Overview of the Study Goals and Objectives, Measurements Obtained, and Features Measured

Jeff Cox

Evans-Hamilton Inc.

Reason For The Study

- The study area is a leasing sale area.
- This region is sparsely measured for currents, especially at depth.
- The area has potential for strong circulation features due to Loop Current, Loop Current eddies, and frontal features entering the area, as well as storms.
- The area has been suggested as a potential source region for Topographic Rossby Waves.
- Increased knowledge is needed in this area to predict potential oil spill transport & environmental effects.

Study Goals & Objectives

- To conduct measurements of currents in deepwater areas of the eastern GOM to increase the understanding of the circulation in this area.
- To collect hydrographic, remote sensing, and other relevant measurements so as to understand the key processes energizing the currents.
- To evolve a better understanding of what drives the circulation in this area, and its variability.
- To provide an improved understanding of the region's circulation useful to help design future studies.

Upper Layer Circulation Processes of Interest

- Loop Current (LC) & Loop Current Eddy (LCE) intrusions
- LC and LCE frontal features, including Cold Core Eddies (CCE)
- LC/LCE/CCE dynamics and interactions
- Eddy-topography interactions and potential slope intensification of currents
- Baroclinic instabilities
- Geostrophic turbulence
- Storm-induced effects

Lower Layer Circulation Processes of Interest

- TRW propagation, refraction, & reflection in the area
- Possible TRW formation in the area
  - by LC/LCE & topography interactions
  - by displacement of deepwater during LC intrusions
- Possible occurrence of deep cyclone & anti-cyclone pairs under LC as LCE's shed
  - Do they occur?
  - Role in steering upper-layer eddies
- Clockwise mean boundary current along escarpment
- Storm-induced effects (if any)

Measurement Plan

- Three tall (M1, M2, M3) & one short (M4) moorings
- Multiple CTP sensors on moorings
- Six PIES (became nine)
- Three hydrographic (CTD & XBT) surveys
- Satellite imagery
- Ancillary wind & coastal river discharge data
- R/V Pelican underway measurements
- Eddy watch maps & buoy data

Moorings Designs

Currents

M1

500m-ADCP

750m

1000m

1250m

1500m

2000m

2500m

M2

M3

Temp/Cond/Press

75m – T/C/P

112m - T

150m – T/C/P

187m - T

225m – T/C/P

300m - T

400m - T

750m - T

1000m - T

1250m - T

1500m - T

2000m - T

2500m - T

2700m

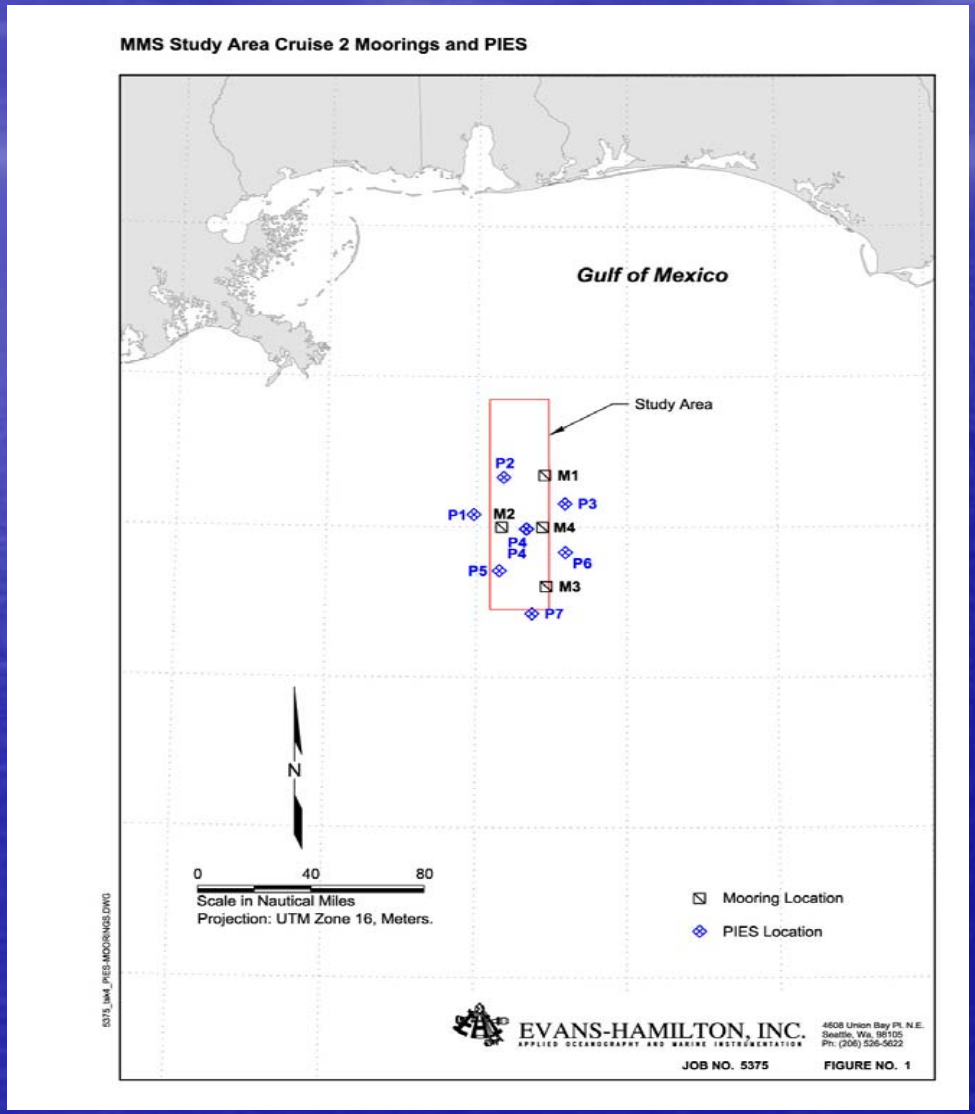
2700m – T

M4

2400m

2500m

Moorings & PIES Locations



Measurement Period

- 18–21 December 2004
  - Seven PIES deployed
- 17–23 January 2005
  - Four moorings deployed
  - First hydrographic survey
- 18–25 August 2005
  - Four moorings serviced
  - Two PIES added
  - Second hydrographic survey
- 20–28 January 2006
  - Moorings & PIES recovered
  - Third extended, intensive hydrographic survey

Data Obtained

MMS Mooring Data

= Good Data
= Bad or Missing Data

= Current Data: Speed Only
= Current Data: Direction Only

= CTD Data: Depth Change - Good Data
= CTD Data: Data not provided due to unknown depth of instrument

= Instruments with Pressure Sensors

	Instrument Type	Serial Number	Measured Parameters	Deployment 1								Deployment 2					
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Mooring 1	SeaBird	59	c,t,p													
	Hugrun	c919	t													
	SeaBird	2697	c,t,p													
	Hugrun	c926	t													
	SeaBird	2698	c,t,p													
	Hugrun	c932	t													
	Hugrun	c933	t													
	ADCP	4487	t,u,v													
	S4	7801745	c,t,u,v													
	Aanderaa	7223	c,t,u,v													
	Aanderaa	7692	t,p,u,v													
	Aanderaa	9722	t,u,v													
	Aanderaa	10053	t,p,u,v													
	Aanderaa	12085	t,p,u,v													
Mooring 2	SeaBird	57	c,t,p													
	Hugrun	c937	t													
	SeaBird	2699	c,t,p													
	Hugrun	c939	t													
	SeaBird	2700	c,t,p													
	Hugrun	c940	t													
	Hugrun	c944	t													
	ADCP	5165	t,u,v													
	S4	8161753	c,t,u,v													
	Aanderaa	7507	c,t,u,v													
	Aanderaa	7771	t,p,u,v													
	Aanderaa	12803	t,u,v													
	Aanderaa	9807	t,p,u,v													
	Aanderaa	12807	t,u,v													
Mooring 3	SeaBird	2701	c,t,p													
	Hugrun	c946	t													
	SeaBird	2702	c,t,p													
	Hugrun	c950	t													
	SeaBird	2703	c,t,p													
	Hugrun	c959	t													
	Hugrun	c960	t													
	ADCP	5699	t,u,v													
	S4	2129	c,t,u,v													
	Aanderaa	12084	c,t,u,v													
	Aanderaa	10643	t,p,u,v													
	Aanderaa	9480	c,u,v													
	Aanderaa	9809	t,p,u,v													
	Aanderaa	12808	t,u,v													

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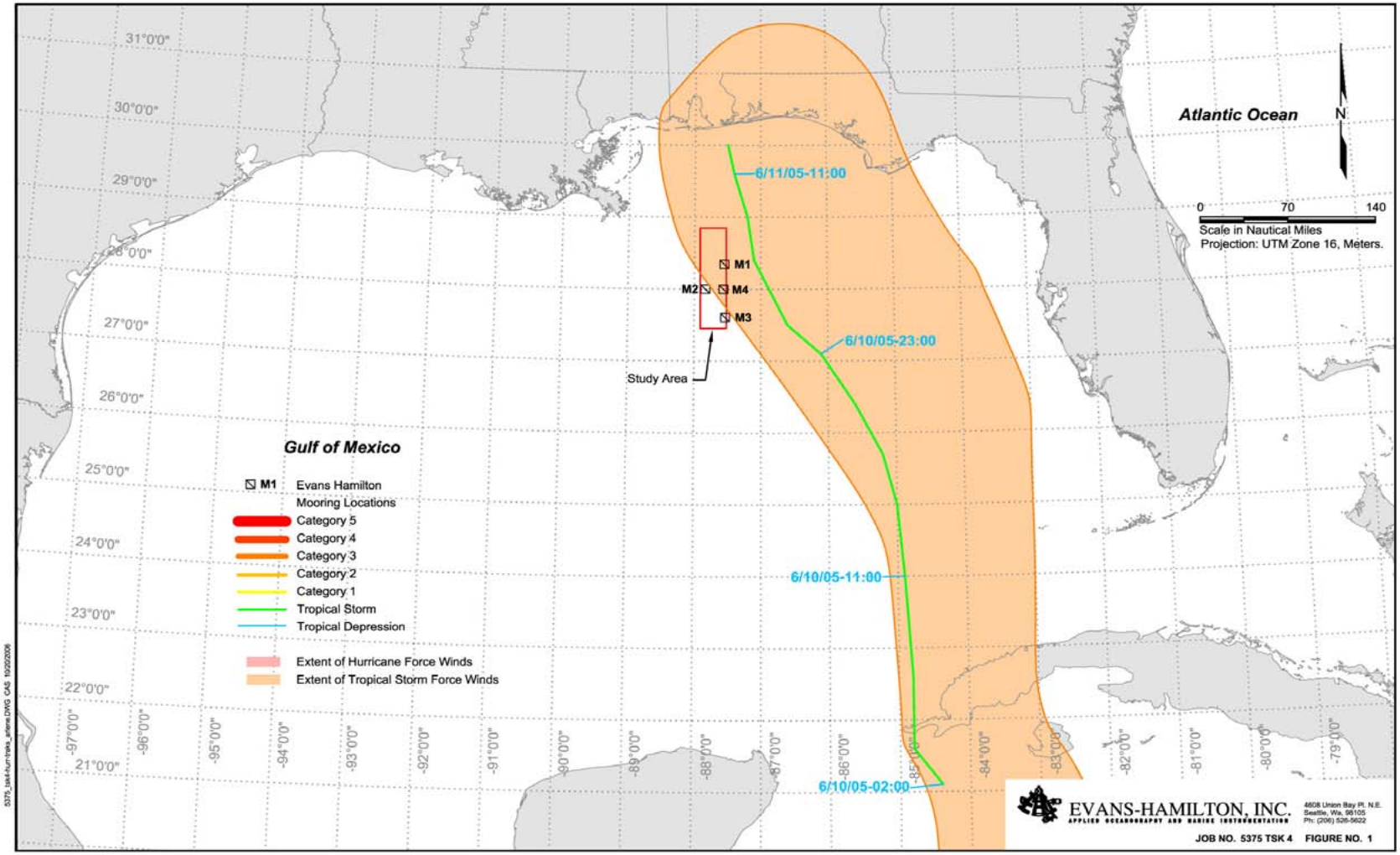
Problems Encountered

