Supplementary Information

Groundwater dynamics and surface water-groundwater interaction in a prograding delta island, Louisiana, USA

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This supplement contains: additional information regarding linear correlations between surface water and environmental signals (Table S1) and the complete, 5-month long data sets for all relevant measured parameters during the field study (9-Sept-2013 to 4-Feb-2014).

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Table S1: Linear correlations between the surface water signal in the channel next to Pintail Island (S3) and environmental factors for the “calm” and “stormy” subsets of the data. All values in table are r^2 and significance is $p < 0.001$.

Surface Water Linear Correlations to Environmental Data		
	Calm	**Storm**
Tides	0.71	0.75
Wind Speed	-0.34	0.03
Precipitation	0.01	0.05
Atchafalaya Discharge	-0.17	-0.2

	N1	N2	N3	M1	M2
Mean (m/h)	0.112	0.017	0.023	0.014	0.028
Standard Dev. (m/h)	0.076	0.012	0.016	0.009	0.018
Median (m/h)	0.09	0.013	0.018	0.013	0.024
Minimum (m/h)	0.008	0.001	0.002	0.003	0.005
Maximum (m/h)	0.252	0.046	0.078	0.04	0.073

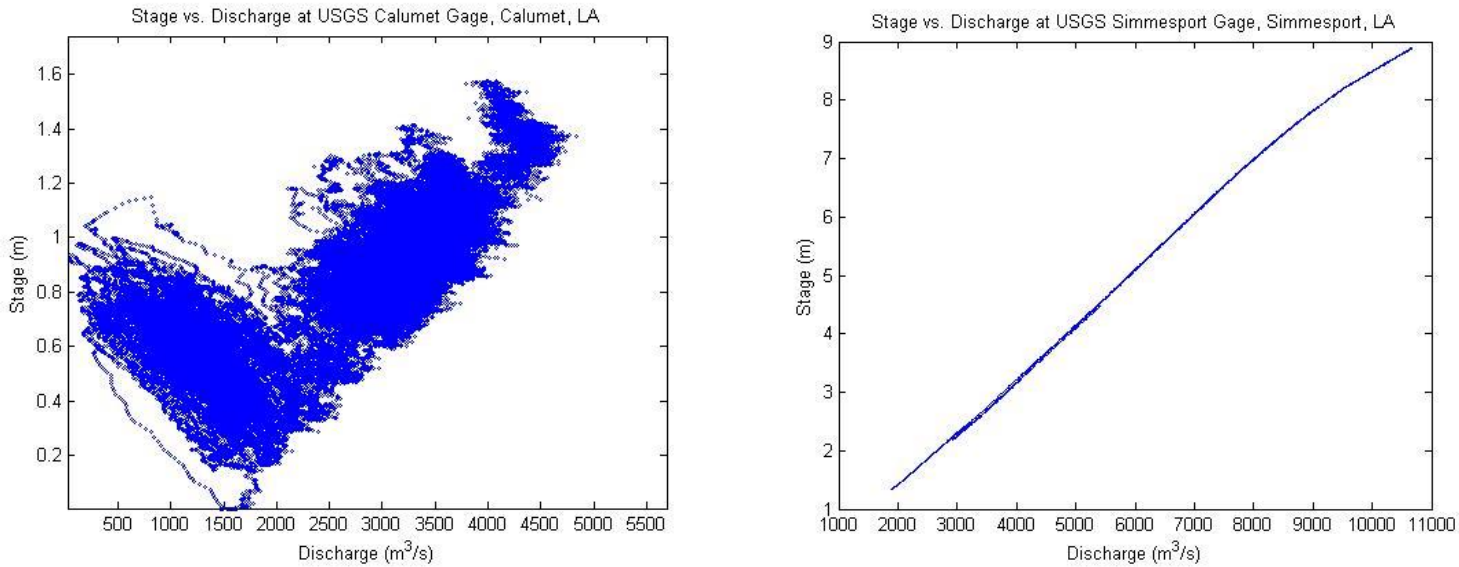
Table S2: Summary of rate of rise analysis for N- and M- transect deep wells during the rising limb of wells' storm hydrographs.

For each storm event, the rate of potentiometric surface change was calculated for both the rising and falling limbs of the well hydrographs as the linear slope between the temporal local minimum and local maximum groundwater head values. Each storm event was categorized by a sharp and rapid rise in groundwater head, followed by a long falling limb between events with a relatively constant slope, especially in the more northern island transects (N, M). Across all wells within the northern (N) and middle (M) transects except location N1, the average rate of potentiometric surface decline between storm events was 3 cm/day. For N1 the rate was 13 cm/day.

Well N1-deep, located closest to the channel of all the wells, showed the fastest average rate of rise overall, an order of magnitude greater than the other four wells analyzed (Table 3). However, the mean rate for N1-deep was skewed by extreme storm events on and around 23-Sep, 6-Oct, 31-Oct, and 17-Nov, which disproportionally affected it more than the other wells and resulted in high rates of rise of 0.199, 0.226, 0.239, 0.252 m/h, respectively. These rapid rises in hydraulic head were well outside the standard deviation of N1-deep rise rates. These instances also coincided with the highest surface water levels observed in the study period, which raised the groundwater head at N1 above the ground surface elevation and flooded the island. The rate of rise for wells N2, N3, M1, and M2 were highest during storms as well, but the range of rises were much smaller for these inland wells than they were for well N1. Lower-island well hydrographs (L, DL) were strongly influenced by surface water fluctuations during both calm and stormy days and thus could not be analyzed in the same manner.

