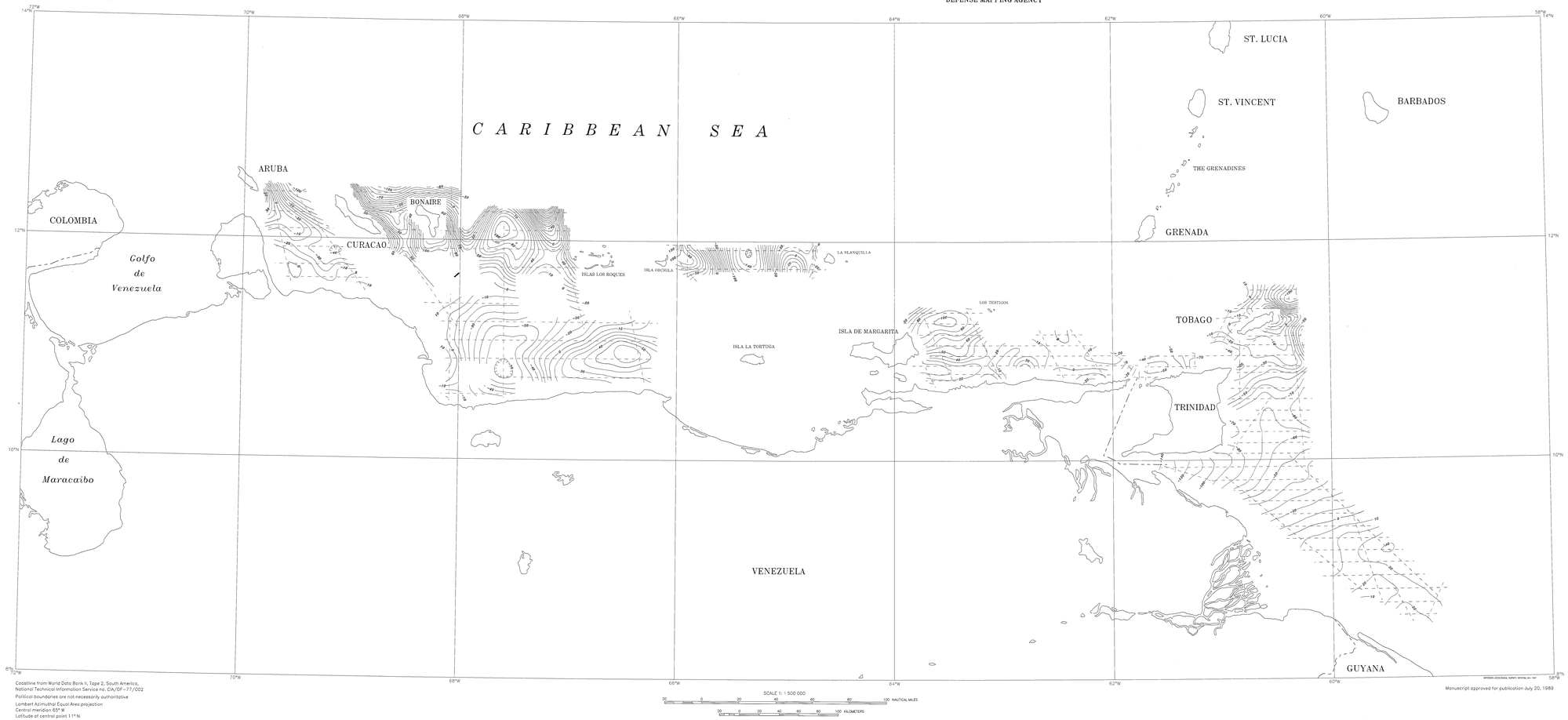
DEPARTMENT OF THE INTERIOR
U. S. GEOLOGICAL SURVEY

Prepared in cooperation with the
DEFENSE MAPPING AGENCY

MISCELLANEOUS FIELD STUDIES
MAP MF–2097–B



Coastline from World Data Bank II, Tape 2, South America, National Technical Information Service no. CIA/DF–77/002
Political boundaries are not necessarily authoritative
Lambert Azimuthal Equal Area projection
Central meridian 65° W
Latitude of central point 11° N

SCALE 1: 1 500 000

20 0 20 40 60 80 100 NAUTICAL MILES
20 0 20 40 60 80 100 KILOMETERS

EXPLANATION OF MAP SYMBOLS

- Free–air gravity contours; interval 10 mgal
- Area of decreasing gravity
- Ship trackline

INTRODUCTION

This map is one of two in a series presenting marine gravity data in the western Caribbean Sea (Folger and others, 1990) and off the coasts of Venezuela and Trinidad–and–Tobago (fig. 1). The data, collected by the U. S. Geological Survey (USGS) in response to a request from the Defense Mapping Agency, are intended to improve gravity coverage where it has been insufficient or inadequate. The information shown on this map represents approximately 16,600 line kilometers of marine gravity data collected around Trinidad–and–Tobago and along the coast of Venezuela from December 4, 1987 to January 27, 1988.

