I'm not a robot

Jupiter's Great Red Spot, a storm so big it could swallow Earth, extends surprisingly deep beneath the planet's cloud tops, scientists have reported.NASA's Juno spacecraft shows Jupiter's Great Red Spot is 350 to 500 kilometres deepThe planet, known as a gas giant, is composed mainly of hydrogen and heliumThe storm has changed shape and could be shrinking in sizeData from NASA's Juno spacecraft is providing a deeper understanding of Jupiter's wondrous and violent atmosphere, including its Great Red Spot, finding the storm extends much further down than first thought.Despite the storm shrinking, it still has a width of 16,000 kilometres and a depth of between 350 and 500 kilometres.The planet, known as a gas giant, is composed primarily of hydrogen and helium, with traces of other gases.The data is giving scientists studying the solar system's largest planet — so big that 1,000 Earths could fit inside it — a three-dimensional account of Jupiter's atmosphere.An instrument called a microwave radiometer enabled scientists to peer beneath Jupiter's cloud tops and investigate the structure of its numerous vortex storms. Lead scientist Scott Bolton, from Southwest Research Institute, said there might not be a hard cut-off at the bottom of the storm."It probably fades out gradually and keeps going down," Dr Bolton said.Jupiter's Great Red Spot captured by NASA's Juno spacecraft. (REUTERS: NASA/JPL-Caltech/SwRI/MSSS/Gerald Eichstad/Sean Doran/Handout )Dr Bolton said assumptions based on how Earth's atmosphere behaves, as well as models produced over the past few decades, had given the impression that the Great Red Spot was a relatively shallow storm."Jupiter works in this mysterious way that we're sort of revealing for the first time because this is the first mission that's been able to look inside the planet," Dr Bolton said."We're seeing surprises."The Juno spacecraft will soon be measuring the depth of the polar cyclones, which might penetrate even deeper beneath the clouds.The Great Red Spot could be the tallest Jovian storm measured with Juno's microwave and gravity-mapping instruments, Dr Bolton said."I wouldn't want to be too quick to guess that we've seen the deepest," he said."But the Great Red Spot is the largest and that makes it special by itself, and you might expect that it might be deeper just because of that."The Great Red Spot has evolved in shape over time and there are indications that it may be shrinking in size."It's the biggest storm in the entire solar system. There isn't anything else like it," Dr Bolton said"The extremes are usually fascinating but they also create incredible beauty."In 2011, Juno has been orbiting the solar system's largest planet since 2016 obtaining information about its atmosphere, interior structure, internal magnetic field and the region. Juno also is due to fly by Jupiter's large moons, Europa and Io, and explore the small rings around the planet.By contrast, some of the surrounding jet streams extend an estimated 3,200 kilometres into Jupiter.NASA recently extended the mission by another four years, to 2025.AP/Reuters Clouds are ice crystals or water drops suspended in the sky. Clouds form when the air cools and water vapor condenses into liquid form.The biggest type of cloud is the cumulonimbus, the towering vertical cloud responsible for thunder, lightning, and hail.Sometimes called thunderheads, these large clouds form when powerful air currents push water vapor upward.Keep reading to learn more about the largest clouds and different cloud types.Cumulonimbus clouds are tall storm clouds that bring thunder, lightning, and hail thanks to strong upward currents.These clouds are common with cold fronts but may form in their own clusters, too.You can tell cumulonimbus clouds apart from others by their sheer size, as they are very tall and tower through the sky, appearing quite ominous at times, particularly on a stormy day.Their typical altitude ranges from 2,000 to 45,000 ft., which is much more than other clouds.Cumulonimbus clouds are much more common in tropical and temperate regions than at the north or south poles.Wherever these clouds are, heavy downpours may follow, as the top part of the cloud has ice crystals and the rest contains liquid water.There are ten main types of clouds, split into low, middle, and high clouds depending on where they appear in the sky.Only two of these clouds transcend more than one level, and cumulonimbus clouds are the only kind to reach all three.When thunderstorms are forecast, it's not uncommon to see cumulonimbus clouds very low to the ground, around 2,000 ft., and then they stretch upward into the sky, surpassing 40,000 ft. in many cases.Cumulonimbus clouds are created through convection as they grow out of small cumulus clouds in warm conditions.Warm updrafts push the air up as these clouds spread out in the sky, getting taller until they eventually have the same energy level as ten atomic bombs.Cumulonimbus clouds are known for big rain, wind, and hailstorms, and they are formed by thermal winds forced upward by warm air.These heavy, dense clouds are prevalent in the American South and Midwest, home to Tornado Alley where big