Day	Date
1	11-Sep-13
2	18-Sep-13
3	19-Sep-13
4	20-Sep-13
5	21-Sep-13
6	24-Sep-13
7	4-Oct-13
8	16-Oct-13
9	19-Oct-13
10	31-Oct-13
11	1-Nov-13
12	18-Nov-13
13	26-Nov-13
14	2-Dec-13
15	3-Dec-13
16	6-Dec-13
17	8-Dec-13
18	9-Dec-13
19	14-Dec-13
20	21-Dec-13
21	28-Dec-13
22	31-Dec-13
23	1-Jan-14
24	13-Jan-14
25	24-Jan-14
26	3-Feb-14
27	4-Feb-14
28	5-Feb-14

Table S3: List of dates included in “stormy” sub-dataset, which experienced sustained winds above 5 m/s or rain events that led to more than 5 mm of accumulation in 24 hours. This “stormy” data subset covered 28 days, with average wind speed of 1.50 +/- 1.38 m/s and average measured precipitation rate of 5.17 mm/day.



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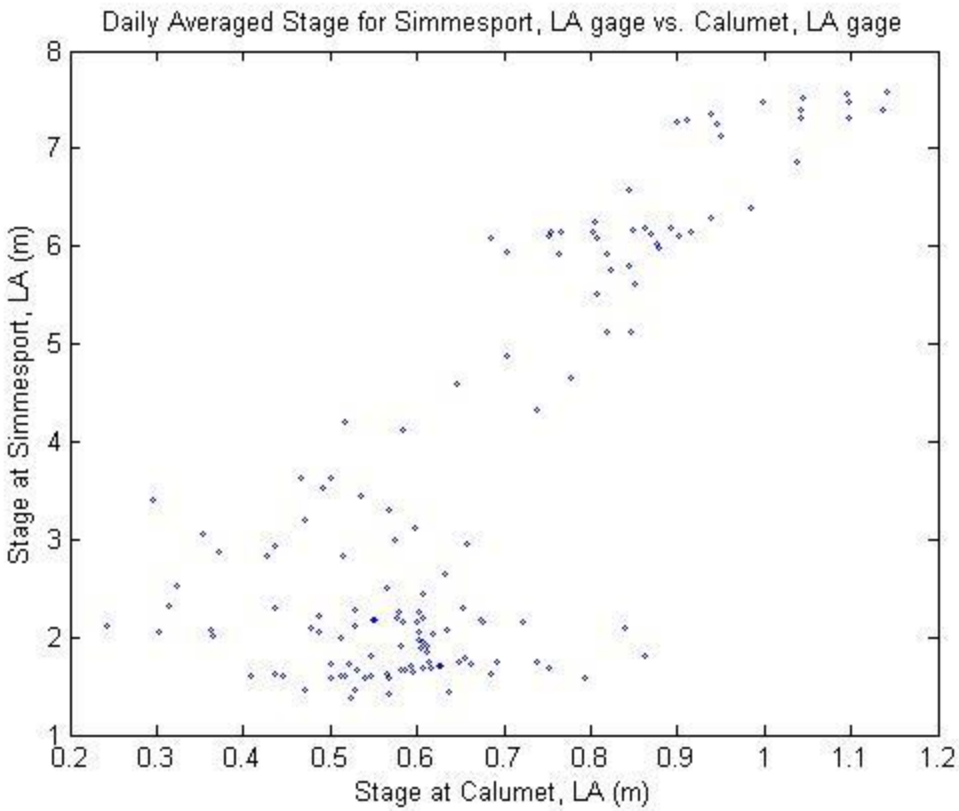
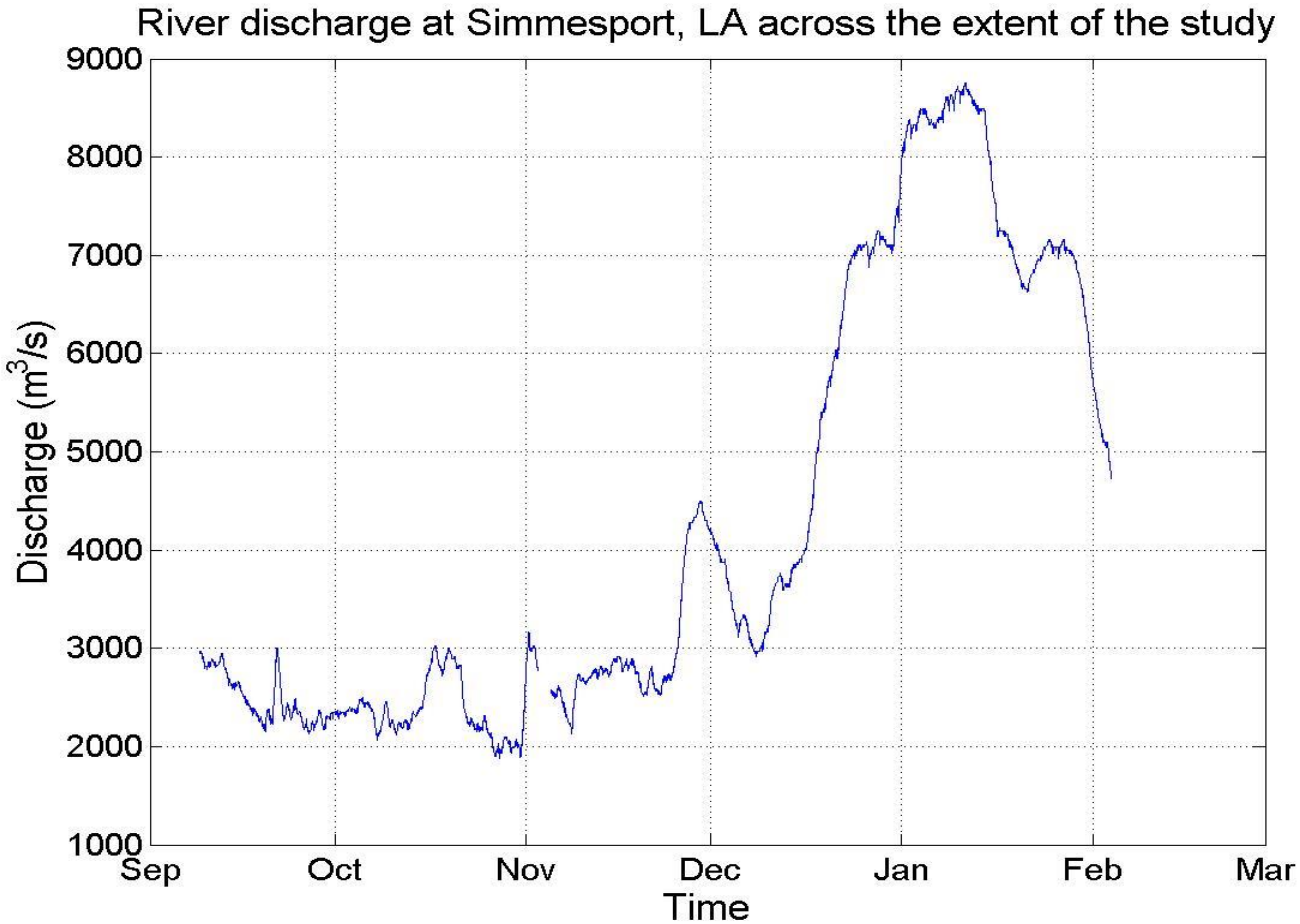


