Thin vortexes in the current field of Mamala Bight (Hawaii)

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Measurements of sea currents by means of bottom-mounted acoustic Doppler profilers (ADP) at the shelf edge near Honolulu (in Mamala Bight) revealed very specific high-frequency peculiarities sporadically appearing in the water column. These peculiarities look like very sharp change of the current velocity with subsequent turn-round of the current vector. Typical ADP record of such peculiarity (hereafter, jump peculiarity) is given in Fig. 1.

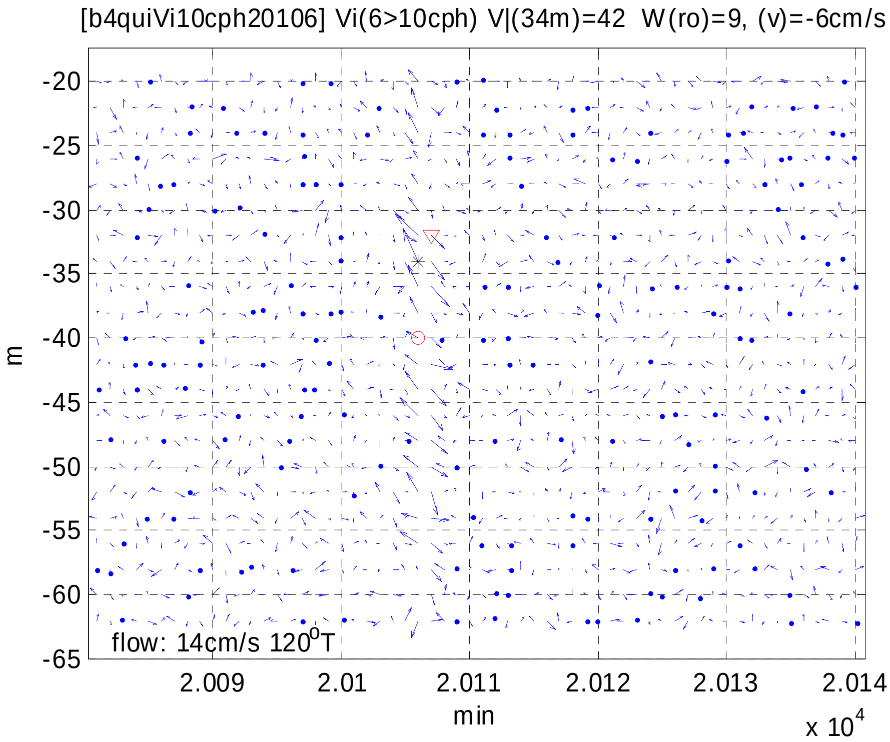

Fig. 1. High-frequency (>10 cph) currents (arrows, upward direction of the arrow is due north) measured by ADP in Mamala Bight in September of 2004. Maximum horizontal current (*) observed at 34 m depth on 20106 min of measurement was 42 cm/s, maximum (o) and minimum (v) vertical currents were 9 and -6 cm/s, respectively. Background flow was 14 cm/s to SE.

After sharp increase of current velocity on 20106 min of measurement current direction has changed from NE to SE through almost the entire water layer.

At the same time, the temperature measurements on the nearby moored thermistor string have not revealed any vertical displacements of the water layers.

Overall there were 920 similar jump peculiarities noticed during 19-day period of observations at the point located on the shelf edge in the center of Mamala Bight.

Very specific features of currents in the observed jump peculiarities may be explained in terms of thin vortexes passing through the ADP beams. Appropriate estimates of vortex parameters are the following: diameter ~10 m, height – the entire water column (~70-80 m), tangential current velocity ~0.5 m/s, the propagation speed ~0.1-0.2 m/s. Some of the peculiarities were accompanied by patches with increasing echo intensity but there were no sign of vertical displacements neither in sound scattering layers nor in isotherms.

The origin of the observed peculiarities might be attributed to intensive submerged discharge of the siege water through a diffuser on the shelf edge in Mamala Bight. The siege water is less dense than surrounding water and goes up in convection cells that may contain vortexes due to background rotation (potential vorticity). The siege water trapped by such vortexes may travel at relatively long distances.