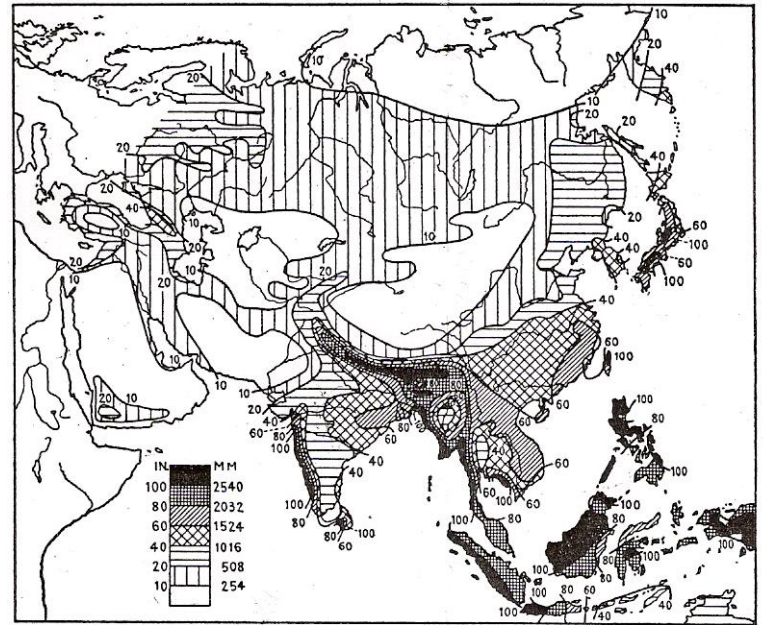
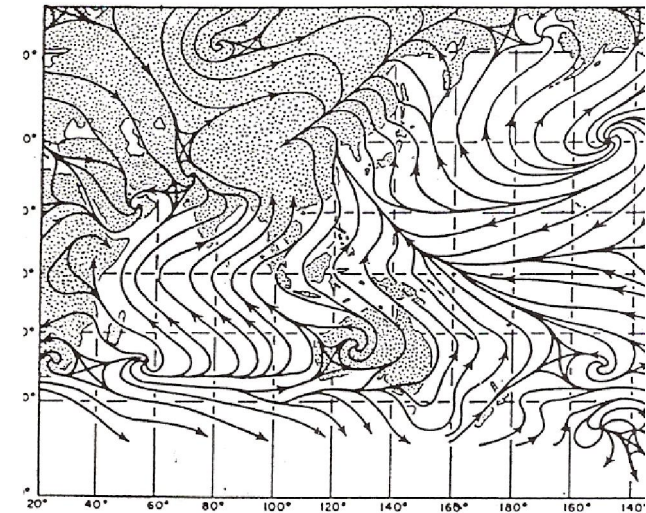
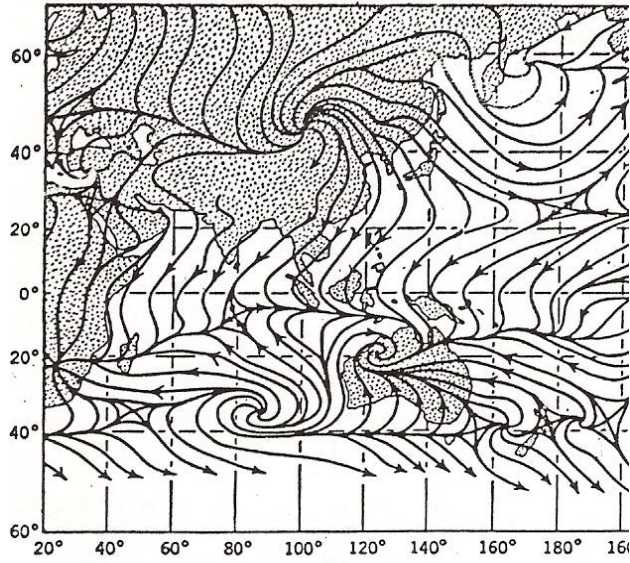


