




**INVESTIGATION REPORT OF ACCIDENT
INVOLVING GEORGIAN AIRWAYS AIRCRAFT
CRJ-100ER (4L-GAE)
AT KINSHASA'S N'DJILI AIRPORT
DEMOCRATIC REPUBLIC OF CONGO (DRC)
ON 04 APRIL 2011**

<p style="text-align: center;"><i>Democratic Republic of Congo</i> <i>Ministry of the Transportation and Ways of Communication</i></p>  <p style="text-align: center;">Permanent office of investigations of aviation Accidents/Incidents</p>	<p style="text-align: center;">FINAL REPORT OF TECHNICAL INVESTIGATION ON THE ACCIDENT OF THE CRJ-100 PLANE, REGISTER 4L-GAE</p>	<p style="text-align: center;">Page 2</p>
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Investigation report of accident involving Georgian Airways CRJ-100ER (4L-GAE), which occurred at Kinshasa's N'DJILI Airport, Democratic Republic of Congo (DRC) on 04 April 2011.

This report contains the details of the investigation carried out by the Investigation Commission established according to the order of Mission n° 410 /CAB /SG /TVC /27 /2011 of April 5, 2011 by the Secretary General of Transport and Minister of Communication of the Government of the DRC, on the circumstances and probable causes of the crash of aircraft type CRJ-100ER, registration 4L-GAE, serial number 7070, which occurred at Kinshasa's N'DJILI international airport on April 4, 2011, at 1256 52 Universal Time. The aircraft was being operated by Georgian Airways on long term charter agreement for United Nation's Stabilization Mission in DRC (MONUSCO).

This investigation was carried out in order to learn lessons from this event so as to prevent similar accidents in future, in accordance with Annex 13 of ICAO. The report does not apportion any blame on any individual or any organization for the accident. Therefore, the use of this report for any purpose other than the one specified, would not be appropriate.

The Draft of the report was shared among all participants of the investigation team. Relevant comments received from Transportation Safety Board of Canada (including from Bombardier) and from Department of Field Support of the United Nations, were incorporated in to the report. Comments received from Georgian Civil Aviation Authority are attached to the report in full, as desired by them.

N.B.: In this report, the times are expressed in Universal Time (UTC); one hour should be added to the times mentioned in the report to get local time at Kinshasa.

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SYNOPSIS

On 04 April 2011, a Georgian Airways Canadian Regional Jet (CRJ 100 ER), registration 4L-GAE, using call sign 'UNO 834', operating a domestic flight from Kisangani to Kinshasa for United Nation's Stabilization Mission in the Democratic Republic of Congo (MONUSCO), crashed during the process of 'Go Around' at Kinshasa Airport, at 1256 52 UTC.

At the time of the accident, Kinshasa airfield was experiencing a severe thunderstorm.


The aircraft impacted the ground 170 meters to the left and abeam the displaced threshold of Runway 24 in about a 10 degrees nose down attitude. At the time of impact, aircraft's heading was 220 degrees and its speed was 180 knots. Following the impact, the aircraft skipped, started breaking up, skidded along the ground and rolled inverted before coming to a halt. During this process, parts of the aircraft including undercarriage, engines, wings and tail section sheared off. Major part of the fuselage including the cockpit portion, came to a rest inverted in one piece about 400 meters beyond the initial impact point.

The aircraft was carrying 29 passengers and 4 crew members. 32 persons died in the accident, the sole survivor was severely injured.

Following the accident, DRC Government set up an Investigation Commission to investigate the accident. Representatives from Georgian Civil Aviation Authority (State of Registration), Georgian Airways (Operator), Transportation Safety Board of Canada (State of design and manufacture of aircraft), National Transportation Safety Board of USA (State of manufacture of Engines) and from Department of Field Support of United Nations (to represent the organization which had chartered the aircraft), were invited to join and assist in the investigation. Initial FDR and CVR readouts were carried out at Bureau d' Enquetes et d' Analyses (BEA) at Paris. Experts from the manufacturer (Bombardier), too, provided vital assistance during the investigation process.

The investigation was led by DRC officials. The DRC team comprised of the following members:

1. Mr. DANIEL LOTANGA KONGA, Director, Department of Inspection of Transport and Means of Communication, Chief of Investigating Team;
2. Mr. NGAKI MUNGULU, Air Adviser of the Minister of Transport and Means of Communications, member;
3. Mr. DISANZAME MAKIENGYA, Aeronautical Director of pool to the Inspection of Transport, member;
4. Mr. NGBOSANDO KODONDI, Director of the Civil Aviation Authority, member;
5. Mr. KALONJI MALUTSHI, Head of Department, Search And Rescue of the Regie de VoieAerienne (RVA), member;
6. Mr. KADIMA, Head of Department of Air Traffic Control/RVA, member.

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Georgian Team:

1. Mr. DAVID GIUNASHVILI, representative of the Georgian Civil Aviation Authority;
2. Mr. ROSTON NASURASHVILI, representative of the Georgian Civil Aviation Authority;
3. Mr. KAKHA CHACHAVA, representative of Georgian Airways;
4. Mr. GALUST SARKISIAN, representative of Georgian Airways;
5. Mr. ZURAB SHUBITIDZE, representative of Georgian Airways.

Accredited representative of Transport Safety Board of Canada:


Mr. BRAD VARDY

Accredited representative of National Transport Safety Board of USA:

Mr. DENNIS JONES

UN's representatives:

1. Mr. VIRENDRA CHHIKARA, representative of MONUSCO ;
2. Mr. EMIL PETRUNOV, representative of UNHQ.

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I. FACTUAL INFORMATION

I.1 History of flight.

On Monday April 4, 2011, a Georgian Airways CRJ-100ER, registration 4L-GAE, chartered by MONUSCO in accordance with contract PD/CO105/08 of May 13, 2008, was planned to carry out a flight on route Kinshasa - Kisangani- Kinshasa, using call sign UNO 834.

The Kinshasa-Kisangani sector was uneventful. At Kisangani, 29 passengers boarded the aircraft for the flight to Kinshasa; 594 kg of luggage was loaded for this sector. Besides the Captain and the Co-Pilot, the crew consisted of a Flight Attendant and a Ground Engineer. Pilot in Command (PIC) was the Pilot Flying (PF) while the Co-Pilot was the Pilot Not flying (PNF) for this sector.

The aircraft took off from Kisangani for Kinshasa at 1118 hours and climbed to Flight Level 300. At 1231 42, the crew reported to Kinshasa Approach that they were over position GURUT (137 NM from Kinshasa), gave their Expected Time of Arrival Kinshasa as 1255 and were conveyed latest Kinshasa weather. At the time, Kinshasa weather being reported was wind 340 degrees, 8 knots, visibility 10 KM, scattered clouds at 2500 feet, Charlie Bravos (CBs) at 3000 feet, CBs in the North East and South East, Temperature 33, dew point 23, QNH 1009, trend NOSIG.

At 1239 51, UNO 834 requested for descent and was cleared to descend to flight level 100. Meanwhile, on the on-board weather radar, the crew were able to notice presence of severe weather around and over Kinshasa airfield.

