03-02-2014

Note on the use of the rdtrans2008.gsb NTv2-grid and naptrans2008.gtx VDatum-grid

Kadaster and Rijkswaterstaat CIV, working together under the name RDNAP, developed RDNAPTRANS^{TM}2008, the precise and official transformation between ETRS89 and the dutch national horizontal and vertical coordinate reference systems the *Stelsel van de Rijksdriehoeksmeting* (RD) and the *Normaal Amsterdams Peil* (NAP) [1]. A 'simplified' procedure has been devolped which uses a NTv2-grid [2][1] for the transformation between ETRS89 and RD as well as a VDatum-grid [3] for the transformation between ETRS89 and NAP. This 'simplified' procedure has the following limitations:

1) The rdtrans2008 NTv2-grid can only give identical results to RDNAPTRANS^{TM}2008 within 1 millimeter at ground level onshore and at mean seal level offshore. The horizontal deviation is approximately 1 millimeter per 50 meter height difference from ground level or mean sea level.
2) An exception to 1) is the border of the RDNAPTRANS^{TM}2008 correction grid. Transformation results within cells of the rdtrans2008 NTv2-grid that are intersected by the border of the RDNAPTRANS^{TM}2008 correction grid can result in deviations of up to 20 centimeter.
3) The naptrans2008 VDatum-grid cannot be used to determine deflections of the vertical. For this the NLGEO2004 geoid model has to be used.
4) The naptrans2008 VDatum-grid is referenced to the Bessel-1841 ellipsoid and cannot be used stand-alone, it has to be used in combination with the rdtrans2008 NTv2-grid.

Taking into account the limitations listed above, the rdtrans2008 NTv2-grid and naptrans2008 VDatum-grid can be used as an alternative to RDNAPTRANS^{TM}2008 to transform geographic ETRS89-coordinates to projected RD-coordinates with grid correction applied and NAP-heights. The figure in appendix 1 shows the precise and official RDNAPTRANS^{TM}2008 flow-chart on the left and on the right the flow-chart for the 'simplified' procedure.

Note that, although the resulting RD/NAP and ETRS89 coordinates from the transformation will be correct, geographic Bessel-1841 coordinates will differ in both procedures and should only be considered as an intermediate result.

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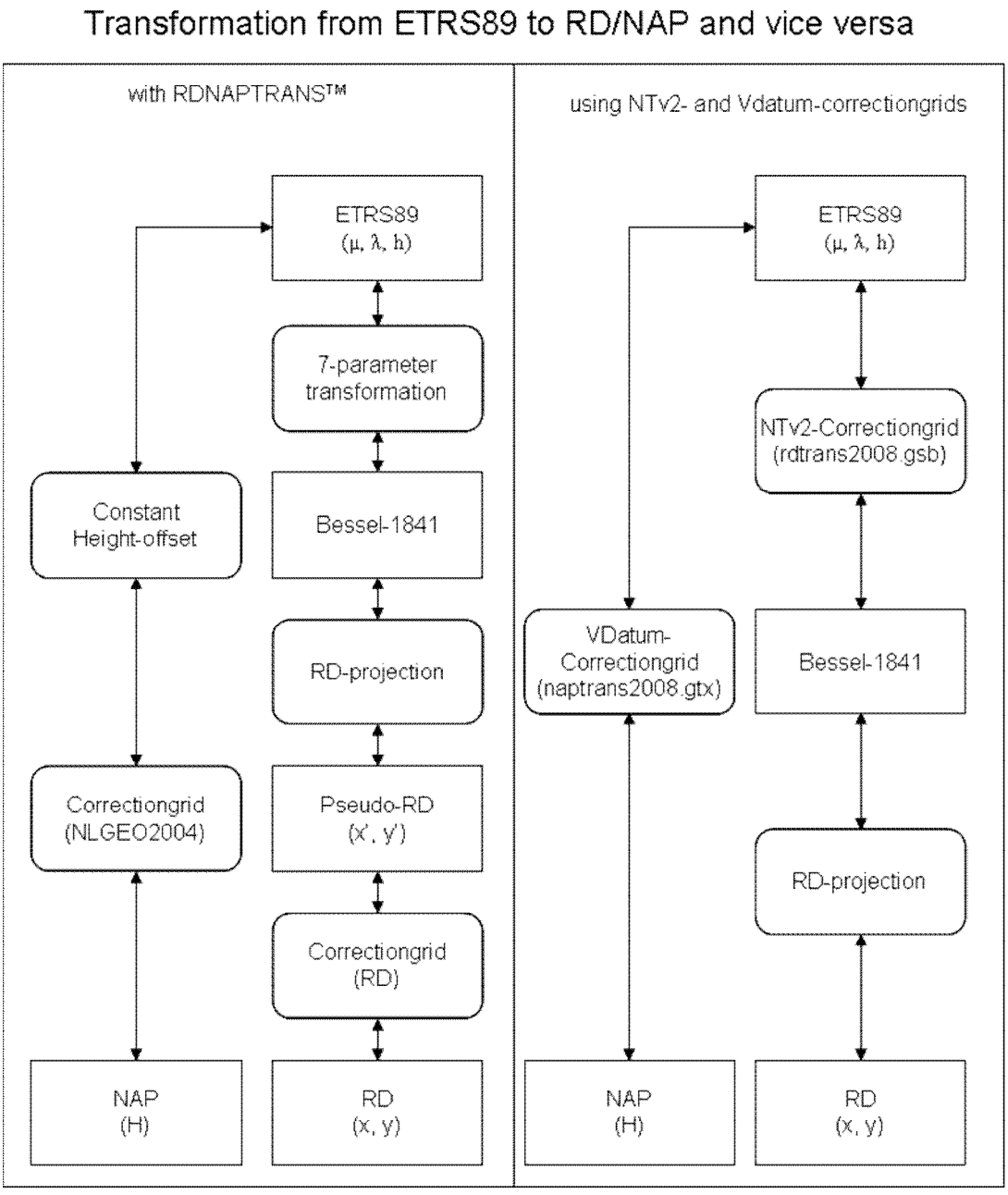
References

[1] De Bruijne, A., Van Buren, J., Kösters, A., Van der Marel, H., *Geodetic reference frames in the Netherlands*, Netherlands Geodetic Comission 43, Delft, 2005. 132 pp.

