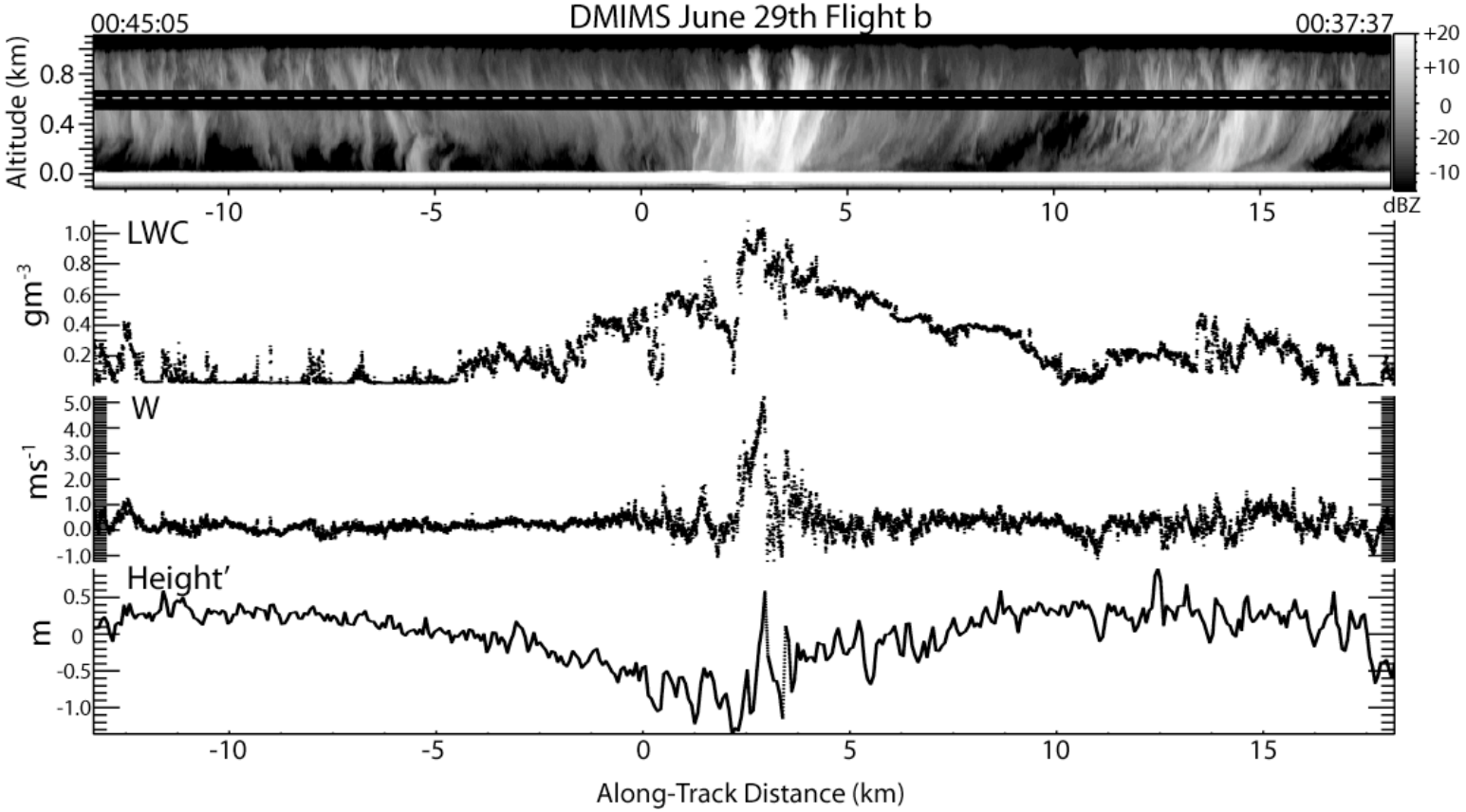
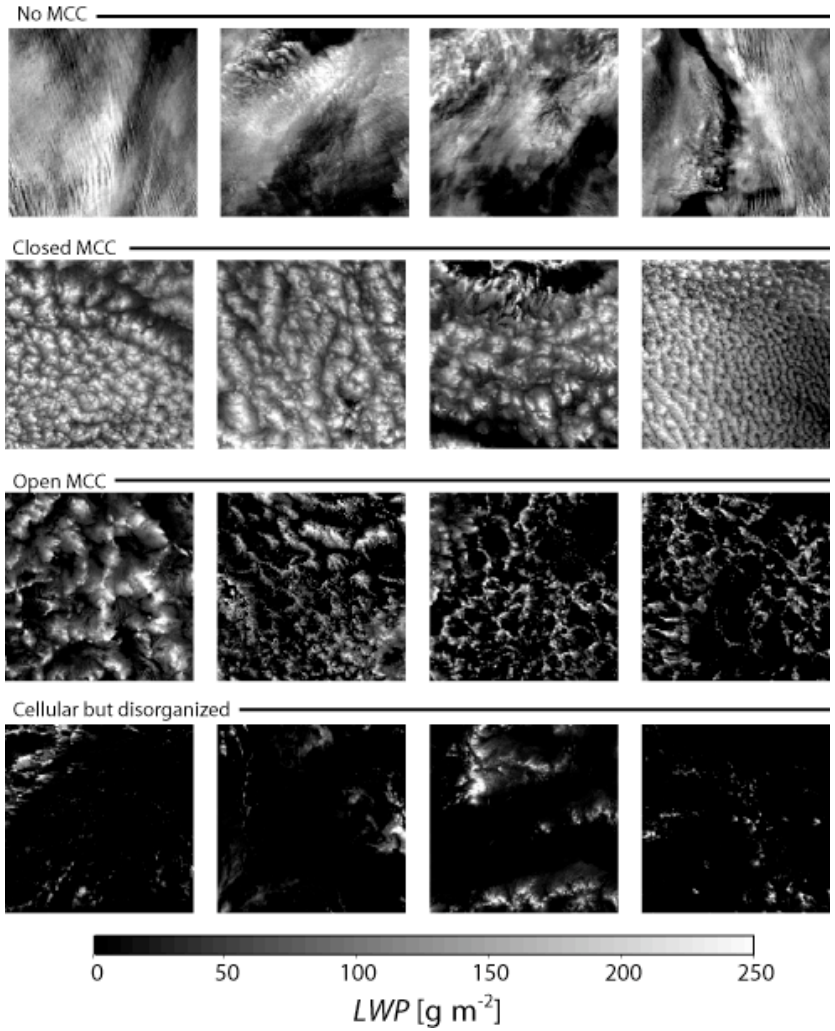
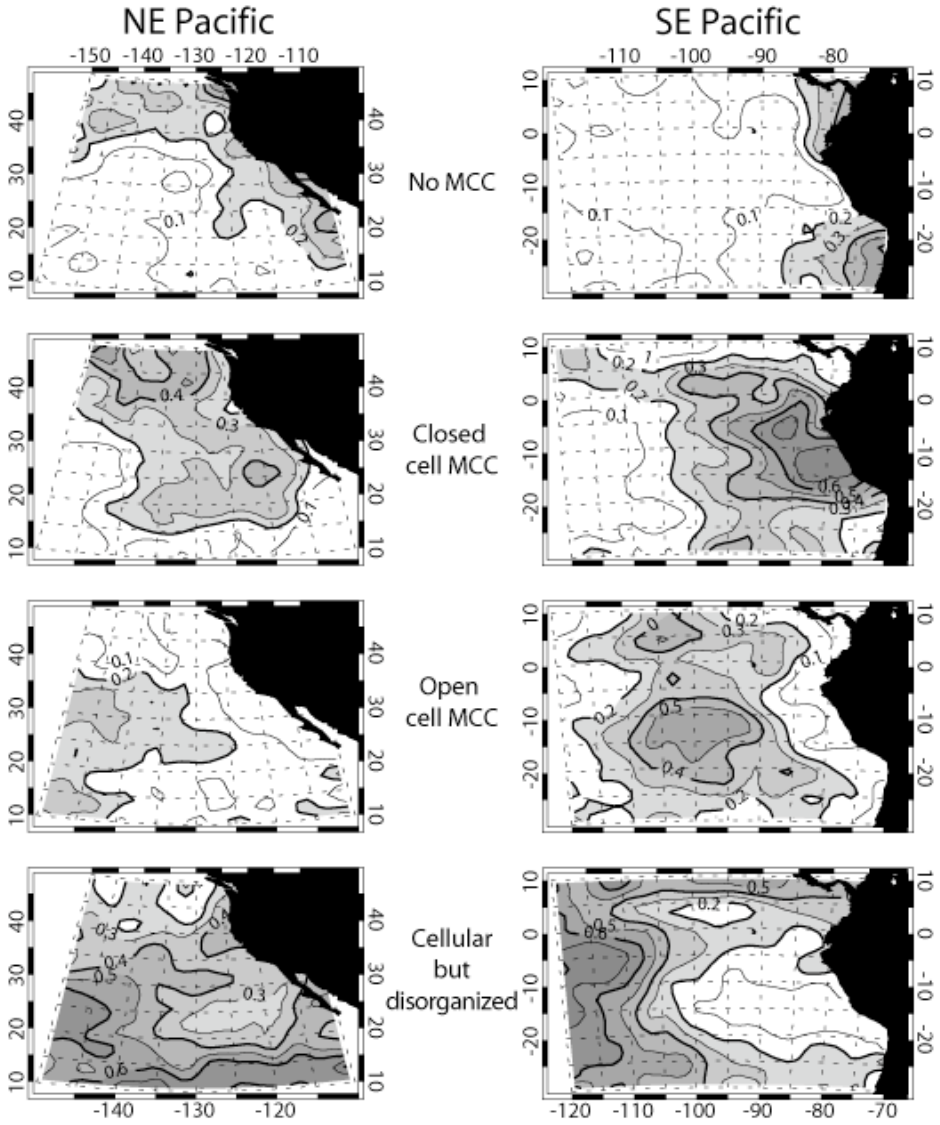
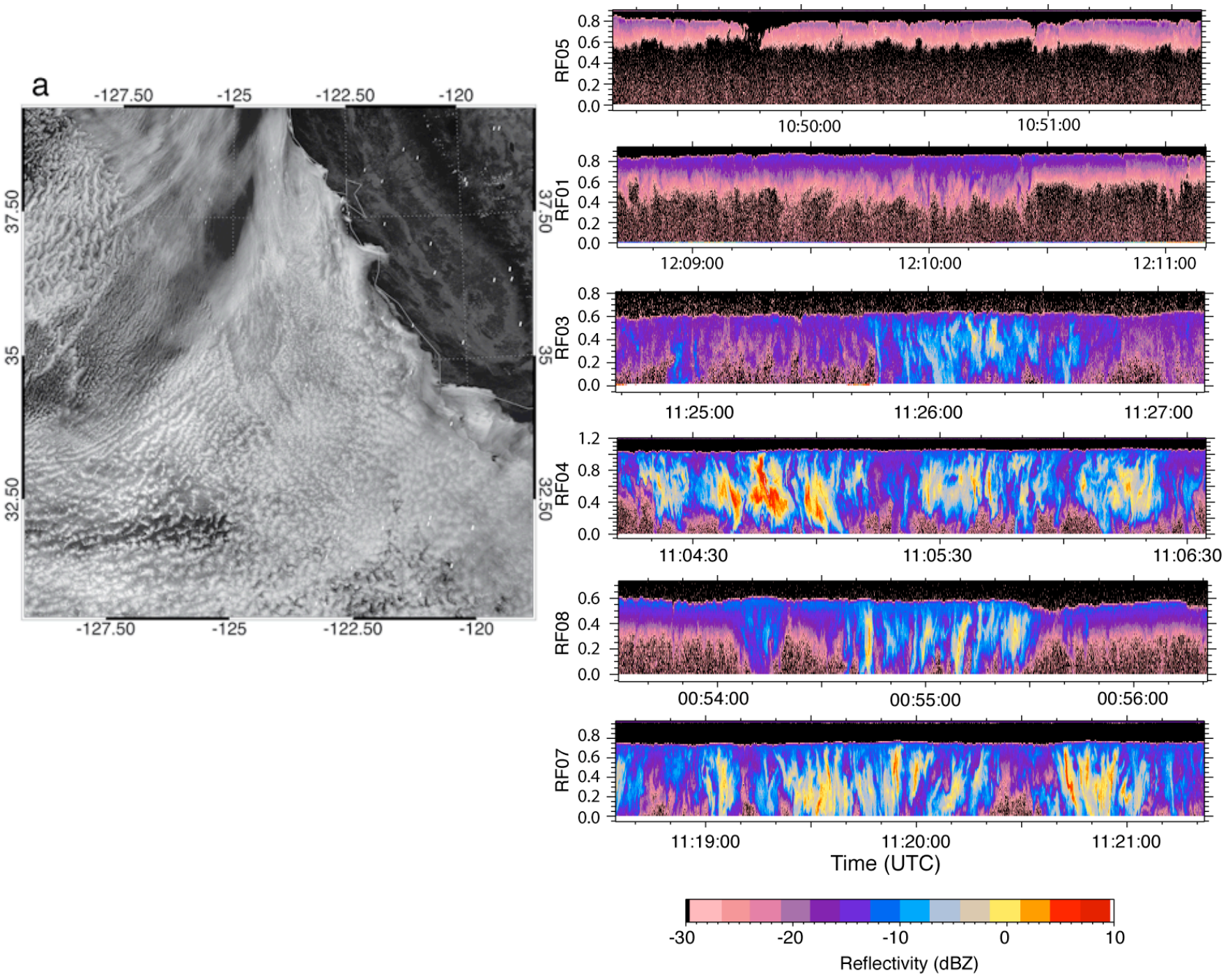
Cloud and Precipitation Structure in VOCALS

