Vertical structure of marine stratocumulus clouds: 7 years of ship observations

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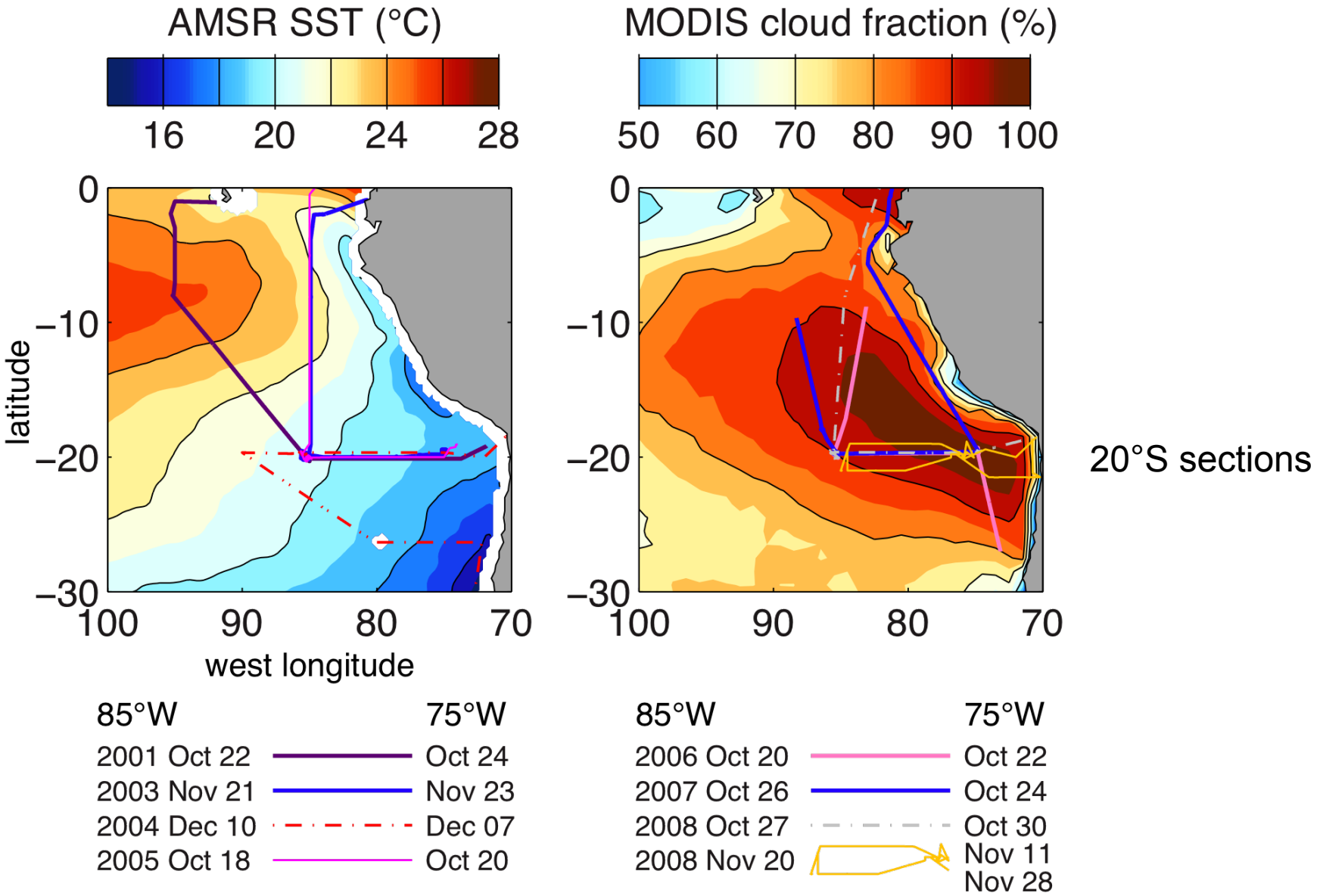


