The historical river:
morphology of the Rhine before river normalization

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1. Introduction

This poster illustrates the use of historic maps and measurement data in reconstruction of river morphology, focusing on the first edition of the Algemene Rivierkaart by Goudriaan and the Hydrographisch und militairische Karte von dem Nieder-Rhein by Wiebeking. The reconstructions based on these maps and data will be used in numerical simulations of historic Rhine river floods such as the large flood of 1809. This will improve our understanding of potential future high discharges of the Rhine river.

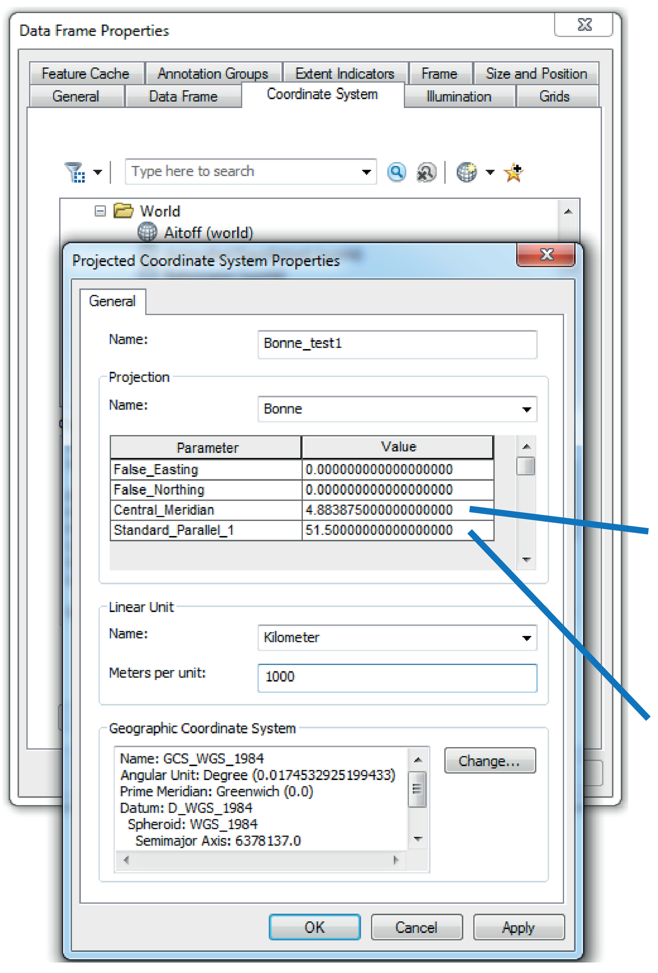
2. Data description

The first edition of the Algemene Rivierkaart covers the Dutch large rivers and the surrounding floodplains at a scale of 1:10,000. The map sheets of the Rhine river branches Waal, Nederrijn and IJssel were produced in the 1830s and early 1840s (Boode, 1979; van den Brink et al., 2002). The Hydrographisch und militairische Karte von dem Nieder-Rhein depicts the Lower Rhine from Linz am Rhein up to Arnhem at a scale of circa 1:30,000. This map series was finished in 1796 (Wiebeking, 1796).

3. Georeferencing

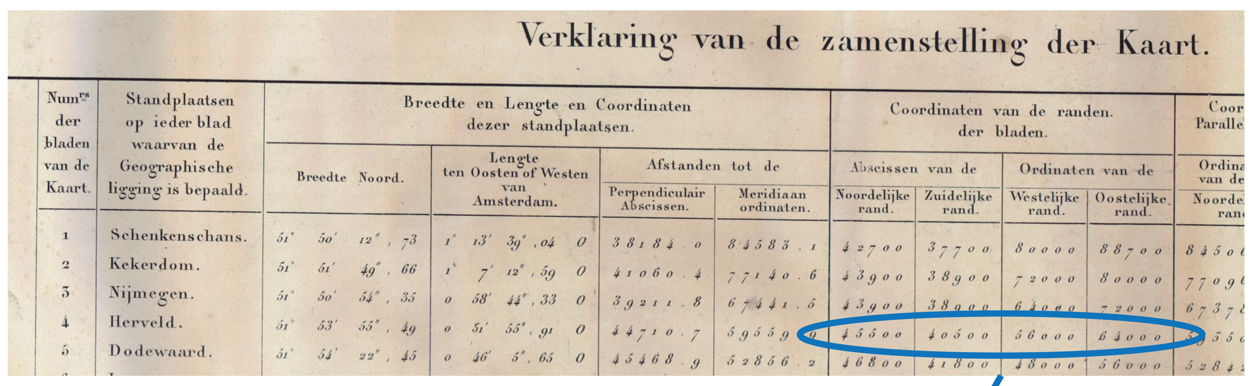
The map series have a high degree of geometric accuracy. Affine (first order) transformations were used for all map sheets. This means that the scanned maps were not deformed, only shifted, scaled and rotated. The georeferencing results were checked by overlaying the maps on a present-day digital elevation map (LiDAR data: AHN in the Netherlands, DGM in Nordrhein-Westfalen).

