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Not My Fault: In praise of maps, good data, and concerns for the future

Lori Dengler for the Times-Standard

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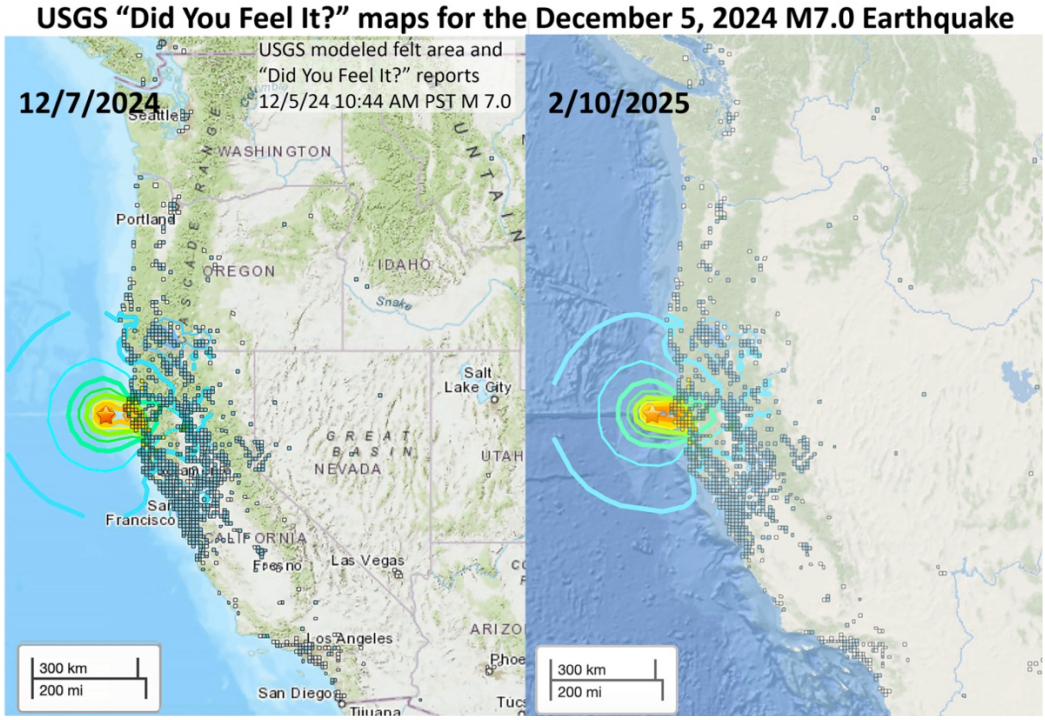

Two different versions of the USGS "Did You Feel It?" map showing the same data but using different base maps. Left shows the map of felt reports two days after the earthquake. The map on the right is a display from early February after the USGS could no longer use maps with the Gulf of Mexico.

I have always loved maps. My favorite books as a child featured maps. My first forays into backpacking introduced me to getting lost and the beauty of topographic maps to find myself. In my adult life, maps are a constant companion – epicenters, strong motion, faults, magnetic anomalies, groundwater, tsunami inundation, and so on and so forth.

Maps have been with us for a very long time. Cave paintings, mammoth tusk engravings, and aboriginal Australian stones depicting geographic features date well into the stone age, preceding writing by many millennia. Academics argue as to the purpose of the earliest maps and it isn't clear that they designated routes on how to get from one place to another but rather created a view of humanity's place in the world.

Geographers point to Ptolemy in the second century A.D. as the first to make maps that gave what we would consider an accurate depiction of the real world. A mathematician, astronomer, astrologer, and music theorist among others, he introduced the idea of coordinates using lines

of latitude and longitude. In Ptolemy's time, it was accepted that the world was round, and he was the first to represent it on a flat surface.

Maps in the earth sciences date back at least to the Egyptians and the Turin Papyrus (1150 BCE) that showed locations of stone quarries and gold deposits. In the 17th to 19th centuries maps become the cornerstones of many earth science disciplines. In 1600, William Gilbert, president of the Royal College of Physicians of London, published De Magnete showing how the earth's magnetic field strength and direction varies over the earth's surface. In 1801, William Smith sketched what would become the first geologic map of Great Britain, a story detailed in Simon Winchester's book The Map that Changed the World. Fifty-six years later, Robert Mallet, an Irish Geophysicist, would present the first isoseismal map showing the patterns of earthquake shaking following the deadly Padua, Italy earthquake. It was the first measurement of earthquake "size" predating the concept of magnitude by eighty years.