20°S sections

ship observations

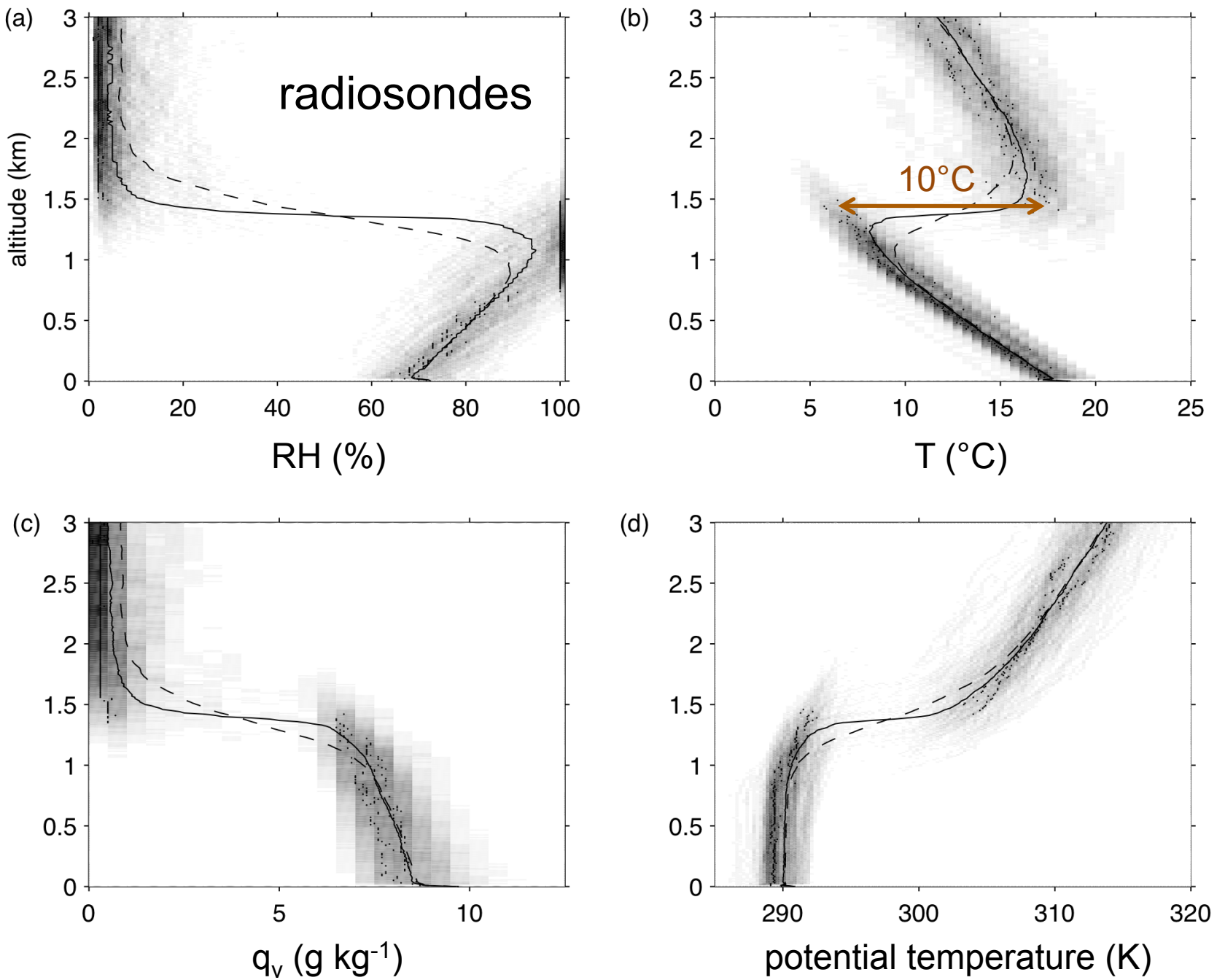
Eight 20°S sections

Cloud and BL vertical structure

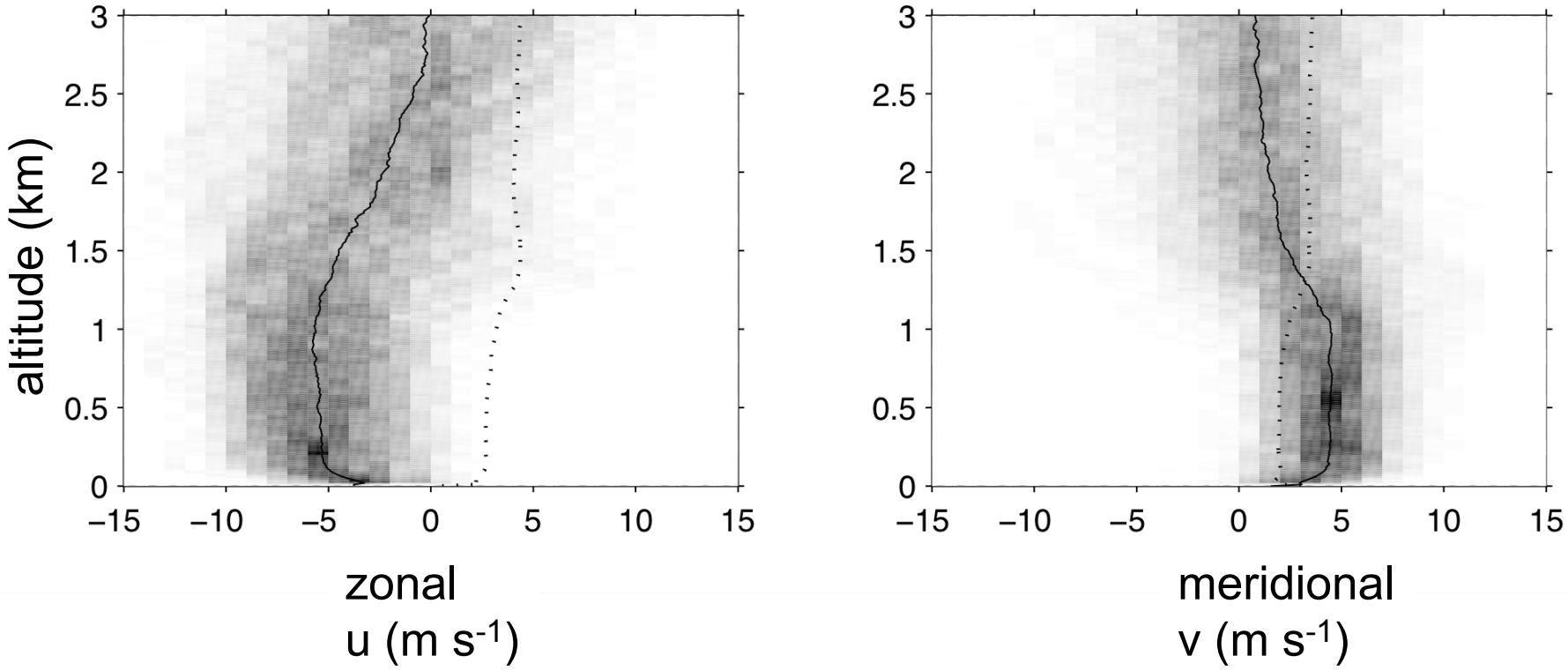
- radiosondes
- remote sensing

