ASL 733: Physics of the Atmosphere

Assignment No. 1: Meteorological elements and Atmospheric Stability

SUBMISSION BY KARTIK KUMAR BANSIWAL, 2021EE30743

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1A i) Discuss the vertical variation of each parameter Morning vs Evening and point wise.

I accessed the University of Wyoming website to obtain the necessary meteorological data for the station assigned to me. Upon retrieval, I extracted data pertaining to Temperature (T), Pressure (P), Humidity (q), and Wind speed (V) for the specified dates: 15 May 2018 and 5 July 2018. I extracted data of the assigned date i.e. 15 July 2018 but unfortunately, the data was not complete, so I extracted data for 15 May 2018 instead. I ensured to download data for both 00 UTC and 12 UTC to capture morning and evening profiles. Upon extraction, I plotted the vertical variation of T, V, q, and P up to 50 km height. The plots illustrate the morning and evening profiles for each meteorological parameter. Analysing these profiles provided insights into the atmospheric conditions at different altitudes throughout the day.
However, as the provided data did not extend up to 50 km, I extrapolated the temperature readings using a logarithmic relation and pressure readings using an exponential relation to ensure a comprehensive analysis. Unfortunately, due to the sporadic nature of the data, I couldn't extrapolate wind speed and relative humidity. To address this, I converted wind speed from knots to meters per second (m/s) using the formula V (knot) × 0.51444 = V(m/s), and also converted temperature from Celsius to Kelvin. This allowed for a more thorough examination of atmospheric conditions despite data limitations.

42182 VIDD New Delhi Observations at 00Z 15 May 2018

PRES hPa	HGHT m	TEMP C	DWPT C	RELH %	MIXR g/kg	DRCT deg	SKNT knot	THTA K	THTE K	THTV K
				1000.0		27				
973.0	216	25.2	19.2	69	14.61	0	0	300.7	343.8	303.3
956.0	391	26.9	16.4	53	12.46	130	9	303.9	341.3	306.2
937.0	591	28.9	13.3	38	10.35	155	6	307.7	339.3	309.6
928.0	687	29.8	11.8	33	9.45	166	4	309.5	338.7	311.2
925.0	719	29.8	10.8	31	8.86	170	3	309.8	337.2	311.4
921.0	758	29.8	8.8	27	7.77	135	2	310.2	334.4	311.6
906.0	904	28.8	6.3	24	6.63	0	0	310.5	331.4	311.8
901.0	953	28.4	5.4	23	6.28	342	0	310.7	330.4	311.9
885.0	1111	26.9	7.7	30	7.48	285	1	310.7	334.1	312.1
876.0	1201	26.0	8.9	34	8.25	255	2	310.7	336.4	312.3
859.0	1374	24.4	11.4	44	9.95	255	3	310.8	341.6	312.6
850.0	1466	23.8	10.8	44	9.66	255	4	311.1	341.1	312.9
845.0	1518	23.6	10.6	44	9.58	260	4	311.4	341.2	313.2
838.0	1590	23.2	10.2	44	9.41	267	5	311.7	341.0	313.5
812.0	1863	21.4	6.9	39	7.74	295	6	312.6	336.9	314.0
790.0	2100	19.8	4.0	35	6.50	305	8	313.3	334.0	314.6
771.0	2310	18.4	1.5	32	5.55	320	11	314.0	331.8	315.0
769.0	2333	18.2	1.2	32	5.46	319	11	314.1	331.6	315.1
700.0	3128	11.4	-2.6	37	4.54	300	11	315.1	329.8	315.9
614.0	4201	1.8	-7.1	51	3.66	295	17	316.1	328.1	316.8
599.0	4403	0.0	-8.0	55	3.51	298	17	316.2	327.8	316.9
567.0	4840	-3.9	-9.9	63	3.20	305	15	316.6	327.3	317.2
556.0	4994	-5.3	-12.3	58	2.69	308	15	316.8	325.8	317.3
539.0	5237	-7.5	-13.5	62	2.52	312	14	317.0	325.4	317.4
528.0	5397	-8.7	-15.7	57	2.14	315	14	317.4	324.7	317.8
526.0	5426	-8.5	-16.2	54	2.06	315	14	317.9	325.0	318.4
517.0	5561	-7.7	-18.7	41	1.70	318	15	320.5	326.4	320.8
500.0	5820	-8.7	-27.7	20	0.79	325	16	322.4	325.3	322.5
494.0	5913	-9.5	-29.5	18	0.68	322	16	322.5	325.0	322.6
452.0	6590	-15.9	-27.9	35	0.86	303	17	322.8	325.9	322.9
448.0	6657	-16.1	-29.1	32	0.77	301	17	323.3	326.2	323.5
435.0	6877	-17.7	-27.8	41	0.90	295	17	324.1	327.4	324.2

430.0	6964	-18.3	-27.3	45	0.95	298	17	324.4	327.8	324.5
400.0	7500	-20.9	-45.9	9	0.16	320	17	327.7	328.4	327.8
393.0	7628	-21.6	-46.9	8	0.14	315	19	328.5	329.1	328.5
332.0	8847	-28.4	-56.0	5	0.06	300	23	335.4	335.6	335.4
300.0	9580	-32.5	-61.5	4	0.03	300	21	339.4	339.6	339.5
293.0	9746	-32.9	-61.9	4	0.03	301	23	341.2	341.3	341.2
280.0	10067	-31.9	-61.9	3	0.03	303	27	347.1	347.2	347.1
278.0	10117	-32.1	-62.1	3	0.03	303	28	347.5	347.6	347.5
269.0	10348	-33.6	-63.0	4	0.03	305	31	348.6	348.8	348.6
256.0	10694	-35.8	-64.3	4	0.03	300	31	350.3	350.4	350.3
250.0	10860	-36.9	-64.9	4	0.02	295	31	351.1	351.2	351.1
206.0	12161	-46.1	-69.8	5	0.02	295	24	356.6	356.7	356.6
200.0	12360	-47.5	-70.5	5	0.01	295	22	357.4	357.5	357.4
181.0	13002	-52.3	-73.9	6	0.01	285	17	359.9	360.0	359.9
165.0	13597	-56.7	-77.0	6	0.01	265	18	362.1	362.2	362.1
150.0	14210	-61.3	-80.3	6	0.00	260	21	364.3	364.3	364.3
122.0	15445	-68.6	-84.9	8	0.00	285	17	373.1	373.1	373.1
116.0	15747	-70.4	-86.0	8	0.00	280	12	375.3	375.3	375.3
110.0	16064	-72.2	-87.2	9	0.00	275	12	377.5	377.5	377.5
102.0	16516	-74.9	-88.9	10	0.00	255	14	380.6	380.6	380.6
100.0	16630	-74.9	-88.9	10	0.00	250	15	382.8	382.8	382.8
88.6	17333	-74.5				224	9	397.0		397.0
83.0	17711	-75.4				210	5	402.6		402.6
81.3	17831	-75.7				195	6	404.4		404.4
79.0	17998	-75.3				175	8	408.5		408.5
76.0	18223	-74.9				205	10	414.0		414.0
70.0	18700	-73.9				170	2	426.0		426.0
67.0	18955	-73.5				140	2	432.1		432.1
65.3	19105	-73.3				98	3	435.8		435.8
61.0	19512	-70.9				345	5	449.7		449.7
59.0	19711	-69.7				0	5	456.6		456.6
57.0	19917	-68.5				30	5	463.9		463.9
50.0	20700	-63.9				90	6	492.5		492.5
42.0	21790	-60.2				120	14	526.9		526.9
34.1	23094	-55.7				46	4	570.9		570.9
34.0	23112	-55.7				45	4	571.3		571.3
32.3	23439	-56.3				43	4	578.2		578.2
30.0	23910	-54.7				40	5	594.9		594.9
21.7	26027	-45.9				88	8	678.9		678.9
20.0	26570	-46.1				100	9	694.3		694.3
19.0	26909	-46.7				111	8	702.7		702.7
16.0	28057	-44.2				150	6	746.3		746.3
13.0	29445	-41.1				100	4	802.4		802.4
12.8	29548	-40.9				91	4	806.8		806.8
12.2	29874	-40.1				62	2	820.7		820.7
11.1	30514	-41.1				5	0	839.6		839.6
11.0	30575	-41.1				0	0	841.8		841.8
10.0	31220	-40.9				70	2	865.7		865.7
8.0	32768	-36.2				105	12	941.4		941.4
7.0	33694	-33.4				50	8	989.6		989.6
6.4	34315	-31.5				59	9	1023.3		1023.3
6.3	34427	-32.5				60	9	1023.6		1023.6
6.0						65	10			

