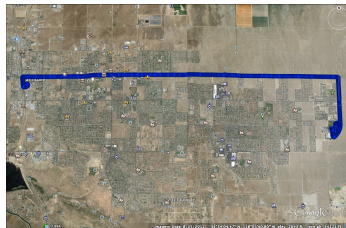
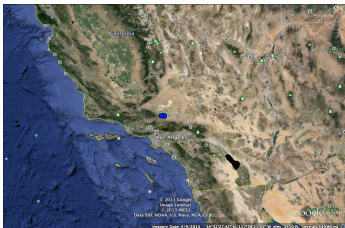


SMALL SATELLITES FOR SECONDARY STUDENTS: ALTITUDE MEASUREMENTS

- Compare the GPS altitude measurements between the three instruments to observe if they are consistent with each other.
- *Time permitting*: Compare the GPS altitude measurements to the barometric altitude.

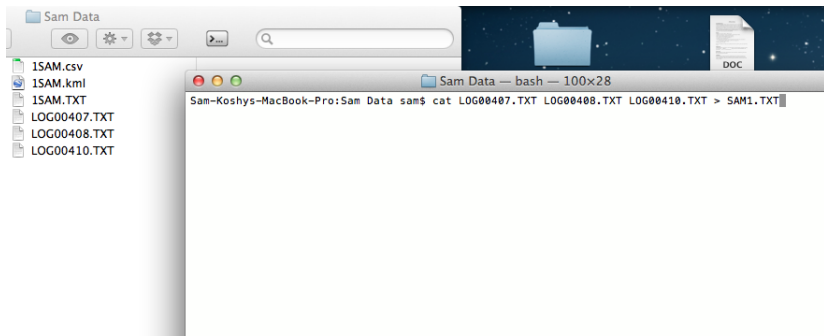
- By exporting our data as a .kml file we were able to confirm the accuracy of the GPS latitude and longitude data:



- Every time the GPS lost connection and reconnected with the device a new .txt file was created. Hence, if we were to only choose the biggest file, a lot of data would have been lost.
- We needed to convert the time to a more accessible format (such as PDT) for presentation purposes

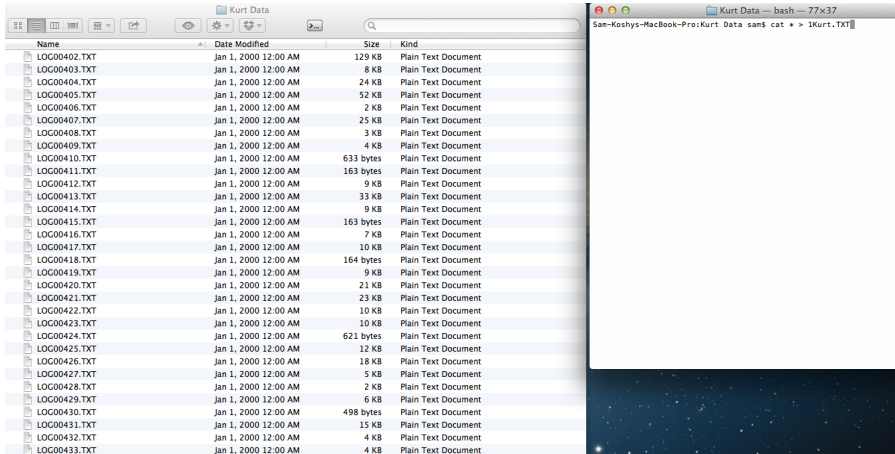
Combining the various .txt files

- A single line of code in the UNIX shell was able to *concatenate* the various .txt files into a single one



Combining the various .txt files

- Combining the files is easy to do even when there are hundreds of them, as was the case for Kurt.



The image shows a Mac OS X desktop environment. On the left is a Finder window titled 'Kurt Data' displaying a list of files. On the right is a terminal window titled 'Kurt Data — bash — 77x37' showing a command to concatenate all .TXT files in the directory.