Figure S2: Daily averages for stage at Simmesport, LA vs. daily averages for stage at Calumet, LA. They exhibit a linear relationship with a slope of 8.5. [USGS, 2014a, b]

Figure S3:



Discharge reported by the USGS at the Atchafalaya River gaging station in Simmesport, LA for the duration of the study [USGS, 2014a].

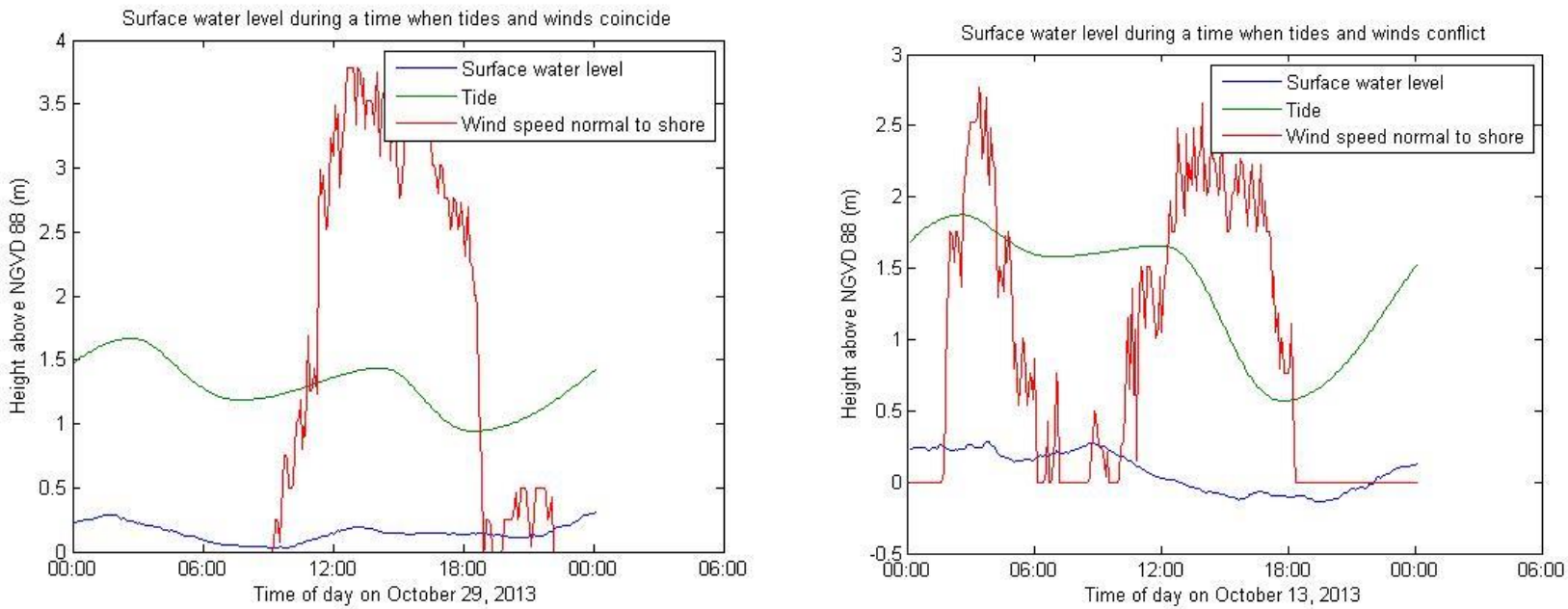


Figure S4: Surface water (logger S3), tides [NOAA, 2014], and wind speed for (a) a day when wind velocity maximum (m/s, daily every afternoon) coincided with tidal maximum (daily, processing by roughly an hour every day) and (b) when wind velocity maximum conflicted with tidal maximum.

Note the relatively constant (and slightly tidal) surface water level when tides and winds coincided and the downward-trending (and non-tidal) surface water level when tides and winds conflicted. Further note that tide, wind speed, and surface water maxima track at approximately the same time when winds and tides coincide, and they are staggered when winds and tides conflict. This supports the finding that surface water levels are affected by both tides and winds.

