ACTUAL EVAPOTRANSPIRATION ANALYSIS
August 2021

Prepared for

Eastern Tule Groundwater Sustainability Agency

Prepared by

LAND IQ

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INTRODUCTION

The Eastern Tule Groundwater Sustainability Agency (ETGSA) has partnered with Land IQ to develop spatial datasets of monthly actual evapotranspiration (ETa) within its district boundaries. In this analysis, remotely sensed data from satellites are calibrated against in-situ measurements from ground-based climate stations to create a spatially continuous map of ETa within ETGSA for the month.

ANALYSIS

Consumptive use analysis is done in in two main parts:

1. Ground truthing measurements and calibration
2. Remotely sensed analysis and summarization

GROUND TRUTHING

Table 1 shows stations that were active and used in the ET model, and Table 2 shows the daily precipitation totals for the month measured by Land IQ stations and California Department of Water Resources CIMIS stations. A current map of the stations showing all locations along with the crop distribution across the district (Figure 1) demonstrates the variety of calibration data available for model building. The precipitation for the entire area is shown in Figure 2.

TABLE 1. SENSORS USED IN DAILY AND MONTHLY ETA ANALYSIS BY CROP CATEGORY

	Number of Active Stations	Number of Used Stations in Model
Alfalfa	10	10
Almonds	23	15
Annuals	3	1
Citrus	14	13
Fallow/Native	6	5
Grapes	12	8
Olives	1	1
Pistachios	11	8
Pomegranates	1	1
Walnuts	1	0

TABLE 2. PRECIPITATION MEASURED BY FIELD STATIONS.

Station ID	Source	August Precipitation (in)
ET_Full_Murcotts	LIQ	0
ET_Full_Fallow	LIQ	0
CIMIS #205: Coalinga	CIMIS	0
CIMIS #5: Shafter	CIMIS	0
CIMIS #15: Stratford	CIMIS	0
CIMIS #54: Blackwells Corner (westside)	CIMIS	0
CIMIS #2: FivePoints	CIMIS	0
CIMIS #146: Belridge	CIMIS	0
CIMIS #39: Parlier	CIMIS	0
CIMIS #105: Westlands	CIMIS	0
CIMIS # 80: Fresno State	CIMIS	0
CIMIS #182: Delano	CIMIS	0
CIMIS #169: Porterville	CIMIS	0
CNGC1	CNRFC	0
FTNC1	CNRFC	0
KTLC1	CNRFC	0
MDRC1	CNRFC	0
PNOC1	CNRFC	0
PRTC1	CNRFC	0
SCSC1	CNRFC	0
USW00023155	GHCN	0
USW00093193	GHCN	0
USW00053119	GHCN	0
USC00044890	GHCN	0
USW00023110	GHCN	0
USC00049367	GHCN	0

CIMIS - California Irrigation Management Information System; CNRFC - California Nevada River Forecast Center; GHCN - Global Historical Climate Network.

