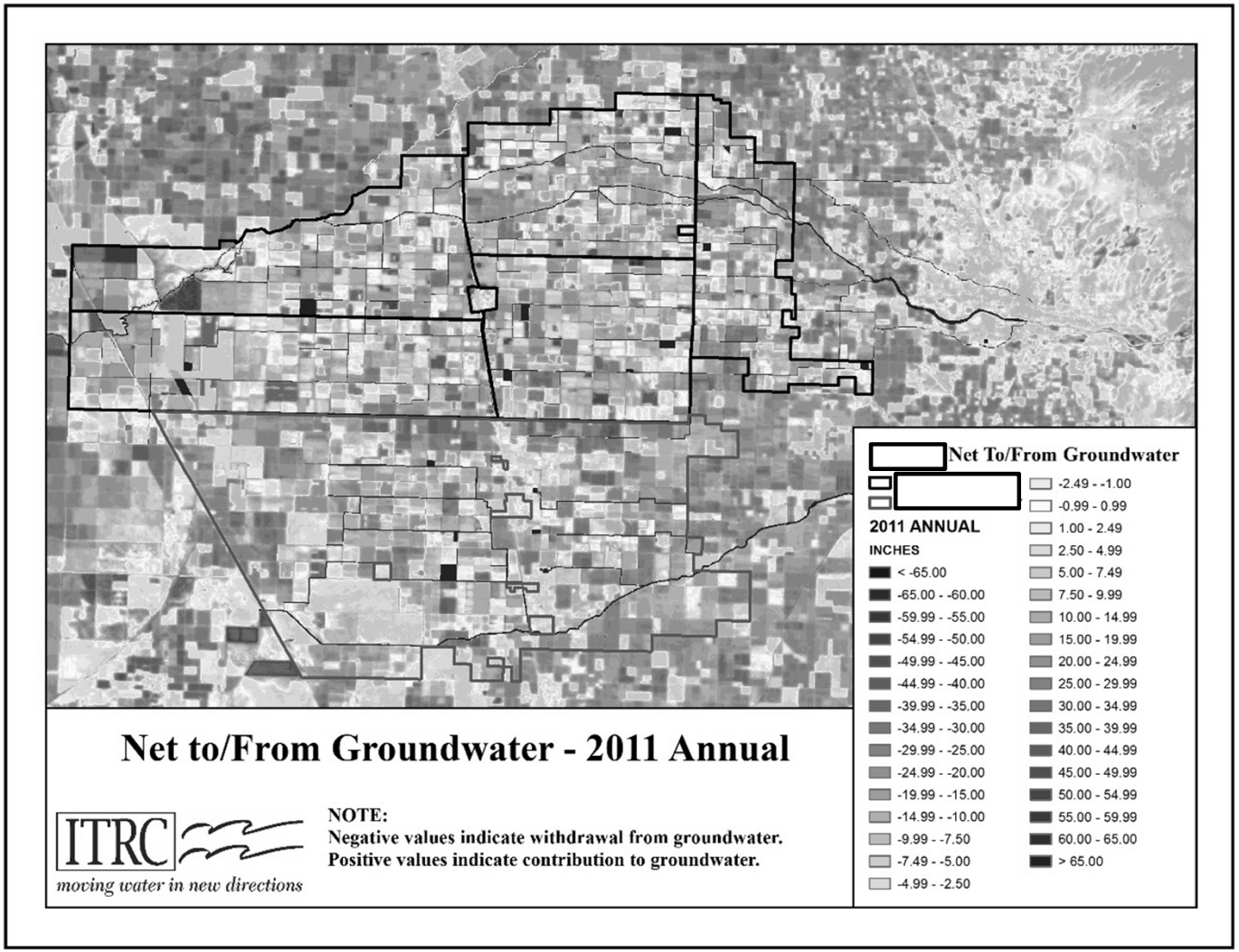
Net To/From Groundwater
2011 ANNUAL
INCHES
< -65.00
-65.00 - -60.00
-59.99 - -55.00
-54.99 - -50.00
-49.99 - -45.00
-44.99 - -40.00
-39.99 - -35.00
-34.99 - -30.00
-29.99 - -25.00
-24.99 - -20.00
-19.99 - -15.00
-14.99 - -10.00
-9.99 - -7.50
-7.49 - -5.00
-4.99 - -2.50
-2.49 - -1.00
-0.99 - 0.99
1.00 - 2.49
2.50 - 4.99
5.00 - 7.49
7.50 - 9.99
10.00 - 14.99
15.00 - 19.99
20.00 - 24.99
25.00 - 29.99
30.00 - 34.99
35.00 - 39.99
40.00 - 44.99
45.00 - 49.99
50.00 - 54.99
55.00 - 59.99
60.00 - 65.00
> 65.00
Net to/From Groundwater - 2011 Annual
ITRC
moving water in new directions
NOTE:
Negative values indicate withdrawal from groundwater.
Positive values indicate contribution to groundwater.