Climate of continents

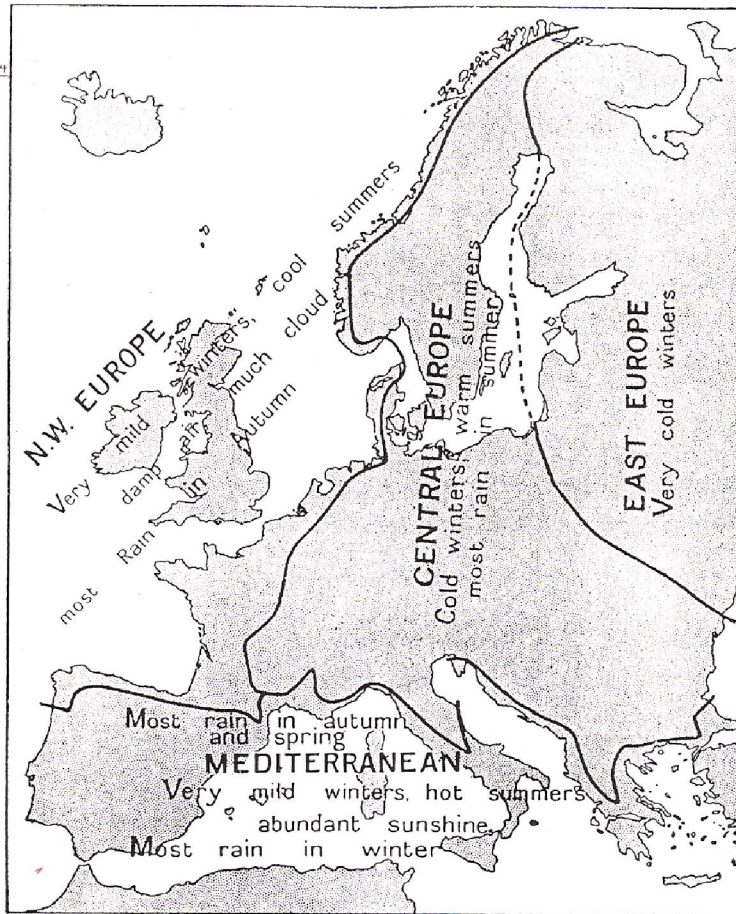
G K Sawaisarje

ASIA

- Asia is the world's largest and most diverse continent, covering about 30 percent of the land area on Earth. The total area is 44,614,000 square km. From meteorological point of view the land mass is considerably large. It Extends from polar region nearly from latitude **78°N** in the northern Russia southwards reaching very close to the equator at Singapore (latitude **1.5°N**).
- Cold area of barometric pressure in winter is observed northeast of the Himalayas and hot low pressure area in summer stretches widely from west to east in the latitude of northwestern China. This distribution of pressure gives southeastern Asia the well known monsoon seasons.
- In winter, precipitation is light over entire continent.
- A much weaker summer monsoon brings rainfall to Japan and eastern Asia.
- While southeastern quadrant of Asia has heavy to excessive annual rainfall, the remainder of continent is dry receiving less than 10 inches annually.
- North of Himalayas, the low plains are extremely cold in winter
- In southwestern Asia (west of India), interior high pressure area controls the winter temperature and temperatures are low due to cool air outflow from high pressure area. Summers are excessively hot and since area is beyond path of monsoonal flow, precipitation is minimal year round.

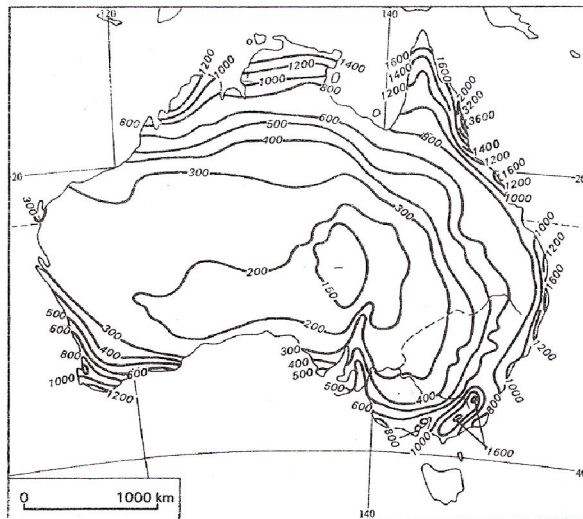
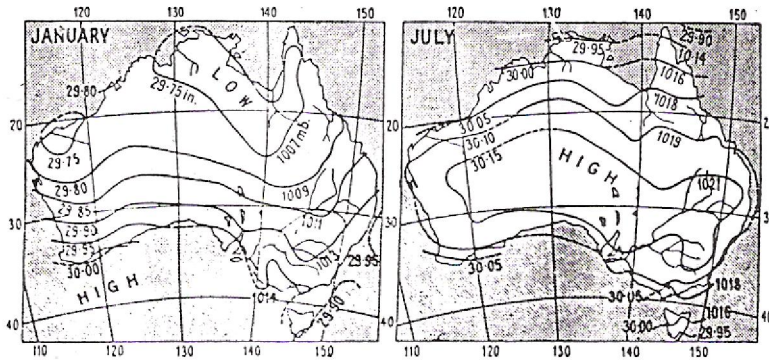


EUROPE



- There is no extensive north-south mountain system.
- Presence of east-west direction of the ranges in the south allows the weather conditions in the maritime west to change rather gradually towards Asia.
- Rainfall is heaviest on the western coasts locally exceeding 60 inches annually and diminishes to less than 20 inches in eastern Russia. Exceptions are that occur in the elevated regions of the Alps and the Caucasus.
- Rain shadow region is found in the Scandinavia. 60 inches of rain occurs in western Norway and less than 20 inches in eastern Sweden.
- Over much of the Europe precipitation is both abundant and evenly distributed throughout the year.
- Around the Mediterranean, most of the precipitation comes in the winter, with very dry summers.
- Isotherms run generally parallel to lines of latitude except in winter, when influence of Gulf Stream causes a profound east-west gradient.
- A few marked dips in isotherms noticed due to elevation or continental type of climate.
- In Scandinavia, winter map shows an abrupt fall in temperature from west coast of Norway to eastern coast of Sweden.
- Coastal mountains eliminate the modifying effects of Ocean, thus allowing a greater range of temperature