At 1249 46, when the aircraft was about 32 NMs from Kinshasa VOR / DME, the crew again sought latest weather information from Kinshasa ATC. They were informed that Kinshasa was reporting 'wind 210 degrees, 8 knots, visibility 8 KM, thunderstorm over the station, scattered cloud at 2500 feet, few Charlie Bravo 3000 feet, Charlie Bravo located north-east, south west and west, broken 12000 feet, temperature 33, dew point 23, QNH 1008, trend NOSIG'. The co-pilot replied to ATC that weather was copied and read back the QNH.

At 1250 31, UNO 854 was cleared for a Straight-In Localizer Approach for Runway 24. (Runway 24 Localizer Approach chart is placed as Appendix A).

The crew discussed options of avoiding the severe weather being displayed on their on-board weather radar by skirting around the radar returns. The aircraft approached the airfield at high speed. The indicated air speed came below 250 knots at 1253 25 when the aircraft was descending through an altitude of 4630 feet and was 13 NM from threshold Runway 24.

While intercepting the Localizer for Runway 24, the aircraft remained to the south (left) of the Localizer path. During the execution of the Localizer Approach, the crew made a more than 15 degree heading change to fly even further away from the Localizer path when the aircraft was between 10-7 NM from Threshold of Runway 24.

As the aircraft came close to the airfield, the co-pilot sighted the runway on his right one o' clock position, when the aircraft was about 9.7 nautical miles from displaced threshold of runway 24. The PIC too, sighted the runway when the aircraft was about 6.4 NM away from Threshold. At that stage, the aircraft speed was 210 knots, altitude was 3250 feet (or about 2252 feet above ground level) and the aircraft was in clean configuration. The crew decided to continue their Approach. PIC disengaged the autopilot, turned towards the runway and gave instructions to co-pilot to configure the aircraft for landing. The crew managed to regain Localizer path and align the aircraft to the runway by the time they were 2 NM from the threshold.

At around this time, Kinshasa airfield was affected by a Squall Line, as depicted by the satellite images obtained from EUMETSAT. These images indicate that the Squall Line with very low cloud base approached Kinshasa from the North East (about 5 o' clock position to the aircraft's final approach path). As the aircraft came on short finals, it encountered rain. By this stage, the aircraft was below the Minimum Descent Altitude (MDA) for Localizer Approach for Runway 24. MDA for Localizer Approach for Runway 24 is 1470 feet or 472 feet Above Ground Level (AGL). The crew switched on wind shield wipers. As they descended further to about 224 feet AGL and runway was not in sight, the crew decided to carry out a Go Around.

During the process of Go Around, a positive rate of climb was established with appropriate airspeed. While climbing through an altitude of 1395 feet (or 397 feet AGL); the aircraft encountered a severe weather phenomenon (probably a microburst). Wind shear warning came on. The aircraft pitched significantly nose down (from about 4-5 degrees nose up attitude to 7 degrees nose down attitude) in a very short time. The aircraft rapidly lost height. Before the crew could react to the pitch down and recover from the steep descent, the aircraft impacted the terrain.

I.2 Injuries to persons:

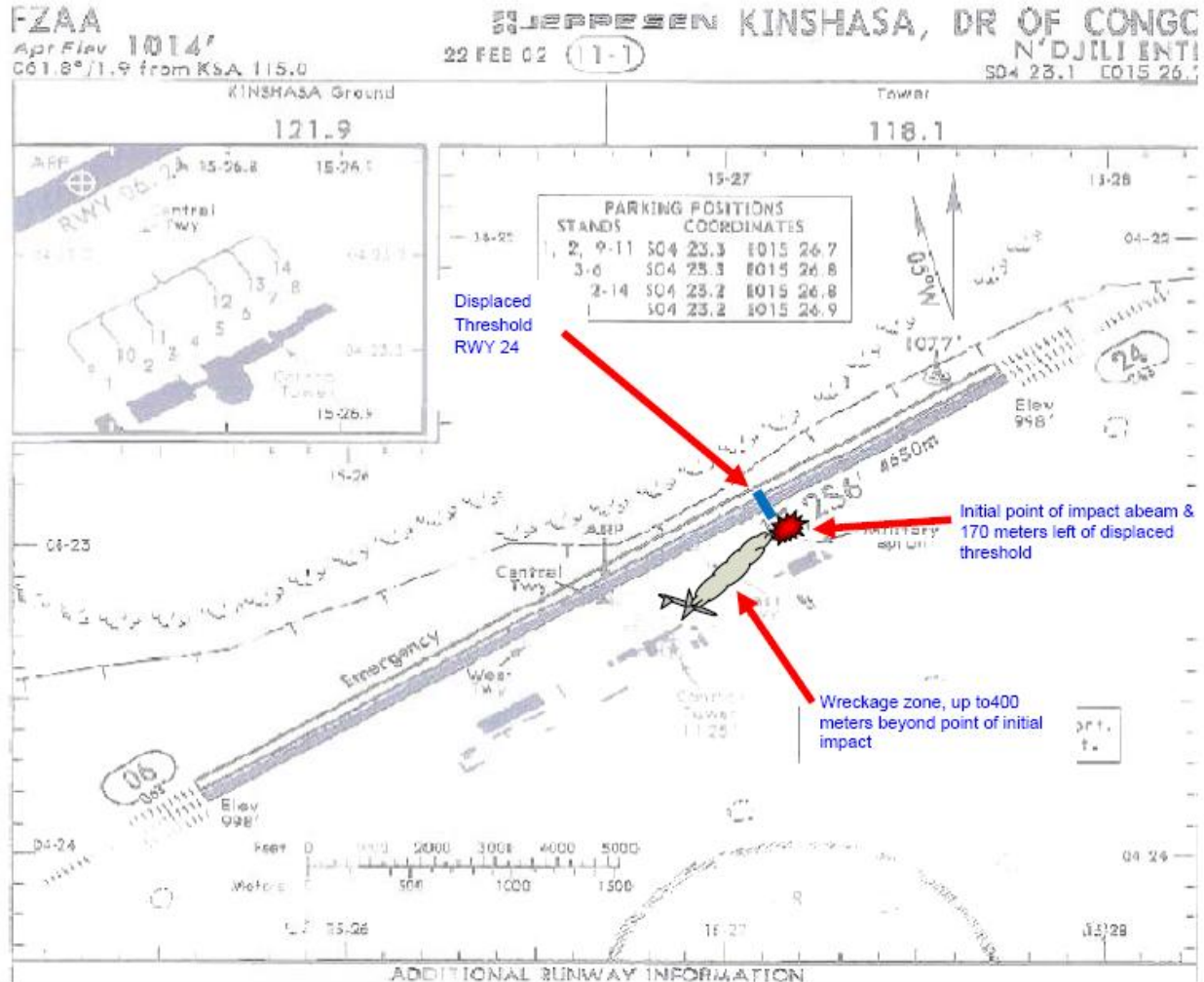
<u>Injuries</u>	CREW	PASSENGERS	OTHERS
Fatal	04	28	Nil
Serious	Nil	01	Nil
Minor/None	Nil	Nil	Nil

I.3 Damage to aircraft:

The aircraft was destroyed in the accident.



