NETHERLANDS GEODETIC COMMISSION

GEODETIC WORK

IN

THE NETHERLANDS

1963—1966

Report prepared for the General Meeting of the International Association of Geodesy, held during the Fourteenth General Assembly of the International Union of Geodesy and Geophysics, Switzerland 1967

1967
Rijkscommissie voor Geodesie, Kanaalweg 4, Delft, Netherlands

I GEOMETRICAL GEODESY

1.1 Primary Triangulation, the Netherlands, 1st January 1963—31st December 1966

A base extension net connecting the base line on the dam between Noord-Holland and Friesland (Afsluitdijk) to the primary points Eierland and Workum was measured in 1965–1966. The reconnaissance showed that because of the dam it was impossible to measure the directions connecting the points Eierland and Workum. To strengthen the figure, consisting of two single triangles, and to increase the possibility of checking, the points Sexbierum (primary point,) Burgwerd and Staveren were connected to these triangles. Fig. 1.1. shows the network chosen. This solution offered the opportunity of using the connecting network as a testnet for electronic- and electro-optical distance measuring instruments.
Before starting the angular measurements in the network, test measurements were carried out in 1964 at the station Lorenzsluizen during four months in order to determine the best method to be applied and the best time of day or night for the angle measurements. The test measurements showed that it was not possible to combine directions over sea and over land at the same time and therefore it was decided to replace Schreiber's method, used in the primary network, by the method with reference mark. The test measurements proved also that the numerical results were not affected by differences in atmospheric circumstances.
In the summer of 1965 all angles in the network were measured, using two Wild T3 theodolites. Each angle was measured 48 times, in 24 positions of the horizontal circle, divided over at least 4 measuring periods. The measurements were performed just after sunrise and in the period before sunset. The results were not entirely satisfactory and for this reason the stations Lorentzsluizen, Workum and Staveren were partly remeasured in 1966.

1.2 Bases

1.2.1 *Base Afsluitdijk*

In September 1965 a base line with a length of 24 km was measured on the Afsluitdijk between Noord-Holland and Friesland (fig. 1.1). The base is not a straight line but broken at two points, about 4 km from the Lorentzsluizen.
The two deflection points were determined by length measurement and by angle measurement from the point Lorentzsluizen. Permanent concrete pillars erected on top of the Stevinsluizen and Lorentzsluizen serve as begin- and endpoint of the base.
The base was measured with the aid of invar wires, twice by four different groups. The endpoints of the day-sections (1200 m) were marked by two concentric iron pipes, driven 1.5 m into