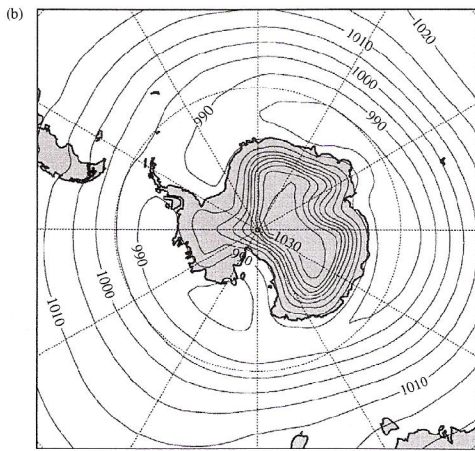
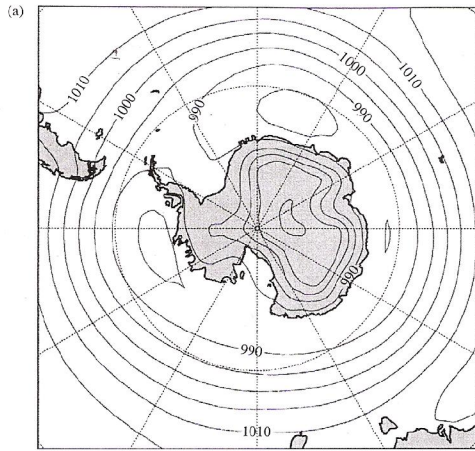
AUSTRALIA

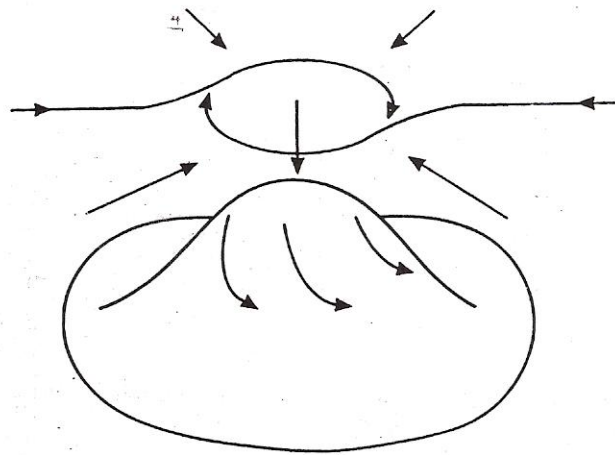


- In southern winter, high pressure area is formed over the interior of Australia and all parts of continent are dry except the southernmost parts.
- During summer, high pressure belt moves south of the continent with dry conditions persisting over the southern and western areas
- 20 inches of precipitation is observed each year over the continent except in extreme southwest and in a strip circling from southeast to northwest.
- Less than 10 inches of annual precipitation is observed in interior, to the south.
- Heavy summer rains of the north are of monsoon origin and winter precipitation over southern coast is of cyclonic type. On the Ocean facing east slopes of mountains along coast, the mean annual rainfall is over 40 inches and in many localities over 60 inches.
- Because of location of Australia, on both sides of Tropic of Capricorn, temperatures far below freezing are to be found only in south at high elevations.
- In Arid interior, extreme maximum temperatures rank with those of hottest regions of the earth.

ANTARCTICA

- Geography
- Antarctica, first explored by R. Amundsen in 1911 is a compact mountainous plateau with an average height of 2500 m. 97% of its area ($1^{1/2}$ times of US) is permanently ice covered, the ice accounting for 90% of the world's ice. The south pole is buried at a depth of 3,000 m with the continent almost symmetrical around it, within 20° of latitude.
-
- Solar radiation
- Sun remains constantly above horizon for at least two months nearly everywhere in the continent. During the southern summer, the earth-sun distance is minimum. This coupled with the elevation of the continent and the purity of its atmosphere make the latitudes of 80°S , which register the lowest temperatures on the earth, receive maximum monthly mean solar radiation. However, 75% of what is received is reflected by the snow covered surface. In the longwave, the surface acts as a black body. Thus a permanent pack ice belt is found around the continent, whose peak area equals that of the continent in September.
- Temperature
- Average monthly temperatures are all well below 0°C . This is due to latitude effect, presence of permanent ice cover and high elevation of the continent.
- Vostok has experienced a world minimum of -88.3°C on 24 August 1960. The annual mean temperature of Byrd station is -29°C and at Vostok -57°C .
-
- Surface Inversion
- Strong surface inversions are common features of the Antarctica atmosphere. Temperature at surface may be as much as 30°C colder than air just a few hundred metres above. This is due to the intense cooling of the surface air.
- This is made possible because of partly covered oceans around the continent cool slowly and the meridional temperatures gradient breeds many intense cyclones
- Winds
- Polar easterlies emanating from the anticyclonic centres creep downwards from the sloping terrain and are converted into sudden downrush of air, jumping to 30-40 knots from lull. These katabatic winds reach gale force, kicking up snow and bringing visibility to zero. These are termed as Blizzards. This katabatic effect is seen up to a distance of 3 km from coast.





