DEEP-C Physical Oceanography in the DeSoto Canyon Region Mooring Data Report

by
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November 2013

Submitted to Deep-C, FLorida State University, Tallahassee, FL
Submitted by Leidos Corporation, Raleigh, NC

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Introduction

The Deep-C Consortium, funded by the Gulf of Mexico Research Initiative (GoMRI), has a primary goal of understanding and modeling the exchange of water and material between the outer continental shelf and the upper continental slope in a region that was impacted by the Deepwater Horizon oil spill. One of the physical oceanographic tasks of the study was to obtain velocity and property (temperature and salinity) measurements on a transect across the shelf break in the vicinity of the shelf break to develop a better understanding of the dynamics of the flow regimes and exchange processes. It is known from previous studies that the outer shelf has flow components that are strongly influenced by the wind through coastal-trapped waves propagating northwards along the west Florida shelf, however, the upper slope is strongly influenced by warm and cold eddies that move in from the deep eastern basin of the Gulf. The complex interactions between these flow regimes, impacts of varying along-slope topography, and interactions with local and remote winds, are some of the processes that this component of the study was designed to address. The resulting observations will be used for detailed analysis by the PI team, and also to support numerical circulation modeling of the oil spill region through model verification and dynamical analysis. The main part of the measurement program was the deployment of six full-depth moorings across the shelf-break in the vicinity of the DeSoto Canyon for a period of one year.

This data report presents a selection of the observations obtained by the mooring component of the study, as well as information on data return, and mooring configurations. The report complements a data CD that contains data files with documentation, issued in October 2013.

The field portion of this study was conducted from May 2012 through May 2013 with six sub-surface and three bottom-mounted ADCP moorings deployed. Water depths were from 50 m to 700m with all but 2 of these moorings at 106 m or less. The moorings were instrumented with temperature, conductivity and pressure sensors for scalar measurements and point as well as profiling current meters for current velocity measurements. Onboard CTD casts were taken on the deployment and retrieval cruises, PE12-26 and PE13-27, respectively, conducted from the *R/V Pelican*. Cruise reports detailing activities and stations, are available from the Deep-C data center[1] [2]. Publically available meteorological and coastal water level data were obtained from NOAA's National Data Buoy Center (NDBC) for buoys and C-MAN stations in the region for the period of this study, and included on the data CD.

[1] DEEP-C PHYSICAL OCEANOGRAPHY CRUISE REPORT, PE12-26 Speer, 10-15 May 2012, R/V Pelican, K. Speer, J. Singer and N. Wienders.

[2] DEEP-C PHYSICAL OCEANOGRAPHY CRUISE REPORT, PE13-27 Speer, 16-19 May 2013, R/V Pelican, C. Hancock, J. Singer and K. Speer.

The moorings were successfully deployed and retrieved with an excellent data return. These data were QA/QC'd and the data distributed to the program PI's. A majority of the instruments, and some of the mooring hardware (floats, releases, etc.) were loaned to Deep-C and SAIC[3] from the Bureau of Ocean Energy Management (BOEM), with the remainder from SAIC's and FSU's inventories. Details of the sources for the moored instruments are given in the time line plots. Under the GoMRI rules of the award, only expendables could be purchased, so the availability of instruments from other sources was crucial for this mooring based observational study. BOEM and Dr. Alexis Lugo-Fernandez are particularly thanked for making instruments and hardware available.

Two tropical storms (Hurricane Isaac, and Tropical Storm Debby) impacted the study area during the program and some limited plots of the oceans response to these events are provided herein.

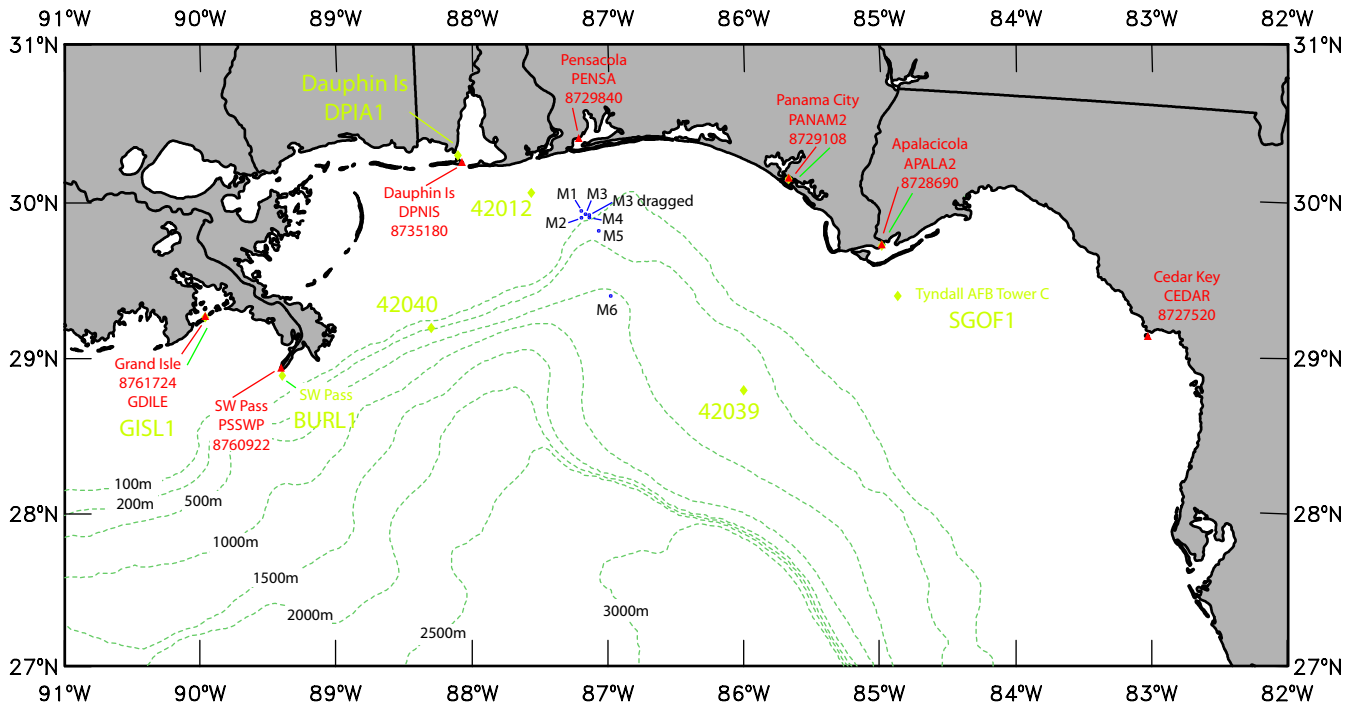
The report is organized as follows: 1) Maps and tables of mooring and CTD locations, followed by sketches of mooring configurations; 2) Time lines and tables showing data return for each instrument. On the time lines, a solid line represents velocities or velocity profiles from acoustic Doppler current profilers (ADCP), and the dashed line represents any or all of temperature, pressure or salinity; and 3) Time series plots of selected data from the six moorings. For the most part the data plots are for 40-hour-low-pass (40-HLP) filtered variables, where coordinate system for velocities has been rotated such that the y-axis (or v-component) is directed along the local isobaths, and x-axis (or u-component) is directed normal to the isobaths into deeper water. The filter removes tides and inertial oscillations with periods less than 40 hours. The local direction of the isobaths is found by inspecting a detailed chart, and comparing to the depth mean principal axis direction for the 40-HLP velocity vectors at each mooring. This direction is noted on the plots where the along-isobath v-component is upwards. Data processing conventions and QA/QC procedures are given in http://www.saicocean.com/SAICdocs/index.html. It is noted that mooring locations M1, M2, etc., and their equivalents F1, F2, etc., are used interchangeably in this document. SAIC database naming requirements forced the change from M to F for filenames and ID's on the data CD.

Data Issues for DEEP-C Instruments

1. FSU Shallow ADCP. The ADCP, S/N 7114, in the trawl resistant bottom mount (TRBM) at M1 was deployed in a water depth of 53m. The processed file yielded 10 bin levels resulting in a calculated depth of 51m at the transducer head, within reasonable depth errors. The pressure sensor for this instrument reported a minimum depth of 28m, about 23m shallower than what would be expected.

[3] Science Applications International Corporation (SAIC) was responsible for deploying and retrieving the moorings along with data processing and QA/QC. SAIC was renamed Leidos Corporation on September 27, 2013.

2. Short FSU ADCP Files. Both FSU WorkHorse ADCP files were short due to an RDI firmware change to 50.40. This occurred during refurbishment/upgrade at RDI prior to deployment. This new firmware no longer recognized the existing memory cards. FSU was informed of this issue after the recovery cruise. The data from WHADCP, S/N 7114, mounted to the TRBM at M1, ended November 8, 2012, however, because of specialized data recovery on the memory card, complete one-year velocity and temperature/pressure records were recovered. Thanks are due to Nicolas Wienders (FSU) for this recovery effort. The data from WHADCP, S/N 718, mounted to the TRBM at M2, ended October 17, 2012, and unfortunately, the specialized data recovery was not successful for this instrument's data card.
3. Schlumberger CTDs. Of the 12 CTDs that were deployed, eight were recovered. Of these eight, one would not communicate (S/N K6746) and one had bad pressure (K6750). All salinity data were bad, most failed after a few days. Only the CTD (S/N K6750) mounted on the M3 TRBM had a conductivity record but it was deemed unusable due to unrealistic values.
4. M3 Mooring Dragged. M3 was deployed on 2012/5/13 with the first valid data at 0600 GMT. Four days later, on 2012/5/17 the mooring was dragged by an unknown vessel for about an hour to a new location with similar water depth. The upper 4 CTDs were lost as well as the top float. The bottom most CTD was the only one recovered. The first good data for this instrument (M0054) at this new site was at 1315 GMT. All data for this instrument on this CD are from this new location.



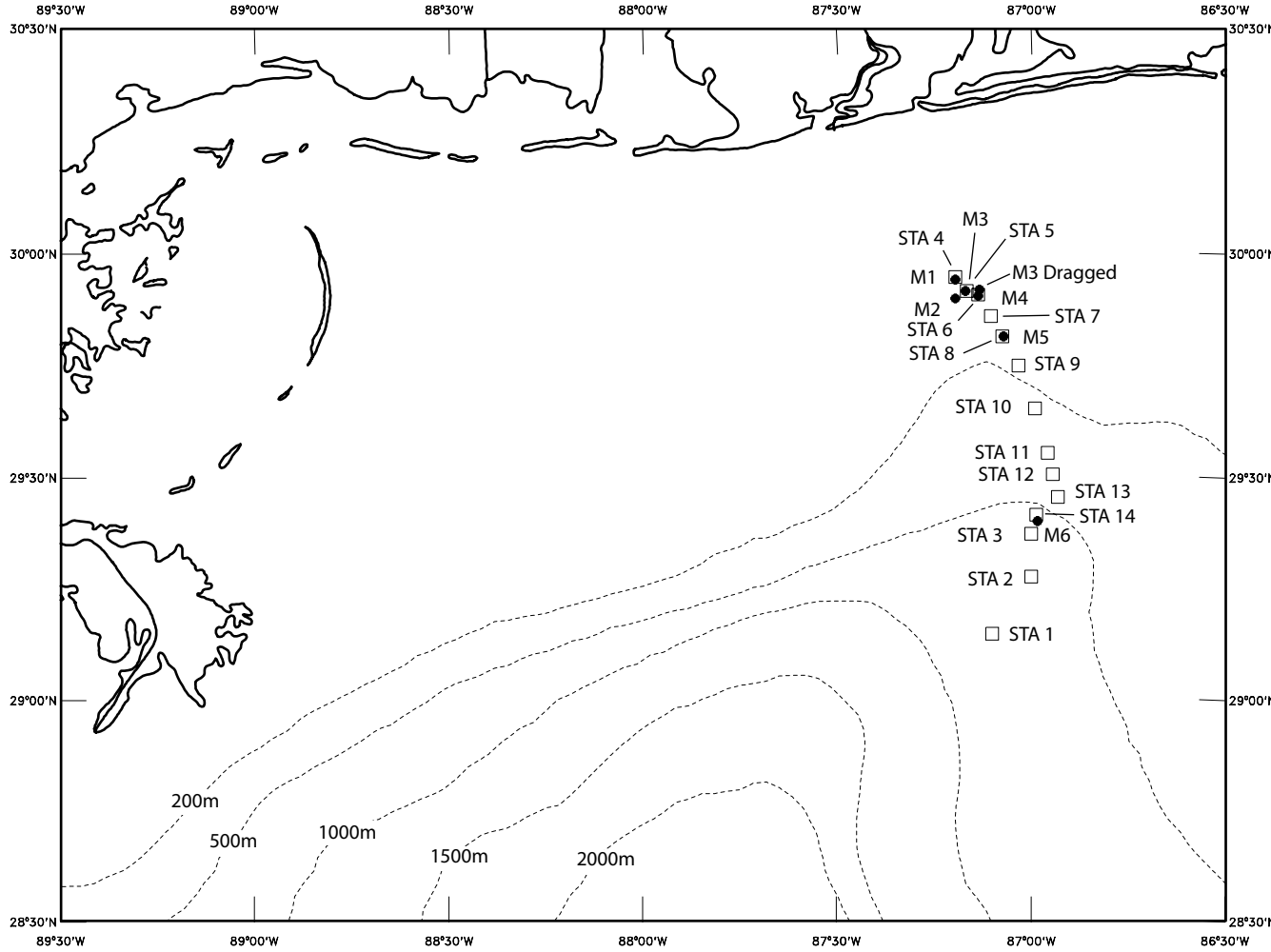
M1 - Deep C Moorings BURL1 - C-MAN, NOS and NDBC Meteological Stations PENSA - NOS, CO-OPS Water Level Stations

