

Ocean Surface Currents – Papa Trajectory Index

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Exploring historic patterns of ocean surface currents with the “Ocean Surface CURrent Simulator” (OSCURS) provides annual or seasonal indices of ocean currents for the North Pacific and Bering Sea, and thus, contributes to our understanding of the year-to-year variability in near surface water movements. This variability has been shown to have an important effect on walleye pollock survival and spatial overlap with predators (Wespestad et al. 2000) and have an influence on winter spawning flatfish recruitment in the eastern Bering Sea (Update on EBS winter spawning flatfish recruitment and wind forcing, this volume; and Wilderbuer et al. 2002). Simulation experiments using the OSCURS model can be run by the general public on the World Wide Web by connecting to the live access server portion of the NOAA-NMFS Pacific Fisheries Environmental Lab’s (PFEL) web site. See the information article, Getting to Know OSCURS, for a summary of such experiments that have already been run.

The Papa Trajectory Index (PTI) is an example of long-term time-series data computed from a single location in the Gulf of Alaska. OSCURS was run 105 times starting at Ocean Station Papa (50° N, 145° W) on each December first for 90 days for each year from 1901 to 2007 (ending February 28 of the next year). The trajectories fan out northeastwardly toward the North American continent and show a predominately bimodal pattern of separations to the north and south. The plot of just the latitudes of the end points versus time (Figure 11) illustrates the features of the data series and the variability of the winter Alaska Current.

To reveal decadal fluctuations in the oceanic current structure relative to the long-term mean latitude (green horizontal line at 54.74° N), the trajectories were smoothed in time with a 5-year running mean boxcar filter. Values above the mean indicate five winters adjacent to that year have an average of anomalously northward (faster speed) surface water circulation in the eastern Gulf of Alaska; values below the mean indicate winters with anomalously southward (slower speed) surface water circulation.

In the winter of 2003 and 2004 the long expected change in modes from north to south narrowly occurred in the 5-year running mean centered on the winter 2003 (Figures 11 and 12). This was strongly influenced by the extreme southward 2002. During 2004-2006 values were near neutral, 2007 was northward, and 2008 was southward (Figures 11 and 12).

The century plot of the 5-year running mean shows four complete oscillations with distinct crossings of the mean; but the time intervals of the oscillations were not constant; 26 years (1904-1930), 17 years (1930-1947), 17 years (1947-1964), and 39 years (1964-2003). The drift from Ocean Weather Station Papa has fluctuated between north and south modes about every 25 years over the last century. The time-series has been updated with winter 2008 calculations and shows circulation was southward. Once the 5-year running mean crosses the zero line it usually stays there for several years.

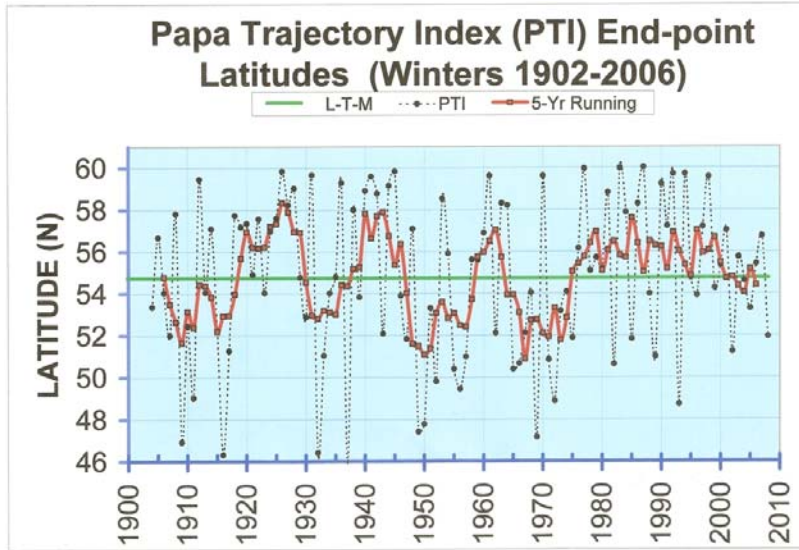


Figure 11. Annual, long-term mean and 5-year running mean values of the PAPA Trajectory Index (PTI) time-series from winter 1902-2008. Large black dots are annual values of latitude of the end points of 90-day trajectories which start at Ocean Weather Station PAPA (50° N, 145° W) each December 1, 1901-2007. The straight green line at 54° 44' N is the mean latitude of the series. The thick red oscillating line connecting the red squares is the 5-year running mean. This shows the variations in the onshore (northeastward) flow, eras when winter mixed layer water drifting from PAPA ended farther north or south after 90 days.

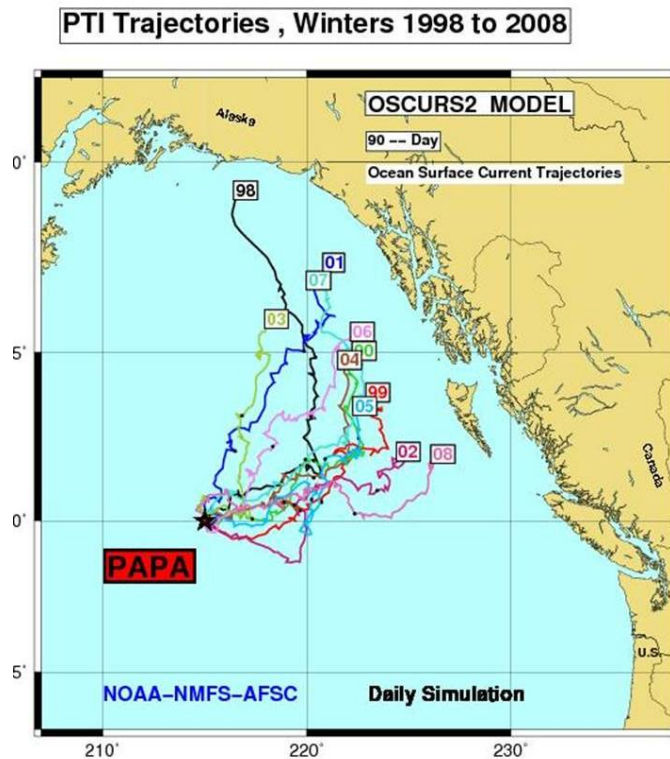


Figure 12. Papa trajectory end points for winters 1998-2008. End points of 90-day trajectories which start at Ocean Weather Station PAPA (50° N, 145°).