Large Eddy Observations (and LES) of SGP Liquid Stratus

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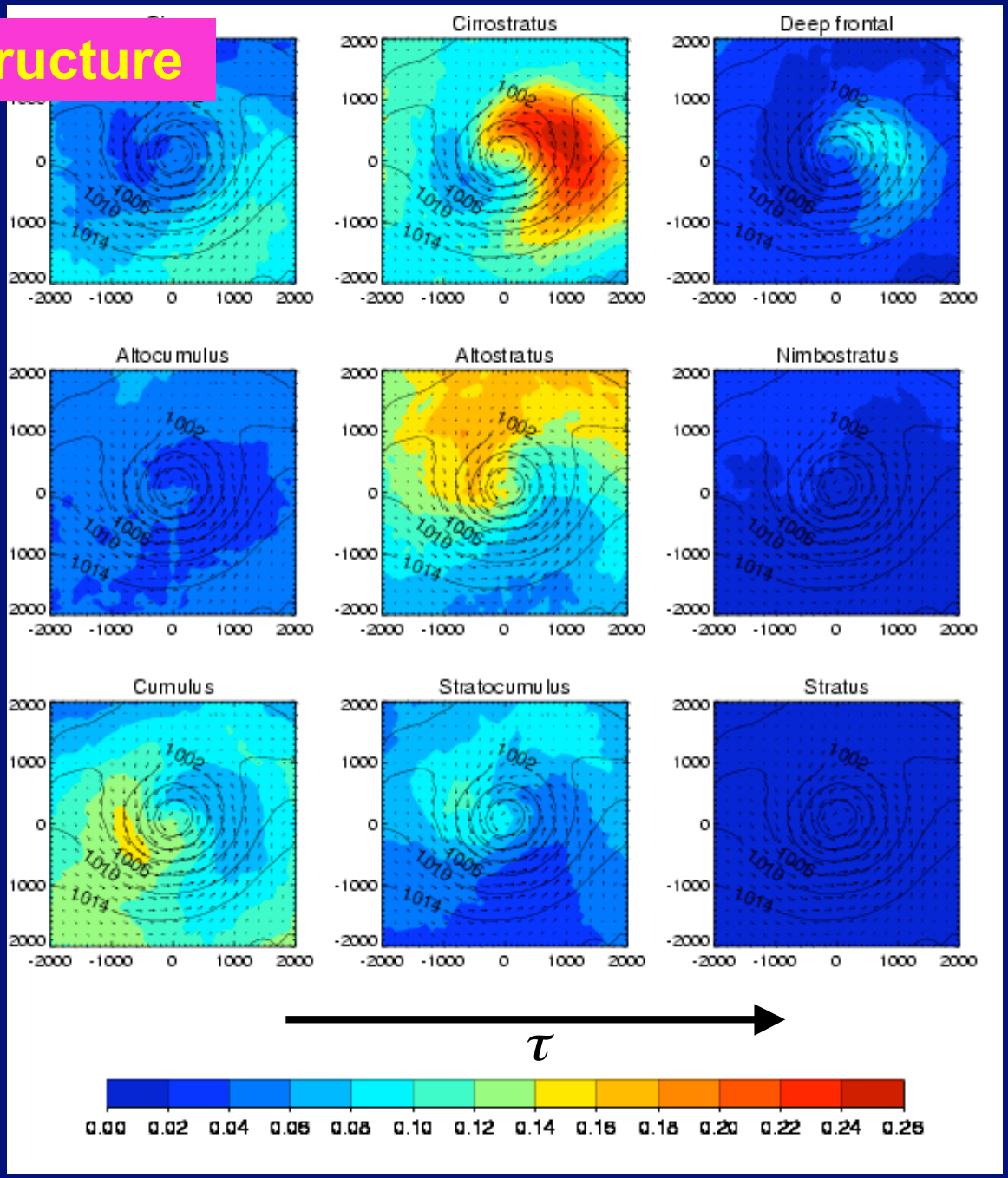
Motivation

- Low clouds significantly influence the global radiation budget (high albedo and expansive coverage)
- Classical studies of low clouds focused on marine environments
- ARM has continuous years of SGP low cloud observations
- Previous studies have focused on their climatological, microphysical, and radiative characteristics (Dong and collaborators, 1997, 1998, 2000, 2002, 2003, 2005)
- Low clouds at SGP frequently associated with synoptic systems

Midlatitude cloud structure



Field and Wood (J. Clim. 2006)

Motivation (cont.)

- Evolution of BL cloud systems is inextricably linked to BL energetics:

  Heat, moisture, mass, and momentum transports

  Entrainment

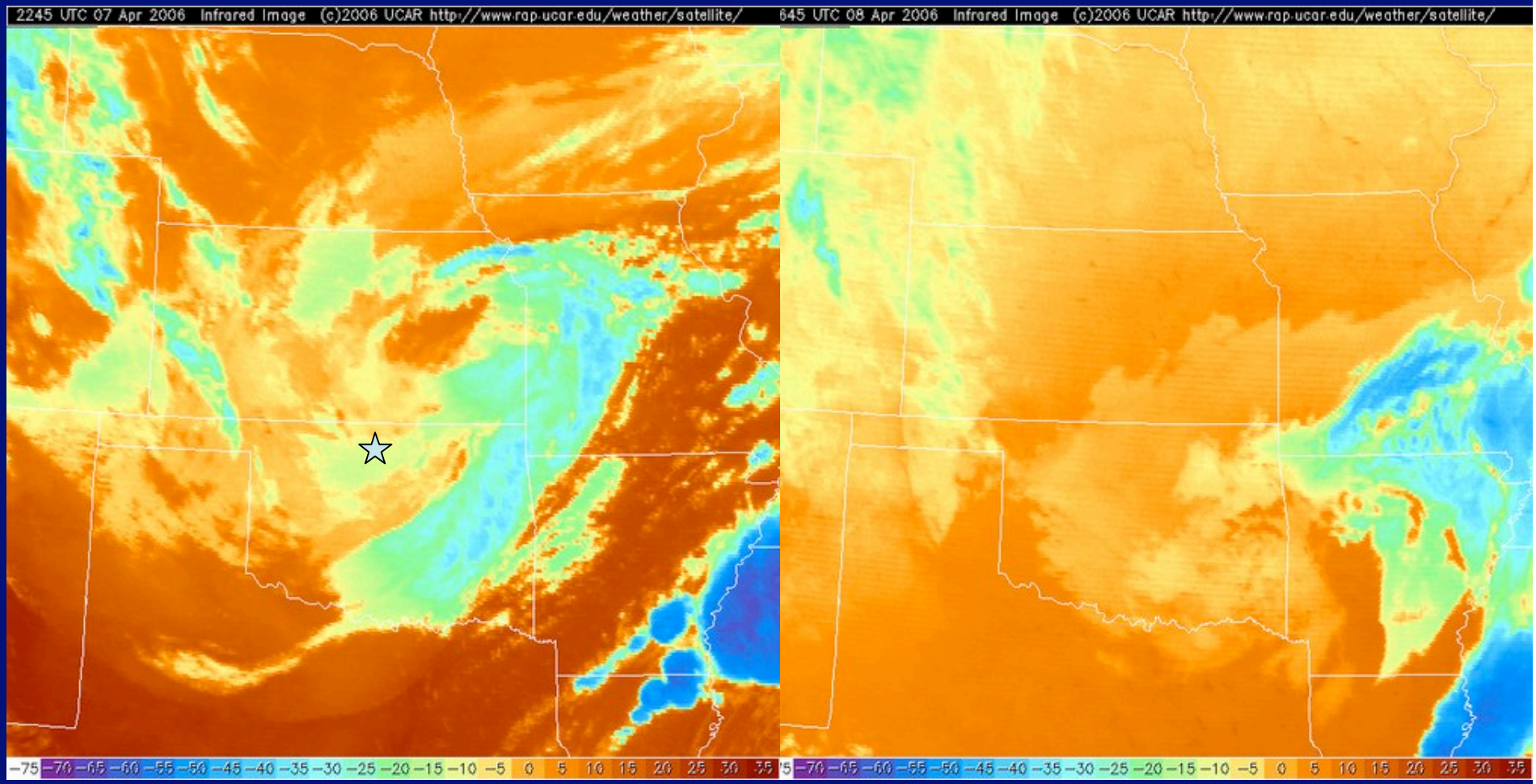
- Tools to explore these quantities:

