

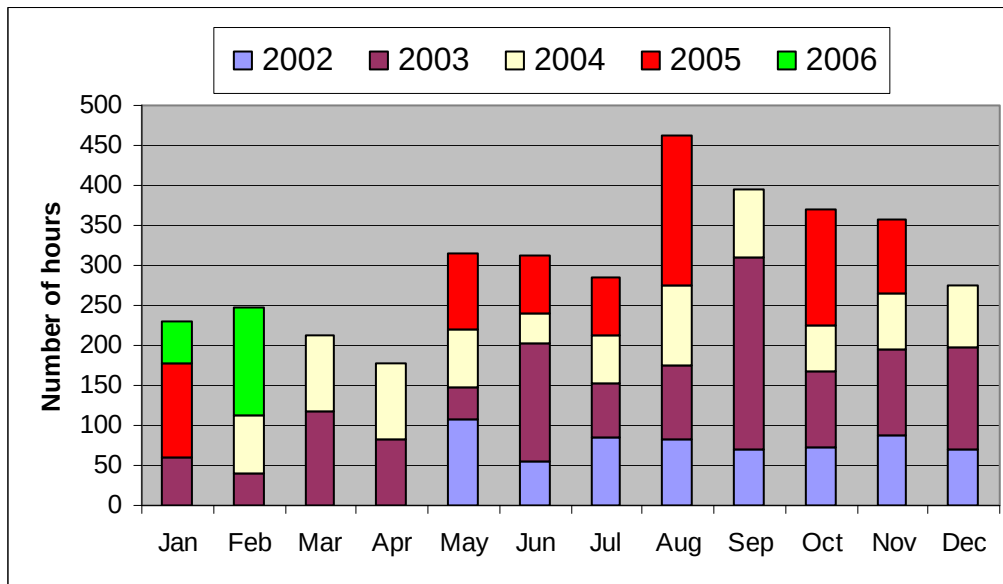


Figure 1. Yuan et. al.

