Equatorial Circulation
suggested reading

Johnson, G.C., M.J. McPhaden, and E. Firing, 2001: Equatorial Pacific Ocean Horizontal Velocity, Divergence, and Upwelling. J. Phys. Oceanogr., 31, 839–849.

Johnson, G. C., B. M. Sloyan, W. S. Kessler, K. E. McTaggart, 2002: Direct measurements of upper ocean currents and water properties across the tropical Pacific during the 1990s. Progr. Oceanogr., 52, 31-61, DOI: 10.1016/S0079-6611(02)00021-6.

Chapter 8, section 'the equatorial current system' in Tomzcak and Godfrey, Regional Oceanography: An Introduction. 2nd edn (2003). Available on-line: http://www.es.flinders.edu.au/~mattom/regoc/pdfversion.html

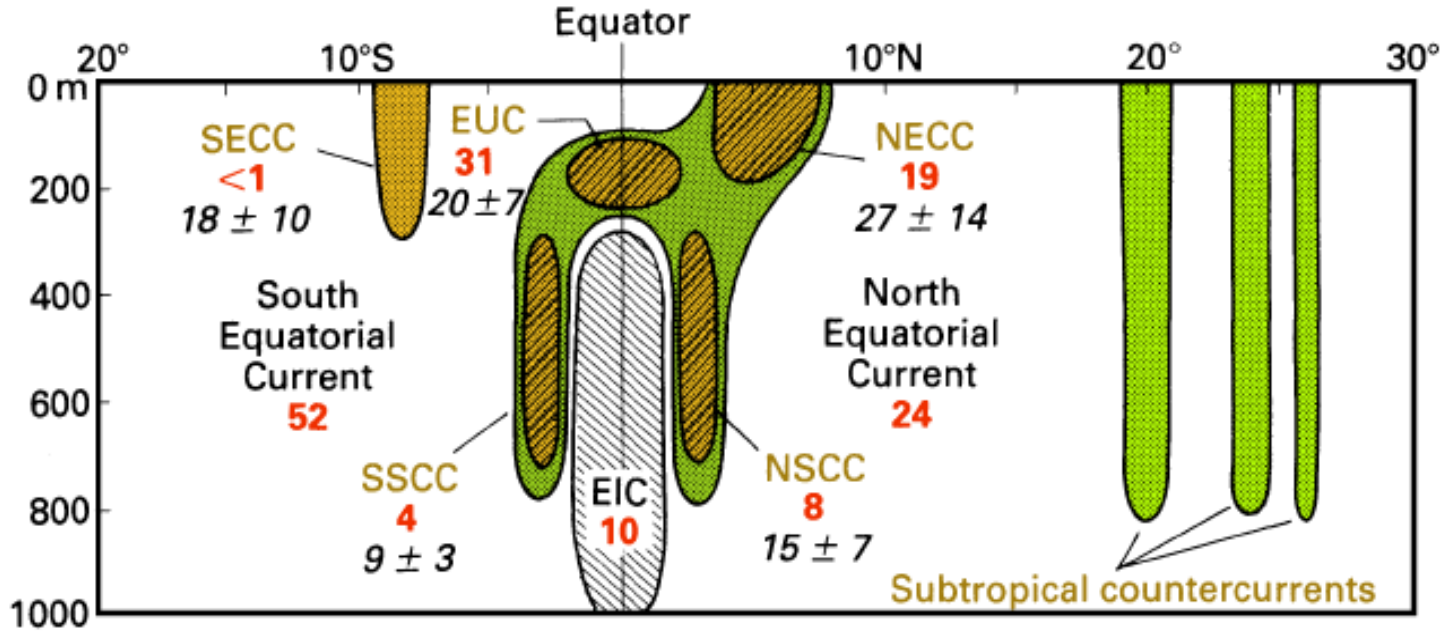
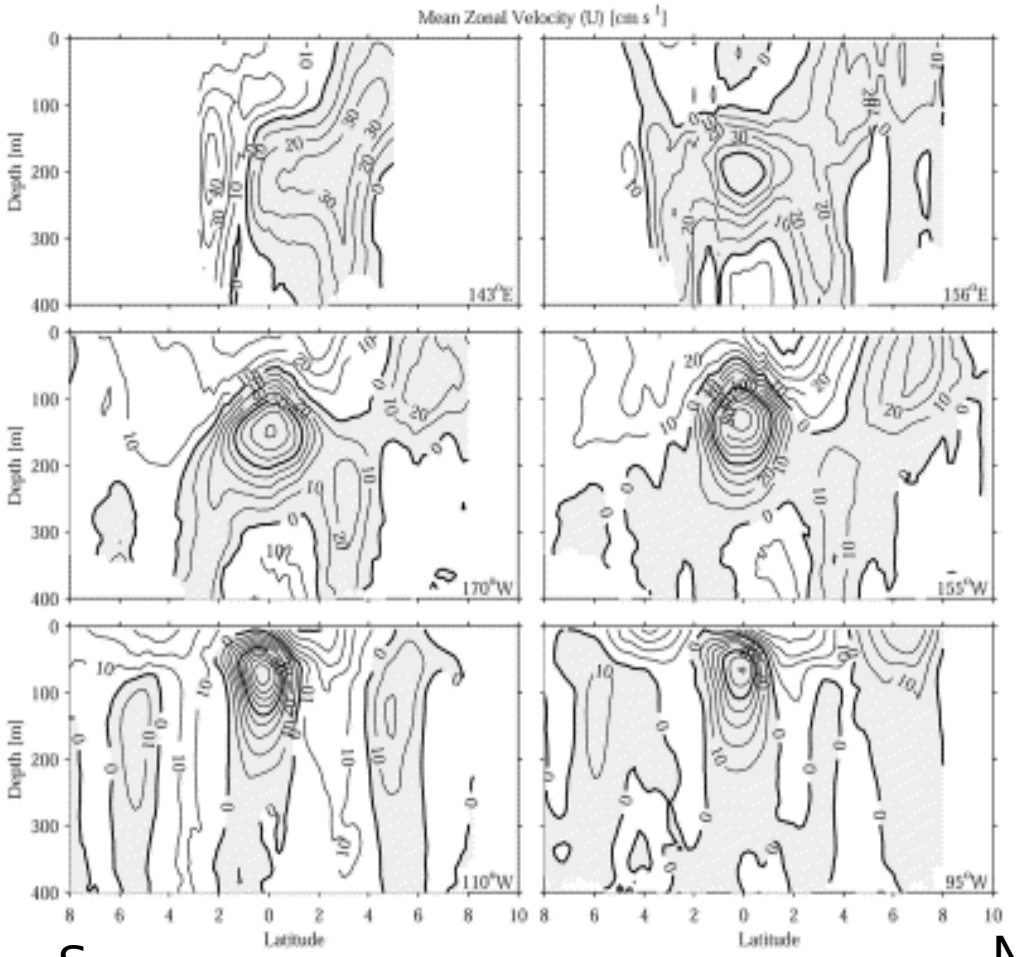
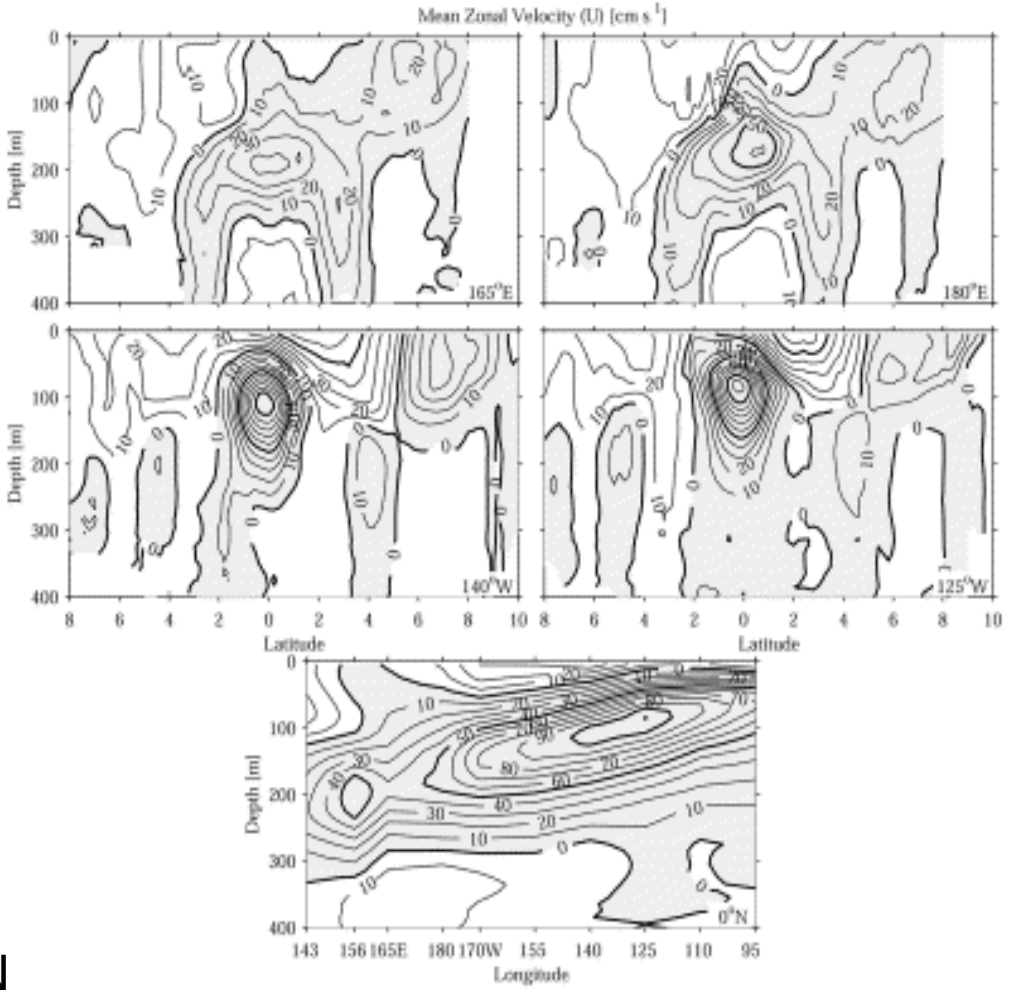


