UHF Wind Profiler (Laboratoire d'Aérologie) Campistrous 10 June 2011- 05 July 2011

Quick Presentation on Data collection, Data processing, Description of the UHF Data files provided to the BLLAST Data Base and Quick-looks during IOPs

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1 Introduction

This document gives information about the data files provided to the data base for the UHF wind profiler sited in the Campistrous CRA (Centre de Recherches Atmosphériques) during BLLAST (10 June to 05 July 2011). Its goal is to give the basic information on the profiler characteristics, physics of the measurement, signal processing, data collection modes, an overview of the observations based on height-time cross- section images, and finally the description of the content of the UHF data files.

2 Wind profiler main characteristics

Latitude: 43°07'27.15" North
Longitude: 0°21'45.33" East
Altitude: 595 m

The UHF wind profiler is permanently installed in Campistrous on the same site as a VHF wind profiler but can also be moved outside the site during scientific campaigns. The UHF radar is used to describe the low troposphere (0.1 to 3 km) and the VHF radar the middle troposphere up to the lower stratosphere (2 km to 18 km).

This wind profiler, the PCL1300 UHF profiler manufactured by Degreane Horizon, is a pulsed Doppler radar working with a transmitted frequency of 1274 MHz and a peak power of 2.5 KW. In order to retrieve the three components of the wind under the assumption of local horizontal homogeneity, five beams with predetermined directions are used: 1 vertical and 4 oblique slanted at 17° from the vertical and disposed in azimuth every 90° (13.4°, 103.4°, 193.4°, 283.4° /North). Each beam has the same angular opening of 8.5°. The pulse repetition frequency, that determines range and velocity ambiguity but also the final radar detection sensitivity, was selected to 25000 Hz.

Data collection was continuous during the experiment on the basis of a repetitive sequence of about 3.5 minutes duration comprising a low and a high mode. The **low mode** was based on a 150 m pulse length, and on 95 level gates spaced along the radial every 75 m starting at 100 m from the radar. The **high mode** was based on a 750 m pulse length, and on 95 level gates spaced along the radial every 150 m starting at 150 m from the radar. So the radial resolution was 75 m and 375 m for the low and high mode, respectively. The use of a larger pulse length permits to increase the vertical coverage for the high mode compared to the low mode at the expense of the radial resolution.

A UHF radar can work in clear air or during precipitation events. In clear air the atmospheric signal is due to the backscattering by spatial irregularities of the air refractivity index (in fact air density) at the scale of half the radar wavelength $\lambda/2$ when the source of the fluctuations comes from a turbulent mixing that follows the behaviour of the Kolmogorov inertial subrange. The requirement is that $\lambda/2$ falls in the inertial subrange domain. Air refractivity is a function of temperature and humidity, the latter dominates in the lower atmosphere. The conjunction of strong turbulence and acute vertical gradient of temperature and humidity produce the strongest echoes. This is the case at the top Zi of the atmospheric boundary layer (ABL) which usually is marked by a maximum of the radar signal. This is currently used to monitor the top of the ABL. Precipitation even weak (drizzle) produces usually backscattering much more intense than clear air. A consequence is that clear air peaks present in the Doppler spectra are masked by precipitation echoes. When precipitation and clear air echoes are of the same importance the signal processing selects the precipitation echo. This often happens at the beginning and end of a precipitation event and sometimes the selection is not easy and causes bad wind measurements.

Vertical profiles of the wind are deduced from the Doppler spectra obtained at every level gates of the five radial directions for each cycle of measurements of 3.5 minutes duration. In order to remove or minimize the impact of extra meteorological scatterings (ground clutter, bird or airplane echoes, radio interference, multi trip echoes,), a median filter is applied on the Doppler spectra using 5 consecutive collecting cycles (corresponding to a time interval of about 25 minutes). The following task of the data processing is to determine the noise level of each Doppler spectra. Then the 4 powerful peaks that emerge above the noise level of each spectrum are retained for subsequent analysis. For these selected peaks the fourth first moments are computed, providing: the mean signal intensity (reflectivity), the mean Doppler radial velocity, the standard deviation (half the spectral width), and the skewness, a measure of the distribution asymmetry. The most important step in the data processing is the selection of the meteorological peak among the four ones retained at each level. This selection is based on time and height continuity and rejections with thresholds. Echoes associated with ground clutter centred on the DC line are usually the most intense echoes at low level (below 1 km). These echoes come from backscatterings from soil, vegetation, buildings nearby the radar. If their mean radial velocity is zero their spectral width that depends on the agitation of trees, leaves or grass by the wind is function of the wind intensity at ground level. Because ground echo peak can mix with the meteorology peak, an underestimation of the wind velocity can result. A particular care is made in the data processing to minimize the effect of ground echoes. The DC line and a certain number of spectral lines close to zero (at the most 5) are removed and replaced by interpolation. Cleaning of meteorological peak from possible ground clutter contamination is made when appropriate tests conclude for that. During migration periods in spring and autumn strong echoes from birds, particularly during the night, are observed up to several kilometres above the ground. These echoes are one of the worst source of bad wind velocity data. A special processing is used to reject them (Merrit algorithm) in real time. To reinforce this rejection a median filtering adapted to this kind of echoes is added in the postprocessing stage. In certain circumstance when birds passage is intense these tests are not enough powerful.

All the raw Doppler spectra are recorded and stored. This allows a reprocessing of the data to improve the retrieval of the atmospheric parameters.

3 Description of the UHF data files provided to the AMMA Data Base

For all the observing period from 10 June 2011 until 05 July, vertical profiles of the three components of the wind along other atmospheric parameters retrieved by the UHF wind profiler of Djougou are written in two ASCII files named:

uhf-LA_BLLAST_10jun11-05jul11-mb.edt2asc
uhf-LA_BLLAST_10jun11-05jul11-mh.edt2asc

The first file corresponds to data collected with the low mode (mb), and the second to data collected with the high mode (mh). Both files have the same structure beginning with a header block and followed by repetitive tables with the same format where are written the successive vertical profiles parameters arranged chronologically in increasing time.

3.1 Description of the header

```
|          BLLAST UHF CRA 10jun11->05jul11,low mode
Radar Number:  40
Radar Altitude (m/sea):   595.00
Radar Latitude (decimal degrees):   43.1331
Radar Longitude(decimal degrees):    0.3669
Beams Number:  5
Transmitter Frequency (MHz): 1274.0000
Level Gates Number:  95
First Level Gate Altitude (m/sea):  695
Gates Height Interval (m):   75
Mean Time between Vertical Profiles (s):  251
Beam Elevation (degree/ground):    90.0     73.0     73.0     73.0     73.0
Beam Azimuth (degree/cw/north):     0.0     13.4    193.4    103.4    283.4
Beam Width(degree):                 8.5      8.5      8.5      8.5      8.5
Doppler Spectra Points Number:      128      128      128      128      128
Pulse Repetition Frequency (Hz): 25000.0  25000.0  25000.0  25000.0  25000.0
Coherent Integration Number:         72       72       72       72       72
Incoherent Integration Number:        3        3        3        3        3
Effective Pulse Length (m):         150      150      150      150      150
Pulse Coding:                         1        1        1        1        1
```

Figure 1: **Table 1**

The header consists in 22 lines (including two blank lines at the bottom). As the header is self-instructive it is not necessary to comment its content that gives the main working parameters of the UHF. Note that the radar did not use a pulse coding and that a median filter using 5 consecutive cycles data was used to obtain each vertical profiles presented in the file.

3.2 Description of the vertical profile tables

DATE (aammjj): 110610 HOUR TU (hhmmss): 152843 NLEV: 42 MEAN NOISE (DB): 5.8 5.8 5.9 5.5 5.7

ALT Zi(m/msl): 3545 885 9999 ALT Zt(m/msl): 9999 9999 9999

ALT m/msl	U(WE)ms-1	V(SN)ms-1	W(VT)ms-1	CN2 m-2/3	ASPT db	2STDw ms-1	SKEW W ( )	EPSI m2s-3	U"W" m2s-2	V"W" m2s-2	-U"W"dUdZ m3s-3	W"T" watt/m2
770.0	1.88	0.58	-0.07	0.1817E-14	-5.49	0.90	0.1400E+00	0.2292E-03	-0.2097E-01	-0.7147E-03	0.9999E+04	0.9999E+04
845.0	1.74	0.52	-0.07	0.4357E-14	-4.09	0.95	-0.3800E+00	0.1399E-03	-0.1903E-01	0.1265E-01	0.1488E-04	0.4593E+01
920.0	2.21	0.90	-0.23	0.4449E-14	0.11	1.14	-0.4440E+01	0.1720E-03	-0.4279E-01	-0.4001E-02	0.6326E-04	0.3993E+01
995.0	2.03	-0.21	-0.30	0.1989E-14	2.41	0.88	-0.4500E+00	0.3350E-03	-0.7508E-01	-0.1514E-01	-0.1688E-03	0.1851E+02
1070.0	2.27	-1.07	-0.42	0.1221E-14	-0.19	0.99	-0.2000E-01	0.3760E-03	-0.1233E+00	-0.9141E-02	0.5982E-03	-0.8161E+01
1145.0	2.86	-1.59	-0.50	0.1754E-14	1.51	1.05	-0.2600E+00	0.2837E-03	-0.7720E-01	-0.1463E-01	0.4115E-03	-0.4695E+01
1220.0	3.17	-1.60	-0.45	0.2600E-14	-1.69	1.06	-0.2200E+00	0.1593E-03	-0.4211E-01	0.2345E-01	0.2134E-03	-0.1987E+01
1295.0	3.62	-1.59	-0.36	0.3262E-14	-2.49	0.96	0.5000E-01	0.1461E-03	0.9999E+04	0.9999E+04	0.9999E+04	0.9999E+04
1370.0	4.26	-1.55	-0.45	0.2582E-14	-0.19	0.95	0.1700E+00	0.9907E-04	-0.9053E-02	-0.8452E-02	0.1002E-03	-0.4294E-01
1445.0	4.87	-1.15	-0.58	0.2100E-14	-0.49	1.12	0.7000E-01	0.8125E-04	0.4610E-01	-0.5739E-01	-0.8470E-05	0.3296E+01
1520.0	4.91	-1.05	-0.74	0.1760E-14	-0.69	1.30	-0.2400E+00	0.9412E-04	0.9406E-01	-0.6743E-01	-0.9086E-04	0.6795E+01
1595.0	4.85	-1.38	-0.74	0.1711E-14	-1.19	1.68	-0.4000E-01	0.1577E-03	0.2829E+00	-0.5186E-01	0.5535E-04	0.3759E+01
1670.0	4.80	-1.49	-0.71	0.1400E-14	-0.59	1.58	-0.3000E-01	0.1283E-03	0.4218E+00	-0.7411E-01	-0.1190E-02	0.4844E+02
1745.0	5.21	-1.74	-0.72	0.1188E-14	-0.49	1.58	-0.5000E-01	0.4164E-03	0.2732E+00	0.9122E-01	-0.1062E-02	0.5431E+02
1820.0	5.49	-1.81	-0.59	0.8309E-15	-0.49	1.58	0.2000E-01	0.4658E-03	0.1854E+00	0.2462E+00	0.7528E-04	0.1434E+02
1895.0	5.76	-2.20	-0.36	0.7783E-15	-0.79	1.54	-0.1000E-01	0.7140E-04	0.1318E+00	0.3454E-01	0.1059E-03	-0.1268E+01
1970.0	5.49	-2.27	-0.02	0.6024E-15	-0.19	2.09	-0.3300E+00	0.1488E-03	-0.6108E-01	-0.2106E-01	0.2968E-03	-0.5438E+01
2045.0	6.22	-1.42	-0.25	0.7015E-15	-0.59	1.46	0.2000E-01	0.3861E-04	0.3767E-01	0.1322E-01	-0.3256E-03	0.1338E+02
2120.0	6.46	-1.34	-0.28	0.1148E-14	-0.29	1.44	-0.2000E-01	0.7493E-04	0.3057E-01	0.1896E+00	-0.1418E-02	0.5485E+02
2195.0	7.04	-0.43	-0.22	0.1632E-14	0.91	1.55	-0.2000E-01	0.8142E-04	0.5025E-01	0.6506E-01	-0.9704E-03	0.3864E+02
2270.0	7.57	0.04	-0.24	0.1026E-14	-1.49	1.35	0.0000E+00	0.9350E-05	-0.3531E-01	0.1191E+00	-0.3349E-03	0.1265E+02
2345.0	7.91	0.25	-0.20	0.6300E-15	-5.39	0.85	0.4000E-01	0.3279E-04	-0.1152E+00	-0.1602E+00	-0.5563E-03	0.2164E+02
2420.0	7.36	-0.33	-0.13	0.5832E-15	-4.19	0.95	0.6000E-01	0.1419E-04	0.2674E+00	-0.4843E-01	-0.1300E-02	0.4826E+02
2495.0	8.86	1.47	-0.38	0.5380E-15	-3.49	0.81	-0.1000E-01	0.8895E-04	-0.1272E+00	-0.1751E+00	0.2073E-02	-0.7288E+02
2570.0	7.45	1.38	-0.27	0.9648E-15	-1.69	1.37	0.3000E-01	0.1403E-03	-0.5342E-01	-0.1866E+00	0.7614E-04	0.2356E+01
2645.0	8.48	1.64	-0.32	0.3442E-14	-1.09	1.57	-0.2000E-01	0.6266E-04	0.5349E-02	-0.8522E-01	-0.6847E-04	0.4817E+01
2720.0	9.37	1.38	-0.35	0.4246E-14	-0.99	1.69	0.1000E-01	0.2477E-03	-0.6811E-01	-0.1967E+00	-0.8204E-03	0.3924E+02
2795.0	9.59	0.63	-0.25	0.2389E-14	-2.19	1.36	0.3000E-01	0.6420E-04	-0.8760E-01	-0.2057E-01	0.3267E-03	-0.9643E+01
2870.0	10.23	0.10	-0.24	0.1943E-14	0.91	1.53	-0.1400E+00	0.2012E-03	-0.7239E-02	-0.7053E-01	-0.2914E-03	0.1809E+02
2945.0	10.86	-0.12	-0.33	0.1366E-14	1.61	1.42	-0.2000E-01	0.9132E-04	-0.1105E+00	-0.6134E-01	0.1237E-02	-0.4208E+02
3020.0	12.07	-0.19	-0.62	0.6497E-15	-3.49	1.01	0.3000E-01	0.9999E+04	0.9999E+04	0.9999E+04	0.9999E+04	0.9999E+04
3095.0	9999.00	9999.00	-0.62	0.1045E-14	1.93	2.02	-0.1900E+00	0.5694E-03	0.9999E+04	0.9999E+04	0.9999E+04	0.9999E+04
3170.0	11.15	4.68	-0.74	0.9882E-15	-1.19	2.14	0.0000E+00	0.3965E-03	0.9999E+04	0.9999E+04	0.9999E+04	0.9999E+04
3245.0	9.79	3.51	-0.05	0.9995E-15	9999.00	9999.00	0.9999E+04	0.5069E-04	0.9999E+04	0.9999E+04	0.9999E+04	0.9999E+04
3395.0	5.91	7.43	-0.24	0.7720E-15	9999.00	9999.00	0.9999E+04	0.6901E-04	0.9999E+04	0.9999E+04	0.9999E+04	0.9999E+04
3470.0	6.01	6.72	0.04	0.1952E-14	9999.00	9999.00	0.9999E+04	0.7625E-04	-0.1743E+00	-0.7563E-01	0.8784E-03	-0.2947E+02
3545.0	7.10	6.43	0.01	0.1183E-13	9999.00	9999.00	0.9999E+04	0.5654E-05	-0.1282E+00	-0.2052E+00	0.7876E-03	-0.2872E+02
3620.0	8.02	6.04	-0.02	0.3197E-13	-0.79	1.29	-0.1000E-01	0.2920E-04	-0.6037E-01	0.2758E-01	0.7737E-03	-0.2735E+02
3695.0	8.57	5.44	0.06	0.2496E-13	0.31	1.33	-0.9000E-01	0.6914E-04	-0.6603E-01	-0.7875E-01	-0.5474E-03	0.2265E+02
3770.0	8.16	4.88	-0.01	0.1573E-13	-1.99	1.91	-0.3000E-01	0.4186E-04	-0.3475E+00	-0.4156E-02	-0.2837E-04	0.2580E+01
3845.0	8.58	3.58	-0.17	0.4646E-14	-0.69	1.63	0.1600E+00	0.1244E-03	-0.9250E-01	-0.2366E+00	-0.5578E-02	0.2095E+03
3920.0	11.16	0.17	-0.39	0.2080E-14	-1.99	1.37	0.0000E+00	0.7525E-04	0.9999E+04	0.9999E+04	0.9999E+04	0.9999E+04

Figure 2: **Table 2**

Table 2 is an example of a data table. It begins with 2 special lines followed by lines of data of 13 parameters including height (13 columns) arranged by measurement level. Note that the number 9999 indicates the absence of measurements or a parameter value considered as bad. We give below an explanation of each parameter of the table:

- *First line:*
  - **DATE:** date (UTC) (yymmdd) of the vertical profile.
  - **HOUR:** mean hour of the data used to obtain the vertical profile (UTC) (hhmmss).
  - **NLEV:** effective number of height levels (the number of the data lines of the table) of the vertical profile presented in the table. When for a level all the 12 physical parameters are set to 9999 the corresponding data level is not written. This explains why in the present example the number of levels is 42 whereas according to the header block the maximum data level should have been 95.
  - **ALT Zi:** altitude Zi of the atmospheric boundary layer (in meters above sea level). Zi is considered to be located at a local maximum of reflectivity. Among several possible candidates, 3 heights are selected and ordered in decreasing reflectivity. The first one has the maximum probability to correspond to the ABL height. These values are meaningless during precipitation events.
  - **ALT Zt:** Altitude of the tropopause (in meters above sea level) Zt is considered to be located at a local maximum of reflectivity. Among several possible candidates, 3 heights are selected and ordered in decreasing reflectivity. The first one has the maximum probability to correspond to the tropopause height. Except in precipitation event UHF signal does not reach the tropopause level, and during precipitation a maximum in reflectivity has theoretically no link with the tropopause at UHF band. Only with a VHF radar it is possible to locate the tropopause height. So do not use these values.
- *Second line:* parameters name and units associated with each data column
  - **ALT:** altitude in meters above sea surface of the data of the line.
  - **U:** zonal wind component in ms^{-1} positive toward east.
  - **V:** meridian wind component in ms^{-1} positive toward north.
  - **W:** vertical wind component in ms^{-1} positive upward. This component comes from a linear least square fit of the five radial velocity measurements under the assumption of local horizontal homogeneity of the wind.
  - **CN2:** reflectivity in units of air refractivity index structure constant C_n^2 in $m^{-2/3}$. This quantity represents the median value of the measurements made by the five beams. Calibration of the profiler was not yet made for this period. We have used here an old radar calibration constant and we think that uncertainty in the reflectivity value is in the range of 6 dB. Calibration of the radar will be made when airborne measurements or disdrometer data will be available.