Method 1) Based on the coordinate system used in map making



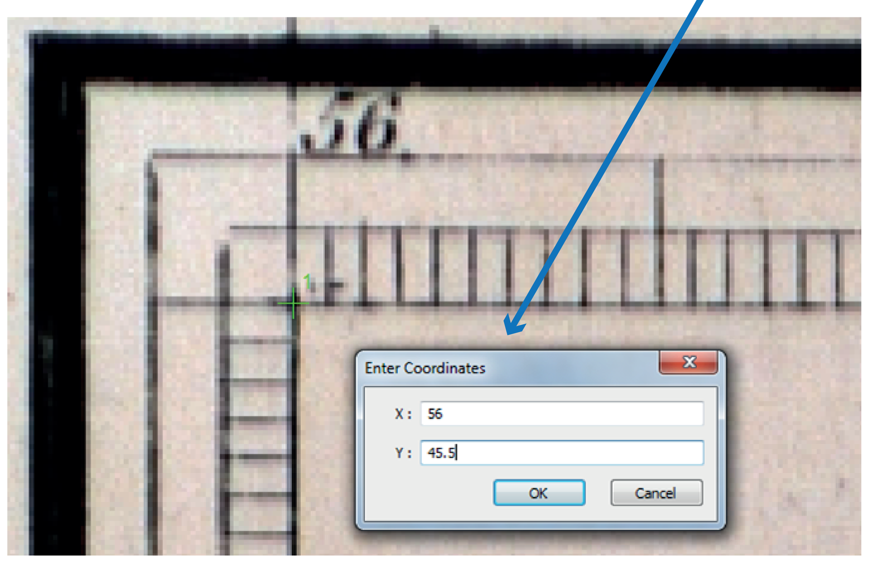
Westertoren, Amsterdam (4°53'01.95")

Chaam (51°30')



Verklaring van de zamenstelling der Kaart.

Num[rs] der bladen van de Kaart.	Standplaatsen op ieder blad waarvan de Geographische ligging is bepaald.	Breedte en Lengte en Coordinaten dezer standplaatsen. Breedte Noord.	Lengte ten Oosten of Westen van Amsterdam.	Afstanden tot de Perpendiculair Abscissen.	Meridiaan ordinaten.	Coordinaten van de randen. der bladen. Abscissen van de Noordelijke rand.	Zuidelijke rand.	Ordinaten van de Westelijke rand.	Oostelijke rand.	Coor Paralle Ordina van de Noorde ran
1	Schenkenschans.	51° 50' 12", 73	1° 13' 39", 04 O	38184.0	84583.1	42700	37700	80000	88700	8450
2	Kekerdom.	51° 51' 49", 66	1° 7' 12", 59 O	41060.4	77140.6	43900	38900	72000	80000	7709
3	Nijmegen.	51° 50' 54", 35	0 58' 44", 33 O	39211.8	67441.5	43900	38000	64000	72000	6737
4	Herveld.	51° 53' 55", 49	0 51' 55", 91 O	44710.7	59559.9	45500	40500	56000	64000	55
5	Dodewaard.	51° 54' 22", 45	0 46' 5", 65 O	45468.9	52856.2	46800	41800	48000	56000	5284



1a) Create original coordinate system in ArcGIS

1b) Type coordinates after selecting map edges

Method 2) Based on ground control points (dike stretches and landmarks)

