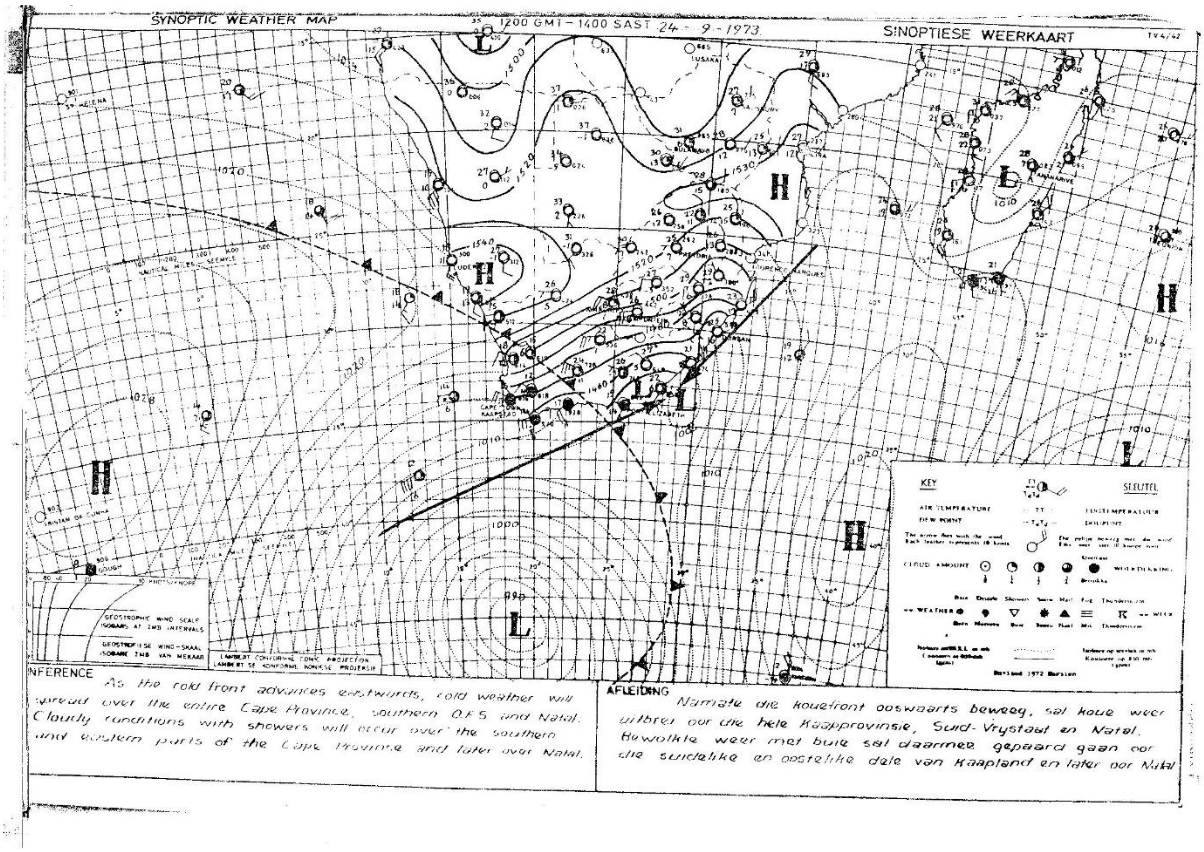
The 1984 Wilbur Ellis Vasco da Gama Yacht Race



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Title page: A synoptic weather chart showing a typical very heavy sea and rogue wave situation.

ABOUT THE AUTHOR

Michael Pierre de Villiers was born in Durban, South Africa. He was trained to World Meteorological Organization class one meteorologist and multi-discipline weather forecaster in the South African Weather Service where he reached the rank of Director. He served on a weather ship in the South Atlantic. He served on World Meteorological Organization expert teams and was World Meteorological Organization rapporteur for the Africa region. He was also a commercial pilot and flying instructor. More recently he was a weather forecaster in the United Arab Emirates, then in England. Now retired.

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2023-05-10

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Introduction

At 1000 South African Standard Time (SAST) on Thursday 26th April, 29 yachts set sail from Durban in the Vasco da Gama yacht race to East London approximately 260 nautical miles (nm) to the south-west along the South Africa coast. During Thursday night off the Transkei coast, in the vicinity of Port St Johns, the fleet ran into a storm with a very extreme sea and a strong gale to storm force south-westerly wind. Two yachts sank, one ran aground on rocks (all the three crews were rescued), one, the Rubicon, disappeared with the loss of all on board. Of the 25 that returned, 9 reported no damage and 2 no significant damage. Only one yacht completed the race. (SA Yachting 1984, Point Yacht Club 1984).

Afterward, the question was should the race have been allowed to start, or been delayed (Ferreira 1894)? This article examines the circumstances surrounding the yacht race. It presents some of the sailor's experiences. The weather information available prior to the race is discussed, as well as a series of four reanalysis weather charts produced sometime after the race and not available until well after the race. It presents research available at the time that explains why such strong winds and enormous waves occur, that led to the disaster and the race abandoned. The author provides a hypothesis for the weather systems that occurred. Weather forecasting limitations at the time are briefly discussed. Anemometer and barographs graphs document the changes in wind and pressure at Durban's Louis Botha Airport and reflect the sequence of weather systems.

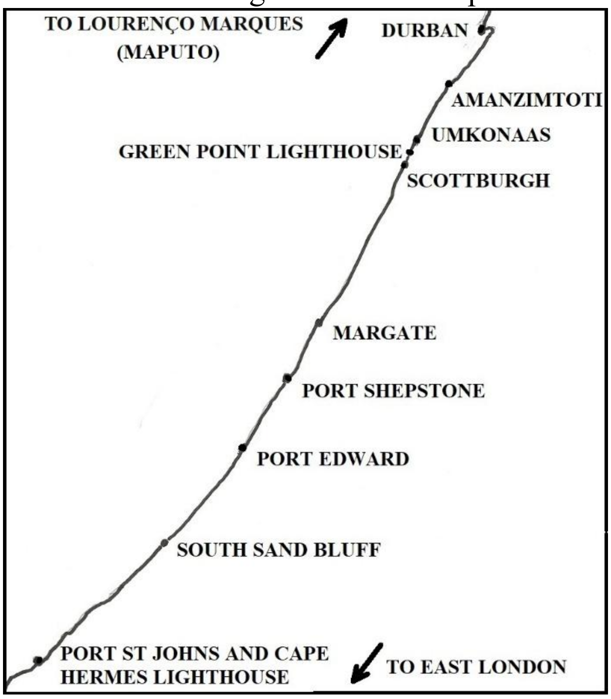


Figure 1. Coast location map.

Throughout the article there alternating references to metric and non-metric values. This is unavoidable due to non-metric units of measurements being in standard use and increasing use of metric units. There is even an interchange between nautical miles and miles, in maritime documents. Similarly various expressions of time are used. Namely, South African Standard Time (SAST), Universal Time Corrected (UTC) previously known as Greenwich Mean Time (GMT) and Zulu (Z) which is the same as UTC and GMT. SAST is 2 hours ahead of the others. Metric and non-metric abbreviations are used except where not used in quotes. That is, verbatim quotes. The map in figure 1 indicates places along the route and mentioned in the text.

History of the race

The Vasco da Gama yacht race is named after the Portuguese explorer Vasco da Gama, the first European who, on his way to India, passed the land he named Natal on the 25th December 1497 (Gadsden 1974). Natal is now known as KwaZulu-Natal. For a number of years it was named the Wilbur Ellis Vasco da Gama race after sponsorship by Wilbur Ellis, the American owner, of Wilbur Ellis yachting equipment chandlery shop in Durban that was managed by Wilfred and Nancy Peirce-Jones (personal communication with Ron Pet and Richard Crockett 2023-05-04/05). It is an annual event, in late April or the earlier part of May, from Durban to East London. It has missed some years during its history. The first seven races starting in 1968 were from Lourenço Marques (now Maputo) to Durban, before politics and war put an end to it. After a hiatus of two years, the race was re-established in 1977, except now it was between Durban and East London with four entries. Popularity increased with a peak of 40 yachts before interest waned due to the toughness of the course "with just four or five boats starting in 2000 and none completing the course" (Crockett 2021). From 2001 to 2014, inclusive, the race returned to Maputo to Durban. For four years, between 2015 and 2018, inclusive, the race was between Durban and Port Elizabeth, a distance of about 390 nm. There was also a gap year or two due to the CAVID-19 pandemic before restarting in 2021 for the 50th race now again between Durban and East London (Crockett 2021). The Vasco da Gama race is generally recognised as the longest established race in South Africa with the 52nd race on the 30th April 2023 and 80 registered yachts.

Race damage

It was described at the time as "probably the biggest tragedy in the history of South African offshore racing" (Cox 1984). Nine yachts were dismasted. Seven knock downs occurred. Knock down occurs when a boat rolls 90 degrees or greater. A boat with appropriate ballast should right herself after being knocked down. Knock downs were; one 90 degrees; one 135 degrees and four 360 degrees (one of these four through 360 degrees four times). One was pitchpoled, Pitchpoled is when a boat's stern is thrown over its bow. One was pooped several times. This means having a wave wash over the stern of the boat. One had the deck partially stove in when knocked down. Rudders were broken amid other damage. Due to all crews wearing harnesses, anyone that was washed overboard was retrieved. (Point Yacht Club 1984, SA Yachting 1984, Crockett 1984 and Cox 1984).