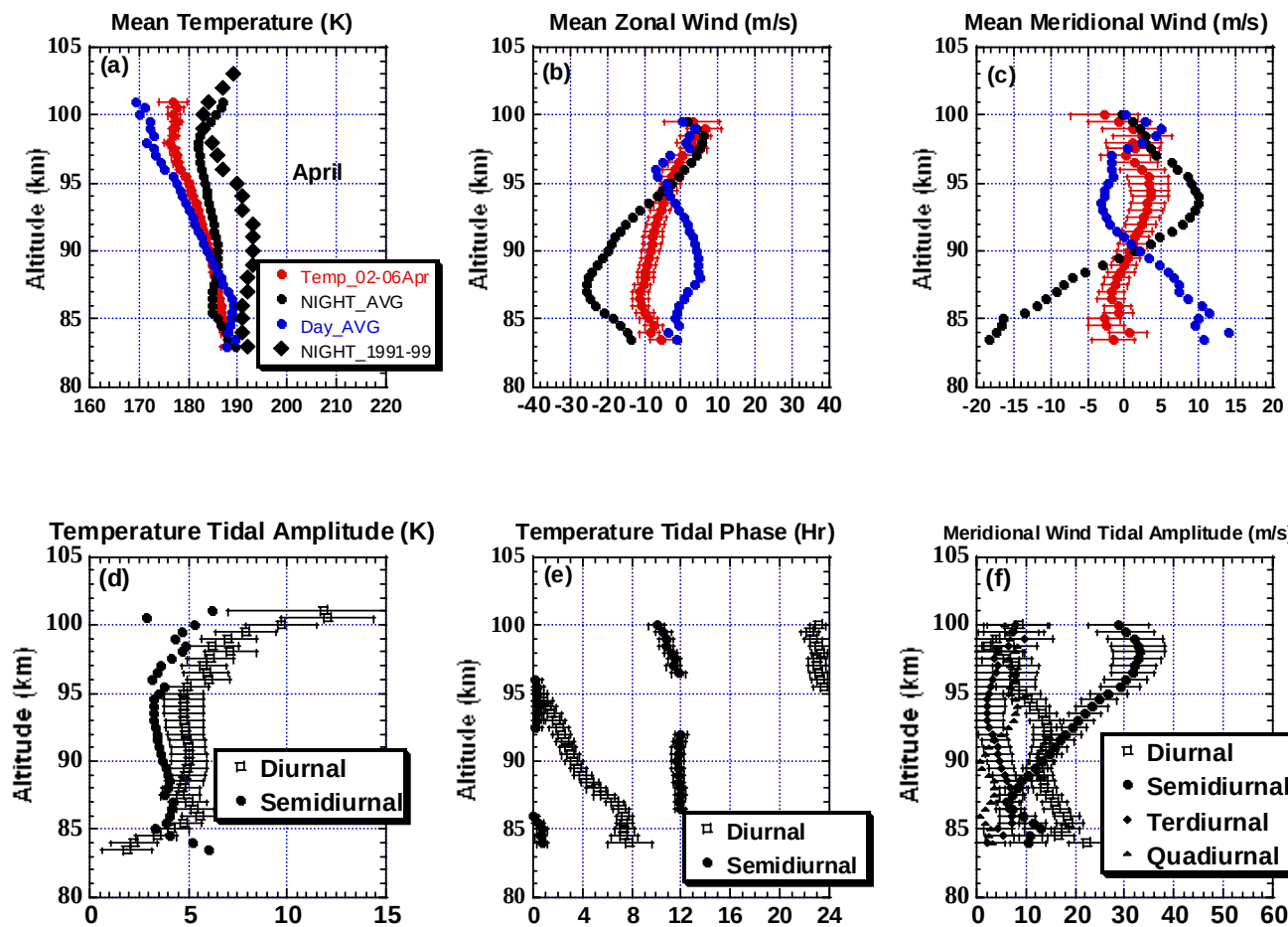


Figure 2 Yuan et. al.

