A few months late but here never-the-less. I had hoped to put out small studies about weather out more often but it turns out that life takes precedent over my time. Perhaps the future will be kinder.

Around the world at a thousand locations, weather balloons launch consistently at 00:00 and 12:00 UTC. Travelling through much of the Earth’s atmosphere, radiosondes measure temperature, humility, wind, pressure, and latitude. Day in and night out, these measurements are used to refine weather models that predict what clouds and sun and rain are to befall mankind over the next few days. The weather balloons are an integral part of understanding the weather we live in.

Since the Homo Sapiens species lives at the bottom of the Earth’s ocean of air, it only makes sense that this area is where all the focus of meteorologists and modelers persists. However, weather balloons go well above what is usually looked at. Figure 1 is a screenshot of a nice little table [http://weatherfaqs.org.uk/book/export/html/174] that shows the heights at various pressure levels. For comparison, consider that 1000mb is at the top of the largest Giant Sequoias tree [https://en.wikipedia.org/wiki/Sequoiadendron\_giganteum], 950mb is at the top of the spire of the 108-story Sears Tower [https://en.wikipedia.org/wiki/Willis\_Tower], 850mb is the height of a medium sized mountain, 450 mb is the top of Denali [https://en.wikipedia.org/wiki/Denali], 300mb is the elevation of Mt. Everest [https://en.wikipedia.org/wiki/Mount\_Everest], 250mb is the heights of airplanes and jet streams [https://en.wikipedia.org/wiki/Jet\_stream], 100mb is where polar stratospheric clouds [https://en.wikipedia.org/wiki/Polar\_stratospheric\_cloud], and 30mb is where the ozone layer peaks [https://en.wikipedia.org/wiki/Ozone\_layer]. It should be noted that the pressure heights are not consistently the same physical height. They may be a few hundred meters higher or lower than the standard atmospheric model depending on the temperature of the air. For example, colder air has higher pressure than warmer air.

While I’m not going to do any major analysis on weather balloon stratospheric measurements (it’s probably been done anyway), I will show how they have changed over the year 2016. Figure 2 [soundings\_2016.png] shows the measured temperature (C) for all radiosonde measurements over the year by pressure height (mb). The colors of the points are greener in the summer and browner in the winter. A big thing to notice is the tropopause at about 200mb. The troposphere decreases in temperature consistently throughout the year until the tropopause. Then the temperature remains rather stationary. While not unusual at all, it’s fascinating to see the science textbook come alive.

Another think to notice that that the stratosphere doesn’t always behave per the standard models. Sometimes the temperature continues to drop even when it’s not supposed to. This is highlighted nicely in Figure 3 [soundings\_temp\_over\_year\_line.png]. The graph shows another way of seeing the temperature (C) of various pressure levels over the year. The extremely cold temperatures in the stratosphere can be seen to occur in mid-December. Interestingly, the temperatures spiked at ground level at the same time. In fact, the stratosphere temperature move all over the place during the winter. I haven’t looked into why, though I guess it’s a combination of planetary waves [https://en.wikipedia.org/wiki/Rossby\_wave] and the dreaded polar vortex [https://en.wikipedia.org/wiki/Polar\_vortex]. Also interesting is the relative passivity of the upper regions of the atmosphere from the beginning of April (coinciding with the melting of snow) through October (when snow makes its appearance). Though, I’m fairly sure that snow and the stratosphere are not directly related.

There is a lot here that could be considered for future study. I’ll probably not do it. It takes time to do the data analysis and even more time to do the writeup. I’m not sure how often I’ll be able to post things – though I hope it’s often enough. I do have other things that I want to look at that I’ve thought would be interesting to residents of Fairbanks.

At some point I’ll post the code to GitHub that I used to gather the data and graph it. I just need to clean the code up and write some documentation.