Diurnal cycle

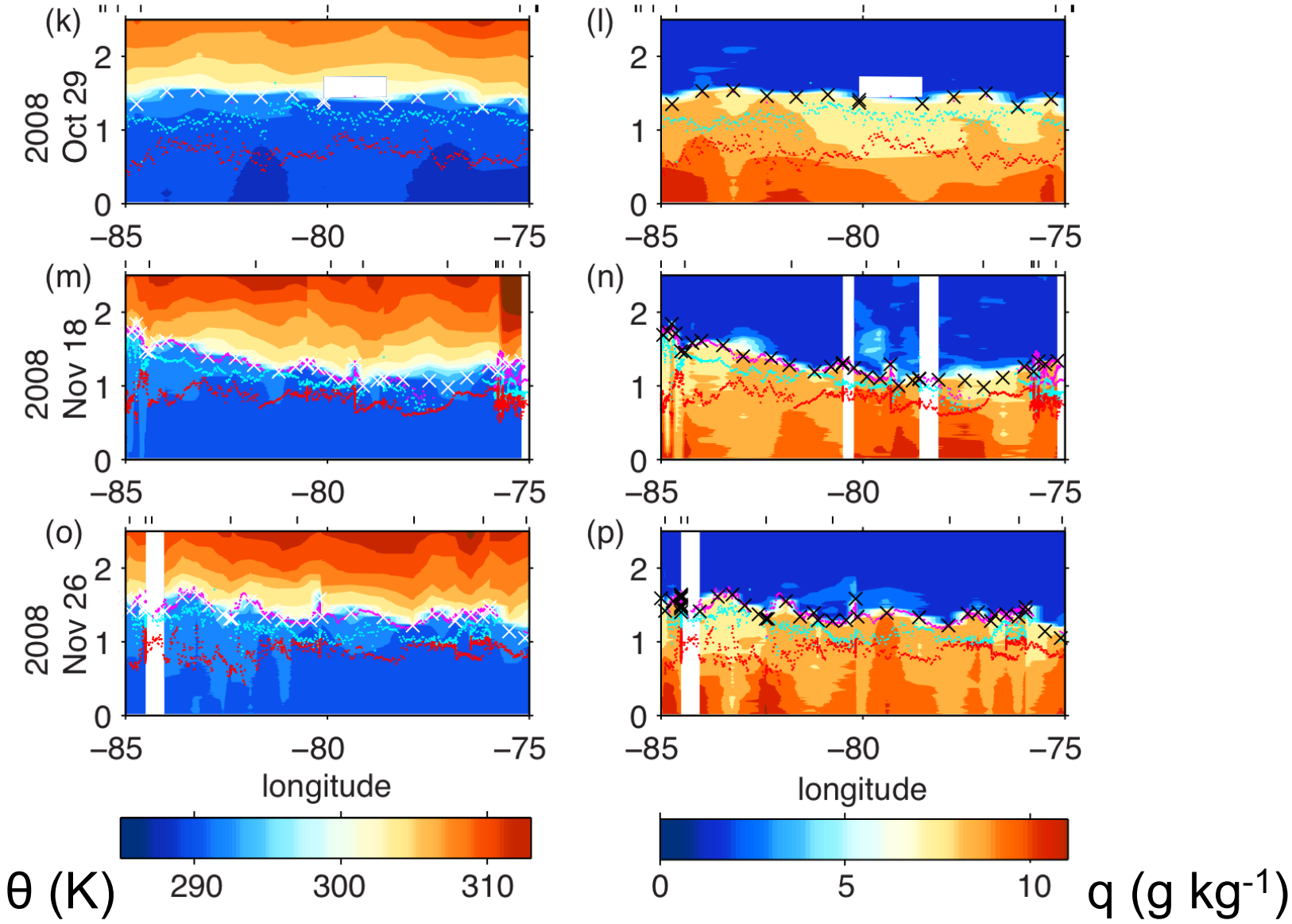
- clouds
- decoupling
- radiative forcing


(a)
radiosondes
altitude (km)
RH (%)
(b)
10°C
T (°C)
(c)
q_v (g kg^{-1})
(d)
potential temperature (K)

