**Supplementary material to the paper "Alaskan Stream flow in the eastern subarctic Pacific and the eastern Bering Sea and its impact on biological productivity"**

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# 1. Origin Lagrangian maps in the study area

We are interested in three different water masses and their transport pathways. To track the Alaskan Stream (AS) waters, the section along the meridian $x_0 = 145°$ W from $y_0 = 58°$ N to $y_0 = 60°$ N is fixed. The particles, which crossed that section in the past, are colored in red on the origin Lagrangian maps. The open-ocean particles, which crossed the section $x_0 = 160.0°$ E $-$ $164.0°$ W, $y_0 = 50.0°$ N in the past, are colored in green. The eastern Bering Sea (BS) particles, which crossed the section from 177.0° E, 62.0° N to 164° W, 55.0° N in the past, are colored in blue (see the yellow line in Fig. 2a in the paper). We removed from consideration all the particles entered into any AVISO grid cell with two or more corners touching the land in order to avoid artifacts due to the inaccuracy of the altimetry-based velocity field near the coast. The corresponding colored Lagrangian maps in Fig. 1S demonstrate clearly origin, history and fate of those water masses in the study area.

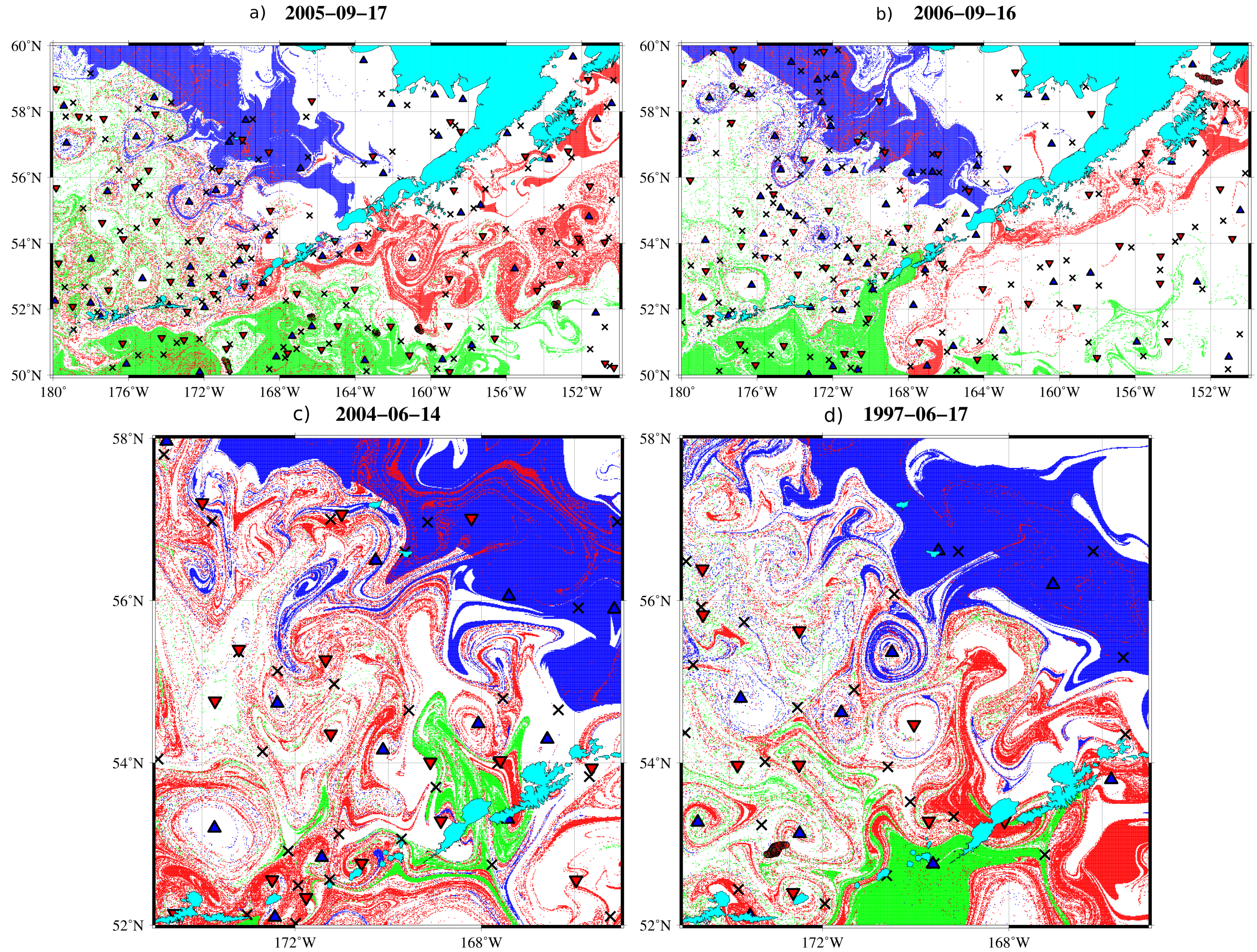


**Figure 1S.** The Lagrangian maps show transport pathways, origin, history and fate of Alaskan Stream (AS) (red), open-ocean (green) and Bering Sea (BS) (blue) waters in a) September 2005, b) September 2006, c) June 2004 (the center of the Pribiloff mesoscale anticyclone is at the point 54.5° N, 168° W) and d) June 1997 (the center of the Pribiloff mesoscale anticyclone is at the point 55.5° N, 171° W). The penetration of the BS shelf waters into the deep basin of the eastern BS is demonstrated by the blue color. Elliptic and hyperbolic stagnation points with zero velocity are indicated by triangles and crosses, respectively.

## 2. Vertical distributions of temperature, salinity and potential density inside and outside of the Alaskan Stream anticyclone in 2005–2006

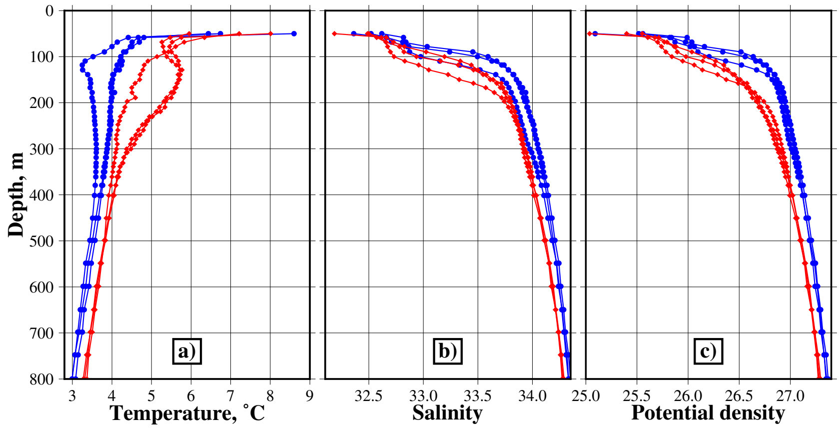