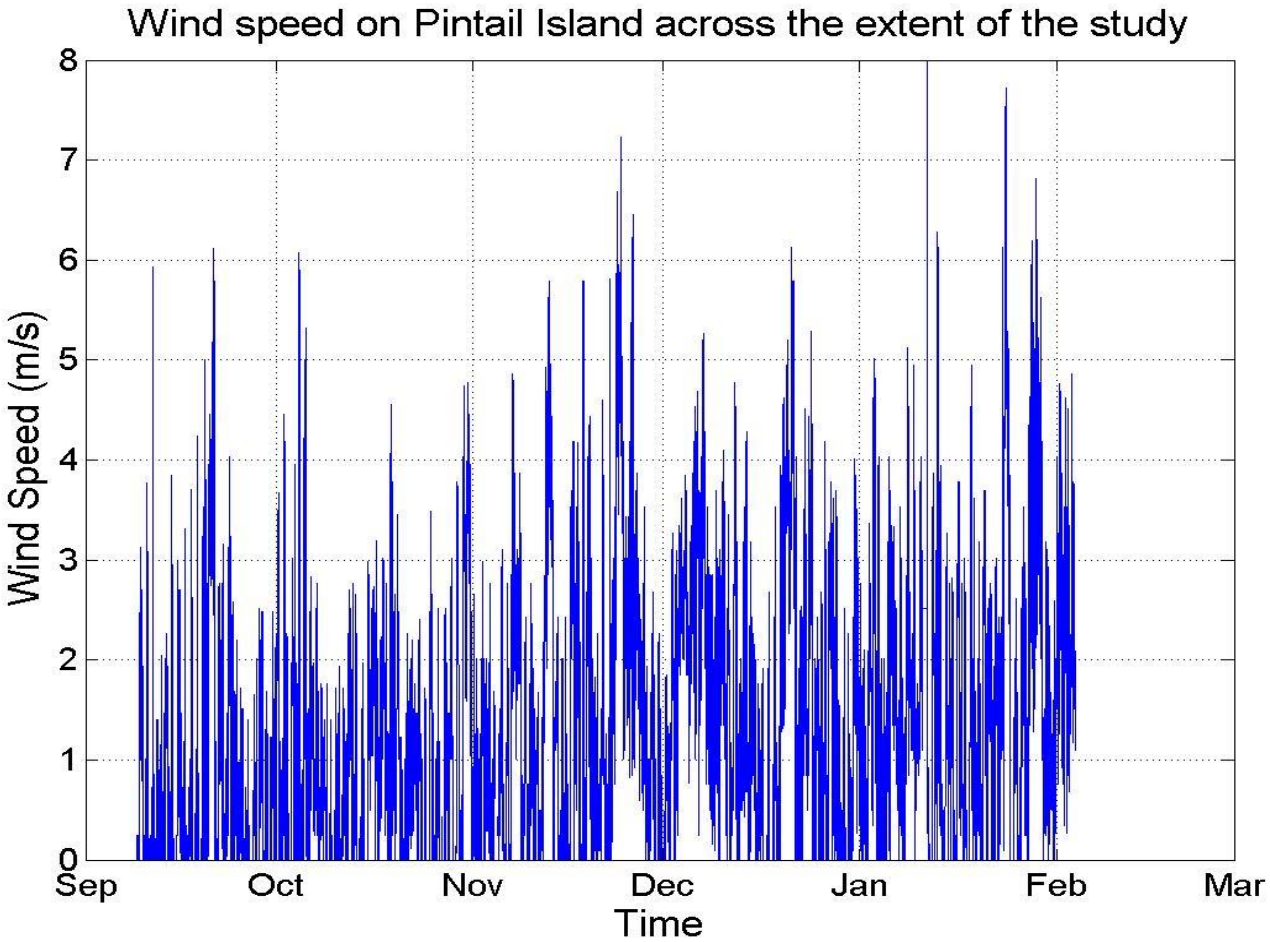


Figure S5: Wind speed recorded for the duration of the study at the weather station on the apex of Pintail Island.