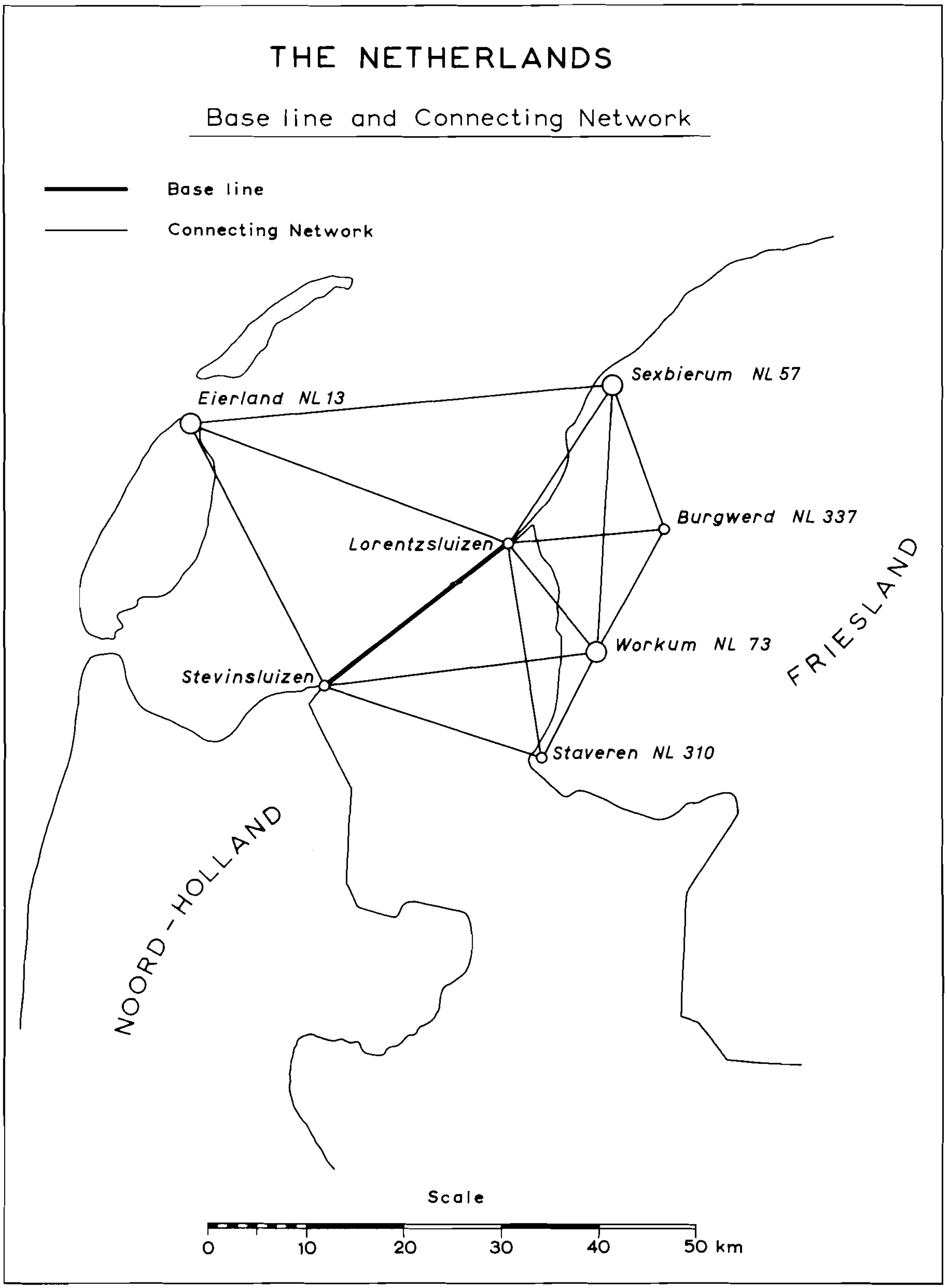

THE NETHERLANDS
Base line and Connecting Network
Base line
Connecting Network
Eierland NL 13
Sexbierum NL 57
Burgwerd NL 337
Lorentzsluizen
Workum NL 73
Stevinsluizen
Staveren NL 310
FRIESLAND
NOORD-HOLLAND
Scale
0
10
20
30
40
50 km

Figure 1.1

the ground. The inner pipes were filled with concrete and provided with Jäderin marks. These points were not removed after the invar wire measurments and are now being used for standardization purposes. In the middle of the base at equal distances from the endpoints a concrete pillar was erected to study the accuracy of geodimeter measurements. A geodimeter NASM-4 was used for this purpose.

1.2.2 *Standard base "Loenermark"*

A report on the standard base "Loenermark", of which the length was determined by the interference method of Väisälä, was published in 1964.

1.2.3 *Publications*

Bruins, G. J., Standard Base "Loenermark". Netherlands Geodetic Commission, Delft, 1964. 44 p. 11 fig.

1.3 Triangulation and Trilateration Hydrographic Office, Royal Netherlands Navy, 1st January 1963—31st December 1966

1.3.1 *The Netherlands*

The existing primary and secondary triangulation is the geodetic framework for hydrographic surveys in the estuaries and along and near the coast. Out of sight of land, positions of sounding in the North Sea are determined by radio position fixing, using the Decca Navigator, or whenever possible, systems of higher accuracy based on the same principles.
In coastal waters radio positioning is checked against geodetic position fixing. All systems in use enable positioning fixing better than the plotting accuracy on the scale of the chart, being for nautical charts 1 : 20,000 or smaller.
The work on determination and redetermination of conspicious second and third order points is continued.
All published nautical charts have by now been transferred to the European datum (first adjustment) and international ellipsoid.