Name	Date Modified	Size	Kind
LOG00402.TXT	Jan 1, 2000 12:00 AM	129 KB	Plain Text Document
LOG00403.TXT	Jan 1, 2000 12:00 AM	8 KB	Plain Text Document
LOG00404.TXT	Jan 1, 2000 12:00 AM	24 KB	Plain Text Document
LOG00405.TXT	Jan 1, 2000 12:00 AM	52 KB	Plain Text Document
LOG00406.TXT	Jan 1, 2000 12:00 AM	2 KB	Plain Text Document
LOG00407.TXT	Jan 1, 2000 12:00 AM	25 KB	Plain Text Document
LOG00408.TXT	Jan 1, 2000 12:00 AM	3 KB	Plain Text Document
LOG00409.TXT	Jan 1, 2000 12:00 AM	4 KB	Plain Text Document
LOG00410.TXT	Jan 1, 2000 12:00 AM	633 bytes	Plain Text Document
LOG00411.TXT	Jan 1, 2000 12:00 AM	163 bytes	Plain Text Document
LOG00412.TXT	Jan 1, 2000 12:00 AM	9 KB	Plain Text Document
LOG00413.TXT	Jan 1, 2000 12:00 AM	33 KB	Plain Text Document
LOG00414.TXT	Jan 1, 2000 12:00 AM	9 KB	Plain Text Document
LOG00415.TXT	Jan 1, 2000 12:00 AM	163 bytes	Plain Text Document
LOG00416.TXT	Jan 1, 2000 12:00 AM	7 KB	Plain Text Document
LOG00417.TXT	Jan 1, 2000 12:00 AM	10 KB	Plain Text Document
LOG00418.TXT	Jan 1, 2000 12:00 AM	164 bytes	Plain Text Document
LOG00419.TXT	Jan 1, 2000 12:00 AM	9 KB	Plain Text Document
LOG00420.TXT	Jan 1, 2000 12:00 AM	21 KB	Plain Text Document
LOG00421.TXT	Jan 1, 2000 12:00 AM	23 KB	Plain Text Document
LOG00422.TXT	Jan 1, 2000 12:00 AM	10 KB	Plain Text Document
LOG00423.TXT	Jan 1, 2000 12:00 AM	10 KB	Plain Text Document
LOG00424.TXT	Jan 1, 2000 12:00 AM	621 bytes	Plain Text Document
LOG00425.TXT	Jan 1, 2000 12:00 AM	12 KB	Plain Text Document
LOG00426.TXT	Jan 1, 2000 12:00 AM	18 KB	Plain Text Document
LOG00427.TXT	Jan 1, 2000 12:00 AM	5 KB	Plain Text Document
LOG00428.TXT	Jan 1, 2000 12:00 AM	2 KB	Plain Text Document
LOG00429.TXT	Jan 1, 2000 12:00 AM	6 KB	Plain Text Document
LOG00430.TXT	Jan 1, 2000 12:00 AM	498 bytes	Plain Text Document
LOG00431.TXT	Jan 1, 2000 12:00 AM	15 KB	Plain Text Document
LOG00432.TXT	Jan 1, 2000 12:00 AM	4 KB	Plain Text Document
LOG00433.TXT	Jan 1, 2000 12:00 AM	4 KB	Plain Text Document

```
San-Koshys-MacBook-Pro:Kurt Data san$ cat * > 1Kurt.TXT
```

Converting the time to PDT

- In the newly exported .csv file create a column of the time differential between each successive measurement
- Convert this new column to the time format HH:MM:SS using the formula: =TEXT(C3,"00\00\00")+0
- Input the starting time in PDT (found in the original .txt file) and add the time differential to each successive row

Time (PDT)	Delta t (s)	Delta t (s)	Time (s)	Lon	Lat	Alt	E
8:24:36			55476	-118.007627	34.5639137	822.2	
8:24:37	0:00:01	1	55477	-118.007635	34.5639175	823.1	
8:24:38	0:00:01	1	55478	-118.007636	34.5639197	824.1	
8:24:39	0:00:01	1	55479	-118.007639	34.5639257	824.6	
8:24:43	0:00:04	4	55483	-118.007651	34.5639295	828.4	
8:24:44	0:00:01	1	55484	-118.007652	34.5639357	829.4	
8:24:45	0:00:01	1	55485	-118.007655	34.5639408	830.6	
8:24:46	0:00:01	1	55486	-118.007658	34.5639405	831.1	
8:24:47	0:00:01	1	55487	-118.007663	34.5639313	830.8	
8:24:48	0:00:01	1	55488	-118.007667	34.5639242	830.6	
8:24:49	0:00:01	1	55489	-118.007669	34.5639217	830.4	
8:24:50	0:00:01	1	55490	-118.007673	34.5639172	830.2	
8:24:51	0:00:01	1	55491	-118.007677	34.5639223	830.7	
8:24:52	0:00:01	1	55492	-118.007679	34.5639237	830.7	
8:24:53	0:00:01	1	55493	-118.007681	34.5639232	830.5	

Altitude with respect to what?

- The listed altitude is in meters and is the MSL altitude (MSL altitude is the distance above where sea level would be if there were no land).

Example:

```
$GPGGA,092725.00,4717.11399,N,00833.91590,E,1,8,1.01,499.6,M,48.0,M,,0*5B
```

Field No.	Example	Format	Name	Unit	Description
0	\$GPGGA	string	\$GPGGA	-	Message ID, GGA protocol header
1	092725.00	hhmmss.sss	hhmmss.ss	-	UTC Time, Current time
2	4717.11399	ddmm.mmmm	Latitude	-	Latitude, Degrees + minutes, see Format description
3	N	character	N	-	N/S Indicator, N=north or S=south
4	00833.91590	dddmm.mmmm	Longitude	-	Longitude, Degrees + minutes, see Format description
5	E	character	E	-	E/W indicator, E=east or W=west
6	1	digit	FS	-	Position Fix Status Indicator, See Table below and Position Fix Flags description
7	8	numeric	NoSV	-	Satellites Used, Range 0 to 12
8	1.01	numeric	HDOP	-	HDOP, Horizontal Dilution of Precision
9	499.6	numeric	mSl	m	MSL Altitude
10	M	character	uMsl	-	Units, Meters (fixed field)
11	48.0	numeric	Altref	m	Geoid Separation
12	M	character	uSep	-	Units, Meters (fixed field)
13	-	numeric	DiffAge	s	Age of Differential Corrections, Blank (Null) fields

- The GPS altitude appears to be consistent but better data is expected from the rocket launch.

