Appendix L2

Quantifying Evaporative Discharge from Bristol and Cadiz Dry Lakes

ESA

Quantifying Evaporative Discharge from Bristol and Cadiz Dry Lakes

Final Report

Presented to:

Cadiz Incorporated

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16 March 2012

Introduction

This final report contains evaporation data collected at the Bristol Dry Lake study site for the time period of May 4 to November 15, 2011 and from the Cadiz Dry Lake study site for the time period of July 20 to November 15, 2011. The eddy covariance method was used to estimate evaporation from the two dry lake beds. The eddy covariance method uses several calculations to estimate the amount of evaporation and these calculations are discussed in the following sections of this report.

Methods

Eddy covariance instrumentation

Eddy covariance (EC) instrumentation installed at each of the study sites consisted of one 3 meter tall EC (**Fig. 1**) tower that included all necessary instrumentation to continuously measure latent heat flux (LE) (i.e., heat transferred to the air in water vapor from evaporation (E)) that was used to calculate E from Bristol and Cadiz Dry Lakes (**Fig. 2**). The EC towers were positioned downwind of the dominant wind direction. The instruments installed on the EC towers consisted of a three-dimensional sonic anemometer (CSAT3, Campbell Scientific Inc., Logan, Utah, USA) to measure the three wind direction components, and an open-path infrared gas analyzer (IRGA) to measure H_2O molar density (LI-7500, LI-COR Inc., Lincoln, Nebraska, USA). All sensors on the EC towers were mounted 2.5 meters above ground surface. Weather (e.g., air temperature, relative humidity, and precipitation) and soil instruments (e.g., soil moisture and soil heat flux) at the EC sites were mounted on an adjacent 3 meter tower (**Fig. 1**). Data from all instruments were recorded with a data logger (CR5000, Campbell Scientific) at a frequency of 10 Hz (10 times per second) and stored on compact flash cards. Data were also transmitted back to the Desert Research Institute (DRI) via cell phone modems. Data were transmitted every hour from the data logger at each of the study sites to a data server located at DRI. DRI personnel checked the data on a daily basis for errors.

Figure 1. Eddy covariance (EC) and meteorological towers and instrumentation located on Bristol Dry Lake located near Cadiz, California.

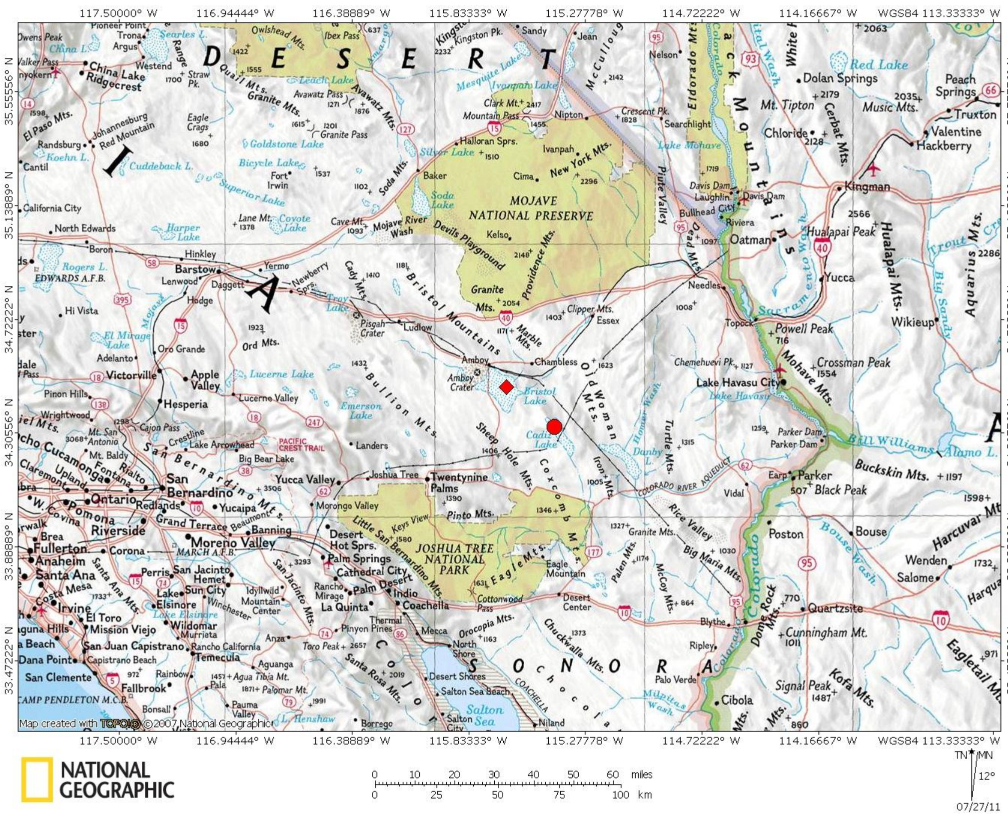

Figure 2. Topographical map showing the location of the Bristol Dry Lake and Cadiz Dry Lake study sites. The red diamond indicates the location (Latitude: 34.470822° N, Longitude: -115.649635° W) of the Bristol Dry Lake eddy covariance instrumentation and the red circle indicates the location (Latitude: 34.326431° N, Longitude: -115.420760° W) of the Cadiz Dry Lake eddy covariance instrumentation that is being used to measure evaporation from the dry lakebeds.