Station information and sounding indices

Station identifier: VIDD
Station number: 42182
Observation time: 180515/0000
Station latitude: 28.58
Station longitude: 77.20
Station elevation: 216.0
Showalter index: -2.24
Lifted index: -1.98

```
LIFT computed using virtual temperature: -2.60
SWEAT index: 213.61
K index: 29.30
Cross totals index: 19.50
Vertical totals index: 32.50
Totals totals index: 52.00
Convective Available Potential Energy: 484.04
CAPE using virtual temperature: 563.41
Convective Inhibition: -525.26
CINS using virtual temperature: -443.77
Equilibrium Level: 323.95
Equilibrium Level using virtual temperature: 321.70
Level of Free Convection: 623.52
LFCT using virtual temperature: 636.59
Bulk Richardson Number: 18.29
Bulk Richardson Number using CAPV: 21.29
Temp [K] of the Lifted Condensation Level: 285.64
Pres [hPa] of the Lifted Condensation Level: 792.35
Equivalent potential temp [K] of the LCL: 340.31
Mean mixed layer potential temperature: 305.31
Mean mixed layer mixing ratio: 11.75
1000 hPa to 500 hPa thickness: 5793.00
Precipitable water [mm] for entire sounding: 29.24
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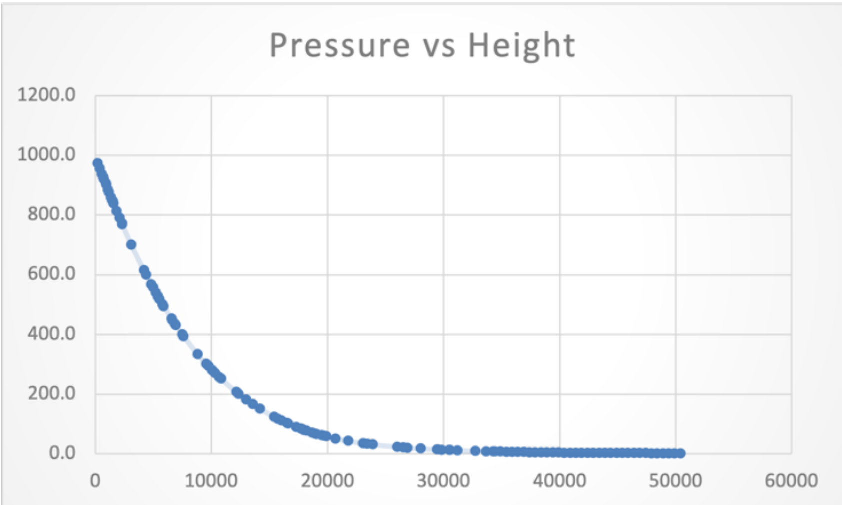
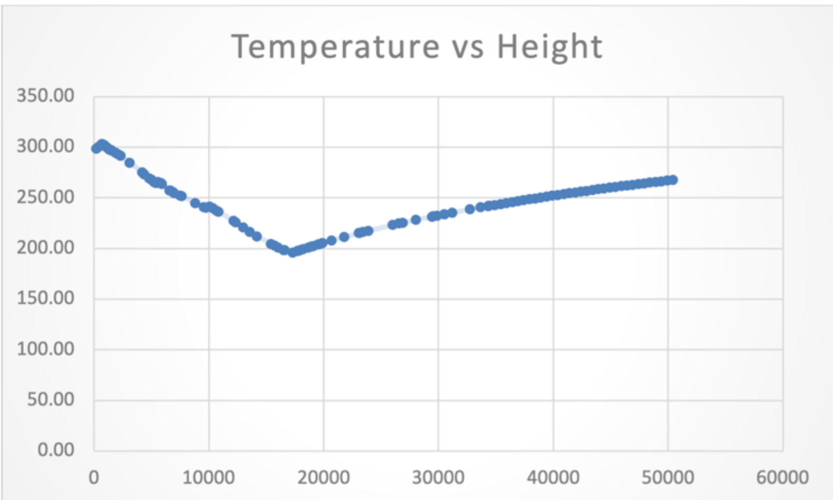
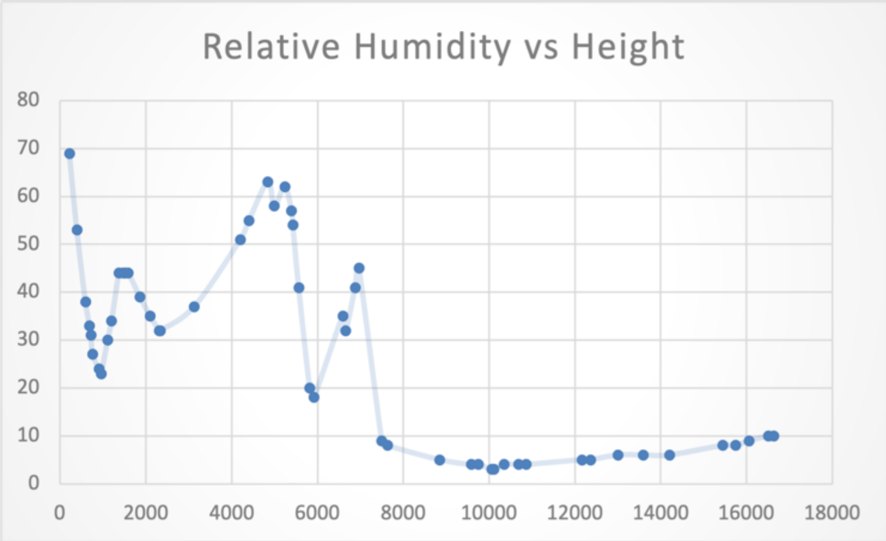


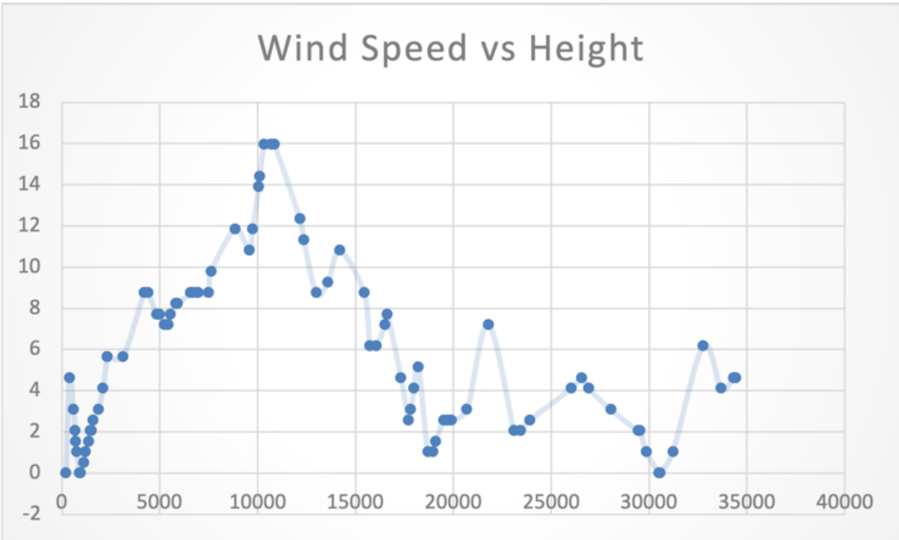
Pressure (hPa) vs Height (m) at 00Z 15 May 2018



Temperature (K) vs Height (m) at 00Z 15 May 2018



Relative Humidity (%) vs Height (m) at 00Z 15 May 2018



Wind Speed (m/s) vs Height (m) at 00Z 15 May 2018

42182 VIDD New Delhi Observations at 12Z 15 May 2018

PRES hPa	HGHT m	TEMP C	DWPT C	RELH %	MIXR g/kg	DRCT deg	SKNT knot	THTA K	THTE K	THTV K
					1000.0	-6				
970.0	216	37.6	18.6	33	14.10	135	4	313.5	357.4	316.1
958.0	345	34.4	19.4	41	15.03	112	6	311.3	357.8	314.1
936.0	584	32.3	18.6	44	14.63	70	10	311.3	356.4	314.0
925.0	705	31.2	18.2	46	14.43	80	10	311.2	355.7	313.9
905.0	900	29.4	17.5	49	14.12	95	10	311.3	354.9	313.9
890.0	1050	28.0	17.0	51	13.89	102	8	311.4	354.2	313.9
875.0	1200	26.9	15.9	51	13.19	110	6	311.8	352.6	314.2
873.0	1221	26.8	15.8	51	13.10	115	5	311.8	352.4	314.3
864.0	1312	25.9	15.3	52	12.82	135	4	311.8	351.5	314.2
851.0	1446	24.6	14.6	54	12.43	154	2	311.8	350.3	314.1
850.0	1456	24.6	14.6	54	12.44	155	2	311.9	350.4	314.2
822.0	1748	23.1	11.1	46	10.16	290	6	313.4	345.2	315.3
789.0	2104	21.4	6.7	39	7.86	305	17	315.1	340.1	316.6
772.0	2294	20.4	4.4	35	6.84	305	19	316.1	338.0	317.4
700.0	3127	12.8	0.8	44	5.83	305	23	316.6	335.5	317.7
673.0	3453	9.7	-1.0	47	5.31	295	29	316.7	334.0	317.7
639.0	3884	5.6	-3.4	52	4.68	301	29	316.8	332.1	317.7
615.0	4196	3.6	-10.4	35	2.83	305	29	318.0	327.5	318.5
586.0	4586	-0.1	-12.1	40	2.59	320	26	318.1	326.9	318.6
577.0	4710	-1.1	-11.1	47	2.85	325	25	318.3	327.9	318.9
535.0	5310	-4.1	-18.1	33	1.73	301	29	321.7	327.8	322.0
510.0	5685	-6.8	-16.3	47	2.11	285	31	322.9	330.2	323.3
507.0	5732	-7.1	-16.1	49	2.16	286	31	323.0	330.5	323.5
500.0	5840	-7.7	-18.7	41	1.76	290	31	323.6	329.8	323.9
497.0	5887	-7.9	-18.9	41	1.74	291	31	323.9	330.0	324.2
488.0	6029	-9.1	-19.1	44	1.74	292	31	324.1	330.3	324.5
479.0	6173	-9.9	-21.9	37	1.39	294	31	324.9	329.9	325.1
469.0	6336	-11.1	-20.1	47	1.66	296	32	325.3	331.2	325.7
419.0	7193	-17.1	-32.1	26	0.62	306	33	328.3	330.7	328.4
411.0	7338	-18.3	-30.3	34	0.75	308	33	328.6	331.4	328.7
400.0	7540	-19.7	-37.7	19	0.37	310	33	329.3	330.8	329.4
395.0	7633	-20.4	-40.2	15	0.29	310	33	329.6	330.7	329.6
386.0	7803	-21.7	-44.7	11	0.19	307	34	330.0	330.8	330.1
363.0	8250	-25.5	-39.5	26	0.34	301	35	330.8	332.2	330.9
310.0	9378	-31.1	-54.1	9	0.08	283	38	338.2	338.6	338.3
302.0	9563	-30.8	-53.8	9	0.08	280	39	341.2	341.6	341.2
300.0	9610	-30.7	-53.7	9	0.09	285	41	342.0	342.4	342.0
297.0	9682	-30.5	-53.5	9	0.09	285	43	343.3	343.6	343.3
293.0	9778	-30.5	-53.5	9	0.09	285	45	344.6	345.0	344.6
287.0	9923	-31.5	-54.2	9	0.08	285	49	345.2	345.6	345.2
282.0	10046	-32.3	-54.9	9	0.08	290	51	345.8	346.1	345.8
250.0	10890	-38.1	-59.1	9	0.05	285	45	349.3	349.5	349.3
230.0	11454	-41.8	-61.7	10	0.04	285	39	352.0	352.2	352.0
204.0	12266	-47.2	-65.5	11	0.03	265	43	355.8	356.0	355.8
200.0	12400	-48.1	-66.1	11	0.03	265	43	356.4	356.6	356.4
178.0	13141	-54.1	-70.5	12	0.02	270	43	358.7	358.8	358.7
150.0	14230	-62.9	-76.9	14	0.01	270	35	361.5	361.6	361.5
135.0	14878	-64.7	-78.7	13	0.01	270	23	369.5	369.5	369.5
133.0	14969	-64.9	-78.9	13	0.01	262	22	370.6	370.6	370.6
129.0	15152	-66.0	-79.7	13	0.01	245	19	371.8	371.9	371.8
120.0	15583	-68.7	-81.6	14	0.00	260	14	374.7	374.7	374.7
117.0	15734	-69.7	-82.2	14	0.00	230	10	375.7	375.7	375.7
101.0	16612	-75.1	-86.1	17	0.00	272	19	381.3	381.3	381.3
100.0	16670	-75.5	-86.5	17	0.00	275	19	381.6	381.6	381.6
80.1	17944	-78.5				214	21	400.4		400.4
78.9	18030	-78.9				210	21	401.3		401.3
70.0	18720	-73.1				180	16	427.7		427.7
50.0	20730	-63.3				95	6	493.9		493.9
31.9	23563	-51.7				95	11	592.6		592.6
30.0	23960	-52.5				95	12	600.9		600.9

29.3	24112	-52.9	92	12	603.9	603.9
25.0	25139	-51.5	75	11	635.9	635.9
22.8	25736	-51.7	65	10	652.3	652.3
20.0	26590	-49.5	50	10	683.9	683.9
18.0	27288	-46.3	70	6	714.9	714.9
17.0	27667	-44.6	30	14	732.2	732.2
16.2	27986	-43.1	50	20	747.1	747.1
16.0	28069	-43.1	55	21	749.6	749.6
15.0	28502	-43.4	55	31	762.6	762.6
14.1	28918	-43.7	68	26	775.3	775.3
14.0	28966	-43.5	70	25	777.5	777.5
13.0	29471	-41.8	70	19	800.1	800.1
10.0	31260	-35.7	125	12	885.1	885.1
9.8	31401	-35.3	111	12	891.7	891.7
9.4	31691	-34.5	81	14	905.5	905.5
9.0	31995	-34.6	50	16	916.2	916.2
8.4	32476	-34.9	123	11	933.5	933.5
8.0	32817	-34.6	175	8	947.8	947.8
6.9	33852	-33.7			992.4	992.4
6.2	34599	-35.3			1016.4	1016.4
6.0	34827	-35.3			1025.9	1025.9

Station information and sounding indices

```
Station identifier: VIDD
Station number: 42182
Observation time: 180515/1200
Station latitude: 28.58
Station longitude: 77.20
Station elevation: 216.0
Showalter index: -4.79
Lifted index: -6.98
LIFT computed using virtual temperature: -7.90
SWEAT index: 322.16
K index: 34.90
Cross totals index: 22.30
Vertical totals index: 32.30
Totals totals index: 54.60
Convective Available Potential Energy: 1988.53
CAPE using virtual temperature: 2195.85
Convective Inhibition: -138.36
CINS using virtual temperature: -74.95
Equilibrium Level: 205.75
Equilibrium Level using virtual temperature: 205.33
Level of Free Convection: 690.87
LFCT using virtual temperature: 712.03
Bulk Richardson Number: 31.65
Bulk Richardson Number using CAPV: 34.95
Temp [K] of the Lifted Condensation Level: 288.61
Pres [hPa] of the Lifted Condensation Level: 764.99
Equivalent potential temp [K] of the LCL: 356.76
Mean mixed layer potential temperature: 311.57
Mean mixed layer mixing ratio: 14.68
1000 hPa to 500 hPa thickness: 5846.00
Precipitable water [mm] for entire sounding: 37.72
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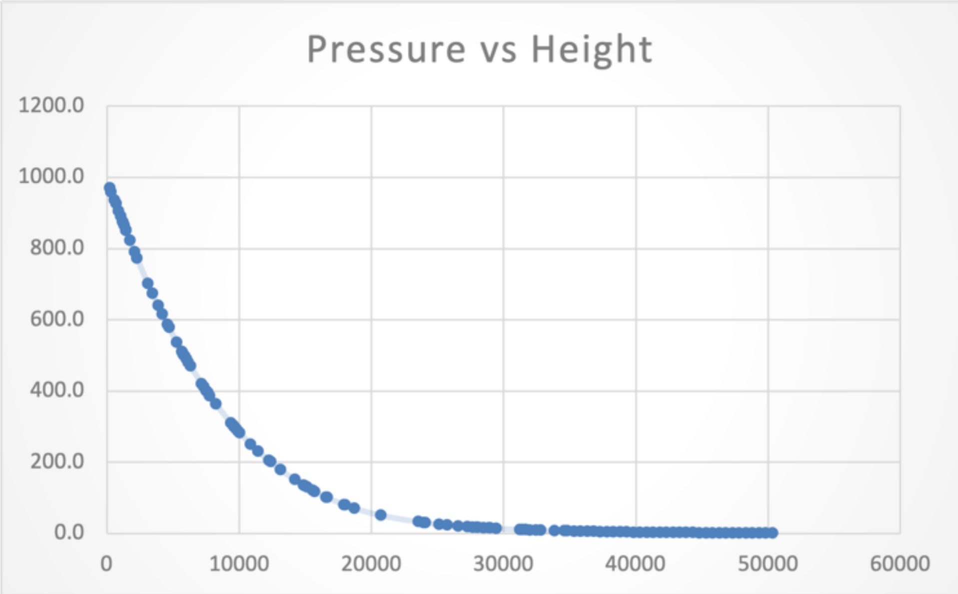
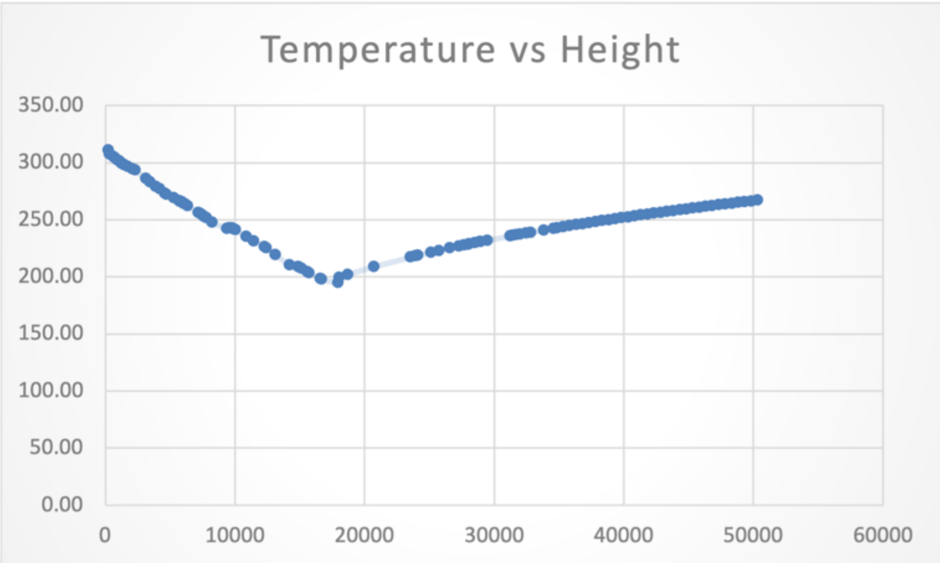
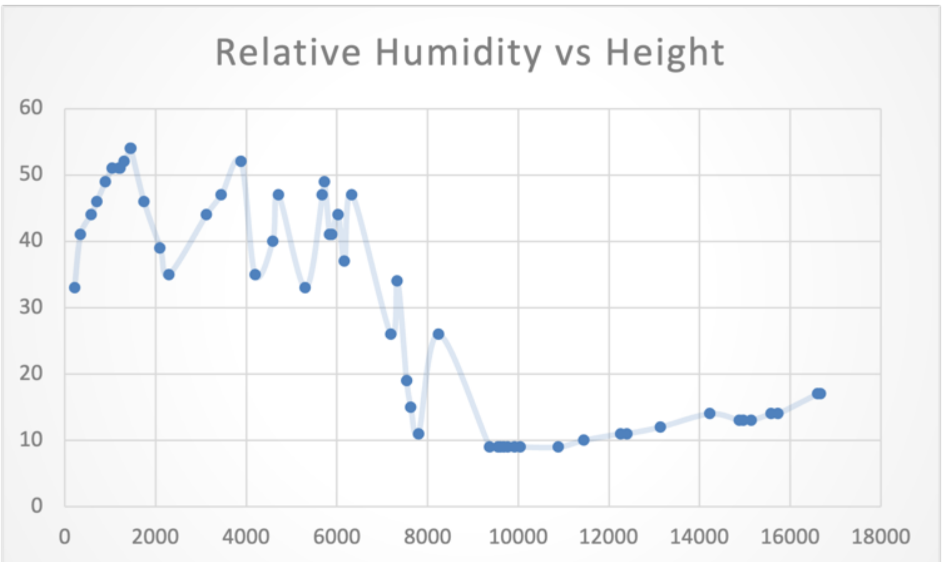


