



ARM case 9507
Southern Great Plains

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ARM case 9507

Location: Southern Great Plains (center at 36.61N,97.49W)

data source:

layer_9507.dat, surface_9507.dat

from <http://iop.archive.arm.gov/arm-iop/1995/sgp/scm-summer/cederwall-scm/scm-forcing/>

Steps to prepare input data (*.txt) for VVM

1)NCL should be installed prior to excute the following commands

2)compile cal_qs.f90 and read_surface_9507.for together and run

input: surface_9507.dat

outputs: i)9507_sfc_t.dat

ii)ARM_9507_sfc.txt (surface data)

3)compile and run read_layer2_9507.for

input: layer_9507.dat

9507_sfc_t.dat

output: ARM_9507_sndlsf.dat (combined sounding, large-scale forcing and surface data).

It extrapolates the data to 90 mb level from 115 mb and 140 mb.

4) To test effect of vertical resolution on the model, 3 settings with different vertical resolution are set up.

Setting 1:

To compile and run the fortran program interper_arm_1.f90

(Do not change parameter nt,nk3 and zb. because nt,nk3 and zb should be consistent with read_layer2_9507.for)

Parameters nz=40, domain=15000m,dz1=100m and mesh type=1 maybe modified according to VVM resolution.

Input: ARM_9507_sndlsf.dat (see 3)

outputs:

i..ARM_9507_interp_zz1.txt (large -scale forcing data at vorticity levels)

Includes: density (rhoz), pressure (Pz), exponential function (Pi), large-scale forcing of vertical velocity (wls), large-scale forcing of potential temperature (thls), large-scale forcing of water vapor mixing ratio (qvls), map factor of vorticity levels (fnz) and height (zz). After the first two lines (header of the file), there is a time sequence of profile data. In each profile data, first line is time (Julian day), number of observation levels and surface pressure, and next line is surface variables.

ARM9507 Forcing Data for VVM (vorticity-levels)

rhoz(kg/m^3)	Pz(Pa)	piz()	wLS(m/s)	thLS(K/h)	qvLS(g/kg/h)	fnz	zz(m)		
199.2290000	20 97170.4300000								
1.1417513058	97170.43000000000	0.9918284000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	4.0344827586	318.1998901367	
1.1301624776	96074.6529171265	0.9885809128	-0.0503304171	0.0297513141	-0.0411535280	3.5029940120	418.1998901367		
1.1150331277	94834.5667784287	0.9848846210	-0.0944778537	0.0531892205	-0.0747890245	3.0952380952	532.3024542393		
1.0990030468	93459.8854219670	0.9807455797	-0.1418395869	0.0704899513	-0.1108340471	2.7725118483	660.5075824444		

ii. ARM_9507_interp_zt1.txt (sounding data at potential temperature levels)

Include: density (rho), pressure(P), potential temperature (theta), water vapor mixing ratio(qv), exponential function(pi), zonal wind(u), meridional wind(v), map factor of theta levels (fnt) and height (zt). After the first two lines (header of the file), there is a time sequence of profile data. In each profile data, first line is time (Julian day), number of observation levels and surface pressure, and next line is surface variables.

```
ARM9507 Sounding Data for VVM (theta-levels)
rho(kg/m^3)  P(Pa)      theta(K)    qv(g/g)     pi()        u(m/s)      v(m/s)      fnt         zt(m)
199.2290000  20 97170.4300000
1.1417513058 97170.4300000000 298.9814000000 0.0149096107 0.9918284000 -1.3888380000 -0.0583140000 4.0344827586 318.1998901367
1.1370376949 96637.2200839796 299.0469811451 0.0148438210 0.9902577418 -1.2739746297 -0.1478785137 3.7500000000 366.4370696239
1.1228189792 95473.7684819429 300.2394388636 0.0144572294 0.9867898725 -2.0670995599 0.0906938705 3.2865168539 473.4883516752
1.1067805494 94157.0478065840 301.5889868204 0.0140197095 0.9828651582 -2.9647080139 0.3606949519 2.9250000000 594.6421978290
```

iii. ARM_9507_basic_state_zz1.txt (basic state variables at vorticity levels)
time averaged profile data during the period of ARM 199507 IOP.
include: level number, density (rhoz), pressure (pz), temperature (tz), potential temperature (thetaz) and height (zz)

iv. ARM_9507_basic_state_zt1.txt (basic state in theta levels)
time averaged profile data during the period of ARM 199507 IOP.
include: level number, density (rho), pressure (p), exponential function (pi), temperature(t), potential temperature (theta), water vapor mixing ratio (qv) and height (zt).

Setting 2:

To compile and run the fortran program `interper_arm_2.f90`
(Do not change parameter `nt,nk3` and `zb`. because `nt,nk3` and `zb` should be consistent with `read_layer2_9507.for`.)

Parameters `nz=40`, `domain=15000m`, `dz1=60m` and `mesh type=1` maybe modified according to VVM resolution.

Input: ARM_9507_sndlsf.dat (see 4)ii)

outputs:

i..ARM_9507_interp_zz2.txt (large -scale forcing data at vorticity levels)

Includes: density (rhoz), pressure (Pz), exponential function (Pi), large-scale forcing of vertical velocity (wls), large-scale forcing of potential temperature (thls), large-scale forcing of water vapor mixing ratio (qvls), map factor of vorticity levels (fnz) and height (zz). After the first two lines (header of the file), there is a time sequence of profile data. In each profile data, first line is time (Julian day), number of observation levels and surface pressure, and next line is surface variables.

```
ARM9507 Forcing Data for VVM (vorticity-levels)
rhoz(kg/m^3)  Pz(Pa)      piz()      wLS(m/s)    thLS(K/h)   qvLS(g/kg/h)  fnz         zz(m)
199.2290000  20 97170.4300000
1.1417513058 97170.4300000000 0.9918284000 0.0000000000 0.0000000000 0.0000000000 7.2222222222 318.1998901367
1.1348368441 96512.7431132084 0.9898797097 -0.0348540124 0.0215348795 -0.0293622079 5.5084745763 378.1998901367
1.1253606172 95681.7267473368 0.9874097282 -0.0643187060 0.0371777069 -0.0518110673 4.4520547945 454.3537362906
1.1131303713 94678.5109946824 0.9844194697 -0.1000334861 0.0561387099 -0.0790218060 3.7356321839 546.6614285983
```

ii. ARM_9507_interp_zt2.txt (sounding data at potential temperature levels)

Include: density (rho), pressure(P), potential temperature (theta), water vapor mixing ratio(qv), exponential function(pi), zonal wind(u), meridional wind(v), map factor of theta levels (fnt) and height (zt). After the first two lines (header of the file), there is a time sequence of profile data. In each profile data, first line is time (Julian day), number of observation levels and surface pressure, and next line is surface variables

ARM9507 Sounding Data for VVM (theta-levels)

rho(kg/m^3)	P(Pa)	theta(K)	qv(g/g)	pi()	u(m/s)	v(m/s)	fnt	zt(m)
199.2290000	20	97170.43000000						
1.1417513058	97170.43000000000	298.9814000000	0.0149096107	0.9918284000	-1.3888380000	-0.0583140000	7.222222222	318.1998901367
1.1385276399	96863.7202499097	299.1556678879	0.0148401428	0.9909196358	-1.4585820953	-0.0533599095	6.250000000	346.1806593675
1.1306805424	96117.4985898961	299.5796598624	0.0146711279	0.9887086218	-1.6282687602	-0.0413066582	4.924242424	414.2575824444
1.1195048721	95202.0642155990	300.5179170134	0.0143669475	0.9859800109	-2.2523203520	0.1464083793	4.062500000	498.4883516752

iii. ARM_9507_basic_state_zz2.txt (basic state variables at vorticity levels) time averaged profile data during the period of ARM 199507IOP.

include: level number, density (rhoz), pressure (pz), temperature (tz), potential temperature (thetaz) and height (zz)

iv. ARM_9507_basic_state_zt2.txt (basic state in theta levels) time averaged profile data during the period of ARM 199507 IOP.

include: level number, density (rho), pressure (p), exponential function (pi), temperature(t), potential temperature (theta), water vapor mixing ratio (qv) and height (zt).

Setting 3:

To compile and run the fortran program interper_arm_3.f90

(Do not change parameter nt,nk3 and zb. because nt,nk3 and zb should be consistent with read_layer2_9507.for)

Parameters nz=40, domain=24000m,dz1=100m and mesh type=1 maybe modified according to VVM resolution.

Here the vertical level calculated according to above parameter, then the levels above 15000m are cut, so the data's nz=31.

Input: ARM_9507_sndlsf.dat (see 4)ii)

outputs:

i..ARM_9507_interp_zz3.txt (large -scale forcing data at vorticity levels)

Includes: density (rhoz), pressure (Pz), exponential function (Pi), large-scale forcing of vertical velocity (wls), large-scale forcing of potential temperature (thls), large-scale forcing of water vapor mixing ratio (qvl), map factor of vorticity levels (fnz) and height (zz). After the first two lines (header of the file), there is a time sequence of profile data. In each profile data, first line is time (Julian day), number of observation levels and surface pressure, and next line is surface variables.

ARM9507 Forcing Data for VVM (vorticity-levels)

rhoz(kg/m^3)	Pz(Pa)	piz()	wLS(m/s)	thLS(K/h)	qvLS(g/kg/h)	fnz	zz(m)
199.2290000	20	97170.43000000					
1.1417513058	97170.43000000000	0.9918284000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	6.8823528290
1.1301630841	96074.6529171265	0.9885809128	-0.0503304171	0.0297513141	-0.0411535280	5.3181819916	418.1998901367
1.1135616087	94710.2519906769	0.9845116587	-0.0989422115	0.0555593514	-0.0781903746	4.3333334923	543.8409423828
1.0948575745	93092.3139757472	0.9796307498	-0.1537231167	0.0715181648	-0.1198614552	3.6562500000	695.1229858398

ii. ARM_9507_interp_zt3.txt (sounding data at potential temperature levels)

Include: density (rho), pressure(P), potential temperature (theta), water vapor mixing ratio(qv), exponential function(pi), zonal wind(u), meridional wind(v), map factor of theta levels (fnt) and height (zt). After the first two lines (header of the

file), there is a time sequence of profile data. In each profile data, first line is time (Julian day), number of observation levels and surface pressure, and next line is surface variables

ARM9507 Sounding Data for VVM (theta-levels)

rho(kg/m ³)	P(Pa)	theta(K)	qv(g/g)	pi()	u(m/s)	v(m/s)	fnt	zt(m)
199.2290000	20 97170.4300000							
1.1417513058	97170.4300000000	298.9814000000	0.0149096107	0.9918284000	-1.3888380000	-0.0583140000	6.8823529412	318.1998901367
1.1372295728	96652.8953301148	299.0309150980	0.0148490295	0.9903044646	-1.2632888147	-0.1510928122	6.0000000000	364.9947619316
1.1222452112	95426.7427435372	300.2876370049	0.0144416036	0.9866497042	-2.0991570047	0.1003367662	4.7755102041	477.8152747521
1.1040349453	93924.1996342517	301.8060028545	0.0139416442	0.9821660378	-3.0942683459	0.3982307677	3.9661016949	616.2768132136

iii. ARM_9705_basic_state_zz3.txt (basic state variables at vorticity levels)

time averaged profile data during the period of ARM 199507IOP.

include: level number, density (rhoz), pressure (pz), temperature (tz),

potential temperature (thetaz) and height (zz) iv.

ARM_9705_basic_state_zt3.txt (basic state in theta levels)

time averaged profile data during the period of ARM 199706 IOP.

include: level number, density (rho), pressure (p), exponential function (pi), temperature(t), potential temperature (theta), water vapor mixing ratio (qv) and height (zt).

Figures of observation to evaluate models results

1)time series : from fig 1 to fig 8., sample program: time_plot.ncl

data source:

9507_sfc_t.dat (see 2)i

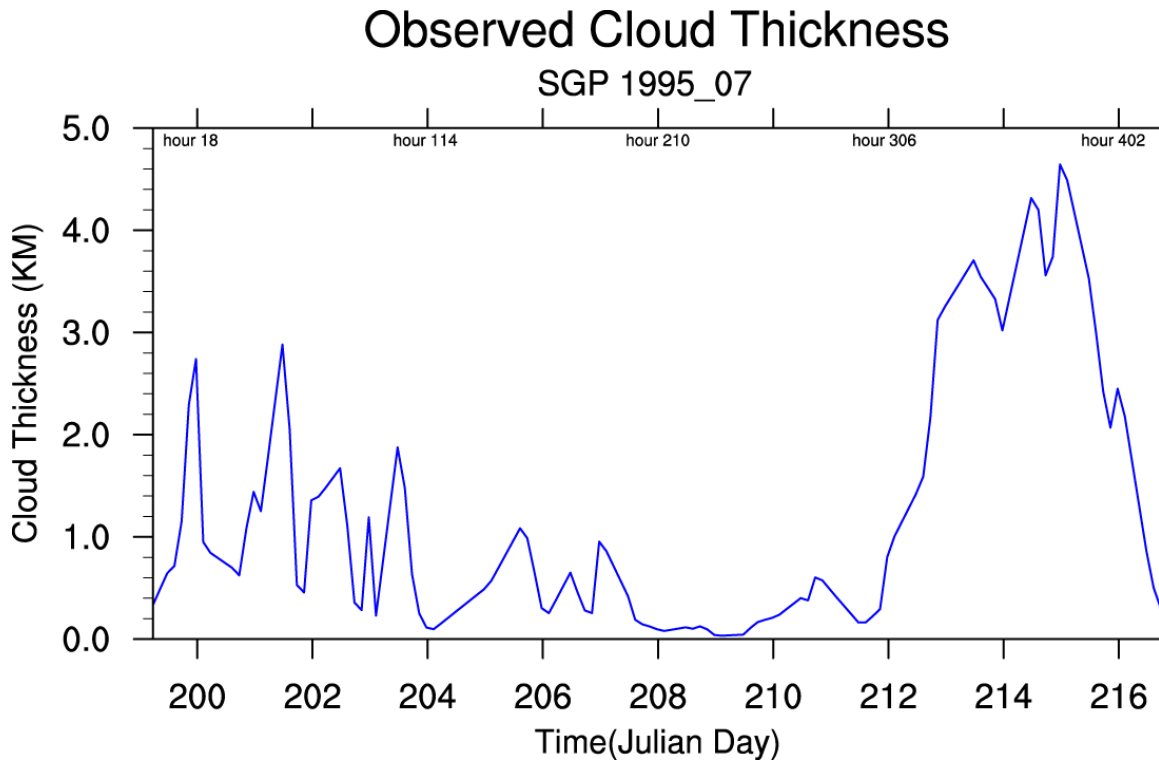


Fig 1. Time series of observed cloud thickness during the July and August 1995 IOP.