- **ASPT:** it represents the aspect ratio in dB of the reflectivity measured by the vertical beam over the mean reflectivity observed by the 4 oblique beams. The normal value is 0, i.e. on the average backscattering at UHF band is not a function of the incidence angle. This ratio can bring insight on the data quality (interpretation only reserved for an exercised user).
- **2STDw:** two times the standard deviation of the selected spectral peak of the vertical beam. It is also called the Doppler spectral width. It is written in ms^{-1}.
- **SKEW W:** the third order moment (skewness) of the selected spectral peak of the vertical beam. It is normalized with the standard deviation of the peak and so it is a non-dimension number.
- **EPSI:** dissipation rate of turbulent kinetic energy ϵ written in m^2s^{-3} . It is derived from the Doppler spectral width under the main assumption of a turbulence following the requirements of the Kolmogorov inertial subrange theory. The general retrieval technique was assessed. The given value, which is the median of the estimation deduced with the five beams, is only significant in clear air.
- **U'W' and V'W':** turbulent vertical momentum flux of the zonal and meridian component of the wind written in m^2s^{-2} . These quantities are derived from the spectral width of the oblique beams using the fact that there are two pairs of beams opposed in azimuth. Error analysis shows that these two retrieved turbulent moments have a very large statistical fluctuation. So in order to get a stable value, an average over consecutive gates and over successive profiles (at least 1 hour) seems necessary. Contrary to ϵ there is no assessment of the retrieval technique. In particular the main default is that the moments are representative of the turbulent scales smaller than the pulse dimension (100 to 400 m at the most) when turbulent scales range up to 1 to 3 km. So our advice is to use these moments and the two others variables deduced from them with great caution. A validation and improvement of the technique are in progress. On an other hand these values are only significant in clear air.
- **-U'W'DU/DZ:** the turbulence mechanical production rate : -(u'w'du/dz+v'w'dv/dz) written in m^3s^{-3} . It makes use of the radar measurement of the vertical profile of the wind components and on the turbulent momentum fluxes retrieved by the profiler (explained above). Value only significant in clear air.
- **W'T':** vertical turbulent flux of temperature expressed in Wm^{-2} . This flux is deduced from the turbulent kinetic energy (TKE) budget equation using the assumption of the stationarity of TKE and negligible horizontal advection. The above 4 turbulent parameters retrieved by the profiler are used. Value only significant in clear air.

- *Data lines:*

  There are $NLEV$ data lines ordered in increasing altitude. All the lines are written with the same data format given in FORTRAN as:

format(f8.1,2x,f7.2,3x,f7.2,3x,f7.2,2x,e11.4,1x,f7.2,1x,f7.2,3x,e11.4,e11.4,e11.4,e11.4,3x, e11.4,3x,e11.4)

4 UHF Observations during BLLAST

We present in the following time-height cross-sections of parameters provided by the UHF profiler in Campistrous (low mode and high mode) for the whole 10 June 2011 − 05 July 2011 period and for the 11 IOPs. The parameters shown are: wind velocity, vertical velocity, median reflectivity, median epsilon, skewness and aspect ratio. The vertical beam noise density, extracted from the Doppler spectra, is also provided at the end.

Strong negative values of wind vertical velocity associated with strong reflectivity values indicate rain episods. IOP's occurred outside these rainy events. This rain episods will be used later on for the radar calibration in order to calculate rain amounts.

The spectral noise density is constant on average, indicating that the working conditions remained the same. Variation of this value would have been connected to the change of the working parameters of the radar (due to temperature for instance), or to its mode of measurement (spreading and leakage of strong echoes can artificially increase the noise level).

Winds are most of the time westerlies but rather frequent easterlies occur in the lower levels which results in a strong shear. Under the BLLAST conditions, the strong shear area is very often associated with a strong gradient in the reflectivity values. Usually, the boundary layer top is taken as the reflectivity maximum in the lower layers. Here, attention will have to be paid to select the right value among the 3 local reflectivity maxima that are provided.

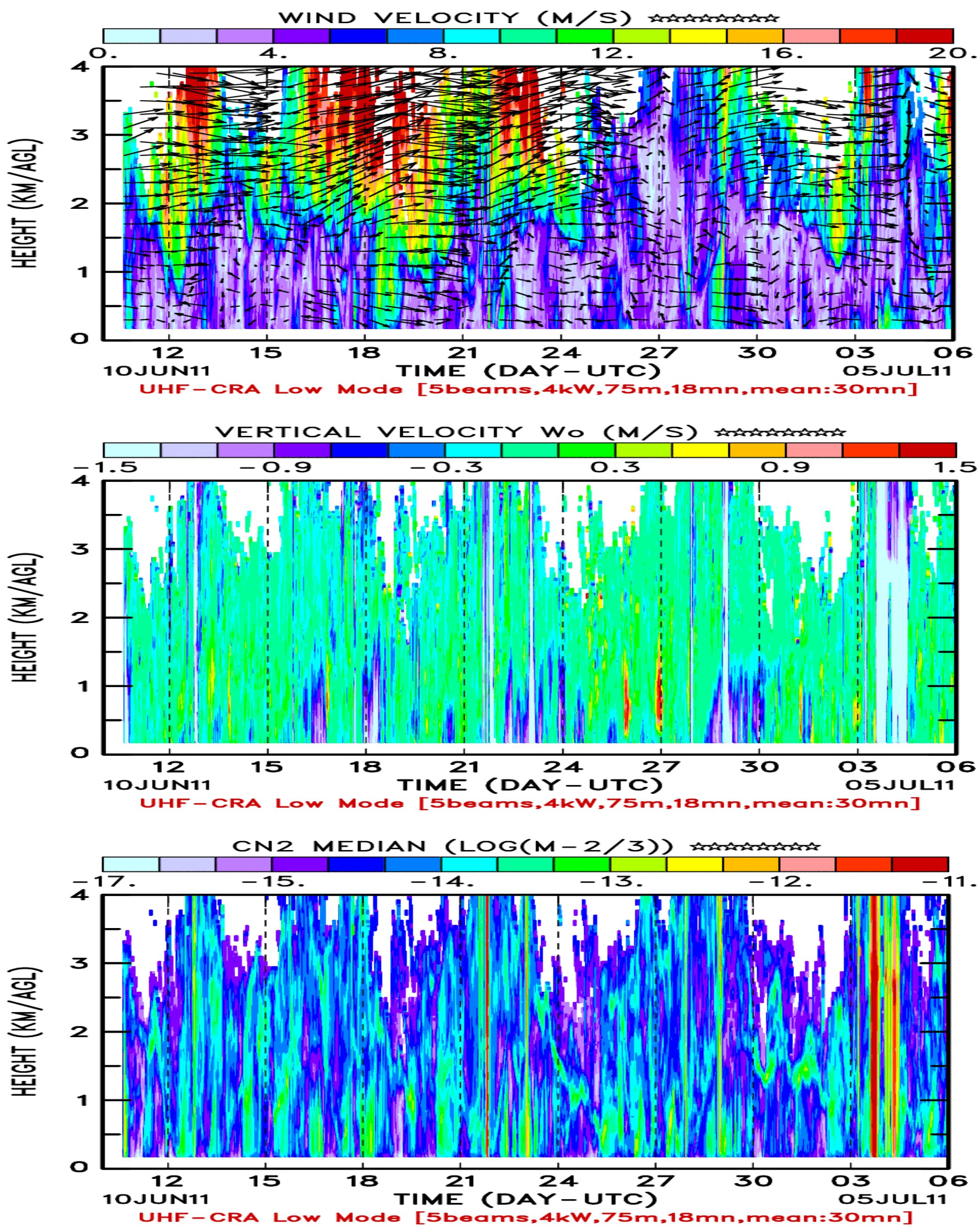
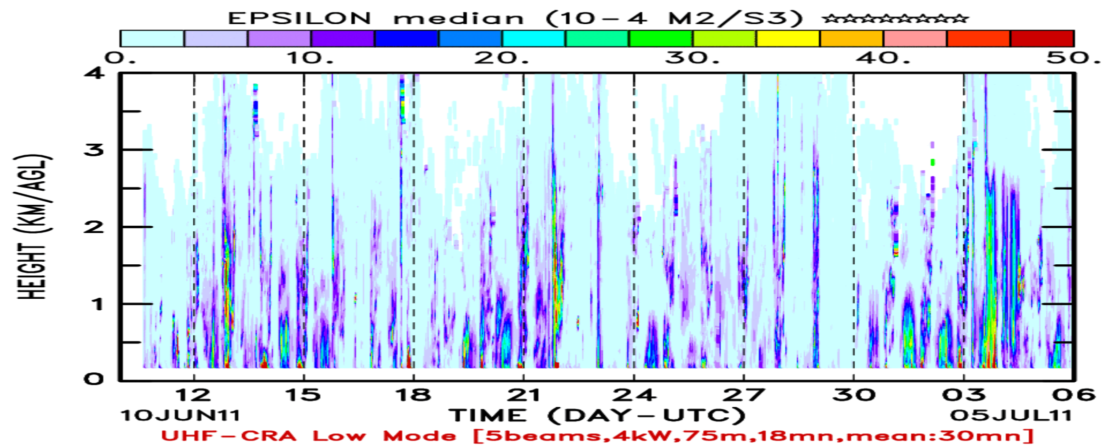
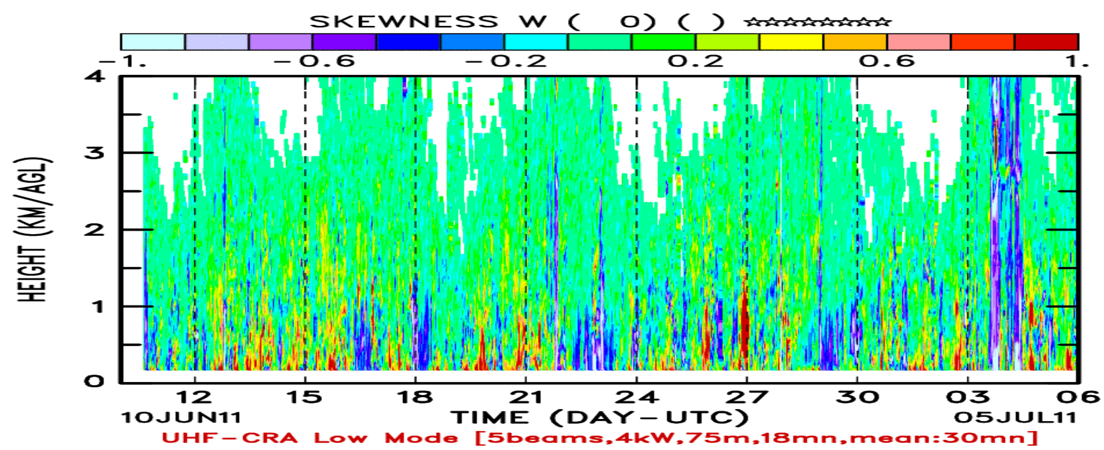


