A Partial Bibliography of the Physical Oceanography of the main area of ‘GATE’
(GARP Atlantic Tropical Experiment)
[5° - 15° N; 20° - 30° W]

Compiled by
VIRGINIA R. ROWLANDS

N.I.O. Internal Report No. A. 58

AUGUST 1972
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THEORY

[Unpublished manuscript]

Causes of formation and disappearance of gyres are dealt with. There are two surveys considered: one south of Cabo Verde and the other off Angola, (Cabo Verde: Atlant-NIRO cruise of R/V 'Olekma', August-September 1964; off Angola: R/V 'Zvezda', August 1967). The Guinea Dome of cold waters, 11º-15ºN, 20º-24ºW is considered. It is concluded that the formation of stable cyclonic and anticyclonic water gyres as well as all the phenomena connected with this process, in particular, the formation of thermic domes, are caused by structural features of the surface barometric field and by the stable anomalies of the tangential wind stress eddy field.

PERLROTH, I. 1969 The distribution of water type structures in the first 300 feet of the equatorial Atlantic.

A model is presented to depict a relationship between the surface current circulation, the vertical temperature gradient profile, the depth of the mixed layer and surface salinity for the area 0º-20ºN, 0º-60ºW. A meander in the mean circulation is located on the cyclonic shift axis in the vicinity of 12ºN, 34º-36ºW and another on the anticyclonic shift axis at 8ºN, 35ºW-37ºW. Historical data was used.

POSTNOVA, I.D. & POPOV, S.II. 1966 Fluctuations of the heat balance in the tropical Atlantic Ocean.
[In Russian]

Heat balance in the area 55ºN-22ºS, 5ºE-41ºW is considered. The work is based on cruises during 1957-1963, particularly 'Sadov' and 'Mikhail Lomonosov XII'.

DISCUSSIONS OF DATA

CARLSON, T.M. 1971 An apparent relationship between the sea-surface temperature of the tropical Atlantic and the development of African disturbances into tropical storms.

Sea surface temperatures in the area for August (1965-1969) are considered.
KIRICHK, A.D. 1971 Water circulation in the north-eastern part of the tropical Atlantic.
International Council for the Exploration of the Sea,
Contribution to Statutory Meeting, C.M. 1971/07, 6pp. & figs.
[Unpublished manuscript]
Geostrophic surface currents were calculated for Feb., May, Aug. and Nov. of the mean year, based on "Hydrometeorological Reference Book for Waters of Western Africa", Leningrad 1964. (Values obtained were lower than the measurements by the R/V 'Zvezda'). It is concluded that the oceanic branch of the Canaries Current turns into the ocean at 20°N, merging with the Northern Equatorial Current, while the lesser part proceeds south and forms quasistationary cyclonic gyres at the Cape Verde Islands.

MAZHITKA, P.A. 1967 Thermal domes in the eastern tropical Atlantic Ocean.
Limnology and Oceanography, 12, (3), 537-539.
The Guinea Dome is centred near 10°N, 22°W during July-September. The dome was noticed by Resignol and Meyrueis (Campagne oceanographique de Gerard-Treca, Office Rech. Sci. Tech. Outre-Mer, Centre Oceanogr. Dakar-Thiaroye, 1964) during the cruise of the 'Gerard Treca' during June 1962, when it was about 160km closer to the shore. Changes in position can be expected as the season advances and anomalies may be present during the individual years. At 20m the decrease in temperature, salinity and oxygen is discernable but the dome is not well developed. It is better developed at 50m and can be traced to about 200m. Cyclonic circulation around the dome appears to be well formed.

MONTGOMERY, R.B. 1938 Circulation in the upper layers of southern North Atlantic deduced with use of isentropic analysis.
Papers in Physical Oceanography and Meteorology, 6, (2), 1-55.
A qualitative description of currents in the Atlantic (0°-30°N) is derived chiefly from the distributions of salinity and oxygen content on σt - surfaces. It was suggested that upwelling from moderate depths could occur in equatorial regions.

International Council for the Exploration of the Sea,
[Unpublished manuscript]
An attempt is made to outline horizontal currents in the area south-east of the Cape Verde Islands on the basis of data on geostrophic circulation obtained during scouting and research cruises of Atlant-NIRO vessels (e.g. SET-R 'Oleksa', 1964-1966). The dome on the boundary of the Equatorial Countercurrent and the North Equatorial Current was observed during July-September. From the results of SET-E9006 'Oleksa' it is apparent that the dome also occurs during May, June and October and its centre varies by 2° latitude and 4° longitude. The circulation was found to consist of: (1) a narrow cyclonic gyre caused by the dome, (2) a northern current opposite in direction to the Canaries Current, (3) the division of the Canaries Current into two branches - oceanic and coastal and (4) cyclogenesis in the south-eastern periphery of the main gyre. The velocity
may reach 10-15 cm/sec in the western part of the gyre and 
30-40 cm/sec in the eastern part. In the south-east 
periphery the north-ward current formation, reaching 25°N in 
all seasons, can be considered as a Canaries Countercurrent. 
The dome is thought to be caused by (1) a cyclonic gyre of 
tangential wind stress, (2) the interaction of the North 
Equatorial Current and the Equatorial Countercurrent in the 
opposite direction and (3) the influence of the African 
continent.

PERLROTH, I. 1969 Effects of oceanographic media on Equatorial Atlantic 
hurricanes. 
Tellus, 21, (2), 230-244.