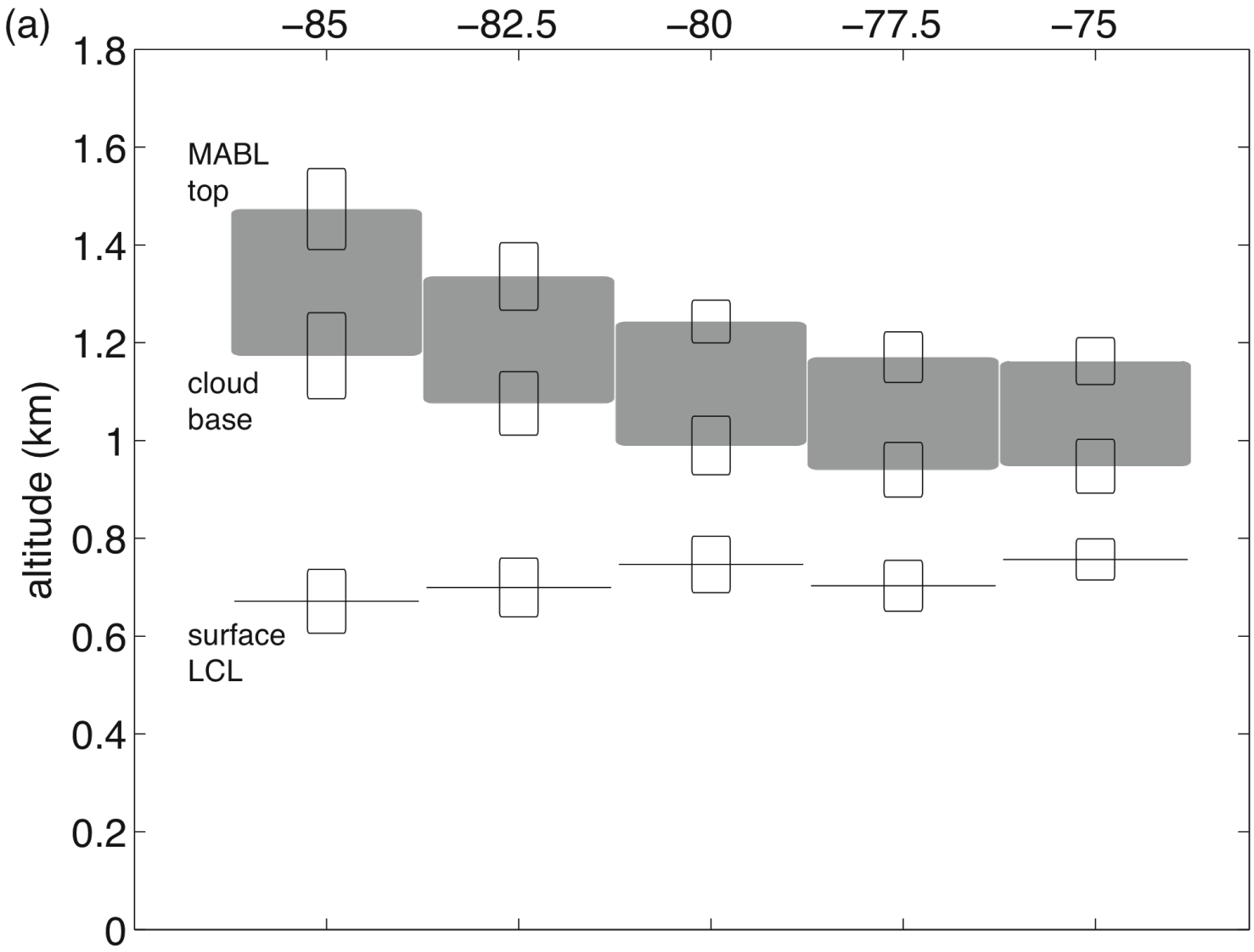
wind

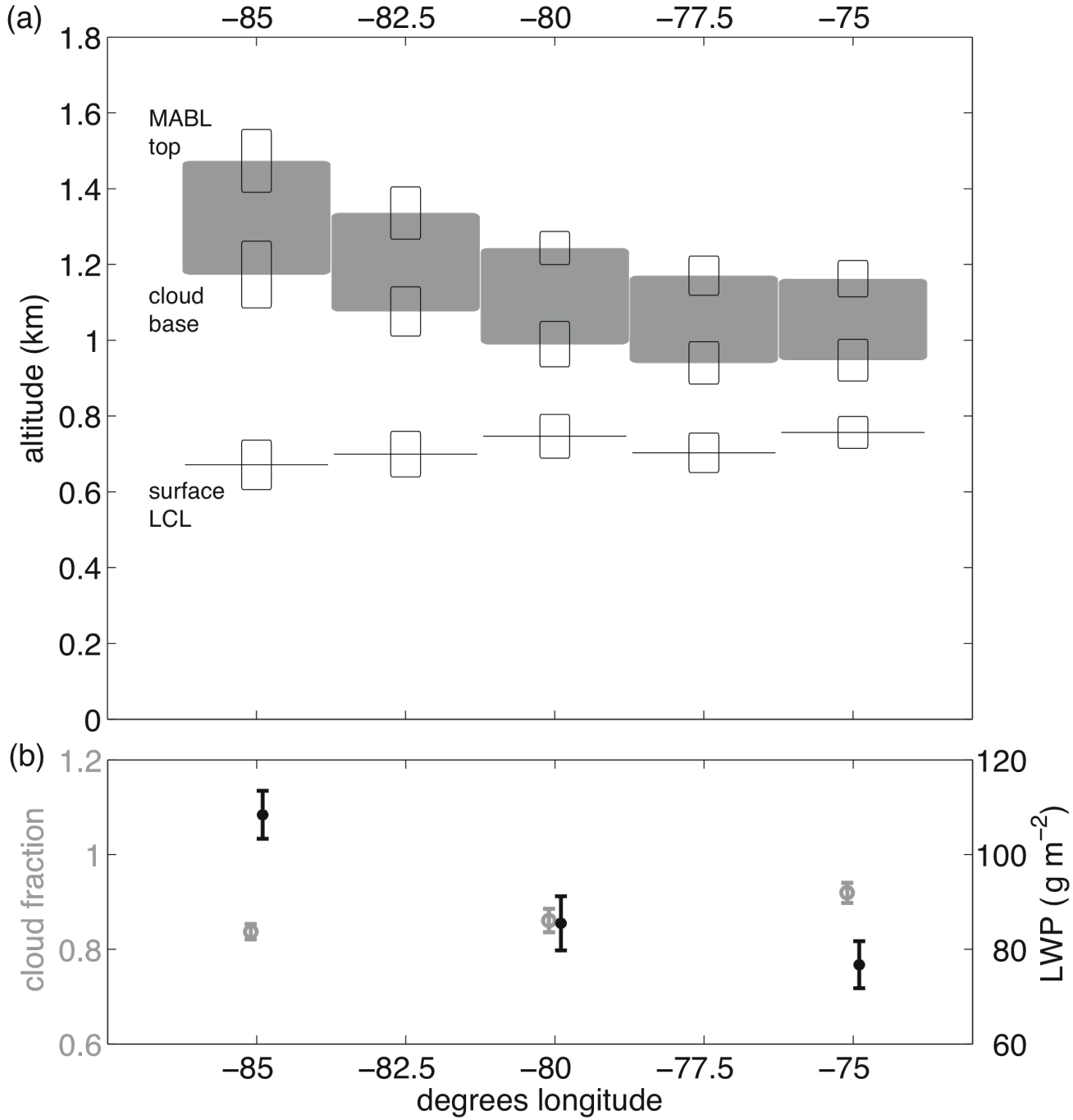

altitude (km)
3
2.5
2
1.5
1
0.5
0
−15
−10
−5
0
5
10
15
zonal
u (m s-1)
meridional
v (m s-1)

