

Mapping Evapotranspiration

Tools and Tips for processing ET rasters

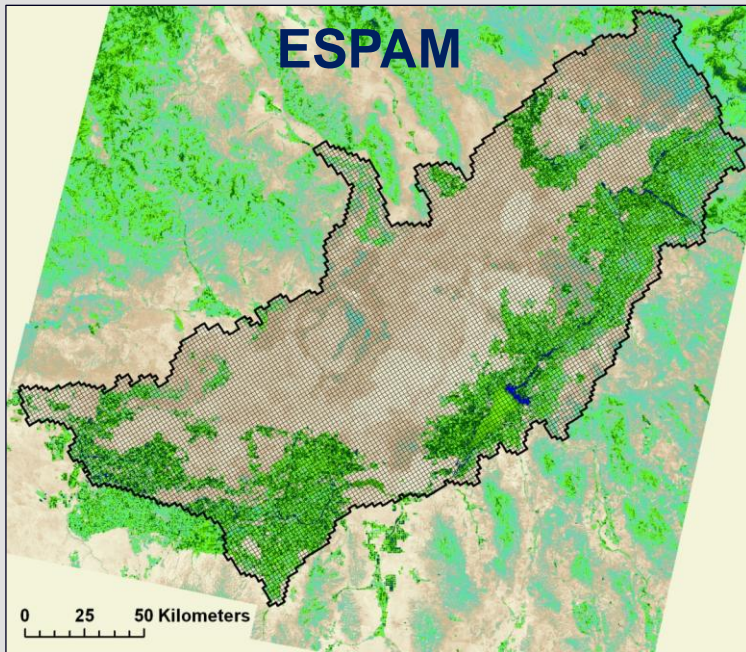
William J. Kramber
Idaho Department of Water Resources

Remote Sensing of ET Workshop, Boise, Idaho, October 26, 2012

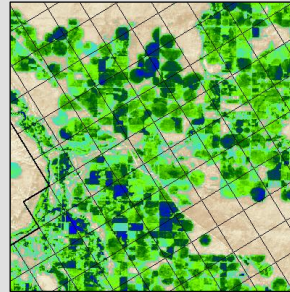
Tools and Tips

- Zonal Statistics as Table
- New ET Map Server
- Tracking METRIC Processing
- Mosaic ET rasters

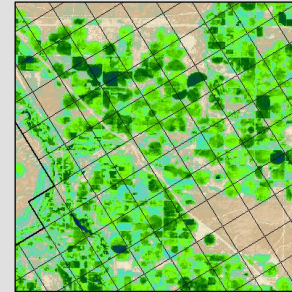
ET by Model Cell



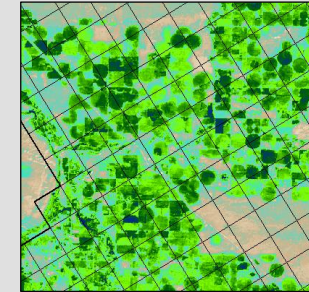
2000



2002

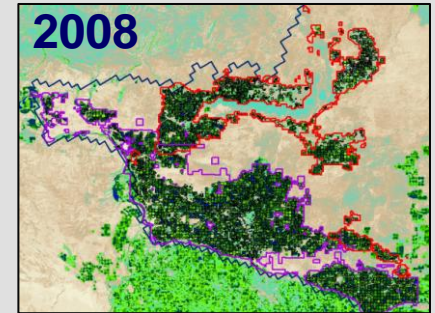
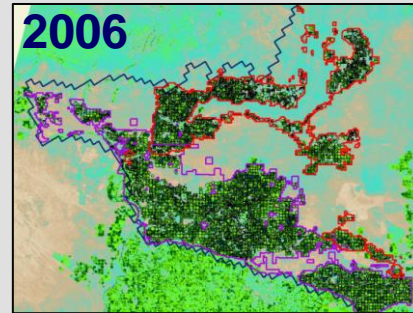
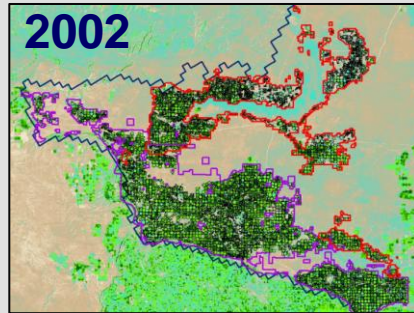
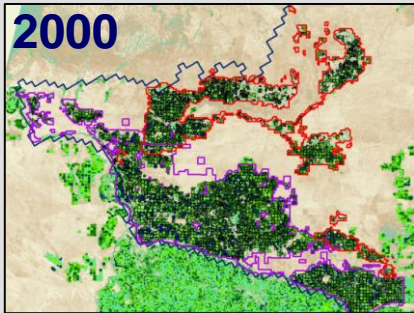