Fig. 8.7. A sketch of the structure of the equatorial current system in the central Pacific Ocean (170°W). Eastward flow is coloured. All westward flow north of 5°N constitutes the North Equatorial Current, westward flow south of 5°N outside the EIC represents the South Equatorial Current. EUC = Equatorial Undercurrent, EIC = Equatorial Intermediate Current, NECC and SECC = North and South Equatorial Countercurrents, NSCC and SSCC = North and South Subsurface Countercurrents. Transports in Sverdrups are given for 155°W (bold figures; based on observations from April 1979 - March 1980) and 165°E (italics, based on January 1984 - June 1986).

Tomczak and Godfrey. Reg. Oceanogr., 1994

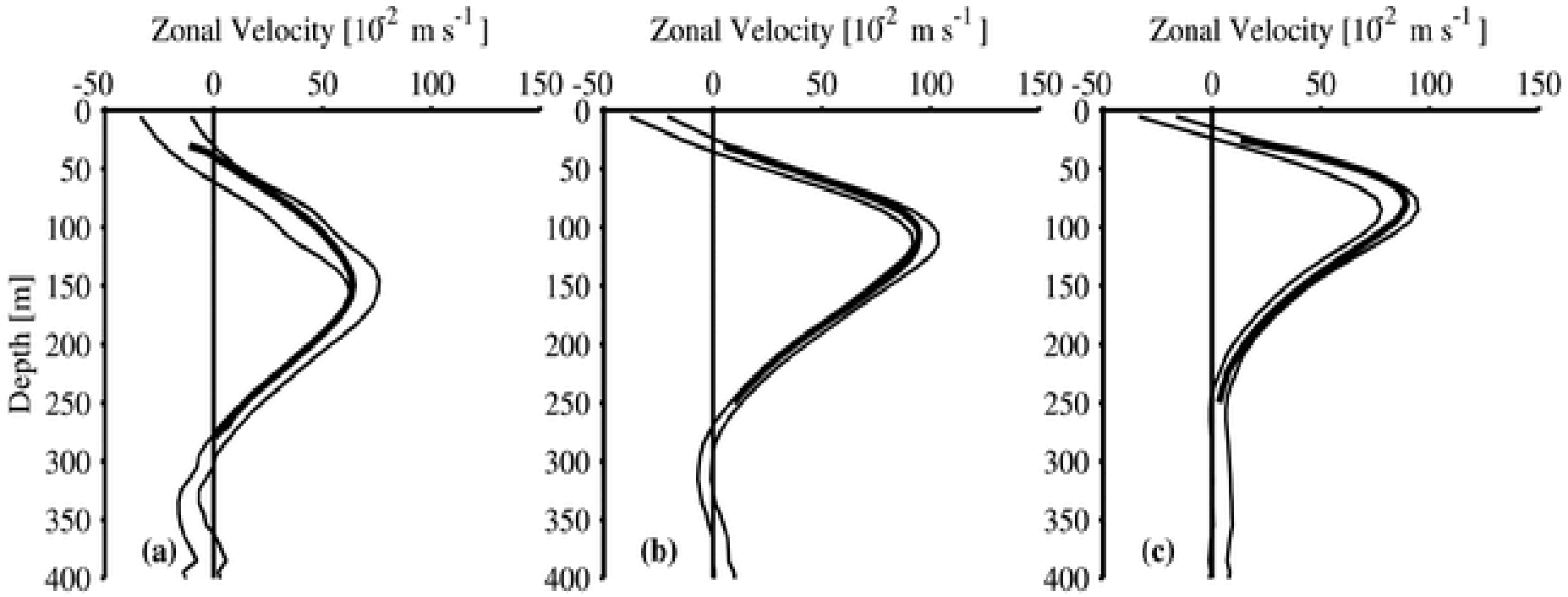


S



N

Johnson et al., Prog. Oceanogr., 2002



170W

140W

110W

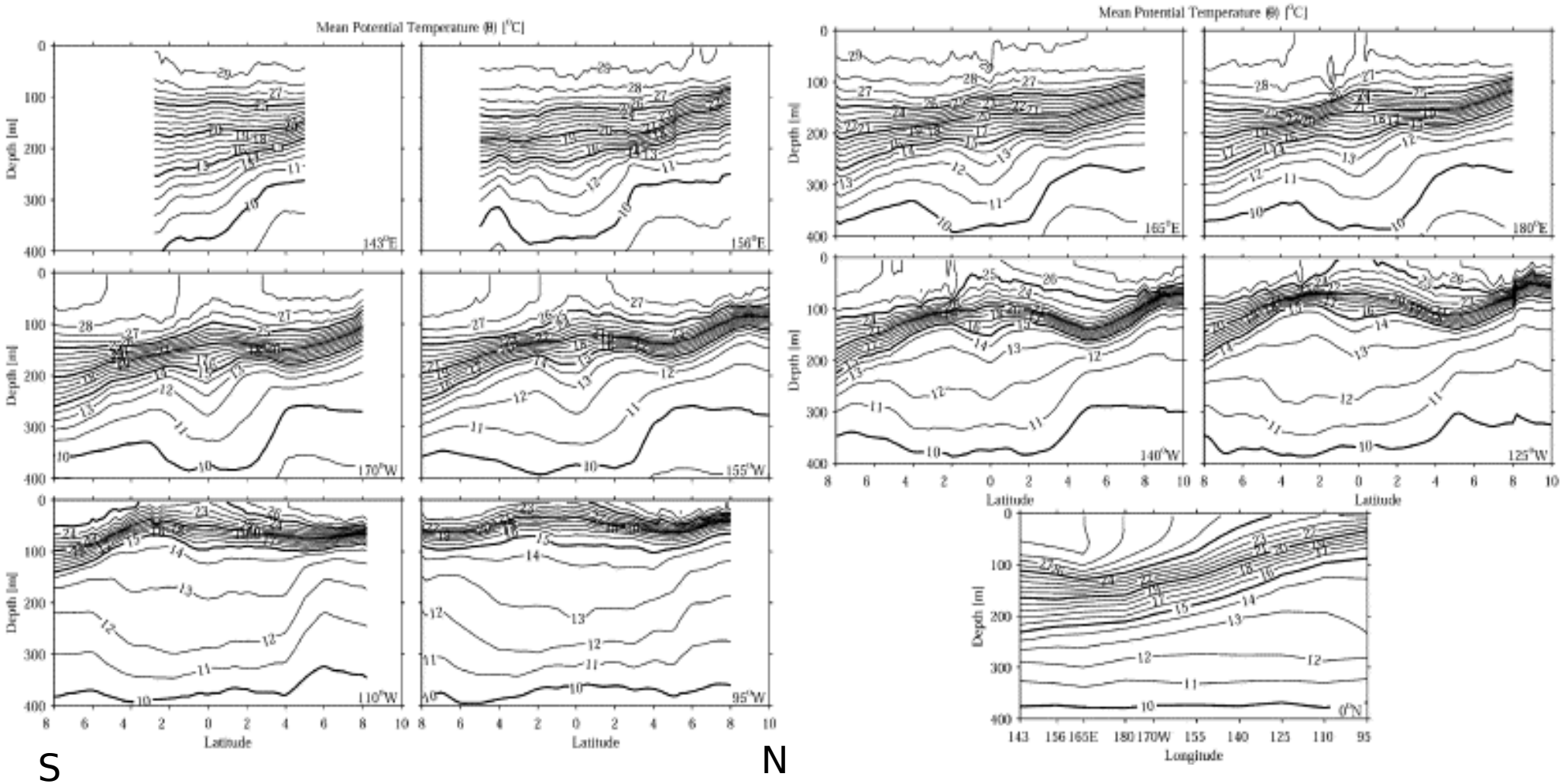
Johnson, McPhaden, Firing, JPO, 2001

