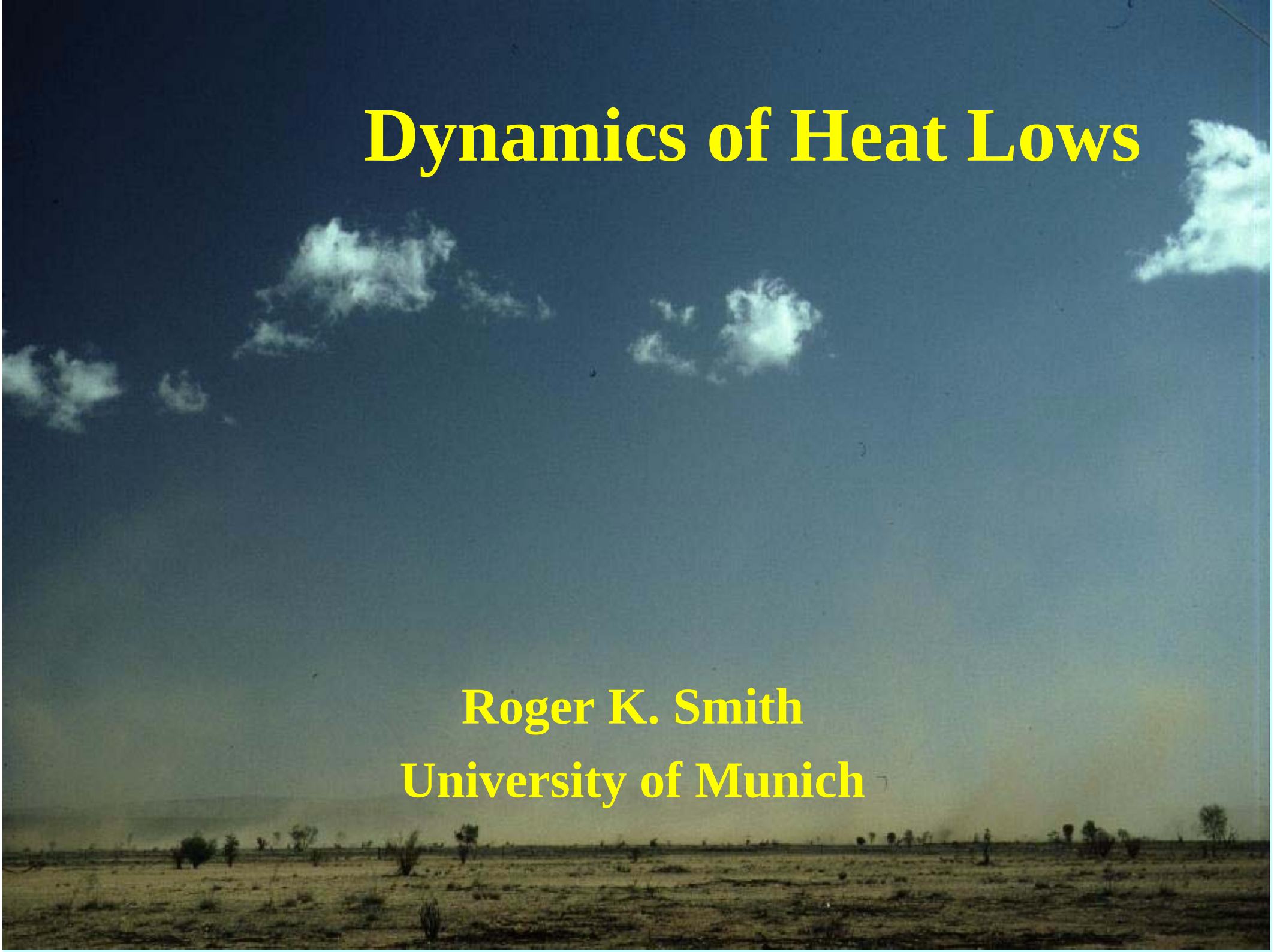


Dynamics of Heat Lows

Roger K. Smith

University of Munich

09 Oct 2002
0830 EST

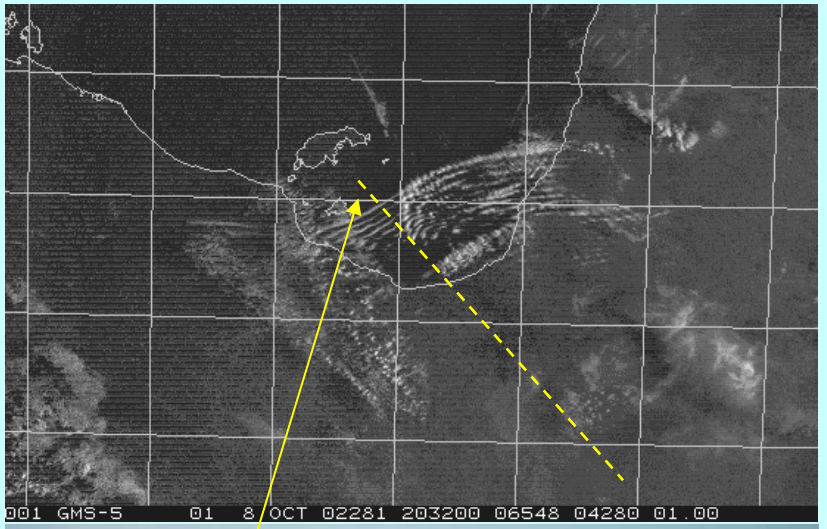
NACL

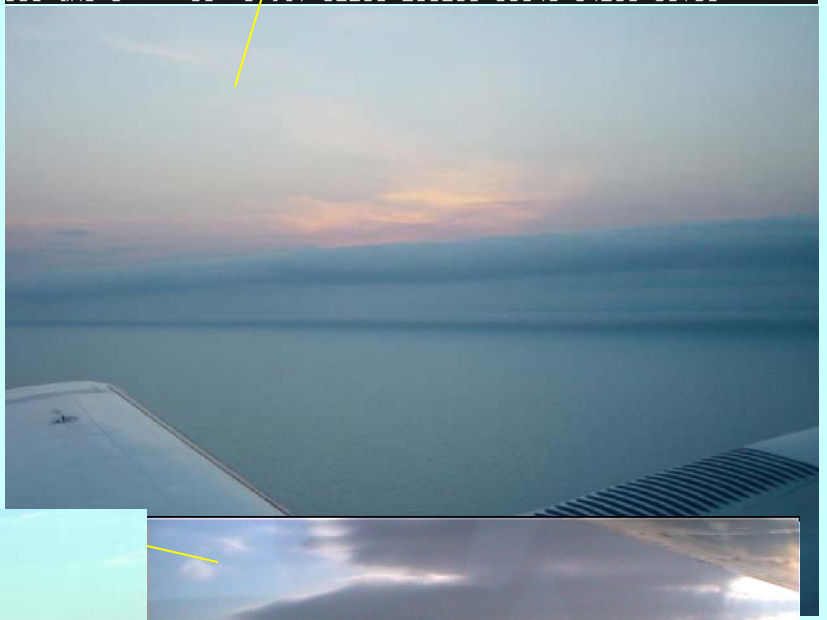
NEMG

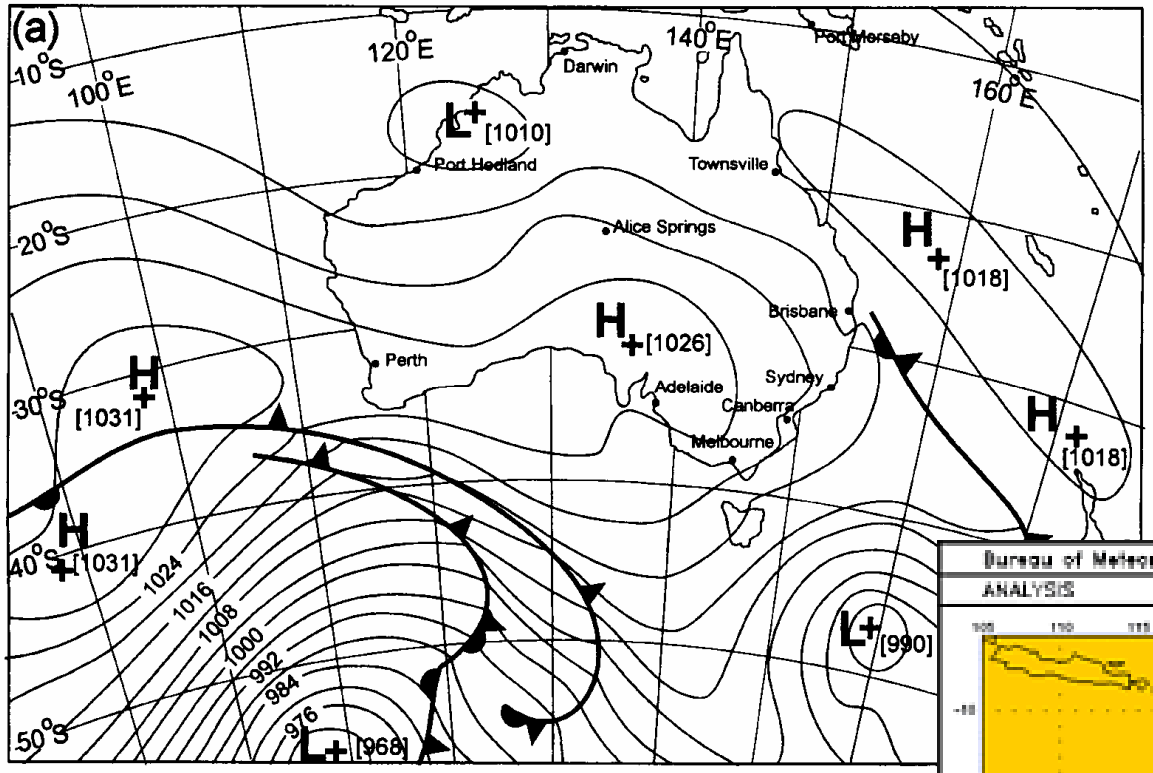
SEMG

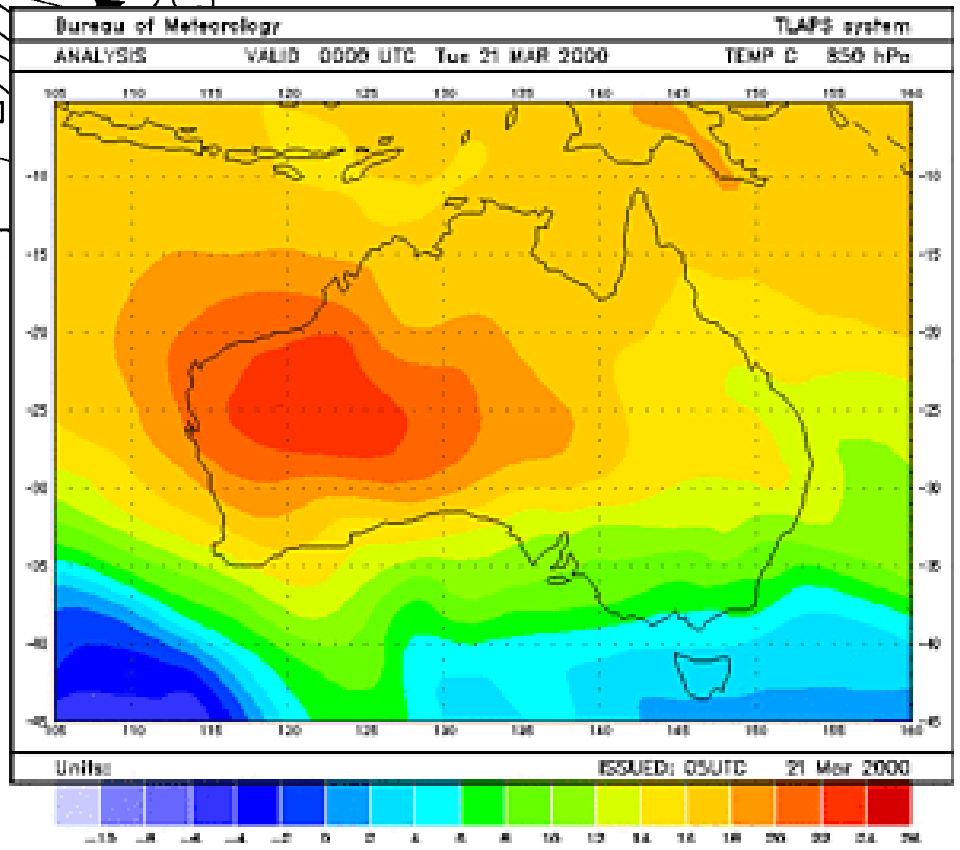
Fig 6

SMG



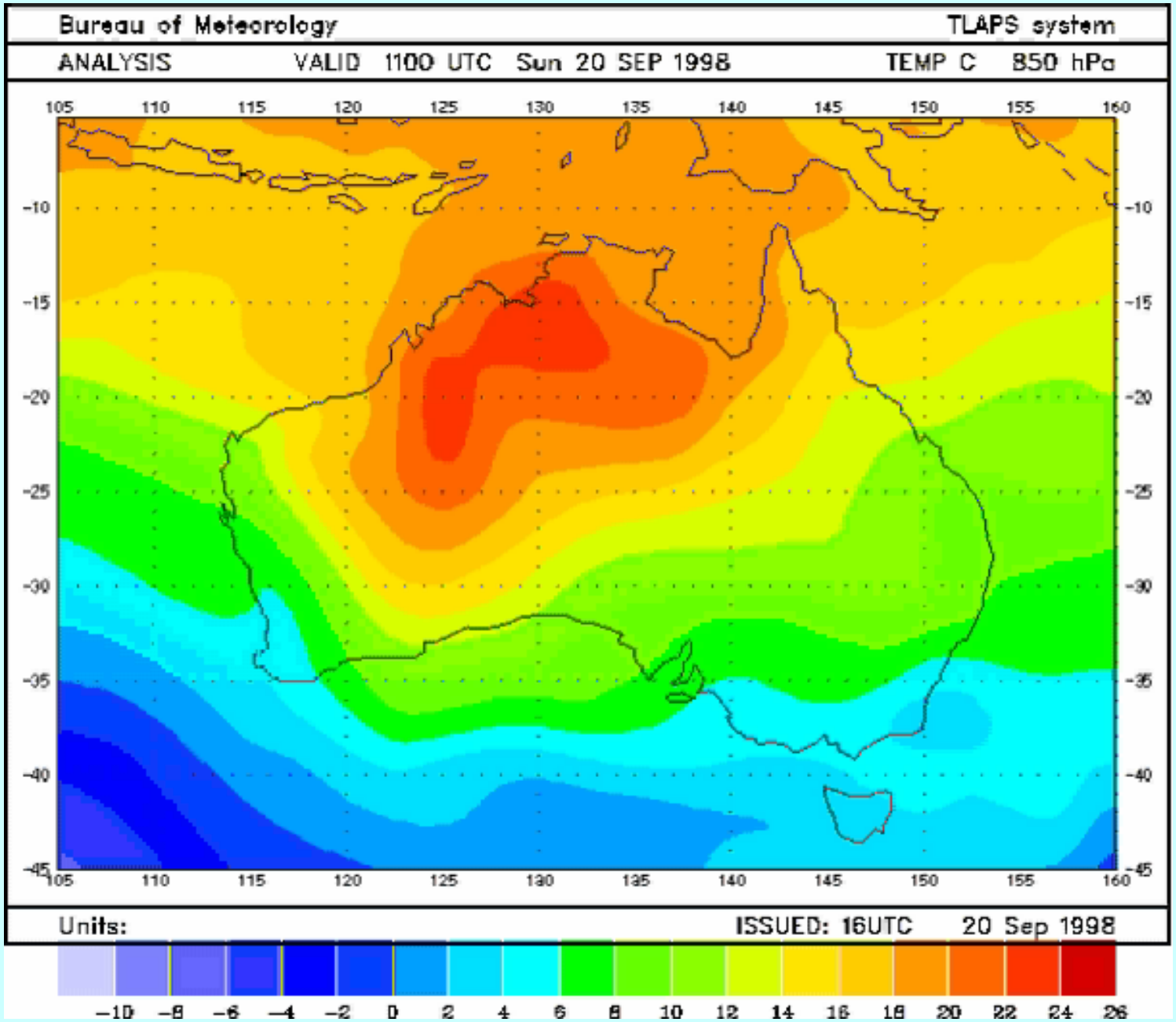



(a)
10°S
20°S
30°S
40°S
50°S