Figure 3: **Whole period: Low mode**





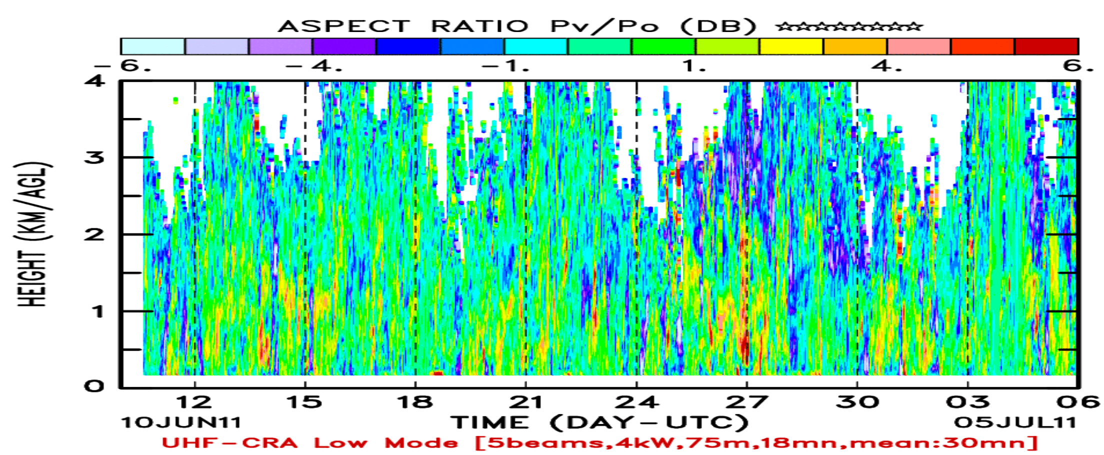


Figure 4: **Whole period: Low mode (continued)**

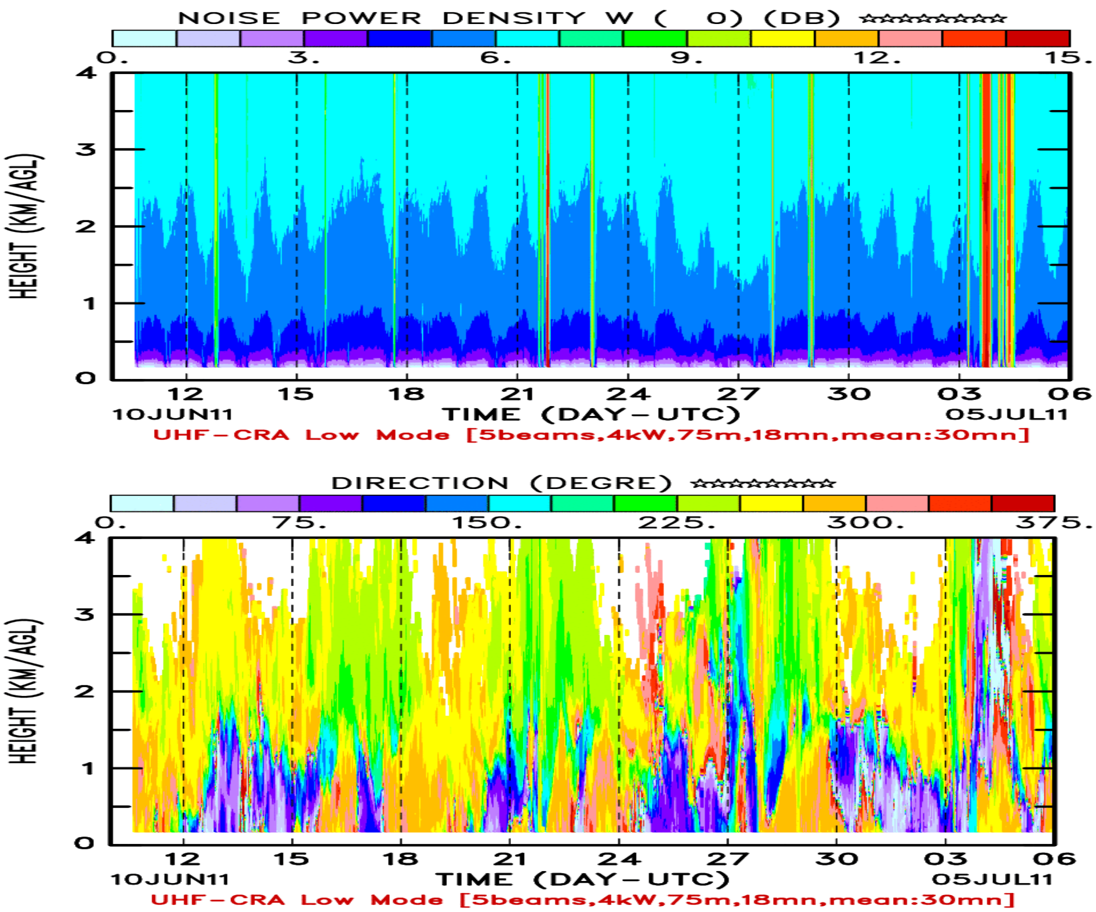


Figure 5: **Whole period: Low mode (continued)**

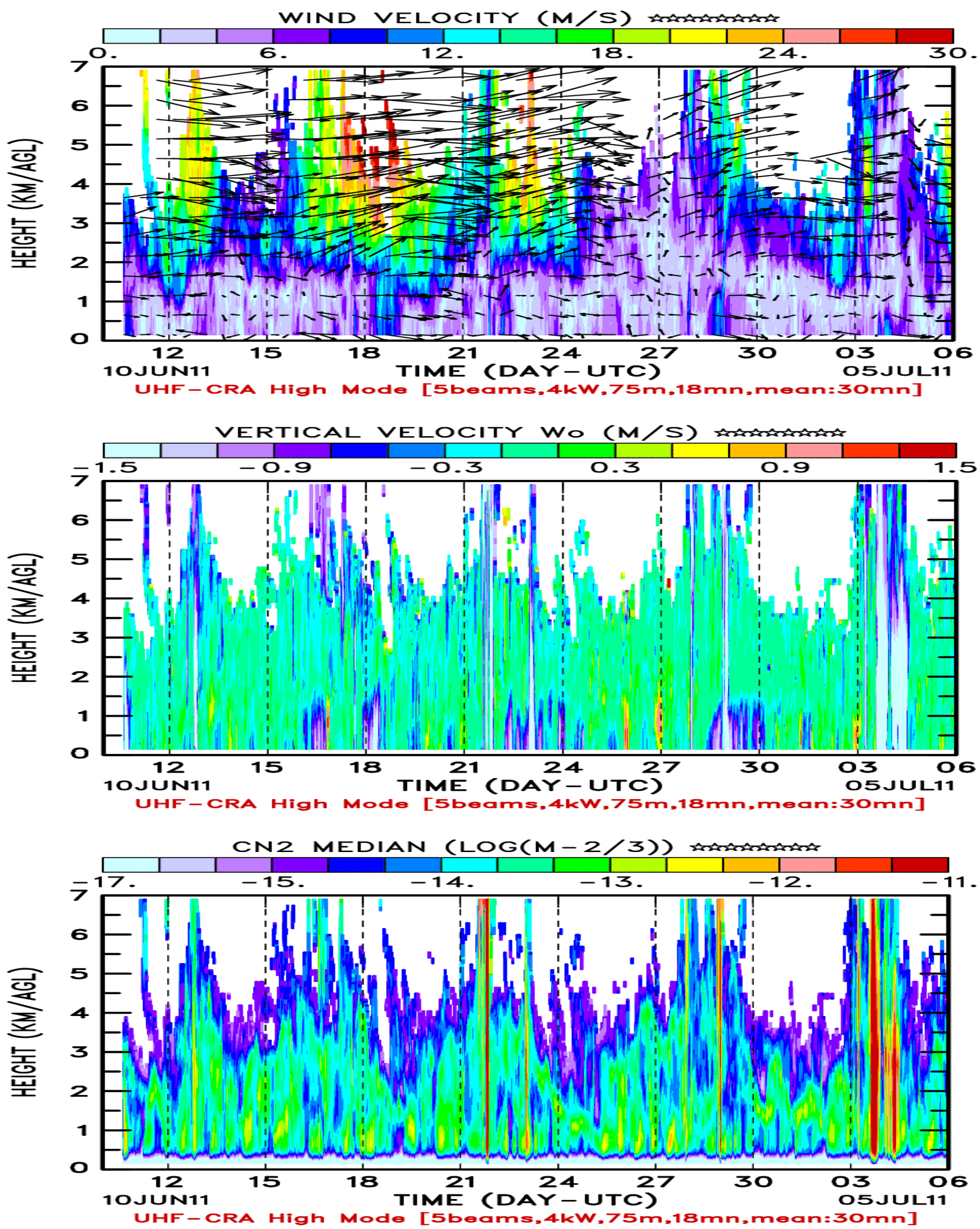


Figure 6: **Whole period: High mode**

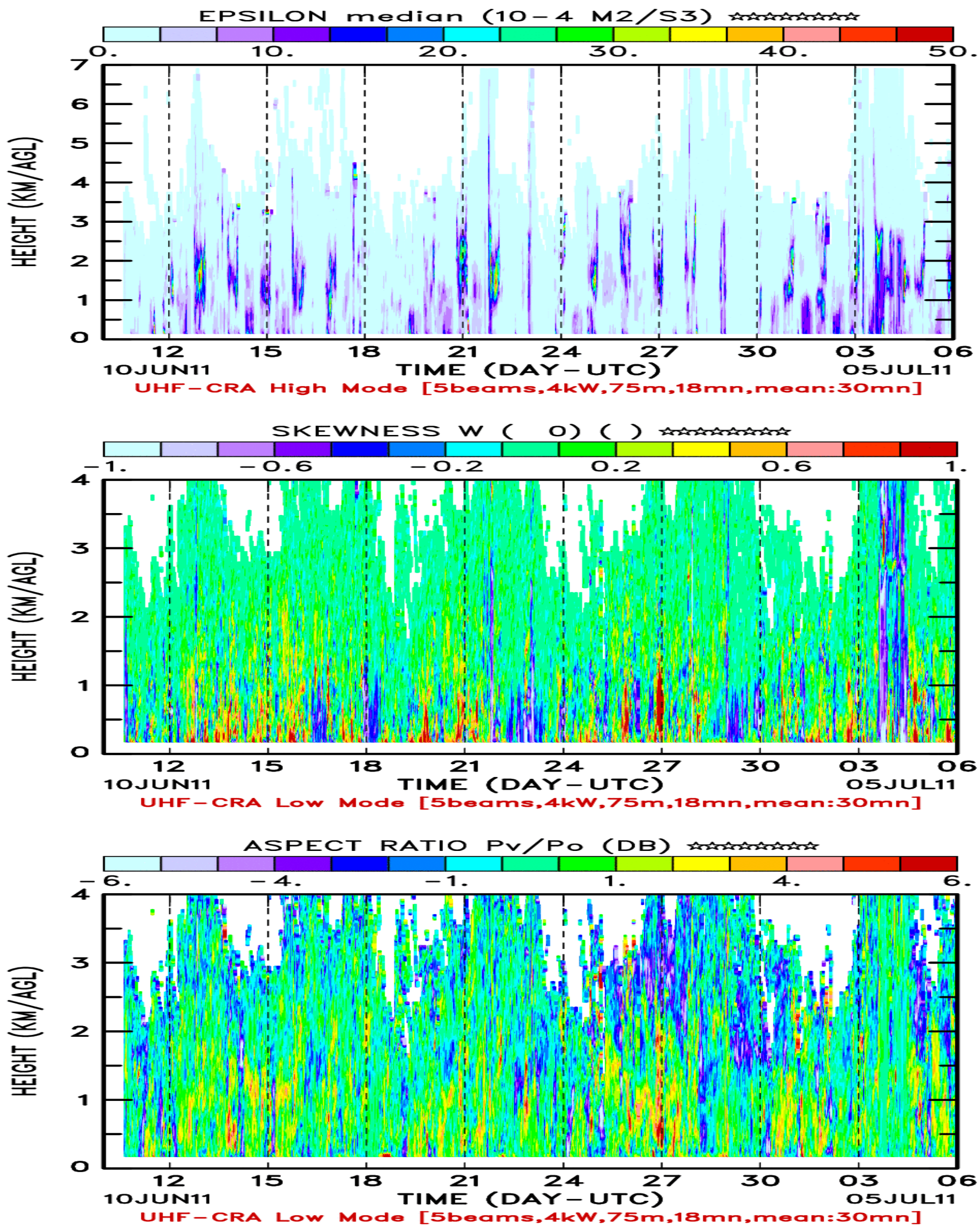
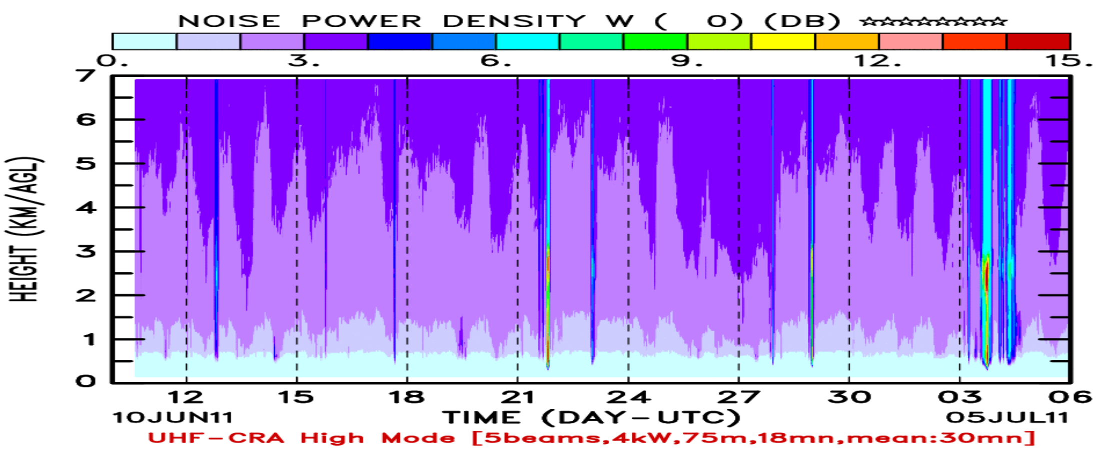