1.3.2 *Surinam*

In 1964 an extensive hydrographic and oceanographic survey of river estuaries, coastal waters and continental shelf of Surinam has been started. A Decca Survey chain was established to enable position fixing beyond the range of landmarks. It is essential for the computation of the hyperbolic position lines, radiated by the system, to know the geodetic distance between the radio-transmitters as well as the angle between the base lines. As no triangulation network exists in Surinam to permit computation of the necessary data, it was decided to measure a traverse with a Wild T2 theodolite and a tellurometer, along the east-west connection, roughly parallel to the coastline. Astronomical azimuths at regular intervals were also observed and connected to the traverse. It appears, that several government services of Surinam are very interested in the results and are willing to assist in this operation.
By now field work is nearly finished and the computations will be completed in due course.

1.4 **Computing Centre, Geodetic Institute of the Technological University Delft**

1.4.1 *General Information*

Statistical investigations on precision and accuracy of the base extension network of the Afsluitdijk-base were carried out.
The free adjustment of the Primary Triangulation, to be used in the European Triangulation, was practically completed. New computer programmes were developed for computations in the plane and on the ellipsoid, as well as for the general problems of least squares adjustment.

1.4.2 *Publications*

ALBERDA, J. E., On the Importance of Decision Theory for Geodesists. Paper presented at the 2nd International Symposium on Geodetic Calculations, Brussels, 1966. 28 p. 3 fig. Tijdschrift voor Kadaster en Landmeetkunde, 's-Gravenhage, 1967, No. 3.

BAARDA, W., Statistical Concepts in Geodesy. Paper presented at the 2nd International Symposium on Geodetic Calculations, Brussels, 1966. 67 p. 1 fig. Netherlands Geodetic Commission, Publications on Geodesy, New Series, Vol. 2, No. 4, Delft ,1967.

KRIJGER, B. G. K., Basic Remarks on the Use of the Computer for Computations in the Plane. Paper presented at the 2nd International Symposium on Geodetic Calculations, Brussels, 1966. 25 p. 3 fig.

KRUIF, J. C. P. DE, Computation of Geodesics on the Ellipsoid. Paper presented at the 2nd International Symposium on Geodetic Calculations, Brussels, 1966. 28 p. 4 fig. Tijdschrift voor Kadaster en Landmeetkunde, 's Gravenhage, 1967, No. 4.

2 LEVELLING AND MOVEMENT OF THE EARTH'S CRUST

2.1 **Precise levelling, the Netherlands, 1st January 1963—31st December 1966**

2.1.1 *General information*

In February 1963 a hydrostatic levelling around Lake IJsselmeer was carried out, making use of the occasion that the lake was covered by a thick ice-crust. The water level of the lake in holes cut in the ice was read at 9 stations simultaneously. Corrections for atmospheric pressure and for the attraction of the sun and the moon were applied.
The accuracy of this levelling was better than normal first-order levelling, so the measurements could be introduced in the adjustment of the Third Precise Levelling as a second step, which improved the accuracy of the north-eastern provinces with respect to Amsterdam.
In 1964 a total of 129 km of first-order levelling was measured to investigate recent crustal movements in an area of the province of Noord-Brabant which is traversed by a system of parallel faults.
In 1965 measurements were started to create a wide levelling network of a few circuits covering the whole country. This network will be measured by a series of concatenated levellings. The 7 km long lead pipe for this operation is laid out in the canals and rivers of the Netherlands and taken up again by a specially equipped ship.
The standard error of one measurement of 7 km is approx. 0.4 mm. which corresponds to a standard error of 0.15 mm/km.
By the end of 1966 the eastern north-south connection of the network (Groningen-Maastricht), comprising 67 set-ups, was completed.
In the period of the report a total of 3015 km of second-order levelling was carried out.