100°E
120°E
140°E
160°E
Darwin
Port Moresby
Port Hedland
Townsville
Alice Springs
Brisbane
Perth
Adelaide
Sydney
Canberra
Melbourne
L [1010]
H [1018]
H [1026]
H [1031]
H [1031]
H [1018]
L [990]
L [968]
1024
1016
1008
1000
992
984
976

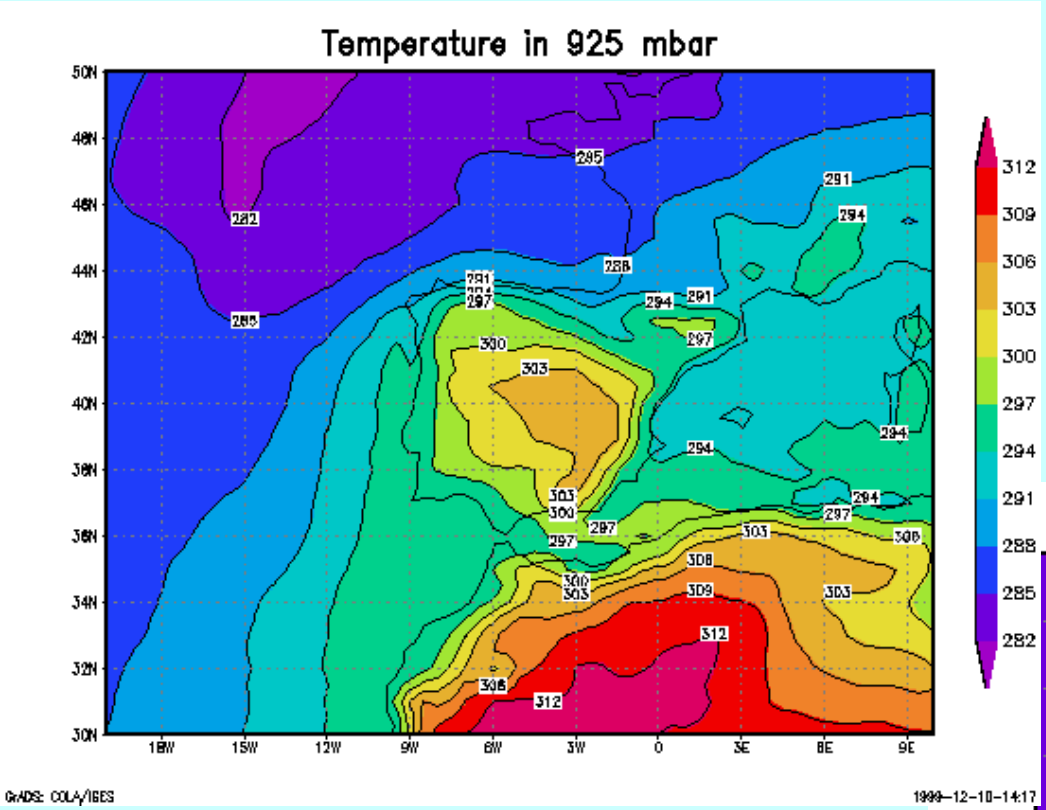

Bureau of Meteorology
TLAPS system
ANALYSIS
VALID 0000 UTC Tue 21 MAR 2000
TEMP C 850 hPa
Units:
ISSUED: 05UTC 21 Mar 2000