  LES

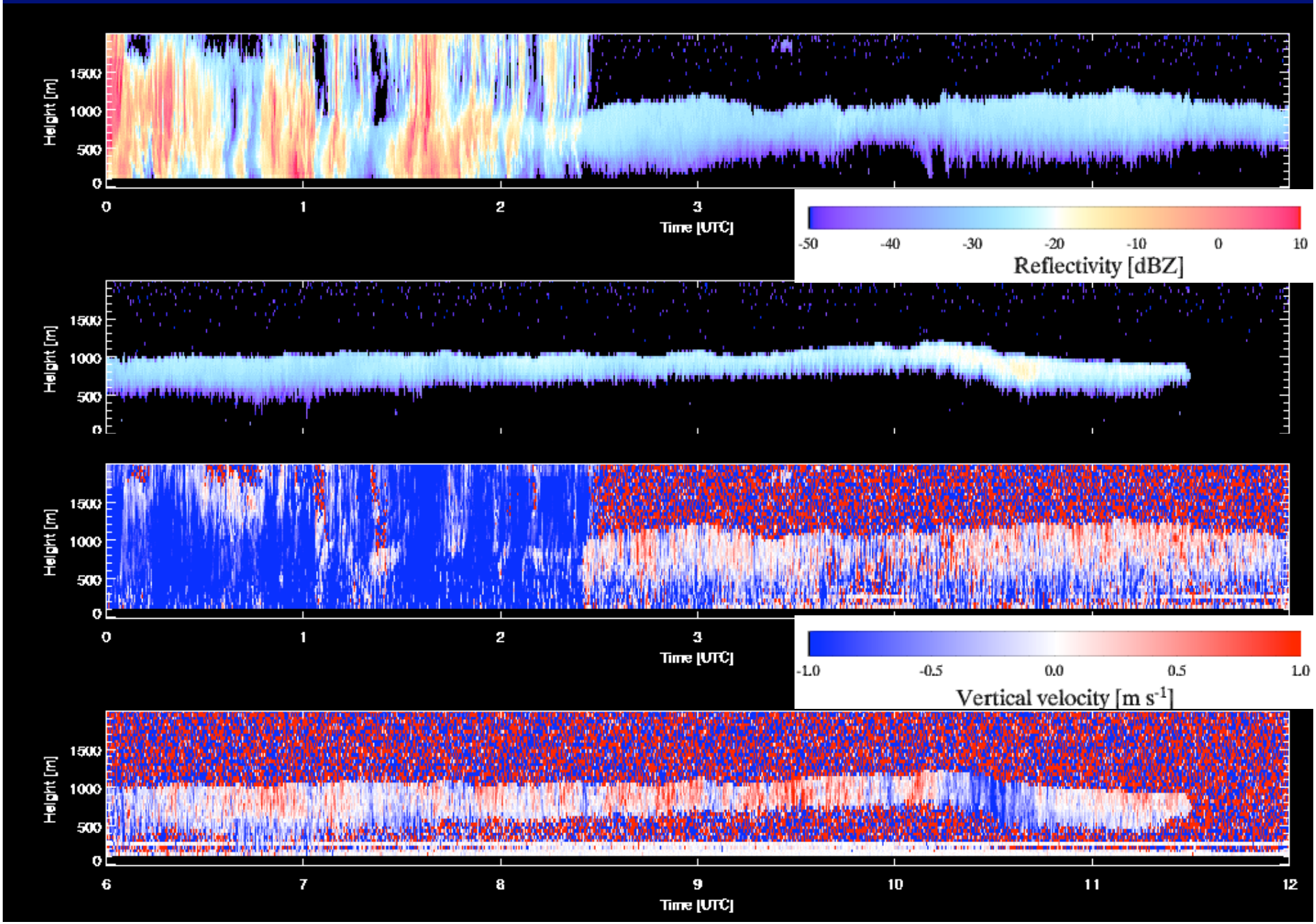
  Large Eddy Observations

- This is a first cut at looking at SGP turbulence and comparing it with what we know from marine stratocumulus.