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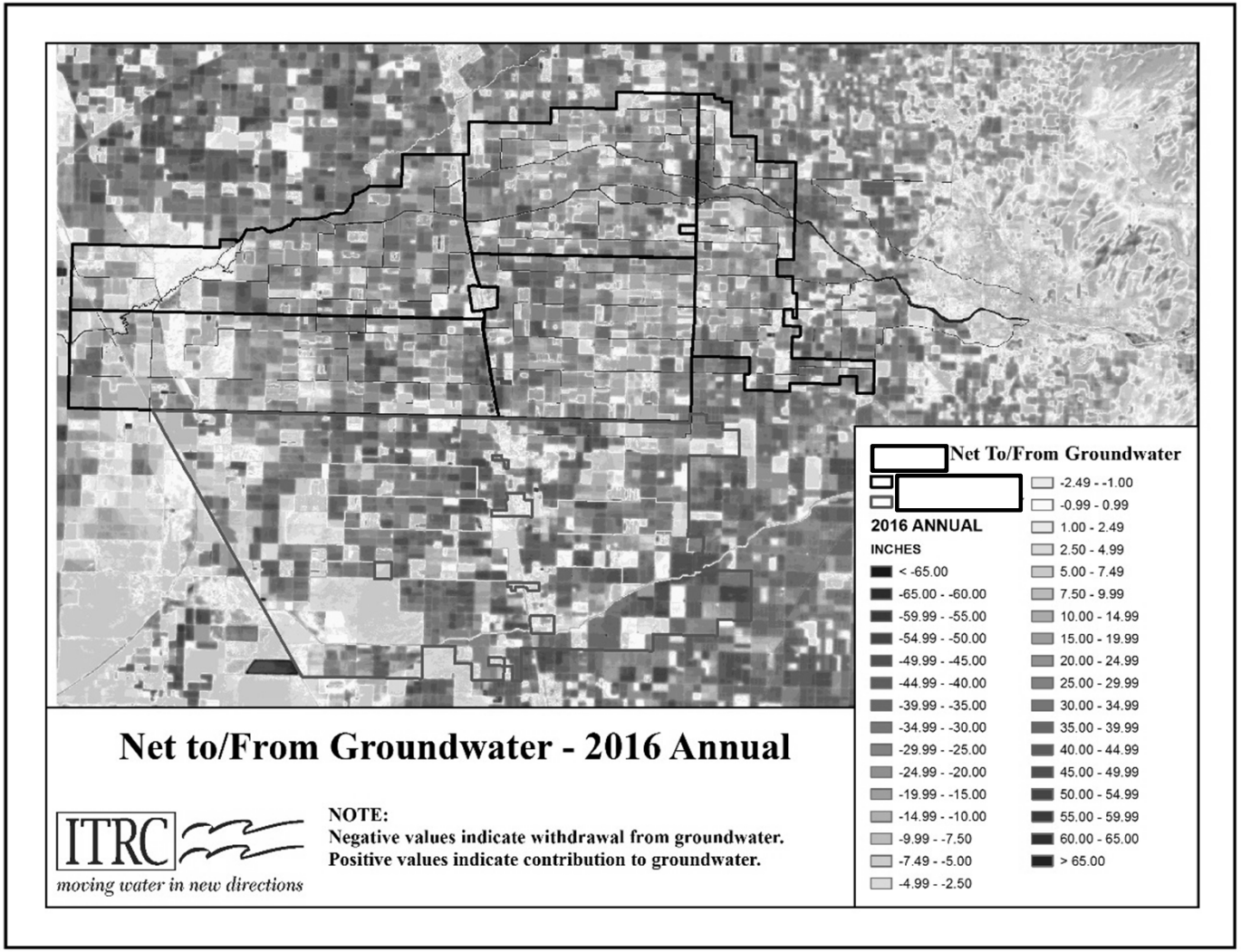
Net To/From Groundwater
2016 ANNUAL
INCHES
< -65.00
-65.00 - -60.00
-59.99 - -55.00
-54.99 - -50.00
-49.99 - -45.00
-44.99 - -40.00
-39.99 - -35.00
-34.99 - -30.00
-29.99 - -25.00
-24.99 - -20.00
-19.99 - -15.00
-14.99 - -10.00
-9.99 - -7.50
-7.49 - -5.00
-4.99 - -2.50
-2.49 - -1.00
-0.99 - 0.99
1.00 - 2.49
2.50 - 4.99
5.00 - 7.49
7.50 - 9.99
10.00 - 14.99
15.00 - 19.99
20.00 - 24.99
25.00 - 29.99
30.00 - 34.99
35.00 - 39.99
40.00 - 44.99
45.00 - 49.99
50.00 - 54.99
55.00 - 59.99
60.00 - 65.00
> 65.00
Net to/From Groundwater - 2016 Annual
ITRC
moving water in new directions
NOTE:
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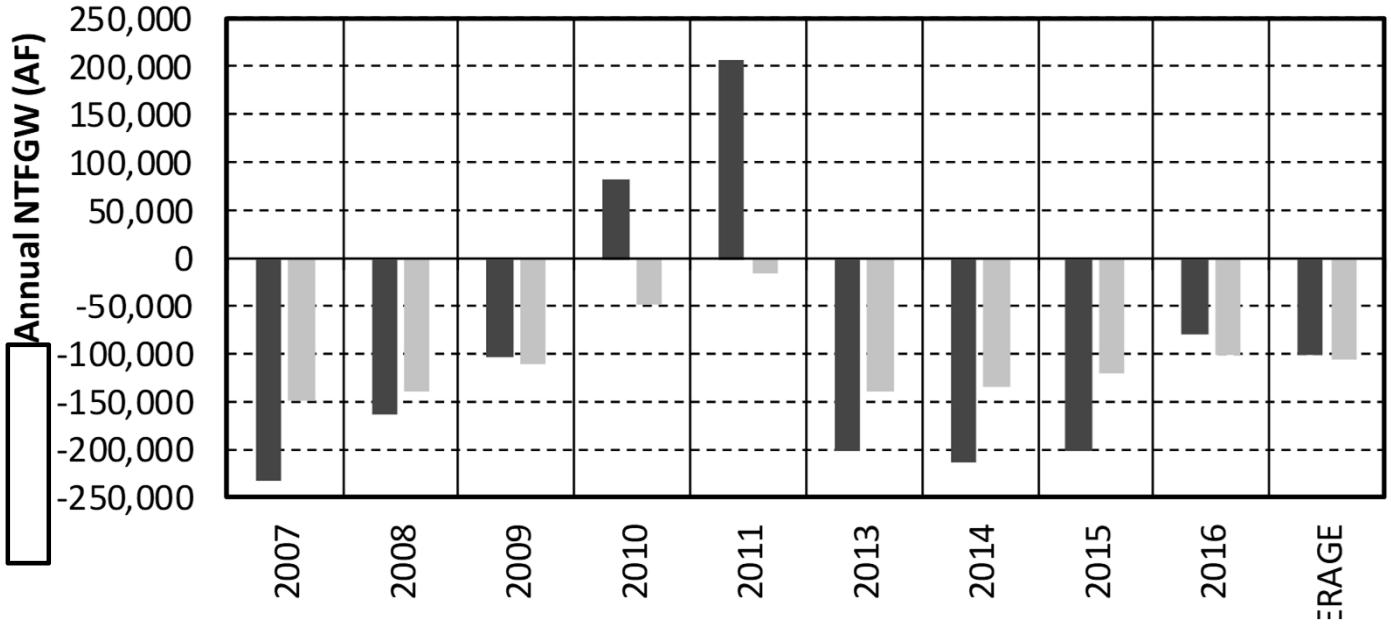
Annual NTFGW



