Something odd in the Gulf of Alaska, February 2014

by Howard Freeland[1]

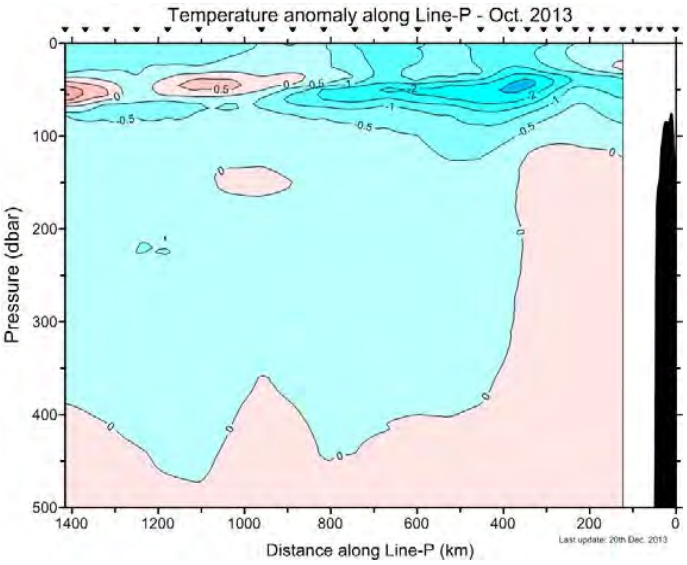

Figure 1a: October 2013

There is something very odd going on in the Gulf of Alaska. Once per month I interpolate Argo observations onto each of the station locations that comprise Line-P, and then compute a Line-P section derived from Argo data. Recent surveys have shown a very rapid influx of anomalously warm and fresh water, apparently arriving from offshore.

In October 2012 temperatures were close to normal, as shown by this simulated Line-P section of deviations from "normal" temperature. For "normal" I use a standard climatology using data from Line-P covering the period 1956-1991 computed by Marie Robert (Fig.1a). By December mild warming was evident offshore and by January the warming was intense (Fig. 1b), and the warming continued to grow in February (Fig.1c).