Maps can be beautiful things and in earth sciences, combine what my first geology professor Howell Williams explained was the essence of the field – art and science. From the intricate colors and patterns on geologic maps to the abstract forms of aeromagnetic variations, science is both aesthetically pleasing and useful.

Maps in my discipline are intended to represent the truth – of a geologic formation, faults, ore body extent, ground water flow, shaking strength, properties of the deep interior, and other earth features No map achieves that as there is never a complete enough data set to absolutely constrain it, but we try to get as close as we can and admit uncertainties in statistical terms.

But what is "true" can vary with the perspective of cartographer or map user. In the sciences today, there is general discipline-dependent international agreement on what maps should contain, how they are displayed, and how it should be annotated and referenced. This is not always the case with other types of maps especially when what they contain may be of political, socio-economic, or religious importance.

Take the "beginning" of our global reference system for example. Most people are aware that the prime meridian (zero longitude) is a line cutting the earth from pole to pole through Greenwich, England. It also marks the spot where universal time (formerly known as Greenwich Mean Time) begins each day.

It hasn't always been that way. In the 4th century an early Indian map maker placed it in India. Cape Verde off the west coast of Africa was a leading candidate for the prime meridian in the 16th and 17th centuries but there were many competing lines. By the 18th century many countries adopted their own starting points, usually near their capitals, creating enormous confusion for world trade.

It wasn't until 1884 at an international conference that the Greenwich Meridian was adopted as the agreed upon prime meridian, largely on the merits of British Empire influence. The French abstained and continued to use the Paris meridian until 1911. The Jesuits and much of Italy continued to use the Monte Carlo Observatory in Rome as their prime meridian as recently as 1960. There is political significance to the zero point.

Political boundaries and place names also engender controversy and disagreement. Maps of areas like Kashmir or the South China Sea appear differently depending upon which side of the dispute you are on. Even in areas of no current conflict, place names can differ, especially when they are close to international borders. Mt Everest goes by Sagarmatha (Nepal) and Chomolungma (China). What we call the Persian Gulf goes by Arabian Gulf in most Arab States.

We now add Gulf of Mexico/America to the disputed names list. All federal agencies have adopted the new name. Google and Apple maps now show Gulf of America – but with a caveat. You still see Gulf of Mexico on international versions of most mapping products. I am currently vacationing in Oaxaca and the issue has arisen a few times, but generally in a joking context.

But the name change has had more serious consequences. I rely on USGS maps for much of how I communicate earthquake information. In early February, while compiling my daily earthquake report (707-826-6020) I suddenly found the USGS maps useless. In a single day all borders and place names had disappeared. The reason? All of these maps had been developed to automatically display data on an ESRI GIS mapping system. ESRI has been the standard geographic information system for most government entities and ESRI maps contained Gulf of Mexico. Changing names on map platforms is not a simple process and it took more than a week for the USGS to come up with a substitute. I don't like the color palette or map quality of the replacement nearly as well as the previous maps, but at least they do include boundaries. On February 20th, ESRI announced that Gulf of America will appear on products for US domestic consumption, but Gulf of Mexico will remain internationally.

My map issue is a small quibble but symbolic of something bigger and more frightening. Is the data safe? Can I trust the data? Will the data continued to be gathered with the goal of providing unbiased information for all who need to work with it both now and in the future? Those are questions I thought I would never ask about the USGS, a data-driven agency whose mission is to "describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological energy, and mineral resources; and enhance and protect our quality of life."

I have many friends and colleagues who have spent their careers in the USGS, NOAA, and other federal agencies on hazard assessment, warnings, and risk reduction. They have created many of the tools I use on a weekly basis for this column – earthquake, tsunami, flood, volcano data. Programs that have taken decades to develop, fine tune, and improve are about to be eliminated or severely cut back. It is ironic that in a time of unprecedented ability to gather data from the deep interior to outer space that this pipeline may be cut off. And if I can't be 100% confidant that maps, tables, or any other form of data represents an unbiased and best estimate of what is true, they are useless.

Lori Dengler is an emeritus professor of geology at Cal Poly Humboldt, and an expert in tsunami and earthquake hazards. The opinions expressed are hers and not the Times--Standard's. All Not My Fault columns are archived online at https://kamome.humboldt.edu/taxonomy/term/5 and may be reused for educational purposes. Call (707) 826-6020 for daily earthquake updates. Leave a message at (707) 826-6019 or email Kamome@humboldt.edu for questions and comments about this column or to request copies of the preparedness magazine "Living on Shaky Ground."