Calculation of evaporation

Average E parameters for each half-hour period, including sensible (H) and latent (LE) heat fluxes were measured using the EC method (as described in Wohlfahrt et al. 2008, and Arnone et al. 2008). These procedures include the following: continuous measurement of the three wind direction components using the 3D sonic anemometer; the molar density of water; and post-process calculation of the vertical wind vector, scalar water vapor density, and co-variance of these two measurements. Quality control of half-hour E rate data followed a five-step procedure (Arnone et al. 2008) that includes comparison of LE, H, and soil heat (G, determined using heat flux plates buried in soil) fluxes to overall net ecosystem energy balance measured with a net radiometer mounted on the tower (Hammerle et al. 2007).

Gap filling and uncertainty analysis

Data gaps from the sites resulting from filtering or missing data were filled using a site-specific regression equation of E on daytime PFD (photon flux density [PFD] of photosynthetically active radiation [PAR]).

Systematic uncertainty of E estimates (Wohlfahrt *et al.* 2008) derive primarily from the collective effects of inherent instrument measurement errors on the large density corrections (Webb *et al.* 1980, WPL) that need to be applied to half-hourly EC E values when measuring E with open-path sensors under conditions of large sensible heat exchange. In these situations, the effects of concurrent air temperature and humidity fluctuations on H_2O densities (ρ_v) must be taken into account. The uncertainty introduced by applying the WPL correction under the range of inherent measurement errors for each instrument (sensor) was estimated by defining a likely relative uncertainty for each independent parameter (instrument measurement) and by applying this in turn to calculate E (see Wohlfahrt *et al.* 2008). Assuming that the various component uncertainties are independent, the combined uncertainty due to the WPL correction was calculated by taking the square root of the sum of the squared individual uncertainties.

Based on manufacturers' specifications, and on past experience with long-term sensor stability, the water vapor density (ρ_v), and static air pressure (P) were assigned uncertainties of 10% (Wohlfahrt *et al*. 2008) while air temperature (T_{air}) was assigned an uncertainty of 2%. Uncertainty in the sensible heat flux may arise from the fact that the sensible heat flux was measured based on speed of sound measurements, which has been shown by Loescher *et al*. (2005) to deviate from sensible heat flux derived from measurements of air temperature with a fast-response platinum resistance thermometer by up to 10% for this specific sonic anemometer model. On the other hand, Ham & Heilman (2003), again for the same anemometer model used in this study, found extremely good correspondence between sonic- and thermocouple-derived sensible heat flux measurements. Additional uncertainty of the sensible heat flux arises from the choice of coordinate system (Lee *et al*. 2004) and from the necessary (small) frequency response corrections (Massman 2001). Based on the evidence presented above and some preliminary sensitivity tests with different coordinate systems (data not shown), a 5% uncertainty for the sensible heat flux (F_H) was assumed. Similar to the sensible heat flux, a 5% uncertainty for latent heat flux (F_{H2O}) was assumed, intended to reflect uncertainties due to choice of the coordinate system and frequency response corrections, which are based on a site-specific cospectral reference model (cf. Massman & Clement 2004; Wohlfahrt et al. 2005) and have been validated against experimentally derived frequency response correction factors following Aubinet et al. (2000) and Aubinet et al. (2001) as described in Wohlfahrt et al. (2005) and Wohlfahrt et al. (2008). Based on this information our choice of 5% uncertainty is justified and not nearly as large as the upper range of potential errors in frequency response correction factors (30%) reported by Massman & Clement (2004).

Calculation of EC footprint

To calculate the area sampled by the EC tower (i.e., the EC footprint), we used the footprint model of Hsieh et al. (2000) to estimate the upwind distance and compass direction that represents 90% of the surface E for each half-hour period ($X_{90\%}$). Each calculated point, or footprint distance and direction, was plotted in ArcGIS and a polygon circumscribed on the outside of the collective set of points that fall within Bristol or Cadiz Dry Lake that contribute to E fluxes from these areas.

Energy balance closure

The validity of the EC E data are being evaluated by calculating the degree to which EC measurements are able to close the ecosystem energy balance using the method described in Hammerle *et al.* (2007). Briefly, this method involves comparing the sum of turbulent heat fluxes—final latent (LE) and sensible heat (H) fluxes—calculated using EC data for each half-hour sampling period, to the available energy, or the difference between net radiation (Rn) and soil heat flux (G), calculated for each half-hour sampling period. Energy balance closure for both EC sites is being calculated as the slope of the best-fit regression line of LE+H on R_n-G using all valid half-hourly values expressed as a percentage.

Results

Bristol Dry Lake

Evaporation

Data collected between May 4 and November 15, 2011 indicate that 49.75 ± 1.55 mm (see **Table 1** for systematic uncertainty) of evaporation have occurred from Bristol Dry Lake from within the EC footprint (**Table 2 - 8)**. Daily evaporation rates during October and November showed a slight decline from previous months mostly due to shorter day lengths and decreasing temperatures as fall and winter approach.

Precipitation occurred at the site on July 30, September 10, September 13, November 4, and November 12. Evaporation values measured on days where precipitation occurred were significantly higher than on days without precipitation. Higher rates of E also were observed for several days after precipitation occurred. In this current report we did not subtract precipitation from the final E value (final E for the month or for the study period); therefore, E rates may be overestimated by the amount of precipitation that fell during the observation period, assuming that all of the precipitation that fell was eventually evaporated.