- Deployment 1
  - Depths shallower than expected at mooring sites, resulting in excellent near-surface CTD data
  - One Aanderaa rotor failed all deployment (M1)
  - One Aanderaa failed for direction for ~½ of deployment (M1)
  - One Aanderaa rotor failed ~½ deployment (M2)
  - ADCPs had some clock jumps (corrected)
  - Top buoy on M2 broke off, top of mooring fell over
- Deployment 2
  - One Aanderaa failed for direction for ~½ of deployment (M1)
  - One Aanderaa rotor failed for ~½ of deployment (M2)
  - ADCPs had some clock jumps (corrected)

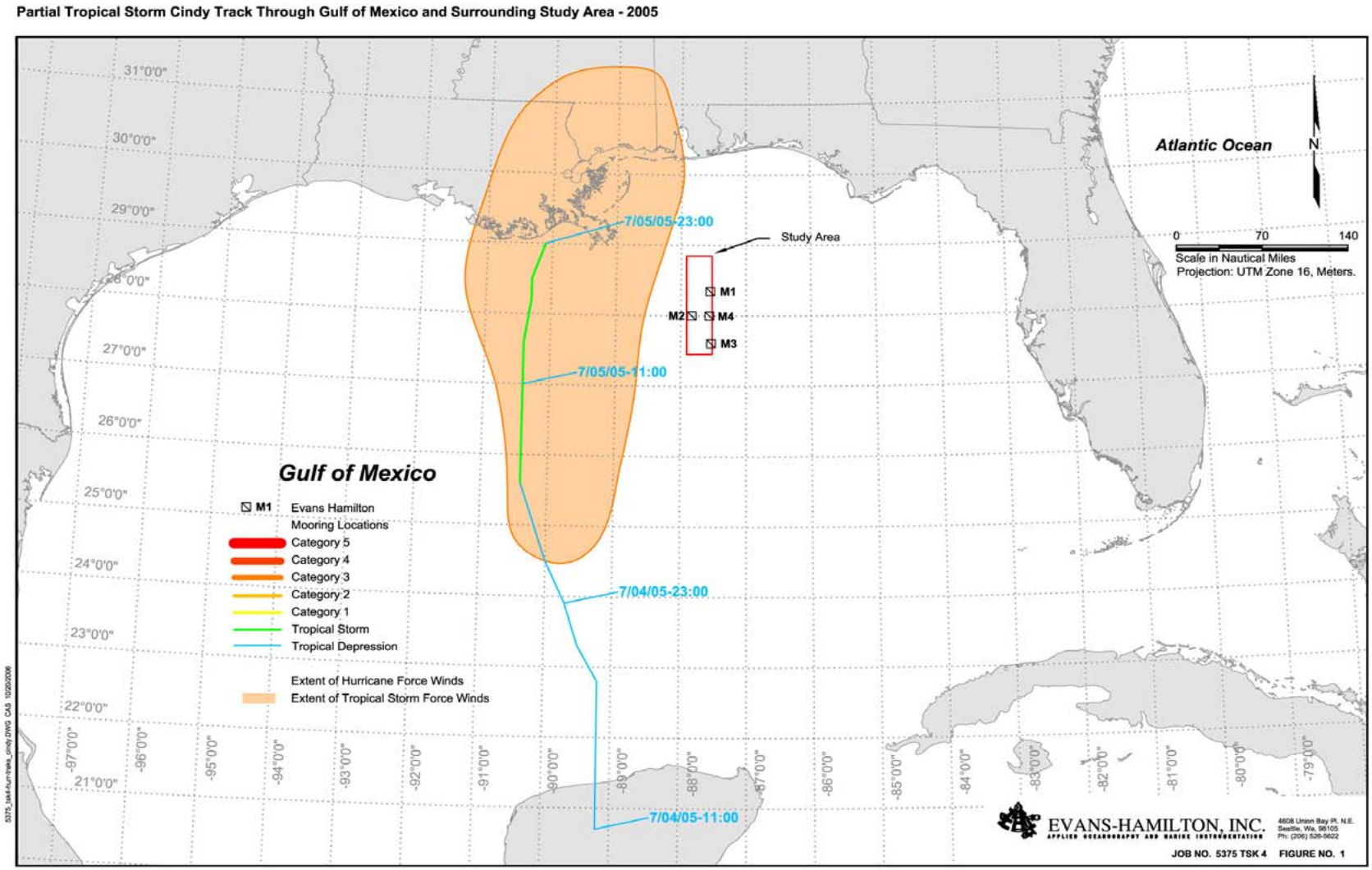
Events During Measurement Period

- Several Loop Current intrusions
- Several Loop Current frontal eddies/cold core eddies
- Two tropical storms
  - Arlene 10–11 June 2005
  - Cindy 4–5 July 2005
- Three hurricanes
  - Dennis 8–10 July 2005 (Category 4)
  - Katrina 26–29 August 2005 (Category 5)
  - Rita 20–23 September 2005 (Category 5)
- One hurricane to south
  - Wilma 21–23 October 2005 (Category 3)