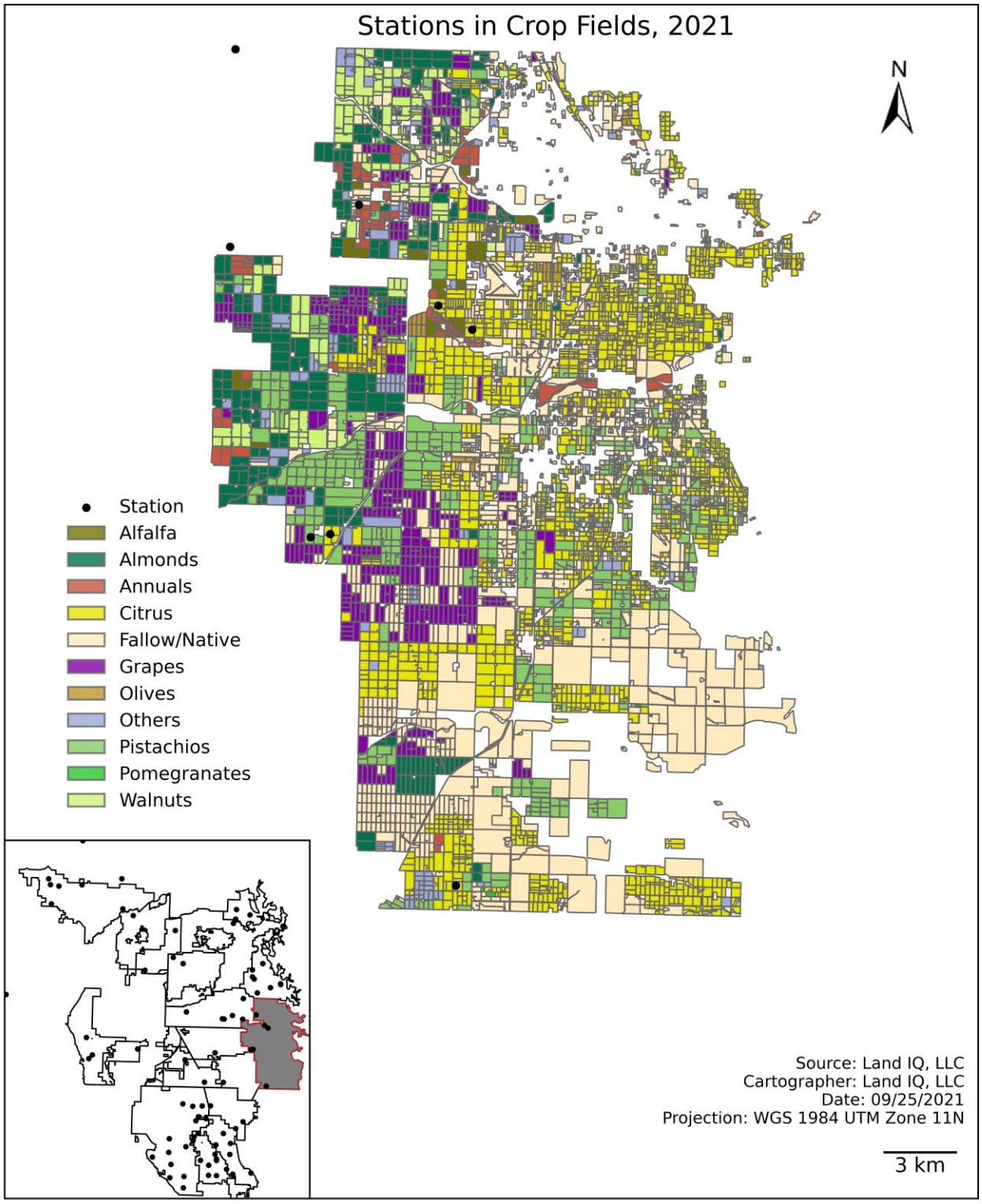

FIGURE 1. MAP OF CROP DISTRIBUTION AND STATION LOCATIONS

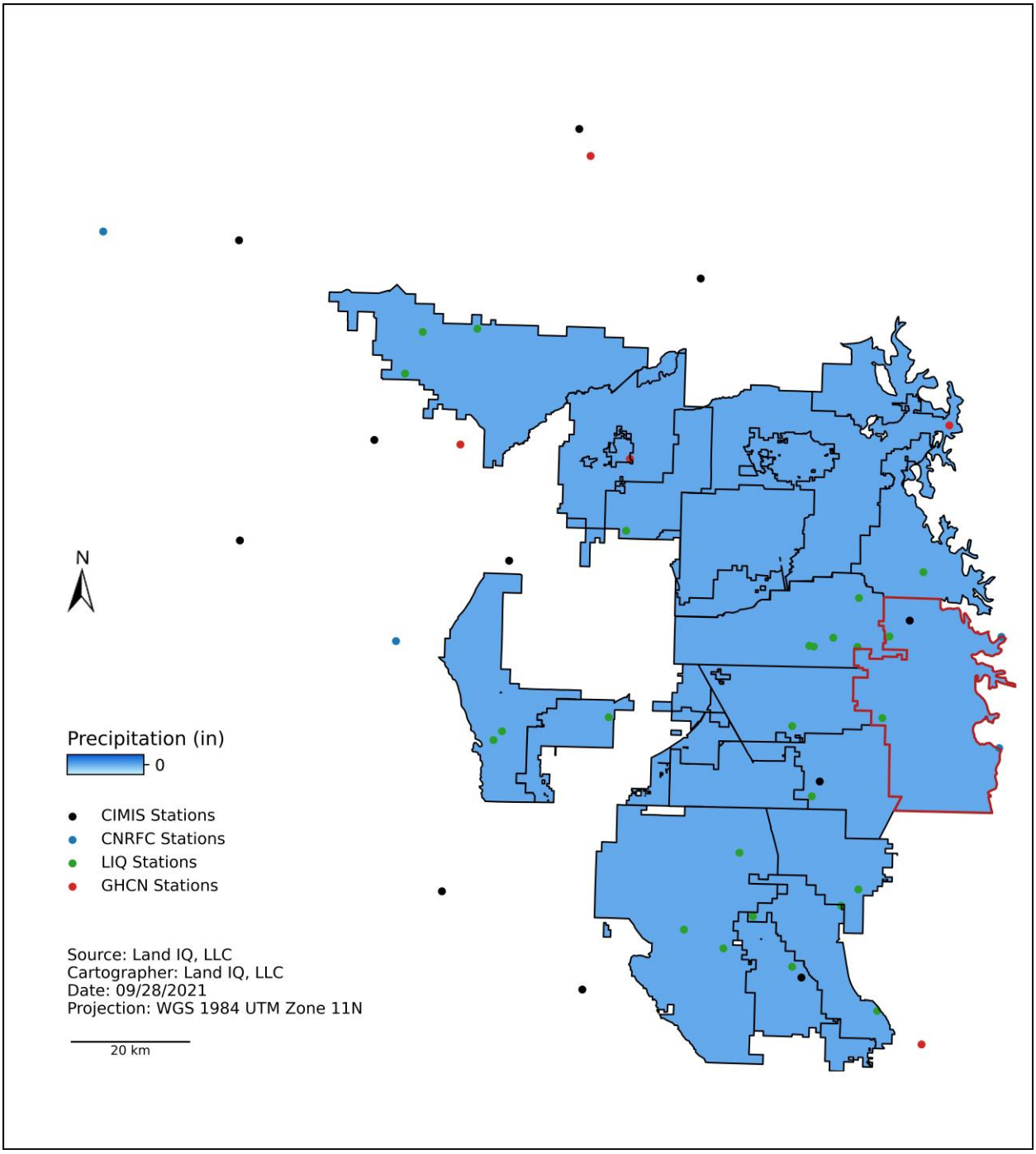

FIGURE 2. PRECIPITATION DURING THE MONTH WITHIN THE ENTIRE ANALYSIS AREA

REMOTE SENSING RESULTS

For this specific analysis, the image analysis dates and sources are shown in Table 3. Other imagery could not be used in the analysis because of cloud cover on the overpass dates. The ETa image is shown in Figure 4 (at the end of this report). Monthly district-wide ETa for the entire 161,257 acres, including depth and volume, is shown in Table 4, and the monthly ETa by field is shown in Table 5. Monthly district-wide precipitation generated from kriging interpolation is shown in Table 6.

TABLE 3. IMAGE DATES AND SOURCES

Date	Image Source
August 04, 2021	Sentinel 2
August 09, 2021	Sentinel 2
August 14, 2021	Sentinel 2
August 14, 2021	Landsat 8
August 29, 2021	Sentinel 2
August 30, 2021	Landsat 8

TABLE 4. MONTHLY DISTRICT ET_A

Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
(mm)	16.9	17.8	36.9	53.6	72.0	87.5	89.2	72.6
(in)	0.7	0.7	1.5	2.1	2.8	3.4	3.5	2.9
