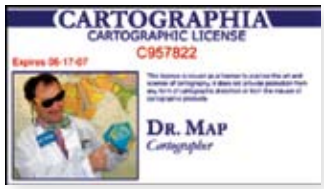
Ask Dr. Map!

a matter of projection



Dear Dr. Map:

Q: What is a qibla map?

A: "Qibla" is Arabic for the direction that a Muslim should face when praying, that is toward Mecca, or more specifically, toward the sacred black cube or Kaaba in Mecca, Saudi Arabia. In a mosque there is usually a niche in the wall to indicate the direction.

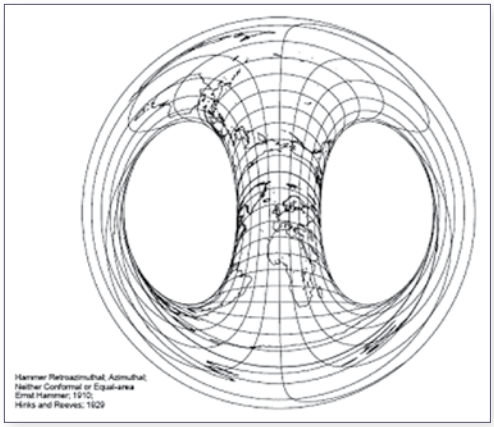


Image source: http://www.ilstu.edu/microcam/map_projections/Azimuthal.html.

Away from the mosque, however, other means must be used, and it is for this reason that early advances in cartography and astronomy so often came from the Arab world. Muslim mathematicians and astronomers have determined that at the two times a year when the Sun is directly overhead of the Kaaba, the shadows cast by the sun point directly away from the qibla. This happens on May 28 at 9:18 GMT and on July 16 at 9:27 GMT. For the half of the world not in the daylight then there are also two moments when the sun is at the antipodes, November 28 at 21:09 GMT and January 16 at 21:29 GMT. Dr. Map has flown on Arabic airlines, where a convenient computer map shows the qibla continuously, and he even has seen it switch directions as the plane flew across the opposite meridian to Mecca. This shortest route method has seen cartographic challenge in North America recently, where some Muslims have argued that the traditional rule is nonsensical, because it leads to absurd results, such as praying to the North when in Alaska (See: muslim-canada.org/qibla.html). So what is a qibla map? It is a map projection on which the qibla is shown for all points. Waldo Tobler, in a paper on qibla maps, notes that qibla maps are retroazimuthal projections, a type of map projection where the parallels are bent downwards towards the equator. "The resulting maps, when extended to the entire world, thus must overlap themselves." This makes qibla maps literally turn themselves inside out, quite a cartographic feat.

Q: My textbook tells me that the United States State Plane system is based on two projections only, the transverse Mercator and the Lambert conic. Is this true?

A: This statement is almost true, but, then, exceptions are what make life interesting, aren't they? A definitive information source with excellent graphics on the state plane system is on-line as part of class material for the Warner College of Natural Resources at Colorado State University. Nice web site guys! (http://www.warnercnr.colostate.edu/class_info/nr502/lg3/datums_coordinates/spcs.html.)

The good news about the State Plane Coordinate system or SPCS is that it is four times as accurate as the Universal Transverse

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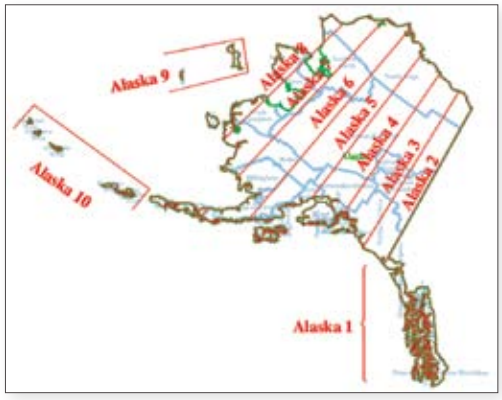
Mercator system. The bad news is that it gets the accuracy by dividing states into zones, and re-projecting the area for each new zone, which, of course, makes for lots of edges that don't fit well together. The system dates to around 1930, when an engineer from North Carolina convinced the Coast and Geodetic Survey to "simplify" local mapping by using plane surveying techniques based on Cartesian (x, y) geometry. The scheme divides states by their E-W vs. N-S orientation, splits them into zones either named (North, Central, etc) or numbered, each with its own false origin, and plots them on either the Lambert conformal conic or the transverse Mercator, with a parallel or central meridian just for that zone.



States elongated from east to west, such as New York, have zones running north-south, so use a transverse Mercator projection, which minimizes error along a N-S meridian. States that are elongated from north to south, such as California, use a Lambert conformal conic projection.

The zones generally follow political boundaries, and no state plane zone spans more than one state. Most zones boundaries follow county lines, except for the giant counties of Alaska. All together, about 120 zones cover the United States.

So, to answer the question, are there only two map projections? The SPCS is full of mind-boggling contradictions and idiosyncrasies. For one thing, it is entirely based on the Clarke 1866 spheroid, except for Michigan, which, for some reason, uses the "Michigan spheroid," placing all Michiganians (or is it Michiganders) some 800 feet up in the air, compared to the rest of the country.

But the most critical from the point of view of the question concerns Alaska. With such large counties, and so much longitudinal extent, Alaska is drawn into 10 zones; zones 2-8 are lined up with meridians and extend N-S. The other three are exceptions, and the panhandle, zone 1, is a major exception because it is drawn on the Hotine Oblique projection.

So, the textbook is mostly true. Yet, in Dr. Map's vast and growing book of cartographic curiosities, that Hotine Oblique now holds a special place. If you live in Juneau, Sitka, Wrangell or Petersburg, take note. And if you live in Ann Arbor, Kalamazoo, Saginaw, Cheboygan, or Iron Mountain, it's probably time to come down to Earth.