Current acronym	Area (10^6 m^2)	Speed (m s^{-1})	Transport (10^6 m^3 s^{-1})	Temperature (°C)	Salinity (PSS-78)
NECC	93 ± 7	0.15 ± 0.03	14 ± 2	24.4 ± 0.3	34.46 ± 0.03
SEC*	53 ± 6	−0.26 ± 0.06	−14 ± 3	25.5 ± 0.4	34.72 ± 0.03
SEC**	176 ± 10	−0.11 ± 0.01	−19 ± 2	23.3 ± 0.4	35.33 ± 0.03
EUC	101 ± 11	0.27 ± 0.03	28 ± 3	18.2 ± 0.4	35.07 ± 0.01
NSCC	61 ± 10	0.07 ± 0.02	4 ± 1	11.5 ± 0.1	34.74 ± 0.01
SSCC	42 ± 10	0.03 ± 0.01	1 ± 1	11.9 ± 0.4	34.87 ± 0.03
EIC	70 ± 11	−0.05 ± 0.02	−3 ± 2	11.4 ± 0.2	34.79 ± 0.01

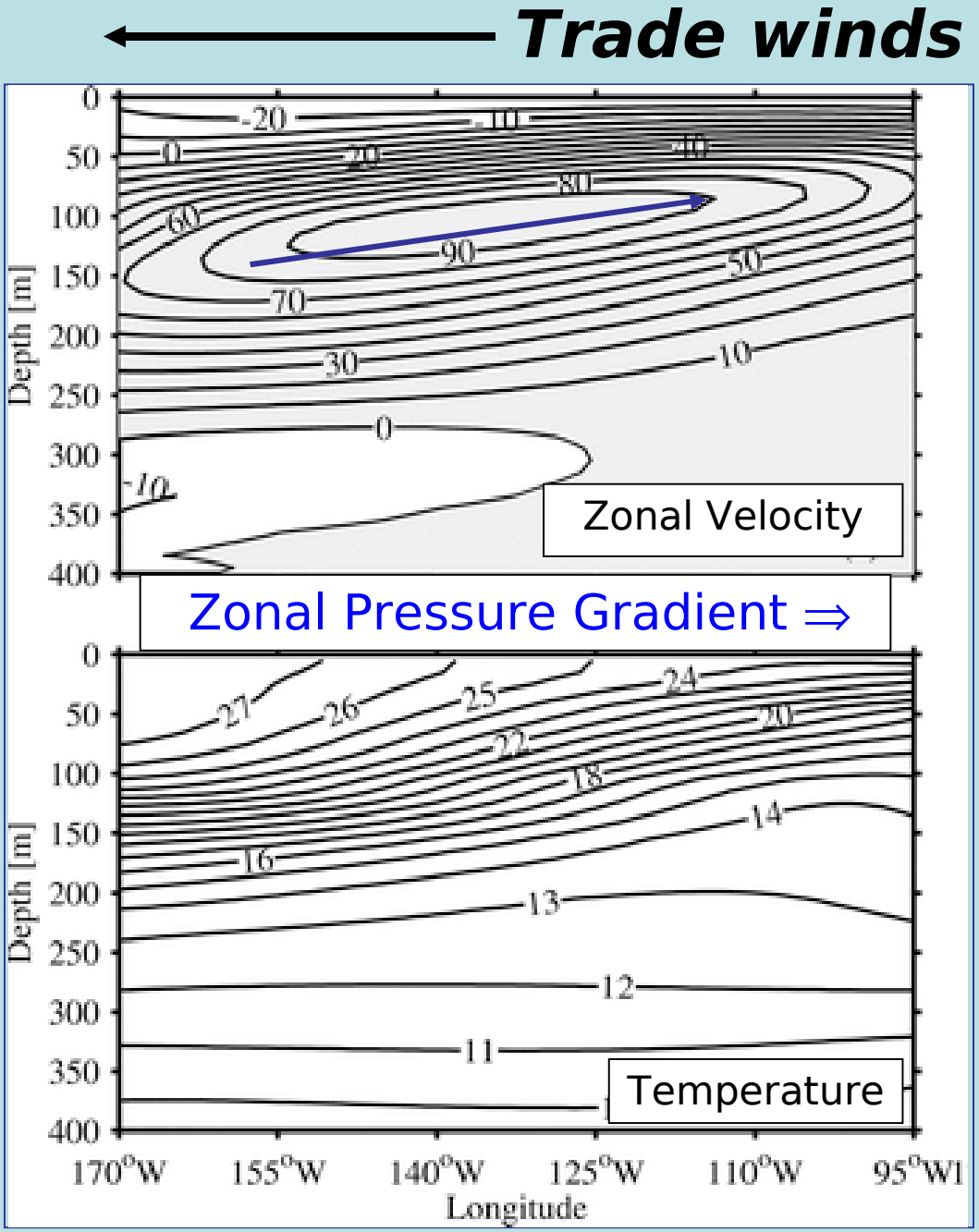
* 0°–5°N
** 8°S–0°

Mean zonal currents in the upper 400 m at 136°W. Estimates are based on third-order polynomial fits vs longitude of data from 85 meridional CTD/ADCP sections taken from 170° to 95°W during 1991–99 (see text). Temperatures and salinities are velocity weighted. Uncertainties are one standard error of the mean

