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cutoff levels for scores on the WISC-R should be lowered from those currently in use for either the WISC or the Stanford-Binet, but additional research is needed to properly determine how much lower.

LITERATURE CITED

Duncan, D. B. 1955. Multiple range and multiple F tests. Biometrics. 11:1-42.

Gironda, R. J. 1977. A comparison of WISC and WISC-R results of urban educable mentally retarded students. Psychology in the Schools. 14:271-275.

Kaufman, A. S., and J. Van Hagen. 1977. Investigation of the WISC-R for use with retarded children: Correlation with the 1972 Stanford-Binet and comparison of WISC and WISC-R profiles. Psychology in the Schools. 14:10-18.

Larrabee, G. J., and R. G. Holroyd. 1976. Comparison of WISC and WISC-R using a sample of highly intelligent children. Psychological Reports. 38:1077-1080.

Schwarting, F. G. 1976. A Comparison of the WISC and WISC-R. Psychology in the Schools. 13:139-141.

Swerdlik, M. E. 1977. The question of comparability of the WISC and WISC-R: Review of the research and implications for school psychologists. Psychology in the Schools. 14:260-270.

Wechsler, D. 1974. Wechsler Intelligence Scale for Children (Revised). Psychological Corporation, New York.

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Physical Sciences

LOW FREQUENCY NEARSHORE CURRENT FLUCTUATIONS ON FLORIDA'S CENTRAL EAST COAST

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Abstract: *Nearshore current measurements in 10 m of water off Hutchinson Island on Florida's central east coast were obtained over 40 da. Data analyses reveal independent alongshore and crosshelf systems of subinertial waves superimposed on a weak southward, essentially alongshore mean current. The crosshelf current fluctuations appear to be wind driven, while only the 2-2.8 da alongshore current fluctuations are coherent with windstress.*°

Nearshore currents encountered on the continental shelf are characterized by a high degree of variability which spans several orders of magnitude in time and spatial scales. The low frequency fluctuations of these currents and their relation to windstress and atmospheric pressure over the inner shelf are of interest here.

Lee and Mayer (1977) observed the currents over the inner shelf (< 6 m water depth) off Miami, Florida to consist of essentially alongshore fluctuations,

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with low frequency oscillations (periods 40 > hr) accounting for 50-60% of the total observed variance. Alongshore fluctuations with periods greater than 3.5 da were highly coherent with the N-S component of the local wind, suggesting an essentially wind driven nearshore circulation.

The currents near the shelfbreak off Miami are largely influenced by "spin-off" eddies and wave-like meanders of the Florida Current. These eddies reappear weekly, have dia between 10 and 30 km and a lifetime of 2-3 wk. Observations by Lee (1975) indicate that the nearshore currents off Miami are, however, somewhat isolated from the current fluctuations at the shelfbreak.

Because the shelf increases in width along the central Florida east coast northward from Miami, a reduction of the influence of the "spin-off" eddies and wave-like meanders on the circulation over the wider inner shelf may be expected, thus resulting in a predominantly wind driven circulation on the inner shelf on Florida's central east coast.

Measurement and Data Analaysis—A 40 da record of half-hourly average current speed and direction measurements was acquired between 25 July and 3 September 1975 using an impeller driven current meter (Endeco Model 105). The meter was set at a depth of 8 m on a taut subsurface mooring located in 10 m of water 1 km offshore. The bathymetry of the area and the location of the current meter site are shown in Fig. 1.

Hourly meteorological data for Miami, Vero Beach, Daytona Beach, and Jacksonville were obtained from the National Climatic Center. The meteorological data obtained from the Vero Beach Airport, about 30 km NW of the current meter site and 4 km inland, were used to represent local atmospheric conditions.

Prior to time series analysis, the wind and current vectors were resolved into alongshore (340 T) and crosshelf components. Auto and cross spectrum estimates of 6 degrees of freedom were obtained by averaging over 3 adjoining raw frequency estimates.