Image shows the initial impact marks of the aircraft. At the moment of impact, the indicated air speed was 180 knots, aircraft attitude was 10 degrees nose down and magnetic heading was 220 degrees. Notice that aircraft components started breaking off immediately following initial impact. The fuselage came to a rest in inverted position about 400 meters beyond the initial impact point.




Threshold of Runway 24 was displaced by 1400 meters. Initial point of impact of the aircraft was abeam and 170 meters left of displaced threshold. Wreckage was spread over 400 meters in impact direction (about 220 degrees).

I.4 Other damage:

Nil.

I.5 Personnel information:

Besides the Pilot in Command and the Copilot, a Flight Attendant and a Ground Engineer were on board the flight.

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1.5.1 Pilot in Command (PIC) details:

Age: 27 years.

License: Airline Transport Pilot License, valid up to 24/11/2011.

Rating: PIC CRJ-100/200 with effect from 29/12/2010.

Total flying experience: 2811 hours 54 minutes.

Total flying experience on CRJ-100/200: 1622 hours 47 minutes.

Experience as PIC on CRJ-100/200: 217 hours 37 minutes.

Duty time in last 24 hours: Nil.

Duty time in last 72 hours: Nil

Duty time in last one week: 7 hours. (The crew had last flown on 31 March 2011; no flight was planned on 01, 02 or 03 April 2011).

1.5.2 Co-Pilot Details:

Age: 22 years.

License: Commercial Pilot License, valid up to 29/12/2011.

Rating: Co-pilot CRJ-100/200 with effect from 30/11/2010

Total Flying Experience: 495 hours 16 minutes

Flying experience on CRJ-100ER: 344 hours 36 minutes.

Duty time in last 24 hours: Nil.

Duty time in last 72 hours: Nil

Duty time in last one week: 7 hours. (The crew had last flown on 31 March 2011; no flight was planned on 01, 02 or 03 April 2011).

1.6. Information about the aircraft

Name of the owner : Georgian Airways Ltd.

Address of the owner : n° 79, Airport/SAMGORI district, TBILISSI, Georgia

Registration : 4L-GAE

Type of aircraft : CRJ-100ER

Serial number of aircraft : 7070

Manufacturer : BOMBARDIER.

1.6.1. Aircraft Documents


Certificate of Registration: 222/1 dated 27/09/2010.

Airworthiness Certificate: 222/4 dated 23/12/2010, valid until 20/12/2011.

Radio station license of the aircraft: 222/1 dated 06/04/2009.

Insurance Policy: C10/GEOR/0005 dated 30/09/2010, valid until 20/09/2011.

Noise Certificate: 222 of 08/11/2007.

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1.6.2 State of the aircraft before departure

The aircraft was in a serviceable state before departure. All systems were functioning satisfactorily.

1.6.3 Mass and Centre of Gravity

The Load and Balance sheet for the Kisangani-Kinshasa sector was not found on the ground at Kisangani or in aircraft papers (in the wreckage).

1.7. Meteorological Information:

1.7.1 Meteorological Services in DRC

All weather observations made by D R Congo Meteorological Department at Kinshasa airfield are done using basic meteorological instruments. Cloud height is estimated visually as no laser equipment is available to measure cloud base. Similarly, visibility is measured using landmarks rather than a Transmissometer. Kinshasa airport meteorological service is not equipped with weather radar thus cannot accurately forecast and determine approach of dangerous weather phenomenon.

To augment meteorological information available to its crew members, MONUSCO had tasked a Contractor- PAE Limited, to provide Meteorological Services including Forecasting and Observation Services, at several airfields in D R Congo. The contractor (PAE Limited) provided these services at Kinshasa as also at Kisangani. However, PAE weather stations were also not equipped with weather radar.

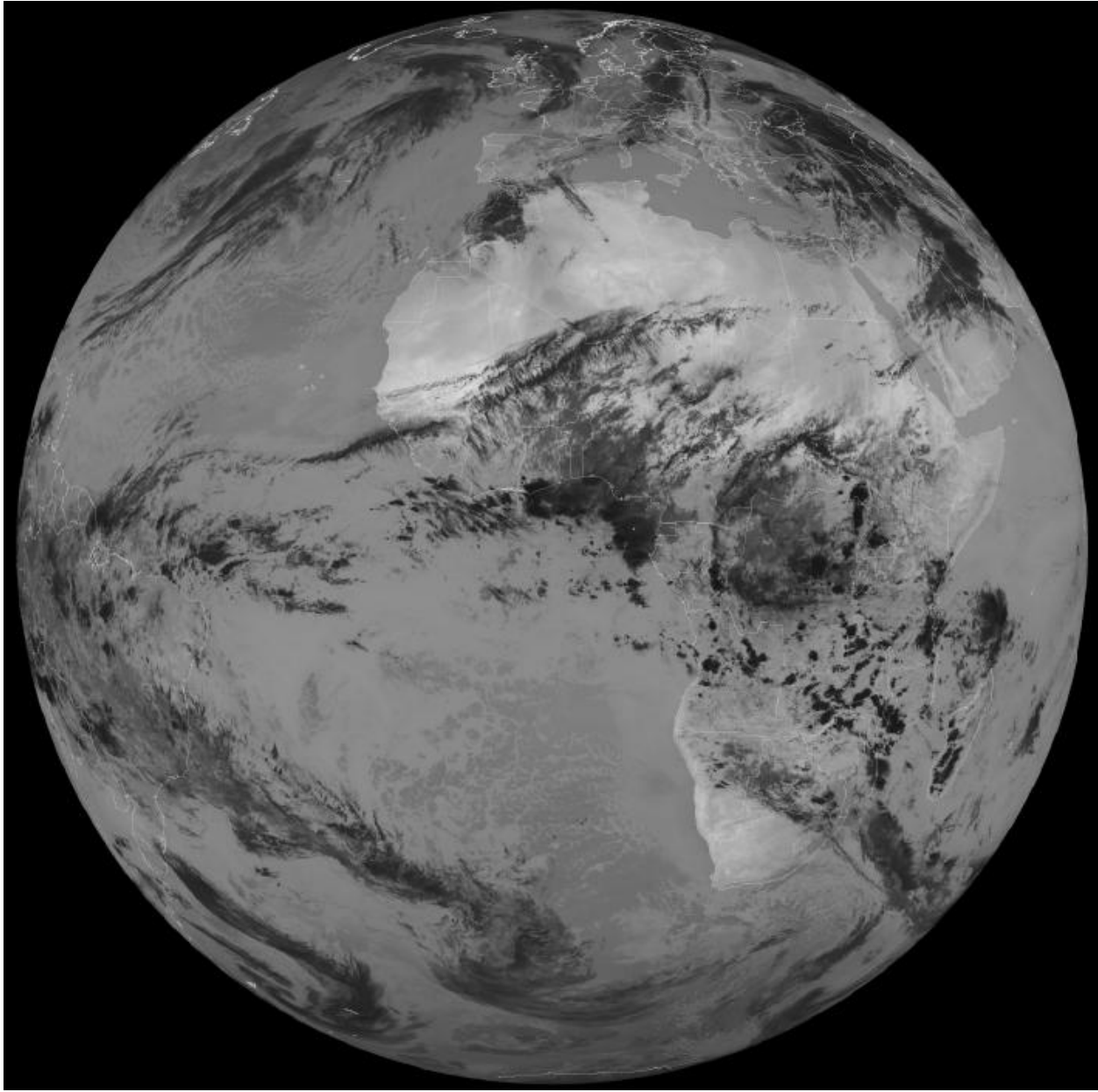
1.7.2 Meteorological phenomenon that affected Kinshasa airfield and its surroundings.