Johnson, McPhaden, Firing, JPO,



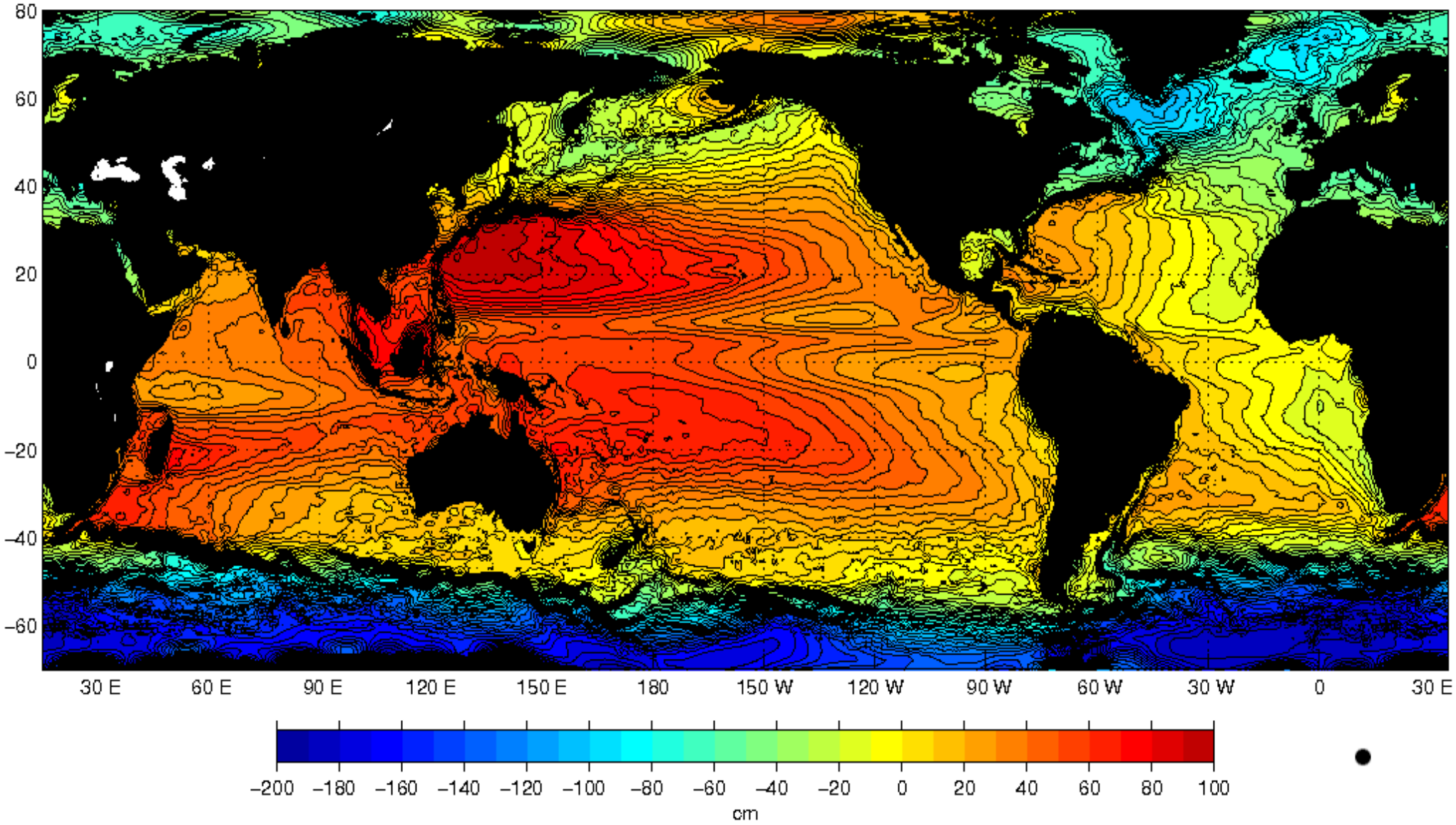
Johnson et al., Prog. Oceanogr., 2002



Equatorial Undercurrent

Johnson, McPhaden & Firing, 2001

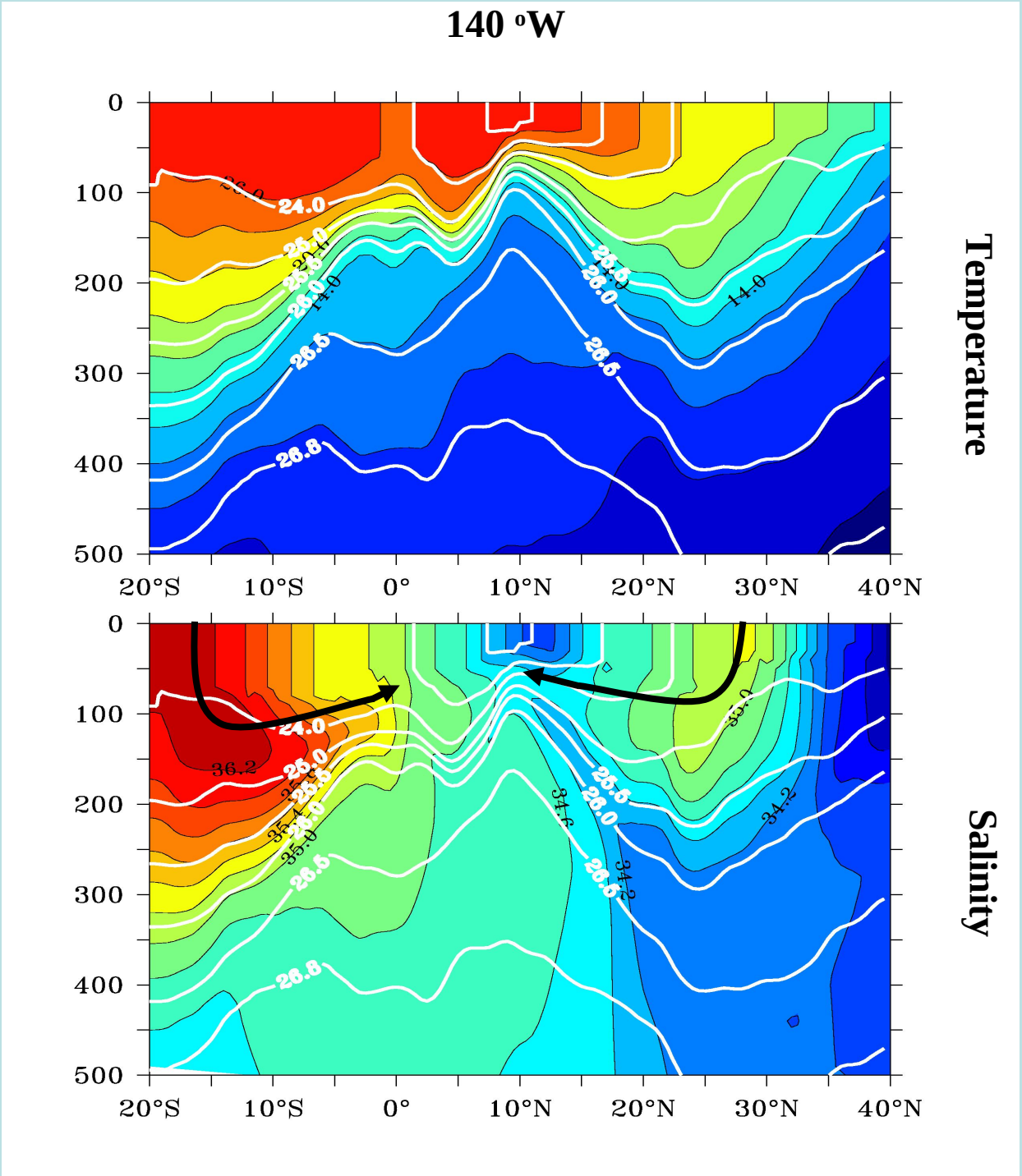
contour interval 5 cm

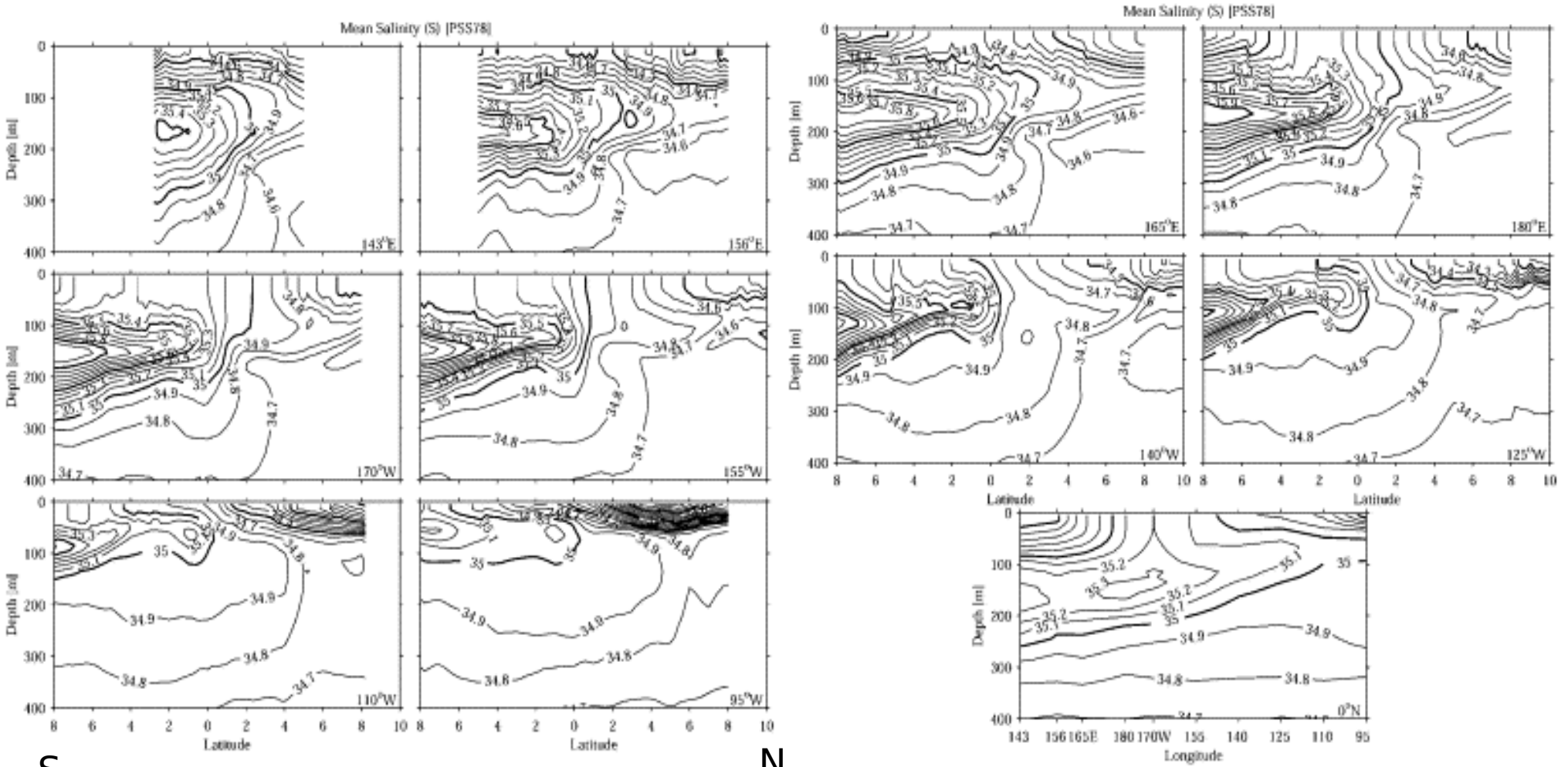


courtesy N. Maximenko

Niiler, Maximenko and McWilliams, 2003

T, S, ρ
140W