Figure 7: **Whole period: High mode (continued)**



cm

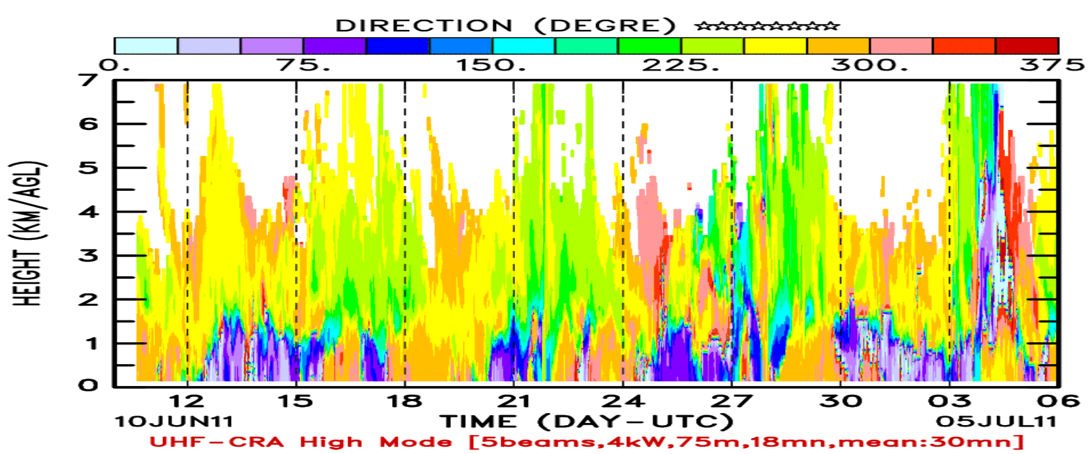


Figure 8: **Whole period: High mode (continued)**

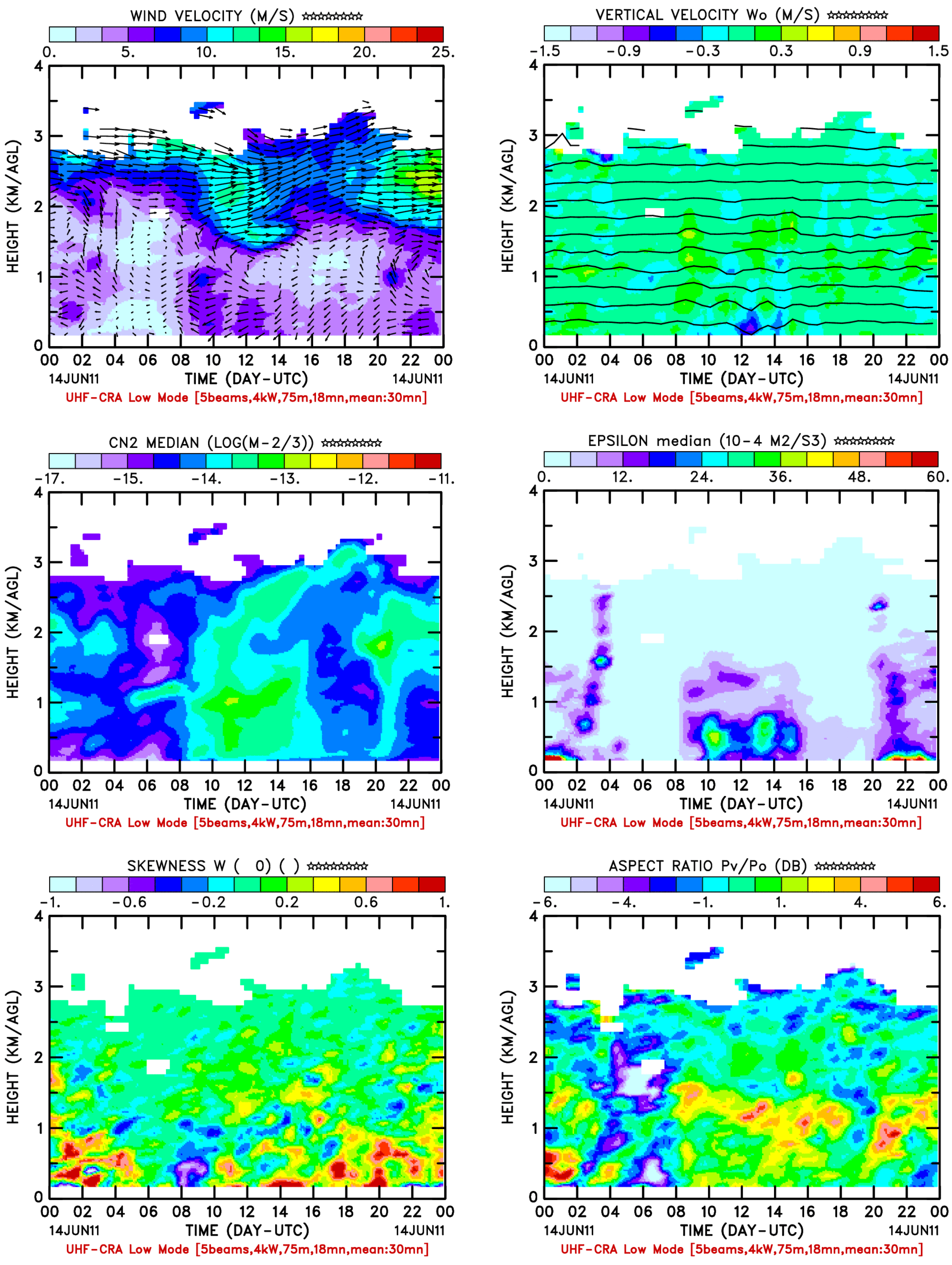


Figure 9: **IOP1 : 2011/06/14 : Low mode**

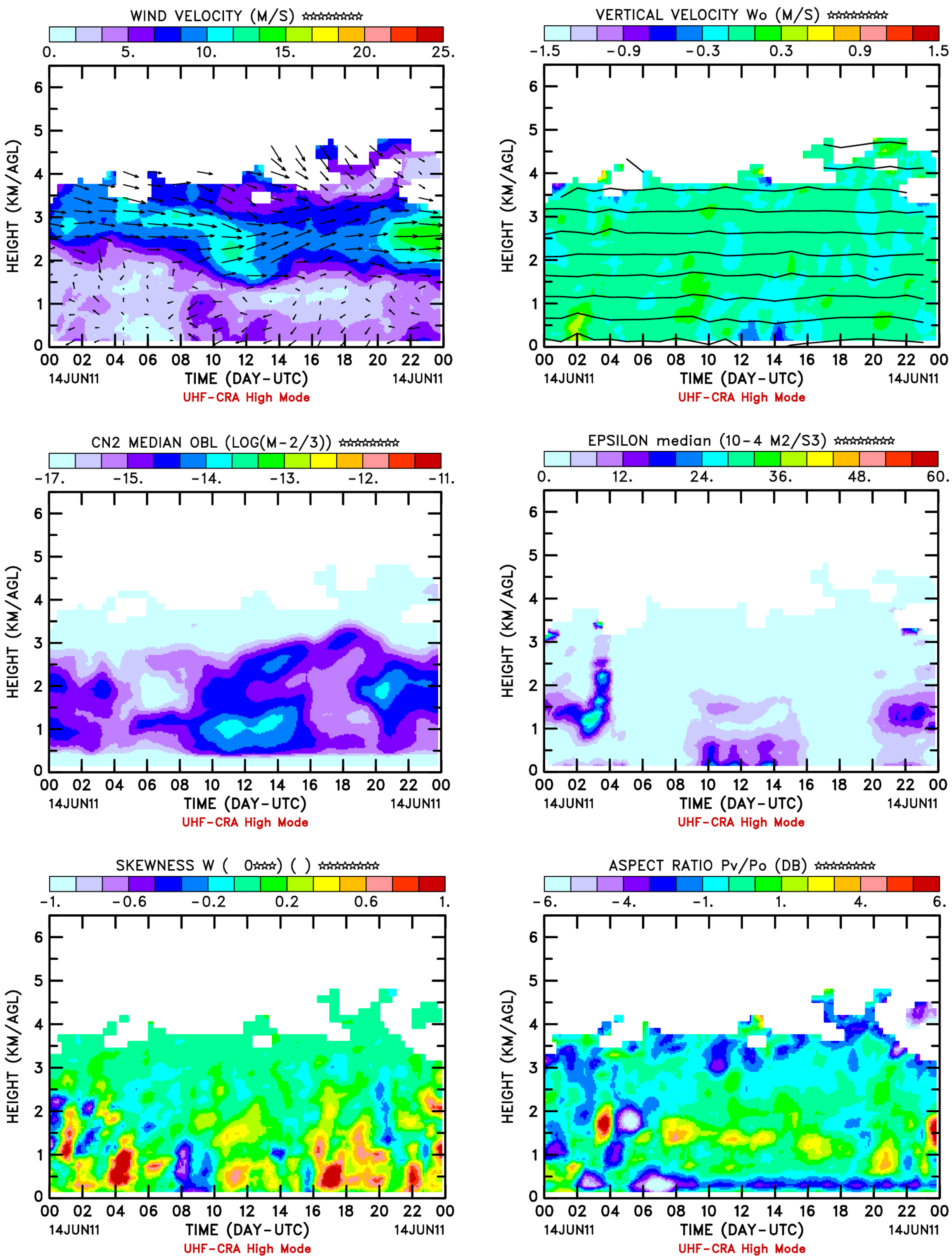


Figure 10: **IOP1 : 2011/06/14 : High mode**

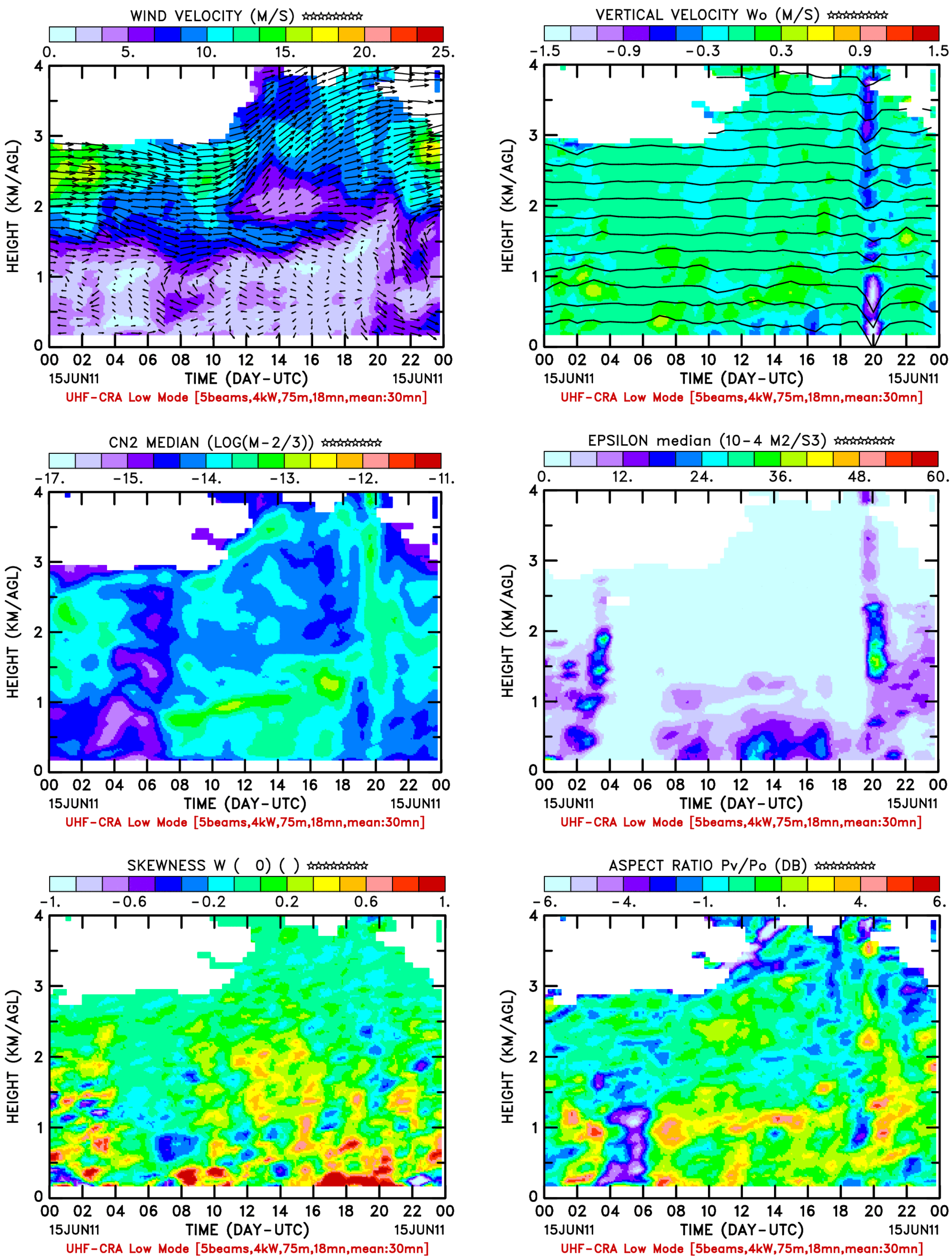


Figure 11: **IOP1 : 2011/06/15 : Low mode**

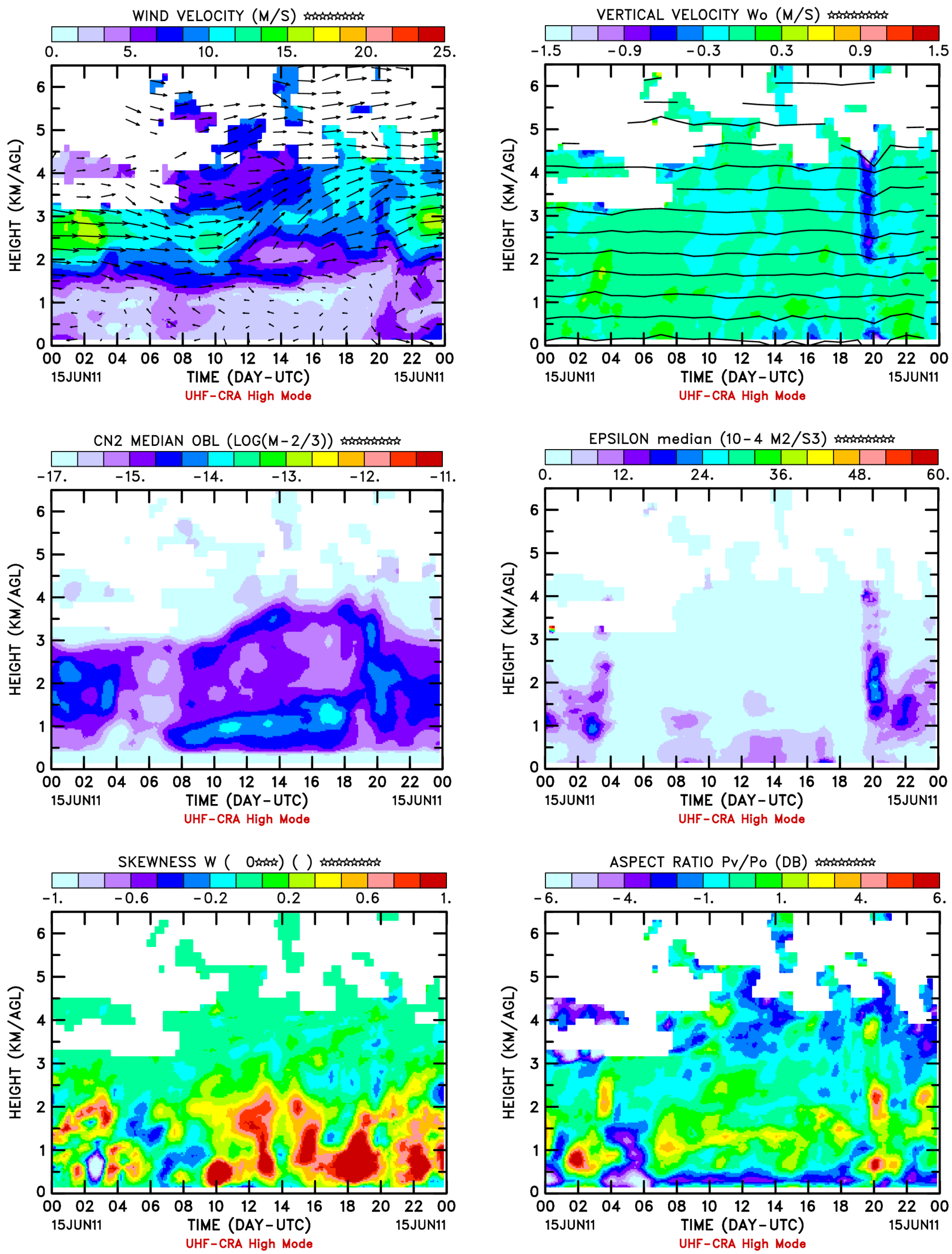


Figure 12: **IOP1 : 2011/06/15 : High mode**