Energy balance closure calculated for the time period between May 4 and November 15, 2011 was 96% (**Fig. 4**; slope value). This high closure value indicates a high degree of methodological certainty in EC E estimates from the Bristol Dry Lake study site. However, the 96% energy balance closure also indicates that the EC method is underestimating E at this site by 4%.

Table 1.Total systematic uncertainty of E (mm) calculated as the square root of the sum of the squared individual sources of uncertainty using density corrected data (Webb *et. al.* , 1980) for Bristol Dry Lake May 4 - November 15, 2011.

Source of uncertainty		Bristol Dry Lake (mm)
T_{air}	(2%)	0.01
ρ_v	(10%)	1.82
P	(10%)	0.00
F_H	(5%)	0.53
F_{H2O}	(5%)	0.04
Total systematic uncertainty		± 1.55

Table 2. Daily sums of evaporation from Bristol Dry Lake near Cadiz, California during the month of May, 2011. Evaporation sums are from points originating from within the EC footprint (see Figure 3).

Date	Daily sum (mm/day)
5/4/2011	0.19
5/5/2011	0.18
5/6/2011	0.23
5/7/2011	0.25
5/8/2011	0.29
5/9/2011	0.19
5/10/2011	0.15
5/11/2011	0.16
5/12/2011	0.22
5/13/2011	0.24
5/14/2011	0.18
5/15/2011	0.16
5/16/2011	0.16
5/17/2011	0.16
5/18/2011	0.46
5/19/2011	0.17
5/20/2011	0.19
5/21/2011	0.22
5/22/2011	0.23
5/23/2011	0.21
5/24/2011	0.15
5/25/2011	0.25
5/26/2011	0.28
5/27/2011	0.21
5/28/2011	0.28
5/29/2011	0.15
5/30/2011	0.17
5/31/2011	0.21
Monthly total (mm/month)	**5.94**

Table 3. Daily sums of evaporation from Bristol Dry Lake near Cadiz, California during the month of June, 2011. Evaporation sums are from points originating from within the EC footprint (see Figure 3).

Date	Daily sum (mm/day)
6/1/2011	0.21
6/2/2011	0.16
6/3/2011	0.18
6/4/2011	0.24
6/5/2011	0.21
6/6/2011	0.14
6/7/2011	0.18
6/8/2011	0.22
6/9/2011	0.18
6/10/2011	0.22
6/11/2011	0.19
6/12/2011	0.33
6/13/2011	0.14
6/14/2011	0.21
6/15/2011	0.48
6/16/2011	0.27
6/17/2011	0.14
6/18/2011	0.23
6/19/2011	0.20
6/20/2011	0.18
6/21/2011	0.19
6/22/2011	0.25
6/23/2011	0.19
6/24/2011	0.21
6/25/2011	0.18
6/26/2011	0.23
6/27/2011	0.22
6/28/2011	0.17
6/29/2011	0.25
6/30/2011	0.22
Monthly total (mm/month)	**6.41**

Table 4. Daily sums of evaporation from Bristol Dry Lake near Cadiz, California during the month of July, 2011. Evaporation sums are from points originating from within the EC footprint (see Figure 3).

Date	Daily sum (mm/day)
7/1/2011	0.22
7/2/2011	0.23
7/3/2011	0.19
7/4/2011	0.33
7/5/2011	0.20
7/6/2011	0.11
7/7/2011	0.43
7/8/2011	0.22
7/9/2011	0.38
7/10/2011	0.50
7/11/2011	0.27
7/12/2011	0.25
7/13/2011	0.25
7/14/2011	0.18
7/15/2011	0.26
7/16/2011	0.16
7/17/2011	0.18
7/18/2011	0.18
7/19/2011	0.21
7/20/2011	0.21
7/21/2011	0.24
7/22/2011	0.14
7/23/2011	0.27
7/24/2011	0.21
7/25/2011	0.23
7/26/2011	0.15
7/27/2011	0.18
7/28/2011	0.23
7/29/2011	0.25
7/30/2011	0.83[†]
7/31/2011	0.45
Monthly total (mm/month)	**7.32**

[†]Measureable precipitation - 7/30/2011: 0.5 mm (0.02 inches).

Table 5. Daily sums of evaporation from Bristol Dry Lake near Cadiz, California during the month of August, 2011. Evaporation sums are from points originating from within the EC footprint (see Figure 3).

Date	Daily sum (mm/day)
8/1/2011	0.32
8/2/2011	0.31
8/3/2011	0.24
8/4/2011	0.26
8/5/2011	0.25
8/6/2011	0.37
8/7/2011	0.28
8/8/2011	0.20
8/9/2011	0.22
8/10/2011	0.38
8/11/2011	0.24
8/12/2011	0.29
8/13/2011	0.25
8/14/2011	0.26
8/15/2011	0.32
8/16/2011	0.24
8/17/2011	0.19
8/18/2011	0.32
8/19/2011	0.23
8/20/2011	0.27
8/21/2011	0.26
8/22/2011	0.29
8/23/2011	0.25
8/24/2011	0.23
8/25/2011	0.25
8/26/2011	0.24
8/27/2011	0.48
8/28/2011	0.31
8/29/2011	0.28
8/30/2011	0.26
8/31/2011	0.38
Monthly total (mm/month)	**8.67**

Table 6. Daily sums of evaporation from Bristol Dry Lake near Cadiz, California during the month of September, 2011. Evaporation sums are from points originating from within the EC footprint (see Figure 3).