Deep C Mooring Locations

Mooring	Latitude	Longitude	Water Depth
M1	29° 56.685’ N	87° 11.614’ W	53 m
M1 TRBM	29° 56.749’ N	87° 11.473’ W	53 m
M2	29° 54.067’ N	87° 11.637’ W	78 m
M2 TRBM	29° 54.078’ N	87° 11.586’ W	79 m
M3 (old)	29° 55.101’ N	87° 10.190’ W	97 m
M3 (new)	29° 55.277’ N	87° 08.059’ W	~98 m
M3 TRBM	29° 53.079’ N	87° 10.088’ W	97 m
M4	29° 54.424’ N	87° 08.173’ W	106 m
M5	29° 48.940’ N	87° 04.242’ W	206 m
M6	29° 24.090’ N	86° 59.012’ W	715 m

Mooring M3 was dragged on day 4 of its deployment.

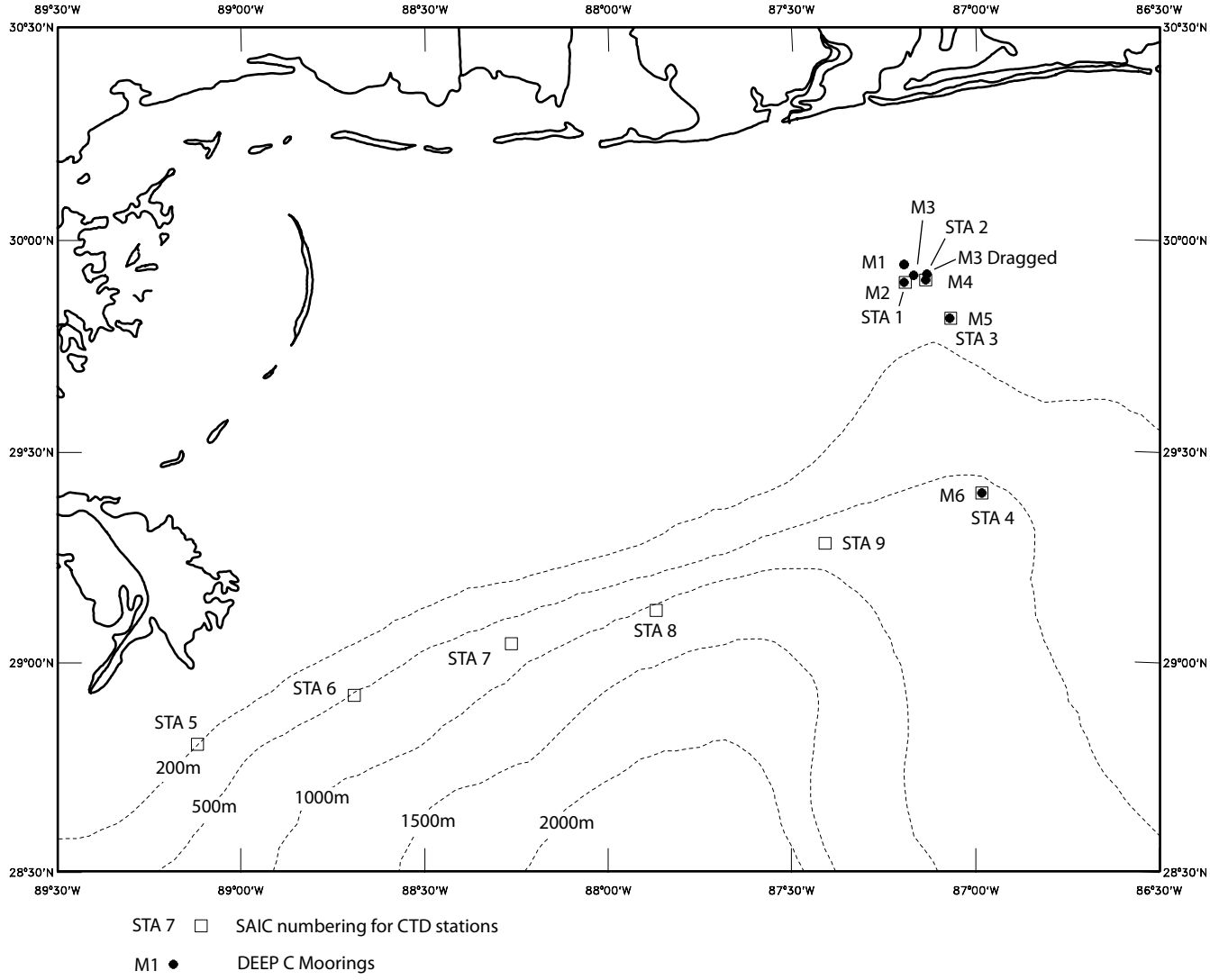
FSU/GRI Moorings and CTD Locations
PE12-26



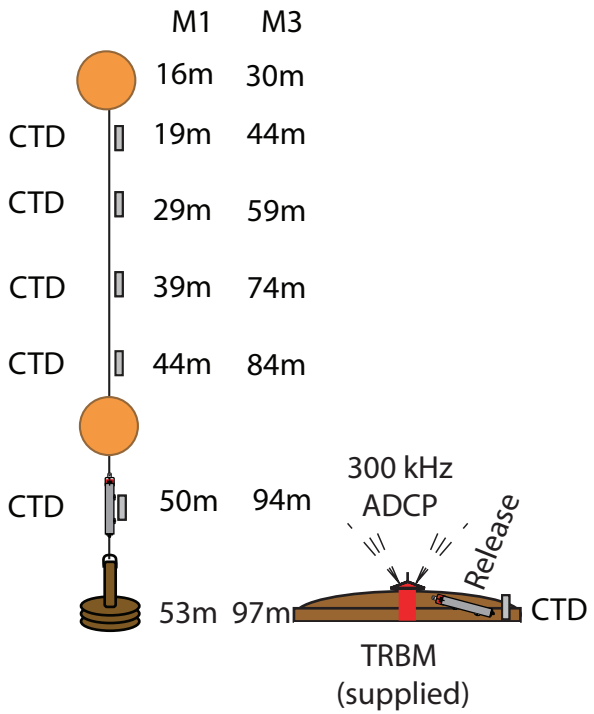
STA 11 □ SAIC numbering for CTD stations

M1 ● DEEP C Moorings

FSU/GRI Moorings and CTD Locations
PE13-27

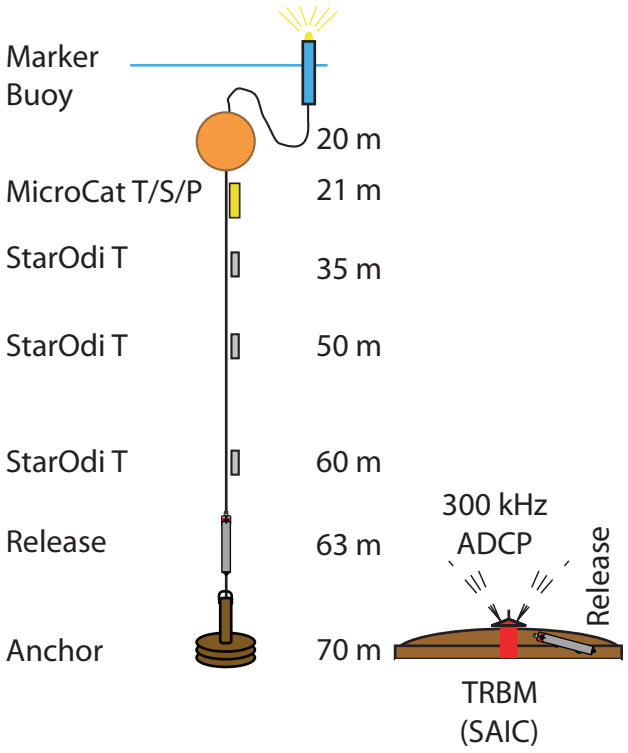


Moorings 1 (53m) and 3 (97m)
(FSU)

