Dr. William D. Grant

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Moored Current Meter and Wind Recorder Measurements Near Point Conception, California: The 1983 OPUS Observations

by

**Kenneth H. Brink
Dolores Chausse
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January 1985

Technical Report

*Funding was provided by the National Science Foundation
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Near Point Conception, California:
The 1983 OPUS Observations**

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Abstract

The OPUS (Organization of Persistent Upwelling Structures) program deployed two current meter (VMCM) moorings near Point Conception, California, during April-July 1983. Current and temperature data from these moorings are summarized here. In addition, data from two nearby NDBC (National Data Buoy Center) meteorological buoys are presented.

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I. Introduction

OPUS (Organization of Persistent Upwelling Structures) is an interdisciplinary program intended to study the coupled physical and biological structure associated with a coastal upwelling center. The program focusses on the particularly strong upwelling locale between Points Conception and Arguello, California. The Spring 1983 intensive field program took place from early April through mid May of that year. Principal investigators providing primarily physical data sets included L. P. Atkinson (Skidaway Institute of Oceanography, hydrography), K. H. Brink (Woods Hole Oceanographic Institution, Doppler acoustic underway currents, and current meter analysis), R. E. Davis (Scripps Institution of Oceanography, drifting buoys, satellite imagery and current meter mooring operations) and D. W. Stuart (Florida State University, meteorology). In addition, the Minerals Management Service sponsored a coincident program in the nearby Santa Barbara Channel.

As a part of the 1983 field program, two current meter moorings were deployed along the 70 m isobath between Points Arguello and Conception (Figure 1). Both moorings were equipped with VMCMs (Vector Measuring Current Meters) at depths of 5, 10, 20, 30, 45 and 60 m. The rationale for the placement of the instruments was as follows. Mooring C-1 ($34^{\circ}30.5'N$, $120^{\circ}36.6'W$) was placed within the estimated core of the upwelling center, based on results from the 1981 OPUS pilot (Brink, Stuart and Van Leer, 1984). The isobath was chosen to be as close to shore as possible without getting into water so shallow as to be completely dominated by the surface and bottom boundary layers. The scientific rationale was to define the flow structures associated with the core of the upwelling center. The C-2 ($34^{\circ}27.5'N$, $120^{\circ}31.7'W$) mooring was placed so as to provide a direct comparison with C-1. Specifically, we wished to know if flow structures were significantly different away from the upwelling center and if the flow would be coherent over the 10 km separation between the moorings. In addition to the OPUS moorings, we obtained meteorological data from NDBC (National Data Buoy Center) buoys 46023 and 46011, denoted as PC and PS respectively on Figure 1.

The OPUS moorings were designed, fabricated, deployed and recovered by personnel from Scripps Institution of Oceanography. Both moorings were identical in design, used surface spherical floats and did not use acoustic

releases (Figure 2). The moorings had weights near the bottom ("CLMP") and were free to drag 32 m of chain (connected to the anchor) over the bottom. On both moorings, the top three current meters were provided by Scripps, while the bottom three were provided by the WHOI Buoy Group. The WHOI instruments were activated and tested by buoy group personnel after shipping to San Diego. The WHOI instruments were shipped, still running, to Woods Hole after recovery.

II. Instrument description and data recovery.

All instruments deployed were Vector Measuring Current Meters (VMCMs). The choice of instrument was made because VMCMs have been shown to perform extremely well in near-surface, wave dominated regimes (Weller and Davis, 1980). The upper three (5, 10, 20 m) instruments on each mooring were fabricated at Scripps, while the lower three (30, 45 and 60 m) were built commercially by EG&G. All instruments recorded data at 7.5 minute intervals. The WHOI instruments measured temperature over the range of -5 to 30°C , while the Scripps instruments measured temperatures over approximately 0 – 25°C . Accuracies on temperature measurements were $\pm 0.1^{\circ}\text{C}$ or better.