(AF)	8,936	9,400	19,535	28,376	38,115	46,309	47,193	38,408

TABLE 5. MONTHLY FIELD ET_A

		ETa (in)							
	Field Size (ac)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
Maximum	814.6	1.6	2.2	3.8	5.4	7.9	8.8	8.1	7.7
Minimum	0.1	0.3	0	0.5	0.4	0.4	0.5	0	0
Average	19.1	0.8	0.9	1.6	2.5	3.3	3.9	4.1	3.4

TABLE 6. MONTHLY DISTRICT PRECIPITATION

Precipitation Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
(mm)	31.0	3.1	27.0	3.7	0	0	0.1	0
(in)	1.2	0.1	1.1	0.1	0	0	0.0	0
(AF)	16,418	1,631	14,262	1,961	0	0	30	0

ACCURACY OF REMOTE SENSING RESULTS

Measured versus predicted monthly ETa is presented in Figure 3. Measured values represent data from field stations, whereas predicted values represented those generated by the Land IQ ET model. Stations are displayed as different symbols by crop types. For instance, all square symbols represent fallow/native stations. The stations are also symbolized by color for station type. Black symbols represent "Full" stations, green ones are "WIQ" stations, and red ones are "Tule Tech" stations. For example, green circles represent measurements and predictions of WIQ citrus stations.