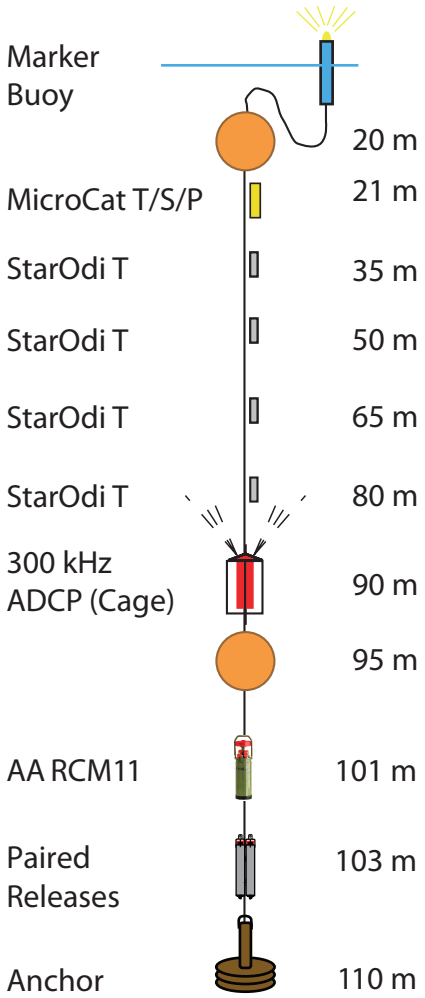


All CTDs on M1 and M3 are
Schlumberger CTDs

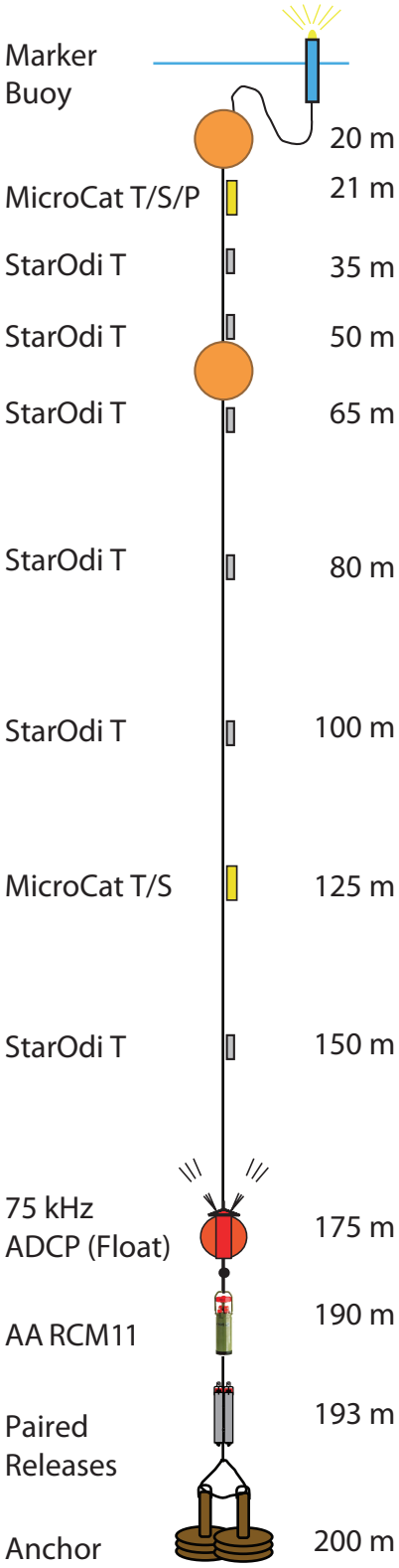
Mooring 2



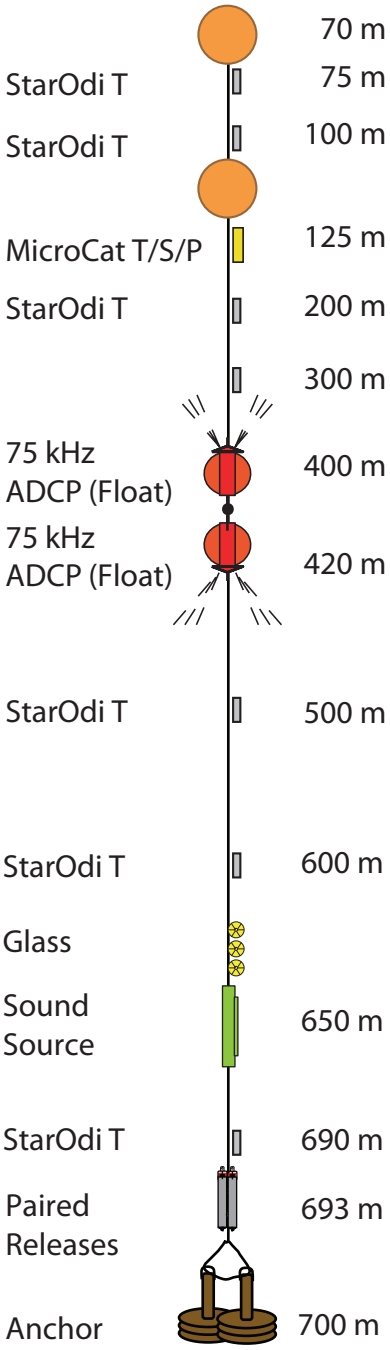
Mooring 4

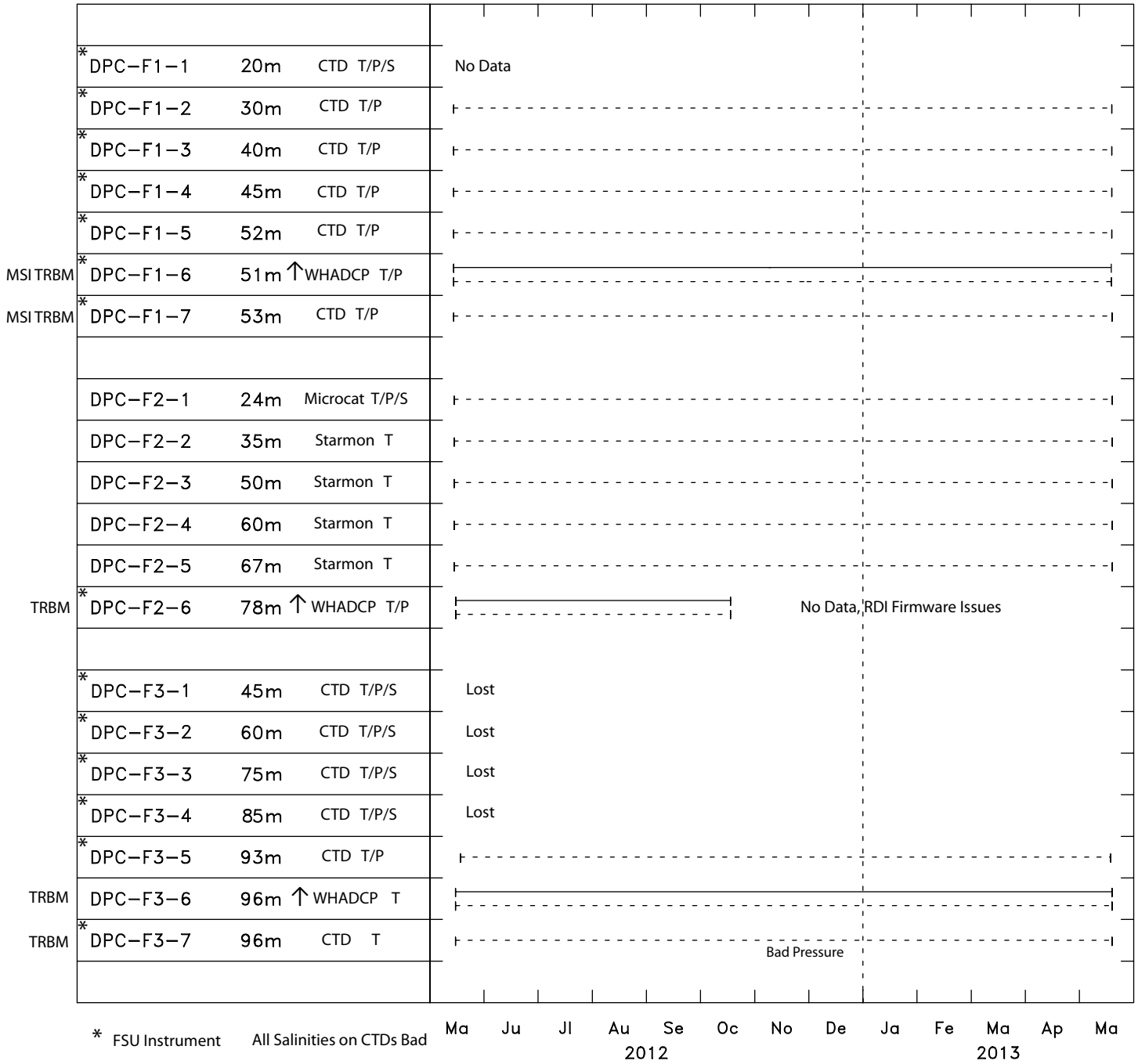


Mooring 5



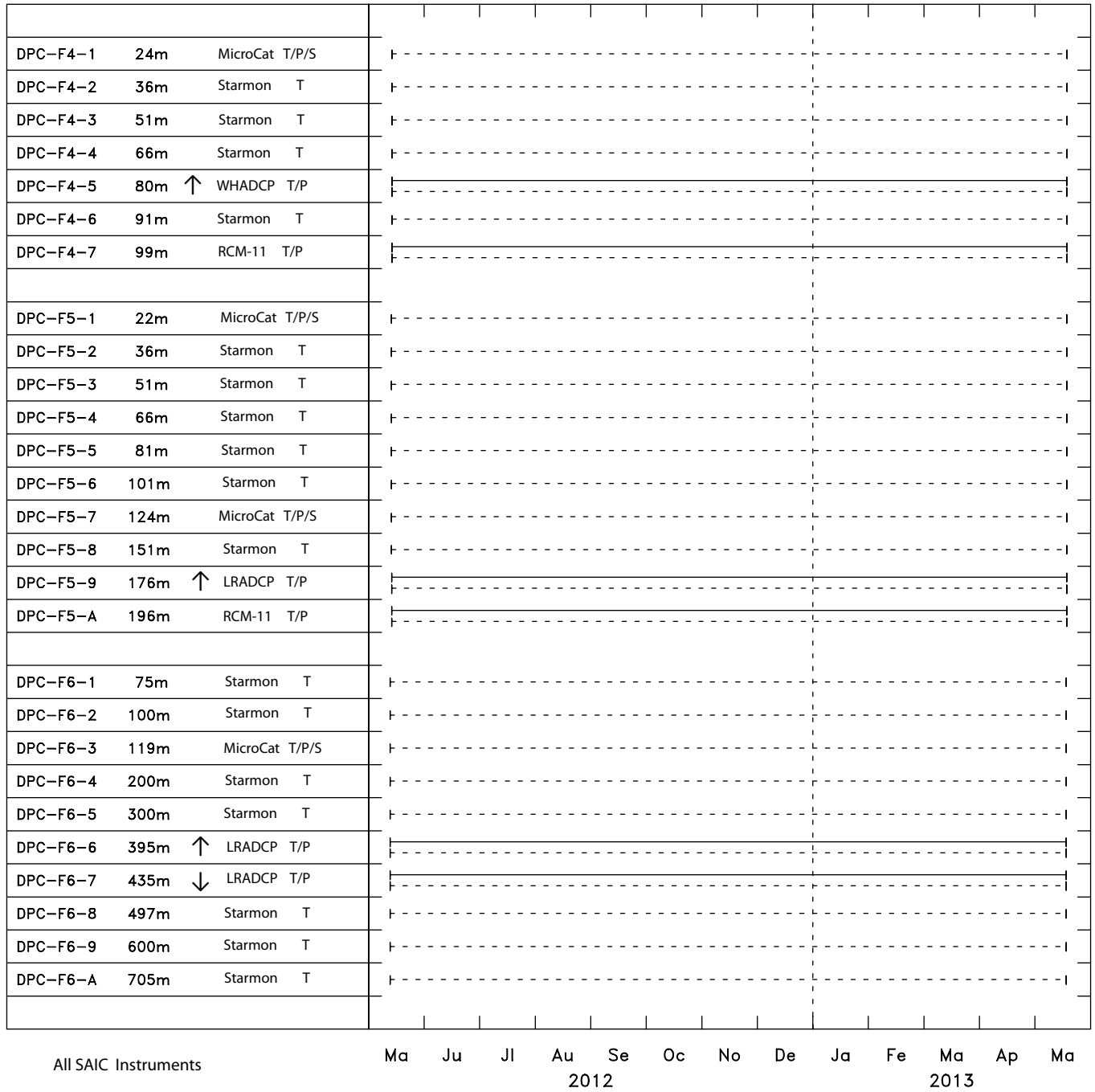
Mooring 6





* FSU Instrument All Salinities on CTDs Bad

SAIC All Other Instruments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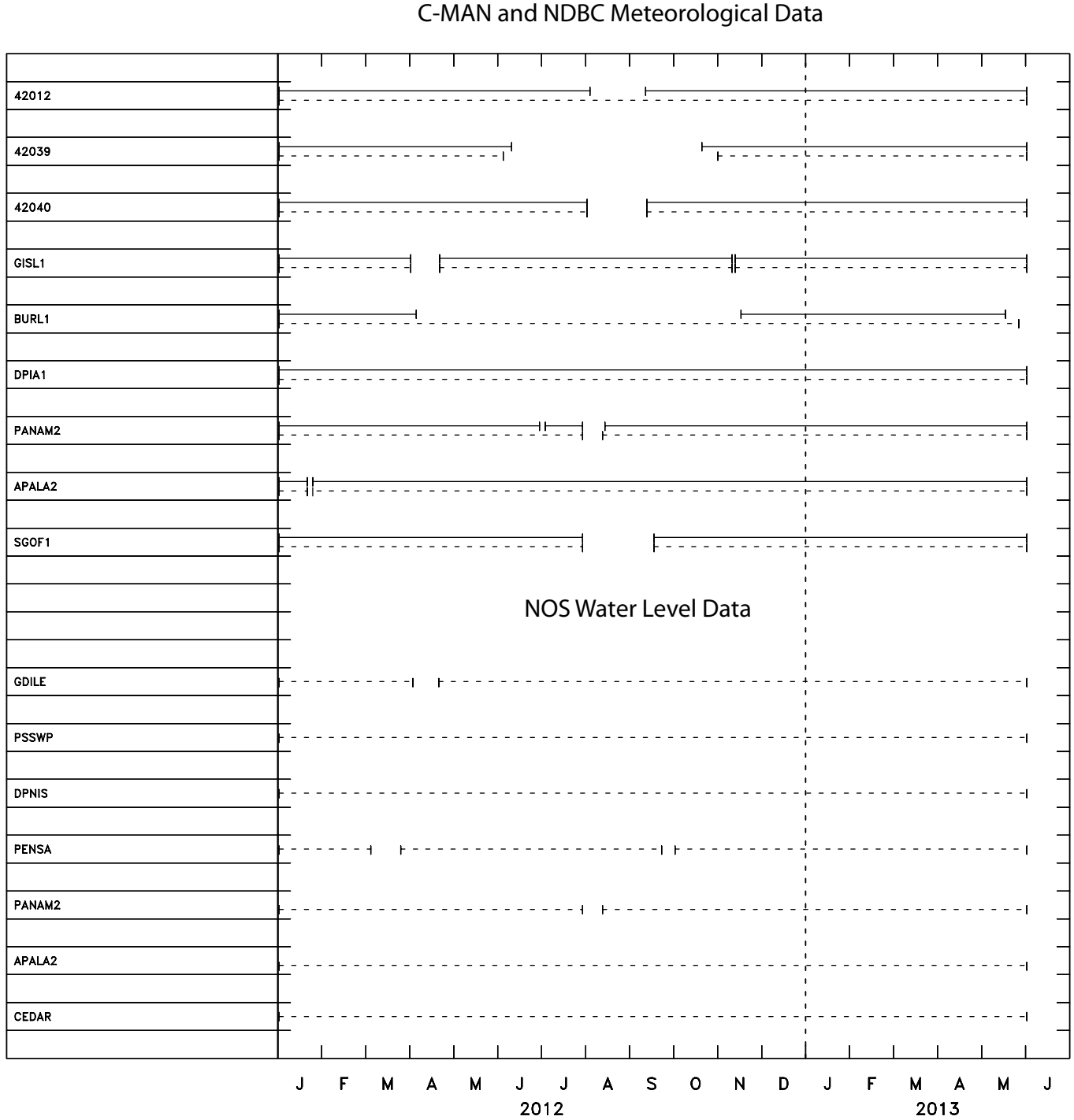
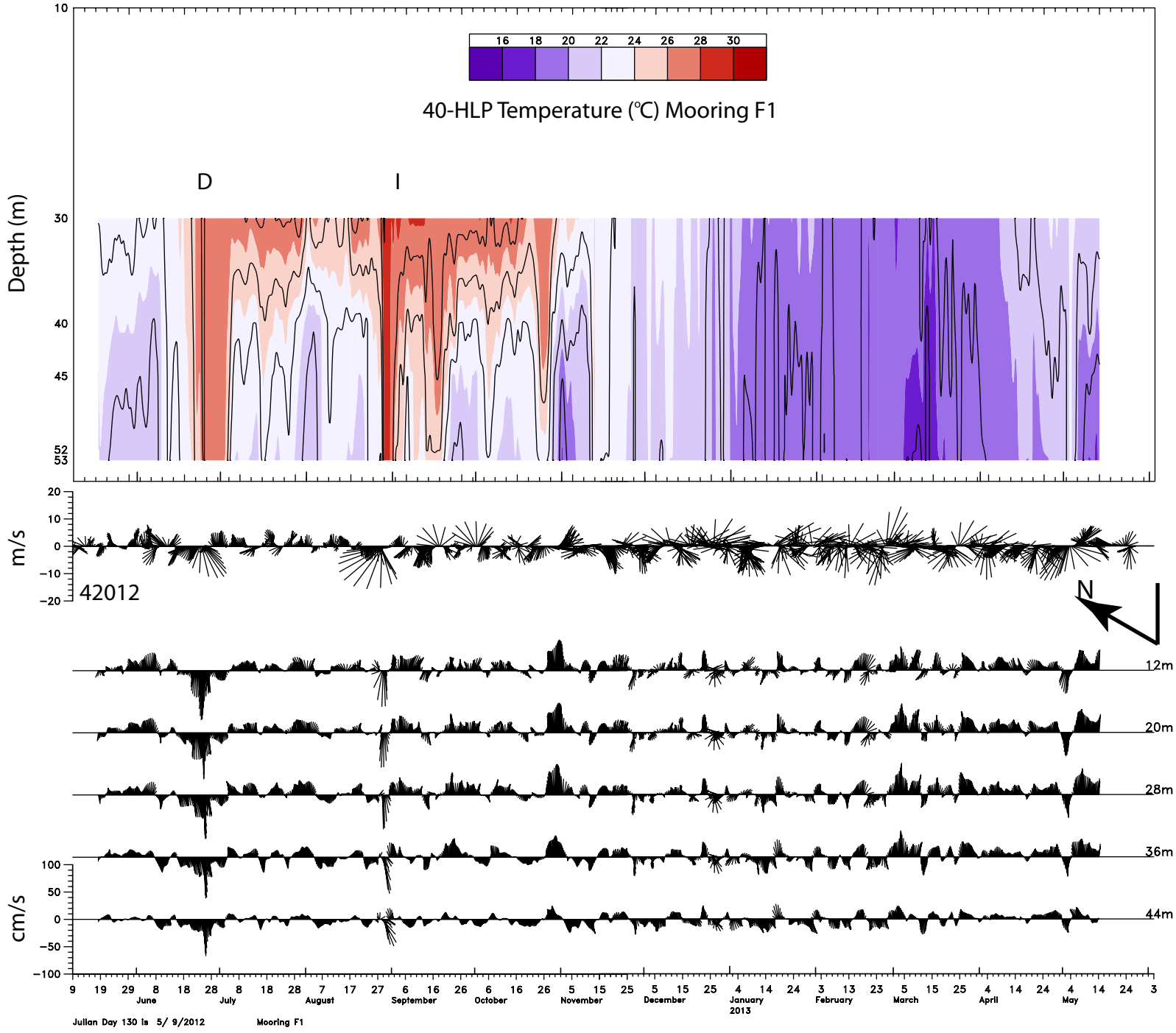
DPC–F4–2 36m Starmon T
DPC–F4–3 51m Starmon T
DPC–F4–4 66m Starmon T
DPC–F4–5 80m ↑ WHADCP T/P
DPC–F4–6 91m Starmon T
DPC–F4–7 99m RCM-11 T/P
DPC–F5–1 22m MicroCat T/P/S
DPC–F5–2 36m Starmon T
DPC–F5–3 51m Starmon T
