The Pacific Ocean Circulation

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General Physical Oceanography
MAR 555

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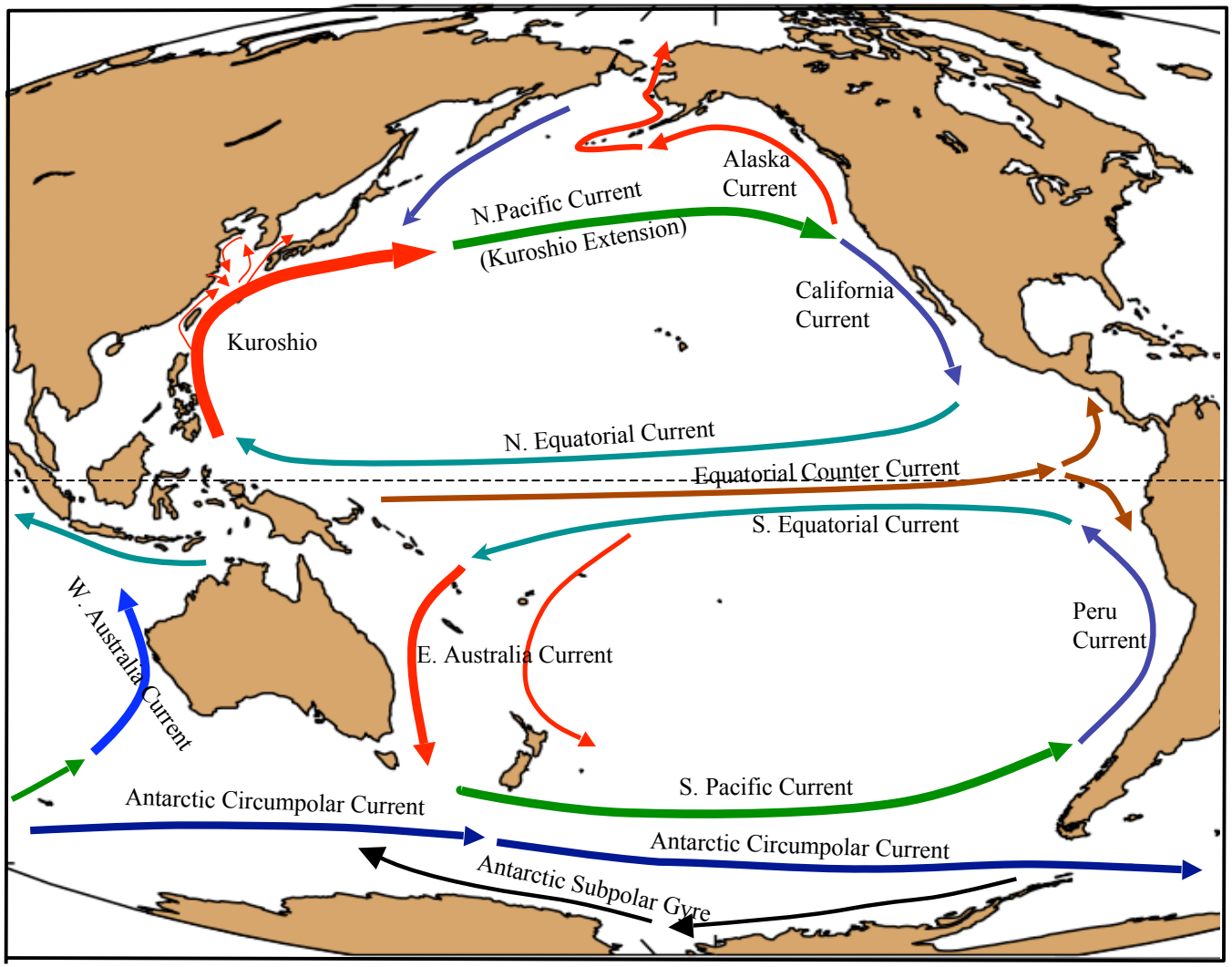
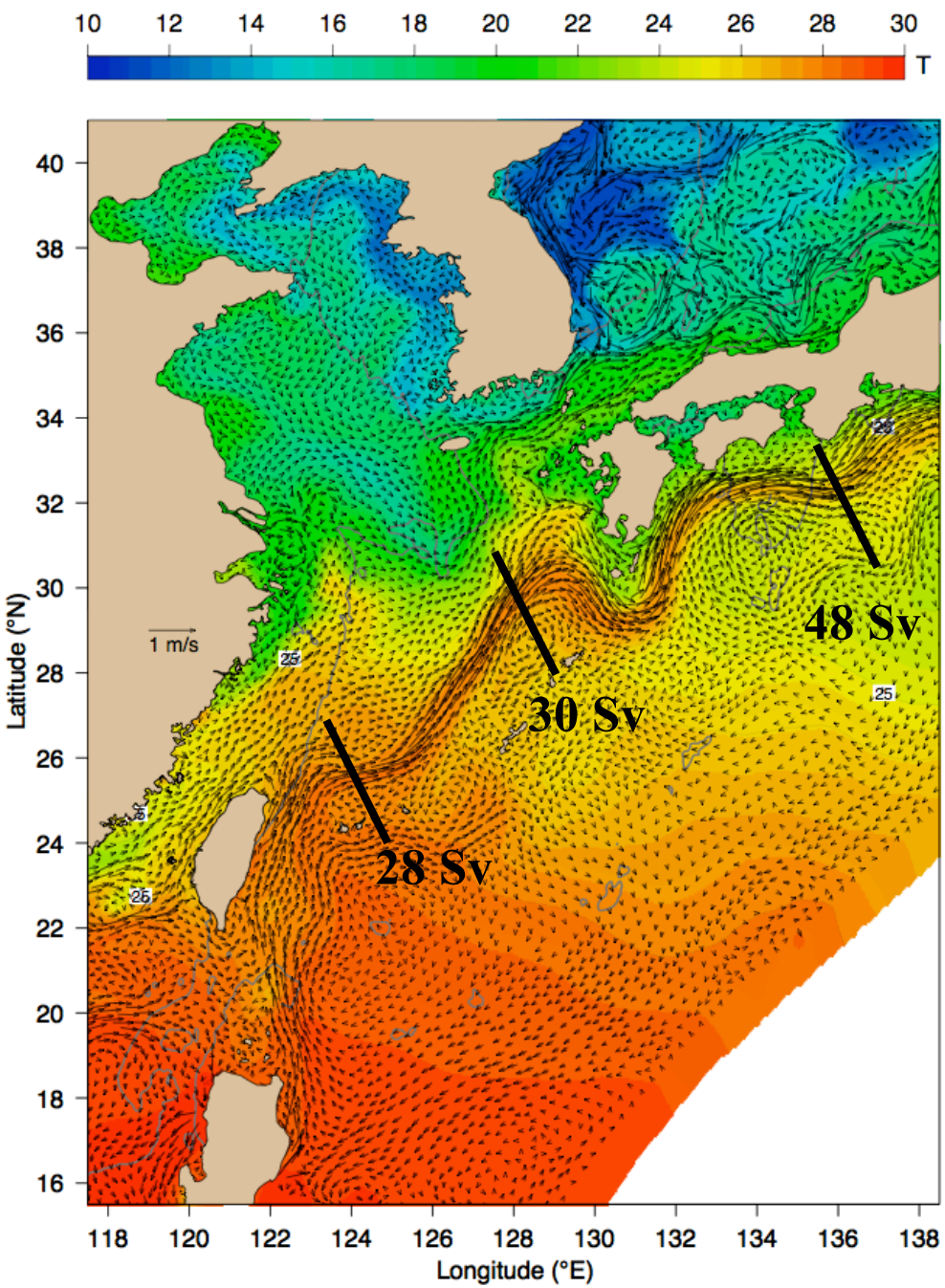
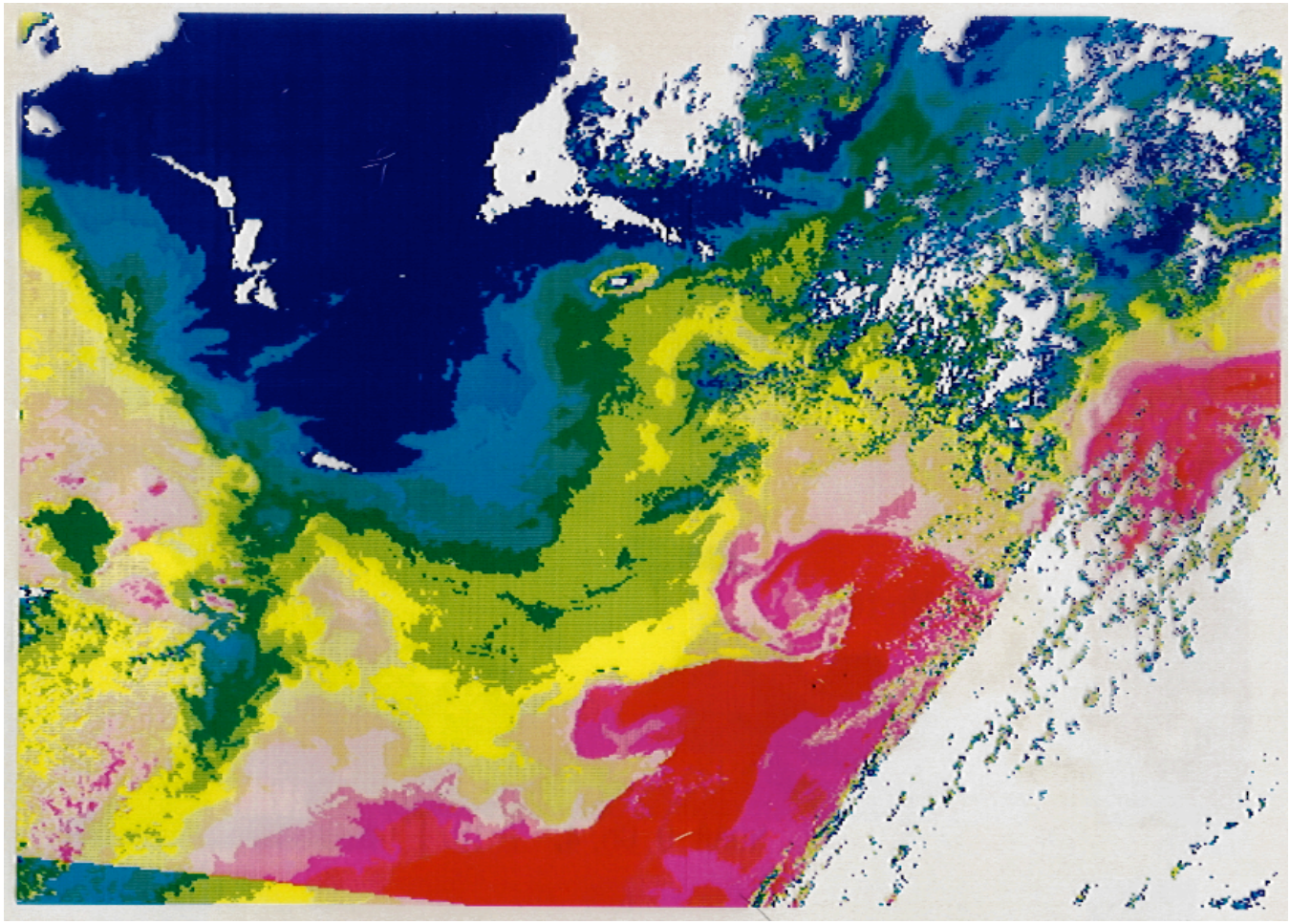