2.1.2 *Instruments*

The automatic instruments Zeiss Ni-2 and Jena Koni 007 together with invar staves and parallel plate micrometer are used with good results.

2.1.3 *Methods*

Apart from the introduction of hydrostatic levelling, methods have not been changed since the previous report.

2.1.4 *Datum of the network*

The datum of the network is Normaal Amsterdams Peil (N.A.P.) fixed by an underground benchmark at Amsterdam.

2.1.5 *Junctions with contiguous networks*

In August 1964 a new connection with Nordrhein-Westfalen was measured from Heinzberg (G.F.R.) to Nieuwstadt (Neth.). The connection point is Isenbruch ($\varphi = 51°02'35''$, $\lambda = 5°52'25''$ E).

2.1.6 *North-West European Levelling Adjustment*

All data of the Third Precise Levelling were handed over to Prof. NITTINGER (Hannover) for the joint adjustment of the Danish, North-West German, Netherlands and Belgian Levellings.

2.1.7 *Special measurements*

Hydrostatic levelling to connect isolated tide gauges in the North Sea and the Rhine estuary with the levelling network was continued.
At the request of the "Wasser- und Schiffahrtsdirektion Bremen" and the "Bundesanstalt für Gewässerkunde" three hydrostatic levellings (one of 9.8 km) were carried out in the Aussenweser (Weser estuary). These hydrostatic levellings connected the tide gauges of the lighthouses Alte Weser and Roter Sand with the German levelling net.

2.1.8 *Publications*

WAALEWIJN, A., Hydrostatic Levelling in the Netherlands. Survey Review, No. 131, January 1964, pp. 212-221, No. 132, April 1964, pp. 267-276. 10 fig.

2.2 **Movements of the Earth's Crust**

2.2.1 *General Information*

The subcommission Crustal Movements of the Netherlands Geodetic Commission studies within the framework of the Commission on Recent Movements of the Earth's Crust (Permanent Commission No. VII) crustal movements in the Netherlands.
The results of the first investigations were laid down in a report presented at the Second Symposium on Recent Crustal Movements held in 1965 at Aulanko (Finland).

2.2.2 *Publications*

WAALEWIJN, A., Investigations into Crustal Movements in the Netherlands. Report presented at the Second Symposium on Recent Crustal Movements, Aulanko (Finland), 1965. 15 p. 4 fig. Netherlands Hydrographic Office, Hydrographic Newsletter, Vol. 1, No. 5, The Hague, 1966, pp. 247-263.

3 GEODETIC ASTRONOMY, GEODETIC STUDY OF THE SATELLITES

3.1 Geodetic Astronomy

3.1.1 *Twin Laplacepunt Ubachsberg-Tongeren*

In the summer of 1966 test measurements were carried out at Ubachsberg and Tongeren for the determination of these two stations as a twin Laplacepoint. The observations were made using a Wild T4 theodolite and the method of Gougenheim is being applied. The definite measurements will probably be made in 1968.

3.1.2 *Publications*

Roelofs, R., Selection of Stars for the Determination of Time, Azimuth and Laplace Quantity by Meridian Transits. Netherlands Geodetic Commission, Publications on Geodesy, New Series, Vol. 2, No. 2, Delft, 1966. 35 p. 28 fig.

Husti, G. J., Simultaneous Determination of Latitude, Longitude and Azimuth by Horizontal Directions at the Sun. Netherlands Geodetic Commission, Publications on Geodesy, New Series, Vol. 2, No. 3, Delft, 1966. 19p. 16 fig.

3.2 Satellite Observations

3.2.1 *General Information*

In the Netherlands one station participates in the programme of the Western-European Sub-Commission of the International Commission for Artificial Satellites.

The station is operated by the Geodetic Institute of the Delft Technological University and the observations are made using a sidereally driven camera of the Bouwers-Maksutov concentric mirror type. The optical characteristics of this camera are: focal length 1200 mm, effective aperture 210 mm, spherical field 5° square.