The bulk of the fleet was well offshore making use of the south-flowing current. Had a gale warning been issued most skippers would have chosen a course much closer to the coast to avoid large seas created by the gale against the current. It would appear the bulk of the boats suffering damage were those that could not reach close to the coast quickly and that damage was inflicted by large waves, not by wind strength per se (Point Yacht Club 1984).

The yachts that sank were the Cape of Good Hope and the Spiffero. At about 0600 SAST on Friday 27th, offshore from the Green Point Lighthouse, the crew of the Cape of Good Hope took to the liferaft. The crews of the yacht Orca and the M V Solly saw the flares. Via radio communication and co-ordinating their courses, they were able to get a reasonable fix on the location of the flares. No Global Positioning System in those days They were then sheltered by the container ship Transvaal until lifted from the liferaft by a South African Air Force Super Frelon helicopter about 1 hour later (Point Yacht Club 1984, Rushworth 1984 and SA Yachting 1984).

At about 0200 SAST on Friday, the Spiffero lost her liferaft, managed to send a mayday message at about 0600 SAST, which was heard by the cargo ship Libreville and relayed to shore. A Kuswag (coast guard) vessel located the yacht at 1730 SAST and took the crew on board. The Spiffero sank while alongside. During the rescue a loose rope entangled and immobilised the Kuswag vessel. It was then towed to East London by another Kuswag vessel

(Point Yacht Club 1984 and SA Yachting 1984) eventually reaching East London at 1500 on Sunday 29th. Kuswag (translation coastguard) boats were a fleet of 4 or 6 coastal pollution control vessels (around 170 gross tons) under the auspices of the Department of Environmental affairs. They were obtained in the early seventies to clear oil spills after a number of serious ship oil spills occurred off the South Africa coast. They were all named Kuswag followed by I to IV or to VI. They also had a few, most likely only two, Partenavia P.68 airplanes. Two registrations were ZS-OYN SA Coastguard VIII and ZS-MIG SA Kuswag VII. English on one side, Afrikaans on the other (unofficial South African Air Force website). The two aircraft numbers VII and VIII suggest there were 6 boats.

The Sensation ran aground on rocks close to the shore north of South Sand Bluff (Point Yacht Club 1984, SA Yachting 1984).

The Rubicon disappeared without trace (Point Yacht Club 1984) with the loss of five lives, four men and one woman (Archer 1984, Crockett 1984, Ferreira 1984, Tribune reporter 1984). According to Yachtsman RSA (1984), there are three circumstances explaining the loss of the Rubicon with its extremely experienced crew and possibly the most experienced skipper in the fleet. They could have succumbed to a rogue wave. The waves were big. The yacht could have pitch poled or rolled down the side and enveloped by the wave when it broke and sunk. Secondly, there was considerable shipping in the area. A yacht race navigation warning had been issued to shipping. There were some close encounters with ships reported and visibility was poor. Some yachts reported electrical failure. If this happened to the Rubicon a ship's lookout would not have seen it. What with the noise and the rough sea a collision with a ship would have gone unnoticed with the yacht sinking so quickly there would be nothing anyone could do. Finally, a wave could have broken with sufficient force to stove in the deck and sink the yacht. The yacht Black Magic suffered a partially stoved in deck.

There is uncertainty regarding the report of one yacht to complete the race. One report says the Capricorn (Point Yacht Club 1984) while another says the Shaya Moya, having ridden the storm, made for East London, but upon being told on Saturday the race was abandoned headed back to Durban (Crockett 1984). Some reports get dates wrong. All agree it started on Thursday, one says this was the 25th (Rushworth 1984) while one mentions after nightfall Friday 26th (Point Yacht Club, 1984), it was after nightfall on Thursday 26th.

Briefly three sailor's experiences

Crockett (1984), aboard Assegai, states that they were easily sailing southward in an increasing north-easterly wind with spinnaker unfurled making good speed of around 18.5 knots (kt). The forecast was "for south-westerly winds of 30-35 knots, while in the early evening broadcast they did say that the winds could be as strong as 45 knots". At around 1600 SAST the wind dropped to calm for about 10 minutes before the wind suddenly backed and strength rapidly increased to around 60kt and the sea rose quickly. The highest speed recorded on the Assegai was 55kt before the recorder failed. The noise from the sea and the wind through the rigging was deafening. He described the waves as "high and extremely steep". The Assegai was about 45nm out to sea and set course toward the coast. At around 00:30 SAST the decision was made to return to Durban. Under bare poles, the Assegai was surfing "at unbelievable speeds". After daybreak, the wind began to moderate and they gradually set more and more sail.

Rushworth (1984), aboard Orca, described sailing southward making about 5-6kt in the Agulhas current in a 20kt north-easterly wind while expecting a 35-45kt south-westerly wind according to the forecast earlier in the morning. However, the 1100 SAST shipping forecast on "the air channel 16" was for "only 25-35 knots". At about 1700 SAST the air pressure was down to 1002 hectoPascals (hPa). The skipper decided to reduce sail to storm jib. "At 7.30 pm the blast struck." The wind speed "shot up to 35 knots" with "a dark low cloud roll over us". By 2100 SAST the "sea had risen alarmingly - 4 to 6 metres," the wind had increased to "40 knots-plus" and the skipper ordered the storm jib down to sail under bare poles. By midnight "the motion was violent," the wind "was 50 to 60 knots," wave crests "were being whipped off and spindrift and spume covered the ocean". He estimated wave height was close to 10 metres (m) with very steep faces. Broaches were becoming frequent and warps were trailed. (During broaching the rudder becomes ineffective with sudden loss of directional control. Long lines (warps), long enough to span two wave lengths, are trailed aft to aid directional control - author). They were then pooped. A "monster wave" broke over the stern causing, fortunately, minor injuries to the skipper and crew. Running before the sea back toward Durban, the wind speed indicator had not been "below 50 knots for five hours" with a maximum of 68kt. Broaches were becoming frequent and serious, because waves of 6 to 10m occurred for approximately 10 to 15 minutes "then a huge set of "growlers" – usually three – would come through about 15 degrees off the course of the previous ones. Although hard to estimate, these appeared to be 3 to 4m higher than the others and because of their steepness, breaking". By first light they were abeam of the Green Point lighthouse midway between Scottburgh and Umkomaas. The cast-iron lighthouse, dating from 1905 is the oldest lighthouse on the KwaZulu-Natal coast. Close inshore and off Amanzimtoti close to Durban at 1000 SAST on Friday, the wind and sea had eased considerably.

Skipper Cox, aboard Magic Carpet, recounted expecting a south-westerly wind of around 30 kt while running "comfortably under spinnaker and full main. Hardly had we spotted the telltale line of clouds across the sky, when we were hit by a full 60 knots plus." Although prepared for the wind the spinnaker was ripped before they reduced sail to bare poles. After assessing the situation, they set a triple reefed mainsail and headed toward shore from 18 miles offshore. The sea became high enough to necessitate going slower. They lowered the main sail and reached the coast under bare poles and "much more manageable" conditions.

Discussion of information available prior to the race

The organisers (Point Yacht Club 1984), ensured that the race was in accordance with regulations at the time. That is, it was sailed under Category II of the Safety Regulations of the Cruising Association of South Africa (CASA). Category I being for trans-ocean races. All competing yachts had home port current seagoing clearances and were re-inspected by the race committee fourteen days before the race. All skippers were "well qualified" (many skippers had higher than required grade CASA Certificates of Competence (Crockett 1984)). The weather was monitored a number of days prior to the race as well as on the day via telephone calls to the Meteorological Office at Durban's Louis Botha Airport, including at 08:30 SAST on the day of the race. Synoptic charts were obtained by facsimile courtesy of the Durban Ocean Sailing Academy. This information, including information available regarding the Mozambique/Agulhas Current, was studied by the Race Committee and was available to competitors. Thursday, the Durban Radio maritime radio station, at 1103 and 1903 SAST, broadcast South Africa coastal shipping forecasts issued by the Pretoria Central Forecast Office, which were received by competitors. Of relevance was the East London to Maputo segment. There was no gale warning until 1903 SAST of a moderate gale about 35kt. Actual weather broadcast at 1503 SAST for Port St Johns, Port Shepstone and Durban reported "nothing untoward". These Durban Radio reports were substantiated by Whitehead (1984), that is, 20-30kt in the weather forecast from the Louis Botha office at 08:30 SAST, no gale warning at 1103 and 1500 SAST and 30-35kt gale warning at 1900 SAST.

Meteorological reports broadcast by the South African Broadcasting Corporation and Durban Radio were monitored (Crockett 1984). These were for south-westerly winds of 30-35kt while in the evening broadcast they did say that the winds could be as strong as 45kt. Cox (1984) said that most crews were expecting "a pleasant 15/18 knot north-easterly to shift to a south-westerly of 25/30 knots sometime" during Thursday night and "the first indication of a gale came from the 07.03pm (1903 local time) weather forecasts from Durban Radio predicting gale force winds of up to 35 knots". Rushworth (1984) wrote that a "35 to 45 knot south-westerly had been predicted earlier that morning" but no mention of the source of his information and "when the 11 am shipping forecast came over the air on channel 16 …. Only 25-35 knots were now expected from the south-west at about 5pm". The source of his information also was not mentioned.