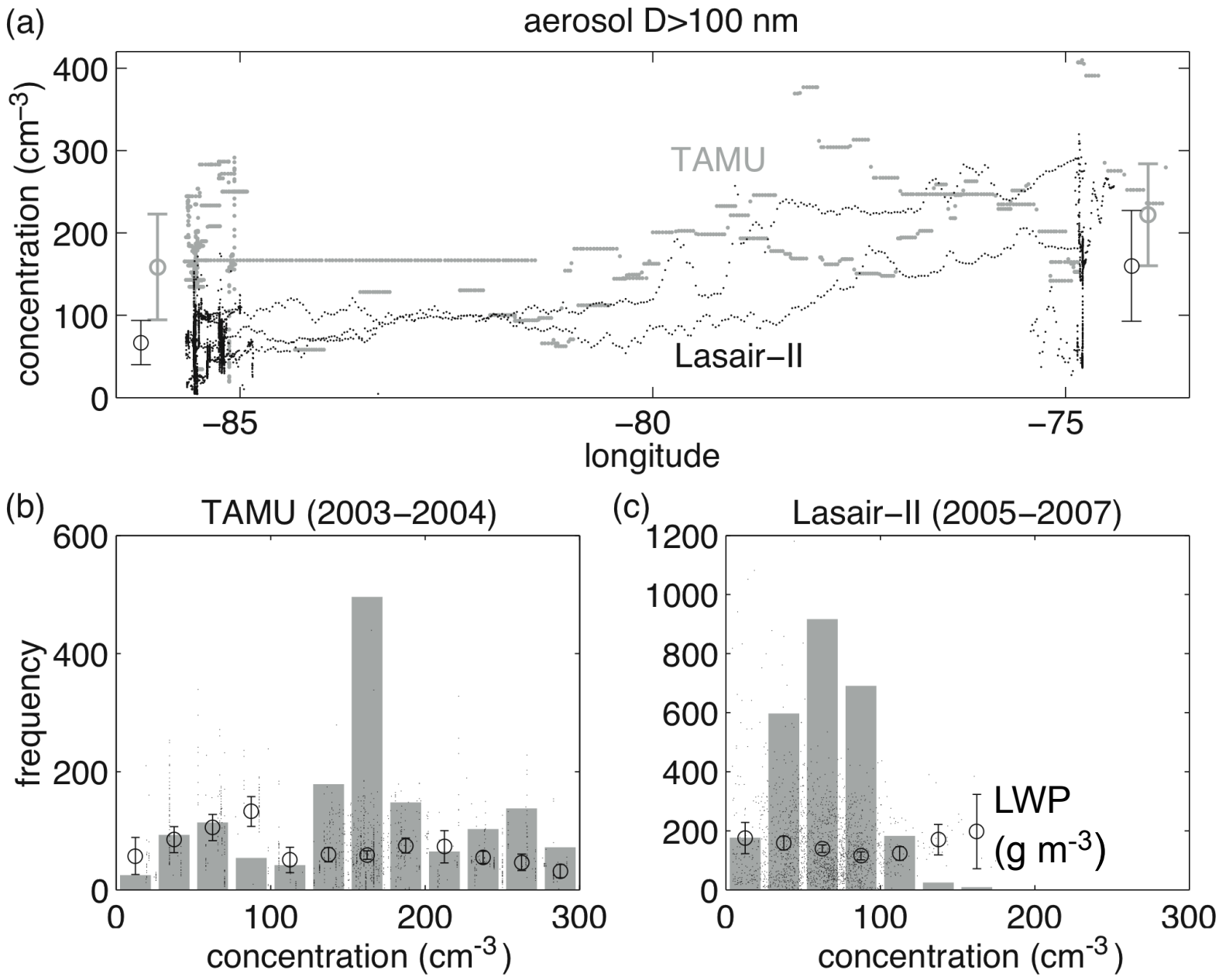
VOCALS 20°S sections



cloud section

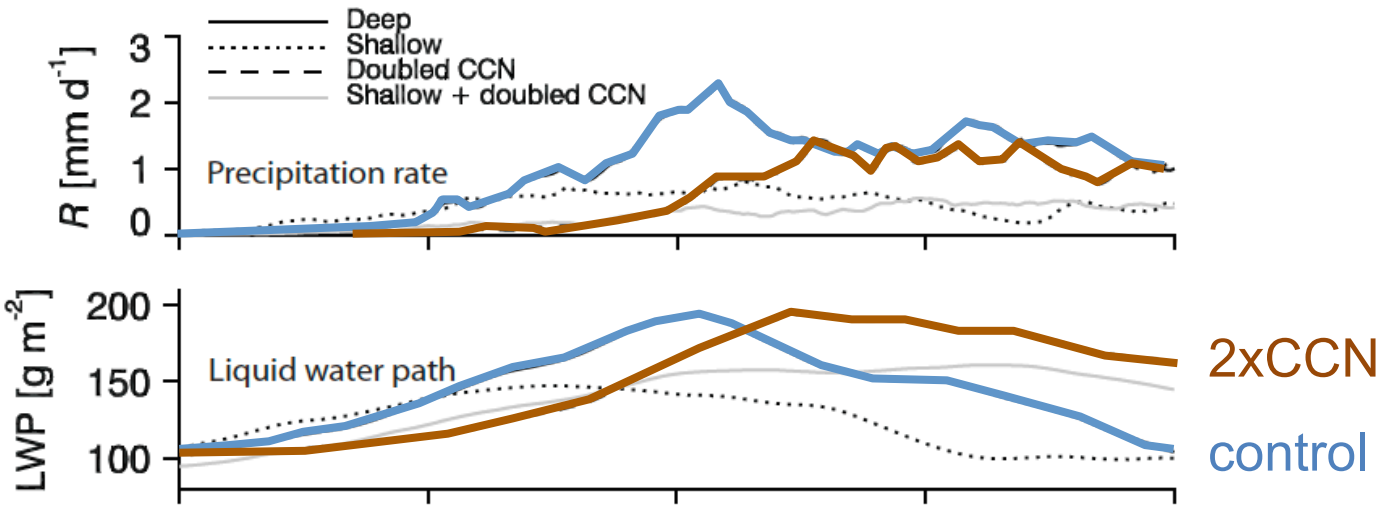



(a)
−85
−82.5
−80
−77.5
−75
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
altitude (km)
MABL
top
cloud
base
surface
LCL
(b)
1.2
1
0.8
0.6
cloud fraction
120
100
80
60
LWP (g m−2)
−85
−82.5
−80
−77.5
−75
degrees longitude