2006

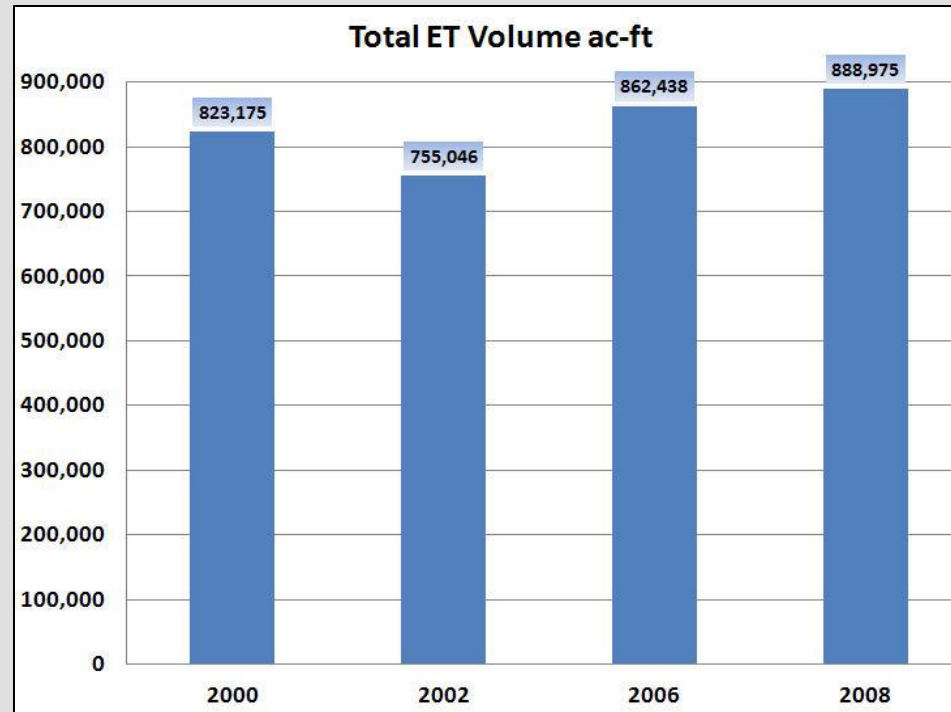


Cell ID	Source	Acres	Mean ET (mm)		
			2000	2002	2006
SP022011	Surface water	105	574	601	782
SP022013	Surface water	59	593	568	552
SP022111	Mixed	122	741	632	791
SP022112	Mixed	388	727	736	704
SP022113	Mixed	350	619	715	739
SP022114	Mixed	73	646	814	738
SP022163	Mixed	369	785	749	867
SP022164	Ground water	12	755	765	840
SP022165	Ground water	227	942	757	782
SP022170	Mixed	81	529	671	879
SP022171	Surface water	69	508	700	714
SP022172	Surface water	45	560	657	771
SP022196	Surface water	320	460	512	567
SP022197	Mixed	51	309	538	465
SP022197	Surface water	505	413	548	581
SP022198	Surface water	546	515	637	654
SP022199	Surface water	632	647	673	713
SP022200	Surface water	428	465	555	592