Vertical temperature gradients for July-September for the top 
200 feet of the ocean in the area 0°-20°N, 0°-60°W were 
analysed and a connection between them and hurricanes derived. 
Currents and surface temperatures were also considered. 
(Historical data, mainly from NODC files and the National 
Weather Records Centre, were used).

RODEN, G.I. 1962 On sea-surface temperature cloudiness and wind 
variations in the tropical Atlantic. 

Records of surface temperatures were investigated for various 
positions, two of which (7.0°N, 28.0°W and 19.0°N, 22.5°E) were in 
the main GATE area. Power spectra of temperature anomalies 
are given.

CURRENT OBSERVATIONS

POGHLASKY, T.E. 1968 Oceanic current and temperature gradients at 12°N, 
27°W. 

Temperature and pressure were measured at neutrally buoyant 
floats as they sank and while they remained at equilibrium 
depths for over four days at 12°N, 27°W. There were two 
centers of five floats each, one at a depth of about 3700m and 
the other about 4500m. The master float of each cluster 
transmitted its own pressure and temperature steadily. The 
other floats were interrogated in turn by the master, so each 
yielded information during 2 of every ten minutes. Temperatures, 
temperature gradients and sinking velocities were determined 
as a function of time and depth, so information on the extent 
of the shear of the horizontal current with respect to the 
vertical direction was obtained. Measurements also showed the 
extent of vertical and horizontal movement in deep water 
while the floats hovered. The mean flow over a period of four 
days at a depth of 3500m was 2 cm/sec in an ESE direction and 
at 4500m was 1 cm/sec in the same direction. There was an 
additional inertial current of approximately 3 cm/sec which 
varied appreciably with depth. There were also vertical 
movements of the water.

The following two references refer to measurements made in the 
area of secondary importance in GATE:

Current and temperature observations were made from a cross-shaped network of buoy stations centred at 16°30'N, 33°30'W. Six ships were used. For more than six months, current speed and direction was measured every thirty minutes at ten depths from 50m to 1500m. Buoys were replaced every 25 days. Current records showed a high variability in time and space even with inertial and tidal oscillations filtered out. Temperature was recorded at 15 minute intervals by photoregistering thermographs at depths of 50 and 200 m. Measurements of ocean microstructure were made with an STD-probe.


Measurements were made by current buoys (17 stations) at 50m, 300m and 1500m centred around 16°30'N, 33°30'W. There was strong time and space variability of mean currents, but this was resolved on filtering out inertial and tidal fluctuations. The inertial and tidal currents were primarily baroclinic. Temperature and salinity was measured for 0-600m.

**OBSERVATIONS OF TEMPERATURE, SALINITY AND DENSITY.**


STD results of the Equalant II cruise of 'Casco' are given. 9 stations were in the main GATE area, roughly along 25°W. Two casts were made per station and 12 Nansen bottles were used per cast. Ship drift calculations were made.


Studies included observations on seasonal changes in the physical and chemical structure of the water masses and in the conditions for primary production in the region between 3° and 15°N and 22° and 30°W (39 stations). The tropical pycnocline is an important factor for productivity. Most favourable conditions for the primary production exist in areas which the tropospheric discontinuity layer rises highly into the euphotic surface layer.
SHIMONOSUKI UNIVERSITY OF FISHERIES 1968 Eastern Pacific Ocean cruise and Central Atlantic Ocean cruise.


Observations were made at 17 stations in the area (all approximately 25°N), 6 with physical and chemical data (including STD) and 11 just BT and surface measurements.

SMED, J. 1970 Oceanographic data from the southern area in the ICGS Service Hydrographique.


Data held by the Service Hydrographique are summarized. In the area 5°-15°N, 20°-30°W there are temperature and salinity observations from 98 serial stations and 943 surface stations.


Notas Minerografadas do Centro de Biologia Piscatoria, No. 29.

STD observations around the Cape Verde Islands were made by the 'Baldaque da Silva'. There were 33 hydrological stations and 11 BT in the 1957 (Oct-Nov) cruise, 69 hydrological stations (coastal) and 24 BT in the 1958 (July-Dec.) cruise and 59 hydrological stations (coastal) and 67 BT in the 1959 (April-July) cruise.

The following reference again describes observations just outside the main GATE area:

FEDOROV, K.N. 1971 The new evidence of the lateral convection in the ocean.

Okeanologiya, 11, (6), 994-998.

[In Russian, English summary]

Temperature and salinity observations around 16°30'N, 33°30'W showed a thin stratum of less saline water stably stratified in the midst of a subsurface layer of high salinity. There were two different thermohaline structures separated by only 2-5 nautical miles.

OTHER OBSERVATIONS

BYCHKOVI, V.S., LIVARDY, V.P. & SELIVANOY, L.V. 1965 The characteristics of distribution of the elements of wind waves and swell in the tropical part of the Atlantic Ocean.


[In Russian]

English translation held in:-


98 records of waves were obtained with a GM-16 wave recorder during the 12th and 14th cruises of the "Mikhail Lomonosov". The 12th cruise in Oct. and Nov. 1962 was in the area 14°N-1°S, while the 14th cruise, Sept. and Oct. 1963, was from 10°N to
15°S. Coefficients of variation and skewness of wave heights for different states of the sea were calculated.


Mean figures, by month and season, for the state of the sea are given.