Results—Statistical analyses of the current meter data indicate periodic flow reversals from essentially alongshore northward to alongshore southward, superimposed on a weak, mostly southward but onshore mean current. The mean velocity is 1.5 cm/sec at 195T; the nearby coastline is oriented 160 to 340T. The diagram of 2 hourly current vectors (Fig. 2) and rotary spectral analysis of the current (not shown) reveal little rotary motion. The coefficients of variation for the u (offshore) and v (alongshore northward) current components are 9.5 and 11.4%, respectively; the alongshore current component being about 17 times more energetic than the offshore component (Hale, 1976). Tidally driven currents account for 30% of the variance of the v-component, the K_1, M_2, O_1, P_1, and N_2 tidal constituents, in decreasing order of magnitude, being the most important components.

The low frequency portion of the v–spectrum of the current (Fig. 3) exhibits 3 broad band subinertial spectrum peaks centered at 0.14, 0.45, and 0.77 cpd (periods of 7.1, 2.2, and 1.3 da, respectively). Less energetic broad band peaks in the u-spectrum occur at periods of 3.5, 1.8, and 1.2 da. Alongshore

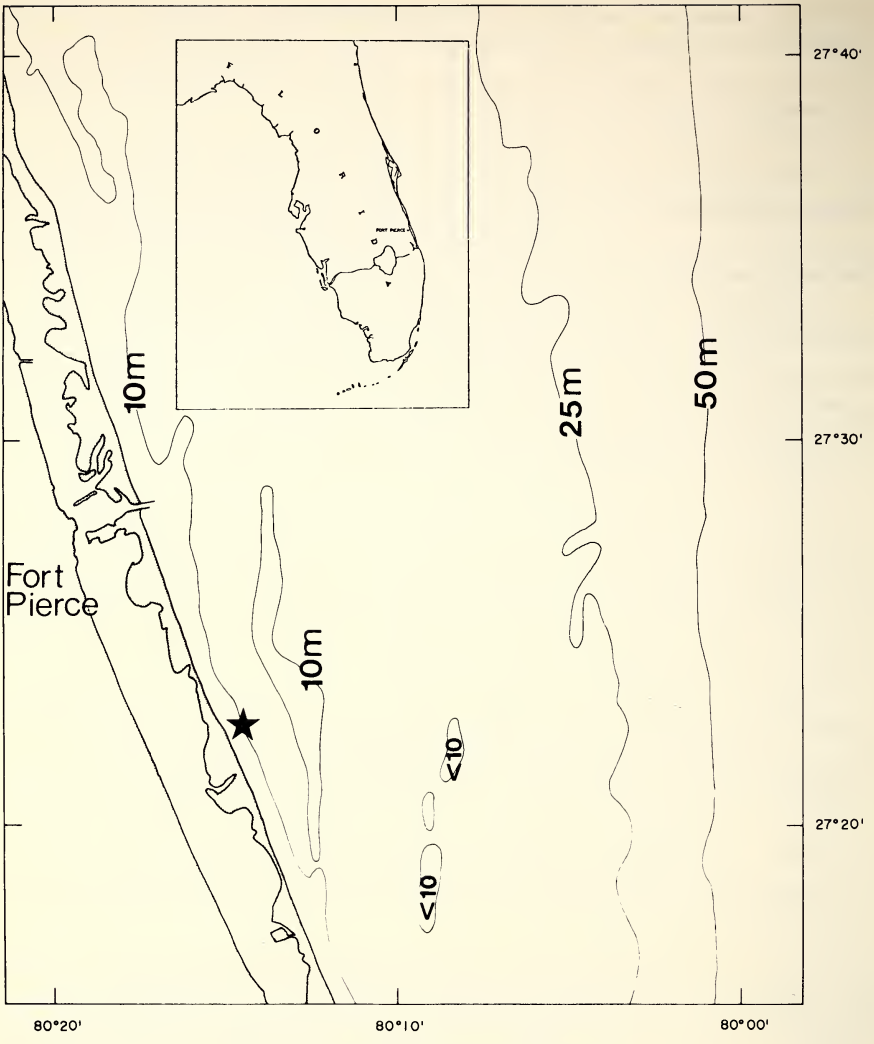

FIG. 1. Site map of current meter.

and crosshelf current oscillations are mutually coherent (at the 95% significance level) in 3 bands with periods of 1.3-1.6, 2.4-2.8, and 4.7-14 da.

Estimates of squared coherence between the alongshore and cross shore components of windstress (π_v and π_x, respectively), alongshore components of atmospheric pressure gradients, and both components of the current were obtained. Fig. 4 shows the coherence estimates between the u and v current components and τ_x and τ_y together with the 90 and 95% significance levels.