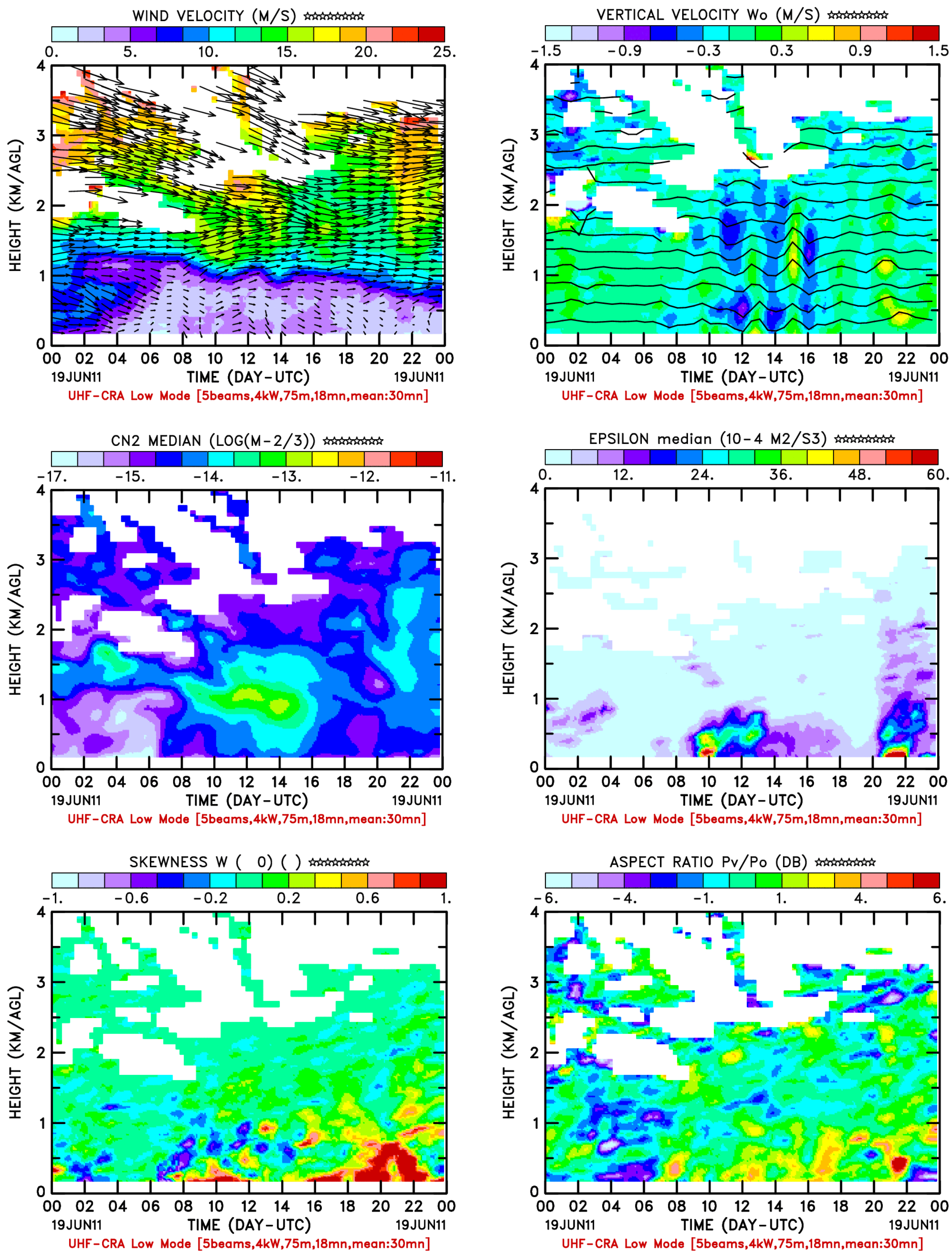


Figure 13: **IOP2 : 2011/06/19 : Low mode**

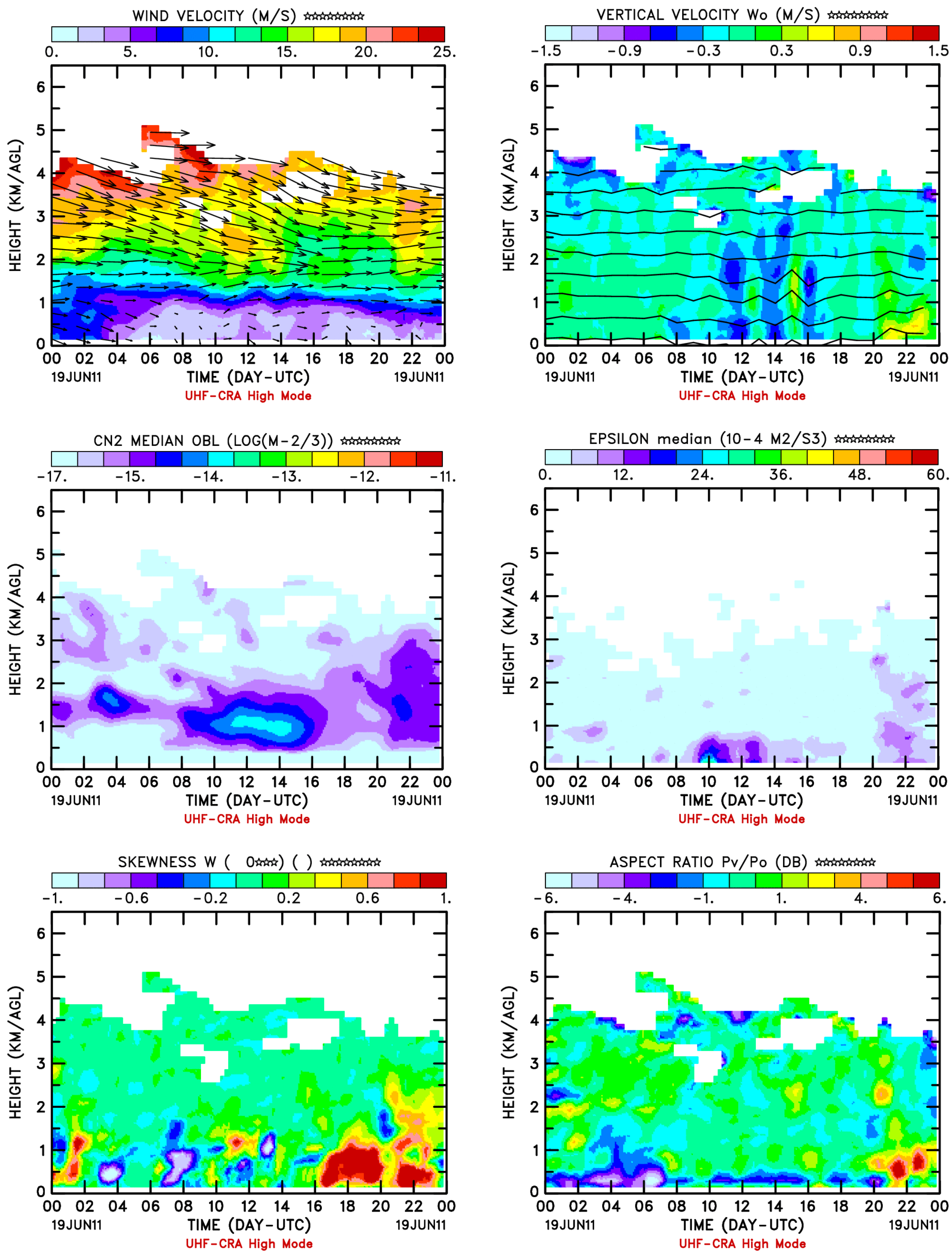


Figure 14: **IOP2 : 2011/06/19 : High mode**

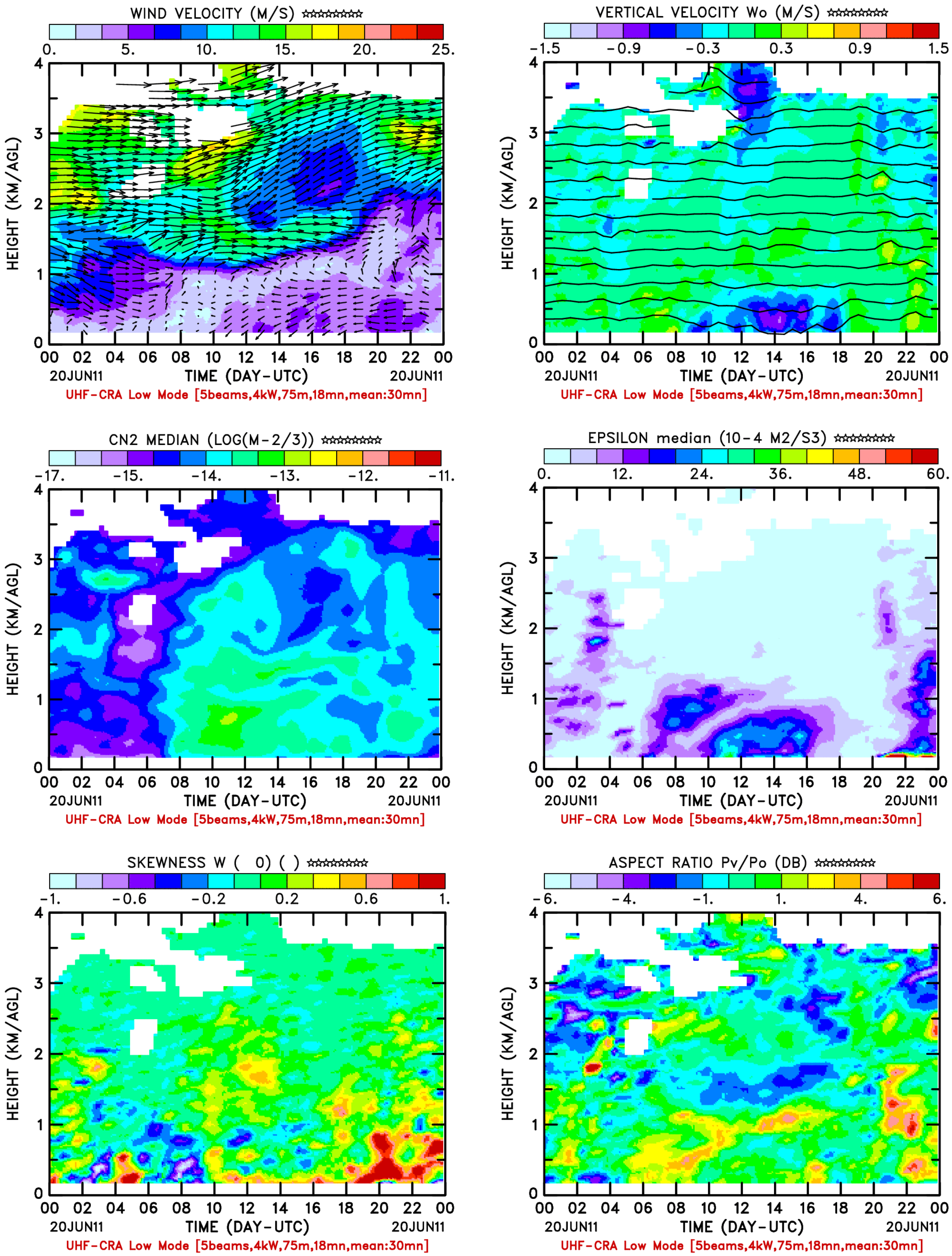


Figure 15: **IOP3 : 2011/06/20 : Low mode**

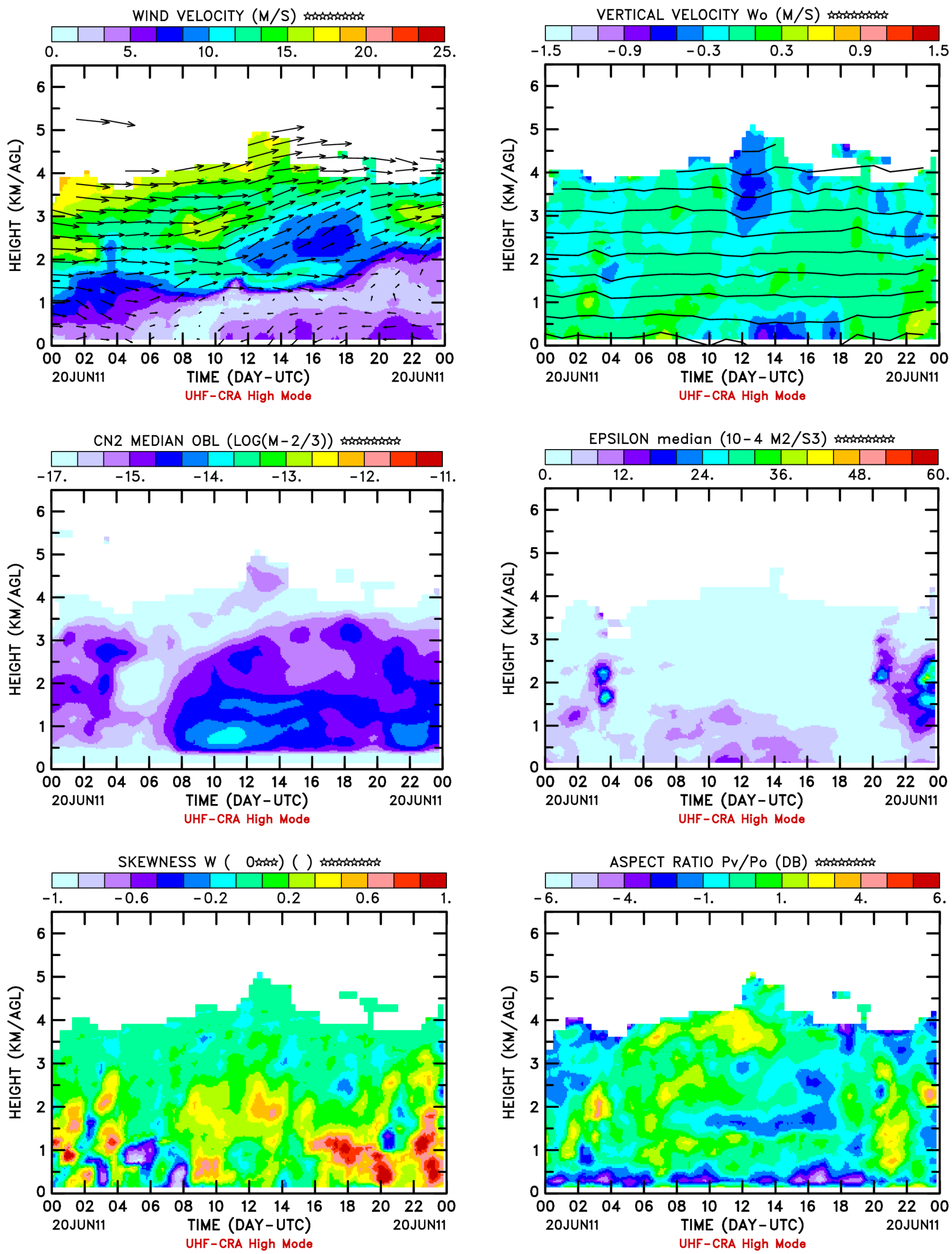


Figure 16: **IOP3 : 2011/06/20 : High mode**

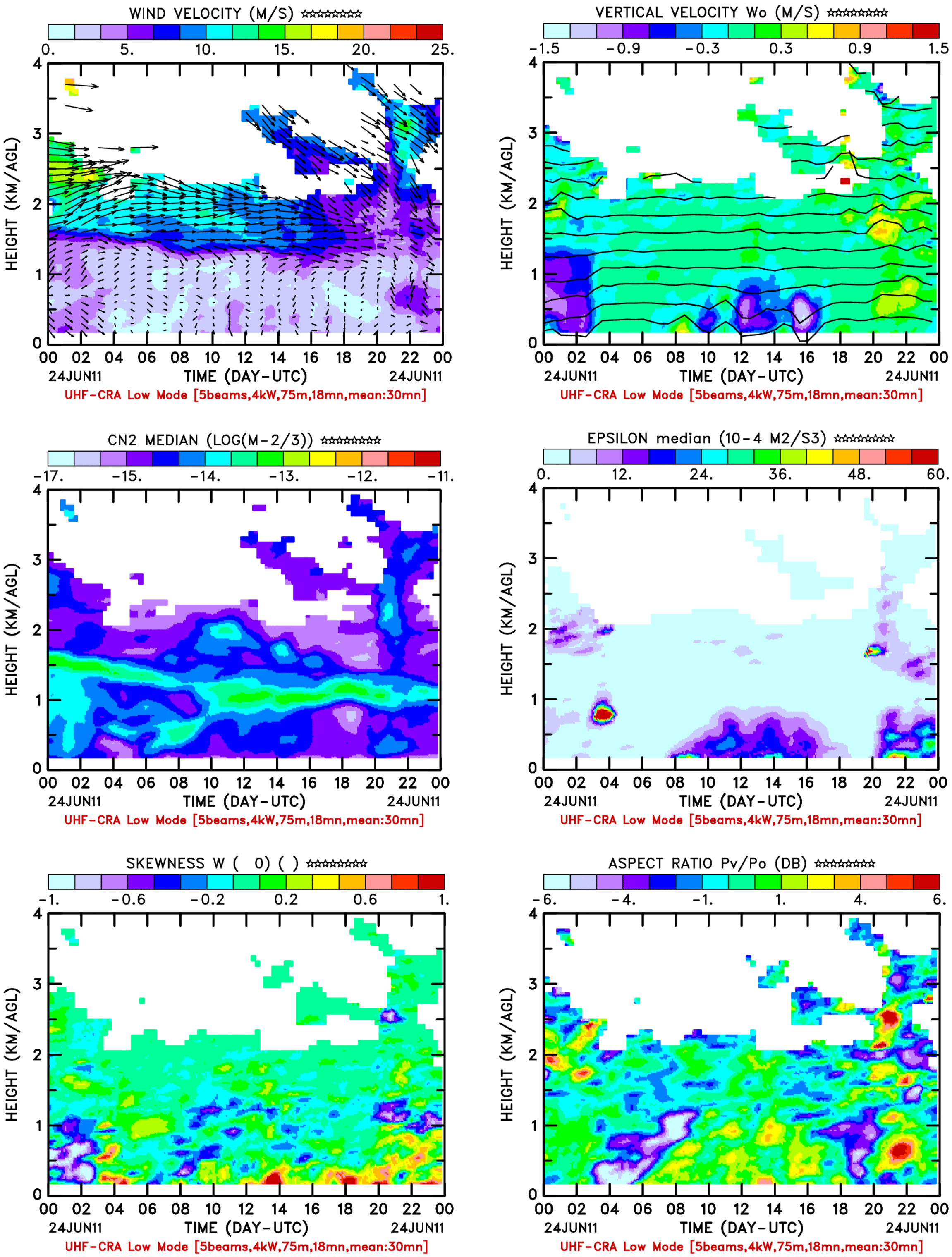


Figure 17: **IOP4 : 2011/06/24 : Low mode**

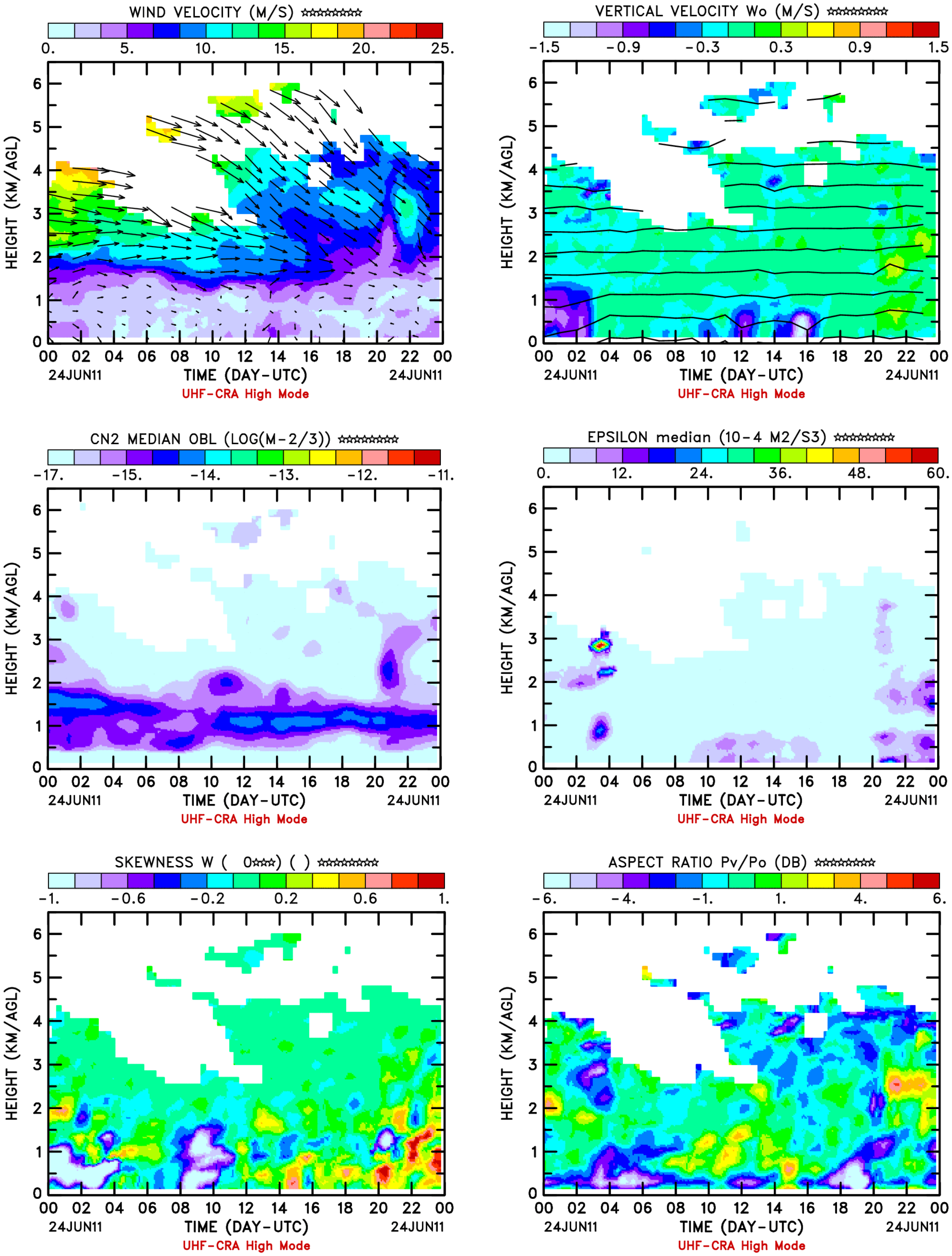


Figure 18: **IOP4 : 2011/06/24 : High mode**