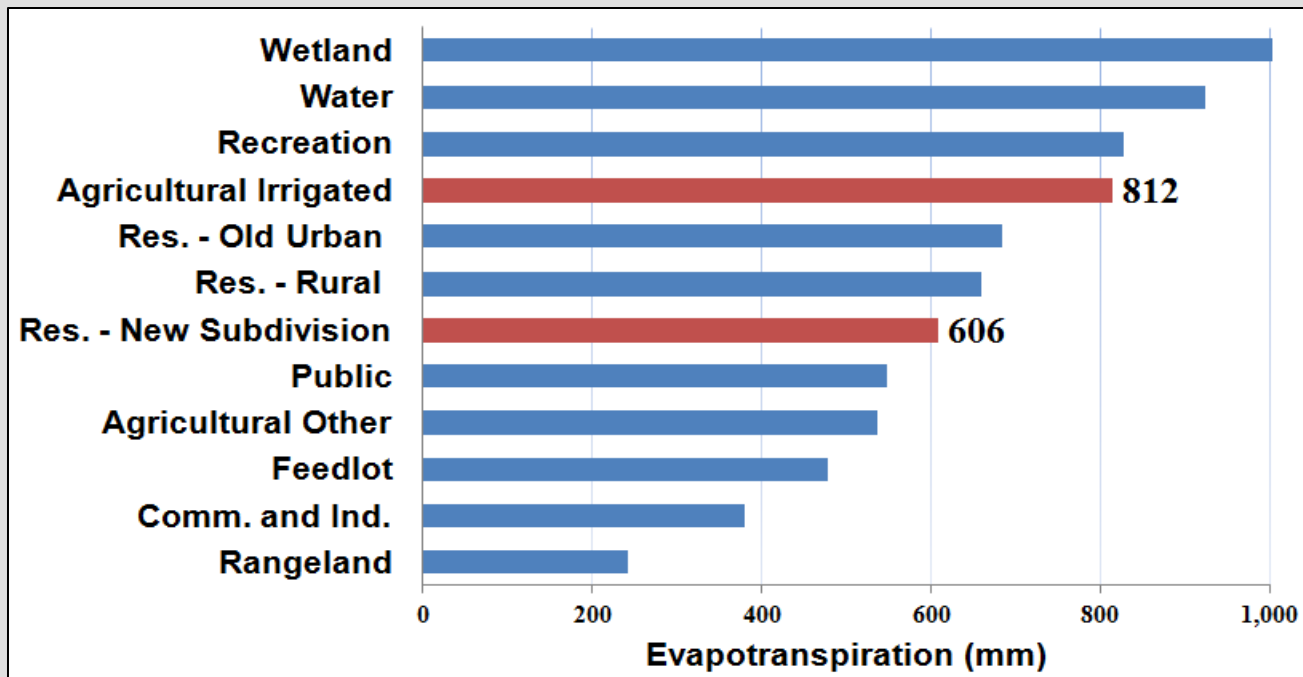
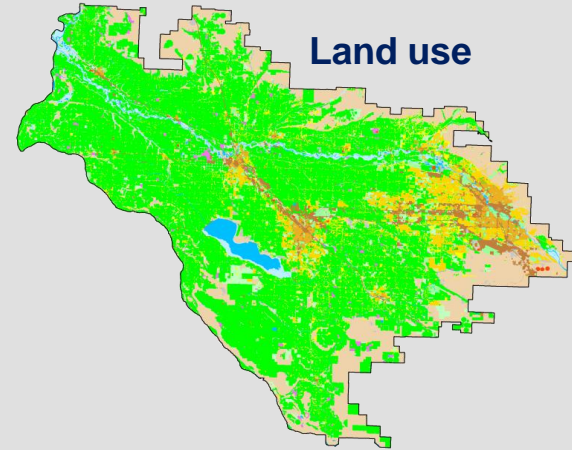
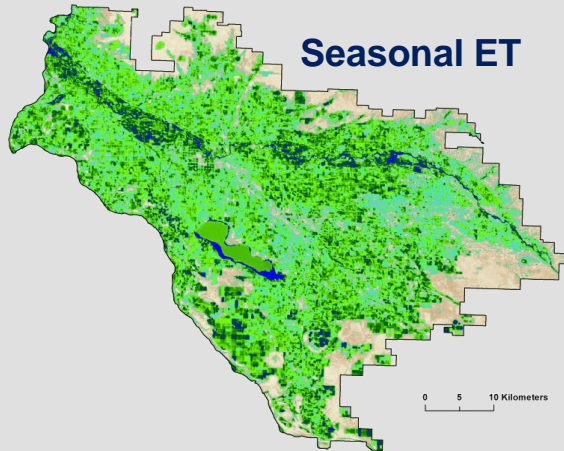
ET by Irrigation Entity



