Geostrophic balance of the equatorial zonal flow

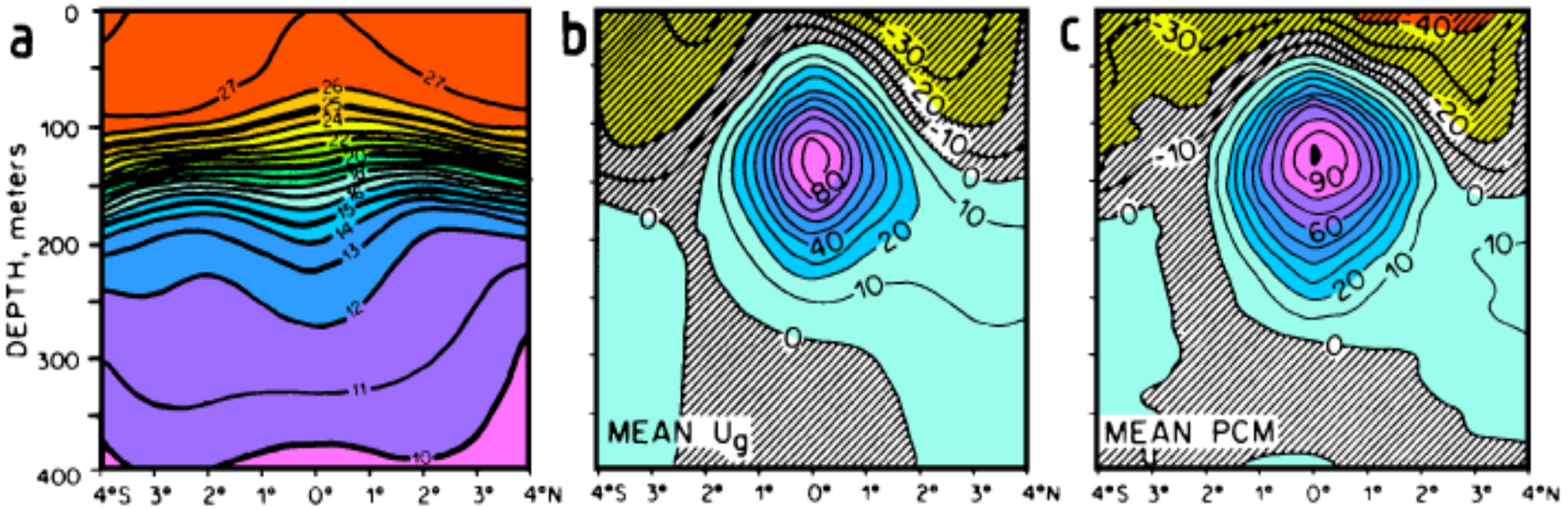


Fig. 8.8. The Equatorial Undercurrent during February 1979 - June 1980 near 155°W. (a) Mean temperature (°C), (b) mean geostrophic zonal velocity (10^{-2} m s^{-1})X, (c) mean observed zonal velocity (10^{-2} m s^{-1}). Note the spreading of the isotherms at the equator. From Lukas and Firing (1984).

Tomczak and Godfrey. Reg. Oceanogr., 1994

The Stommel model: transition from Ekman balance to non-rotational physics on the equator

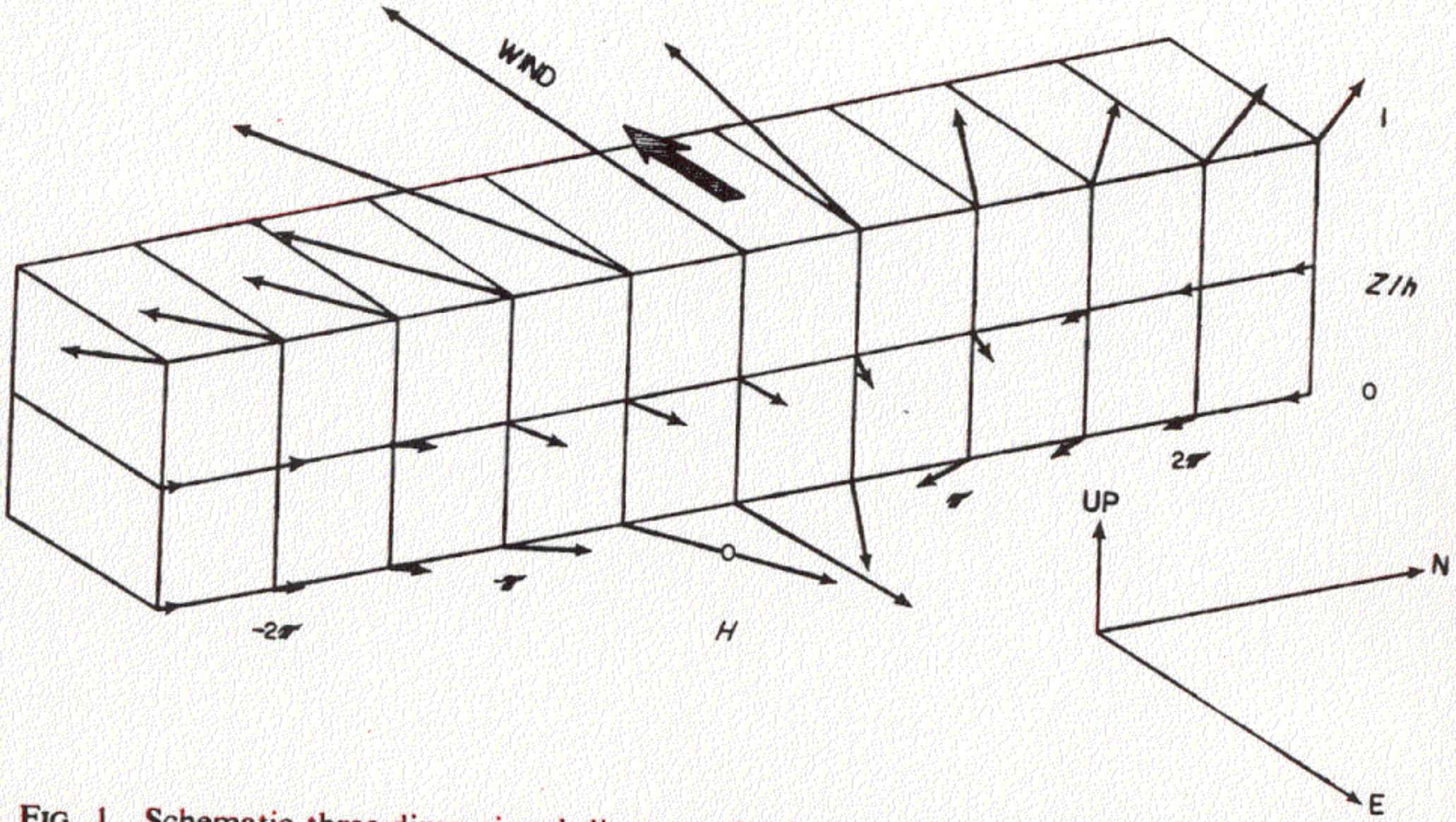
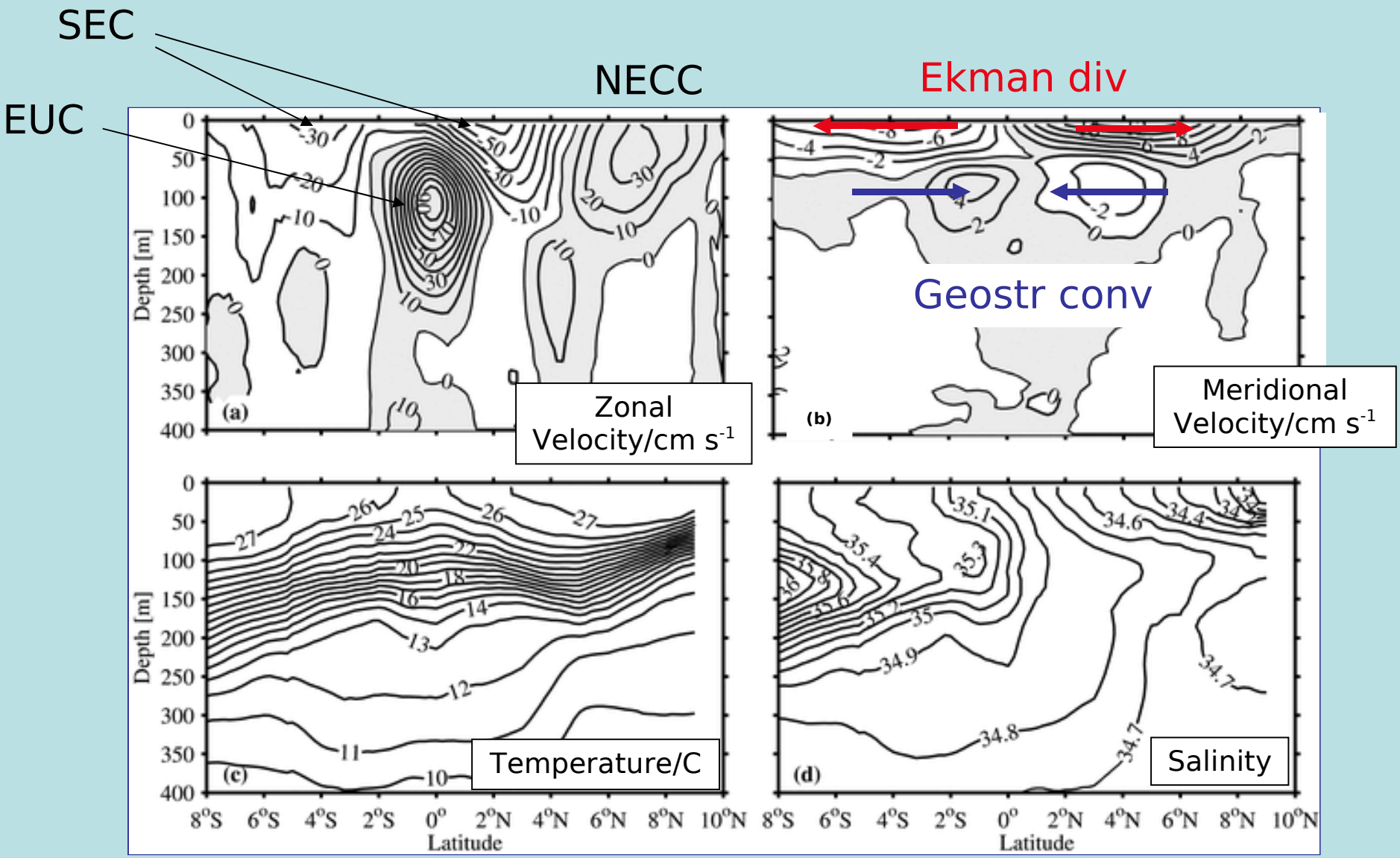