- A simple conceptual model of the Antarctic tropospheric circulation, after James (1989). Low level katabatic outflow is balanced by upper level convergence and subsidence over the continent, which maintains a cyclonic circulation in the middle troposphere

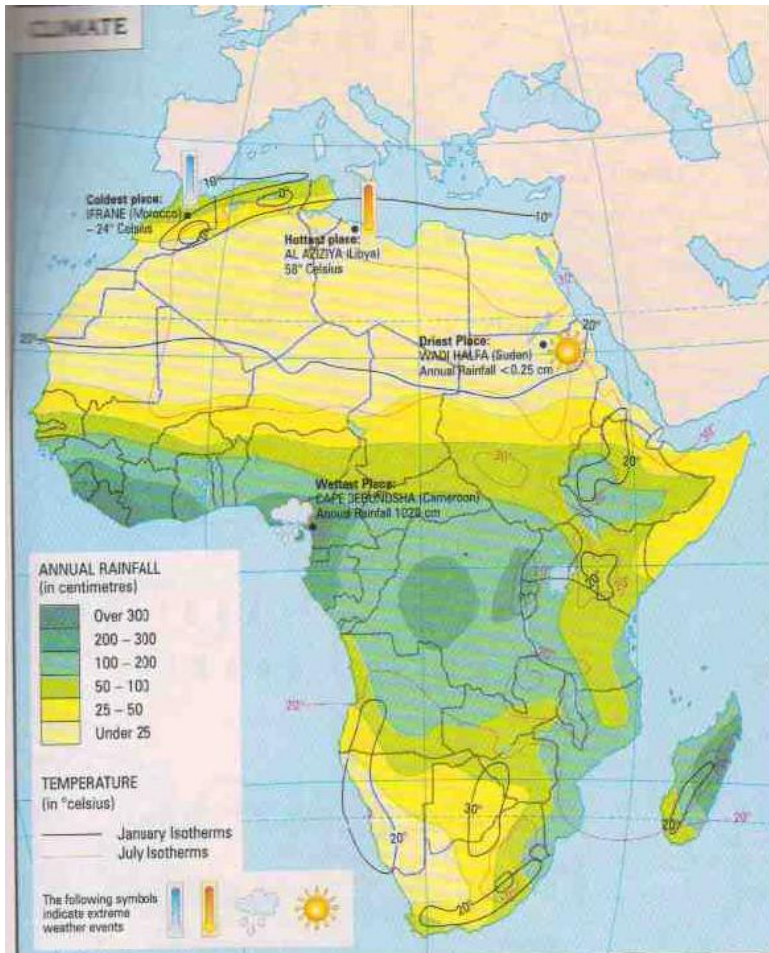
ARCTIC



- Arctic, the northernmost continent of the earth, is centred on the North Pole.
- Arctic boundary
- The area enclosed by the arctic circle (lat. 66°30'N)
- The position of 10°C isotherm of the warmest month July. (Southernmost limit of the Arctic Zone.)
- Arctic Ocean is fairly centrally located around the North Pole.
- Siberia, Canada, Greenland lies within Arctic circle.
- Largest ice sheet in the Northern Hemisphere is in Greenland with an elevation of about 3000m
- Parts of Finland, Sweden, Norway and Alaska lie north of the Arctic circle.
- We also find Tundra, permafrost, taiga and boreal forest.

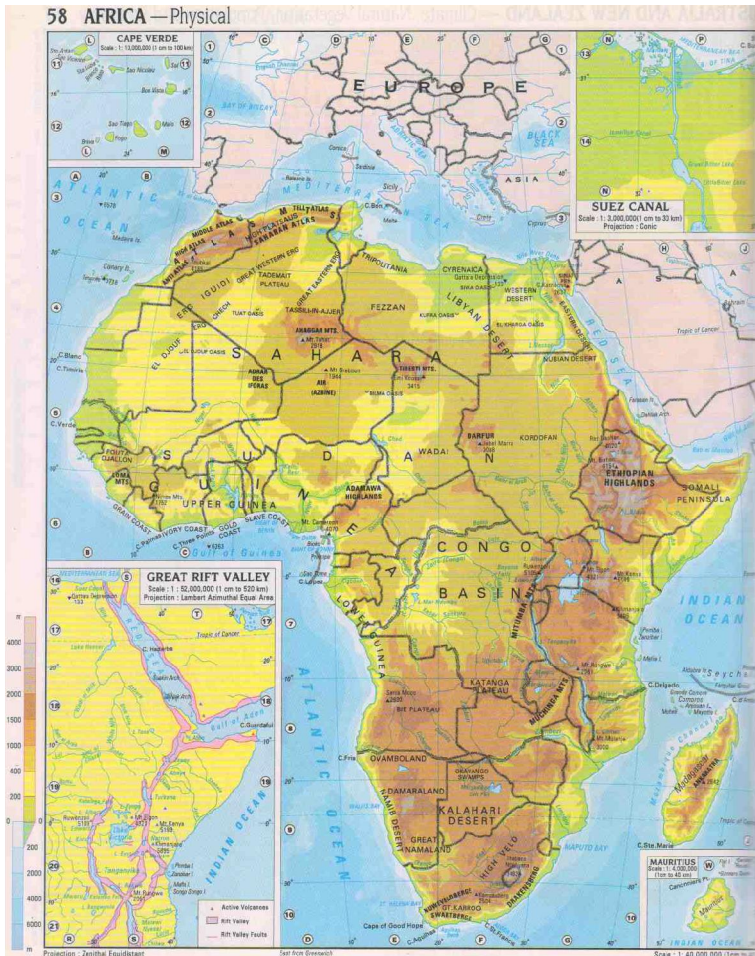
- Important factor that determines the climate of an area is the amount of energy it receives from the sun.
- Winter
- Cold winter temperatures in the Arctic result from lack of Sun's energy.
-
- Land-sea-ice distribution
- In northern hemisphere, the water features include the Arctic, North Atlantic and North Pacific Oceans.
- These bodies of water act as temperature modulators
- Exception occurs when large areas are covered by ice in winter.
- The land features are the northern continents of Eurasia, North America, the island of Greenland, and the Canadian Archipelago. They tend to show the direct results of the extremes of seasonal heating and cooling by their seasonal temperature variations.
- Mountain barriers
- The arctic mountain ranges of Siberia and North America contribute to the climate and air mass characteristics of the region.
- They resist movement of air from west to east.
- During the periods of weak circulation, the air is blocked by the ranges and remains more or less stagnant over the area. It acquires the temperature and moisture characteristics of the underlying surface. These areas are air mass source regions during winter when the surface is covered with snow and ice.
- The Greenland ice cap is essentially the mountain range more than 10,000 feet above the mean sea level.
- At times, winter temperatures in the Arctic are unusually high due to deep low centres moving into the Arctic, coupled with compression of air (the Fohen effect) as it blows down off the sloping edges of the ice caps, primarily the Greenland ice cap.
-
- Precipitation
- Precipitation amounts are small, varying from 5 to 15 inches annually in the continental interior and 3 to 7 inches along the arctic coastal area and over the ice pack.
- The Climate over the Arctic Ocean and adjoining coastal areas is dry. Most of the annual precipitation falls as snow on the Arctic Ocean and adjacent coastal areas and ice caps.
- Most of the annual precipitation falls as rain over the interior.