140 °W
Temperature
Salinity
0
100
200
300
400
500
20°S
10°S
0°
10°N
20°N
30°N
40°N
24.0
26.0
26.5
26.8
14.0
36.2
35.0
34.6
34.2

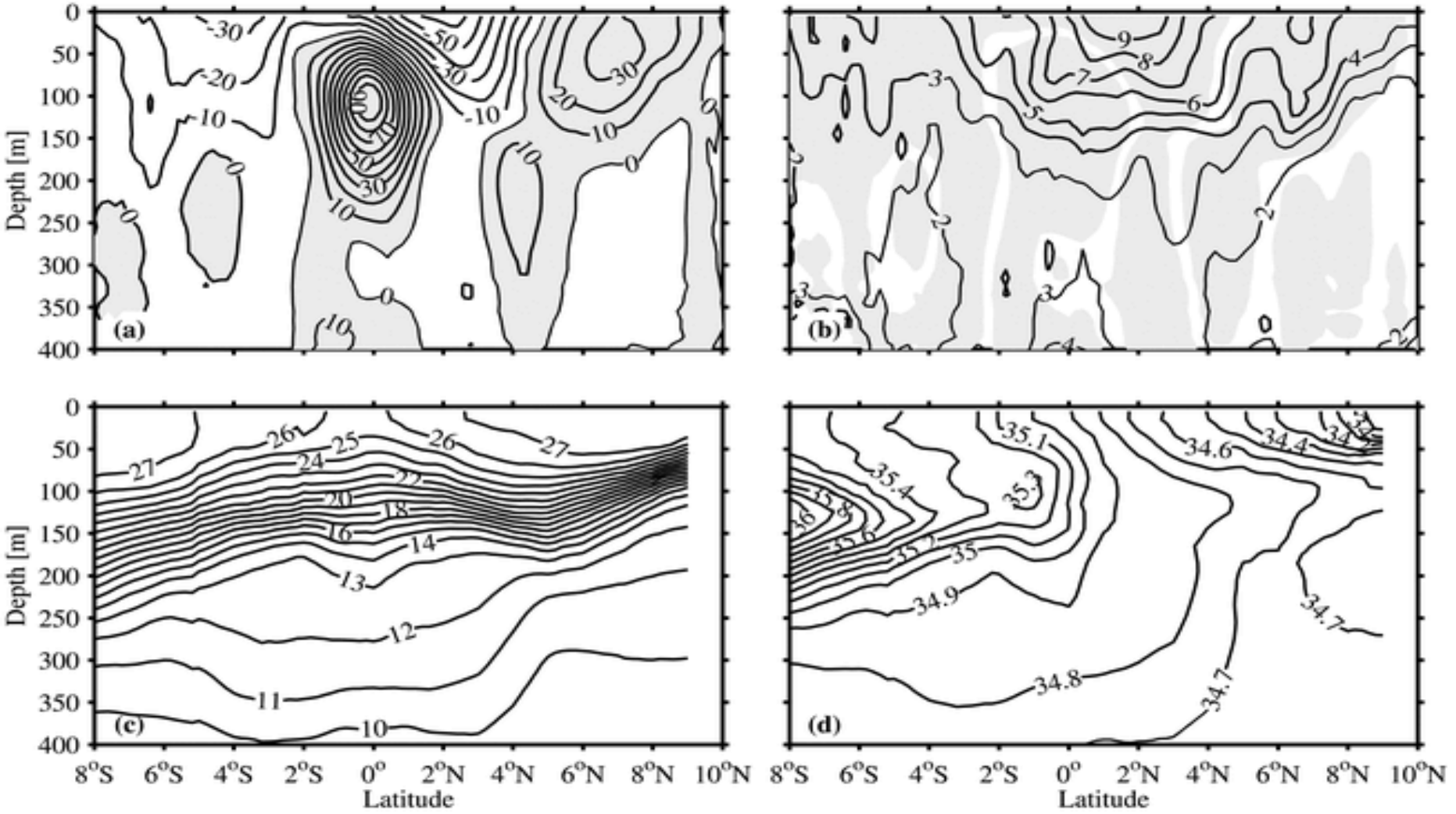


Johnson et al., Prog. Oceanogr., 2002

136W

U / cm/s

Stand. Err. Of U / cm/s



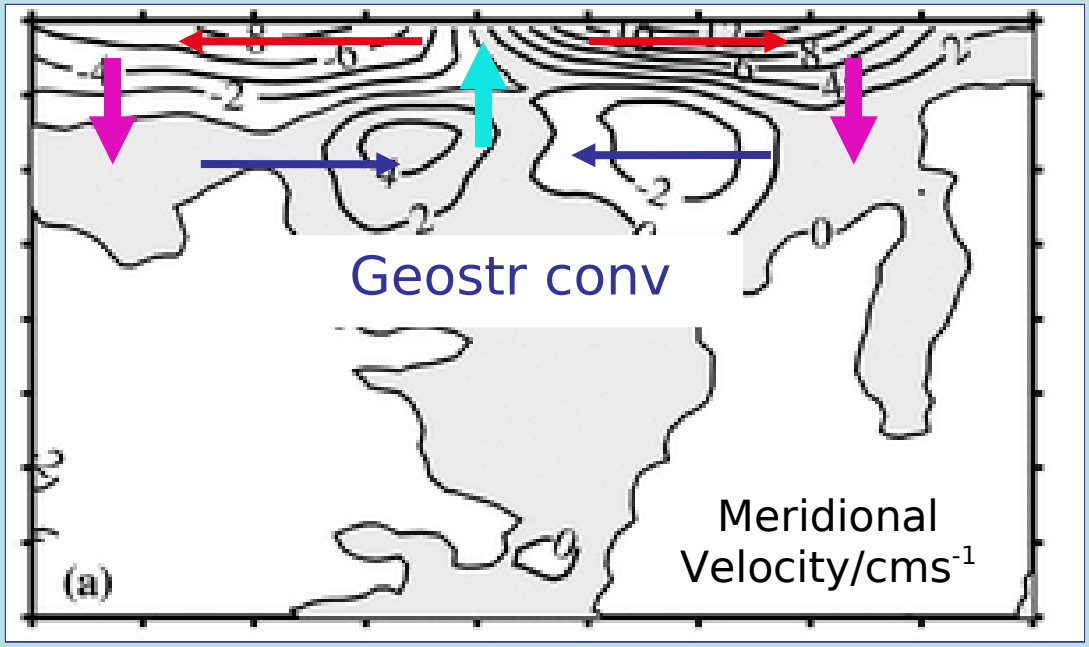
T/C

S/psu

Johnson, McPhaden, Firing, JPO, 2001

Vertical Velocity (w)