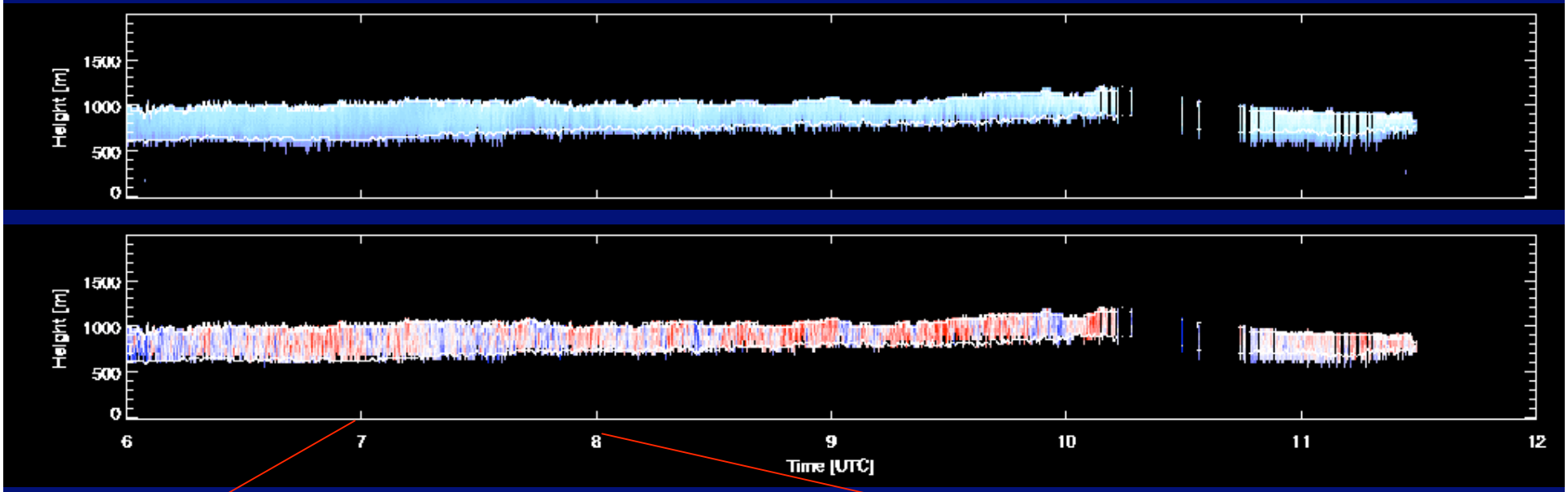
7-8 April 2006

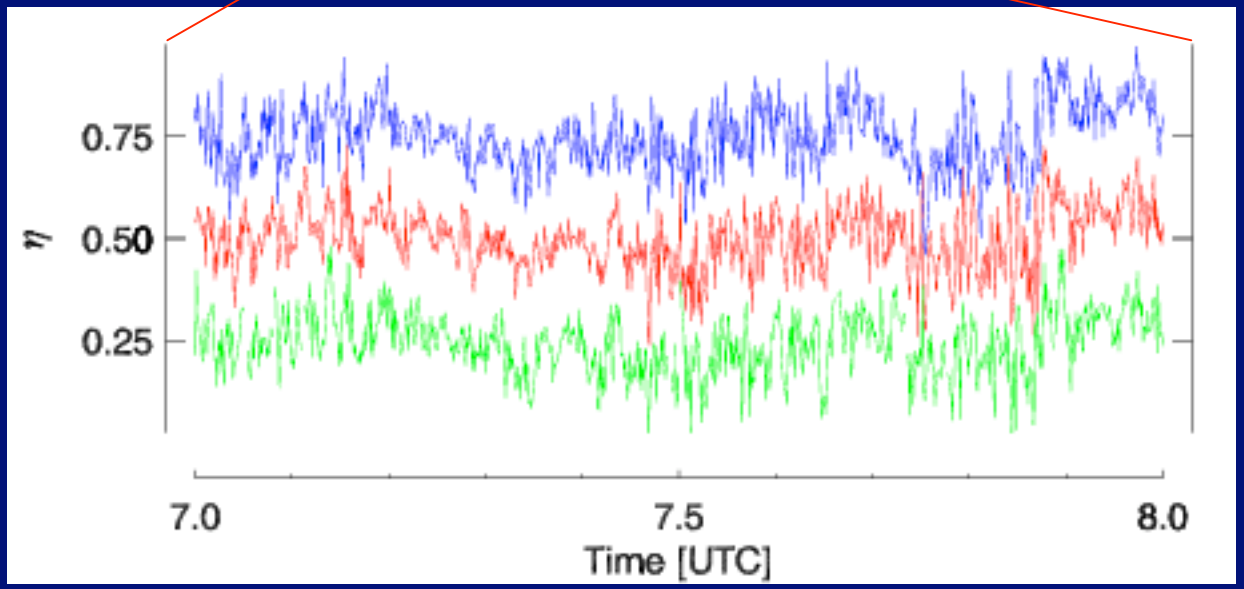


WACR (0-2 km) reflectivity and velocity, 8 April 2006



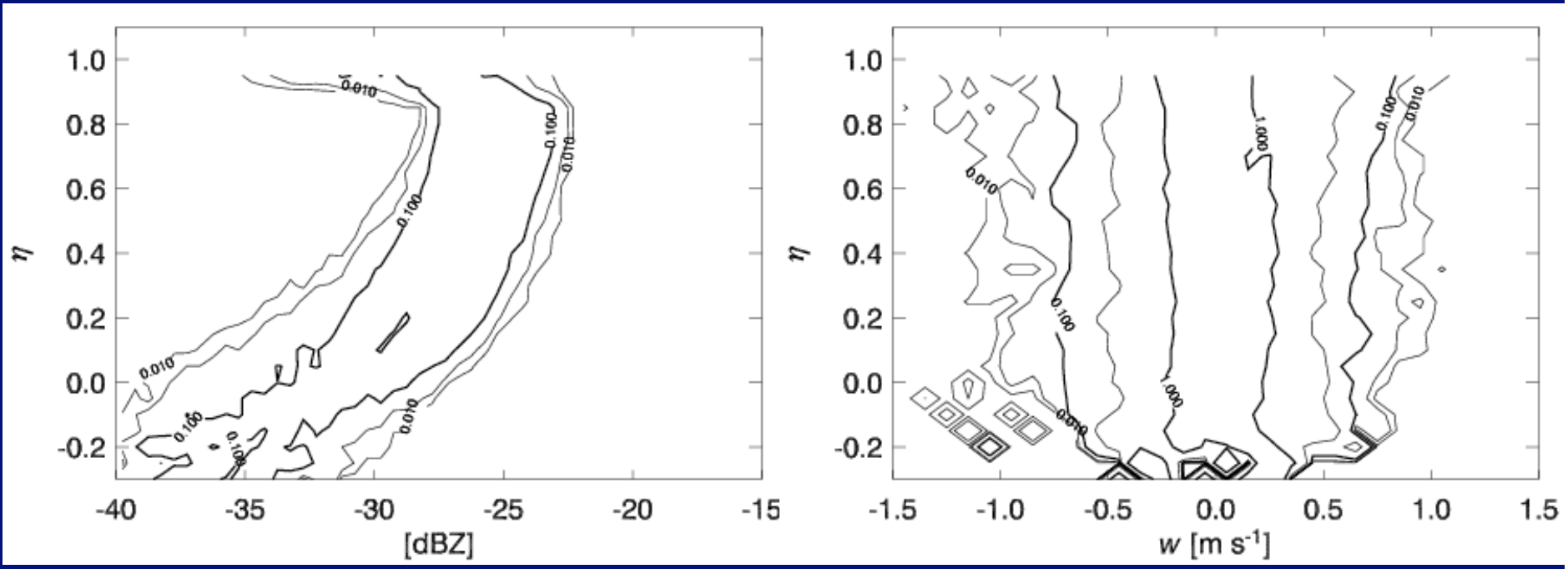
Processed reflectivity and velocity