The C-1 mooring was deployed on March 31, 1983, and the C-2 mooring was deployed on April 1, 1983. Recovery of both moorings took place by July 29, 1983. Both deployment and recovery were carried out from the R/V NEW HORIZON. All six Scripps instruments performed flawlessly over the entire period. Of the six deeper instruments two (C-1 at 30 m and C-2 at 45 m) stopped producing reliable velocity measurements in mid June due to electronic failures. A third instrument (C-1 at 60 m) failed after approximately 50 hours of operation. In this case, an exposed terminal corroded, allowing the instrument to flood. None of the current meters experienced any problems with biofouling.

III. Data Processing.

a. Current meter data.

The data tapes from the six shallow current meters were read and translated to practical units at Scripps, and the results sent to WHOI. Similar processing took place at WHOI for the remaining instruments. All of the data were then subjected to standard WHOI editing procedures including a check on the time base, truncation to remove launch and recovery transients, removal of

erroneous data cycles and interpolation to fill resulting gaps. All data were then subjected to hourly averaging. Low-pass filtered time series were created using the Oregon State LLPA cosine-Lanczos filter. This filter has 119 weights, a half-power point of 1.96 days and a half-amplitude point of 1.67 days. The LLPA filter is particularly efficient for the removal of tidal variability.

b. Meteorological buoy data.

The meteorological data were compiled by D. Stuart, who obtained the records from the National Data Buoy Center. Both meteorological buoys recorded air and water temperature, atmospheric pressure, wave height, wave period and wind velocity. Data arrived at WHOI in the form of hourly averages. Water temperature was recorded through the buoy hull at 0.75 m depth. The PS buoy was a discus buoy with its anemometer at 10 m height. The PC buoy was initially a "NOMAD" type buoy with a 5 m anemometer, but was replaced on April 15, 1983, by a discus buoy identical to that at the PS location. See Hamilton (1980) for a description of the buoys.

Numerous gaps appeared in the meteorological data. Gaps of five hours or less were filled in by linear interpolation. Longer gaps were filled by regression or vector regression (e.g. $U_2 = aU_1 + bV_1 + c$) between the two buoys. This appears reasonable, since all hourly records were well correlated between the two buoys. Wind records from PC prior to April 15 were extrapolated to a 10 m anemometer height using the method of Large and Pond (1981) for neutral stability. Wind stress was computed from the hourly data, again using a formula due to Large and Pond (1981). Low-pass filtered data were generated using the OSU LLPA filter.

The wave field data is defined as follows. The wave height h_w is the "significant wave height," defined as the average wave height of the largest 1/3 of the waves present. The wave period given is the spectrally averaged period for the hourly interval. Definitions in terms of wave spectra can be found in Neumann and Pierson (1966, pg. 351 and equation 12.25, respectively).

IV. Data presentation.

Results from the measurements are presented through both statistical summaries (Tables 2-4) and graphically (Figures 3-7). Further, autospectra of

currents, temperatures and wind stress are presented in Figures 8-10. Definitions of variable names are presented in Table 1. All vector quantities have been rotated 45° into the x-y frame of Figure 1, roughly representing an onshore-alongshore coordinate system.

Instrument locations are identified by mooring number and depth in meters. For example, C1-20 means the C1 mooring at 20 m depth.

Definitions in the statistical tables require further clarifications. Means (over the record length shown) are denoted by an overbar. Standard deviations are denoted by a prime and were computed after a linear trend (a, computed by a least squares fit) was removed. Likewise, independence time scales I (Lumley and Panofsky, 1964) and major axis orientations θ_p were computed after removal of the trend. Standard deviations in the principal axis reference frame (e.g. u'_p and v'_p) are also given. Finally, standard errors of the means ϵ were computed following Lumley and Panofsky (1964, p. 37). The mean flow direction $\theta_{\bar{v}}$ and major axis direction θ_p are measured counterclockwise relative to the x axis. The angle represents the direction towards which the flow proceeds.