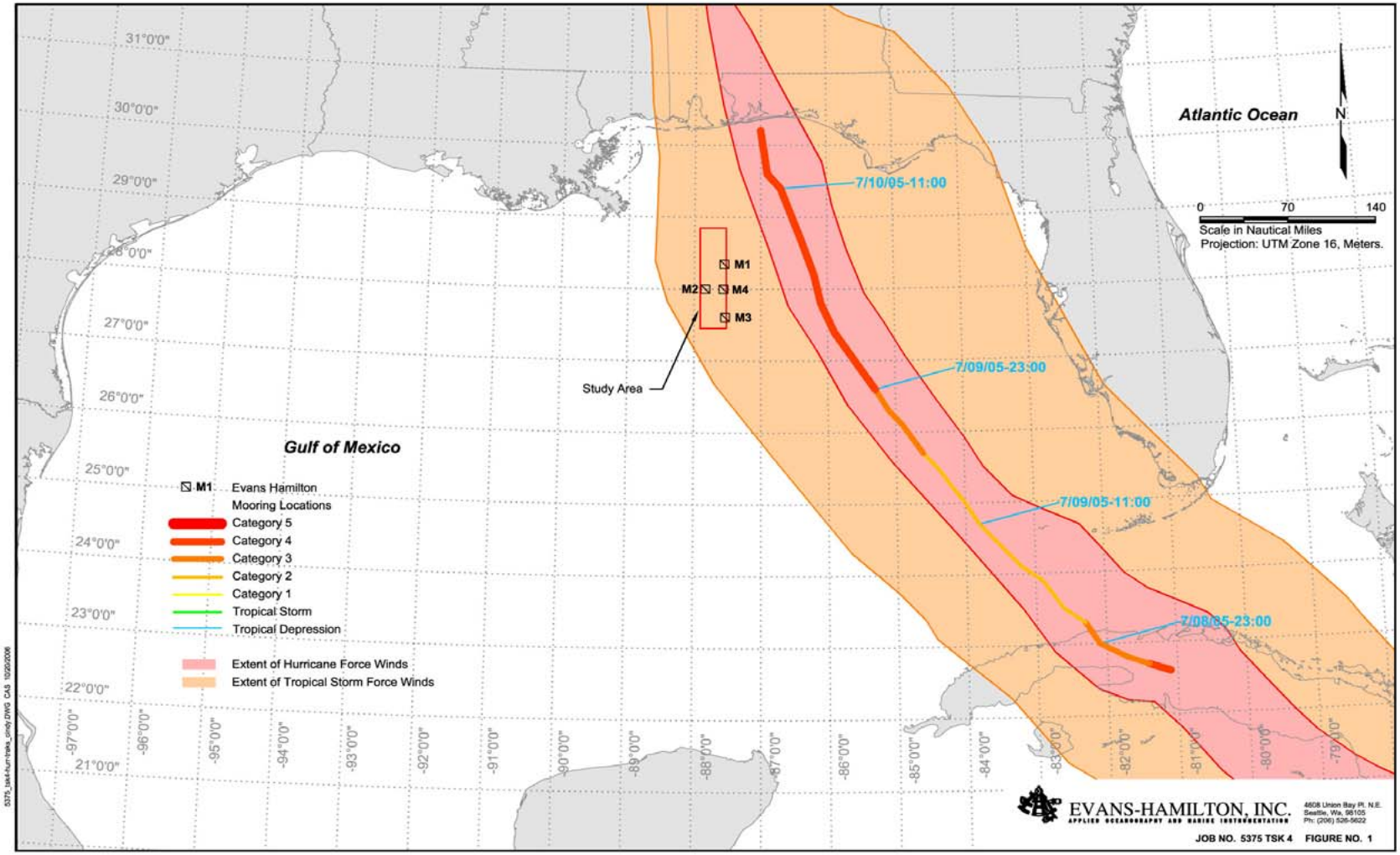
Tropical Storm Arlene



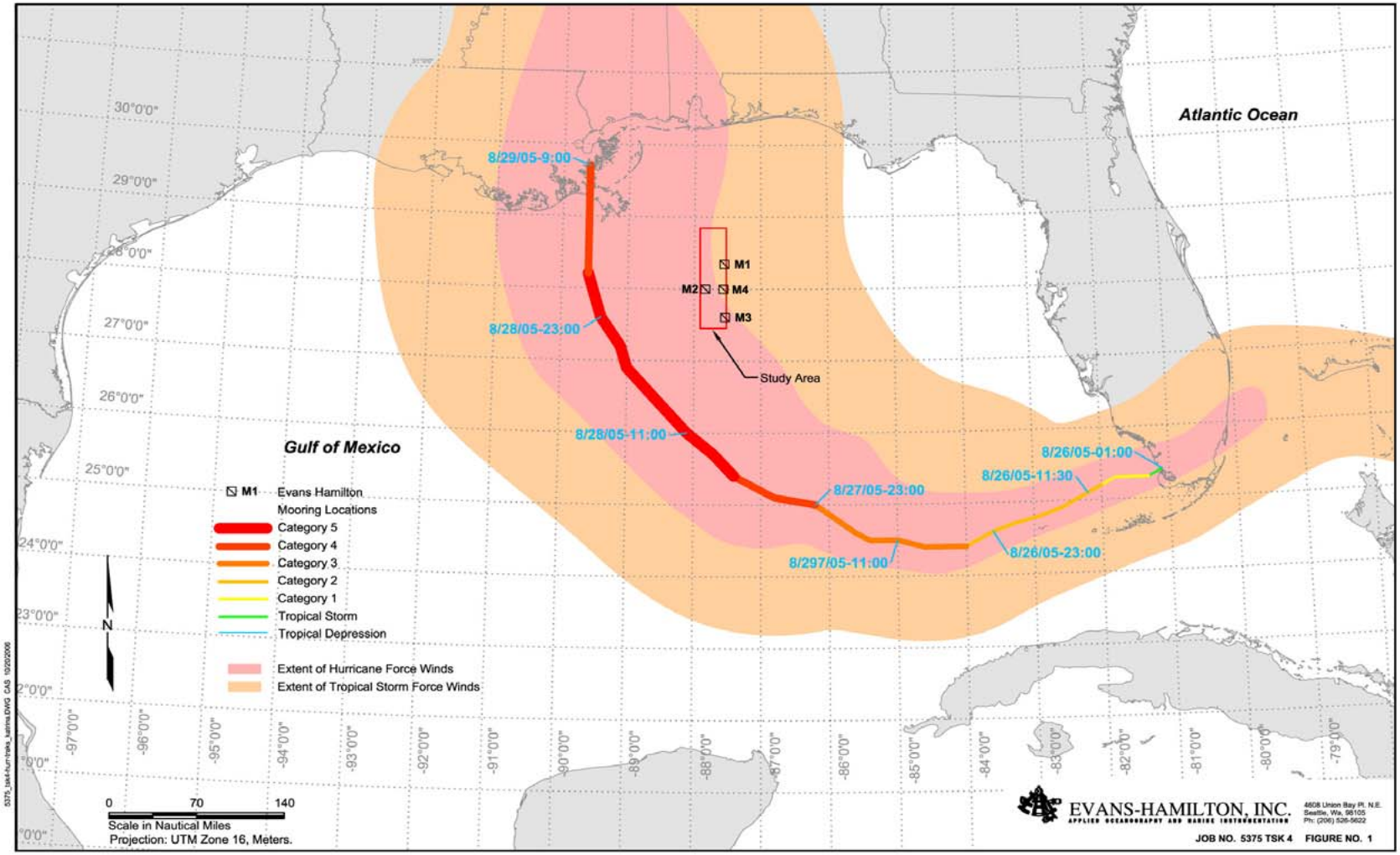
Tropical Storm Cindy



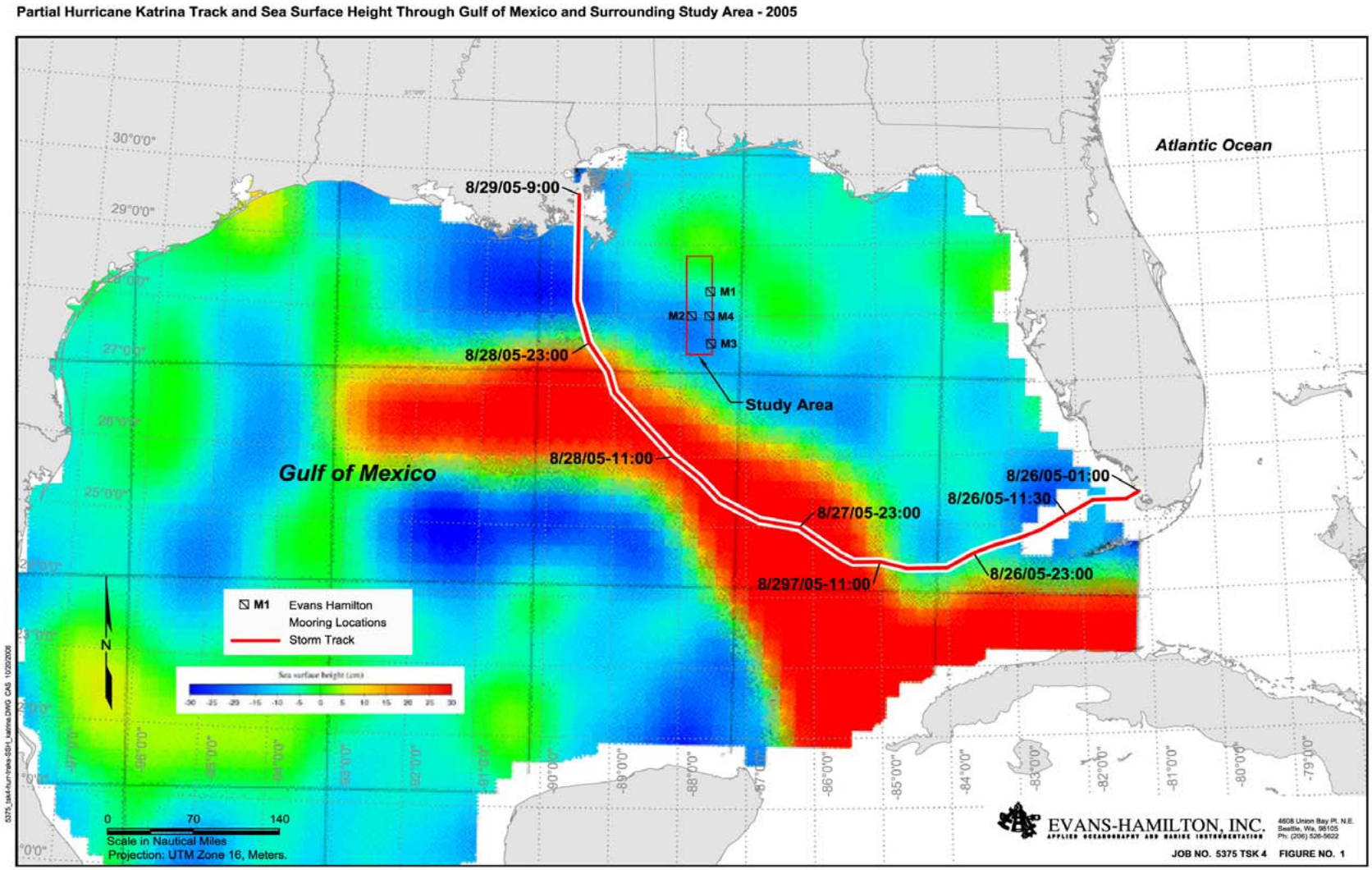
Hurricane Dennis



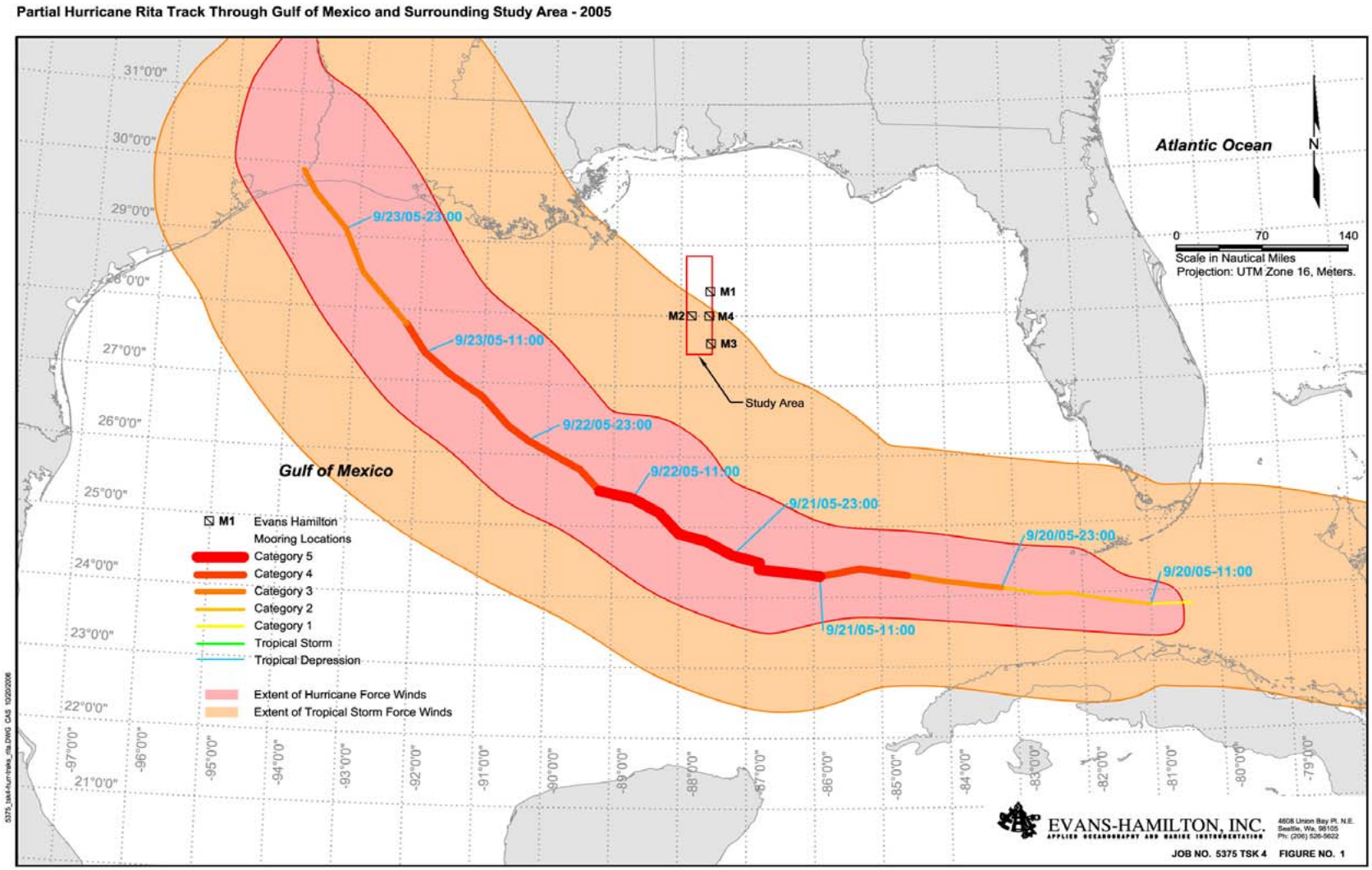
Hurricane Katrina



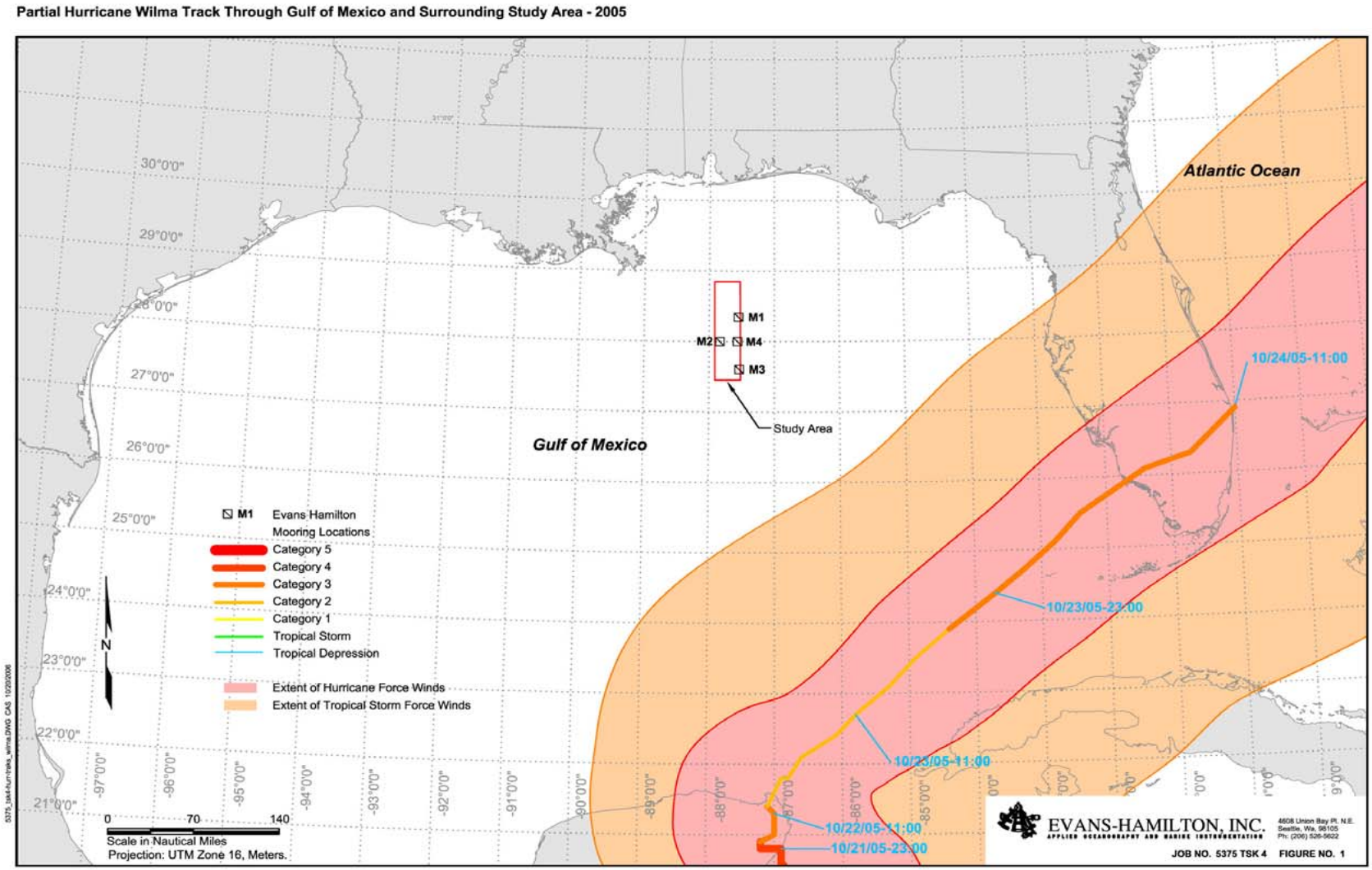
Hurricane Katrina Path vs. SST



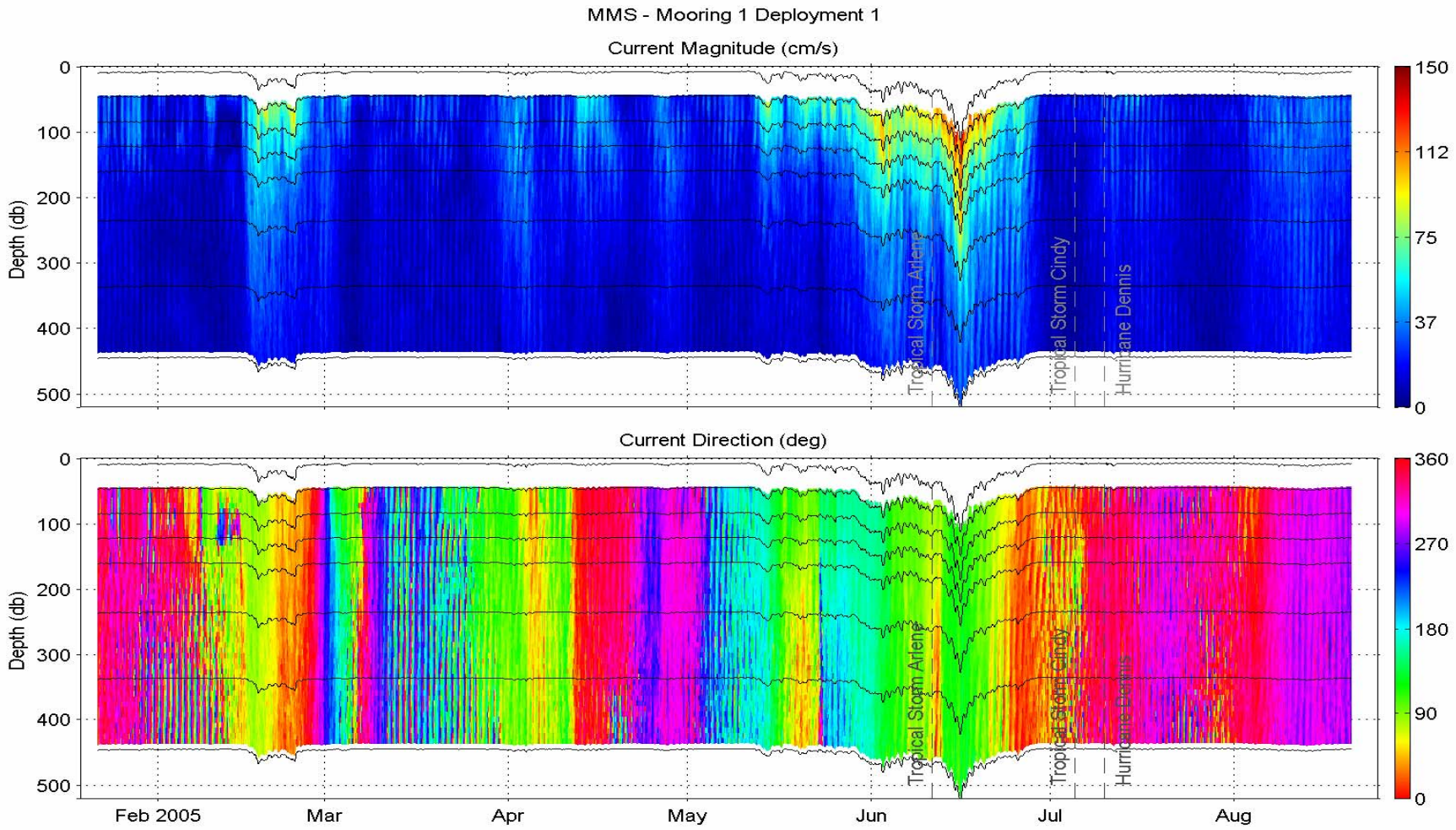
Hurricane Rita



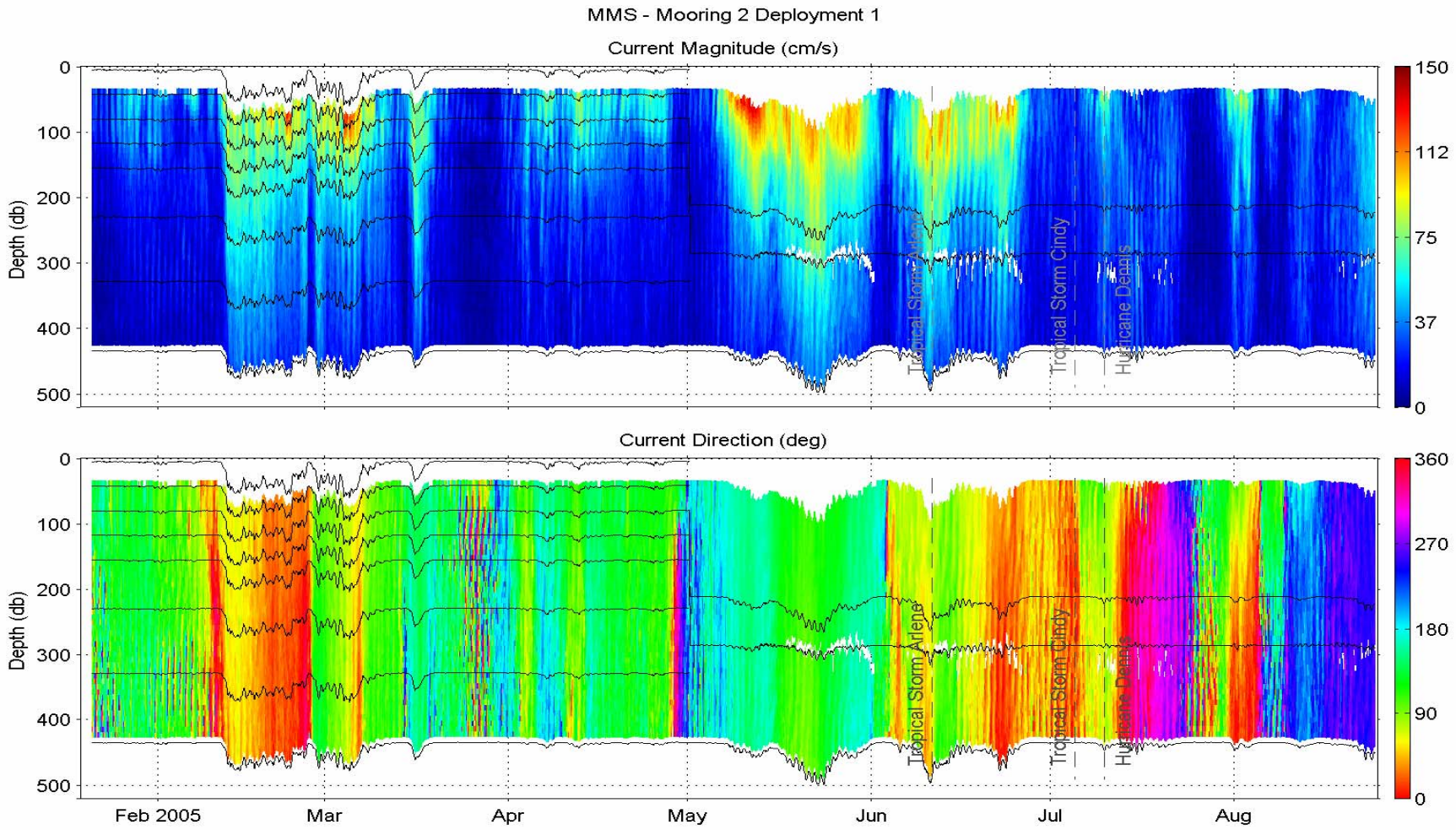
Hurricane Wilma



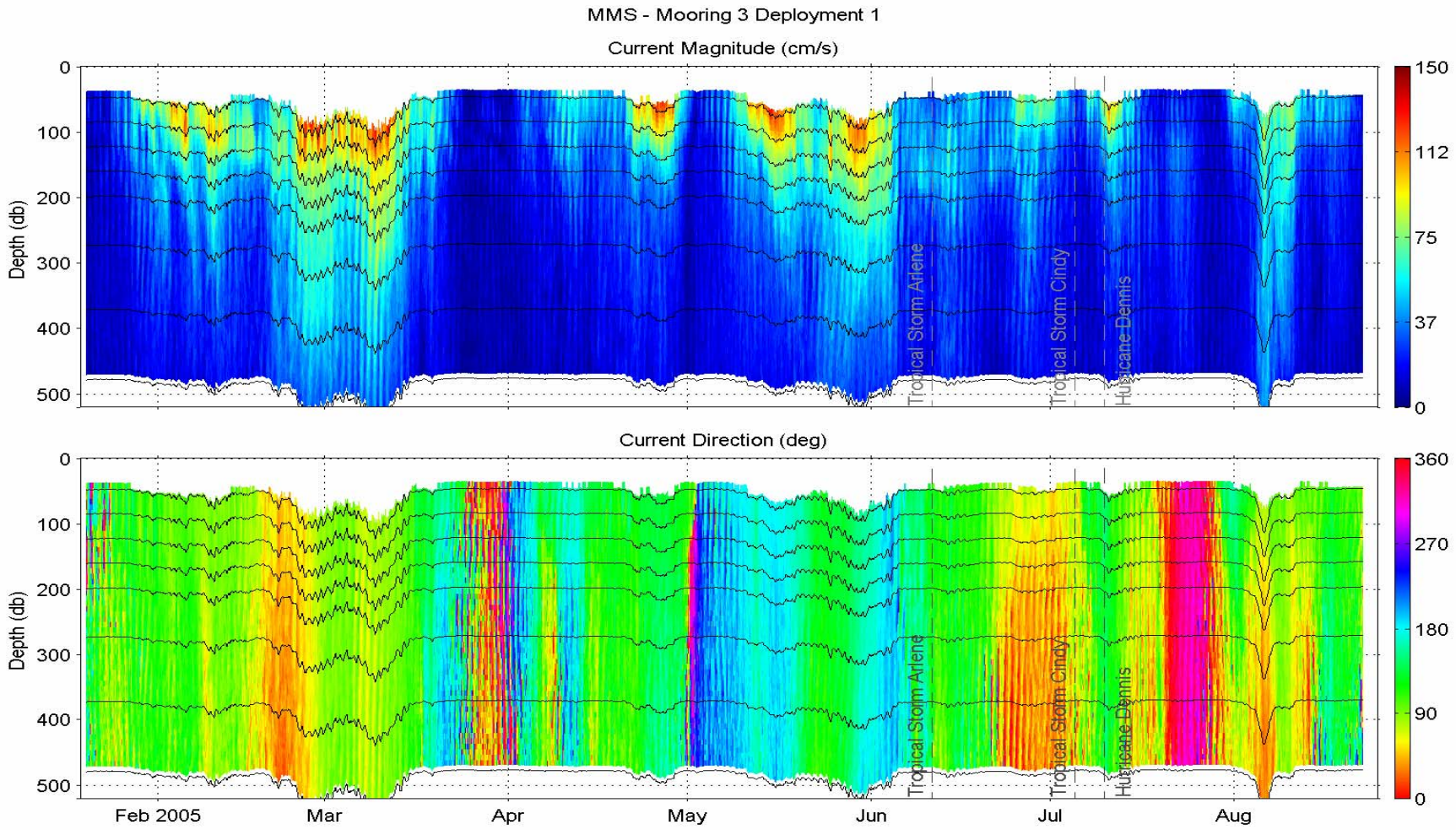
Mooring M1 – Deployment 1 – Currents



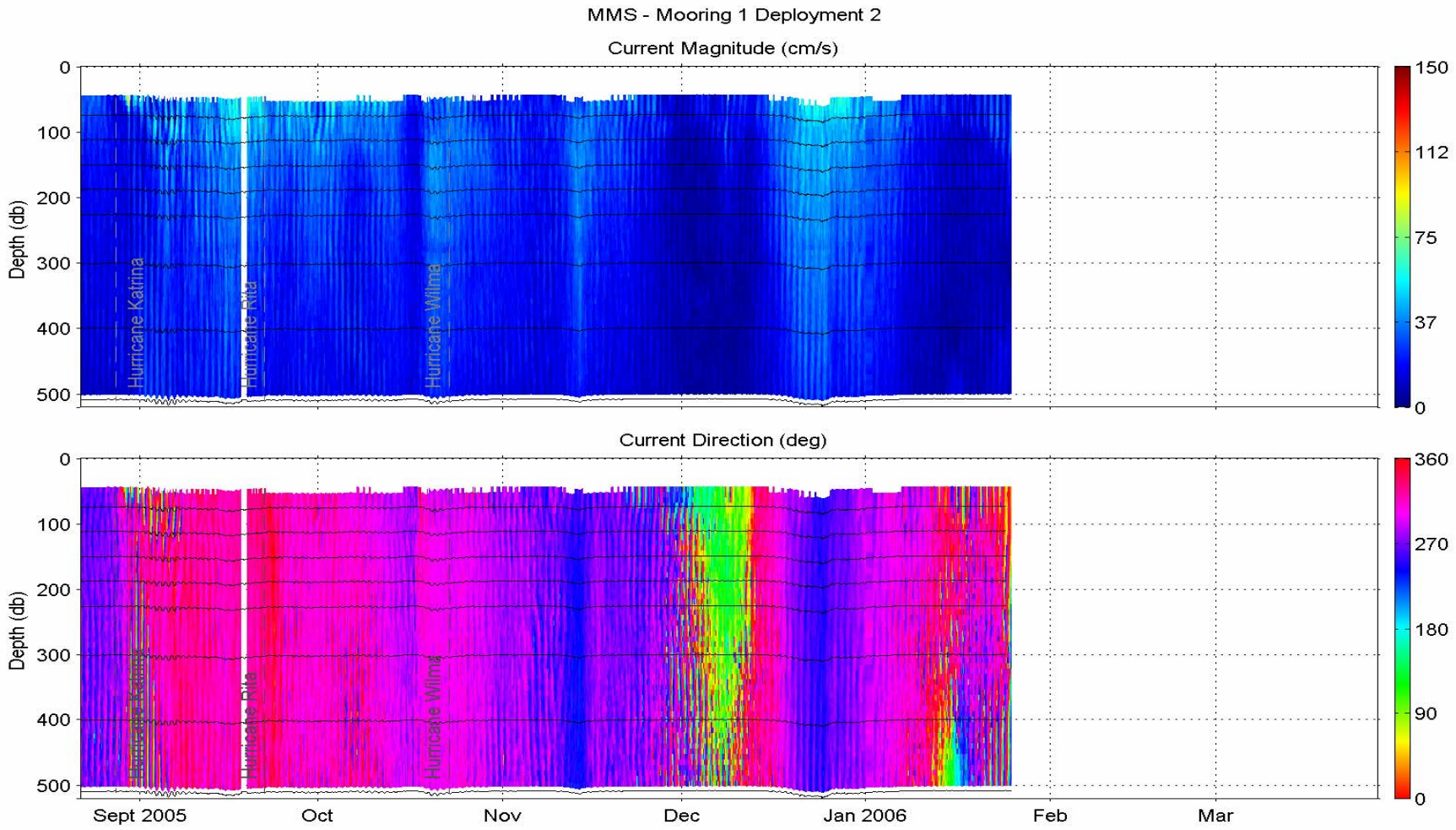
Mooring M2 – Deployment 1 – Currents



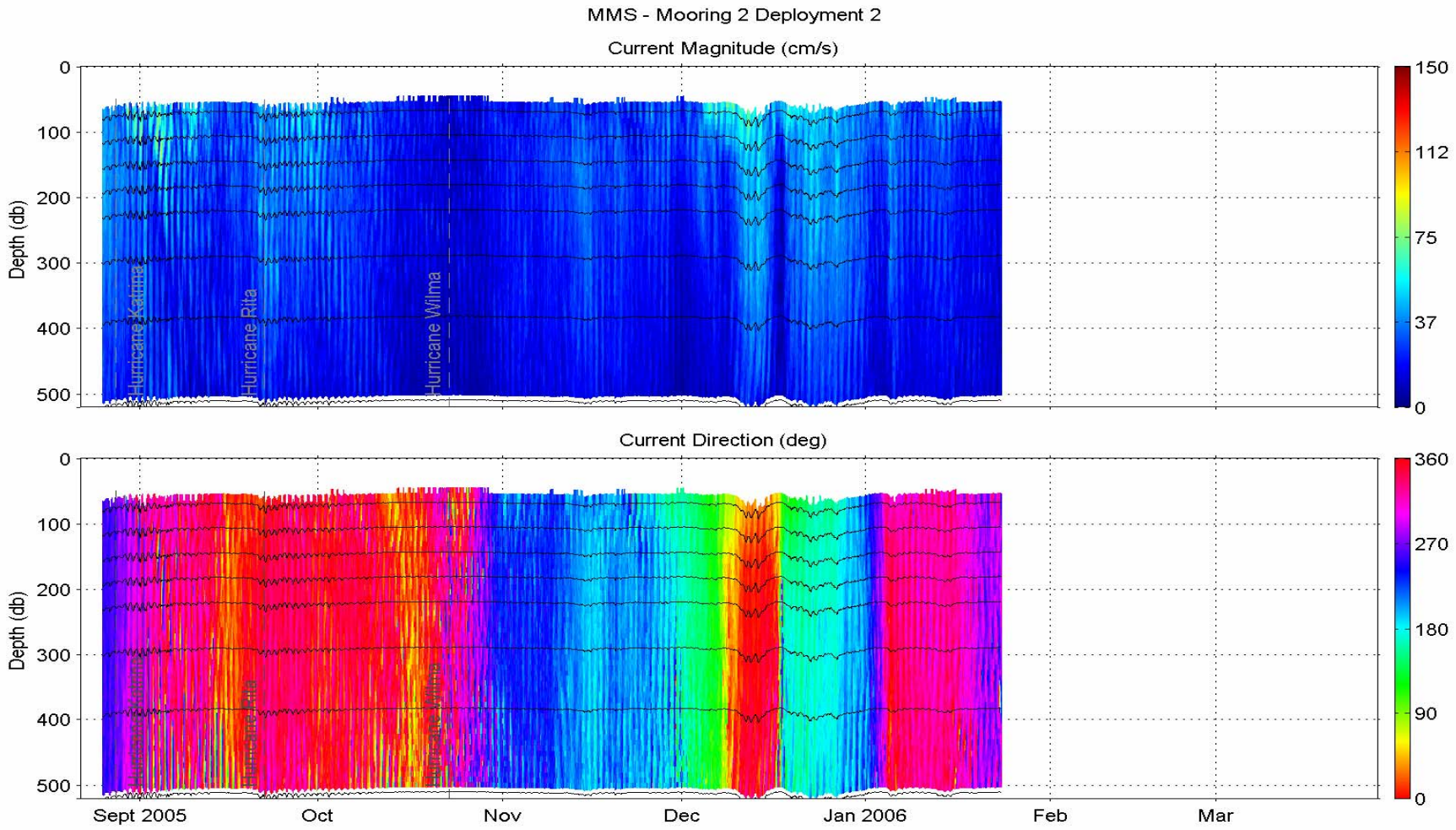
Mooring M3 – Deployment 1 – Currents



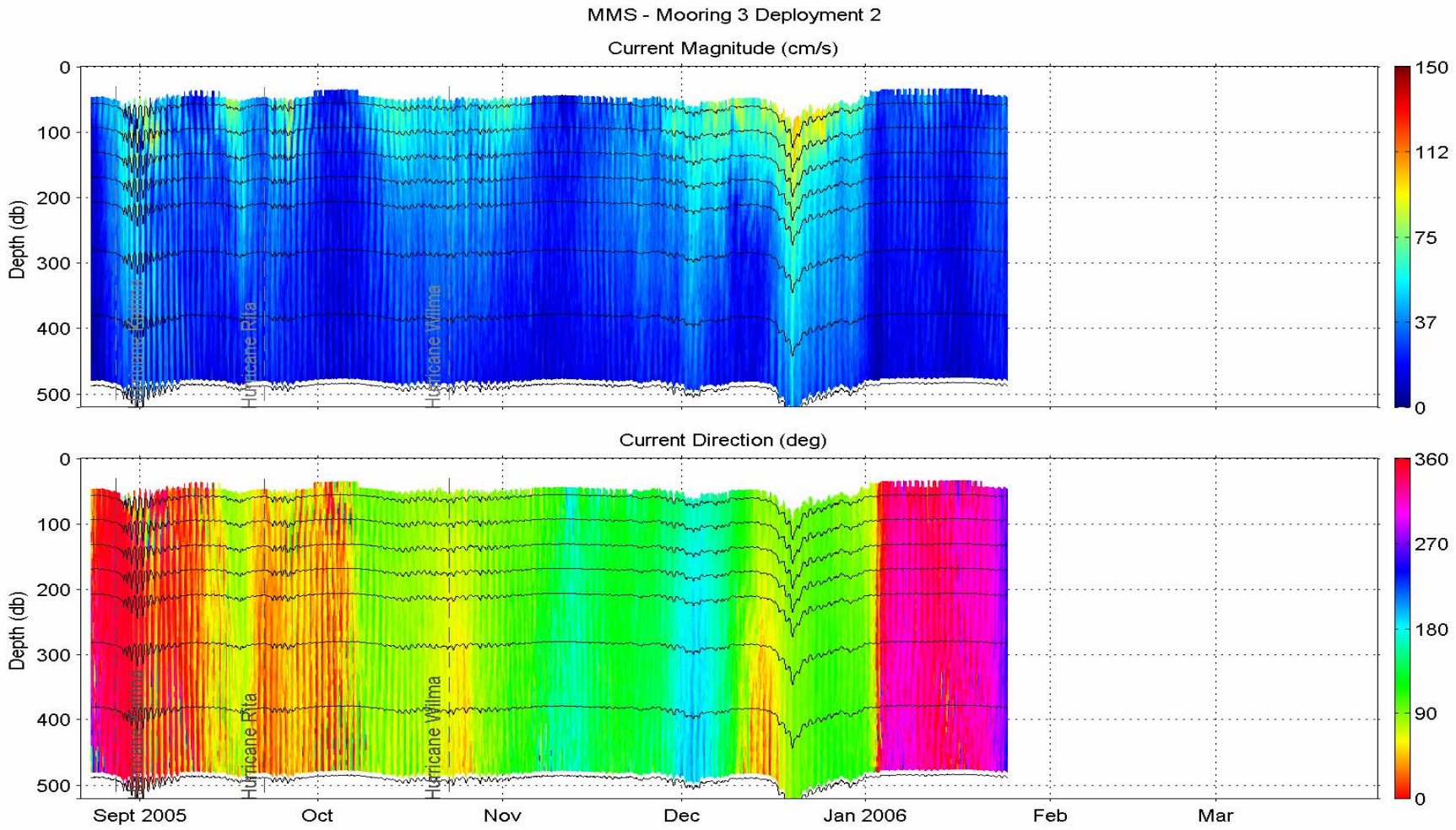
Mooring M1 – Deployment 2 – Currents