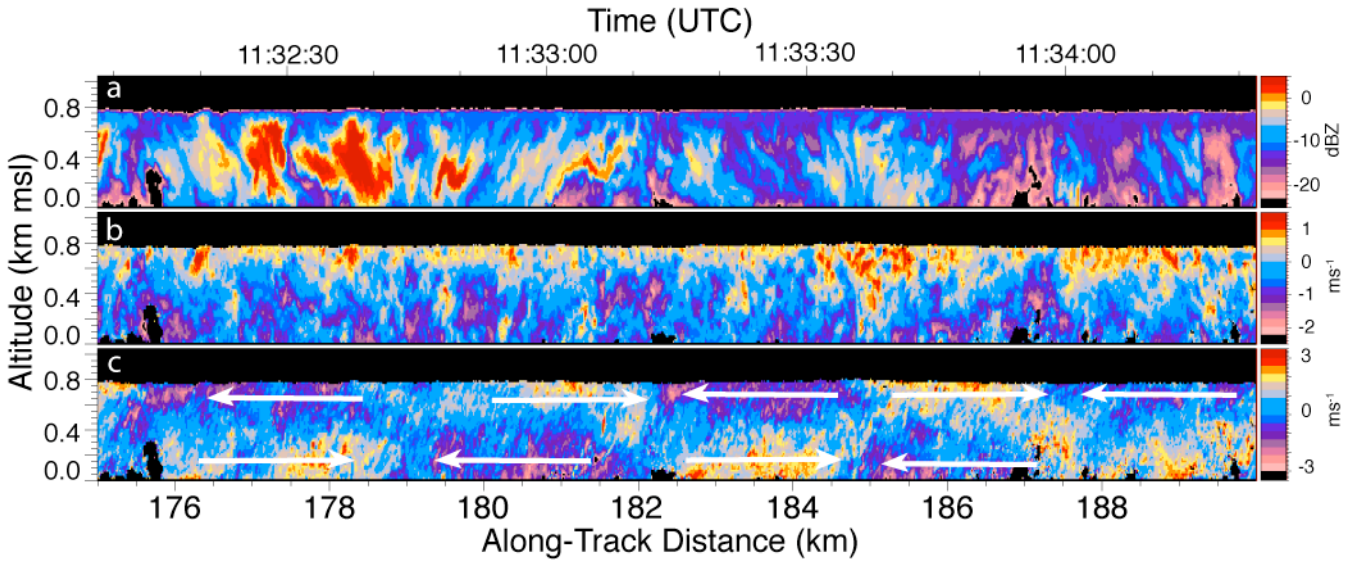
How does the interaction of drizzle with mesoscale organization, cloud microphysics, and boundary layer dynamics work to determine the structure of the stratocumulus-topped boundary layer ?