V. Acknowledgements

Gerald Parks and Jim DuFour (S.I.O.) fabricated the moorings and conducted the deployment and recovery. Brian Skelly (W.H.O.I.) took charge of preparing and testing the WHOI VMCMs. Ann Spencer and George Tupper (W.H.O.I.) gave help on data processing. We wish to thank the officers and crew of the R/V NEW HORIZON for their help in mooring and recovery operations. We are grateful to Dr. D. W. Stuart (F.S.U.) for relaying the meteorological data, and to the National Data Buoy Center, NSTL Station, for providing the data. This work was supported by NSF (National Science Foundation) grants OCE82-13968 (K.H.B.) and OCE80-14942 (R.E.D.).

VI. References

- Brink, K. H., D. W. Stuart and J. C. Van Leer, 1984. Observations of the coastal upwelling region near $34^{\circ}30'N$ off California: Spring 1981. Journal of Physical Oceanography, 14, 378-391.
- Hamilton, G. D., 1980. NOAA data buoy office programs. Bulletin of the American Meteorological Society, 61, 1012-1017.
- Large, W. S. and S. Pond, 1981. Open ocean momentum flux measurements in moderate to strong winds. Journal of Physical Oceanography, 11, 324-336.
- Lumley, J. L. and H. A. Panofsky, 1964. The Structure of Atmospheric Turbulence. Wiley, 239 pp.
- Neumann, G. and W. J. Pierson, Jr., 1966. Principals of Physical Oceanography. Prentice-Hall, Inc., 545 pp.
- Weller, R. A. and R. E. Davis, 1980. A vector measuring current meter. Deep-Sea Research, 27, 565-582.

Table Titles:

- 1) Definition of symbols.
- 2) Statistics for hourly OPUS current meter data.
- 3) Statistics of the low-pass filtered OPUS current meter data.
- 4) Statistics of the meteorological buoy data.

Figure Captions

- Figure 1: Locator map of the OPUS mooring array. All depths are in meters. The symbols PS and PC represent NDBC buoys 46011 (NDBOS) and 46023 (NDBOC), respectively. The coordinate system shown is that used throughout the data report.
- Figure 2: A schematic of the OPUS current meter mooring designs. Chain and wire diameters are in inches, and "CLMP" is a weight.
- Figure 3: Hourly data at C-1.
 (a) Stick diagrams of PS wind stress and C-1 currents.
 (b) Temperature time series at the PS buoy (surface temperature) and at the C-1 mooring.
- Figure 4: Hourly data at C-2.
 (a) Stick diagrams of PS wind stress and C-2 currents.
 (b) Temperature time series at the C-2 mooring.
- Figure 5: Low-pass filtered data at C-1.
 (a) Stick diagrams of PS wind stress and C-1 currents.
 (b) Stick diagram of PS wind stress, and plots of temperature at 5, 10, 20, 30 and 45 m depth. The highest temperature is at 5 m and the lowest at 45 m.
- Figure 6: Low-pass filtered data at C-2.
 (a) Stick diagrams of PS wind stress and C-2 currents.
 (b) Stick diagram of PS wind stress, and plots of temperature at 5, 10, 20, 30, 45 and 60 m. The highest temperature is at 5 m and the lowest at 60 m.
- Figure 7: Low-pass filtered wind stress at the NDBC buoys. PS is labelled NDBOS and PC is labelled NDBOC.

Figure 8: Spectra of scalar currents and of temperature at the C-1 mooring. The scalar spectrum is the sum of the two velocity component spectra.

- a) Data at 5 m and 10 m.
- b) Data at 20 m and 30 m.
- c) Data at 45 m.

Figure 9: Spectra of scalar currents and of temperature at the C-2 mooring. The scalar spectrum is the sum of the two velocity component spectra.

- a) Data at 5 m and 10 m.
- b) Data at 20 m and 30 m.
- c) Data at 45 m and 60 m.

Figure 10: Spectra of scalar wind stress and of water temperature at the NDBC buoys. The PS buoy is labelled NDBOS and the PC buoy is labelled NDBOC. The scalar spectrum is the sum of the two stress component spectra.

TABLE 1: Definition of symbols.