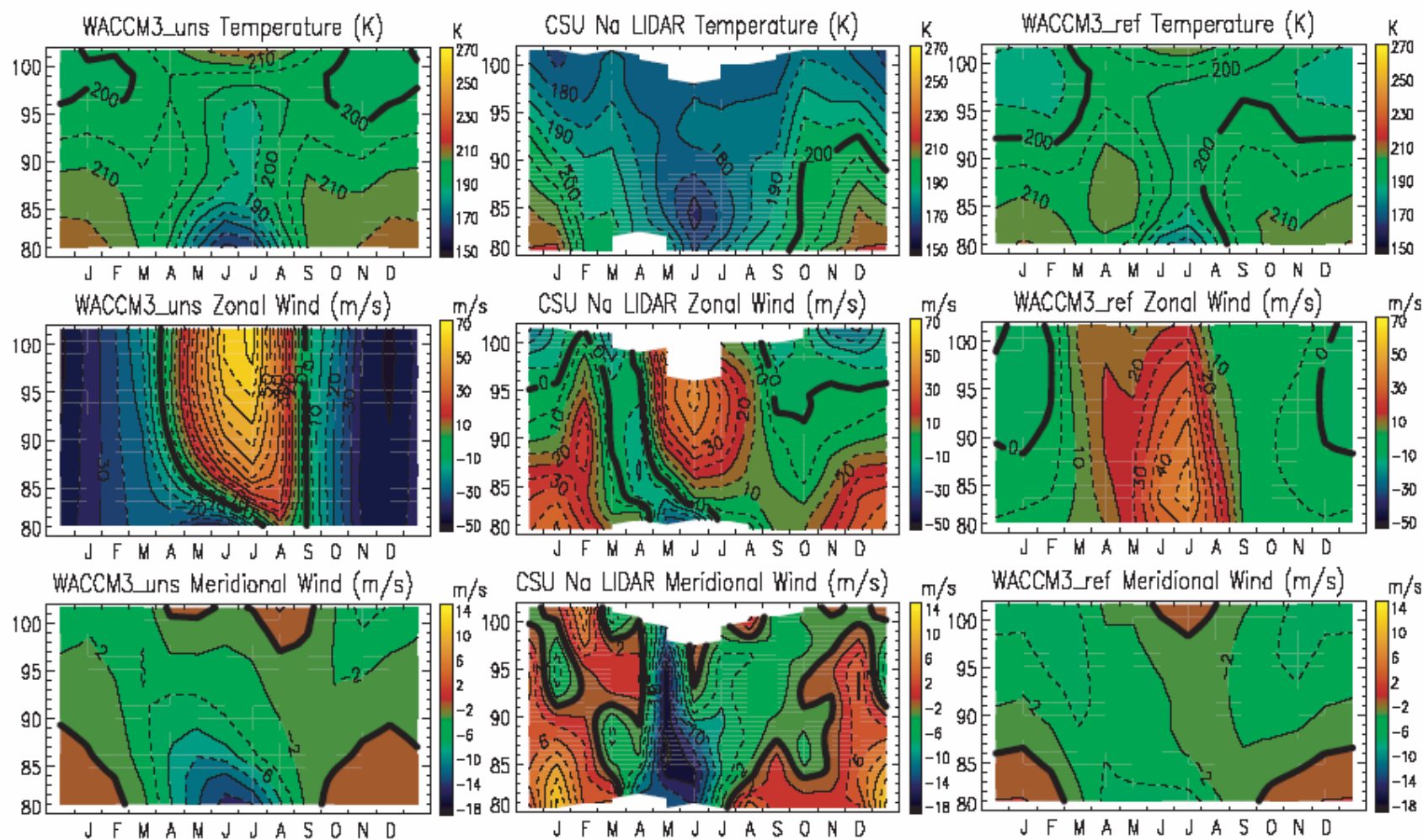


Figure 3. Yuan et. al.

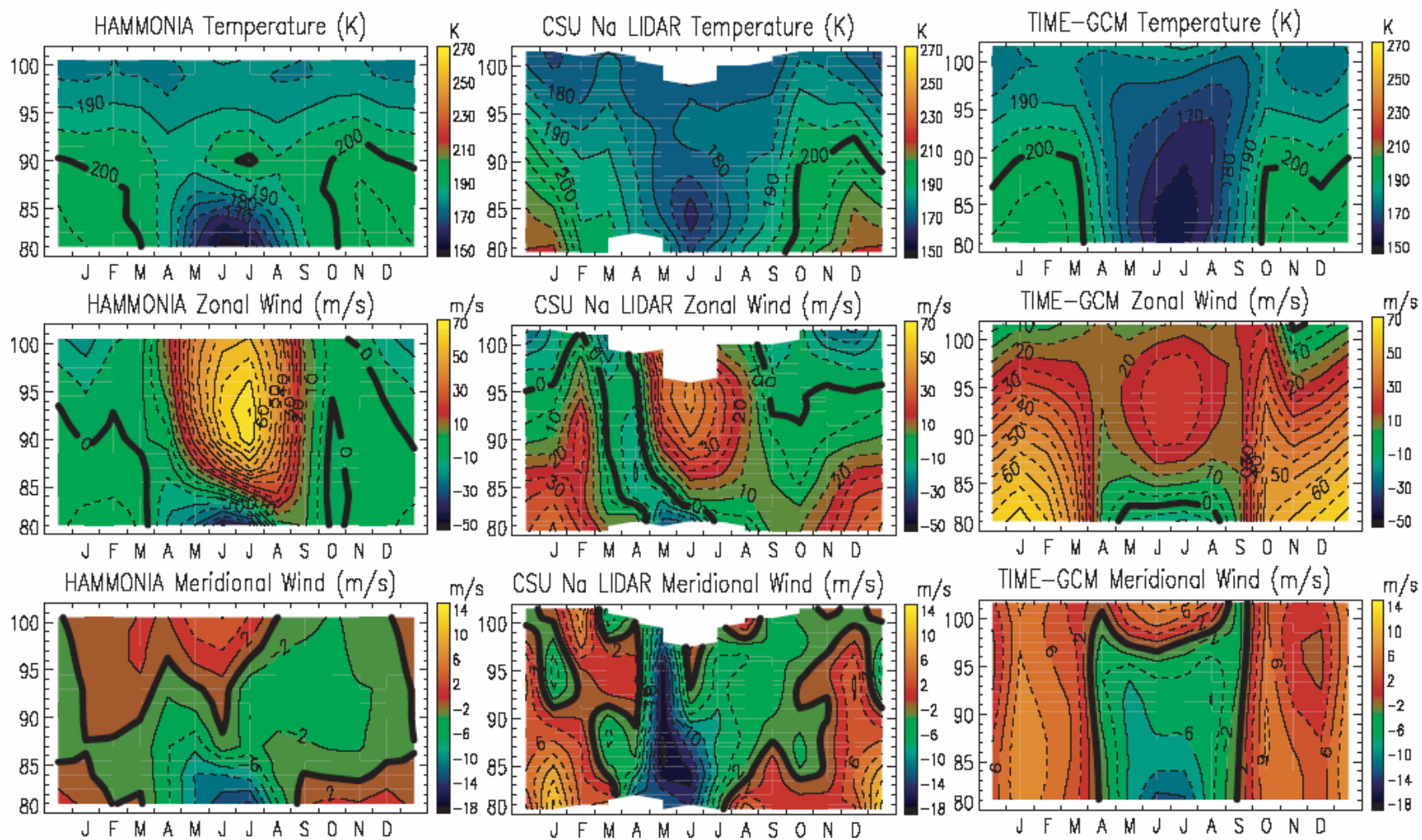


Figure 4. Yuan et. al.

