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So, how much of the Earth's surface is covered by rain gauges?

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The measurement of global precipitation, both rainfall and snowfall, is of critical importance to a wide range of users and applications. The fundamental means of measuring precipitation is the rain gauge. Although rain gauges have many drawbacks (including not measuring snowfall well), they remain the de facto source of precipitation information across the Earth surface for hydro-meteorological purposes. While the accuracy and representative of each gauge can be assessed and monitored, a key limitation of rain and snow gauges is in their distribution across the globe. Gauges tend to be limited to the land surface where their distribution and density is very variable, while over the oceans very few gauges are available and measurements available at island locations may not truly represent those of the surrounding oceans.

The total numbers of gauges across the Earth, as noted in the literature, varies greatly primarily due to temporal sampling resolutions, periods of operation, the latency of the data and the availability of the data. These numbers range from a few thousand which are available in near real time, to an estimated hundreds of thousands if one includes all available 'official' gauges (this number might swell more if all amateur gauges are included, with crowdsourcing capable of providing even more). Considering those gauges that are routinely used in the generation of global precipitation products (i.e. those available and of reasonable quality), the physical area covered by rain gauges varies by a factor of about 25. Calculations suggest that if all available rain gauges are included, they would cover between 120 and 3,000 m2. For comparison, equivalent areas range from 267 m2 for the centre circle of a football (soccer) pitch, or about 260 m2 for a tennis court to about 3,000 m2 for half a football pitch. Each gauge should represent more than just the orifice of the gauge itself, however, observations and modelling suggest that the correlation distance of gauges varies greatly with precipitation regime and integration period. If one takes the GPCC-available gauges (67,000) and assumes that each gauge is independent, and represents a 5 km radius surrounding region, this represents less than 1% of the Earth's surface. The situation is further confounded for snowfall which tends to have a larger correlation length and greater measurement uncertainty.