Crockett (1984) mentions South African Weather Bureau (SAWB, now the South African Weather Service (SAWS)) weather facsimile charts issued daily. These were received by Chris Bonnet at the Ocean Sailing Academy, which he made available to the organisers and competitors. These charts are an analysis of observations valid at 1200 UTC (1400 SAST). When analysed for distribution about two hours after the valid time, communications being as they were then, not all the expected global observations are available. Observations in the Atlantic Ocean were limited to the islands and Voluntary Observing Ships (VOS). VOS is a World Meteorological Organization (WMO) international programme where member countries recruit ships to observe record and transmit marine meteorological and oceanographic observations while at sea. Drifting weather buoys were in their infancy. They began to be deployed during the 1980s. Early spectrum satellite imagery facilitated identification of major systems. although lacking finer detail. Charts were re-analysed every 24 hours for archiving and publication. Comparison of these charts with re-analysed charts will be discussed later. Chris Bonnet told Assegai skipper Terry Clarence and Richard Crockett that there "were two low pressure systems moving up the coast, one weak and one strong" and that Chris had spoken to the Durban meteorological office and in Pretoria and that "the second front could be quite severe" but that they "could not categorically state that this would be the case" (Crockett 1984). This uncertainty was attested to by a quote by the author a week later in the Sunday Tribune on the 6th, that it was easy to be wise after the event and that were signs of conditions favourable for severe weather, but that no one expected it to be so severe (Ferreira 1984).

Crockett (1984) included two of these charts in his article (figure 2). These are reproduced here courtesy of Yachtsman RSA. Notice the chart for Wednesday 25th has the annotation received in Durban at 1445Z, two hours and forty-five minutes after the valid time. This is consistent with the analysis time mentioned above and confirmation of incomplete data. The second chart on the 26th would only have been available at least 4 hours after the race had begun.

The isobar labels on the weather facsimile chart at 1200Z on the 25th (figure 2a), are indistinct making determination of values difficult. While still indistinct, enlargement suggests that the Atlantic Ocean Anticyclone (AOA, anticyclone = high pressure cell) maximum closed isobar is 1024hPa. This matches the centre of the AOA in the chart below at 1200Z on the 26th (figure 2b). Using similar 4hPa spacings as on the chart of the 26th, the Indian Ocean Anticyclone (IOA) maximum isobar is 1032hPa (the same as on the 26th). Following the isobars to the deep low south of South Africa, at ~44°S 18°E, it has a central isobar of 984hPa while the lowest pressure on the coast at the south-west tip of South Africa is 1000hPa with 992hPa at the lowest

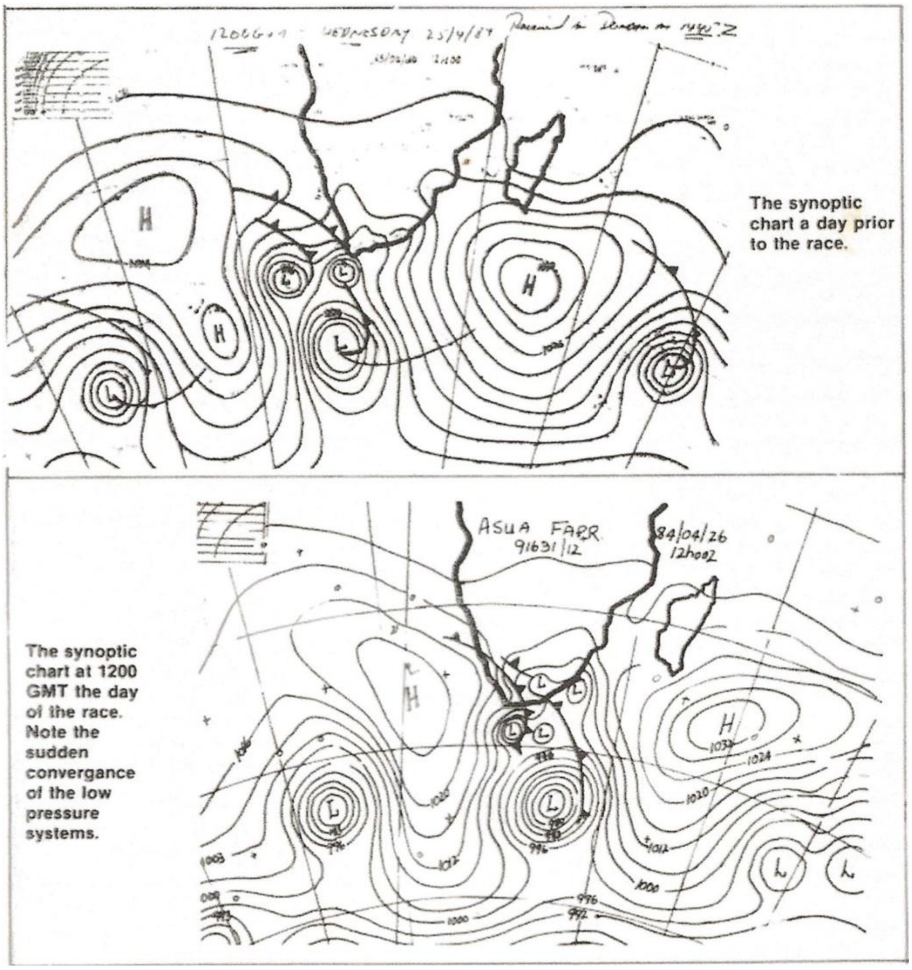
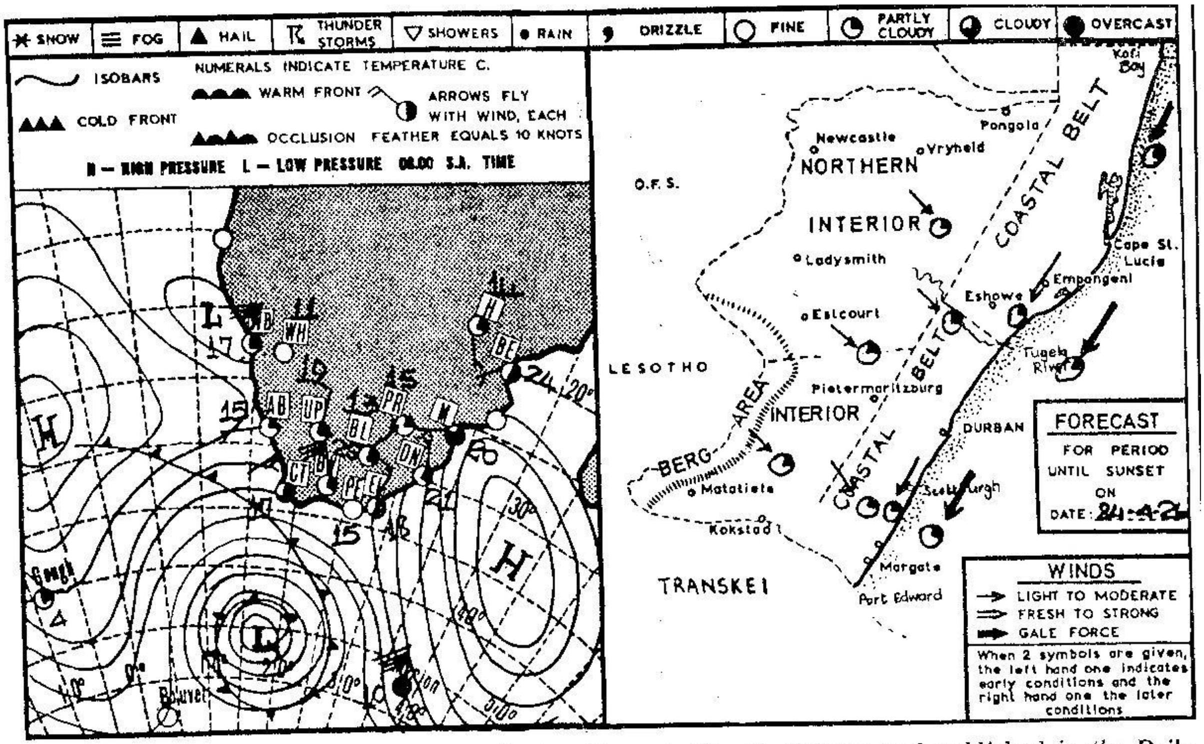


Figure 2. SAWB 1400 SAST weather facsimile charts 25th April 1984 2a above and 26th April 1984 2b below.

closed isobar in the small low. To the west of this low is a secondary low-pressure cell 996hPa. The geostrophic wind scale at the top left of the chart is so blurred so as to be useless. However, given the drawn isobar spacings for these two lows one would be forgiven for thinking that winds could be in the vicinity of fresh to strong in these two lows, particularly the low close to the southern tip of the Cape. However, north-westerly winds of only 15kt were recorded at this time at Cape Town and Mossel Bay. Strong to at least gale force winds were likely around the deep low to the south. The fetch associated with this low would be optimistically about 10 degrees latitude. At 60 nautical miles (nm) per degree this would be about 600nm. The central isobar of the IOA high pressure cell is 1032hPa. Associated with it, a fresh to strong north-easterly wind could be expected along the KwaZulu-Natal coast. Indeed, 30kt was reported at the Cape St Lucia lighthouse well north of Durban while 25kt at Durban. There is some doubt regarding the analysis of the two lows in the vicinity of the South-West Cape, although with hindsight these may have been significant forewarning. This will be explained later when discussing the reanalysis. Based on this chart received and advice received by the race committee and competitors, the weather conditions did not appear significantly onerous.