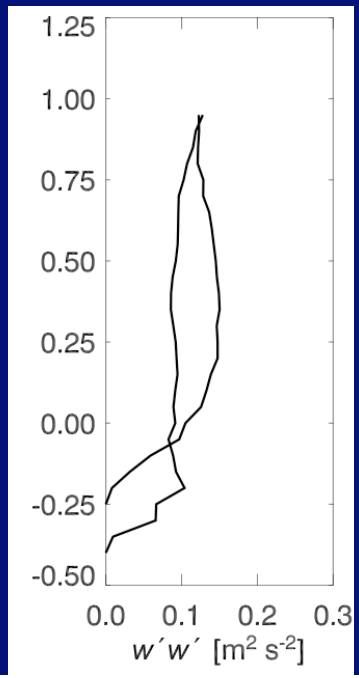


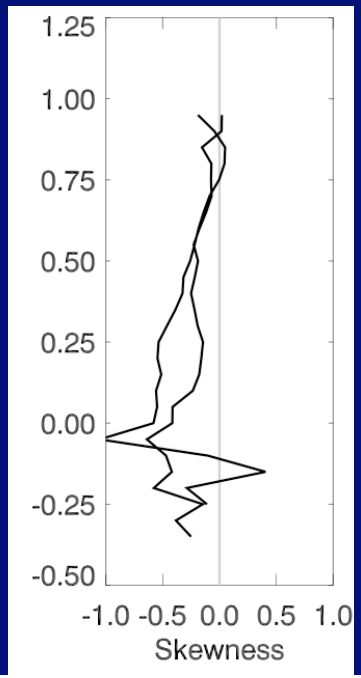


Vertical velocity at 3 levels in the cloud — coherent structures

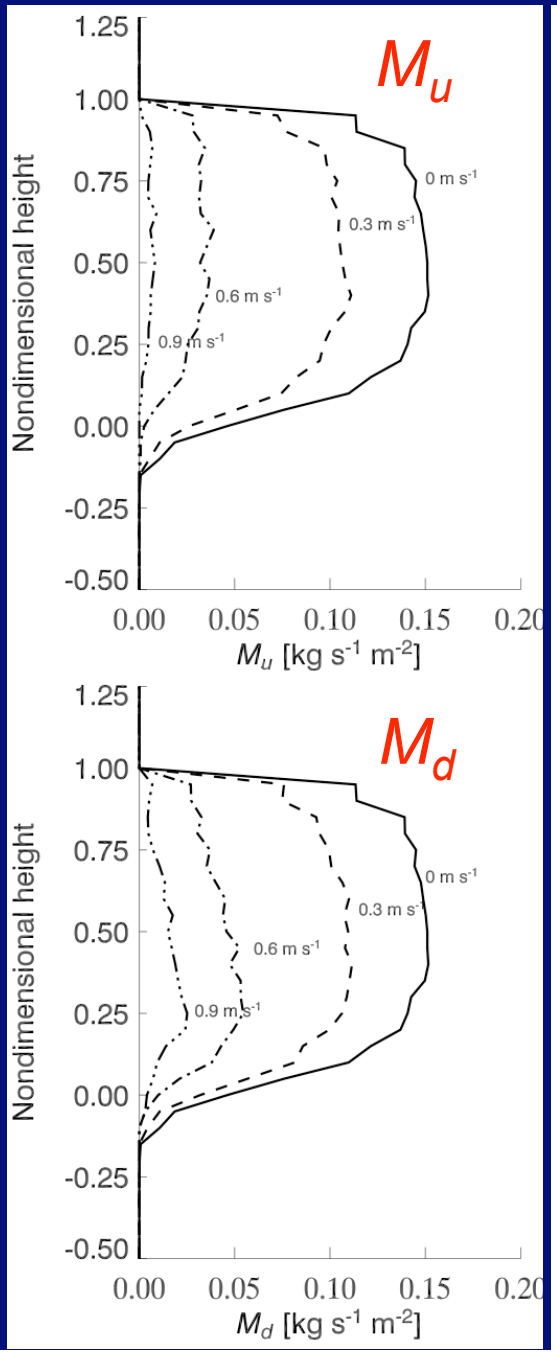
LEO statistics

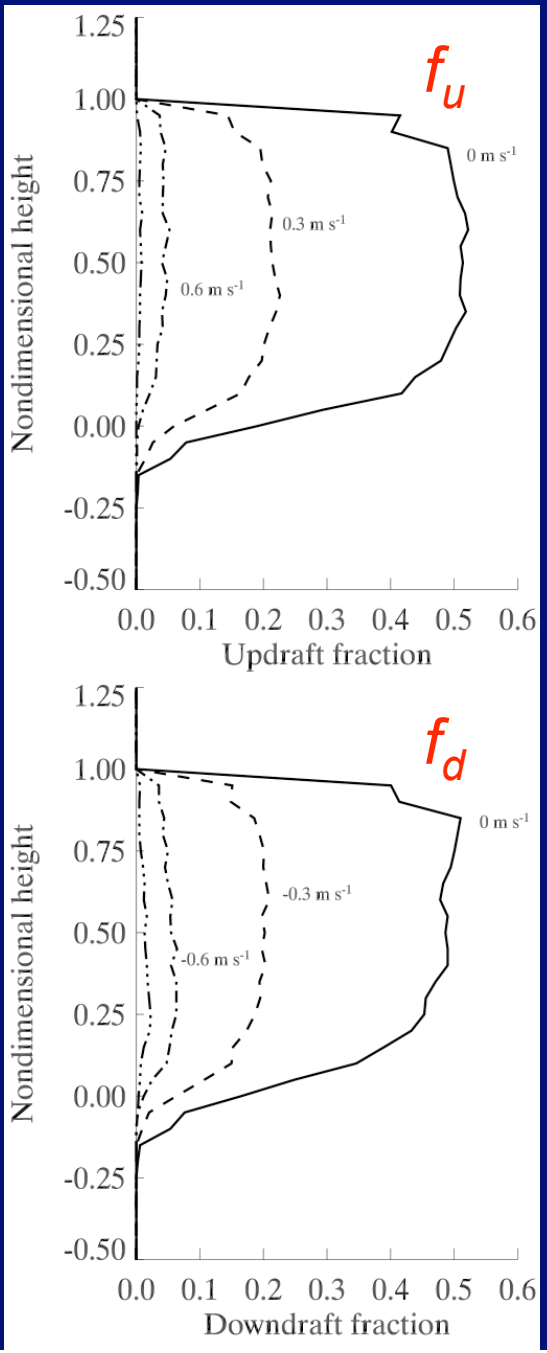