thunder clouds bring deadly storms.There are three key conditions needed for cumulonimbus clouds to form, including:Consistent supply of moist warm air, rising at 25–70mphIncreased tropospheric winds which give cumulonimbus clouds their heightUnstable atmosphere without temperature inversionsThere are three stages of cumulonimbus cloud formation, starting with the cumulus stage as condensation builds up inside the cloud's base.Next is the mature stage, when the clouds produce a thunderstorm or mix with others to create a supercell.Finally, there's the dissipating stage as the clouds begin to break up, usually around 25–30 minutes after the mature stage.Cumulonimbus clouds cause heavy rain and thunderstorms across the globe, so if you see these tall, towering thunderclouds, you'll definitely want to grab an umbrella.For cumulonimbus clouds and all clouds in general, water builds up in larger droplets, eventually falling to the ground as rain or snowflakes in colder air.There may be sleet or freezing rain when the droplets melt during the fall to the ground, only to get colder as they hit the surface.You will often see hail with cumulonimbus clouds during severe weather events. Hail forms as air currents move rain and snow throughout the atmosphere, with water turning into ice as it gets colder.The ice chunks continue to grow in size until they eventually fall out of the sky and hit the ground as potentially damaging hail.While big cumulonimbus clouds cause rain, thunder, and lightning, large cumulus clouds are found in fair-weather skies.When you look up on a nice day and see white, fluffy clouds, you're most likely looking at cumulus clouds, which are low to the ground near 2,000 to 3,000 ft.Cumulus clouds are found around the world, apart from Antarctica, where the air is too cold.They don't really cause noticeable precipitation, other than the occasional brief shower caused by congestus cloud buildup when cumulus clouds are very tall and narrow.Thermal convection currents are created during sunny weather as the sun warms up the ground, leading to cumulus clouds with their distinctive puff.Cumulus clouds are split into three types: humilis, mediocris, and congestus. Humilis clouds are wide and short, while mediocris clouds are similar in height and width.Water droplets in the atmosphere are responsible for cloud formation, as water consistently evaporates from the ground up.There is always water vapor in the sky, but it remains invisible until the air cools down and condenses into liquid form.The air is then saturated with water vapor, allowing clouds to form.Clouds only form in cool air, and water condensation may occur around sea salt, ice, or dust in the atmosphere.Conditions such as wind and temperature play a key role in what type of clouds form and how they appear in the sky.Cumulus and cumulonimbus clouds form as warm air rises from the Earth's surface to turn water vapor into liquid.Other clouds like stratus and lenticular are formed when the wind hits the side of mountains and pushes upward.Low-pressure areas and weather fronts also cause air to rise and clouds to form.Weather fronts occur when two large air masses collide near the earth's surface and force air currents up.With varying temperatures and humidity levels in each air mass, the conditions are right for weather fronts to create clouds, particularly those with precipitation.These transition zones often lead to severe weather, such as heavy rain or wind as seen in cumulonimbus clouds.With a warm weather front, a mass of hot air slides over a pocket of cold air, pushing the warm air up to form low status, altocumulus, and high cirrus clouds.Larger cumulonimbus and nimbostratus clouds often result from warm fronts, too.Similarly, cold fronts can form cumulonimbus clouds and associated thunderstorms, as well as stratus and stratocumulus clouds.When a heavy mass of cold air pushes warm air up, white, fluffy cumulus clouds appear, too.Cumulonimbus clouds are the largest, while cirrus and cirrocumulus are the smallest. Both are quite light and wispy, appearing high in the sky and visible from airplanes around 20,000–40,000 feet.Many people think cirrus clouds resemble silky tufts of hair, as they appear light and delicate, the total opposite of towering thunderclouds.These high-level clouds are mainly made of ice crystals, giving them their white, steaky look, similar to a jet streak.Cirrus clouds are more feathery than cirrostratus clouds, which may appear slightly thicker.These small clouds typically form when dry, warm air rises, causing water vapor to condense around tiny dust particles.As the smallest and highest clouds in the atmosphere, cirrus and cirrocumulus don't lead to ground-level precipitation and are instead known for nice weather on a blue-sky day.Just keep in mind that the rise in air masses and currents often signals a change in the weather, so if there are cirrus clouds, there may be a shift coming in the next few days. This is an archived article and the information in the article may be outdated. Please look at the time stamp on the story to see when it was last updated. Dear Tom, What is the highest cloud top ever recorded? — Brian