# Grids & Datums

## Republic of Serbia

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"Serbia's history has been punctuated by foreign invasions, from the time the Celts supplanted the Illyrians in the 4th century *BC*, through to the arrival of the Romans 100 years later, the Slavs in the 6th century *AD*, the Turks in the 14th century, the Austro-Hungarians in the late 19th and early 20th centuries, and the Germans briefly in WWII. A pivotal nation-shaping event occurred in *AD* 395 when the Roman Emperor Theodosius I divided his empire giving Serbia to the Byzantines, thereby locking the country into Eastern Europe. This was further cemented in 879 when Saints Cyril and Methodius converted the Serbs to the Orthodox religion. Serbian independence briefly flowered from 1217 with a golden age during Stefan Dušan's reign (1346-55). After his death Serbia declined and at the pivotal Battle of Kosovo in 1389 the Turks defeated Serbia, ushering in 500 years of Islamic rule. Early revolts were crushed but one in 1815 led to de facto Serbian independence that became complete in 1878" (*Lonely Planet, 2013*).

"The Kingdom of Serbs, Croats, and Slovenes was formed in 1918; its name was changed to Yugoslavia in 1929. Various paramilitary bands resisted Nazi Germany's occupation and division of Yugoslavia from 1941 to 1945, but fought each other and ethnic opponents as much as the invaders. The military and political movement headed by Josip "Tito" Broz (Partisans) took full control of Yugoslavia when German and Croatian separatist forces were defeated in 1945. Although Communist, Tito's new government and his successors (he died in 1980) managed to steer their own path between the Warsaw Pact nations and the West for the next four and a half decades. In 1989, Slobodan Milosevic became president of the Republic of Serbia and his ultranationalist calls for Serbian domination led to the violent breakup of Yugoslavia along ethnic lines. In 1991, Croatia, Slovenia, and Macedonia declared independence, followed by Bosnia in 1992. The remaining republics of Serbia and Montenegro declared a new Federal Republic of Yugoslavia (FRY) in April 1992 and under Milosevic's leadership, Serbia led various military campaigns to unite ethnic Serbs in neighboring republics into a "Greater Serbia." These actions were ultimately unsuccessful and led to the signing of the Dayton Peace Accords in 1995. Milosevic retained control over Serbia and eventually became president of the FRY in 1997. In 1998, an ethnic Albanian insurgency in the formerly autonomous Serbian province of Kosovo provoked a Serbian counterinsurgency campaign that resulted in massacres and massive expulsions of ethnic Albanians living in Kosovo. The Milosevic government's rejection of a proposed international settlement led to NATO's bombing of Serbia in the spring of 1999, to the withdrawal of Serbian military and police forces from Kosovo in June 1999, and to the stationing of a NATO-led force in Kosovo to provide a safe and secure environment for the region's ethnic communities. FRY elections in late 2000 led to the ouster of Milosevic and the installation of democratic government" (*WorldFactbook, 2013*).

Slightly smaller than South Carolina, Serbia is bordered by: Bosnia and Herzegovina (302 km) (*PE&RS*, March 2013), Bulgaria (318 km) (*PE&RS*, January 2002), Croatia (241 km) (*PE&RS*, July 2012), Hungary (151 km) (*PE&RS*, April 1999), Kosovo (352 km), Macedonia (62 km) (*PE&RS*, March 2013), (*PE&RS*, May 2012), Montenegro (124 km), and Romania (476 km) (*PE&RS*, May 2001). With rich fertile plains to the north; limestone ranges and basins to the east; ancient mountains and hills to the southeast; the lowest points are the Danube River and Trgoviški Timok (35 m); the highest point is Midžor (2,169 m) (*WorldFactbook & NGA GeoNames Search, 2013*).

**"For a long period of time in the Austro-Hungarian Army the pace (1 pace = 0.75 meters) was used as the unit of length measurement. The range of the guns and rifles was determined in paces. This was the main reason that the 1:75,000 scale was adopted in 1872" *(op. cit. Glusic, 1959).***

"With the establishment of Austrian Cadaster in 1817, Cadastral triangulation with its 10 plain rectangular system (Cassini-Soldner projection) was started. The Military topographical survey in order to utilize reduced cadastral planimetry, adopted all 10 cadastral systems. For the northern part of Serbia (*north of Belgrade – Ed.*), The Budapest, Gellérthegy Observatory was used for Hungary where from 1817 to 1874, $\Phi_o$ = 47° 29' 15.97" North, $\Lambda_o$ = 36° 42' 51.57" East of Ferro; since 1879, $\Phi_o$ = 47° 29' 14.93" North, $\Lambda_o$ = 36° 42' 51.69" East of Ferro; in the Hermannskogel system of K.u.K. III MT, $\Phi_o$ = 47° 29' 14.07147" North, $\Lambda_o$ = 36° 42' 56.2316" East of Ferro. The triangulation of each system was carried out independently. The scale and the orientation were based either on a directly measured base line and directly determined azimuth or on a side and an azimuth of II Military triangulation. Each of the systems was computed independently with the adjustment carried out empirically. The coordinates were computed in Cassini-Soldner projection, and represent an average value obtained from individual values computed in different ways after the removal of the angular and side differences empirically.