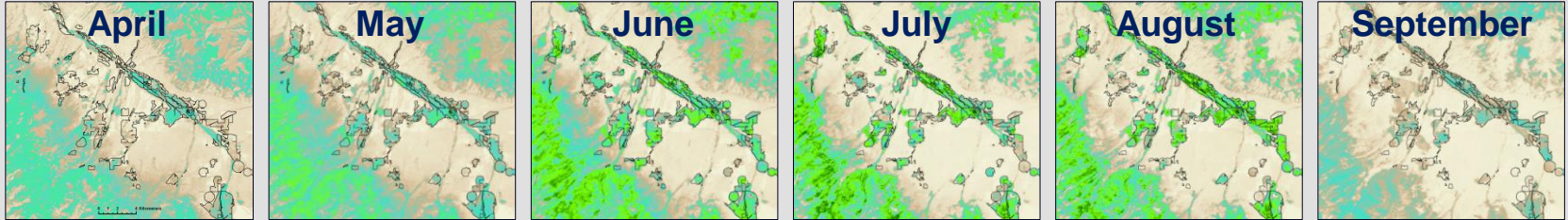
METRIC ET for Irrigated Land by Irrigation Entity				
Irrigation Entity	Mean ET mm	Acres	ET Volume ac-ft	ET ac-ft/acre
2000				
American Falls Reservoir Dist #2	815	86,932	232,592	2.68
North Side Canal Co LTD	859	204,558	576,611	2.82
Irrigation Entities Overlap Area	828	5,146	13,971	2.72
Total		296,636	823,175	2.78
2002				
American Falls Reservoir Dist #2	657	97,590	210,332	2.16
North Side Canal Co LTD	768	210,827	530,939	2.52
Irrigation Entities Overlap Area	779	5,389	13,775	2.56
Total		313,805	755,046	2.41
2006				
American Falls Reservoir Dist #2	796	100,004	261,306	2.61
North Side Canal Co LTD	831	215,011	586,337	2.73
Irrigation Entities Overlap Area	837	5,385	14,795	2.75
Total		320,399	862,438	2.69
2008				
American Falls Reservoir Dist #2	843	91,441	252,816	2.76
North Side Canal Co LTD	915	206,796	620,615	3.00
Irrigation Entities Overlap Area	927	5,109	15,545	3.04
Total		303,346	888,975	2.93



ET by Land Use

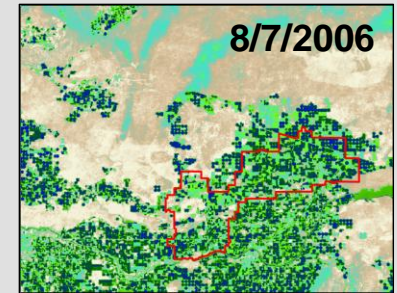
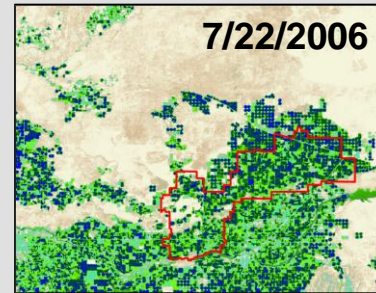
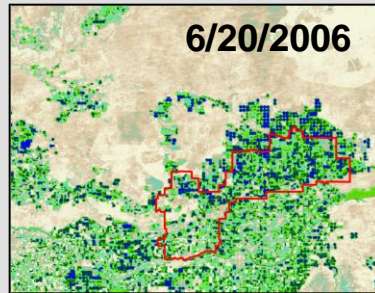
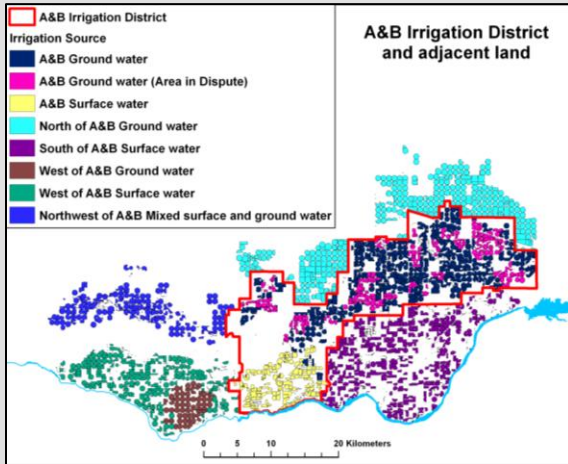