FIG. 1. Schematic three-dimensional diagram of the combined frictional and geostrophic flow field in the neighbourhood of the equator, not showing the vertical component of velocity (which can in principle be determined from continuity).

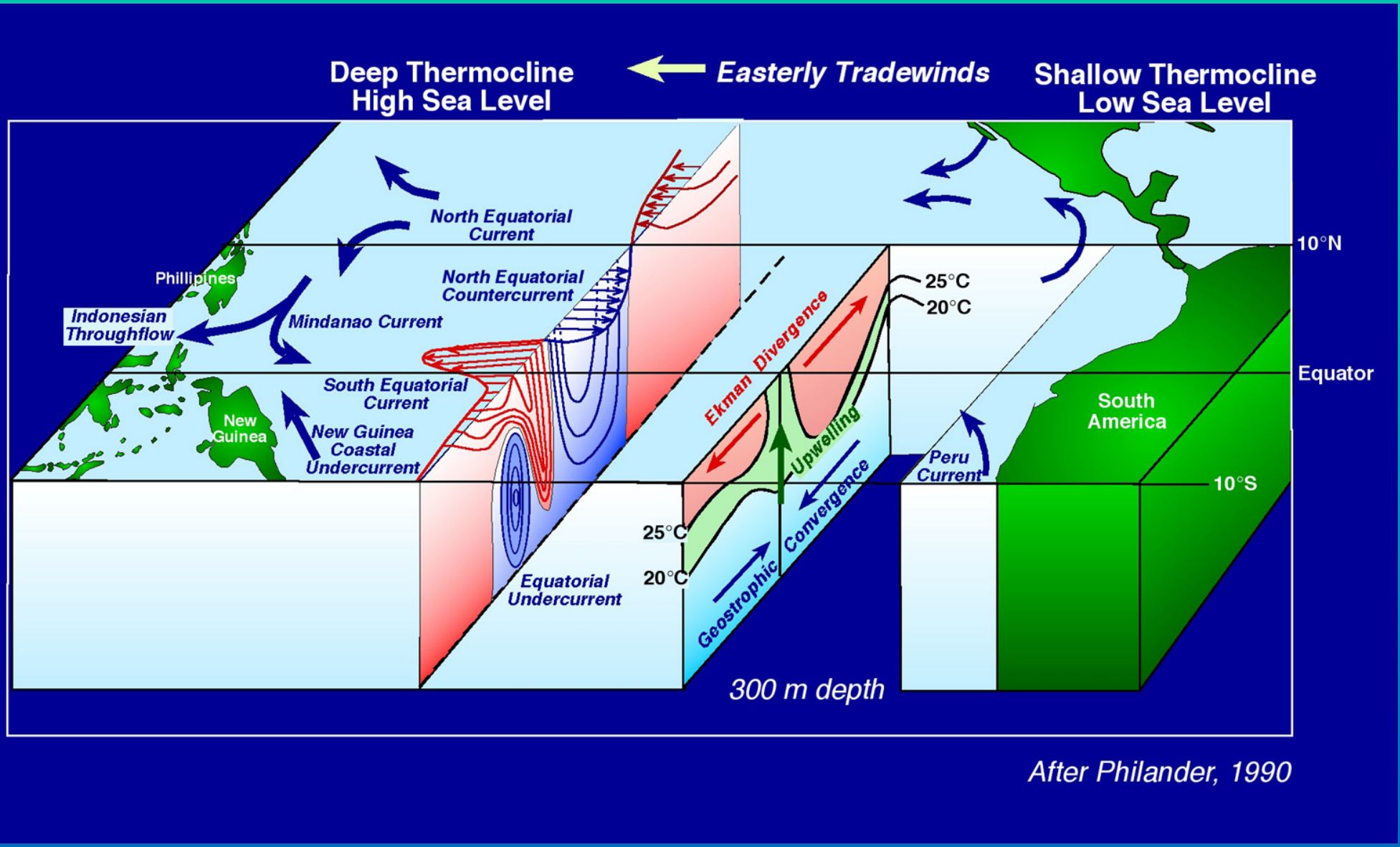
Stommel, 1959, DSR., 6, 298-302

Meridional Structure, 136°W



Johnson, McPhaden& Firing, 2001

Ocean Circulation Schematic



After Philander, 1990

Complex vertical structure of flow even at great depth

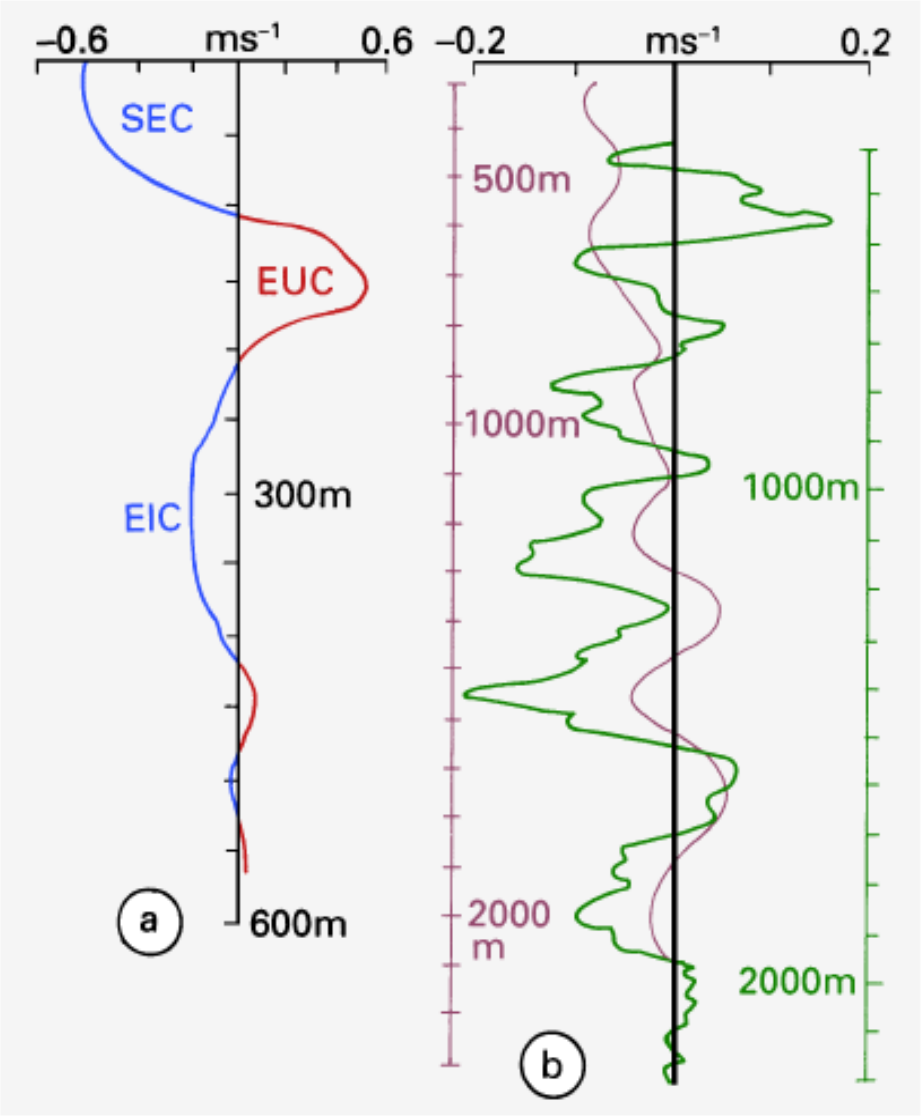


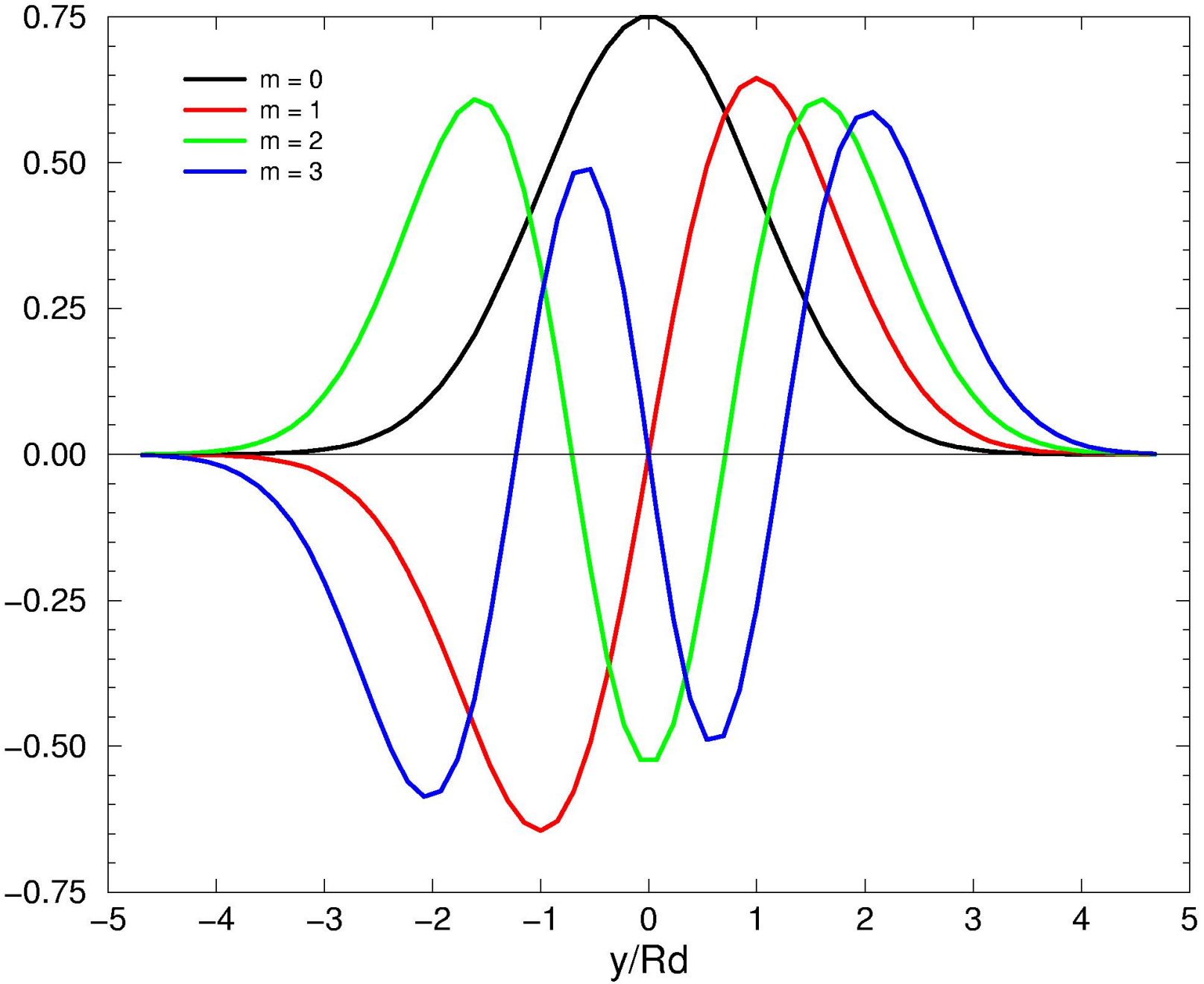
Fig. 8.15. Evidence for banded structure of currents at the equator.
(a) The South Equatorial Current (SEC), Equatorial Undercurrent (EUC), and Equatorial Intermediate Current (EIC) at 165°E;
(b) deep equatorial currents at 150 - 160°W during 1980 (solid line, right depth scale) and during March 1982 - June 1983 (thin line, left depth scale). The cores of all current bands coincide if the entire current system during 1982/83 is shifted upward some 130 m.
Note the different depth and velocity scales. Adapted from Delcroix and Henin (1988) and Firing (1987).