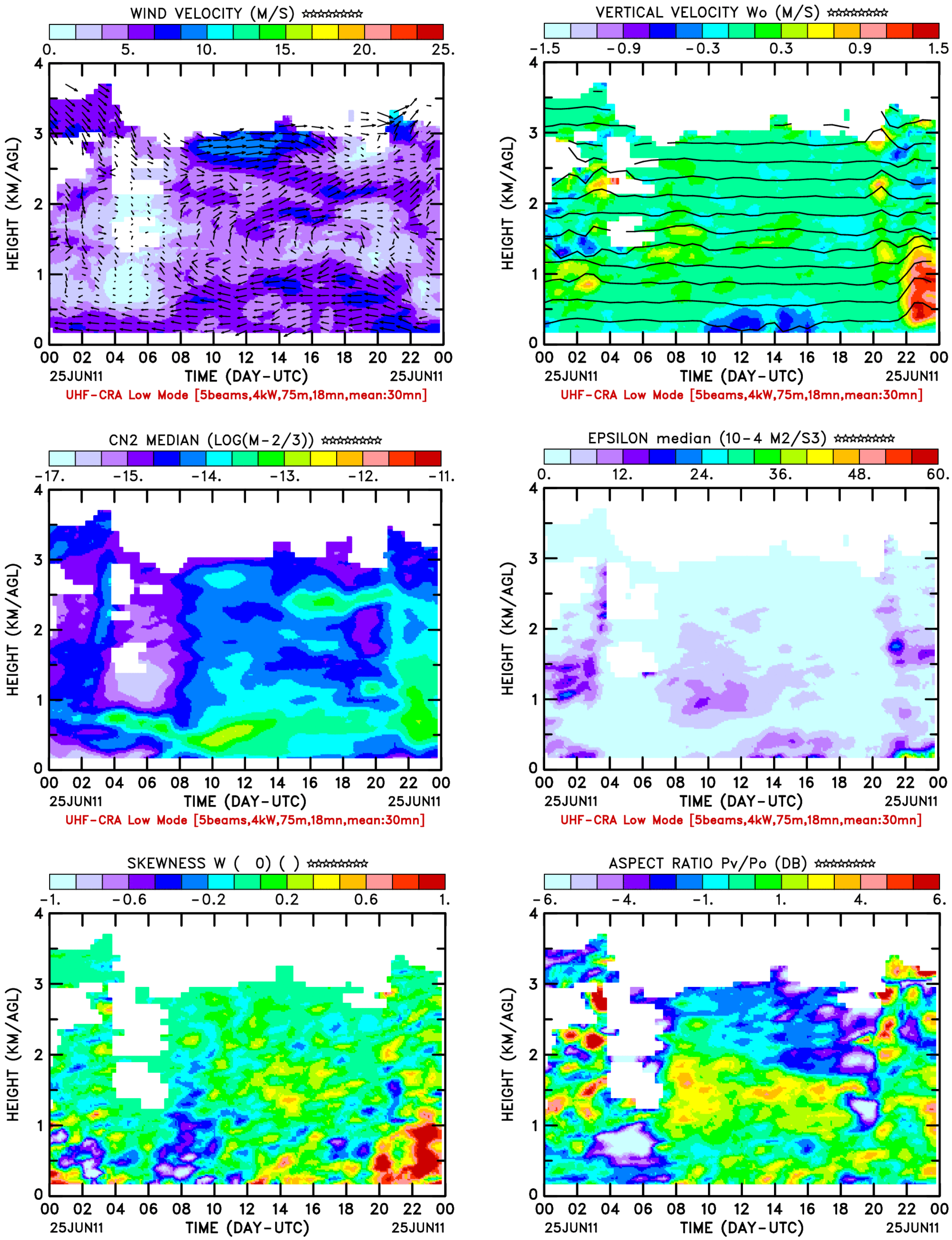


Figure 19: **IOP5 : 2011/06/25 : Low mode**

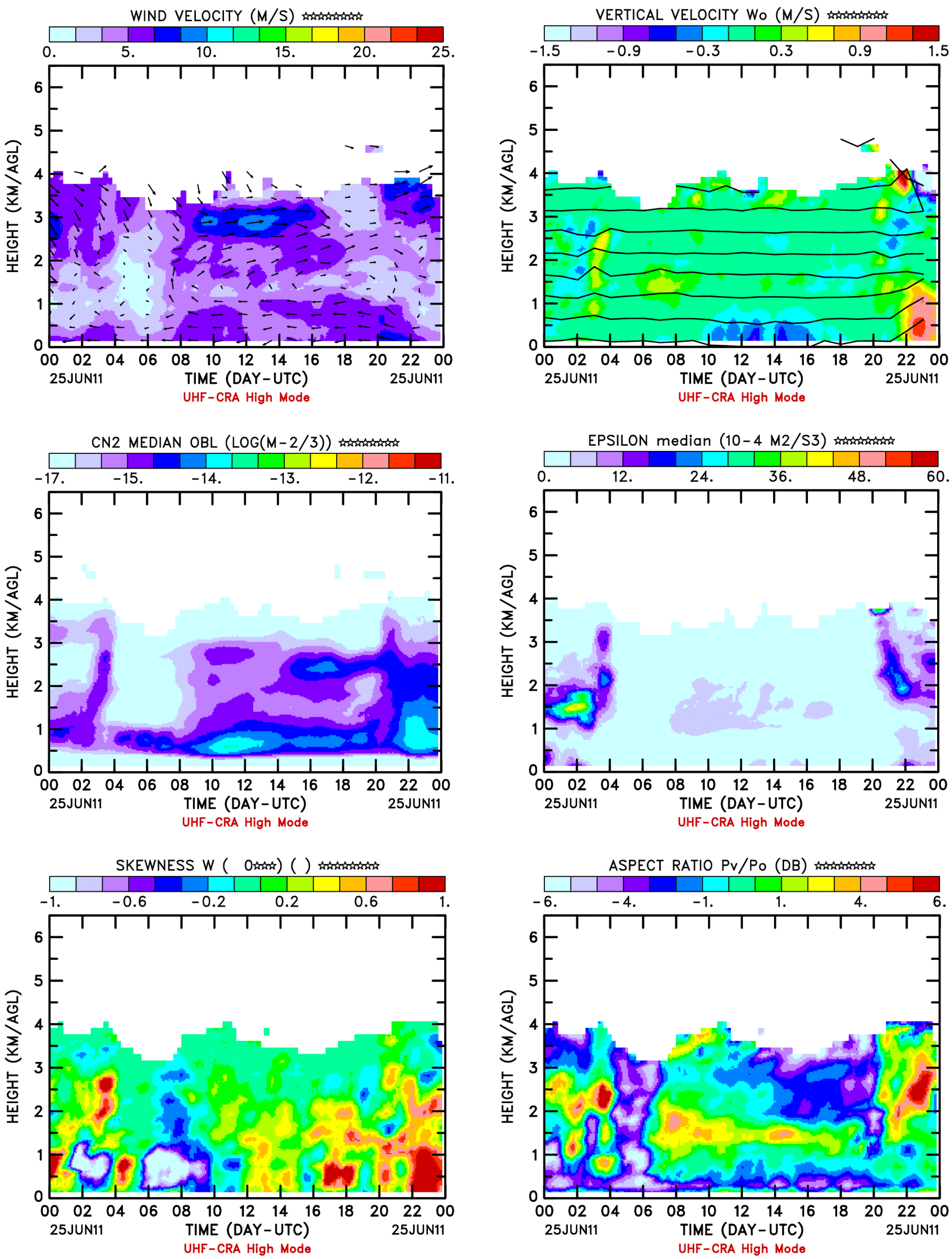


Figure 20: **IOP5 : 2011/06/25 : High mode**

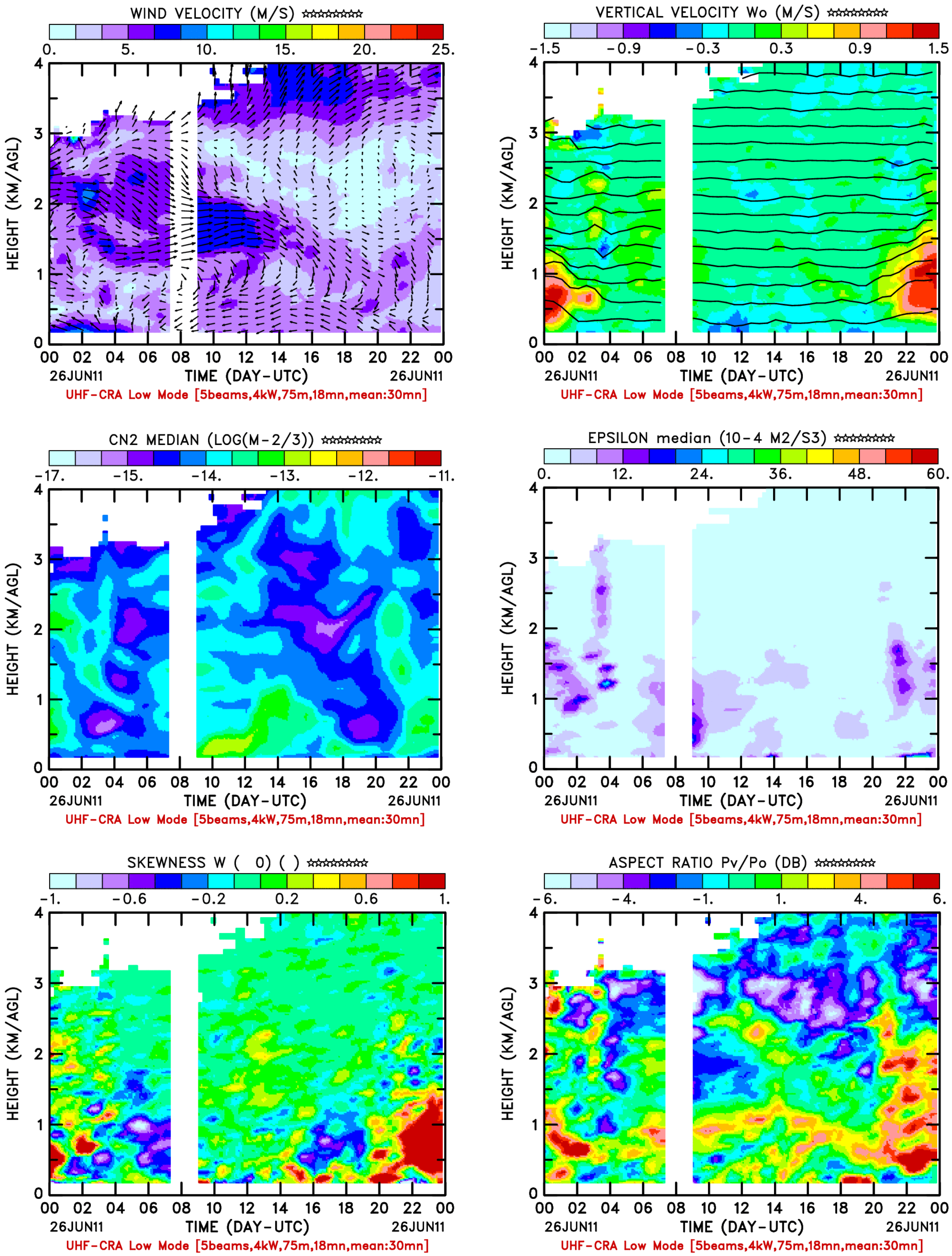


Figure 21: **IOP6 : 2011/06/26 : Low mode**

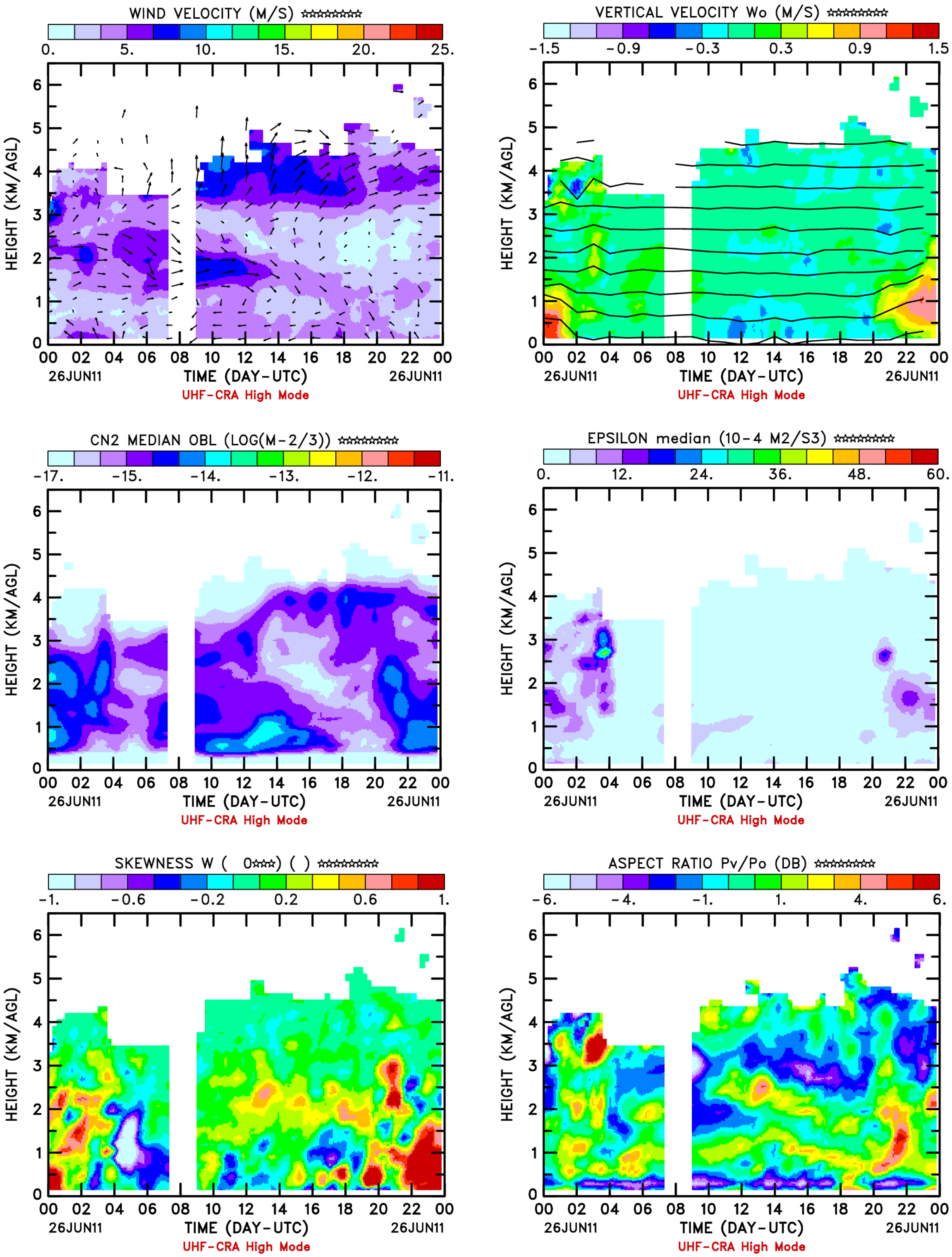


Figure 22: **IOP6 : 2011/06/26 : High mode**

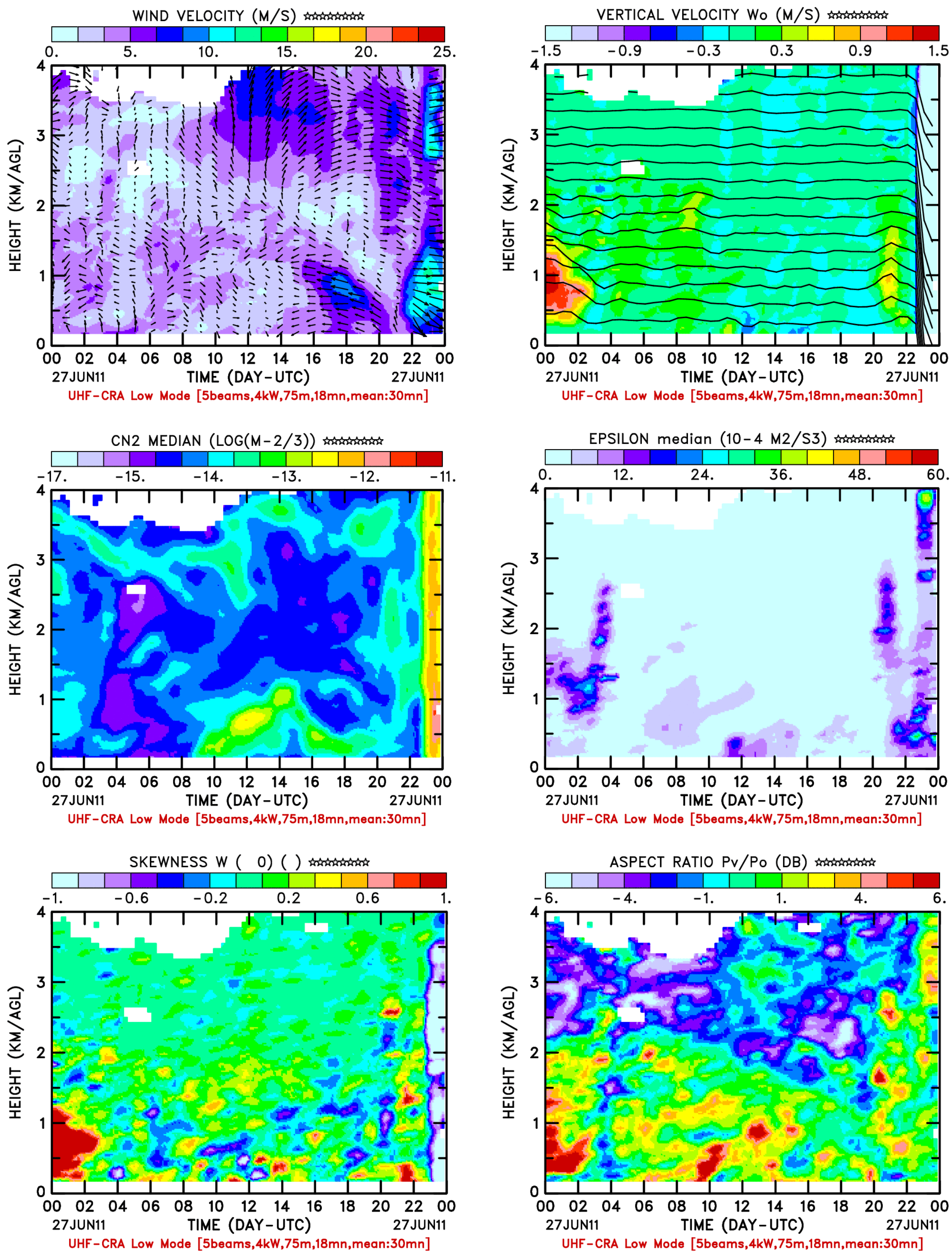


Figure 23: **IOP7 : 2011/06/27 : Low mode**

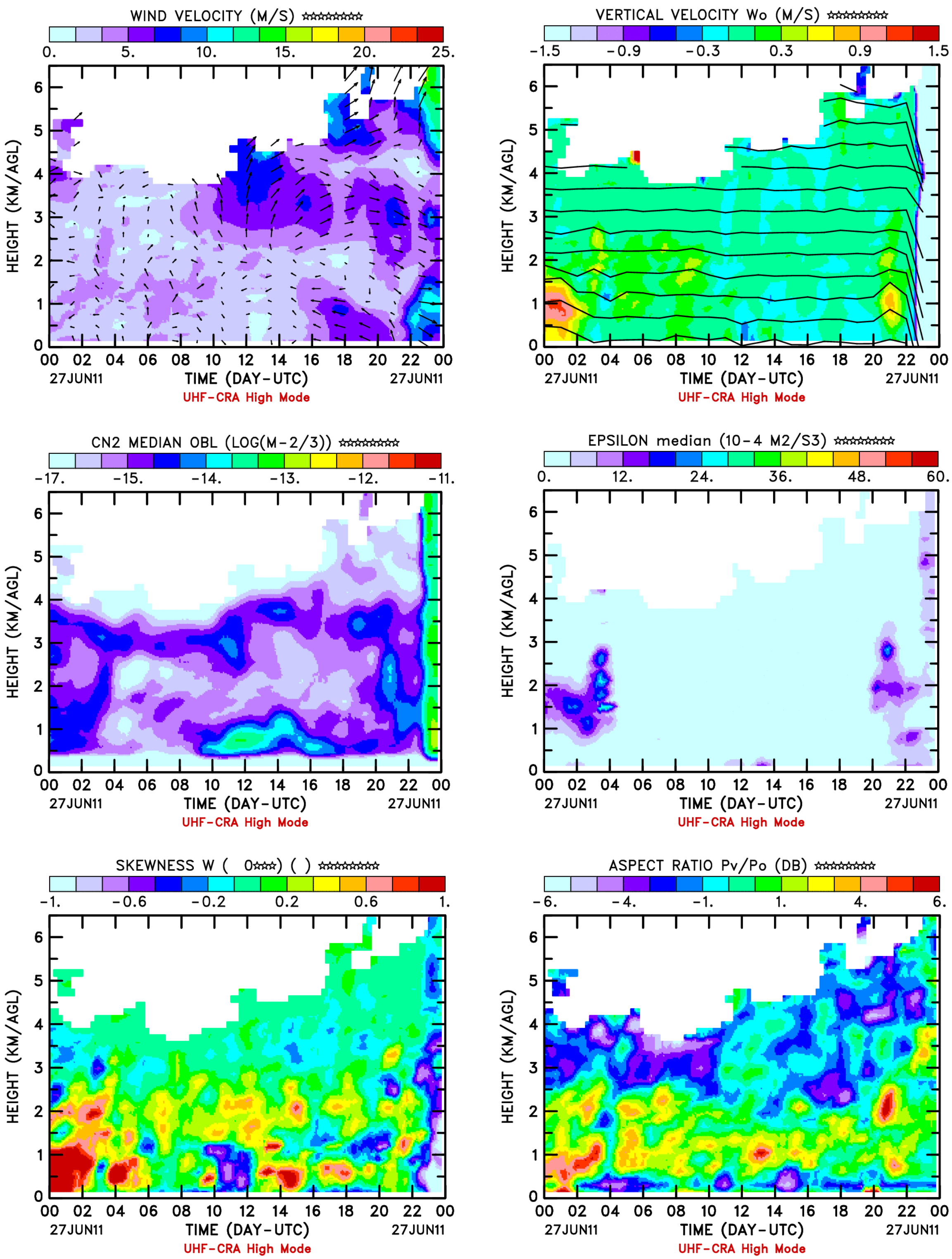


Figure 24: **IOP7 : 2011/06/27 : High mode**