[2] Junkins, D.R., Farley, S.A., *NTv2 Developers Guide*, Geodetic Survey Division, Natural Resources Canada, 1995.

[3] National Oceanic and Atmospheric Administration, *VDatum Development*, http://vdatum.noaa.gov/development.html, accessed 15 April 2013

Appendix 1: Flowcharts for transformation from ETRS89 to RD/NAP



Appendix 2: rdtrans2008.gsb and naptrans2008.gtx test sheet

The transformation between ETRS89 and RD/NAP procedure should be tested in both directions. The rdtrans2008.gsb consists of one parent grid and one child grid, the naptrans2008.gtx consists of one grid, the bounding boxes of the grids, in Bessel-1841 geographic coordinates, are given by:

		NTv2-parent grid	NTv2-child grid	VDatum-grid
Latitude	Minimum	50° 30′ 00.000″	50° 30′ 00.000″	50° 30′ 00.000″
Latitude	Maximum	55° 50′ 00.000″	54° 00′ 00.000″	55° 50′ 00.000″
Latitude	Interval	00° 05′ 00.000″	00° 00′ 30.000″	00° 00′ 30.000″
Longitude	Minimum	02° 30′ 00.000″	03° 00′ 00.000″	02° 30′ 00.000″
Longitude	Maximum	07° 40′ 00.000″	07° 40′ 00.000″	07° 40′ 00.000″
Longitude	Interval	00° 05′ 00.000″	00° 00′ 30.000″	00° 01′ 00.000″

The coordinates below are computed with the RDNAPTRANS™2008. the differences when using the rdtrans2008.gsb and naptrans2008.gtx grids should not exceed, except for point 10 (see limitation 2) of the rdtrans2008 NTv2-grid):

RD x and y coordinates:	0.001 meters
NAP heights and ETRS89 ellipsoidal heights:	0.001 meters
ETRS89 latitude and longitude:	0.00000001 degrees

From ETRS89 to RD/NAP

No.	Name	ETRS89			RD/NAP		
		latitude (°)	longitude (°)	h (m)	x (m)	y (m)	NAP (m)
01	Texel	53.160753042	4.824761912	42.8614	117380.1200	575040.3400	1.0000
02	Noord-Groningen	53.419482050	6.776726674	42.3586	247380.5600	604580.7800	2.0000
03	Amersfoort	52.155172897	5.387203657	43.2551	155000.0000	463000.0000	0.0000
04	Zeeuws-Vlaanderen	51.368607152	3.397588595	47.4024	16460.9100	377380.2300	3.0000
05	Zuid-Limburg	50.792584908	5.773795547	174.9478	182260.4500	311480.6700	129.000
06	Maasvlakte	51.947393898	4.072887101	47.5968	64640.8900	440700.0101	4.0000
07*	No_rd&geoid	50.687420405	4.608971812		100000.6700	300000.8900	
08*	No_geoid	51.136825197	4.601375361		100000.6700	350000.8900	
09*	No_rd	52.482440839	4.268403889		79000.0100	500000.2300	
10*	edge_rd	51.003976532	3.891247830		50000.4500	335999.6700	

From RD/NAP to ETRS89

No.	Name	RD/NAP			ETRS89		
		x (m)	y (m)	NAP (m)	latitude (°)	longitude (°)	h (m)
01	Texel	117380.1200	575040.3400	1.0000	53.160753042	4.824761912	42.8614
02	Noord-Groningen	247380.5600	604580.7800	2.0000	53.419482050	6.776726674	42.3586
03	Amersfoort	155000.0000	463000.0000	0.0000	52.155172897	5.387203657	43.2551
04	Zeeuws-Vlaanderen	16460.9100	377380.2300	3.0000	51.368607152	3.397588595	47.4024
05	Zuid-Limburg	182260.4500	311480.6700	129.000	50.792584908	5.773795547	174.9478
06	Maasvlakte	64640.8900	440700.0100	4.0000	51.947393898	4.072887101	47.5968
07*	No_rd&geoid	100000.6700	300000.8900		50.687420405	4.608971812	
08*	No_geoid	100000.6700	350000.8900		51.136825197	4.601375361	
09*	No_rd	79000.0100	500000.2300		52.482440839	4.268403889	
10*	edge_rd	50000.4500	335999.6700		51.003976532	3.891247830	

*) Points 07 - 10 are outside the region where interpolation between either the NLGEO2004 geoid or the RD correction grid points is possible. RD is defined only within the region enclosed by the

following points (in RD), outside this region RD coordinates can be computed, but the output should be handled with care.

Corners of the validity region for RD:

x (m)	y (m)
140000	630000
100000	600000
80000	500000
-8000	390000
-8000	335000
100000	335000
160000	288000
220000	288000
301000	450000
301000	615000
260000	630000