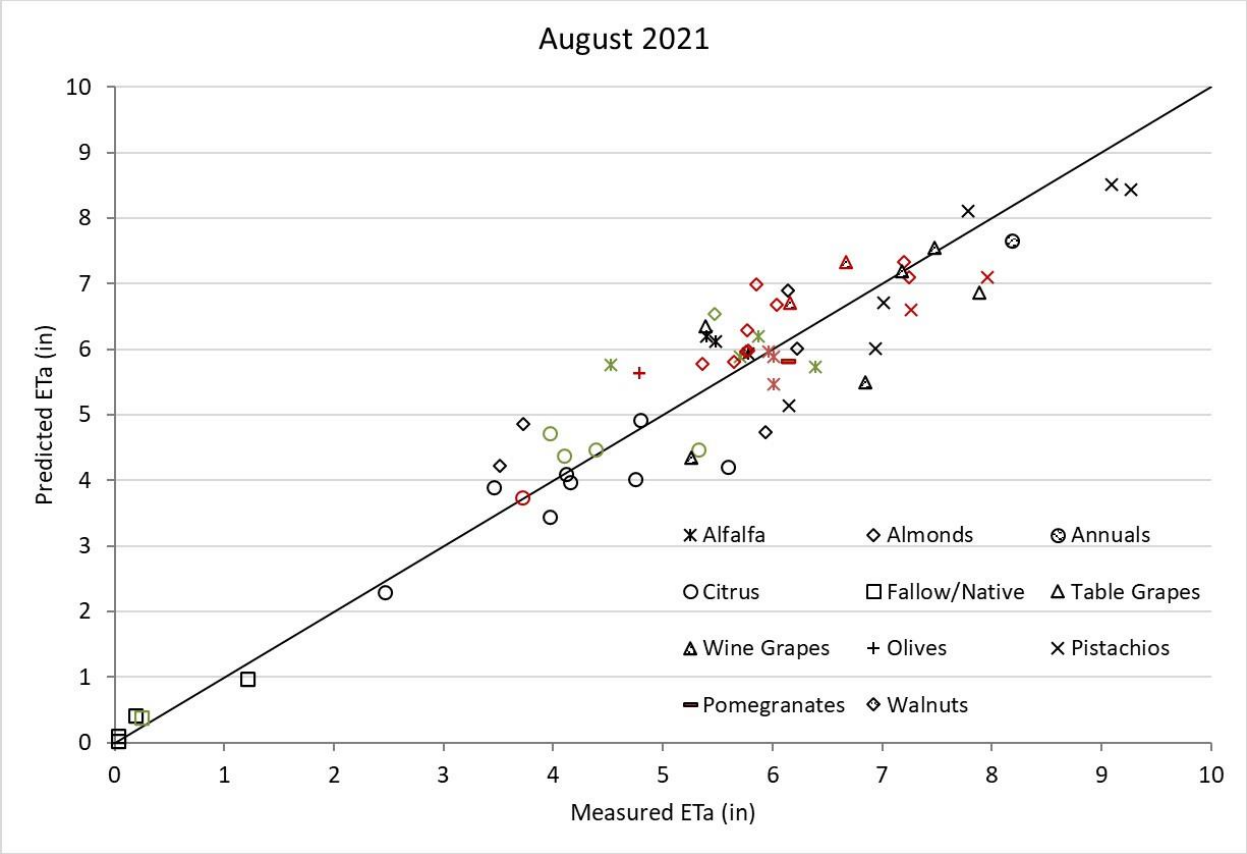

FIGURE 3. MEASURED VERSUS PREDICTED ETA FOR THE MONTH. SYMBOL COLORS REPRESENT THE STATION TYPES (BLACK = FULL, GREEN = WATER IQ (WIQ), RED = TULE TECH)

Table 7 shows the accuracy results for this month. The R^2 value is the relative measure of fit of the observed data to the predicted result, where a value of 1 indicates a perfect fit. RMSE can be interpreted as the standard deviation, where a value of 0 in would indicate perfect fit to the observed data.