DPC–F5–4 66m Starmon T
DPC–F5–5 81m Starmon T
DPC–F5–6 101m Starmon T
DPC–F5–7 124m MicroCat T/P/S
DPC–F5–8 151m Starmon T
DPC–F5–9 176m ↑ LRADCP T/P
DPC–F5–A 196m RCM-11 T/P
DPC–F6–1 75m Starmon T
DPC–F6–2 100m Starmon T
DPC–F6–3 119m MicroCat T/P/S
DPC–F6–4 200m Starmon T
DPC–F6–5 300m Starmon T
DPC–F6–6 395m ↑ LRADCP T/P
DPC–F6–7 435m ↓ LRADCP T/P
DPC–F6–8 497m Starmon T
DPC–F6–9 600m Starmon T
DPC–F6–A 705m Starmon T
All SAIC Instruments
Ma Ju Jl Au Se Oc No De Ja Fe Ma Ap Ma
2012
2013

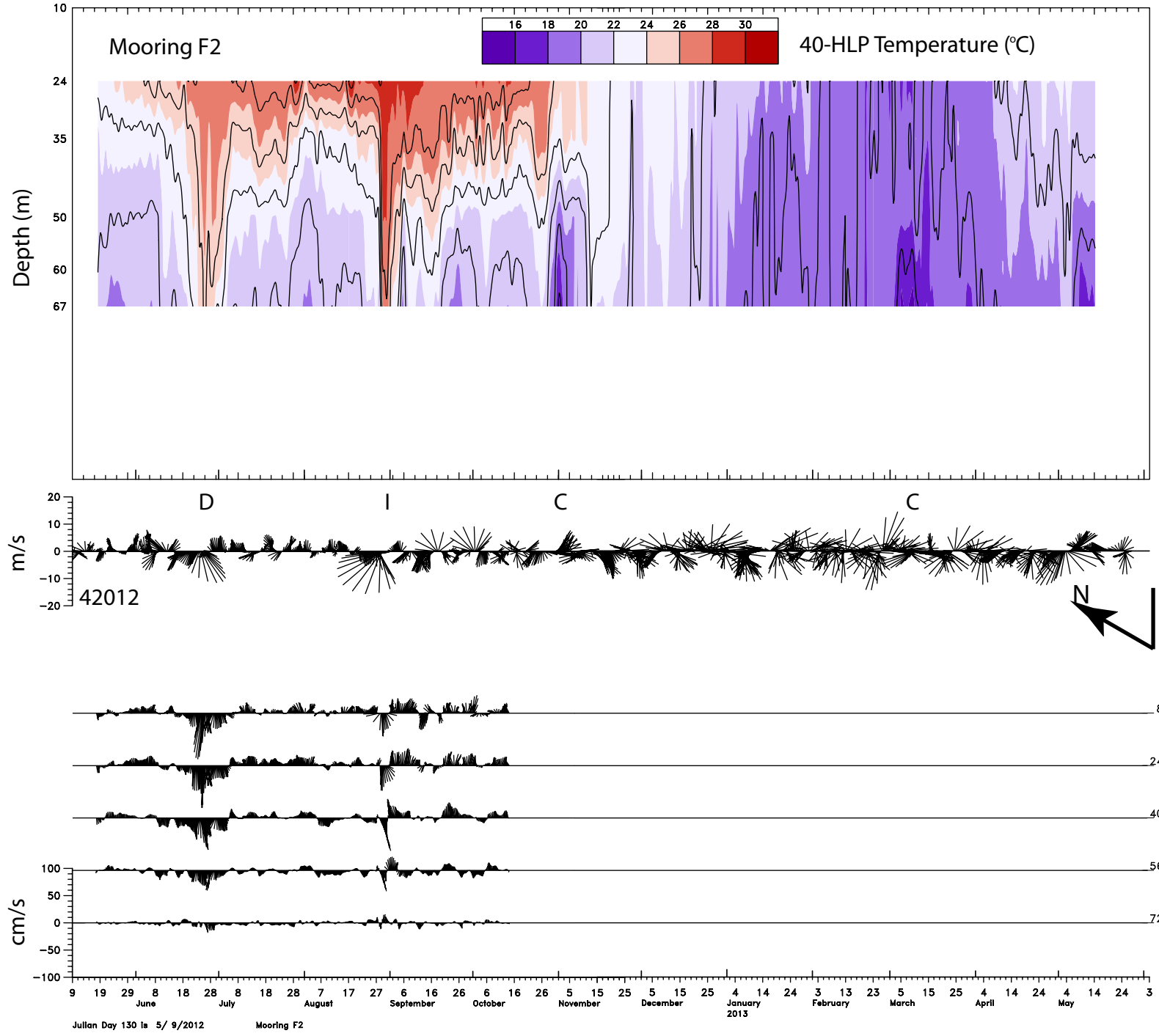

C-MAN and NDBC Meteorological Data
42012
42039
42040
GISL1
BURL1
DPIA1
PANAM2
APALA2
SGOF1
NOS Water Level Data
GDILE
PSSWP
DPNIS
PENSA
PANAM2
APALA2
CEDAR
J F M A M J J A S O N D J F M A M J
2012
2013