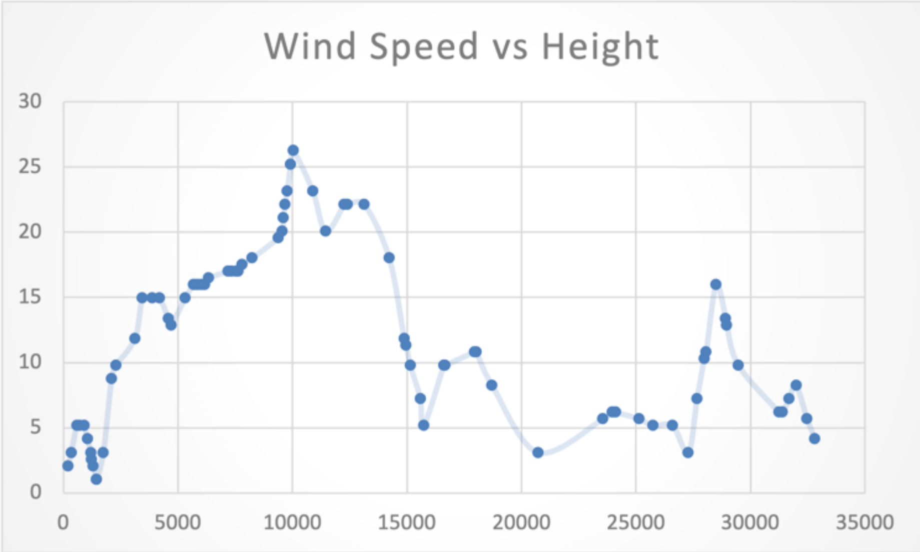
Pressure (hPa) vs Height (m) at 12Z 15 May 2018



Temperature (K) vs Height (m) at 12Z 15 May 2018



Relative Humidity (%) vs Height (m) at 12Z 15 May 2018



Wind Speed (m/s) vs Height (m) at 12Z 15 May 2018

42182 VIDD New Delhi Observations at 00Z 05 Jul 2018

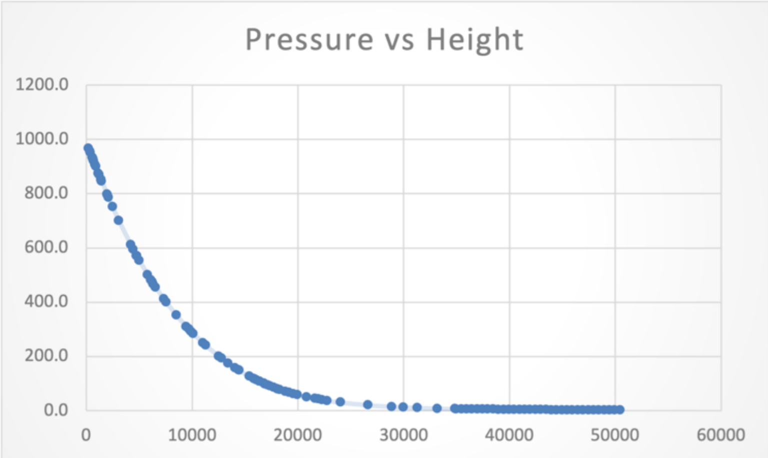
PRES hPa	HGHT m	TEMP C	DWPT C	RELH %	MIXR g/kg	DRCT deg	SKNT knot	THTA K	THTE K	THTV K
				1000.0		-38				
966.0	216	29.0	25.4	81	21.71	0	0	305.1	370.6	309.1
956.0	323	28.4	23.4	74	19.38	90	4	305.4	363.9	309.0
951.0	377	28.2	23.3	75	19.38	135	6	305.7	364.2	309.2
935.0	551	27.6	23.0	76	19.34	107	4	306.6	365.1	310.1
931.0	595	27.5	22.8	76	19.22	100	4	306.8	365.1	310.4
928.0	628	27.4	22.7	76	19.13	112	4	307.0	365.1	310.5
925.0	661	27.4	22.4	74	18.84	125	3	307.3	364.5	310.8
920.0	709	27.6	22.6	74	19.18	142	3	308.0	366.4	311.5
907.0	835	26.9	21.4	72	17.99	185	4	308.6	363.4	311.9
900.0	904	26.6	20.7	70	17.37	185	4	308.9	361.9	312.1
875.0	1153	25.2	18.2	65	15.27	218	4	309.9	356.8	312.8
870.0	1204	24.7	18.3	68	15.48	225	4	310.0	357.4	312.8
852.0	1387	23.0	18.8	77	16.26	235	6	310.0	359.9	313.0
850.0	1408	22.8	18.8	78	16.35	235	6	310.0	360.1	313.1
846.0	1449	22.6	18.6	78	16.22	240	6	310.2	360.0	313.2
798.0	1957	19.5	15.3	77	13.88	305	7	312.1	355.1	314.7
794.0	2000	19.2	15.0	77	13.69	305	7	312.3	354.7	314.8
785.0	2098	18.5	14.4	77	13.32	305	8	312.5	353.9	315.0
751.0	2478	15.8	12.1	79	11.95	301	7	313.6	350.9	315.8
700.0	3073	12.4	7.6	73	9.44	295	5	316.2	346.1	318.0
611.0	4196	5.7	-5.2	45	4.27	270	3	321.0	335.2	321.9
595.0	4415	4.4	-7.7	41	3.61	300	4	322.0	334.1	322.7
571.0	4755	2.4	-11.6	35	2.77	310	6	323.4	332.9	323.9
570.0	4769	2.3	-11.7	35	2.76	310	6	323.4	332.9	323.9
554.0	4998	0.0	-13.0	37	2.55	300	5	323.4	332.2	323.9
500.0	5810	-7.3	-15.3	53	2.34	265	3	324.1	332.2	324.5
481.0	6110	-9.3	-12.4	78	3.09	215	7	325.2	335.8	325.8
474.0	6224	-8.2	-20.0	38	1.66	210	10	327.9	333.9	328.3
467.0	6339	-7.1	-27.7	18	0.85	240	10	330.8	333.9	330.9
455.0	6542	-5.1	-41.1	4	0.23	241	11	335.7	336.6	335.7
411.0	7331	-9.1	-46.1	3	0.15	244	12	340.4	341.1	340.4
400.0	7540	-10.5	-44.5	4	0.18	245	13	341.2	342.0	341.3
352.0	8503	-16.4	-40.9	10	0.31	250	15	346.0	347.3	346.0
310.0	9460	-22.3	-37.3	24	0.50	254	15	350.5	352.6	350.6
300.0	9700	-23.9	-39.9	21	0.40	255	15	351.6	353.3	351.7
292.0	9897	-25.4	-40.9	22	0.37	245	16	352.2	353.8	352.3

283.0	10125	-27.1	-42.1	23	0.33	245	16	352.9	354.3	353.0
250.0	11010	-34.3	-49.3	20	0.17	245	14	354.9	355.7	355.0
240.0	11288	-36.5	-51.7	19	0.14	230	13	355.7	356.4	355.8
200.0	12530	-46.5	-62.5	15	0.04	220	14	359.0	359.2	359.0
193.0	12765	-48.5	-64.5	14	0.03	219	14	359.4	359.6	359.4
175.0	13388	-53.8	-68.6	15	0.02	215	14	360.9	361.1	360.9
157.0	14080	-59.6	-73.2	16	0.01	225	10	362.4	362.4	362.4
150.0	14370	-62.1	-75.1	16	0.01	230	14	362.9	362.9	362.9
148.0	14451	-62.6	-75.5	16	0.01	230	15	363.3	363.4	363.3
126.0	15420	-69.3	-80.9	17	0.00	215	7	368.4	368.5	368.4
118.0	15815	-72.0	-83.1	18	0.00	180	7	370.4	370.4	370.4
116.0	15918	-72.7	-83.7	18	0.00	170	7	370.9	371.0	370.9
113.0	16070	-73.6	-84.6	17	0.00	155	7	372.1	372.1	372.1
108.0	16334	-75.1	-86.1	17	0.00	165	9	374.1	374.1	374.1
107.0	16388	-75.1	-86.1	17	0.00	170	8	375.1	375.1	375.1
100.0	16780	-75.5	-86.5	17	0.00	205	1	381.6	381.6	381.6
98.0	16896	-75.7				30	2	383.4		383.4
94.0	17136	-76.2				115	8	387.0		387.0
90.2	17373	-76.7				104	7	390.6		390.6
85.2	17701	-75.7				88	5	399.1		399.1
80.7	18012	-77.5				73	3	401.6		401.6
79.1	18127	-77.7				67	2	403.5		403.5
77.0	18282	-77.0				60	1	408.2		408.2
70.0	18830	-74.3				95	12	425.1		425.1
66.0	19176	-71.9				95	9	437.6		437.6
62.0	19545	-69.3				92	10	451.2		451.2
57.7	19973	-69.7				88	12	459.6		459.6
50.0	20840	-62.5				80	15	495.8		495.8
44.0	21632	-60.3				80	16	519.6		519.6
41.9	21936	-60.9				80	16	525.4		525.4
39.5	22304	-59.5				80	17	537.9		537.9
36.6	22780	-60.1				80	17	548.2		548.2
30.0	24030	-56.7				80	19	589.5		589.5
20.0	26660	-48.7				85	15	686.3		686.3
14.3	28894	-41.5				83	17	779.6		779.6
12.2	29965	-42.9				81	18	810.9		810.9
10.0	31310	-40.3				80	19	868.0		868.0
7.6	33193	-37.1				88	25	951.7		951.7
6.0	34845	-32.2				95	30	1039.1		1039.1
5.9	34962	-31.9						1045.6		1045.6

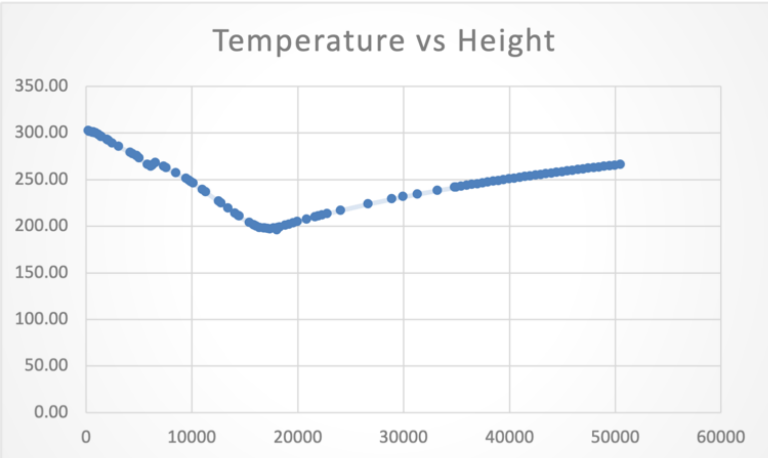
Station information and sounding indices

Station identifier: VIDD
Station number: 42182
Observation time: 180705/0000
Station latitude: 28.58
Station longitude: 77.20
Station elevation: 216.0
Showalter index: -7.59
Lifted index: -9.12
LIFT computed using virtual temperature: -10.20
SWEAT index: 384.60
K index: 44.10
Cross totals index: 26.10
Vertical totals index: 30.10
Totals totals index: 56.20
Convective Available Potential Energy: 1625.84
CAPE using virtual temperature: 1902.43
Convective Inhibition: -84.74
CINS using virtual temperature: -62.33
Equilibrum Level: 140.71
Equilibrum Level using virtual temperature: 140.39
Level of Free Convection: 777.34

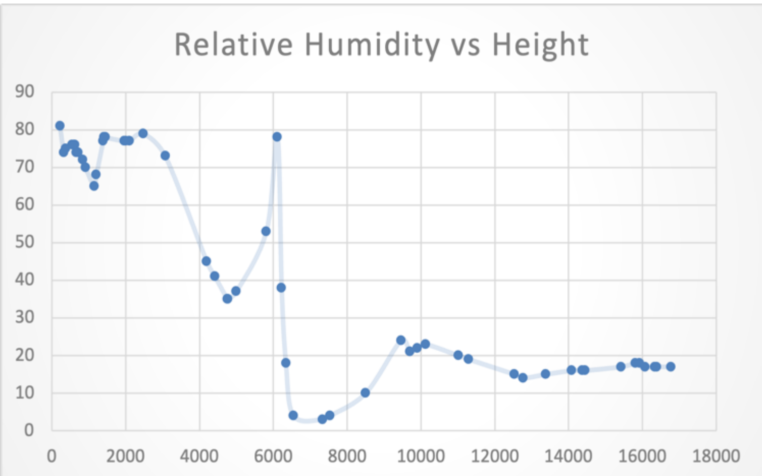
```
LFCT using virtual temperature: 797.37
Bulk Richardson Number: 245.04
Bulk Richardson Number using CAPV: 286.73
Temp [K] of the Lifted Condensation Level: 295.30
Pres [hPa] of the Lifted Condensation Level: 880.31
Equivalent potential temp [K] of the LCL: 365.20
Mean mixed layer potential temperature: 306.26
Mean mixed layer mixing ratio: 19.53
1000 hPa to 500 hPa thickness: 5848.00
Precipitable water [mm] for entire sounding: 51.82
```



