

## = Prevailing winds =

Prevailing winds are winds that blow predominantly from a single general direction over a particular point on the Earth 's surface . The dominant winds are the trends in direction of wind with the highest speed over a particular point on the Earth 's surface . A region 's prevailing and dominant winds are often affected by global patterns of movement in the Earth 's atmosphere . In general , easterly flow occurs at low and medium latitudes globally . In the mid @-@ latitudes , westerly winds are the rule and their strength is largely determined by the polar cyclone . In areas where winds tend to be light , the sea breeze / land breeze cycle is the most important to the prevailing wind ; in areas which have variable terrain , mountain and valley breezes dominate the wind pattern . Highly elevated surfaces can induce a thermal low , which then augments the environmental wind flow .

Wind roses are tools used to determine the direction of the prevailing wind . Knowledge of the prevailing wind allows the development of prevention strategies for wind erosion of agricultural land , such as across the Great Plains . Sand dunes can orient themselves , or perpendicular to , the prevailing wind regime within coastal and desert locations . Insects drift along with the prevailing wind , while birds are able to fly more independently of it . Prevailing winds in mountainous locations can lead to significant rainfall gradients within the topography , ranging from wet across windward @-@ facing slopes to desert @-@ like conditions along their lee slopes . Prevailing winds can have differences due to the uneven heating of the Earth .

## = = Determination for a location = =

A wind rose is a graphic tool used by meteorologists to give a succinct view of how wind speed and direction are typically distributed at a particular location . Presented in a polar coordinate grid , the wind rose shows the frequency of winds blowing from particular directions . The length of each spoke around the circle is related to the frequency that the wind blows from a particular direction per unit time . Each concentric circle represents a different frequency , emanating from zero at the center to increasing frequencies at the outer circles . A wind rose plot may contain additional information , in that each spoke is broken down into color @-@ coded bands that show wind direction ranges . Wind roses typically use 8 or 16 cardinal directions , such as north ( N ) , NNE , NE , etc . , although they may be subdivided into as many as 32 directions .

## = = Climatology = =

### = = = Trades and their impact = = =

The trade winds ( also called trades ) are the prevailing pattern of easterly surface winds found in the tropics near the Earth 's equator , equatorward of the subtropical ridge . These winds blow predominantly from the northeast in the Northern Hemisphere and from the southeast in the Southern Hemisphere . The trade winds act as the steering flow for tropical cyclones that form over world 's oceans , guiding their path westward . Trade winds also steer African dust westward across the Atlantic ocean into the Caribbean sea , as well as portions of southeast North America .

### = = = Westerlies and their impact = = =

The westerlies or the prevailing westerlies are the prevailing winds in the middle latitudes ( i.e. , between 35 and 65 degrees latitude ) , which blow in areas poleward of the high pressure area known as the subtropical ridge in the horse latitudes . These prevailing winds blow from the west to the east , and steer extra @-@ tropical cyclones in this general manner . The winds are predominantly from the southwest in the Northern Hemisphere and from the northwest in the Southern Hemisphere . They are strongest in the winter when the pressure is lower over the poles , such as when the polar cyclone is strongest , and weakest during the summer when the polar

cyclone is weakest and when pressures are higher over the poles .

Together with the trade winds , the westerlies enabled a round @-@ trip trade route for sailing ships crossing the Atlantic and Pacific oceans , as the westerlies lead to the development of strong ocean currents in both hemispheres . The westerlies can be particularly strong , especially in the southern hemisphere , where there is less land in the middle latitudes to cause the flow pattern to amplify , which slows the winds down . The strongest westerly winds in the middle latitudes are called the Roaring Forties , between 40 and 50 degrees south latitude , within the Southern Hemisphere . The westerlies play an important role in carrying the warm , equatorial waters and winds to the western coasts of continents , especially in the southern hemisphere because of its vast oceanic expanse .

The westerlies explain why coastal North America tends to be wet , especially from Northern California to Alaska , during the winter . Differential heating from the sun between the land which is quite cool and the ocean which is relatively warm causes areas of low pressure to develop over land . This results in moisture rich air from the Pacific Ocean to flow from the west , resulting in frequent rainstorms and wind on the coast . This moisture continues to flow eastward until orographic lift caused by the Coast , Cascade , Columbia and Rocky Mountains cause a rain shadow effect which limits further penetration of these systems and associated rainfall eastward . This trend reverses in the summer when strong heating of the land causes high pressure and tends to block moisture @-@ rich air from the Pacific from reaching land . This explains why most of coastal North America in the middle latitudes experiences dry summers , despite abundant rainfall in the winter .

