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Chapter 1 : Chapter Moisture,Clouds, and Precipitation

Water vapor in the air changes to a liquid and forms dew, fog, or clouds Water vapor requires a surface to condense on Possible condensation surfaces on the ground can be the grass, a car window, etc.

Similar ascent is seen around tropical cyclones outside of the eyewall , and in comma-head precipitation patterns around mid-latitude cyclones. Occluded fronts usually form around mature low-pressure areas. When it gets cold, Mars has precipitation that most likely takes the form of ice needles, rather than rain or snow. It falls as showers with rapidly changing intensity. Convective precipitation falls over a certain area for a relatively short time, as convective clouds have limited horizontal extent. Most precipitation in the tropics appears to be convective; however, it has been suggested that stratiform precipitation also occurs. Orographic lift and Precipitation types Orographic 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 relatively 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. Windward sides face the east to northeast trade winds and receive much more rainfall; leeward sides are drier and sunnier, with less rain and less cloud cover. Snow Lake-effect snow bands near the Korean Peninsula in early-December The band of precipitation that is associated with their warm front is often extensive, forced by weak upward vertical motion of air over the frontal boundary which condenses as it cools and produces precipitation within an elongated band, [54] which is wide and stratiform , meaning falling out of nimbostratus clouds. In the Northern Hemisphere , poleward is towards the North Pole , or north. Within the Southern Hemisphere , poleward is towards the South Pole , or south. Southwest of extratropical cyclones, curved cyclonic flow bringing cold air across the relatively warm water bodies can lead to narrow lake-effect snow bands. Those bands bring strong localized snowfall which can be understood as follows: The temperature decrease with height and cloud depth are directly affected by both the water temperature and the large-scale environment. The stronger the temperature decrease with height, the deeper the clouds get, and the greater the precipitation rate becomes. Because of the ruggedness of terrain, forecasting the location of heavy snowfall remains a significant challenge. Monsoon and Tropical cyclone Rainfall distribution by month in Cairns showing the extent of the wet season at that location The wet, or rainy, season is the time of year, covering one or more months, when most of the average annual rainfall in a region falls. Tropical rainforests technically do not have dry or wet seasons, since their rainfall is equally distributed through the year. The wet season is a time when air quality improves, [63] freshwater quality improves, [64] [65] and vegetation grows significantly. Soil nutrients diminish and erosion increases. The previous dry season leads to food shortages into the wet season, as the crops have yet to mature. Developing countries have noted that their populations show seasonal weight fluctuations due to food shortages seen before the first harvest, which occurs late in the wet season. Earth rainfall climatology On the large scale, the highest precipitation amounts outside topography fall in the tropics, closely tied to the Intertropical Convergence Zone , itself the ascending branch of the Hadley cell. Mountainous locales near the equator in Colombia are amongst the wettest places on Earth. In Asia during the wet season, the flow of moist air into the Himalayas leads to some of the greatest rainfall amounts measured on Earth in northeast India. Plastic gauges have markings on the inner cylinder down to 0. After the inner cylinder is filled, the amount inside it is discarded, then filled with the remaining rainfall in the outer cylinder until all the fluid in the outer cylinder is gone, adding to the overall total until the outer cylinder is empty. These gauges are used in the winter by removing the funnel and inner cylinder and allowing snow and freezing rain to collect inside the outer cylinder. Some add anti-freeze to their gauge so they do not have to melt the snow or ice that falls into the gauge. Weighing gauges with antifreeze should do fine with snow, but again, the funnel needs to be removed before the event begins. For those looking to measure rainfall the most inexpensively, a can that is cylindrical with straight sides will act as a rain gauge if left out in the open, but its accuracy will depend on what ruler is used to measure the rain with. Any of the above rain gauges can be made at home, with enough know-how. Any particulates of liquid or solid water in the atmosphere are known as hydrometers. Formations due to condensation, such as clouds, haze , fog, and mist, are composed of hydrometeors. All precipitation types are made up of hydrometers by definition, including virga, which is precipitation which evaporates before reaching the ground. This includes the vast expanses of ocean and remote land areas. In other cases, social, technical or administrative issues prevent the dissemination of gauge observations. As a result, the modern global record of precipitation largely depends on satellite observations. The sensors are almost exclusively passive, recording what they see, similar to a camera, in contrast to active sensors radar , lidar that send out a signal and detect its impact on the area being observed. Satellite sensors now in practical use for precipitation fall into two categories. Thermal infrared IR sensors record a channel around 11 micron wavelength and primarily give information about cloud tops. Due to the typical structure of the atmosphere, cloud-top temperatures are approximately inversely related to cloud-top heights, meaning colder clouds almost always occur at higher altitudes. Further, cloud tops with a lot of small-scale variation are likely to be more vigorous than smooth-topped clouds. Various mathematical schemes, or algorithms, use these and other properties to estimate precipitation from the IR data. The frequencies in use range from about 10 gigahertz to a few hundred GHz. Additional sensor channels and products have been demonstrated to provide additional useful information including visible channels, additional IR channels, water vapor channels and atmospheric sounding retrievals. However, most precipitation data sets in current use do not employ these data sources. IR works best in cases of deep, vigorous convectionâ€”such as the tropicsâ€”and becomes progressively less useful in areas where stratiform layered precipitation dominates, especially in mid- and high-latitude regions. The more-direct physical connection between hydrometeors and microwave channels gives the microwave estimates greater skill on short time and space scales than is true for IR. However, microwave sensors fly only on low Earth orbit satellites, and there are few enough of them that the average time between observations exceeds three hours. This several-hour interval is insufficient to adequately document precipitation because of the transient nature of most precipitation systems as well as the inability of a single satellite to appropriately capture the typical daily cycle of precipitation at a given location. In some cases the long-term homogeneity of the dataset is emphasized, which is the Climate Data Record standard. In other cases, the goal is producing the best instantaneous satellite estimate, which is the High Resolution Precipitation Product approach. In either case, of course, the less-emphasized goal is also considered desirable. One key result of the multi-satellite studies is that including even a small amount of surface gauge data is very useful for controlling the biases that are endemic to satellite estimates. The difficulties in using gauge data are that 1 their availability is limited, as noted above, and 2 the best analyses of gauge data take two months or more after the observation time to undergo the necessary transmission, assembly, processing and quality control. Thus, precipitation estimates that include gauge data tend to be produced further after the observation time than the no-gauge estimates. As a result, while estimates that include gauge data may provide a more accurate depiction of the "true" precipitation, they are generally not suited for real- or near-real-time applications. The rainfall will be greater and the flooding will be worse than the worst storm expected in any single year. The rainfall will be extreme and flooding to be worse than a 1 in 10 year event.

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Key Concepts Ch. Moisture, Clouds, and Precipitation After reading and studying Ch. 17, you should be able to. Concept 1:List the processes that cause water to change from one state of matter to another.

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Chapter 4 : Condensation - Precipitation

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For precipitation to form, cloud droplets must grow in volume by roughly one million times. Cold Cloud Precipitation â€¢ The Bergeron process is a theory that relates the formation of precipitation to supercooled clouds, freezing nuclei, and the different saturation levels of ice and liquid water.

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11/28/ Classification of clouds according to height and form (continued).

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Moisture, Clouds, and Precipitation Chapter 12 Lecture Outline. Humidity: Water Vapor in the Air â€¢Humidity - general term for amount of water vapor in the air.

Chapter 9 : Moisture, Clouds, and Precipitation

Moisture, Clouds and Precipitation. c Explain the importance of water vapor and its influence on weather (clouds, relative humidity, dew point, precipitation).