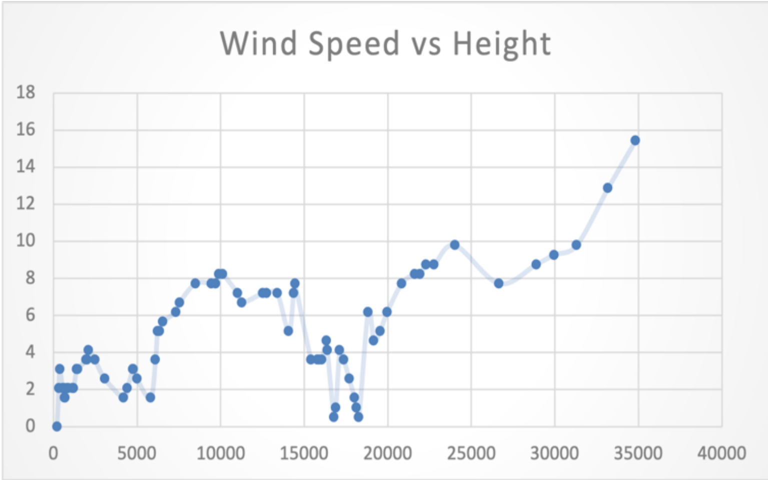
Pressure (hPa) vs Height (m) at 00Z July 2018



Temperature (K) vs Height (m) at 00Z 5 July 2018



Relative Humidity (%) vs Height (m) at 00Z 5 July 2018



Wind Speed (m/s) vs Height (m) at 00Z 5 July 2018

42182 VIDD New Delhi Observations at 12Z 05 Jul 2018

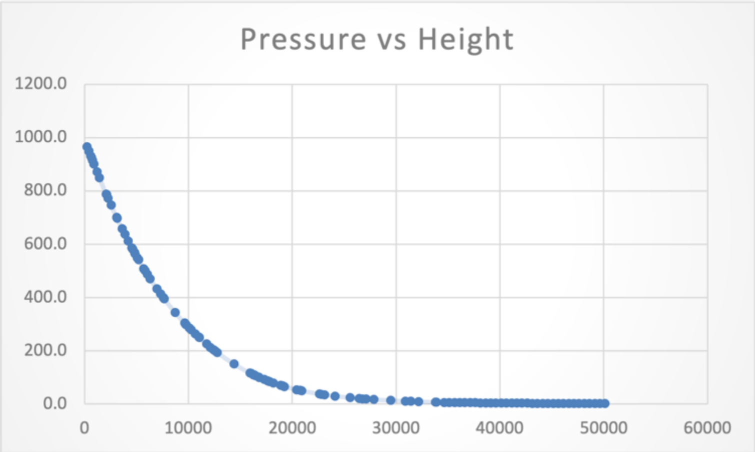
PRES hPa	HGHT m	TEMP C	DWPT C	RELH %	MIXR g/kg	DRCT deg	SKNT knot	THTA K	THTE K	THTV K
					1000.0	-40				
966.0	216	31.8	19.8	49	15.29	315	3	308.0	354.5	310.8
950.0	388	32.2	19.3	47	15.04	355	4	309.8	355.9	312.6
948.0	410	32.2	19.2	46	15.00	352	4	310.0	356.1	312.8
932.0	585	31.5	18.5	46	14.60	330	8	310.9	355.9	313.6
925.0	663	31.2	18.2	46	14.43	325	8	311.2	355.7	313.9
915.0	761	30.8	17.8	46	14.22	321	8	311.8	355.8	314.4
901.0	898	29.8	17.4	47	14.10	315	9	312.1	355.8	314.7
871.0	1200	27.6	16.6	51	13.83	305	9	312.8	355.8	315.4
850.0	1417	26.0	16.0	54	13.64	300	8	313.4	355.8	315.9
787.0	2091	20.6	12.6	60	11.78	280	8	314.6	351.5	316.8
786.0	2102	20.5	12.4	60	11.67	280	8	314.6	351.2	316.8
772.0	2257	19.2	10.2	56	10.22	273	7	314.8	346.9	316.7
746.0	2548	16.8	9.2	61	9.85	260	6	315.2	346.3	317.1
700.0	3090	12.2	7.2	71	9.18	270	7	316.0	345.1	317.7
698.0	3114	12.0	7.0	71	9.08	270	7	316.0	344.8	317.7
658.0	3607	9.0	1.0	57	6.29	265	9	318.0	338.4	319.2
637.0	3875	7.0	2.0	70	6.99	263	10	318.7	341.3	320.0
612.0	4203	5.1	-1.4	63	5.69	260	11	320.1	338.8	321.2
586.0	4558	3.0	-5.0	56	4.52	256	14	321.7	336.8	322.6
581.0	4627	2.6	-4.5	60	4.75	255	14	322.0	337.8	322.9
569.0	4796	1.6	-3.2	70	5.34	252	12	322.8	340.5	323.8
564.0	4867	1.2	-4.8	64	4.77	251	11	323.1	339.1	324.1
549.0	5084	-0.1	-3.5	78	5.41	247	7	324.1	342.1	325.1
542.0	5186	-0.5	-3.7	79	5.40	245	6	324.8	342.8	325.8
508.0	5703	-2.8	-4.8	86	5.33	225	4	328.1	346.2	329.2
500.0	5830	-3.3	-5.0	88	5.31	205	4	328.9	347.0	330.0
487.0	6038	-4.2	-5.7	89	5.17	140	3	330.4	348.1	331.4
470.0	6317	-5.3	-6.6	91	5.00	163	3	332.3	349.6	333.3
433.0	6954	-8.1	-9.4	90	4.34	215	4	336.7	352.1	337.6
414.0	7303	-9.6	-11.0	89	4.01	175	5	339.1	353.5	340.0
400.0	7570	-10.7	-12.2	89	3.77	225	5	341.0	354.6	341.8
395.0	7665	-11.3	-13.2	86	3.52	235	5	341.4	354.2	342.2
343.0	8726	-17.9	-24.7	55	1.52	210	8	346.6	352.4	346.9
304.0	9633	-23.5	-34.5	36	0.68	228	10	350.8	353.6	351.0
300.0	9730	-24.1	-35.1	36	0.65	230	10	351.3	354.0	351.4
298.0	9778	-24.5	-35.3	36	0.64	225	10	351.4	354.0	351.5
285.0	10101	-27.3	-36.3	42	0.61	215	11	351.9	354.4	352.0
279.0	10252	-28.3	-38.0	39	0.52	210	12	352.6	354.7	352.7
264.0	10644	-31.0	-42.5	32	0.35	225	12	354.2	355.7	354.3

251.0	11002	-33.5	-46.5	26	0.23	220	9	355.7	356.8	355.8
250.0	11030	-33.7	-46.7	26	0.23	220	9	355.8	356.8	355.9
225.0	11758	-40.3	-50.3	33	0.17	200	13	356.6	357.4	356.6
213.0	12127	-43.1	-53.6	31	0.12	190	15	357.9	358.4	357.9
204.0	12417	-45.3	-56.1	29	0.09	180	16	358.9	359.3	358.9
200.0	12550	-46.3	-57.3	28	0.08	185	19	359.3	359.7	359.3
193.0	12786	-47.9	-58.9	27	0.07	184	19	360.4	360.7	360.4
150.0	14400	-61.3	-69.3	34	0.02	180	19	364.3	364.4	364.3
116.0	15943	-75.1	-80.1	46	0.01	175	14	366.5	366.5	366.5
114.0	16044	-75.5	-80.5	46	0.01	175	14	367.6	367.6	367.6
110.0	16252	-72.7	-78.7	40	0.01	171	12	376.6	376.6	376.6
109.0	16306	-71.9	-77.9	40	0.01	170	11	379.1	379.1	379.1
106.0	16469	-72.9	-78.5	43	0.01	125	3	380.2	380.2	380.2
101.0	16752	-74.7	-79.5	47	0.01	125	4	382.1	382.1	382.1
100.0	16810	-75.3	-80.2	46	0.01	125	4	382.0	382.0	382.0
92.1	17283	-77.1				101	9	387.5		387.5
86.8	17623	-75.3				84	12	397.8		397.8
85.5	17710	-75.1				80	13	399.9		399.9
84.0	17813	-75.0				75	14	402.2		402.2
79.0	18169	-74.5				80	18	410.2		410.2
70.0	18870	-73.7				140	15	426.4		426.4
68.0	19045	-72.9				135	11	431.7		431.7
66.0	19225	-72.1				85	11	437.2		437.2
54.0	20436	-66.5				60	15	475.9		475.9
51.0	20781	-64.8				85	19	487.5		487.5
50.0	20900	-64.3				95	17	491.5		491.5
38.0	22602	-56.7				68	19	551.0		551.0
37.0	22770	-56.9				65	19	554.7		554.7
35.2	23085	-57.3				72	18	561.6		561.6
30.0	24100	-53.5				95	14	598.2		598.2
24.0	25558	-48.9				45	17	651.0		651.0
21.0	26431	-46.1				70	20	684.6		684.6
20.0	26750	-45.1				90	26	697.4		697.4
19.0	27095	-44.8				95	29	708.7		708.7
17.0	27843	-44.0				110	15	734.1		734.1
13.3	29493	-42.3				98	17	793.2		793.2
10.8	30899	-43.1				89	19	838.9		838.9
10.0	31420	-41.1				85	20	865.0		865.0
9.0	32148	-39.3				80	28	898.4		898.4
7.1	33786	-35.2				85	32	978.3		978.3
7.0	33884	-34.9				85	32	983.3		983.3
6.3	34612	-33.1				92	27	1021.1		1021.1
6.0						95	25			

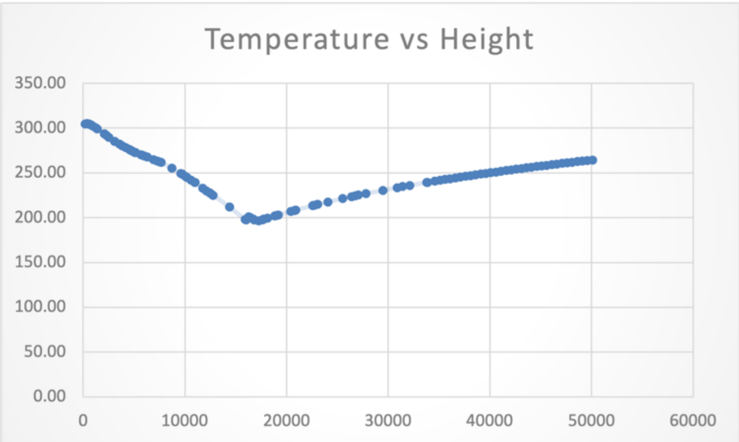
Station information and sounding indices

```
Station identifier: VIDD
Station number: 42182
Observation time: 180705/1200
Station latitude: 28.58
Station longitude: 77.20
Station elevation: 216.0
Showalter index: -2.22
Lifted index: -2.16
LIFT computed using virtual temperature: -2.46
SWEAT index: 212.01
K index: 40.30
Cross totals index: 19.30
Vertical totals index: 29.30
Totals totals index: 48.60
Convective Available Potential Energy: 232.24
CAPE using virtual temperature: 303.89
Convective Inhibition: -214.49
CINS using virtual temperature: -180.40
```

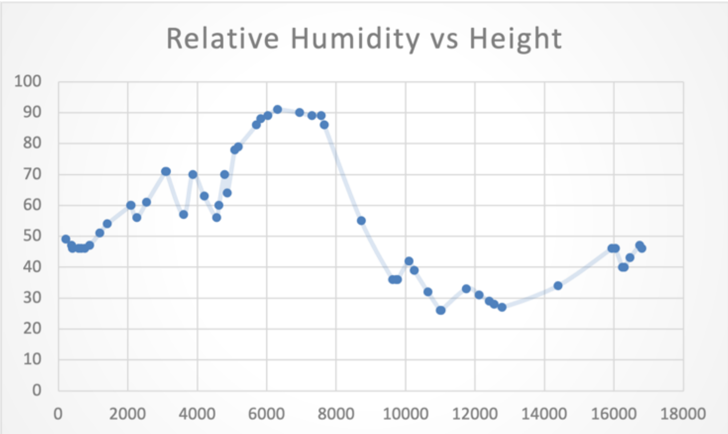
```
Equilibrum Level: 409.47
Equilibrum Level using virtual temperature: 407.08
Level of Free Convection: 689.02
LFCT using virtual temperature: 706.89
Bulk Richardson Number: 47.07
Bulk Richardson Number using CAPV: 61.59
Temp [K] of the Lifted Condensation Level: 289.14
Pres [hPa] of the Lifted Condensation Level: 782.97
Equivalent potential temp [K] of the LCL: 355.50
Mean mixed layer potential temperature: 310.08
Mean mixed layer mixing ratio: 14.84
1000 hPa to 500 hPa thickness: 5870.00
Precipitable water [mm] for entire sounding: 53.22
```



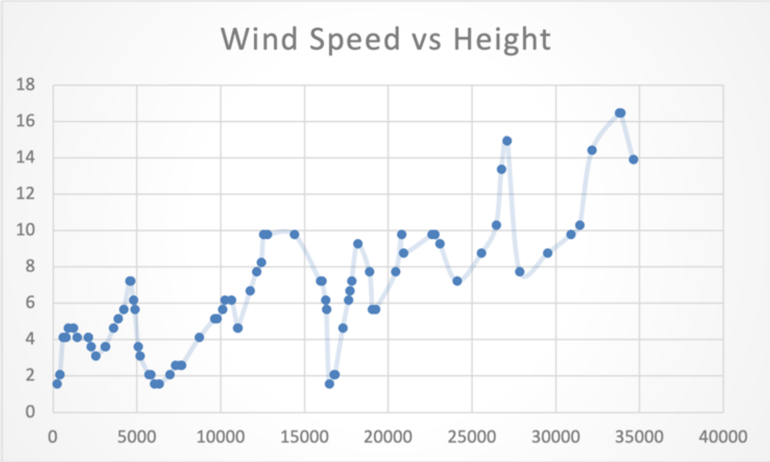
Pressure (hPa) vs Height (m) at 12Z July 2018



Temperature (K) vs Height (m) at 12Z 5 July 2018



Relative Humidity (%) vs Height (m) at 12Z 5 July 2018



Wind Speed (m/s) vs Height (m) at 12Z 5 July 2018

1A ii) Also identify troposphere, tropopause, stratosphere and stratopause and mention the geometric heights.