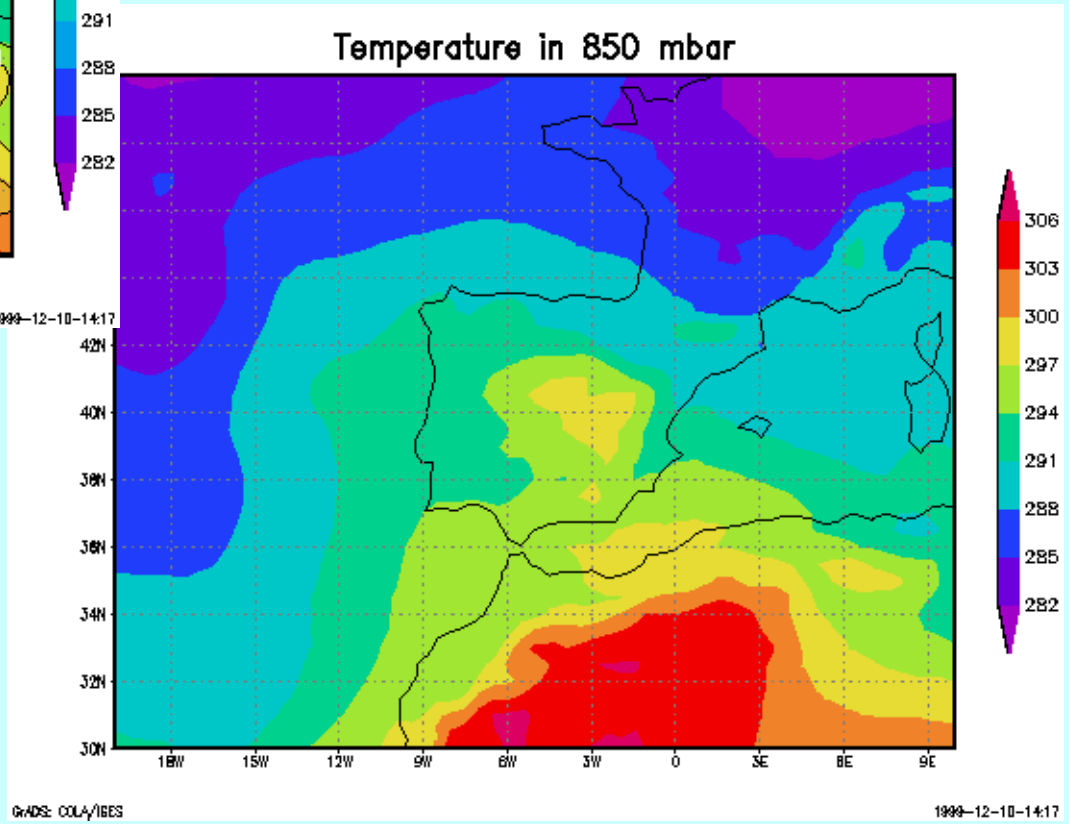
v
i
e

850 mb Temperature – 20 Sep 1998 - 11 Oct 1998



Heat low over the Iberian Peninsula





The Saharan heat low

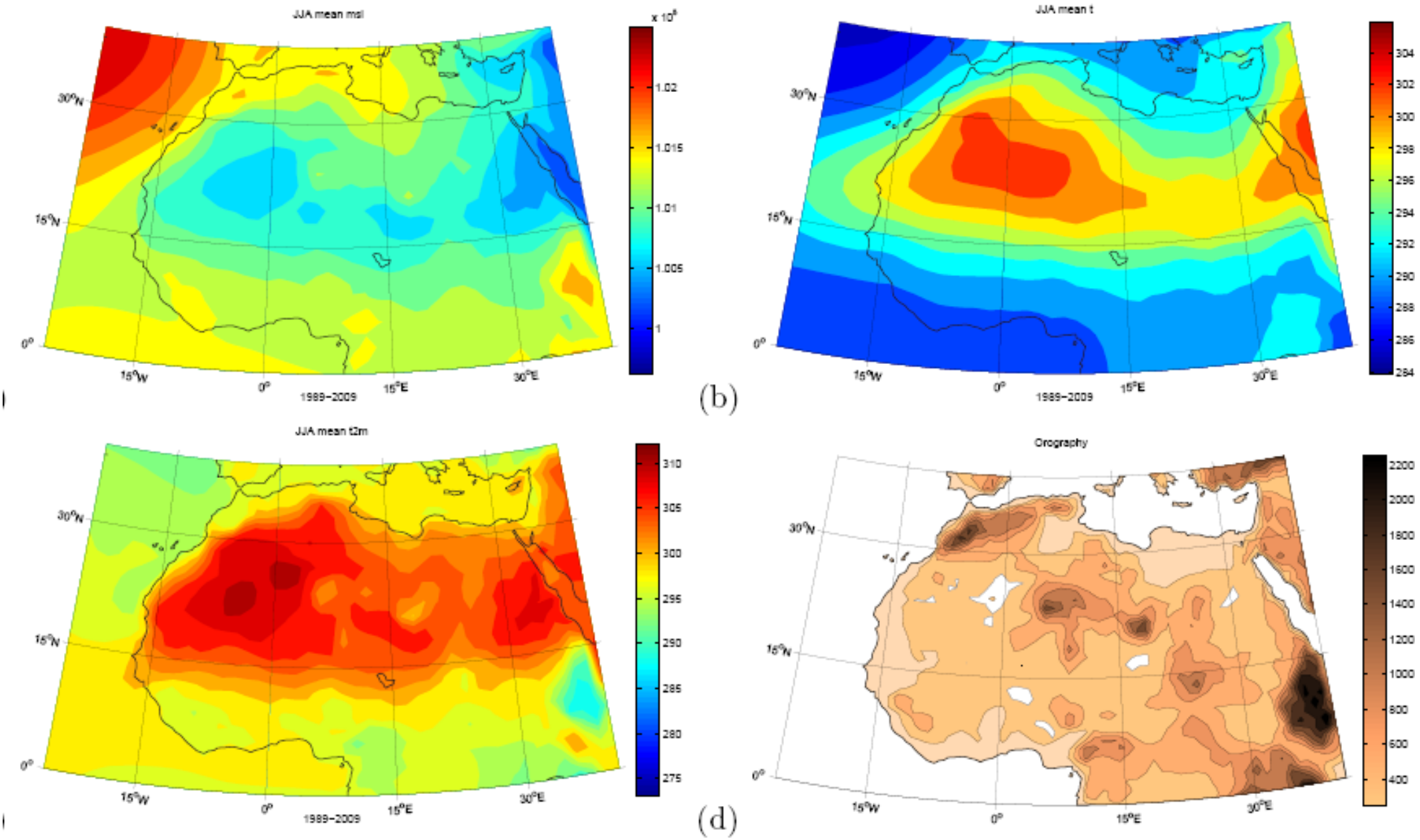
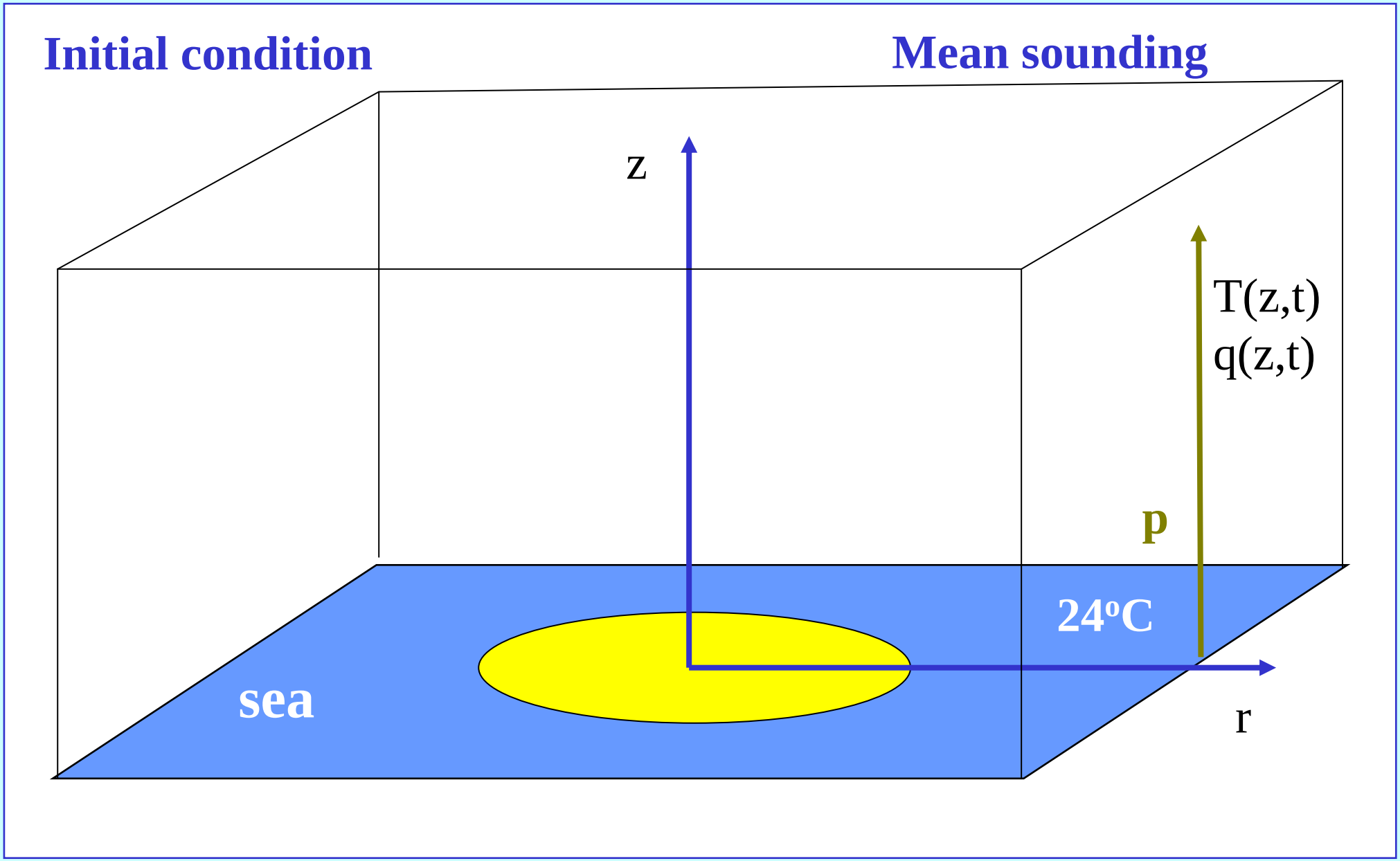
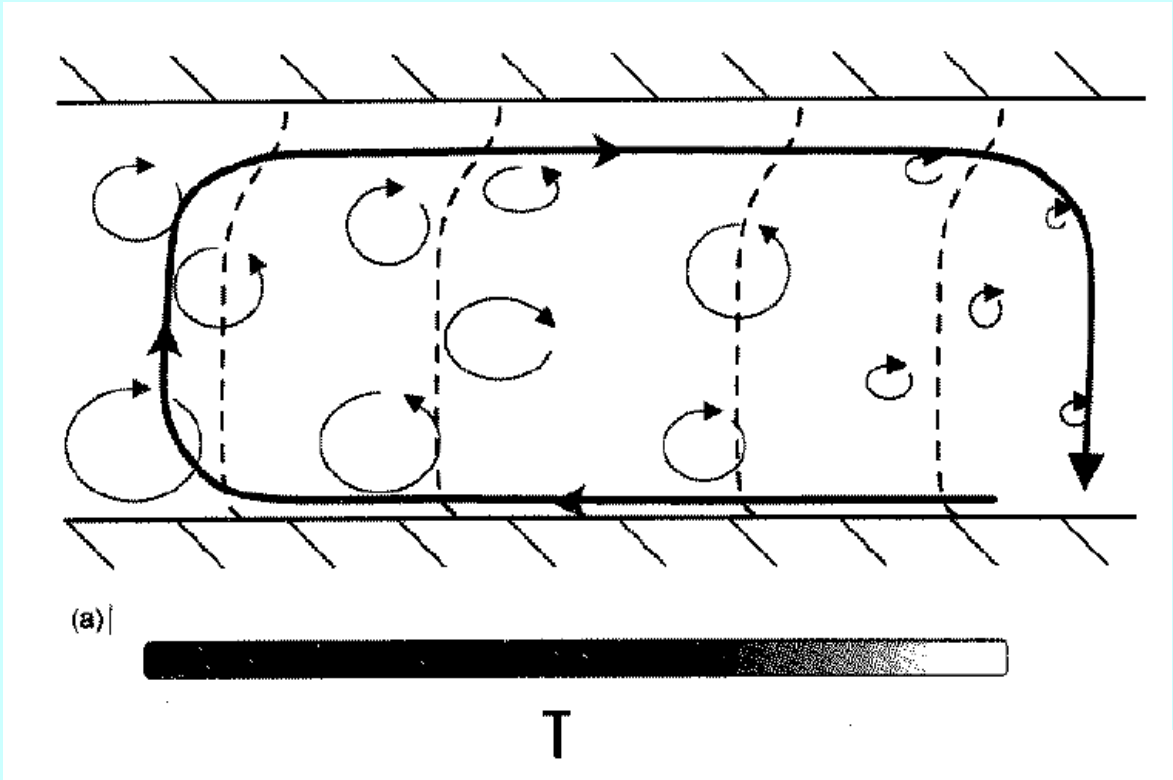