The 25th 0800 SAST (0600Z) weather facsimile chart, prepared by the Durban meteorological office for the evening Daily News on the 25th (reproduced in the Sunday Tribune on the 13th May, figure 3), is more straight forward, minus the lows at the Cape. It depicts an AOA, IOA, deep low to the south and suggestion of a weak coastal low, or weakness, on the Cape south coast with a preceding NNW offshore 30kt wind at Mossel Bay. The absence of isobar labels complicates the analysis. However, assuming similar AOA and IOA pressures and noting that there are 13 isobars from the deep low to both the AOA and IOA, both should have the same central pressure. For convenience, splitting the difference between the 1032hPa IOA and 1024hPa AOA, they are assumed to be both 1028hPa. This results in a deep low of 980hPa at ~46°S 17°E. That is, close to the weather facsimile chart low 6 hours later at 1200Z on the 25th (figure 2a). As with the chart of the 25th at 1200Z, there is the suggestion of strong to gale force



The weather map issued by the Louis Botha Airport Weather Ofice and published in the **Daily News** *on April 25, the day before the race began, shows a well developed cell of low pressure south of the continent. The existence of this low pressure cell the day before the race gave rise to the freak wave conditions which devastated the fleet of yachts. By the next day the pattern was changing, but the heavy seas were already on their way — rolling across the ocean to where they met the fleet on the Thursday night. The arrows on the right predict gale force winds for the period up to sunset of the first day of the race, just before the storm struck the fleet*

Sunday Tribune 1984-05-13

Figure 3. SAWB Durban weather office daily News weather map 25th April 1984 reproduced courtesy of the Sunday Times.

winds with a preceding low pressure cell NNW 40kt wind at Marion Island. The fetch still appears to be about 10 degrees, possibly 13 degrees, so 600 to 780nm. Early morning offshore winds along the coast from Durban to East London were 10kt to 15kt. It is also worth noting the 30kt northerly wind at Mossel Bay, which will be discussed below with reference to the 25th reanalysis chart. The 0800 SAST chart is not too dissimilar from the weather fax chart 6 hours later at 1200Z (figure 2a). Notice in the right-hand frame the forecast NE gale along the KwaZulu-Natal coast later on the 26th (race start day).

In figure 2b, the 1200Z chart Thursday 26th, has become complex with four lows and the deep low to the south at approximately 46°S 30°E with a lowest closed isobar at 976hPa, that is, it has deepened by 8hPa during 24 hours, still with a fetch of about 600nm. Returning to the small lows in the figure, the coastal low, on the south-east coast in the vicinity of the Transkei has a lowest isobar of 1000hPa while the low off the Cape south coast (with a cold front attached) apparently has a lowest isobar of 996hPa. Again, there is uncertainty regarding the analysis of lows nearer to the coast and will be explained in the following section.

Reanalysis charts

In the following figures, consider the four 24 hours later reanalysis 1200 GMT – 1400 SAST charts, for archiving and publication from the 24th to the 27th, inclusive. Unfortunately, these charts are not publicly available until considerable time later, well after the race, after going to the drawing office.

Tuesday 24th (figure 4). The chart for the 24th shows the AOA centred rather further south than usual at ~1024hPa, 40°S and west of Gough Island. The centre of the IOA at ~1032hPa is also further south than usual at ~43°S and north-east of Marion Island. The annual position of the sub-tropical high-pressure belt is approximately 30°S, 35°S in summer and about 3 to 4 degrees north of 30°S in winter (Hayward and Steyn 1968). A low-pressure system was centred at ~996hPa was at ~43°S 08°E. The pressure gradients due the southern extent of the highs indicate considerable air advection southward ahead of the low and northward west of the low. Two hPa isobar spacing on the geostrophic wind scale in the bottom left of the chart suggest generally 40-50kt winds west of the deep low, while two ships further north and north-west indicate 20-25kt winds. The fetch is estimated at 600nm with a measure of uncertainty due to data lacking further south. The IOA produced 10-20kt winds along the east and south-east coasts of South Africa while the usual pre-trough system lee low coastal low, of ~1010hPa, due to divergence caused by the higher altitude offshore air flow from the escarpment (de Villiers 1992).

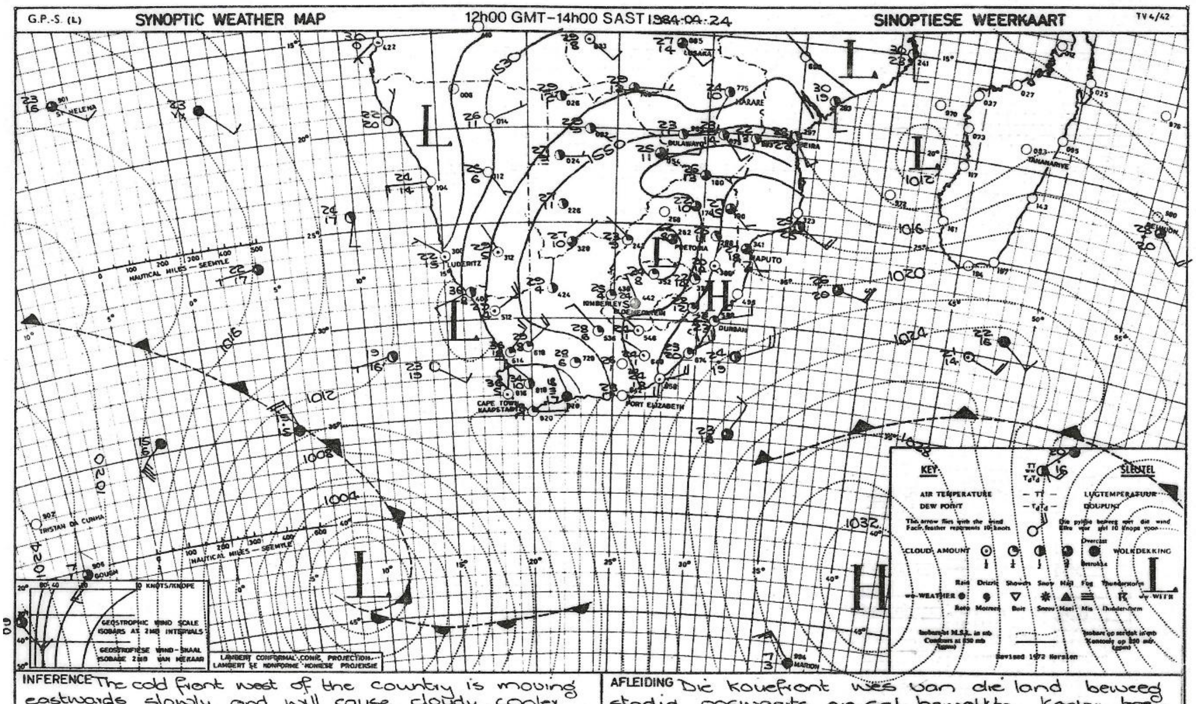


Figure 4. SAWB synoptic weather map 1400 SAST 24th April 1984.

Wednesday 25th (figure 5). The pre-race day chart shows the AOA still ~1024hPa and far south centred ENE of Gough Island and the IAO still ~1032hPa now at ~41°S 54°E and still further south than normal. Also still inducing a marked air advection southward east of the low and northward west of the low. The deep low to the south has moved 2 degrees southward to ~45°S and eastward to ~18°E, but deepened to ~984hPa. The pressure gradients between the three systems remains similar to the previous day. If anything, it has intensified with the geostrophic wind estimation generally ~40-60kt, possibly stronger nearer the core with a similar estimated 600nm fetch. Meanwhile along the east and south-east coasts of South Africa, the IOA has caused a 30kt wind at the Cape St Lucia lighthouse with 25kt at Durban and 25kt at Port St

Johns. At the Cape the pre-trough coastal low moved to the Cape south coast and deepened to ~1002hPa due to increased divergence in the increased north-westerly wind at the escarpment level (a form of Dines compensation), the wind now 15-20kt NW in the vicinity of the SW Cape and 30kt at Mossel Bay in the 0800 SAST chart (figure 3). This early morning 30kt wind is probably a combination of the off-escarpment air flow and early katabatic effect. The increased north-westerly flow led to Berg wind (or Föhn wind) effect at the coast with exceptional 35°C at Mossel Bay and Port Elizabeth and 34°C at East London (de Villiers 1996). The intensity of the situation over the South-West Cape suggests that this was perhaps more than just a coastal low. The other point of interest is the development of a secondary low of ~1004hPa at ~37°S 11°E, probably due to negative vorticity development in air flow following the trough. In general, this chart resembles the weather facsimile chart on the 25th (figure 2a).

