Characteristics of the Coastal Flow in Southeastern Lake Michigan


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Eulerian Measurements

Beginning in October 1997 ten current meter moorings were deployed along the southeastern coast of Lake Michigan to help quantify the offshore-onshore flux of materials. Timeseries data from the meters are presented to the right with a figure showing the mooring locations.

The “A” and “V” designations correspond to data obtained by a Vector Averaging Current Meter (VACM) and an Acoustic Doppler Current Profiler (ADCP), respectively. Data are from the earlier VACM (solid black line) and from the ADCP (dashed line) that corresponds to the 12 m depth. The surface VACM data from April 9 through May 9 is the earlier VACM data used in the present paper. Although data were captured at constant depth, the ADCP bin corresponds to constant velocity. Hence, offshore flows are identified by a “+” sign, onshore flows are shown by a “-” sign, and a very weak westerly offshore flow is also highlighted and shown as weak offshore flow at nearly all of the moorings and also shown as weak onshore flow in April.

Over longer time scales, the longshore and cross-shore barotropic current response over winter '97 - '98 reveal a strong offshore flow with mean currents nearly an order of magnitude stronger than the cross-shore component. Time averaged data from surface moorings reveal that the longshore component is stronger than the cross-shore component, and this is evident in the barotropic current response that is stronger than the baroclinic component (e.g., the excluded seasonal signal). The surface flows are shown as a net northerly longshore and a very weak westerly offshore flow. The effects of coastal stratification are seen to begin near the middle of April when inertial oscillations appear in the time series. Only the shallow moorings show these oscillations in April. The 60 m deep moorings do not stratify until May.

Surface flow characteristics were also observed using satellite reporting drifting buoys during April '98 and '99.

Lagrangian Measurements (April 1999)

CODE type drifters deployed in Lake Michigan

During April 1998 and 1999 satellite reporting drifters were used to study the surface flow field of the lake. In 1998 eight drifters were deployed 25 km apart along the 20 m depth contour from a USCG helicopter. Based upon results from that experiment the 1999 efforts were modified, and drifters were deployed at such a rate that 5 different drifters were deployed every 2-3 days during the first two weeks of April. Although 25 drifters were deployed, the idea was to use USCG surface vessels to scatter out a total of 10, 12, and 14 drifters near St. Joseph, Michigan City and Calumet Harbor, respectively.

Preliminary results from the April '99 experiment are shown to the right.

In general the drifter trajectories show numerous current reversals with the strongest currents occurring along the northern shore. The trajectories tend to follow the bathymetry with the longest episode of significant offshore transport seen in late April. The mean drifter speed was 5 cm/s.

More detailed analyses will require resolving the surface wind field which exhibited complex flow associated with several frontal systems that crossed through the study region.

A total of 8 drifters were lost in '99. The spring 2000 experiment will use all remaining drifters (17) and the study area will be concentrated along the northern and northeastern.