Another Cold Winter in the Gulf of Alaska

by Skip McKinnell, William Crawford and Howard Freeland

The surface of the Gulf of Alaska in winter is often determined by the state of the El Niño-Southern Oscillation cycle. The La Niña that followed the 2010 El Niño began to abate late in the winter of 2012 and by the boreal spring, the equatorial Pacific was ENSO-neutral. The eastern equatorial Pacific is warmer than average by up to 2°C (Fig. 1), and the central equatorial Pacific is warming with an increased risk of a swing to El Niño in the fall of 2012 (forecast: http://www.bom.gov.au/climate/enso). Cold sea surface temperature (SST) anomalies in April/May 2012 were pervasive in the eastern North Pacific (Fig. 2).

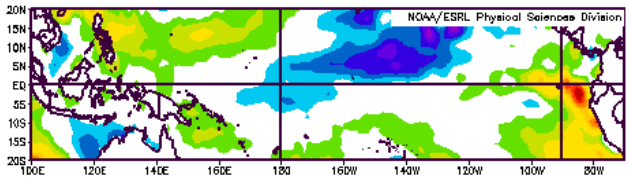

Fig. 1 Average sea surface temperature (SST) anomalies (°C) in the tropical Pacific during April/May 2012. Anomalies range from -2°C to +2°C. Figure courtesy of NOAA/ESRL Physical Sciences Division.

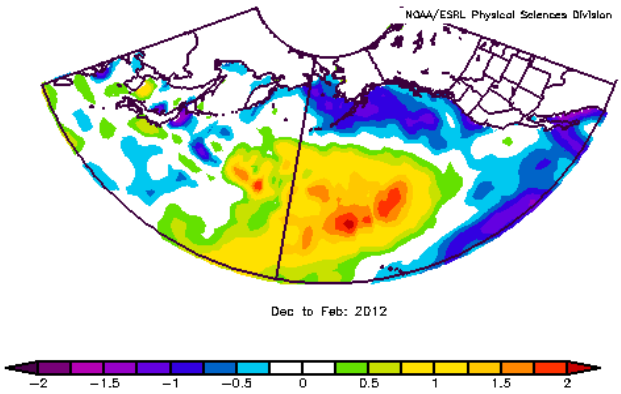

Fig. 2 Winter SST anomalies in the North Pacific. Much of the Gulf of Alaska was below the 1981–2010 average. Figure courtesy of NOAA/ESRL Physical Sciences Division.

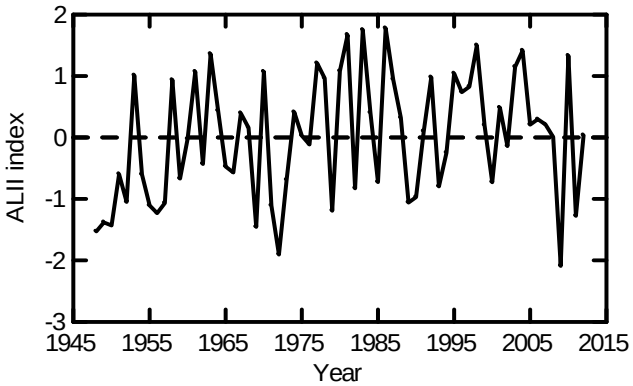

Fig. 3 A winter (DJF) Aleutian Low index computed from the integral of area-weighted average sea level pressure > 1008.5 hPa (data source: NCEP/NCAR Re-analysis).

Recent winters have featured extreme Aleutian Lows (in both directions), but the winter of 2012 was at the long-term average (Fig. 3). Strong Aleutian Lows are generally associated with warmer SST in the Northeast Pacific and years with weak Aleutian Lows are colder. Coastal SST was cooler than expected from Aleutian Low activity (Fig. 4) and the anomalies can be related to anomalies in wind direction. Anomalous winter westerlies can provide for colder winters (Fig. 5).

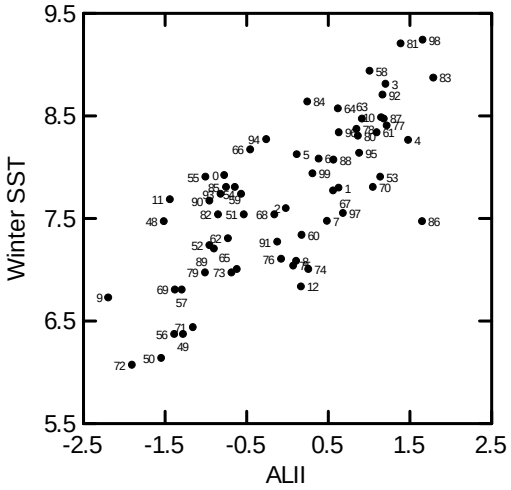

Fig. 4 Coastal winter (DJF) sea surface temperature (SST) versus winter Aleutian Low activity from 1948 to 2012. Point labels indicate the year of January/February for each average value. The winter of 2011/2012 (indicated by 12) was a strong negative anomaly. SST data are courtesy of Institute of Ocean Sciences, Fisheries and Oceans Canada, and sea level pressure data for the ALII are courtesy of the NCEP/NCAR Re-analysis.