Alaska
Current
N.Pacific Current
(Kuroshio Extension)
California
Current
Kuroshio
N. Equatorial Current
Equatorial Counter Current
S. Equatorial Current
W. Australia Current
E. Australia Current
Peru
Current
S. Pacific Current
Antarctic Circumpolar Current
Antarctic Circumpolar Current
Antarctic Subpolar Gyre



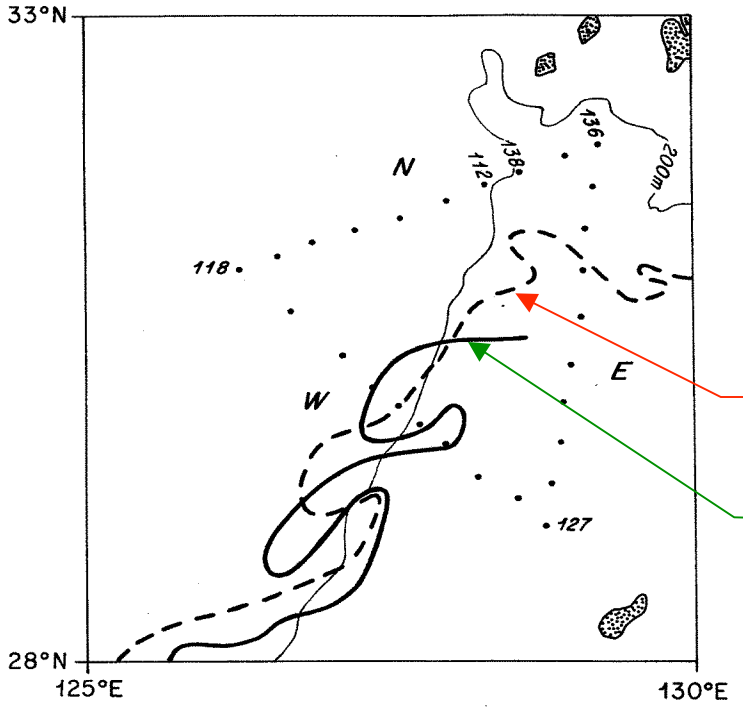
1. **Connection of Kuroshio to the East China Sea;**
2. **Transport increases as it flows northeastward along the slope;**
3. **Recirculation**
4. **Slope eddies**
5. **Rings**

Example 2: Frontal eddies

NOAA-AVHRR Satellite Image: June 3 1986



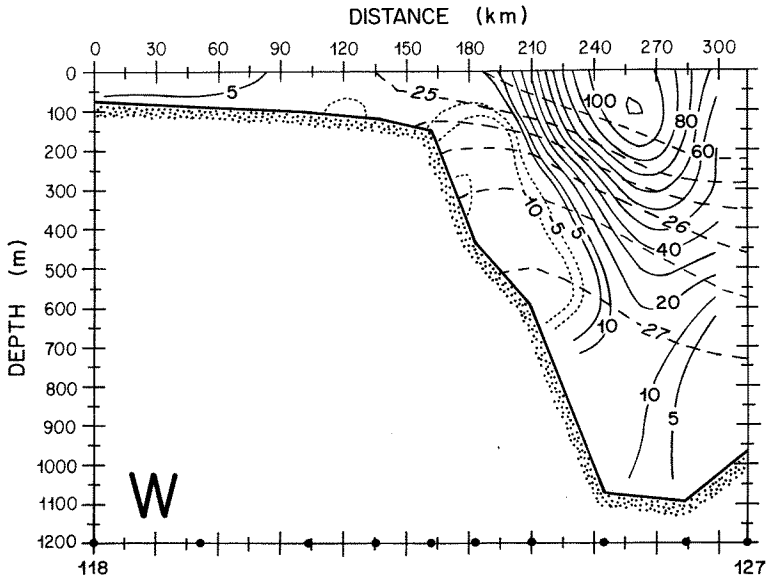
Horizontal scale: 10-100 km; life time: 10-30 days; velocity: 10 m/s