By 14th February 1967 fifty successful observations had been made, including 15 simultaneities, 8 on Echo-2 and 4 on Pageos. An additional 15 observations were reported by the end of April, 1967. Until the decay of the Geos-A optical beacon in December 1966 about 10 flash sequencies had been recorded successfully.

Echo and Pageos plates provide from about 5 to 40 chopped images or trial chops per plate, leading to an equal number of astronomically referred directions, recorded versus time. Experience suggests that these individual directions are accurate to about 1″ (standard deviation).

3.2.2 *Publications*

AARDOOM, L., MUNCK, J. C. de, An Experiment on Photographic Satellite Tracking. 3 p. 1 fig. in: G. Veis, The Use of Artificial Satellites for Geodesy, North Holland Publishing Company, Amsterdam, 1963, pp. 158-160.

MUNCK, J. C. de, Expériment sur la photographie de satellites artificiels avec une haute précision 2 p. 1 fig. in: Réseau géodésique européen par observation de Satellites. Comptes rendus du symposium, Paris 14–16 décembre 1964, Imprimerie de l'Institut Geographique National, Paris, 1965, pp. 143-144.

4 GRAVIMETRY

4.1 Oceanographic Expedition NAVADO

The Geodetic Institute of the Delft Technological University participated from November 1964–September 1965 in "NAVADO III", an oceanographic expedition on the North Atlantic. HNMS "Snellius", a survey vessel of the Royal Netherlands Navy, made ten east-west crossings along the parallels of 22°, 25°, 28°, 31°, 34°, 37° 40°, 43°, 46 and 49° North (fig. 4.1) during which gravity observations were carried out with a Askania sea gravimeter. During the first six crossings gravimeter Gss 2 - No. 11, belonging to the Department of Geodesy and Geophysics, University of Cambridge, was used while for the last four crossings use was made of instrument Gss 2-No. 19 of the Geodetic Institute of the Delft Technological University.
Continuous observations were made. The measured gravity was reduced for the Eötvös effect and for the drift of the instrument. Free air anomalies were computed by subtracting the normal gravity of the international ellipsoid from the measured gravity. The profiles of free air anomalies are published together with the simultaneously measured depth of the ocean and the intensity of the magnetic field in special issue No. 3 to Volume I of the Hydrographic Newsletter (published by the Netherlands Hydrographic Office). From these profiles the mean anomalies were computed for each degree longitude (e.g. the mean anomaly between 24.5° and 25.5° West is indicated at 25°W). The results are shown in fig. 4.1.

4.2 Surinam

In April 1966 a gravity survey was carried out on the continental shelf of Surinam. The measurements were again made on board of the "Snellius" with gravimeter Gss 2 - No. 19 of the Geodetic Institute of the Delft Technological University. The results are being published in special issue No. 4 to Volume I of the Hydrographic Newsletter which will appear in the course of 1967.

4.3 Publications

The Oceanographic Expedition NAVADO. An Abstract of the Commanding Officer's Reports. Netherlands Hydrographic Office, Hydrographic Newsletter, Vol. 1, No. 4, The Hague, 1965, pp. 216-218.
NAVADO III. Bathymetric, Magnetic and Gravity Investigations. Netherlands Hydrographic Office, Hydrographic Newsletter, Vol. I, special issue No. 3, The Hague, 1967.
Oceanographic Exploration of the Continental Shelf of Surinam. Netherlands Hydrographic Office, Hydrographic Newsletter Vol. 1, special issue No. 4, The Hague, 1967.

5 DYNAMIC GEODESY

5.1 **Surinam**

The gravity survey on the continental shelf of Surinam (see section 4.2) revealed the same irregular anomaly field as observed on the mainland. Additional computations of relative deflections of the vertical will be made.

5.2 **Publications**

VENING MEINESZ, F. A., Volcanicity Cause of Equilibrium Disturbances of the Geoid. Koninklijke Nederlandse Akademie van Wetenschappen, Proceedings, Series B. 66, No. 1, Amsterdam, 1963, pp. 1-2.