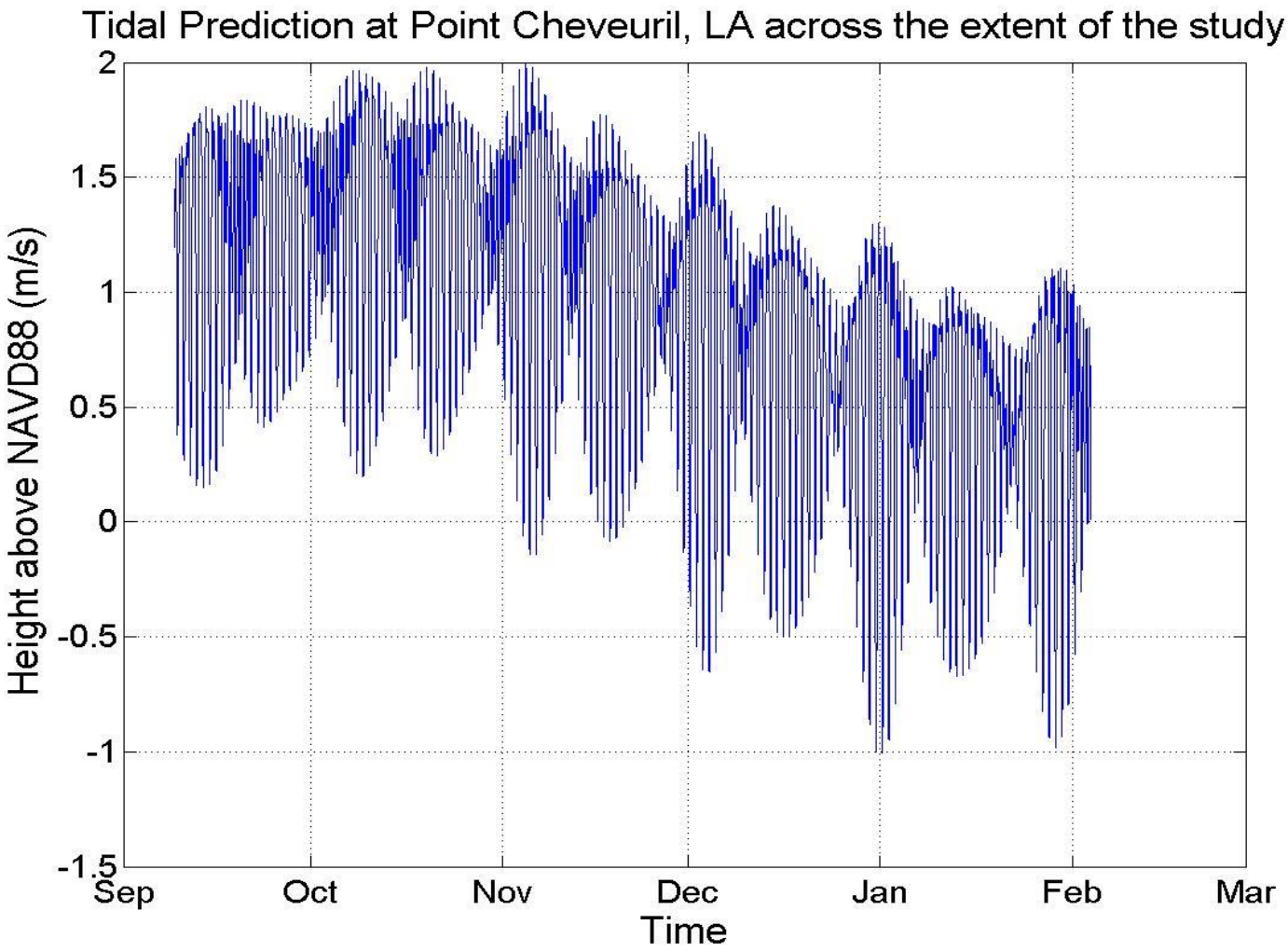


Figure S6: Tidal prediction at Point Cheveuril, LA (10 miles west of Pintail Island) for the duration of the study [NOAA 2014].

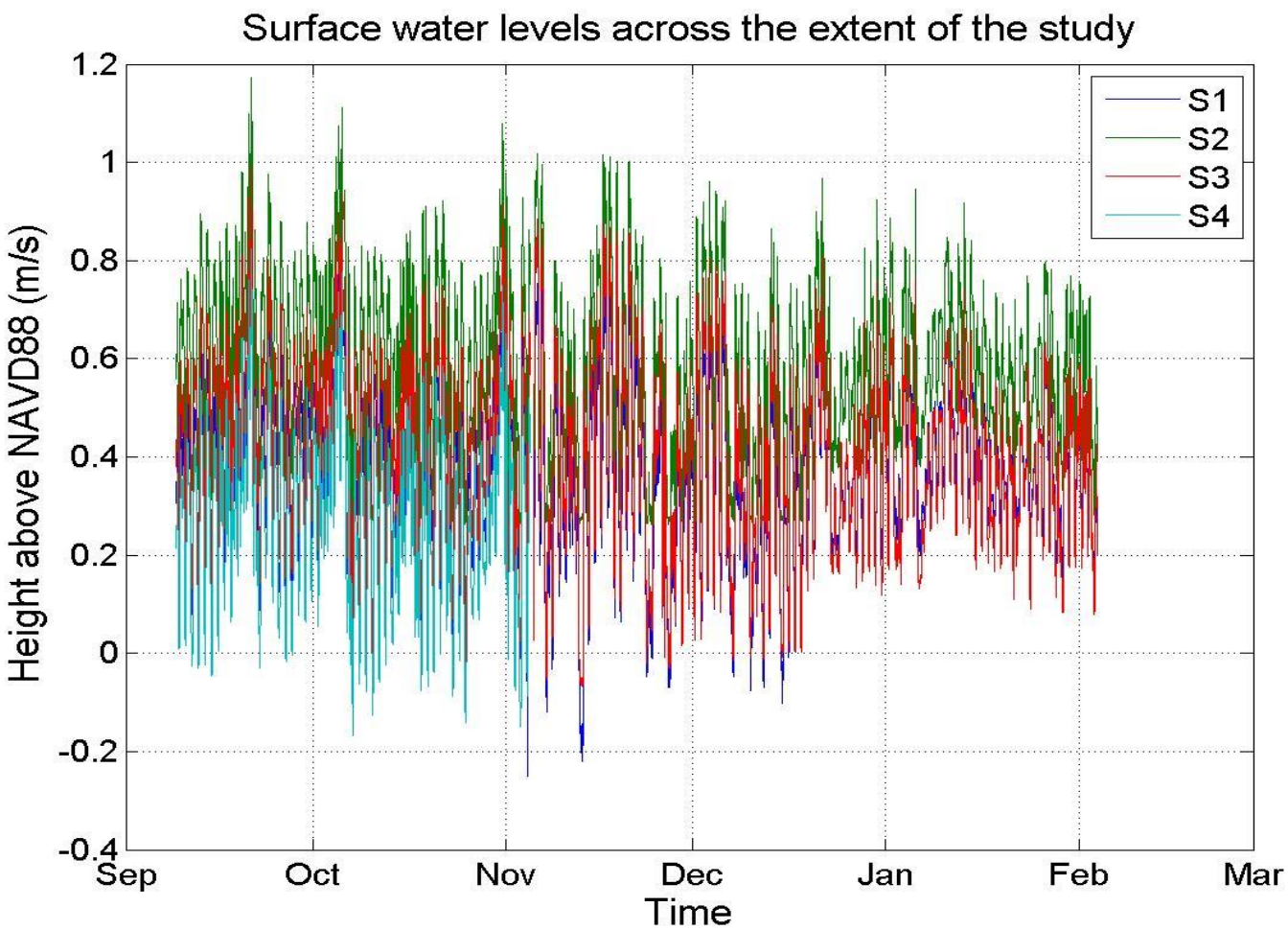


Figure S7: Surface water levels recorded for the duration of the study. Logger S4 was irreparably damaged following the first collection event and thus does not have readings beyond 04-Nov-2013.