Eddies propagate downstream as the instability develops

1/28/86

2/8/86

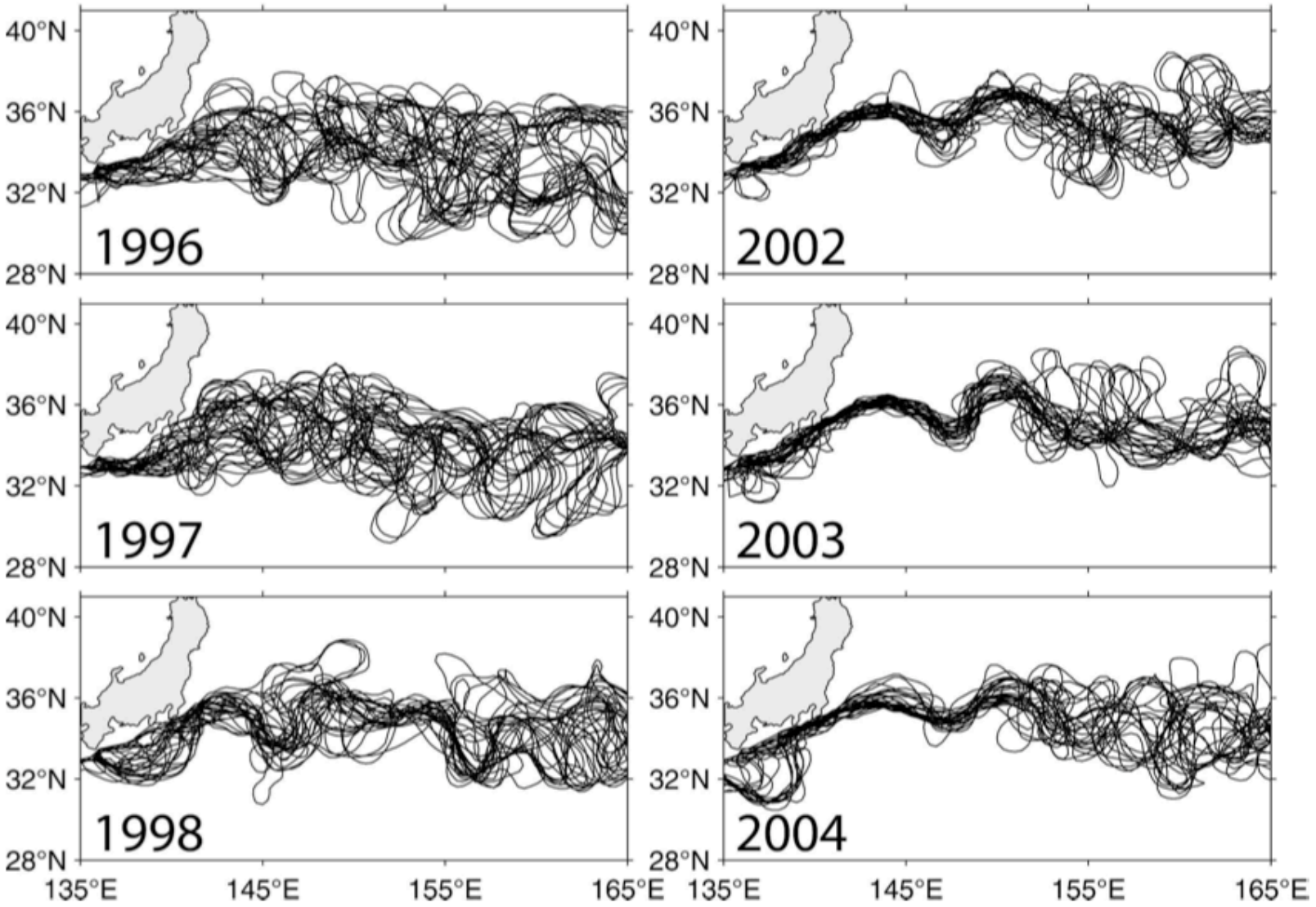


Eddy diameter: 60 km;