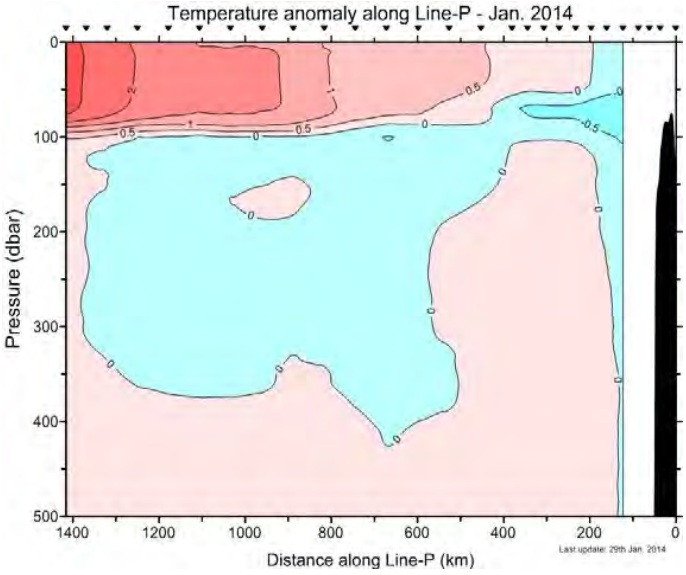

Figure 1b: January 2014

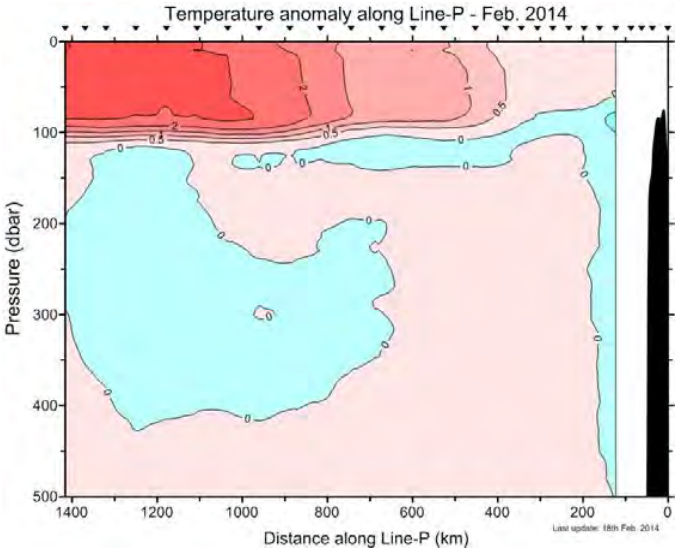

Figure 1c: February 2014

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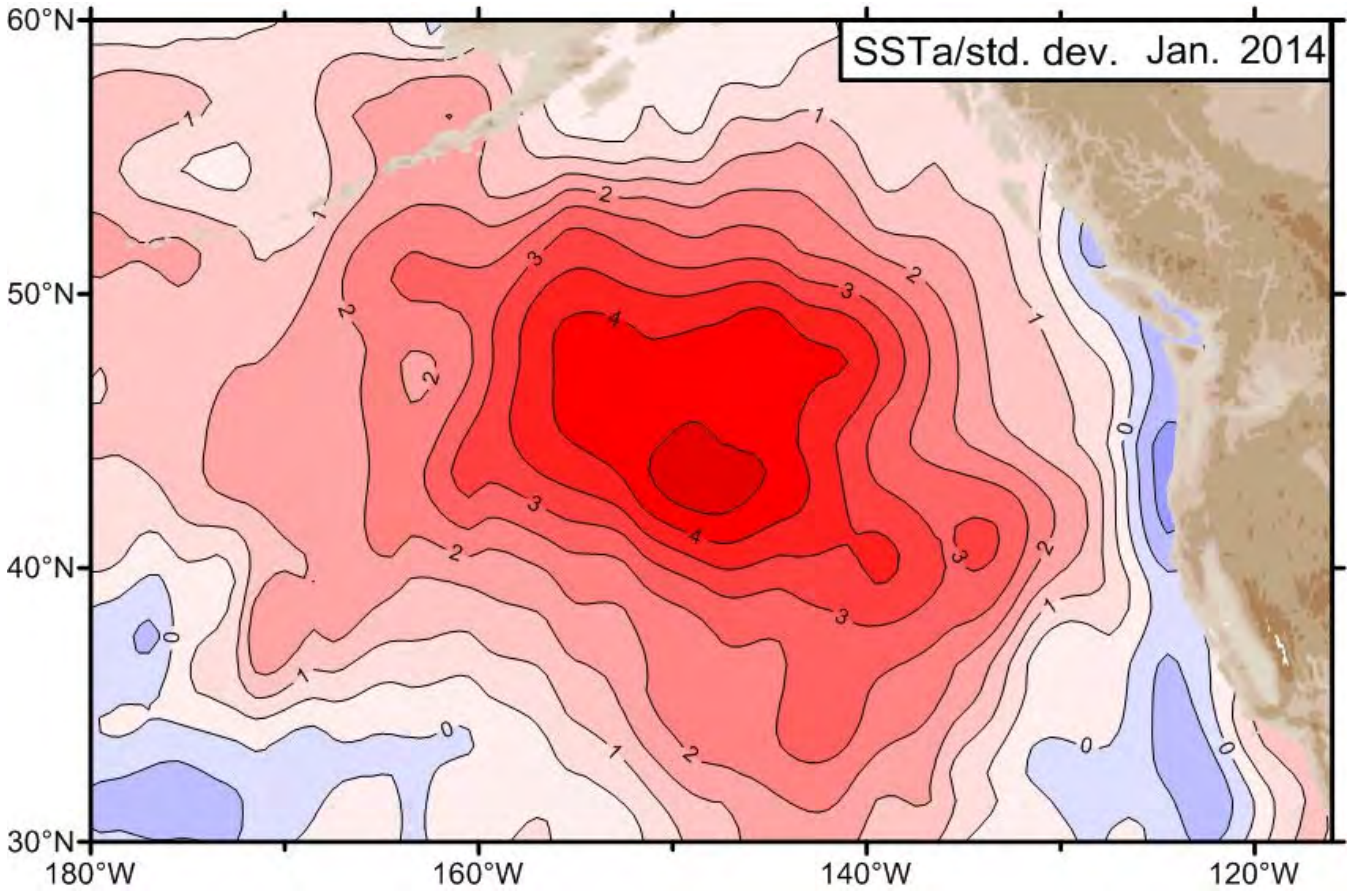

Figure 2: January 2014 temperature departure (in standard deviations) from the 1981-2013 Reynolds NCEP dataset.