AFRICA



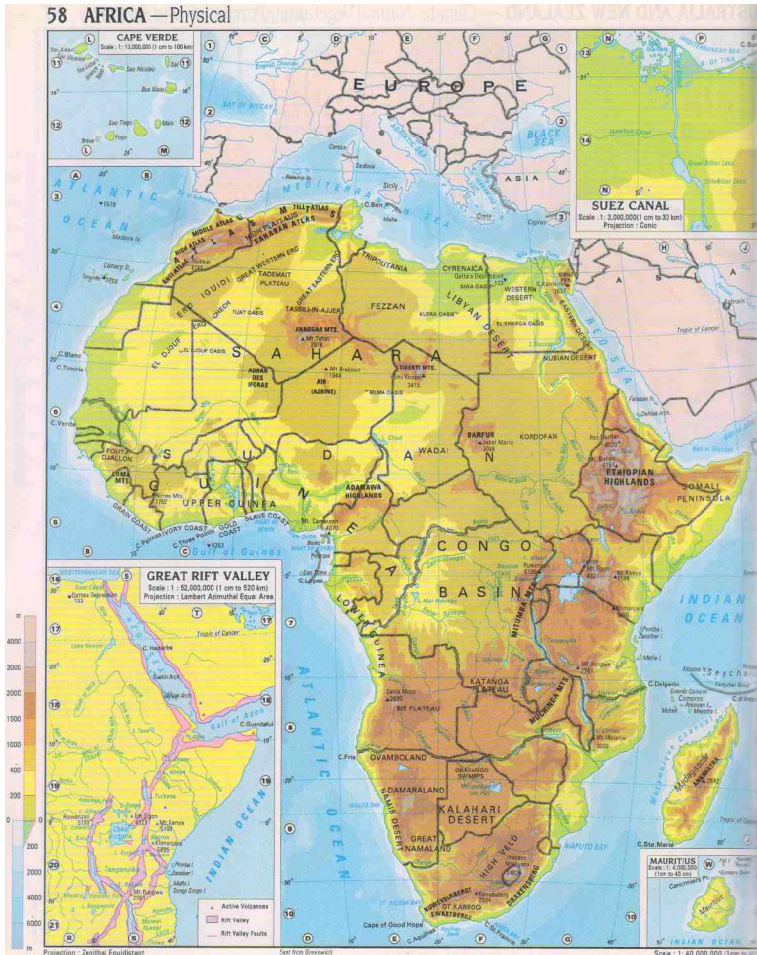
- The entire African Continent is within the tropical zone. The equator bisects the continent and in the area north and south of the equator, the climates is similar. Due to broad northern area in the east west direction, maritime effects inland are minimal. High Pressure belts dominate the southern section during winter and low pressure during summer.
- Presence of cold currents along its western shores allows an influx of cool winds and associated weather.
- No high mountain ranges present.
- Precipitation is greatest near the equator (60 to 80 inches to over 120 inches in places). It decreases sharply to the north (less than 10 inches) and gradually decreases south of the equator (average of 20 to 40 inches). Precipitation belt of ITCZ moves with the seasons.