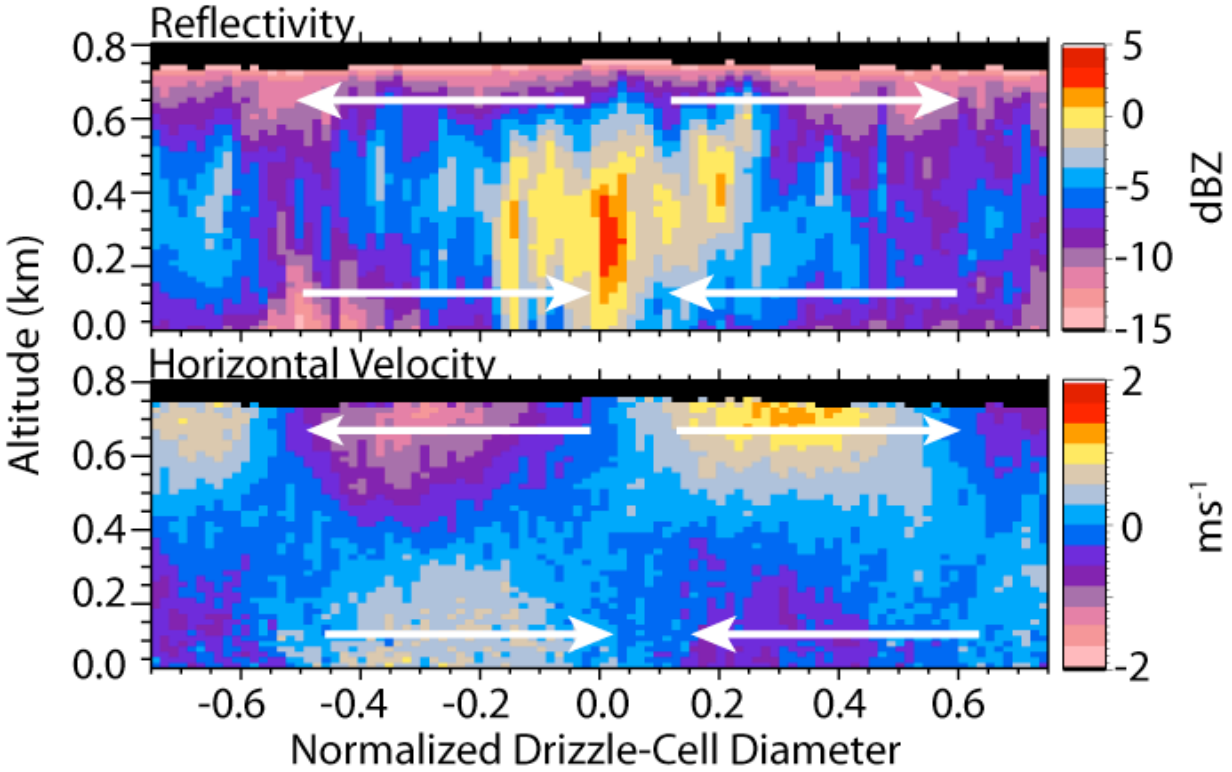


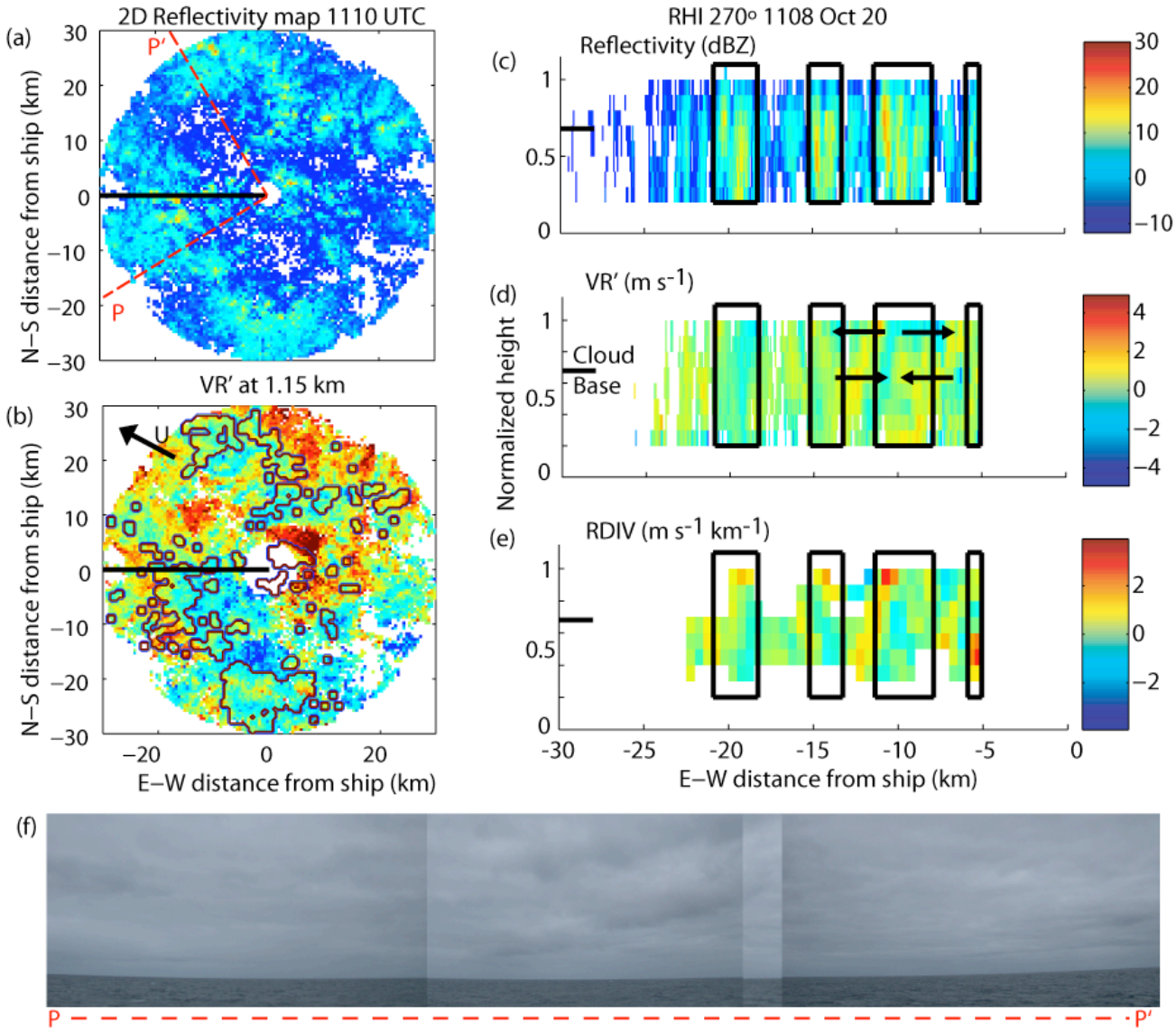

No MCC
Closed MCC
Open MCC
Cellular but disorganized
0
50
100
150
200
250
LWP [g m-2]


NE Pacific
SE Pacific
No MCC
Closed cell MCC
Open cell MCC
Cellular but disorganized

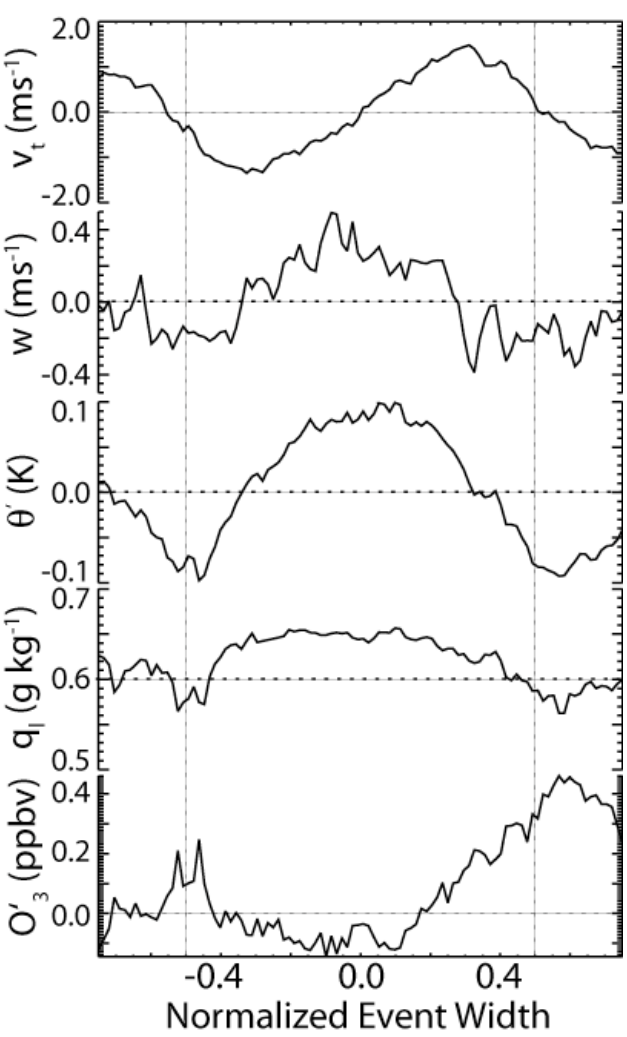

a
-127.50
-125
-122.50
-120
37.50
35
32.50
RF05
RF01
RF03
RF04
RF08
RF07
10:50:00
10:51:00
12:09:00
12:10:00
12:11:00
11:25:00
11:26:00
11:27:00
11:04:30
11:05:30
11:06:30
00:54:00
00:55:00
00:56:00
11:19:00
11:20:00
11:21:00
Time (UTC)
-30
-20
-10
0
10
Reflectivity (dBZ)


Time (UTC)
11:32:30
11:33:00
11:33:30
11:34:00
a
b
c
Altitude (km msl)
0.8
0.4
0.0
0
-10
-20
dBZ
1
0
-1
-2
3
-3
ms-1
176
178
180
182
184
186
188
Along-Track Distance (km)