Date	Daily sum (mm/day)
9/1/2011	0.49
9/2/2011	0.55
9/3/2011	0.44
9/4/2011	0.49
9/5/2011	0.67
9/6/2011	0.38
9/7/2011	0.46
9/8/2011	0.55
9/9/2011	1.04
9/10/2011	1.09†
9/11/2011	0.75
9/12/2011	0.63
9/13/2011	1.34†
9/14/2011	0.52
9/15/2011	0.52
9/16/2011	0.51
9/17/2011	0.54
9/18/2011	0.60
9/19/2011	0.48
9/20/2011	0.53
9/21/2011	0.51
9/22/2011	0.50
9/23/2011	0.50
9/24/2011	0.58
9/25/2011	0.44
9/26/2011	0.27
9/27/2011	0.23
9/28/2011	0.20
9/29/2011	0.18
9/30/2011	0.22
Monthly total (mm/month)	**13.76**

†Measureable precipitation - 9/10/2011: 11.43 mm (0.45 inches); 9/13/2011: 5.84 mm (0.23 inches).

Table 7. Daily sums of evaporation from Bristol Dry Lake near Cadiz, California during the month of October, 2011. Evaporation sums are from points originating from within the EC footprint (see Figure 3).

Date	Daily sum (mm/day)
10/1/2000	0.24
10/2/2000	0.19
10/3/2000	0.31
10/4/2000	0.26
10/5/2000	0.59
10/6/2000	0.19
10/7/2000	0.23
10/8/2000	0.18
10/9/2000	0.13
10/10/2000	0.13
10/11/2000	0.13
10/12/2000	0.25
10/13/2000	0.19
10/14/2000	0.13
10/15/2000	0.13
10/16/2000	0.11
10/17/2000	0.18
10/18/2000	0.17
10/19/2000	0.15
10/20/2000	0.07
10/21/2000	0.14
10/22/2000	0.14
10/23/2000	0.13
10/24/2000	0.06
10/25/2000	0.11
10/26/2000	0.21
10/27/2000	0.12
10/28/2000	0.13
10/29/2000	0.15
10/30/2000	0.12
10/31/2000	0.10
Monthly total (mm/month)	**5.37**

Table 8. Daily sums of evaporation from Bristol Dry Lake near Cadiz, California during the month of November, 2011. Evaporation sums are from points originating from within the EC footprint (see Figure 3).

Date	Daily sum (mm/day)
11/1/2011	0.19
11/2/2011	0.08
11/3/2011	0.09
11/4/2011	0.26[†]
11/5/2011	0.44
11/6/2011	0.24
11/7/2011	0.18
11/8/2011	0.16
11/9/2011	0.15
11/10/2011	0.13
11/11/2011	0.09
11/12/2011	0.37[†]
11/13/2011	0.33
11/14/2011	0.04
11/15/2011	0.16
Monthly total (mm/month)	**2.28**

[†]Measureable precipitation - 11/04/2011: 0.25 mm (0.01 inches); 11/12/2011: 0.25 mm (0.01 inches).

Table 9. Cumulative percentage of all eddy covariance (EC) evaporation (E) values within the EC footprint (see Figure 3) originating from Bristol Dry Lake derived from increasing radial distances from the EC tower located near Cadiz, California between May 4 and November 15, 2011.

Distance from EC tower (radius m)	30 minute EC values within footprint (%)
<100	6.08%
<200	26.86%
<300	39.93%
<400	47.77%
<500	52.51%
<600	56.24%
<700	59.08%
<800	61.42%
<900	62.89%
<1000	64.49%
<2000	77.72%
<3000	87.95%
<4000	93.92%
<5000	97.02%
<6000	98.71%
<7000	99.44%
<8,000	99.77%
<9,000	99.91%
<10,000	99.99%
>10,000	0.01%