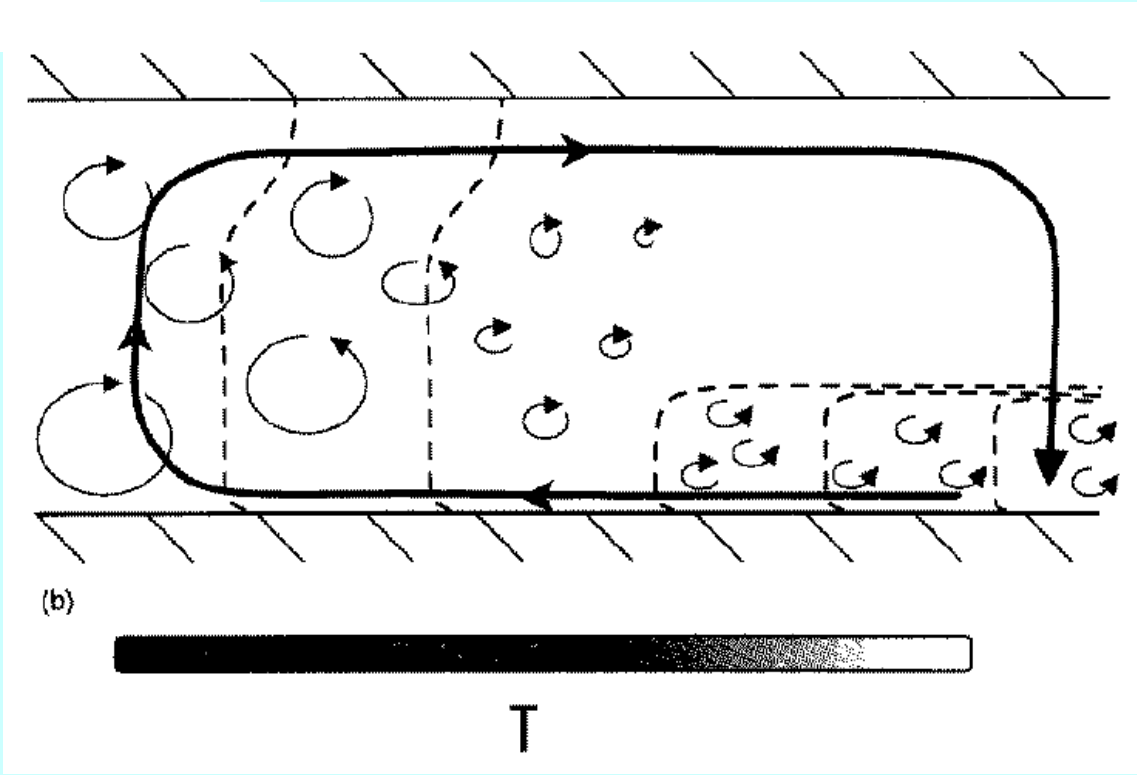
Figure 1: ECMWF ERA Interim climatological mean (1989-2009) fields for June/July/August (JJA) for (a) mean sea level pressure, (b) temperature at 850 hPa, (c) 2 metre temperature and (d) orographic height.

The basic thought experiment for intensification

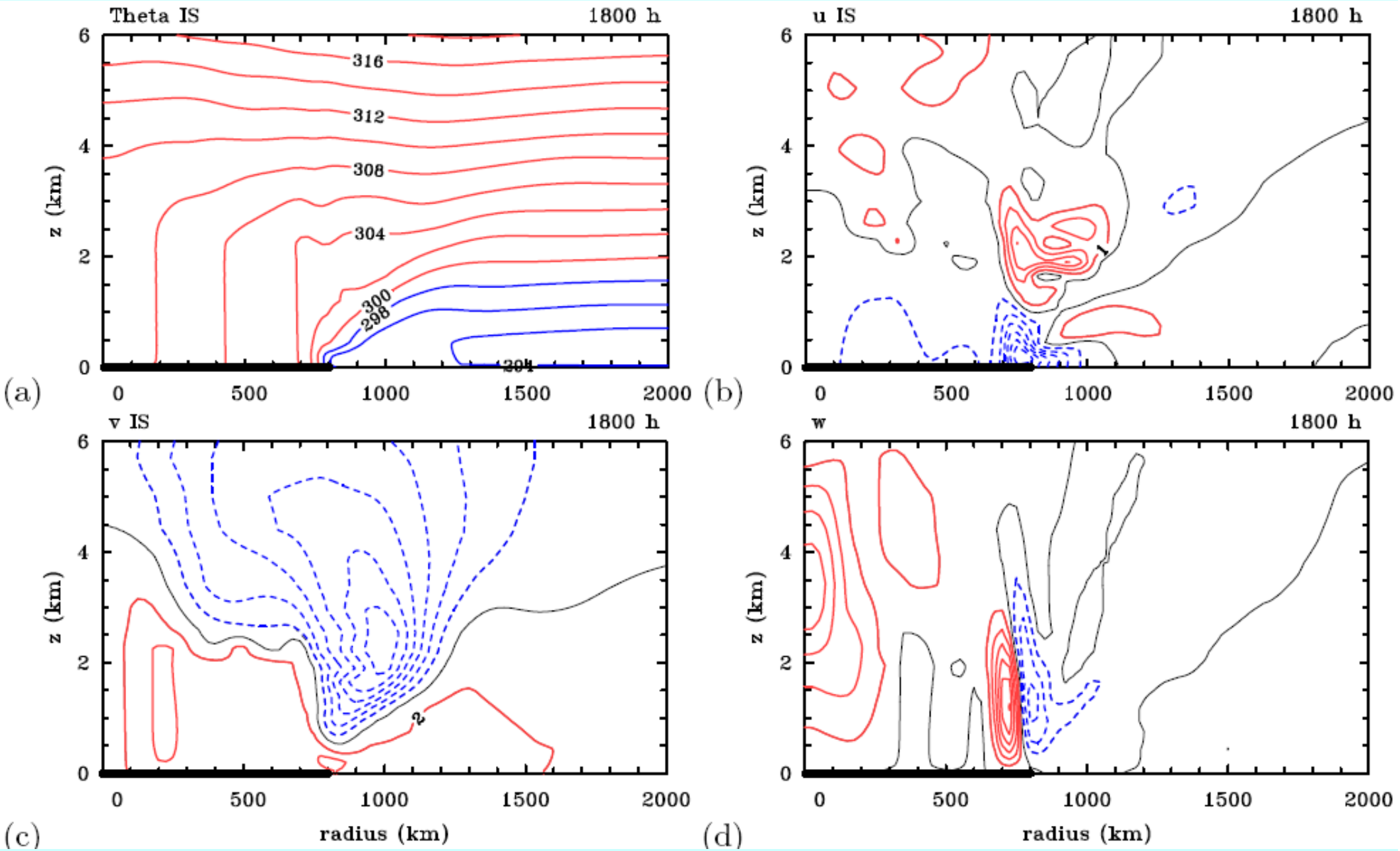




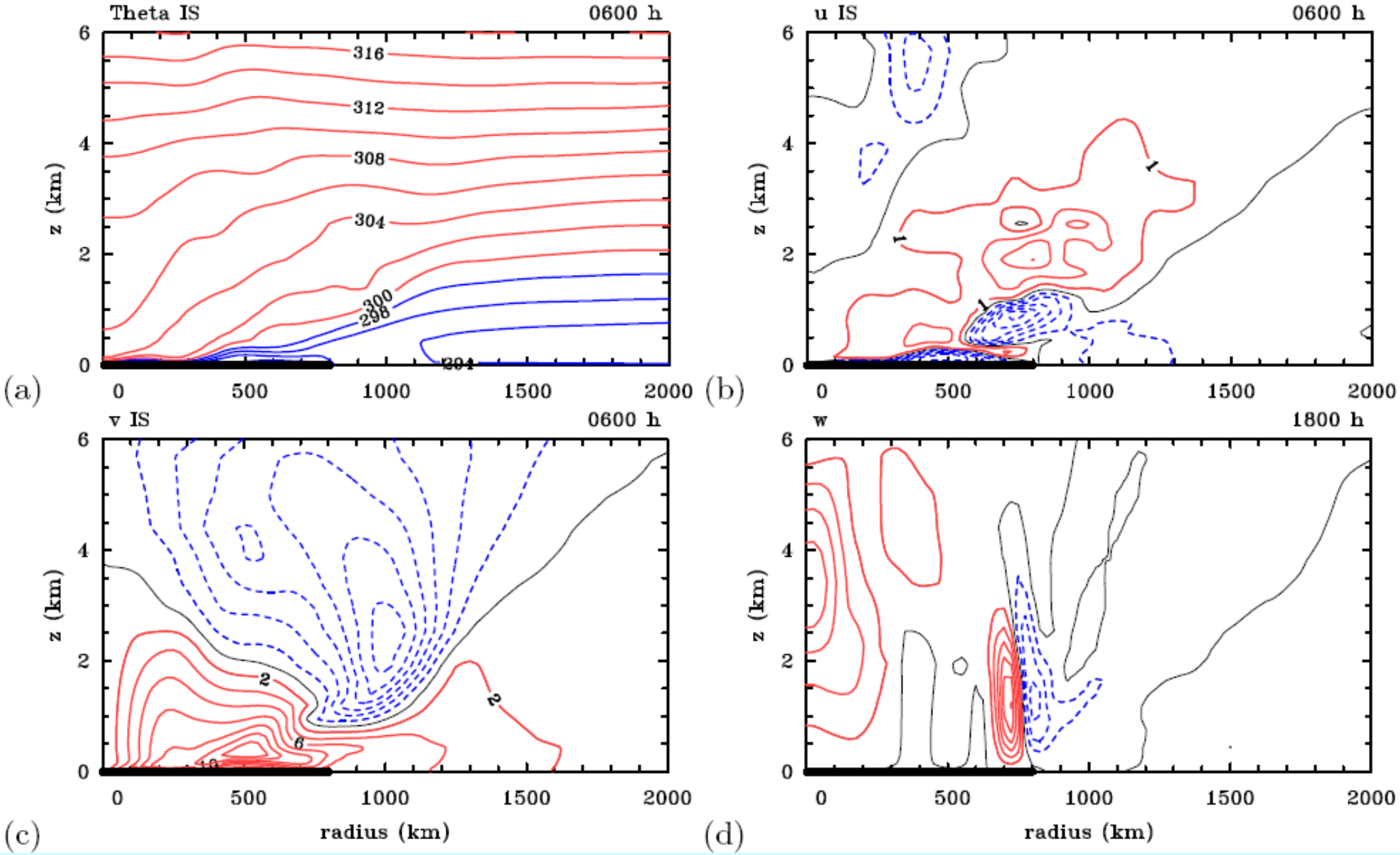
From Emanuel et al. (1994)