Current meter data

u	onshore (x) velocity
v	alongshore (y) velocity
T	temperature

Meteorological buoy data

U	onshore (x) wind velocity
V	alongshore (y) wind velocity
τ^x	onshore wind stress
τ^y	alongshore wind stress
p	atmospheric pressure
T_a	air temperature
T_w	water temperature
h	wave height
P_w	wave period

TABLE 2: Statistics for hourly OPUS current meter data.

Record	Start	Stop	Length (hours)	$\bar{u}$ cm/s	$\bar{v}$ cm/s	$\bar{T}$ °C	u' cm/s	v' cm/s	T' °C	I_u (d)	I_v (d)	I_T (d)	$\epsilon_{\bar{u}}$ cm/s	$\epsilon_{\bar{v}}$ cm/s	$\epsilon_{\bar{T}}$ °C	θ_p °	$u'p$ cm/s	$v'p$ cm/s	$\theta_{\bar{v}}$ °	a_u (cm/s)/hour	a_v (cm/s)/hour	a_T (°C)/hour
C1-5	4/1 0100	7/27 1600	2824	-7.3	-1.6	13.34	10.8	15.0	1.22	11	20	80	1.0	1.8	0.29	72.7	10.2	15.4	192.4	-1.94×10^{-3}	3.43×10^{-3}	1.63×10^{-3}
C1-10	4/1 0100	7/27 1600	2824	-4.4	1.5	13.04	9.7	14.1	1.15	11	21	81	0.9	1.7	0.28	77.9	9.5	14.3	161.2	-1.04×10^{-3}	3.49×10^{-3}	1.49×10^{-3}
C1-20	4/1 0100	7/27 1600	2824	1.7	4.5	12.62	8.0	14.0	1.00	10	21	78	0.7	1.7	0.24	93.9	8.0	14.0	69.3	0.29×10^{-3}	3.33×10^{-3}	1.20×10^{-3}
C1-30	4/1 0200	6/18 1100	1882	3.4	3.2	11.73	7.8	10.7	0.81	10	20	76	0.8	1.6	0.23	114.7	6.8	11.4	43.3	0.84×10^{-3}	-2.48×10^{-3}	0.22×10^{-3}
C1-45	4/1 0200	7/28 1100	2842	2.4	5.6	11.98	7.6	11.5	0.80	9	17	71	0.6	1.3	0.18	110.5	6.8	12.0	66.8	-0.31×10^{-3}	1.85×10^{-3}	0.91×10^{-3}
C2-5	4/1 1900	7/28 1000	2824	-8.0	2.3	13.77	11.6	17.7	1.20	8	14	74	0.9	1.8	0.27	65.9	9.5	19.0	164.0	-0.56×10^{-3}	4.67×10^{-3}	1.84×10^{-3}
C2-10	4/1 1900	7/28 1000	2824	-5.8	5.0	13.54	10.9	16.8	1.14	8	17	73	0.8	1.8	0.26	67.8	9.2	17.8	139.2	-0.59×10^{-3}	4.89×10^{-3}	1.68×10^{-3}
C2-20	4/1 1900	7/28 1000	2824	0.1	9.6	12.85	9.2	16.9	1.03	10	18	74	0.8	1.9	0.24	80.6	8.9	17.0	89.4	0.07×10^{-3}	6.87×10^{-3}	1.29×10^{-3}
C2-30	4/1 2000	7/29 1200	2848	1.9	7.6	12.62	7.1	13.8	0.90	8	18	70	0.5	1.6	0.20	86.2	7.0	13.8	76.0	-0.31×10^{-3}	3.27×10^{-3}	1.06×10^{-3}
C2-45	4/1 2000	6/16 1300	1818	2.2	4.0	11.48	7.7	11.3	0.64	5	10	61	0.6	1.2	0.17	84.4	7.6	11.4	61.2	0.25×10^{-3}	-0.63×10^{-3}	0.09×10^{-3}
C2-60	4/1 2000	7/29 1200	2848	-1.7	4.0	11.67	11.1	12.1	0.68	4	7	56	0.6	0.8	0.13	61.4	10.6	12.5	113.0	-0.57×10^{-3}	2.85×10^{-3}	0.75×10^{-3}