Observed Cloud Top Height SGP 1995_07

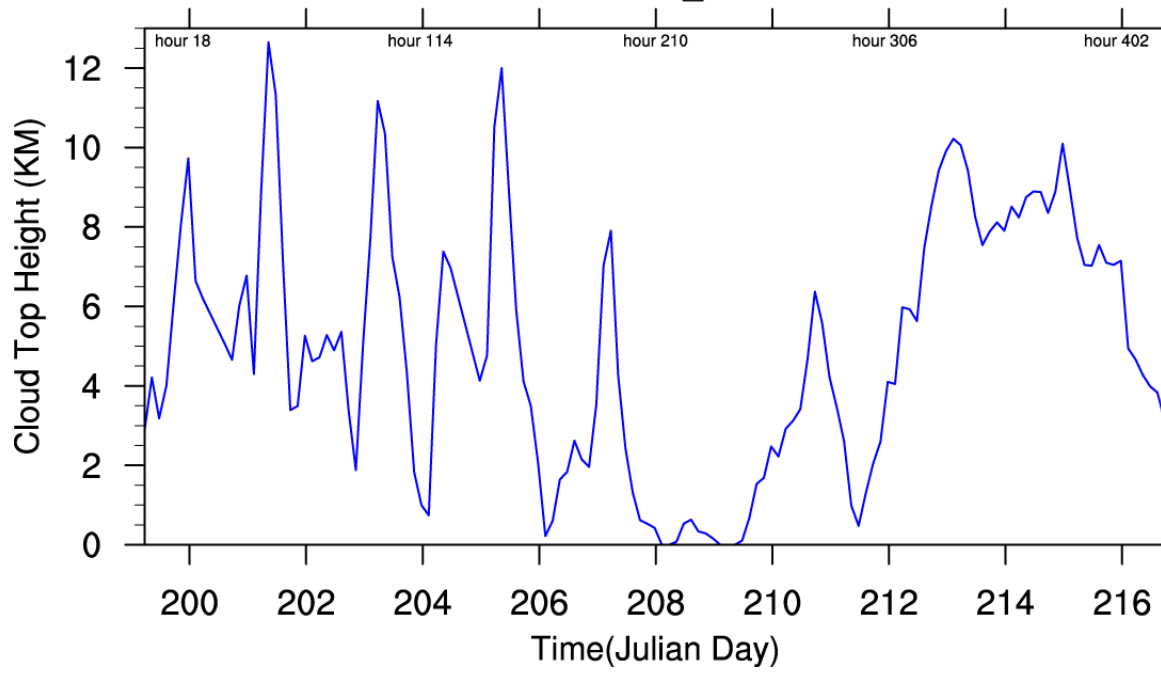


Fig 2. Time series of observed Cloud top height during the July and August 1995 IOP.

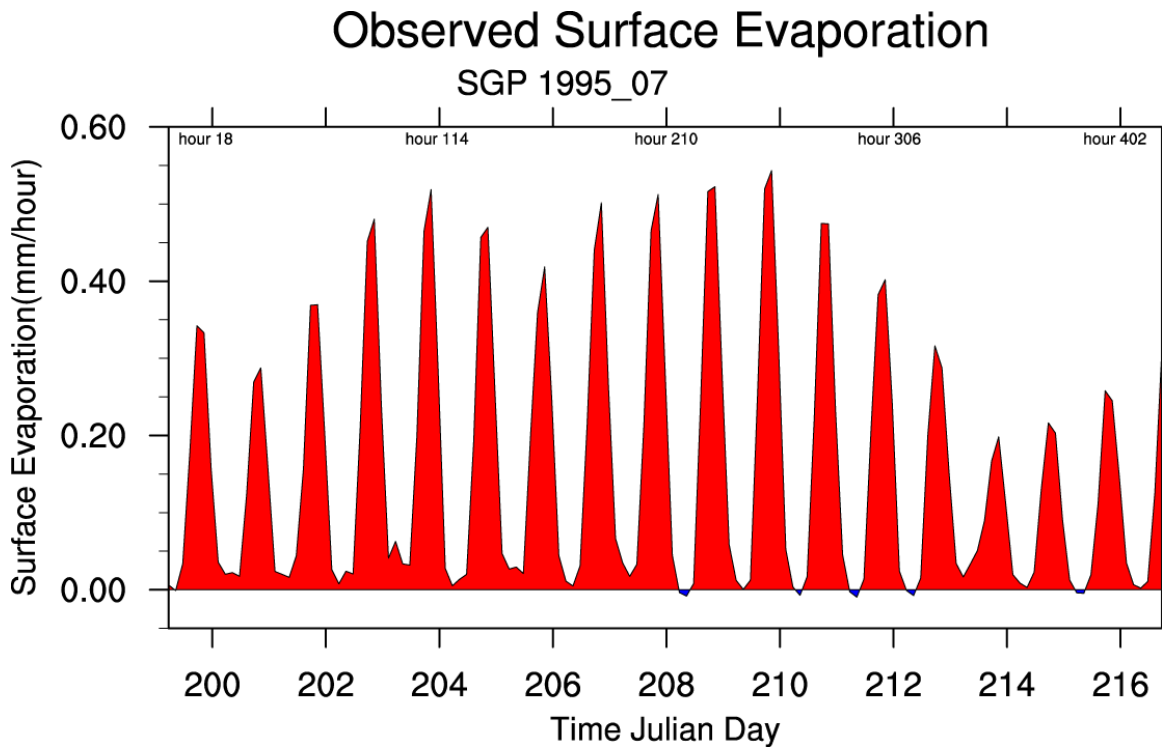


Fig 3. Time series of observed Surface evaporation rate during the July and August 1995 IOP.

Observed Surface Sensible Heat Flux

SGP 1995_07

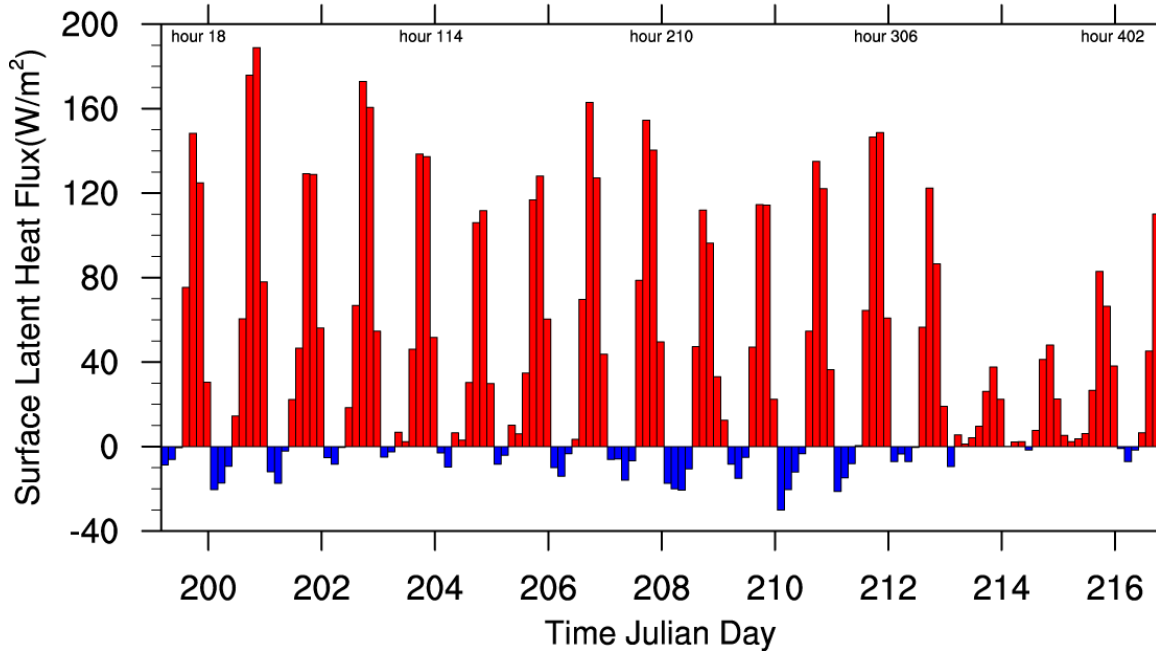


Fig 4. Time series of Surface sensible heat flux during the July and August 1995 IOP.

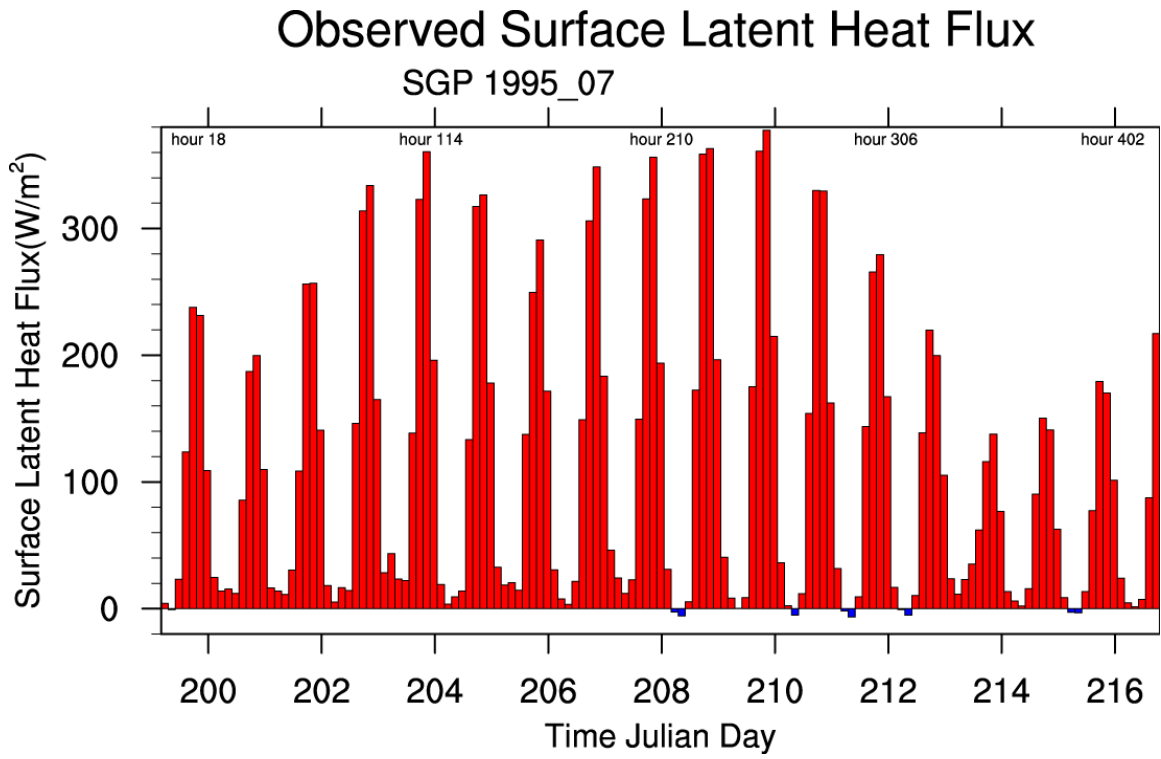


Fig 5. Time series of observed Surface latent heat during the July and August 1995 IOP.

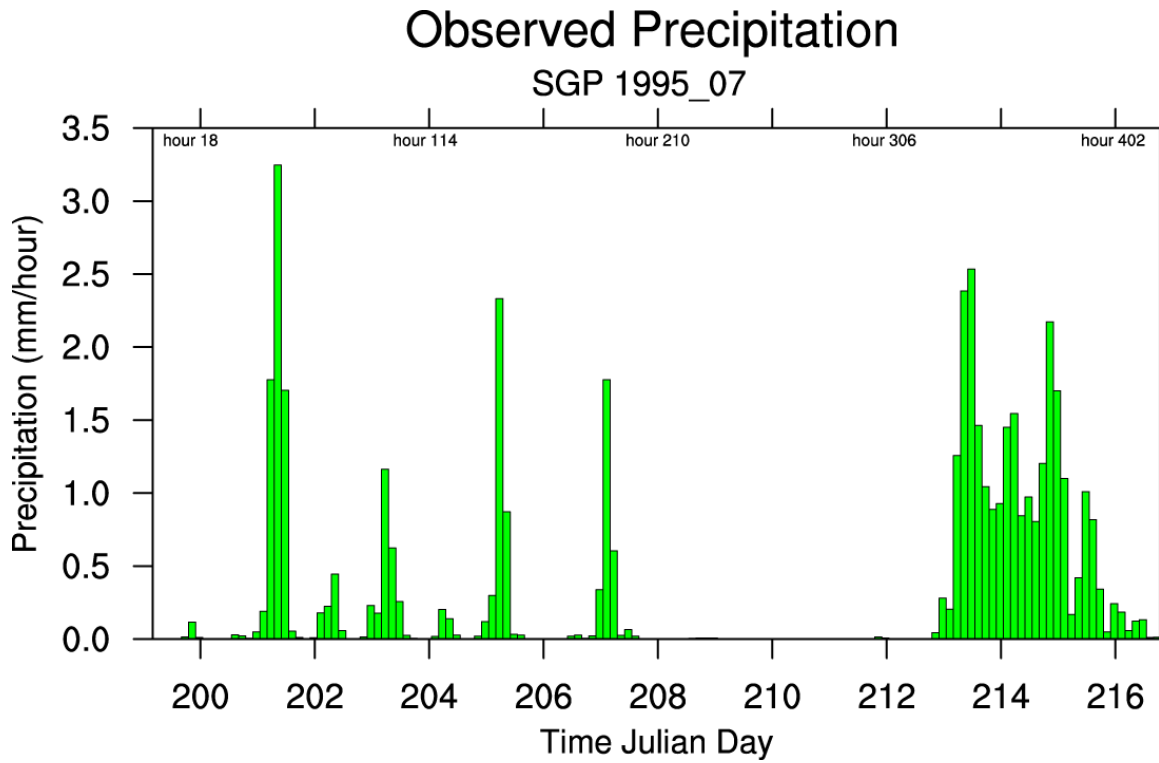


Fig 6. Time series of observed surface precipitation rate during the July and August 1995 IOP.

