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Statistical Characteristics of the Large-Scale Response of Coastal Sea Level to **Atmospheric Forcing**

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ABSTRACT

As part of a study of the large-scale response of coastal sea level to atmospheric forcing along the west coast of North America during June-September 1973, Halliwell and Allen calculate space- and time-lagged cross-correlation coefficients R_{\perp} between adjusted sea level ζ at fixed alongshore locations $\zeta(y_0)$ and the alongshore component of the wind stress τ at general alongshore positions $\tau(y)$. Similarly, correlation coefficients $R_{\zeta\zeta}$ and $R_{\tau\tau}$ involving, respectively, $\zeta(y_0)$ versus $\zeta(y)$ and $\tau(y_0)$ versus $\tau(y)$ are computed. The $R_{\tau}\zeta$ correlations show a consistent asymmetry in time and space lag (t_I, y_I) , with maximum values of R_{1} found for $\tau(y)$ to the south of $S(y_{0})$ and leading in time. The $R_{\tau\tau}$ correlations are typically symmetric in t_L and in y_L while $R_{\zeta\zeta}$ generally show sea level fluctuations to the south leading those to the north in time. It is shown here that the observed correlation coefficients involving \(\frac{1}{2} \) are consistent with those derived from solutions to the forced, first-order wave equation with

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a linear friction term where an assumed form of $R_{\tau\tau}$, based on observations, is used as a forcing function. Similar investigations are carried out in the frequency domain where corresponding theoretical space-lagged squared coherences and phases are calculated. Qualitative agreement with observed behavior is obtained in several instances for the space-lagged statistical functions in both time and frequency domains. Additional new results include theoretical expressions for the relation in wind-forced regions of alongshore propagation velocities of $\frac{1}{2}$, determined from lagged cross-correlation coefficients or cross-spectral phase differences between variables at different alongshore positions, to the free-wave propagation speed c, the determination of c from $R \mathcal{L}$, the variation with frequency of alongshore coherence scales of ζ and of coherence and phase between ζ and local τ .



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