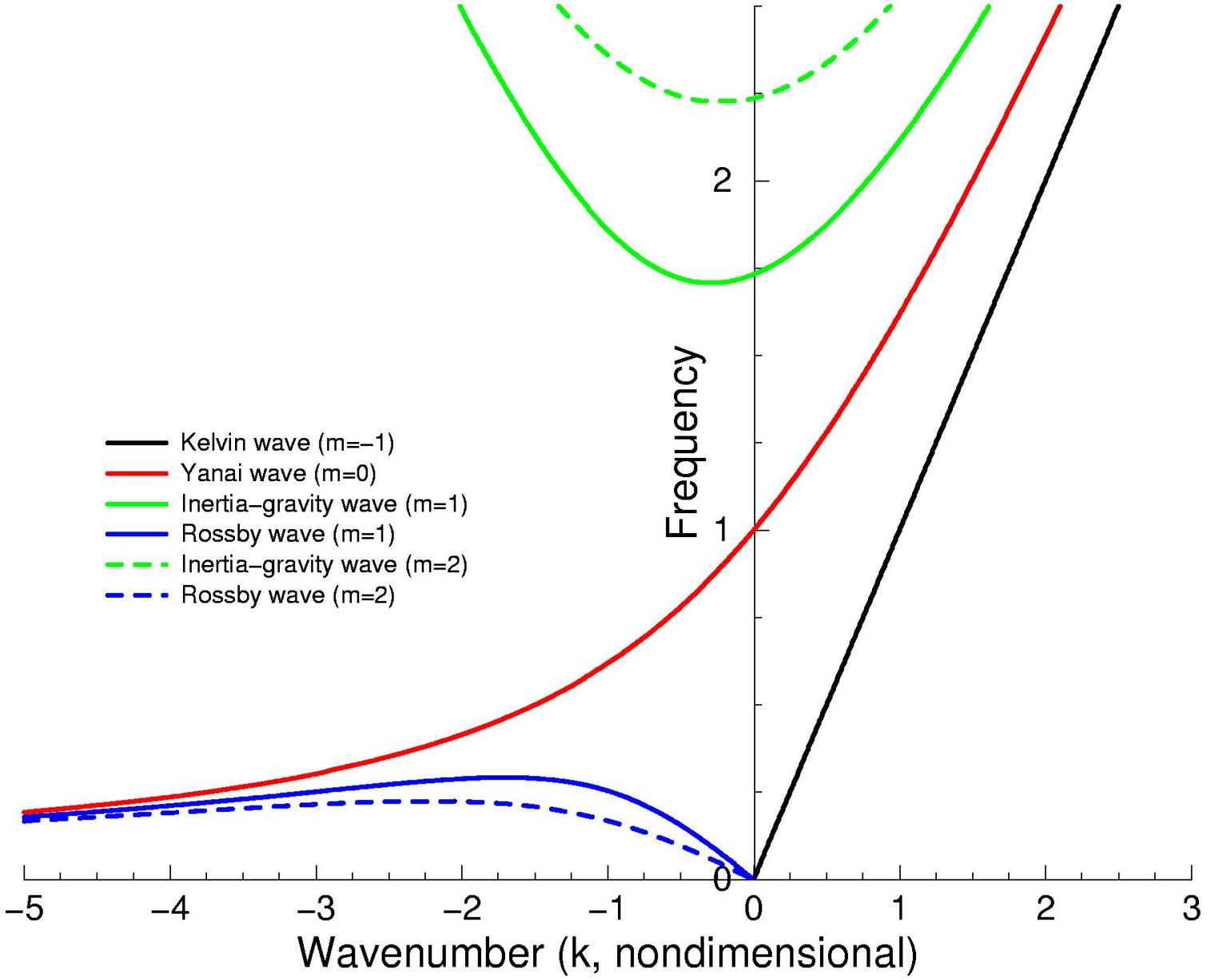
Tomczak and Godfrey, RO

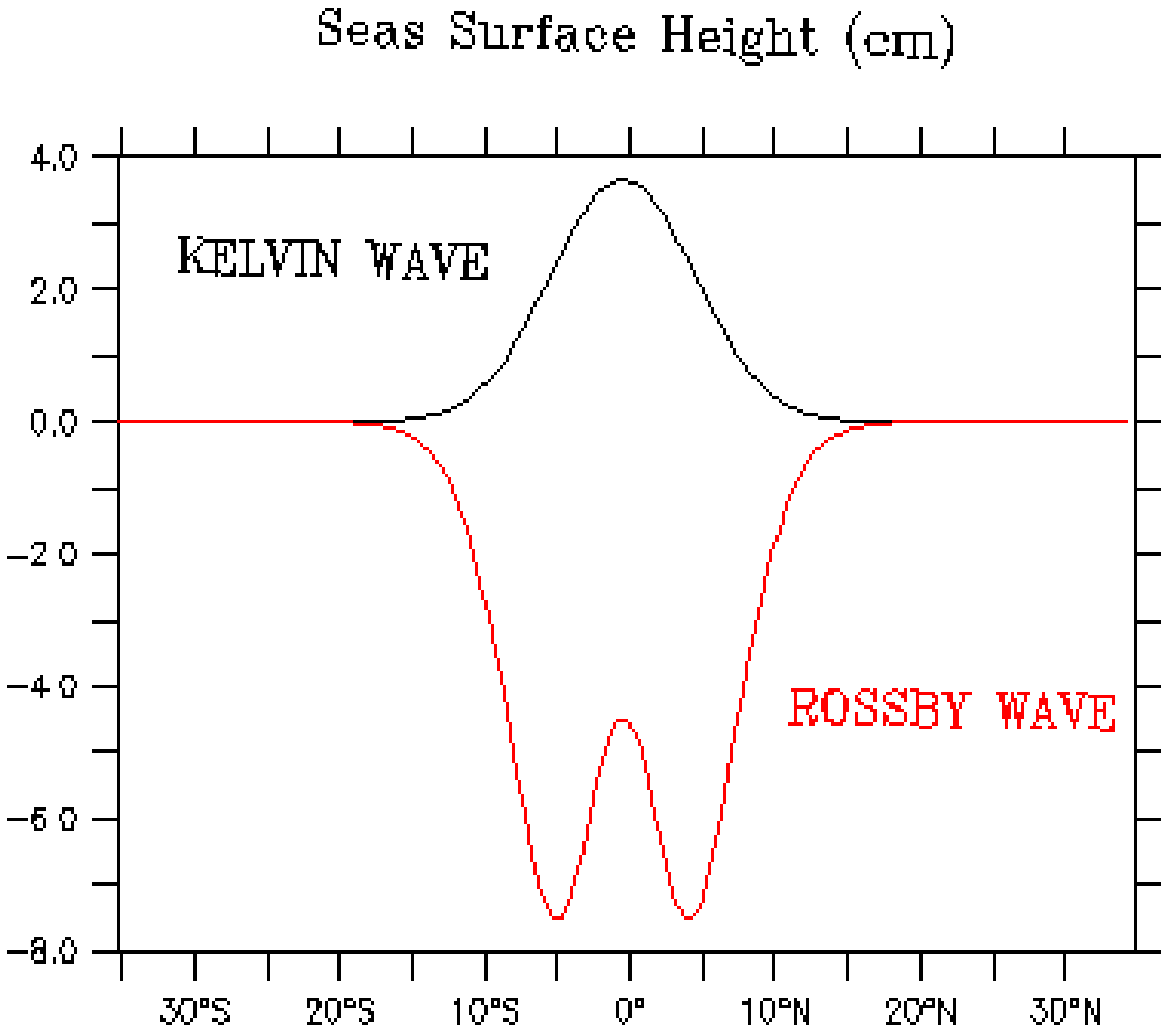
Eastern tropical Pacific
suggested reading

Kessler, W. S., 2006: The circulation of the eastern tropical Pacific: A review. Prog. Oceanogr., 69, 181-217.

Willett, C. S., R. R. Leben and M.F. Lavin, 2006: Eddies and tropical instability waves in the eastern tropical Pacific: A review. Prog. Oceanogr., 69, 218-238.


0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−5
−4
−3
−2
−1
0
1
2
3
4
5
y/Rd
m = 0
m = 1
m = 2
m = 3


Kelvin wave (m=−1)
Yanai wave (m=0)
Inertia−gravity wave (m=1)
Rossby wave (m=1)
Inertia−gravity wave (m=2)
Rossby wave (m=2)
Frequency
0
1
2
−5
−4
−3
−2
−1
0
1
2
3
Wavenumber (k, nondimensional)