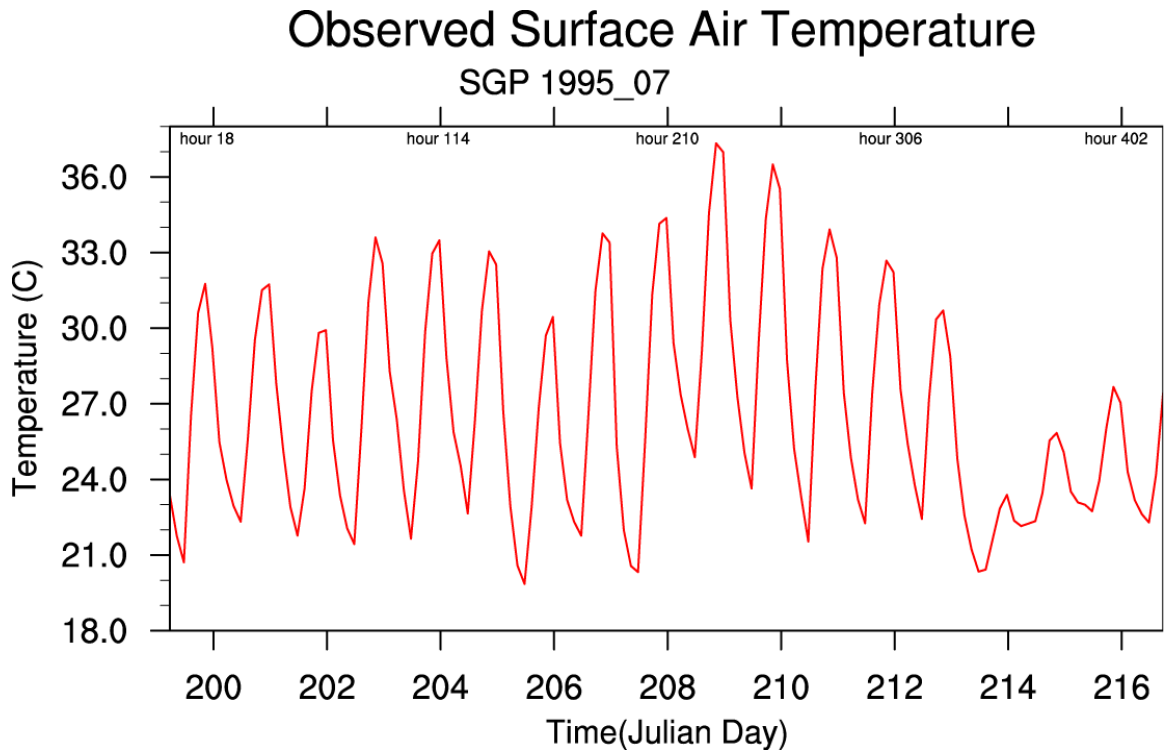


Fig 7. Time series of observed surface air temperature during the July and August 1995 IOP.

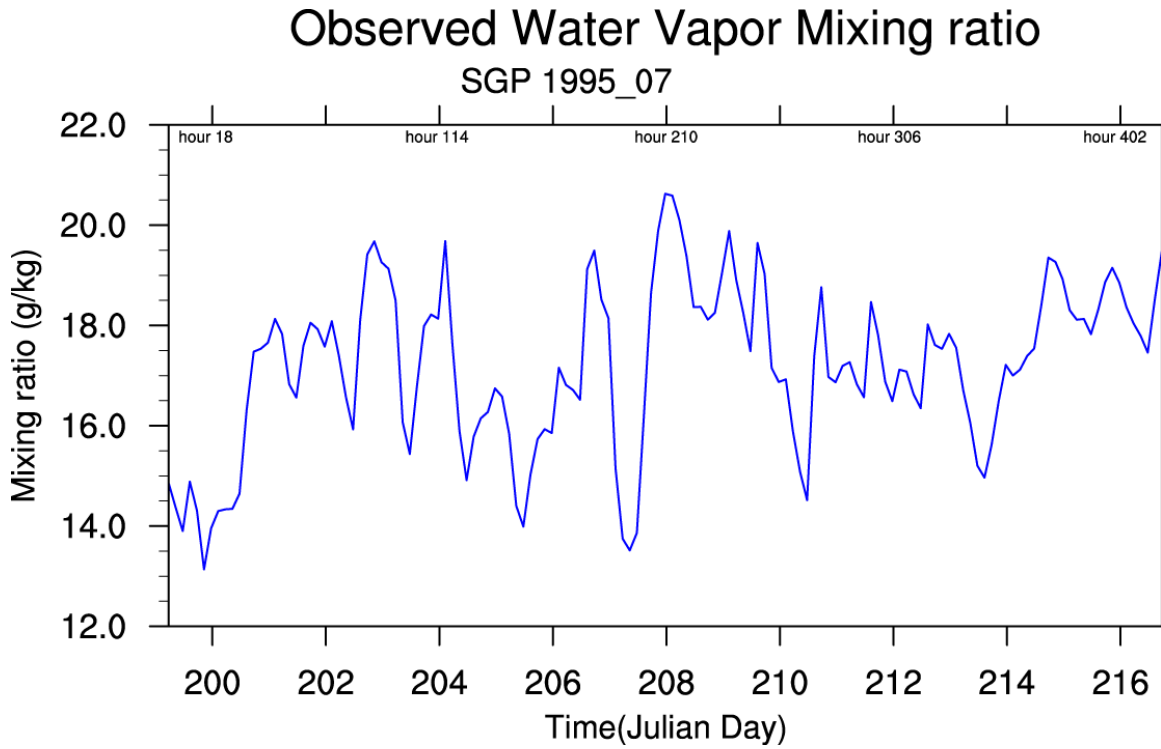


Fig 8. Time series of observed surface water vapor mixing ratio during the July and August 1995 IOP.

2) Vertical profiles: from Fig 9 to Fig 18

data: ARM_9507_interp_zz1.dat and ARM_9507_interp_zt1.dat

sample program: profi_w.pro

profi_t.pro

profi_q.pro

profi_lsf.pro

profi_u.pro

Omega 1995_07

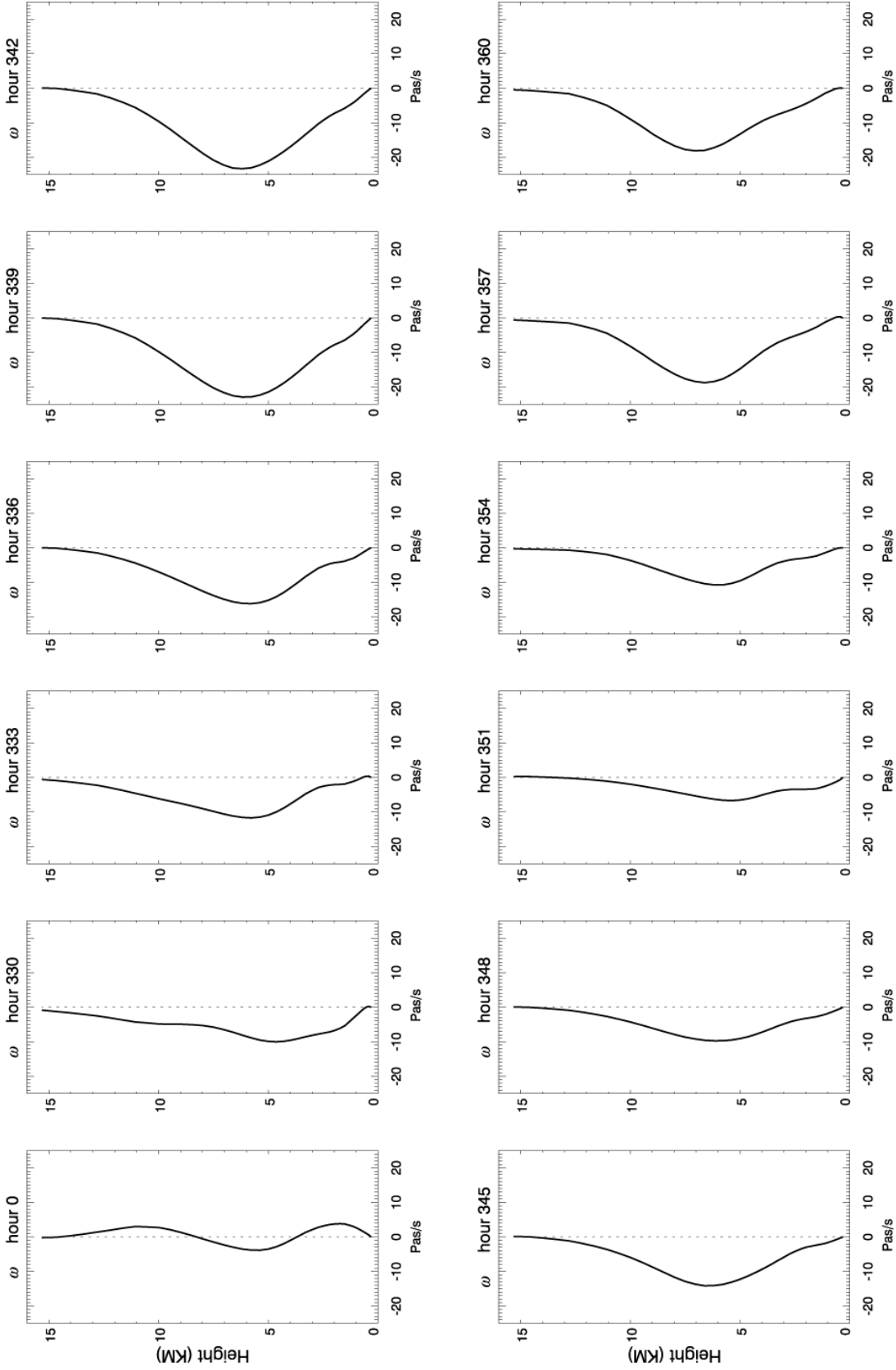


Fig 9. Vertical profiles of observed omega at selected time during the July and August 1995 IOP.

Omega 1995_07

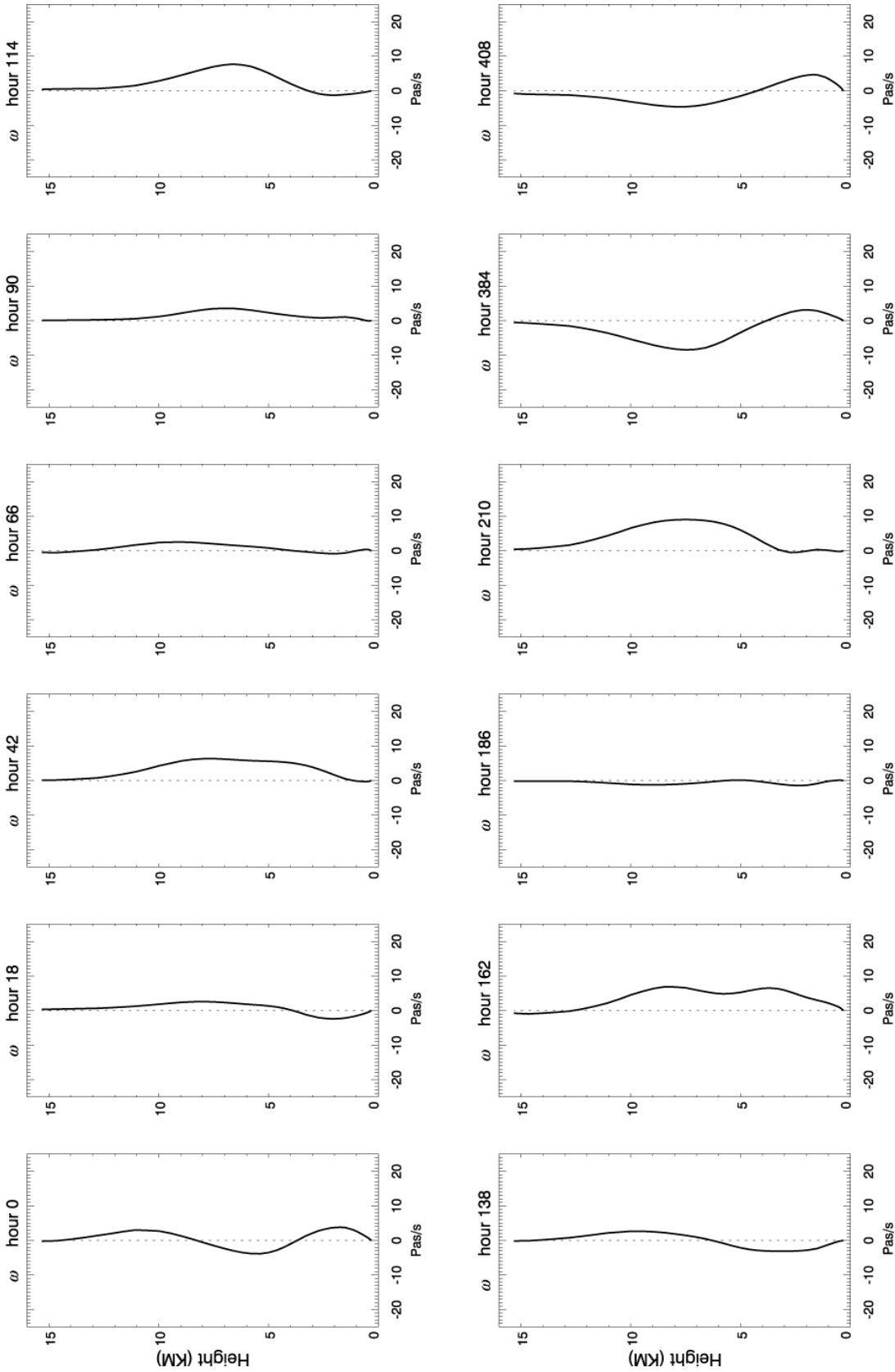


Fig. 9 Continued

Vertical Velocity 1995_07

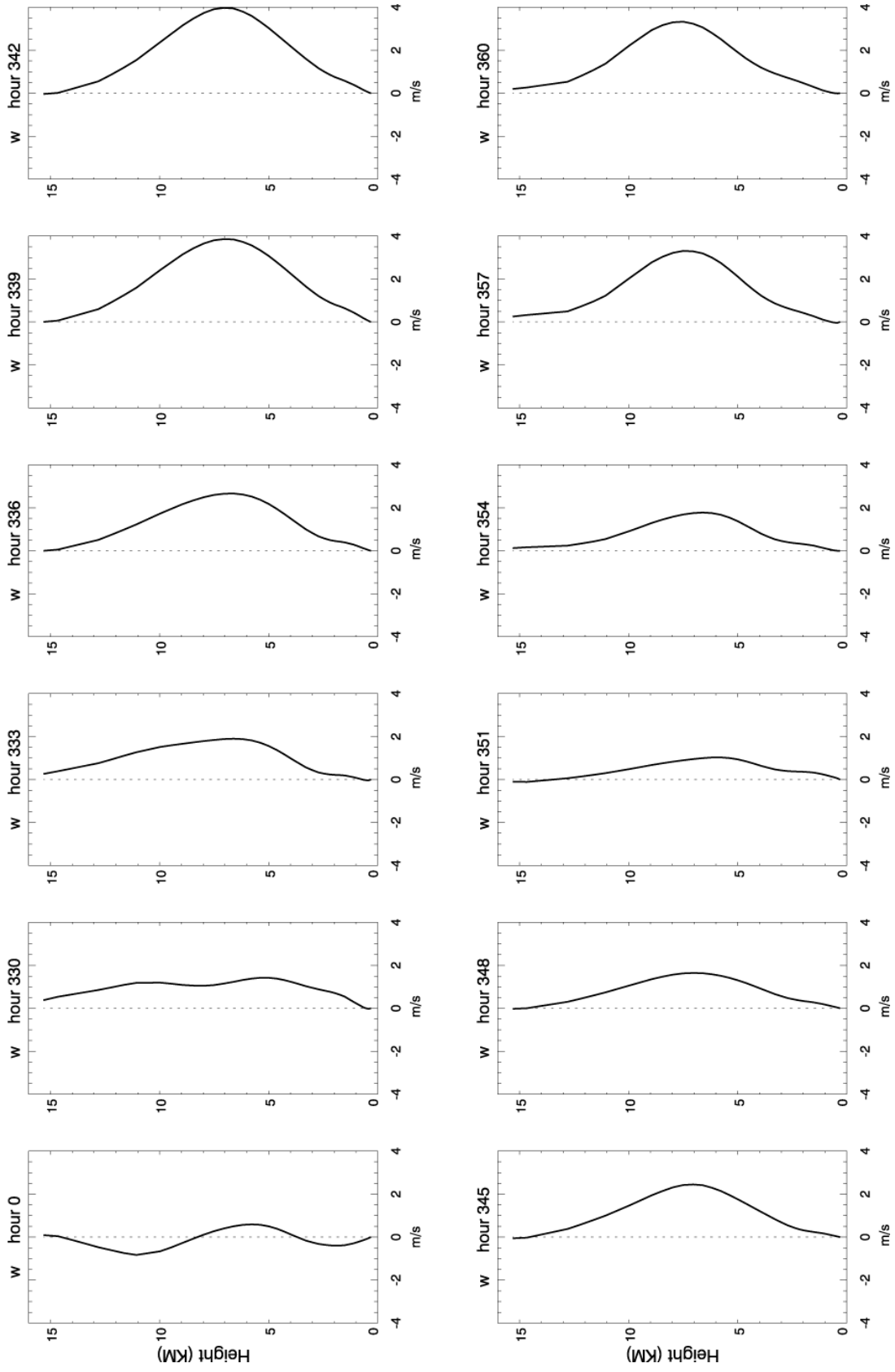


Fig 10. Vertical profiles of observed vertical velocity at selected time during the July and August 1995 IOP.