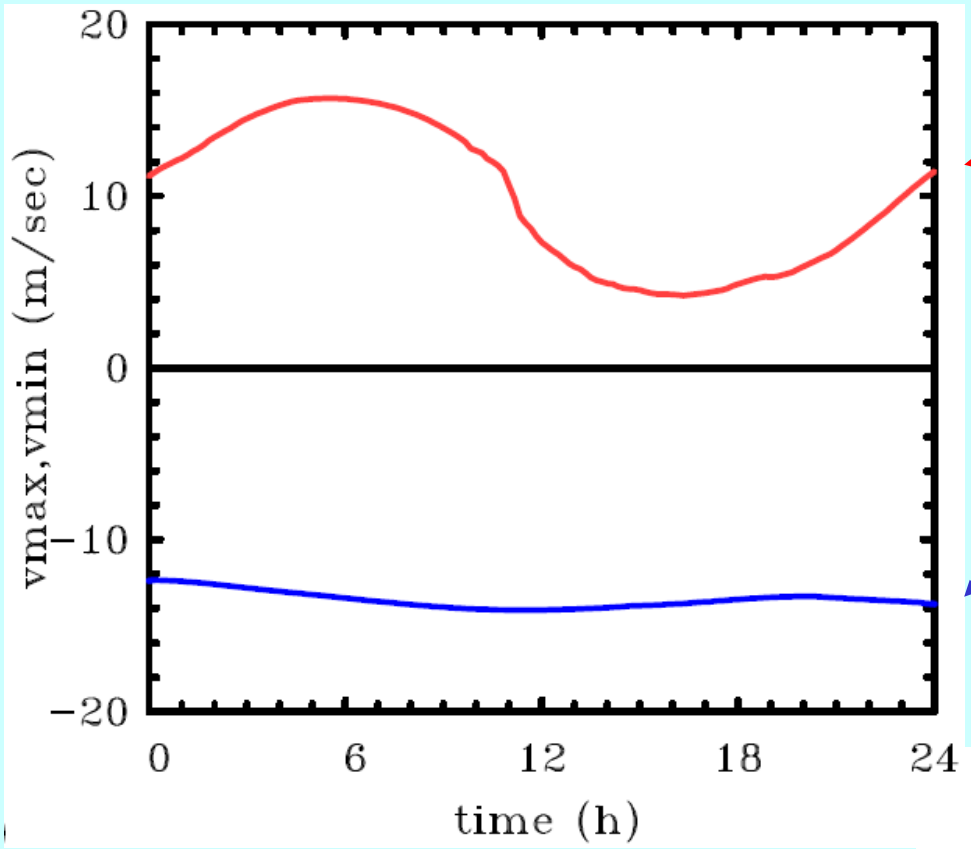


Flat island - 1800 UTC



Flat island - 0600 UTC

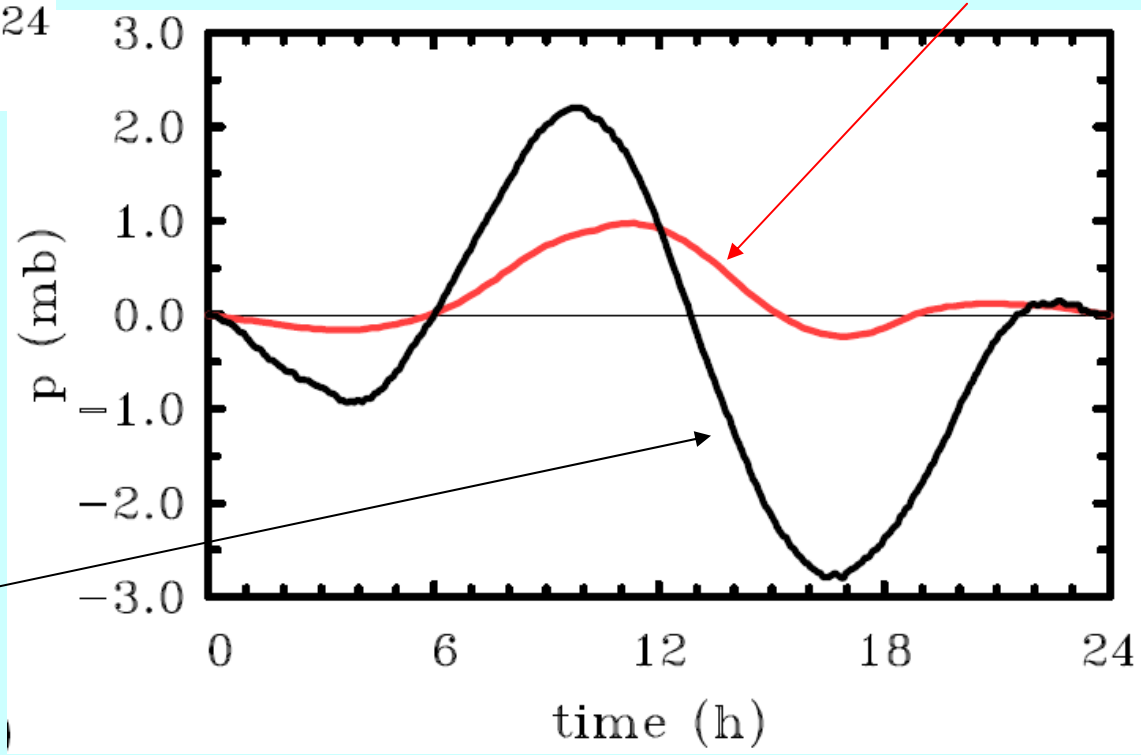




Low-level cyclone

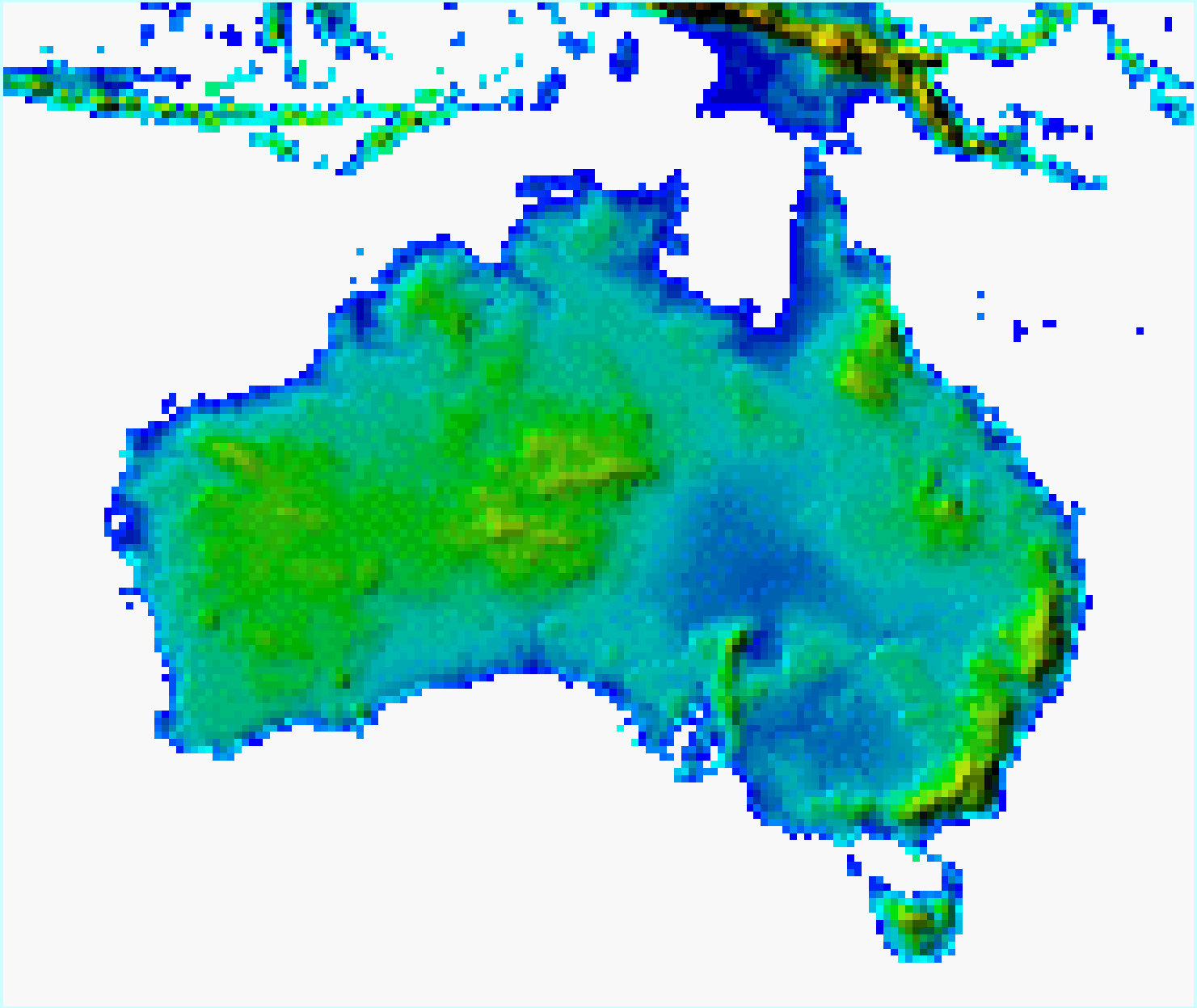
Upper-level anticyclone

Minimum sea level pressure

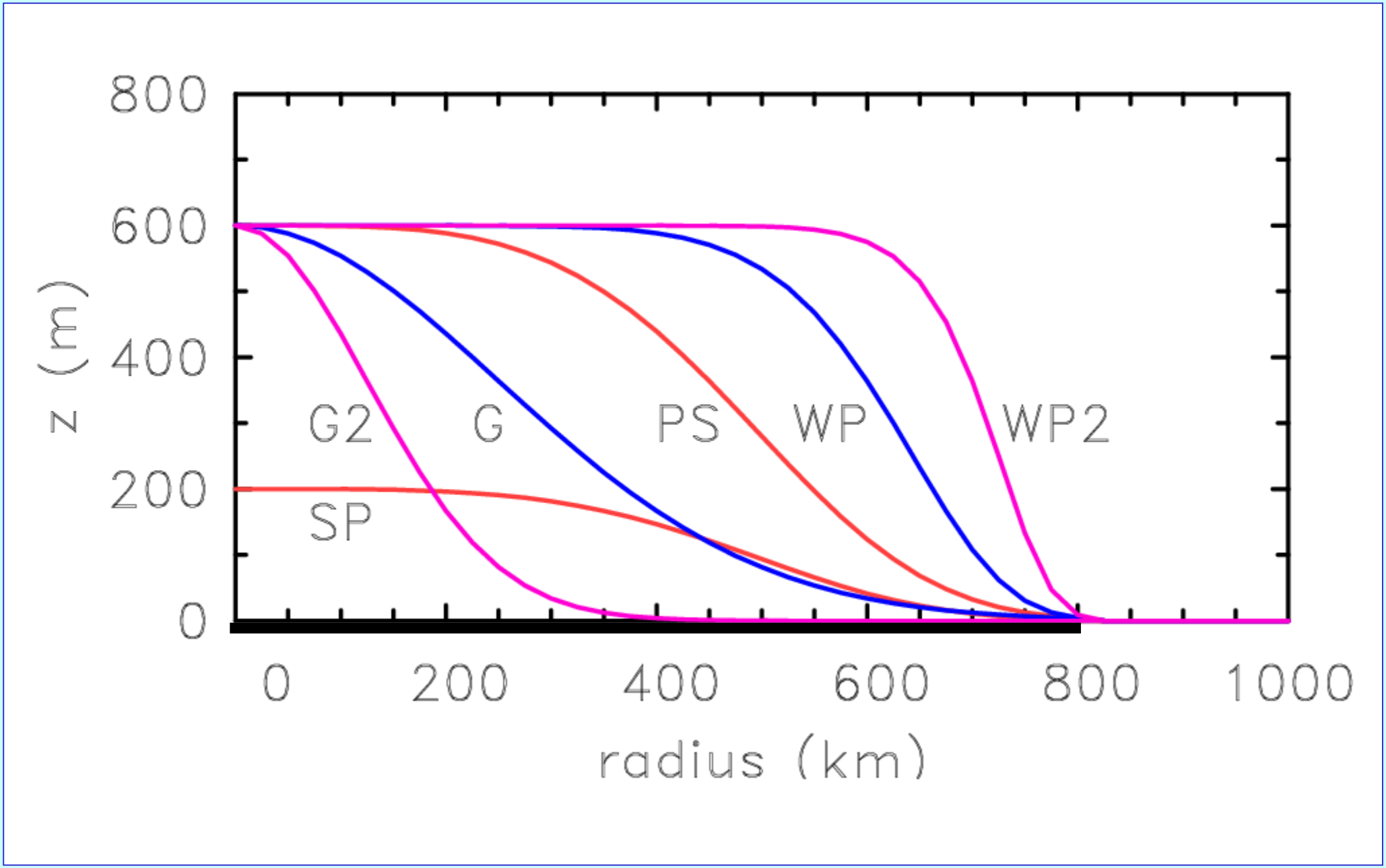


Typical observed diurnal pressure

Orography of Australia



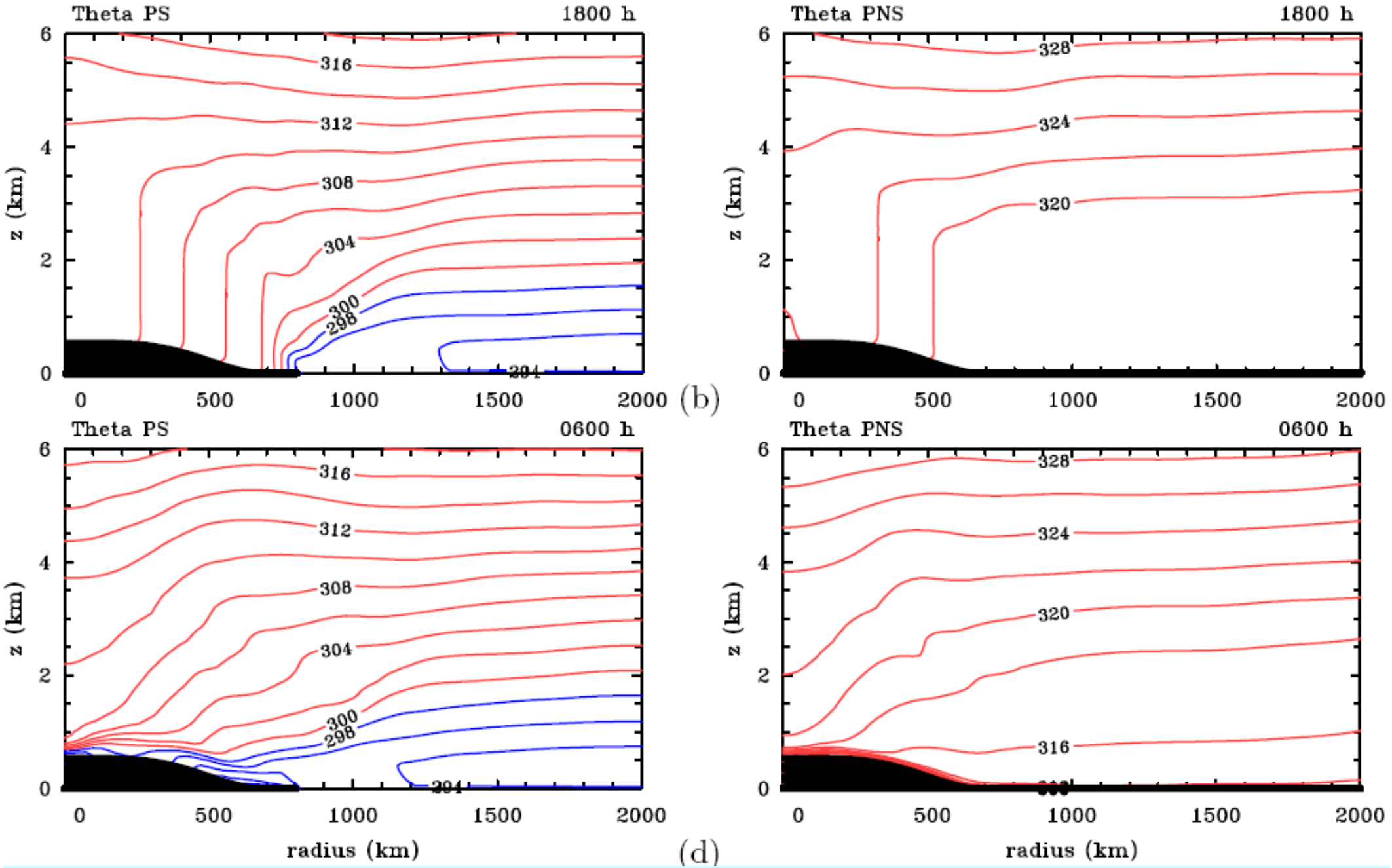
Idealized orography

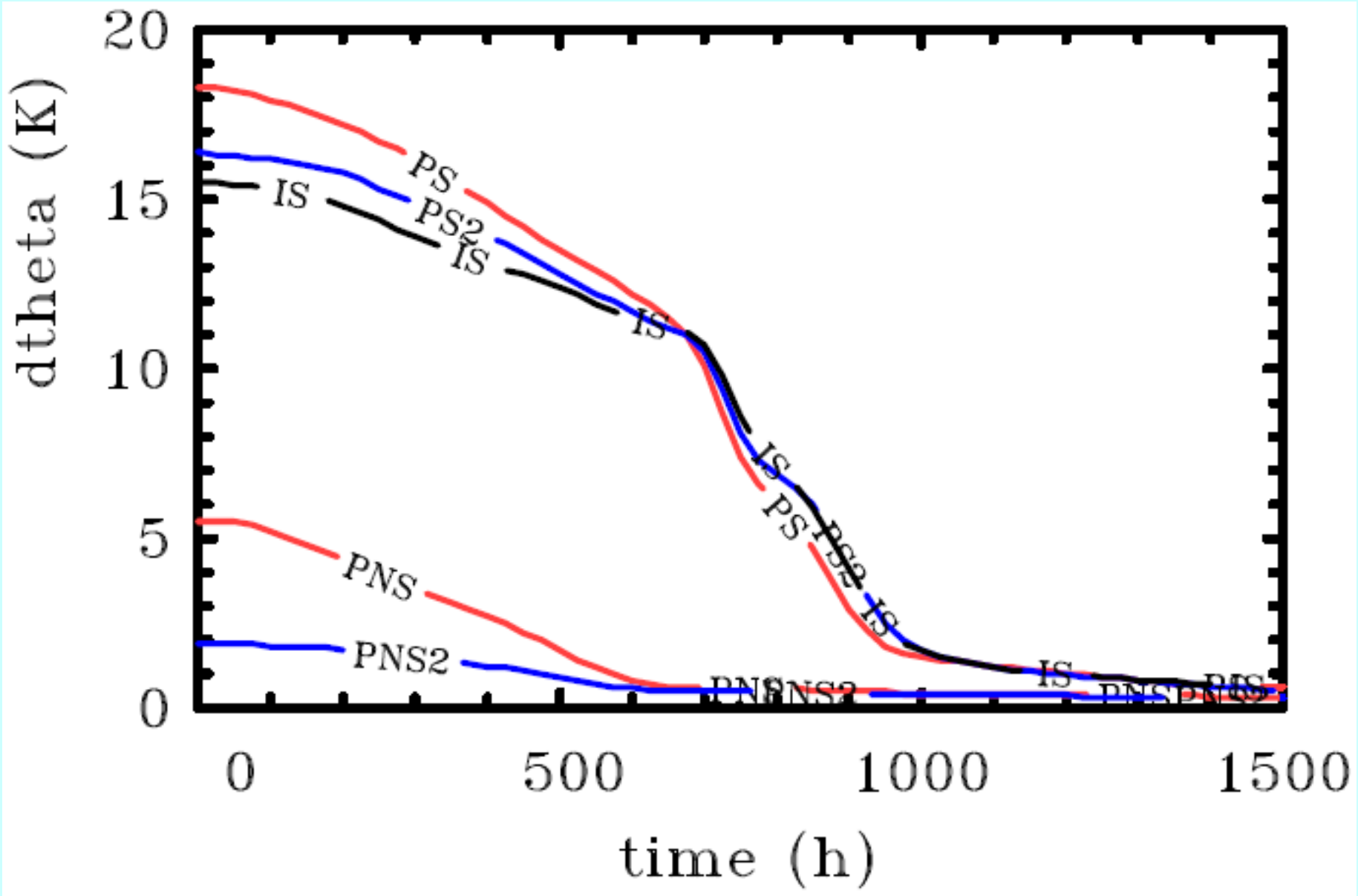


Plateau - sea

Orography

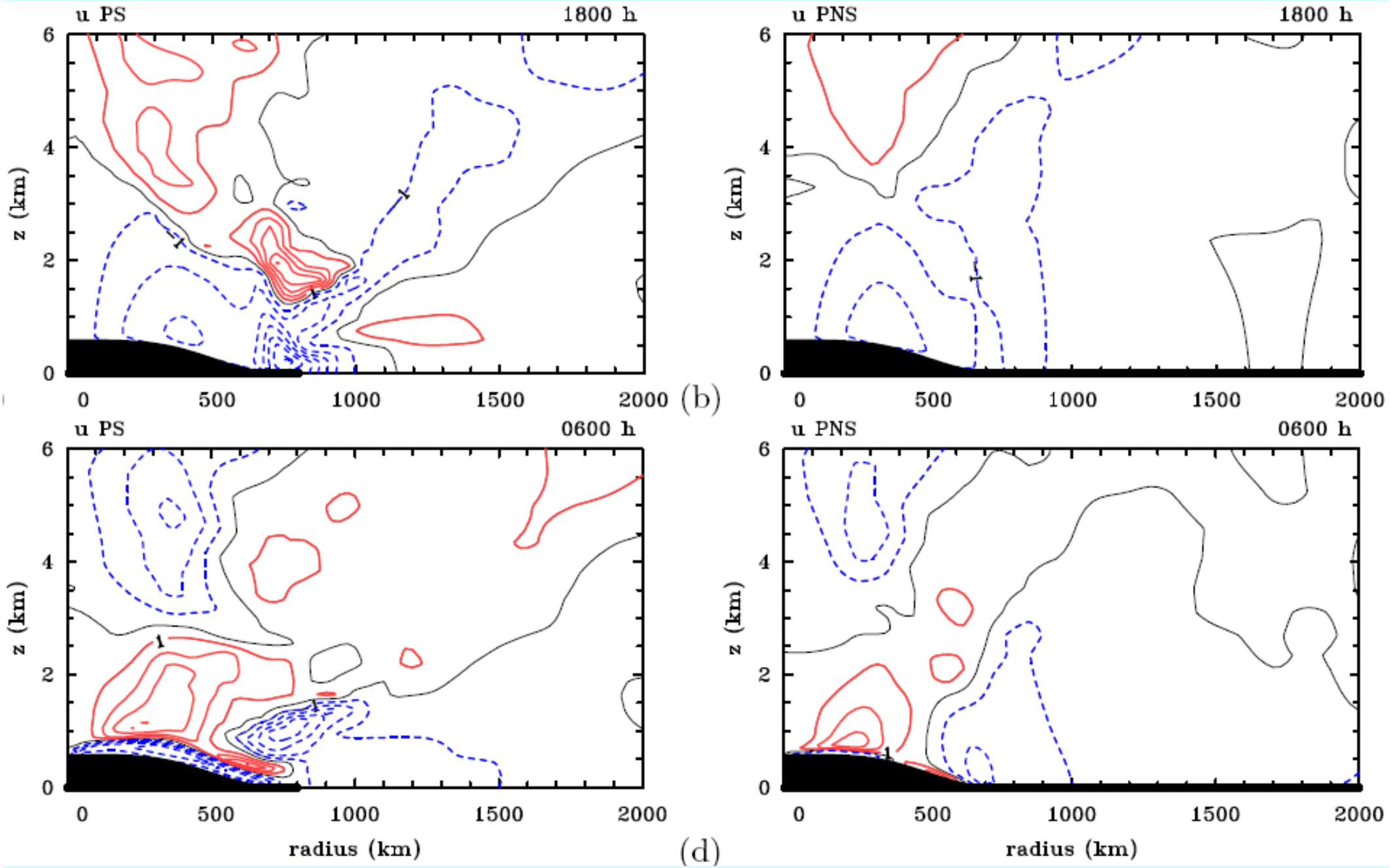
Plateau – no sea




dtheta (K)
time (h)
0
5
10