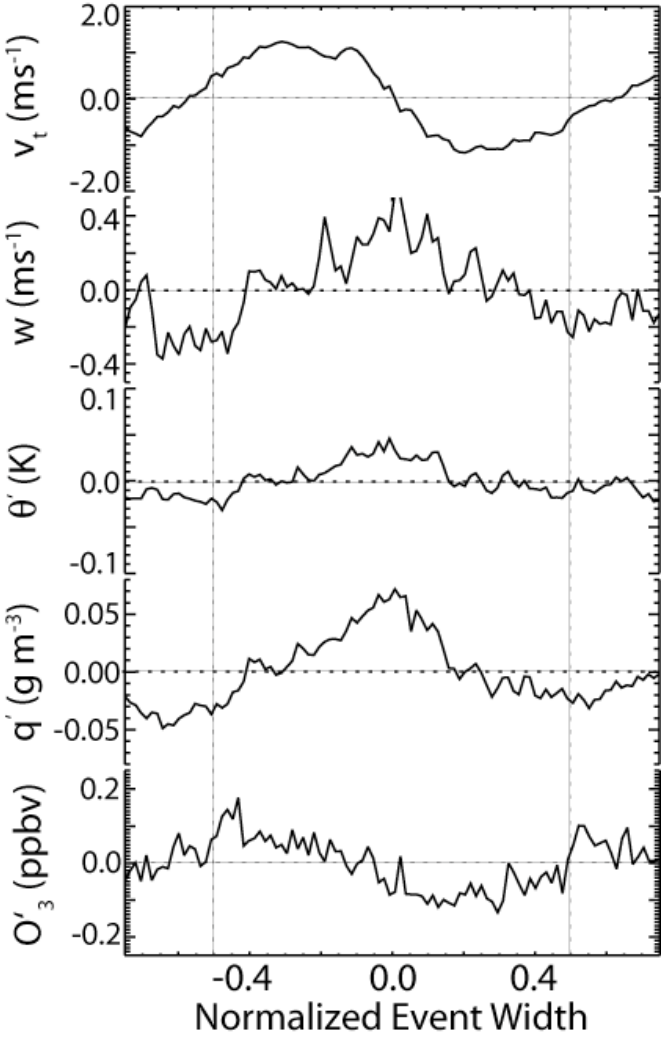

Reflectivity
Horizontal Velocity
Altitude (km)
0.8
0.6
0.4
0.2
0.0
5
0
-5
-10
-15
dBZ
2
0
-2
ms-1
-0.6
-0.4
-0.2
0.0
0.2
0.4
0.6
Normalized Drizzle-Cell Diameter

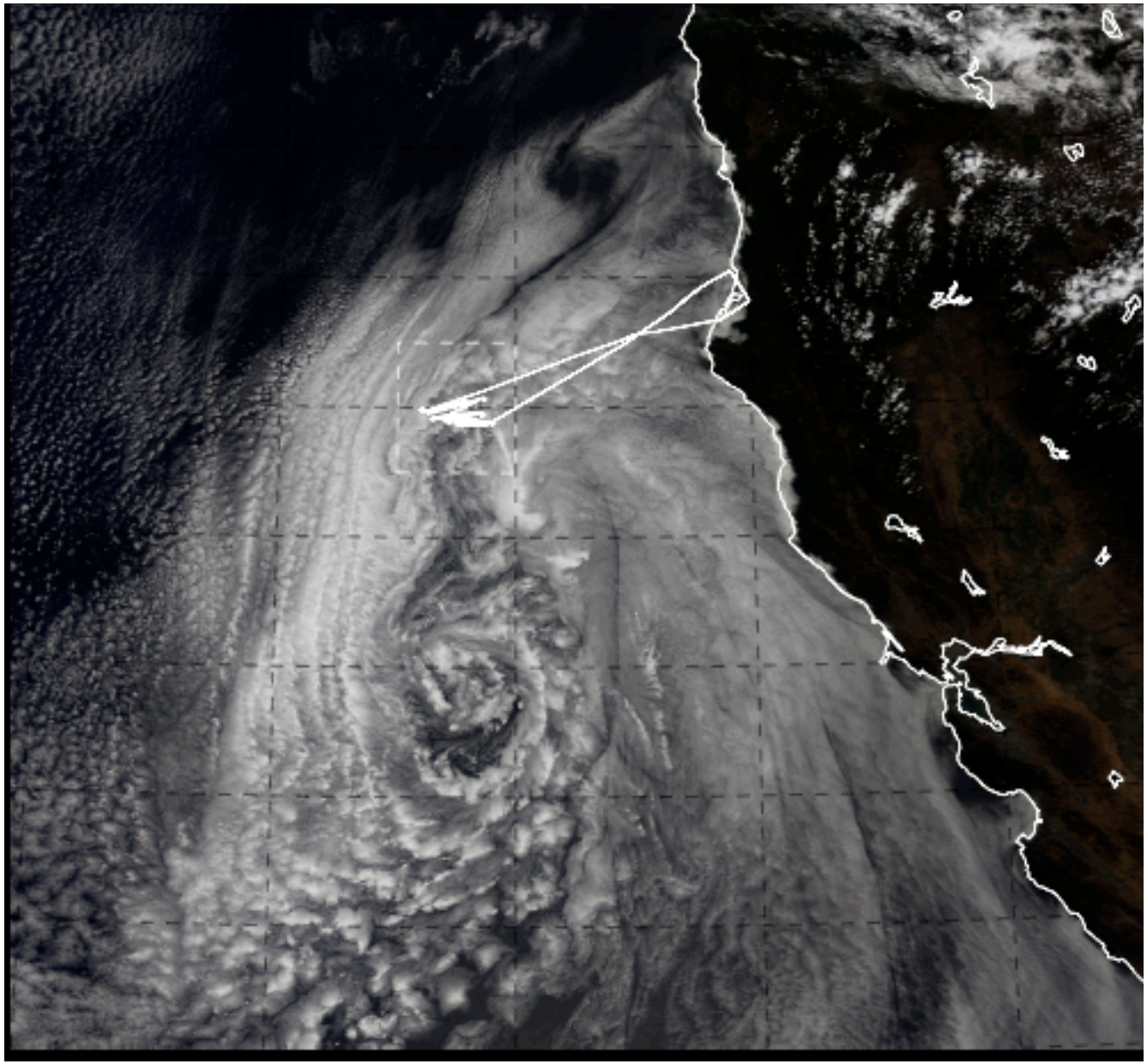

(a)
2D Reflectivity map 1110 UTC
P′
P
N–S distance from ship (km)
(b)
VR′ at 1.15 km
U
N–S distance from ship (km)
E–W distance from ship (km)
RHI 270° 1108 Oct 20
(c)
Reflectivity (dBZ)
(d)
VR′ (m s-1)
Cloud
Base
Normalized height
(e)
RDIV (m s-1 km-1)
E–W distance from ship (km)
(f)
P
P′

Cloud-Top



Surface Leg

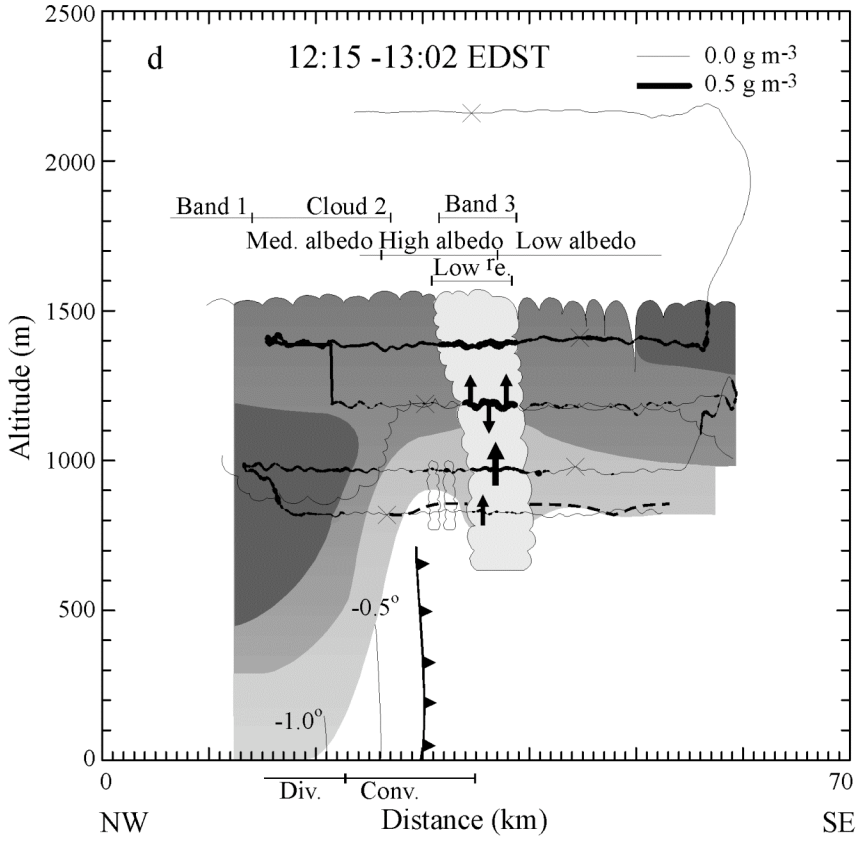




In the VOCALS open-cell regime, is the organization characterized by:

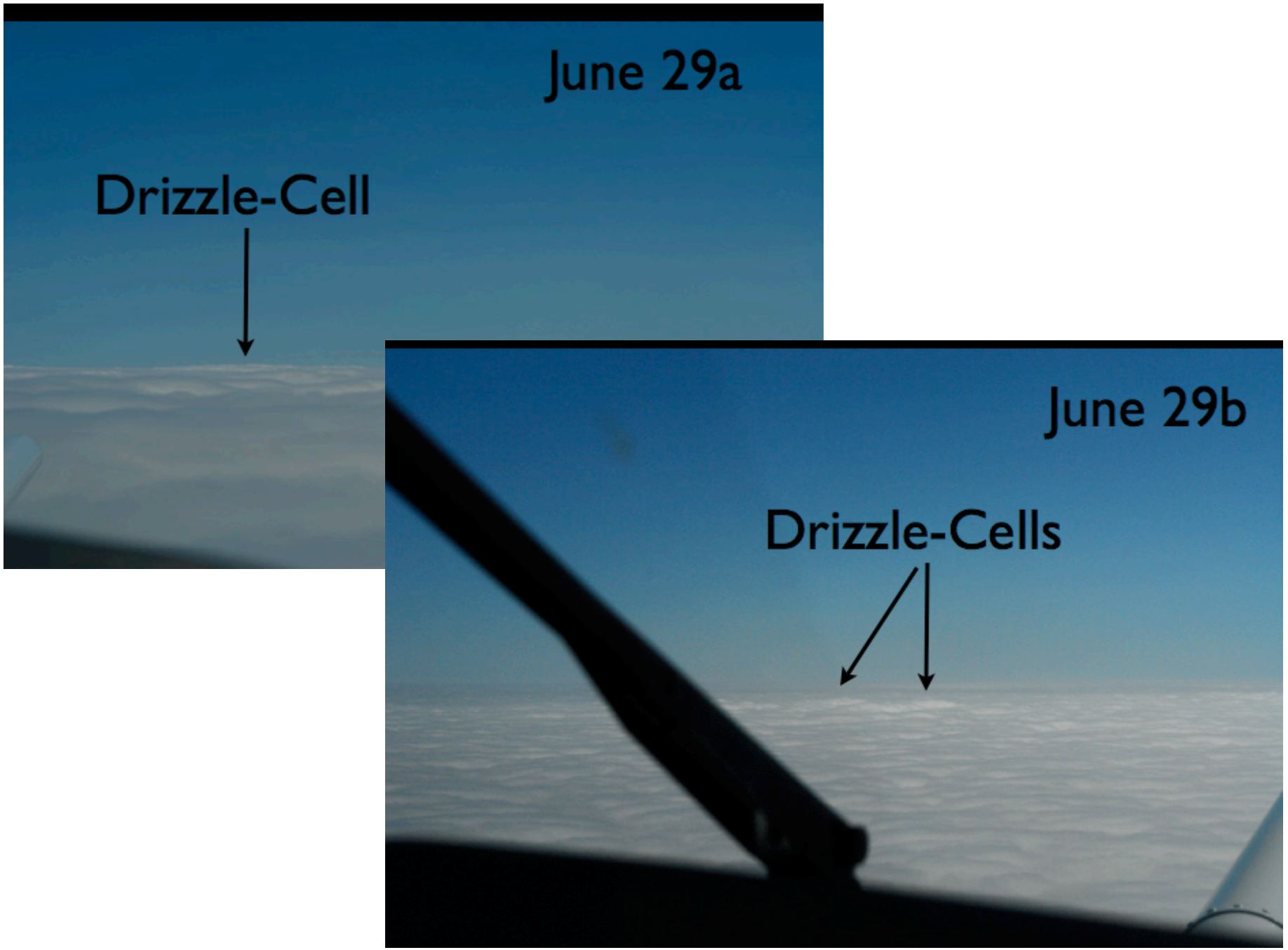
a. Same cumulus cell keeps pumping?

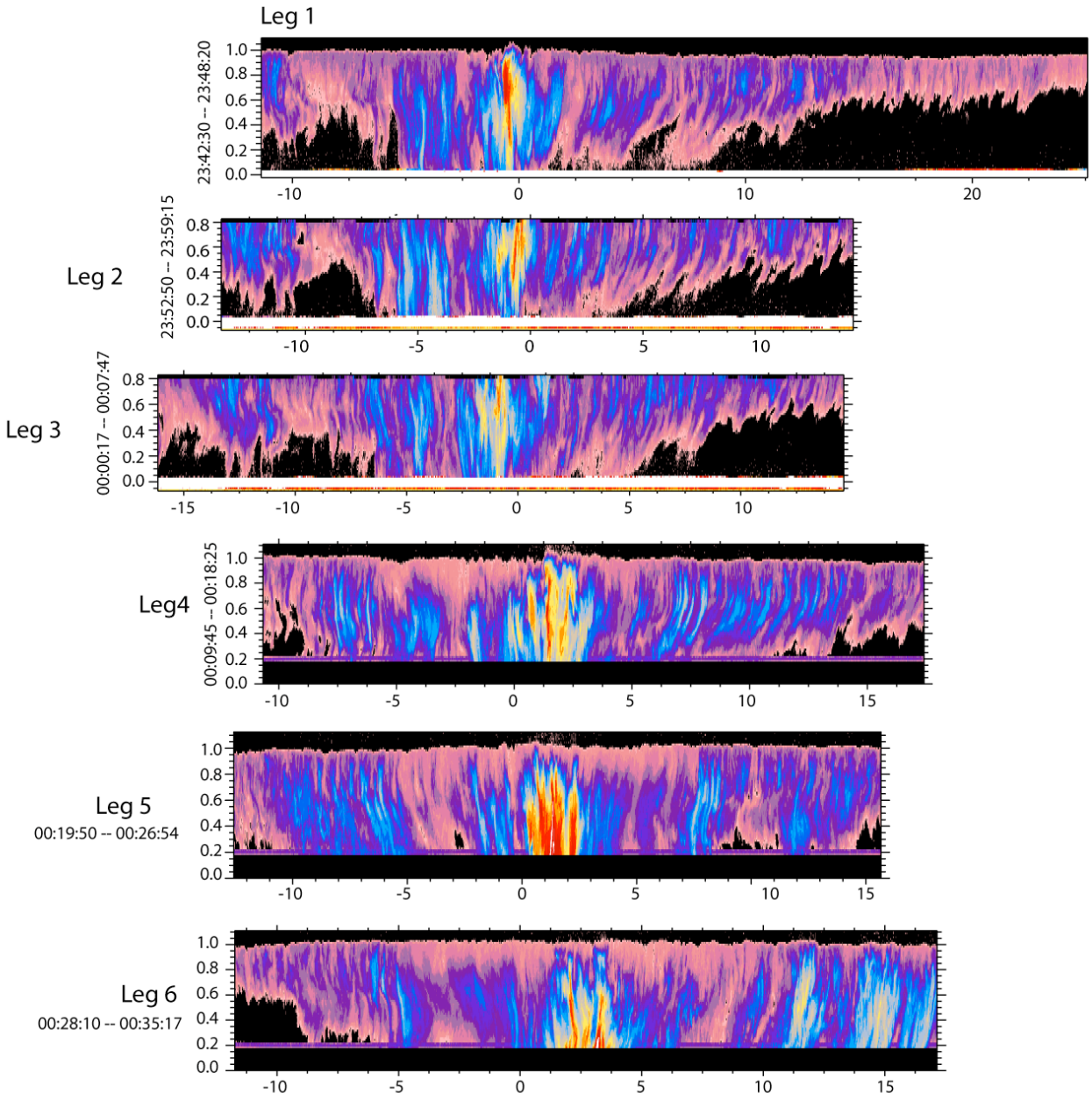
b. Cells go through a life-cycle, with cold air downdrafts triggering new convective clouds?