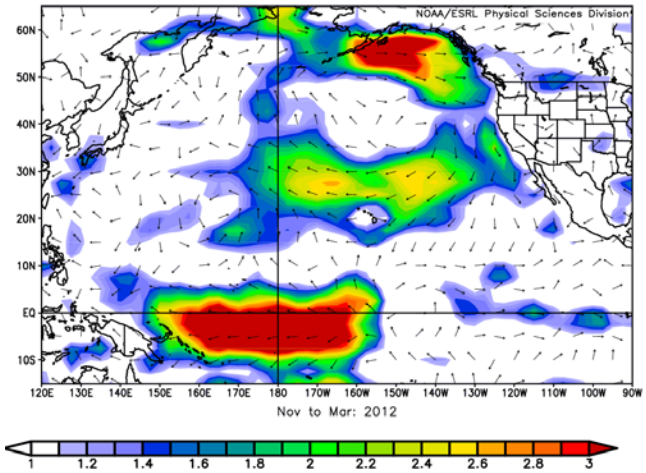

Fig. 5 Winter anomalies in wind speed (arrows indicate direction of the anomaly) in 2012. Enhanced zonal winds over the Gulf of Alaska brought cooler air and sea temperatures to the North American west coast. Units are m/s. Figure courtesy of NOAA/ESRL Physical Sciences Division.

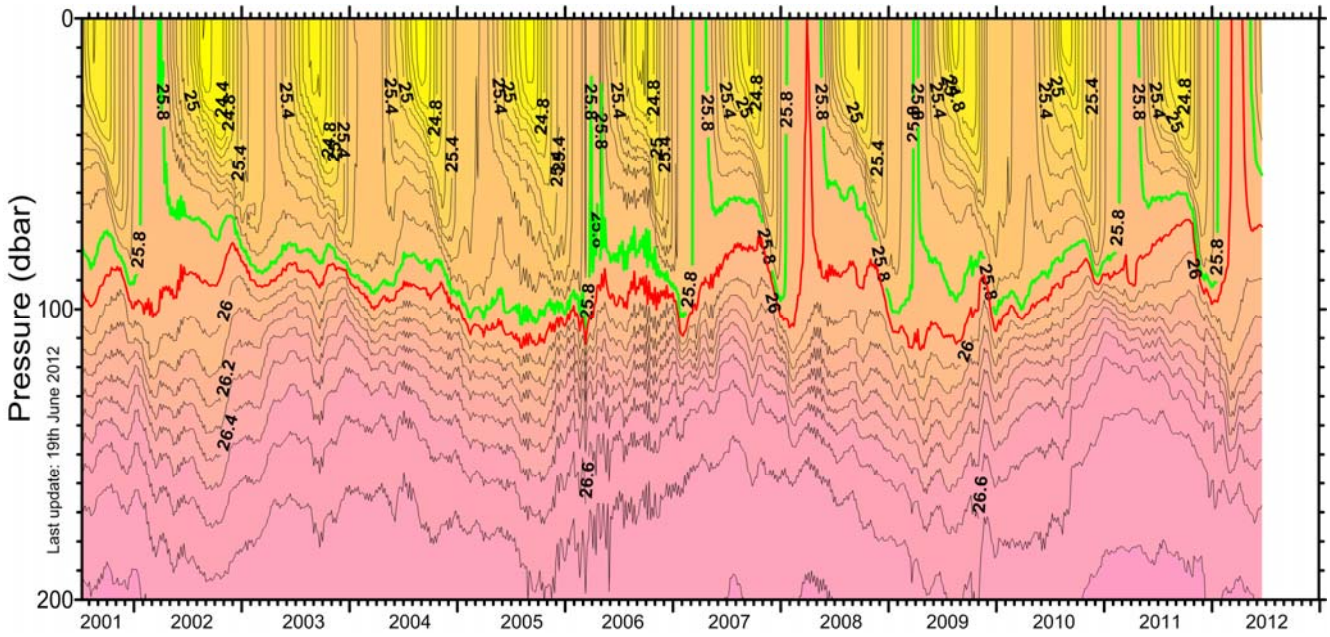

Fig. 6 Density contours at Station Papa estimated from Argo profiles. The winter of 2012 features a rare ventilation of the 25.9 contour (red). It suggests that nutrient concentrations in the surface waters of the Gulf of Alaska will be higher than average in spring. Regularly updated figures can be found at http://www.pac.dfo-mpo.gc.ca/science/oceans/data/projects/argo/LineP/P_St.gif.

The cold temperatures observed in coastal regions were reflected in a deeper than average mixed layer depth in the Northeast Pacific (Fig. 6). The Gulf of Alaska develops a seasonal surface stratification and shallow mixed layer in the summer and fall that deepens through the winter until March or April. In 2012, the 25.9σ_0 density contour reached the surface at Station Papa for approximately 2 months. This had not occurred in any winter since Argo profiles first became available in 2001. Ventilation of denser layers increases oxygen concentrations at depth and increases nutrient concentrations in the surface waters.

Dr. Skip McKinnell (mckinnell@pices.int) is the Deputy Executive Secretary of PICES. For two years (2008–2010) he served as an author and Editor-in-Chief of the PICES North Pacific Ecosystem Status Report.

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Dr. Howard Freeland (howard.freeland@dfo-mpo.gc.ca) is a Research Scientist with Fisheries and Oceans Canada at the Institute of Ocean Sciences, in Sidney, British Columbia. Howard has conducted research on the changing circulation of the Northeast Pacific and the climatic status of the oceans. His overwhelming interest over that last 12 years has been the steady development of the international Argo project. Howard is shown visiting an old friend, Baba Yaga, in Khabarovsk.