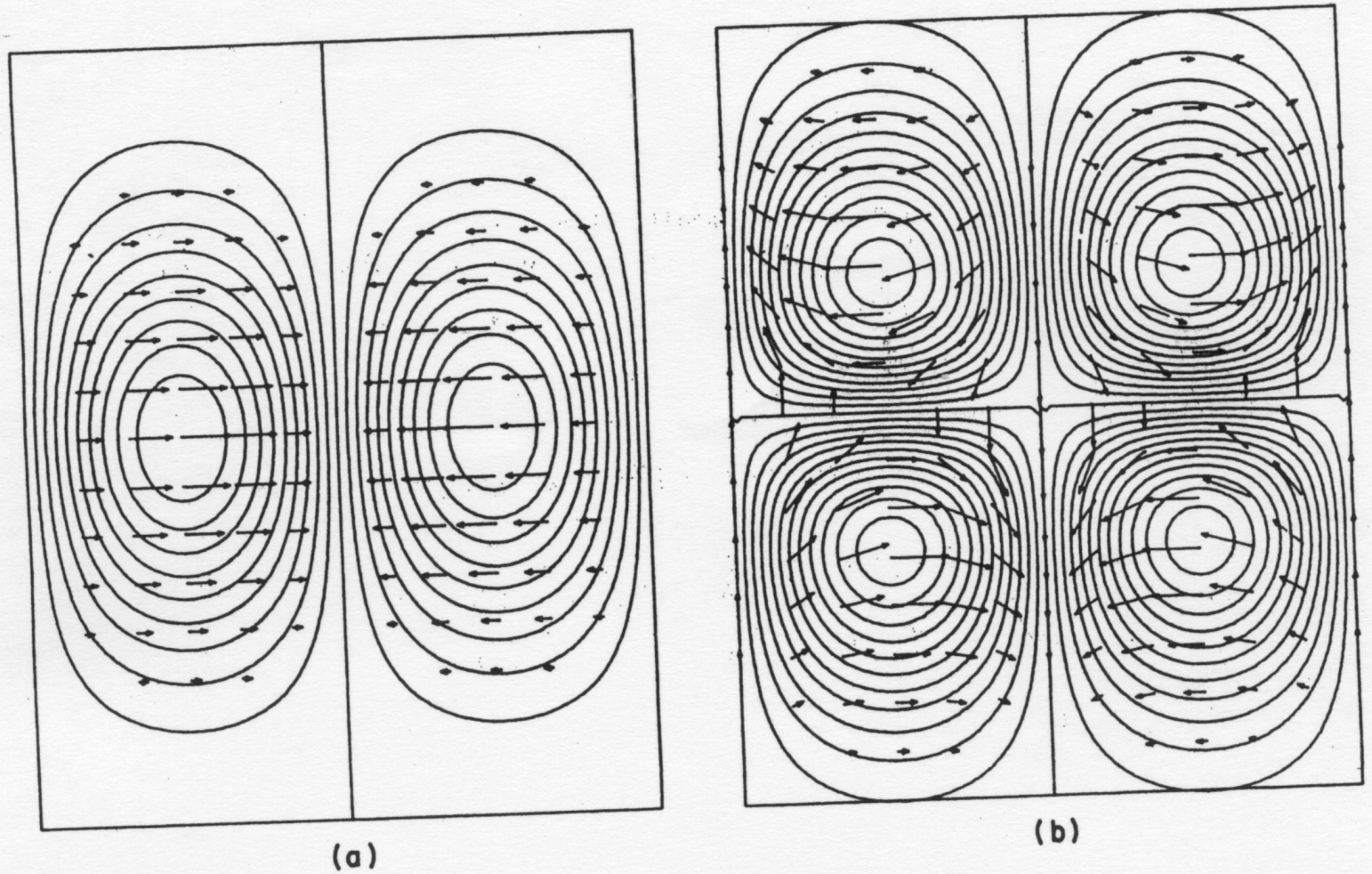
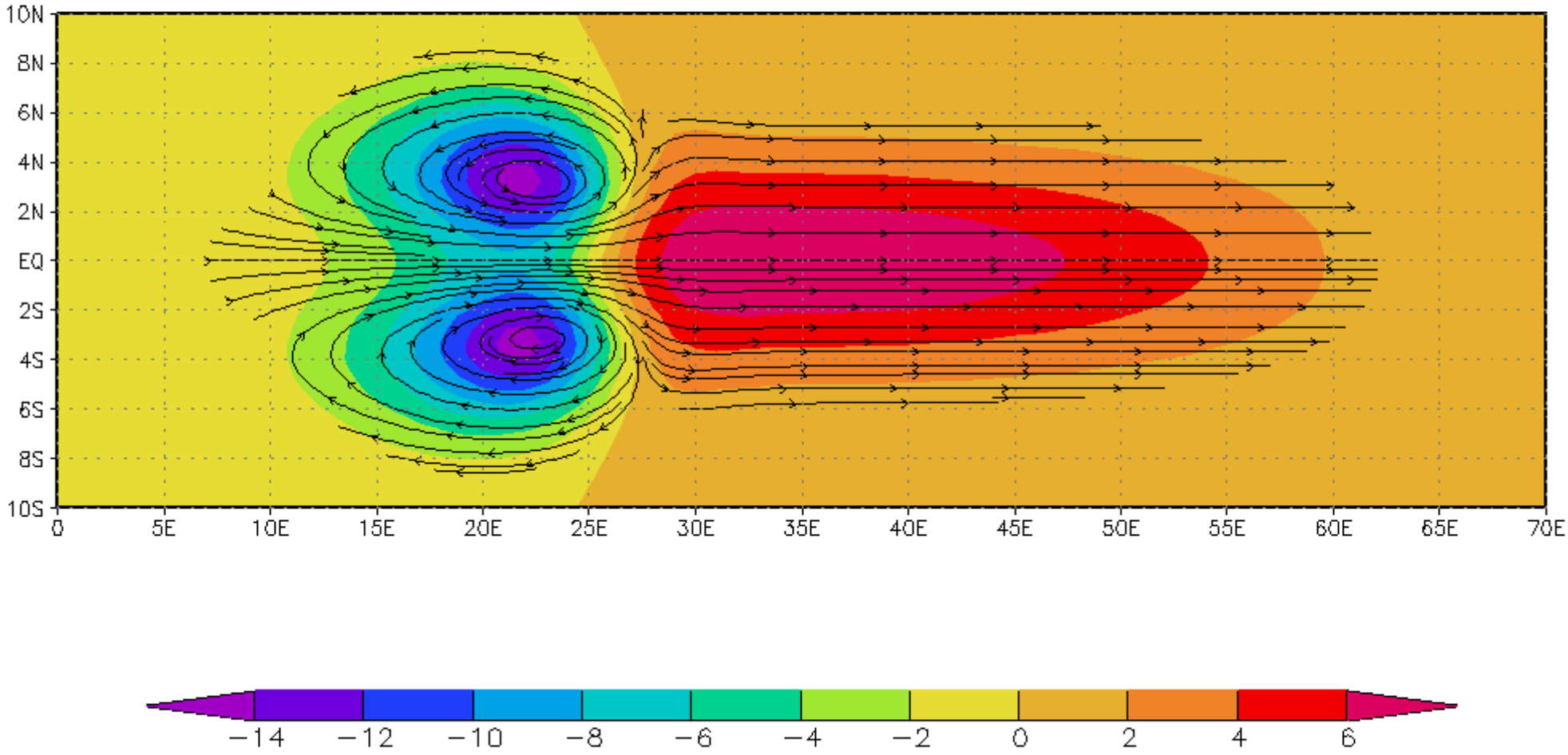
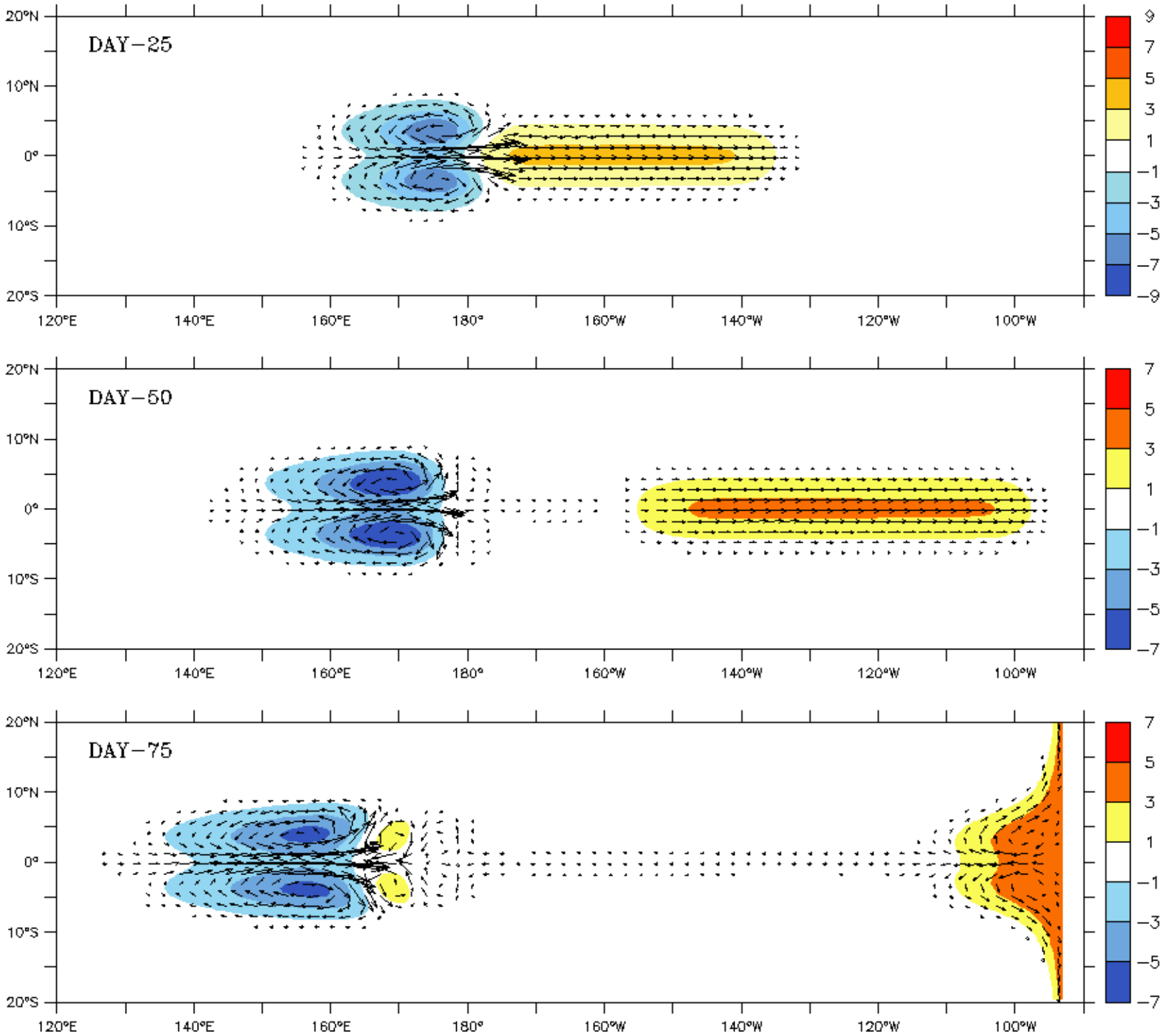
