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Approximate solution for the transformation

CH1903 ⇔ WGS84

These formulas are thought to be used mainly for navigation purposes.

These formulas must not be used for cadastral surveying or geodetic applications !

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Approximate formulas for the direct transformation of: ellipsoidal WGS84 coordinates (φ, λ, h) ⇒ Swiss projection coordinates (y, x, h')

(Precision in the order of 1 metre)

After : [H. Dupraz, Transformation approchée de coordonnées WGS84 en coordonnées nationales suisses, IGEO-TOPO, EPFL, 1992]

The parameters were re-determined by U. Marti (May 1999). In addition, the units were changed so that the parameters are comparable to the values published in [Bolliger 1967].

1. The latitudes φ and longitudes λ have to be converted into arcseconds ["]

2. The following auxiliary values have to be calculated (differences of latitude and longitude relative to the projection centre in Bern in the unit [10000"]) :

$$\varphi' = (\varphi - 169028.66'')/10000$$
$$\lambda' = (\lambda - 26782.5'')/10000$$

3.

y [m] =		600072.37		
	+	211455.93	* λ'	
	-	10938.51	* λ'	* φ'
	-	0.36	* λ'	* φ'^{2}
	-	44.54	* λ'^{3}	
x [m] =		200147.07		
	+	308807.95		* φ'
	+	3745.25	* λ'^{2}	
	+	76.63		* φ'^{2}
	-	194.56	* λ'^{2}	* φ'
	+	119.79		* φ'^{3}
h' [m] =	h –	49.55		
	+	2.73	* λ'	
	+	6.94		* φ'

4. Numerical example :

given :	φ = 46° 2' 38.87"	λ = 8° 43' 49.79"	h = 650.60 m
⇒	φ' = -0.326979	λ' = 0.464729	
⇒	y = 699 999.76 m	x = 99 999.97 m	h' = 600.05 m
result NAVREF :	y = 700 000.0 m	x = 100 000.0 m	h' = 600 m

The precision of the approximate formulas is better than 1 metre in position and 0.5 metres in height everywhere in Switzerland.

Remark on the heights: In these formulas, one is supposed to work with ellipsoidal heights as obtained by GPS measurements. If 'heights above sea level' are used, the heights are the same in both systems on the 1 metre level. Therefore, no transformation is necessary.

Approximate formulas for the direct transformation of:
Swiss projection coordinates (y, x, h')
⇒ ellipsoidal WGS84 coordinates (φ, λ, h)

(Precision in the order of 0.1")

These formulas were derived by U. Marti in May 1999, based on the formulas in [Bolliger, 1967]

1. The projection coordinates y (easting) and x (northing) have to be converted into the civilian system (Bern = 0 / 0) and have to expressed in the unit [1000 km]:
   $y' = (y - 600000\ m)/1000000$
   $x' = (x - 200000\ m)/1000000$

2. The longitude and latitude have to be calculated in the unit [10000"]:

   $\lambda' =$ 2.6779094
   \+ 4.728982 * y'
   \+ 0.791484 * y' * x'
   \+ 0.1306 * y' * x'^{2}
   \- 0.0436 * y'^{3}

   $\varphi' =$ 16.9023892
   \+ 3.238272 * x'
   \- 0.270978 * y'^{2}
   \- 0.002528 * x'^{2}
   \- 0.0447 * y'^{2} * x'
   \- 0.0140 * x'^{3}

   h [m] = h' + 49.55
   \- 12.60 * y'
   \- 22.64 * x'

3. Longitude and latitude have to be converted to the unit [°]
   $\lambda = \lambda' * 100 / 36$
   $\varphi = \varphi' * 100 / 36$

4. Numerical example:

given:	y = 700 000 m	x = 100 000 m	h' = 600 m
⇒	y' = 0.1	x' = -0.1	
⇒	λ' = 3.14297976	φ' = 16.57588564	h = 650.55 m
⇒	λ = 8° 43' 49.80"	φ = 46° 02' 38.86"	
result NAVREF:	λ = 8° 43' 49.79"	φ = 46° 02' 38.87"	h = 650.60 m

The precision of the approximate formulas is better than 0.12" in longitude, 0.08" in latitude and 0.5 metres in height everywhere in Switzerland.

Remark on the heights: In these formulas one is supposed to work with ellipsoidal heights as obtained by GPS measurements. If 'heights above sea level' are used, the heights are the same in both systems on the 1 metre level. Therefore, no transformation is necessary.