Gibson, Arden, N.C. Dear Brian, It's not precisely known, but in general the higher the cloud top (in the middle latitudes), the more severe the weather associated with the cloud will be. The reference, of course, is to cumulonimbus clouds, the clouds that produce thunderstorms. In the Chicago area, typical summer thunderstorms develop to heights of 35,000 to 45,000 feet, but the tops of severe thunderstorms that produce large hail, damaging winds and even tornadoes can reach to 60,000 feet or more. The devastating Plainfield tornado of Aug. 28, 1990, developed from a thunderstorm that towered to 65,000 feet. Earth's tallest thunderstorms form in the tropics, where tops have been measured to about 75,000 feet — more than 14 miles into the atmosphere. Archive July 13, 2004 If raindrops on roses are among your favorite things, University of Washington researchers have encountered some monster drops that could change your mind. On two occasions, separated by four years and thousands of miles and in very different conditions, raindrops were measured at sizes similar to or greater than the largest ever recorded. The largest ones were at least 8 millimeters in diameter, about the same as the largest previously observed, and were possibly a centimeter — about four-tenths of an inch or one-fourth the diameter of a golf ball — according to findings published today in the online edition of Geophysical Research Letters, a journal of the American Geophysical Union. As they fall toward earth, raindrops don't have the cliché teardrop shape, said Peter Hobbs, a UW atmospheric sciences professor. Instead, they are shaped more like a parachute, or a jellyfish. "Most of the water is around the rim of the drop, while the upper part of the drop is a very thin film of water," Hobbs said. When air forces through the thin film at the top, large drops break up into many smaller drops. Large drops also can break up when they collide with other drops. In laboratory conditions, breakup usually happens when the drops reach about 5 millimeters, or about one-fifth of an inch, in diameter. In clouds, when drops reach that size they generally break up in collisions with other drops. "That's why it's so rare to see a raindrop of 5 millimeters or more on the ground, because it would mean the drop had avoided collisions with the many other drops in a cloud," Hobbs said. Yet the UW Cloud and Aerosol Research Group recorded raindrops of at least 8 millimeters, and perhaps a centimeter, during research flights through cumulus congestus clouds spawned by a burning forest in Brazil in 1995. Giant raindrops also were recorded during a flight through cumulus clouds in clean marine air over the Marshall Islands in 1999. Hobbs and Arthur Rangno, a UW atmospheric sciences research meteorologist, are co-authors of the paper documenting the findings. The work was supported by funding from the National Science Foundation and the National Aeronautics and Space Administration. The scientists speculate the giant raindrops in the polluted air above the burning Amazon forest could have formed around large ash particles, while those in the Marshall Islands might have been spawned by particles of sea salt. It is not unusual to see large drops in clouds formed in clean marine air because there are fewer particles on which the water can collect, Hobbs said. But smoky air typically produces small raindrops because there are so many particles for the water to condense upon, so it is unclear why the huge raindrops formed over Brazil. He noted that collisions of drops can produce larger drops that then gather up additional small drops as they fall, much as a drip does as it slides down a window pane. That could be what happened in the Brazil storm clouds, as a few favored raindrops fell through, and collected, smaller drops present in large concentrations within particular regions of the clouds. The scientists discovered the giant raindrops as they culled mountains of data recorded when the research group still operated its own aircraft. The aircraft was sold in 2002, but scientists still are going through data from a number of missions, including campaigns in Africa and the United States, as well as Brazil and the South Pacific. "We collected so much data on those flights, recording thousands of events a minute, and it will take years to analyze all of the information," Hobbs said. "We just discovered the giant drops by accident when we were looking for something else." ### For more information, contact Hobbs at (206) 543-6027 or phobbs@atmos.washington.edu or Rangno at (206) 543-7643 or art@atmos.washington.edu Thunderstorms are fascinating natural phenomena that can reach impressive heights. The highest thunderstorm cloud ever recorded topped out at 65,000 feet (approximately 19,812 meters), occurring in 1990. This remarkable event was tied to a powerful cumulonimbus cloud, known for its dramatic vertical growth and severe weather capabilities. Understanding such extremes enhances awareness of severe weather and its potential impact. Meteorologists continue to study these towering giants, as they play a critical role in weather systems worldwide. The World Meteorological Organization monitors