To determine the nature and movement of weather that affected Kinshasa airfield and its surroundings on 04 April 2011, assistance was requested from EUMETSAT. A series of Satellite images in Infra-Red band for the time period between 1142 hours and 1342 hours for 04 April were obtained and analyzed.

A study of these images indicates that a Squall Line comprising of significant cloud mass with very low cloud base, transited through Kinshasa Terminal Area from North East Direction, affected Kinshasa Airfield, before moving away in South West direction. The images also confirm that the cloud mass associated with the Squall Line was growing in size during its passage over Kinshasa airfield. Its speed of movement was estimated to be 40-50 KMPH. Kinshasa meteorological observers, not being equipped with weather radar, were not aware of the approach of this severe weather system.

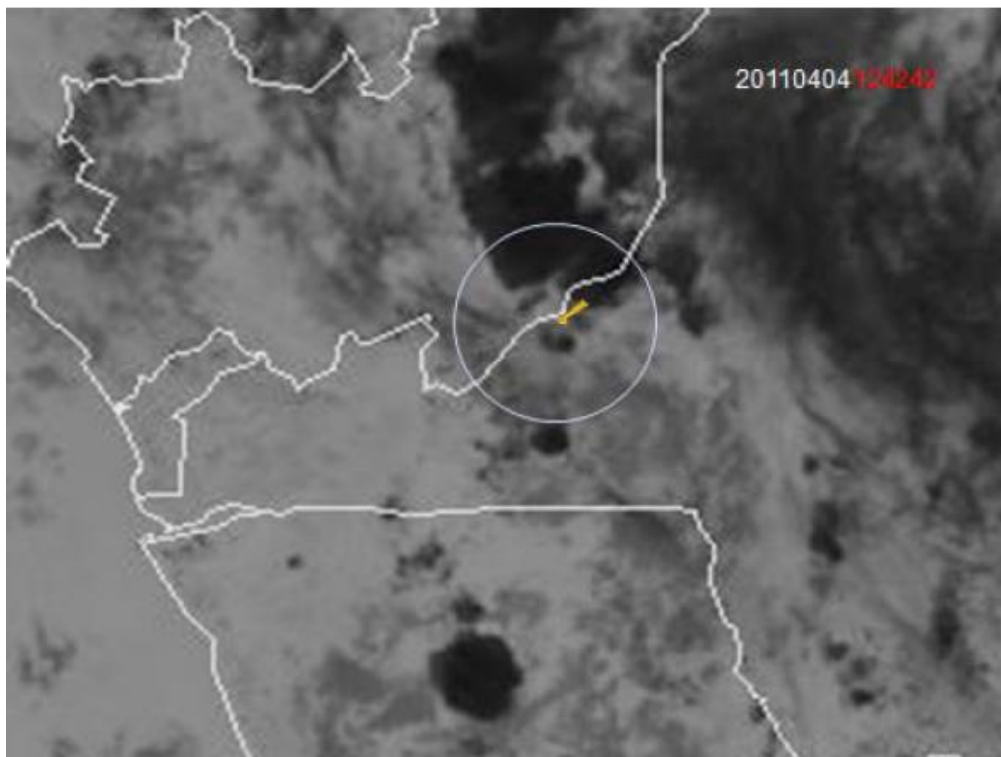


EUMETSAT Infra-Red images used to analyze weather over Kinshasa on 04/04/2011:



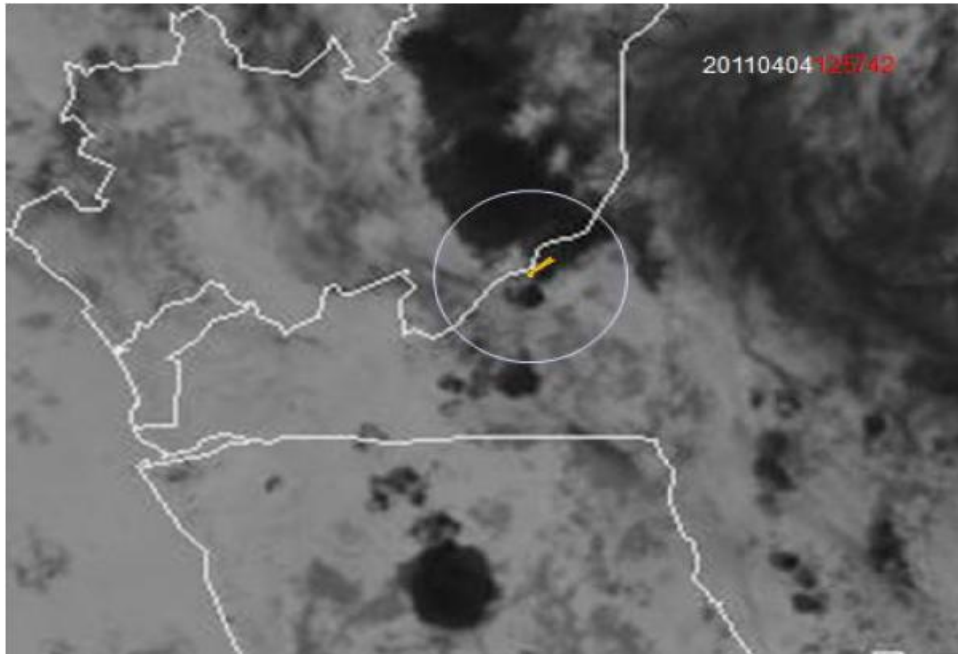
Above: EUMETSAT IR image of weather over Africa on 04/04/2011, taken at 1257 42

Following two pages: Extracts of the satellite images for the relevant time period are placed in the next set of pictures, to show the movement of the Squall Line. Approximate Localizer path direction is superimposed on the extract of the EUMETSAT images, to indicate movement of the Squall Line in relation to the Localizer Approach path; however, the same is not drawn to scale. Time when each image was taken is marked in red.