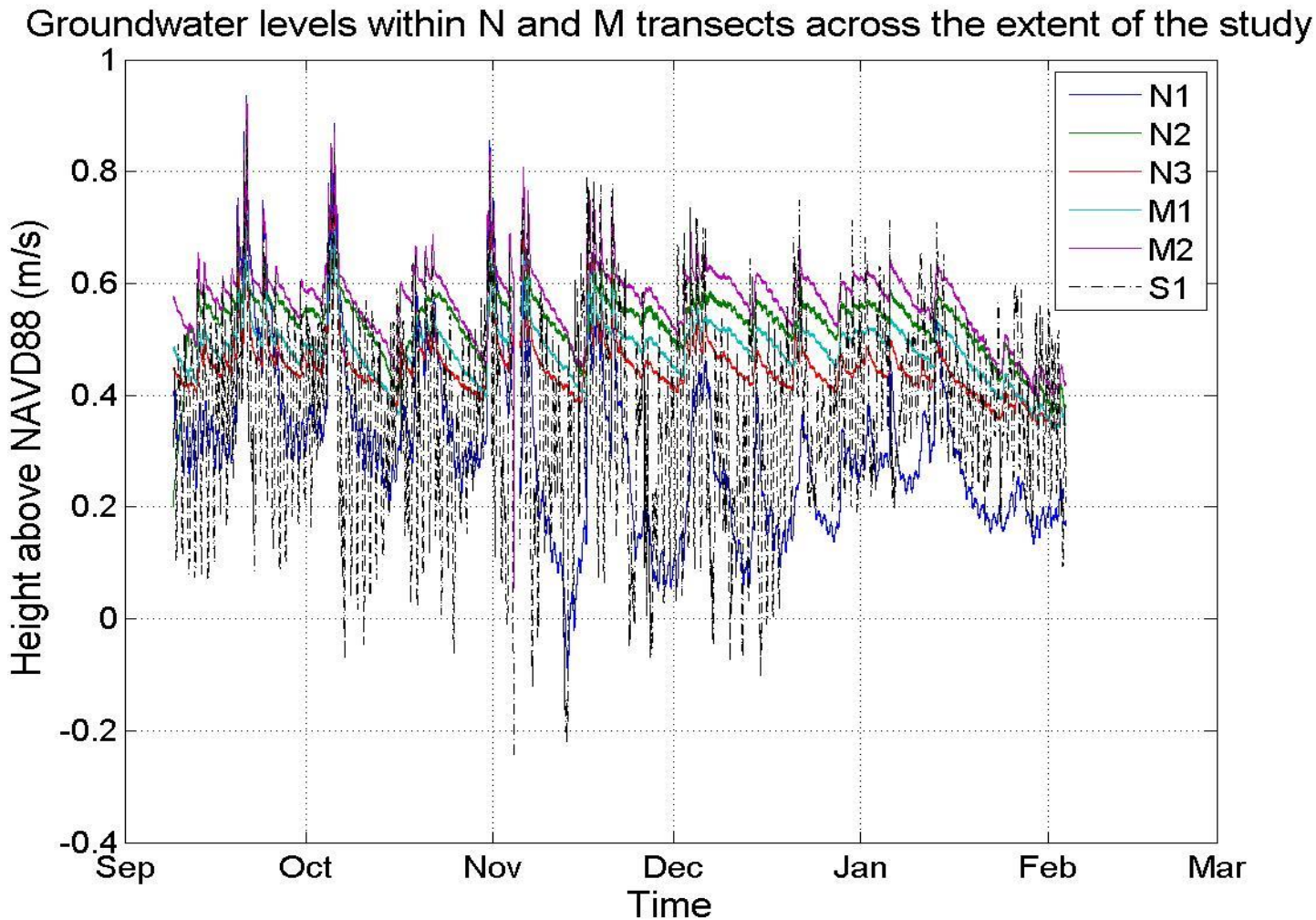


Figure S8: Groundwater levels recorded for the duration of the study for the N and M transects (deep wells only).

