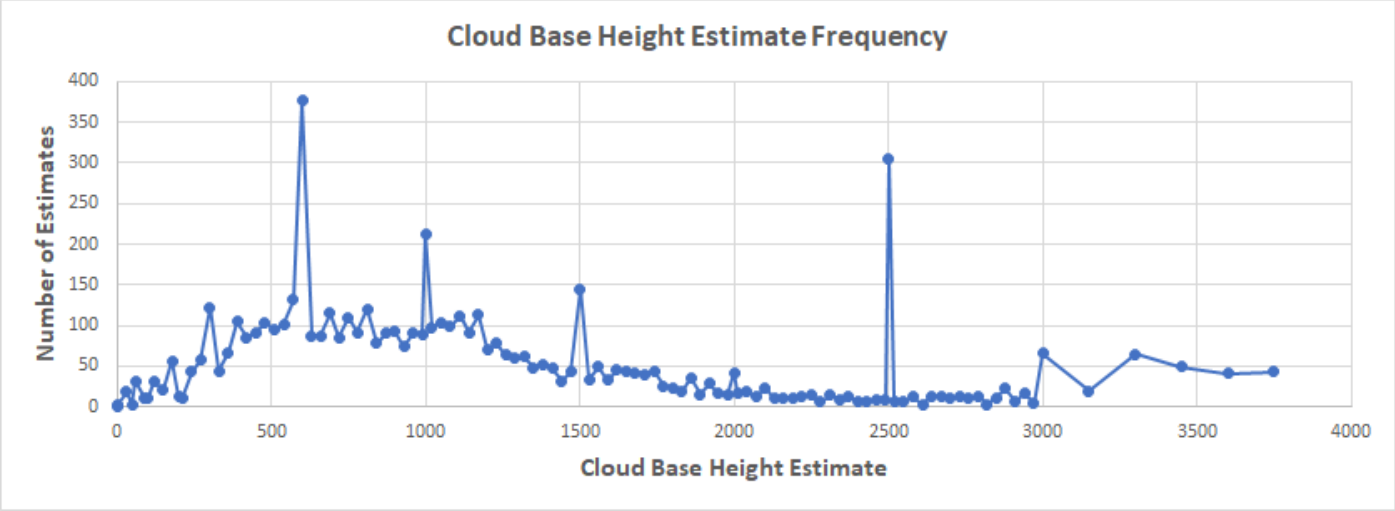
Cloud Base Height Detective Work

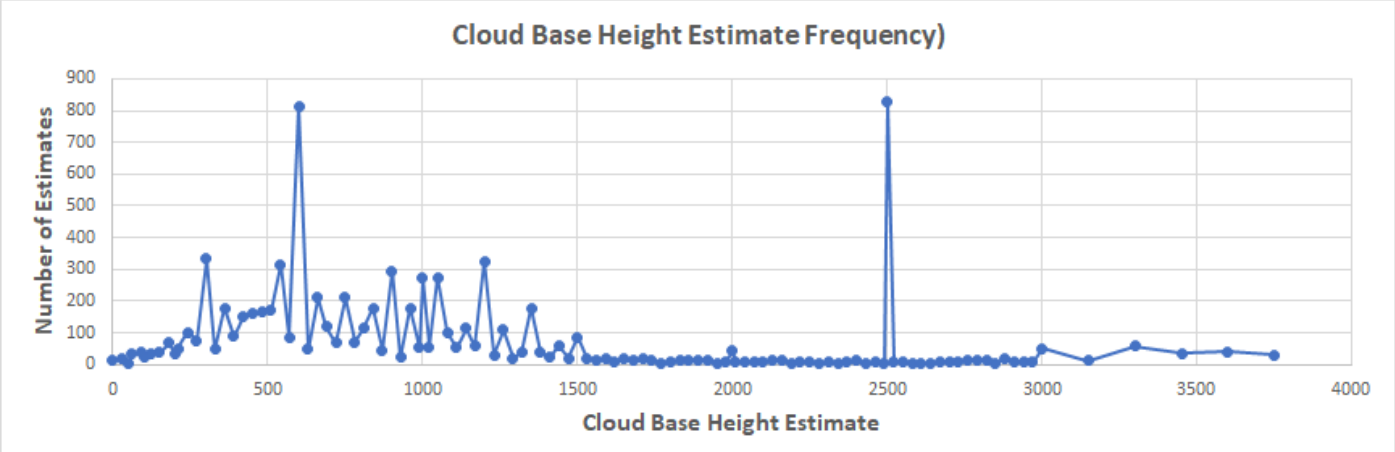
While I was looking at the official cloud base estimates, I thought that it would be interesting to look at the distribution of cloud base estimates that have been made over the period that I have been doing comparisons with my weather station. To do that I queried my database so that it gave the number of estimates for each height in the table using the following query

```
select cloud_base_m, count(cloud_base_m)  from WeatherStation.wmo_obs wo where wo.station_index = 6 group by cloud_base_m
```