Vertical Velocity 1995_07

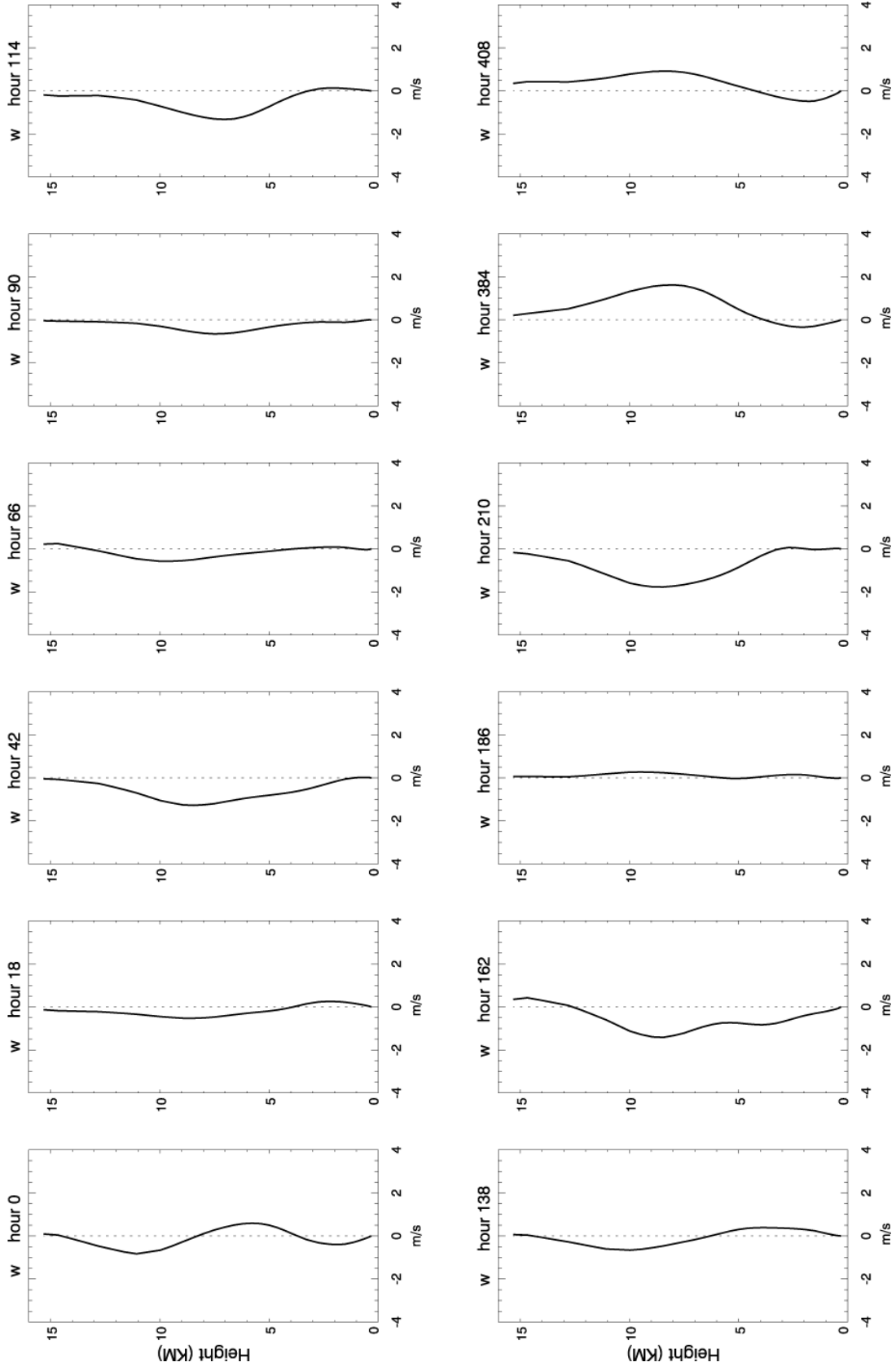


Fig 10. continue

Water Vapor Mixing Ratio 1995_07

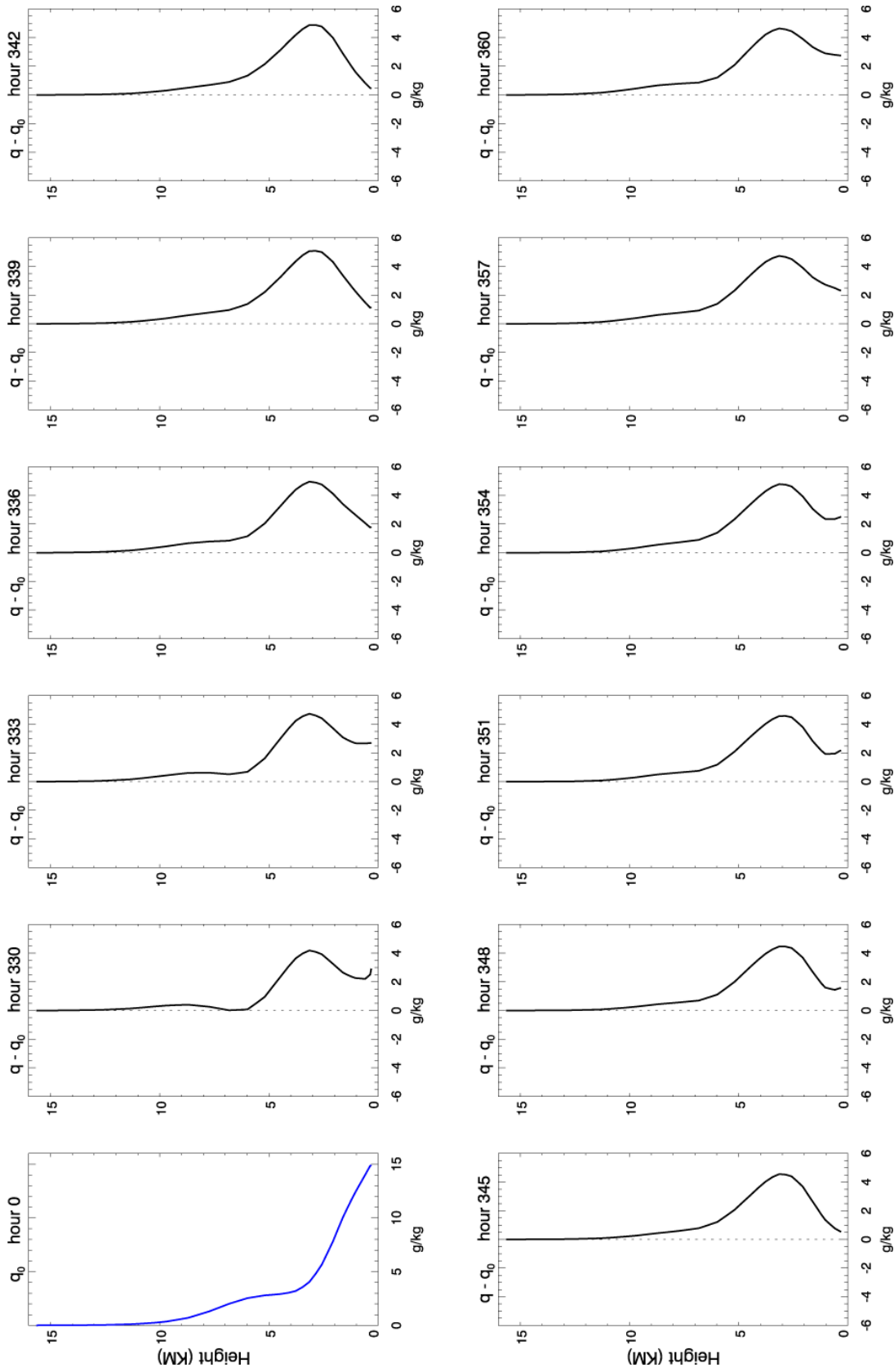


Fig 11. Vertical profiles of observed water vapor mixing ratio at selected time during the July and August 1995 IOP.