Table 1(a) Monthly diurnal mean temperatures over Fort Collins, CO (41°N, 105°W)

Alt/km	TC1/K	TC2/K	TC3/K	TC4/K	TC5/K	TC6/K	TC7/K	TC8/K	TC9/K	TC10/K	TC11/K	TC12/K
76	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	238.4
77	231.1	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	226.8	232.5
78	229.4	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	220.5	231.3
79	226.7	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	211.1	215.6	228.6
80	223.8	NoValue	196.7	NoValue	189.0	NoValue	184.6	189.7	196.5	206.1	221.9	223.4
81	220.7	199.8	196.2	NoValue	190.4	174.2	183.3	190.9	196.0	203.4	209.5	219.2
82	217.5	197.6	198.1	NoValue	187.1	171.1	178.0	187.8	194.2	201.5	207.9	217.7
83	215.0	196.3	197.3	187.7	182.7	169.4	176.9	185.7	192.7	200.9	207.3	217.0
84	212.8	194.2	196.0	187.4	179.4	167.4	176.6	184.3	191.7	201.2	206.5	216.3
85	210.6	192.6	194.7	187.1	178.4	168.2	176.6	184.2	190.9	201.6	205.5	215.2
86	208.2	192.3	193.9	186.6	177.3	169.6	177.3	184.4	190.0	201.7	204.6	213.6
87	205.3	192.4	193.4	186.1	176.6	171.9	178.4	184.6	189.3	201.9	203.9	211.5
88	202.6	192.0	192.7	185.5	176.5	173.9	179.2	184.7	188.4	201.6	203.2	209.8
89	199.7	191.4	191.7	185.0	176.7	176.1	179.7	184.8	187.2	201.0	202.0	207.9
90	196.8	190.3	190.9	184.4	177.4	178.1	180.2	184.6	186.1	200.1	200.5	205.8
91	194.4	189.1	190.2	183.6	178.2	179.6	180.6	184.4	185.0	199.2	199.1	203.8
92	191.7	187.4	189.4	182.8	179.0	180.8	180.8	183.9	184.0	198.1	197.6	201.3
93	189.1	185.4	188.5	181.9	179.2	181.4	180.7	183.0	183.1	196.8	195.7	198.7
94	186.6	183.4	187.5	181.0	179.1	181.2	180.4	182.1	182.3	195.6	193.6	196.0
95	184.5	181.8	186.5	180.2	178.3	181.0	180.1	181.3	181.6	194.3	191.8	193.4
96	182.2	180.2	185.1	178.3	179.0	179.8	179.7	180.2	180.8	192.7	190.0	190.3
97	179.7	178.5	184.0	177.5	178.4	180.4	179.3	179.3	180.1	191.0	188.6	187.3
98	177.7	177.8	183.0	176.2	178.9	168.1	178.5	178.1	179.0	189.2	187.2	184.9
99	175.9	176.8	182.6	177.1	178.5	NoValue	178.4	176.5	177.4	187.6	185.8	182.4
100	174.3	177.1	181.8	177.9	179.9	NoValue	179.2	174.7	175.8	186.0	184.6	180.2
101	173.2	178.9	181.0	179.0	NoValue	NoValue	NoValue	NoValue	175.1	184.3	183.7	178.4
102	174.3	NoValue	177.9	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	183.1	184.1	177.4
103	176.9	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	182.1	185.3	176.4
104	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	179.0	NoValue	179.1
Ave. Unc.	0.82	0.82	0.85	0.86	0.99	0.81	0.92	0.75	0.63	0.80	0.80	0.91

Table 1(b) Monthly diurnal mean zonal winds over Fort Collins, CO (41°N, 105°W)