What this does is select the cloud base height and the number of times that each cloud base height has been entered over the span of my database (11-Dec-2019 to 13-Sep-2020) for Parafield Airport. I was expecting that there would be a bit of smooth curve of height estimates, perhaps with maybe a couple of peaks for the common low level cloud heights. The resulting graph was a bit unexpected.



There was a curve with a hump as I expected, but there are anomalous peaks at (possibly)300 metres, 600 metres, 1000 metres 1500 metres and 2500 metres. It seemed unlikely that these peaks reflect an actual narrow range of cloud base heights. I



did a quick plot of Adelaide Airport and I got unexpected peaks as well, predominantly at 600 metres and 2500 metres.

These graphs set me wondering why there were such high anomalous peaks in the height estimations.

In an attempt to gain more information, I ran the following script for Parafield airport:

```
select count(time( aifstime_utc)), time( aifstime_utc) from WeatherStation.wmo_obs wo
where  wo.cloud_base_m = 2500 and station_index = 6
group by time(aifstime_utc)
```

count(time(aifstime_utc))	time(aifstime_utc)
16	01:30:00
18	02:30:00
16	04:30:00
13	05:30:00
15	07:30:00
21	08:30:00
26	10:30:00
18	11:30:00
25	13:30:00
21	14:30:00
22	16:30:00
20	17:30:00
23	19:30:00
22	20:30:00
15	22:30:00
15	23:30:00

The result of the script was interesting, so re-ran it for Adelaide Airport and got the same type of anomalies as the Parafield Airport. What caught my eye was that over the period of about 10 months, there were no cloud base height measurement of exactly 2500 metres every three hours.

