The Entrainment Interface Layer in a DYCOMS-II Stratocumulus LES

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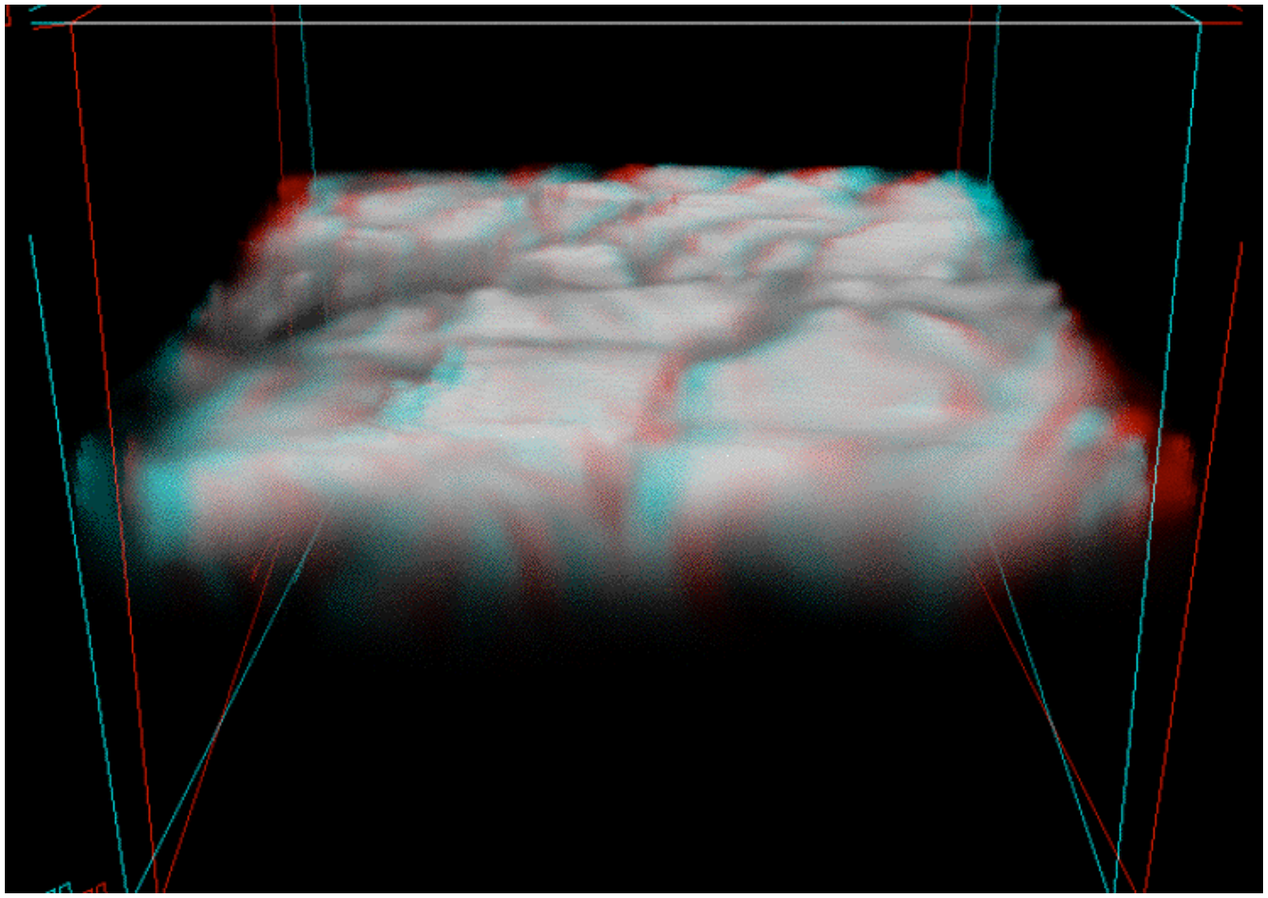
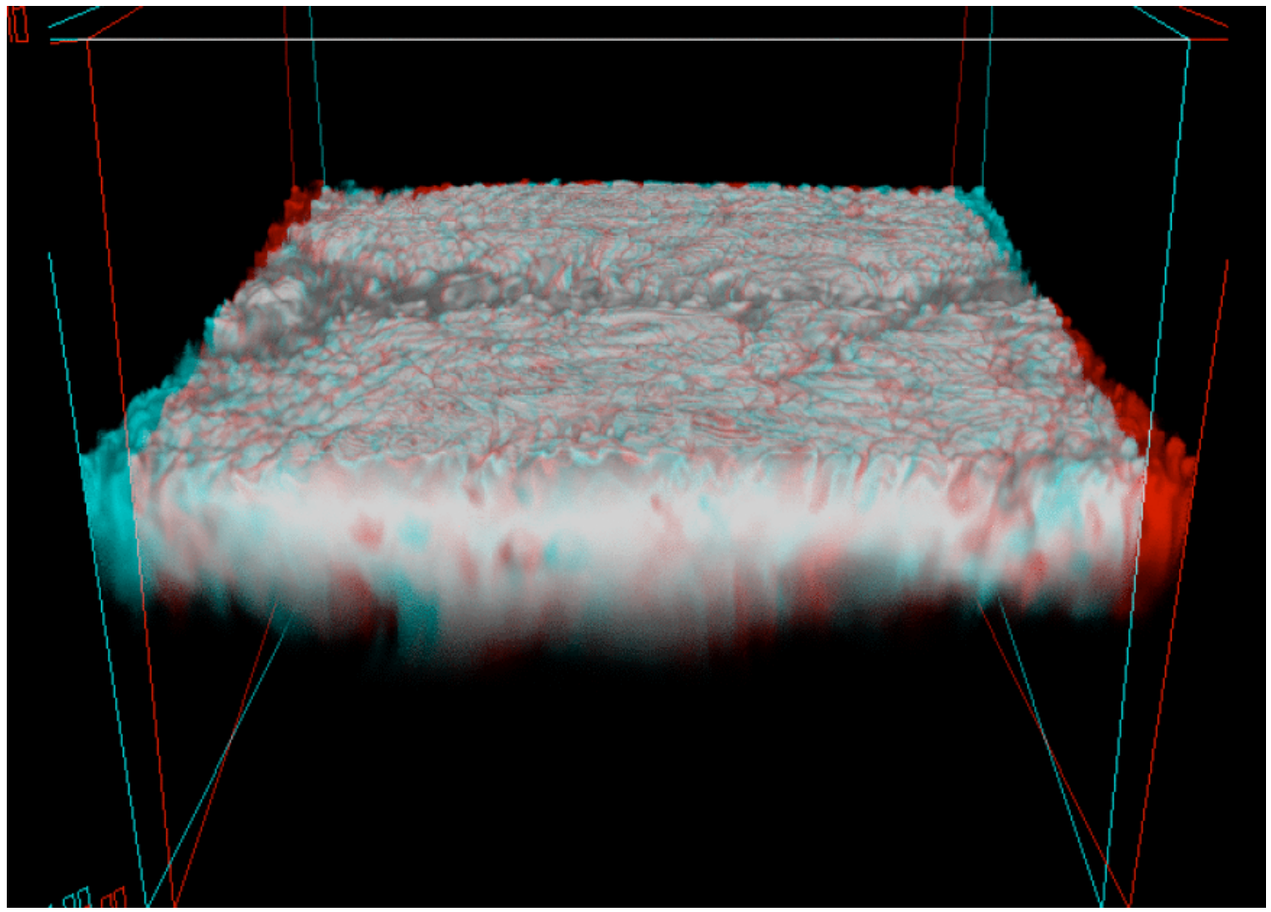
outline

