



## Abstract View

[Volume 6, Issue 5 \(September 1976\)](#)

### Journal of Physical Oceanography

Article: pp. 721–734 | [Abstract](#) | [PDF \(950K\)](#)

# The Noutidal Flow in the Providence River of Narragansett Bay: A Stochastic Approach to Estuarine Circulation

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(Manuscript received January 22, 1976, in final form April 12, 1976)

DOI: 10.1175/1520-0485(1976)006<0721:TNFITP>2.0.CO;2

### ABSTRACT

Atmospherically driven flow in the Providence River (a partially mixed estuary) has been examined using a 51-day velocity record measured 2 m from the bottom. Velocity fluctuations at time scales between the steady-state gravitational convection and the tidal oscillations were large and almost exclusively wind-induced. The mean and variance of the velocity component lying along the channel axis were  $11.7 \text{ cm s}^{-1}$  (landward) and  $166.9 \text{ cm}^2 \text{ s}^{-2}$ . Of this axial current variance 48% resided at subtidal frequencies as compared to 45% associated with semidiurnal tides (the remaining 7% was mostly due to higher tidal harmonies). Over the most energetic portion of the axial current spectrum (periodicities of 4–5 days), 97% of the variance was coherent with the wind velocity component lying along the direction of maximum fetch, with the current lagging the wind by about 4 h. Owing to this extremely high coherence, a linear time-invariant stochastic model reproduced the axial current from the two orthogonal wind velocity components to within an rms error of  $2.3 \text{ cm s}^{-1}$ . The wind also had a marked effect upon the density field. It is concluded that the effects of wind can permeate the entire water column of a partially mixed estuary and can be of equal (or greater) importance to the circulation as the tides or gravitational convection.

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