= = = Polar easterlies = = =

The polar easterlies ( also known as Polar Hadley cells ) are the dry , cold prevailing winds that blow from the high @-@ pressure areas of the polar highs at the north and South poles towards the low @-@ pressure areas within the westerlies at high latitudes . Like trade winds and unlike the westerlies , these prevailing winds blow from the east to the west , and are often weak and irregular . Due to the low sun angle , cold air builds up and subsides at the pole creating surface high @-@ pressure areas , forcing an equatorward outflow of air ; that outflow is deflected westward by the Coriolis effect .

= = Local considerations = =

= = = Sea and land breezes = = =

In areas where the wind flow is light , sea breezes and land breezes are important factors in a location 's prevailing winds . The sea is warmed by the sun to a greater depth than the land due to its greater specific heat . The sea therefore has a greater capacity for absorbing heat than the land , so the surface of the sea warms up more slowly than the land 's surface . As the temperature of the surface of the land rises , the land heats the air above it . The warm air is less dense and so it rises . This rising air over the land lowers the sea level pressure by about 0 @.@ 2 % . The cooler air above the sea , now with higher sea level pressure , flows towards the land into the lower pressure , creating a cooler breeze near the coast .

The strength of the sea breeze is directly proportional to the temperature difference between the land mass and the sea . If an offshore wind of 8 knots ( 15 km / h ) exists , the sea breeze is not likely to develop . At night , the land cools off more quickly than the ocean due to differences in their specific heat values , which forces the daytime sea breeze to dissipate . If the temperature onshore cools below the temperature offshore , the pressure over the water will be lower than that of the land , establishing a land breeze , as long as an onshore wind is not strong enough to oppose it .

= = = Circulation in elevated regions = = =

Over elevated surfaces , heating of the ground exceeds the heating of the surrounding air at the same altitude above sea level , creating an associated thermal low over the terrain and enhancing any lows which would have otherwise existed , and changing the wind circulation of the region . In areas where there is rugged topography that significantly interrupts the environmental wind flow , the wind can change direction and accelerate parallel to the wind obstruction . This barrier jet can increase the low level wind by 45 percent . In mountainous areas , local distortion of the airflow is more severe . Jagged terrain combines to produce unpredictable flow patterns and turbulence , such as rotors . Strong updrafts , downdrafts and eddies develop as the air flows over hills and down valleys . Wind direction changes due to the contour of the land . If there is a pass in the mountain range , winds will rush through the pass with considerable speed due to the Bernoulli principle that describes an inverse relationship between speed and pressure . The airflow can remain turbulent and erratic for some distance downwind into the flatter countryside . These conditions are dangerous to ascending and descending airplanes .

Daytime heating and nighttime cooling of the hilly slopes lead to day to night variations in the airflow , similar to the relationship between sea breeze and land breeze . At night , the sides of the hills cool through radiation of the heat . The air along the hills becomes cooler and denser , blowing down into the valley , drawn by gravity . This is known a katabatic wind or mountain breeze . If the slopes are covered with ice and snow , the katabatic wind will blow during the day , carrying the cold dense air into the warmer , barren valleys . The slopes of hills not covered by snow will be warmed during the day . The air that comes in contact with the warmed slopes becomes warmer and less dense and flows uphill . This is known as an anabatic wind or valley breeze .

= = Effect on precipitation = =

Orographic precipitation occurs on the windward side of mountains and is caused by the rising air motion of a large @-@ scale flow of moist air across the mountain ridge , resulting in adiabatic cooling and condensation . In mountainous parts of the world subjected to consistent winds ( for example , the trade winds ) , a more moist climate usually prevails on the windward side of a mountain than on the leeward or downwind side . Moisture is removed by orographic lift , leaving drier air ( see katabatic wind ) on the descending and generally warming , leeward side where a rain shadow is observed .

In South America , the Andes mountain range blocks Pacific moisture that arrives in that continent , resulting in a desertlike climate just downwind across western Argentina . The Sierra Nevada range creates the same effect in North America forming the Great Basin and Mojave Deserts .

= = Effect on nature = =

Insects are swept along by the prevailing winds , while birds follow their own course . As such , fine line patterns within weather radar imagery , associated with converging winds , are dominated by insect returns . In the Great Plains , wind erosion of agricultural land is a significant problem , and is mainly driven by the prevailing wind . Because of this , wind barrier strips have been developed to minimize this type of erosion . The strips can be in the form of soil ridges , crop strips , crops rows , or trees which act as wind breaks . They are oriented at a right angle to the wind in order to be most effective . In regions with minimal vegetation , such as coastal and desert areas , transverse sand dunes orient themselves perpendicular to the prevailing wind direction , while longitudinal dunes orient themselves parallel to the prevailing winds .