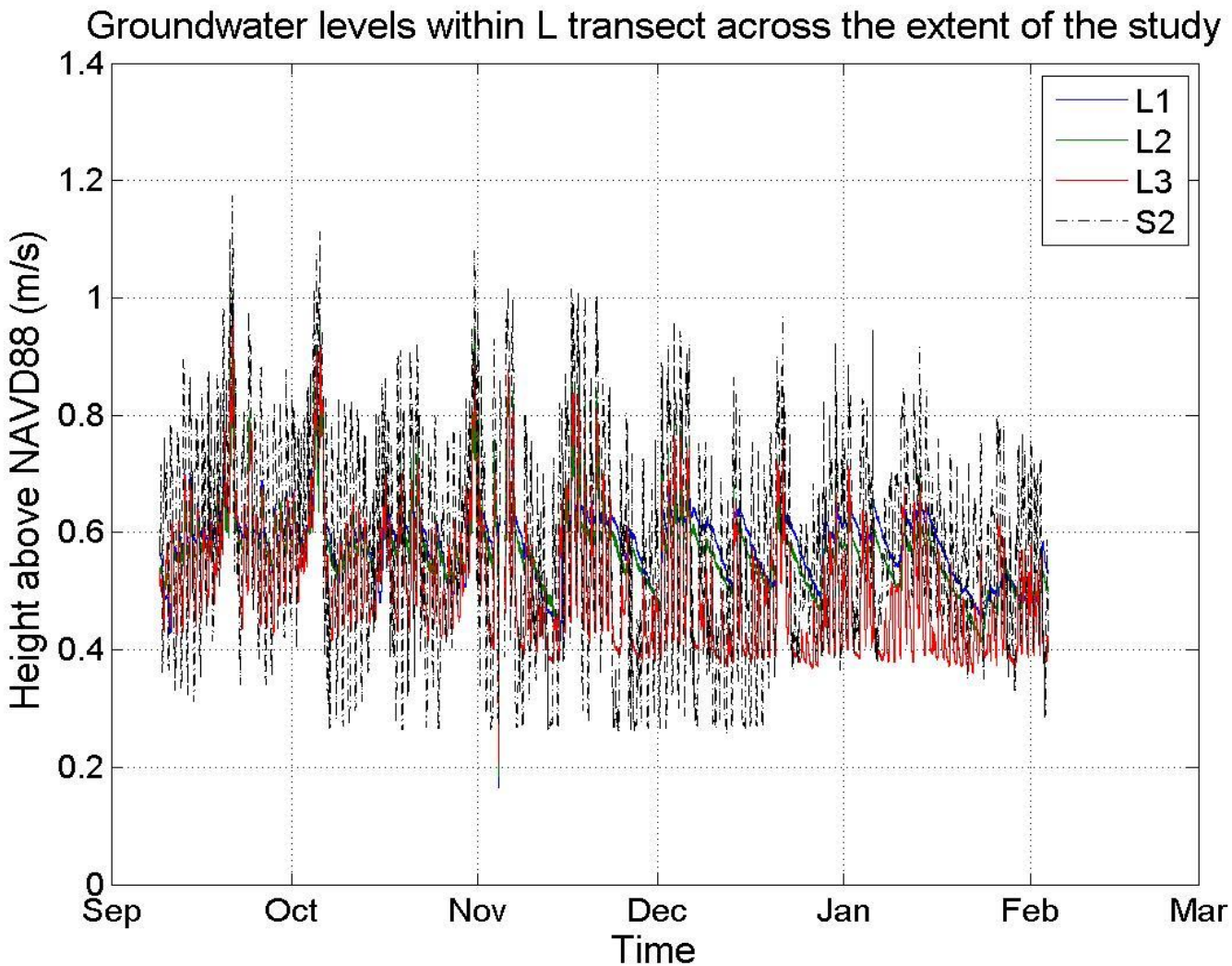


Figure S9: Groundwater levels recorded for the duration of the study for the L transect (deep wells only, except L2, which is shallow).