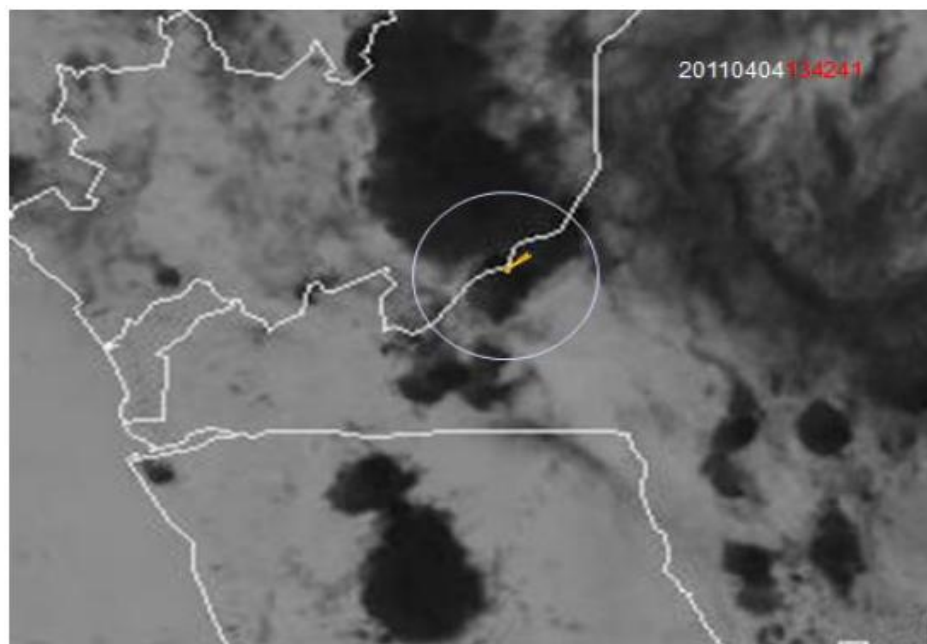





Above: EUMETSAT Infra Red photo of 1242 42 (about 16 minutes before the accident) showing Kinshasa airfield and Runway 24 Localizer Approach path (not to scale).

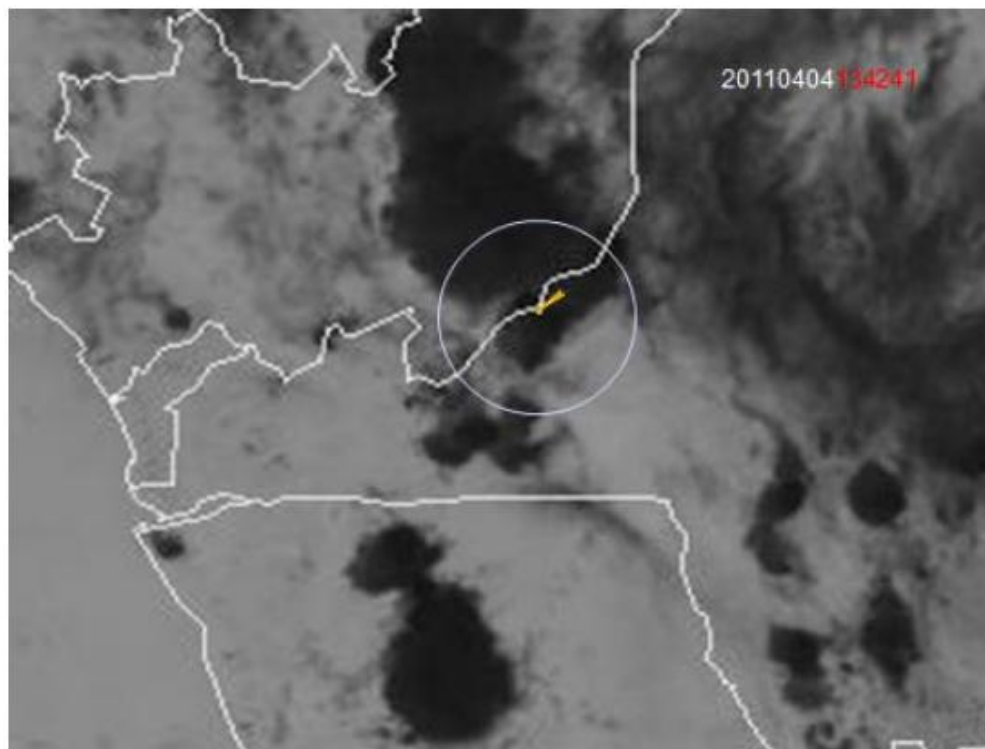


Above: EUMETSAT Infra Red photo of 1257 42 (about 50 seconds after the accident) showing Kinshasa airfield and Runway 24 Localizer Approach path (not to scale).



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Above: EUMETSAT Infra Red photo of 1312 41 (about 16 minutes after the accident) showing Kinshasa airfield and Runway 24 Localizer Approach path (not to scale).




Above: EUMETSAT Infra Red photo of 1342 41 (about 46 minutes after the accident) showing Kinshasa airfield and Runway 24 Localizer Approach path (not to scale).

1.7.3 Meteorological information available to the crew.

On the day of the accident, before departing from Kinshasa, the crew were given a thorough meteorological briefing by the PAE provided service. After completing the Kinshasa – Kisangani sector, the crew were provided another weather update, including being provided latest satellite imagery of the weather en route to Kinshasa. Information about approach of Squall Line / severe weather at Kinshasa was not available with the crew before the flight.

During the flight from Kisangani to Kinshasa, on making initial contact with Kinshasa Approach, the crew were given Kinshasa weather at 1226 57. The weather passed on was ‘Wind 340, 8 knots, visibility 10 kilometres, scattered 2500 feet, CB 3000 feet, CB located north-east, south-east, temperature 33, dew point 23, QNH 1009, NOSIG’.

The Squall Line approaching Kinshasa Airfield and its movement were observed by the crew on the aircraft’s weather radar when they were over 80 nautical miles from Kinshasa VOR. Repeated discussion

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amongst the crew members regarding ‘Magenta’ being shown at and around Kinshasa airfield on their on-board weather radar, took place between 1237 Z and 1255 Z, as evident on the CVR Transcript.

The crew sensed a discrepancy between the weather being reported by Kinshasa ATC and the weather picture available on their weather radar. Hence, the crew again asked the ATC about the weather at 1249 46. The ATC gave the weather stating ‘Wind 210 degrees, 8 knots, visibility 8 kilometres, thunderstorm over station, scattered 2500 feet, few CB 3000 feet, CB located north-east, south-west and west, broken 12000feet, temperature 33, dew point 23, QNH 1008, NOSIG’. At this time the aircraft was about 32 miles on the DME.

At 1255 29 seconds (only 83 seconds before the accident), Kinshasa ATC called up the aircraft and informed the crew that the surface winds had become 280/25 knots. The crew acknowledged the same and continued their Approach. This was the last weather information provided to the crew.

I.8 Navigation aids.

Kinshasa N’DJILI airport has the following Navigation and Landing aids:

- One NDB
- One VOR/DME (located 1 KM beyond threshold Runway 06. The DME is thus, located about 2.3 NM from displaced threshold Runway 24).
- One ILS of Category 2 for Runway 24; however, due to threshold being displaced, the Glide slope was not available, only the Localizer was available.
- Calibration of Navigation and Landing aids had not been done since 2004.

I.9 Telecommunications.

Communications between Air Traffic Control and UNO 834 functioned normally on the day of the accident.