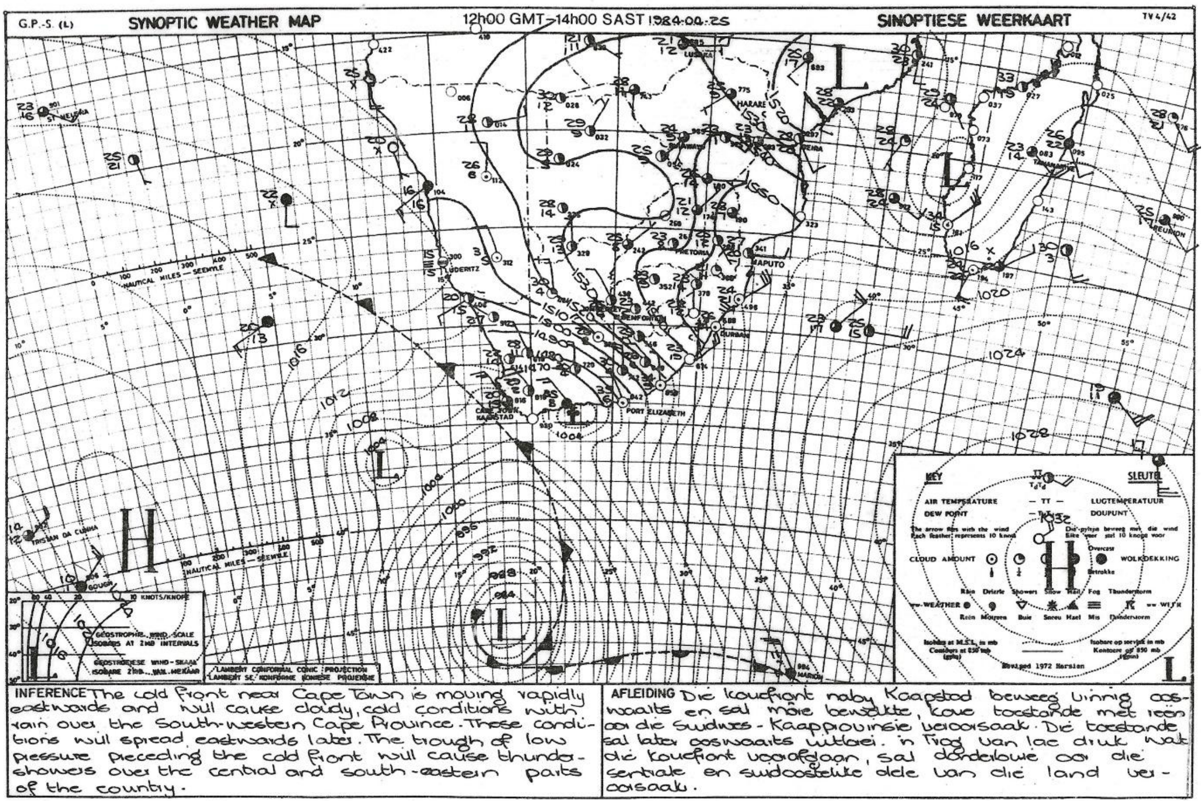


Figure 5. SAWB synoptic weather map 1400 SAST 25th April 1984.

Thursday 26th (figure 6). Race day. The yachts set sail four hours before the validity time of this chart and the weather facsimile chart (figure 2b). The AOA has been squeezed somewhat northward by the approach of another low to the west in the vicinity of Gough Island. The AOA is now at ~34°S 05°E and now with ~1026hPa highest closed isobar, 2hPa higher than 24 hour earlier. The IOA is now in the vicinity of 42°S 60°E ~1028hPa highest closed isobar 4hPa lower than 24 hours before. The deep low approaching Marion Island ~47°S 32°E has deepened further to a central pressure of ~978hPa. There is still marked advection either side of the deep low. A longer fetch toward the south-east coast has now developed. At least 10 degrees to 40°S, ~600nm, potentially beginning to reach toward 35°S, 15 degrees and ~900nm. The geostrophic scale continues to indicate 40-60kt winds, possibly stronger nearer to the deep low centre. A coastal low has moved north-eastward along the coast to south of Durban with a central pressure ~1002hPa. More interestingly, cyclogeneses has occurred to the south of East London, possibly development and eastward movement of the suspected more than coastal low the previous day. The secondary low has also deepened to ~1002hPa and moved eastward to 38°S 20°E.

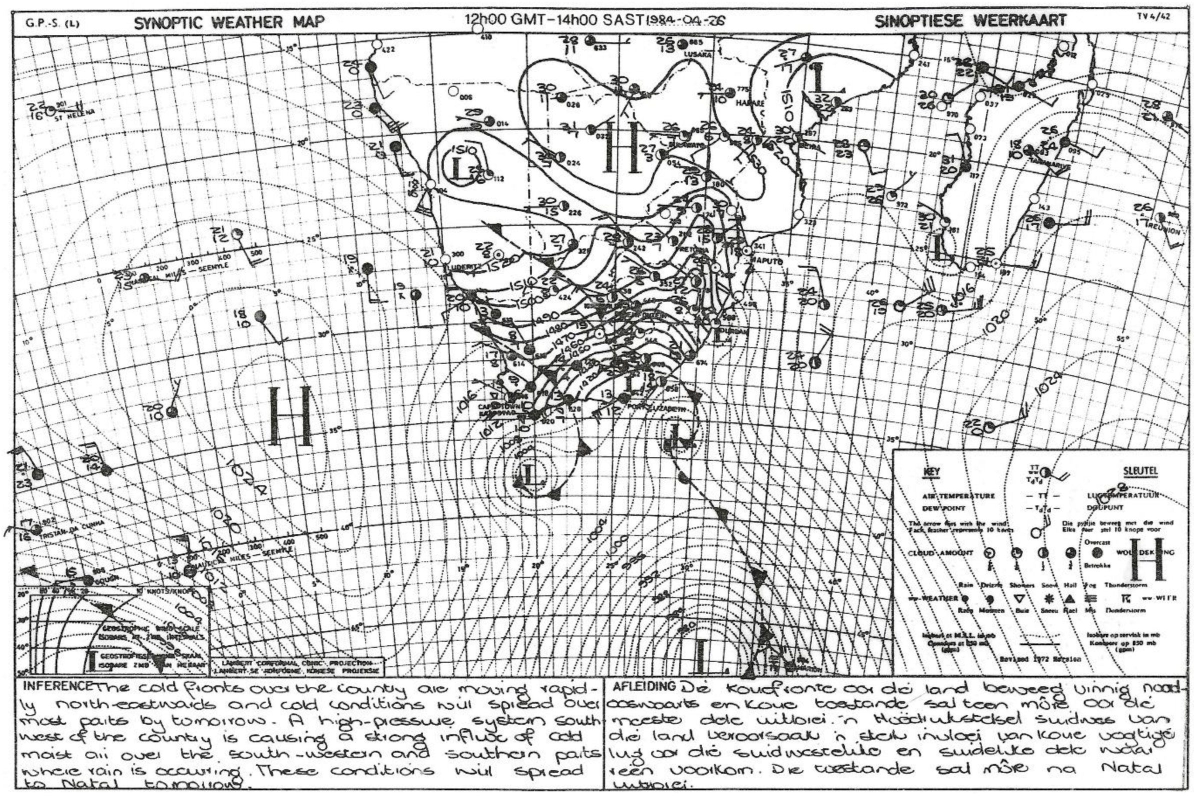


Figure 6. SAWB synoptic weather map 1400 SAST 26th April 1984.

Friday 27th (figure 7). By 1400 SAST most yachts had returned to Durban. The AOA, at ~1024hPa, is now an elongated shape at 35°S near the South-West Cape to 30°S 00°E/W. The centre of the IOA is off the east of the chart. The new deep low, ~1000hPa, from the west is

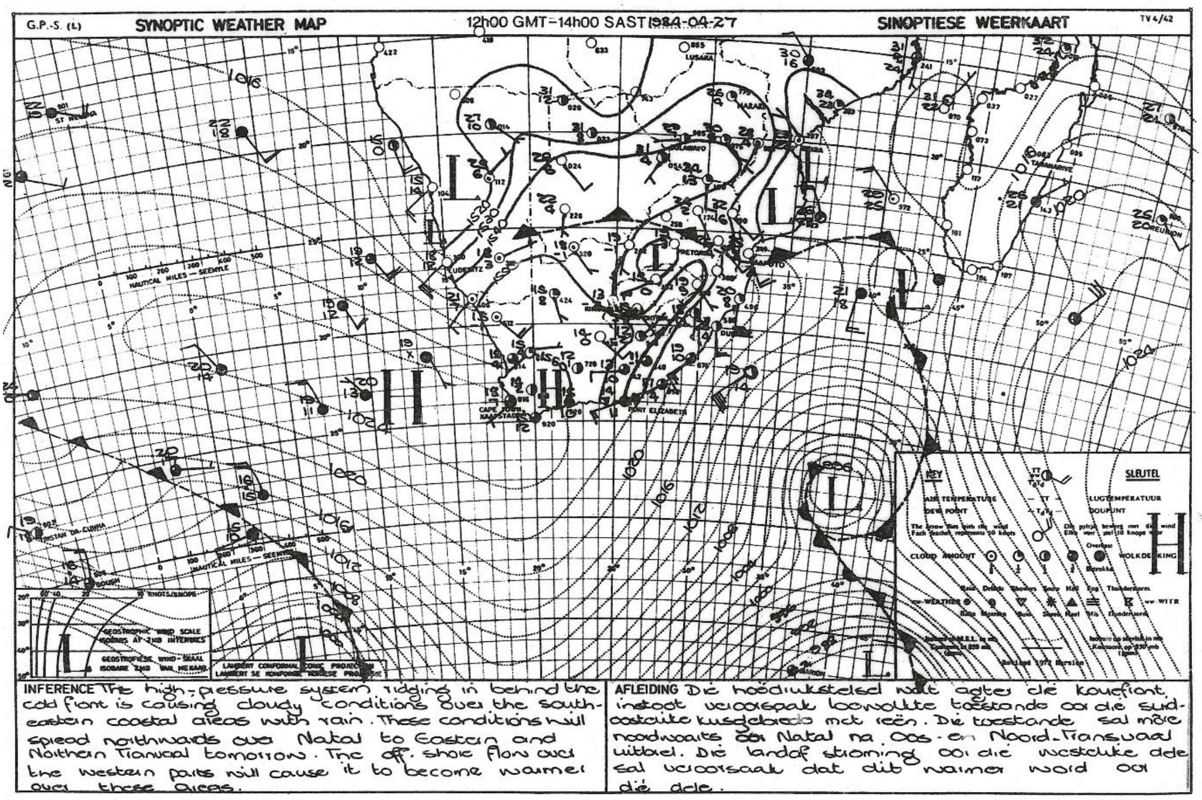


Figure 7. SAWB synoptic weather map 1400 SAST 27th April 1984.

now at ~48°S 04°E. The important deep low passed east of Marion Island to ~48°S 43°E to an uncertain 980hPa. Meanwhile, the low that was off the East London coast has moved quickly to SW of Madagascar at ~27°S 42°E and filled to ~1014hPa. Of greater significance is the low that was off the SW Cape the previous day, is now at ~ 38°S 39°E and deeper at 996hPa. There is also a more marked circulation around this low and combined with the deep low, has a longer fetch from the SW, possibly around 1200nm. The coastal low has vanished and higher pressure from the interior has begun to intrude seaward of the KwaZulu-Natal coast resulting in gradually decreasing wind and sea along the KwaZulu-Natal coast in the lead to 1400 SAST.