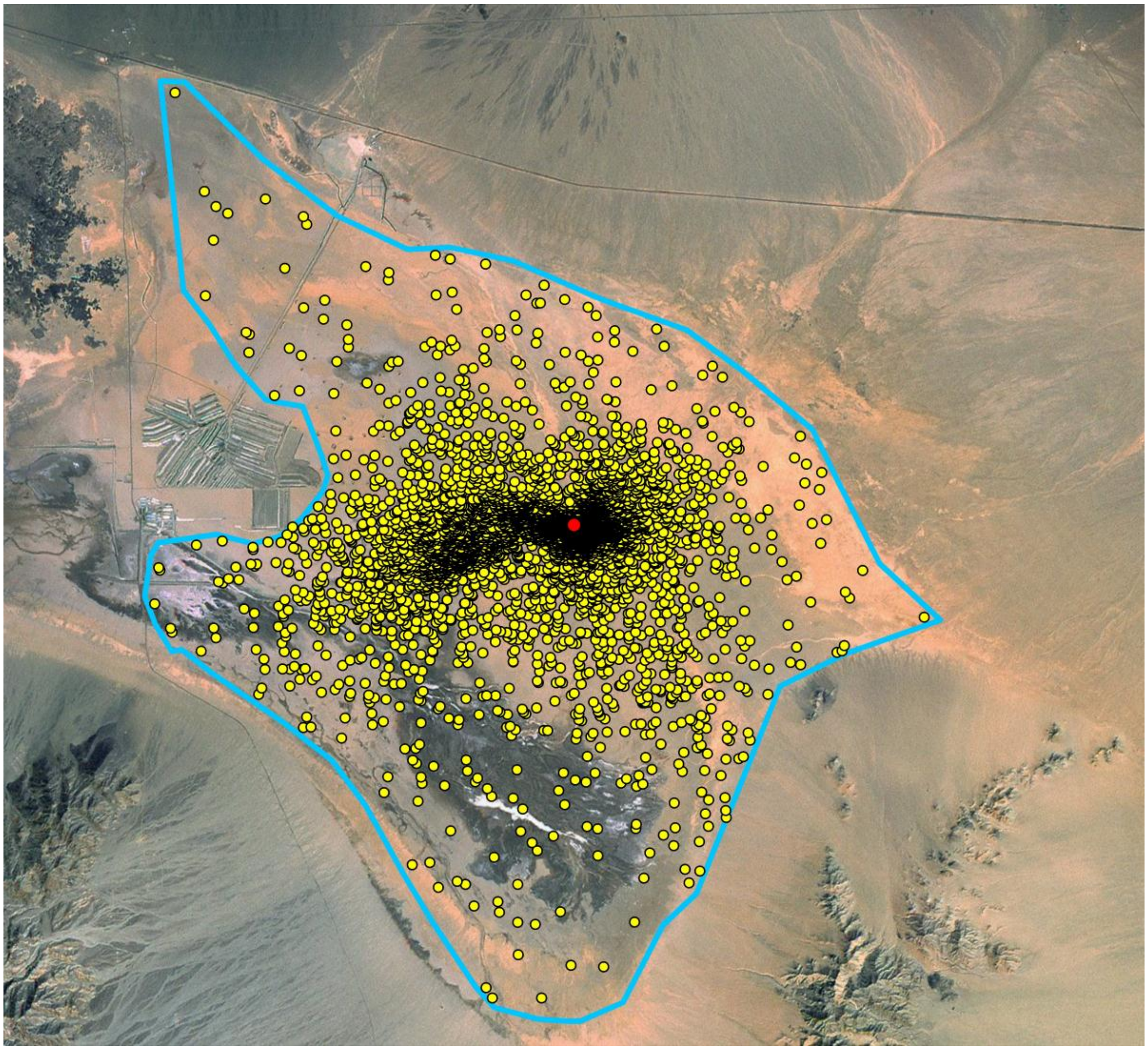

Figure 3. Footprint for the EC tower located on Bristol Dry Lake located near Cadiz, California. The red dot indicates the location (Latitude: 34.470822° N, Longitude: -115.649635° W) of the EC tower on the dry lakebed. Yellow points represent individual 30-min flux values measured by the EC instrumentation between May 4 and November 15, 2011. The light blue line represents the footprint area.