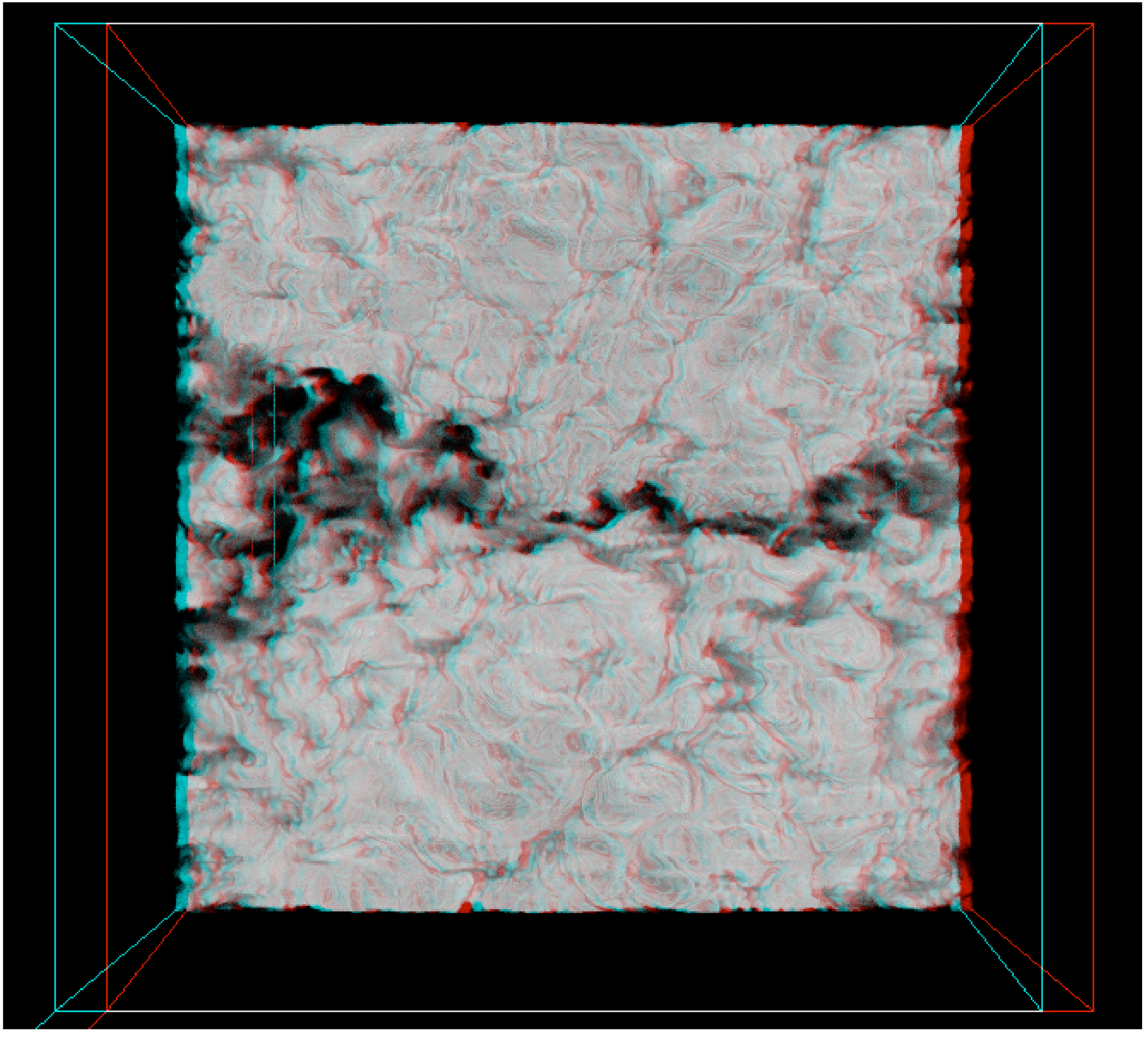
- LES description and visualization
- LES vs aircraft
  - pdfs
  - cloud holes
- entrainment interface layer characteristics
- summary

UU LES DYCOMS-II Sc LES

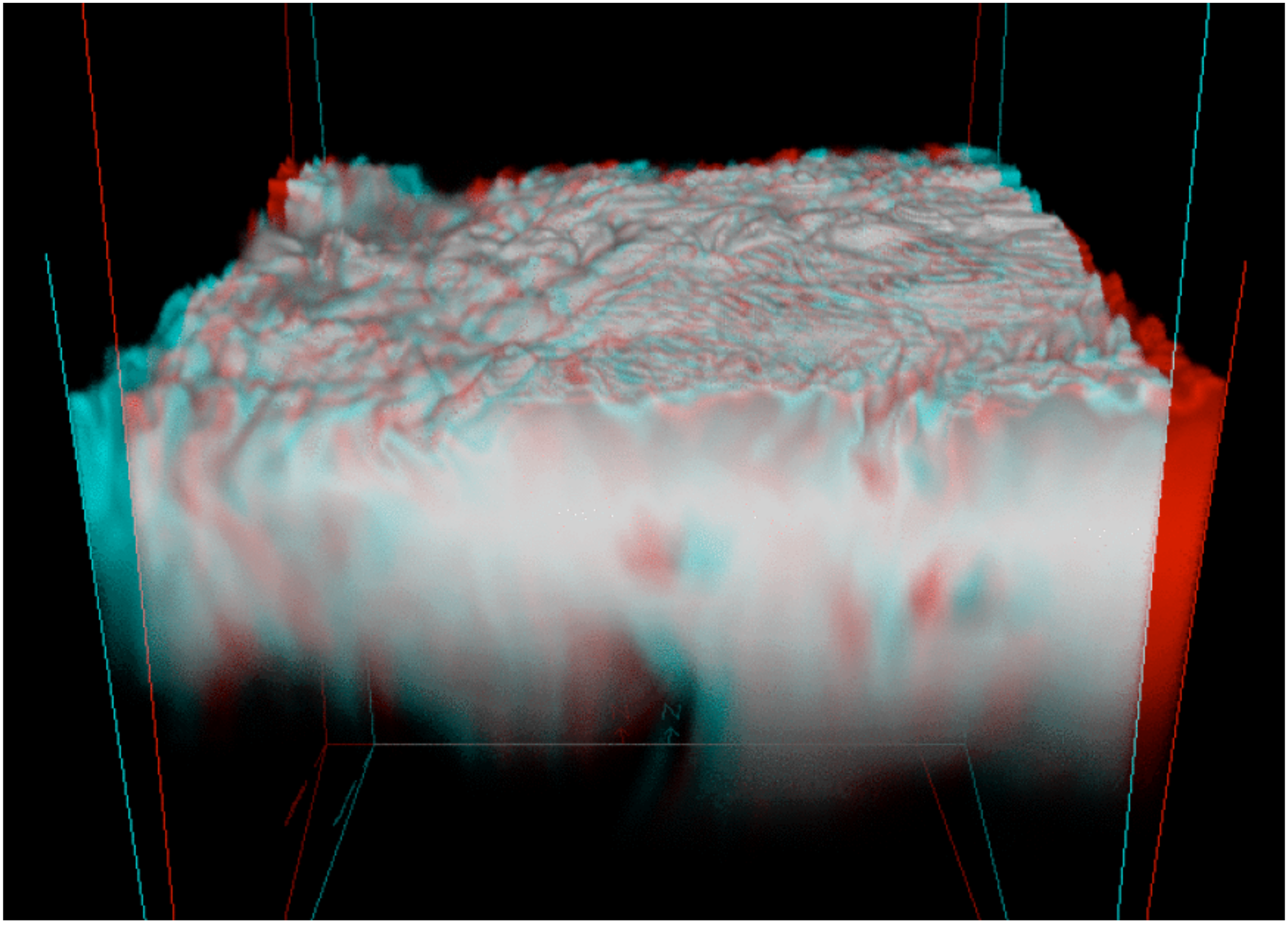
- standard setup except spun-up to a horizontal grid size = 6.25 m for a short time







a quarter of the domain



Aircraft obs (10-m avg)