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Thus the unstable relationships among the positions of origins and among the orientations of systems caused the discrepancies along the boundaries of provinces (systems) which made the construction of a uniform map impossible. The stations were marked by wooden posts. Stone markers were placed 30-50 years later where the remnants of wooden posts and signals were found. At the time of placing the stone markers, 12% of the stations were not found.

"Topographical surveys were carried out by plane table method. The instructions for the survey changed gradually (1807, 1817, 1833, and 1860) and the manner of drafting also was subject to many changes; thus the plane table sheets were not completed uniformly. Prior to 1860, elevations, except for trig points, were not measured. The instructions of 1860 provided the measurement of elevation for detail points as well as the introduction of contour lines The scale remained 1:28,800 as in the first topographic survey. Because some of the Second topographical survey sheets were used as a base for the Third topographical survey it is important to know the areas where the topographical survey was based on reduced cadastral planimetry. The cadastral survey was not yet completed at the time this topographical survey was under way and the cadastral maps were not used in Serbia and Banat (Vojvodina) surveyed topographically in 1864-1866" (*Mapping of the Countries in Danubian and Adriatic Basins, Andrew M. Glusic, Army Map Service Technical Report No. 25, June 1959*). Later editions were re-ambulated and compiled at 1:75,000 scale.

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"When Russia occupied the Danube Principalities (the Old Romania) in 1853, the Turco-Russian tension led to the Crimean War. During this war, Austria forced its former ally, Russia, to give up this occupation, and Austrian armies took their place between 1854 and the Paris conference resolving the peace at the end of Crimean War. The MGI made a whole geodetic survey in Wallachia (Oltenia and Muntenia) and Northern Dobrogea. This survey was the first systematic geodetic triangulation in Romania (*Timár, G. (2008): Habsburg geodetic and cartographic activities in the Old Romania, Studii şi Cercetări , Seria Geologie-Geografie [Complexul Muzeal Bistriţa-Năsăud ] 13: 93-102*). The Central European Arc Measurement, later the European Arc Measurement (*Mittel-Europäische Gradmessung* and *Europäische Gradmessung*), respectively; brokered by the Prussians in the 1860s, had this reason behind the curtain. These projects aimed to determine the real and accurate size and shape of the Earth. However, not all European countries were prepared to make the necessary measurements and provide them to the community. This could be a possibility for the Austrians to offer their help to the Turkish Empire to make the necessary measurement. Whatever was the background, the Turkish authorities entered the Austrian survey teams to the European parts of the empire, and the survey was made between 1871 and 1875 in the whole European territory of the Turkish Empire.

"The tension between Russia and Turkey broke out in a new war in 1878. The Congress of Berlin, resolving the peace after the hostilities, let the Serbs and the Bulgarians to form their own countries. As Serbia sought for any possibility to unite all southern Slavs into a country (in the later Yugoslavia), it was a 'natural' enemy of the actual ruler of many claimed territories, the Habsburg Empire. The tension was increased further by the occupation of Bosnia-Herzegovina by the Austro-Hungarian Monarchy. No further Austrian surveys were made prior to the WWI here" (*The Austro-Hungarian Triangulations in the Balkan Peninsula (1853–1875), Béla Kovács and Gábor Timár*).

The Ferro prime meridian was widely used in Europe as the standard, proposed in 1634 as the "Westernmost point of the Old World." Commonly considered as being 20° west of the Paris meridian, and according to the French *Bureau International de l'Heure*, the civilian Greenwich-Ferro difference is $\Delta\lambda$ = 17° 39' 45.975". The military used the value of Theodor Albrech where $\Delta\lambda$ = 17° 39' 46.020", which was the official shift used for Yugoslavian cartography (*The Ferro Prime Meridian, Gábor Timár, Geodézia És Kartográfia, pp.3-7, 2007*).

The Active Geodetic Reference Network of Serbia (AGROS) was founded in 2005. With average distance between stations being 70 km, the entire Serbian territory has 32 Global Navigation Satellite Systems (GNSS) sites. International cooperation covers connections to GNSSnet.hu (Hungary), MAKPOS (Macedonia), BULIPOS (Bulgaria), CROPOS (Croatia), MONTEPOS (Montenegro), and ROMPOS (Romania) (*Republic Geodetic Authority of Serbia – AGROS, N. Tesla, N. Matic, V. Milenkovic, U.N./Turkey/European Space Agency Workshop, 14-17 September 2010, Istanbul*).

Cadastral mapping in Serbia to-date still employs the Gauss-Krüger Transverse Mercator, the Cassini-Soldner, and the Oblique Stereographic projections in various scales ranging from 1:500 to 1:5,000 (*Land Administration in Post Conflict Serbia, I. Aliksic, Z. Gospavic, Z. Popovic, 2003*).