

## **Web Mercator: the de facto standard, the controversy, and the opportunity**

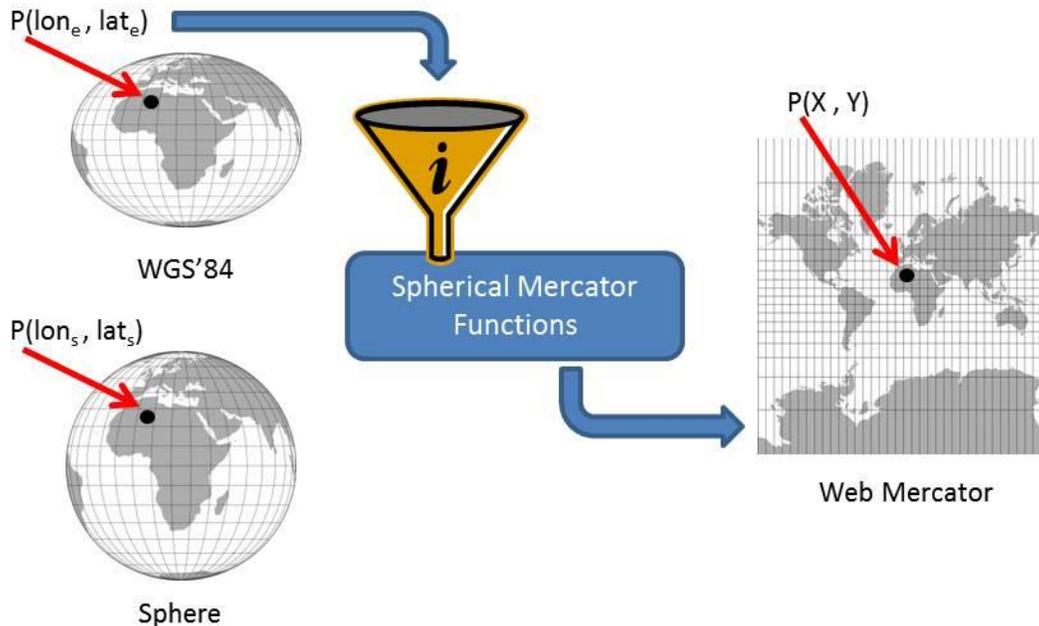
Four hundred and fifty years ago, the Flemish geographer and cartographer Gerardus Mercator presented the most popular map projection ever. It became fairly the standard projection for nautical maps because of its ability to represent lines of constant course (aka rhumb lines or loxodromes) as straight segments. However, it was also widely used in other types of maps.

As Mercator projection exaggerates much the areas far from the equator, it has often been criticized for its inappropriate use. Ten years ago, the use of Mercator projection was mainly limited to nautical maps. Cartography instructors in Geomatics schools were spending less and less time to discuss its properties or even its history in the class, while they were focusing to other projections more appropriate for general reference maps. It is then that Google's choice to adopt a variation of Mercator projection in the first version of Google Maps revived the projection's long fame. The variant known as Web Mercator or WGS84 Pseudo-Mercator has rapidly become the de facto standard for Web Mapping applications.

Today, more and more Cartography instructors feel the urge to dig back the old books and recall what themselves or their own instructors were so diligently taught 25 or 50 years ago. They definitely need to understand the peculiarities of the new variant as well as the implications of its use. They are the ones who are intended to teach Geomatics students and professionals about a variant of Mercator projection that just a few years ago in 2008 the Geodesy Subcommittee of the Oil and Gas Producers (aka EPSG) rejected as "technically flawed". The same variant that recently the National Geospatial-Intelligence Agency of the US Department of Defense declared as unacceptable for any official use, because a general lack of understanding of its properties has caused considerable confusion and misuse. Despite that, Web Mercator is well established and adopted by all major online map providers, including Google Maps, Bing Maps, MapQuest, and OpenStreetMap.

The controversy and vigorous confusion about the new standard was fostered by the various codes and parameters floating around since its introduction in 2005. An unofficial code "900913" (GOOGLE spelled with numbers) was initially assigned to the variant as suggested by Google. Since 2008, EPSG introduced another two official identifiers 3785 and 3857. Although, all three of them have increasingly been used by web developers and general users, they represent different variants.

Web Mercator suggests an ellipsoidal earth based on WGS'84 ellipsoid. All map features are assigned ellipsoidal coordinates. Then, the formulas of the spherical Mercator are used to project those features on the map. Notice that the ellipsoidal coordinates of any point P were never transformed to spherical. Apparently, this is the reason that EPSG rejected this variant and tagged it as "an inappropriate geodesy and cartography". Northing deviations may reach the 40km at the latitude of 70deg. On the flip side, calculations are much simpler (and therefore computationally faster and less expensive), which is very beneficial in a web-based environment.



Web Mercator also offers some important properties inherited by the Mercator projection. The north-up orientation along with the rectangular geographic grid turns very convenient for multiscale representation in web applications. Conformality is not maintained, however Web Mercator is practically conformal at small scales. Last but not least, cutting off at a latitude near  $\pm 85^\circ$  the map is a perfect square. This is a property that helps in tiling and indexing the map.

It is commonly stated that a map on the screen does not require the accuracy of a paper map. Deviations in conformality are hard to identify with the naked-eye, while measurements are being supported by analytical tools provided by digital systems that transform the geometry back to the ellipsoidal coordinates before any computation takes place. Many skeptics argue that Web Mercator is the projection of the “well informed users”. It is the responsibility of Cartography instructors to prepare more such users. The rapid growth and expansion of the Web Mapping is brewing the perfect storm of opportunity for cartography theory to regain its central role in mapping the world.

### Further Reading

Web Mercator, Wikipedia, [https://en.wikipedia.org/wiki/Web\\_Mercator](https://en.wikipedia.org/wiki/Web_Mercator) [visited on Sept. 15, 2015].

Aitchison, A., 2011. The Google Maps / Bing Maps Spherical Mercator Projection, <https://alastaira.wordpress.com/2011/01/23/the-google-maps-bing-maps-spherical-mercator-projection/> [visited on Sept. 15, 2015].

Battersby, S.E., Finn, M.P., Usery, E.L., Yamamoto, K.H., 2014. [Implications of Web Mercator and Its Use in Online Mapping.](#) *Cartographica* 49 (2): 92. doi:10.3138/carto.49.2.2313.