ET by Water Right

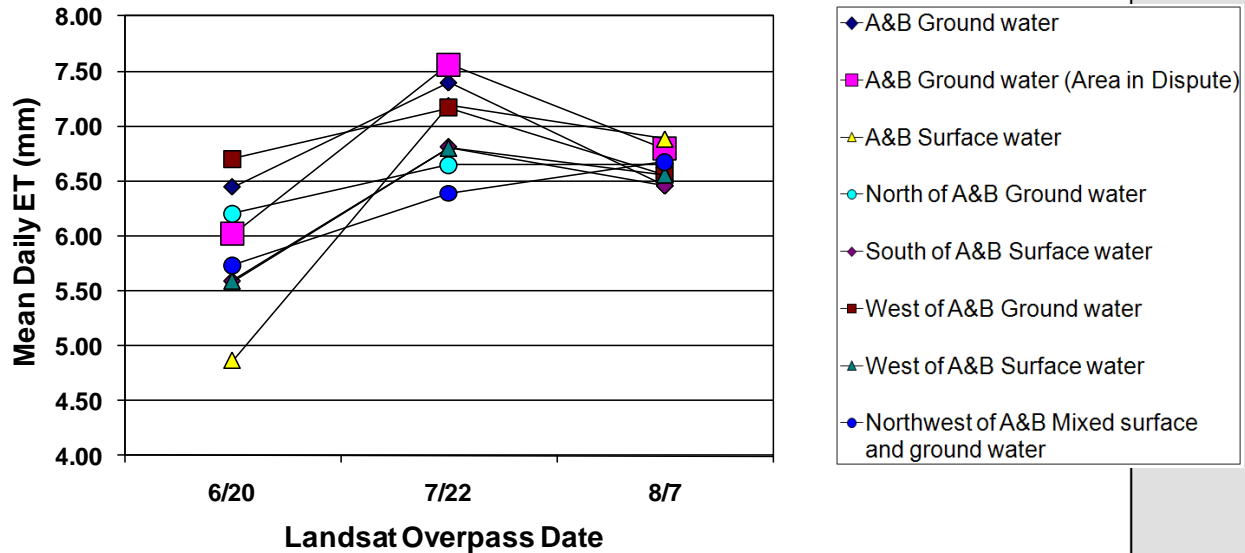


Water Right	Acres	Mean ET (mm)	ET acre-feet
74-1008	83	297	81
74-1016	41	506	68
74-1030	24	332	26
74-1036	51	350	59
74-1058	51	629	105
74-1061	14	736	34
74-1083	22	490	36
74-1103	53	599	104
74-1106	198	343	223
74-1114	42	422	59
74-1140	27	960	85

ET by fields



Year 2006: Mean Daily Evapotranspiration (ET)



Zonal Statistics as Table

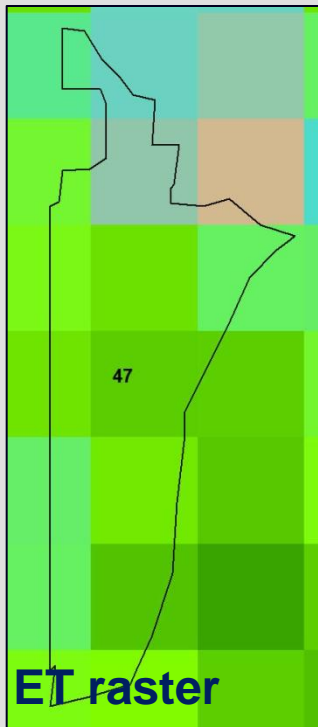
ET statistics by zones

- Zones
 - Water rights
 - Model cells
 - Land use classes
- Converts zones to raster
 - You can control cell size
 - Set Snap Raster
- Be careful with small zones