Water Vapor Mixing Ratio 1995_07

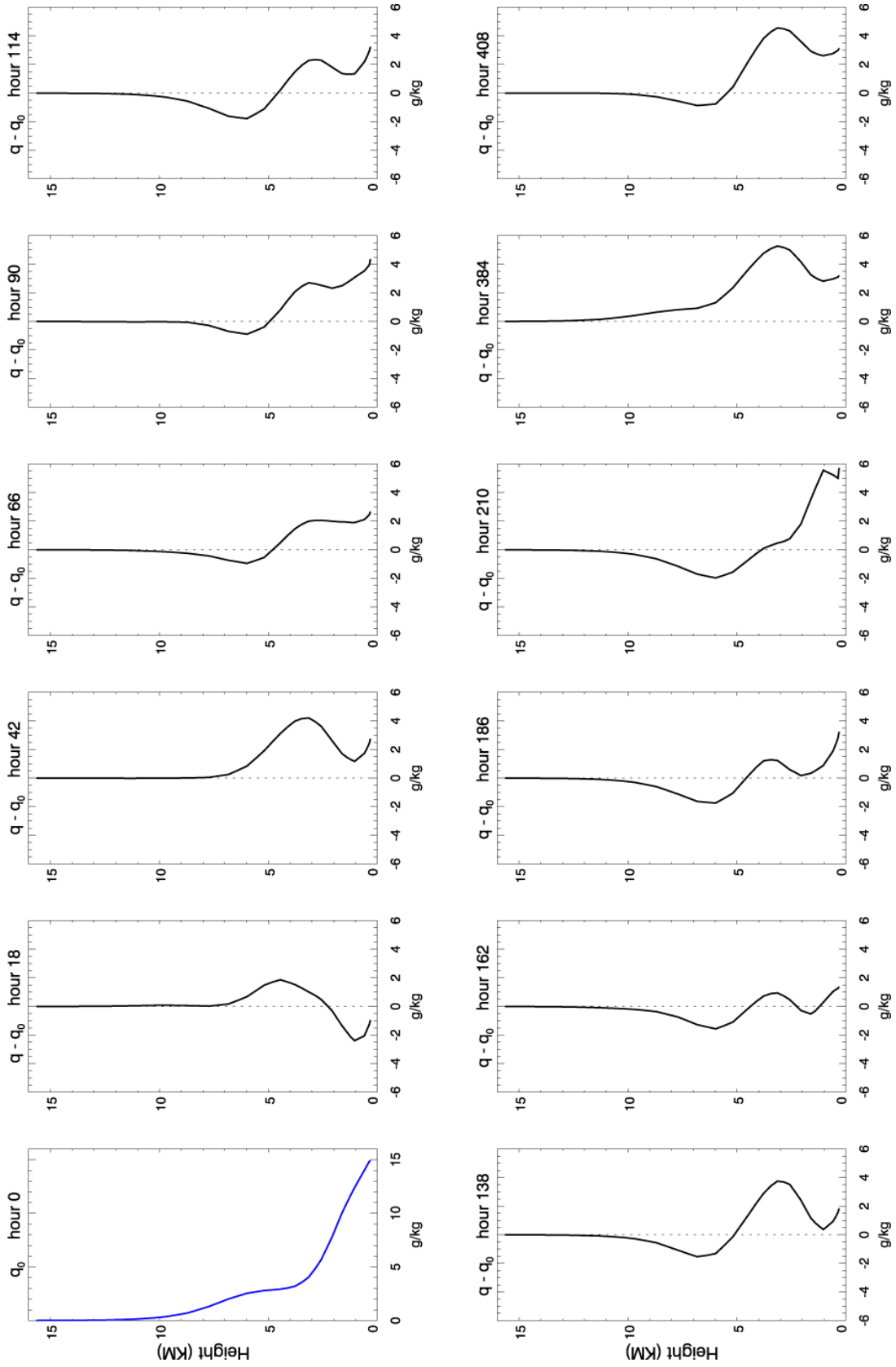


Fig 11. Continued

Temperature 1995_07

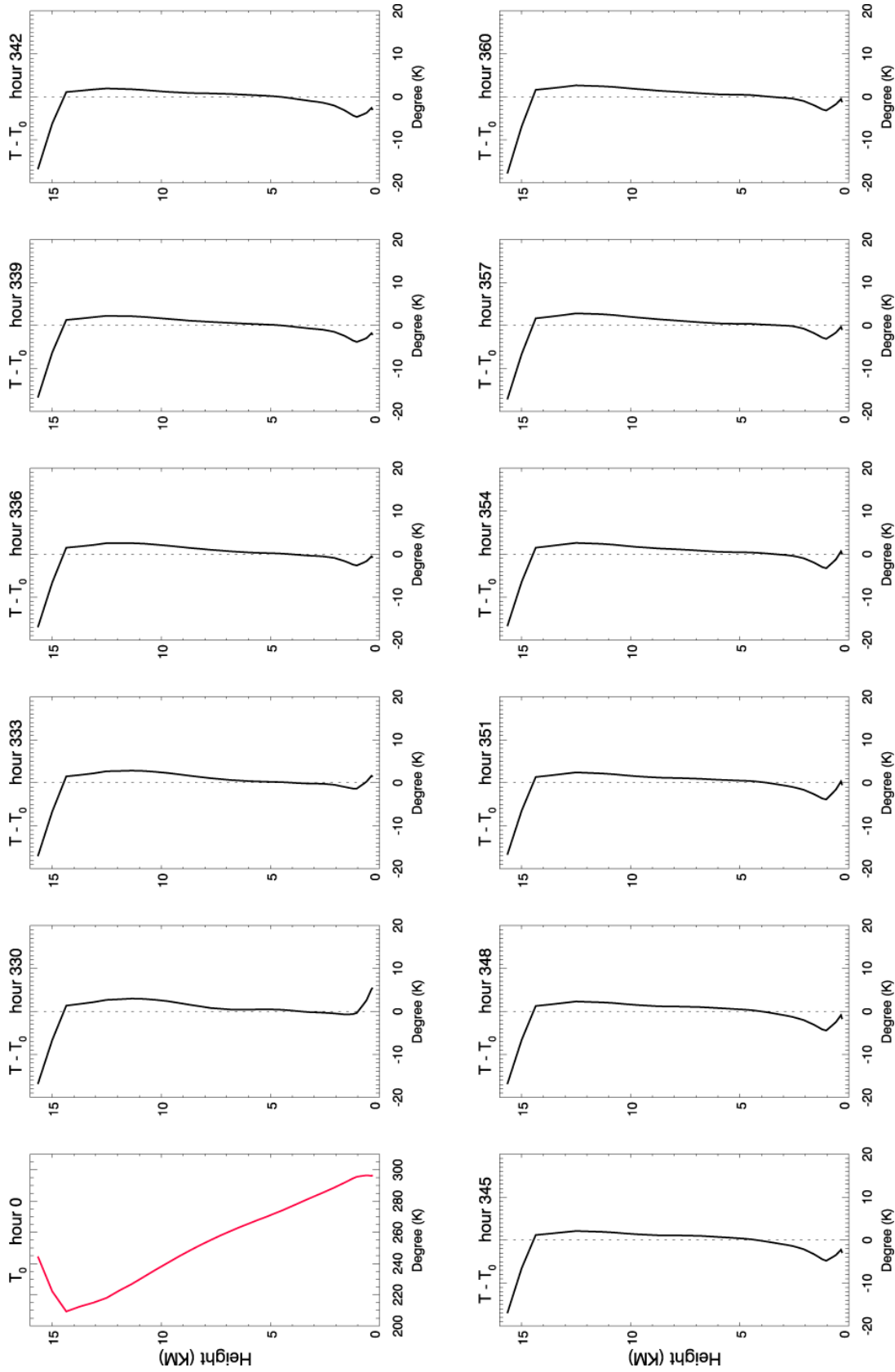


Fig 12. Vertical profiles of observed air temperature at selected time during the July and August 1995 IOP.

Temperature 1995_07

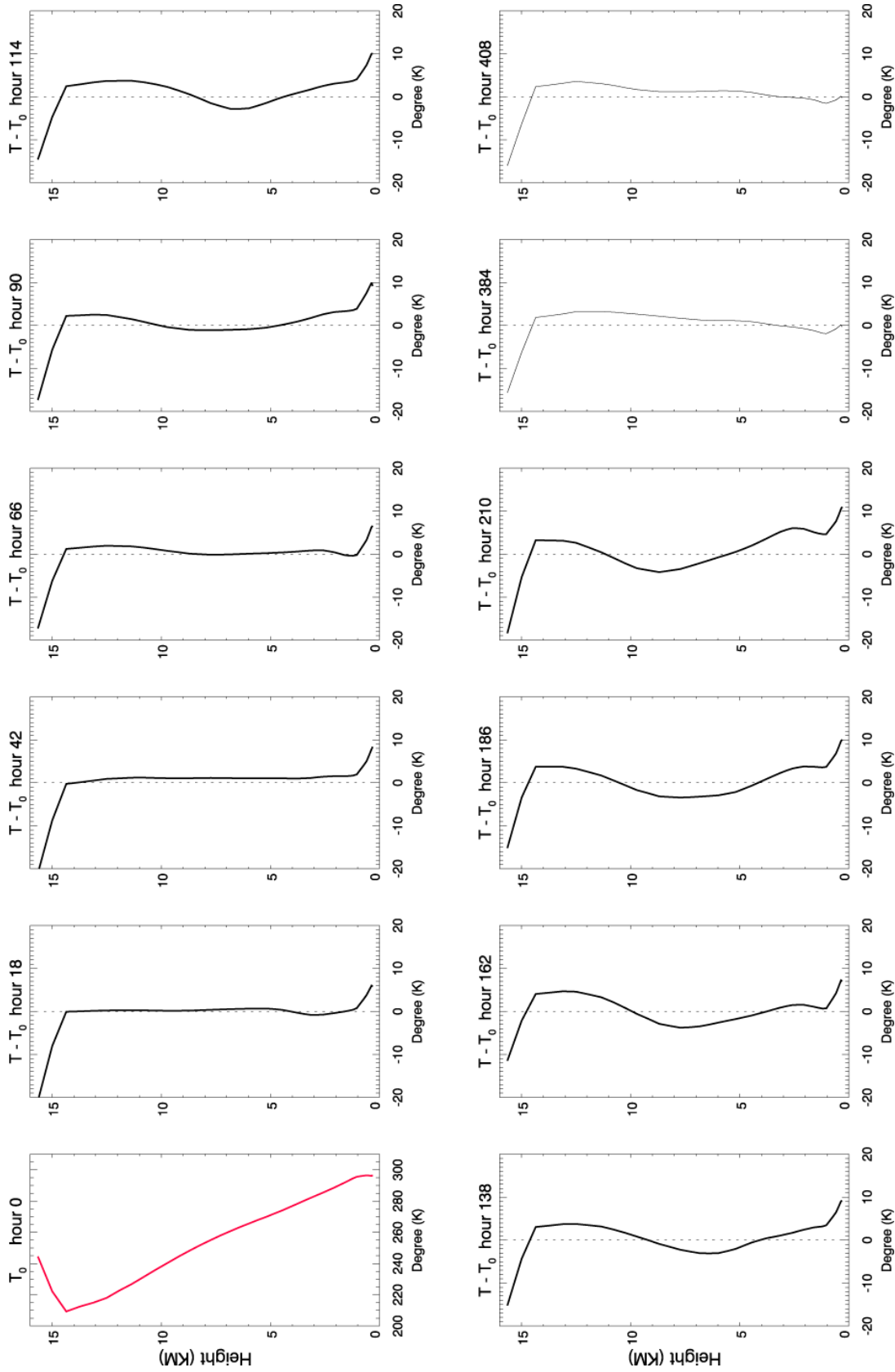


Fig 12. Continued

Potential Temperature 1995_07

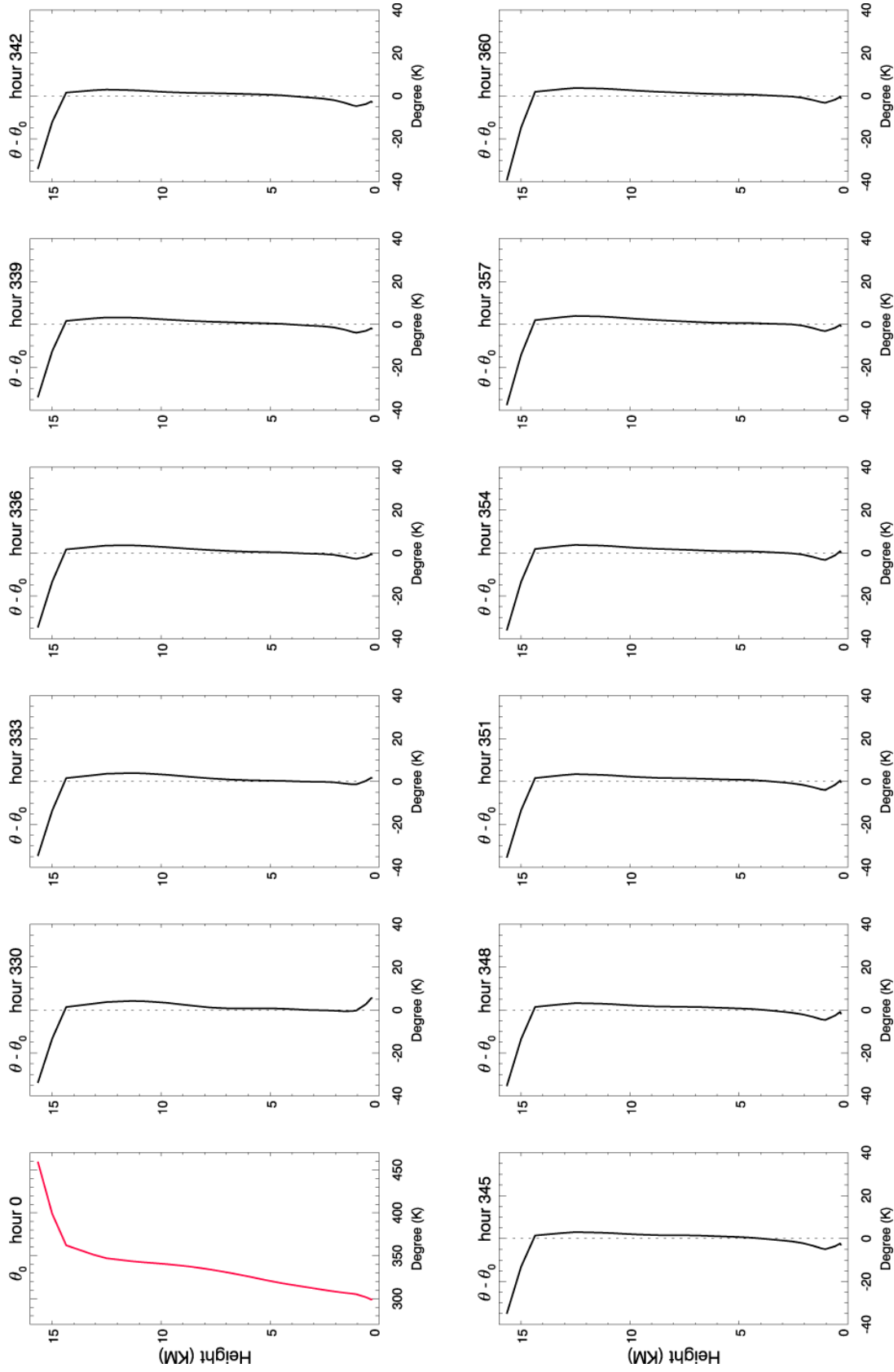


Fig 13. Vertical profiles of observed air potential temperature at selected time during the July and August 1995 IOP.