TABLE 3: Statistics of the low-pass filtered OPUS current meter records

Record	Start	Stop	Length (hours)	$\bar{u}$ cm/s	$\bar{v}$ cm/s	$\bar{T}$ °C	u' cm/s	v' cm/s	T' °C	I_u (d)	I_v (d)	I_T (d)	ϵ_u cm/s	ϵ_v cm/s	ϵ_T °C	θ_p °	$u'p$ cm/s	$v'p$ cm/s	θ_v °	a_u (cm/s) day	a_v (cm/s) day	a_T (°C) day
C1-5	4/3 1800	7/24 2400	2700	-7.1	-1.5	13.31	6.6	12.6	1.19	1.0	1.5	9.6	0.9	2.1	0.49	78.9	6.2	12.8	191.9	-5.24 x 10 ⁻²	6.94 x 10 ⁻²	3.93 x 10 ⁻²
C1-10	4/3 1800	7/24 2400	2700	-4.2	1.6	13.01	6.0	11.9	1.10	1.0	1.5	5.2	0.8	1.9	0.33	79.9	5.7	12.1	159.1	-3.00 x 10 ⁻²	7.44 x 10 ⁻²	3.58 x 10 ⁻²
C1-20	4/3 1800	7/24 2400	2700	1.8	4.6	12.60	4.3	11.9	0.95	1.0	1.4	5.6	0.6	1.9	0.30	94.8	4.2	12.0	68.6	0.59 x 10 ⁻²	7.37 x 10 ⁻²	2.91 x 10 ⁻²
C1-30	4/3 1800	6/15 1800	1758	3.4	3.4	11.70	4.9	8.6	0.74	1.0	1.4	3.6	0.8	1.7	0.23	113.3	3.5	9.2	45.0	1.78 x 10 ⁻²	-8.36 x 10 ⁻²	0.19 x 10 ⁻²
C1-45	4/3 1800	7/25 1800	2718	2.3	5.7	11.97	4.3	9.3	0.71	1.0	1.0	5.7	0.6	1.2	0.23	106.9	3.4	9.6	68.0	-0.33 x 10 ⁻²	+3.82 x 10 ⁻²	2.23 x 10 ⁻²
C2-5	4/4 1200	7/25 1800	2700	-7.8	2.6	13.76	6.7	13.6	1.15	0.8	2.7	4.7	0.8	3.0	0.33	70.4	5.0	14.3	161.6	-2.33 x 10 ⁻²	11.3 x 10 ⁻²	4.48 x 10 ⁻²
C2-10	4/4 1200	7/25 1800	2700	-5.7	5.3	13.52	6.2	12.7	1.07	0.8	2.7	5.1	0.7	2.8	0.32	72.5	5.0	13.2	137.1	-2.27 x 10 ⁻²	11.8 x 10 ⁻²	4.09 x 10 ⁻²
C2-20	4/4 1200	7/25 1800	2700	4.5	9.8	12.84	5.3	13.0	0.96	1.0	2.3	5.4	0.7	2.6	0.30	85.4	5.2	13.0	65.3	-0.75 x 10 ⁻²	16.4 x 10 ⁻²	3.17 x 10 ⁻²
C2-30	4/4 1200	7/26 1800	2724	1.9	7.9	12.60	3.9	10.9	0.84	1.5	1.8	5.4	0.6	1.9	0.26	89.2	3.9	10.9	76.5	-0.67 x 10 ⁻²	8.46 x 10 ⁻²	2.56 x 10 ⁻²
C2-45	4/4 1200	6/14 0000	1698	2.2	4.2	11.46	3.2	7.4	0.57	1.5	1.2	3.1	0.7	1.4	0.17	92.2	3.2	7.4	62.4	2.79 x 10 ⁻²	-2.33 x 10 ⁻²	0.06 x 10 ⁻²
C2-60	4/4 1200	7/27 0000	2730	-1.7	4.1	11.65	3.2	7.2	0.55	2.0	0.9	5.5	0.6	0.9	0.17	95.9	3.2	7.2	112.5	-0.65 x 10 ⁻²	7.78 x 10 ⁻²	1.85 x 10 ⁻²

TABLE 4: Statistics of the meteorological buoy data.