**Figure 2S.** The vertical distributions of temperature, salinity and relative density in September 2005 and 2006 inside (red color) and outside (blue color) the Alaskan Stream anticyclone 2005–2006 centered at around 54° N, 161° W in Fig. 1Sa on 17 September 2005 and at 51° N, 167° W in Fig. 1Sb on 16 September 2006. The data were taken from the Argo buoys nos. 4900342, 4900397, 4900646 and 4900705. Similar to ASAC 2003–2004 (see Figs. 2d–f in the paper), the ASAC 2005–2006 core was composed of relatively low salinity (33.7–33.9) and low density (26.7–26.9) waters. The temperature of waters inside of the anticyclone was 1–2 degrees in Celsium higher than outside it.

## 3. Annual changes of the wind stress curl in the northern North Pacific and the meridional and zonal velocities in the eastern Bering Sea

The changes in the Aleutian Low activity and the wind stress curl in the northern North Pacific in winter determine year-to-year changes in velocities in some areas of the eastern Bering Sea (see Fig. 5a in the paper). An increase (decrease) of the WSC in the North Pacific in November – March is accompanied by increased (decreased) velocities at the boundaries of the anticyclonic eddies in the central part of the deep Bering Sea in summer and fall (Fig. 3Sa). An intensification of the Aleutian Low and a large positive wind stress curl result in increasing of the northward flow on the Bering Sea outer shelf in the areas located close to the Pribiloff, Zhemchug and Navarin canyons (Fig. 3Sb). An increase (decrease) of the wind stress curl in the northern North Pacific in November – March with a 1-year lag is accompanied by increased (decreased) velocities at the boundaries of the anticyclonic eddies located in the area of Aleutian North Slope Current in summer and fall (Fig. 3Sc).