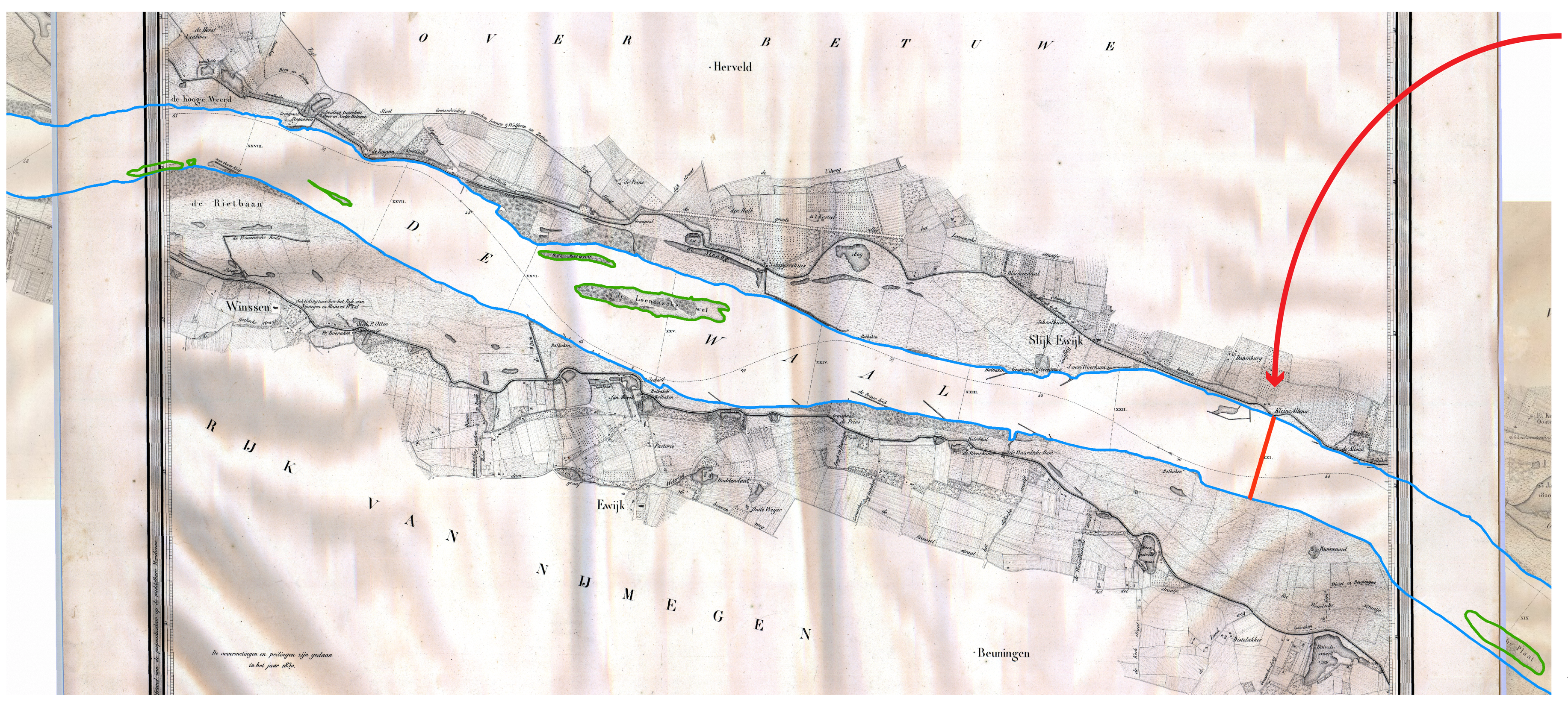
Maximum offsets after Method 1 are circa 150 m, which is larger than the anticipated model resolution of 50 m. Method 2 gives improved results with maximum offsets below 50 m. This method is therefore preferred for maps of this age.

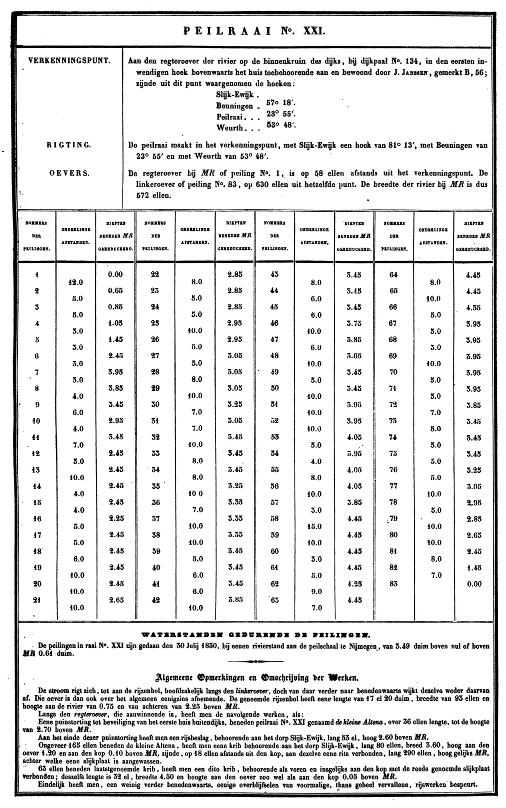
After georeferencing, we manually digitized (vectorized) the river shore lines and islands to reconstruct the historical (early 19th century) planform geometry of the Rhine.

Algemene Rivierkaart Eerste Druk Serie 1 Blad 4 Herveld

4. Bathymetry reconstruction

The Algemene Rivierkaart (first edition) is accompanied by registers with a detailed cross profile for each km along the river





The Hydrographisch und militairische Karte shows depths at scattered measurement locations.

Hydrographisch und militairische Karte Blatt 1 detail

5. Discussion points

- Reliability of historic maps and measurement data
- What is the best method for interpolation of bathymetry between cross sections and between scattered points?
- Application of historic river morphology in hydraulic modelling
- Potential other applications of reconstructed morphology?
- Georeferencing and implementing data from tables: time-consuming but worth it?

References

Boode, M.F. (1979) 150 jaar rivierkaarten van Nederland. Report of the Meetkundige Dienst, Rijkswaterstaat. Delft, the Netherlands.
van den Brink, P.P.W.J., Hoofs, J., van der Pijl, Y. (2002) Kartobibliografie van de Rivierkaart (1830-1961). Report of the Meetkundige Dienst, Rijkswaterstaat. Delft, the Netherlands.
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