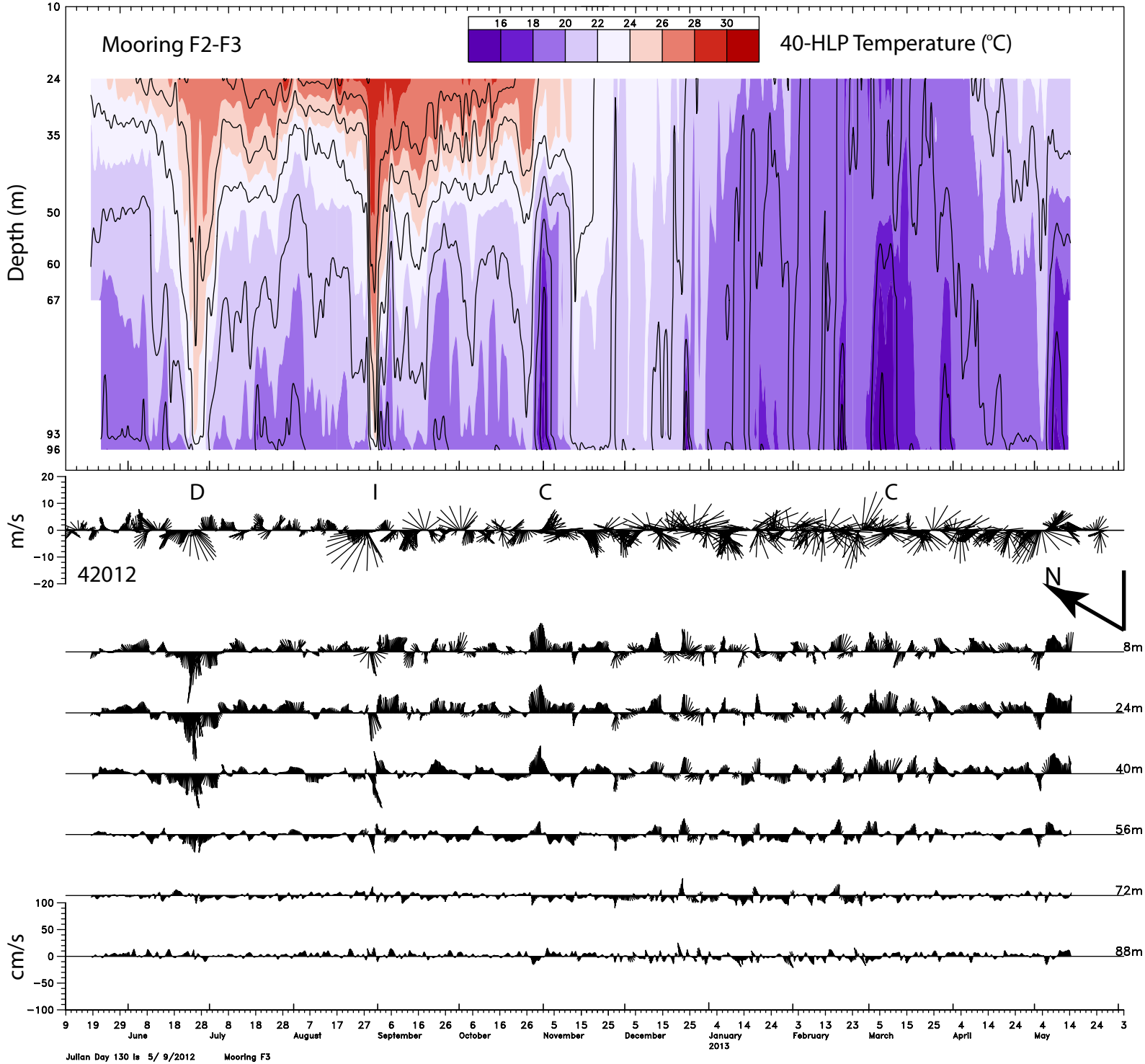
			DEEP-C Moorings	% Data Return by Mooring					
					F1	F1			F3	F3
Level	Instrument	Scalar		Depth m	Good	Possible		Depth m	Good	Possible
1	CTD	S		20	0	35509		45	0	35082
		T			0	35509			0	35082
		P			0	35509			0	35082
2	CTD	S		30	0	35509		60	0	35082
		T			35509	35509			0	35082
		P			35509	35509			0	35082
3	CTD	S		40	0	35509		75	0	35082
		T			35509	35509			0	35082
		P			35509	35509			0	35082
4	CTD	S		45	0	35509		85	0	35082
		T			35509	35509			0	35082
		P			35509	35509			0	35082
5	CTD	S		52	0	35509		93	0	35082
		T			35509	35509			35082	35082
		P			35509	35509			35082	35082
6	WHADCP TRBM	Currents		51	26635	26635		96	8857	8857
		T			26635	26635			8857	8857
		P			26635	26635				
7	CTD TRBM	S		53	0	35514		96	0	35430
		T			35514	35514			35430	35430
		P			35514	35514			0	35430
	Totals				435005	719082			123308	650234
	Percent Good					60.494492				18.963635

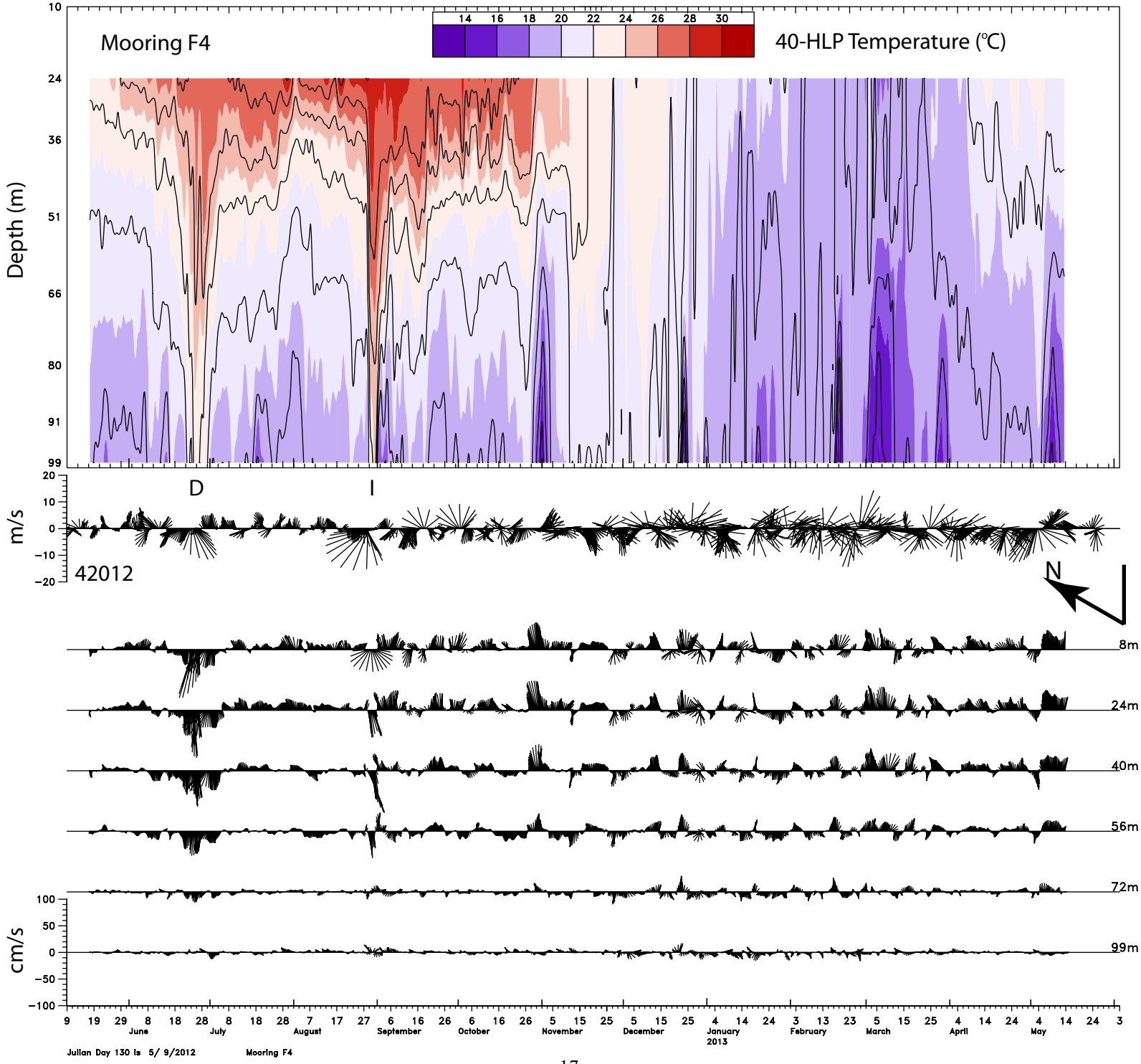
					F2	F2			F4	F4
Level	Instrument	Scalar		Depth m	Good	Possible		Depth m	Good	Possible
1	MicroCat	S		24	17757	17757		24	17751	17751
		T			17757	17757			17751	17751
		P			17757	17757			17751	17751
2	Starmon	T		35	17757	17757		36	17751	17751
3	Starmon	T		50	17757	17757		51	17751	17751
4	Starmon	T		60	17757	17757		66	17751	17751
5	Starmon	T		67	17757	17757		N/A		
5	WHADCP	Currents		N/A				80	8875	8875
		T							8875	8875
6	WHADCP	Currents		78	11180	11180		N/A		
		T			11180	11180				
		P			11180	11180				
6	Starmon	T		N/A				91	17751	17751
7	RCM-11	Currents		N/A				99	8875	8875
		T							8875	8875
		P							8875	8875
	Totals				157839	157839			168632	168632
	Percent Good					100.00				100.00

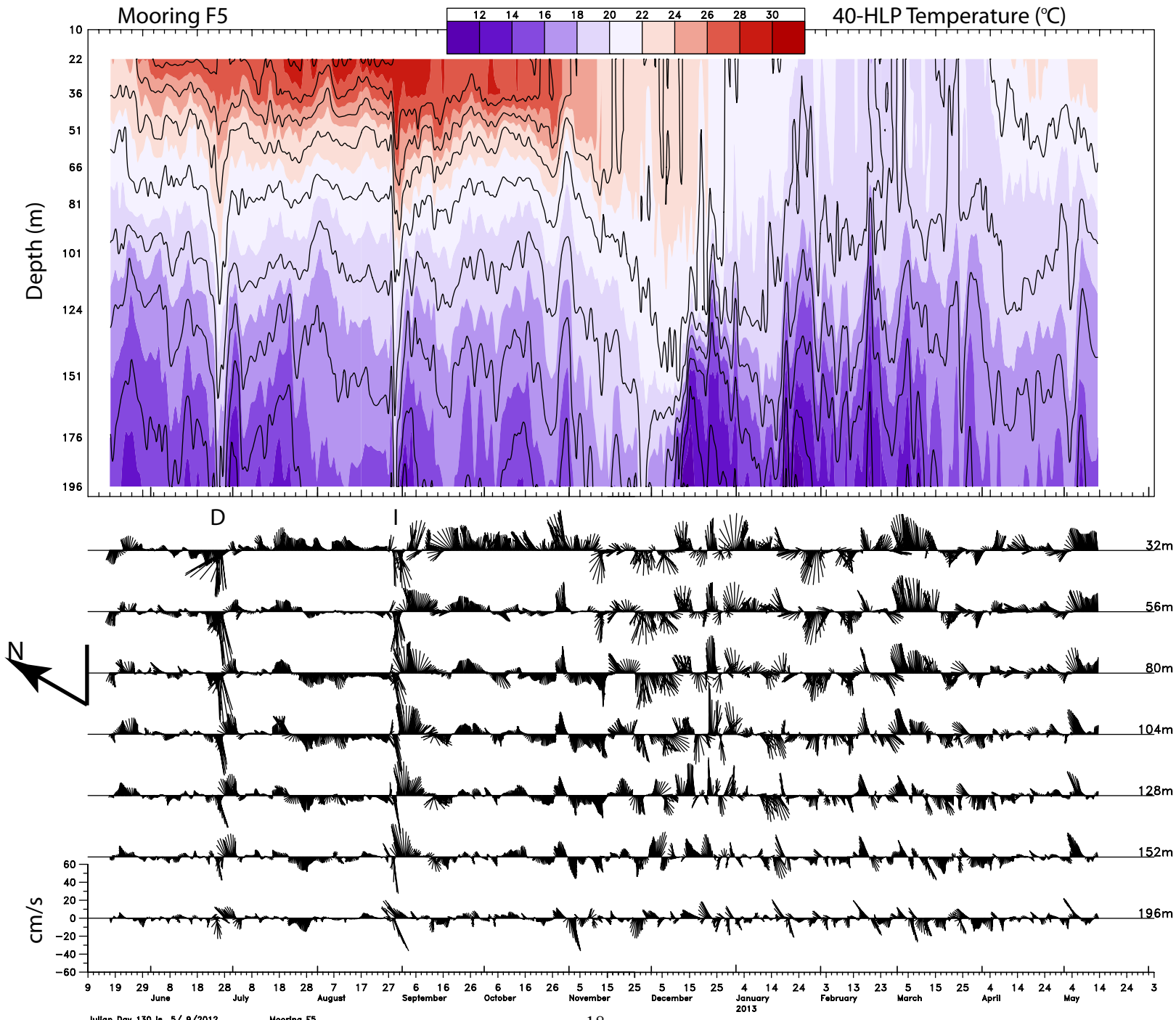
					F5	F5			F6	F6
Level	Instrument	Scalar		Depth m	Good	Possible		Depth m	Good	Possible
1	MicroCat	S		22	17758	17758		N/A		
		T			17758	17758				
		P			17758	17758				
1	Starmon	T		N/A				75	17785	17785
2	Starmon	T		36	17758	17758		100	17785	17785
3	Starmon	T		51	17758	17758		N/A		
3	MicroCat	S		N/A				119	17785	17785
		T							17785	17785
		P							17785	17785
4	Starmon	T		66	17758	17758		200	17785	17785
5	Starmon	T		81	17758	17758		300	17785	17785
6	Starmon	T		101	17758	17758		N/A		
6	LRADCP	Currents		N/A				395	8892	8892
		T							8892	8892
		P							8892	8892
7	MicroCat	S		124	17758	17758		N/A		
		T			17758	17758				
		P			17758	17758				
7	LRADCP	Currents		N/A				435	8892	8892
		T							8892	8892
		P							8892	8892
8	Starmon	T		151	17758	17758		498	17785	17785
9	LRADCP	Currents		176	8878	8878		N/A		
		T			8878	8878				
		P			8878	8878				
9	Starmon	T		N/A				600	17785	17785
10	RCM-11	Currents		196	8879	8879		N/A		
		T			8879	8879				
		P			8879	8879				
10	Starmon	T		N/A				705	17785	17785
	Totals				266367	266367			231202	231202
	Precent Good					100.00				100.00