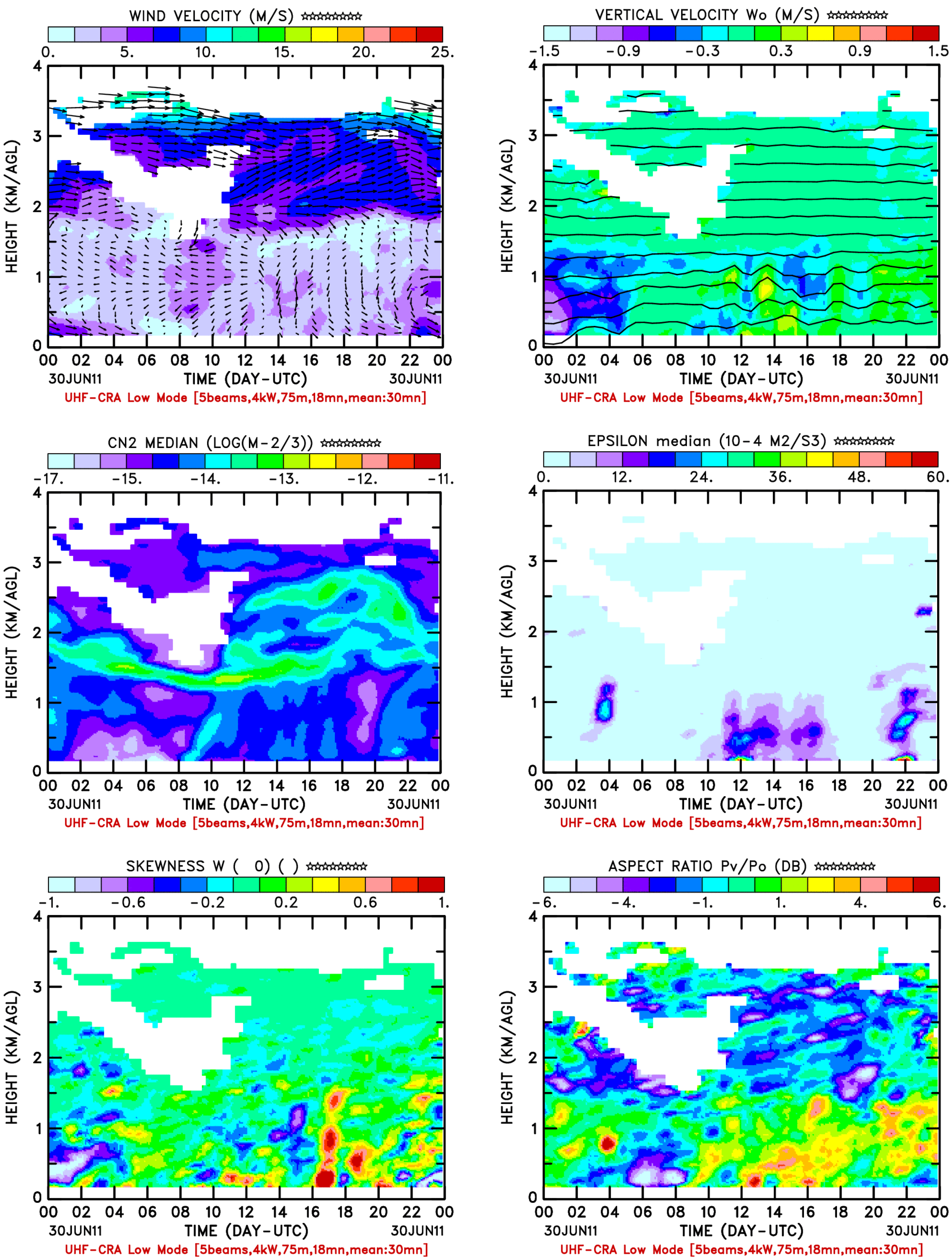


Figure 25: **IOP8 : 2011/06/30 : Low mode**

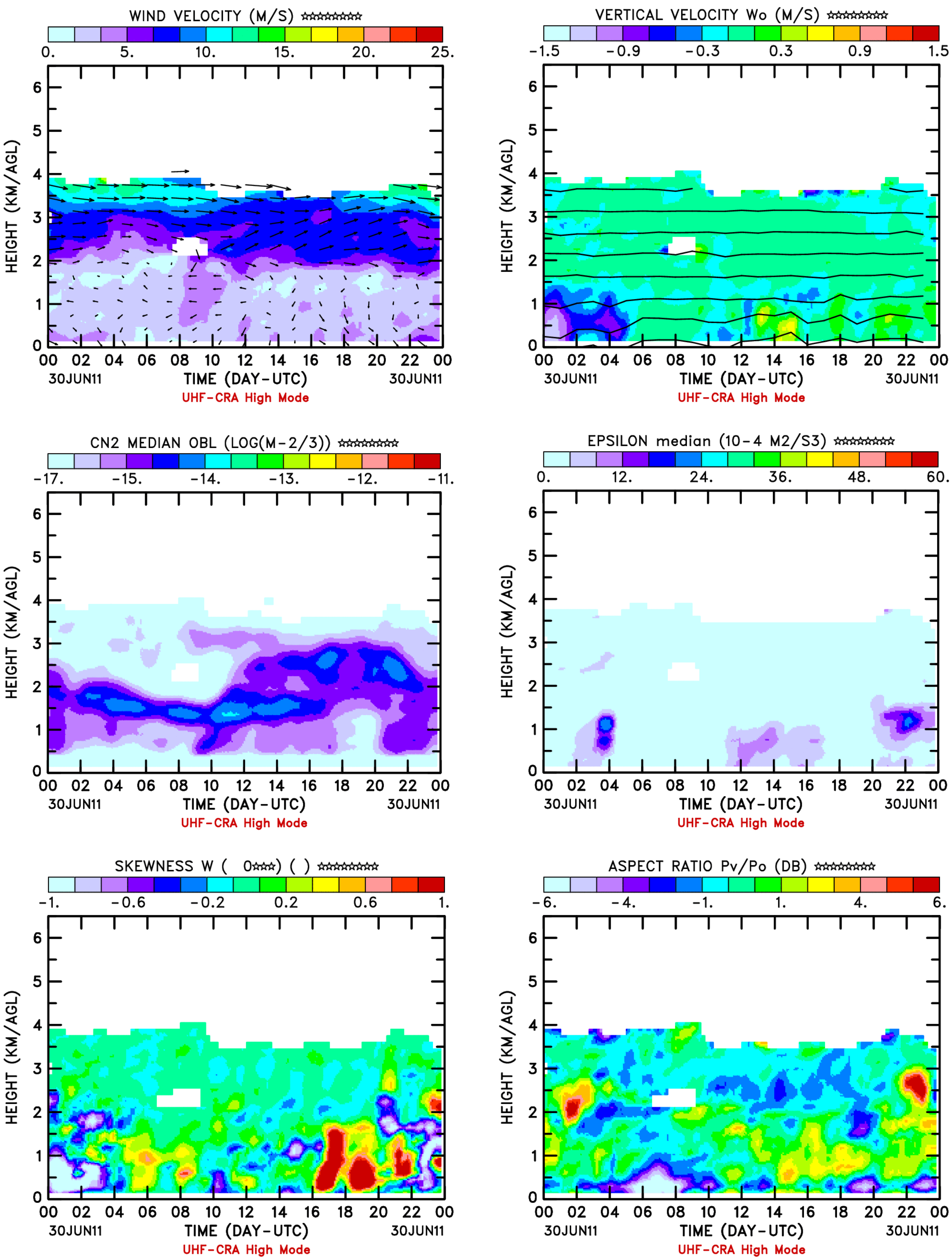


Figure 26: **IOP8 : 2011/06/30 : High mode**

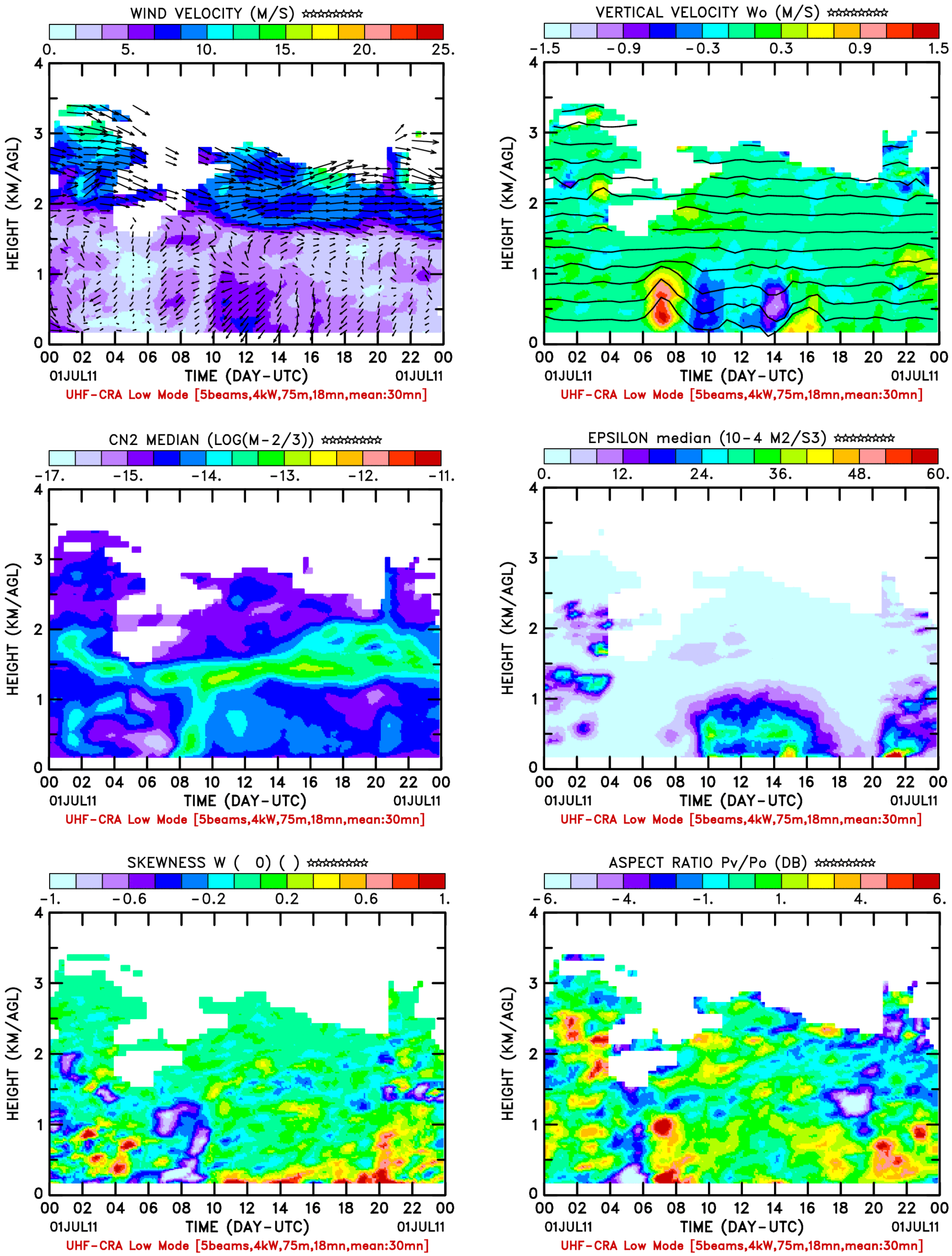


Figure 27: **IOP9 : 2011/07/01 : Low mode**

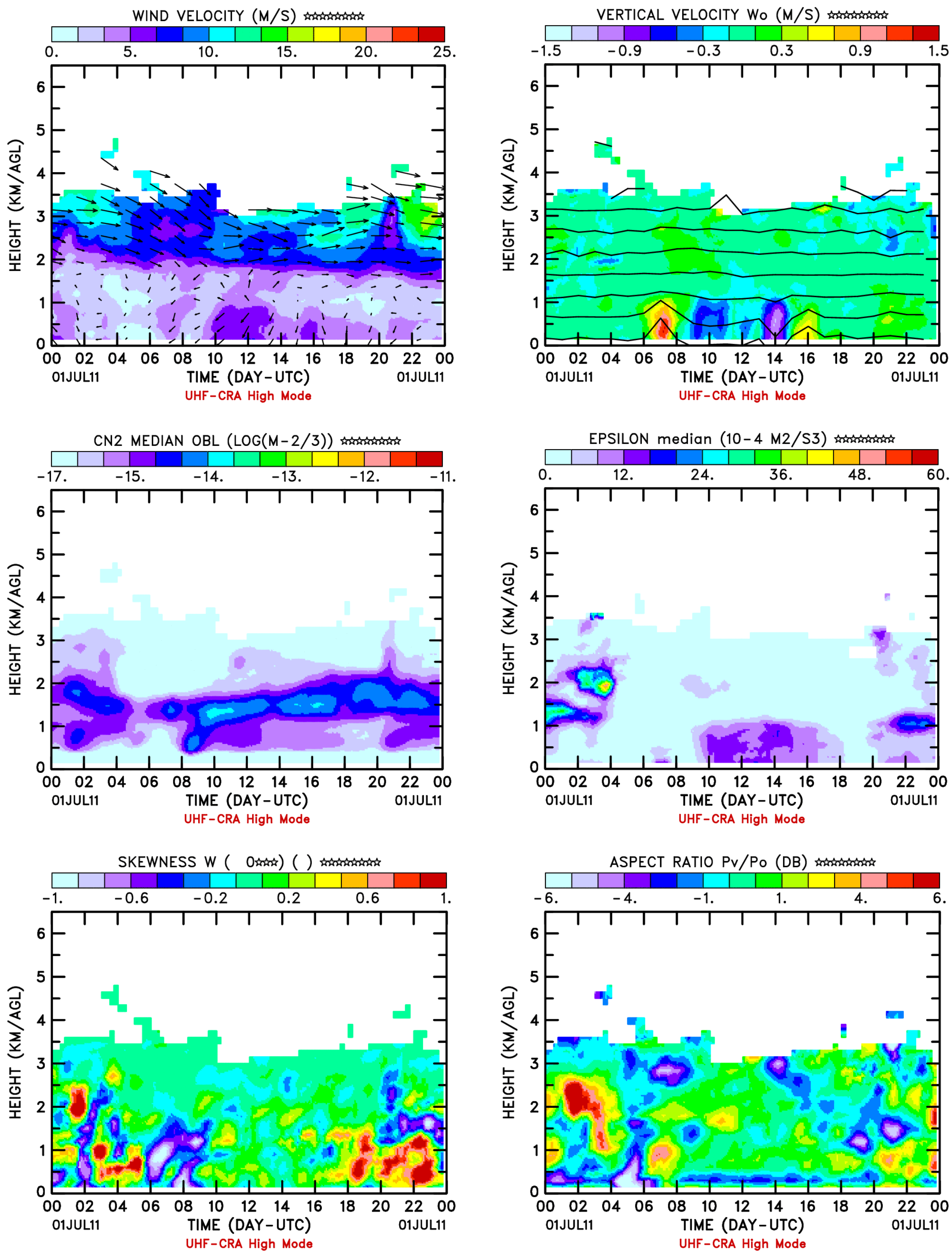


Figure 28: **IOP9 : 2011/07/01 : High mode**

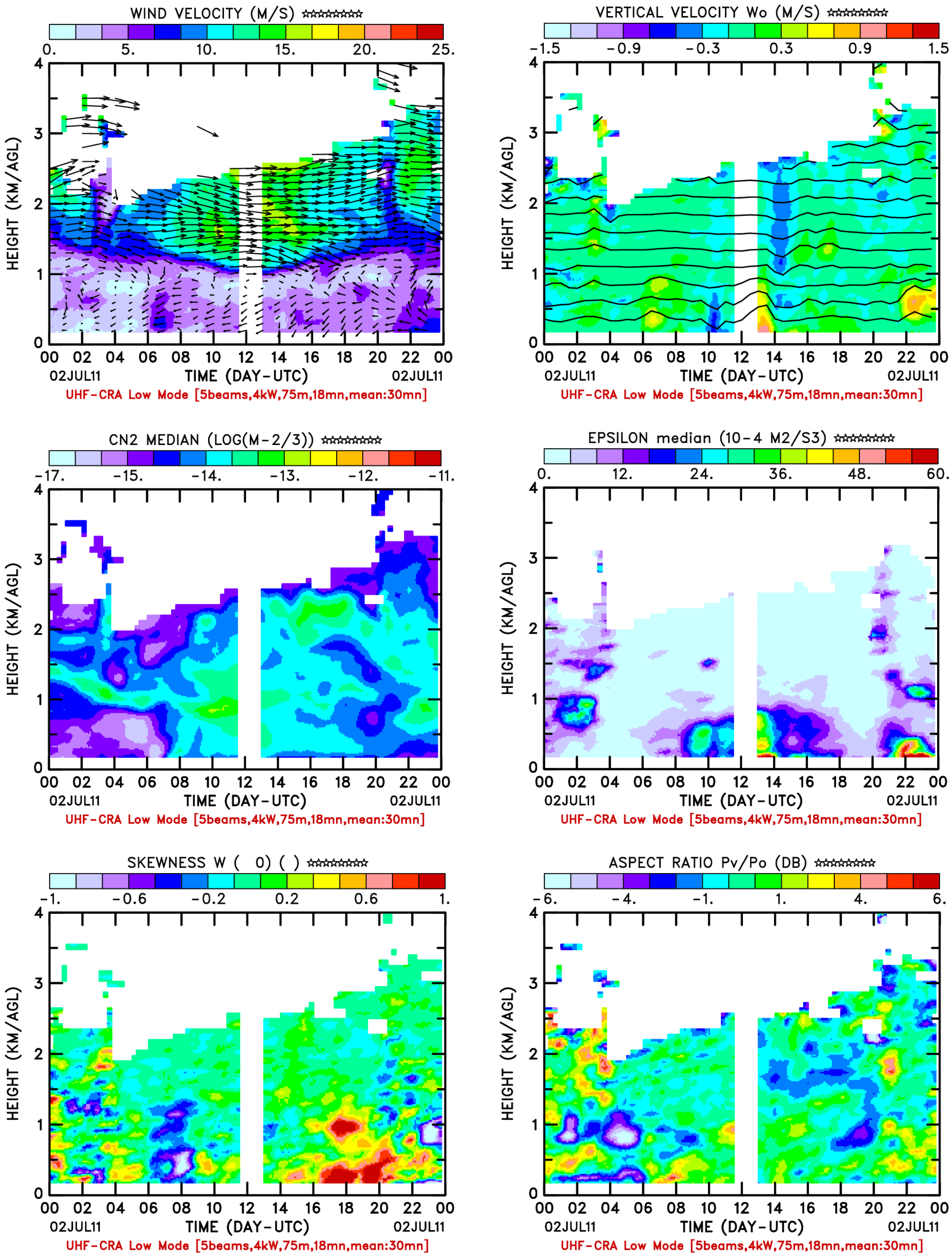


Figure 29: **IOP10 : 2011/07/02 : Low mode**

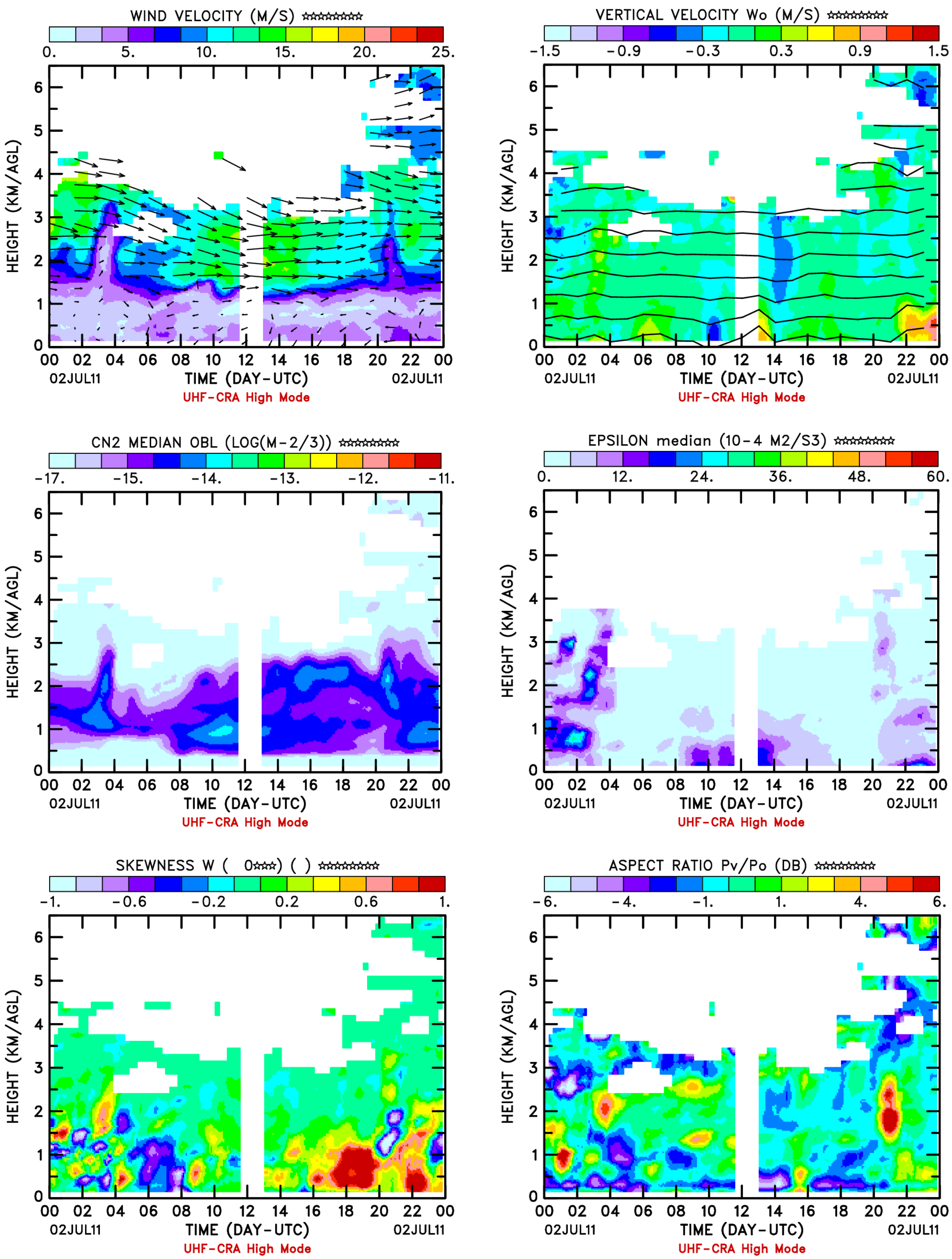


Figure 30: **IOP10 : 2011/07/02 : High mode**