Identification of Atmospheric Layers:

- Troposphere: This layer, where temperature decreases with altitude, was identified for the following data (Readings are taken approximately, Error can be +- 500m)
  00Z 15 May 2018 – Troposphere identified between [0 m – 17333 m]
  12Z 15 May 2018 – Troposphere identified between [0 m - 17994 m]
  00Z 5 July 2018 – Troposphere identified between [0 m –18012 m]
  12Z 5 July 2018 – Troposphere identified between [0 m – 17283 m]

- Stratosphere: Above the tropopause, the stratosphere exhibited a relatively stable temperature profile with a slight temperature increase with height, extending up to 50 km in all the cases as the T vs z graphs show the increment till 50 km, and we can't predict for the further height. (Readings are taken approximately, Error can be +- 500m)
  00Z 15 May 2018 – Stratosphere identified between [17333 m – 50000 m]
  12Z 15 May 2018 – Stratosphere identified between [17994 m – 50000 m]
  00Z 5 July 2018 – Stratosphere identified between [18012 m – 50000 m]
  12Z 5 July 2018 – Stratosphere identified between [17283 m – 50000 m]

- Tropopause: The tropopause, marking the boundary between the troposphere and stratosphere, was identified at
  00Z 15 May 2018 –Tropopause identified at [17333 m +- 500 m]
  12Z 15 May 2018 – Tropopause identified at [17994 m +- 500 m]
  00Z 5 July 2018 – Tropopause identified at [18012 m +- 500 m]
  12Z 5 July 2018 – Tropopause identified at [17283 m +- 500m]

- Stratopause: The stratopause, separating the stratosphere and mesosphere, was observed at
  00Z 15 May 2018 – Stratopause identified at [50000 m or beyond]
  12Z 15 May 2018 – Stratopause identified at [50000 m or beyond]
  00Z 5 July 2018 – Stratopause identified at [50000 m or beyond]
  12Z 5 July 2018 – Stratopause identified at [50000 m or beyond]

These observations provide valuable insights into the vertical structure of the atmosphere and its diurnal variations.

1B Calculate thermal stability, dynamic stability and non-local stability for both days (total 2 days and both at 00 UTC and 12 UTC) for the entire boundary layer from surface up to 750 mb pressure level in the following 3 steps:
(i) Plot Temperature, ELR, DALR and Thermal stability with altitude. To represent, thermal stability plot with altitude, use symbols 1, 2 and 3 for stable, neutral and unstable case respectively.

To further analyze atmospheric conditions, I performed stability calculations for the specified days and times, focusing on thermal stability, dynamic stability, and non-local stability.

Thermal Stability Analysis: Plotting Temperature and Lapse Rates: I plotted the temperature profile along with the Environmental Lapse Rate (ELR) and Dry Adiabatic Lapse Rate (DALR) to assess thermal stability. Additionally, I marked regions of stable, neutral, and unstable conditions using symbols 1, 2, and 3 respectively.

Assessment of Thermal Stability: The plot revealed regions of stability where the ELR is lower than the DALR, indicating stratification, while regions with ELR exceeding DALR signify instability, often associated with convective activity.

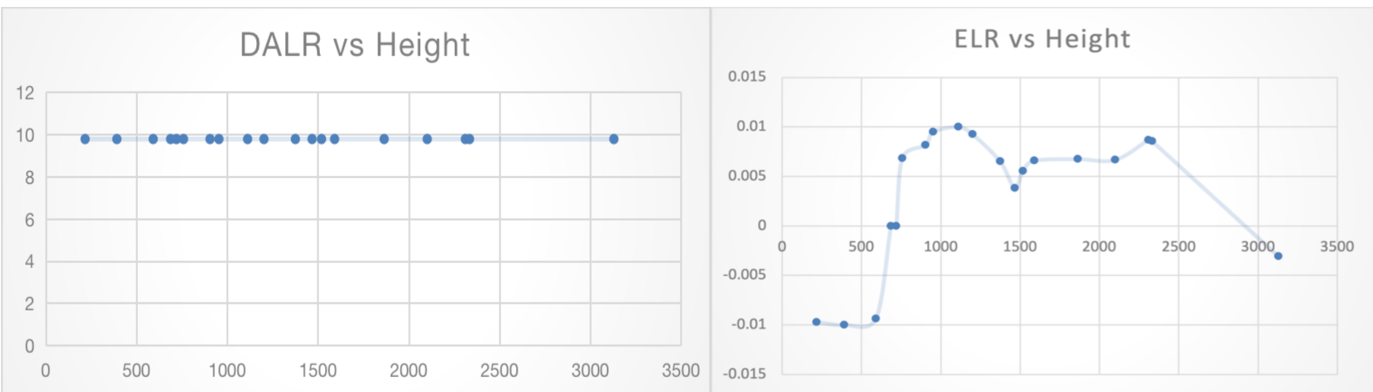
Dynamic Stability Analysis: Dynamic Stability Assessment: Dynamic stability was evaluated by analysing the vertical profile of buoyancy, shear terms, and Richardson number. I plotted these parameters against altitude to identify regions of stable and unstable atmospheric conditions.

Interpretation of Dynamic Stability: The Richardson number helped in assessing the balance between buoyancy and shear forces. Values below a critical threshold indicated unstable conditions, while higher values signified stability.

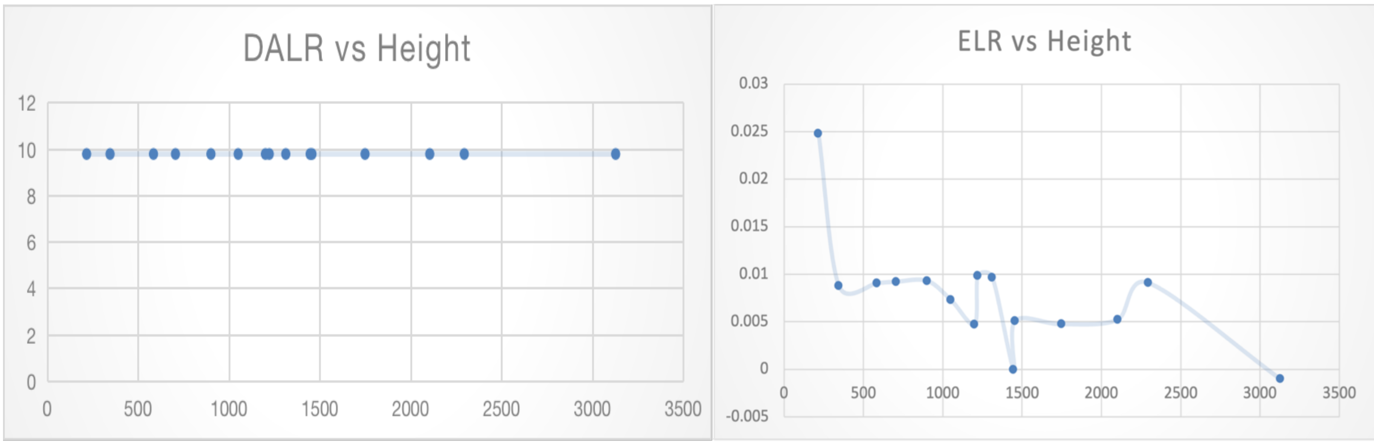
Local and Non-local Stability Analysis: Plotting Temperature and Potential Temperature: Temperature and potential temperature profiles were plotted to analyse local and non-local stability. Local stability reflects vertical temperature gradients, while non-local stability considers horizontal temperature variations.

Comparison of Local vs. Non-local Stability: By comparing temperature and potential temperature profiles, I assessed the influence of horizontal temperature gradients on atmospheric stability.

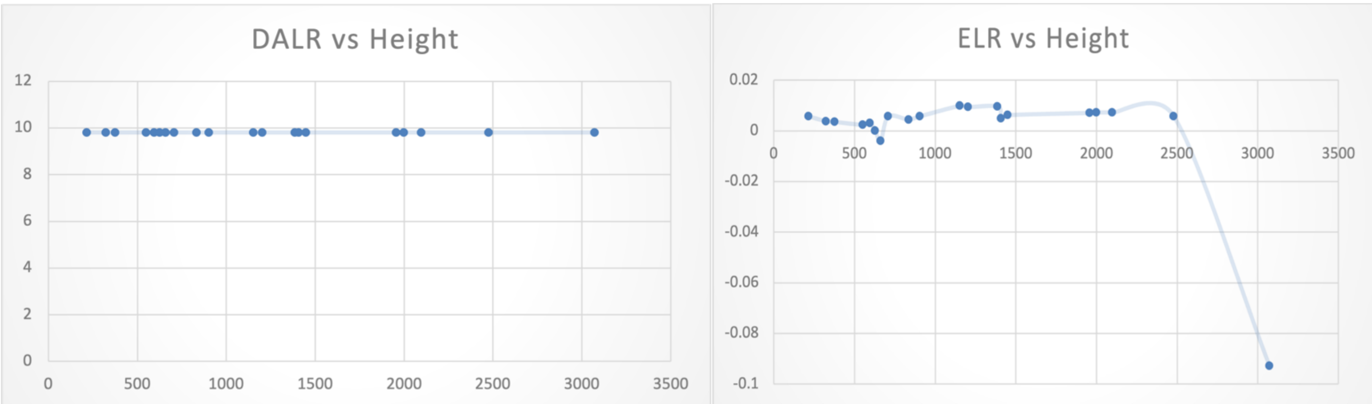
Thermal Stability: Morning and evening profiles showed variations in stability, with daytime heating leading to increased instability due to convective processes.
Dynamic Stability: The Richardson number indicated a transition from stable to unstable conditions with the onset of convective activity during the day.
Local vs. Non-local Stability: Differences between local and non-local stability highlighted the role of horizontal temperature gradients in modulating atmospheric stability.



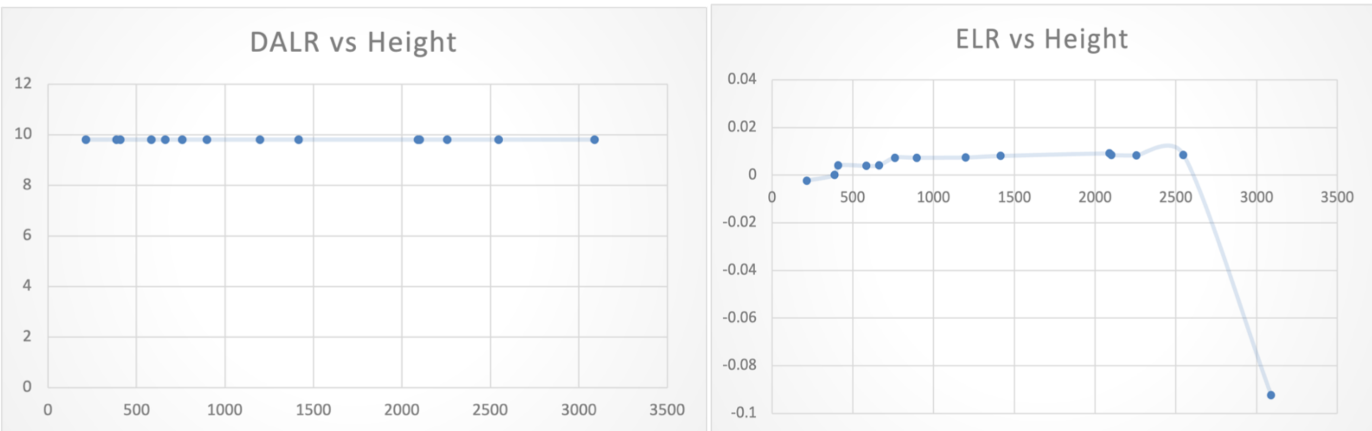
DALR & ELR Plots at 00Z 15 May 2018



DALR & ELR Plots at 12Z 15 May 2018



DALR & ELR Plots at 00Z 5 July 2018



DALR & ELR Plots at 12Z 5 July 2018

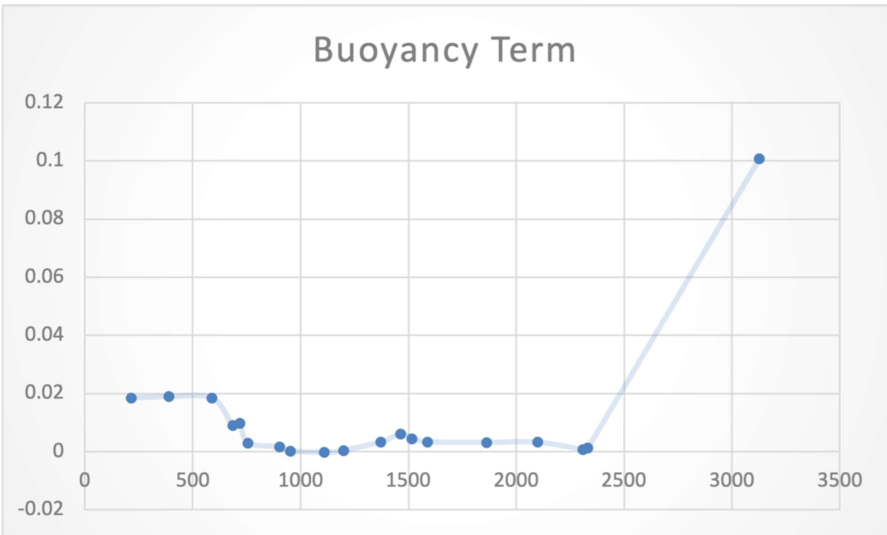
In all cases examined, it was observed that the Environmental Lapse Rate (ELR) consistently remained less than the Dry Adiabatic Lapse Rate (DALR). This comparison indicates that the atmospheric lapse rate favoured stability, as the unsaturated air was prone to being stable throughout the analysed scenarios.

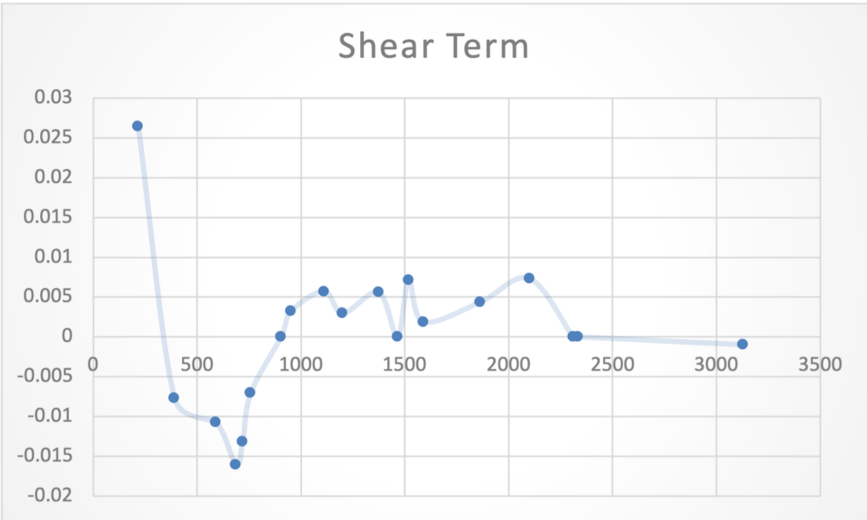
Also DALR>>ELR, this is the case of strongly stable condition.