58 AFRICA—Physical



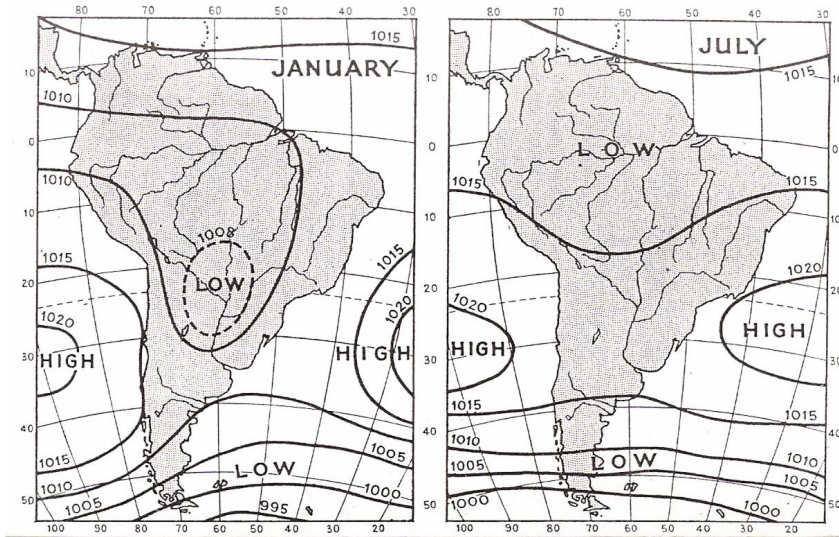
- Air mass movement and influences allow for a division of eight climate regions.
- Northern Region
- Includes great Sahara desert, a source of dry continental type air mass. It is very hot during day throughout the year but it is very cool at night due to lack of moisture, hence strong radiational cooling.
- Southwestern Region
- is arid to semiarid area, known as a Kalahari desert and does not have extreme temperature as land area involved is much smaller.
- Northcentral Region
- Is a semiarid area located along the edge of the Sahara. Occasionally gets precipitation in winter due to maritime air from the Mediterranean in the south.
- Sub-Equatorial Region
- Extends towards the equator from semiarid region in the north. This region is wet during November-March and dry during the rest of the year. Temperatures show little seasonal variation (68°F to 86°F) because of close proximity to the equator with only exception in western portion during winter which is influenced by cool weather from the north.

58 AFRICA—Physical



- Equatorial Region
- Includes the southwest tip of northern Africa and the region between 5°N and S latitudes, extending from the western coast to Lake Victoria. It is wettest climate with two distinct rainy seasons associated with the northward and southward movement of ITCZ. Rainfall averages over 120 inches annually in some areas. No significant mountains present in the region. Temperatures are moderate year round.
- Southeast Coastal Region
- Has a humid subtropical climate. It has rainfall all year (45 inches on average) and temperatures remain generally moderate all year, ranging from an average maximum of 72°F in winter (July) to 89°F in summer (January)
- Southeastern interior Region
- Has a wet and dry type of maritime climate however it is considered temperate because of lower temperatures common to the higher elevation.

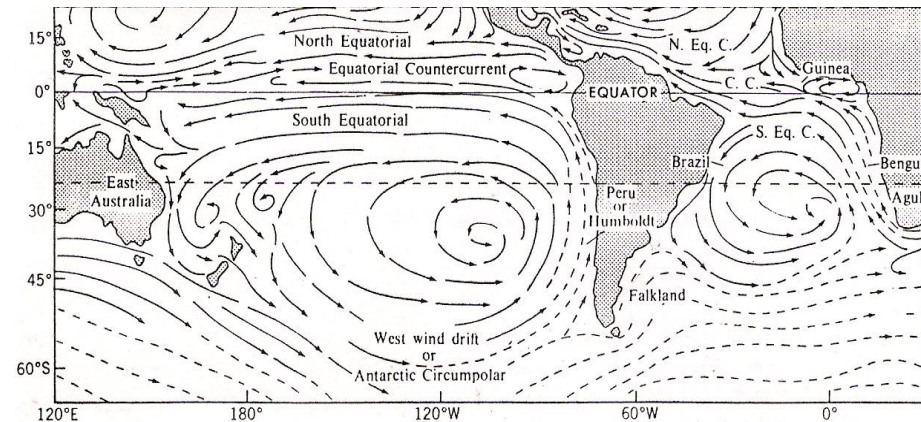
SOUTH AMERICA

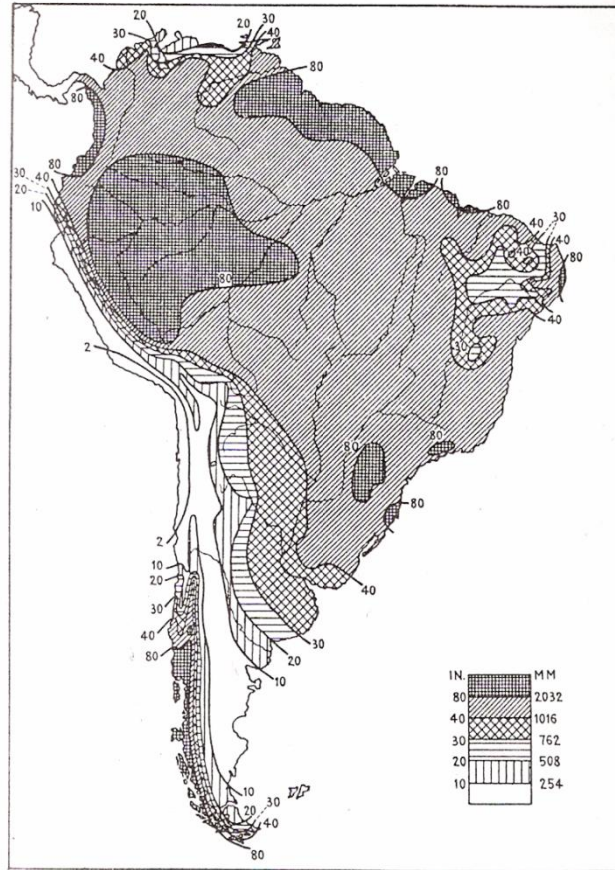


- South America has a variety of climates.
- cP air does not exist here because the continent tapers sharply from north to south.
- The larger northern area is close to the equator and does not experience the influx of cold maritime polar air from the south.
- Tropical climates prevail over much of continent. Due to presence of the high Andes Mountains along the western coast, some areas are extremely dry and others are extremely wet.