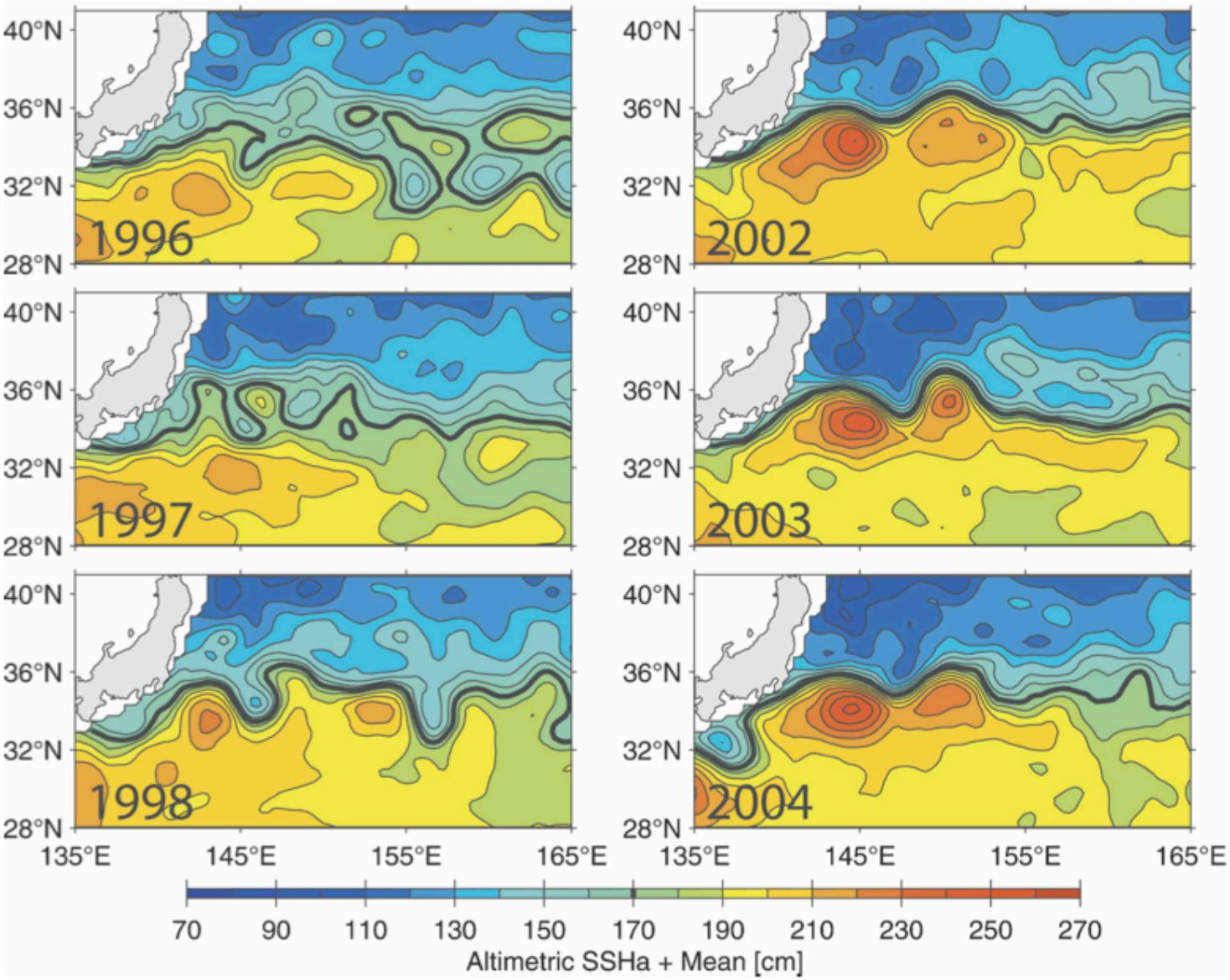
Moving speed: 20-40 cm/s

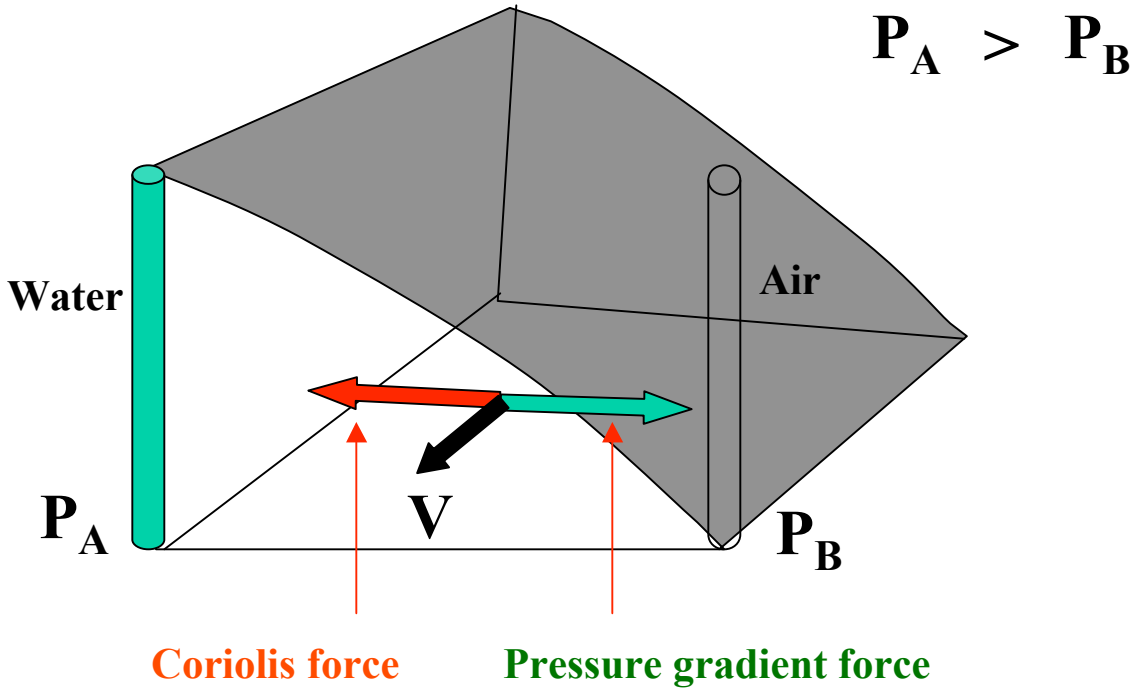
Eddy rotating velocity: 5-15 cm/s

Yearly paths of the Kuroshio and Kuroshio Extension defined by the 170-cm contours in the weekly Sea Surface Height (SSH) fields (from **Qiu and Chen, 2005-JPO**)



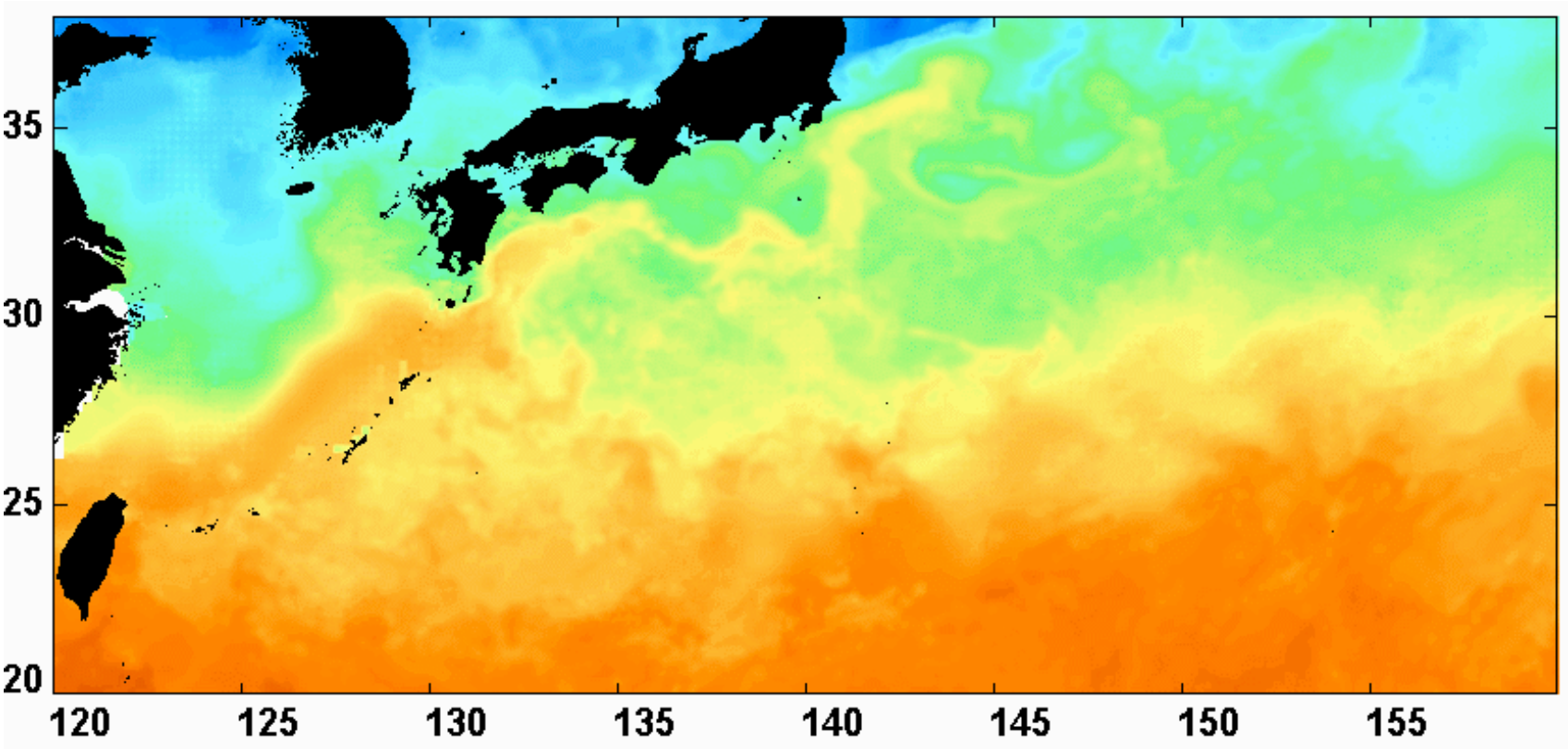
Maps of yearly averaged sea surface height field. Contour intervals are 10 cm with the thick lines denoting the 170-cm contours (from Qiu and Chen, 2005-JPO)



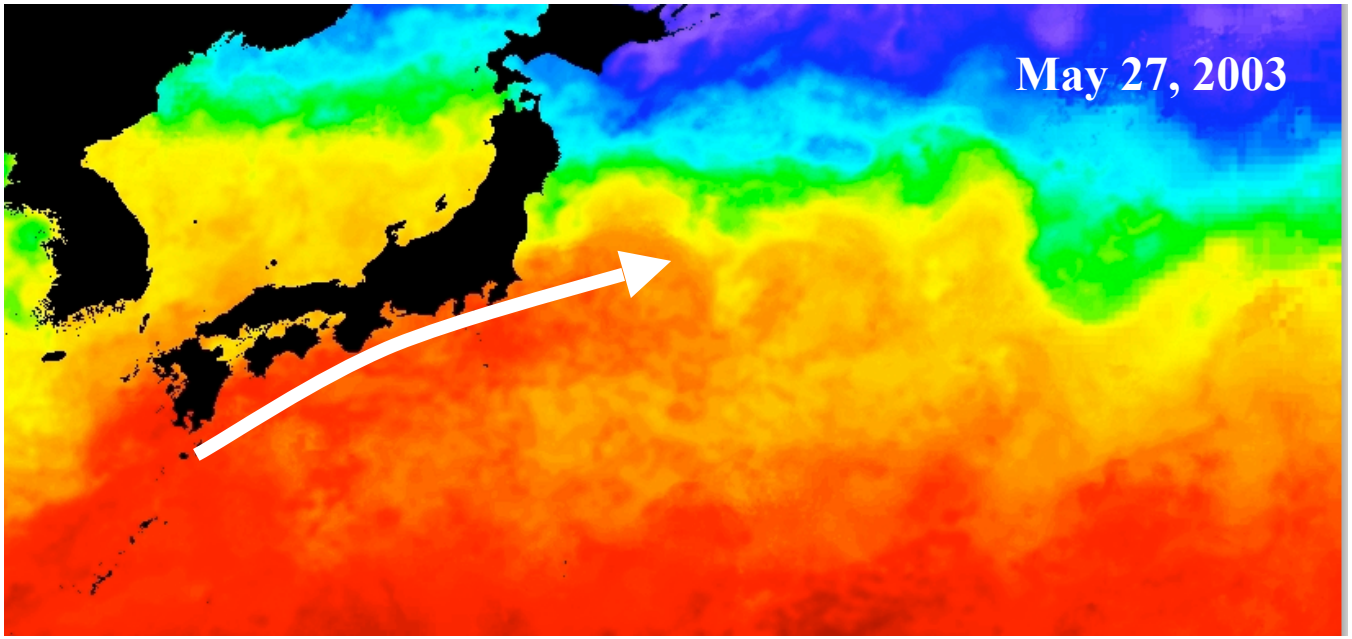


If the flow is geostrophic, on the northern hemisphere, the water movement is parallel to the slope of the sea surface and the higher sea level is always on the right.