Alt/km	U1/(ms ⁻¹)	U2/(ms ⁻¹)	U3/(ms ⁻¹)	U4/(ms ⁻¹)	U5/(ms ⁻¹)	U6/(ms ⁻¹)	U7/(ms ⁻¹)	U8/(ms ⁻¹)	U9/(ms ⁻¹)	U10/(ms ⁻¹)	U11/(ms ⁻¹)	U12/(ms ⁻¹)
76	48.9	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	37.4
77	43.7	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	37.4	41.1
78	43.3	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	20.0	33.6	38.9
79	42.0	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	21.7	30.3	39.0
80	40.8	NoValue	18.9	NoValue	NoValue	NoValue	NoValue	NoValue	5.8	16.7	25.5	36.3
81	40.7	29.2	14.6	NoValue	-22.3	NoValue	NoValue	-2.5	14.8	13.6	22.5	33.1
82	38.8	24.1	10.4	14.2	-20.2	-19.3	3.0	5.6	13.7	13.5	20.8	31.5
83	36.0	23.8	7.0	3.1	-13.3	3.7	8.4	8.2	13.4	10.1	19.1	30.5
84	33.0	21.9	6.2	-8.4	-8.4	12.1	10.8	9.3	12.8	8.0	17.1	29.7
85	29.7	22.5	5.3	-8.8	-3.2	15.7	15.1	11.9	10.6	5.8	14.9	27.6
86	26.1	23.9	4.4	-10.8	4.3	21.2	19.5	13.9	9.7	3.4	13.4	24.1
87	21.5	25.8	2.7	-11.1	9.9	26.3	22.9	14.5	9.3	1.9	12.1	20.3
88	17.5	27.7	0.8	-9.6	15.0	30.2	25.9	15.0	8.6	1.4	10.5	16.6
89	13.5	29.2	-1.0	-9.1	20.7	35.5	29.0	15.7	7.4	1.0	8.0	12.3
90	10.7	29.0	-2.1	-8.2	25.6	39.1	31.5	16.7	5.7	0.9	5.6	8.7
91	9.1	28.6	-2.5	-7.6	29.1	41.9	32.7	17.6	3.6	0.4	3.8	6.3
92	7.1	27.4	-2.4	-6.8	32.5	43.7	33.5	18.5	1.3	-0.2	2.1	4.5
93	5.3	24.4	-2.4	-5.7	34.1	45.6	34.1	19.1	-0.6	-0.4	1.0	3.2
94	3.8	21.3	-2.5	-4.4	36.9	47.6	34.2	19.4	-1.7	-0.2	0.5	1.8
95	2.2	16.9	-3.0	-2.9	36.9	46.7	33.3	19.1	-2.4	-0.0	0.4	0.3
96	-0.5	16.0	-4.5	-1.8	35.8	46.7	30.4	17.8	-3.5	-1.2	0.1	-1.7
97	-3.8	15.5	-6.5	0.2	36.9	NoValue	26.6	15.7	-5.4	-2.2	-1.7	-4.1
98	-6.2	12.8	-9.4	2.6	41.7	NoValue	22.2	11.9	-5.2	-3.0	-3.7	-6.8
99	-8.0	9.5	-13.4	6.4	44.2	NoValue	16.7	9.7	-7.7	-3.6	-6.8	-10.1
100	-7.6	5.1	-16.4	NoValue	52.4	NoValue	13.3	6.8	-11.9	-1.9	-11.9	-15.0
101	-8.3	-2.4	-18.9	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	-2.9	-15.6	-19.6
102	-9.1	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	-2.4	-22.2	-23.0
103	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	-7.0	-30.5	-21.1
104	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	-28.8
Ave. Unc.	2.9	2.7	2.3	3.0	2.7	2.8	2.4	1.9	2.0	2.4	2.1	2.8

Table 1(c) Monthly diurnal meridional winds over Fort Collins, CO (41°N, 105°W)