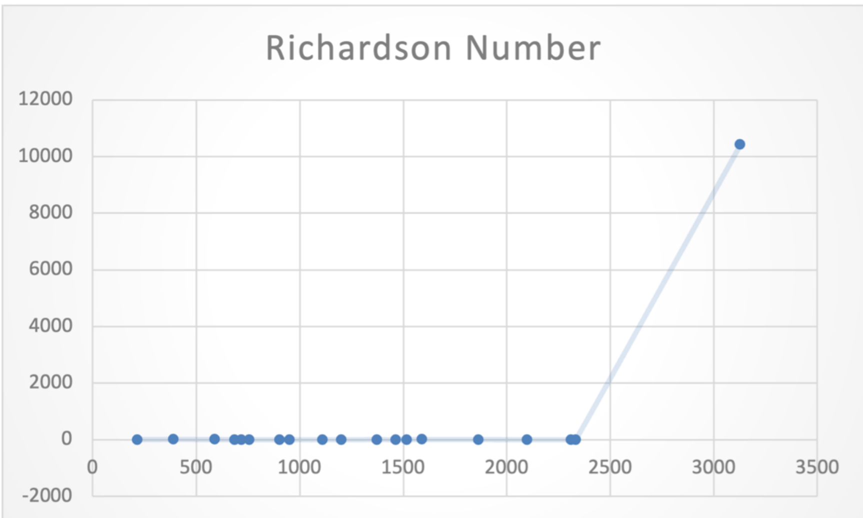
So at all the points in the Thermal Stability vs Altitude plot, the plot will be 1 (Stable) for all the points in the given graphs. Also I have shown the Temperature vs Altitude plots in A i).

1B ii) Assess dynamic stability with altitude on a plot along with related forcing parameters(buoyancy/ shear terms) and Richardson number.