Potential Temperature 1995_07

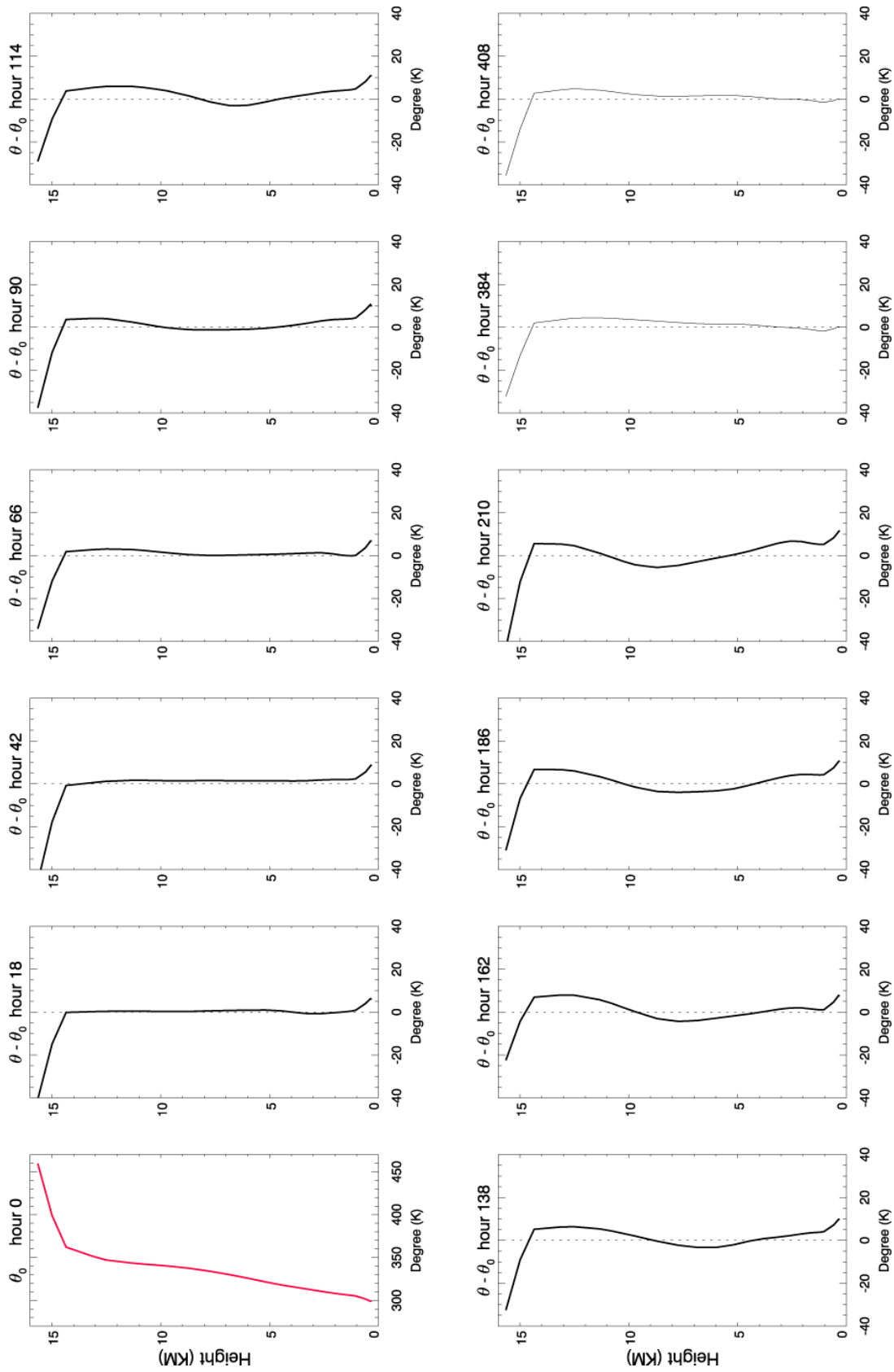


Fig 13. Continued

Large-scale forcing of Water Vapor Mixing ratio 1995_07

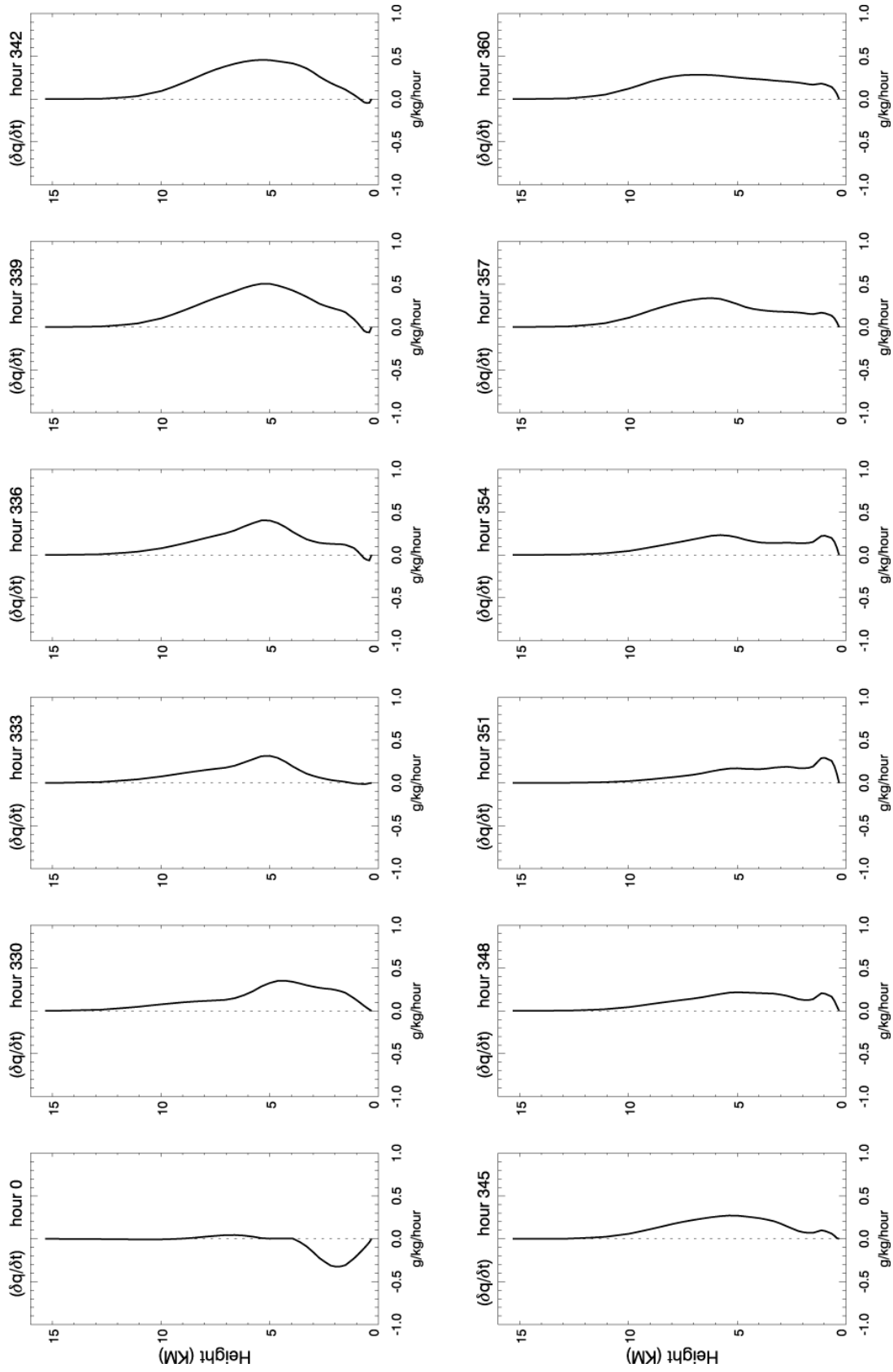


Fig 14. Vertical profiles of large-scale forcing of water vapor mixing ratio at selected time during the July and August 1995 IOP.

Large-scale forcing of Water Vapor Mixing ratio 1995_07

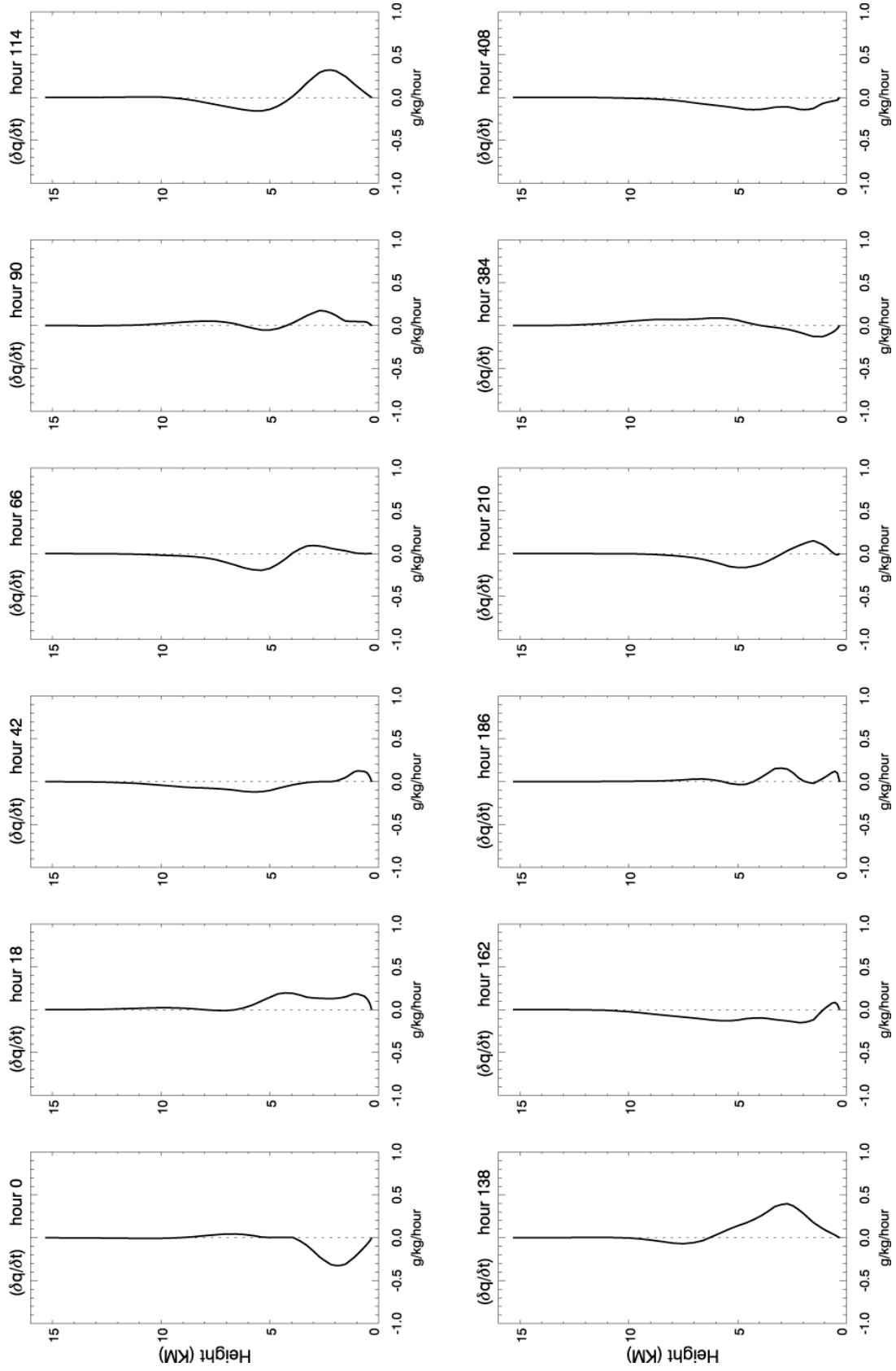


Fig 14. Continued

Large-scale forcing of Temperature 1995_07

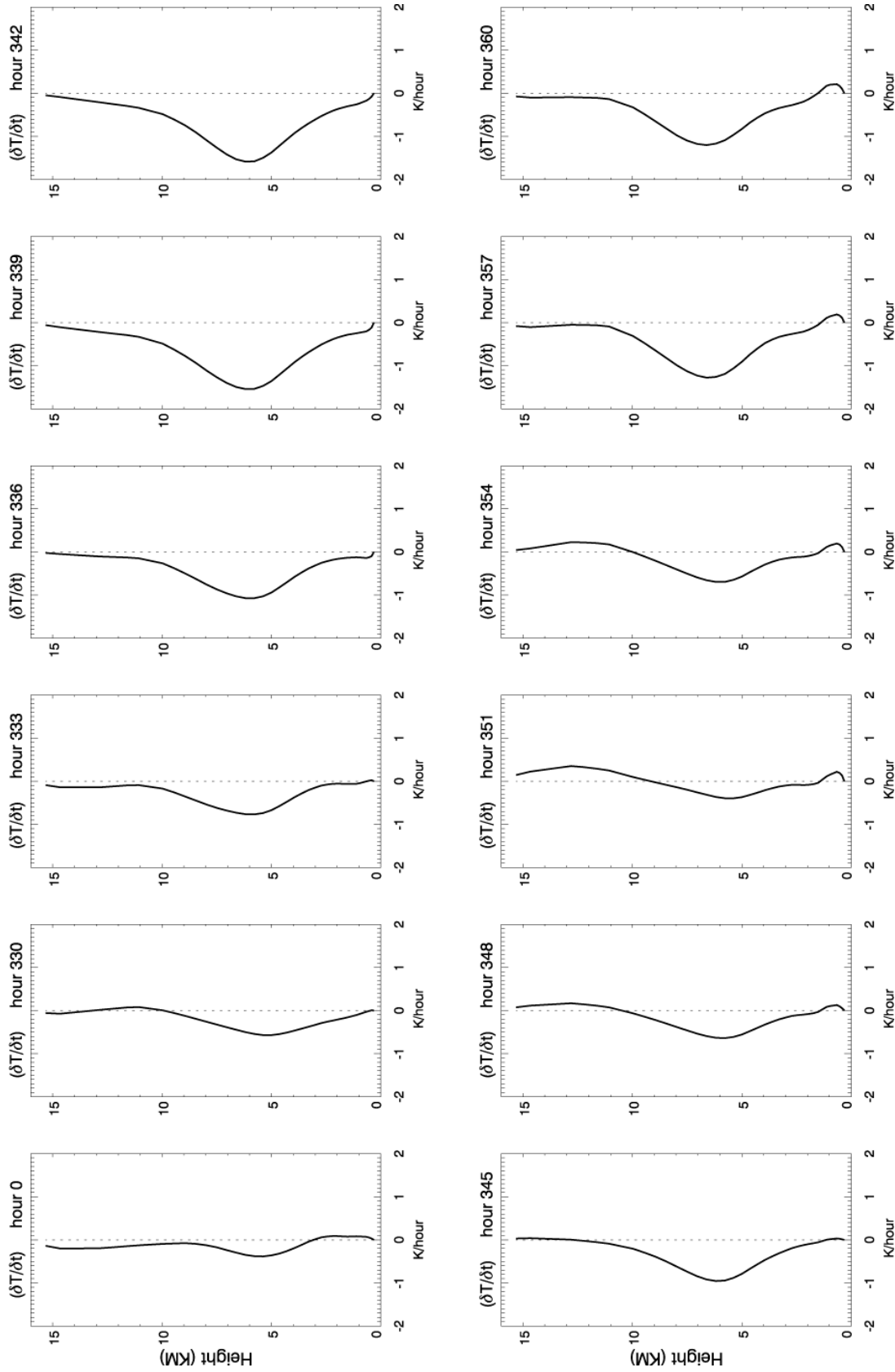
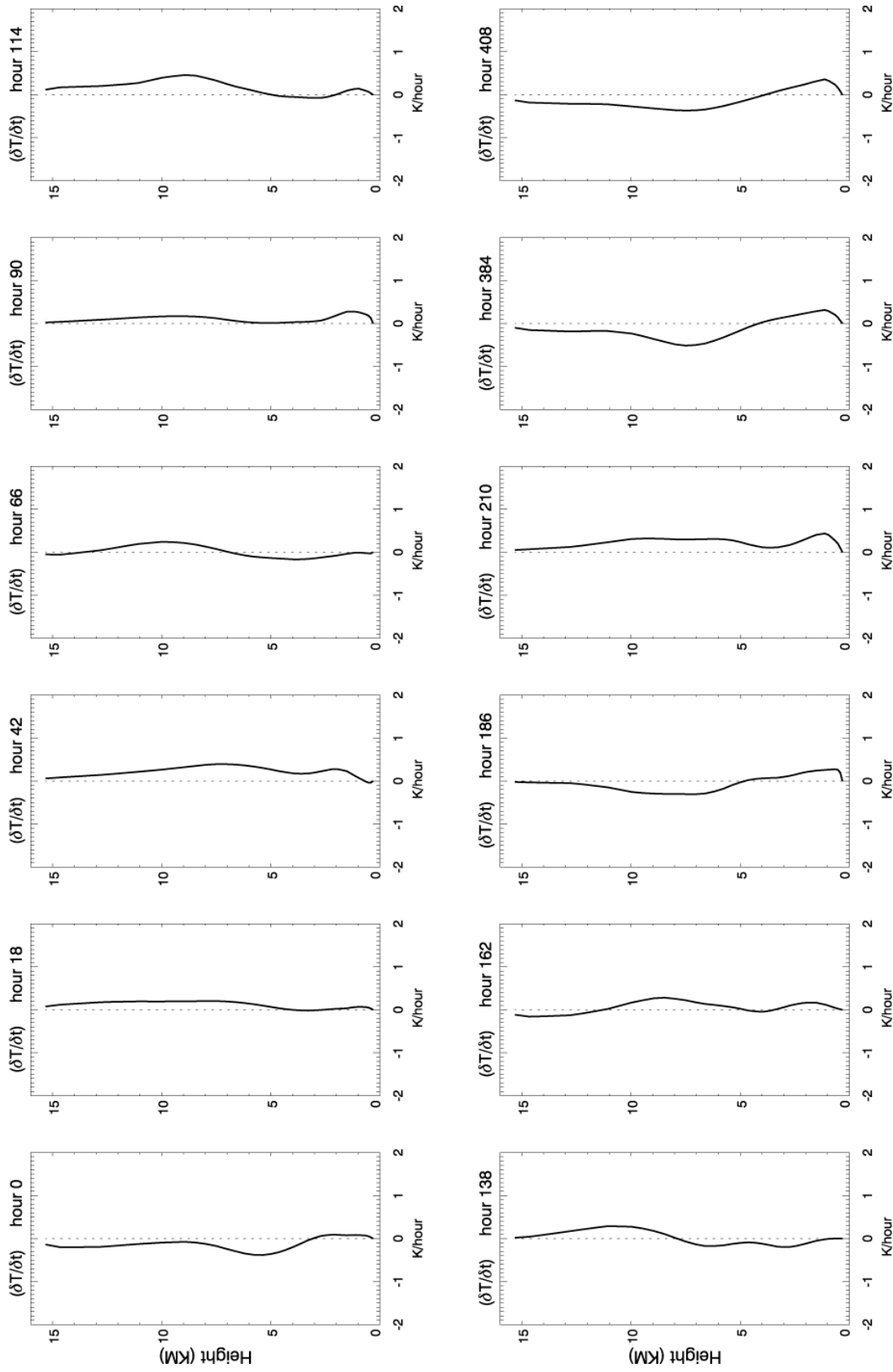


Fig 15. Vertical profiles of observed large scale forcing of temperature at selected time during the July and August 1995 IOP.