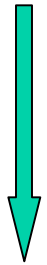
A cold-cold ring detected on April 29, 2001

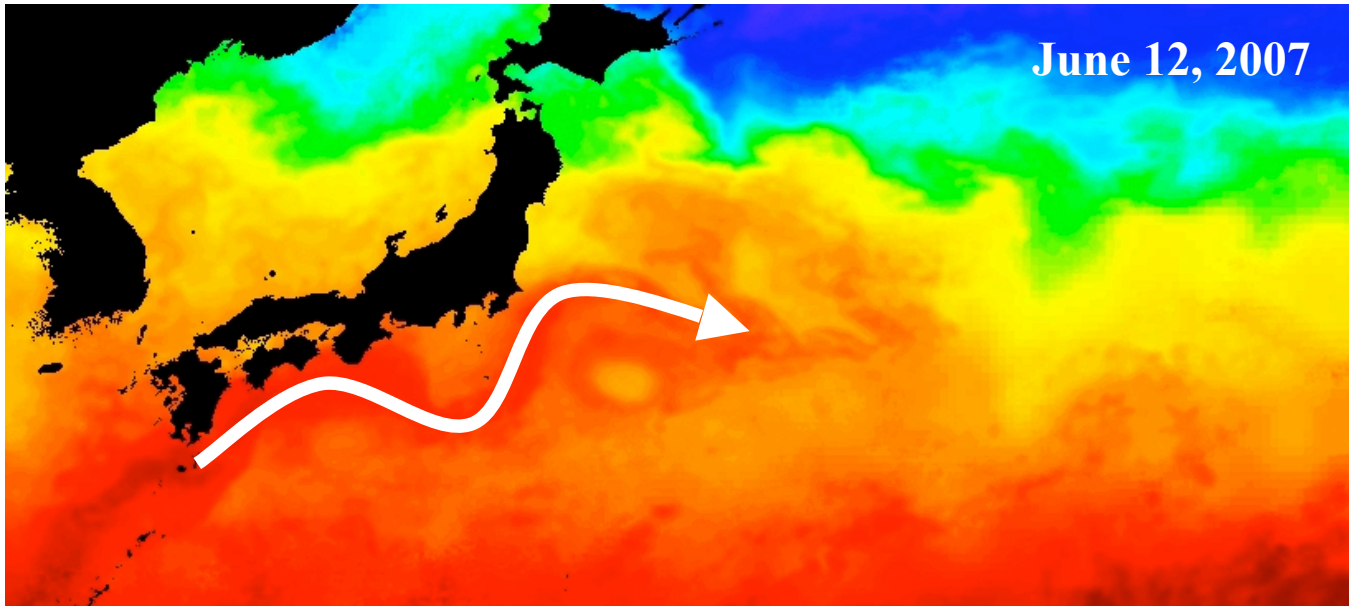


http://www.ocean.caos.tohoku.ac.jp/%7Emerge/sstbinary/actvalbm.cgi



Characteristic of Kuroshio:

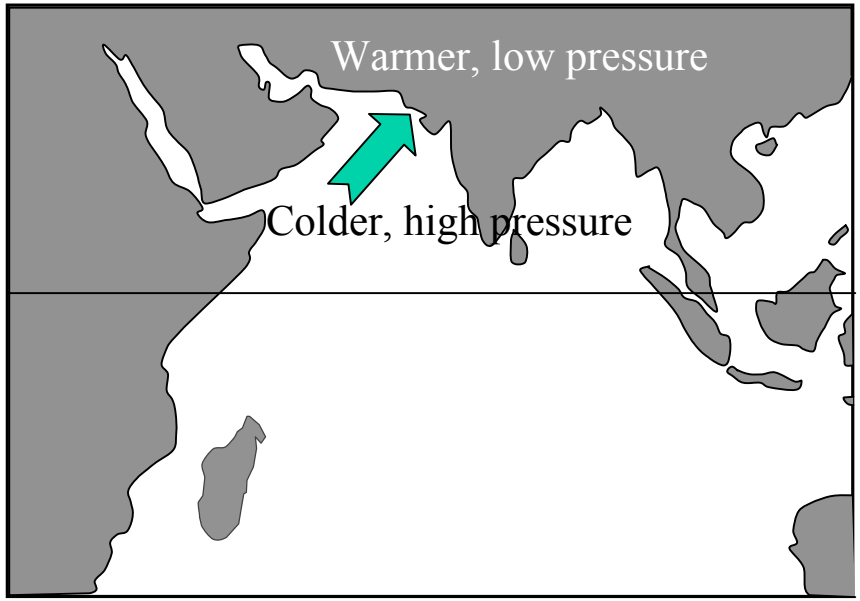




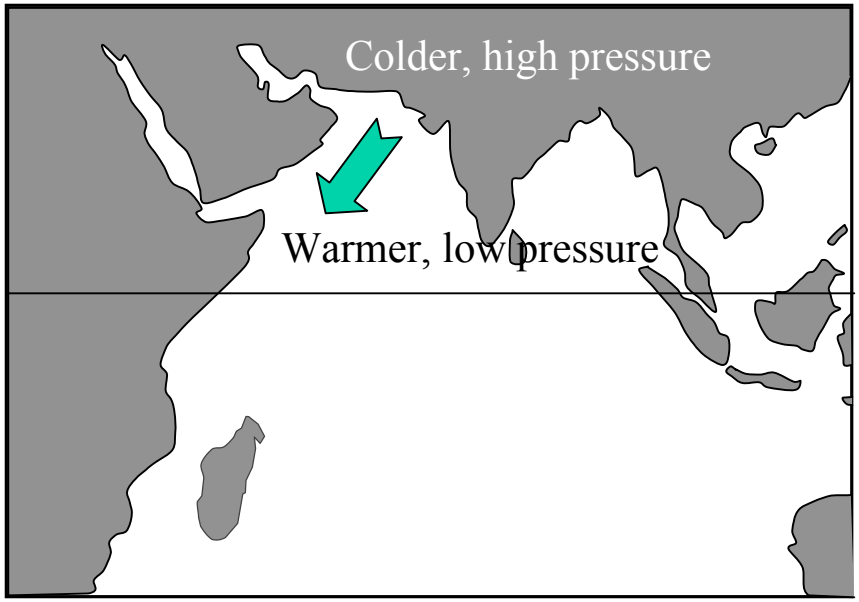
Bi-mode paths

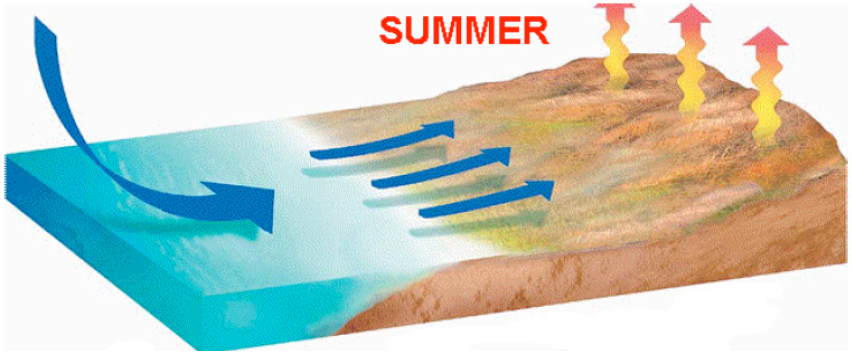
The Indian Ocean: Monsoon Climate: Monsoonal circulation