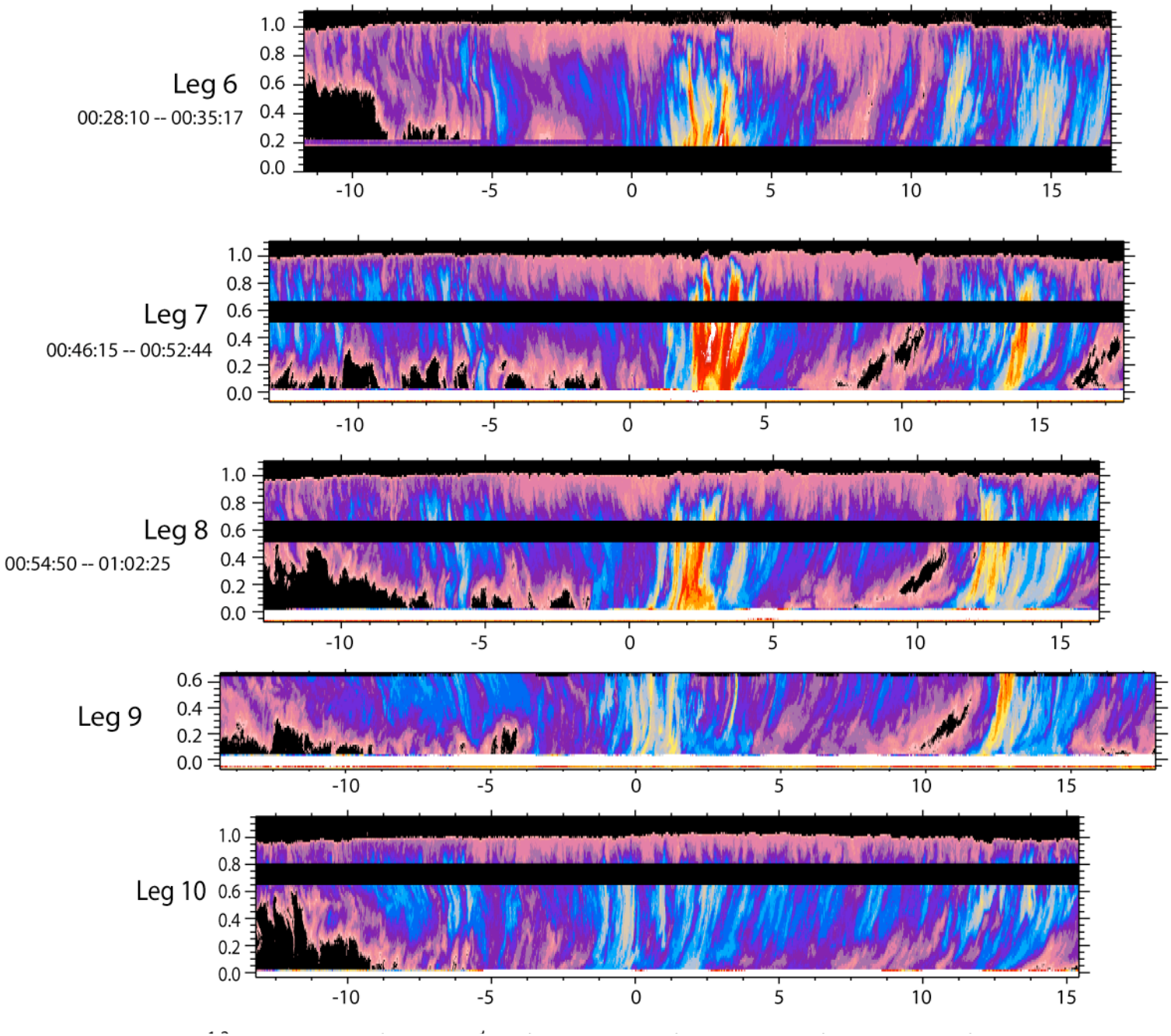


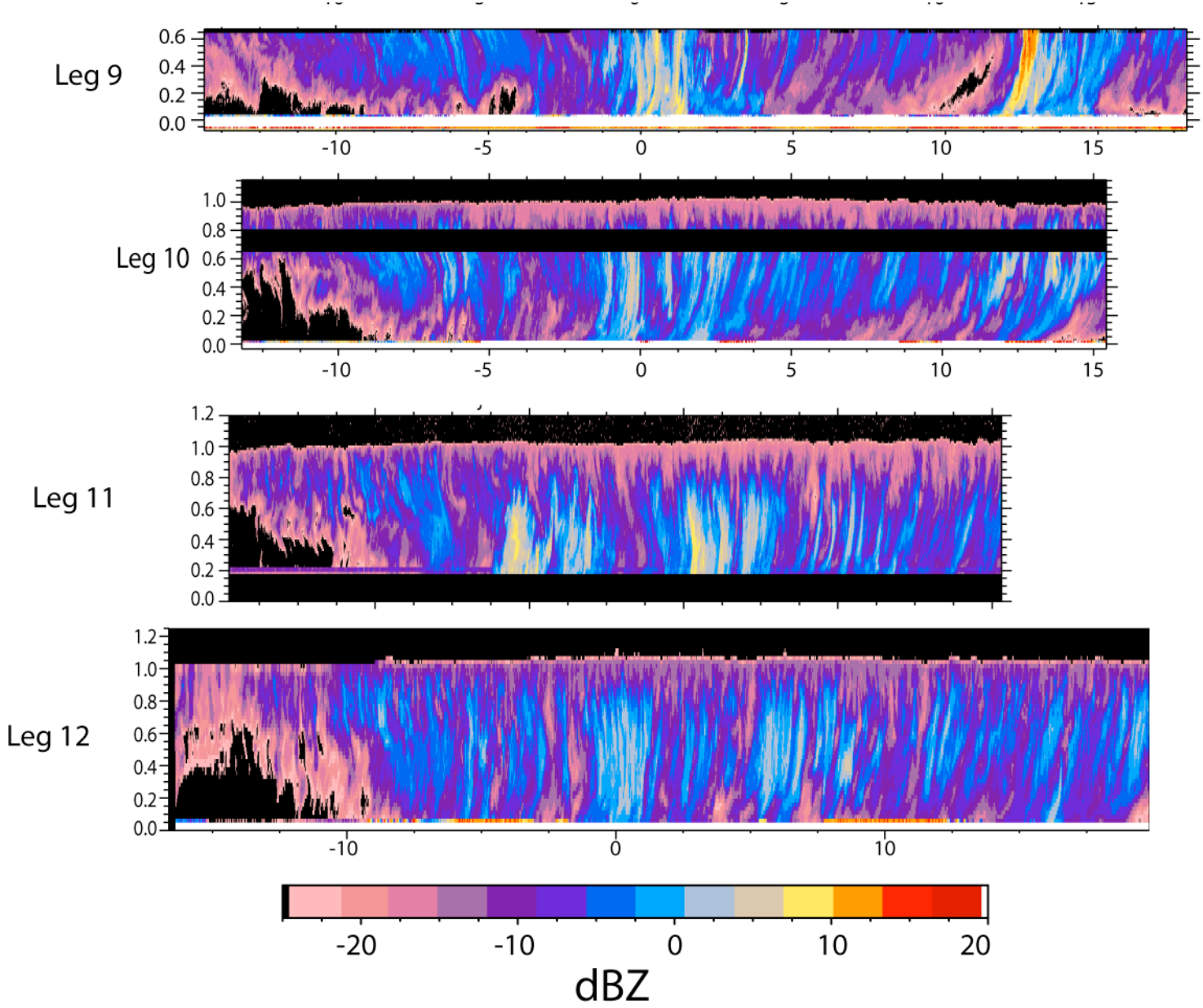
Does precipitation-cooling lead to significant pressure perturbations? Use dGPS to examine.

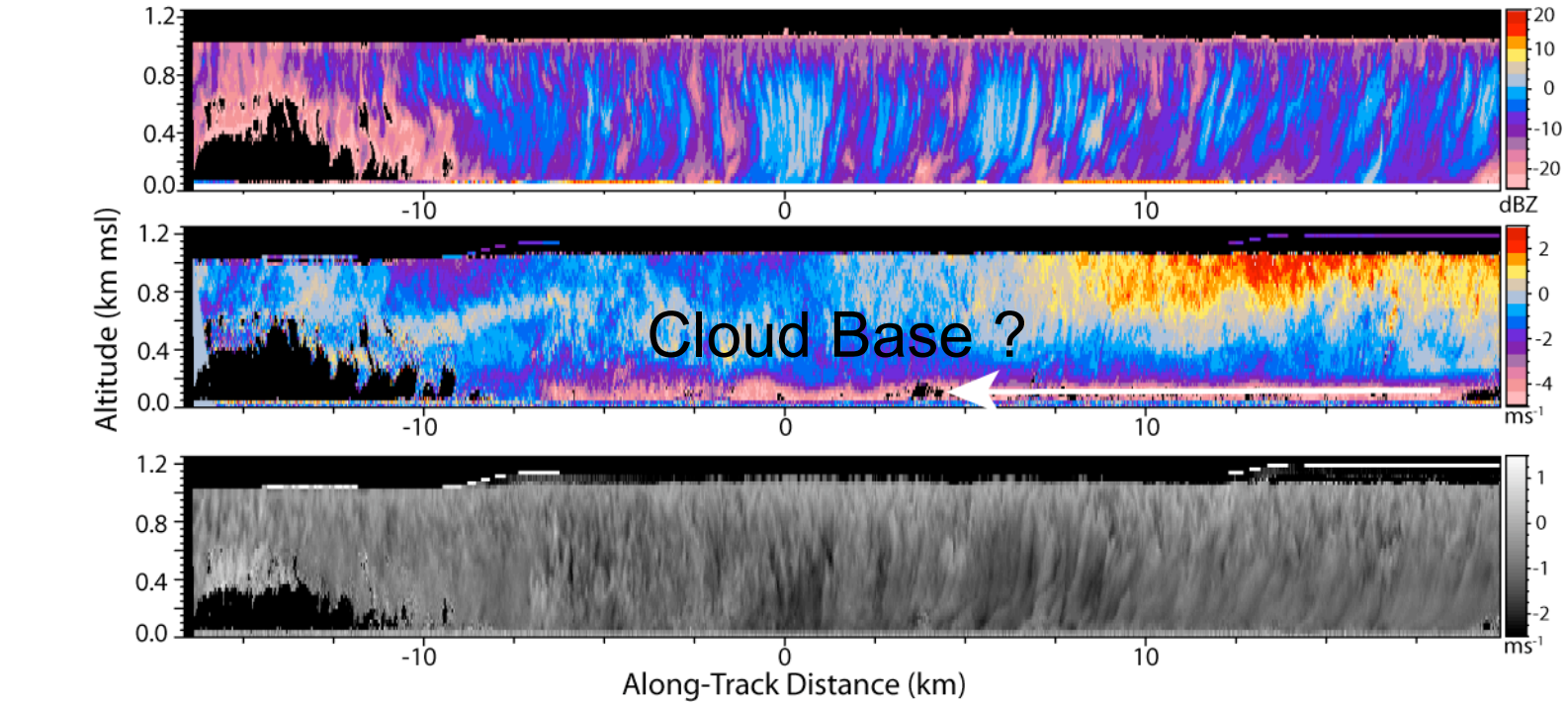
Generations of bands developing, precipitating and triggering new bands. Cumulus rising up into stratocumulus, observed west of Tasmania, Jensen et al, 2000.