Large-scale forcing of Temperature 1995_07



F1g 15. Continued

Large-scale forcing of Potential Temperature 1995_07

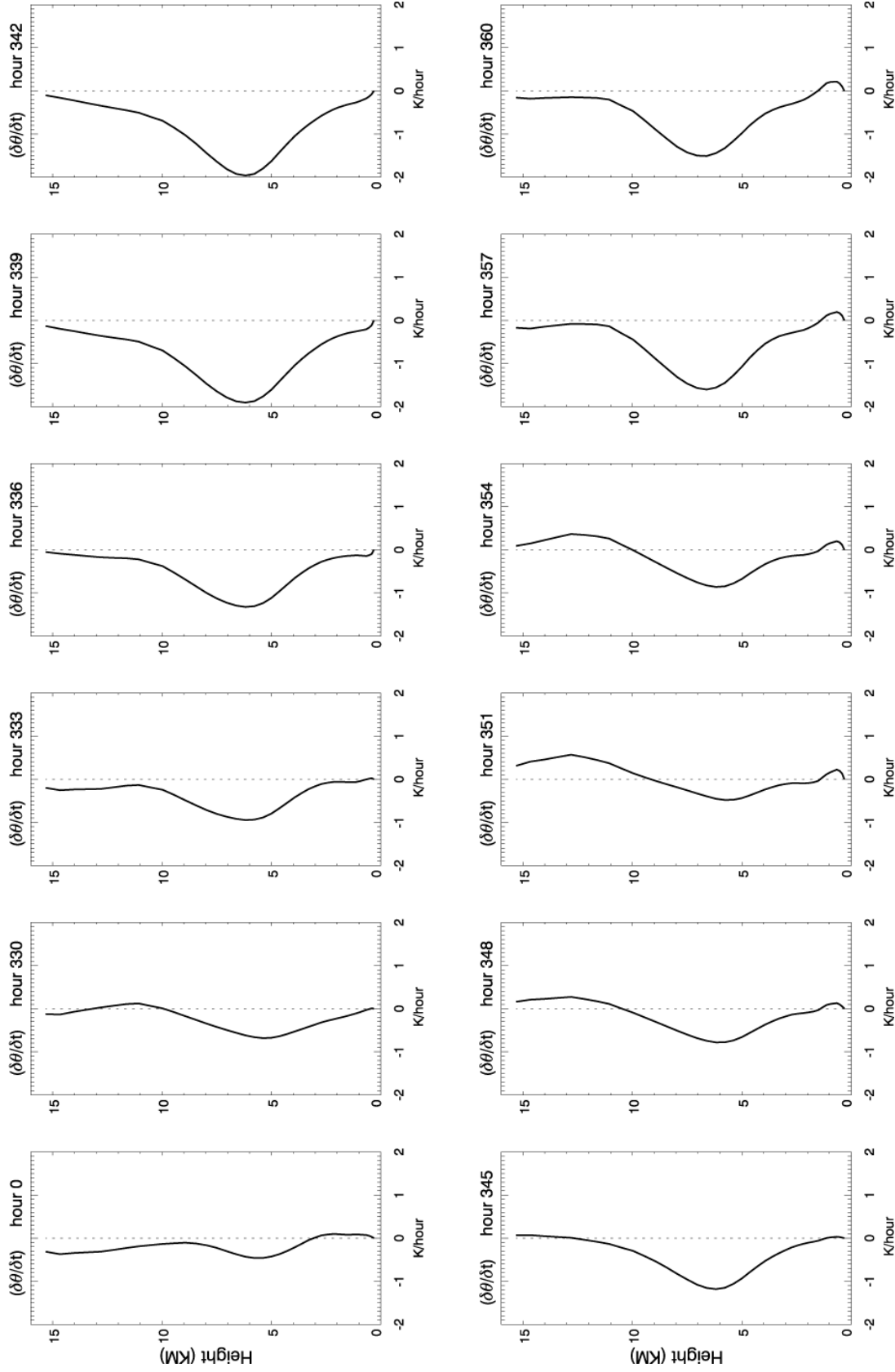


Fig 16. Vertical profiles of observed large scale forcing of potential temperature at selected time during the July and August 1995 IOP.

Large-scale forcing of Potential Temperature 1995_07

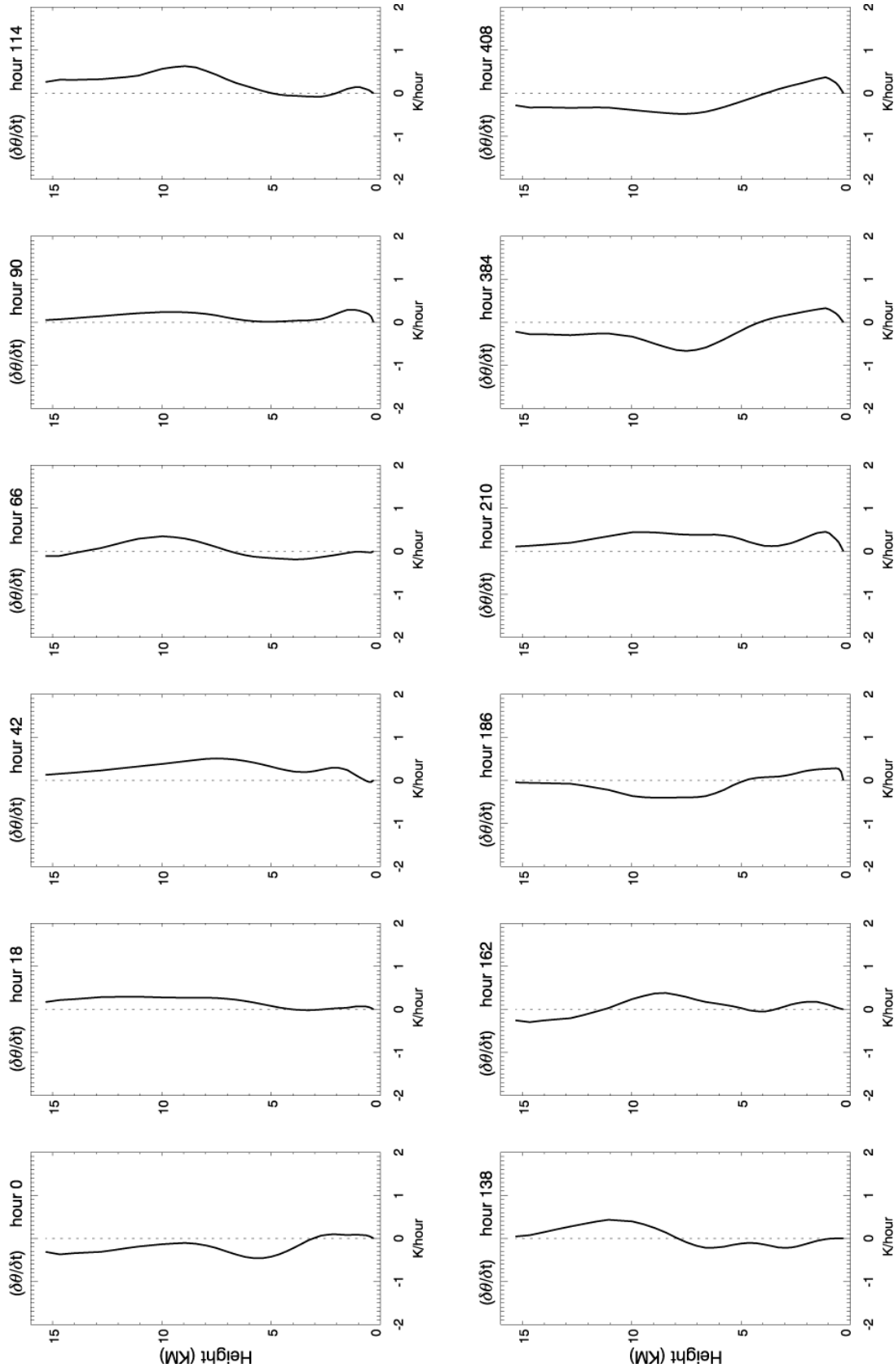


Fig 16. Continued

Zonal Wind 1995_07

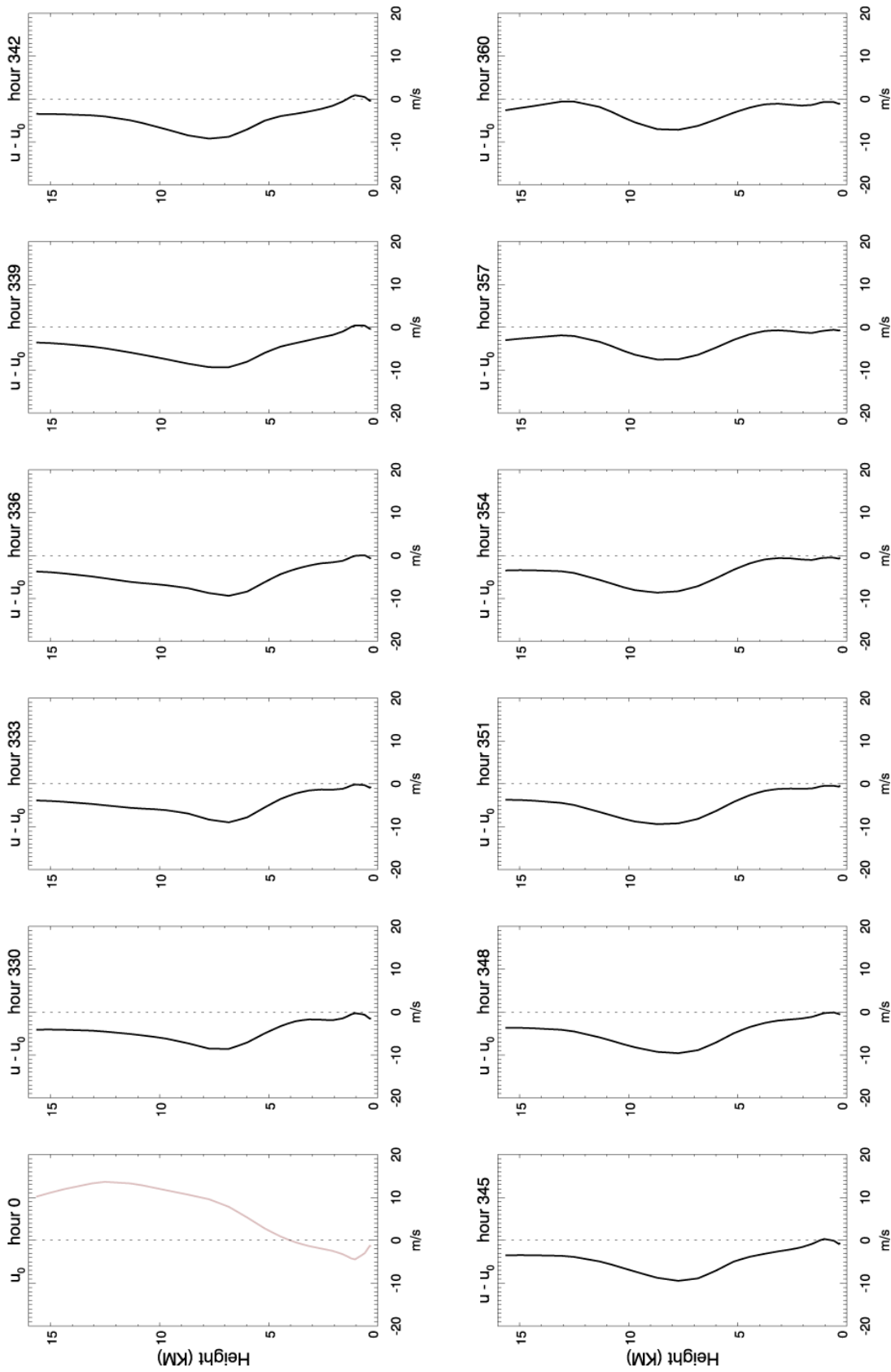


Fig 17. Vertical profiles of observed zonal wind at selected time during the July and August 1995 IOP.