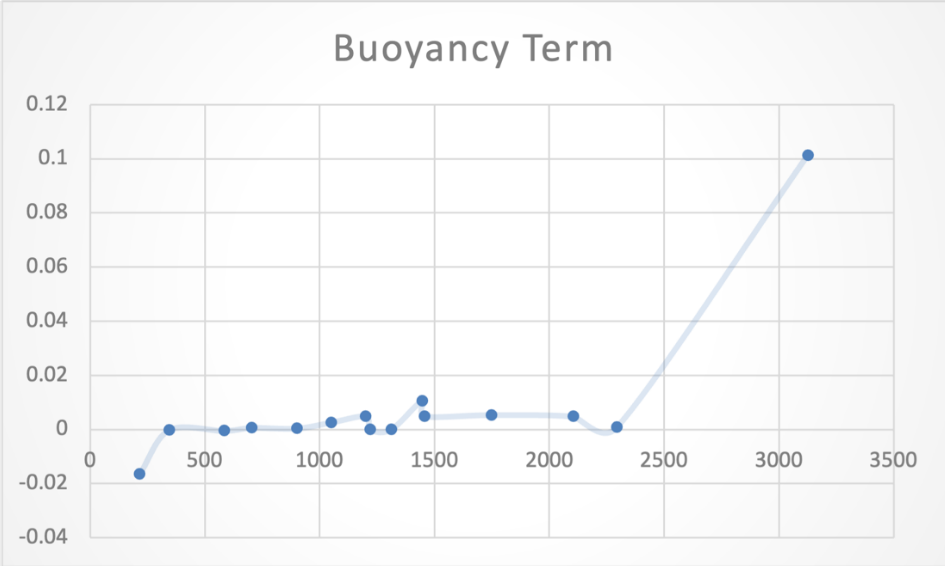
At 00Z 15 May 2018

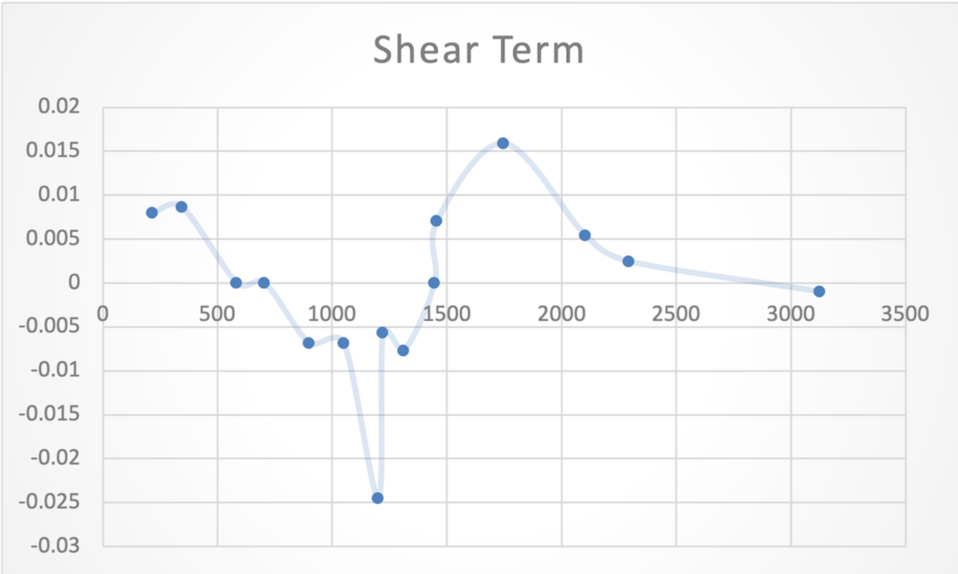


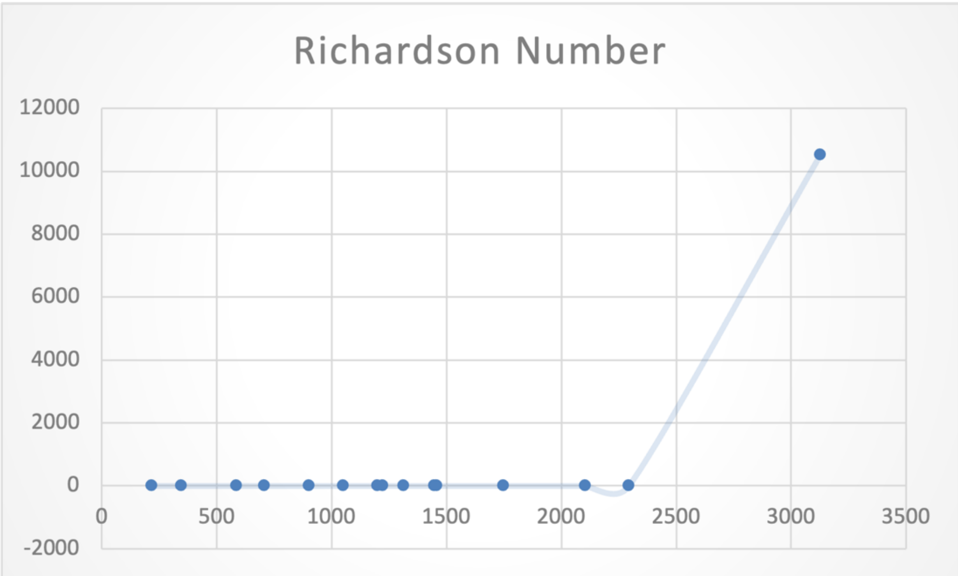




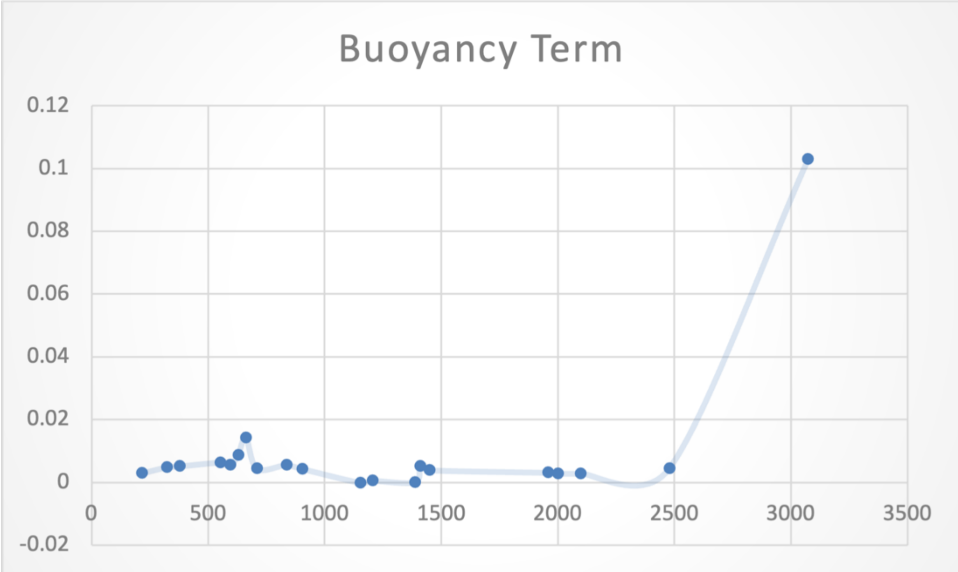
At 12Z 15 May 2018

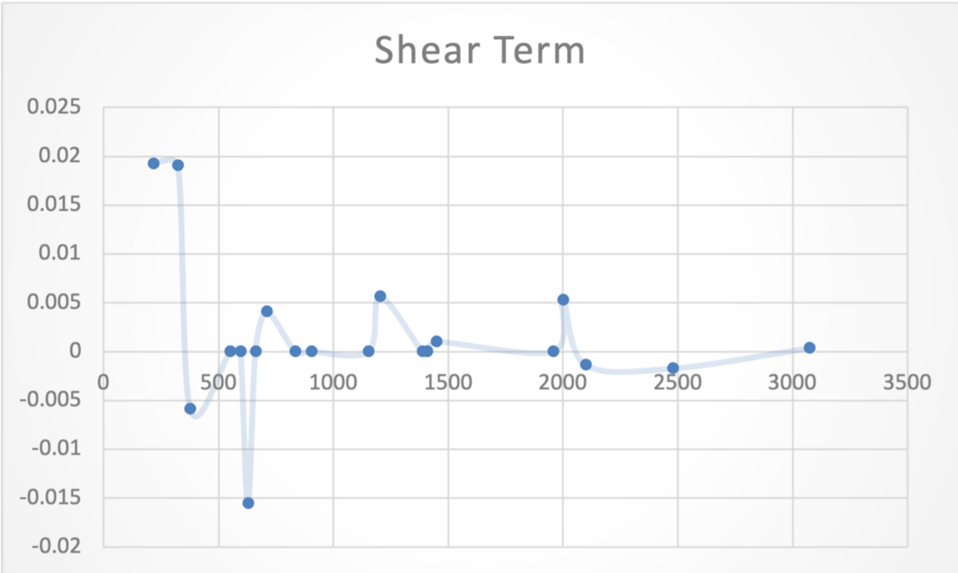


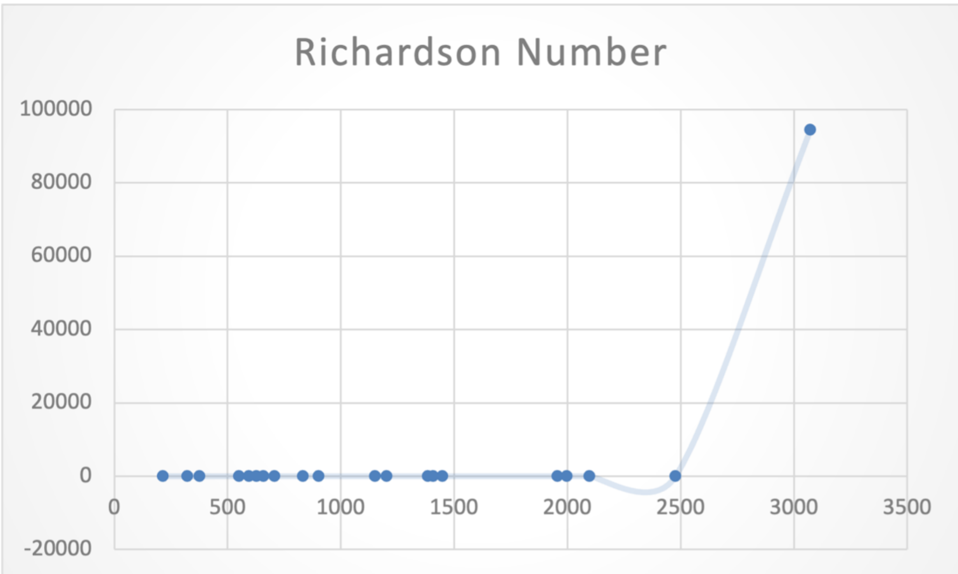




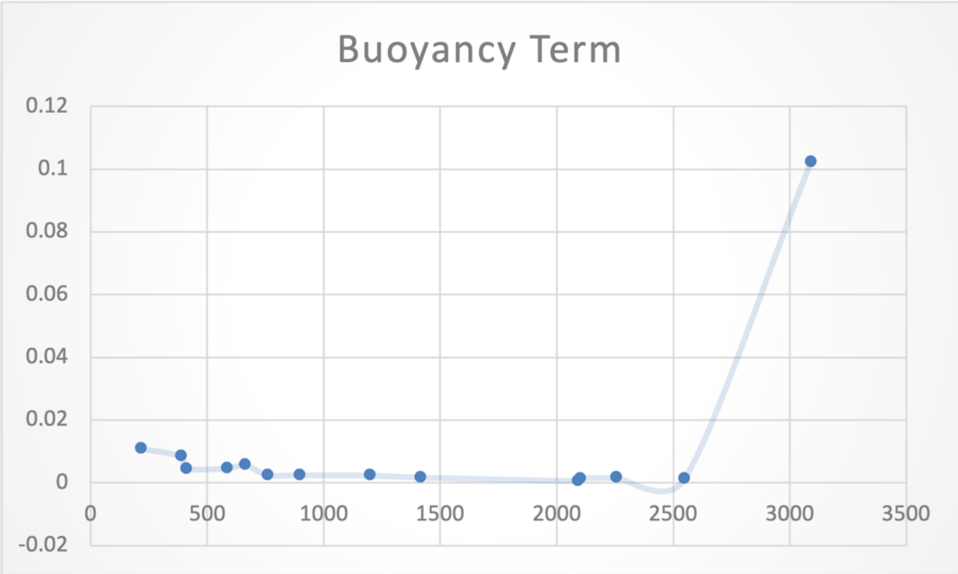
At 00Z 5 July 2018

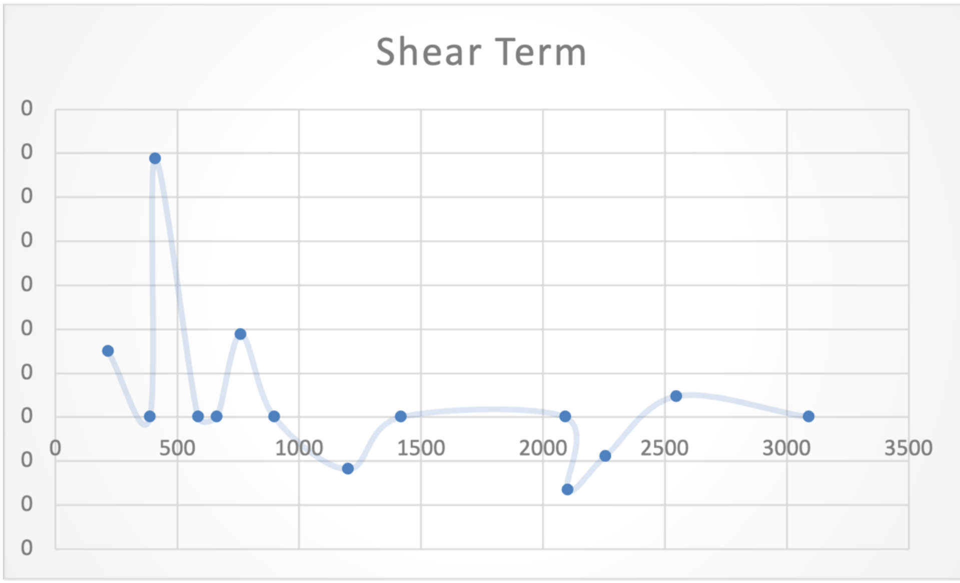


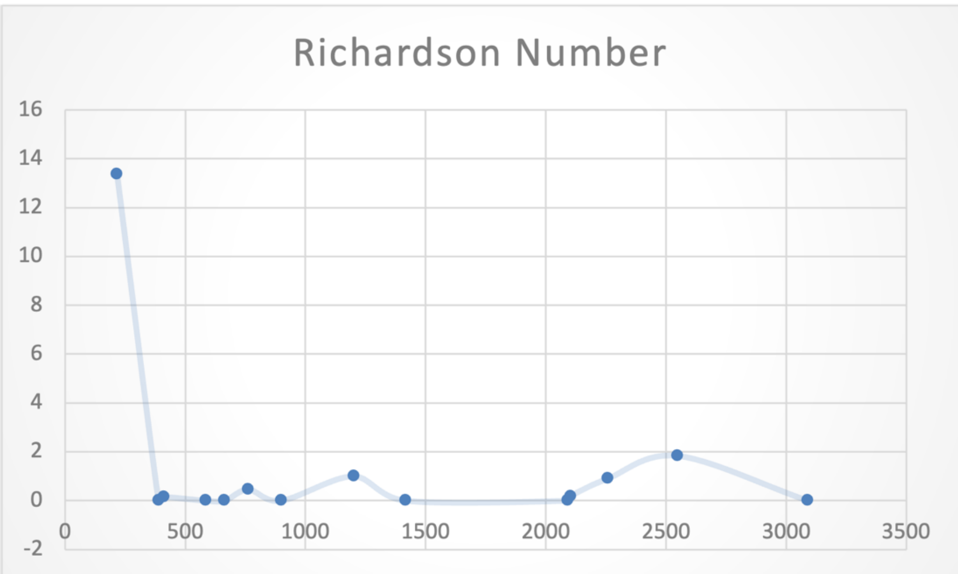




At 12Z 5 July 2018





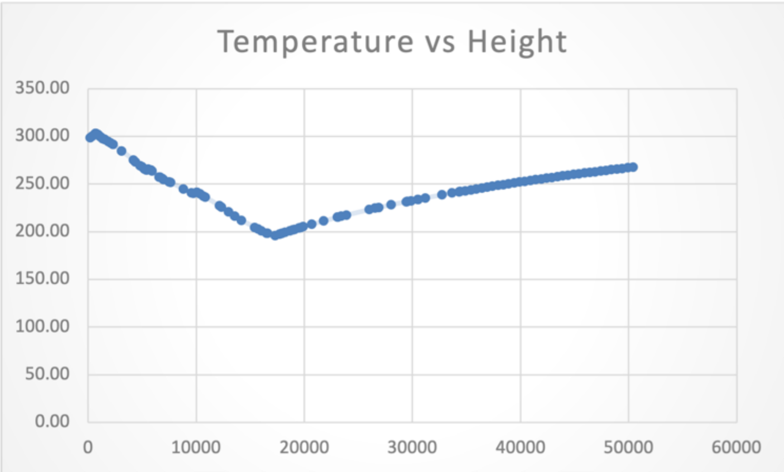


Finally, we can analyze the Richardson number values to assess dynamic stability with altitude.

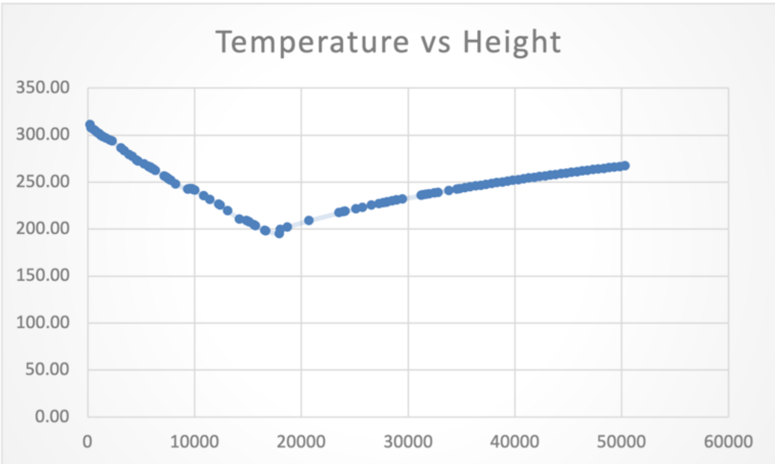
When Ri< Ric, the flow is called dynamically unstable. Otherwise for larger Ri, the flow is dynamically stable. Statically, unstable air results in negative Richardson numbers, which also implies dynamic instability. So Ri>0.25 for dynamically stable condition, we analyze the plots and get the stability results.

1B iii) Plot temperature, potential temperature, non-local and local stability with altitude.

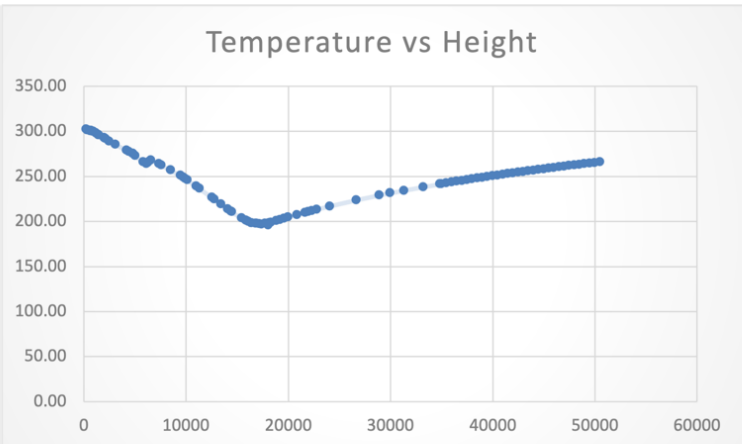
Temperature Plots:



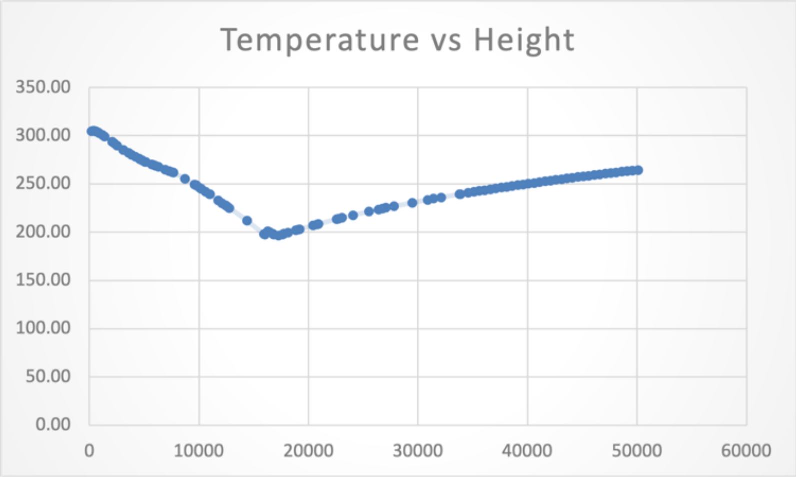
Temperature (K) vs Height (m) at 00Z 15 May 2018



Temperature (K) vs Height (m) at 12Z 15 May 2018

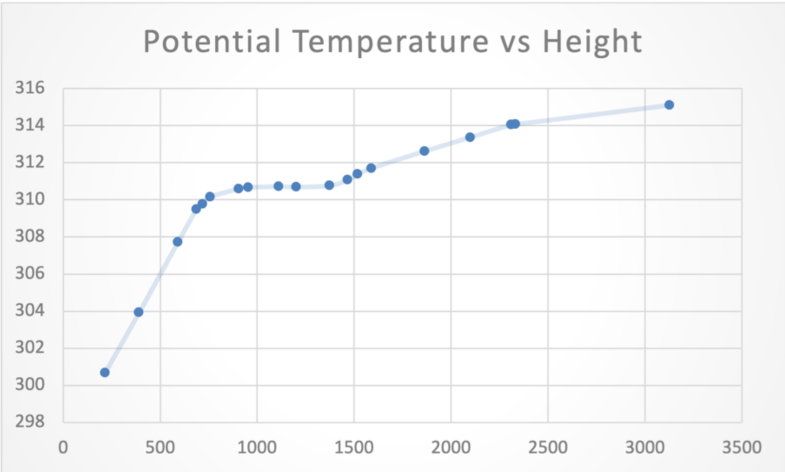


Temperature (K) vs Height (m) at 00Z 5 July 2018

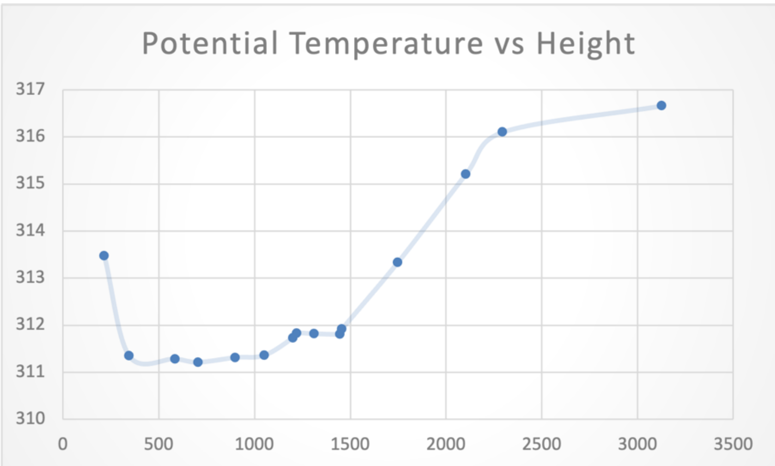


Temperature (K) vs Height (m) at 12Z 5 July 2018

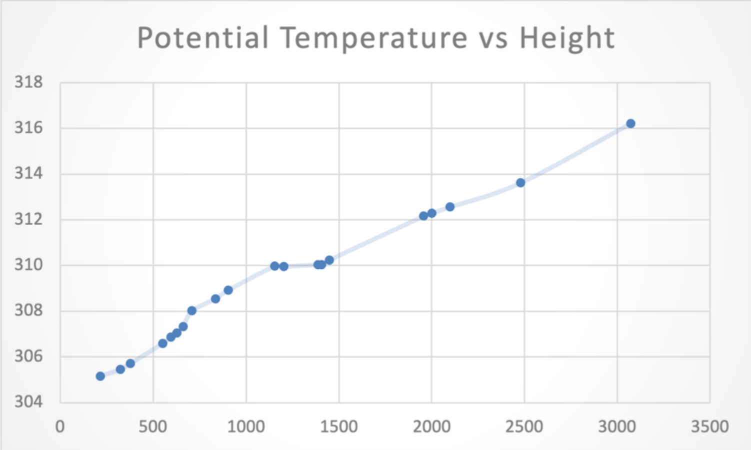
Potential Temperature Plots:



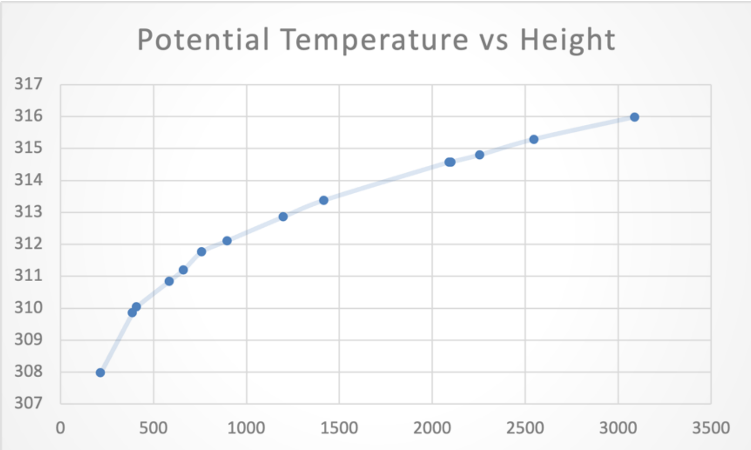
Potential Temperature (K) vs Height (m) at 00Z 15 May 2018



Potential Temperature (K) vs Height (m) at 12Z 15 May 2018



Potential Temperature (K) vs Height (m) at 00Z 5 July 2018



Potential Temperature (K) vs Height (m) at 12Z 5 July 2018

Local Stability and Non Local Stability

Analyze Local Stability: Compare the gradient of the potential temperature profile (change in potential temperature with height) with the ELR. If the potential temperature increases with height at a rate greater than the ELR, the atmosphere is locally stable. If the potential temperature decreases with height at a rate greater than the ELR, the atmosphere is locally unstable. In all the cases, the atmosphere is locally stable.