15
20
0
500
1000
1500
PS
IS
PS2
IS
IS
PS
IS
PNS
PNS2

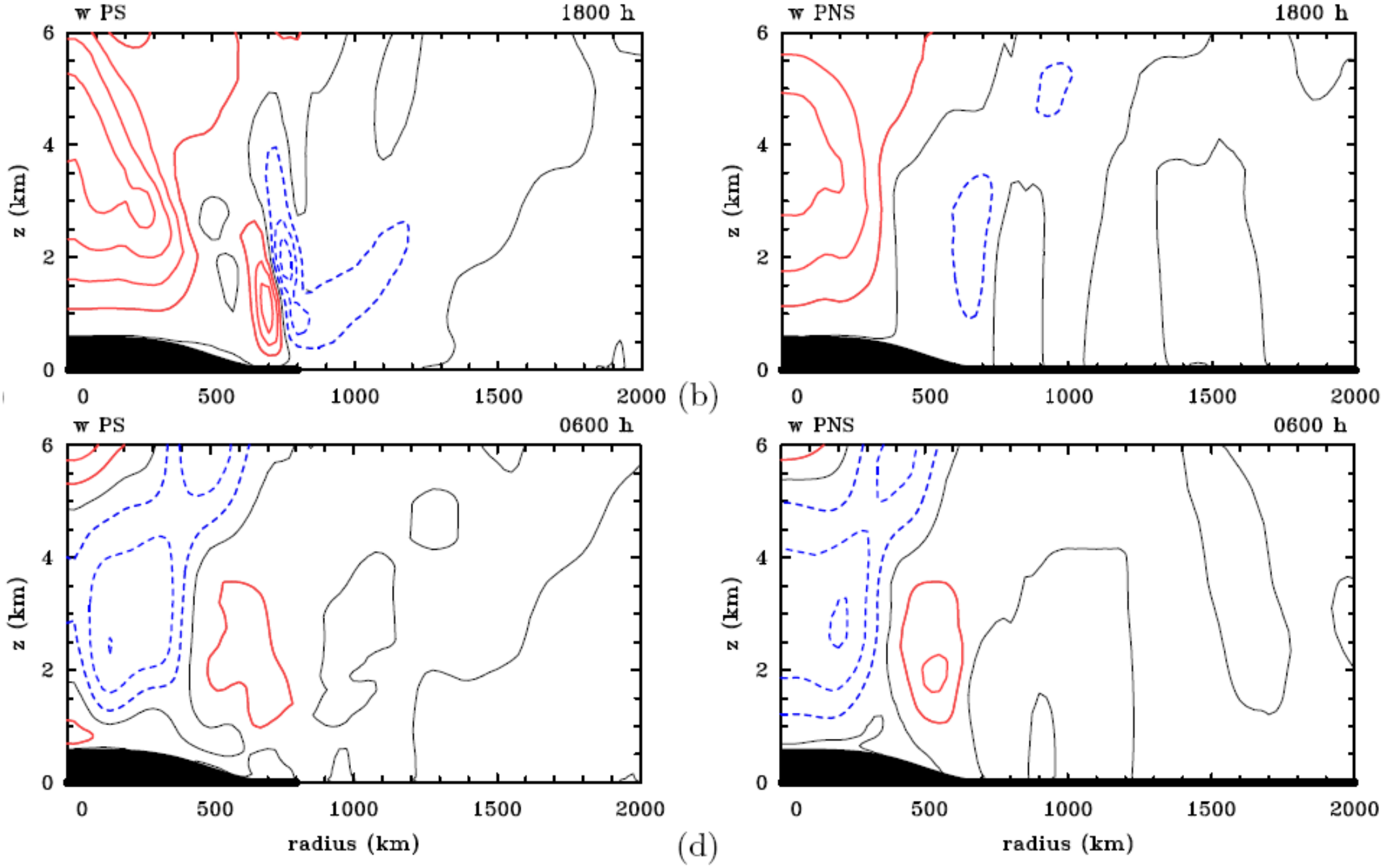
Plateau - sea

Plateau – no sea



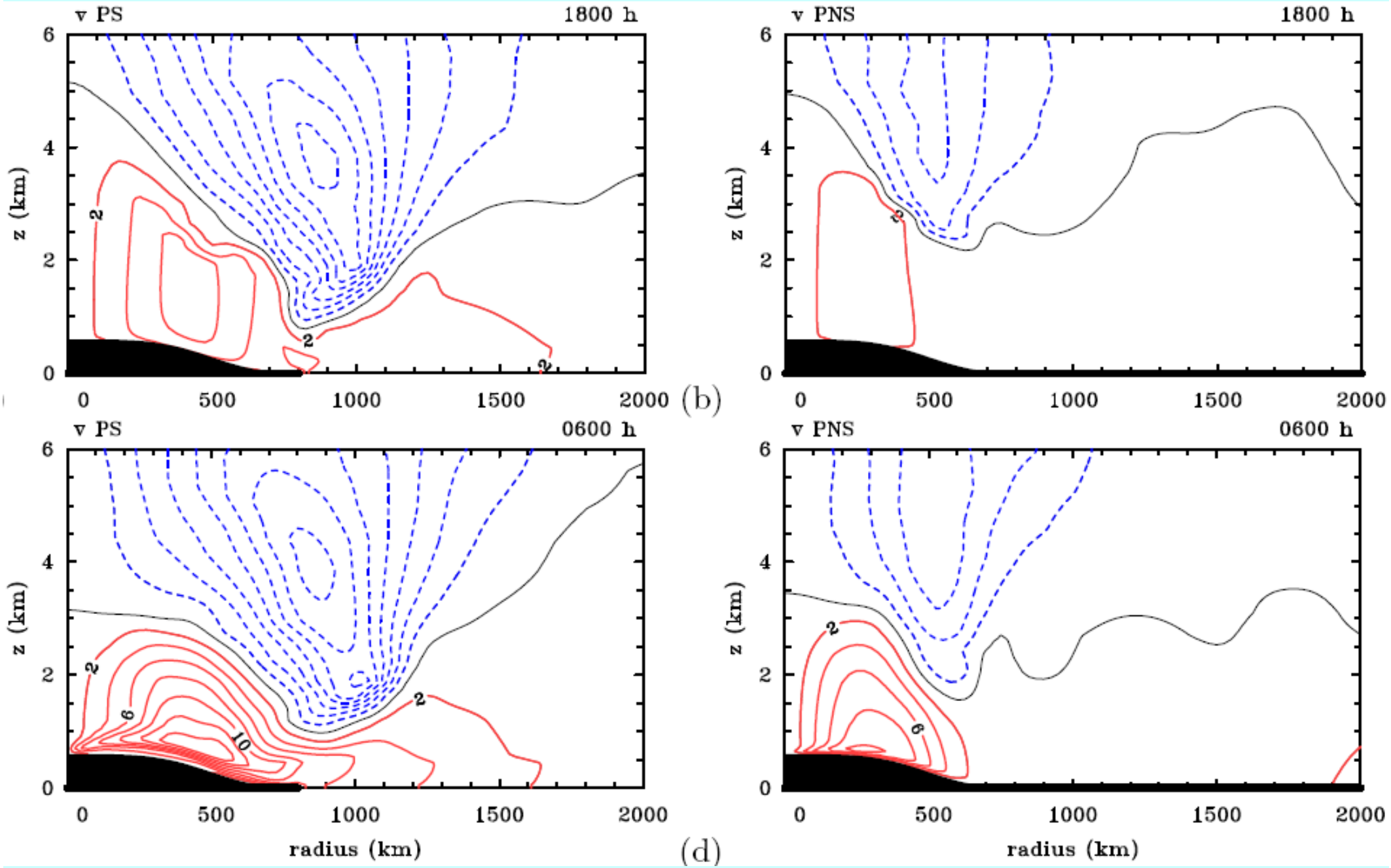
Plateau - sea

Plateau – no sea



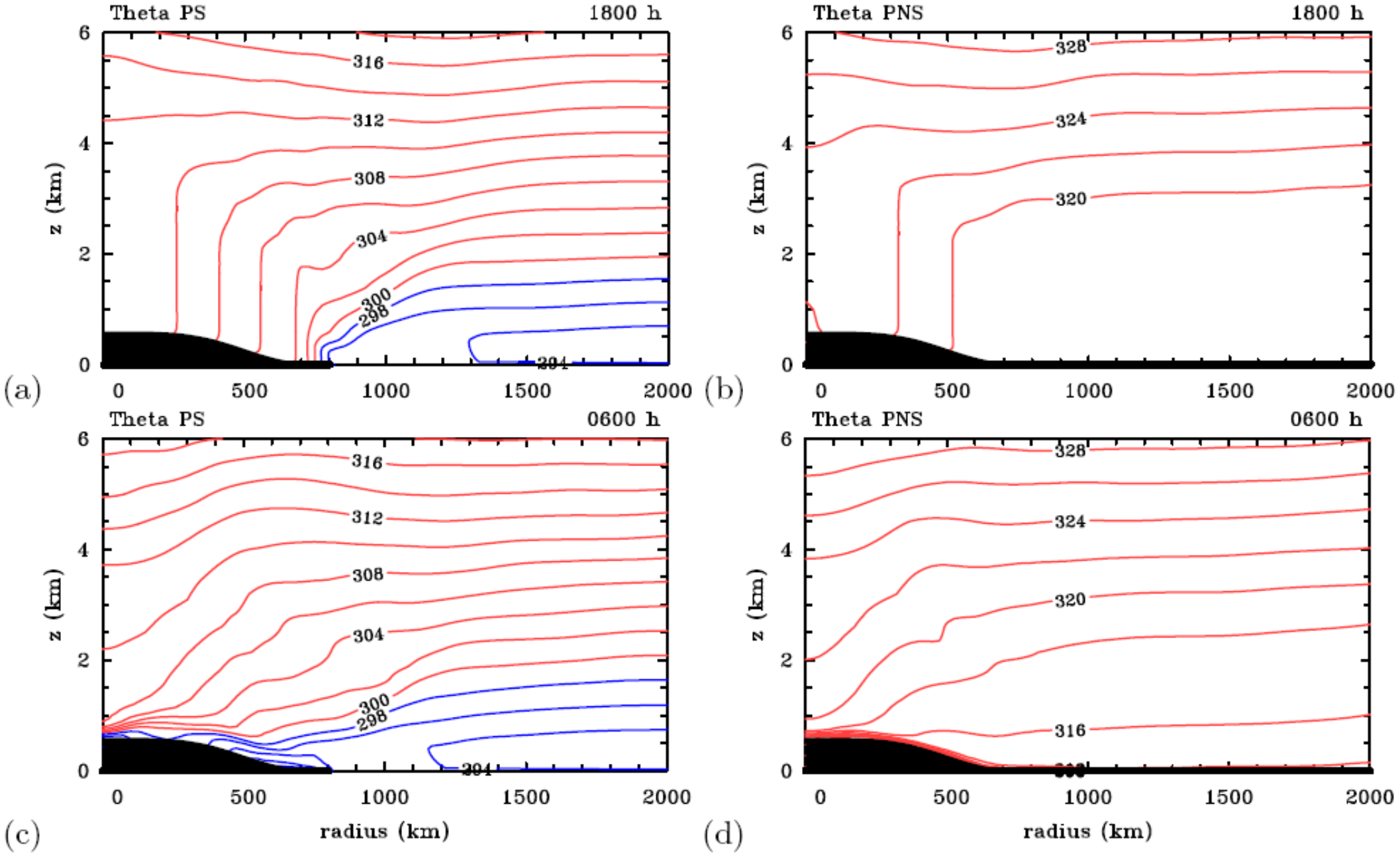
Plateau - sea

Plateau – no sea



Plateau - sea

Plateau – no sea



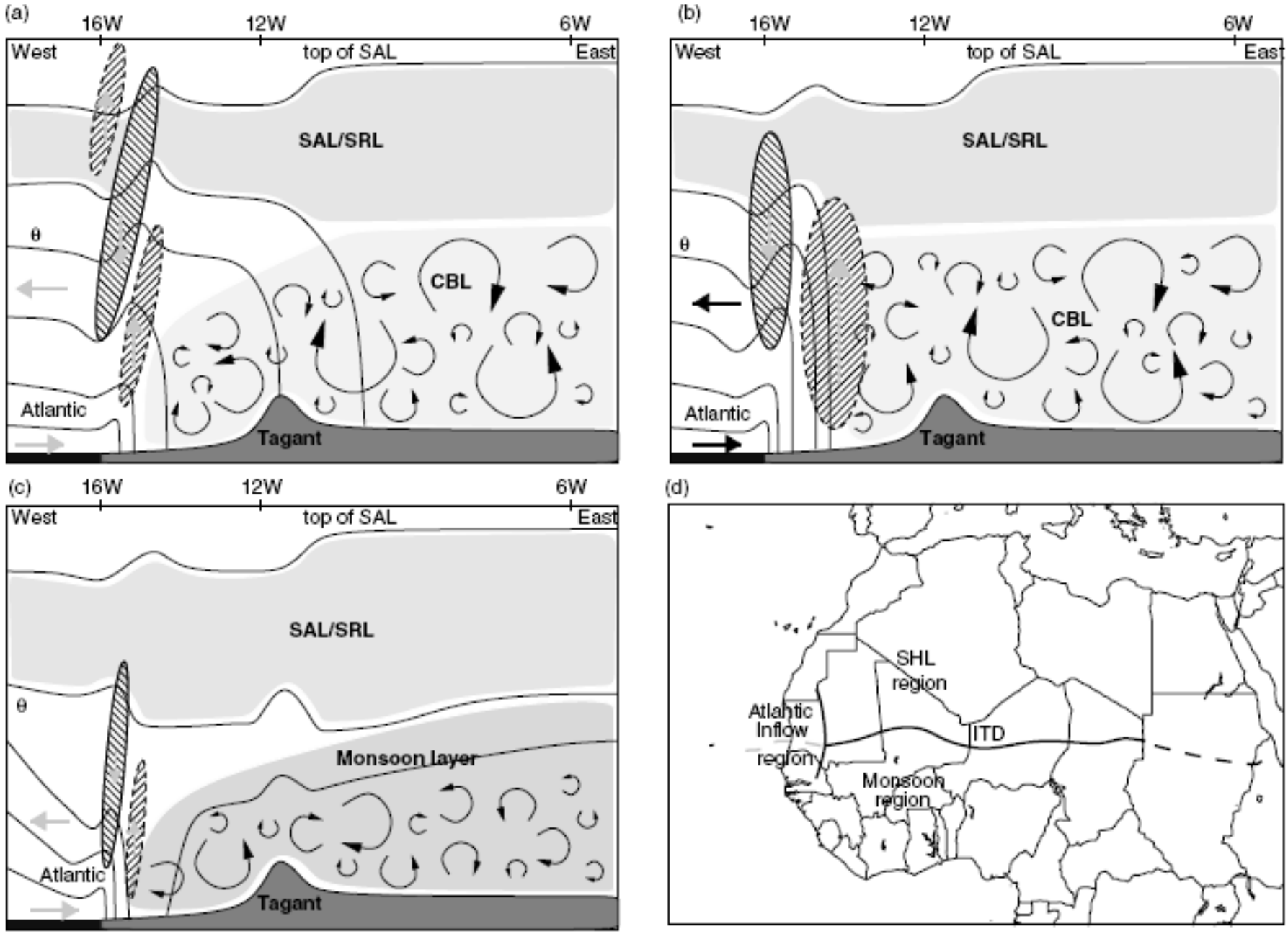


Figure 3. Sketches of Atlantic Inflow modes as longitudinal vertical sections at around 18°N. Typical isentropes are indicated as black contours, to be compared with Figure 2: (a) the maritime mode with the baroclinic zone from the coast towards the Tagant and the SHL east of the Tagant, (b) the heat low mode with the SHL shifted towards the Atlantic coast, and (c) the monsoon mode with the ITD being north of 18°N. (d) shows a horizontal view; the Atlantic Inflow reaches into both the SHL region in the north and the monsoon region in the south. The Atlantic Inflow comprises the sea breeze and coastal front, the baroclinic zone, and the gravity wave together with the frontal circulation.

m ma ry

1. Heat lows are relatively shallow systems
2. Cyclonic circulation at low levels, anticyclonic aloft
3. Late afternoon minimum in surface pressure
4. Broadscale baroclinicity and sea breeze produce low-level convergence into the heat low during the afternoon
5. Low-level jet intensifies the convergence during the late evening and early morning
6. Maximum tangential wind/relative vorticity occurs in the early morning
7. Tangential wind/relative vorticity is weak during the afternoon when convective mixing is at its peak
8. Low-level flow is highly ageostrophic
9. Similarities with pre-frontal troughs over central Australia

Thank you for your interest