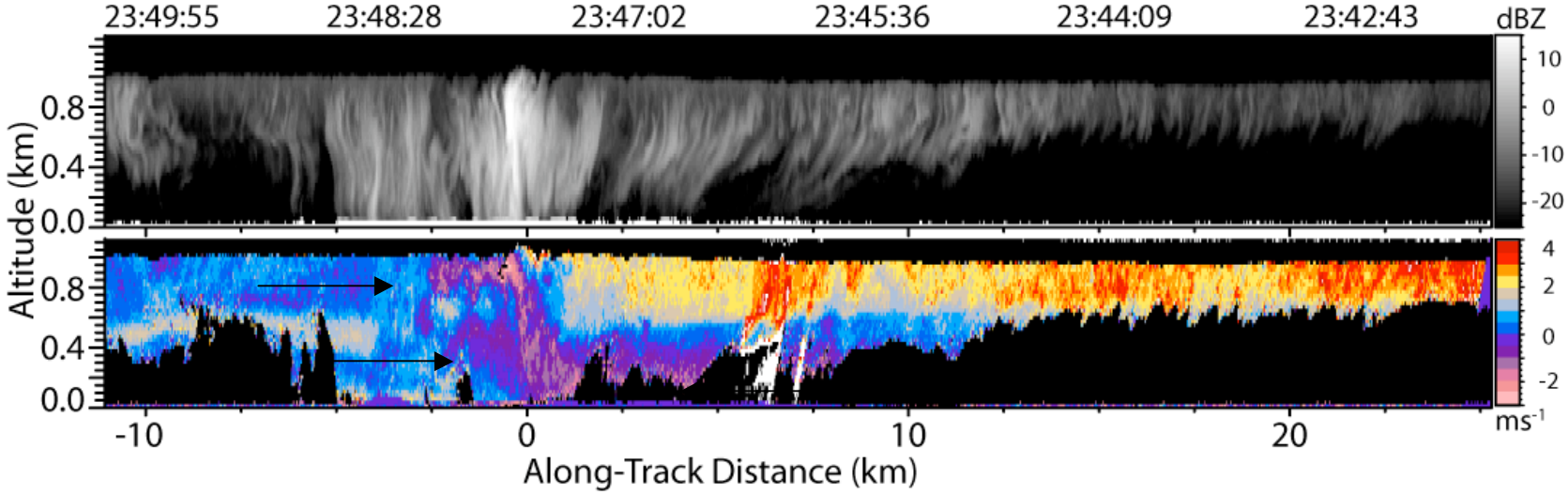

June 29a
Drizzle-Cell
June 29b
Drizzle-Cells

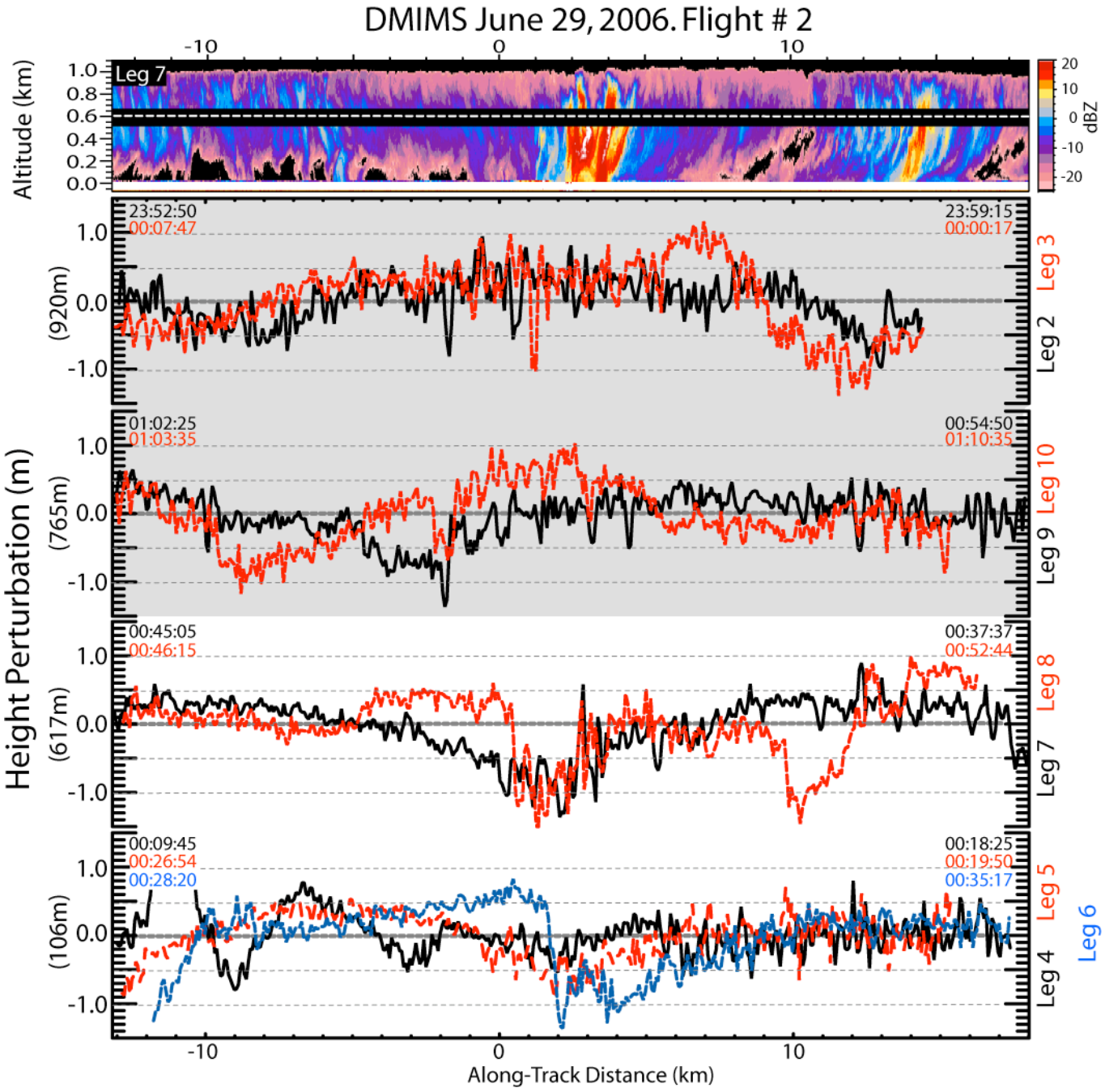

Leg 1
23:42:30 -- 23:48:20
Leg 2
23:52:50 -- 23:59:15
Leg 3
00:00:17 -- 00:07:47
Leg4
00:09:45 -- 00:18:25
Leg 5
00:19:50 -- 00:26:54
Leg 6
00:28:10 -- 00:35:17


Leg 6
00:28:10 -- 00:35:17
Leg 7
00:46:15 -- 00:52:44
Leg 8
00:54:50 -- 01:02:25
Leg 9
Leg 10
1.0
0.8
0.6
0.4
0.2
0.0
-10
-5
0
5
10
15