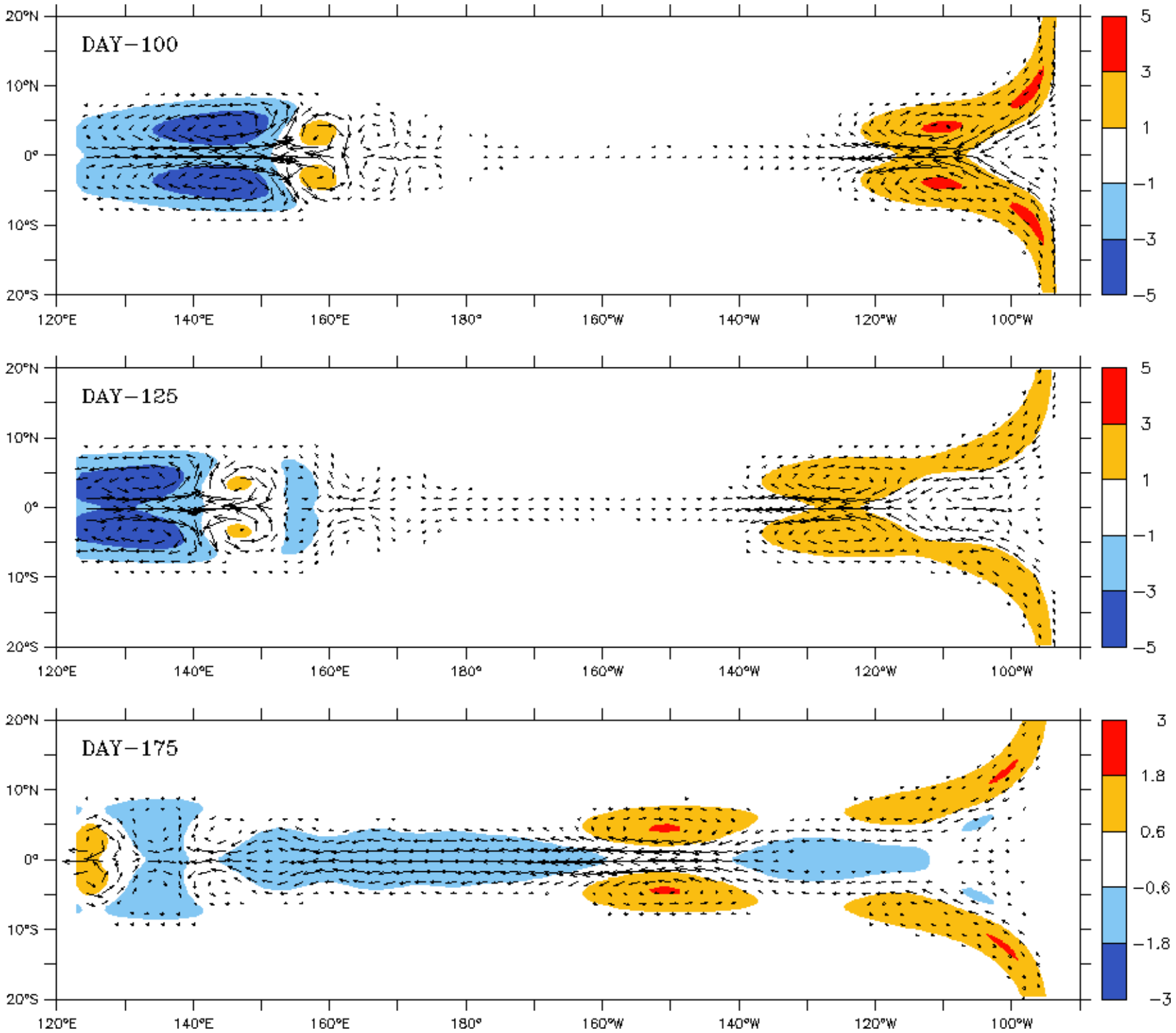
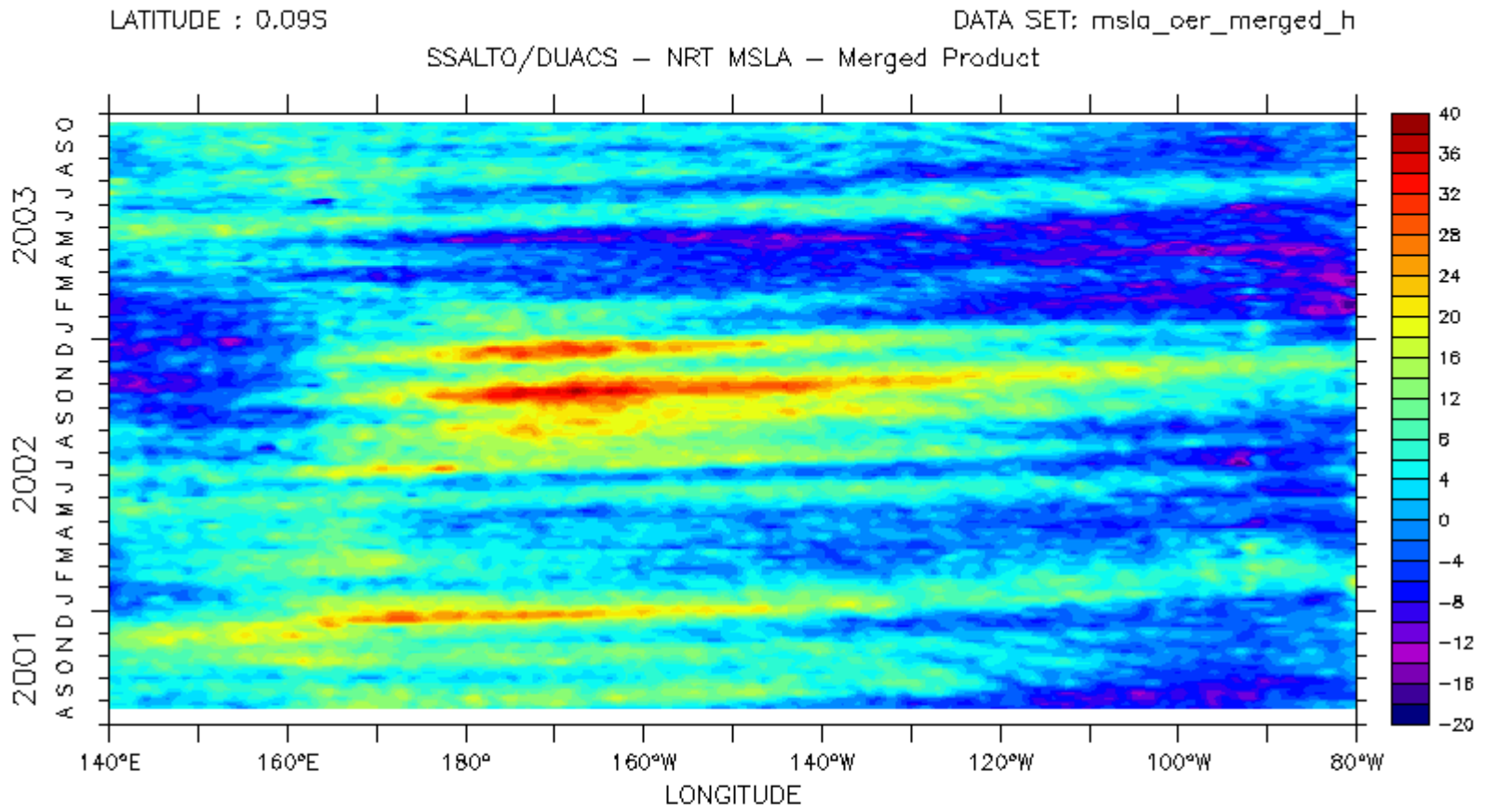


