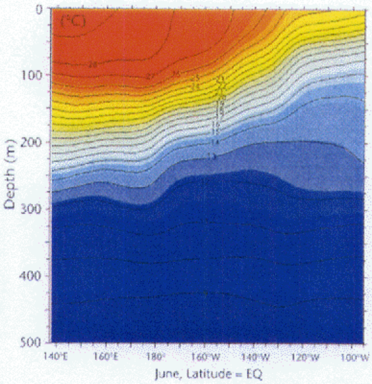

Figure A.4
Equatorial depth-section across the Pacific Ocean showing average temperature for June. Note the deep mixed layer in the west (left side), the thermocline (layer of closely packed isotherms indicating a strong vertical temperature gradient) and the very cold waters at depth.
(NOAA/PMEL, USA)

piling up of warm waters in the western margins. As a consequence, sea level is some 60 cm higher and the thermocline is pushed deeper in the western Pacific Ocean.

In addition to the wind-driven current in the direction of the wind a lateral drift is generated by the prevailing wind. This is the Ekman turning* that is induced in wind-driven currents by the rotation of the Earth. In the Southern Hemisphere the lateral drift is to the left of the wind direction and in the Northern Hemisphere the drift is to the right.

Lateral drift is particularly important because it is a primary factor for inducing upwelling of cold water in the surface layer of the ocean. For example, southeasterly winds blowing parallel to the coasts of northern Chile, Peru and southern Ecuador induce a westward drift away from the coast in the northward flowing surface waters of the Peruvian current. Water at depth is drawn to the surface to replace the diverging surface waters. The slow upward flow is from a depth of around 300 metres, and upwelling raises the thermocline. Turbulence generated by the surface wind stress mixes colder water from the top of the thermocline to the surface. The raised thermocline off the South American coast in the equatorial depth-section is largely an outcome of this upwelling.

Across the Pacific Ocean, particularly in central and eastern longitudes, Ekman turning also induces a drift away from the equator in both hemispheres. A raising of the thermocline and upwelling of cold water occur along the equator as a result of the diverging lateral drifts in the surface current. Figure A.5a represents the sea level setup and thermocline variation across the equatorial Pacific Ocean that develops as a consequence of the prevailing Trade Winds. Figure A.5 (b and c) indicates the changes in sea level setup and thermocline depth resulting from stronger and weaker Trade Winds respectively.

* Ekman turing: Wind blowing across water establishes a surface current in the direction of the wind. However, because of the rotation of the Earth the current has a lateral drift to the right of the wind direction in the Northern Hemisphere and to the left of the wind direction in the Southern Hemisphere. An easterly wind at the equator will cause divergence in the wind-driven surface ocean current away from the equator in each hemishpere and induce upwelling at the equator.

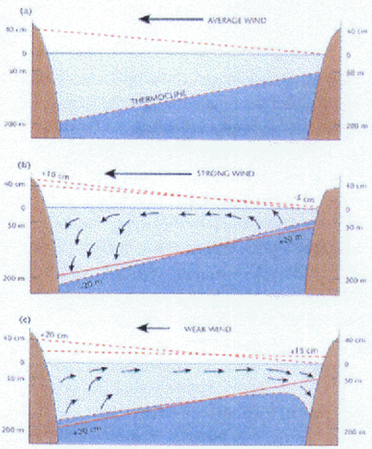

Figure A.5
Stylized depth-section across the equatorial Pacific Ocean showing a) the raised sea level and lowered thermocline in the west under the influence of the Trade Winds, and how the sea level and thermocline depth changes under b) strong Trade Winds and c) weak Trade Winds. Depths below 0 are shown in metres, depths above 0 in centimetres
(Glantz *et al.*, 1987)

Sea surface temperatures

Seasonal winds can quickly modify sea surface temperatures in the coastal margins through upwelling, such as occurs annually offshore from the Pacific Coast of South America. Persisting seasonal winds over the open ocean can also significantly modify sea surface temperatures. Winds generally act to cool the ocean surface through transfer of latent energy during evaporation, and exchange of heat between the ocean to the atmosphere. A wind-driven current will have a local heating or cooling effect according to the prevailing sea surface temperature gradient.

The annual cycle of sea surface temperature can be seen in Figure A.6. A number of seasonal wind effects can be identified in different regions of the globe.

The sea surface temperatures of the northern Indian Ocean reach their maximum during the later part of the Northern Hemisphere spring (especially April–May). The temperature and humidity of the air over the region rises as a precursor to the onset of the Asian summer monsoon. With the onset of southwesterly winds associated with the summer monsoon, cooling of these waters commences during June. The cooling of the northwestern Indian Ocean is aided by upwelling as the seasonal wind blows parallel to the Somali coast, and from