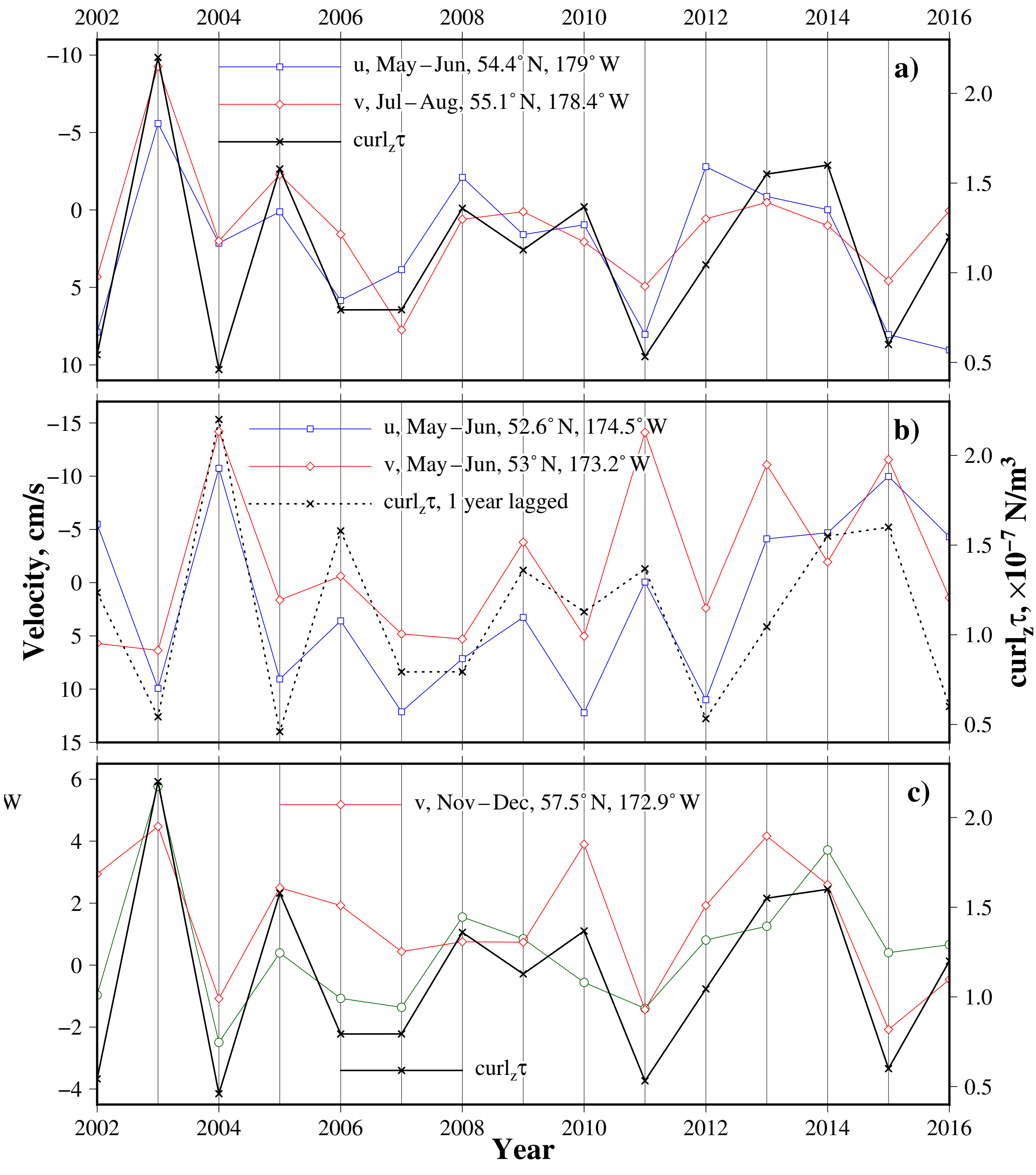


**Figure 3S.** a), b) and c) The year-to-year changes of the wind stress curl (November – March) in the northern North Pacific and the meridional and zonal velocities in the eastern Bering Sea.