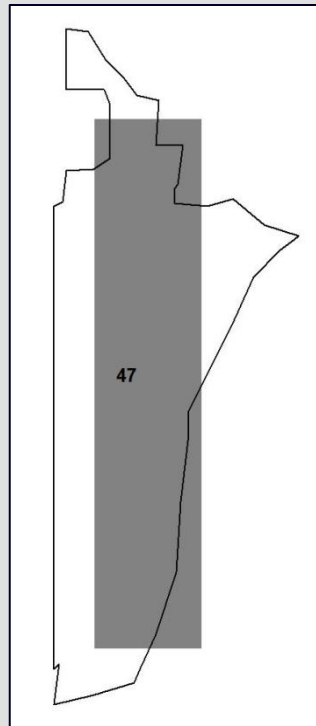
Zonal Statistics as Table

Converts polygon zones to raster
Default cell size is ET raster cell size

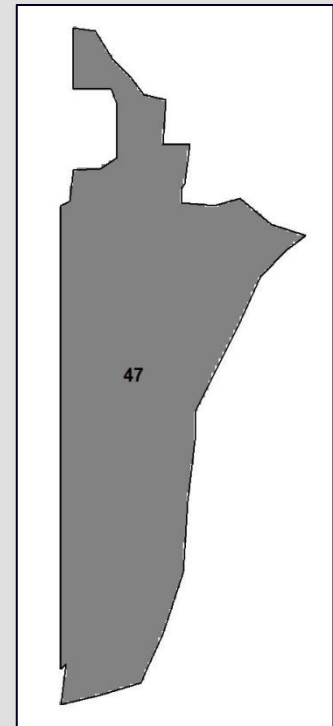
Original polygon
1.62 acres



Default 30 meter cells
1.11 acres
Mean ET: 171.60 mm
ET ac-ft: 0.63



1 meter cells
1.63 acres
Mean ET: 166.16 mm
ET ac-ft: 0.89



ET Map Server

In development

- Search for ET data
 - Date, County, Basin, Irrigation Company, Landsat scene
- ET Statistics
 - Water rights
 - Irrigation companies

Search For Evapotranspiration Data Sets

Choose a search method below.

▶ [Date](#)

▶ [County](#)

▶ [Administrative Basin](#)

▼ [Irrigation Company](#)

Choose an Irrigation Company to search in. Not all Irrigation Companies have ET data associated with them.
Choose Irrigation Company

TWIN FALLS CANAL CO ▼

Search

▶ [Landsat](#)

▶ [Browse All ET Data](#)

Name	Date	Location	Action
Path 39 - 40 - April 1996	4/1/1996	Path 3940	ET Statistics Show On Map
Path 39 - 40 - May 1996	5/1/1996	Path 3940	ET Statistics Show On Map
Path 39 - 40 - June 1996	6/1/1996	Path 3940	ET Statistics Show On Map
Path 39 - 40 - July 1996	7/1/1996	Path 3940	ET Statistics Show On Map
Path 39 - 40 - August 1996	8/1/1996	Path 3940	ET Statistics Show On Map
Path 39 - 40 - September 1996	9/1/1996	Path 3940	ET Statistics Show On Map
Path 39 - 40 - October 1996	10/1/1996	Path 3940	ET Statistics Show On Map

Path 39 - 40 - August 2006

Data Date: August 2006

File: p3940_200608_et.img [Download Dataset](#)

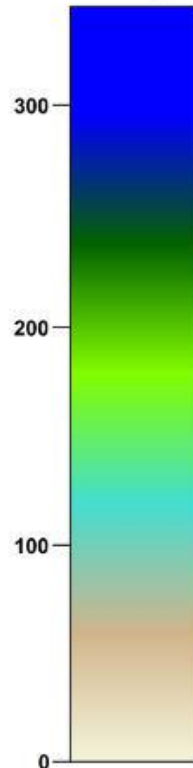
Data Area: Path 3940

Zoom In Zoom Out Pan Draw Polygon Zoom To ET Layer Full Extent Identify

[Change Background](#)



Evapotranspiration
(in millimeters)
Monthly



ET Statistics

Irrigation Entities

No Irrigation Entity Selected

[ET Statistics For Irrigation Entity](#)

Water Rights

Water Right

36 - 2141

[Search](#)

Found The Following Water Uses Eligible For ET Statistics For 36-2141 (RightID 421575)

IRRIGATION

[ET Statistics For Water Right](#)

Results of ET Statistics

ET Statistics	Value
Water Right Number 36-2141	
ET Dataset	p3940_200608_et.img
AREA	631800
MIN	9
MAX	162
RANGE	153
MEAN	87.3
STD	21

[Save as CSV File](#)