The only subinertial, alongshore current fluctuations significantly coherent (> 95% significance) with both components of the windstress have a period of 2.8 da. At this period small peaks are found in the τ_x and τ_y spectra. Oscillations

in the 2-2.8 da band, which include the peak in the v-spectrum, are also significantly coherent with τ_x.

The spectrum of the local sea level pressure shows no distinct peaks. Spectrum peaks were found in the alongshore component of the atmospheric pressure gradient at 1.1 cpd for the Miami–Jacksonville gradient and a 0.8 cpd for the Miami–Vero Beach gradient. Significant squared coherence between the alongshore currents and the longshore component of both the Miami–Jacksonville

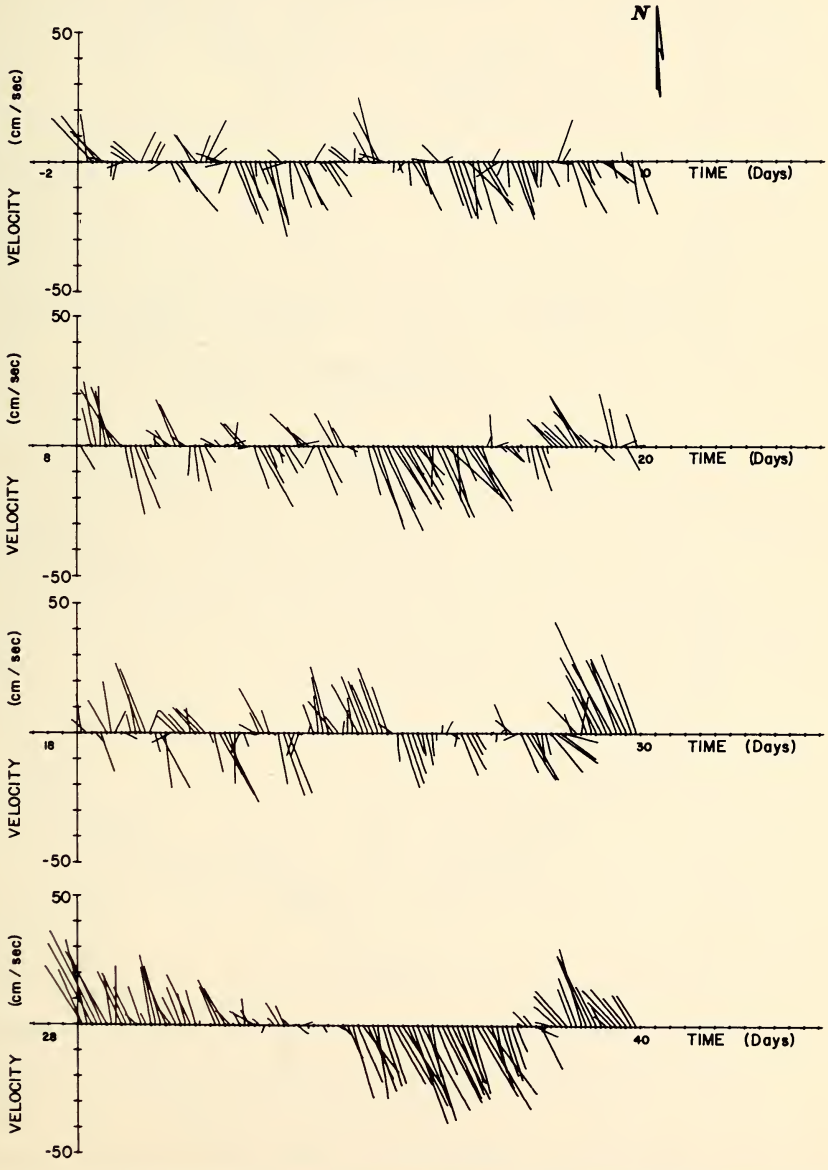

Fig. 2. Stick diagram of 2 hourly current vectors 25 July-3 September 1975.