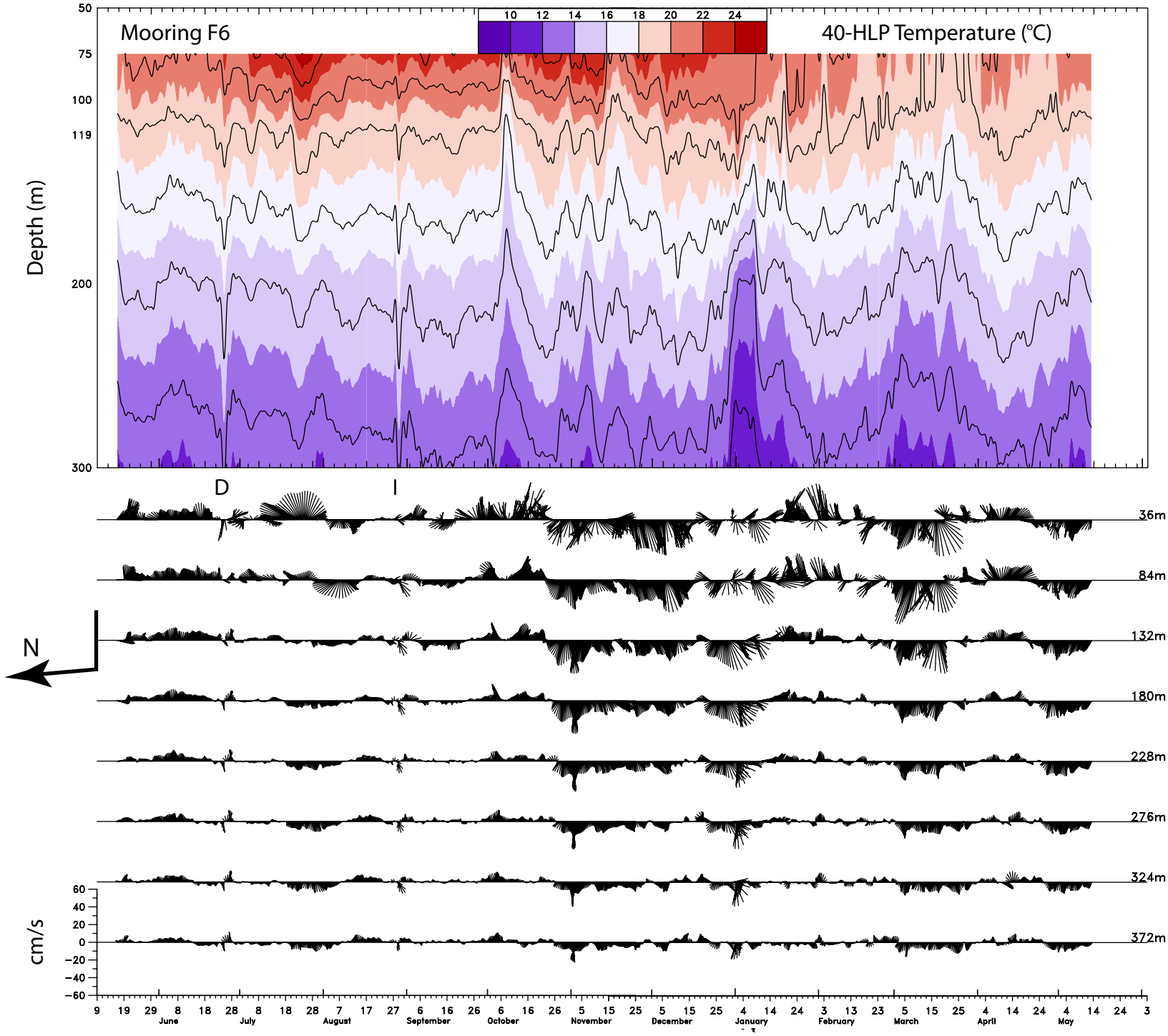

16 18 20 22 24 26 28 30
40-HLP Temperature (°C) Mooring F1
D
I
Depth (m)
10
30
40
45
52
53
m/s
20
10
0
−10
−20
42012
N
12m
20m
28m
36m
44m
cm/s
100
50
0
−50
−100
9 19 29 8 18 28 8 18 28 7 17 27 6 16 26 6 16 26 5 15 25 5 15 25 4 14 24 3 13 23 5 15 25 4 14 24 4 14 24 3
June
July
August
September
October
November
December
January
2013
February
March
April
May
Julian Day 130 is 5/ 9/2012
Mooring F1

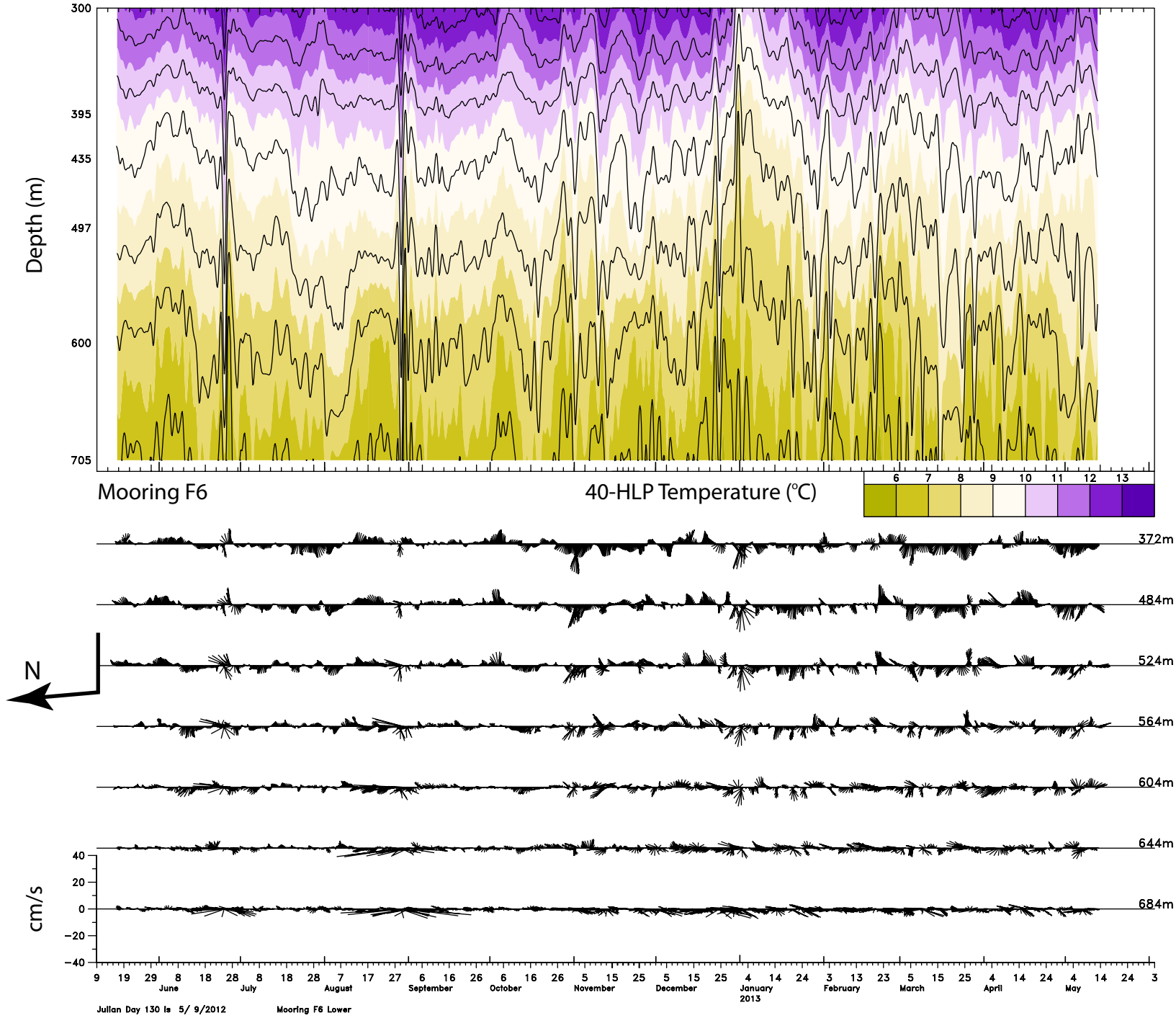

Mooring F2
16 18 20 22 24 26 28 30
40-HLP Temperature (°C)
Depth (m)
10
24
35
50
60
67
D
I
C
C
m/s
20
10
0
−10
−20
42012
N
8m
24m
40m
56m
72m
cm/s
100
50
0
−50
−100
9 19 29 8 18 28 8 18 28 7 17 27 6 16 26 6 16 26 5 15 25 5 15 25 4 14 24 3 13 23 5 15 25 4 14 24 4 14 24 3
June
July
August
September
October
November
December
January
2013
February
March
April
May
Julian Day 130 is 5/ 9/2012
Mooring F2

