Abstract View

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The Response of a Steep-Sided, Narrow Canyon to Time-Variable Wind Forcing

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ABSTRACT

The response of a relatively narrow (~ 7 km wide) and deep (~ 450 m deep) steep-sided (up to 45° bottom slope) submarine canyon to strong wind forcing is explored using data from an 18-element moored array as well as CTD surveys in the vicinity of Astoria submarine canyon. The data are used to describe spatial patterns and phase relationships between lateral velocity, vertical velocity, temperature, relative and stretching vorticity, alongshelf wind, and the flow incident on the canyon.

Upwelling within the canyon is simultaneous and spatially uniform to zero order, and vertical velocity is highly correlated and in phase with alongshelf wind. Vertical velocity within the canyon is not related to flow incident on the canyon except during strong upwelling. Above the canyon, temperature, rather than vertical velocity (time rate of change of temperature), is in phase with wind. Estimated vertical velocities within the canyon were as great as 50 m d^{-1} (upward) during upwelling and 90 m d^{-1} (downward) during wind relaxation following upwelling events.

At depths ~ 100 m above the canyon the flow field is undisturbed by the canyon topography. At depths ~ 40–100 m above the canyon, a cyclonic circulation pattern occurs, but only during conditions of weak incident flow (i.e., Rossby number <0.25). At depths ~ 80 m below the canyon rim, cyclonic vorticity is in phase with alongshelf wind and with vertical velocity: minimum cyclonic vorticity (or weak anticyclonic vorticity) is coincident with maximum upwelling and southward (upwelling favorable) wind, and maximum cyclonic vorticity is coincident with maximum downwelling and minimum southward wind (or weak northward wind).

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