- Northeastern Climate
- Consists mainly of high temperature and humidity and copious rainfall throughout the year.
- September is warmest month with average temperatures of around 82°F. January is the coldest month with average temperatures of around 79°F.
- Night time temperatures rarely fall below 65°F. Rainfall averages 87 inches annually with 12 inches falling in June and just over 2 inches falling in October.
- Higher elevations of this area have greater ranges of temperature, humidity and precipitation which are not extreme.
-
- Southern Climate
- The warmest month is January which averages 74°F. July average 49°F is coolest month. Precipitation occurs fairly evenly throughout the year and averages 38 inches. There is no distinct rainy season. Below 40°S latitude, climate is progressively drier and cooler. However extreme southern tip of South America is characterized by year round cold and damp climate due to strong maritime influence.

- West Coast Climate
- The areas along west coast from northern Peru to the middle of Chile is a desert. North and south of this desert midsection, the climate is quite humid.
- The northwest coast has a typical tropical climate with wet and dry seasons.
- Below central Chile, the climate is generally rainy and cool. Summer does not exist. Winter temperatures average above freezing.





- South America projects far south into the southern middle latitudes. It extends from 12°N in the Northern Hemisphere southwards upto about 55°S in the Southern Hemisphere. The largest and most compact part of the continent lies in the neighborhood of the equator spreading over the two Tropics. The entire north-south oriented continent lies in tropical, temperate and even polar latitudes. While the broad northern part comes under the influence of warm equatorial climate, its southernmost tip is exposed to the effect of very cold Antarctic influence.

NORTH AMERICA

- The weather in the United States, with minor exceptions, is typical of all weather types within the temperate regions of the North American, European, and Asiatic Continents.
- The general circulation in the United States, is from west to east.
- There are many subdivisions of weather regions in the United States.
- Northwest Pacific Coast Area
- This area has more precipitation primarily due to result of frontal phenomena, consisting mainly of occlusions, which move in over the coast from area of the Aleutian low and orographic lifting of moist, stable maritime air. Stratus and fog are common in all seasons. Rainfall is most frequent in winter and least frequent in the summer.

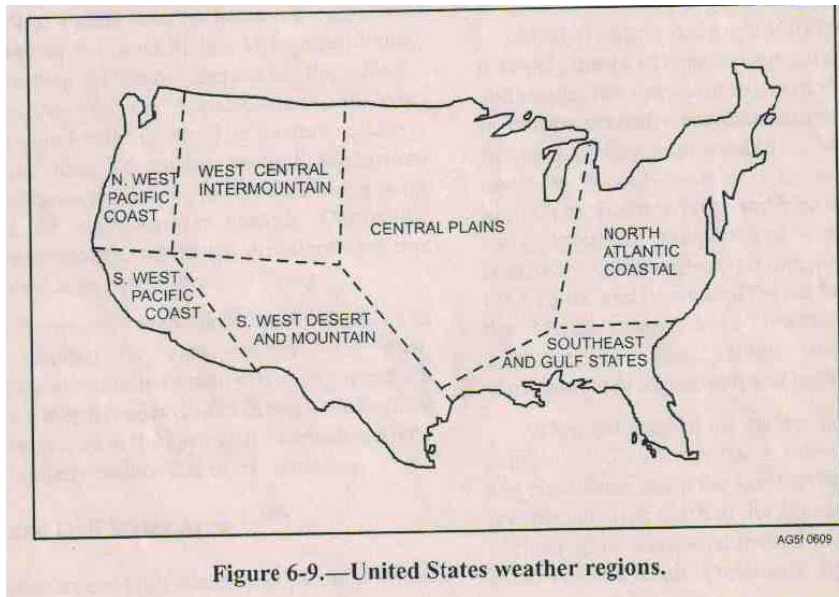


Figure 6-9.—United States weather regions.

- Southwest Pacific Coast Area
- This area experiences a Mediterranean type climate, occurs exclusively in the Mediterranean and southern California in the Northern Hemisphere. This climate is characterized by warm to hot summers, tempered by sea breezes, and by mild winters. Little or no rainfall occurs in the summer and only light to moderate rain in the winter.
- Cold fronts rarely penetrate this area. Weather in this area is due to circulation of moist pacific air from the west. In summer, fog and stratus result due to stable air, which is forced over mountain ranges causing showers or snow.
- Intermountain West Central area.
- This area includes Great Plains region. This area is located east of the Cascade and coastal ranges, west of the Mississipi Valley, and north of the southwest desert area. The climate is generally cold and dry in winter and warm and dry in summer. Most of the area is semiarid.
- The western mountain range acts as a climate barrier. Maximum rainfall occurs in the spring, due to passage of cyclonic storms. In mid winter, a cold high is centred in this region which prevents possibility of storm passages. Annual precipitation is normally light.
- Southwest Desert and Mountain area.
- This area includes lower California and some of southeast California as well as the southern portions of Arizona, New Mexico and Texas. This area is surrounded by high mountains and is either very arid or actual desert. Annual rainfall is seldom exceeds 5 inches. Northerly section have cold winters and all parts have extremely hot summers. Spring and summer thunderstorms are caused by mT air being forced aloft at the mountains and are almost severe.