(a)
aerosol D>100 nm
concentration (cm−3)
400
300
200
100
0
TAMU
Lasair−II
−85
−80
−75
longitude
(b)
TAMU (2003−2004)
frequency
600
400
200
0
0
100
200
300
concentration (cm-3)
(c)
Lasair−II (2005−2007)
1200
1000
800
600
400
200
0
LWP
(g m-3)
0
100
200
300
concentration (cm-3)

Overall, no correlation between LWP and CCN.

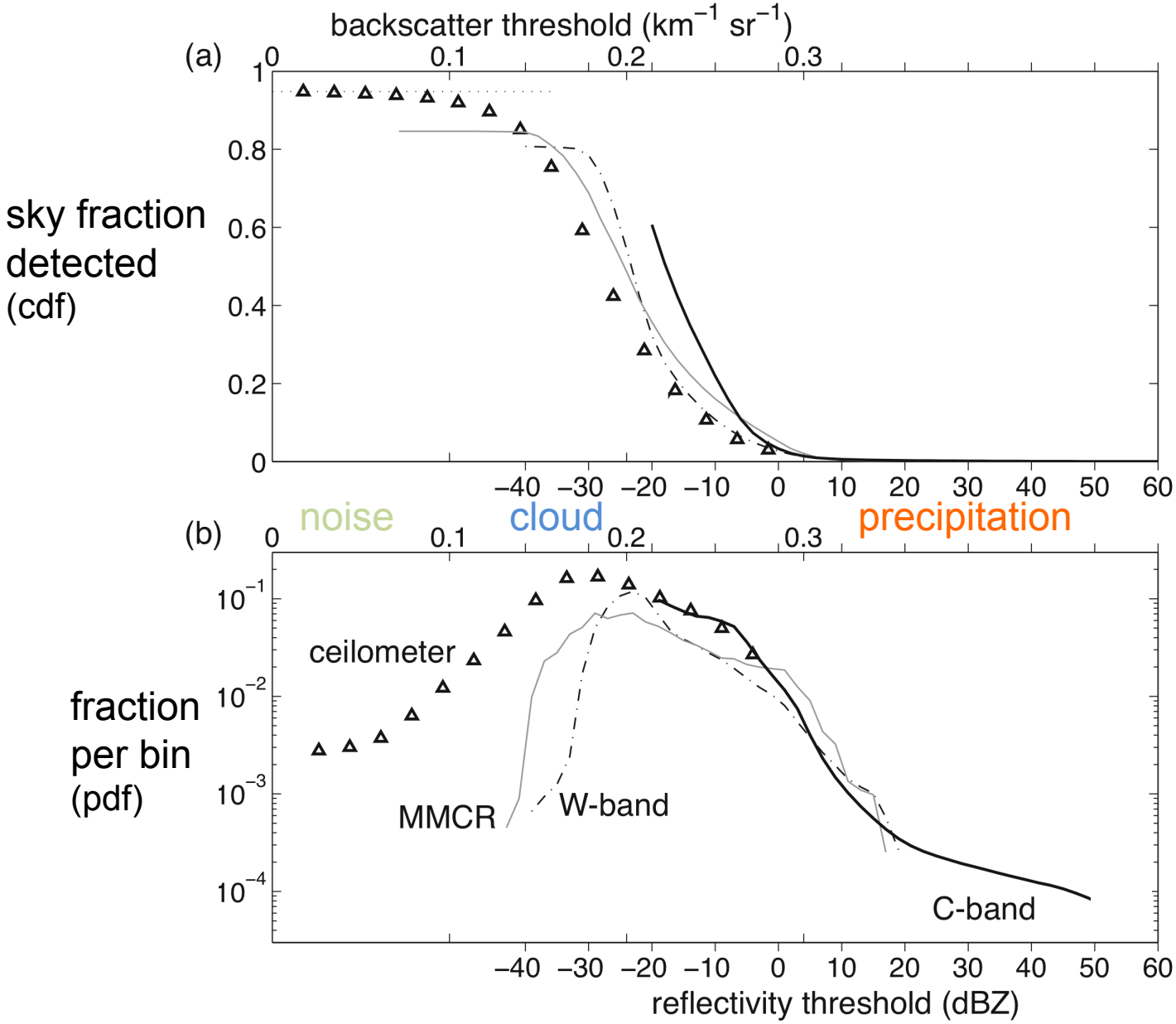
- Do other variables overwhelm aerosol-cloud feedbacks?
- Aerosol-cloud feedbacks may not lead to a correlation between LWP and CCN.



near-LES model, Mechem et al. 2011

Remote sensing

- 3.2 mm (94 GHz) motion-stabilized W-band cloud radar
- 5 cm (6 GHz) scanning C-band precipitation radar
- Ceilometer optical backscatter
- NOAA high-resolution Doppler lidar
- Microwave radiometer (integrated liquid and vapor)


backscatter threshold (km^{-1} sr^{-1})
(a)
sky fraction detected (cdf)
noise
cloud
precipitation
(b)
fraction per bin (pdf)
ceilometer
MMCR
W-band
C-band
reflectivity threshold (dBZ)

overhead cloud sensing

How frequent/widespread are clouds?

