atmospheric surface pressure over the warmer water of the west maintain a zonal pressure gradient that sustains the Trade Winds

In the eastern equatorial Pacific Ocean off the coast of South America there is a marked seasonality in sea surface temperature The annual cycle of sea surface temperature is associated with the strengthening and weakening of the local southeast Trade Winds, which wax and wane with the annual migration north and south of the intertropical convergence zone. The equatorial Trade Winds weaken and upwelling of cold water in the coastal regions is at a minimum during the Southern Hemisphere summer as the intertropical convergent zone is furthest south. As a consequence, the coastal sea surface temperatures off Ecuador and Peru are at a maximum during February and March. The cooling trend returns as the intertropical convergence zone moves northward during the Southern Hemisphere winter, causing the Trade Winds and upwelling to strengthen

Over the northern Pacific Ocean, particularly off the East Asian continent, there is a strong annual cycle of seasonal heating and cooling of the surface waters. The cooling during the Northern Hemisphere winter is enhanced by very cold airflow from the Asian continent that extracts heat from the East China Sea and the northwestern Pacific Ocean. The surface layers warm during the Northern Hemisphere summer months, as the monsoon reverses and solar heating increases.

The annual cycle of sea surface temperature in the South Pacific is significantly less than that of the North Pacific, reflecting the absence of a continental influence comparable to Asia and its seasonal reversal of winds

Monsoon circulations

A greater proportion of water covers the Southern Hemisphere than the Northern Hemisphere. Consequently, evaporation from the oceans of the Southern Hemisphere is a stronger source of moisture and latent energy for the atmosphere than is evaporation from the oceans of the Northern Hemisphere However, the greater proportion of land in the Northern Hemisphere causes the average global temperature to be warmer and a strong source of direct heat to the atmosphere during the Northern Hemisphere summer. The spatial and seasonal asymmetries of the heating sources to the atmosphere are an important background to a consideration of the monsoon systems.

Differential summer heating between the tropical landmasses and the surrounding seas establish surface temperature and pressure gradients that provide the energy to initiate, and assist to maintain, seasonal monsoons. The Asian monsoon is particularly strong because of the geography of the Indian and Pacific Oceans and the topography of the Himalaya Mountains and Tibetan Plateau The wind circulation of the Asian monsoon extends westward to Africa and eastward across the Pacific Ocean

Very cold air and high surface atmospheric pressure forms over the Asian continent, particularly over the Tibetan Plateau, during the Northern Hemisphere winter At the surface cold air flows out from the region of high pressure, both eastwards around a strongly formed Aleutian low pressure system in the North Pacific and south-westward into the South China Sea and the northern Indian Ocean. The wind circulation of south Asia is very persistent for several months and is referred to as the Asian winter monsoon. The scale of the winter monsoon is judged from the local departures of surface pressure and wind flow of January from annual averages as shown in Figure A 7a

During the Northern Hemisphere summer, rising air in deep atmospheric convective clouds over the relatively hot landmass of Asia draws surface air from the surrounding relatively cooler waters of the northern Indian Ocean, the South China Sea and the East China Sea. The southwesterly airflow over the Indian subcontinent and the south to southeasterly flow of the Indo-China Peninsula have high humidity and converge towards the region of lower pressure over the relatively hot Asian continent This large-scale circulation is the dominant summer monsoon of Asia The scale of the monsoon can be judged by the departure from the annual mean of the surface pressure and wind fields over the oceans during July shown in Figure A 7b.

The maps of average outgoing longwave radiation for January, April, July and October in Figure A.8 show the seasonal progress of the focus of tropical convection over the Indo-Pacific region