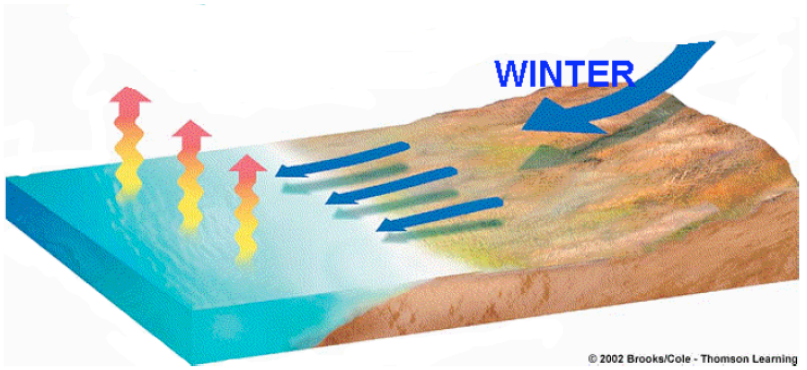
Summer: South-west monsoon



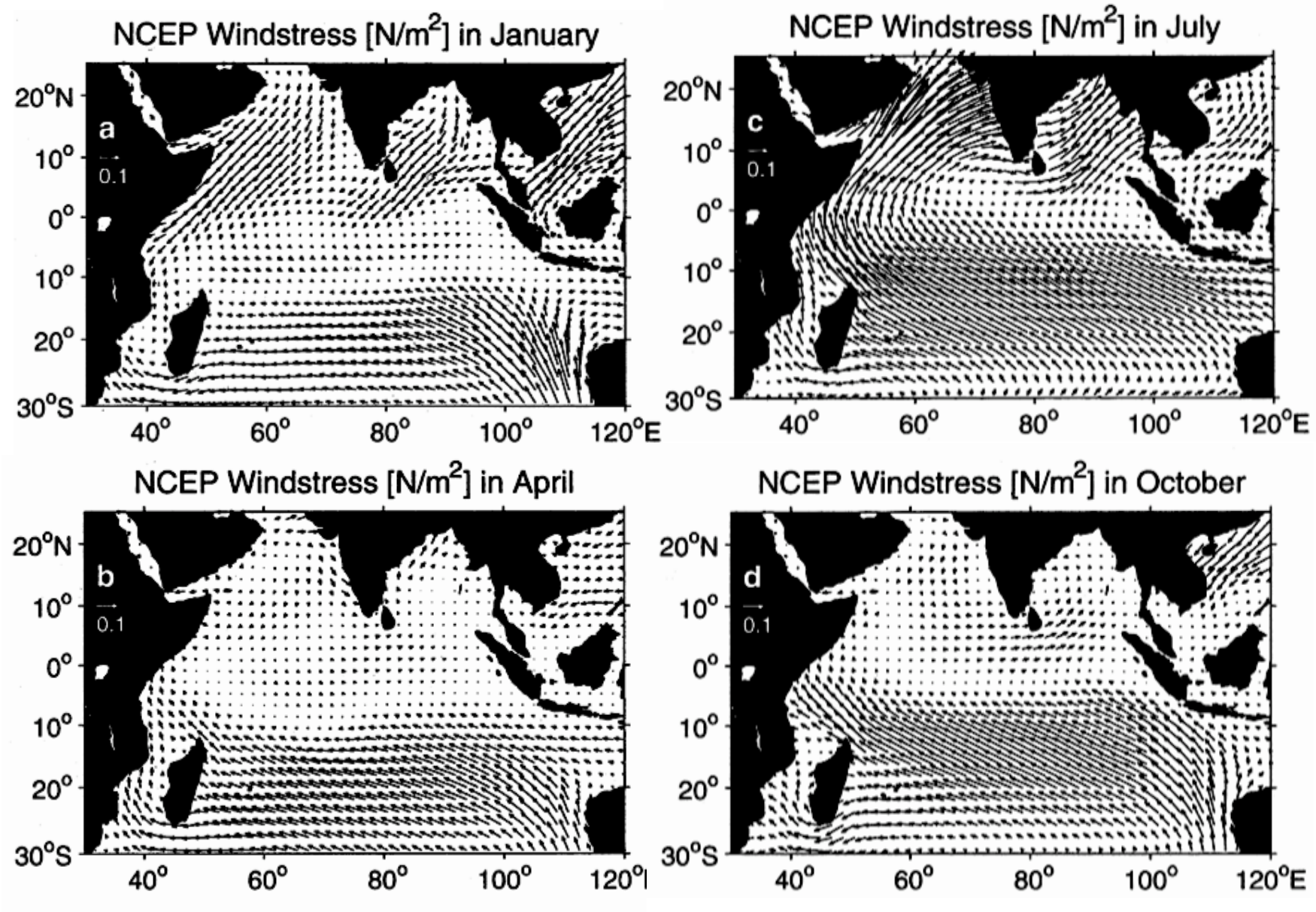
Winter: North-east monsoon

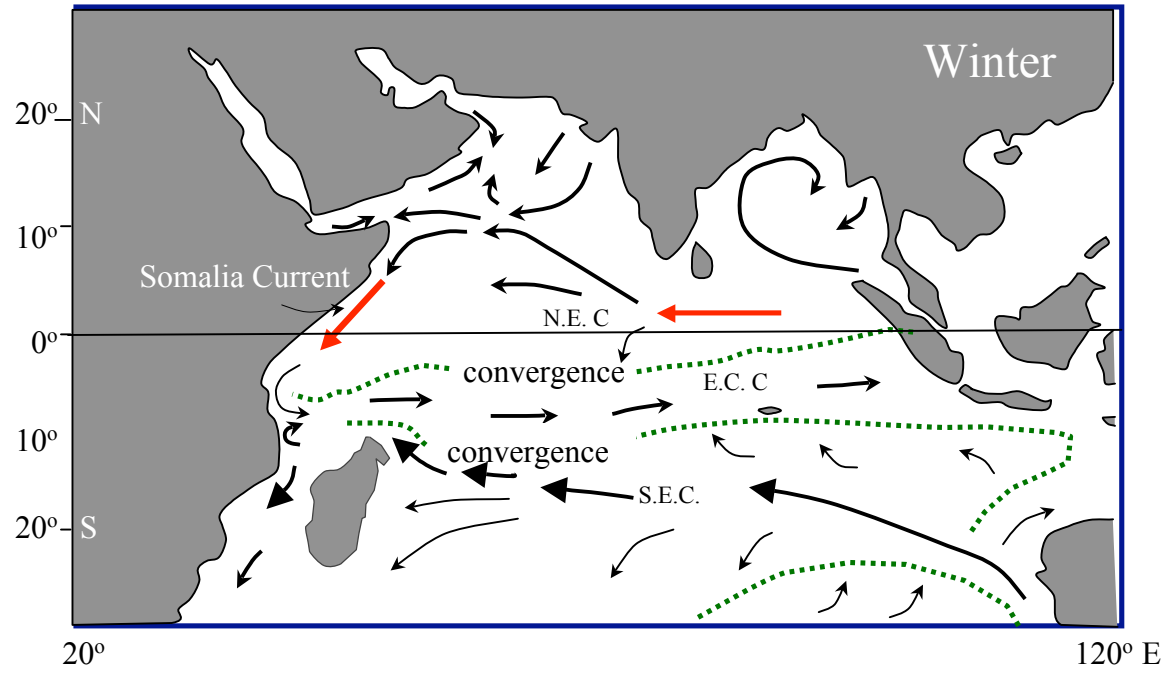


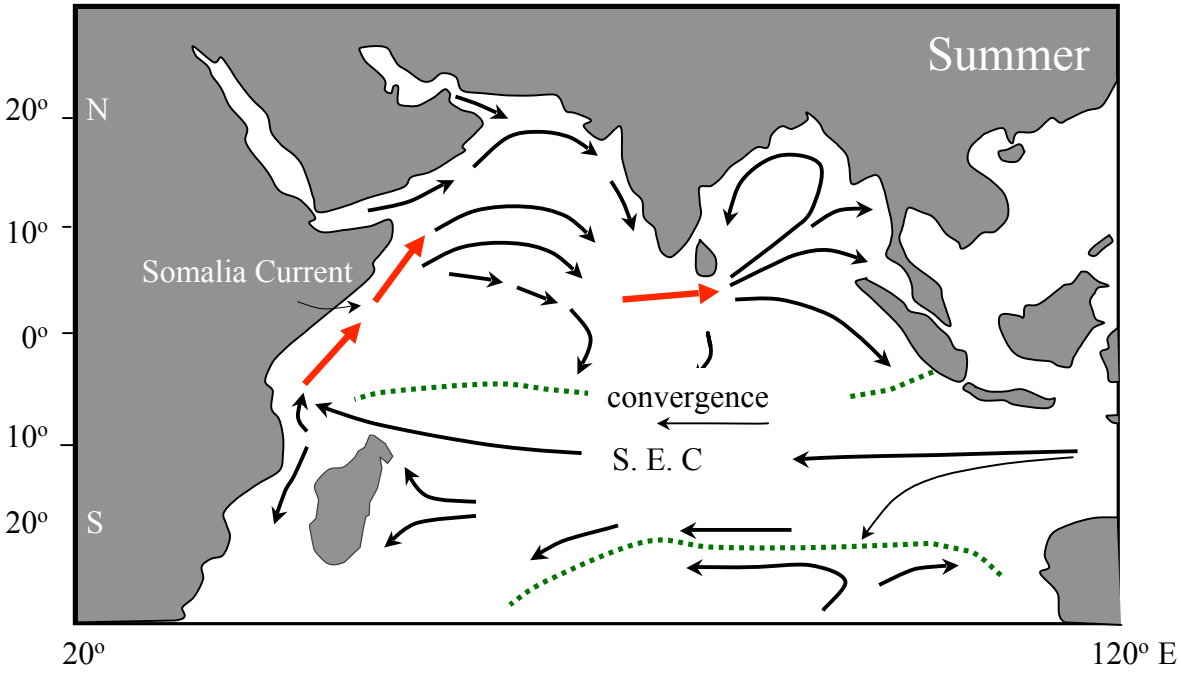




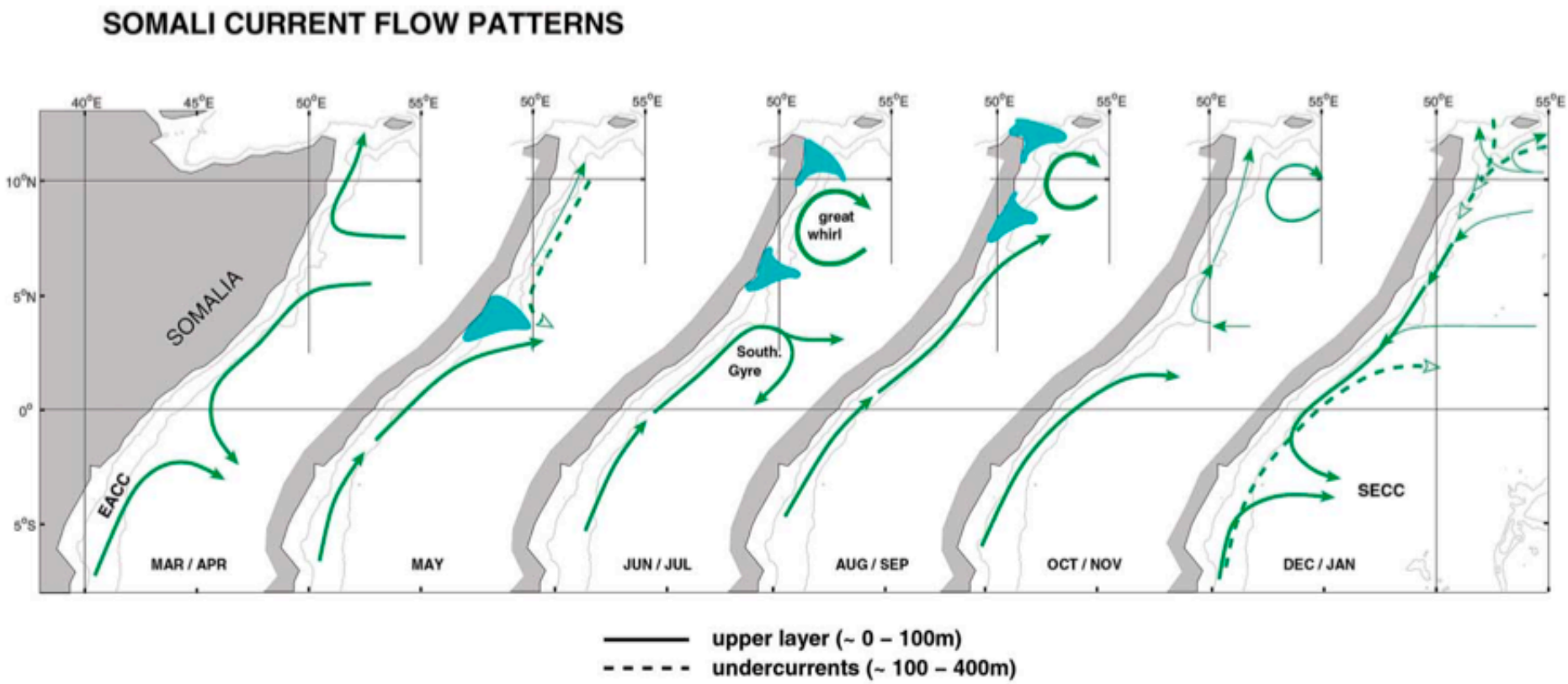
From Schott and McCreary (2001)




Winter
20º N
10º
0º
10º
20º S
Somalia Current
N.E. C
convergence
E.C. C
convergence
S.E.C.
20º
120º E


Summer
20º N
10º
0º
10º
20º S
Somalia Current
convergence
S. E. C
20º
120º E