	Hourly		LLPA	
	PS	PC	PS	PC
start	4/1 0000	4/1 0000	4/3 1800	4/3 1800
stop	7/31 2300	7/31 2300	7/29 0600	7/29 0600
length (hours)	2928	2928	2802	2802
$\bar{u}$ (m/s)	-0.8	-1.4	-0.8	-1.4
$\bar{v}$ (m/s)	-5.6	-7.3	-5.5	-7.1
$\bar{\tau}^x$ (dyne/cm ²)	-0.11	-0.24	-0.11	-0.24
$\bar{\tau}^y$ (dyne/cm ²)	-0.76	-1.12	-0.74	-1.09
$\bar{T}_a$ (°C)	13.3	14.1	13.3	14.0
$\bar{T}_w$ (°C)	14.21	14.47	14.18	14.47
$\bar{p}_a$ (mb)	1014.3	1013.8	1014.1	1013.6
$\bar{h}_w$ (m)	1.9	2.2	--	--
$\bar{p}_w$ (s)	6.1	6.1	--	--
u' (m/s)	1.7	1.9	1.2	1.5
v' (m/s)	4.6	4.2	4.3	3.9
$\tau^{x'}$ (dyne/cm ²)	0.22	0.29	0.15	0.22
$\tau^{y'}$ (dyne/cm ²)	0.82	0.89	0.72	0.78
T_a' (°C)	0.9	0.9	0.7	0.8
T_w' (°C)	0.91	0.97	0.87	0.93
p_a' (mb)	3.1	3.0	3.1	2.9
h_w' (m)	0.8	0.9	--	--
p_w' (s)	1.0	1.1	--	--
$\theta_{\bar{v}}$	-98.1	-100.9	-98.3	-101.2
$\theta_{\bar{\tau}}$	-98.2	-102.1	-98.5	-102.4

TABLE 4 continued

	PS	Hourly	PC	PS	LLPA	PC
I_u (hrs)	15		17	36		42
I_v (hrs)	29		28	37		36
$I_{\tau x}$ (hrs)	16		20	33		32
$I_{\tau y}$ (hrs)	27		27	34		33
I_{T_a} (hrs)	60		64	152		148
I_{T_w} (hrs)	84		89	177		122
I_{p_a} (hrs)	30		30	37		38
I_{h_w} (hrs)	28		31	--		--
I_{p_w} (hrs)	25		28	--		--
$\epsilon_{\bar{u}}$ (m/s)	0.2		0.2	0.2		0.3
$\epsilon_{\bar{v}}$ (m/s)	0.6		0.6	0.7		0.6
$\epsilon_{\tau \bar{x}}$ (dyne/cm ²)	0.02		0.03	0.02		0.03
$\epsilon_{\tau \bar{y}}$ (dyne/cm ²)	0.11		0.12	0.11		0.12
$\epsilon_{\bar{T}_a}$ (°C)	0.2		0.2	0.2		0.3
$\epsilon_{\bar{T}_w}$ (°C)	0.22		0.24	0.31		0.27
$\epsilon_{\bar{p}_a}$ (mb)	0.4		0.4	0.5		0.5
$\epsilon_{\bar{h}_w}$ (m)	0.1		0.1	--		--
$\epsilon_{\bar{p}_w}$ (s)	0.1		0.2	--		--