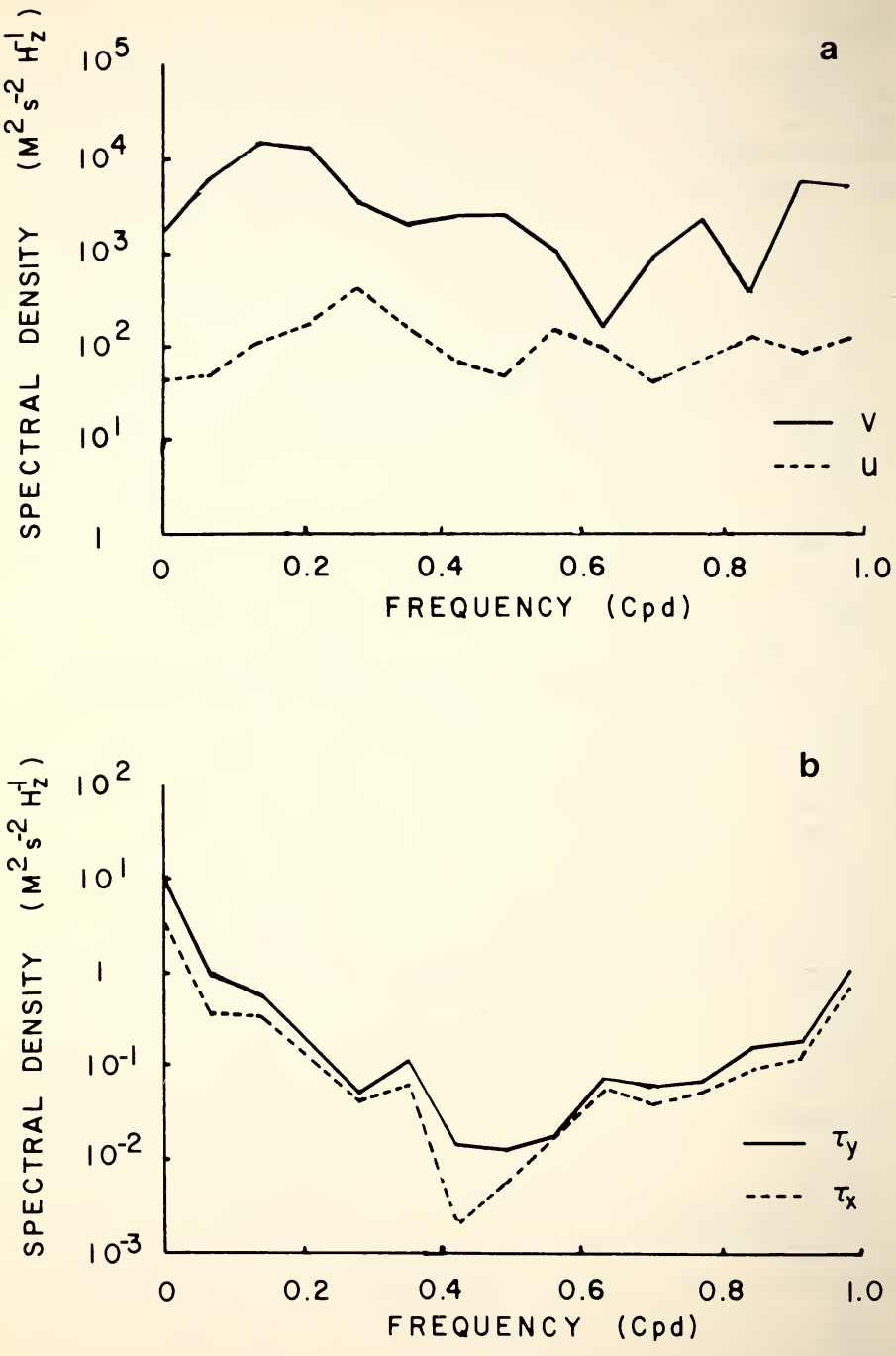

FIG. 3. a. Autospectra of u (offshore) and v (alongshore) components of the current. b. Crosshore (τ_x) and longshore (τ_y) autospectra of the windstress.

