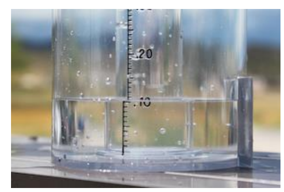
Reading a Rain Gauge

Reading a rain gauge is simple. We can look at the measurement marks on the side of a rain-capturing device, and find the level of water collected from a passing storm. Depending on what system is used where we live, we can read inches or millimeters and say how much rain has fallen. But the device collects a volume of liquid, doesn't it? Why do rain gauges measure rain in millimeters or inches, which are units of *length,* instead of in pints or liters, which are units of *volume*?

Rain gauges collect rain, or snow, in one spot. By looking at the level of water and reading the measurement mark on the gauge, we can see how much has fallen over a period of time, in a 24-hour day, for example.



Credit (both images): CoCoRaHS

Picture a Pool

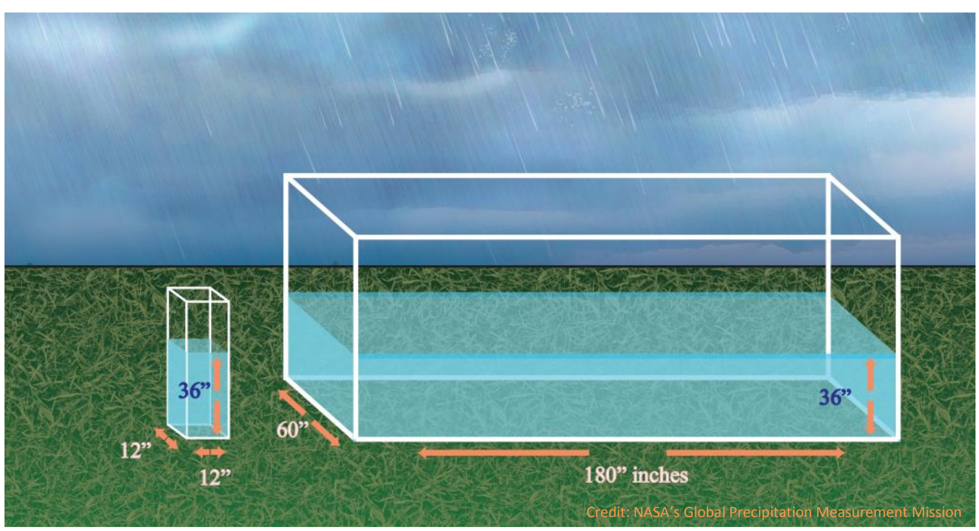
To find a volume of an object, in this case rainwater, you need to know the area of the base of the object and its height. For a rectangular rain gauge you can measure the area of the base like this: *length x width,* and then multiply by the *height* of the water.

volume = length x width x height

Now let's put our hypothetical, rectangular rain gauge on the grass next to an equally hypothetical and also rectangular swimming pool. Our swimming pool is empty. A thunderstorm rains over both of them. They both collect a *volume* of rainwater.

The base of a rain gauge is a small area (small *length x width*); you can hold one in your hand. During a storm, you know by looking that it will collect a small volume of rainwater. The base of a rectangular swimming pool is a much larger area (big *length x width*). During that same storm, the pool will collect a much larger volume of rainwater.

But what about the *height*? Does the collected water rise the same amount in the swimming pool as it does in the rain gauge?



The answer is yes. Not convinced? Think about it this way.

Let's fill our rectangular swimming pool with row upon row of rectangular rain gauges sitting right beside each other. The rain gauges in the pool are identical to each other and to the one sitting on the grass. We roll back time and the storm rains again.

If the rectangular rain gauge on the deck fills with rainwater to a certain height, it stands to reason that each identical rain gauge in the pool will fill to the same height. Thus when the rain gauges aren't there and the rain falls directly into the pool, the rainwater will rise to the same *height* measurement as the rain gauge on the grass.

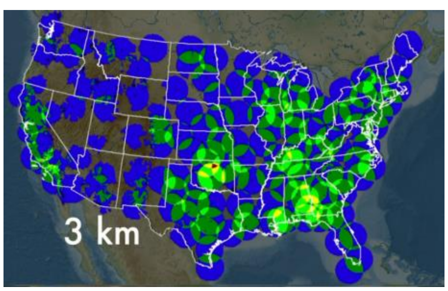
But because the area of the pool is much bigger than the area of the rain gauge, they each hold a different *volume* of water. What stays the same no matter what size container is used to collect the rainwater, whether it's a rain gauge or a pool or a bucket, is the *height* that the water rises. That's why to figure out how much rain has fallen we measure the *height* of water in a rain gauge.

Math Makes Measuring Manageable

Credit: Bryan Lee Jie Long

Rain gauges are calibrated so they can be a lot smaller than a swimming pool, while generally giving usable measurements of rainfall.

But a rain gauge collects precipitation information in one small spot that is used to represent a wide area. While rain does fall generally evenly over broad regions, it may be more intense at different places, or the storm might have just missed the location of the gauge. In the real world, any number of factors can affect how well a rain gauge collects rain water, including damage to (or bird's nests inside) the gauge itself, and if there's even one there.



Ground-based radar coverage in the U.S., showing gaps over mountains and limited extent over the oceans. Credit: NASA/SVS

Other tools scientists use to measure rain are ground-based radar instruments. These instruments send out a radar signal that hits and bounces back from precipitation particles. The data it returns tells scientists what kind of precipitation is happening, whether it is rain, or snow, or hail, or ice. Radar covers a much larger area than a rain gauge—an average area of 50,000 square miles (a range of 125 miles in each direction.)

However, big gaps still exist in data collection because the ground-based radar instruments aren't located everywhere on our planet. The best way for scientists to see the big picture of our planet's weather—as it's happening and where it's happening—is to examine precipitation data that satellites gather as they orbit Earth.

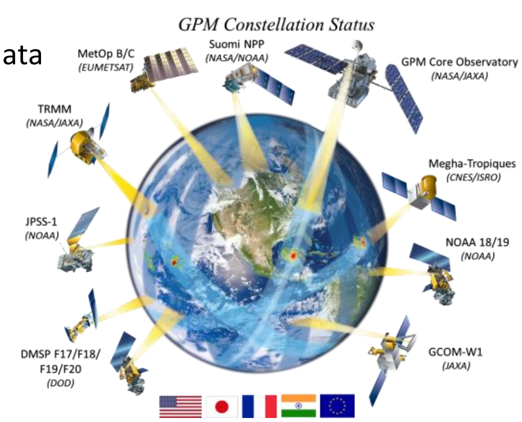


Illustration of the Global Precipitation Measurement Mission satellite constellation

Credit: NASA/GPM

Links for more about the images used in this article:
Rain gauges: http://www.cocorahs.org
Rain gauge and pool:
"Rainin' on my Birthday" by Bryan Lee Jie Long, a winner of GPM's "Unique Perspectives" photo contest. http://go.nasa.gov/V6ffK7
Ground radar: http://svs.gsfc.nasa.gov/goto?11165
GPM Satellite Constellation: http://go.nasa.gov/1vxw3UO