From Schott and McCreary (2001)



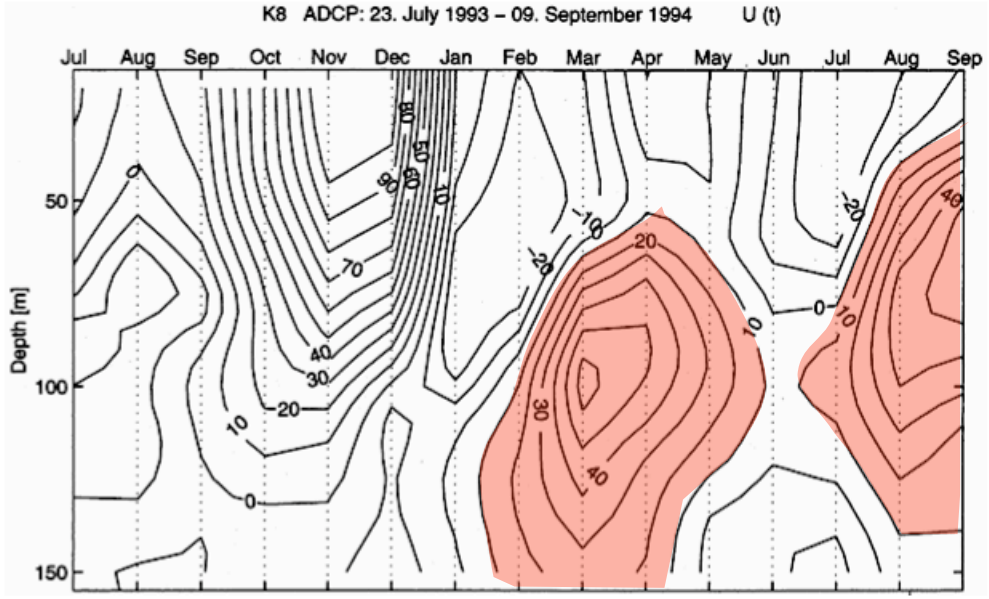
1. Velocity: ~3.7 m/s
2. Transport: ~ 60 SV in the upper 200 m;
3. Change of its direction with season
4. Energetic upwelling during summer

Indian Ocean Equatorial Undercurrent

In the Pacific and Atlantic Ocean, EUC is the quasi-permanent eastward current in the thermocline;

In the Indian Ocean, however, a permanent EUC is absent in the eastern Indian Ocean due to the large, seasonally varying nature of the forcing.