I.10 Information about the airport

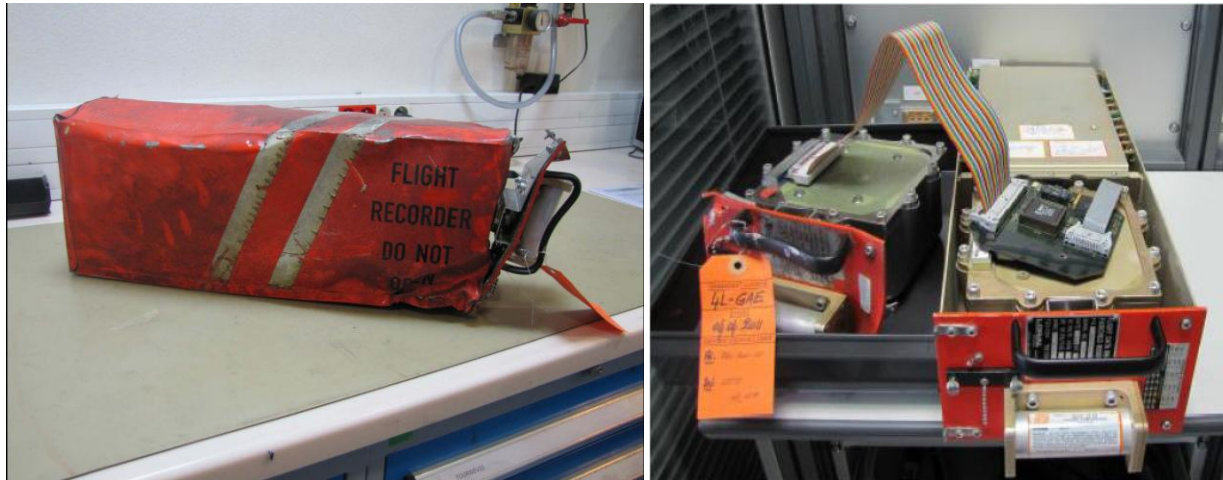
Kinshasa N’DJILI international has one runway with an orientation of 241/061. Due to threshold for Runway 24 having been displaced by 1400 meters, 3300 meters of runway was available for use (Annex A).

I.11 Flight Recorders

The aircraft was equipped with a Fairchild F1000 Flight Data Recorder and a L3 Com A200S Cockpit Voice Recorder. The recorders were deciphered at Bureau d’ Enquetes et d’Analyses (BEA) at Paris in May 2011. Flight Data Recorder had suffered damage during the accident and direct download of data was not possible. BEA used alternate procedures to download data from the FDR. The data was later transferred electronically to Transportation Safety Board, Canada which took the lead in analysis of data,



in coordination with Bombardier Inc. An animation of the flight based on the FDR data was prepared and electronically disseminated to all parties to the investigation in September, 2011.



Fairchild F1000 Flight Data Recorder




L3 Com A200S Cockpit Voice Recorder.

I.11.1 Information available from Flight Data recorder:

I.11.1.1. Exploitation of data information extract from FDR

The FDR was able to provide good information about the sequence of events leading up to the accident. Downloaded Data indicated that all aircraft systems were functioning normally and no technical failures were recorded during the flight.

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As indicated by CVR, PIC carried out the Approach briefing at 1233 28 when the aircraft was about 135 NM away from the airfield. PIC was the designated Pilot Flying for the Approach. PIC briefed for a Straight-In Localizer Approach for Runway 24, with Minimum Descent Altitude (MDA) being 1470 feet (472 Feet AGL). Vref was calculated to be 135 knots for a landing weight of 19,500 KG. During the Approach briefing, no mention was made of any bad weather expected around Kinshasa.

I.11.1.2.Heading changes to avoid en route Weather:

EUMETSAT images show that there was a significant cloud mass present on the aircraft's track, in the enroute phase of flight. The crew made minor heading changes to avoid this cloud mass. FDR indicates that the aircraft changed heading to the left from 246 degrees to 239 degrees, between 1237 44 to 1238 03 (at an approximate distance of 105 NM from Threshold). It turned further left from 235 degrees to 229 degrees between 1240 15 to 1240 39 (at about 90 NM from Threshold).

The cloud mass responsible for the above mentioned Heading changes can be seen clearly in the EUMETSAT image of 1242 42. Track flown by the aircraft in relation to this cloud mass can be discerned in the graphic placed at Appendix B.

I.11.1.3.Initial Descent Phase:

Descent permission was requested at 1239 51. Descent was commenced from FL 300 in Vertical Speed (VS) mode of autopilot at 1240 53, with throttles brought back to idle position and initial rate of descent of 1500 feet per minute. At the time, the aircraft was about 87 NM from the Threshold. The aircraft made minor heading changes during the descent phase as well. It turned from a heading of 228 degrees to 234 degrees between 1243 19 to 1243 38 (at about 69 NM from Threshold). It turned further right from 236 degrees to 250 degrees between 1244 16 to 1244 50 (at about 61 NM from Threshold).


At 1244 19, the aircraft was cleared to intercept radial 061 for Straight-In Localizer Approach runway 24. At 1245 53, it turned right from 251 degrees to 262 degrees to intercept radial 061.

I.11.1.4.High Speed during Approach phase:

During descent through Flight Level 100, aircraft's Indicated Air Speed (IAS) was more than 250 knots. The speed remained more than 250 knots until descending through 4650 Feet. D R Congo's Air Space Regulations require the IAS to be maintained below 250 knots below FL 100.

I.11.1.5.Approach Phase:

The PIC changed over to Localizer frequency at 12 52 26 seconds when the aircraft was about 20 miles on DME. At this stage, the IAS was 263 knots and aircraft was descending in clean configuration through Flight Level 060 with the engines at idle. The aircraft did not intercept the Localizer path but continued flying to the left (south) of the Localizer path. At 1253 59, when the aircraft was 10 NM to Threshold, the crew made heading change to the left to 225 degrees to fly even further away from the Localizer path.

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Flight Spoilers were selected to partially down at 1254 20 and were selected fully down at 1254 45. Autopilot was selected off at 1254 52.

I.11.1.6. Final Approach Segment:

Localizer deviation recorded on the FDR reveals that the aircraft was not aligned with the Localizer path during the Approach phase, including beyond the Final Approach Fix (FAF). The aircraft did not overfly the FAF but flew south abeam it at 1255 15, in clean configuration and at idle power setting. At that stage, its altitude was 2700 feet and its IAS was 208 knots (73 Knots above Vref, 8 knots above Flap lowering speed).

At 1255 21 seconds (about 4.2 NM from the displaced Threshold), the IAS came below 200 knots and the Captain asked for Flaps 8. Undercarriage locked down at 1255 27. Engine thrust setting during most part of descent remained at idle till 1255 48 seconds.

Between 1255 28 to 1255 55 and between 1256 20 to end of recording, rapid oscillations in elevator movement / corresponding vertical g fluctuations and short period movements of rudder/yaw damper, were recorded on the FDR.

At 1255 51 seconds (one minute before the accident), the Captain asked for Flaps 30. At that stage, the aircraft speed was 178 knots, which is above flap 30 lowering speed, so the over speed warning came on.

At 1256 03 seconds, the aircraft descended through 500 feet on radio altimeter with a speed of 181 knots (46 knots above Vref), at idle power setting, with flaps at 30 degrees.

45 degree flaps were asked for at 1256 06 seconds when the speed was 185 knots. Shortly thereafter, aircraft intercepted the Localizer path.

The aircraft reached Minimum Descent Altitude (MDA) of 472 feet at 1256 11 seconds with a speed of 173 knots (38 knots above Vref).