## 4. Distribution of chlorophyll *a* concentration and salinity in the eastern Bering Sea

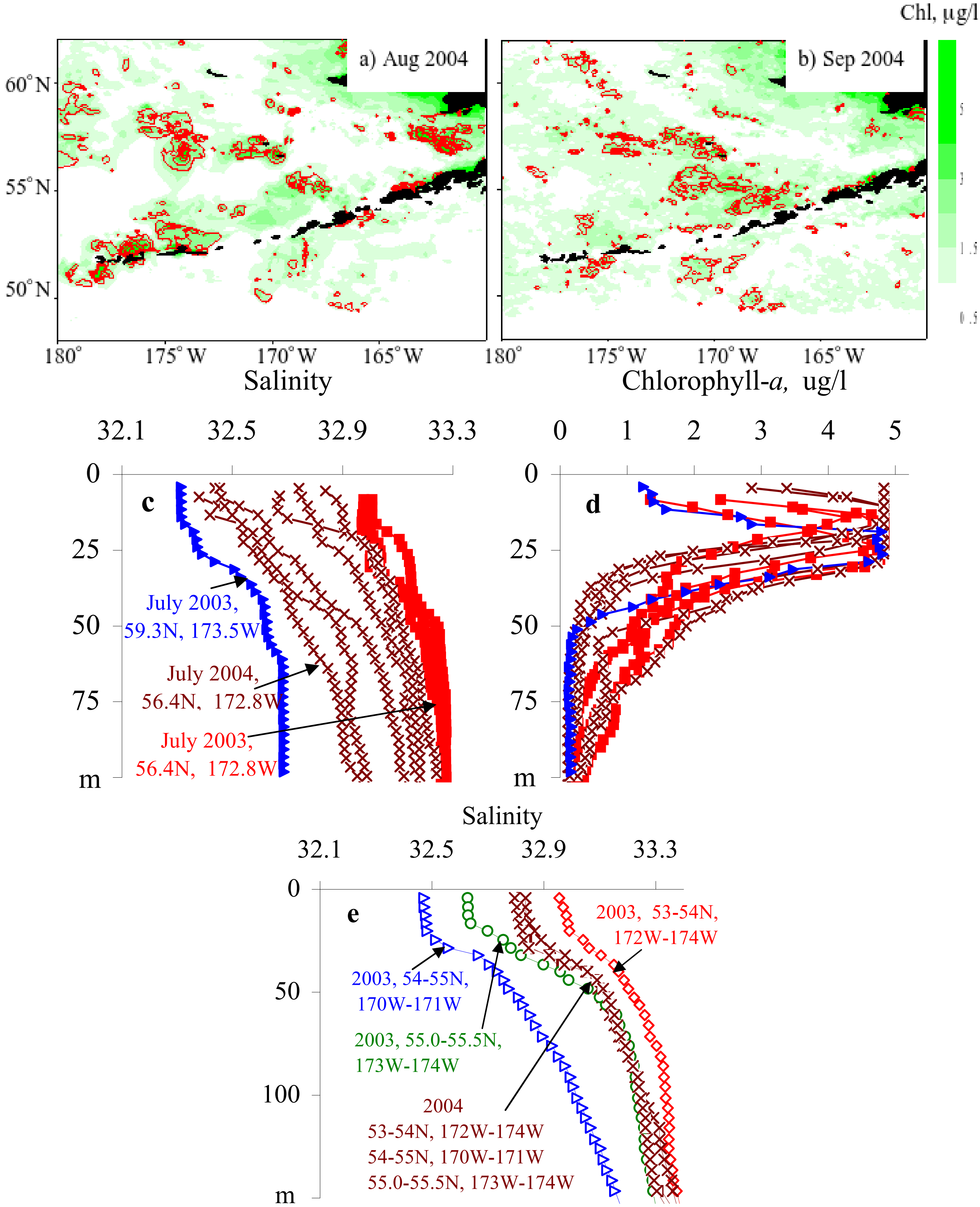


**Figure 4S.** a) and b) Distribution of the chlorophyll *a* concentration in August and September 2004 shown by the green color and the difference in chlorophyll *a* concentration between 2004 and 2003 shown by the red color lines; 1–5 $\mu$g/l with the interval equal to 1 $\mu$g/l. c) and d) The vertical distributions of salinity and chlorophyll *a* in July 2003 and July 2004 in the eastern BS and e) the vertical distribution of salinity in the eastern Bering Sea in July – September 2003 and 2004 (the data from the Argo buoys nos. 4900142, 4900145, 4900165, 4900167 and 4900168).

# 5. The impact of anticyclonic eddies on the chlorophyll *a* distribution in the study area

The impact of anticyclonic eddies on the chlorophyll *a* distribution (the MODIS data) in the AS area can be demonstrated by using a Lagrangian indicator $L = \int_0^T \sqrt{u^2 + v^2}dt$ which is a measure of a distance passed by advected particles. A studied area has been seeded with a large number of virtual particles whose trajectories have been computed backward in time in the AVISO velocity field for a month from the date indicated on the corresponding maps. The $L$ maps visualize not only the very vortex structures but also a history of water masses to be involved in the vortex motion in the past.