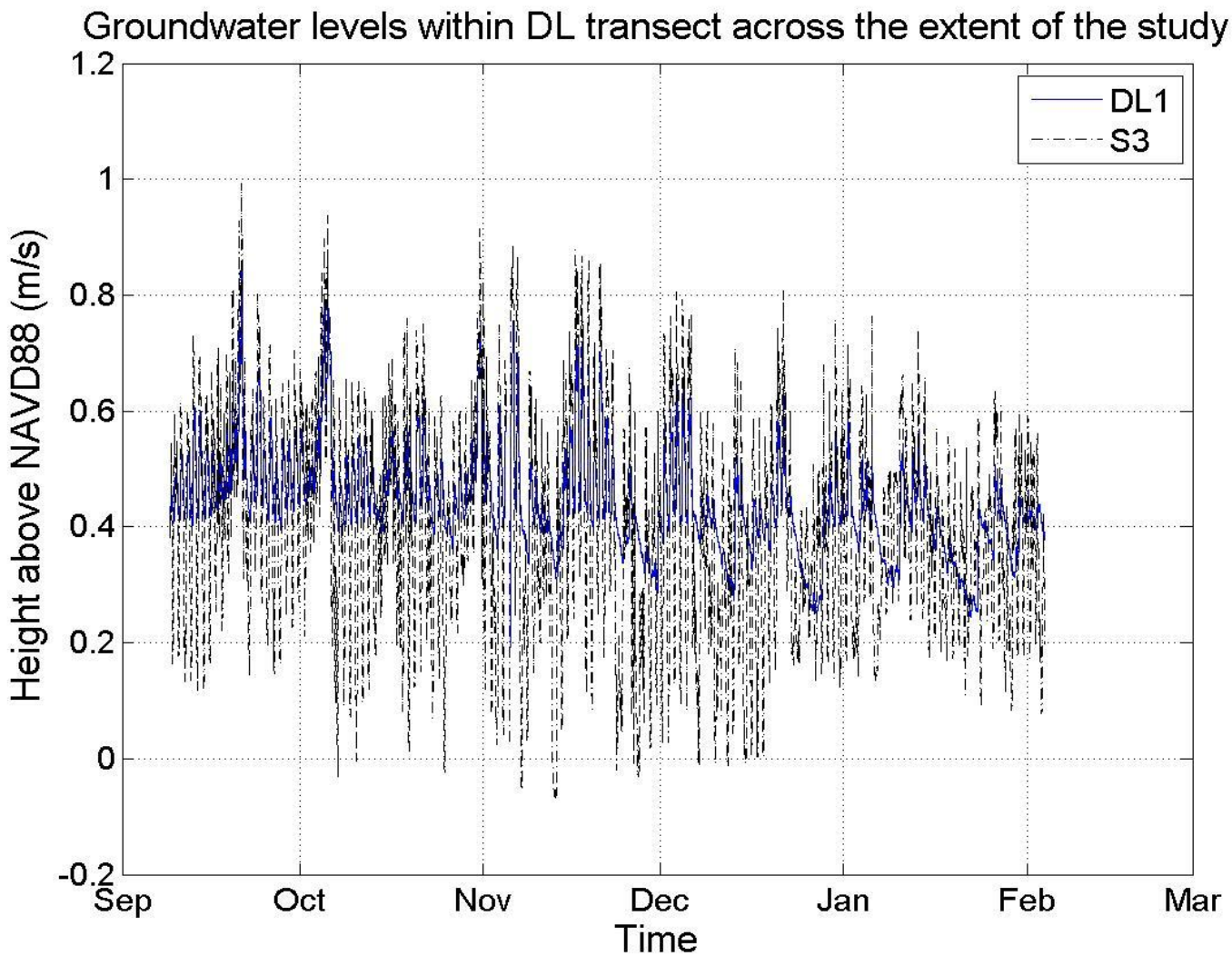


Figure S10: Groundwater levels recorded for the duration of the study for the DL transect (deep well only).

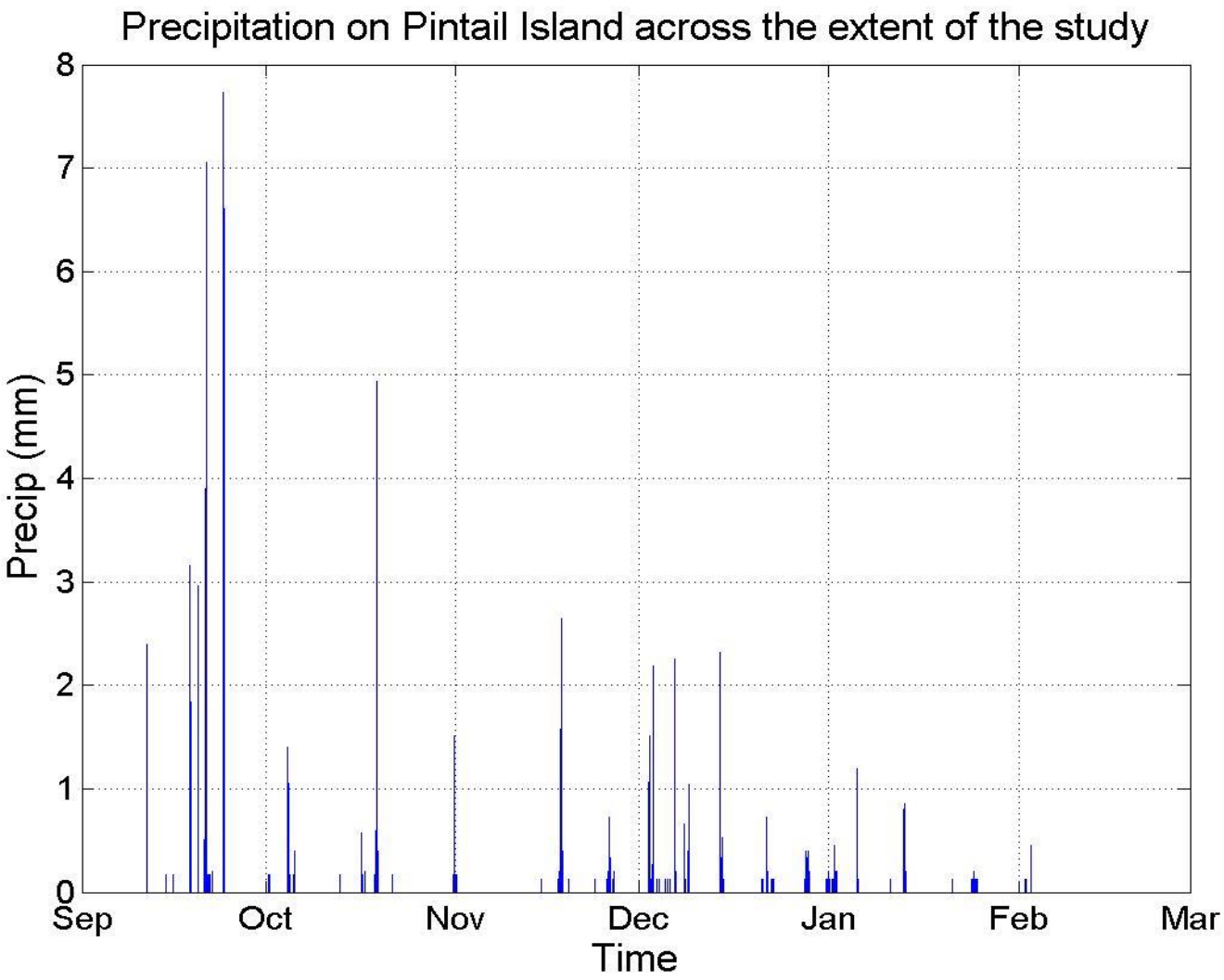


Figure S11: Precipitation recorded for the duration of the study at the weather station on the apex of Pintail Island.

References

NOAA, 2014, Tide Predictions - Point Chevreuil 8764634 Tidal Data Daily View - http://tidesandcurrents.noaa.gov/noaatidepredictions/NOAATidesFacade.jsp?Stationid=8764634

USGS, 2014a, USGS Current Conditions for USGS 07381490 Atchafalaya River at Simmesport, LA: http://waterdata.usgs.gov/nwis/uv/?site_no=07381490

USGS, 2014b, USGS Current Conditions for USGS 07381590 Wax Lake Outlet at Calumet, LA: http://waterdata.usgs.gov/nwis/uv/?site_no=07381590