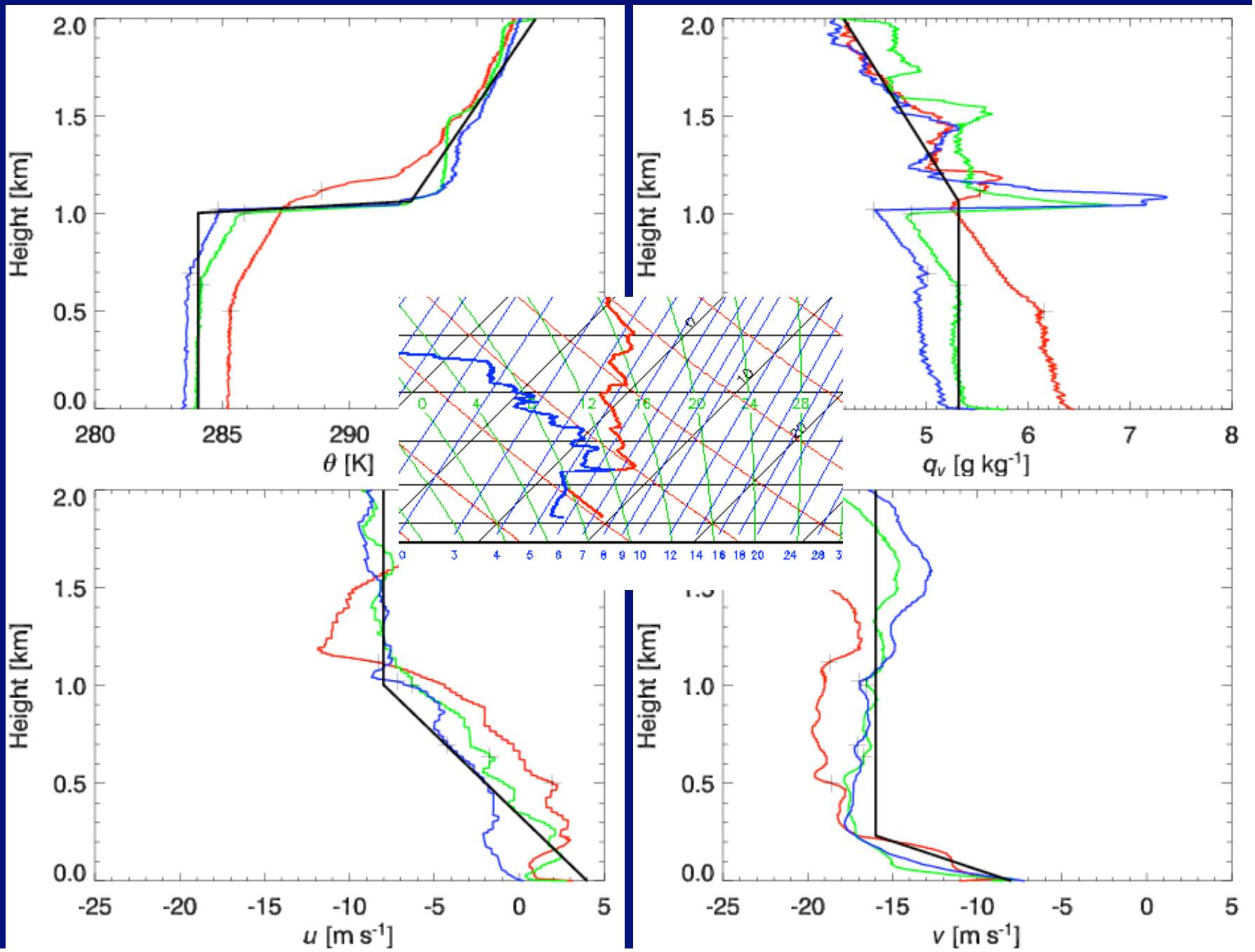
LEO statistics



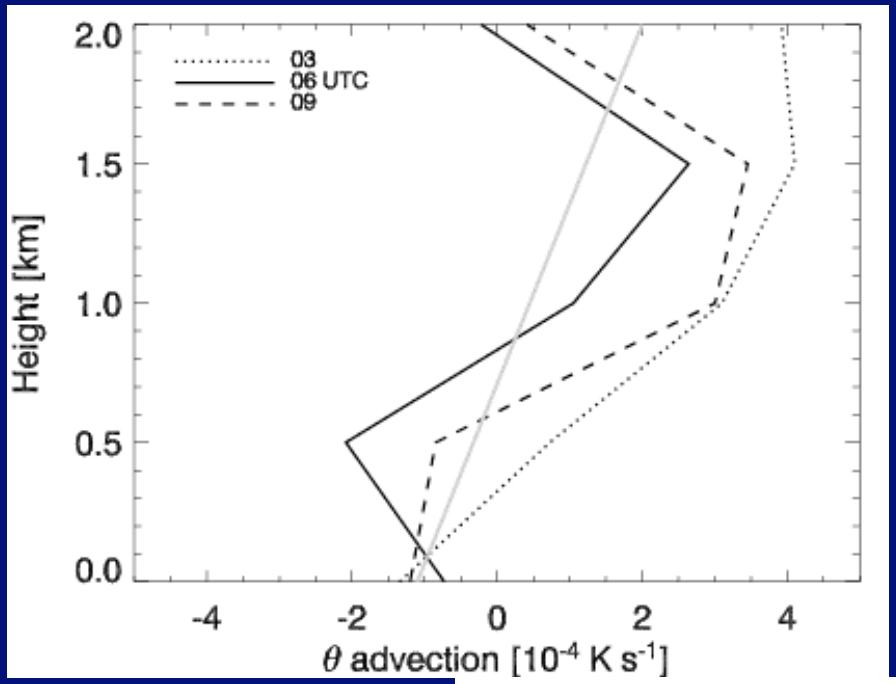


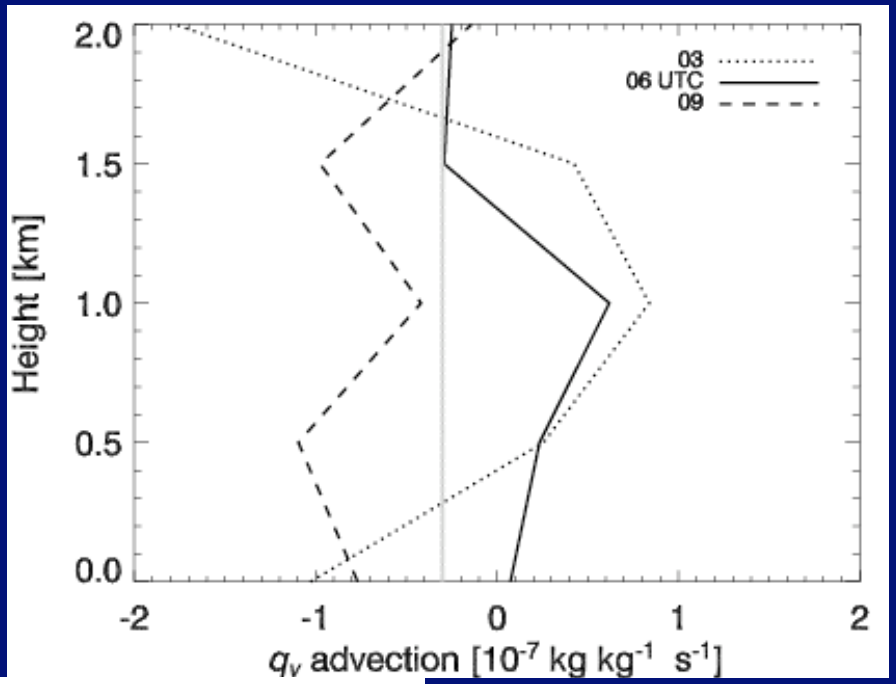
Updraft and downdraft mass flux and fraction, partitioned by vertical velocity