- ceilometer cloud fraction

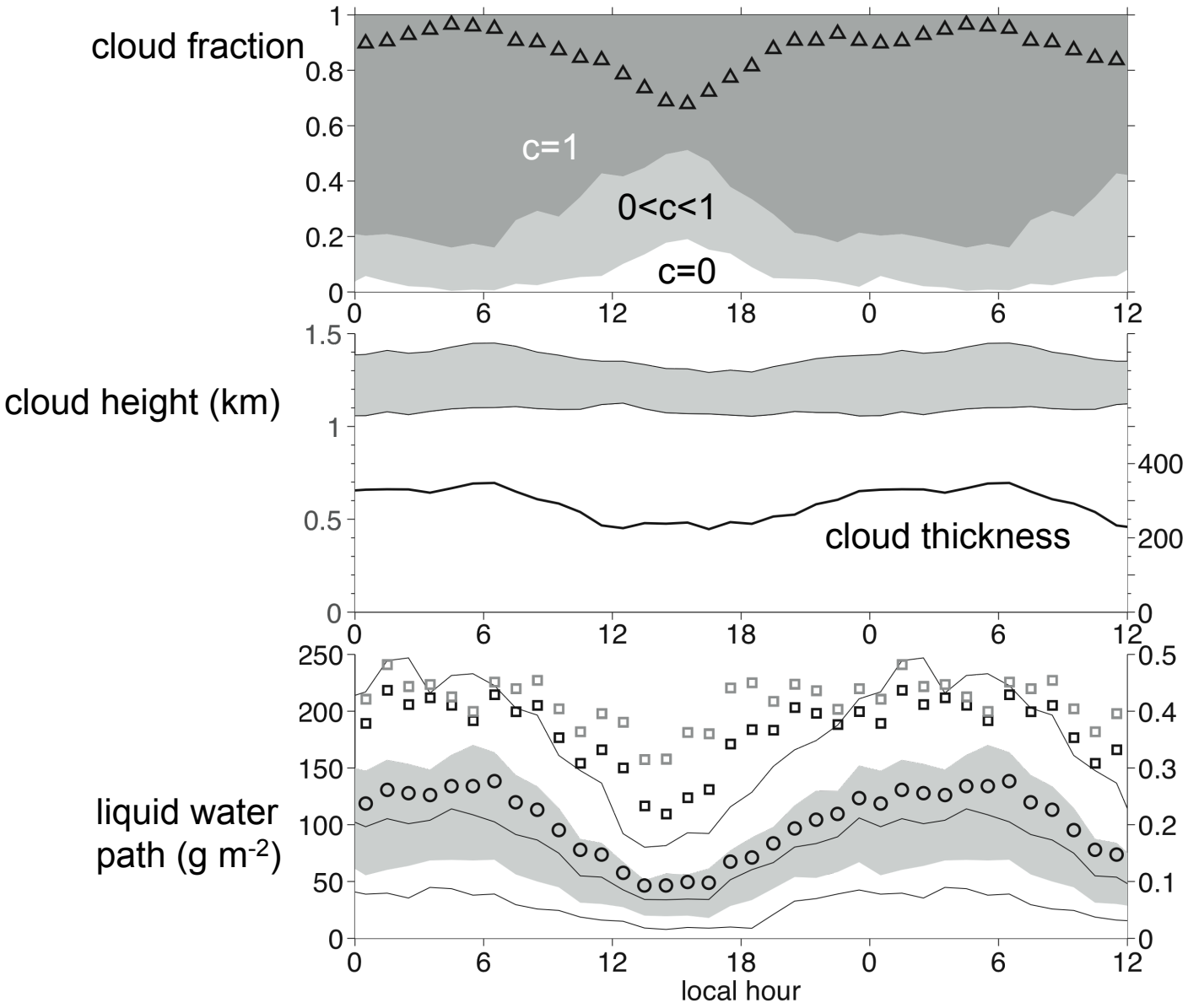
How thick are clouds?

- cloud base (ceilometer)
- cloud top (radar)

How intense are clouds?

- liquid water path (LWP)