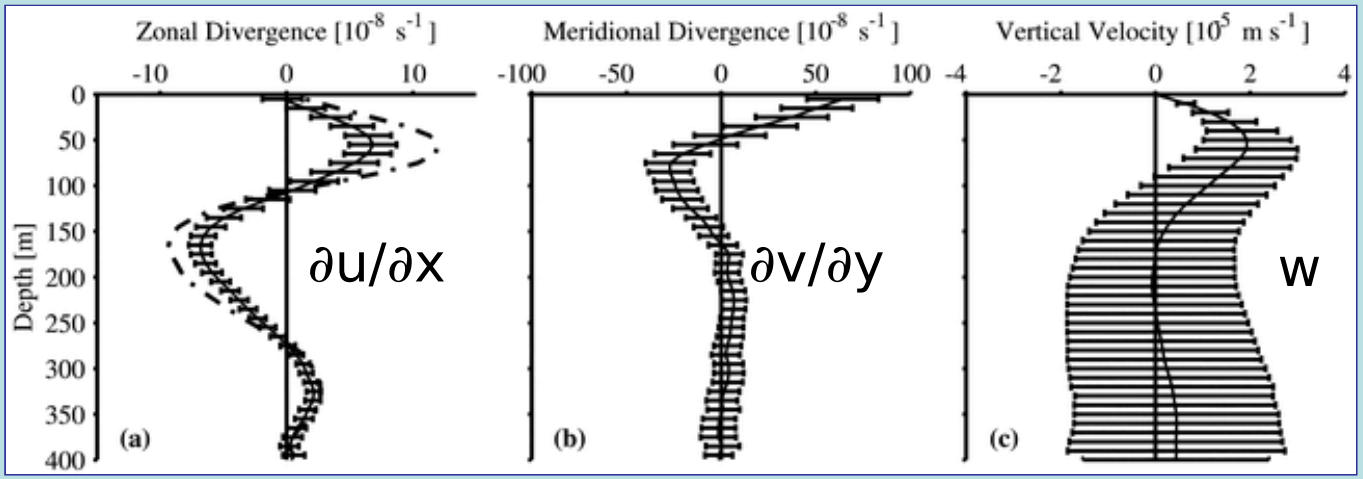
Ekman div

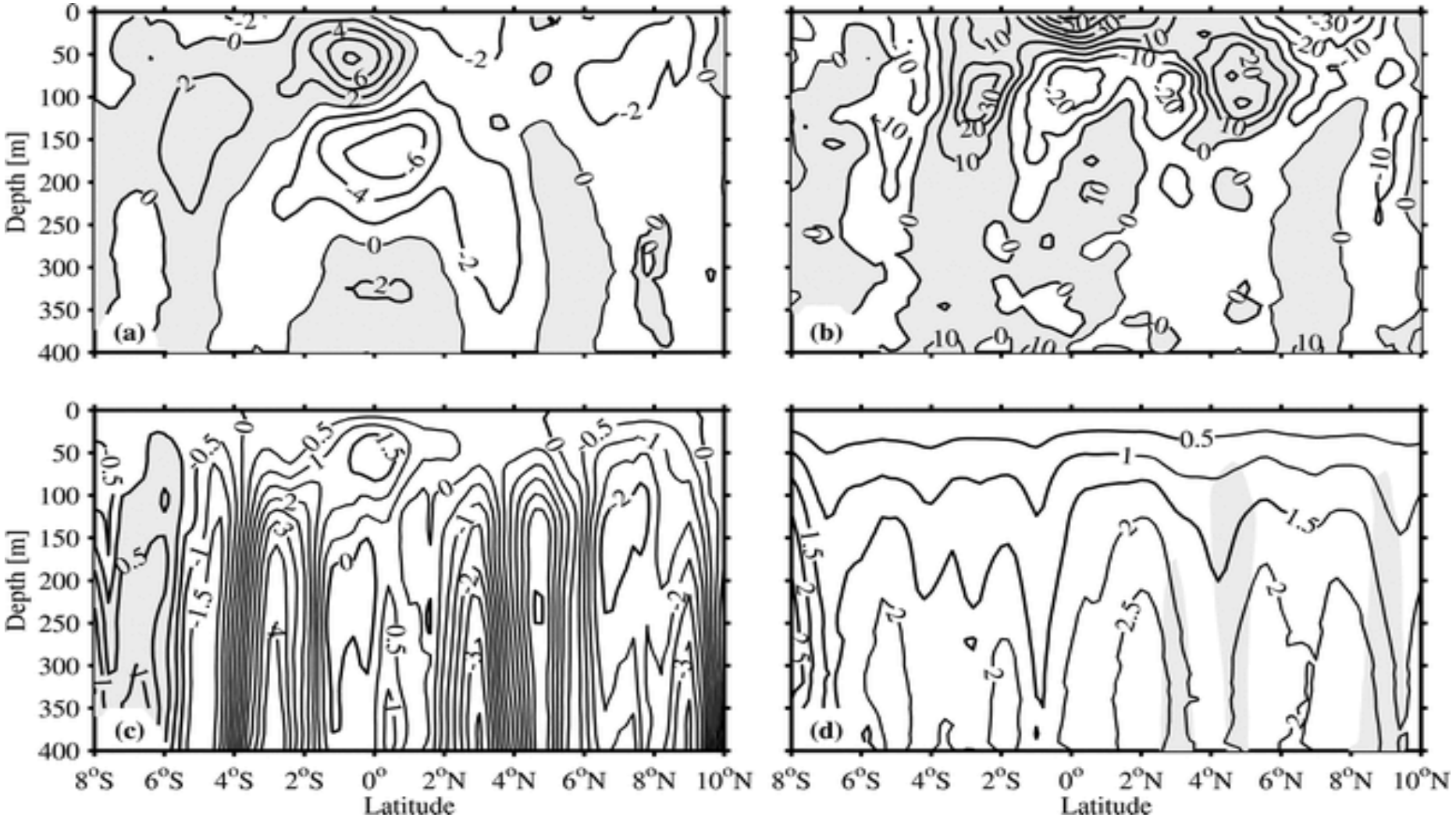


Continuity:

$w=-\int(\partial u/\partial x+\partial v/\partial y)dz$

0°, 136°W





Johnson, McPhaden, Firing, JPO, 2001

Geostrophic balance of the equatorial zonal flow

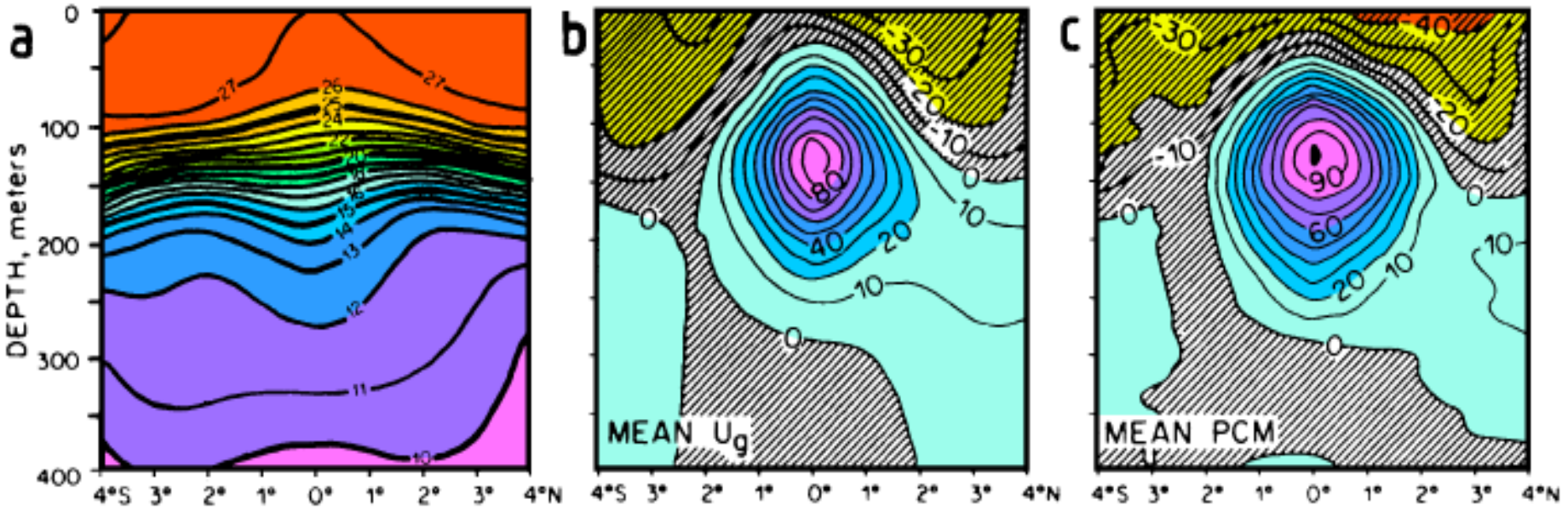


Fig. 8.8. The Equatorial Undercurrent during February 1979 - June 1980 near 155°W. (a) Mean temperature (°C), (b) mean geostrophic zonal velocity (10^{-2} m s^{-1})X, (c) mean observed zonal velocity (10^{-2} m s^{-1}). Note the spreading of the isotherms at the equator. From Lukas and Firing (1984).