METHODS

Data were collected aboard the Research Vessel (RV) *Starella*, a converted 73–m stern trawler owned and operated by J. Marr and Sons of Hull, England, under contract to the USGS. Nominal survey speed was 10 knots (18.5 km/hr). Two LaCoste and Romberg (LaR) Air–Sea Gravity Meters (S–26 and S–41) were operated continuously during the surveys. The dual metering provided immediate, or real–time, checks on meter performance and quality control on data collected. Both gravity meters were of standard beam–type configuration that included capacitance readouts, LaR 6200A analog–to–digital converter boxes, and USGS computer processing and recording systems. Ten–second samples of LaR raw spring tension, average beam, and cross–coupling signals were logged and used to compute the raw digital gravity values. The raw digital gravity readings were filtered by three stages of lag–20–s resistive capacitance (RC) filtering in the instrument plus three stages of lead–20–s RC digital filtering. A 5–min symmetrical digital filter was applied in the computer processing. The standard auto–reader analog gravity readings provided a graphic check on the digital computations. All land gravity stations were on the International Gravity Standardization Net (IGSN) 1971 datum. Land gravity values were calibrated to the shipboard values at dockside using a LaR Model G Geodetic Gravity Meter (G–170).

All positions were computed in the World Gravity System (WGS)–84 datum and filtered in exactly the same manner as were the gravity signals. The primary navigation system used during the cruise was a General Electric CVL–12 Correlation Sonar/Sperry MK–29 MOD 3 Gyrocompass interfaced to a USGS computer system that calculated dead reckoning (DR) positions every 10 s (McCullough and others, 1989). Global Positioning System (GPS) and Transit Satellite fixes were used for updating and control. Elements of a Magnavox S–5000 integrated navigation system were used to convey positioning information to the ship's bridge. The DR system provided precision to about 0.5 percent, or about 5 m/25 km root mean square (RMS), after linear drifts between satellite fixes were removed.

Data were recorded digitally on hard disk every 10 s and periodically were transferred to tape. Real–time 10–s digital plots of various system parameters were continuously logged. Plotted variables included time; DR and GPS latitudes and longitudes; and their differences; Eotvos correction calculated from DR and GPS; raw and filtered gravity from both meters; and their differences; Eotvos–corrected gravity; ship's speed and direction; and gravity–platform heave and sway acceleration, which was needed to monitor sea–state effects on the gravity meters.

All parameters were monitored continuously by the watchstanders and party chief. With such data, problems with components of the system were readily identified and corrected; if corrections could not be made, traverse lines were rerun immediately. This real–time editing or recapture of data virtually eliminated data loss. Subsequent editing aboard the ship on an IBM–AT XENIX computer system provided gravity and navigation plots, and backup listings of time, positions, and Eotvos–corrected gravity. Line intersection points, crossing values, and statistics were routinely recorded and analyzed. For this cruise the statistics of the line–crossing differences were 1.2 mgal RMS. Base gravity readings before and after the cruise established the drift rate for the marine gravimeters (–1.45 mgal in 42 days for S–26; –0.97 mgal in 42 days for S–41). This correction was applied to the data in the laboratory, where the tapes were reformatted, regional gravity field removed, and free–air gravity anomalies calculated. The resulting contour map of free–air gravity anomalies enlarges the existing data base, which was sparse for the nearshore area around Trinidad–and–Tobago and along the coast of Venezuela (see, for example, Bowin and others, 1982).

MAPPING TECHNIQUE

Eotvos–corrected gravity data (free–air values) were reduced to 6–min samples and gridded using a standard minimum–tension gridding technique. This procedure has two stages: initial estimate, and biharmonic iteration with scattered–data feedback. The initial estimate selects data points within a grid cell by their proximity to the grid node, and averages them using an inverse–distance weighting function that depends on the angular distance between points. Once averaged, the grid nodes are re–evaluated (second stage) using a biharmonic cubic spline function, which is followed by a scattered–data feedback procedure (Dynamic Graphics, Inc., 1986). The grid–cell size for this map is approximately 2900 m on a side. Contour lines are truncated along shore and at the open–ocean margins using zone blanking.

ACKNOWLEDGMENTS

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Figure 1. – Map areas of the two published marine gravity surveys in this series.

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MAP SHOWING FREE–AIR GRAVITY ANOMALIES OFF THE COASTS OF VENEZUELA AND TRINIDAD– AND–TOBAGO

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