Analyze Non-local Stability: Consider the overall shape of the potential temperature profile. A decrease in potential temperature with height indicates a stable atmosphere, while an increase in potential temperature with height suggests an unstable atmosphere.

So in case of non local stability, considering the overall shape of all the potential temperature profiles, there is an increase in potential temperature with height, so this suggests an unstable atmosphere.

1B iv) Discuss each plot in terms of (a) thermal, dynamic and local Vs non-local stability & (b) also discuss day/night case for each of the three stability types

Thermal Stability: Thermal stability refers to the stability of the atmosphere due to vertical temperature variations. A thermally stable atmosphere occurs when temperature increases with height (temperature inversion), inhibiting vertical motion and turbulence. Conversely, a thermally unstable atmosphere occurs when temperature decreases with height, promoting vertical motion and turbulence.

Dynamic Stability: Dynamic stability considers the stability of the atmosphere due to the balance between buoyant forces and forces related to vertical wind shear. Dynamic stability is related to the Richardson number, which quantifies the ratio of buoyancy forces to shear forces. A high Richardson number indicates stable conditions, where buoyant forces dominate, while a low Richardson number indicates unstable conditions, where shear forces dominate.

Local vs. Non-local Stability: Local stability refers to the stability of a parcel of air relative to its immediate surroundings, typically assessed by comparing potential temperature gradients. Non-local stability considers larger-scale atmospheric conditions and is assessed based on the overall shape of the potential temperature profile.

Day/Night Cases: During the day, solar heating of the Earth's surface creates convective instability, leading to upward vertical motion and turbulent mixing. This often results in a well-mixed boundary layer and a decrease in thermal stability. At night, radiative cooling of the Earth's surface leads to the formation of a stable boundary layer, with temperature inversions and reduced vertical mixing. Dynamic stability may vary with the diurnal cycle due to changes in wind shear and boundary layer structure.

1C Estimate heights for LCL,LFC and EL and also depict on the plot.

For the subsequent analysis, I plotted temperature, potential temperature, non-local stability, and local stability against altitude. Additionally, I estimated heights for the Lifted Condensation Level (LCL), Level of Free Convection (LFC), and Equilibrium Level (EL) and depicted them on the plot.

At 00Z 15 May 2018:

- LCL is at 891.0875 hPa and 17.7970 degrees C. => Height = 1111m
- LFC is at 647.7339 hPa and 5.7169 degrees C. => Height = 3778m
- EL is at 296.2267 HPa and -32.7144 degrees C. => Height = 9746m

At 12Z 15 May 2018:

- LCL is at 738.5907 hPa and 14.3194 degrees C. => Height = 2714m
- LFC is at 693.3824 hPa and 12.0514 degrees C. => Height = 3012m
- EL is at 206.3575 HPa and -46.6827 degrees C. => Height = 12266m

At 00Z 5 July 2018:

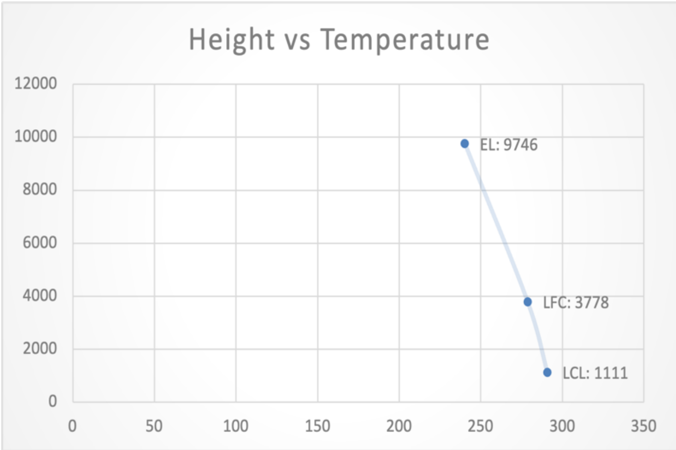
- LCL is at 916.8485 hPa and 24.5252 degrees C. => Height = 709m
- LFC is at 817.4168 hPa and 20.7758 degrees C. => Height = 1785m
- EL is at 117.7442 HPa and -72.0888 degrees C. => Height = 16918m

At 12Z 5 July 2018:

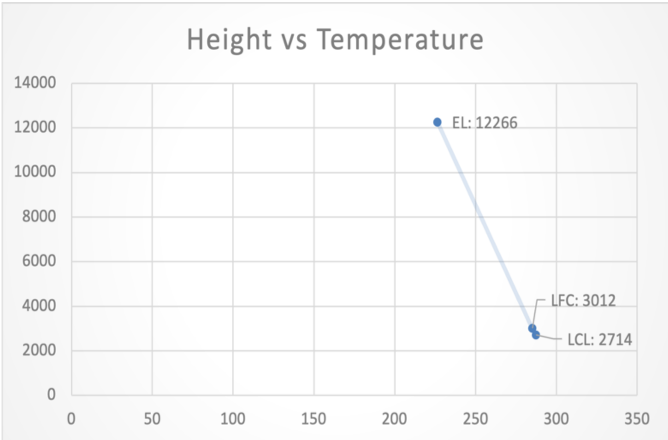
- LCL is at 811.9159 hPa and 17.0296 degrees C. => Height = 1823m
- LFC is at 678.6841 hPa and 10.5773 degrees C. => Height = 3358m
- EL is at 417.2822 HPa and -9.3360 degrees C. => Height = 7303m

Plots:

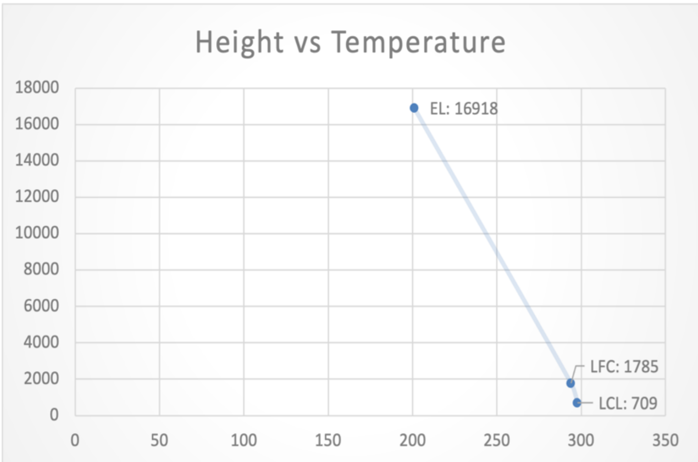
- LCL, LFC, EL at 00Z 15 May 2018 (Height is in m and Temperature is in K)



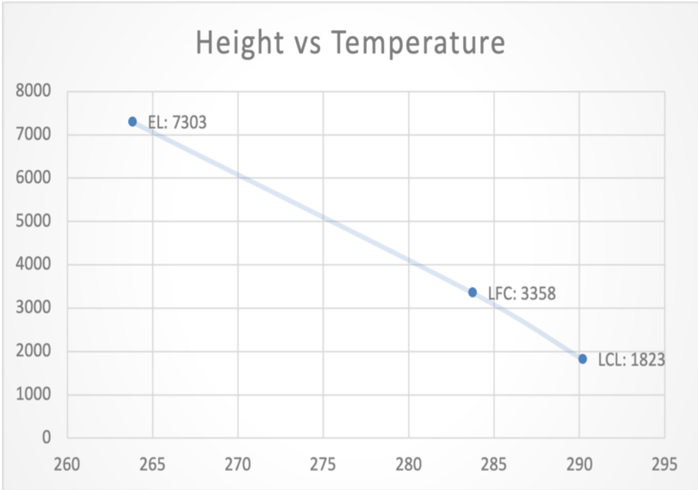
- LCL, LFC, EL at 12Z 15 May 2018 (Height is in m and Temperature is in K)



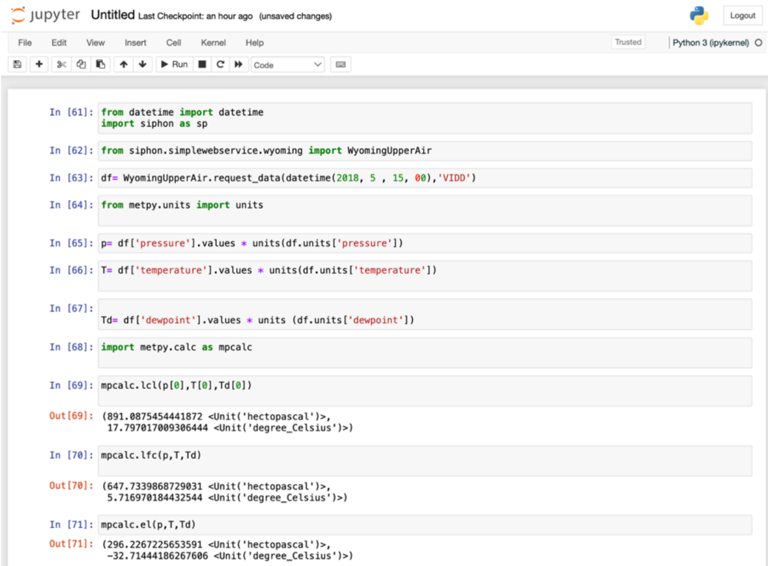
- LCL, LFC, EL at 00Z 5 July 2018 (Height is in m and Temperature is in K)



- LCL, LFC, EL at 12Z 5 July 2018 (Height is in m and Temperature is in K)



After calculating the LCL and LFC using the formulae, the code verifies these values using the provided equations. Finally, the verified altitudes are plotted on the temperature profile plot, and their values are printed out.



```
In [61]: from datetime import datetime
         import siphon as sp

In [62]: from siphon.simplewebservice.wyoming import WyomingUpperAir

In [63]: df= WyomingUpperAir.request_data(datetime(2018, 5 , 15, 00),'VIDD')

In [64]: from metpy.units import units

In [65]: p= df['pressure'].values * units(df.units['pressure'])

In [66]: T= df['temperature'].values * units(df.units['temperature'])

In [67]:
         Td= df['dewpoint'].values * units (df.units['dewpoint'])

In [68]: import metpy.calc as mpcalc

In [69]: mpcalc.lcl(p[0],T[0],Td[0])

Out[69]: (891.0875454441872 <Unit('hectopascal')>,
          17.797017009306444 <Unit('degree_Celsius')>)

In [70]: mpcalc.lfc(p,T,Td)

Out[70]: (647.7339868729031 <Unit('hectopascal')>,
          5.716970184432544 <Unit('degree_Celsius')>)

In [71]: mpcalc.el(p,T,Td)
Out[71]: (296.2267225653591 <Unit('hectopascal')>,
          -32.71444186267606 <Unit('degree_Celsius')>)
```

LCL, LFC, EL at 00Z 15 May 2018

```
In [1]: from datetime import datetime
        import siphon as sp

In [2]: from siphon.simplewebservice.wyoming import WyomingUpperAir

In [3]: df= WyomingUpperAir.request_data(datetime(2018, 5 , 15, 12),'VIDD')

In [5]: from metpy.units import units

In [6]: p= df['pressure'].values * units(df.units['pressure'])

In [7]: T= df['temperature'].values * units(df.units['temperature'])

In [8]:
        Td= df['dewpoint'].values * units (df.units['dewpoint'])

In [9]: import metpy.calc as mpcalc

In [10]: mpcalc.lcl(p[0],T[0],Td[0])

Out[10]: (738.5907074672687 <Unit('hectopascal')>,
          14.319476932154885 <Unit('degree_Celsius')>)

In [12]: mpcalc.lfc(p,T,Td)

Out[12]: (693.3824460375246 <Unit('hectopascal')>,
          12.051411937727515 <Unit('degree_Celsius')>)

In [13]: mpcalc.el(p,T,Td)
Out[13]: (206.3575302077792 <Unit('hectopascal')>,
          -46.68276320130306 <Unit('degree_Celsius')>)
```

LCL, LFC, EL at 12Z 15 May 2018

```
In [34]: from datetime import datetime
         import siphon as sp

In [35]: from siphon.simplewebservice.wyoming import WyomingUpperAir

In [36]: df= WyomingUpperAir.request_data(datetime(2018, 7 , 5, 00),'VIDD')

In [37]: from metpy.units import units

In [38]: p= df['pressure'].values * units(df.units['pressure'])

In [39]: T= df['temperature'].values * units(df.units['temperature'])

In [40]:
         Td= df['dewpoint'].values * units (df.units['dewpoint'])

In [41]: import metpy.calc as mpcalc

In [42]: mpcalc.lcl(p[0],T[0],Td[0])

Out[42]: (916.8485701487782 <Unit('hectopascal')>,
          24.52525705538403 <Unit('degree_Celsius')>)

In [43]: mpcalc.lfc(p,T,Td)

Out[43]: (817.4168904017502 <Unit('hectopascal')>,
          20.77589457938184 <Unit('degree_Celsius')>)

In [44]: mpcalc.el(p,T,Td)
Out[44]: (117.74429274540336 <Unit('hectopascal')>,
          -72.08883321056521 <Unit('degree_Celsius')>)
```

LCL, LFC, EL at 00Z 5 July 2018

```
In [23]: from datetime import datetime
         import siphon as sp

In [24]: from siphon.simplewebservice.wyoming import WyomingUpperAir

In [25]: df= WyomingUpperAir.request_data(datetime(2018, 7 , 5, 12),'VIDD')

In [26]: from metpy.units import units

In [27]: p= df['pressure'].values * units(df.units['pressure'])

In [28]: T= df['temperature'].values * units(df.units['temperature'])

In [29]:
         Td= df['dewpoint'].values * units (df.units['dewpoint'])

In [30]: import metpy.calc as mpcalc

In [31]: mpcalc.lcl(p[0],T[0],Td[0])

Out[31]: (811.9159125187479 <Unit('hectopascal')>,
          17.02961653714283 <Unit('degree_Celsius')>)

In [32]: mpcalc.lfc(p,T,Td)

Out[32]: (678.6841440209489 <Unit('hectopascal')>,
          10.573397155888532 <Unit('degree_Celsius')>)

In [33]: mpcalc.el(p,T,Td)
Out[33]: (417.28228823250487 <Unit('hectopascal')>,
          -9.33601536349365 <Unit('degree_Celsius')>)
```

LCL, LFC, EL at 12Z 5 July 2018

---END OF ASSIGNMENT--