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Why the need for NET GW use?

- Sustainable Yield is a NET value (no guessing at on-farm efficiency)
- GW sustainability has little to do with gross groundwater pumping
- GW use can be independently tracked and verified
- Historical and near real-time evaluations of conditions
- Variable Spatial Scales
  - Parcel level
  - GSA/District level

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Where could metering be required

- Extraction of GW within one basin for use in a different basin/subbasin
- In this case GROSS = NET because all of the water is moved out of the subbasin

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Proposal

1. Historic (10+ year) ETc and NTFGW
   - 2008-2018 excluding 2012 (~$100,000)
   - For use in groundwater models and for calibration

2. Continuous ETc and NTFGW – Individual GSA's or groups of GSA's
   - 2019 and into the future (cost depends on # of GSA's)

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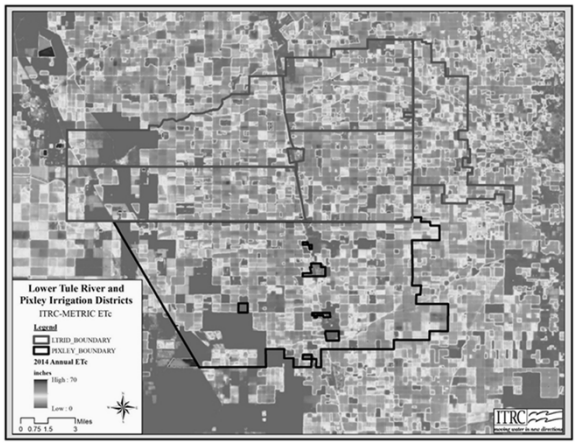
ITRC-METRIC and NTFGW
Information that will be provided

- Current and Historic ETc
- Net GW Use (both GIS)
- Reduction in ETc to become sustainable



- Net recharge
- Tracking month to month GW use/recharge for individual farms, districts, and GSA's
- And more

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Thank You

- Questions?

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