TABLE 4 continued

	PS	Hourly PC	PS	LLPA PC
θ_{pv}	78.9	73.8	77.7	73.5
u'_p (m/s)	1.4	1.5	0.8	0.9
v'_p (m/s)	4.7	4.4	4.4	4.1
$\theta_{p\perp}$	81.3	76.0	80.2	76.1
$\tau_p^{x'}$ (dyne/cm ²)	0.18	0.20	0.09	0.11
$\tau_p^{y'}$ (dyne/cm ²)	0.83	0.91	0.73	0.81
a_u (m/s/hr)	-0.44×10^{-3}	-0.31×10^{-3}	-0.53×10^{-3}	-0.47×10^{-3}
a_v (m/s/hr)	-1.45×10^{-3}	-1.67×10^{-3}	-1.84×10^{-3}	-2.01×10^{-3}
a_{τ_x} (d/cm ² /hr)	-0.52×10^{-4}	-0.31×10^{-4}	-0.69×10^{-4}	-0.61×10^{-4}
a_{τ_y} (d/cm ² /hr)	-1.54×10^{-4}	-2.77×10^{-4}	-2.32×10^{-4}	-3.55×10^{-4}
a_{T_a} (°C/hr)	1.02×10^{-3}	1.14×10^{-3}	1.11×10^{-3}	1.21×10^{-3}
a_{T_w} (°C/hr)	0.99×10^{-3}	1.44×10^{-3}	1.05×10^{-3}	1.47×10^{-3}
a_{p_a} (mb/hr)	-0.69×10^{-3}	-0.83×10^{-3}	-0.65×10^{-3}	-0.81×10^{-3}
a_{h_w} (m/hr)	-0.86×10^{-4}	-1.03×10^{-4}	--	--
a_{p_w} (s/hr)	-0.275×10^{-3}	-0.07×10^{-3}	--	--

Figure 1:

Locator map of the OPUS mooring array. All depths are in meters. The symbols PS and PC represent NDBC buoys 46011 (NDBOS) and 46023 (NDBOC), respectively. The coordinate system shown is that used throughout the data report.

Figure 2:

A schematic of the OPUS current meter mooring designs. Chain and wire diameters are in inches, and "CLMP" is a weight.

Figure 3a:

Hourly data at C-1.
Stick diagrams of PS wind stress and C-1 currents.

MOORING C1

Figure 3b:

Hourly data at C-1.
 Temperature time series at the PS buoy (surface temperature) and at the C-1 mooring.

Figure 4a:

Hourly data at C-2.
Stick diagrams of PS wind stress and C-2 currents.

Figure 4b:

Hourly data at C-2.
Temperature time series at the C-2 mooring.

Figure 5a:

Low-pass filtered data at C-1. Stick diagrams of PS wind stress and C-1 currents.

Figure 5b:

Low-pass filtered data at C-1. Stick diagram of PS wind stress, and plots of temperature at 5, 10, 20, 30 and 45 m depth. The highest temperature is at 5 m and the lowest at 45 m.

Figure 6a:

Low-pass filtered data at C-2. Stick diagrams of PS wind stress and C-2 currents.

Figure 6b:

Low-pass filtered data at C-2. Stick diagram of PS wind stress, and plots of temperature at 5, 10, 20, 30, 45 and 60 m. The highest temperature is at 5 m and the lowest at 60 m.

Figure 7:

Low-pass filtered wind stress at the NDBC buoys. PS is labeled NDBOS and PC is labeled NDBOC.

Figure 8a:

Spectra of scalar currents and of temperature at the C-1 mooring, at 5 m and 10 m. The scalar spectrum is the sum of the two velocity component spectra.

Figure 8b:

Spectra of scalar currents and of temperature at the C-1 mooring, at 20 m and 30 m. The scalar spectrum is the sum of the two velocity component spectra.

Figure 8c:

Spectra of scalar currents and of temperature at the C-1 mooring, at 45 m. The scalar spectrum is the sum of the two velocity component spectra.

Figure 9a:

Spectra of scalar currents and of temperature at the C-2 mooring at 5 m and 10 m. The scalar spectrum is the sum of the two velocity component spectra.

Figure 9b:

Spectra of scalar currents and of temperature at the C-2 mooring at 20 m and 30 m. The scalar spectrum is the sum of the two velocity component spectra.

Figure 9c:

Spectra of scalar currents and of temperature at the C-2 mooring at 45 m and 60 m. The scalar spectrum is the sum of the two velocity component spectra.

Figure 10:

Spectra of scalar wind stress and of water temperature at the NDBC buoys. The PS buoy is labeled NDBOS and the PC buoy is labeled NDBOC. The scalar spectrum is the sum of the two stress component spectra.

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