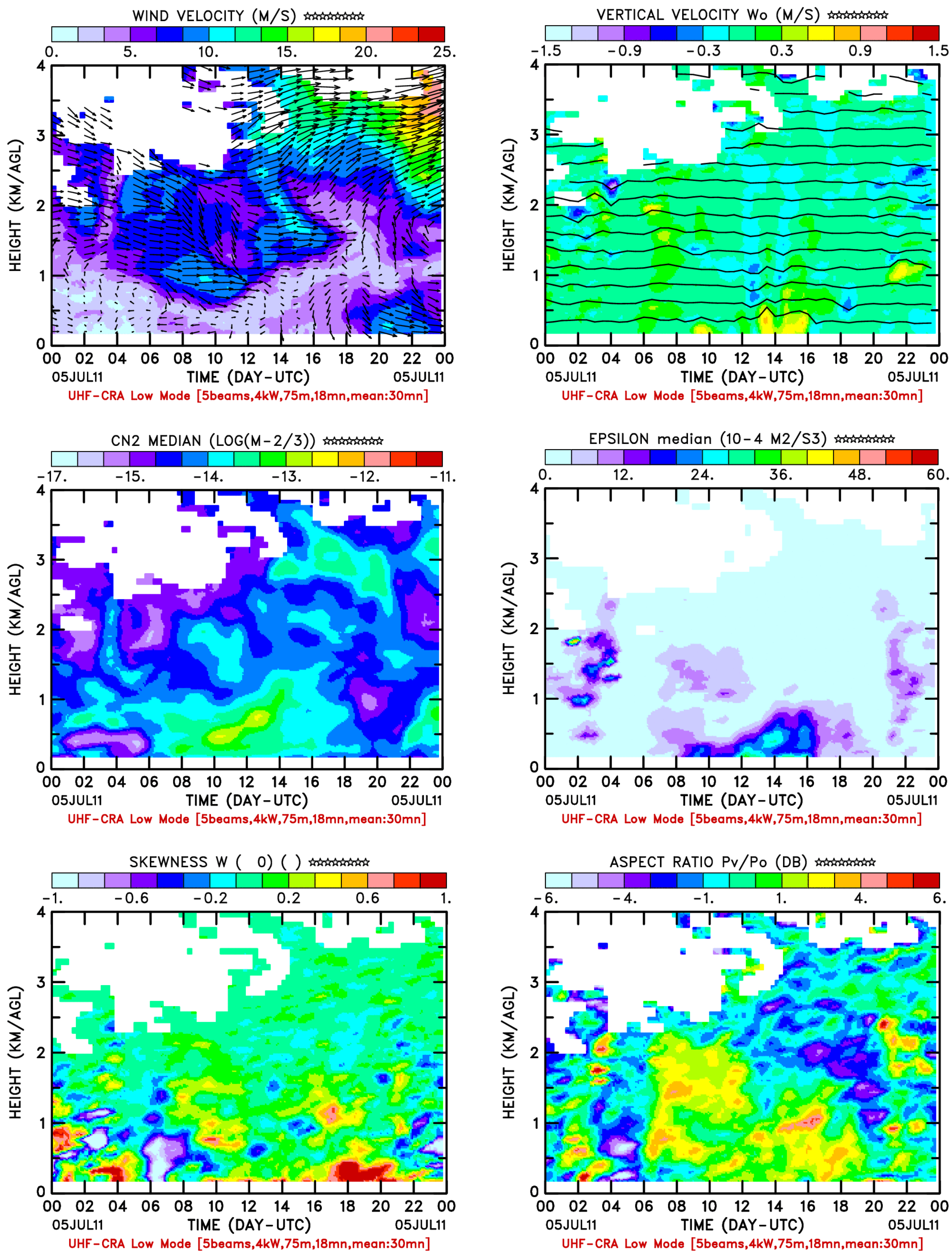


Figure 31: **IOP11 : 2011/07/05 : Low mode**

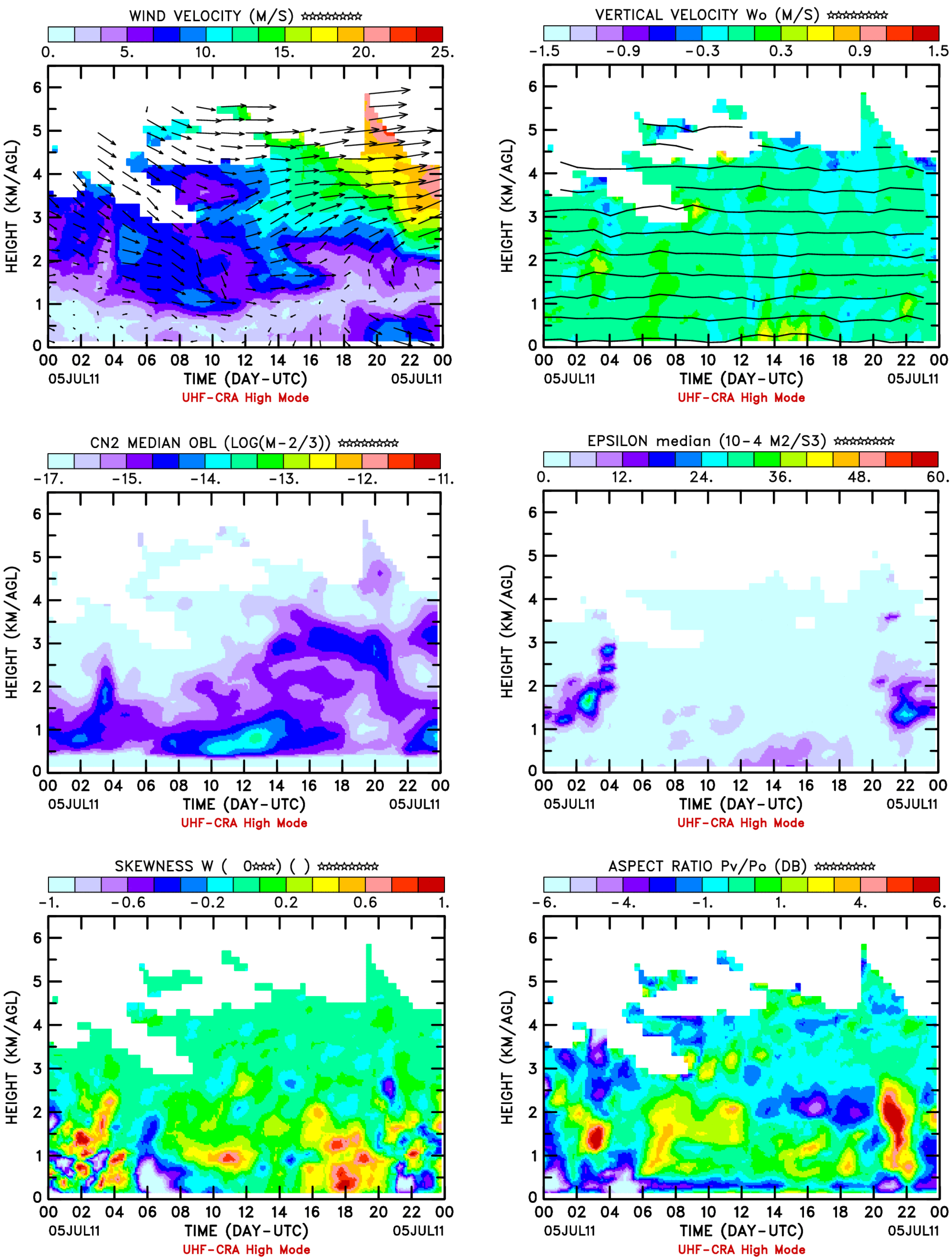


Figure 32: **IOP11 : 2011/07/05 : High mode**

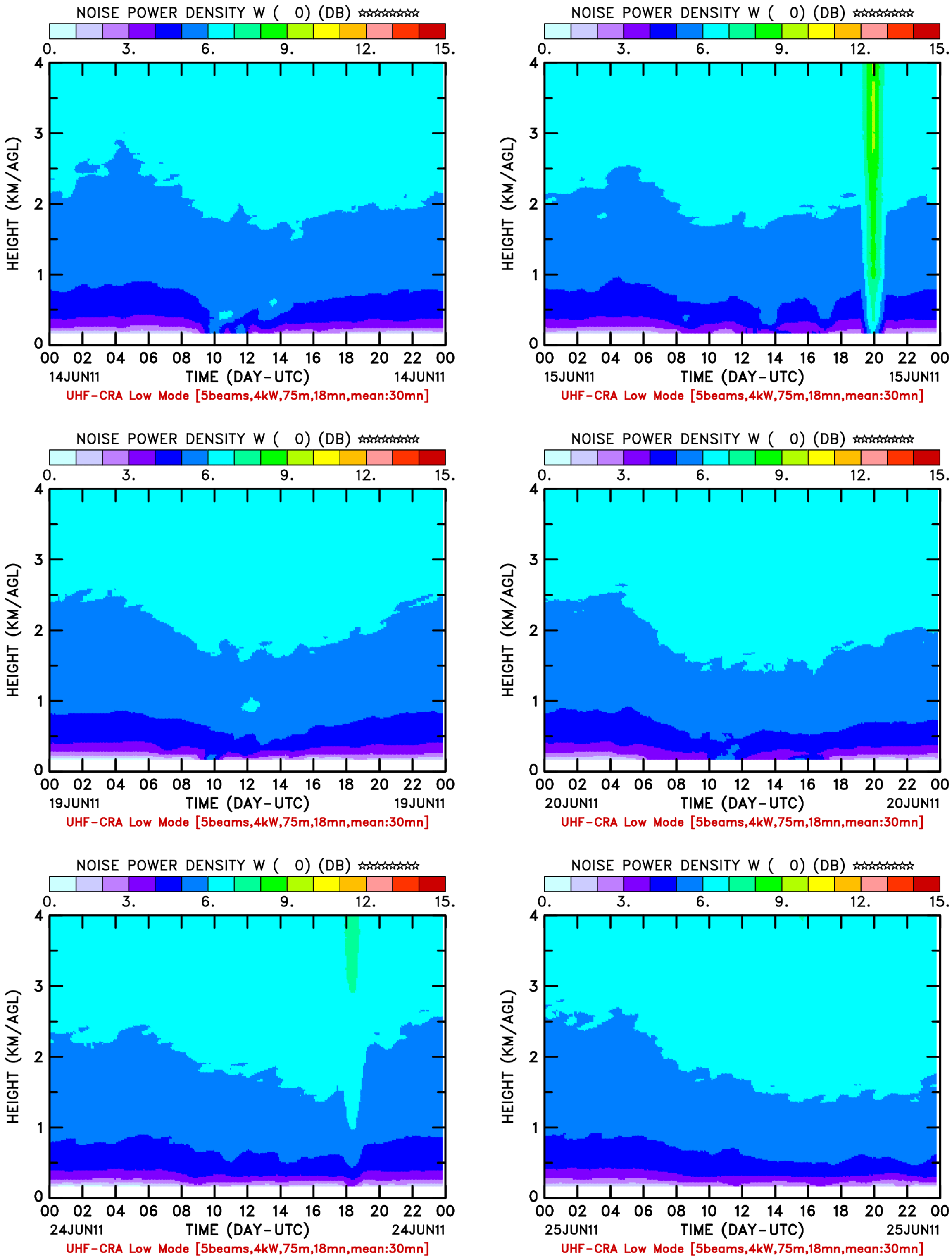


Figure 33: **Noise : Low mode**

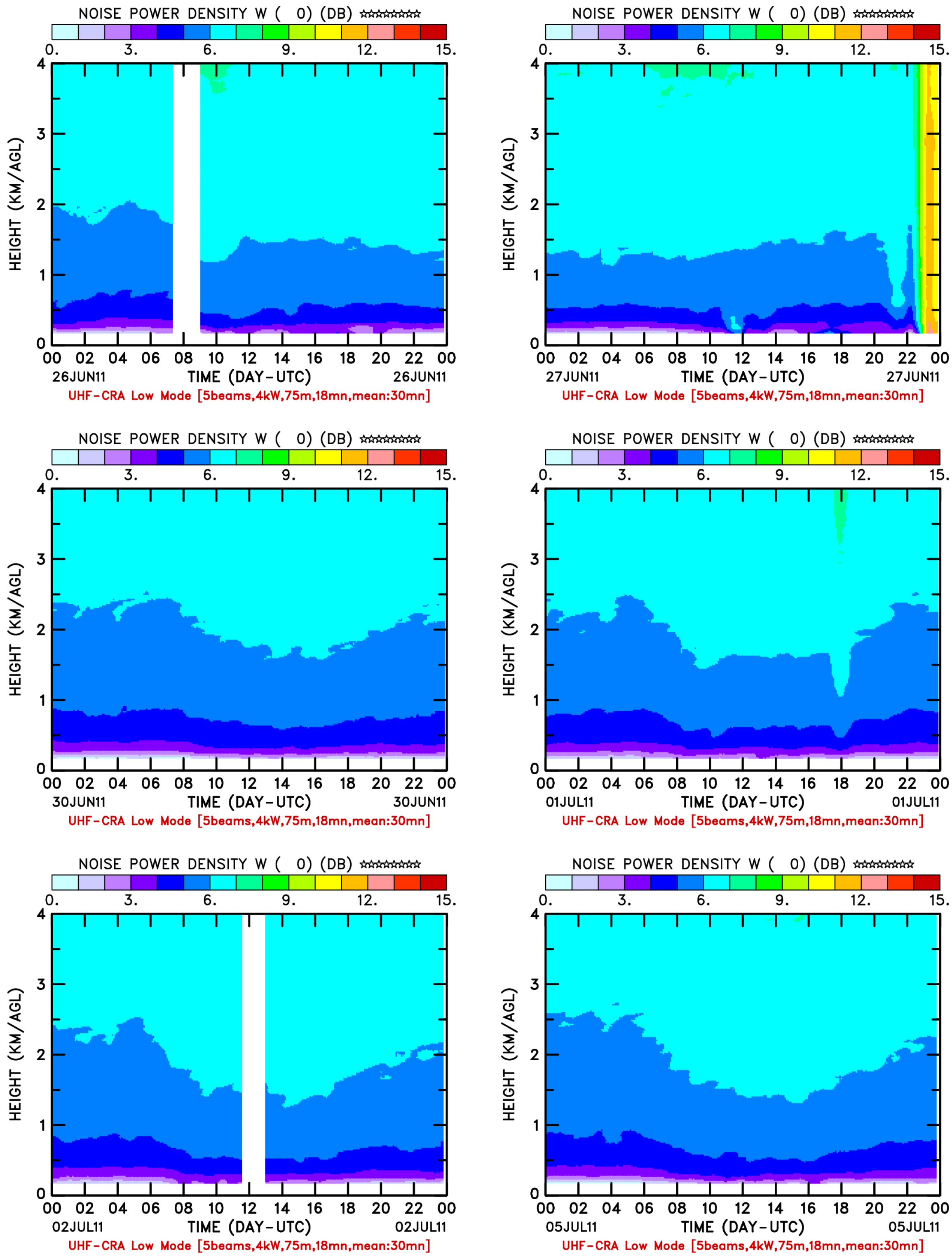


Figure 34: **Noise :Low mode (continued)**

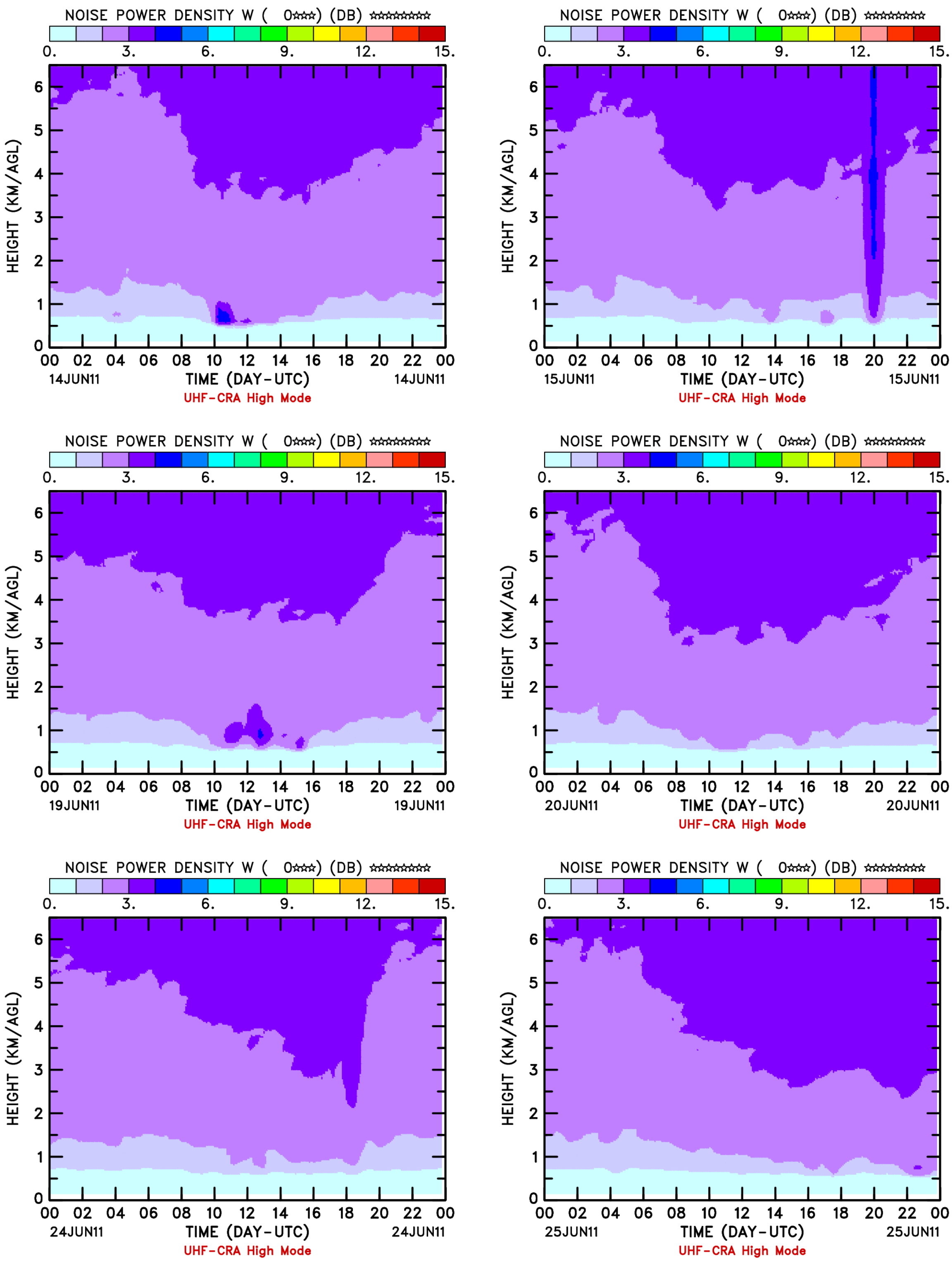


Figure 35: **Noise : High mode**

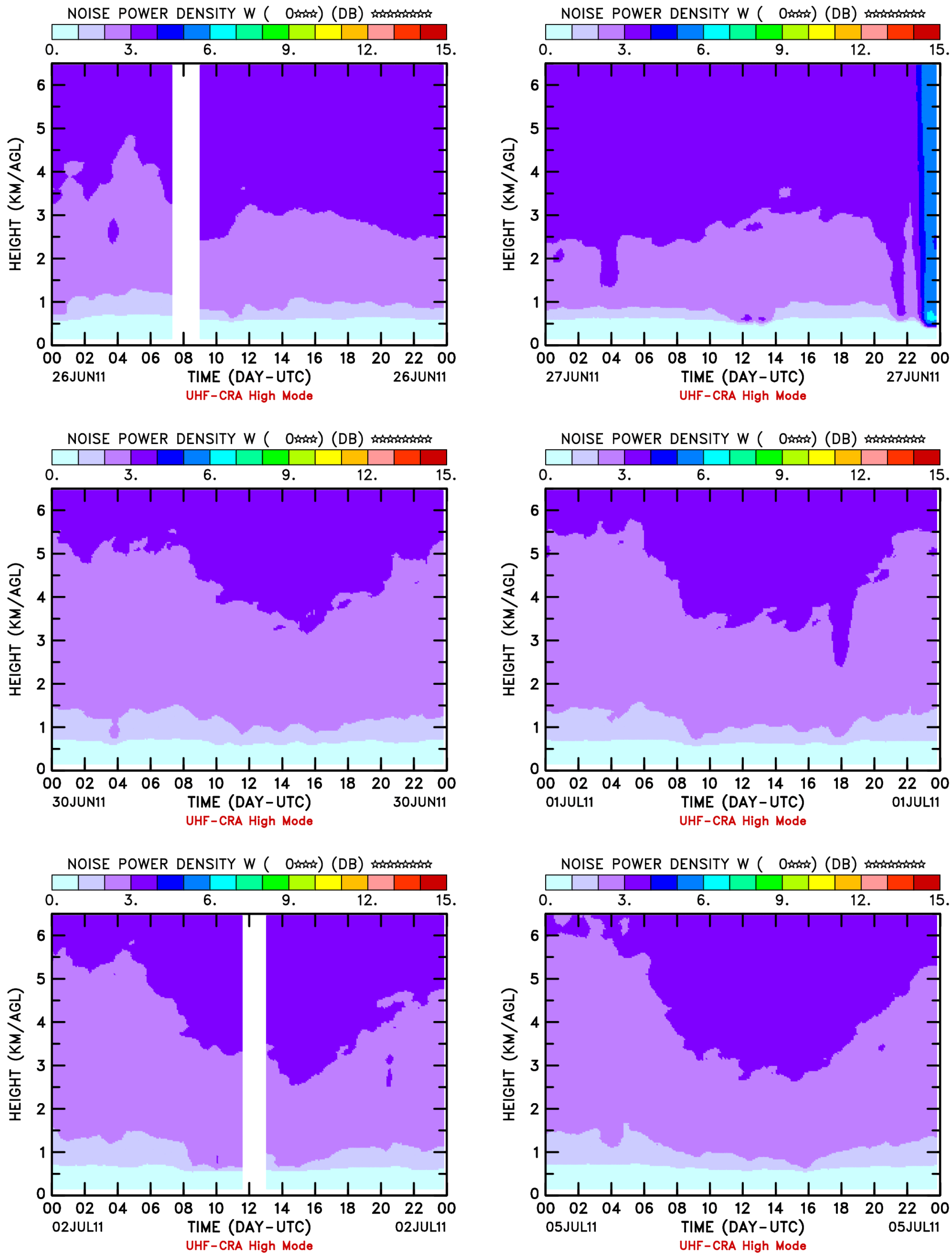


Figure 36: **Noise : High mode (continued)**