TABLE 7. MEASURED VS. PREDICTED MONTHLY ETA

R^2	RMSE (IN)
0.9	0.6

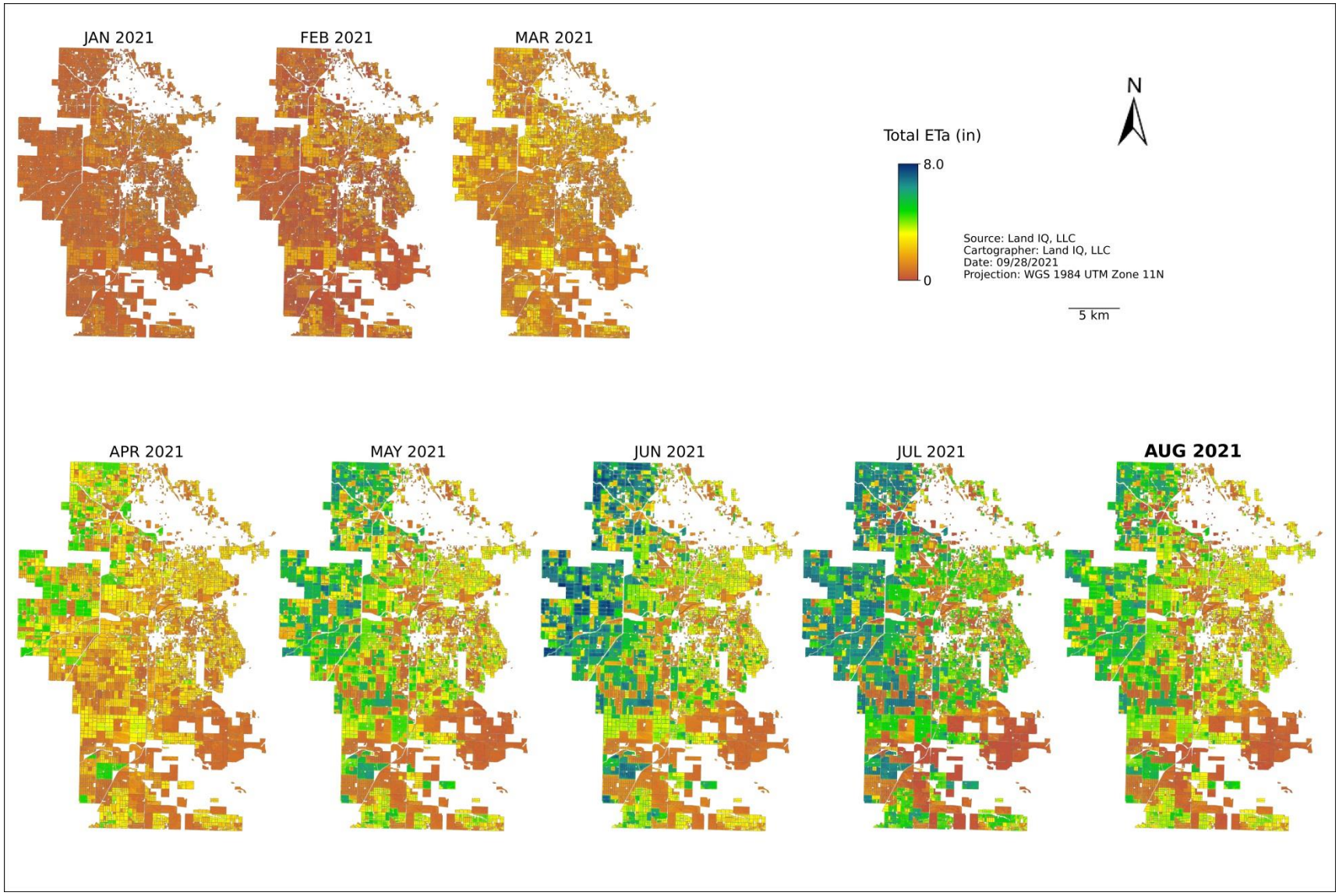

FIGURE 4. PIXEL LEVEL TOTAL ET_A (in) FOR THE MONTH