these events, contributing to our understanding of atmospheric behavior. Knowing the heights and characteristics of the tallest thunderstorms aids in predicting extreme weather events, which can have significant effects on communities. The study of thunderstorm clouds offers insight not only into the storms themselves but also into the broader patterns of severe weather. By exploring the highest recorded thunderstorms, readers can gain a better appreciation of the dynamic processes that shape our atmosphere. Anatomy of Thunderstorms Thunderstorms are complex systems made up of various components. Understanding their formation and structure is key to recognizing their potential severity. Thunderstorms can produce phenomena like lightning, hail, and even tornadoes. Formation and Structure Thunderstorms form in three main stages: cumulus, mature, and dissipating. They begin as cumulus clouds, which are warm, rising air currents. As the temperature increases, these clouds can develop into more structured systems. The cumulonimbus cloud is the core of a thunderstorm. It can reach heights of 12 kilometers or more, extending through the troposphere and into the stratosphere. Within these clouds, powerful updrafts generate strong winds and can result in an overshooting top—the highest point of the cloud. Conditions such as surface temperature and humidity greatly influence thunderstorm development. The Most Extreme Thunderstorms Some thunderstorms reach remarkable heights, boasting cloud tops over 20 kilometers. These storms are often classified as supercells, which are known for their severe weather and rotation. Supercells can produce large hail and intense lightning. Extreme thunderstorms commonly occur near the equator, where warm air converges and rises. They are studied using radar technology to track movements and predict severe weather conditions. The presence of wind shear often leads to the formation of tornadoes within these storms. Each thunderstorm's ability to reach such heights can indicate the potential for dangerous weather patterns. Understanding these aspects can help communities prepare for severe weather events. Impacts and Records Thunderstorms significantly influence the atmosphere and can create dangerous conditions on the surface. Understanding historical records and their effects highlights the importance of monitoring these powerful weather events. Historical Thunderstorm Records The highest thunderstorm clouds, particularly those in the tropics, can reach astonishing heights. For example, some thunderstorms have reached over 20 kilometers (about 12 miles) high. This height allows storms to generate severe weather, including damaging lightning strikes. The National Weather Service tracks these events, documenting storms with the highest recorded precipitation levels, updrafts, and hail sizes. Notable records include the severe supercell thunderstorm in Vivian, South Dakota, which produced a record-breaking hailstone of 20 cm in diameter. Historical measurements indicate that thunderstorms with the tallest cloud tops host the most severe weather. Severe thunderstorm activity greatly impacts local communities, causing damage from wind and flash flooding. Effects on the Atmosphere and Surface Severe thunderstorms have a profound impact on both the atmosphere and the surface. These storms are crucial in the water cycle, as they bring intense precipitation. For example, thunderstorms generate ice crystals in cold clouds at high altitudes, which then fall as rain or hail. Lightning produced during these events can cause wildfires and electrical outages. Wind damage from thunderstorms can uproot trees and damage structures. Moreover, flash flooding is a primary concern, especially in low-lying areas. Heavy rains in a short period can overwhelm drainage systems, leading to hazardous conditions. Monitoring these impacts helps communities prepare for and respond to severe weather. Understanding thunderstorm behavior is essential for safety and minimizing property damage. Share — copy and redistribute the material in any medium or format for any purpose, even commercially. Adapt — remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Attribution — You must give appropriate credit , provide a link to the license, and indicate if changes were made . You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. ShareAlike — If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. No additional restrictions — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. Clouds come in a range of sizes, from a small cumulus cloud through to a massive thunderstorm. We know the cloudiest place in the wold is in Colombia, but where is the biggest cloud? Even the smallest clouds are already quite large. Take this little cumulus cloud as an example: Although this cumulus cloud is small by cloud standards, it is already quite large (Imaged during CREATE). The bottom of this cloud is about 1km from the ground [1]. Knowing this, we can convert the sizes of things in this image to sizes in the real world. This gives us a cloud width (about 1.5km) and the height (around 300m) - the same as the Shard (you can see the real Shard - bottom centre