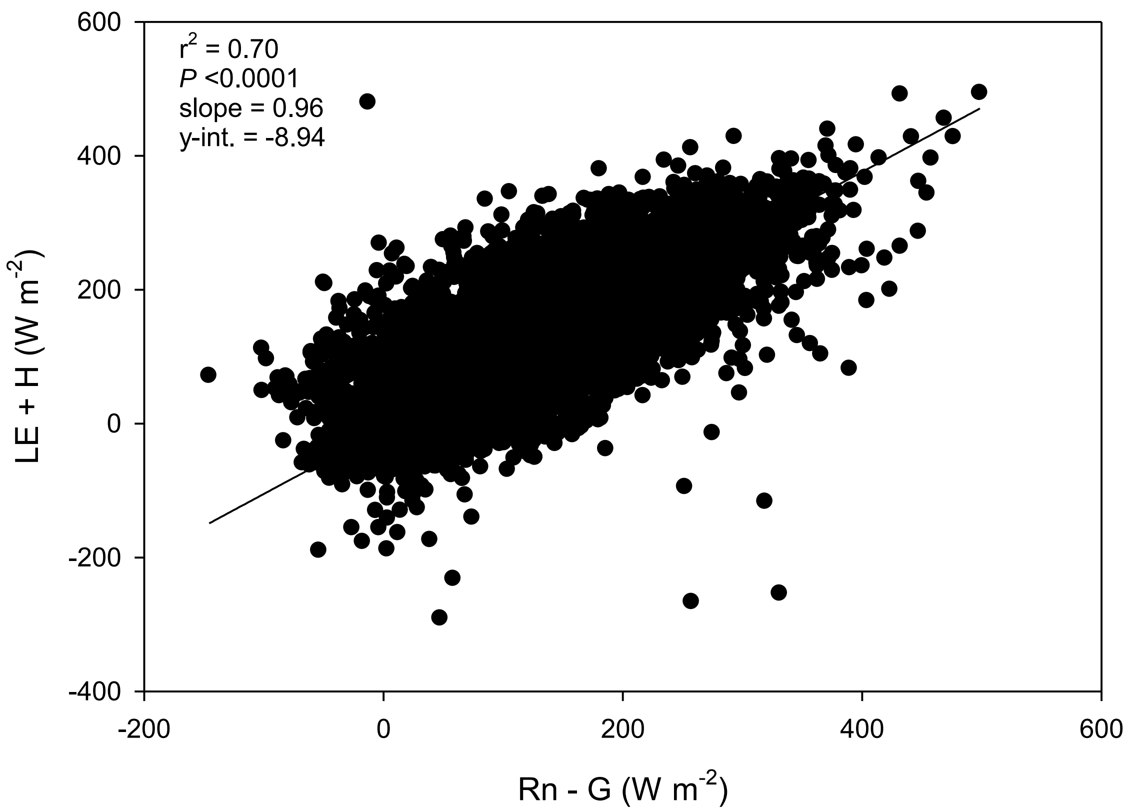

Figure 4. Energy balance closure for the Bristol Dry Lake study site located near Cadiz, California between May 4 and November 15, 2011.

Cadiz Dry Lake

Evaporation

Data collected between July 20 and November 15, 2011 indicate that 57.06 ± 1.24 mm (see **Table 10** for systematic uncertainty) of evaporation have occurred from Cadiz Dry Lake from within the EC footprint (see **Figure 5**, **Table 11 – 15**). Daily evaporation rates during October and November showed a slight decline from previous months mostly due to shorter day lengths and decreasing temperatures as fall and winter approach.

Precipitation occurred at the site on July 30, September 5, September 10, September 13. November 4, and November 12. Evaporation values measured on days where precipitation occurred were significantly higher than on days without precipitation. Higher rates of E also were observed for several days after precipitation occurred. In this current report we did not subtract precipitation from the final E value (final E for the month or for the study period), therefore E rates may be overestimated by the amount of precipitation that fell during the observation period, assuming that all of the precipitation that fell was eventually evaporated.

Table 10.Total systematic uncertainty of E (mm) calculated as the square root of the sum of the squared individual sources of uncertainty using density corrected data (Webb *et. al.* , 1980) for Cadiz Dry Lake July 20 - November 15, 2011.

Source of uncertainty		Cadiz Dry Lake (mm)
T_{air}	(2%)	0.00
ρ_v	(10%)	0.05
P	(10%)	0.00
F_H	(5%)	0.15
F_{H2O}	(5%)	1.35
Total systematic uncertainty		± 1.24

Table 11. Daily sums of evaporation from Cadiz Dry Lake near Cadiz, California during the month of July 2011. Evaporation sums are from points originating from within the EC footprint (see Figure 5).

Date	Daily sum (mm/day)
7/20/2011	0.55
7/21/2011	0.54
7/22/2011	0.52
7/23/2011	0.51
7/24/2011	0.52
7/25/2011	0.70
7/26/2011	0.62
7/27/2011	0.47
7/28/2011	0.56
7/29/2011	0.50
7/30/2011	1.99[†]
7/31/2011	1.06
Monthly total (mm/month)	**6.57**

[†]Measureable precipitation - 7/31/2011: 5.59 mm (0.22 inches).

Table 12. Daily sums of evaporation from Cadiz Dry Lake near Cadiz, California during the month of August 2011. Evaporation sums are from points originating from within the EC footprint (see Figure 5).

Date	Daily sum (mm/day)
8/1/2011	0.98
8/2/2011	0.74
8/3/2011	0.80
8/4/2011	0.56
8/5/2011	0.58
8/6/2011	0.58
8/7/2011	0.59
8/8/2011	0.66
8/9/2011	No data*
8/10/2011	No data*
8/11/2011	No data*
8/12/2011	No data*
8/13/2011	No data*
8/14/2011	No data*
8/15/2011	No data*
8/16/2011	0.52
8/17/2011	0.57
8/18/2011	0.65
8/19/2011	0.54
8/20/2011	0.57
8/21/2011	0.57
8/22/2011	0.79
8/23/2011	0.84
8/24/2011	0.83
8/25/2011	0.43
8/26/2011	0.18
8/27/2011	0.51
8/28/2011	0.67
8/29/2011	0.48
8/30/2011	0.59
8/31/2011	0.73
Monthly total (mm/month)	**14.97**

*Data logger failure

Table 13. Daily sums of evaporation from Cadiz Dry Lake near Cadiz, California during the month of September 2011. Evaporation sums are from points originating from within the EC footprint (see Figure 5).

Date	Daily sum (mm/day)
9/1/2011	0.84
9/2/2011	1.36
9/3/2011	0.86
9/4/2011	0.59
9/5/2011	1.60[†]
9/6/2011	1.44
9/7/2011	1.25
9/8/2011	0.78
9/9/2011	0.98
9/10/2011	1.04[†]
9/11/2011	2.06
9/12/2011	1.10
9/13/2011	1.14[†]
9/14/2011	2.20
9/15/2011	0.72
9/16/2011	0.57
9/17/2011	0.55
9/18/2011	0.38
9/19/2011	0.53
9/20/2011	0.61
9/21/2011	0.73
9/22/2011	0.57
9/23/2011	0.66
9/24/2011	0.66
9/25/2011	0.72
9/26/2011	0.21
9/27/2011	0.38
9/28/2011	0.31
9/29/2011	0.28
9/30/2011	0.28
Monthly total (mm/month)	**21.61**

[†]Measureable precipitation - 9/5/2011: 2.54 mm (0.10 inches); 9/10/11: 0.254 (0.01 inches); 9/13/2011: 0.5 mm (0.02 inches).