Tracking METRIC Processing

- Worksheet
- Batch commands

Tracking Worksheet

METRIC ESPA 1986 Path 40 South																	
	Sat	Date	DoY	m001	m01	Select CH	m02	m011	m012	Rerun m02	Sharpen Ts_dem, Ts	Rerun m011	Rerun m012	Rerun m02	m03	m10	Cloud masking
1	L5	3/25	84	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		4/1	91	Synthetic (use for 3/31 and 4/1)													synthetic
2	L5	4/10	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x
3	L5	4/26	116	x	x	x	x	x	x	x	x	x	x	x	x	x	x
4	L5	5/12	132	x	x	x	x	x	x	x	x	x	x	x	x	x	x
5	L5	5/28	148	x	x	x	x	x	x	x	x	x	x	x	x	x	no clouds
6	L5	6/13	164	x	x	x	x	x	x	x	x	x	x	x	x	x	x
7	L5	6/29	180	x	x	x	x	x	x	x	x	x	x	x	x	x	x
8	L5	7/31	212	x	x	x	x	x	x	x	x	x	x	x	x	x	no clouds
9	L5	9/1	244	x	x	x	x	x	x	x	x	x	x	x	x	x	x
10	L5	9/17	260	x	x	x	x	x	x	x	x	x	x	x	x	x	x
11	L5	10/3	276	x	x	x	x	x	x	x	x	x	x	x	x	x	x
12	L5	11/4	308	x	x	x	x	x	x	x	x	x	x	x	x	x	x

METRIC ESPA 1986 Path 39																	
	Sat	Date	DoY	m001	m01	Select CH	m02	m011	m012	Rerun m02	Sharpen Ts_dem, Ts	Rerun m011	Rerun m012	Rerun m02	m03	m10	Cloud masking
1	L5	4/3	93	x	x	x	x	x	x	x	x	x	x	x	x	x	x
2	L5	4/19	109	x	x	x	x	x	x	x	x	x	x	x	x	x	x
3	L5	5/5	125	too cloudy													
4	L5	6/6	157	x	x	x	x	x	x	x	x	x	x	x	x	x	x
5	L5	6/22	173	x	x	x	x	x	x	x	x	x	x	x	x	x	x
6	L5	8/9	221	x	x	x	x	x	x	x	x	x	x	x	x	x	x
7	L5	9/10	253	x	x	x	x	x	x	x	x	x	x	x	x	x	x
8	L5	10/12	285	x	x	x	x	x	x	x	x	x	x	x	x	x	no clouds

Notes: 1) m002 and m003 were run statewide. 2) The cloud mask images were developed before selecting the cold and hot pixels but the cloud masking is done last.
3) For m02, leave E70 (Metric model constants) at 0 for first run; but you may need to change E70 to 1 for the 2nd and 3rd runs of m02.