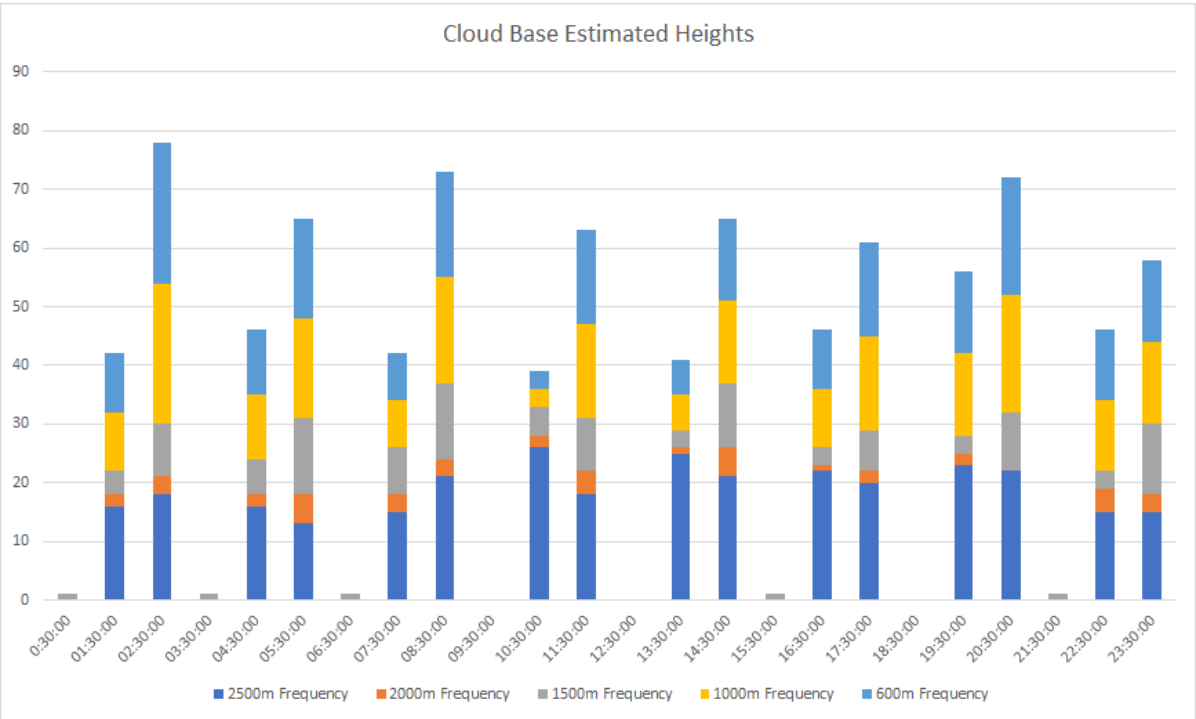
Without daylight saving being in force, these gaps would correspond to the local 15:00, 18:00, 21:00, 00:00, 03:00, 06:00, 09:00 and 12:00 observations. I checked the readings during and outside the daylight saving time and that did not seem to affect the location of the gaps.

Because I believe that the cloud base field is left empty when there is no measurable cloud base, the next step is to determine if empty fields are missing from those periods that have 2500 metre values being used to indicate cloud heights that are too high to measure. This was checked with the following script for Adelaide Airport:

```
select count(*), time( aifstime_utc) timeofday from WeatherStation.wmo_obs wo
where  wo.cloud_base_m is null and station_index = 3
group by time(aifstime_utc)
```

This result of the query is too big to fit neatly in the magazine, but it showed that there were cloud base readings in every half hour where no cloud bases were recorded. This means that the theory that a ceilometer is using 2500 if there is no measurable cloud base, does not seem valid.

I combined the queries for 600m, 1000m, 1500m, 2000m and 2500m and got an interesting graph.



While there are cloud base height observations every 30 minutes the cloud base estimates of exactly 600m, 1000m, 1500m, 2000m and 2500m, these values go missing every three (3) hours. A check of the observations indicates that cloud base heights are being recorded above and below those specific heights in those periods where the exact heights are missing. I looked at the breakdown of 08:30 and 09:30 readings looking at the cloud bases around 1000 metres (750 metres to 1250 metres) as recorded at Parafield Airport (as the odd peaks are more prominent) with the following results.

	height	count
1	780	1
2	810	2
3	900	1
4	930	1
5	960	1
6	990	1
7	1,000	18
8	1,050	1
9	1,110	2
10	1,230	1

On the left is the cloud base readings for the 08:30 observations from Parafield Airport. On the right are the 09:30 cloud base observations at Parafield. The difference is quite pronounced. I then wondered if there was a trend in cloud base heights through the day, and it was that I realised another apparent anomaly Looking the graph on the bottom of the previous page there is a repeating 3-hour cycle of getting exactly the readings that I've been looking at. Wondering the total number of estimates followed that 3- hourly cycle, I plotted out the total number of estimates. It appeared to have a diurnal cycle, as well as a 3-hourly cycle.

	height	count
1	780	4
2	810	3
3	840	2
4	870	2
5	900	2
6	930	2
7	960	2
8	990	2
9	1,020	2
10	1,050	3
11	1,080	1
12	1,110	2
13	1,140	2
14	1,170	3
15	1,200	1
16	1,230	1