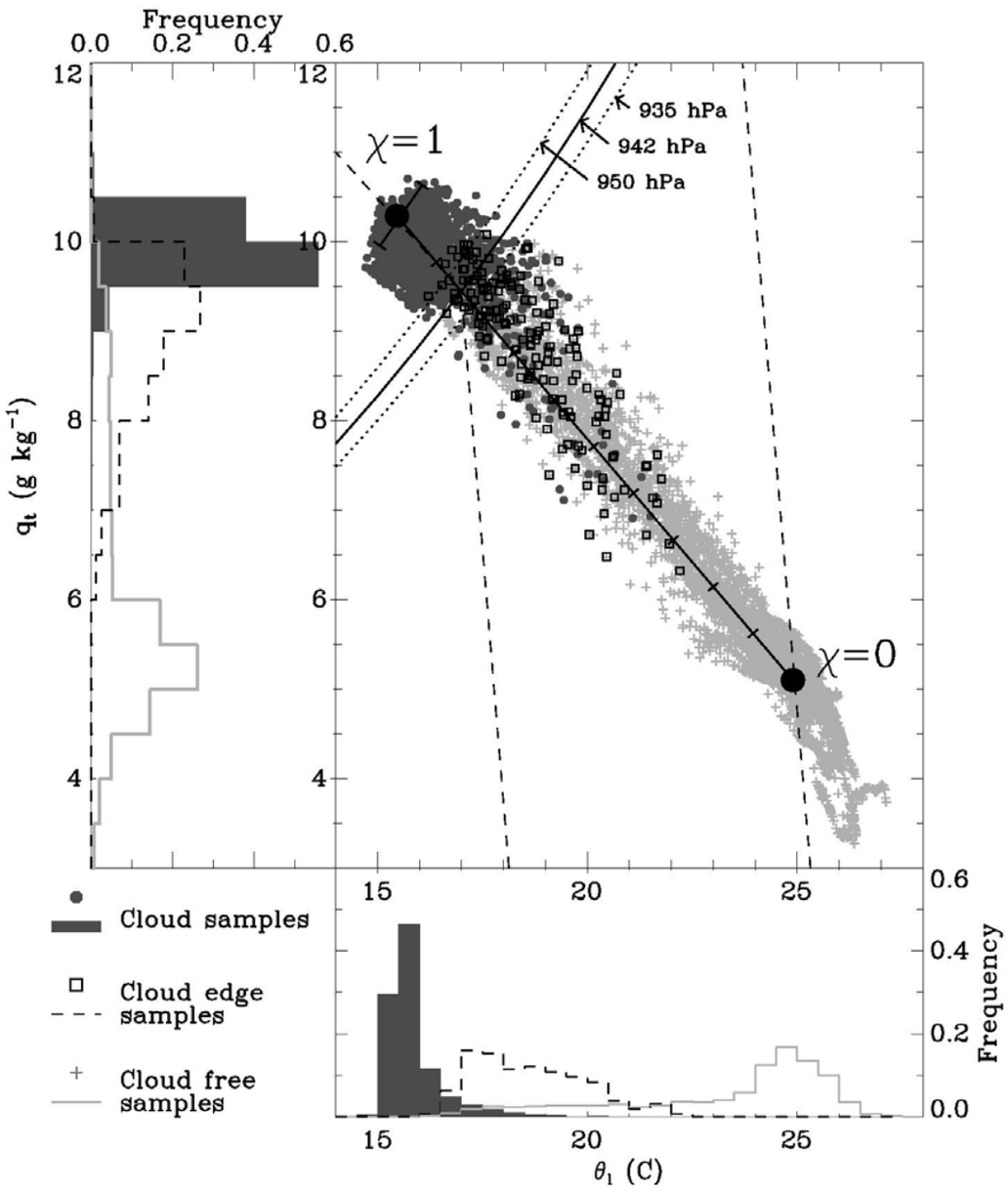
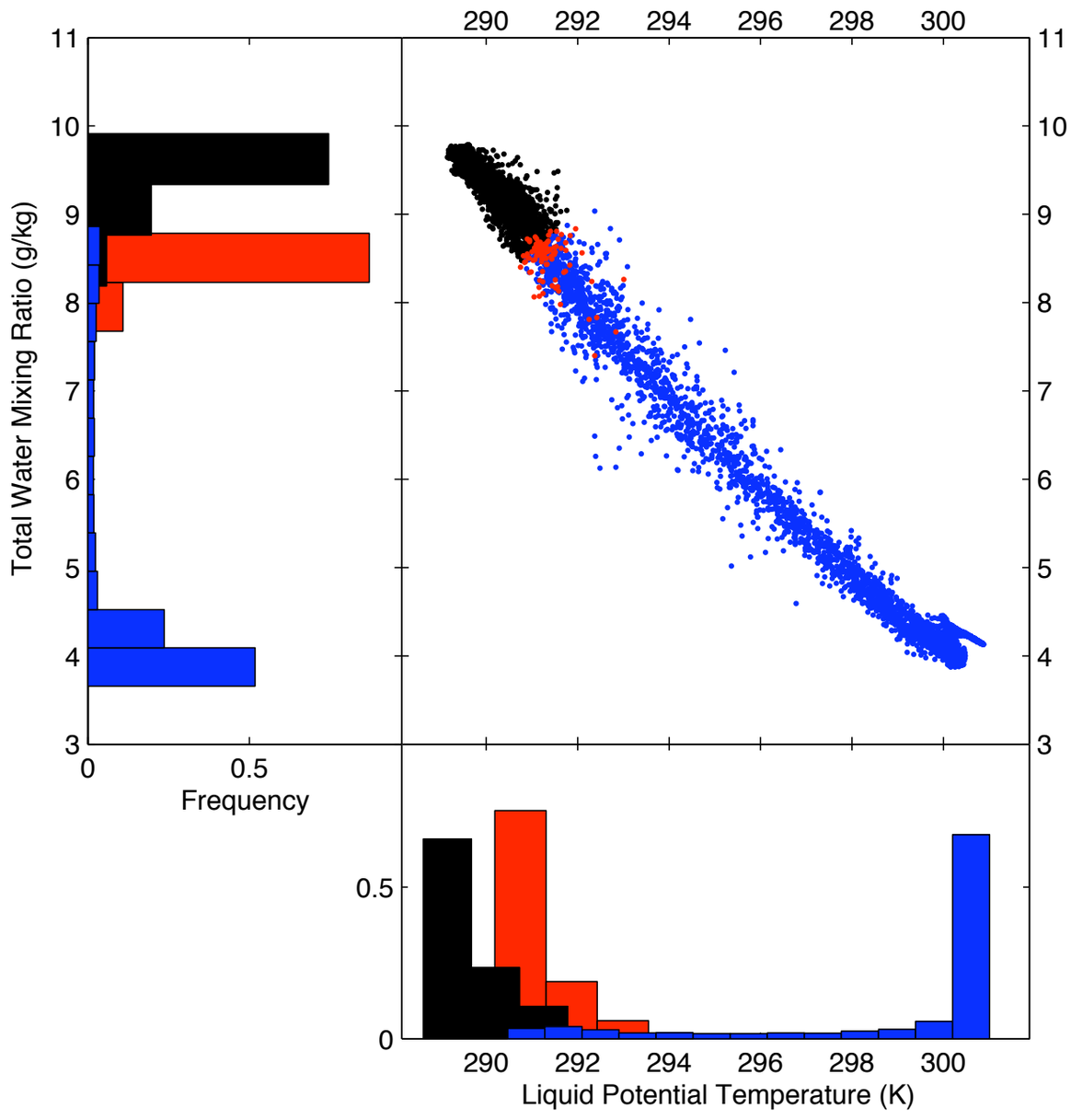


Figure 3a : Scatterplot of q_t vs. θ_l for the DYCOMS-II case (same data set as in Fig. 1). Different symbols are used for cloud, clear air and clear air samples adjacent to cloudy samples (edge samples), as indicated in the legend. Three saturation curves are drawn for 935, 942 and 950 hPa, as indicated by the labels. Isobaric mixing at 942 hPa between air from the free troposphere (χ=0, θ_{le}=24.9 C, q_{ve}=5.1 g kg^{-1}) and from adiabatic cloudy air (χ=1, θ_{li}=15.5 C, q_{ti}=10.3 g kg^{-1}) is represented by the solid straight line. This mixing line is graduated from 0 to 1 every 0.1. The error bar of the adiabatic cloud reference corresponds to an error of ± 0.5 C on the estimation of the cloud base temperature. The two dashed lines are the constant virtual temperature lines corresponding to the free troposphere and to the adiabatic cloudy air. Frequency distributions of θ_l and q_t are shown along the two axis for cloud, clear air and cloud edge samples separately.

Burnet and Brenguier (2006)

LES (dx=6 m)