Fig. 11.2. Contours of surface elevation and arrows representing currents for (a) a Kelvin wave and (b) an eastward-propagating mixed planetary–gravity wave. Both waves have eastward phase velocity and eastward group velocity. Fluid particles move parallel to the equator in the case of the Kelvin wave and move anticyclonically around elliptical orbits in the case of the mixed wave. The figures show a range of latitudes corresponding to ± 4 equatorial Rossby radii.

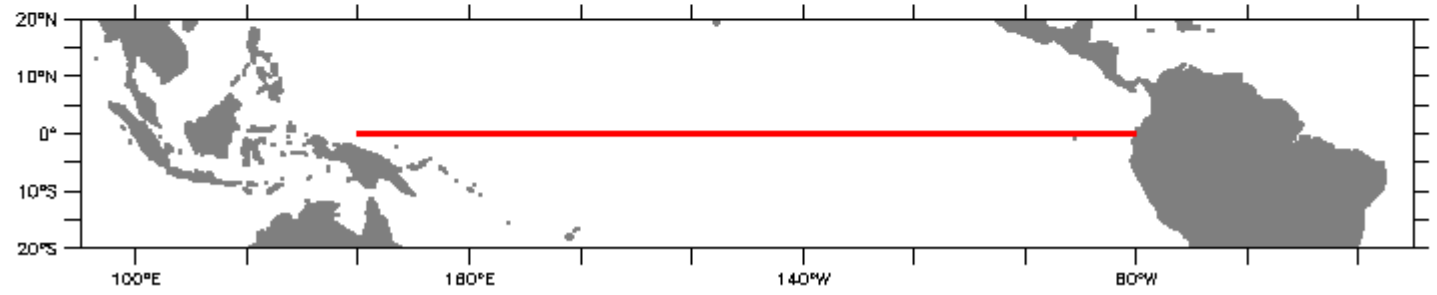

10N
8N
6N
4N
2N
EQ
2S
4S
6S
8S
10S
0
5E
10E
15E
20E
25E
30E
35E
40E
45E
50E
55E
60E
65E
70E
−14
−12
−10
−8
−6
−4
−2
0
2
4
6