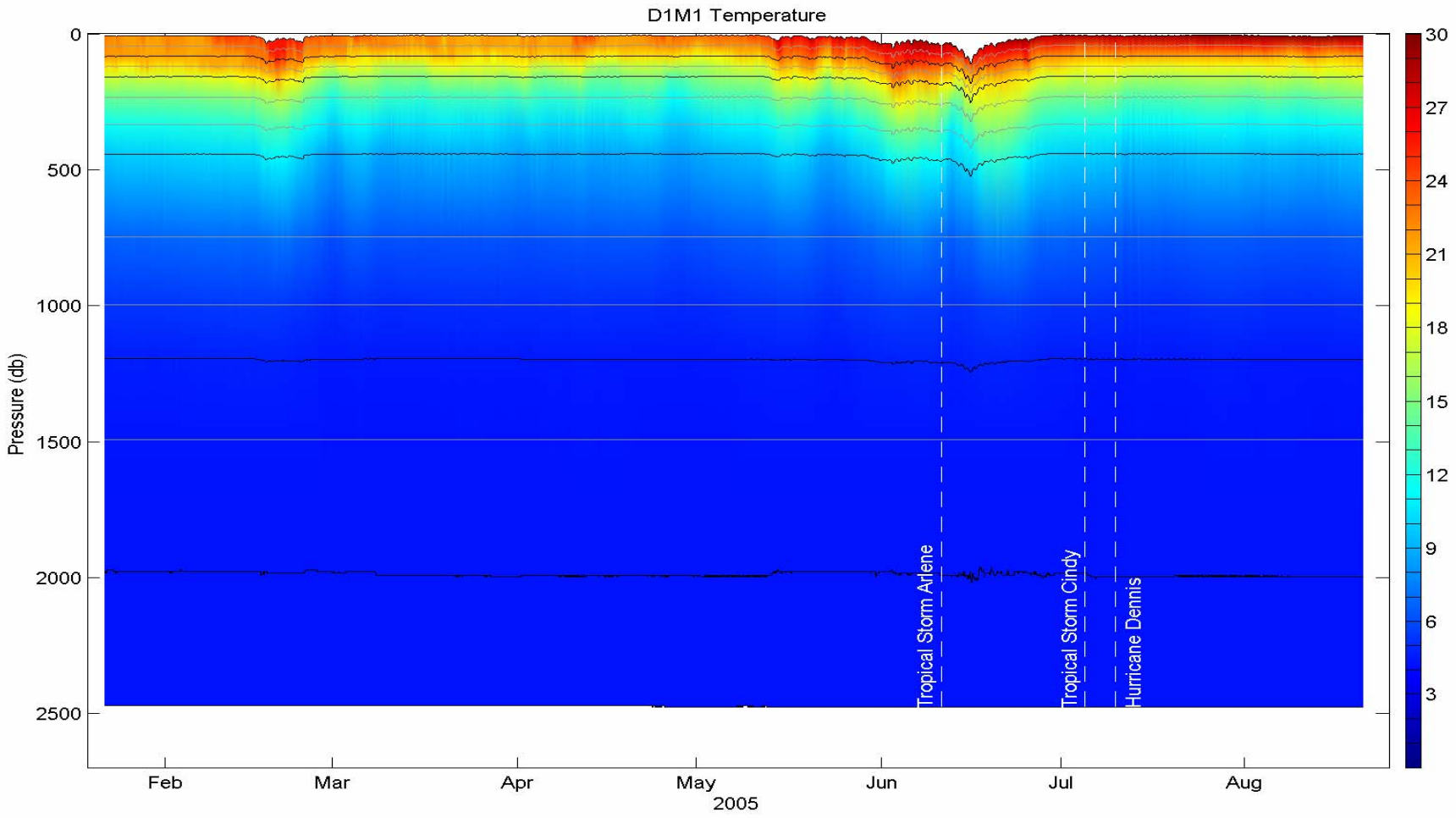
Mooring M2 – Deployment 2 – Currents



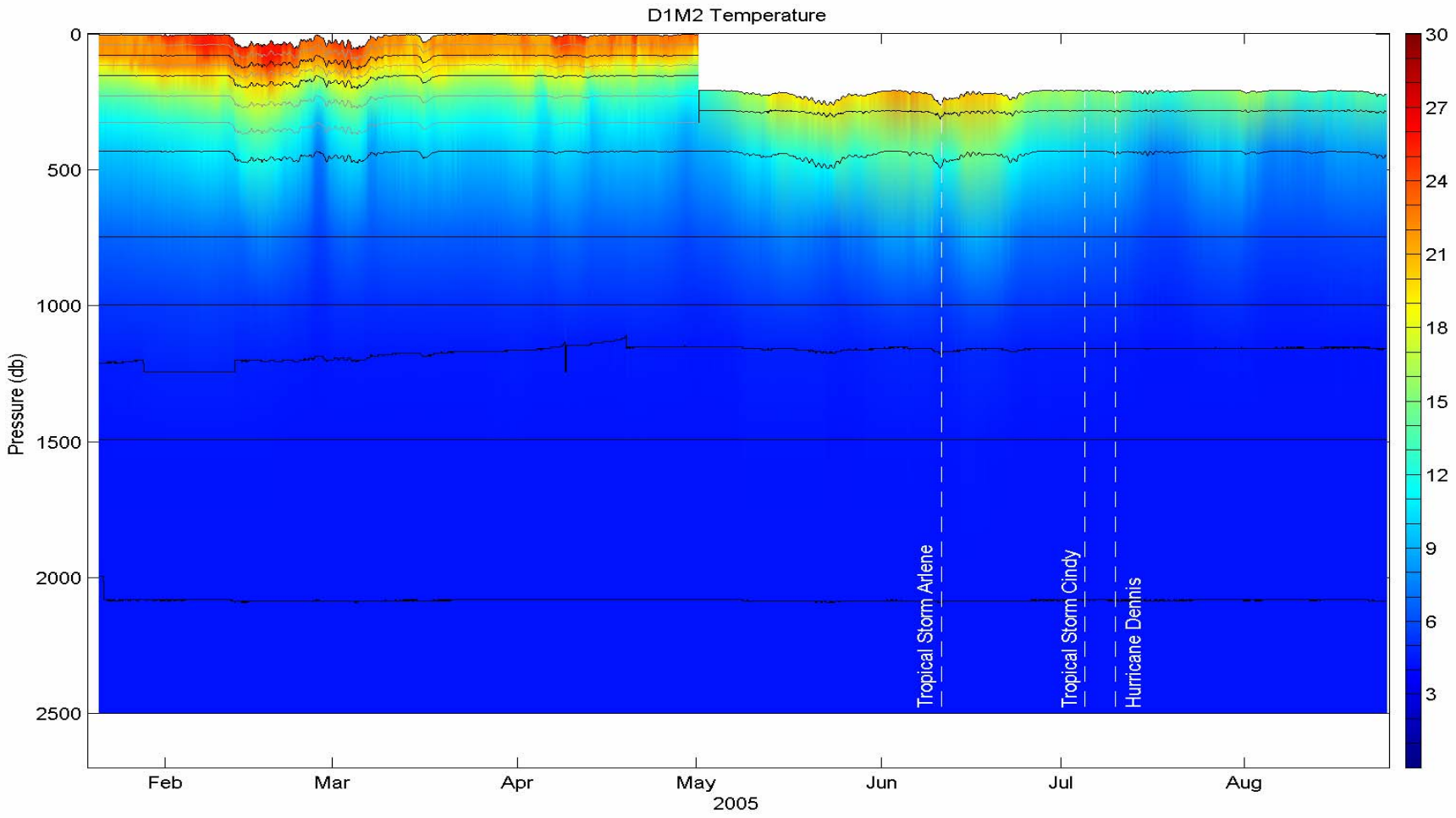
Mooring M3 – Deployment 2 – Currents



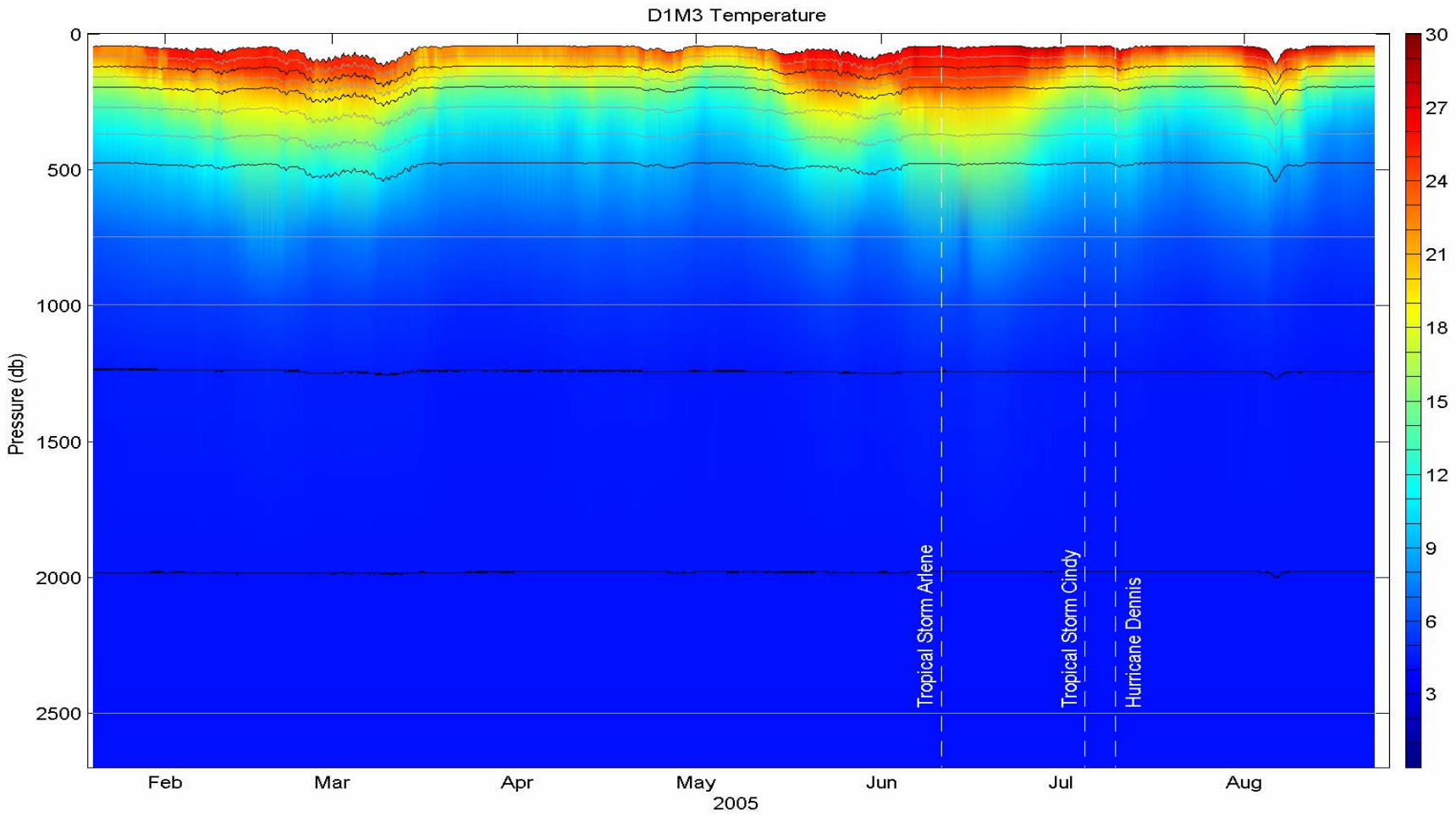
Mooring M1 – Deployment 1 – Temperature



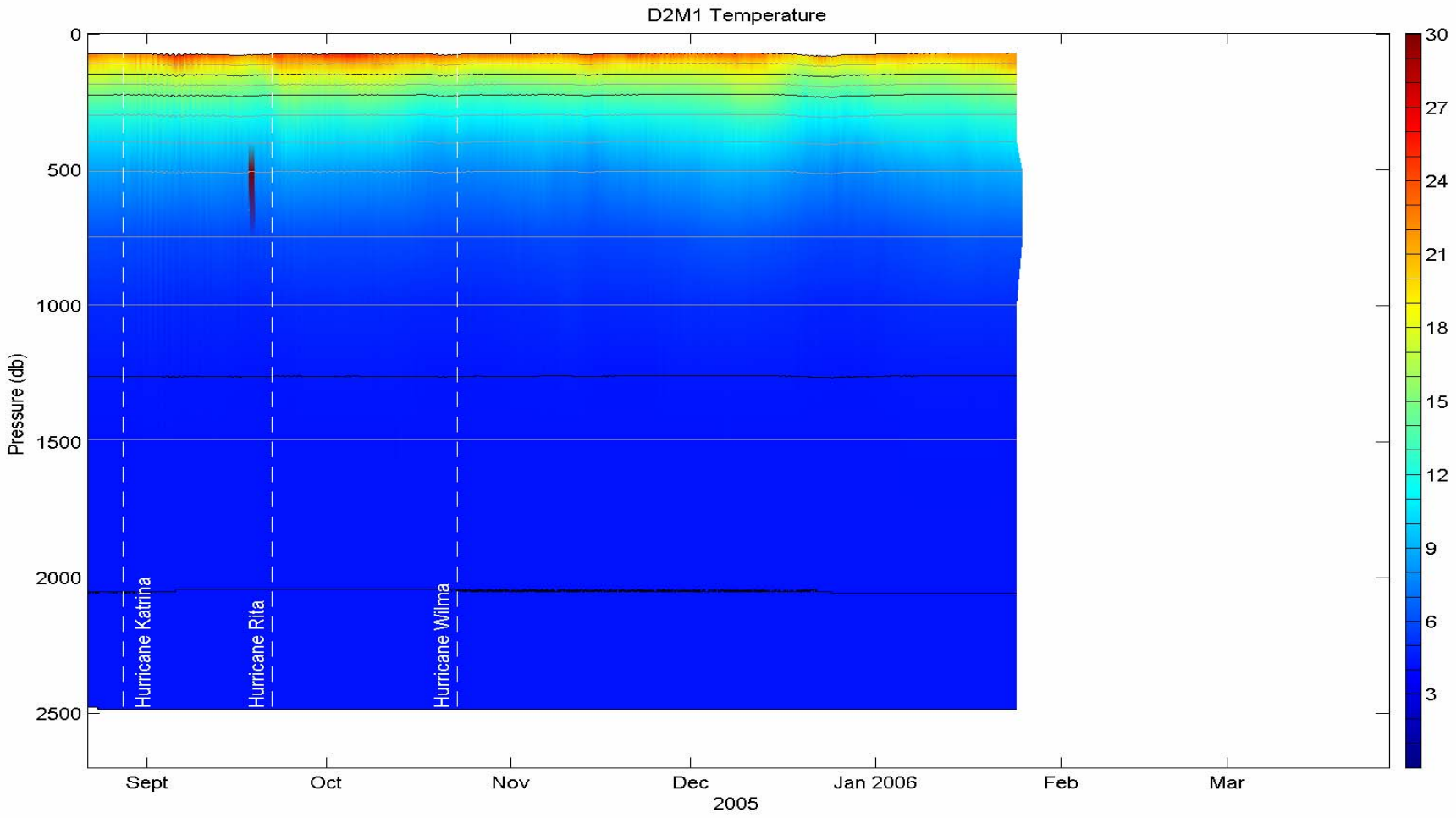
Mooring M2 – Deployment 1 – Temperature



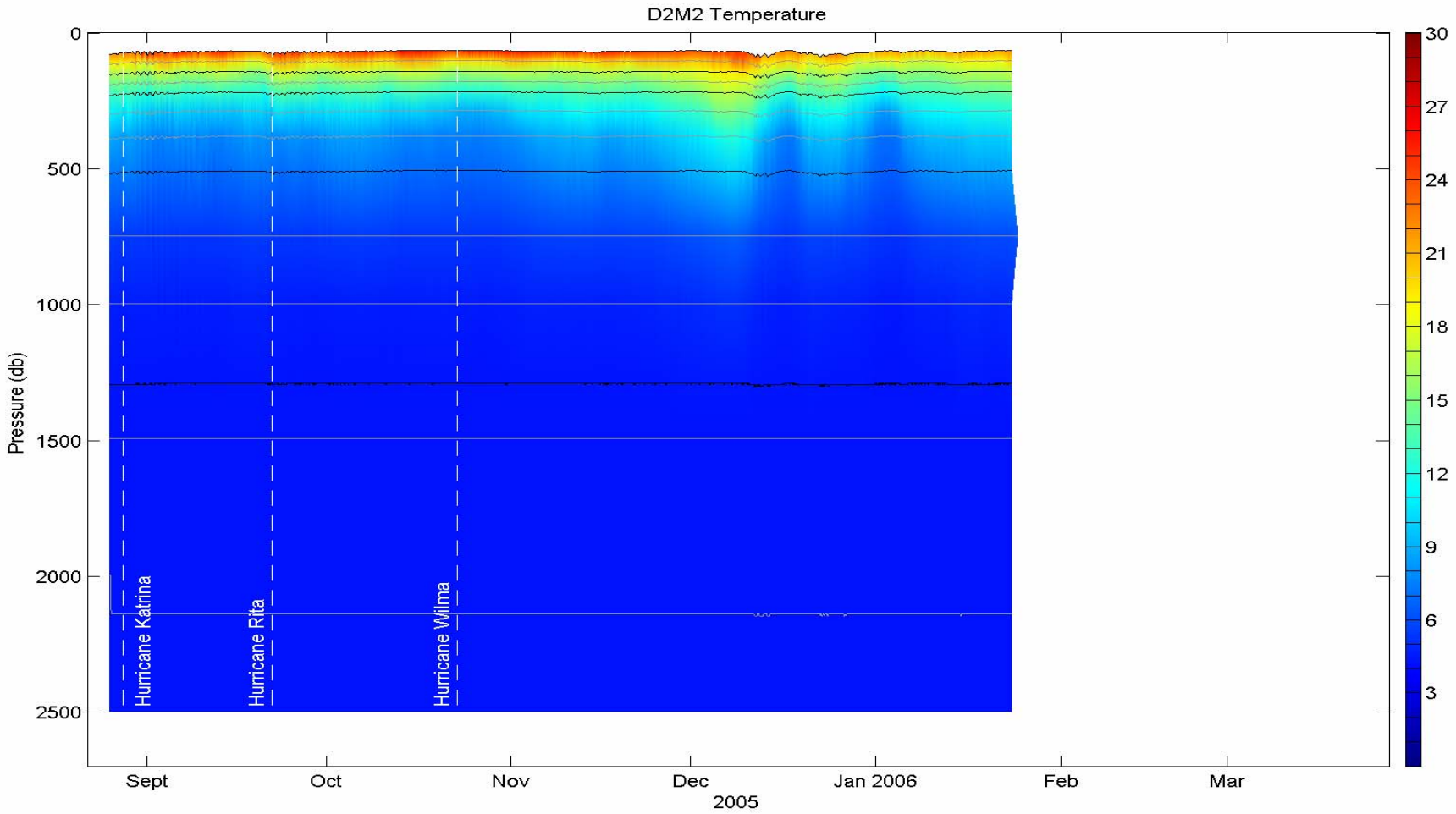
Mooring M3 – Deployment 1 – Temperature



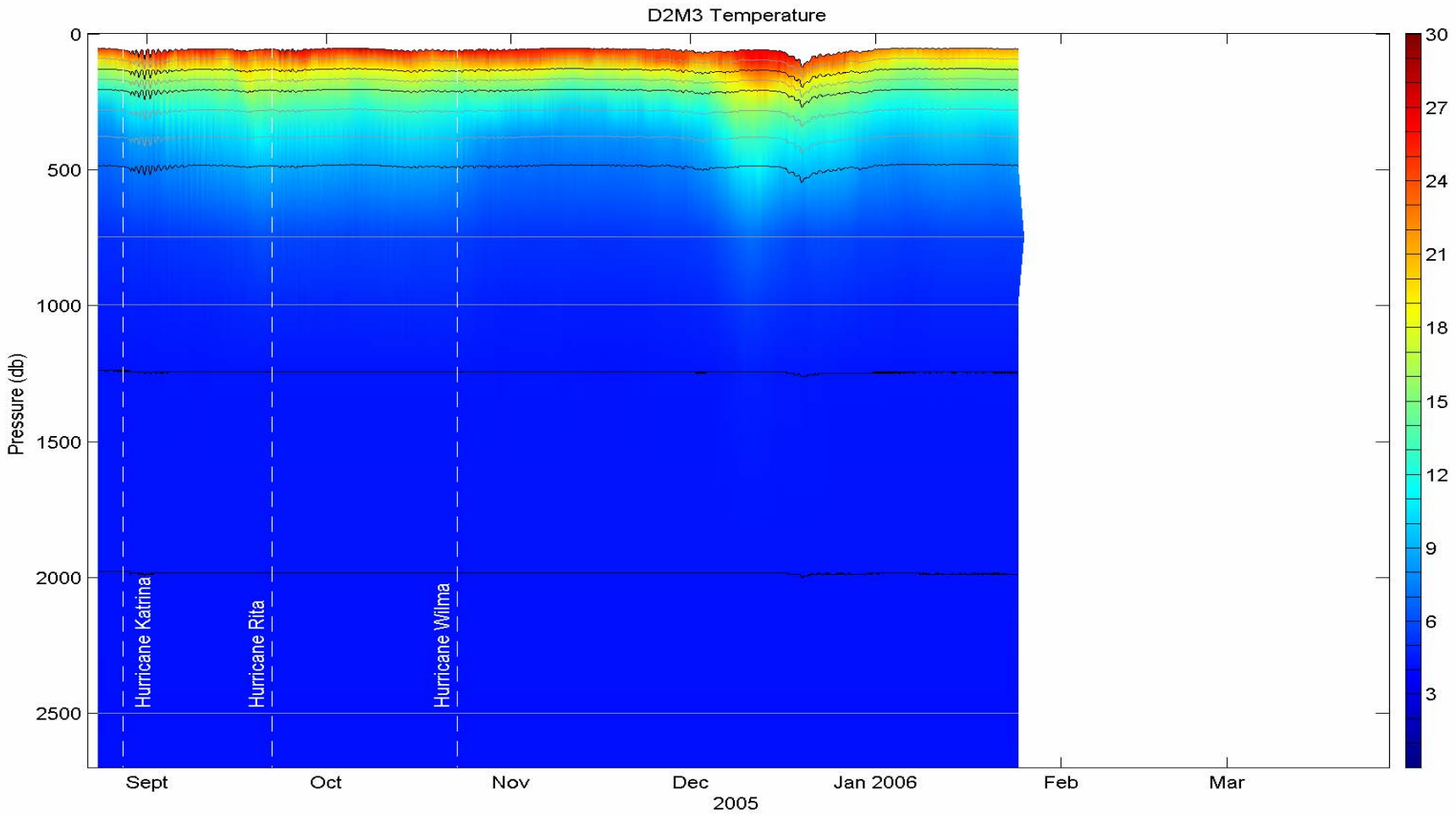
Mooring M1 – Deployment 2 – Temperature



Mooring M2 – Deployment 2 – Temperature



Mooring M3 – Deployment 2 – Temperature



Data Analysis Team & Responsibilities

- Evans-Hamilton, Inc.
  - Data processing, QA/QC, analysis coordination, deliverables
- Dr. Robert Leben (University of Colorado) – PI