Tomczak and Godfrey. Reg. Oceanogr., 1994

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

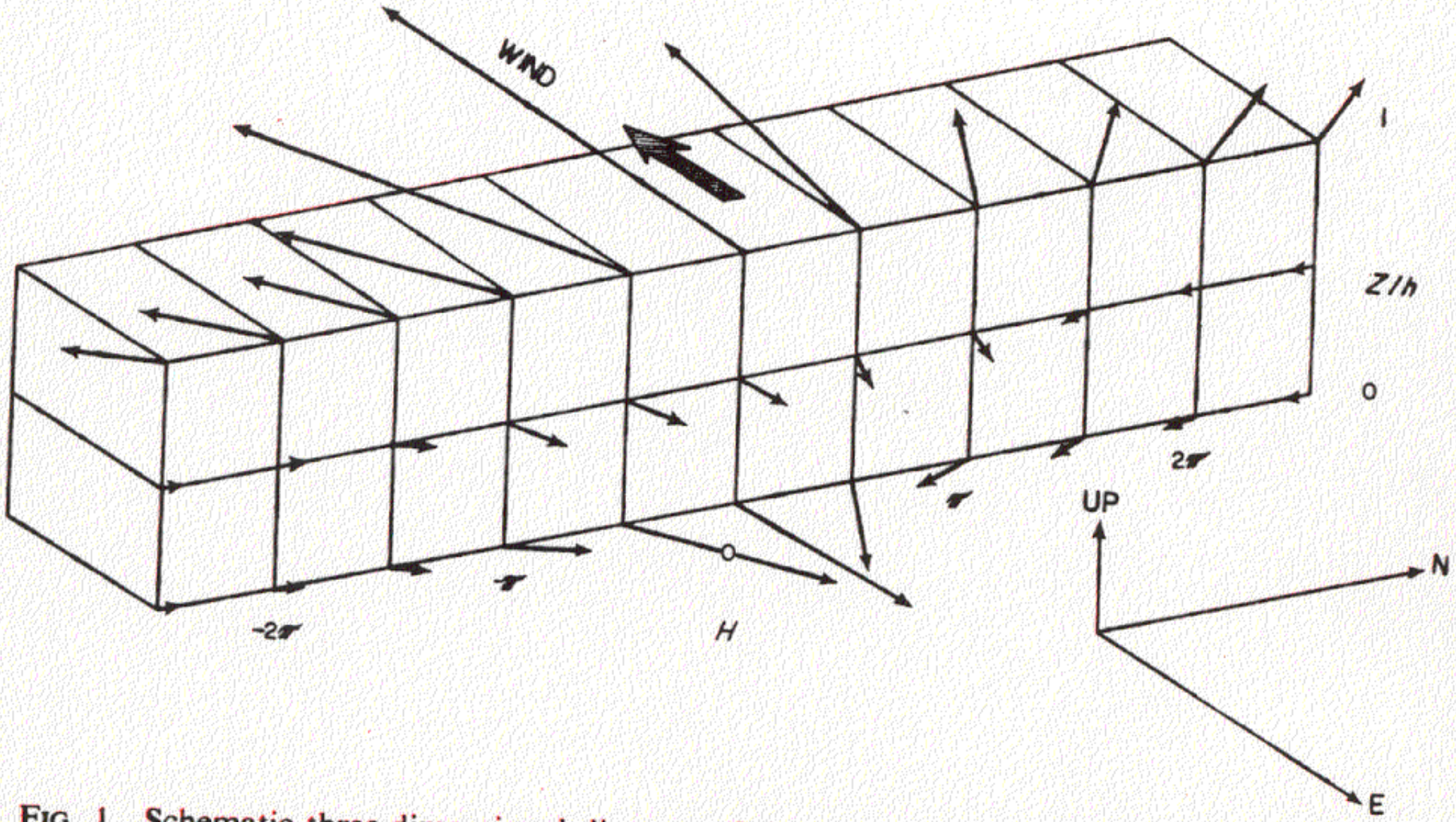
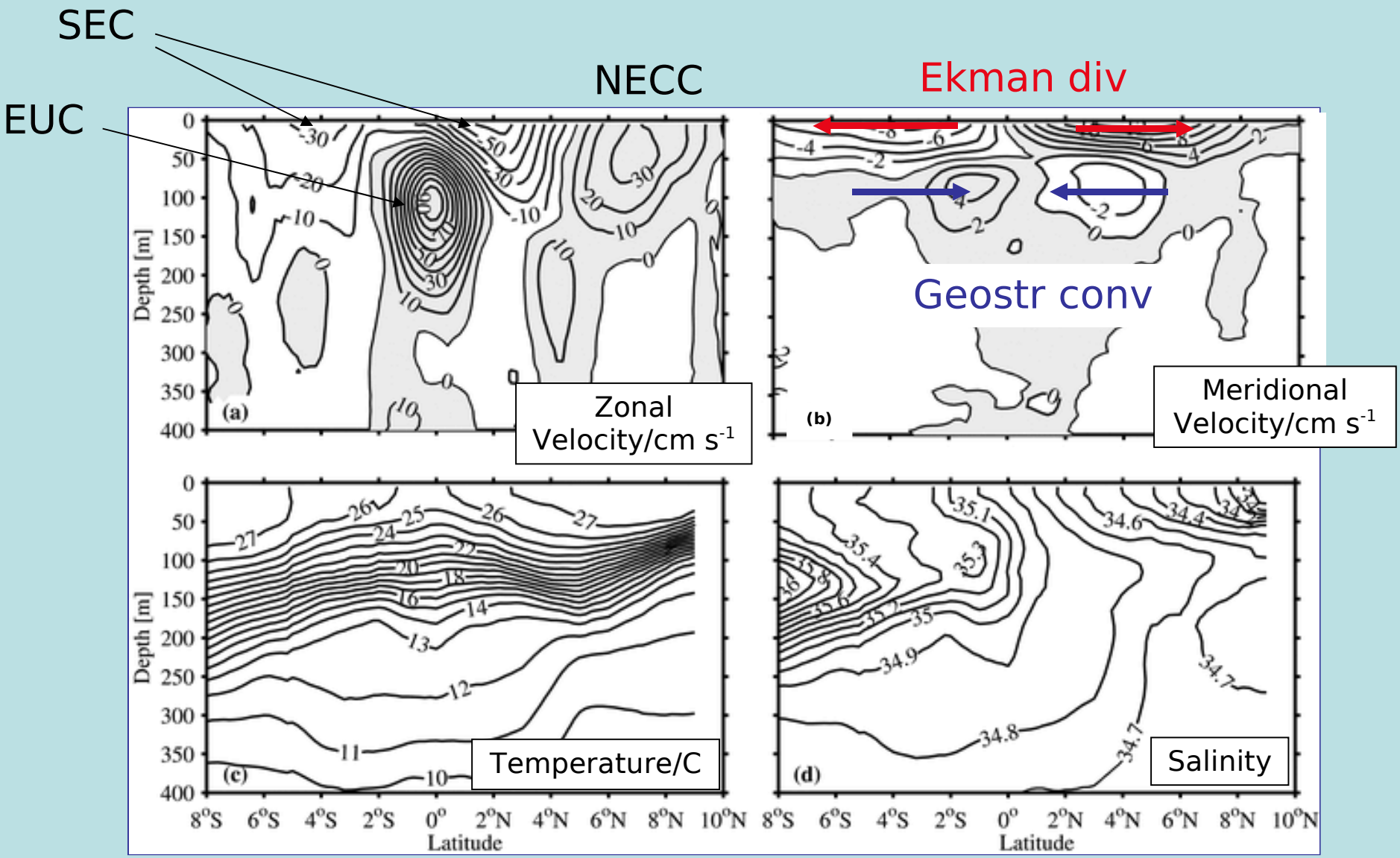


FIG. 1. Schematic three-dimensional diagram of the combined frictional and geostrophic flow field in the neighbourhood of the equator, not showing the vertical component of velocity (which can in principle be determined from continuity).