Zonal Wind 1995_07

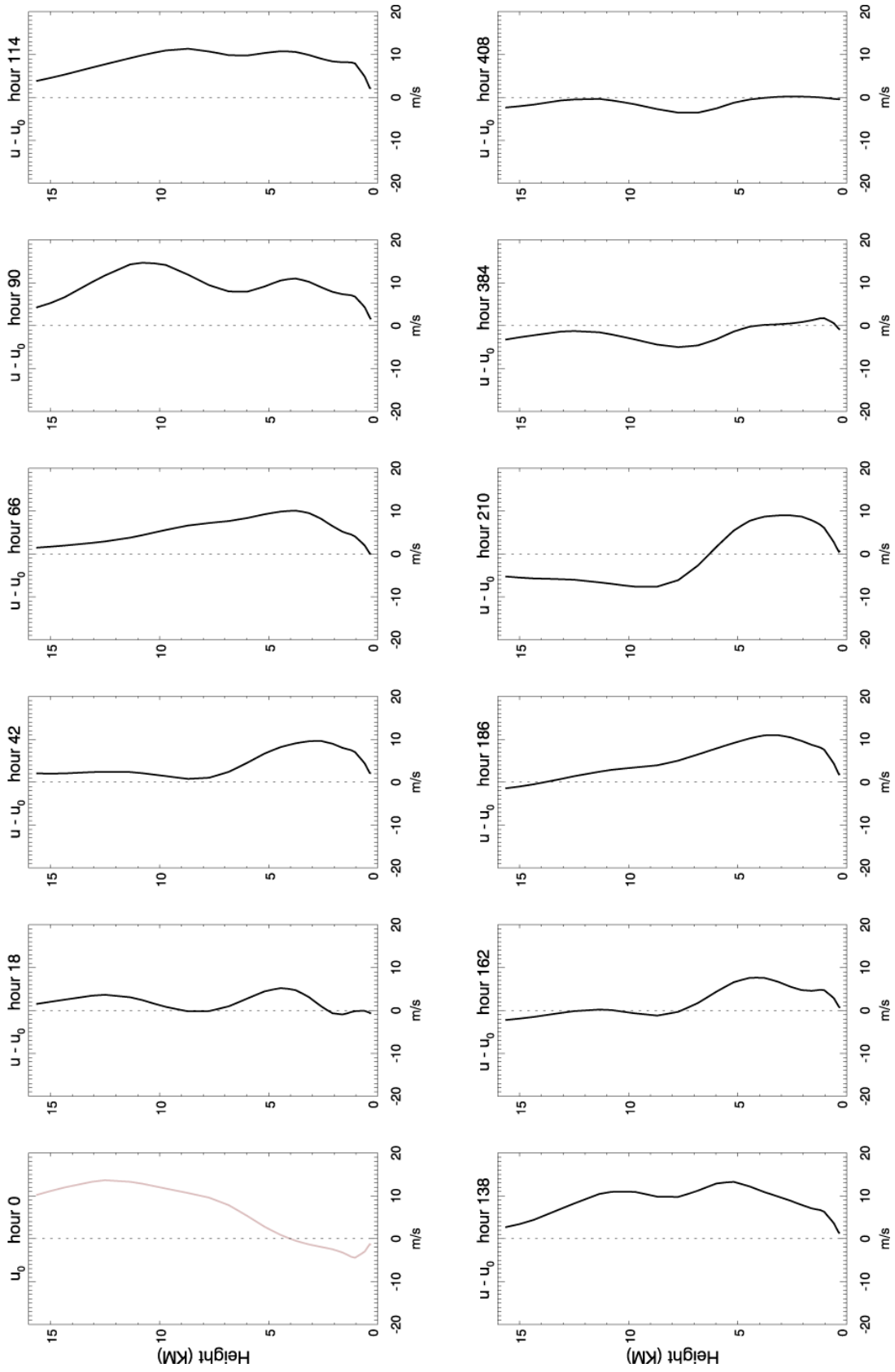


Fig 17. Continued

Meridional Wind 1995_07

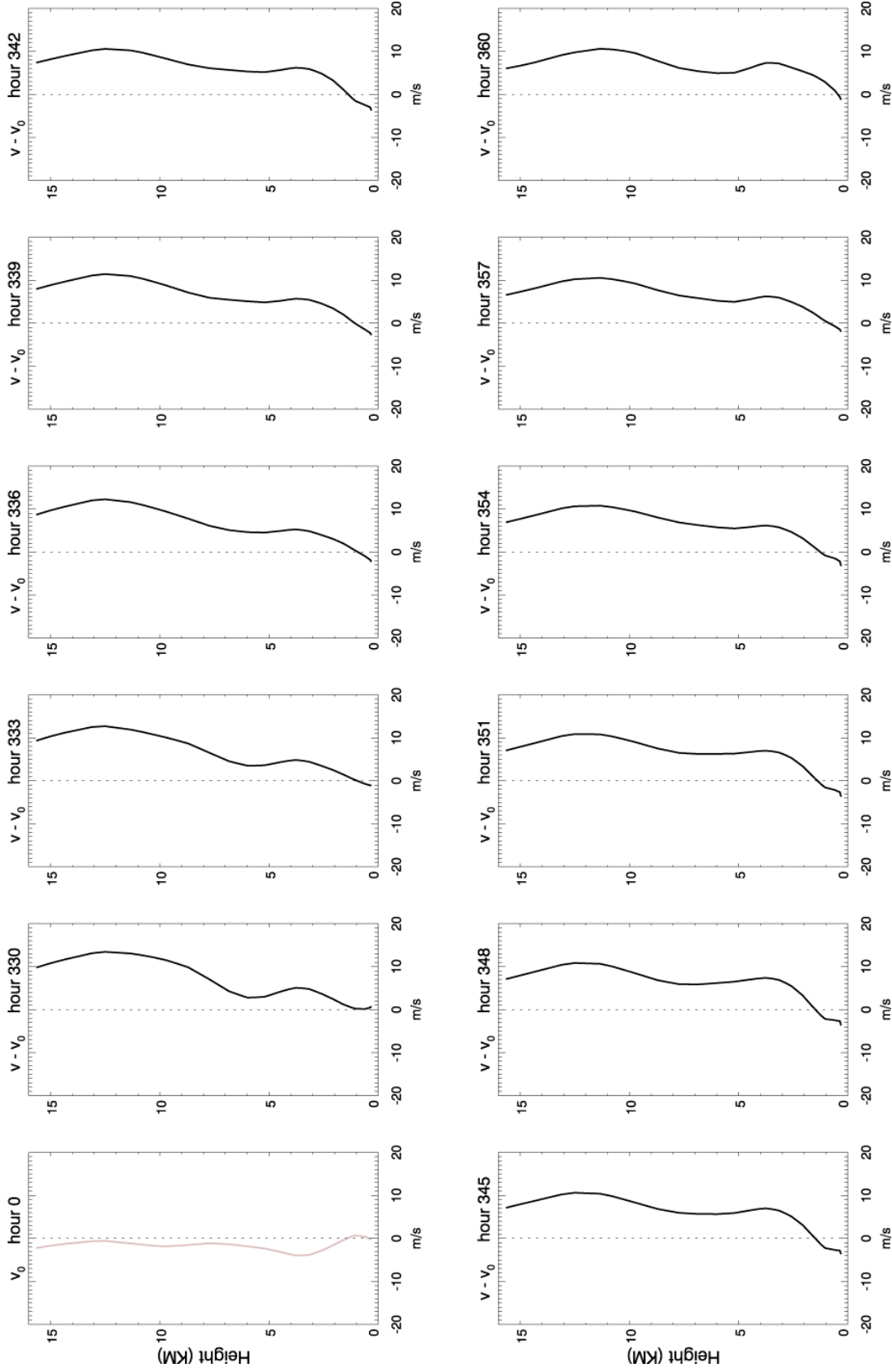


Fig 18. Vertical profiles of observed meridional wind at selected time during the July and August 1995 IOP.

Meridional Wind 1995_07

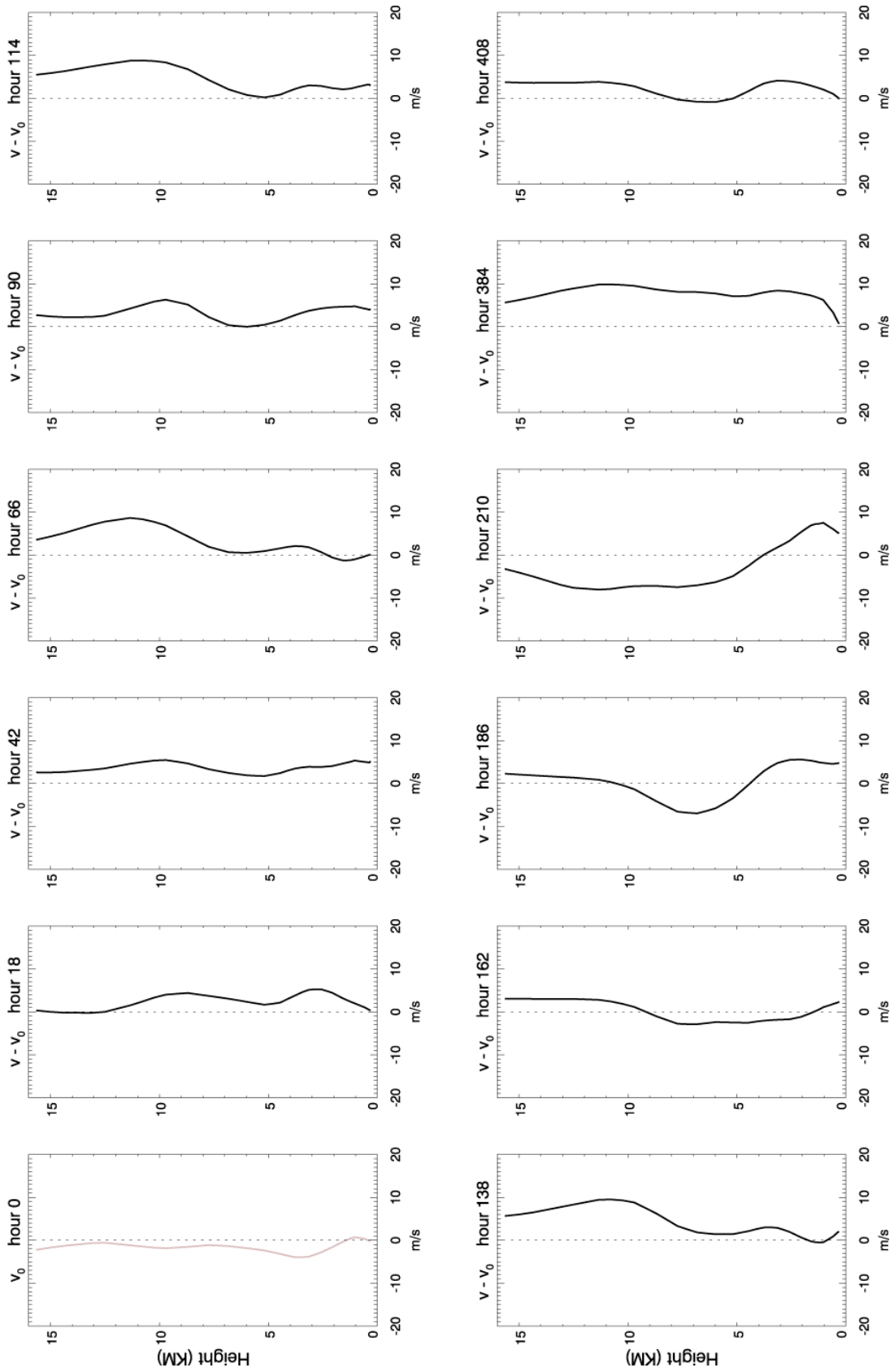


Fig 18. Continued

3) Profiles averaged during the period from 61.7291 to 82.3542 Julian day.
 Data: ARM_0003_basic_state_zt1.txt (see 5)iv)
 Sample program: prof_b.pro.

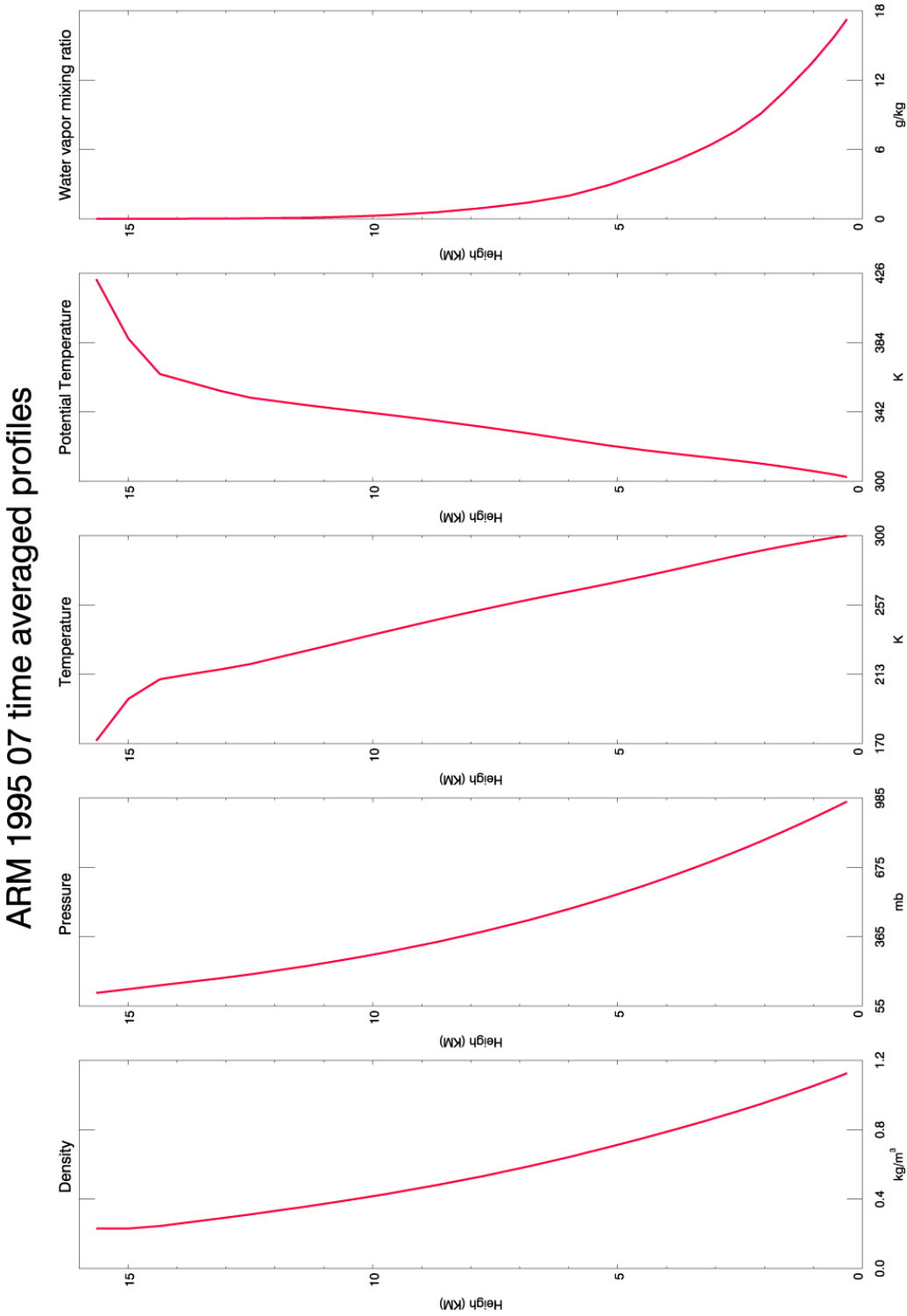


Fig 19. Time averaged profiles during the period of July and August 1995 IOP.

List of sample programs:

- 1.cal_qs.f90
- 2.read_surface_9507.for
- 3.read_layer2_9507.for
- 4.interp_arm-1.f90
- 5.interp_arm_2.f90
- 6.interp_arm_3.f90
- 7.time_plot.ncl
- 8.profi_t.pro
- 9.profi_w.pro
- 10.profi_q.pro
- 11.profi_lsf.pro
- 12.profi_u.pro
13. prof_b.pro

list of data files for VVM:

- ARM_9507_sfc.txt
- setting 1
 - ARM_9507_basic_state_zt1.txt
 - ARM_9507_basic_state_zz1.txt
 - ARM_9507_interp_zt1.txt
 - ARM_9507_interp_zz1.txt
- setting 2
 - ARM_9507_basic_state_zt21.txt
 - ARM_9507_basic_state_zz2.txt
 - ARM_9507_interp_zt2.txt
 - ARM_9507_interp_zz2.txt
- setting 3
 - ARM_9507_basic_state_zt3.txt
 - ARM_9507_basic_state_zz3.txt
 - ARM_9507_interp_zt3.txt
 - ARM_9507_interp_zz13txt