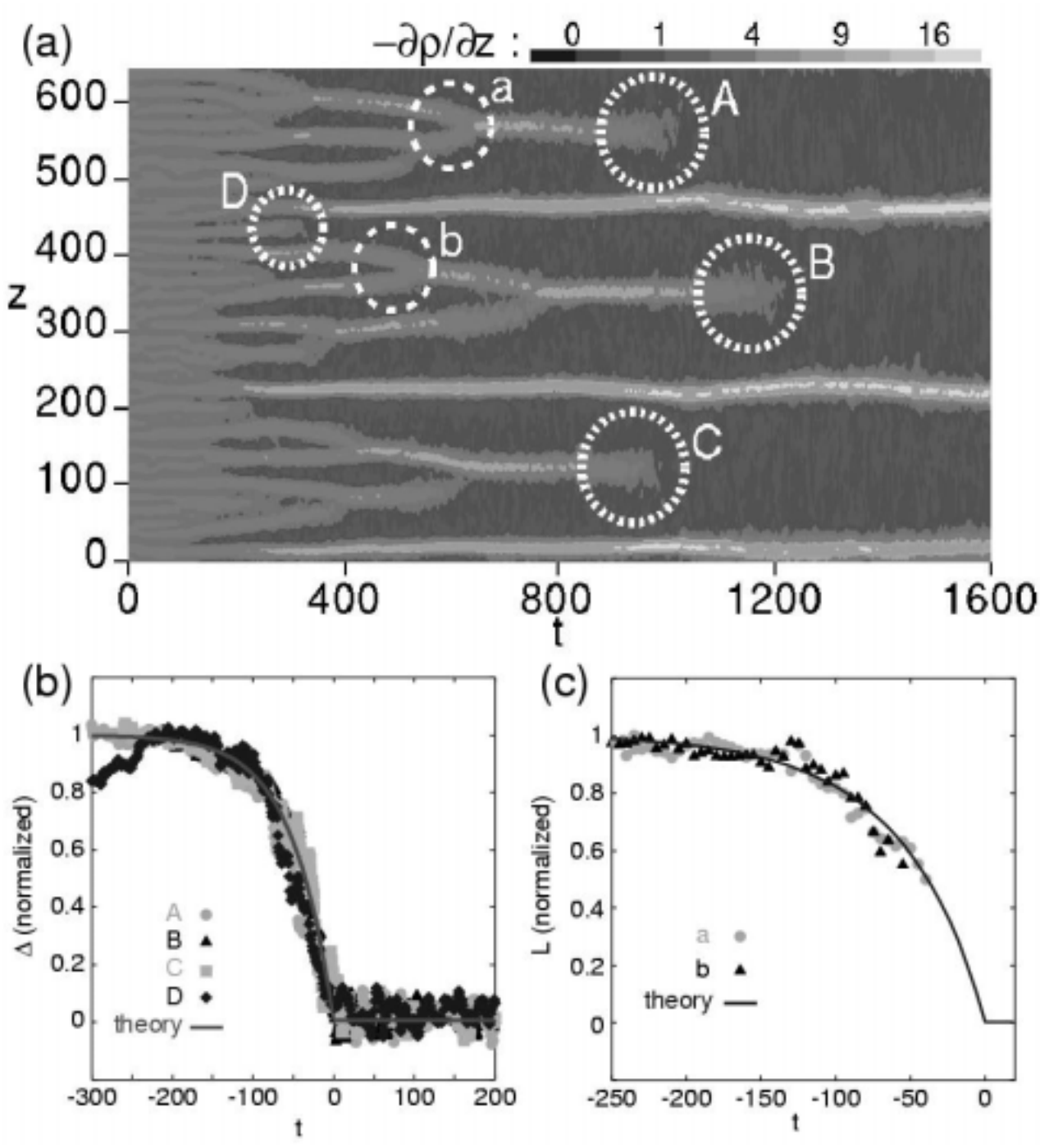
Evolution of multi-layered diffusive convection

Takashi Noguchi[1]; Hiroshi Niino[2]

[1] Ocean Research Inst., Univ. of Tokyo; [2] Div. of Marine Meteor., Ocean Res. Inst., Univ. of Tokyo

http://dpo.ori.u-tokyo.ac.jp/dmmg

Time evolution of a multi-layered convective system which is produced and maintained by diffusive convection is investigated by a two-dimensional numerical simulation. Convective layers reproduced by two-dimensional numerical simulation repeat merging with adjacent layers and increase their thickness until a single convective layer fills the whole calculation domain. Two distinct processes of the layer evolution are observed: a) vanishment of density gap between layers, and b) merging of density interfaces. A simple mechanistic model was devised to understand the physical processes which controls the layer merging. The model assumes 1) inviscid motions of convective plumes and 2) turbulent entrainment due to the impingement of the plumes at the density gap between layers. The mechanistic model can successfully reproduce the merging processes.


(a)
−∂ρ/∂z :
0
1
4
9
16
a
A
D
b
B
C
z
600
500
400
300
200
100
0
0
400
800
1200
1600
t
(b)
Δ (normalized)
1
0.8
0.6
0.4
0.2
0
A
B
C
D
theory
-300
-200
-100
0
100
200
t
(c)
L (normalized)
1
0.8
0.6
0.4
0.2
0
a
b
theory
-250
-200
-150
-100
-50
0
t