Table 14. Daily sums of evaporation from Cadiz Dry Lake near Cadiz, California during the month of October 2011. Evaporation sums are from points originating from within the EC footprint (see Figure 5).

Date	Daily sum (mm/day)
10/1/2011	0.57
10/2/2011	0.17
10/3/2011	0.06
10/4/2011	0.18
10/5/2011	0.16
10/6/2011	1.50
10/7/2011	0.63
10/8/2011	0.35
10/9/2011	0.16
10/10/2011	0.20
10/11/2011	0.15
10/12/2011	0.29
10/13/2011	0.36
10/14/2011	0.23
10/15/2011	0.24
10/16/2011	0.22
10/17/2011	0.25
10/18/2011	0.30
10/19/2011	0.23
10/20/2011	0.20
10/21/2011	0.26
10/22/2011	0.31
10/23/2011	0.18
10/24/2011	0.16
10/25/2011	0.02
10/26/2011	0.07
10/27/2011	0.25
10/28/2011	0.21
10/29/2011	0.17
10/30/2011	0.18
10/31/2011	0.37
Monthly total (mm/month)	**8.65**

Table 15. Daily sums of evaporation from Cadiz Dry Lake near Cadiz, California during the month of November 2011. Evaporation sums are from points originating from within the EC footprint (see Figure 5).

Date	Daily sum (mm/day)
11/1/2011	0.36
11/2/2011	0.52
11/3/2011	0.13
11/4/2011	0.28[†]
11/5/2011	0.77
11/6/2011	0.20[†]
11/7/2011	0.53
11/8/2011	0.29
11/9/2011	0.57
11/10/2011	0.43
11/11/2011	0.23
11/12/2011	0.32
11/13/2011	0.59
11/14/2011	0.29
11/15/2011	0.25
Monthly total (mm/month)	**5.26**

[†]Measureable precipitation - 11/4/2011: 1.52 mm (0.06 inches); 11/6/11: 0.76 (0.03 inches)

Table 16. Cumulative percentage of all eddy covariance (EC) evaporation (E) values within the EC footprint (Figure 5) originating from Cadiz Dry Lake derived from increasing radial distances from the EC tower located near Cadiz, California between July 20 and November 15, 2011.

Distance from EC tower (radius m)	30 minute EC values within footprint (%)
<100	13.46%
<200	38.89%
<300	49.18%
<400	54.88%
<500	58.87%
<600	61.73%
<700	64.55%
<800	66.29%
<900	67.93%
<1,000	69.49%
<2,000	81.23%
<3,000	87.53%
<4,000	91.79%
<5,000	94.96%
<6,000	96.64%
<7,000	97.82%
<8,000	98.63%
<9,000	99.13%
<10,000	99.36%
>10,000	0.62%