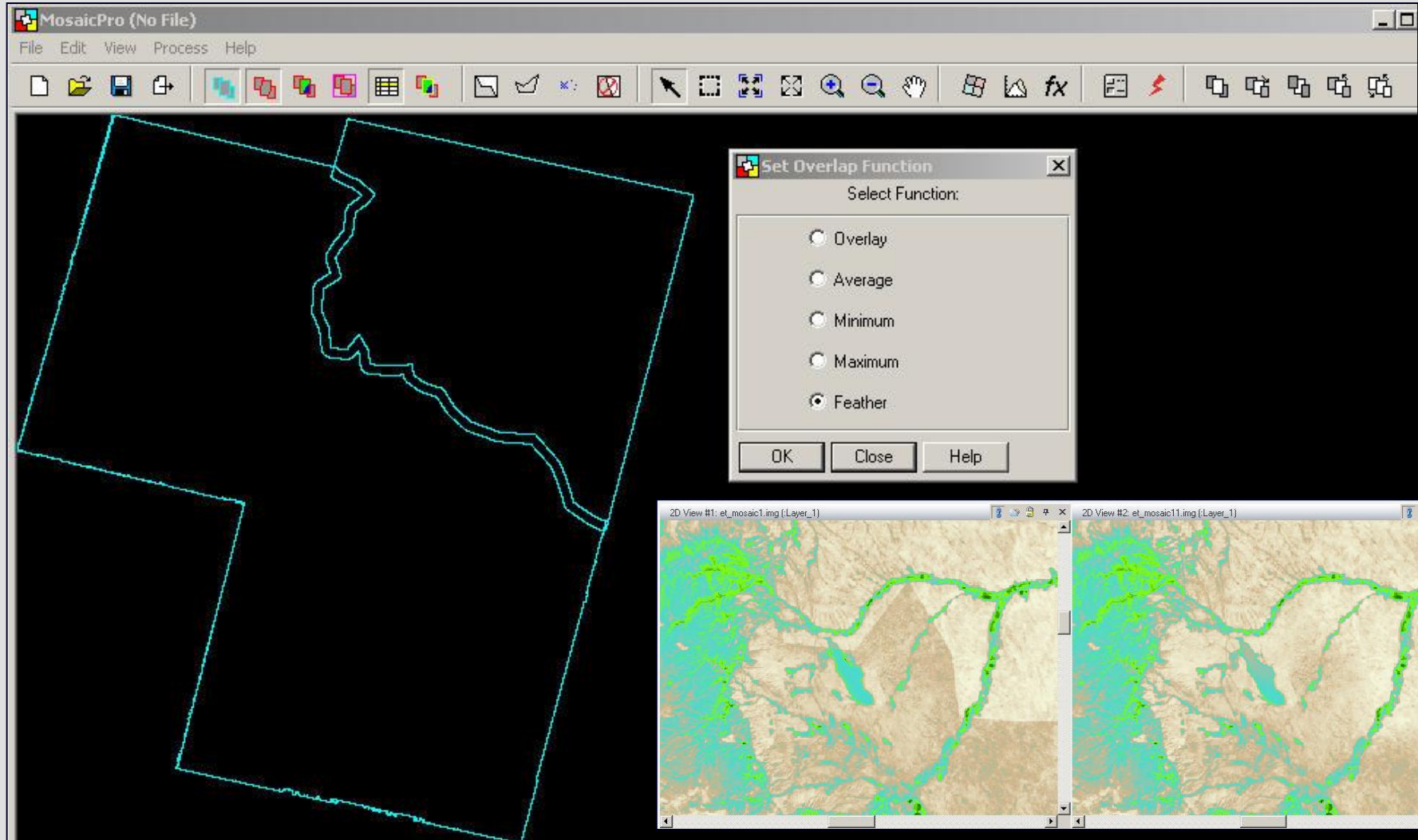
Model Sequence (from Rick Allen)

- Run m001 and m01.
- Select cold pixel, enter data for cold pixel onto "dT function" sheet
- If the toggle on "Metric model constants" sheet, cell E63 is set on, run m011.
- Run m012.
- 5a. Calibrate. Select hot pixel, enter data onto "dT function" sheet and run m02 (perhaps several times) until the final cold and hot pixels are selected.
Use the VBPopulator to populate all models through m02.
- 5b. When the calibration has 'stabilized' and is final, Rerun m011, m012 and m02.
- Sharpen Ts_dem.img.
Enter the names of the sharpened Ts.img and the sharpened Ts_dem.img into Model_docum sheet, cells D58 and D59 and repopulate m011 and m012.
- ReRun m011, m012. (the hot and cold pixel should not need reselecting, provide they were in a large enough uniform context to not be modified by sharpening)
- Rerun m02 for the final time using the sharpened Ts.img, Ts_terrain.img, Ts_TallVeg.img, and Ts_dem_TallVeg.img images.
- Run m03 to adjust ETrF for nonag.
- Cloud gap fill etrf24.img output from m03. But develop cloud mask before selecting Cold and Hot pixels because the mask is used in the process.
Need ETrF for water for each image date using etrf_water_forcloudmasking.gmd--this value will be assigned to water during the cloud masking.
- Create synthetic images.
- Compute Daily ETrF and ET images using spline and ET production models.
- Compute Monthly ET images from daily images.
- Mosaic p39 and p40 monthly ET images.
- Produce Seasonal ET image by adding monthly mosaicked ET images.

6. Sharpen Ts_dem.img

- Arc Clip (3x)
- Arc Block Statistics (4x)
- ERDAS s1_water_flag.gmd
- ERDAS s2_aoi_and_thermal_regions.gmd
- ArcThermal Sharpen Tool (4x)
- ERDAS s3_average_ts_dem.gmd
- ERDAS s4_ts_sharpen.gmd

Mosaic ET Rasters



Order	Ref.	Vis.	Image Name	Area	Resample	RMS	Online	Exclude Areas	Illumination Equalized	Image Dodged	Color Balanced	Histogram t
1	✓		e:/metric/feather/et_east_masked.img	Active	NN	0.0000	✓					
2			e:/metric/feather/et_west.img	Active	NN	0.0000	✓					

Demo

- Zonal Statistics as Table
- ET Map Server