of the image, about 6km away). You could fit the shard almost completely inside this cloud (if you could lift it 1km above the ground) Drawing this cloud on a map, we get a better idea of the scale. This cloud is about 2km from the camera (almost directly over Buckingham Palace), but covers a large amount central London. The cloud on a map of central London along with some other important landmarks. This cloud is narrower than it is wide, but it is still stretches almost an extra kilometre away from the camera. This relatively small cloud is actually pretty large, but it wasn't even close to the largest cloud that day. Some clouds are much, much bigger, where is the biggest? (Determining the biggest cloud is not straightforward, but if you really cannot wait, you can skip ahead to the answer). Actually, an even more fundamental question is - 'What do we mean by a cloud?'. There are many regions around the world the have large cloudy regions. Stratocumulus clouds in particular form layers that stretch for thousands of kilometres, but are only a few hundred metres thick. While they cover a large area, I don't think many people would consider this a single cloud - I definitely wouldn't. These cloudy areas are large, but are not really a single cloud, so they aren't the biggest clouds (ISS30-E-20366) Image courtesy of the Earth Science and Remote Sensing Unit, NASA Johnson Space Center. Instead, we will consider the biggest cloud as being the one with the largest vertical extent (height). This leads to another problem - most satellites can only see the tops of clouds. It turns out you can measure the temperature of a cloud top relatively easily and this matches quite closely to the height of the cloud top (colder clouds are higher). There are some very cold clouds out there [2], which have some very high cloud tops, but without knowing where the bottom of the cloud is, can we say they are the biggest? [3]. If we want to see both the top and the bottom of a cloud, the easiest way to do this is with radar. In the same way that radars can see aircraft, they can also see rain. If you have the right kind of radar, they can also see clouds and rain. Luckily, there is one of these 'cloud radars' in space (sensibly named CloudSat), so we can map cloud sizes around the world. Radar cross-sections of clouds over Ireland (top) and a true-colour image (bottom) [4]. The radar points straight down, so cuts a cross section through the clouds along the red line. The brown regions in the top image show where you get stronger radar signals (thick cloud or heavy rain). The blue regions are clouds missed by the radar, but seen by lidar (a laser). In this case over Ireland, there are two types of clouds, both with a similar height top. In the top-down image, they both look the same, but the radar shows us they are actually very different. On the left, there are thinner, high-level cirrus. They have a top at about 6km, but are only a few km thick and don't get close to the surface. On the right, there are convective clouds. Not only do they have high cloud tops, but they stretch almost all the way to the surface. These clouds are actually raining (dark brown in the radar image), which hides the actual location of the bottom of the cloud [5]. For these cases, we can estimate the height of the bottom of the cloud using the Espy estimate for cloud base height, based on the surface temperature and humidity. Although the temperature of the cloud top gives us a good idea about its height, this depends on knowing how the temperature of the atmosphere is changing with height - this is not always simple. Unfortunately, the radar is not so great at seeing cloud tops either. The stealthy little ice crystals at the top of clouds have a very weak radar return, so are often missed by radars. Worried about the radar stealth characteristics of your new fighter jet? Just make it a 50th of a millimetre across. Lockheed Martin, if you want any other design tips, my email is at the bottom of the article. The solution is to use a lidar (like a radar, but using a laser). Luckily, there is also a lidar in space designed exactly for this problem! The CALIPSO satellite carries a green laser for measuring clouds and aerosols in the atmosphere. You can actually see this laser from the ground if you know where to look (don't use anything more powerful than binoculars though)! The CALIPSO satellite is orbiting at about 700km, travelling at close to 8km a second. The laser sends out a pulse of light once every 20th of a second. Capturing a photo of this from the ground is absolutely amazing! (Gregg Hendry/Ball Aerospace/NASA) The CALIPSO lidar is extraordinarily sensitive to cloud droplets and ice crystals, allowing it to accurately measure the height of the cloud top. This sensitivity comes at a cost though - it cannot see the bottoms of thick clouds, so we still need the radar. Fortunately, these two satellites fly very close to each other. For many years, they were only 15 seconds apart! [6] With good measurements of the cloud top and bottom, we can now locate the biggest cloud [7]. So where are the big clouds? This map is the 3000 biggest clouds in the satellite combined