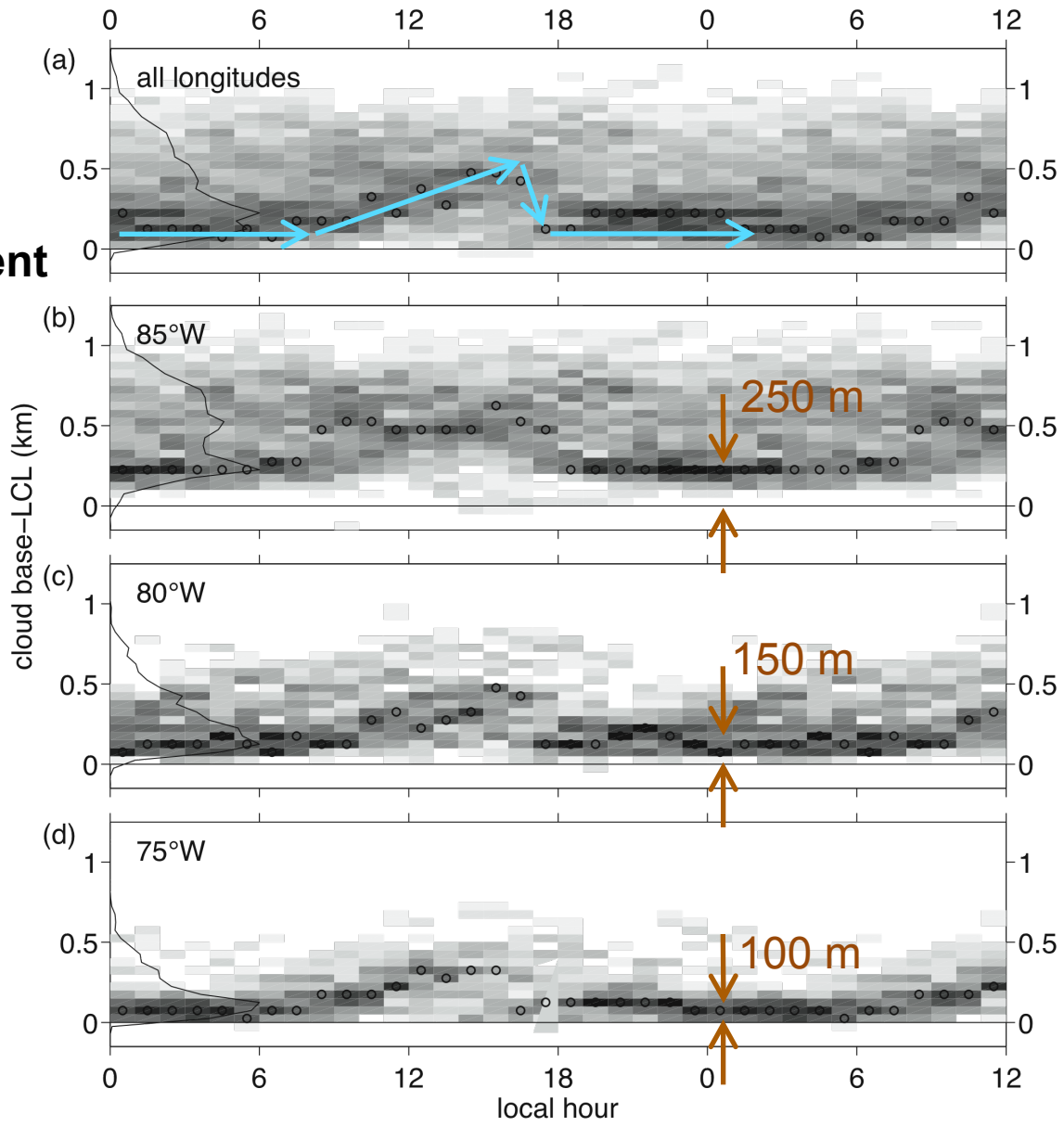
diurnal cycle



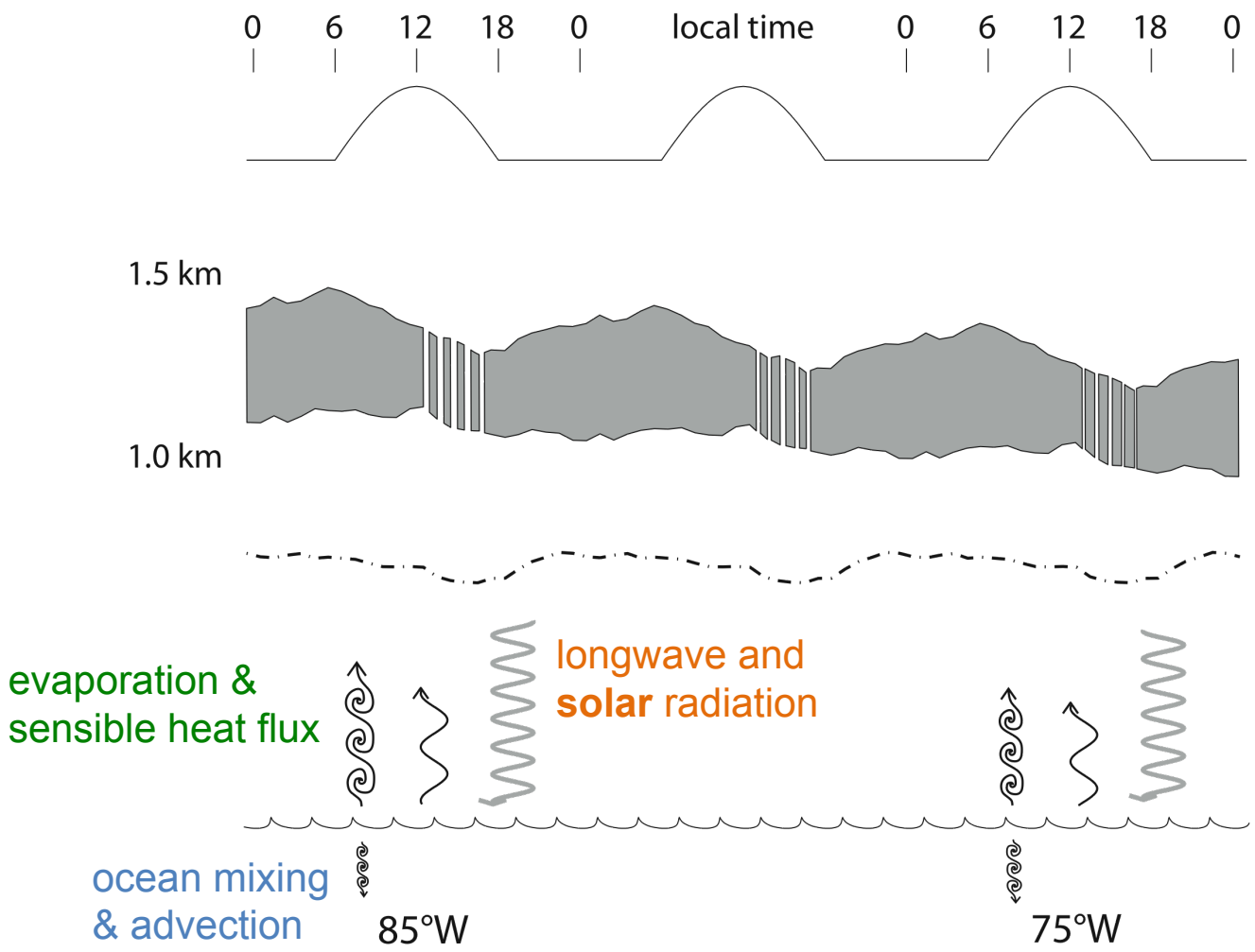
diurnal cycle of decoupling

Cloud base–LCL displacement
a thermodynamic indicator of decoupling.

Cloud base is not correlated to base-LCL displacement
except in afternoon.



summary



de Szoeke et al.
to be submitted

de Szoeke et al.
2010