Hypothesis and the cause of freak waves

The author's hypothesis is that, after setting sail, the yachts had a favourable following strong to near gale NW wind assisted by the 2-4kt Agulhas current before the weak coastal low passed with a lull in the wind to calm (as recorded by Crockett 1984) and indicated on the 1400 SAST reanalysis chart on the 25th (figure 5). Then the low that was off the East London coast arrived. Remember this is the low that was west of the SW Cape on the 25th (figure 5) experiencing increased cyclogeneses while passing eastward south of South Africa. About 1600 SAST (Crockett 1984) or 1930 SAST (Rushworth 1984) this low brought 35-45kt winds and the sea rising to 4-6m by 2100 SAST. 2400 SAST the wind was 50-60kt and waves close to 10m with very steep faces (Rushworth 1984). Interpolation of this low south, of the SW Cape at 1400 SAST on the 26th (figure 6) to its position at1400 SAST on the 27th (figure 7) places it at ~43°S 30°E at 2400 SAST on the 26th. In the absence of the availability of intervening charts it is suggested that this low experienced further cyclogenesis to around 996hPa, the values shown at 1400 SAST on the 27th (figure 7), possibly lower than 996hPa in the interim 2400 SAST on the 26th, with increased associated pressure gradient. In the process enhancing the ~1200nm fetch from the SW, thereby accounting for the strong to hurricane winds and very high sea.

Research by Mallory (1974) concluded that a strong NE wind preceding a cold front (or trough system) accentuates the speed of the ~100 miles (~160km) wide Agulhas Current that is usually kept seaward of the 100 fathoms escarpment line (600ft, ~200m). Between Durban and Port St Johns it is 5 miles (8km) offshore with 1000 fathoms (~2000m) within 15 miles (25km). Maximum velocity of the current is immediately seaward of the 100 fathoms line. It usually flows at ~3-4kt, is known to reach 5kt and possibly 8kt. A rapid wind direction change to SW and increased strength occurs with the passing of a cold front associated with a deep low further south, up to gale force and immediately a very rough sea. Eastward movement of the system can be around 25kt. Locally generated conditions, such as a preceding coastal low, closer inshore low with locally generated waves 3-4m high and 60-50m wavelength in the opposing current. Fully developed ~6m waves in a long fetch associated with a deep low further south, travelling at 30-35kt reach the current and increase to ~8m with a wavelength of 150m. When, wave trains of different wavelengths coincide abnormally high waves up to 18m can be generated, albeit for a short period of time "perhaps a matter of minutes". Movement against the current causes the lee face of the wave to become very steep with a preceding abnormally deep trough. These freak, or rogue waves, are most likely to be encountered north of Port St Johns. Crockett (1984) also wrote that sea charts for the area do warn mariners that up to 20m freak waves may be encountered along the edge of the continental shelf to 20 miles seaward when the barometric pressure is low with a strong south-westerly and rough sea. Evidence that mariners were aware of Mallory's research. This is supported by research mentioned by Shillington and Schumann 1993.

Yachts of much shorter length are better able to ride the large waves than large ships, although much more uncomfortable and perhaps devastating for the crews. According to Mallory (1974) the bow of a large southward moving ship, without warning, encounters a sloping and deep trough, probably longer than the length of the ship. At the end of the trough, it ploughs into a very steep and large wave ~18m high travelling toward the ship at up to 30kt. There is no time for the bows to rise and it gets buried in the wave. The wave crashes down onto the deck, usually between numbers 1 and 2 hatches (figure 8). The great weight of water places enormous stress and strain, not only on the deck, but also the ship's structure resulting in not only damage to the hatches and deck, but also structural damage sufficient to break the ship's back and cause it to sink.

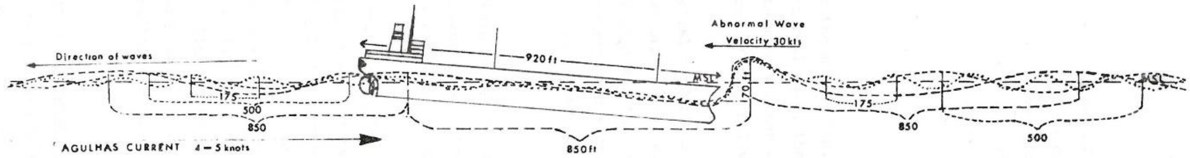


Figure 8. "Sinusoidal curves of three wave trains having wave lengths of 850, 500 & 175 feet, which become in-phase for a short period thereby creating an abnormal wave about 70 feet high. In advance of the wave is a long deep trough" (Mallory 1974).

Among ships reported to have suffered as a result of freak waves along the south-east coast of South Africa are; the World Glory, 13th June 1968. broke her back and sank. SW wind and fetch 800 miles for past 36 hours (Mallory 1974). The bow entered the base of a wave estimated to be 21m that passed under the ship. At midships with the bow and stern unsupported, the resulting severe hogging cracked the upper deck. The bow was raised by another huge wave causing severe sagging. The ship split in two (Monroe 1993); Bencruachan, 3rd May 1973, severe damage forward, SW wind and fetch 600 miles for past 36 hours (Mallory 1973); Svealand, 25th September 1973 (Mallory 1974); the Norwegian tanker Wilstar, 17th May 1974, severe bow damage by a freak wave off the South Africa east coast had 2.5 cm (1 inch) plates bent like paper (Nickerson 1993). Of the 10 damage events recorded by Mallory (1974), fetches varied between 800-1200 miles with one exception 600 miles. Possibly the earliest record of a ship lost due to a freak wave was the steamship Waratah on the 28th July 1909. Ships logs at the time mention SW gales with a mountainous sea. The ship sailed southward from Durban. Two signallers at the Qora River mouth (some distance north of East London, through their telescope, saw a heavily rolling ship. When looking again, the ship had vanished. The captain of the Harlow said that shortly after seeing the Waratah there were two bright explosions in the vicinity of where he saw the ship, which could mean burning coal exploding (Natal Mercury, 1984). Coal's tendency to ignite and smoulder while stored was a known problem. Coal carried in bulk can emit flammable methane gas and some coal types may be liable to self-heating resulting in spontaneous combustion.

Calculation of wave height

At the time, calculation of wave height was primitive. Considering Mallory's (1974) results, it is therefore likely that yachts, within the current seaward of the 100 fathoms line, encountered freak waves of 18m. One very old method was Stevenson's (1818-1887) formula wave height (feet) = 1.5√fetch (miles) (Townson 1981) assuming a fetch of 1200 miles yields a wave height of 52ft (16m). A 1200nm (2222km) fetch is used in this article based on the likely fetch on the 1400 SAST reanalysis charts on the 26th from 48°S 20°E to 33°S 30°E 115nm and on the 27th 48°S 20°E to 33°S 30°E 1282nm. Using the WMO (1976) graph in figure 9, using 2222km

(1200nm) fetch, produces a 95m wave and 12.5 seconds (s) wave period at 20ms^{-1} (39kt), 14m and 15s at 25 ms^{-1} (49kt) and 20m 17.5s at 30 ms^{-1} (58kt). Using a 48 hour time limit during the two days (26th and 27th) produces very little difference. Flattening of the curve means there is no appreciable increase in the wave height or wave period longer than a 1200nm (2222km) fetch. Bearing in mind Mallory's results of ~18m waves and the WMO results, Rushworth's (1984) observations presented earlier, namely winds 35-40kt plus with 3-6m waves increasing to 50-60kt wind and 10m waves with steep sides while indicative of the predominant sea state, his huge "growlers" usually three at a time possibly could well be 18-20m high. Even Stevenson's formula appears to have stood the test of time.