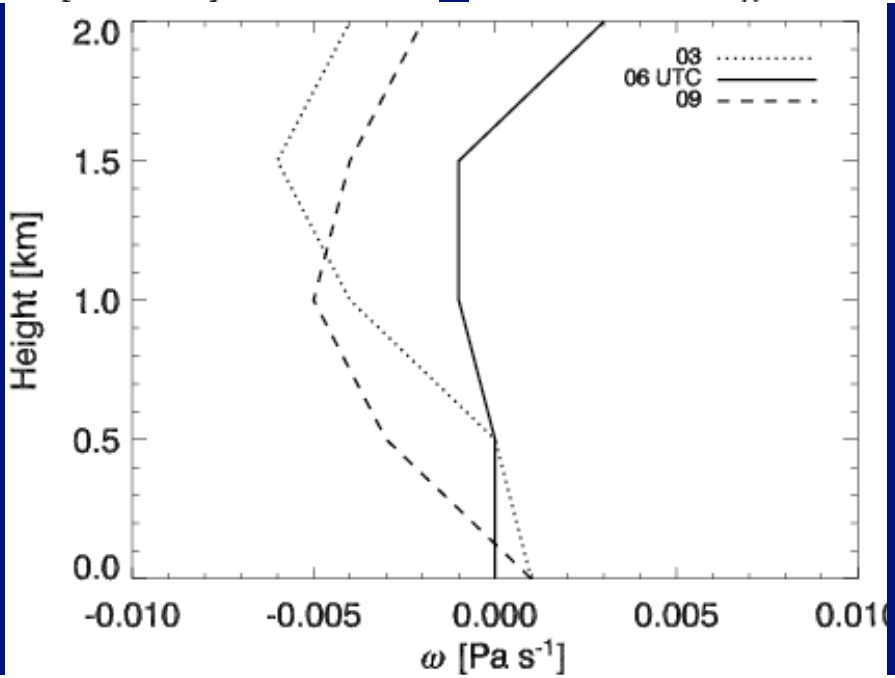
LES initial conditions



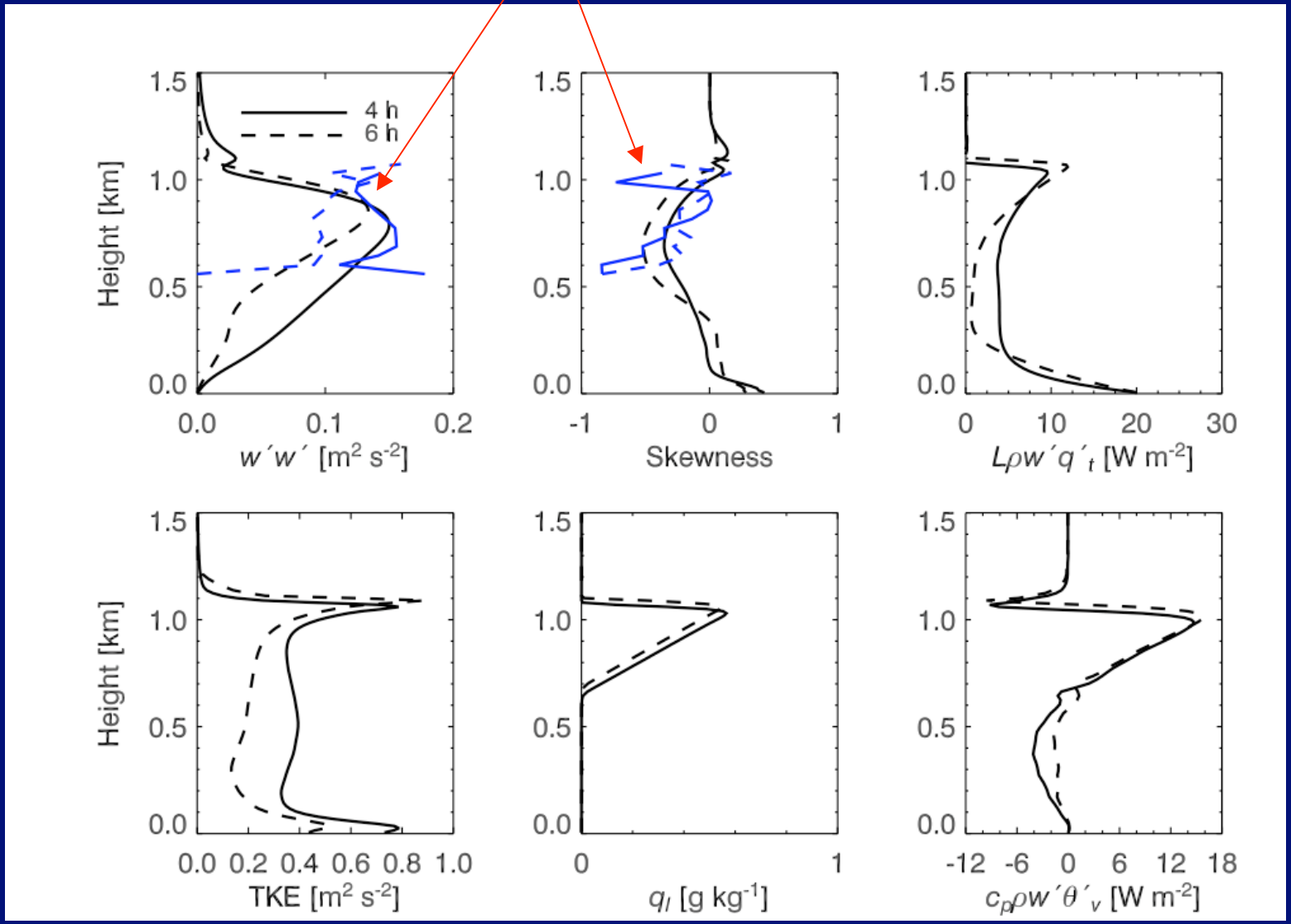
LES large scale forcings





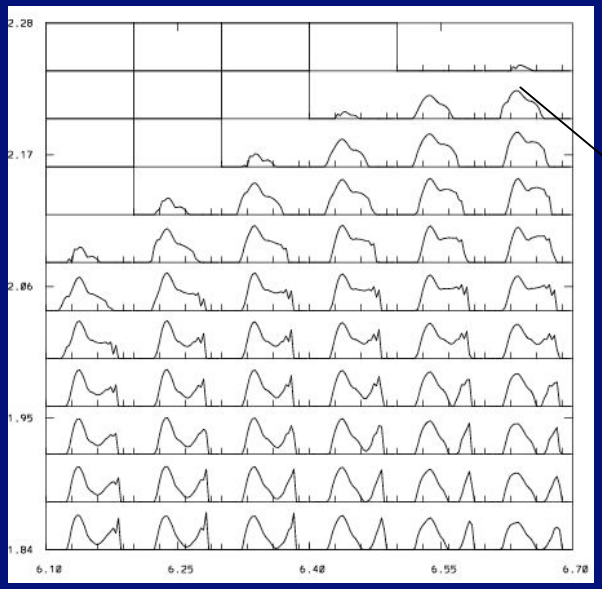


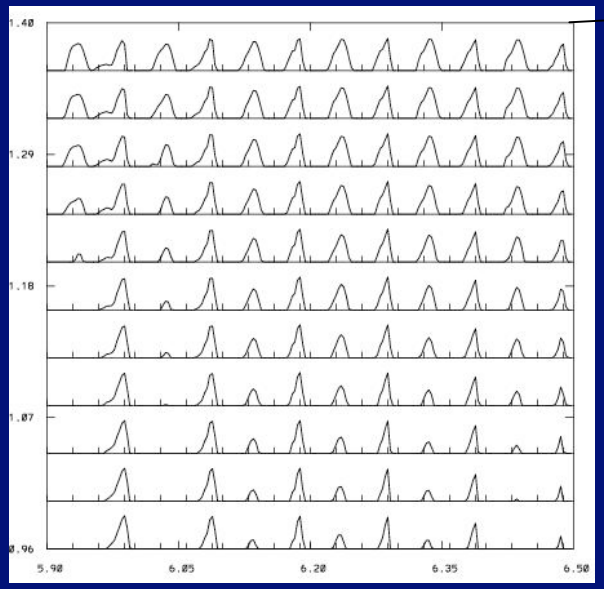
LES results