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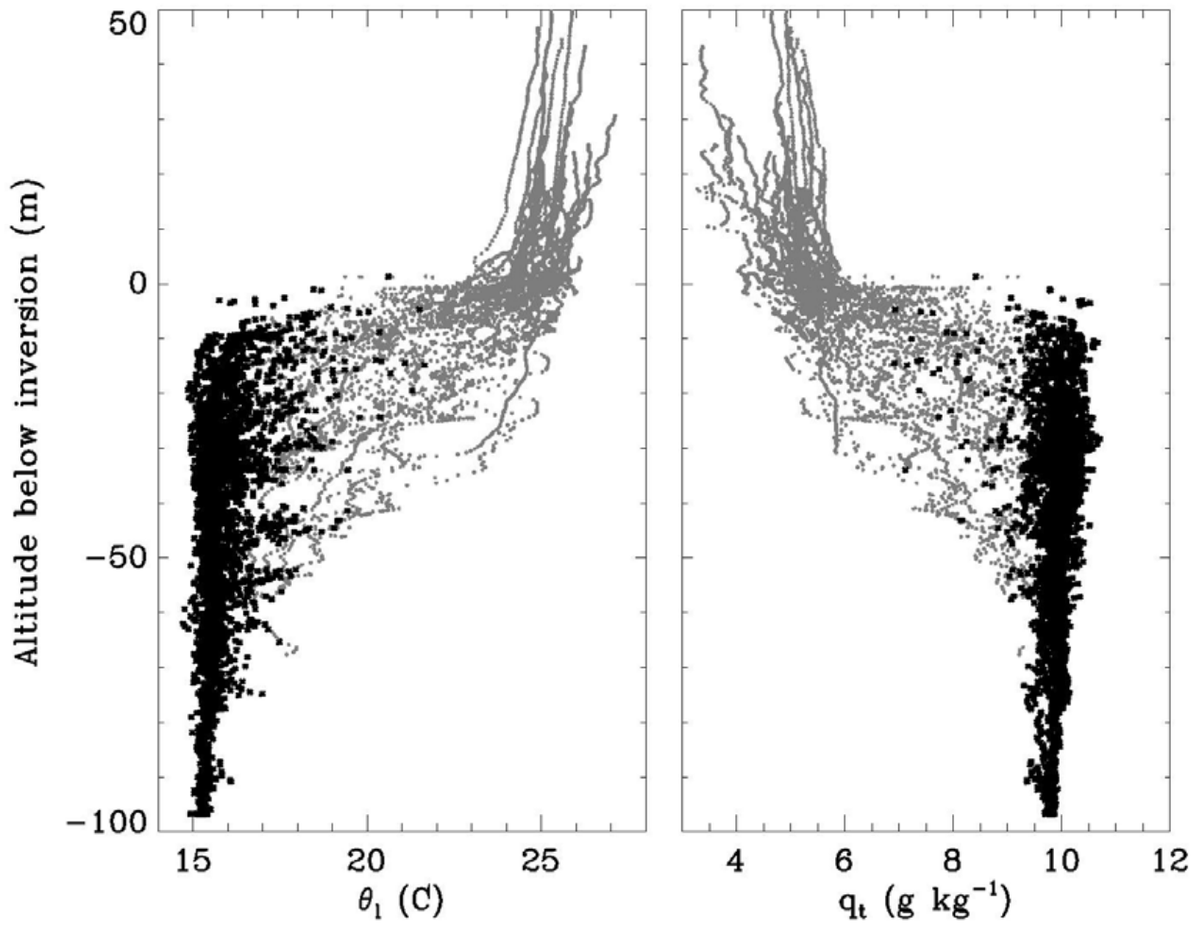
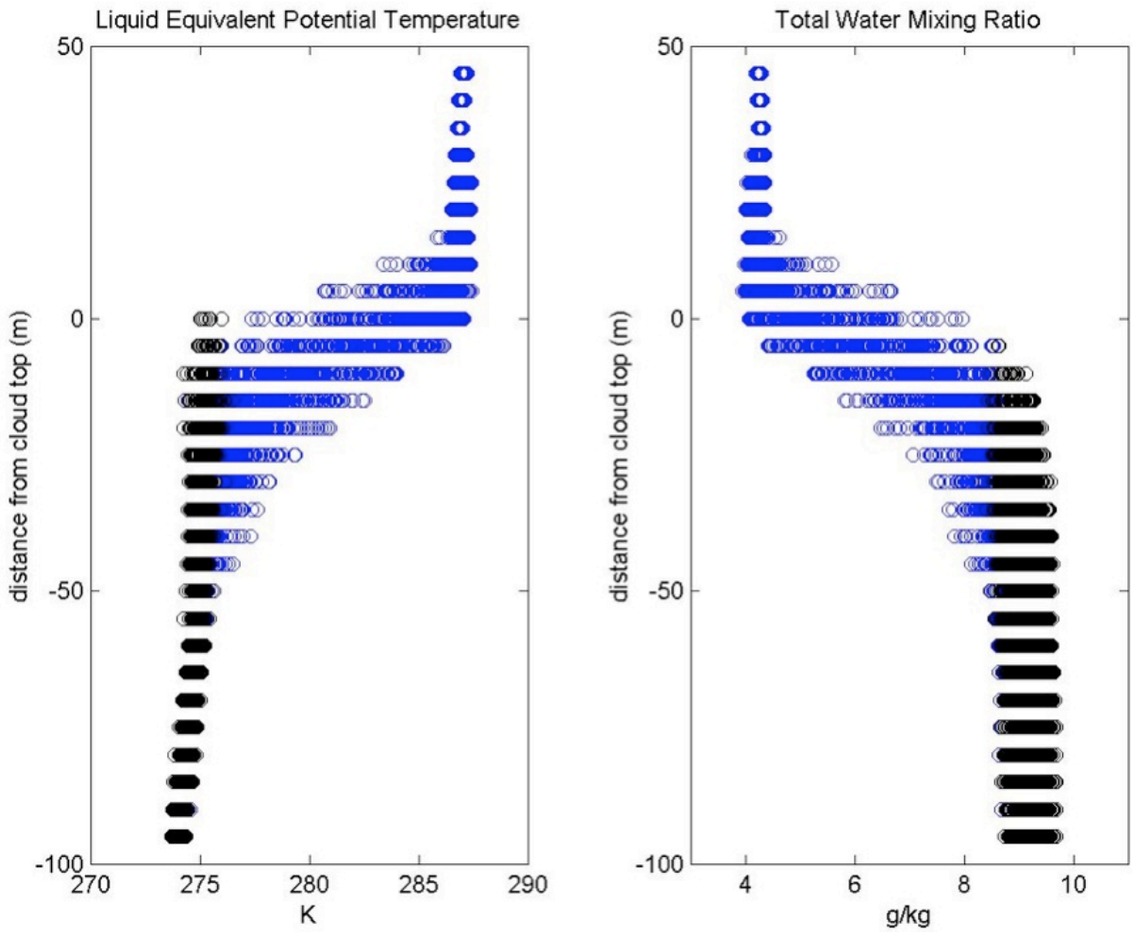


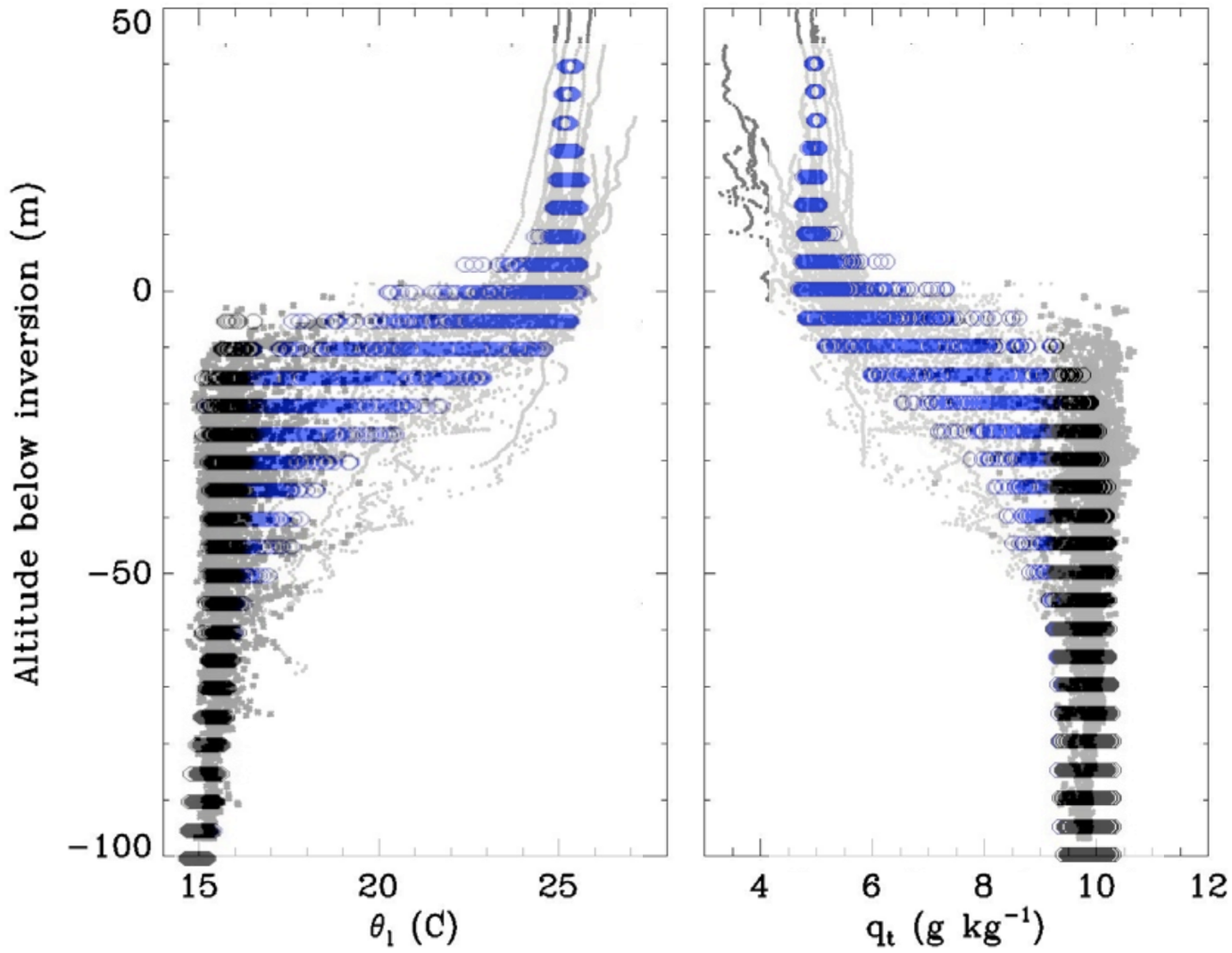


from Burnet and Brenguier (2006)

Figure 1 : Vertical profiles of θ_l (left) and q_t (right) for the 14 traverses of the cloud top profiling circle of the DYCOMS-II RF03 flight between 11:45 and 12:17 UTC. Cloudy samples (N>3 cm^{-3}) are in black and clear air samples are in grey. The altitude is relative to the height of the inversion determined for each profile separately.

Aircraft obs (10-m avg)

LES (dx=6 m)



from Burnet and Brenguier (2006)