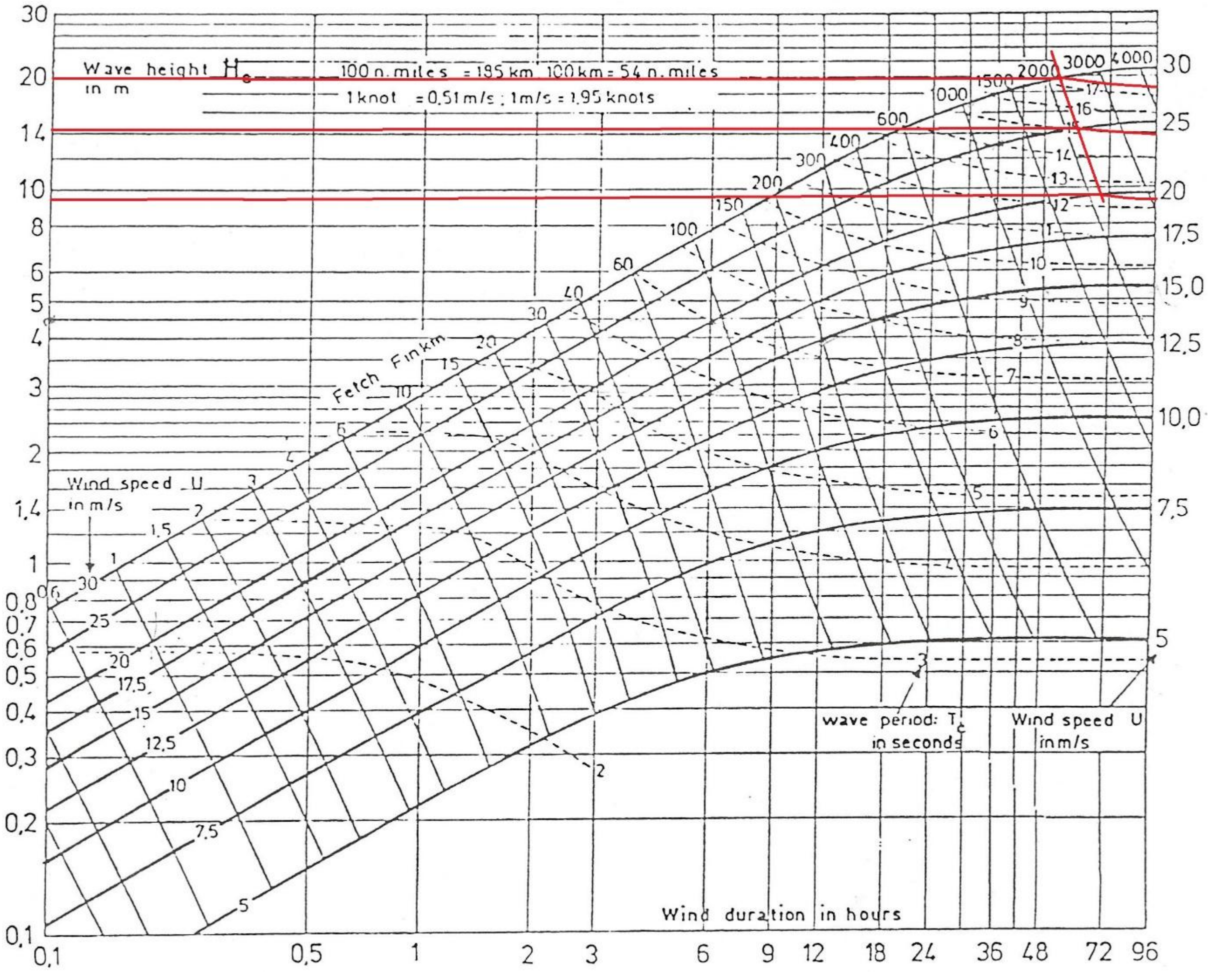


Figure 9. Wave forecasting diagram (WMO 1976). Wave height (m) on the left of the figure, hours below. Wind speed in ms^{-1} along the right and curved lines sloping to the left. Fetch in km in lines sloping to the right. Wave period in seconds curved dashed lines.

Anemometer and barograph charts

The barograph and anemometer charts, figures 10 and 11, respectively, at Durban's Louis Botha Airport for the period 0800 SAST Thursday 1984-04-27 to 0800 SAST 1984-04-28 are interesting. The photocopy of the anemometer readings, being limited to A4 size starts at 1400 SAST. All daily recordings were made on clockwork drums, which were rewound every Monday at 0800 SAST. The charts hourly values were read, checked by a second person and later entered by another person on a large monthly return sheet. The grand total of the daily rows had to match the grand total of the 24 hourly columns totals. Corrections were made to hourly barograph values against the more accurate hourly barometer reading. The chart hourly times were adjusted for clock errors. For example, the barograph trace ends short of 0800 SAST, although the chart was removed at 0800 SAST. The clocks rarely keep 100% accurate time. Hence the adjusted hourly marks graduated toward the end of the trace in figure 10. As a matter of interest there were similar calibration and time adjustments made to clockwork

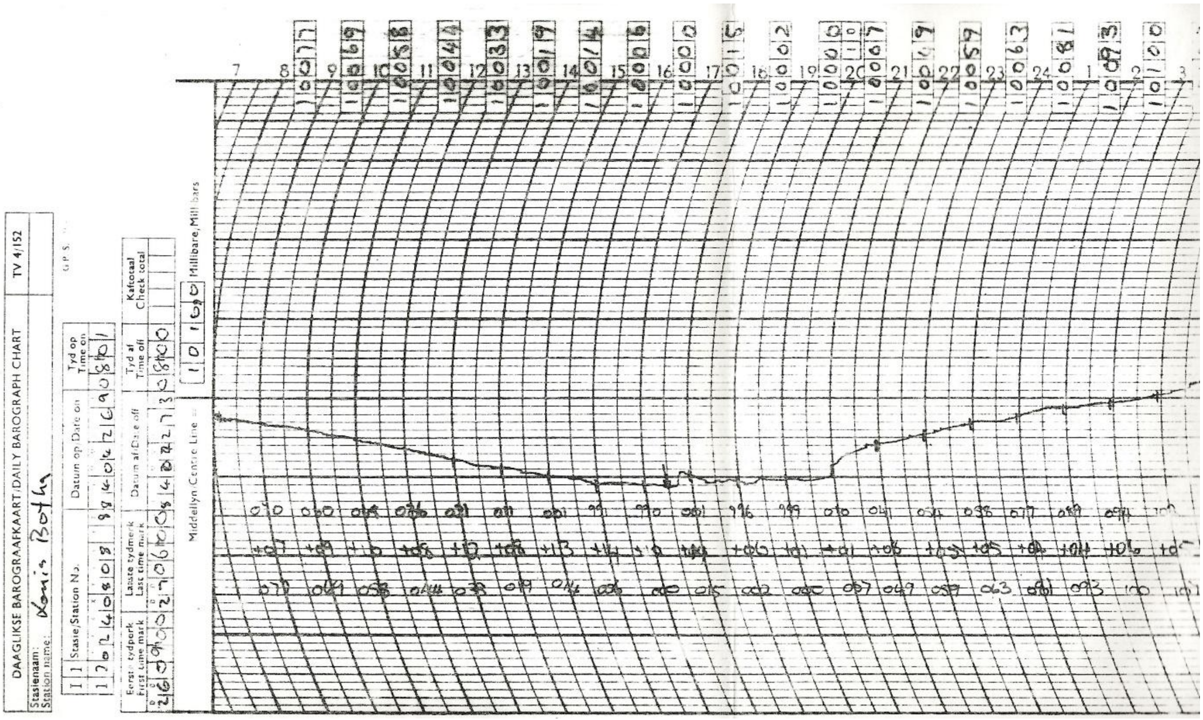


Figure 10. SAWB barograph chart recorded at Durban's Louis Botha Airport for the period 0800 SAST Thursday 1984-04-27 to 0800 SAST 1984-04-28

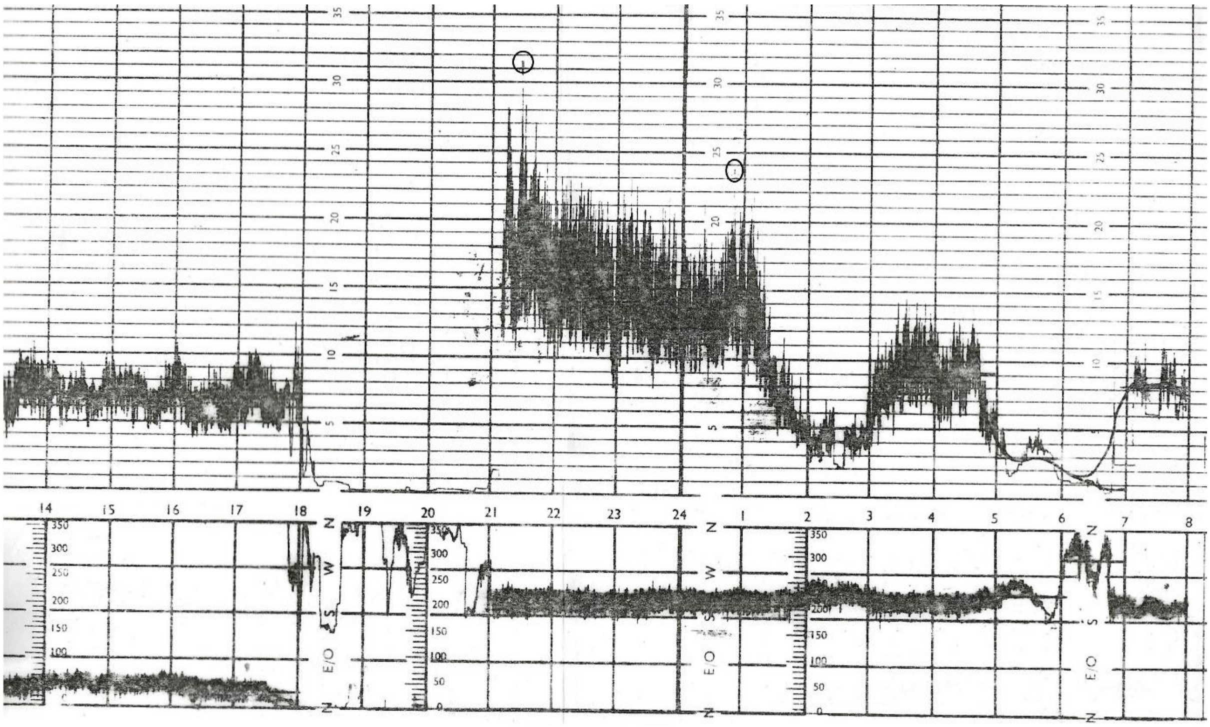


Figure 11. SAWB anemometer chart recorded at Durban's Louis Botha Airport from 0800 SAST Thursday 1984-04-27 to 0800 SAST 1984-04-28 showing only hours 14 to 08.

thermograph and hygrograph charts. Returning to the barograph and anemometer charts, comparing the two while reading from left to right, air pressure gradually lowered while the IOA retreated with a 5- ms^{-1} (~10-20kt) north-easterly wind channelled along the NE/SW oriented coast. Until around 1730 SAST when an arrow indicates the lowest pressure on the chart of 999.0hPa corrected to 1000.0hPa. Shortly before 1800 SAST there is brief nearly 2hPa pressure increase. Meanwhile there is an abrupt and brief fluctuation of the wind direction to mainly westerly of 5-10 ms^{-1} with a gust to 12 ms^{-1} (~24kt). This was the passing of the weak coastal low. There was then a 3 hours spell of fairly steady pressure and calm to near calm wind, the direction fluctuating from south to north through westerly. The lull before the storm. At 2100 SAST, the barograph indicates a sudden rise of nearly 2hPa increasing to 3hPa in total during ~15 minutes with a steady rise thereafter. At 2100 SAST, the anemometer changed to a mainly SSW direction, within 10 minutes a sudden and gusty mainly 15-20 ms^{-1} (~30-40kt) wind with a maximum gust of 31.5 ms^{-1} (~63kt) marked by a circle on the chart. The wind continued from a mainly SSW direction at 10-20 ms^{-1} (~20-40kt) with another peak gust at 23.5 ms^{-1} (~47kt) until the wind moderated considerably to approximately 5-10 ms^{-1} (~10-20kt) from 0100 SAST on the 27th. Notice the much lighter and somewhat variable direction wind after 0500 SAST. This is consistent with higher pressure from the interior beginning to intrude seaward of the KwaZulu-Natal coast mentioned in discussion of the reanalysis chart of the 27th (figure 7).