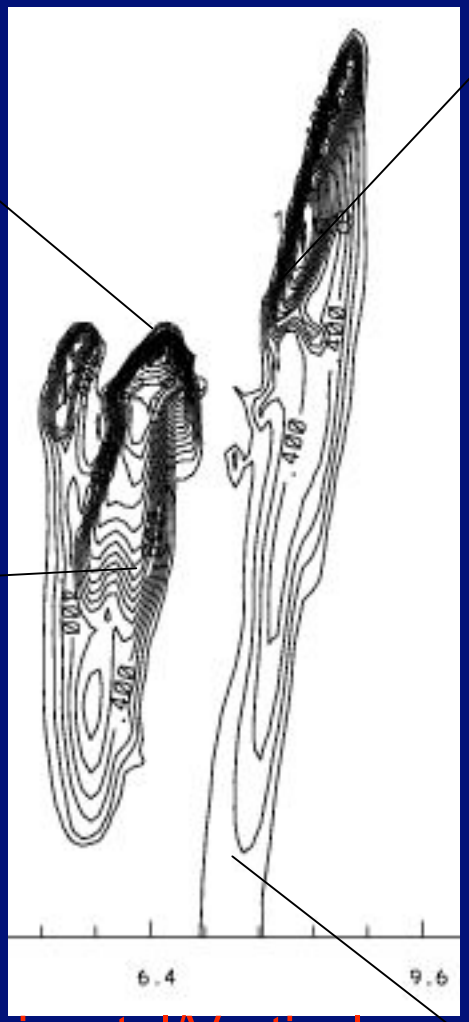

WACR profiles
4 h
6 h
Height [km]
1.5
1.0
0.5
0.0
0.0
0.1
0.2
w´w´ [m² s⁻²]
-1
0
1
Skewness
0
10
20
30
Lρw´q´t [W m⁻²]
0.0 0.2 0.4 0.6 0.8 1.0
TKE [m² s⁻²]
0
1
ql [g kg⁻¹]
-12 -6 0 6 12 18
cpρw´θ´v [W m⁻²]