VENING MEINESZ, F. A., Relative Movements of Continents. Koninklijke Nederlandse Akademie van Wetenschappen, Proceedings, Series B. 66, No. 1, Amsterdam, 1963, pp. 3-7.

VENING MEINESZ, F. A., Two Types of Deep Ocean Trenches. Koninklijke Nederlandse Akademie van Wetenschappen, Proceedings, Series B. 66, No. 2, Amsterdam, 1963, pp. 55-63, 5 fig.

VENING MEINESZ, F. A., The Earth's Crust and Mantle. Elsevier Publishing Company, Amsterdam, 1964. 124 p. 24 fig.

VENING MEINESZ, F. A., Interpretation of Gravity Anomalies on the Westcoast of South America and in the Caribbean. Netherlands Geodetic Commission, Publications on Geodesy, New Series, Vol. 2, No. 1, Delft, 1964, pp. 5-22. 20 fig.

VENING MEINESZ, F. A., The Puerto Rico Trench; Two Types of Deep Ocean Trenches. Netherlands Geodetic Commission, Publications on Geodesy, New Series, Vol. 2, No. 1, Delft, 1964, pp. 23-28. 5 fig.

VENING MEINESZ, F. A., Mantle-Currents below the Mediterranean Area. Koninklijke Nederlandse Akademie van Wetenschappen, Proceedings, Series B. 67, Amsterdam, 1964, pp. 215-219.

VENING MEINESZ, F. A., The Anchorage Earthquake. Koninklijke Nederlandse Akademie van Wetenschappen, Proceedings, Series B. 67, Amsterdam, 1964, pp. 339-340.

VENING MEINESZ, F. A., A Cause of Changes of the Secular Geomagnetic Field. Koninklijke Nederlandse Akademie van Wetenschappen, Proceedings, Series B. 67, Amsterdam, 1964, pp. 341-343.

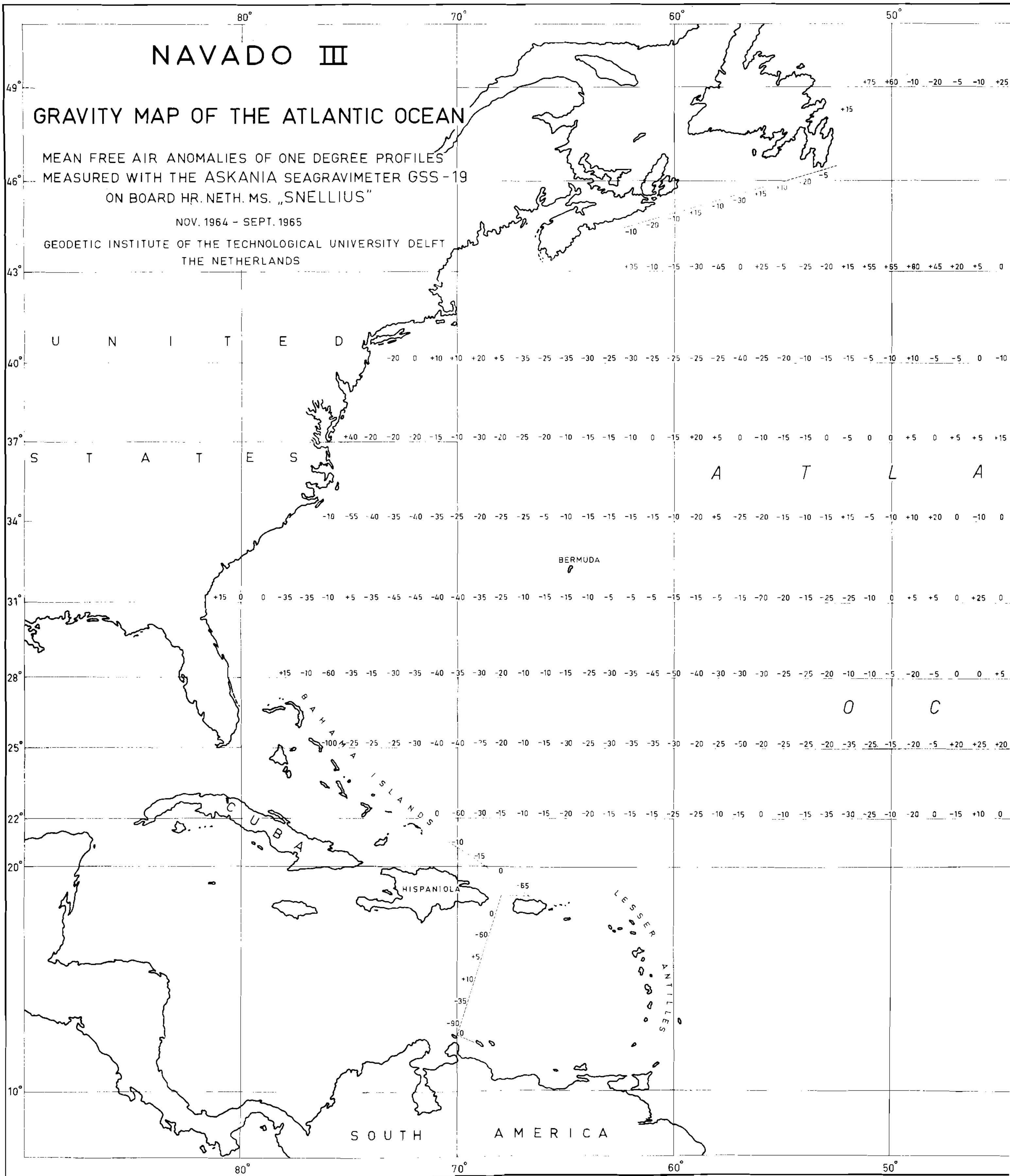
VENING MEINESZ, F. A., Has Polar Wandering Influenced the Pattern of Mantle Convection? Koninklijke Nederlandse Akademie van Wetenschappen, Proceedings, Series B. 67, Amsterdam, 1964, pp. 435-440.