Weather forecasting at the time of the race

Post-race, the question asked was why was the race not postponed (Ferreira 1984)? Credit to the organisers, they did all they could to obtain as much information about the weather leading up to the start of the race, at the time of the start and available weather forecasts from the SAWB. The truth is, the collection of weather observations and weather forecasting was nowhere near as sophisticated at it is today. This has already been alluded to above. Communication was limited to the telephone, telex machine and more recently, the facsimile machine, all of these via landline, or radio. There was no Internet, or mobile phones. Added to the problem was the vast expanse of ocean around the south of Africa with very little in the way of observations, particularly to the west over the South Atlantic from whence almost all weather systems arrive. Expert knowledge was not as freely available as it is today in the 21st century, usually restricted to universities and other institutions with much less cross collaboration and research papers lying in university or state libraries. For example, while forecasters in Durban were aware of the very heavy sea that could be generated off the south-east coast, they were not aware of Mallory's research. The author only became aware of it after transfer to the Pretoria Central Forecast Office in 1985.

It was no easy task forecasting the weather for the coasts of South Africa and the great expanse of surrounding ocean with a dearth of information. The SAWB had the 2nd largest marine forecast area in world after the United States of America (perhaps the SAWS still does). In the west, from the South African coast, it extended northward to the Angola coast then west along the Equator to 20°W then south to 50°S then east to 70°E then northward to 25°S then west to the South Africa coast with the Mozambique Channel. In the summer months, when supply ships headed south to bases in the Antarctic, forecasts were issued on request to the Antarctic coast. The South African supply ship also required daily forecasts with 5 day forecasts while it was tied up at the ice, not only for the use of the ship's crew, but also the helicopter crews. Ad-hoc forecasts were also requested by deep-sea tugs on their way to rescue a ship in distress that could be passing well to the south, as well as deep-sea tugs towing vessels to be scraped in India and further east in Asia. These would often tow 2 vessels. The biggest of the deep-sea tugs were the SA John Ross (since renamed Smit Amandla) and SA Wolraad Woltemade (scraped in 2010). The John Ross (built in Durban, 1976) and her sister Wolraad Woltemade (built in Leith, 1975) were for a number of years the world's largest salvage tugs. Still in the future was forecasting for the Mossgas platform (circa 1989) off the south coast in the vicinity of Mossel Bay. Particularly important was forecasting the sea and swell during towing of the rig to its site and subsequent operation.

Surface observations were limited to sparse synoptic reports from VOS ships mainly in the shipping lanes to North America and Europe, the far east and to a much lesser extent, to South America. Synoptic reports were received from the Falklands, Gough, Marion, Crozet and Kerguelen in the south, St Helena and Ascension in the north. There were and still are, observation bases in the Antarctic, including SANAE (South African National Antarctic Expedition).

Added to the lack of surface observations was limited upper air data. This was limited to twice daily atmospheric soundings obtained by sending hydrogen filled balloons with attached radiosondes twice a day at 0200 and 1200 SAST from 6 or 7 sites in South Africa and one each at Marion and Gough islands. Available daylight visible spectrum satellite images were available a few times per day. The author, guest speaker at a Rotary lunch, was asked whether these images were helpful. The response was that they enabled us to make our mistakes with greater confidence.

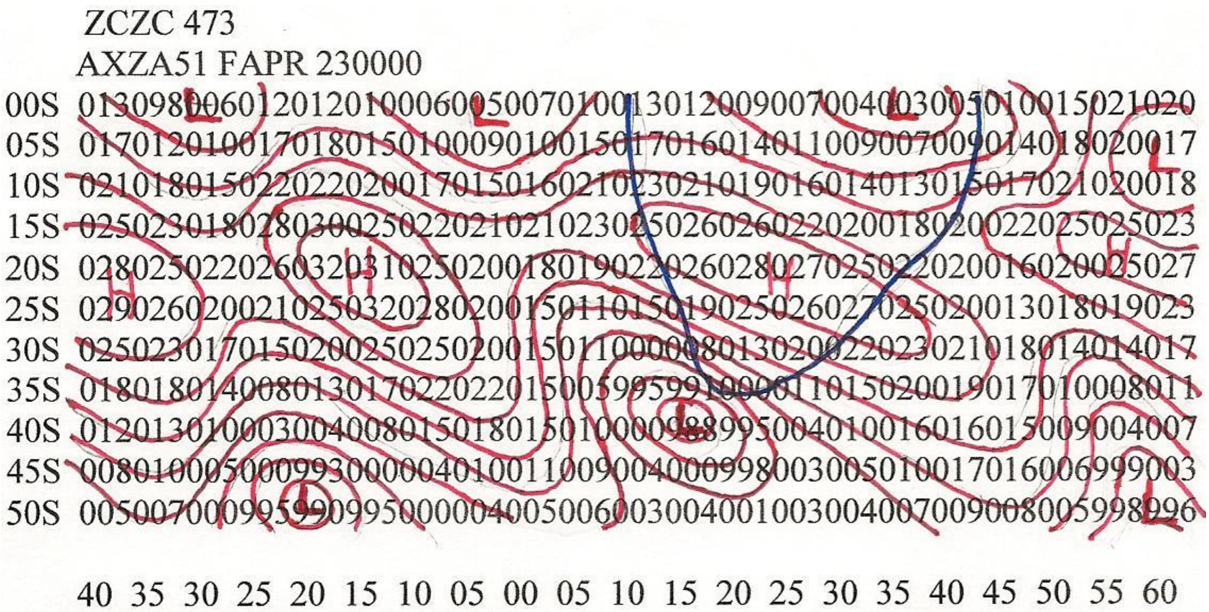


Figure 12. Example of the type of NWP product first available at SAWB regional offices.

Primitive numerical weather prediction (NWP) modelling at the time became available in the early 80s. In Durban this was limited to a once daily coded European Centre for Medium-range Weather Forecasts prediction of surface pressure for 24 and 48 hours ahead that would be received via landline on a telex machine. An example, created from memory, is shown in figure 12. The latitudes and longitudes could be determined by knowing the top left value. This was 0S 40W with 5 degrees spacing. The latitudes and the left and longitude below have been added for clarification. Surface sea level pressure values consisted groups of 3 being the last 3 whole digits in hPa, or, as they were called in those days, millibars. For example, 012 = 1012 hPa and 995 = 995 hPa. The position of the important land mass is known, so this could be superimposed on the analysed surface prognosis. It was then left to the forecaster's experience to interpret the weather. At the time NWP marine modelling was not available.

In the circumstances weather forecasting was difficult. Experience was all important. Weather systems could develop and remain undetected. Hopefully observations and atmospheric soundings at Gough Island would give advance warning. Techniques used included; plotting previous island synoptic reports at 3° intervals downstream (to the east) to simulate extra observations; close attention to Gough and Marion soundings to detect passing warm/cold fronts and air mass change (such as 850 hPa wet-bulb potential temperature) and careful reanalysis of previous charts to ensure the latest chart followed the prior sequence of events.

Conclusion

In answer to the question should the race have been allowed to start, or perhaps delayed, it is the author's opinion that, based on information at the time, it was probably the correct decision. Skippers were warned that it could be challenging later. Could the weather forecast have been better? The extent of the AOA further south than normal in figure 2a on the 25th, and strong IOA with marked pressure gradients between them and a marked low hinted something was brewing. There was a warning that the low west could be a problem. Owing to lack of sufficient evidence nothing more definite was stated. Systems could develop unnoticed, or weaken, until there was an observation in the vicinity that was either explicit or hinted at something in the area. With hindsight it was not the correct decision. However, it is always easy to be wise after the fact.

Regarding weather forecasting, enormous advances in weather forecasting have been made since the 1980s. Communication of information is one area; from landline telephones and telex machines to computer processors, satellite communication; the Internet and mobile telephones have enabled rapid dissemination of information. In particular, weather forecasting has benefited from the sophisticated NWP models now available and are continually improving. Although, the author's experience is that they can still be dodgy three days ahead and longer. Weather forecasting has become less of an art and more of a science. While experience and NWP model interpretation skill, is still important, computer applications now provide remarkable information that require no interpretation, simply an ability to read.

In the light of information available today the race would no doubt have been delayed, or cancelled. Although, cancelled may not have been an enthusiastic option for the yacht crews.

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