As an independent check that the warming is real and not dependent on a single erratic float; 1) I have checked nearby floats and four floats surrounding Station Papa in January 2014, all show this large warming; 2) on the very same day (February 20) that this note is being written, a new float (WMOID 4901766) has been deployed at Ocean Station Papa and its first profile gives near-surface temperatures only a few hundredths of a degree Celsius different from the interpolated values; and 3) the Reynolds data set, that does not include Argo floats data, shows the same anomaly.

The anomaly is huge. The Reynolds (NCEP) data for the NE Pacific shows a huge high-temperature anomaly. Figure 2 is computed as the temperature field reported for January 2014 minus the average over all Januaries in the Reynolds dataset (1981-2013), i.e. excluding this anomalous year, divided by the spatially-varying standard deviation. The Reynolds maps are fairly heavily smoothed but show anomalies exceeding four standard deviations away from the mean. Four standard deviations away from the mean state is **HUGE**.

Figure 3 is a plot of surface properties interpolated from Argo floats, temperature (red), salinity (green) and sigma-t (black), averaged over January at Ocean Station Papa for all years for which there is reliable Argo data. This shows little variability, year-to-year, from 2002 to 2013, and then a large change in properties in January 2014. Again we see huge deviations from normal conditions with temperature in January 2014 4.4 standard deviations above the mean, salinity 3 standard deviations below the mean and as a consequence of both low salinity and high temperature, we see extremely low surface density by 4.4 standard deviations.

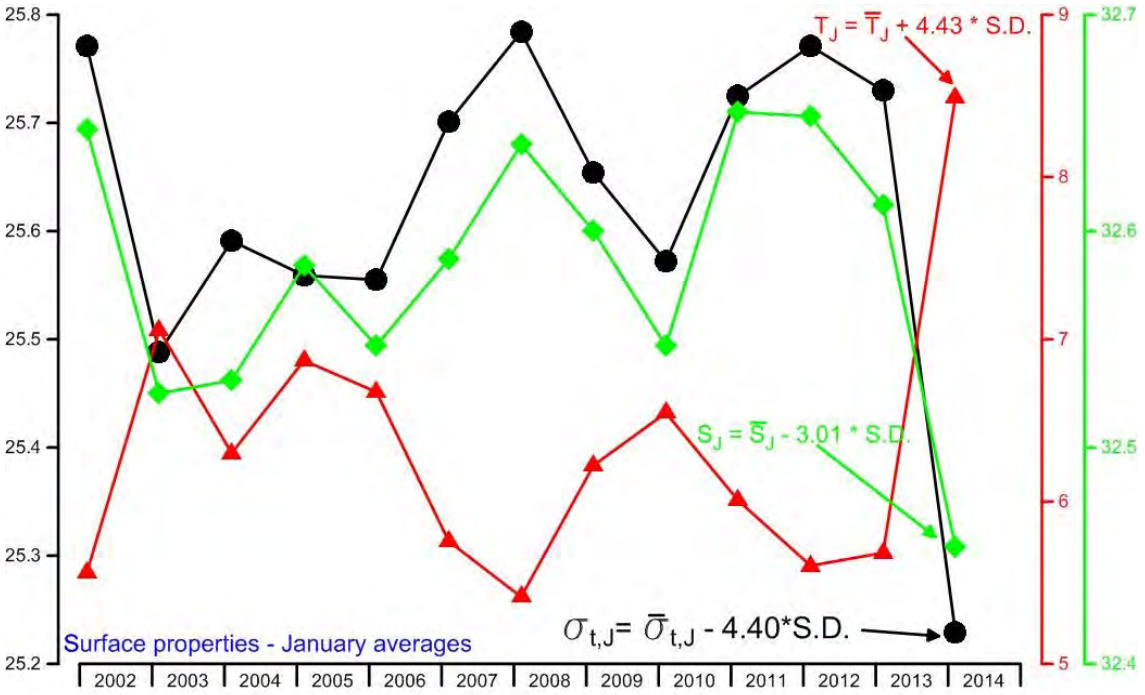

Figure 3: January average surface properties at Station Papa, interpolated from Argo float data