In this ocean, "The EUC is a transient equatorial-wave phenomenon, rather than features of the mean circulation (Schott and McCreary, 2001)"



From Schott and McCreary (2001) Fig. 25. Monthly-mean zonal current components in upper 150 m at 80.5°E on the equator, measured by upward-looking ADCP in fall 1993 and spring 1994, and eastward EUCs during February–May 1994 and at a shallower depth in August 1994

Indian Ocean EL Niño

The Equatorial Dipole Mode

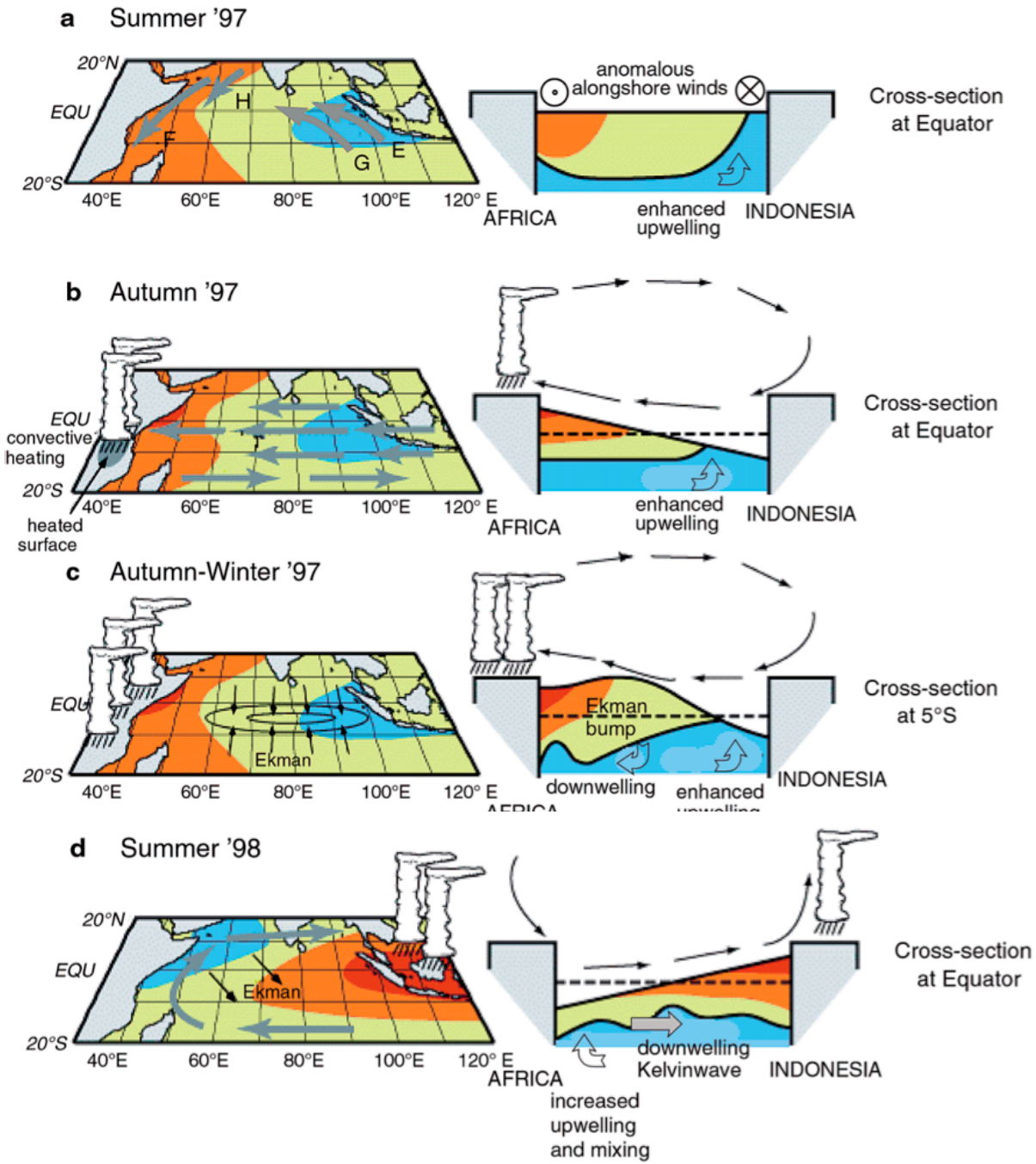
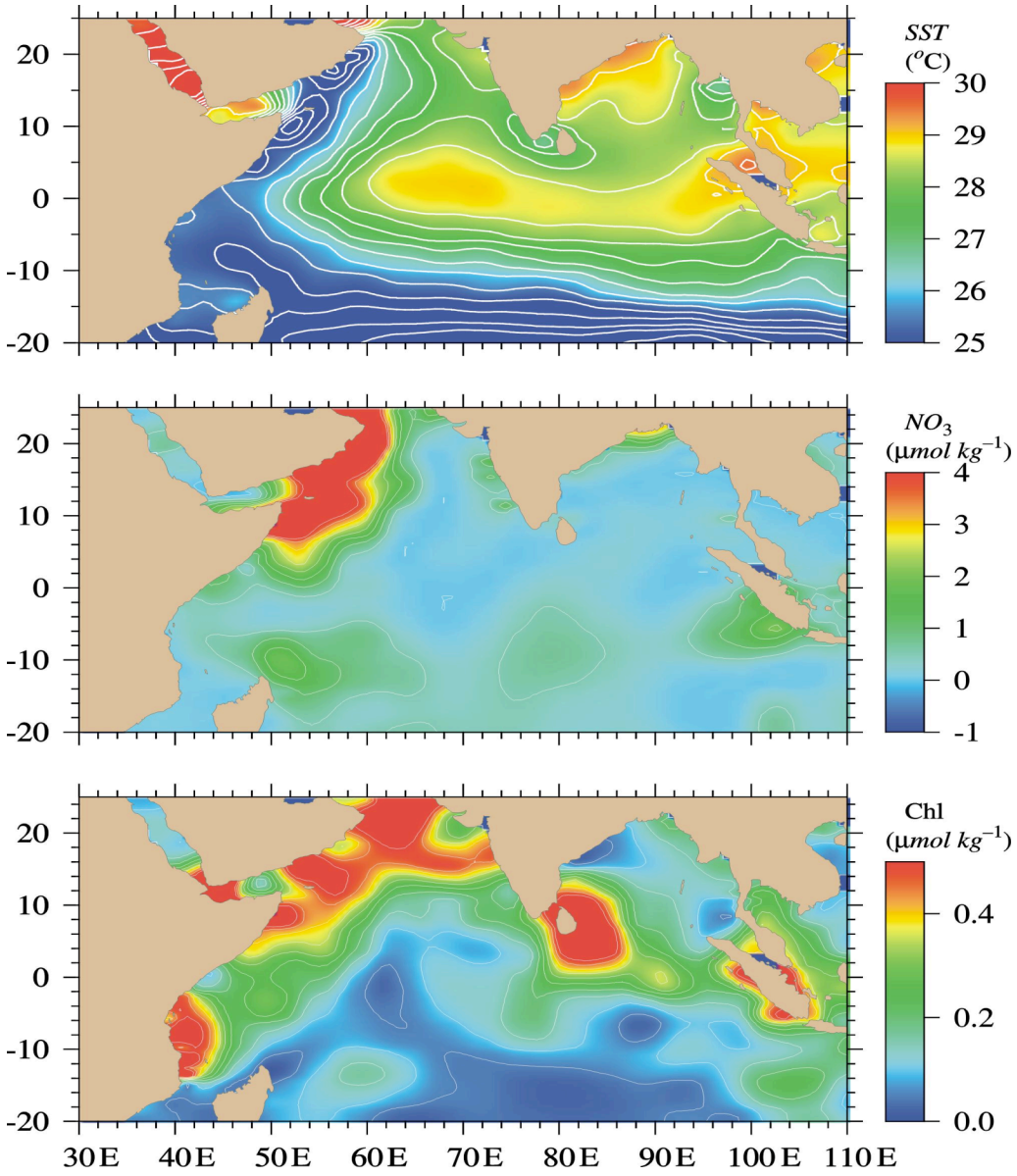


Fig. 72. The development of the Indian Ocean Mode according to Webster et al. (1999, their Fig. 4). See text for details.

Schott and McCreary (2001)
Progress in Oceanography
51, 1-123

Northern Summer