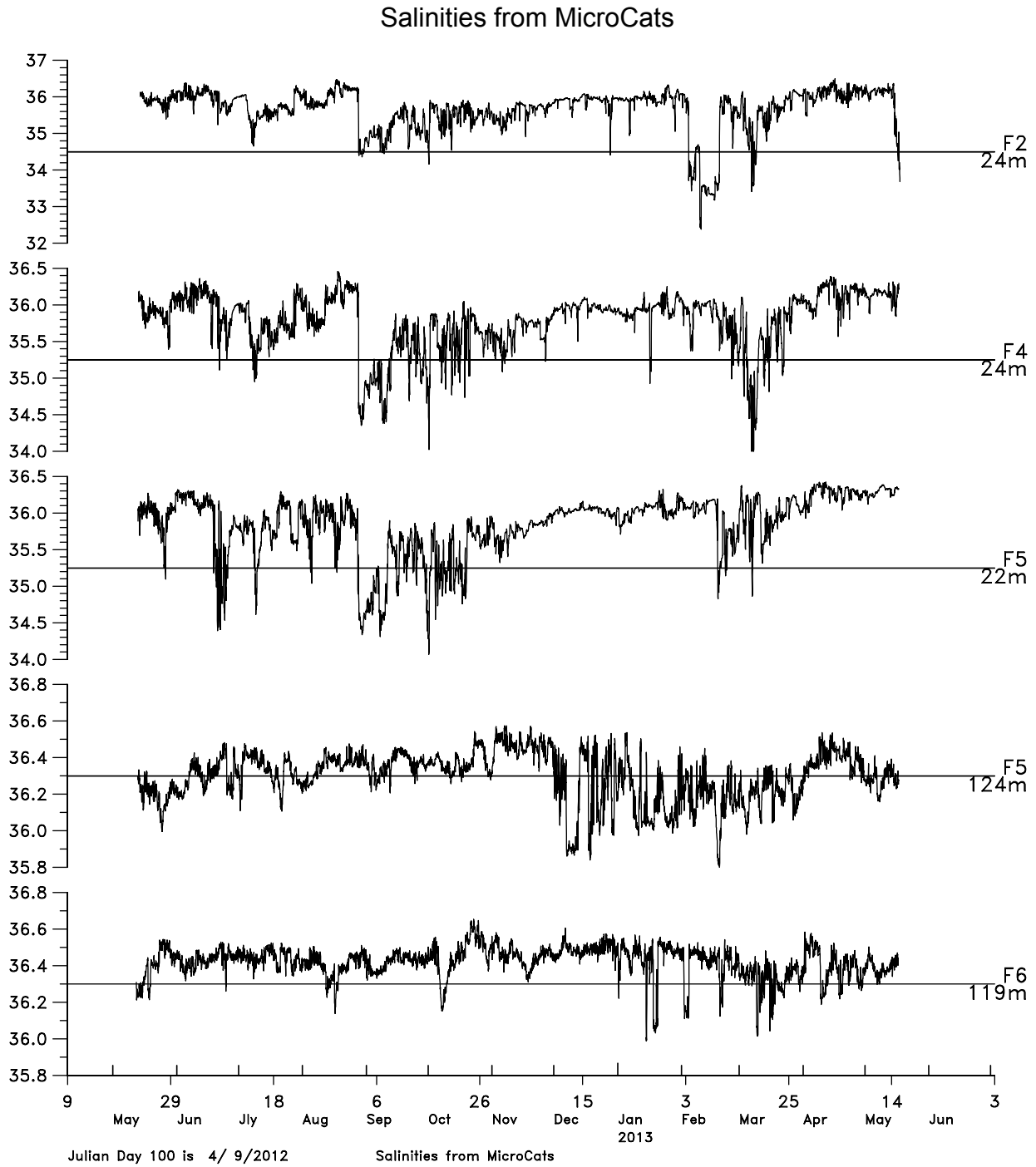

Mooring F2-F3
40-HLP Temperature (°C)
16 18 20 22 24 26 28 30
Depth (m)
10
24
35
50
60
67
93
96
D
I
C
C
m/s
20
10
0
−10
−20
42012
N
8m
24m
40m
56m
72m
88m
cm/s
100
50
0
−50
−100
9 19 29 8 18 28 8 18 28 7 17 27 6 16 26 6 16 26 5 15 25 5 15 25 4 14 24 3 13 23 5 15 25 4 14 24 4 14 24 3
June July August September October November December January 2013 February March April May
Julian Day 130 is 5/ 9/2012 Mooring F3

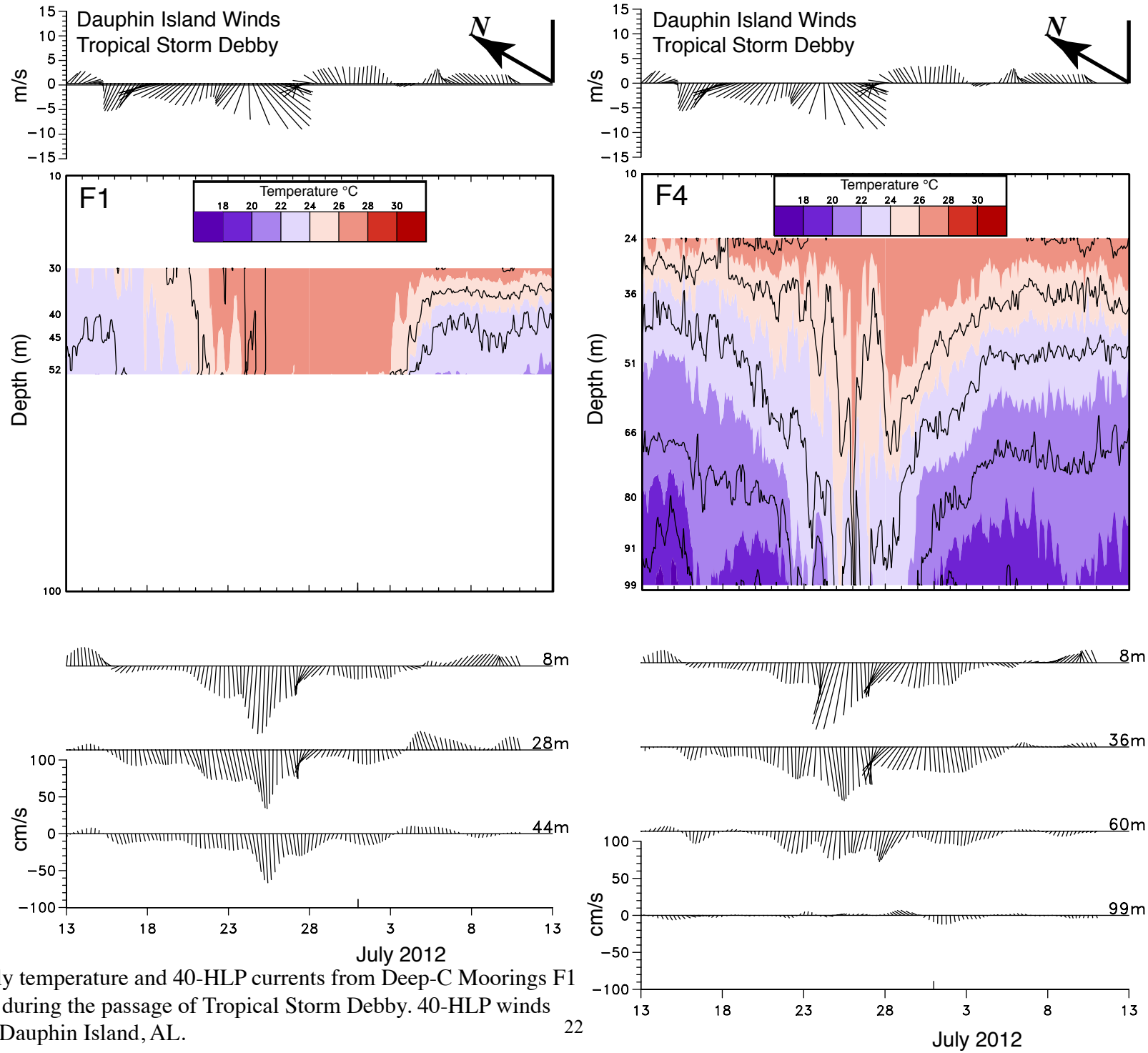

Mooring F4
40-HLP Temperature (°C)
14 16 18 20 22 24 26 28 30
Depth (m)
10 24 36 51 66 80 91 99
D
I
m/s
20 10 0 −10 −20
42012
N
8m
24m
40m
56m
72m
99m
cm/s
100 50 0 −50 −100
9 19 29 8 18 28 8 18 28 7 17 27 6 16 26 6 16 26 5 15 25 5 15 25 4 14 24 3 13 23 5 15 25 4 14 24 4 14 24 3
June July August September October November December January 2013 February March April May
Julian Day 130 is 5/ 9/2012
Mooring F4


Mooring F5
40-HLP Temperature (°C)
12 14 16 18 20 22 24 26 28 30
Depth (m)
10 22 36 51 66 81 101 124 151 176 196
D
I
32m
56m
80m
104m
128m
152m
196m
N
cm/s
60 40 20 0 −20 −40 −60
9 19 29 8 18 28 8 18 28 7 17 27 6 16 26 6 16 26 5 15 25 5 15 25 4 14 24 3 13 23 5 15 25 4 14 24 4 14 24 3
June July August September October November December January 2013 February March April May
Julian Day 130 is 5/ 9/2012
Mooring F5

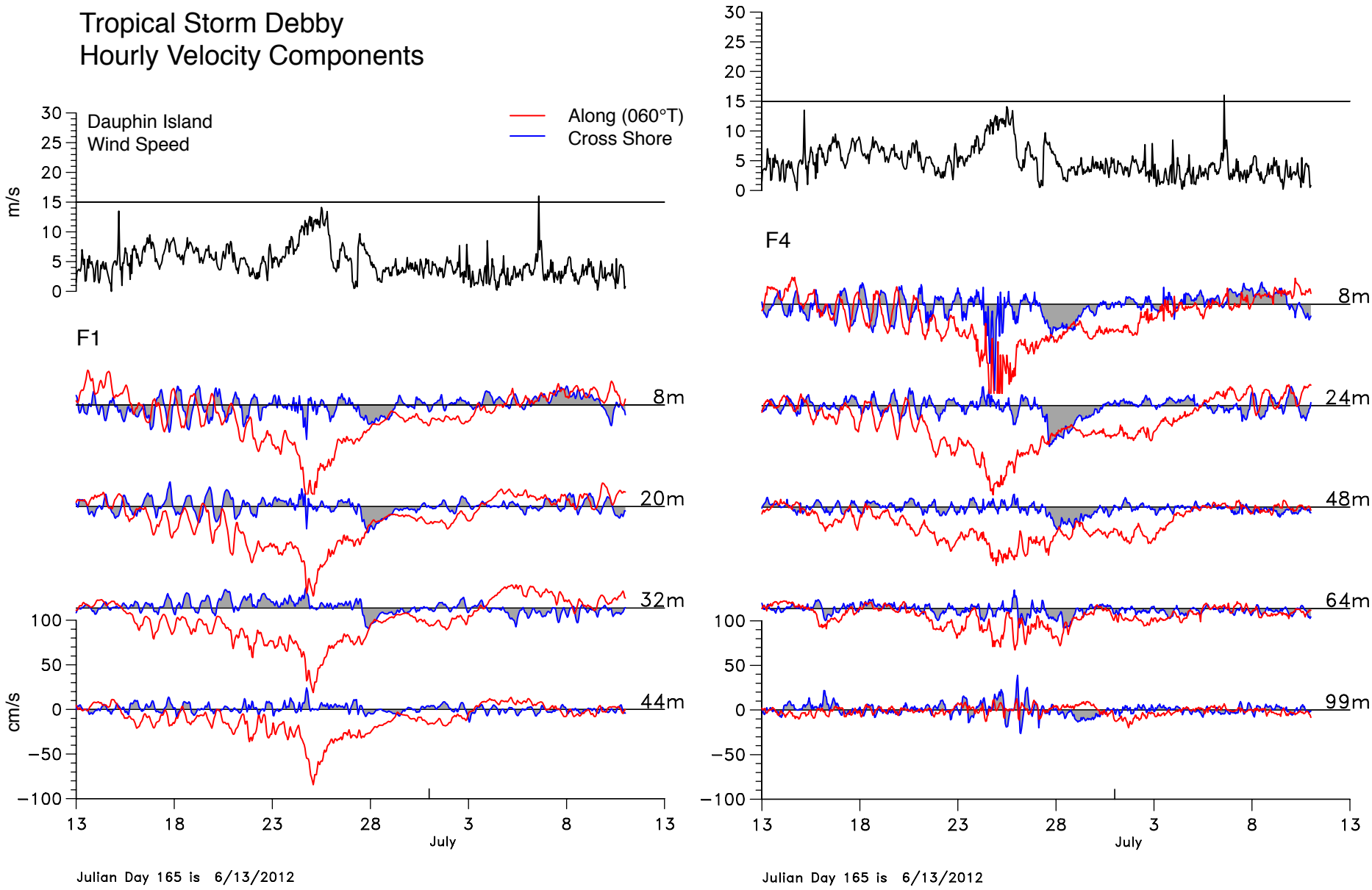

Mooring F6
40-HLP Temperature (°C)
10 12 14 16 18 20 22 24
Depth (m)
50
75
100
119
200
300
D
I
36m
84m
N
132m
180m
228m
276m
324m
372m
cm/s
60
40
20
0
−20
−40
−60
9 19 29 8 18 28 8 18 28 7 17 27 6 16 26 6 16 26 5 15 25 5 15 25 4 14 24 3 13 23 5 15 25 4 14 24 4 14 24 3
June July August September October November December January February March April May
Julian Day 130 is 5/ 9/2012
Mooring F6 Upper