radar-lidar record between 2006 and 2016 [8]. The biggest 100 are in red. The 3000 biggest clouds in the satellite radar-lidar record. The biggest 1000 are in green and the biggest 100 are in red. They are some clear patterns. Most of the big clouds are near the equator. While there are some big clouds over the Amazon and central Africa, the majority are over South Asia and the West Pacific. This might have been what you expected if you know about tropical weather patterns. These regions have large amounts of rising air and some really big thunderstorms, creating lots of rain [9]. All of these 3000 clouds are over 17km thick, but the biggest of these convective storms is almost 20km thick! I find it hard to picture how big these clouds are. The Wokingham Storm, a large storm by UK standards and the original 'supercell' storm, was only a bit over 10-12km high. This is already higher than the height of many airliners, but the biggest thunderstorms are almost twice as tall as this! Thunderstorms in the tropics were always likely to be among the biggest clouds. The biggest cloud needs a low cloud base, this means a low surface altitude in a humid location. The tropical ocean fits this perfectly. The tropical ocean near Australia, a perfect place for big clouds (NASA/JSC). You also need to have a high cloud top. The maximum cloud top height is limited by how temperature changes in the atmosphere, setting a 'lid' on clouds. Clouds form in rising air and hot air rises as it is less dense than its surroundings. In the lower part of the atmosphere (where we live), temperature decreases with height [10]. This means a bit of air rising from the surface can remain warmer (and hence less dense) than the surrounding air, continuing its trip upwards. However, at the tropopause (usually between 10 and 15km), temperatures start to increase again. The rising air is now denser (and heavier than its surroundings), so it stops rising, limiting the height of the cloud. You can see the tropopause in this picture of large thunderstorms over the Caribbean. They are so intense, that they increase in height until they reach the tropopause, which caps how tall they can grow [11]. Flat-topped anvils on thunderstorms, where their height is limited by the tropopause. Big clouds need a high tropopause (NASA/Johnson Space Center) The height of the tropopause varies around the globe, but is the highest in the tropics, near the Equator. As it limits the height of thunderstorms, this then explains why we see the biggest thunderstorms over the tropical ocean, particularly Indonesia. The competition for biggest thunderstorm in the records comes down to these two clouds. This one, over northern Argentina Biggest thunderstorm number 1 (BT1) - over Argentina in 2010. 19.6km thick. The orange regions are the radar signal and the blue regions are the lidar signal (in regions with a small radar signal). and this one, over the Gulf of Carpentaria near Australia Biggest thunderstorm number 2 (BT2) - near Australia in 2007. 19.2km thick. The biggest thunderstorm in the record. According to the criteria we set out above, thunderstorm number 1 is the largest. It is not entirely a fair comparison though. BT1 is near the South Atlantic Anomaly, which sounds like something out of the X-Files, but is actually a regions where the Earth's magnetic field weakens, causing noise in the lidar signal (the blue speckle for BT1, compared to BT2). I am much more confident about the height of BT2, which has a strong radar return right to the top [12], making it the biggest thunderstorm in the combined radar-lidar satellite record! However, although these tropical thunderstorms are large, they are not the biggest clouds on Earth. If you look back at the map of the biggest clouds, there are a large amount over the Antarctic! While the tropopause (and so the cloud lid) is lower here, what if you could form clouds above the tropopause? Deep in the Antarctic winter, hidden up high in the darkness and cold, a special kind of cloud forms. Most clouds on Earth are formed almost entirely of water. While water plays a role in these clouds, it is nitric acid that drives their formation, with water collecting onto the nitric acid particles. Only forming below -78C, the polar stratospheric clouds (PSCs) form high up in the atmosphere, at altitudes up to about 25km. Polar stratospheric clouds over McMurdo station, Antarctica (Wikipedia). Forming so high allows these cloud to have an extraordinary vertical size. While they are not very dense (unlike the thunderstorms), some of them form near 25km and stretch right down to the troposphere. With the tropopause not limiting their height, these are the biggest clouds in the world. Radar (orange) and lidar (blue) cross sections of the biggest cloud in the world (maybe). This is the overall biggest cloud on record, which formed downwind of the West Antarctic Ice Cap and the Ellsworth Mountains. By forcing air to rise, the mountains generate an upwards travelling wave in the atmosphere that forms these absolutely colossal clouds [13]. If you live in the mid-latitudes (like me), you probably see mid-sized storms relatively often. You might even be lucky enough to