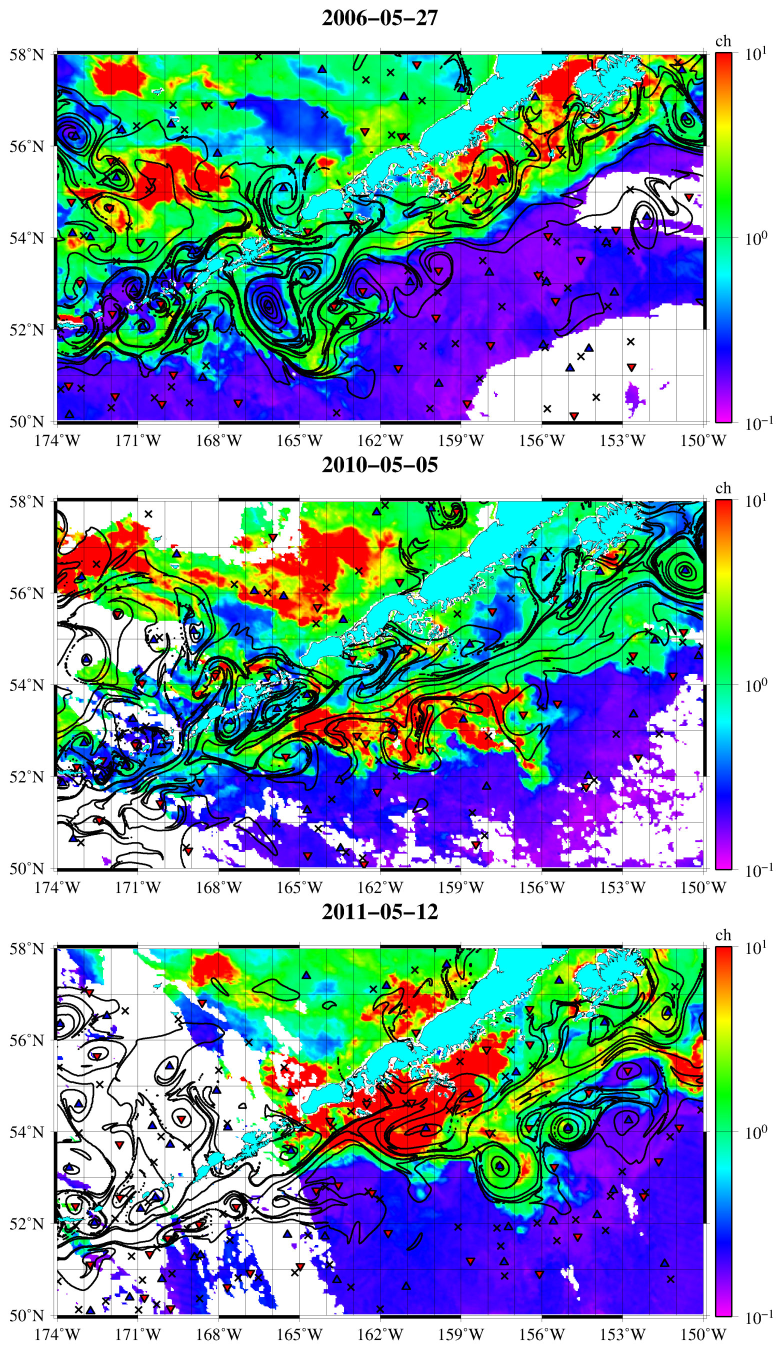


**Figure 5S.** The black isolines of the Lagrangian indicator $L$ with the step of 200 geographic minutes imposed on the chlorophyll *a* distribution in the AS area (May 2006, May 2010 and May 2011). They enclose stable mesoscale eddies, such as ones with the elliptic points at 52.5° N, 165° W and at 53° N, 164° W. The dominant feature in the chlorophyll *a* distribution in the surface layer is a contrast between coastal and offshore waters. The coastal waters are productive with high values of chlorophyll *a* (>6 $\mu$g/l), and the off waters are oligotrophic with low chlorophyll *a* values (<1 $\mu$g/l). The filaments with high chlorophyll *a* concentration are wrapped around persistent mesoscale eddies.