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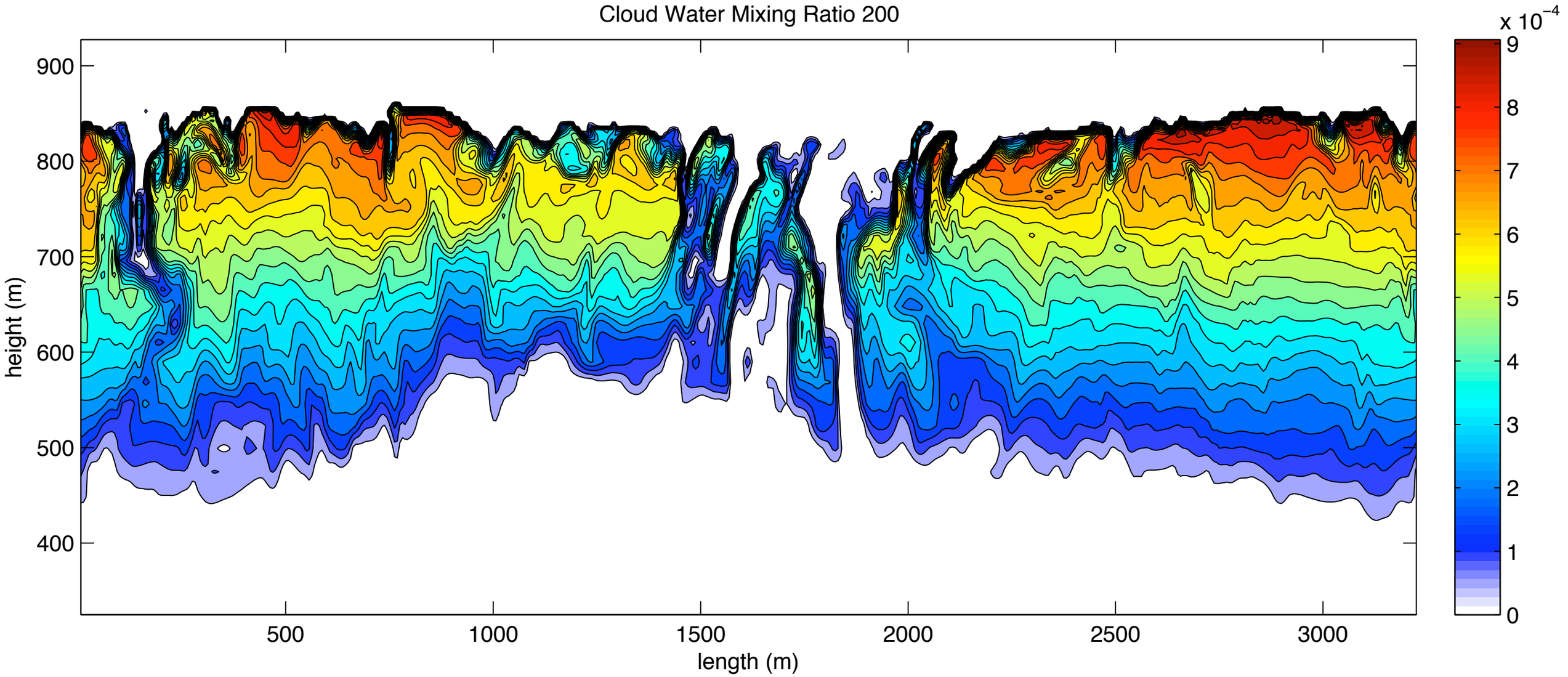
LES profiles shifted downwards by 10 m. LES values scaled to match aircraft obs at +50 m and -100 m.


Cloud Water Mixing Ratio 200
x 10^-4
9
8
7
6
5
4
3
2
1
0
900
800
700
600
500
400
height (m)
500
1000
1500
2000
2500
3000
length (m)

Total Water Mixing Ratio 200

x 10^{-3}

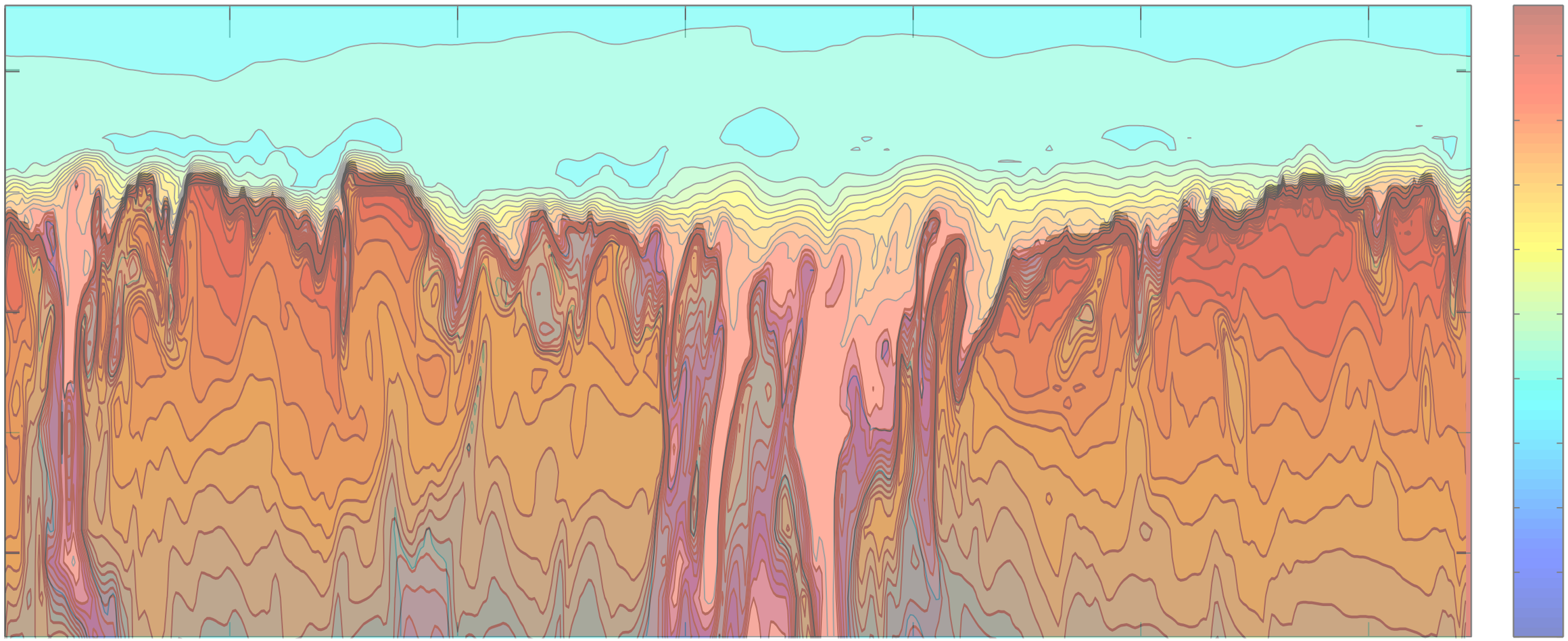
height (m)

900
850
800
750
700

500
1000
1500
2000
2500
3000

length (m)

9
8
7
6
5
4
3
2
1
0

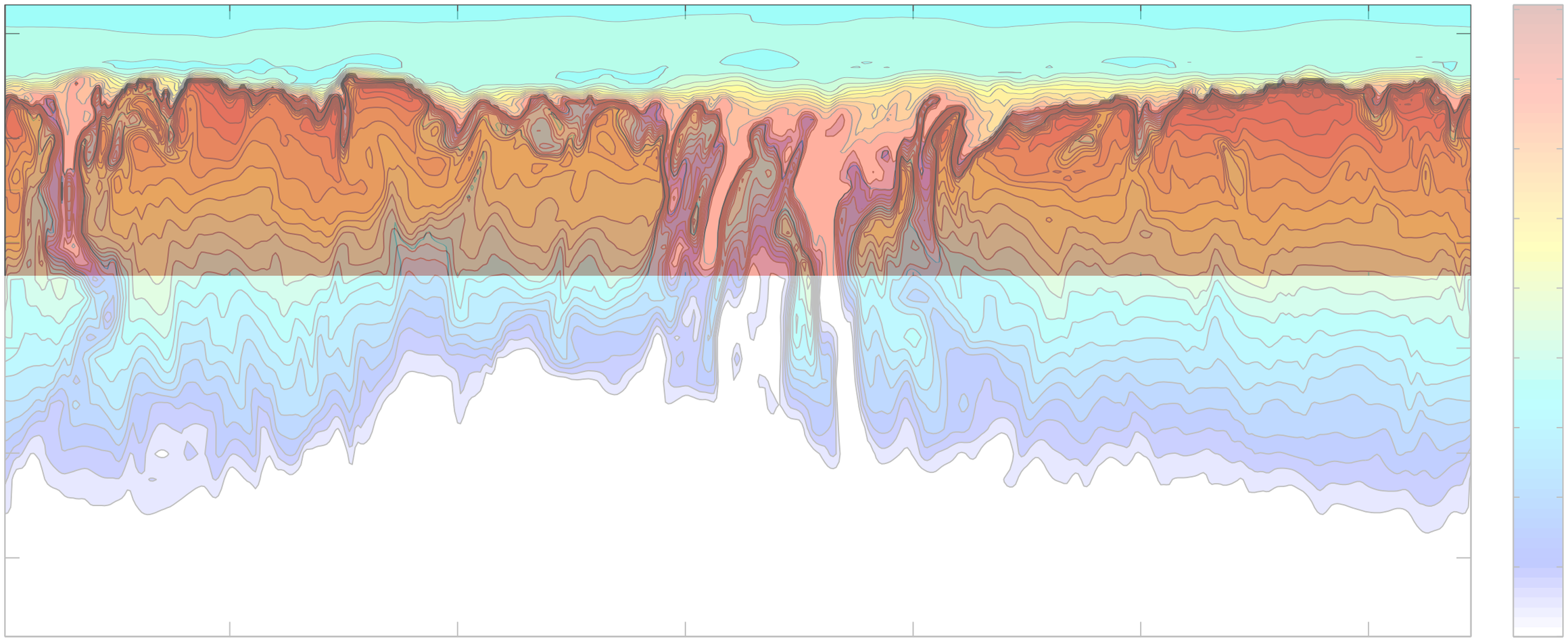


U−wind Component 200

900
850
800
750
700
height (m)