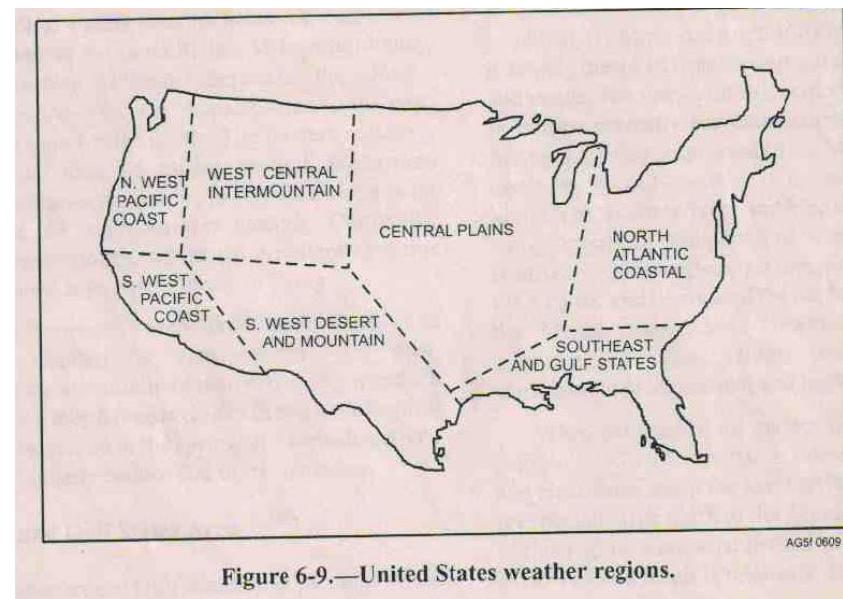
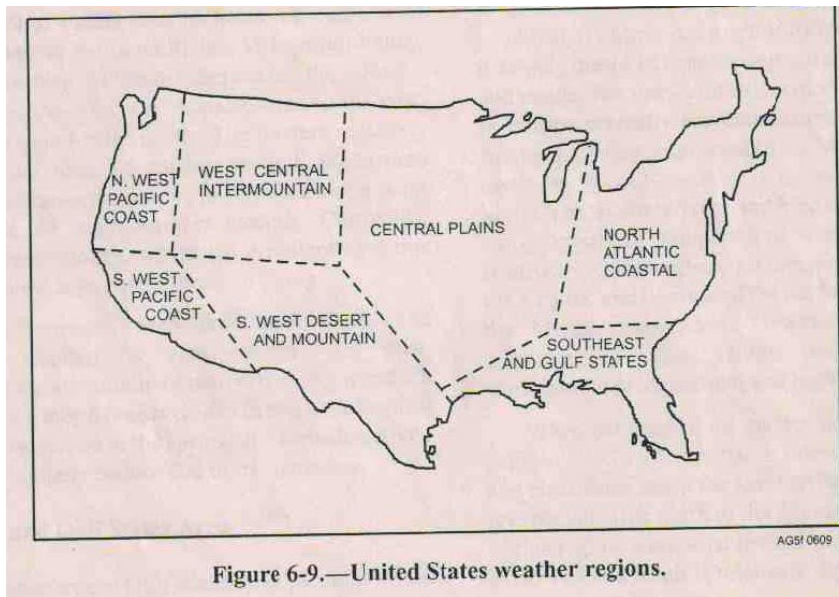


Figure 6-9.—United States weather regions.



- Central Plain areas.
- This area includes the continental climate regions of the Great Plains, Mississippi Valley, and the Appalachian Plateau between the Rocky mountains to west, the Appalachians to the east, and Gulf States to the south.
- Western Section is drier than the eastern section.
- Winter time outbreak and associated wave phenomena along polar fronts cause the main weather hazards. Convective air mass thunderstorms in summer are prevalent over this area.
- Frontal passages (cold and warm) and associated weather is common. Thunderstorms occurs in spring and tornado activity becomes a climatic feature due to its frequency.
-
- South east and Gulf States area.
- Includes all states bordering on the Gulf of Mexico as well as the South California and Georgia. Stagnating southbound cold fronts , rapidly moving squall lines, air mass thunderstorms and stratus clouds occur in various combinations and makes this area especially complex one for forecaster.
- Frontal passages can be expected only in the late fall, winter, and early spring. Gulf stratus , a circulation phenomena affects this area in the winter . This is mainly due to southerly warm , moist Gulf air at surface is cooled from below to saturation.
- Southerly circulation in summer causes warm, moist air to be heated from below and convective thunderstorms are common and generally severe.
-
- North Atlantic Coastal area.
- It is an area of storm track convergence, and cyclonic storm activity is frequent in winter over the Great Lakes. Good weather prevails in Summer due to predominant influence of the Bermuda high.