Newer cell

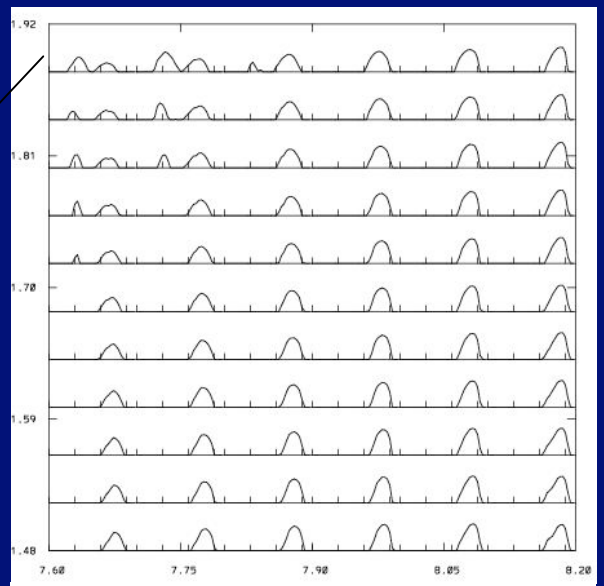
Decaying cell… mostly precip

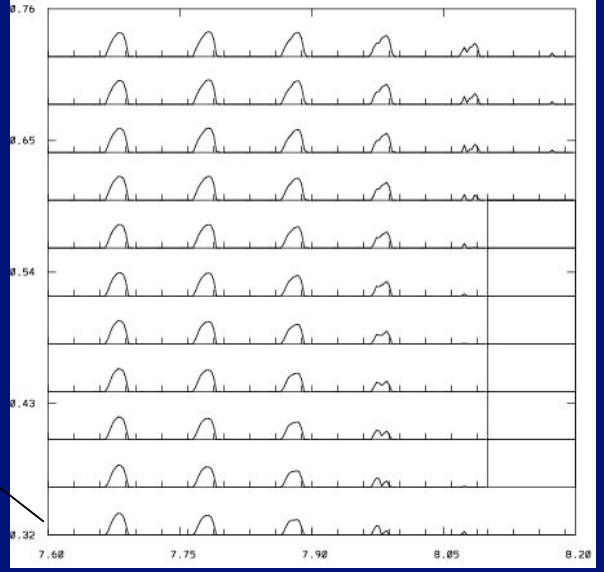






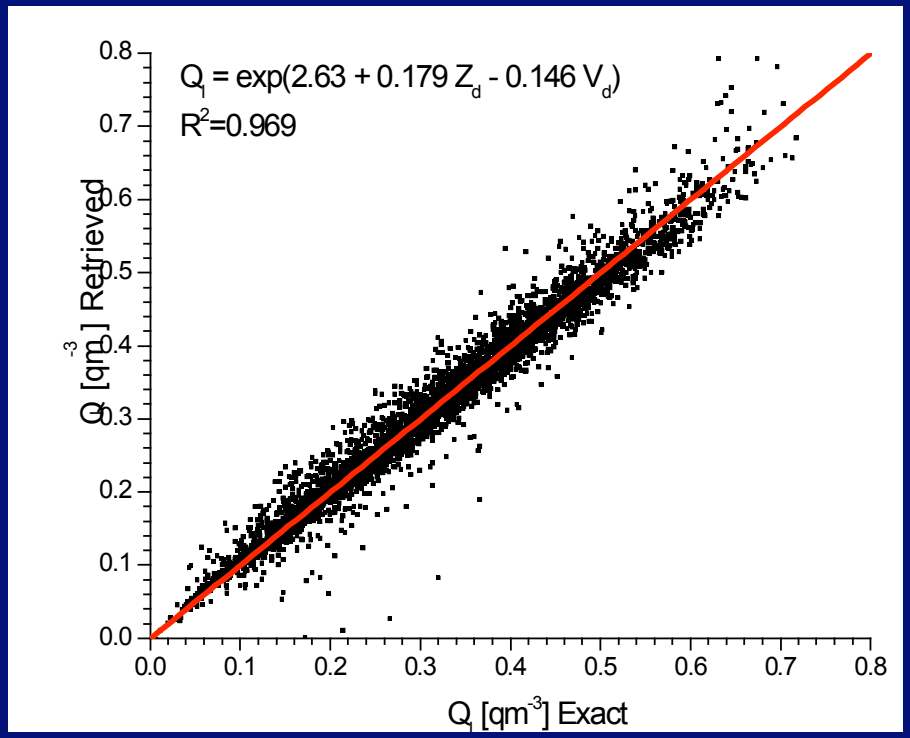
Horizontal/Vertical Ratio 1:3





Microphysical uncertainties in ZV-Q retrievals

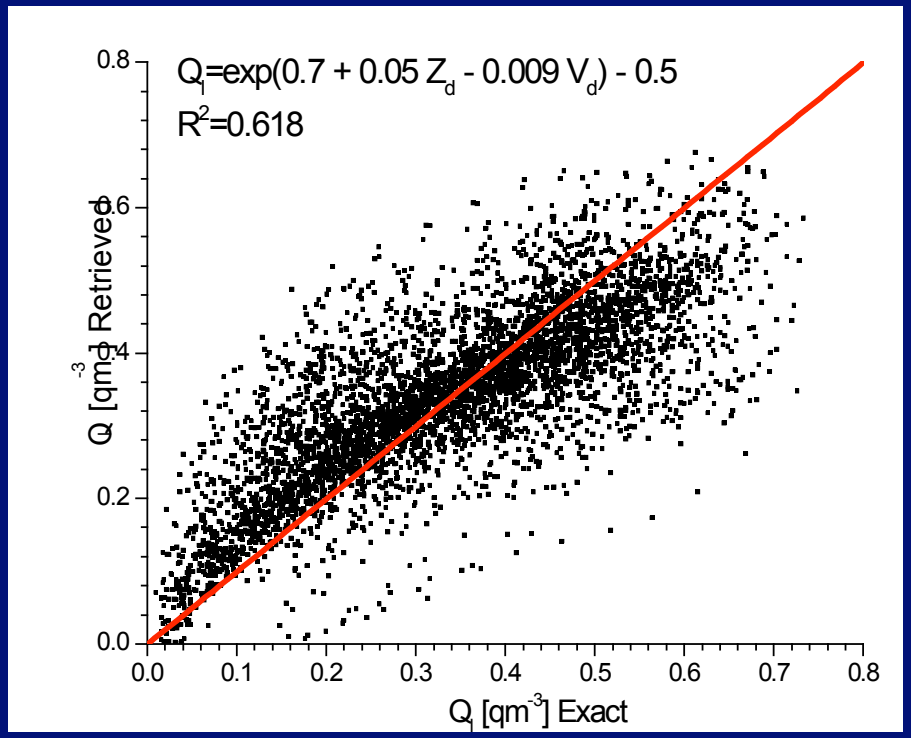
Moderate drizzle



r^2=0.76 (Z only)

r^2=0.97 (Z and V)

Heavy drizzle



r^2=0.18 (Z only)

r^2=0.62 (Z and V)

(*Kogan/Kogan/Mechem, J. Hydromet., GEWEX special issue, 2006, conditionally accepted*)

Summary and Questions

- Similar grid volume sizes of MMCR/WACR and LES begs for intercomparison
- Direct comparison of LEO and LES requires strongly constrained forcings
- LES and LEO turbulence quantities look similar
- Value of the OSSE technique for retrieval evaluation

- Stationarity of statistics from point measurements in quickly evolving cases?