Why are there upwellings on the northern shelf of Taiwan under northeasterly winds?

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Abstract

Upwellings are observed on the northern shelf of Taiwan during northeasterly winds. Analytical and realistic numerical models are used to explain how vertical motions are created by divergence and convergence produced by wind acting on the vorticity field of two strong jets: the Kuroshio and Taiwan Warm Current. The seaward increase in cyclonic vorticity of the Kuroshio across the shelf edge favors a stronger Ekman transport on the western side of the jet, producing upwelling at the shelfbreak under a northeasterly wind. A similar mechanism for generating vertical motions is found across the Taiwan Warm Current. The numerical model results indicate that the vorticity effects can account for up to 30~50% of the total variation in the surface Ekman transport. Except during summer's weak southwesterlies, northeasterly wind is dominant over the East China Sea, suggesting that the vorticity effects may be prominent in the observed shelfbreak upwelling in non-summer months.