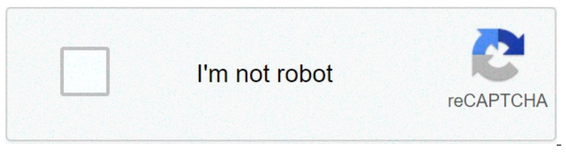

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Longest distance between two countries

Three of the longest sightlines on earth: Mt. Dankova, Krygystan to Hindu Tagh, China 538km (green), Pic de Finestrelles, Spain to Pic Gaspard, France 443km (red), and Mt. Sanford, USA to Denali, USA 318km (pink). Driving through the prairies can seem boring. The road is fairly straight, the terrain is flat, and the scenery repetitive. But during these drives, there is one thing that always seems to captivate me: trying to determine how far off into the distance I can see, since all the things that make the drive tedious are also the conditions that favour long sightlines. With no mountains, trees, or other blockades in the way, the earth's natural curvature seems to be the only variables in play. So, after some simple geometry, one can figure out that the horizon is about 4.7 km away. Is that far enough to be impressive? If you think of standing on the start line of a 5 km running race, and if the route is perfectly straight and flat, it is kinda cool that one should be able to just barely see the finish line from the start line. So I guess that's pretty impressive. But, are there further sightlines on earth? The higher up an observer is, the further away the horizon is. At sea level, it would be 4.7 km away. If we include another variable, in addition to the curvature of the earth (which essentially is constant), and increase the height of the observer, we most definitely can increase our maximum line of sight. If I take the elevator to the top of the Bow Tower in downtown Calgary (236m tall) and look out, the elevated position will assuredly allow me to see a whole lot further. Some additional calculations suggest my longest sightline (the horizon) would be 10x longer from this high up vantage point than it was on flat ground, at about 54 km. On a clear day, one could see the town of High River from the top of the Bow. Now that is pretty impressive. So the higher up the observer is, the further the horizon is, and the longer the sightlines are. So the next logical question is: how far could a person see from the top of Mt. Everest? The answer: 336 km, which is like seeing Calgary from Edmonton, which is definitely impressive. But crazy enough, that is not the furthest sightline on Earth. The taller the target being looked at is, the further it can be behind the horizon and still be seen, as its top will be able to "peak" above the horizon. See, all the examples above are limited by the curvature of the earth, and that is why the horizon seems to be the limiting factor. But there are two additional variables in play that can allow for some truly amazing sightlines: the height of the target and the temperature of the air. The height of the target is intuitively obvious, as we all realize we can see Calgary's skyline from way further away than 4.7 km. In fact, Calgary's skyline can be seen at least 50 km away since the height of the city's buildings allow them to "peak" above the horizon, allowing for a fairly significant increase in sightline length. The taller the target, the further behind the horizon it can be and still have its top visible. The air temperature variable is not quite as intuitive, but it really is simply a real world example of a concept all spectacle wearers rely on daily: refraction. Refraction allows for light passing through a medium of different densities to bend and focus in predictable ways. The medium in a pair of spectacles is glass, and the glass is shaped in either a convex or concave manner to help focus light into a person's eye based on if they are nearsighted or farsighted. However, the medium the light is passing through can also be air, and if the density gradient of the air is just right, it can allow light to bend around the curvature of the earth. Cool air near the earth's surface with hotter air above is required to bend light in such a manner, which would further increase our maximum line of sight (the opposite conditions, hot air at the surface and cool air higher up will cause light to bend away from the earth, which is how mirages in the desert are formed). Cold air at the earth's surface, and warmer air above allows light to bend around the earth, increasing the maximum line of sight. So to recap, a tall vantage point, a tall target, proper air temperature, and a clear line of sight are all requirements for maximum viewing distance. By plugging all this information into a computer and cross- referencing it to a map of the world, we can determine the line of sight from Mt. Dankova in Kyrgyzstan to Hindu Tagh in China, is the longest sightline on earth at a whopping 538 km. Now that is only theoretical, as it has never been proven by photograph. The furthest photographed sightline in the world is 443 km, from Pic de Finestrelles in the Spanish Pyrenees to Pic Gaspard in the French Alps, almost 100x further than what can be seen driving along the prairies and staring at the horizon. An eyechart letter would need to be over 600m tall for it to be legible from 440km away. A letter that size could fit two whole city blocks on top of it. You may be wondering: how does 20/20 and the observer's visual acuity play into all of this? Well visual acuity tells us what the minimum size an object has to be before the observer can see it at a given distance. So if you have 20/20 vision and are looking out at the horizon (on the prairies, 4.7km away) an object would have to be at least 1.37 m tall (and wide) for it be seen, or else it would be invisible. And if one was to place a standard eyechart “E” on top of Pic Gaspard, how large would it have to be to be legible from Pic de Finestrelles? 644m in height and width, large enough for some of Calgary’s largest buildings to rest upon.Travelling the longest sightline on earth at 32 times the speed of sound. Total distance of 443 km, from Pic de Finestrelles in the Spanish Pyrenees to Pic Gaspard in the French Alps Dr. Burke is an optometrist practicing at Calgary Vision Centre. Calculating the distance to the horizon while driving is only distracted driving if you are using pen and paper for the math. Opinions above do not constitute medical advice, and readers should consult with their optometrist if they have questions or concerns about their eye health We sometimes need the distance between two countries in econometric models, for instance in gravity models. Bur for some countries, I think this measure could cause problem. Let’s take an example. If we want to model the volume of trade between country (i) and country (j), the economic theory says it will depend on the distance between (i) and (j). Let (i) be China, (j_1) Japan, and (j_2) India. The distance between (i) and (j_1) will be lower than between (i) and (j_2). Can we consider, though, that Japan is farther from China than India is? So, rather than compute the distance between two head cities, it might be more accurate to compute the closest distance between the borders. If a border is shared by country (i) and country (j), then the distance should be zero. This is extremely simple to do using R, and it gives me an occasion to use the rbind_all function from the R package dplyr. We could obtain the table even faster using cbind_all, but at the moment it is still in development. [Edit 2017-11_17: See in the comments below and updated and improved version of this by Matt T.] Note that the relation is symmetric, hence we can optimize the computation. library(maps) library(geosphere) library(dplyr) world.map