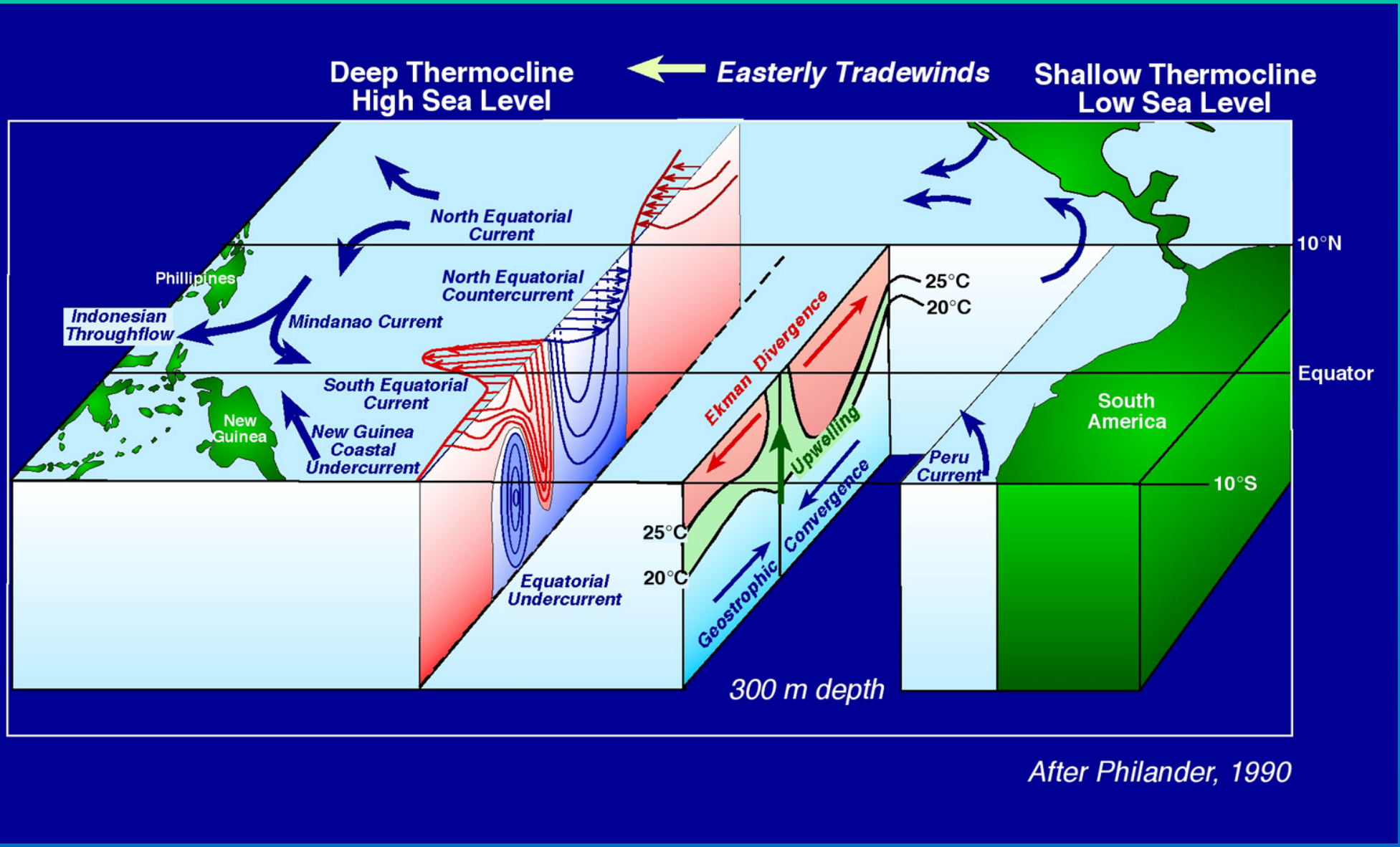
Stommel, 1959, DSR., 6, 298-302

Meridional Structure, 136°W



Johnson, McPhaden& Firing, 2001

Ocean Circulation Schematic



After Philander, 1990

Complex vertical structure of flow even at great depth

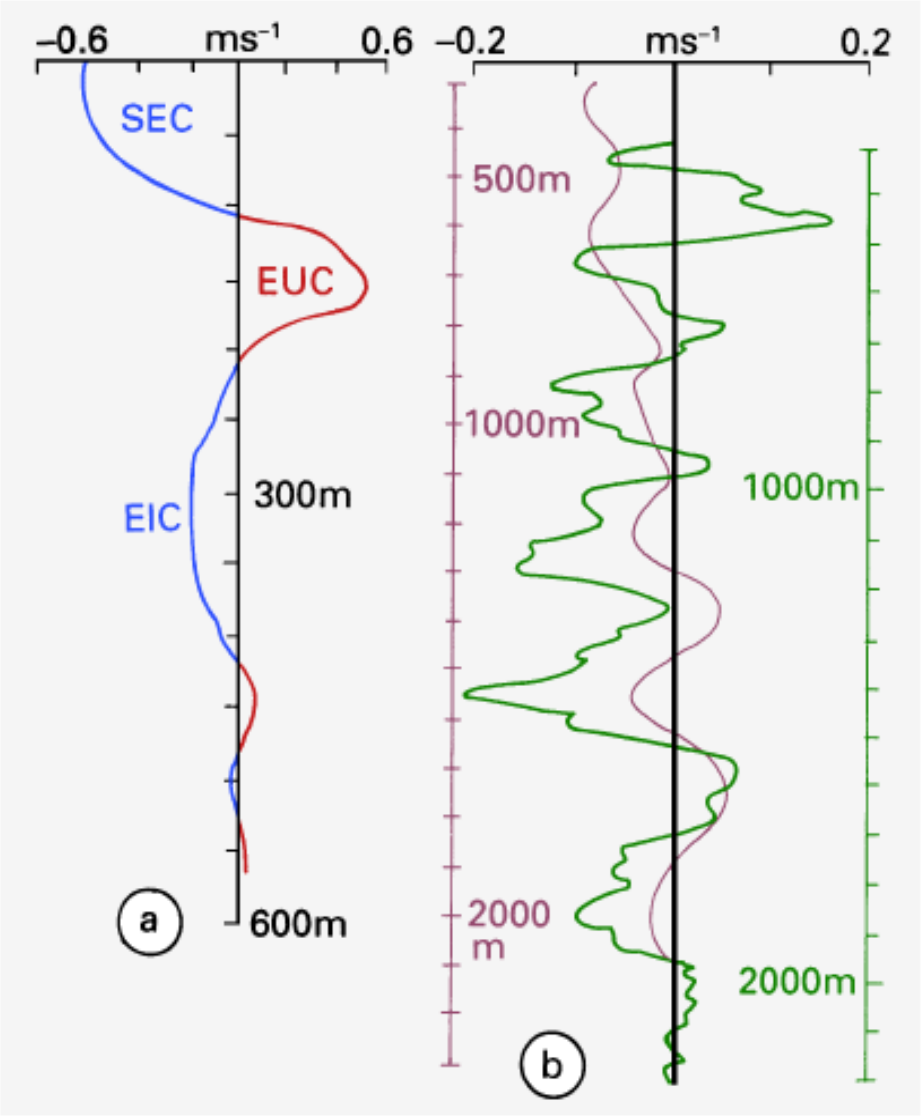


Fig. 8.15. Evidence for banded structure of currents at the equator.
(a) The South Equatorial Current (SEC), Equatorial Undercurrent (EUC), and Equatorial Intermediate Current (EIC) at 165°E;
(b) deep equatorial currents at 150 - 160°W during 1980 (solid line, right depth scale) and during March 1982 - 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