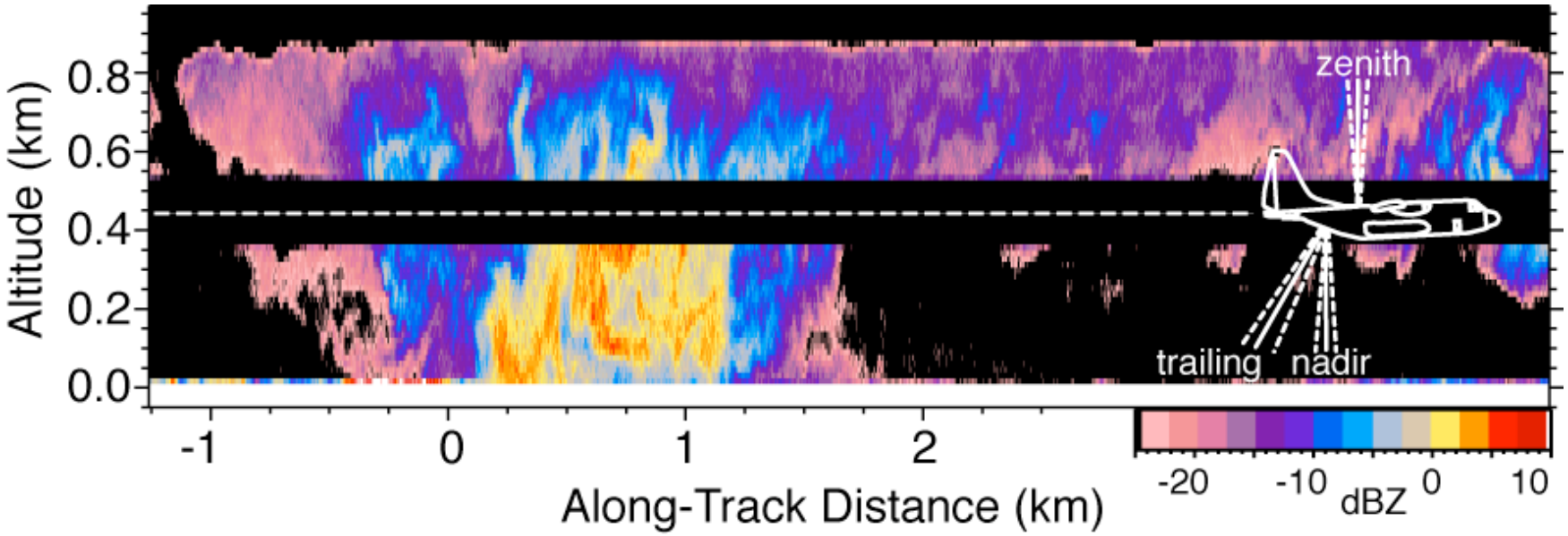

Leg 9
Leg 10
Leg 11
Leg 12
dBZ
-20
-10
0
10
20


Cloud Base ?
Altitude (km msl)
Along-Track Distance (km)
dBZ
ms-1


23:49:55
23:48:28
23:47:02
23:45:36
23:44:09
23:42:43
dBZ
Altitude (km)
Along-Track Distance (km)
ms-1


DMIMS June 29, 2006. Flight # 2
Altitude (km)
Leg 7
dBZ
Height Perturbation (m)
23:52:50
00:07:47
23:59:15
00:00:17
Leg 3
Leg 2
(920m)
01:02:25
01:03:35
00:54:50
01:10:35
Leg 10
Leg 9
(765m)
00:45:05
00:46:15
00:37:37
00:52:44
Leg 8
Leg 7
(617m)
00:09:45
00:26:54
00:28:20
00:18:25
00:19:50
00:35:17
Leg 5
Leg 6
Leg 4
(106m)
Along-Track Distance (km)

Wyoming Cloud Radar (WCR)



- 95 GHz (3.16mm) Doppler radar.
- 3-Beams
  - 2-down -- Vertical Plane Velocity Fields Below AC
  - 1 - up -- Cloud & Drizzle Structure from within BL
- ~100 - 120m to 1st good gate.
- 250ns (37.5m) Transmit Pulse. Return Sampled @ 15m
- Approximate Sensitivity @ 0.5 km:
  - -30 dBZ (down)
  - -25 dBZ (up)

ATMOSPHERIC SCIENCE

King Air Research (n2uw)

WCL Specification:

Ultra-pulsed Nd:YAG laser from Big Sky Laser Technique, Inc	
Transmit wavelength	355 nm
Transmit pulse length	10 ns (3 m)
Range gate resolution	3.75 m
Pulse Rep. Frequency	10 Hz
Beam Width	~ 1 cm + 0.3 mrad
Pulse Averaging (typical)	1-4 (typical) 0.1-0.4 s along track
Detector(s)	2 orthogonal PMT (co- & cross-pol pwr)

WCL Data System:

Licel Data Acquisition and software Module

Built on LabView to run on standard Windows PC

Data transfer and accesibility via network

Upward-looking Only On the C-130

ATMOSPHERIC SCIENCE

King Air Research (n2uw)

Supercooled Water

Ice precipitation

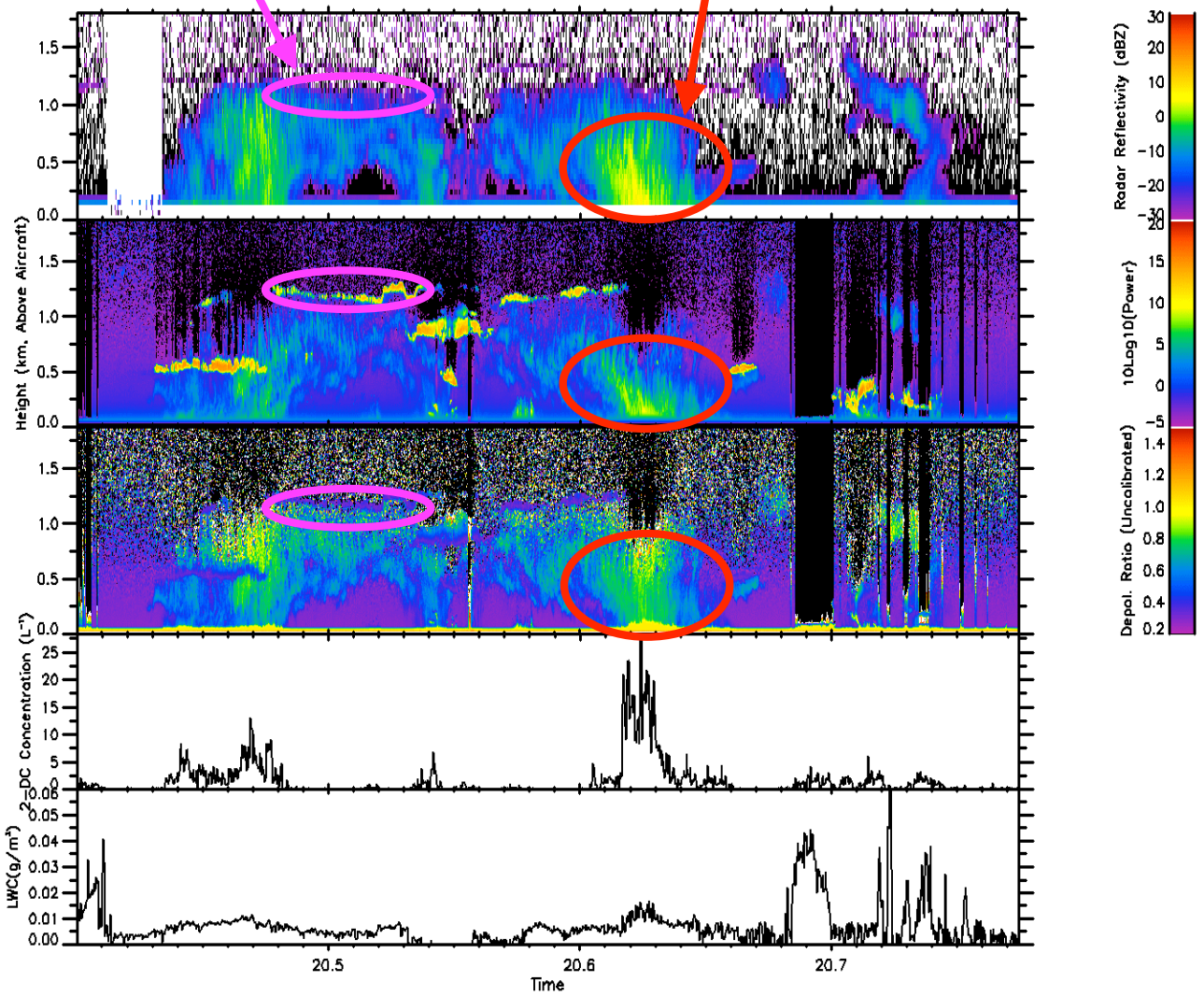
WCR

WCL Backscattering

WCL Depolarization

2-DC Concentration

LWC



A few things to take away

- There's more to life than POCs and Closed-Cells.
- Drizzle mostly falls into updrafts.
- Need to estimate the total evaporation **and** the evaporation profile.