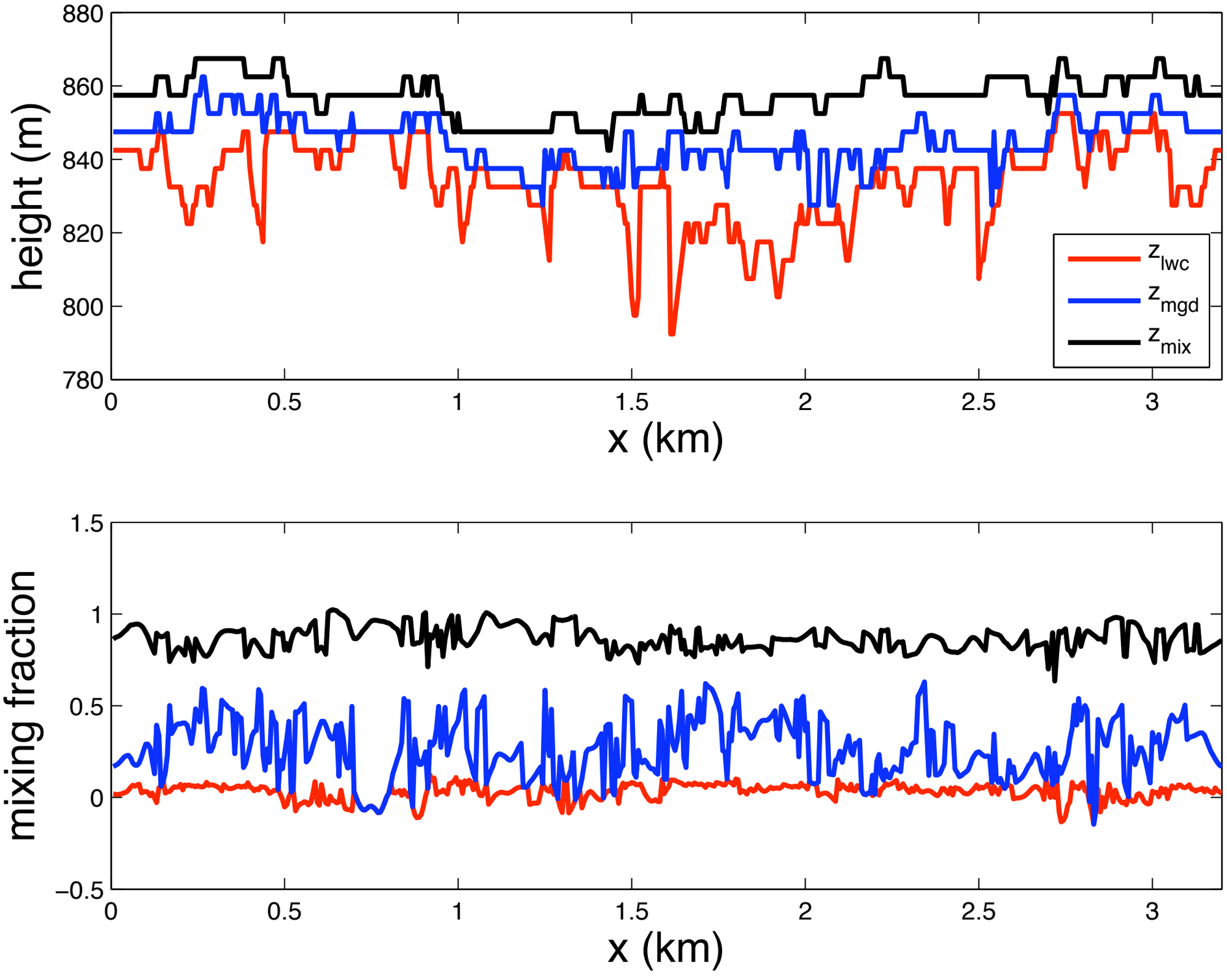
500
1000
1500
2000
2500
3000
length (m)