see a really large thunderstorm. To see these super-large polar stratospheric clouds though, you will need to take a bit of a trip. It is dark and cold in Antarctica over winter, but the rewards are worth it (if you want to see the biggest clouds in the world that is). Please send me any nice pictures you get! Cloud sizes, with the author for scale Comments by email. The limited spatial sampling of CloudSat and CALIPSO means that there are almost certainly other very large clouds out there (although with a height that is not as well validated). If you have any other contenders, please let me know! Notes¶ Thunderstorms can be terrifying, and are certainly one method nature uses to remind us of how small we actually are. No matter where you live, you probably know a few people that are afraid of thunder, you might be one as well. This is entirely normal because not many things in the world are as frightening as the sound and power of thunder. Thunderstorms are storms that are characterized by the presence of lightning and its sound, which is known as thunder. They are usually accompanied by rains and strong winds and mostly occur inside of clouds that are known as a cumulonimbus. Throughout human history, there were many huge and dangerous thunderstorms, but the biggest one recorded was in India, and it occurred on December 1st, 2014. It was the highest voltage thunderstorm ever recorded, with 1.3 billion volts. Measuring Electric Potential Sunil Gupta, a scientist at the Tata Institute of Fundamental Research in Mumbai, measured the voltage of this thunderstorm along with his colleagues. They used a special instrument known as the muon telescope to measure the electric potential of this thunderstorm. The exact electric potential is determined by measuring the voltage between the highest and the lowest parts of a thundercloud. The muon telescope measures a lesser-known subatomic particle called the muon. A muon is similar to an electron, but it is much heavier. This particular model of the telescope was called the GRAPES-3, and it can measure particles with extremely high energy levels that come from space. These particles are known as cosmic rays. Lightning storm over a city. The telescope typically manages to register around 2.5 million muons every minute, but once a thunderstorm hits, the numbers change drastically and quickly. The researchers at the Indian institute managed to find a way to express these changes in the number of muons as the voltage of the storms that are passing through. The Storm Of The Century This all helped them measure the voltage of the storm that appeared over India on December 1st, 2014. During this thunderstorm, the number of muons decreased by 2 percent, which is a huge decline. This can be expressed as the equivalent of 1.3 billion volts of electric potential. Of course, this was not a single bolt, but instead the power of the entire electric field that was generated by the thunderstorm. If you are wondering how big the voltage of standard thunderstorms is, it usually does not go over 100 million volts. This goes to show just how huge this particular thunderstorm was. The measured voltage was ten times bigger than the previously measured biggest thunderstorm. This makes this storm over India especially impressive and puts it in a category similar to other phenomena that produce extremely large amounts of energy, such as terrestrial gamma-ray flashes. The measurements made during this storm might not work in other thunderstorms, however, and they might require some tweaking to the method used. Some scientists propose the usage of drones or balloons that would help us make more accurate measurements. However, by using this model, we were able to record a thunderstorm that could generate the power on the level of a terrestrial gamma-ray flash, which is something we've only dreamed about prior to this event. Share Contact an Account Manager Supercells are powerful thunderstorms which form around a mesocyclone, a deep, rotating updraft. At up to several kilometres across, they can last several hours, making them the longest-lasting and largest of all thunderstorms. They often occur on the Great Plains of the USA and can spawn tornadoes. Records change on a daily basis and are not immediately published online. For a full list of record titles, please use our Record Application Search. (You will need to register / login for access)Comments below may relate to previous holders of this record. Clouds play a vital role in our weather and climate systems, creating fascinating phenomena that can captivate anyone. Among these, the quest for understanding the biggest cloud ever recorded leads to astonishing discoveries. The largest cloud known in the universe is a massive 12-billion-year-old mass of water, containing around 140 trillion times more water than all of Earth's oceans combined. This extraordinary find not only challenges existing knowledge about the origins of water but also pushes the boundaries of what we understand about clouds and their significance. Cumulus clouds, often seen on sunny days, and thunderstorms are just a small fraction of the diverse world of clouds. These weather systems help