Alt/km	V1/(ms ⁻¹)	V2/(ms ⁻¹)	V3/(ms ⁻¹)	V4/(ms ⁻¹)	V5/(ms ⁻¹)	V6/(ms ⁻¹)	V7/(ms ⁻¹)	V8/(ms ⁻¹)	V9/(ms ⁻¹)	V10/(ms ⁻¹)	V11/(ms ⁻¹)	V12/(ms ⁻¹)
76	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue
77	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue
78	8.7	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	4.4	4.2
79	11.6	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	4.7	6.3
80	13.4	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	2.0	4.6	2.7
81	14.3	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	10.8	NoValue	2.0	4.9	3.0
82	14.9	NoValue	NoValue	NoValue	-9.2	NoValue	-2.0	6.6	2.4	2.2	3.6	3.2
83	13.3	5.5	6.7	NoValue	-11.4	-12.3	-2.5	3.5	2.9	2.6	2.5	6.3
84	12.6	4.9	1.4	-10.0	-12.7	-14.8	-4.5	-0.2	2.6	1.2	0.9	6.1
85	11.6	4.4	0.1	-5.7	-14.7	-14.9	-6.0	-0.3	3.5	-0.9	0.2	6.3
86	10.2	4.1	-2.2	-2.7	-16.6	-13.7	-6.6	-1.8	3.5	-2.3	0.2	5.9
87	8.5	4.5	-3.0	-1.6	-16.8	-12.2	-4.7	-3.0	2.4	-3.3	0.8	5.2
88	6.8	4.3	-4.0	-1.7	-16.6	-11.7	-5.1	-3.7	0.7	-2.9	1.1	4.8
89	5.6	3.5	-4.9	-1.0	-16.3	-10.5	-5.9	-3.8	-0.6	-2.3	0.9	5.1
90	4.2	2.5	-4.5	-0.1	-15.3	-7.6	-6.4	-3.2	-1.4	-1.7	0.3	5.6
91	2.4	2.0	-2.8	0.7	-15.4	-4.6	-6.5	-2.7	-1.9	-0.9	-0.1	5.7
92	0.4	1.5	-0.7	1.4	-15.6	-2.8	-6.1	-2.1	-2.5	0.0	-0.5	5.6
93	-2.2	0.6	1.4	2.2	-15.6	-1.3	-5.3	-1.9	-3.4	0.7	-0.4	6.1
94	-4.1	0.1	2.8	2.9	-15.2	0.0	-4.8	-2.2	-3.8	0.7	0.6	6.4
95	-5.1	0.8	3.5	3.5	-15.3	0.7	-4.8	-2.9	-3.6	0.0	1.6	6.3
96	-5.3	1.5	3.4	3.2	-16.3	1.3	-5.1	-3.5	-3.3	-0.7	2.1	6.0
97	-4.9	3.1	2.9	2.4	-13.5	2.0	-5.2	-4.2	-2.6	-1.5	0.8	5.0
98	-3.8	5.2	2.0	1.7	-11.9	2.5	-3.4	-5.0	-2.0	-2.8	-0.2	3.6
99	-2.4	7.8	0.7	1.2	-10.9	NoValue	-2.1	-1.7	-2.2	-2.6	-1.1	2.2
100	-1.1	8.0	-2.1	1.0	-8.7	NoValue	-0.1	2.6	-3.0	-2.2	-1.2	0.5
101	-0.4	8.3	-5.8	-2.7	NoValue	NoValue	NoValue	7.0	-4.7	-2.0	-1.0	-0.3
102	1.1	12.4	-5.0	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	-1.3	0.7	-0.8
103	2.0	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	-2.2	1.8	-1.5
104	3.1	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	NoValue	3.1	-5.9
Ave. Unc.	2.4	2.2	2	2.6	2.3	2.3	2.5	1.9	1.9	1.9	2	2.2

Table 2 Observation and Model Comparisons

Instrument	Summer Mesopause (T/K; z/km; Mon)	Winter Mesopause (T/K; z/km; Mon)	Summer Peak zonal wind (u/ms ⁻¹ ; z/km; Mon)	Winter zonal wind reversal Altitude (km; Mon)	Summer peak meridional wind (u/ms ⁻¹ ; z/km; Mon)
Lidar*	167.4; 84; Jun	173.2; 101; Jan	47.6; 94; Jun	95.5; Dec-Jan	-16.8; 87; May and -14.9; 84; Jun
WACCM, uns†	168.6; 81(80); Jun	197.4; 99(97.5); Dec	71.4; 102(100); Jul	62.5(62.5); Dec-Jan	-12.7; 81(80); Jun
WACCM, ref†	169.9; 76(76); Jun	191.9; 99(97.5); Jan	48.3; 83.5(82.5); Jun	88.5(87.5); Dec-Jan	-12.6; 76(76); Jun
HAMMONIA†	157.6; 81; Jun	184.1; 102; Dec	74.8; 93; Jul	93; Dec-Jan	-16.6; 81; Jun
TIME-GCM†	160.7; 83(82); Jul	182.2; 100(98); Dec	29.4; 95(94); Jul	104(102); Dec-Jan	-10.7; 81(80); Jun

*Geometric altitude; †Equivalent geometric altitude; Altitudes within the brackets are geopotential height