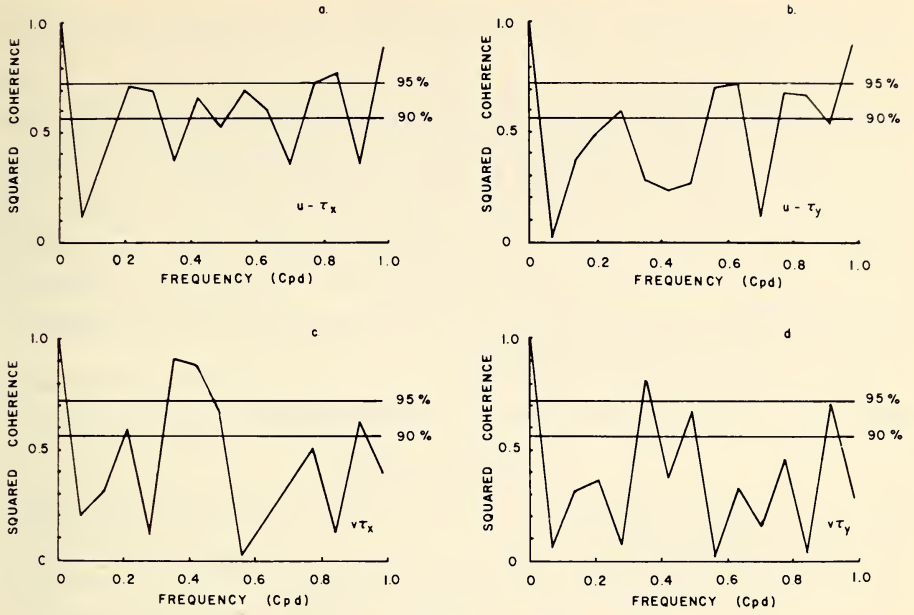

FIG. 4. Squared coherence estimates between components of the windstress and current.

and the Miami–Vero Beach atmospheric pressure gradient were found only at 0.77 cpd. At that frequency the coherence between Miami–Vero Beach pressure gradient and the v-component is approximately twice the coherence between the same component and the Miami–Jacksonville pressure gradient.

The only significant (> 95%) coherence between the crosshelf current and the wind is found with τ_x for motions with a period of 1.2 da. If the 90% significance limit were acceptable, all oscillations corresponding to peaks in the u-spectrum would be coherent with both components of the windstress.

DISCUSSION—None of the peaks of the u and v current spectra are found to occur at the same frequency, suggesting an alongshore system of subinertial waves which is independent of a system of crosshelf subinertial current fluctuations. The significant coherences which are observed between the u and v components probably result from the deflection into the crosshelf direction, of the more energetic, basically alongshore but onshore subinertial oscillations, by the nearby coast.

The coherence (if a 90% significance level is accepted) of the crosshelf currents with both components of the windstress suggest wind forced crosshelf low frequency current oscillations. The peaks of the u–spectrums do not align with any energetic components of the windstress. The generating mechanism of the crosshelf system of current fluctuations appears to be frequency selective.

The high observed coherence between v and τ_x and to a lesser, but still significant, degree with τ_y in the 2-2.8 da period band suggests wind forced alongshore subinertial waves, such as continental shelf waves. The available data

are, however, insufficient to determine the nature of these waves. Brooks (1975), found no evidence for the presence of shelf waves from tidal height measurements along the Florida east coast north of Boynton Beach. The nature and forcing of the 1.3-1.6 and 4.7-14 da period alongshore current fluctuations is also not clear. Coherent oscillations between the alongshore current and alongshore components of the atmospheric pressure gradient similar to the ones described here for the 1.3-1.6 da motions have been reported by Kielman and Düing (1974) in deeper water in the straits of Florida. A longer data record will be required to determine whether the observed 4.7-14 da current oscillations are wind induced or a result of the forcing of the inner shelf waters by meanders or spin-off eddies of the Florida Current.

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LITERATURE CITED

Brooks, D. A. 1975. Wind-forced continental shelf waves in the Florida current. Ph.D. dissert. Univ. Miami. Coral Gables.

Hale, D. A. 1976. Observations of the nearshore current off Hutchinson Island, East Central Florida. M.S. Thesis. Florida Inst. Tech. Melbourne, Florida.

Kielman, J., and W. Düing. 1974. Tidal and sub-inertial fluctuations in the Florida current. J. Phys. Ocean. 4:227-236.

Lee, T. N. 1975. Florida current spin-off eddies. Deep-Sea Res. 22:753-765.

———, and D. A. Mayer. 1977. Low-frequency current variability and spin-off eddies along the shelf of south east Florida. J. Mar. Res. 35:193-219.