Vening Meinesz, F. A., Origin of the Crustal Structure of the Mid-Ocean Ridges. Koninklijke Nederlandse Akademie van Wetenschappen, Proceedings, Series B. 68, Amsterdam, 1965, pp. 114-116.

Vening Meinesz, F. A., Dams Dangerous in Tectonically Unstable Areas (for example on the Italian side of the Alps). Tectonophysics, 1, pp. 517-519. Discussion. In: Continental Drift. Phil. Trans. Roy. Soc., 258, pp. 314-316.

Vening Meinesz, F. A., The Areas where the Two Parts of the Alpine-Himalayan Geosyncline Meet Each Other. Koninklijke Nederlandse Akademie van Wetenschappen, Proceedings, Series B. 69, Amsterdam, 1966, pp. 55-57.

Vening Meinesz, F. A., The Subcrustal Current-System between Alps and North Sea in the Present Period. Koninklijke Nederlandse Akademie van Wetenschappen, Proceedings, Series B. 69, Amsterdam, 1966, pp. 230-234.


NAVADO III
GRAVITY MAP OF THE ATLANTIC OCEAN
MEAN FREE AIR ANOMALIES OF ONE DEGREE PROFILES
MEASURED WITH THE ASKANIA SEAGRAVIMETER GSS-19
ON BOARD HR. NETH. MS. „SNELLIUS"
NOV. 1964 - SEPT. 1965
GEODETIC INSTITUTE OF THE TECHNOLOGICAL UNIVERSITY DELFT
THE NETHERLANDS
U N I T E D
S T A T E S
A T L A
O C
BERMUDA
BAHAMA ISLANDS
CUBA
HISPANIOLA
LESSER ANTILLES
SOUTH AMERICA
80°
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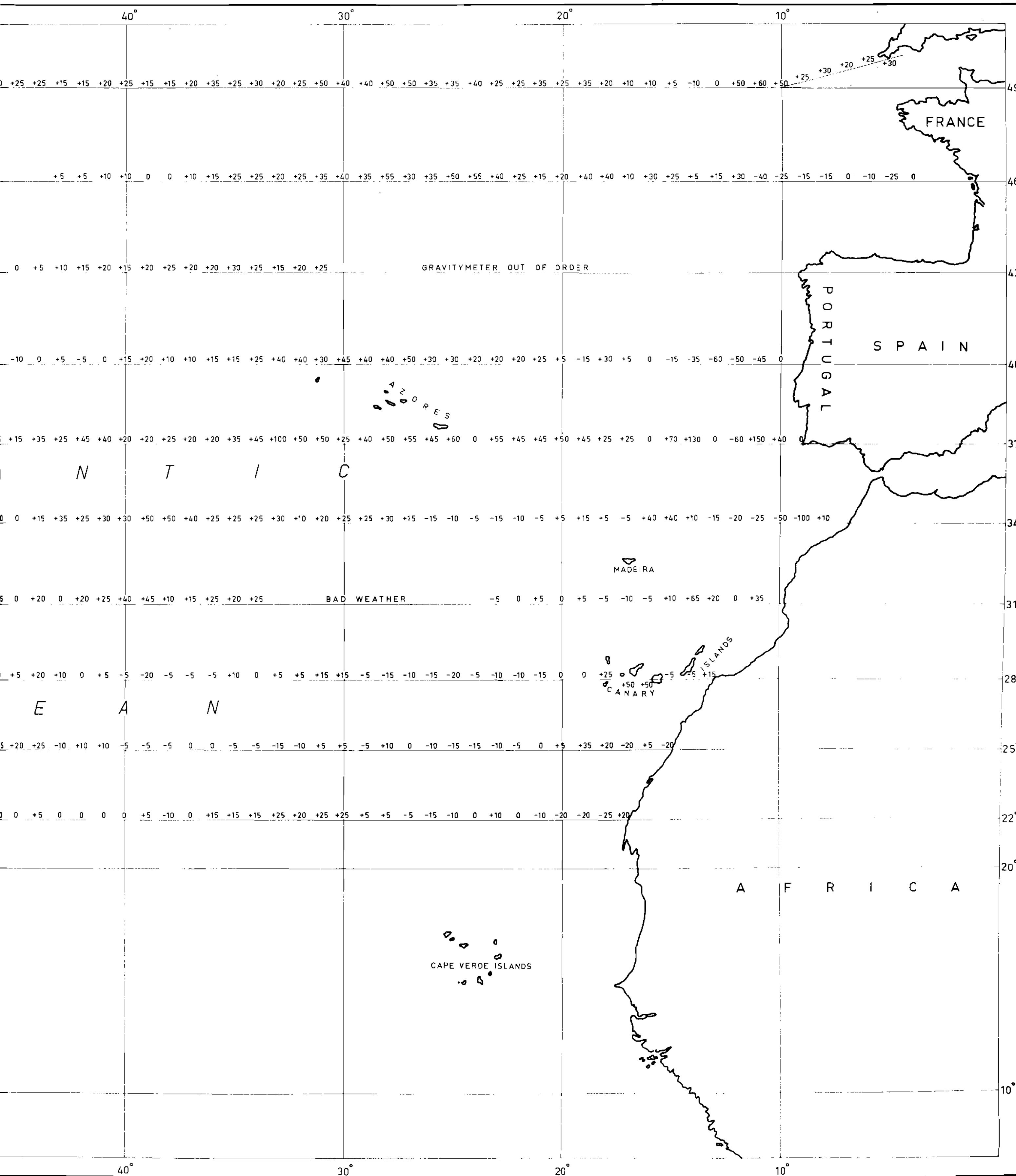
Figur


40°
30°
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FRANCE
SPAIN
PORTUGAL
GRAVITYMETER OUT OF ORDER
AZORES
N T I C
MADEIRA
BAD WEATHER
CANARY ISLANDS
E A N
A F R I C A
CAPE VERDE ISLANDS

igure 4.1