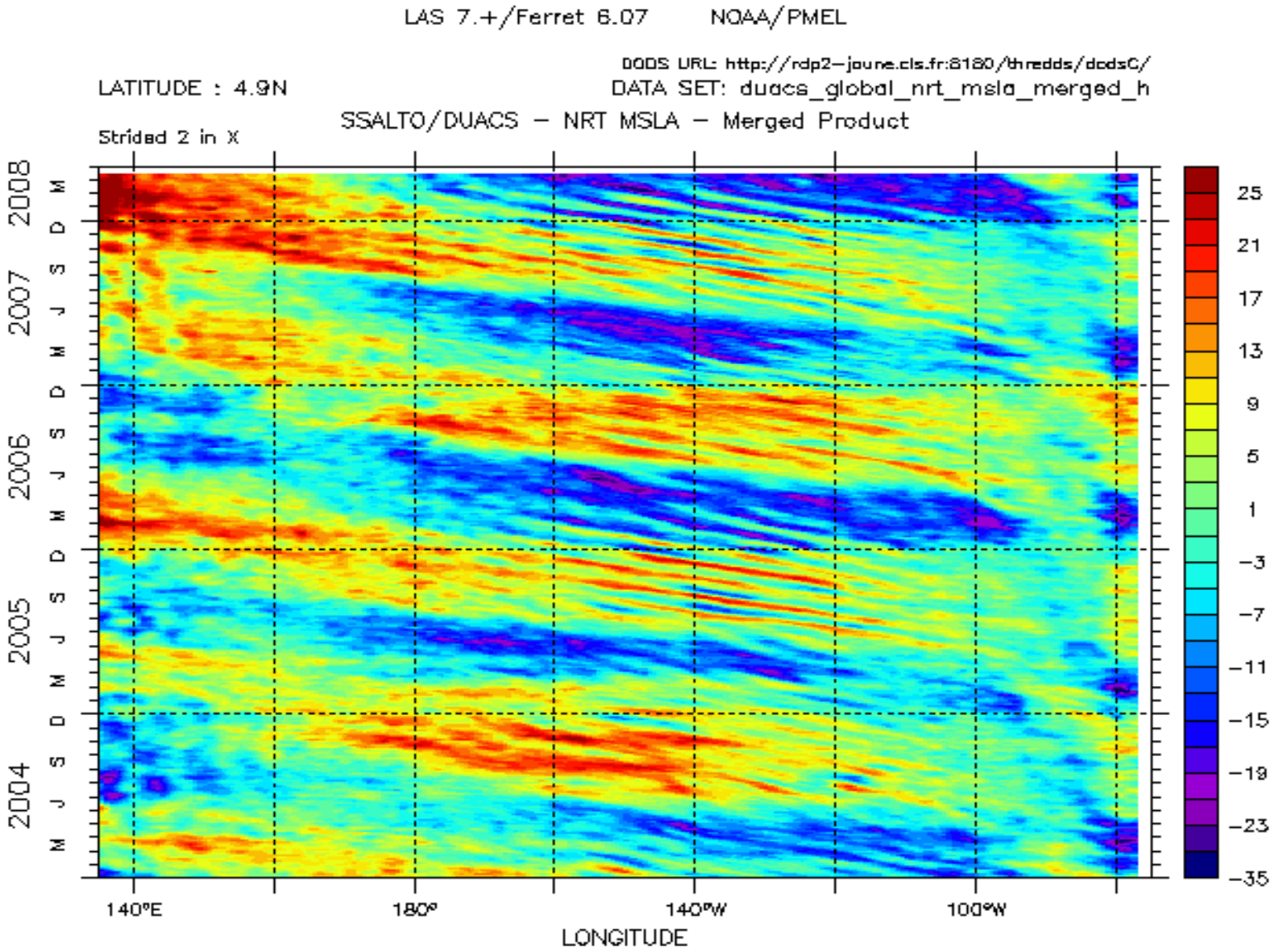



DAY−100
20°N
10°N
0°
10°S
20°S
120°E
140°E
160°E
180°
160°W
140°W
120°W
100°W
5
3
1
−1
−3
−5
DAY−125
20°N
10°N
0°
10°S
20°S
120°E
140°E
160°E
180°
160°W
140°W
120°W
100°W
5
3
1
−1
−3
−5
DAY−175
20°N
10°N
0°
10°S
20°S
120°E
140°E
160°E
180°
160°W
140°W
120°W
100°W
3
1.8
0.6
−0.6
−1.8
−3


LATITUDE : 0.09S
DATA SET: msla_oer_merged_h
SSALTO/DUACS – NRT MSLA – Merged Product
2003
2002
2001
A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
140°E
160°E
180°
160°W
140°W
120°W
100°W
80°W
LONGITUDE
40
36
32
28
24
20
16
12
8
4
0
−4
−8
−12
−16
−20

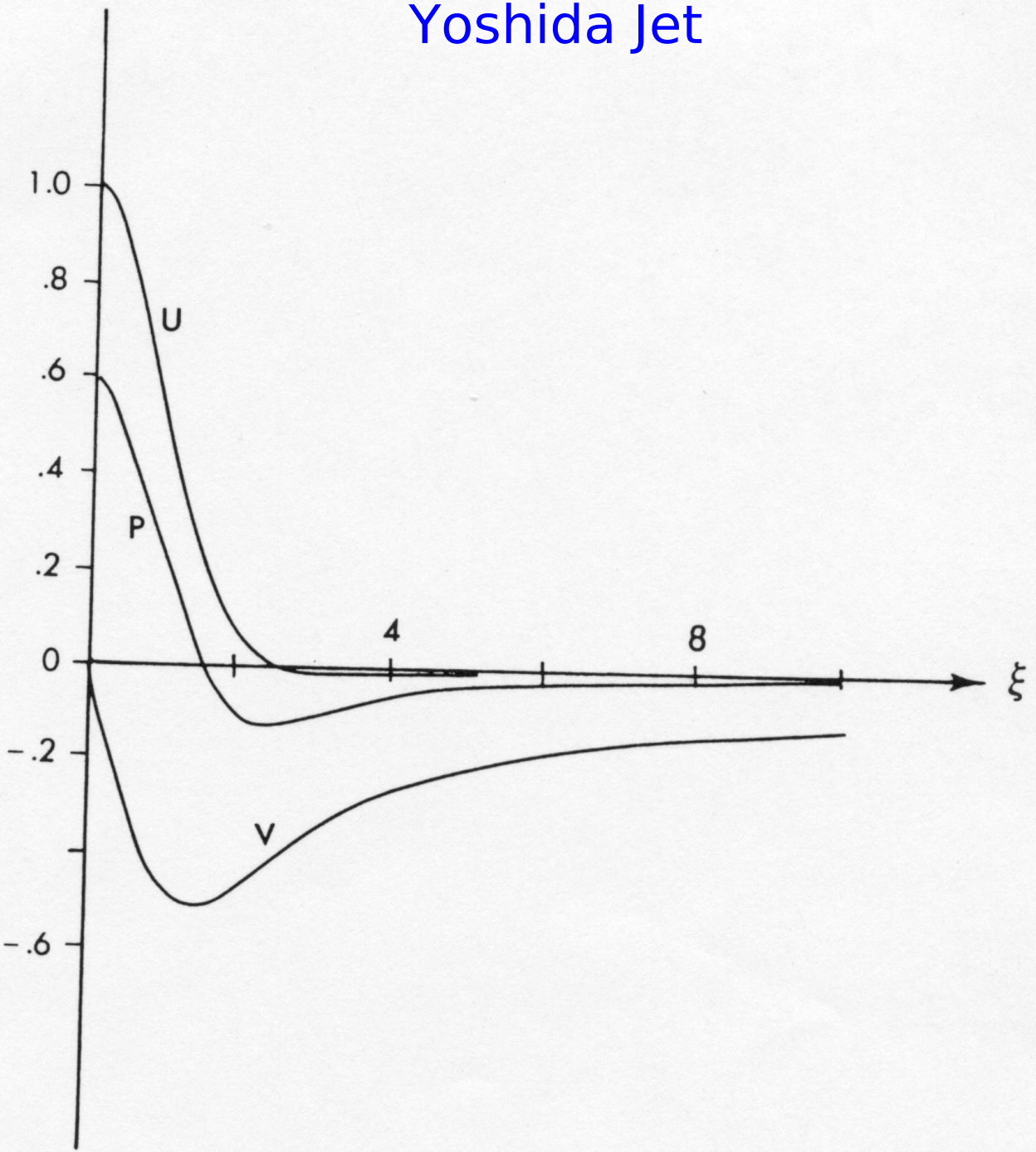
H (cm)