regulate our climate and are crucial in the study of climate change. From towering storm clouds to delicate formations in the sky, clouds offer an incredible diversity that intrigues meteorologists and weather enthusiasts alike. Exploring this topic can provide valuable insights into the forces that shape our planet. By examining the various types of clouds and their impacts on weather patterns, we gain a deeper appreciation for these atmospheric phenomena. For those interested in a deeper exploration of weather systems, articles about atmospheric phenomena can provide further insights into the science behind clouds and climate. Understanding these elements can enhance our knowledge and promote a greater appreciation for the intricate connections in our atmosphere. Record-Breaking Clouds Clouds can reach remarkable sizes and types, showcasing the diverse phenomena in the atmosphere. The following sections explore the largest cloud formations, their geographic locations, and the climatic conditions that influence their development. Largest Cloud Formation The largest cloud formation ever recorded is a massive structure found in space rather than in Earth's atmosphere. It is a 12-billion-year-old mass of water that holds an astonishing 140 trillion times more water than all of Earth's oceans combined. On Earth, cumulonimbus clouds are notable for their size and strength. These towering clouds can reach altitudes of over 12 kilometers (about 39,000 feet), forming thunderstorms full of energy. They often develop in warm, humid conditions and can be found in tropical areas like Brazil and the Marshall Islands. Geographic Extremes Cloud distributions vary significantly across regions. Noctilucent clouds are primarily seen in higher latitudes, forming at altitudes around 80 kilometers (50 miles), just above most of the atmosphere. They glow after sunset, reflecting sunlight, making them visible during twilight. In contrast, cumulonimbus clouds thrive in tropical climates near the equator. The Gulf of Carpentaria in Australia is known for its dramatic cloud formations, including "Morning Glory" clouds, unique and long waves of cloud that occur regularly in that region. Climatic Influences Climatic factors play a significant role in cloud formation. For instance, cirrus clouds, which are thin and wispy, often form at high altitudes where the air is cold and dry. Conversely, the warm, moist air over oceans contributes to the development of extensive cumulonimbus clouds. This moisture fuels storms, leading to heavy rain and thunderstorms. The varying temperatures and humidity levels across geographic regions contribute to the diversity in cloud types and formations observed around the world. These different influences demonstrate how interconnected weather patterns and cloud formations are, highlighting the complexity of Earth's atmosphere. The Science of Cloud Formation Cloud formation occurs through various processes in the atmosphere. Understanding how clouds develop involves looking at different types of clouds, the role of weather systems, and the factors that influence their size. Cumulus and Cumulonimbus Development Cumulus clouds start as small, white puffs forming from rising warm air. These updrafts carry moisture, creating cloud droplets. As seeding occurs, cumulus clouds can grow larger, becoming cumulonimbus clouds associated with thunderstorms. These towering clouds can reach the tropopause, the boundary between the troposphere and the stratosphere. Cumulonimbus clouds can produce severe weather. They create lightning, rain, and sometimes hail. In the process, ice crystals can form in the upper regions as temperatures drop. If conditions permit, these can lead to giant raindrops that fall to the ground, sometimes causing virga, where precipitation evaporates before reaching earth. The Role of Weather Systems Weather systems play a vital role in cloud formation. High-pressure and low-pressure systems influence air movement, temperature, and humidity. When warm, moist air encounters cool air, it rises, leading to cloud formation. A supercell, a rotating thunderstorm, can develop under the right conditions. It leads to significant weather events, including tornadoes. The updraft in a supercell can be particularly strong, allowing for the formation of massive, well-structured cumulonimbus clouds. These systems often produce severe thunderstorms that can create hazardous conditions. Factors Influencing Cloud Size Various factors influence cloud size and formation. Temperature differences, humidity levels, and topography all play a role. Air that is warm holds more water vapor, promoting cloud formation. Cumulus congestus is an example of a cloud type that can grow large due to strong updrafts. As air rises, it cools and water vapor condenses into cloud droplets, contributing to its size. Landscapes like mountains can also affect how clouds develop by forcing air upwards. Additionally, environmental stability affects cloud development. In stable air, clouds may remain low and puffy, while unstable air leads to towering clouds that reach high into the atmosphere. The interaction of these factors defines the cloud's characteristics.