  - Remote sensing products, identification & movement of LC, LCE, & LCFE features, geostrophic flow
- Dr. Kathleen Donahue & Dr. Randy Watts (University of Rhode Island) – PI
  - PIES, geostrophic flow
- Dr. Peter Hamilton (SAIC) – PI
  - Lower layer eddies & processes, formation & effects of TRWs, upper/lower layer couplings
- Dr. Steve DiMarco (Texas A&M University) – PI
  - Inertial & superinertial motions, analysis of kinetic energy variations for weather & mesoscale events, response to extreme atmospheric events
- Dr. George Forristall (Forristall Ocean Engineering.) – PI
  - Upper layer dynamics, LCE/ACE/frontal eddy effects, upper/lower layer couplings, slope intensification of currents, extreme value distribution

Analysis & Report Schedule

	2004						2005												2006												2007								
Month	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
Months After Award		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
Bank information for EFT (7 days)	▲																																						
Post Award Meeting (2 weeks)	▲																																						
Summary of Discussions	▲																																						
NODC Archiving Agreement		▲																																					
Letter to MMS			▲																																				
Quarterly Reports				◇			◆			◇			◇			◇			◆			◇			◇			◇			◆			◇			◇			
ITM in New Orleans					▼												▼																						
Fieldwork																																							
Mobilization																																							
Deployments						P	D							S					R																				
Cruise Report																																							
Data Processing																																							
Data Analysis																																							
Draft Report Preparations																																							
NODC Archiving Submission	38 months																																						38m
Synthesis Report - draft	38 months																																						38m
Review comments received																																							
Synthesis Report - proof	within 30 days of comments																																						
Synthesis Report - final (1)	within 30 days of proof approval																																						
Synthesis Report - final (2)	within 30 days of final 1 approval																																						
Report Cover Graphic	38 months																																						38m
Technical Summary - draft	38 months																																						38m
Technical Summary - proof	concurrent with Synthesis proof																																						
Technical Summary - final	concurrent with Synthesis final																																						
PowerPoint Presentation - draft	concurrent with Synthesis draft																																						38m
PowerPoint Presentation - final	concurrent with Synthesis final																																						

▲ Discrete event

◇ Quarterly status report

◆ Quarterly status report including yearly summary

P=PIES deployment, D=mooring deployment, **S**=Service of moorings, R=mooring & PIES recovery

Draft version

Proof version

Final version

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