20°N
10°N
0°
10°S
20°S
100°E
180°E
140°W
80°W



Maps of Sea Level Anomalies Merged (cm)

Yoshida Jet



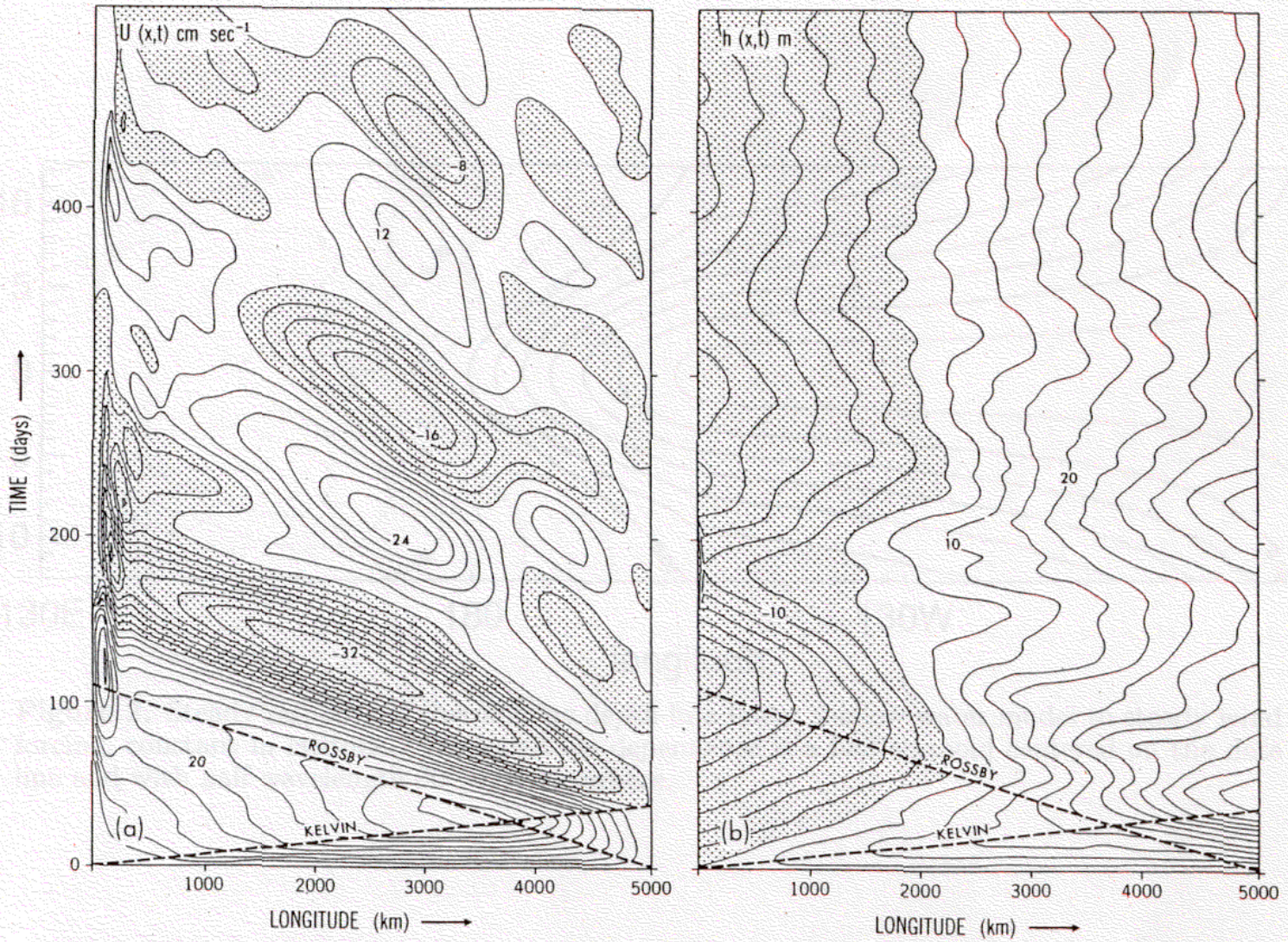


Figure 3.18. Changes in the zonal velocity component (centimeters per second) and in departures from the mean depth of the thermocline along the equator after the sudden onset of spatially uniform eastward winds. The dashed lines indicate the speeds at which Kelvin and the gravest Rossby mode propagate. The thermocline is elevated and motion is westward in shaded areas.

Philander

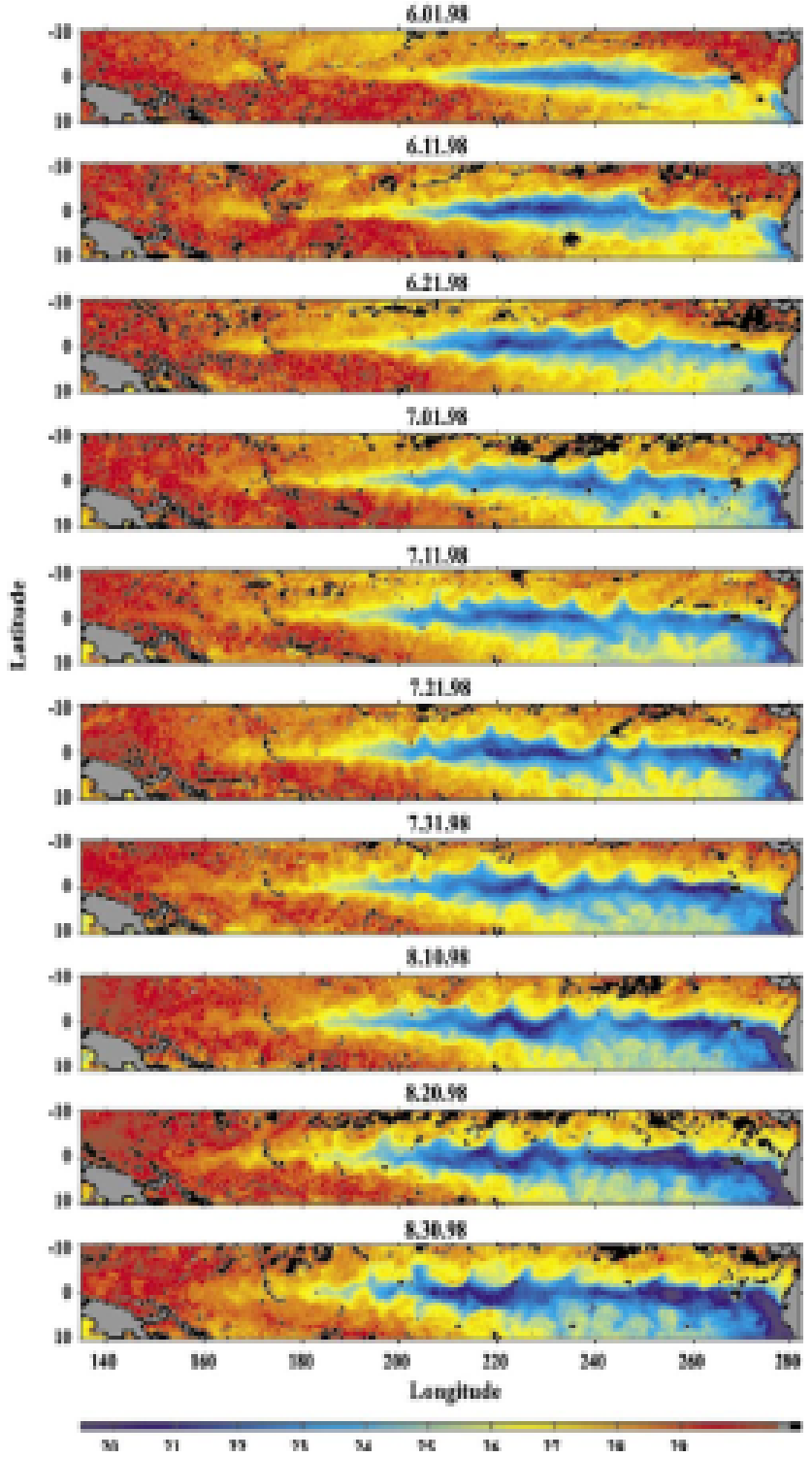


Fig. 2. Tropical instability waves (TIW) seen in imagery from the Tropical Rainfall Measuring Mission (TRMM) Microwave Imager (TMI). TMI imagery courtesy of Remote Sensing Systems (http://www.ssmi.com/).