The aircraft was in landing configuration by 1256 14. By this time, aircraft was abeam the Missed Approach Point (MAP).


Flight Directors were asked to be selected off at 1256 18, thereafter the PIC was flying on 'Raw Data'.

Rate of Descent for the Final Approach segment between abeam the FAF (at 1255 15) to MAP (at 1256 14) varied from about 400 feet per minute to 2400 feet per minute.

CVR indicates that the aircraft entered rain at 1256 22. PIC asked for wind shield wipers to be put on at 1256 26, at this stage the aircraft was below 300 feet AGL.

I.11.1.7. Go Around Phase:

At 1256 30 seconds, when descending through 224 feet AGL, the co-pilot remarked 'No, I do not see anything, let's Go Around'

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The PIC ordered a Go Around at 1256 32 with a call of ‘Go Around, Flaps 8’. At that time, the aircraft was at 218 feet AGL, with an IAS of 156 knots, at about 80 %RPM setting.

For the Go Around, thrust was opened to about 89-90 %; pitch attitude was increased initially to about 8 degrees nose up which came down subsequently to lower pitch values. Undercarriage was not selected up.

Flight Data Recorder shows that during the Go Around, when the aircraft was climbing through 397 feet AGL with a pitch of 4-5 degrees nose up and at an indicated air speed of 149 knots, there was an external influence on the aircraft at 1256 43. This external influence resulted in the aircraft pitch changing to 7 degrees nose down within the next five seconds. Windshear warning came on at 1256 45, pitch attitude steepened further to about 9-10 degrees nose down, and the speed increased to 180 knots. As a consequence, the aircraft rapidly lost height.

The last recorded Global Positioning System (GPS) position was at 1256 49 seconds (as FDR records GPS position only once every four seconds). The impact with the ground seems to have occurred at 1256 52.

In the very last second before the aircraft impacted the ground, there was an attempt by the crew to pull up the nose of the aircraft, as evidenced by a significant and instantaneous elevator deflection recorded on the FDR.

The detailed FDR readouts are placed as Appendix C.


I.11.1.7.FDR analysis of previous flights flown by the same crew:

The same set of flight crew had flown five sectors in previous days as the PIC had only recently arrived in DRC. FDR data was available for these five sectors. One of these sectors had been flown on the day of the accident (Kinshasa- Kisangani sector). Four sectors had been flown by the same crew on 31 March when they flew on route Kinshasa- Kananga-Kamina-Kananga-Kinshasa.

Having noticed the non- standard descent and approach profile flown by the crew in the accident flight, Investigation Team members decided to review the descent and approach profiles flown by the crew during the previous five flights too. Data for last ten minutes of these five flights was downloaded by TSB and sent to all investigation team members. The data revealed that on two of these previous five flights, crew had carried out non -standard descents as the aircraft’s indicated air speed had not been reduced below 250 knots while descending below 10,000 feet. In one of these flights, the speed was above 250 knots till as late as 5100 feet.

I.11.2 Data from the Cockpit Voice Recorder (CVR)

The CVR contained two hours of recording which covered the duration of the entire flight from Kisangani to Kinshasa. For the purpose of the investigation, relevant portions of the CVR were transcribed with particular emphasis on the last 30 minutes of the flight.

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I.11.2.1 Extract of relevant portion of CVR:

CVR transcript has been described in two parts. The first part deals with UNO 834's communication with Kinshasa ATC. Second part covers internal communication amongst the crew members and some Enhanced Ground Proximity Warning System (EGPWS) audio call outs/warnings that were audible on the CVR.

An extract of the relevant portion of the CVR is attached as Appendix D.

I.11.2.2 Communication with Kinshasa ATC:

UNO 834 tried to make initial contact with Kinshasa Area Control on 126.1 MHz at 1226 36. On getting no response, crew changed over to Kinshasa Approach and made radio contact at 1231 39. Kinshasa Approach passed on Kinshasa Weather to UNO 834 which was 'Wind 340, 8 knots, visibility 10 kilometres, scattered 2500 feet, CB 3000 feet, CB located north-east, south-east, temperature 33, dew point 23, QNH 1009, NOSIG'.

At 1239 51, the crew established contact with Kinshasa Area and requested descent from their cruising altitude of Flight Level 300. At that time, their DME distance was 96 NM. Kinshasa Area Control cleared the aircraft to descend to Flight level 100 and to report passing FL 245.


After several unsuccessful attempts, the crew established contact with MONUSCO Air Operations on Flight Following Frequency at 1241 33, when the crew advised the Flight Follower about their estimated arrival time being 1300.

At 1243 15, the crew reported passing FL 245 and were cleared by Kinshasa Area Control to change over to Kinshasa Approach frequency.

At 1243 59, the crew established contact with Kinshasa Approach Control and reported their position as passing flight level 240 at 68 miles DME. Kinshasa Approach directed the aircraft to report reaching FL 100. The crew acknowledged the instruction and requested permission to intercept radial 061 for a Straight-In Localizer Approach for Runway 24. Kinshasa Approach cleared the aircraft for Radial 061 and asked the crew to report at FL 100.

Upon Kinshasa Approach's request, the crew reported their position as passing flight level 140, DME 37 at 1249 03. Approach cleared the aircraft to continue descent to FL 060 and to report Approaching for Straight-In Approach.

At 1249 46, Crew requested Kinshasa Approach for latest weather report. Kinshasa Approach provided the latest weather which was 'Wind 210 degrees, 8 knots, visibility 8 kilometres, thunderstorm over station, scattered 2500 feet, fewCB 3000 feet, CB located north-east, south-west and west, broken 12000feet, Temperature 38, correction 33, dew point 23, QNH 1008, NOSIG'.

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Approach asked the aircraft to report its position at 1250 25. Crew reported that they were passing FL 100, DME 30 miles. At this stage, the aircraft was cleared for Straight -In Approach and asked to report established on the Localizer.

Upon Approach's request, they reported their position as descending through flight level 060 at 20 miles at 1252 15. Approach again directed the crew to report established on the Localizer.

At 1253 29, Approach requested the crew for their position. The crew reported being at 14 miles inbound, at 4500 feet. They were cleared for further descend to 3500 and were asked to report reaching.

At 1254 41, the crew reported that they were established on the Localizer for runway 24 at 3500 feet. Approach asked the aircraft to change over to Kinshasa Tower Frequency.

The crew changed over to Tower frequency of 118.1 and established contact with Tower at 1254 55. Tower control asked them to report on Short Finals.

At 1255 29, Kinshasa Tower advised the crew that surface winds had become 280 degrees, 25 knots. Crew acknowledged having copied the message.

At 1256 38, the crew made a call to Kinshasa Tower that the aircraft was going around. Record of this call on Kinshasa ATC tape recording was not confirmed. This was the last communication from the aircraft to the Tower.

Note: The distances mentioned in the CVR are DME distances. DME is located along the runway direction, about 2.3 NMs from the Displaced Threshold of Runway 24.

I.11.2.3 CVR record of internal communication amongst the crew members:


The Approach briefing was carried out by the PIC at 1233 28, during which he briefed the co- pilot that they would be carrying out a Localizer Approach for Runway 24 at Kinshasa.