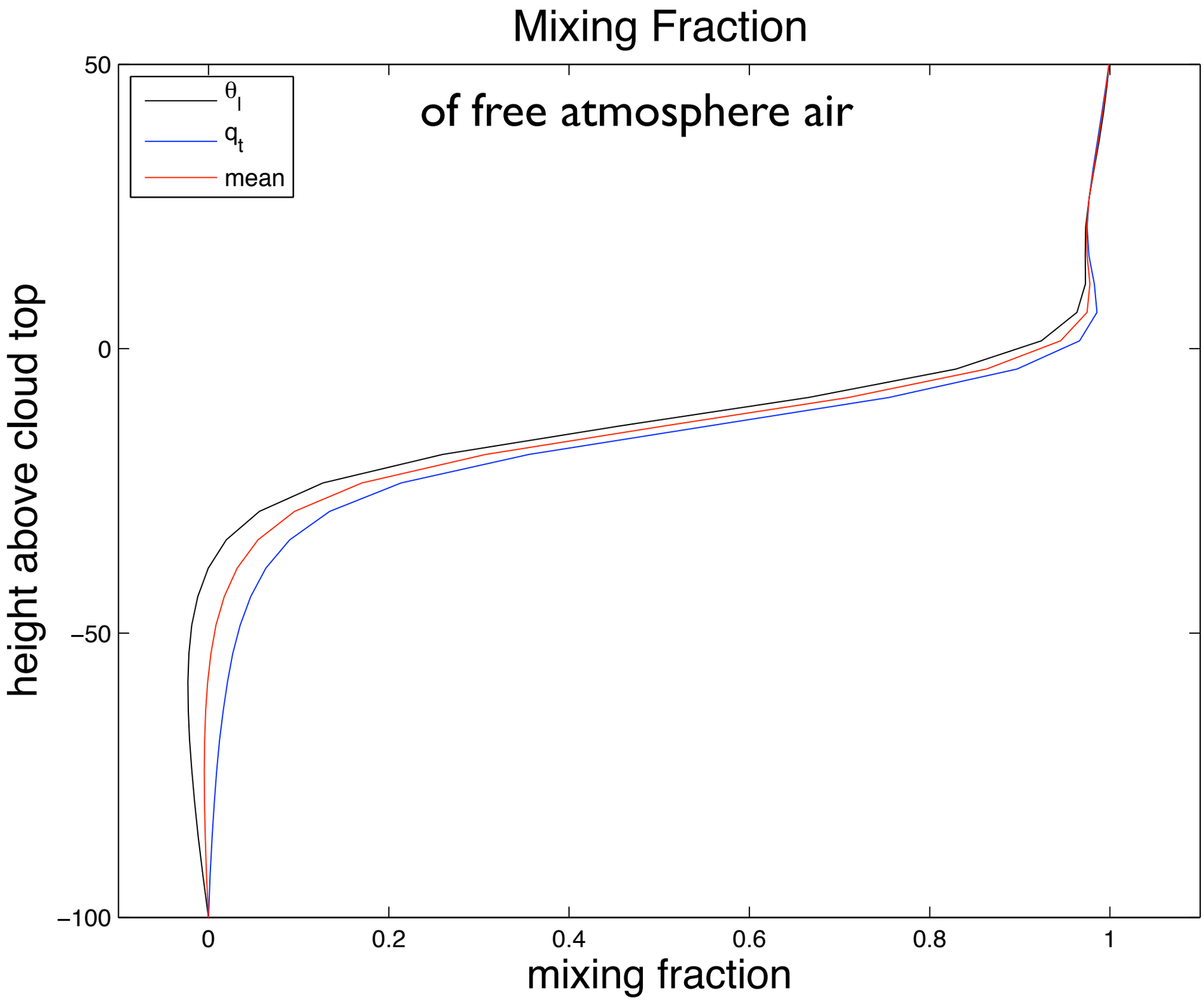
2.5
2
1.5
1
0.5
0
−0.5
−1
−1.5
−2



Interface heights

- mixing top
- maximum gradient level
- cloud top



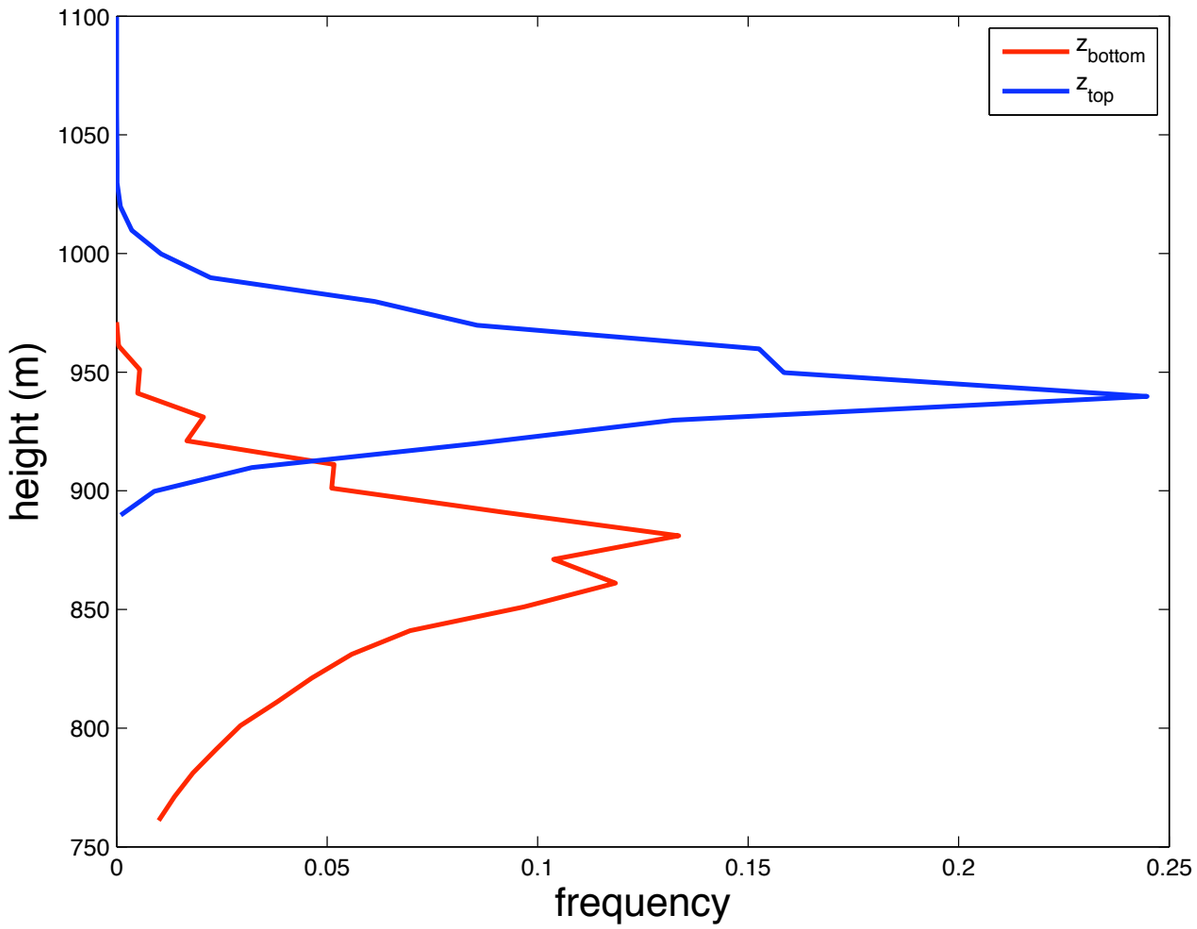

Mixing Fraction
of free atmosphere air
θl
qt
mean
50
0
−50
−100
height above cloud top
0
0.2
0.4
0.6
0.8
1
mixing fraction

Define EIL by mixture fraction of free atmosphere:

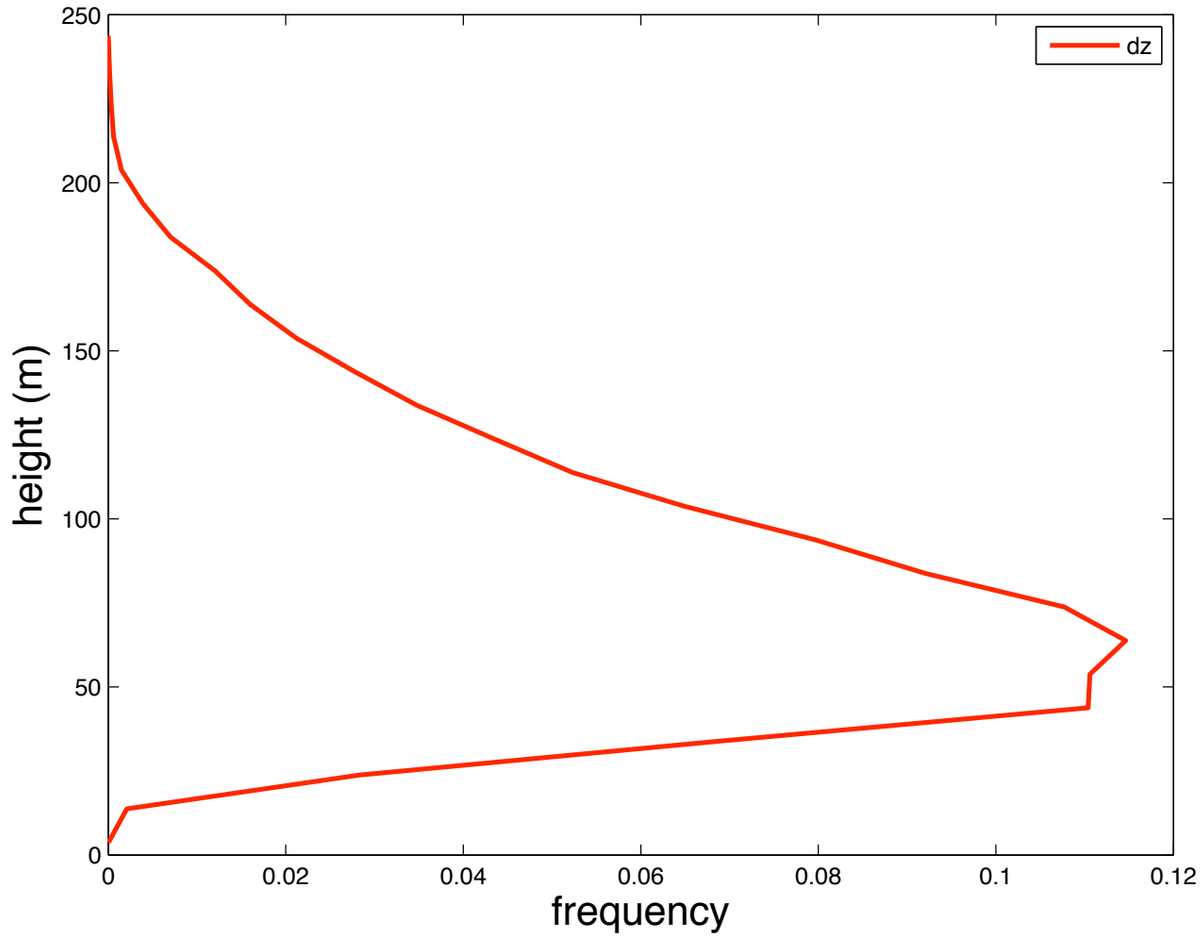
top = 0.9

bottom = 0.1

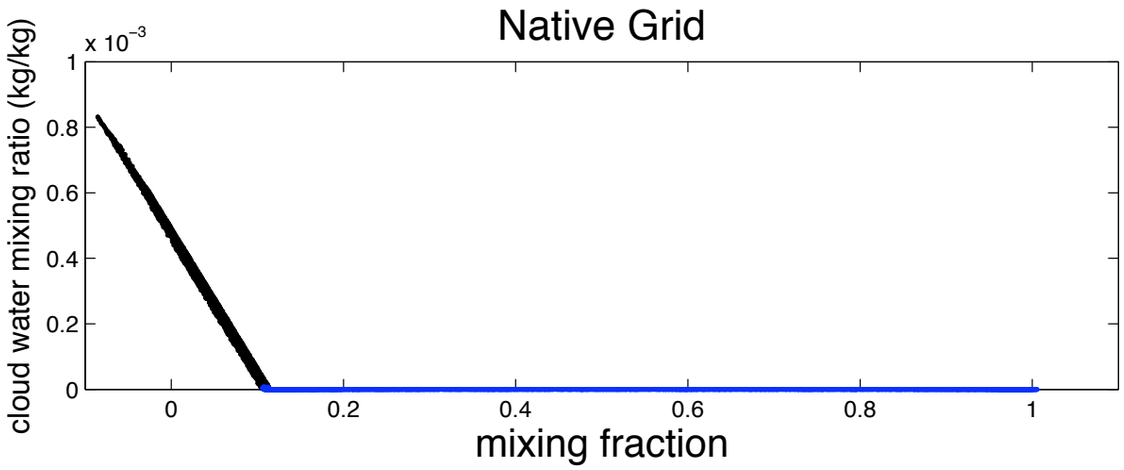
top, bottom height frequencies

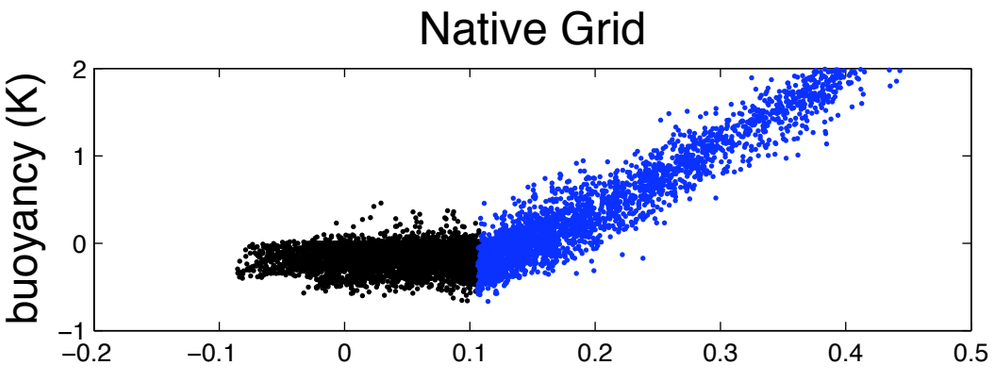


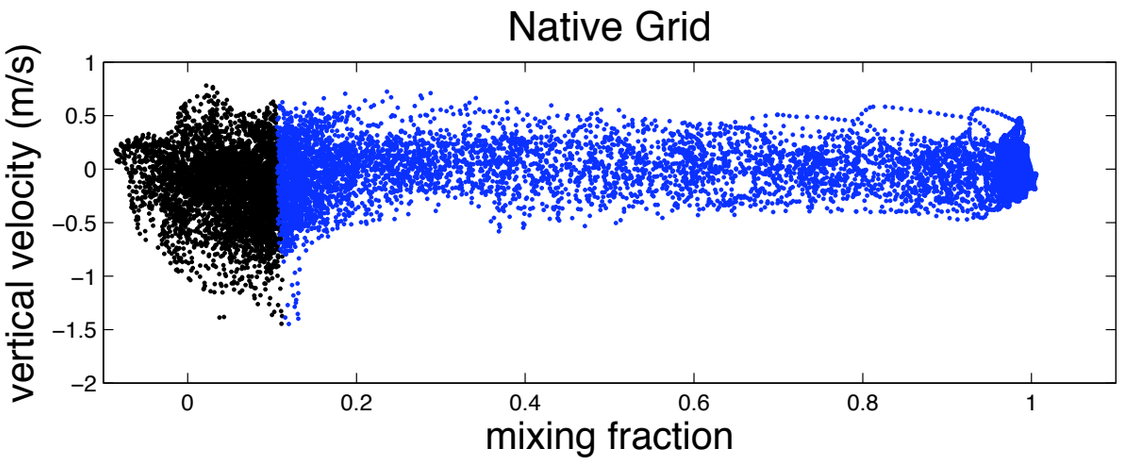
EIL thickness frequency

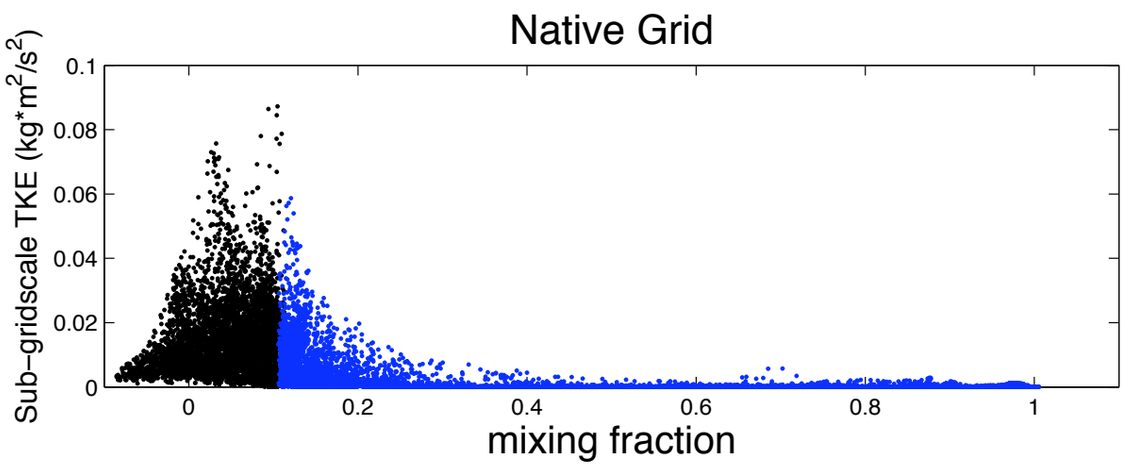


EIL properties vs mixing fraction

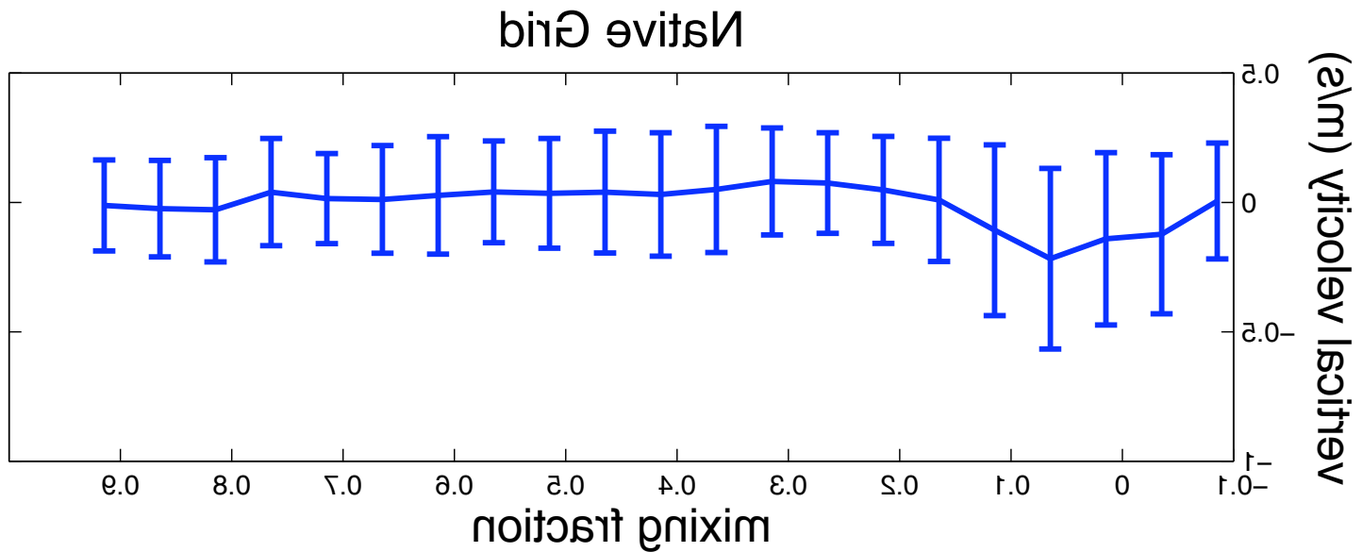


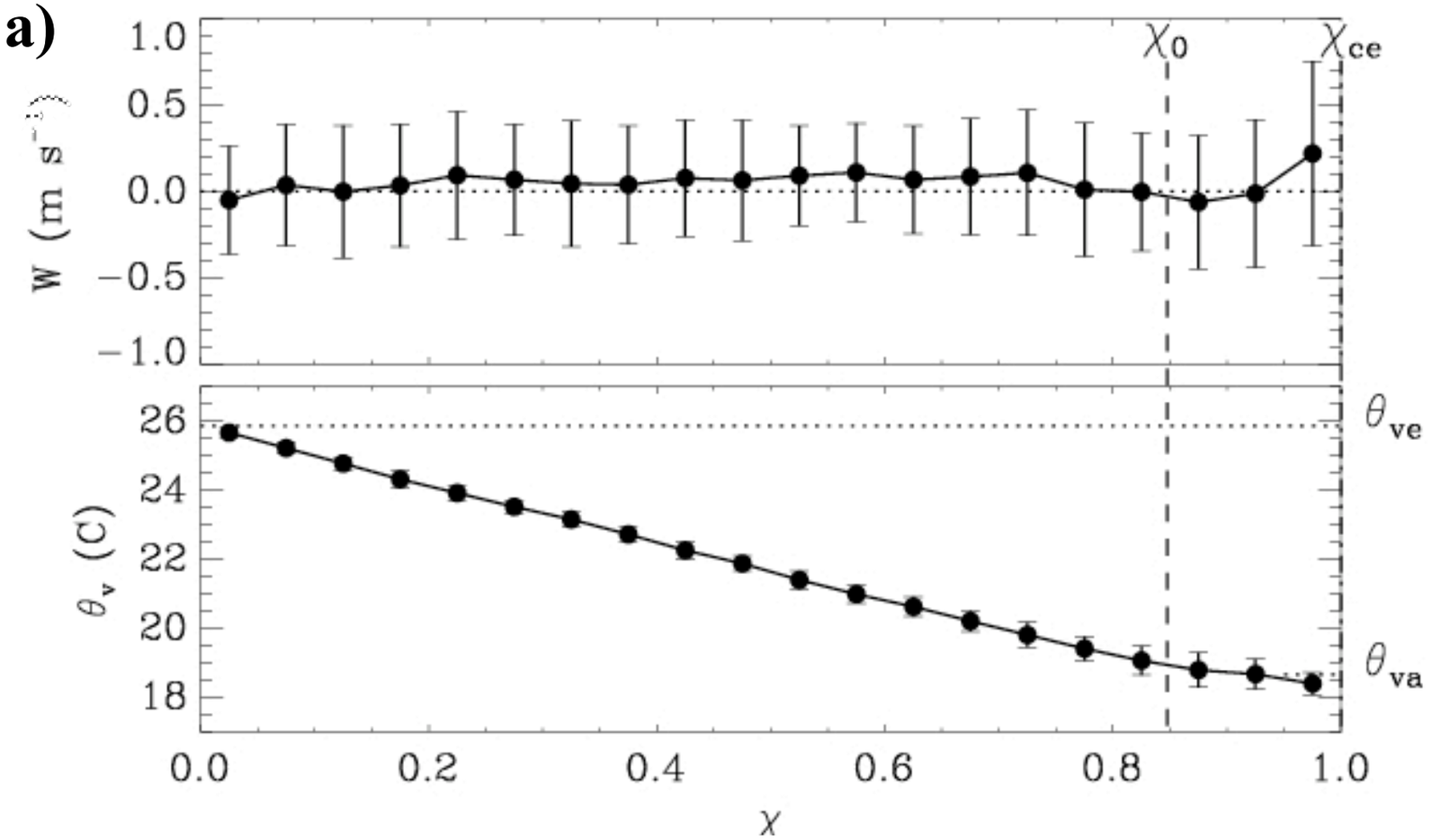






Vertical velocity vs mixture fraction





Burnet & Brenguier 2006

Summary