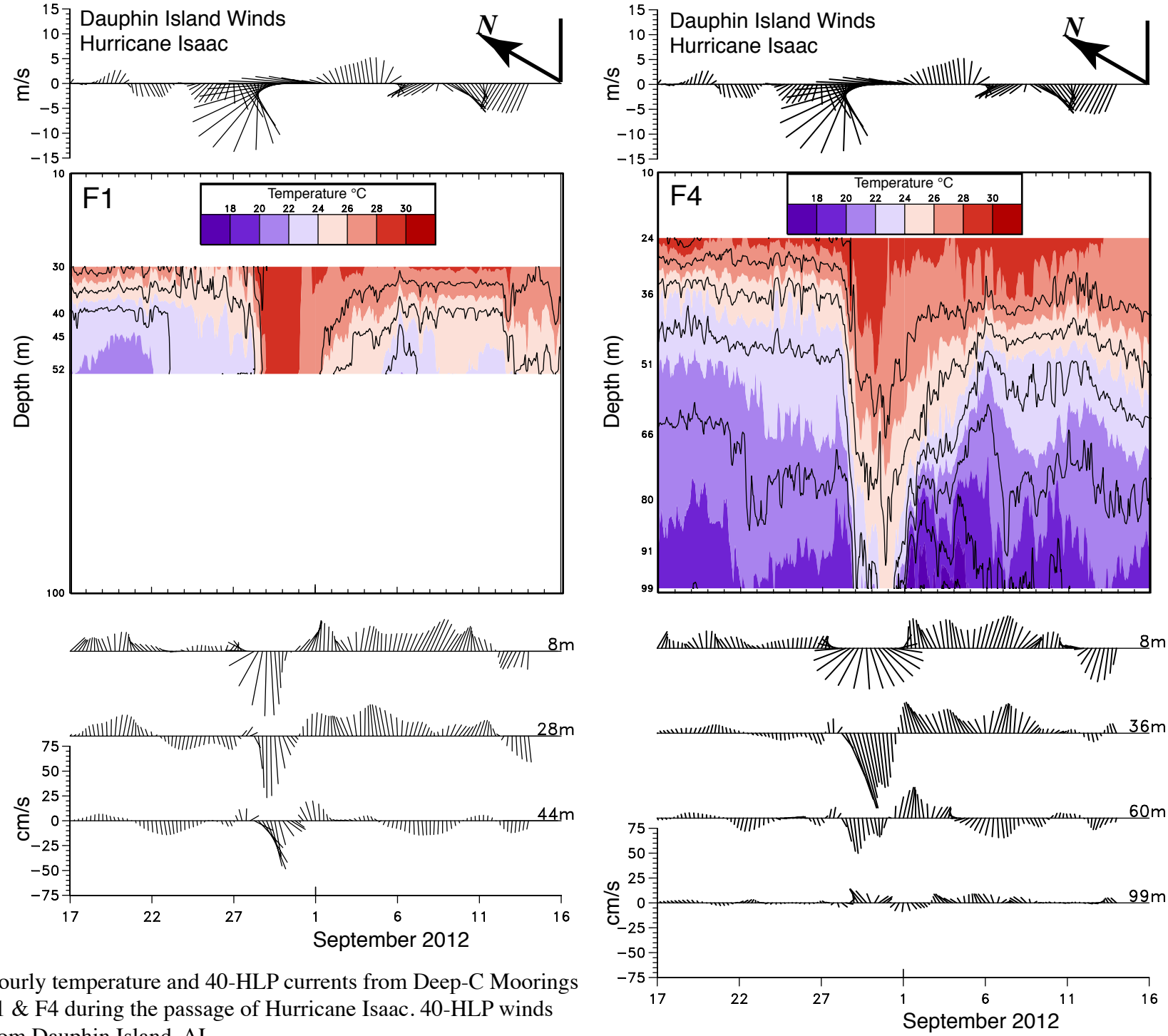

Depth (m)
300
395
435
497
600
705
Mooring F6
40-HLP Temperature (°C)
6 7 8 9 10 11 12 13
372m
484m
524m
564m
604m
644m
684m
N
cm/s
40
20
0
−20
−40
9 19 29 8 18 28 8 18 28 7 17 27 6 16 26 6 16 26 5 15 25 5 15 25 4 14 24 3 13 23 5 15 25 4 14 24 4 14 24 3
June July August September October November December January 2013 February March April May
Julian Day 130 is 5/ 9/2012
Mooring F6 Lower


Salinities from MicroCats
F2
24m
F4
24m
F5
22m
F5
124m
F6
119m
9
May
29
Jun
18
Jly
6
Aug
Sep
26
Oct
15
Nov
Dec
3
Jan
2013
25
Feb
Mar
14
Apr
May
3
Jun
Julian Day 100 is 4/ 9/2012
Salinities from MicroCats

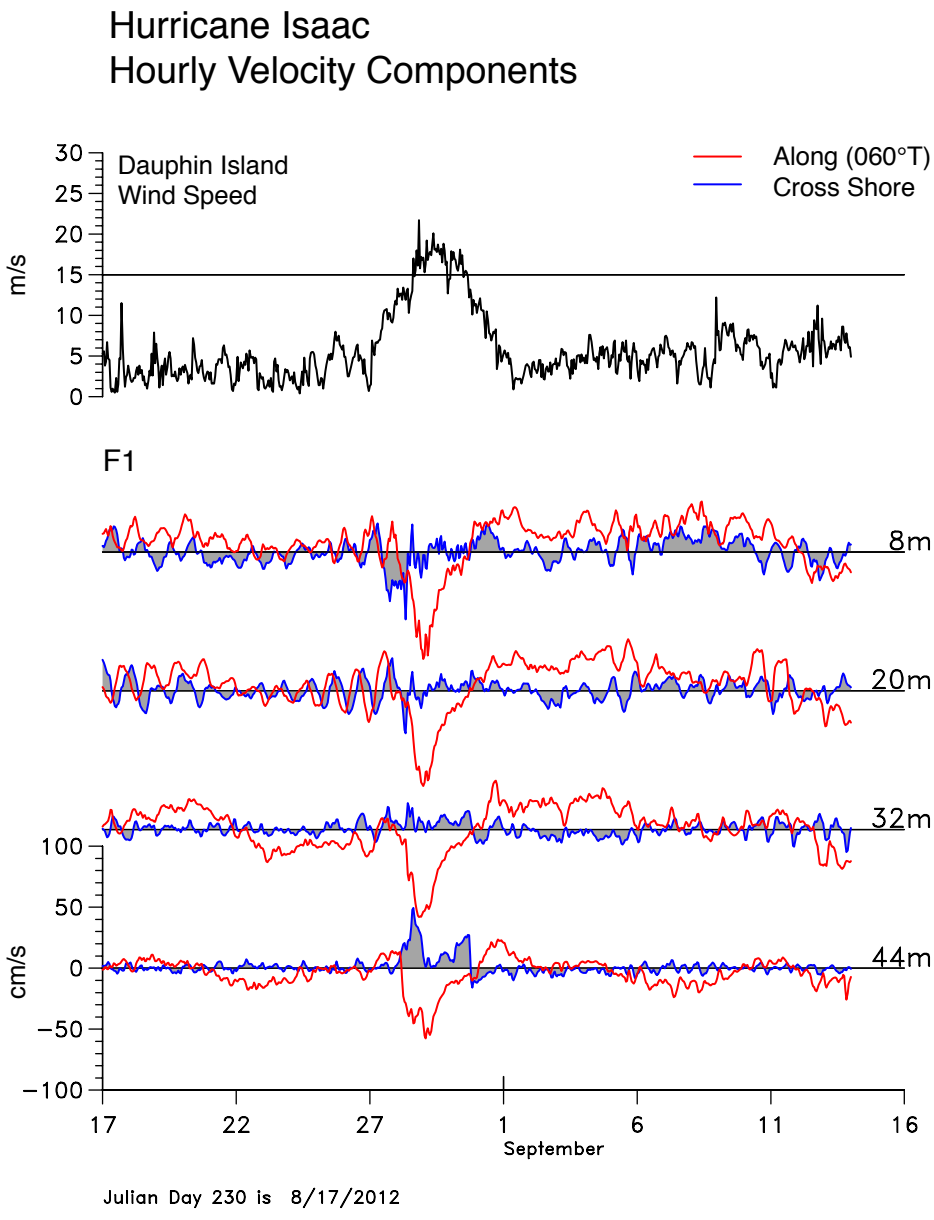


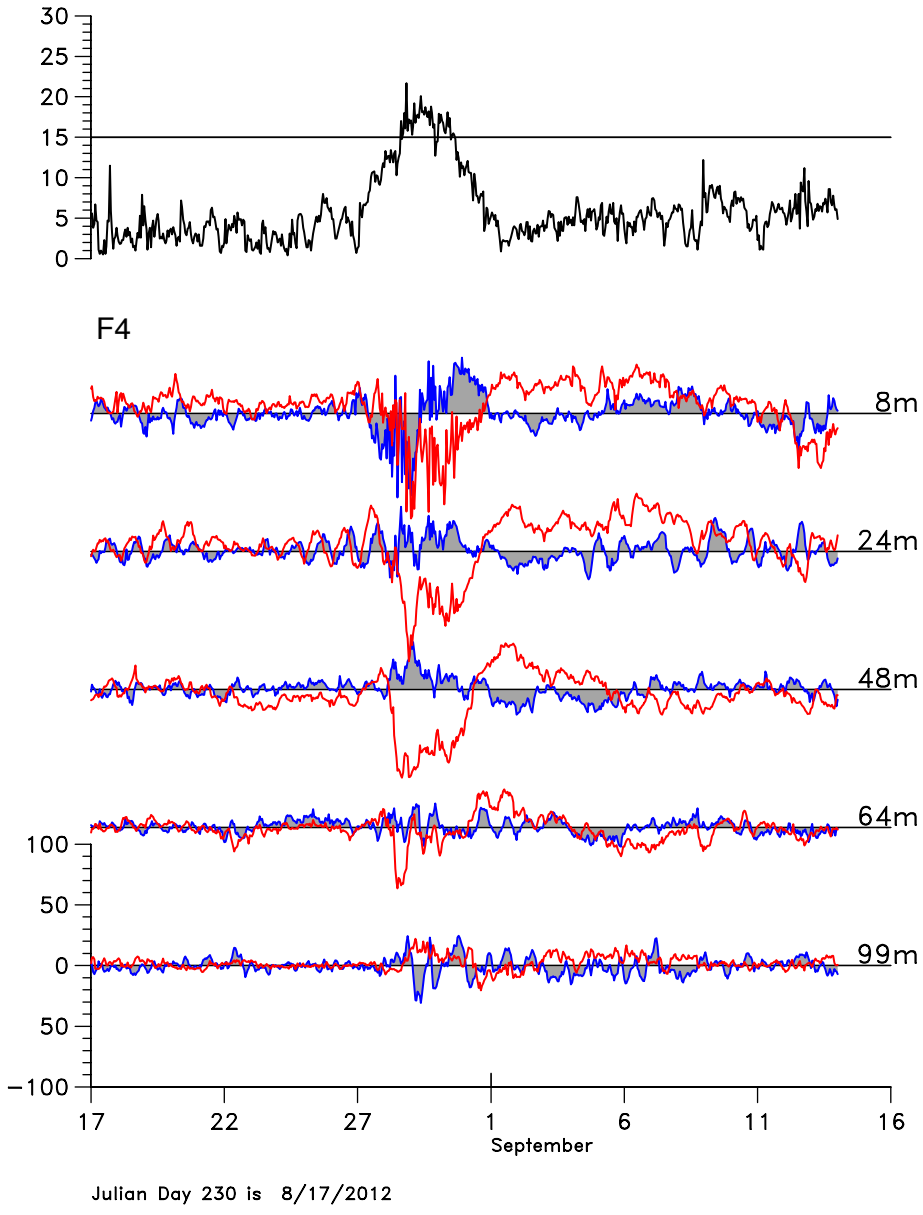
Hourly temperature and 40-HLP currents from Deep-C Moorings F1 & F4 during the passage of Tropical Storm Debby. 40-HLP winds from Dauphin Island, AL.


Tropical Storm Debby
Hourly Velocity Components
Dauphin Island
Wind Speed
Along (060°T)
Cross Shore
m/s
F1
8m
20m
32m
44m
cm/s
July
Julian Day 165 is 6/13/2012
F4
8m
24m
48m
64m
99m
July
Julian Day 165 is 6/13/2012



Hourly temperature and 40-HLP currents from Deep-C Moorings F1 & F4 during the passage of Hurricane Isaac. 40-HLP winds from Dauphin Island, AL.


Hurricane Isaac
Hourly Velocity Components
Dauphin Island
Wind Speed
Along (060°T)
Cross Shore
m/s
F1
8m
20m
32m
44m
cm/s
September
Julian Day 230 is 8/17/2012


F4
8m
24m
48m
64m
99m
September
Julian Day 230 is 8/17/2012