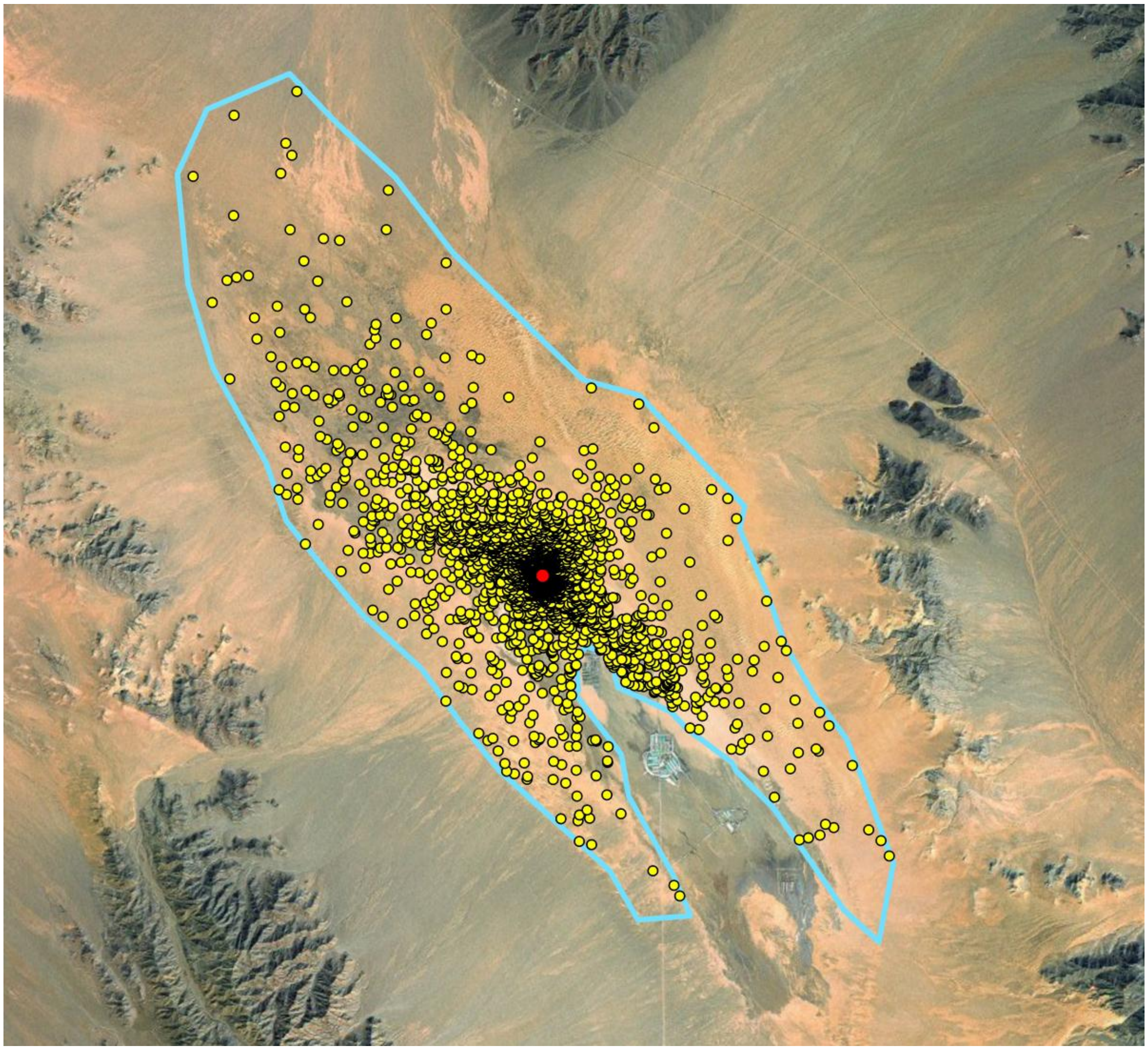

Figure 5. Footprint for the EC tower located on Cadiz Dry Lake located near Cadiz, California. The red dot indicates the location (Latitude: 34.326431° N, Longitude: -115.420760° W) of the EC tower on the dry lakebed. Yellow points represent individual 30-min flux values measured by the EC instrumentation between July 20 and November 15, 2011. The light blue line represents the footprint area.

Energy balance closure calculated for the time period between July 20 and November 15, 2011 was 111% (**Fig. 6**; slope value). This high closure value indicates a high degree of methodological certainty in EC E estimates from the Cadiz Dry Lake study site; however, energy balance closures over 100% indicate that the final E value (57.06 ± 1.24 mm) is being overestimated by approximately the amount of the overestimation, in this case 11% or 6.28 mm.

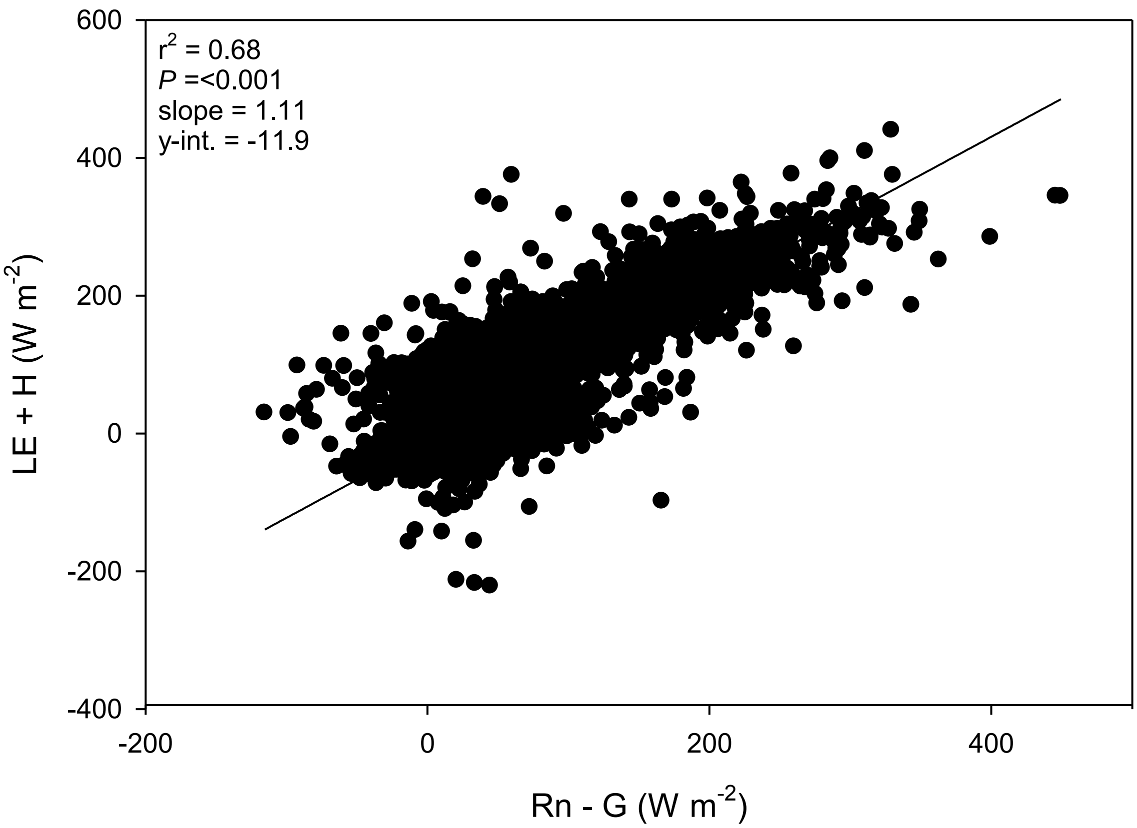

Figure 6. Energy balance closure for the Cadiz Dry Lake study site located near Cadiz, California between July 20 and November 15, 2011.

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