The presence of surface water with anomalously low density must create an energetic barrier to mixing. Further, the Gulf of Alaska appears to have been relatively storm-free during the winter of 2013/14 (I have no objective evidence for that statement, just my gut feeling that there have been few storms). So it should come as no surprise that mixing this winter is very weak. Figure 4 (next page) shows a contour plot of sigma-t at Ocean Station Papa, interpolated from Argo, and contoured versus depth and time.

The annual cycle is obvious. But look at the deep stratification at the beginning of February 2014 in Figure 4: there are five black contours between the surface and the first marked coloured contour (just coloured to help a person's eye follow its history). We have never seen such high stratification persisting into the late winter and this must have important effects on the replenishment of nutrients to the surface waters over winter.

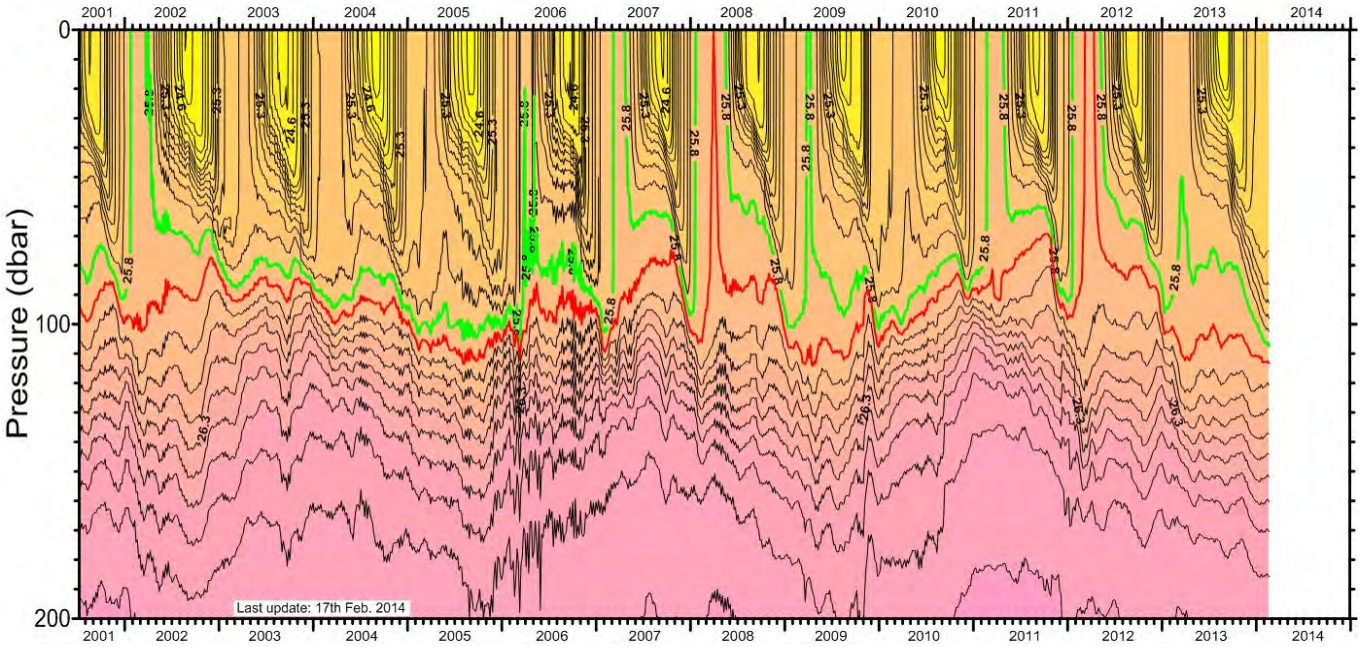

Figure 4: Water density (sigma-t minus 1000 kg per m^3) at Station Papa, interpolated from Argo data.