CVR transcript contains details of extensive discussion amongst the crew members about the weather en route and over Kinshasa.

First indication of Crew's realization of the presence of bad weather en route to Kinshasa was evident at 123719, when the aircraft was between position GURUT and UDRID, over 100 NMs from Kinshasa. The crew got this indication through their on-board weather radar.

At 1237 19, the co- pilot suggested to the Captain that they would 'request radial 075 and then will see. Captain agreed with the suggestion to go around the clouds, being seen during the enroute phase.

Shortly thereafter, at 1238 19, the crew again discussed the weather when the Captain said that the (radar) beam was clearly showing the clouds. The co-pilot said that he would leave the weather radar beam at 0 to minus 1 degree.

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Between 1244 37 and 1247 54, extended communication amongst the crew of extreme bad weather being present at and around Kinshasa and the way to avoid it, is heard on the CVR. The co-pilot exclaimed at 1245 59 that the weather return being picked up on their radar was very big. Crew also discussed that the clouds were moving, so in next 10 minutes needed to reach the airfield, the clouds would have moved off the airfield. They also seemed to have a doubt whether the returns being picked up on the weather radar were ground echoes or were severe weather (Magenta) indications. The co-pilot confirmed that the returns were not ground echoes but were radar returns (Magenta) from very severe weather.

At 1249 34, when approaching about 32 NMs from the airfield, the PIC directed the co-pilot to ask again for latest weather as the ATC had reported 10,000 meters visibility earlier while the weather being shown on weather radar seemed much worse.

Between 1251 00 and 1253 15, the crew discussed a way to go through / in between / around the weather. Co- pilot was also again heard exclaiming about the huge size of the cell/severe weather, seen on their weather radar. Co- pilot also suggested to wait and orbit for 10 minutes as the cell could be observed to be moving already, but the Captain did not respond to the suggestion. At this stage, the Captain asked the co-pilot about the Minimum Safety Altitude (MSA) at Kinshasa. The co- pilot replied that MSA was 4500 feet and then could be heard wishing that they had arrived five minutes early. The Captain asked for “Continuous Ignition” to be put ON.

At 1254 00, the co-pilot remarked “Did it move? No, it stays there”. Shortly thereafter, he made visual contact with the runway on his right. The Captain wished to reconfirm if ‘Continuous Ignition’ had been put on. Co- pilot confirmed that ‘Continuous Ignition’ was ‘On’ and further prompted the Captain to go to the right (towards Localizer/Approach path), because even though the weather radar was showing strong radar return over the airfield, the runway was visible and the path to the runway was clear.

At this stage, the aircraft was parallel to the Localizer path and the Captain asked the co- pilot to report to the ATC that they were established on the Localizer.

The Captain visually spotted the runway at 1254 53.

Over speed Audio warning is audible on the CVR between 1255 51 and 1256 22 as the flaps were being lowered in excess of permissible speed.

At 1256 21, sound similar to rain falling on the cockpit was picked up on the CVR. Captain asked for windscreen wipers to be put ‘On’. Rain falling on the windscreen is audible on the CVR till end of recording.

At 1256 30, the co-pilot told the PIC that he could not see anything and suggested a Go Around. The PIC ordered a Go Around and called for flaps 8. The co-pilot acknowledged flaps 8 and announced to Tower that the aircraft was going around.



At 1256 45, the co-pilot could be heard exclaiming in an abusive/graphic slang (at this stage, FDR data indicates that the aircraft was affected by the severe weather phenomenon which caused the aircraft to pitch down in a short time).

At 1256 48, Windshear warning coming on could be heard on the CVR. Almost immediately, the PIC ordered “flaps up”. The co-pilot acknowledged “flaps up” and then brought the PIC’s attention to the aircraft speed. This was the last recorded message on the CVR.

I.12 Information about the wreck and the impact

At the time of impact with the ground, aircraft’s Indicated Air Speed was 180 knots, Pitch attitude was 10 degrees (nose down), Bank angle 4 degrees (left wing down) and Magnetic heading 220 degrees. The impact lead to severe damage to the aircraft, the undercarriage sheared off. Aircraft continued skidding, sliding and rolling in its impact direction. During the process, various parts of the aircraft, the engines and the tail section broke off. The main part of the fuselage slid in an inverted position for a considerable distance, before it came to rest.



One of the engines separated from the fuselage




The main landing gear broke off.

L.12.1 Wreckage Diagram *Wreckage Diagram showing location of major components is attached as Appendix E.*



Above: Major part of the fuselage came to a rest about 400 meters away from initial impact point.

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I.13 Medical and pathological information

32 out of 33 occupants died in the accident. The sole survivor suffered injuries to the spinal column and was airlifted to South Africa for medical care. Autopsies of the crew members were requested to be carried out.

I.14 Fire

Minor fire was noticed on the wings which had detached from the aircraft, the same was extinguished by the fire fighters. The fuselage did not catch fire.

I.15 Questions relating to Rescue

The main part of the wreckage came to a stop within 200 metres of a building used by Kinshasa Airport Emergency Crash and Rescue (ECR) Team. ATC sounded the alarm by blowing the emergency siren. Kinshasa airfield ECR personnel responded to the accident immediately.

MONUSCO also had its ECR personnel and Fire Trucks / appropriate equipment at Kinshasa airfield; however they were located on the other side relative to the ATC and much farther away from the accident site. Because of the raging thunderstorm over the airfield at the time of the accident, MONUSCO ECR personnel did not hear the emergency siren. They also did not hear the sound of the accident. Thus, they could join the rescue effort only after a short delay.

At the time of the accident, MONUSCO's ambulance along with paramedic team was available at the airport and took active part in post- accident rescue activities.

The main part of the fuselage came to a rest inverted and in a badly damaged condition. The severe nature of the accident caused massive external and internal injuries to the occupants. ECR teams brought out the crew and the passengers from the wreckage. Most of them were already dead, while a few were badly injured but alive. Nine injured survivors were rushed to a local hospital, some of them died on the way to the hospital. Amongst those who reached the hospital alive, all but one succumbed to their injuries. Only one passenger survived the accident, although he too, suffered extensive injuries.


I.16 Tests and Research

Nil.

I.17 Organizational and management information.

I.17.1 Organization of Georgian Airways Limited

Georgian Airways is a prominent airline of Georgia and had a valid Air Operator Certificate issued by Georgian Civil Aviation Authority (CAA). It was approved for Scheduled and Non Scheduled operations to Europe, Africa and Asia. It was also an IATA Operational Safety Audit (IOSA) certified airline.

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I.17.2 Georgian Airways Training Program:

Georgian Airways Training Manual contained details of different training programmes for its pilots, including the training programme to be followed for ‘Upgrade to Captain’. The Training Manual had been approved by Georgian Civil Aviation Authority. This ‘Upgrade’ training program required only one simulator flight to be flown by the Trainee Captain from the left seat before commencing Line Oriented Flight Training (LOFT). After carrying out requisite sectors of LOFT, the Trainee Captain was tested and declared fit to fly as a Captain. It is also worth noting that no CRJ simulator is available in Georgia. Therefore, the crew had to be sent abroad for any simulator training.

I.17.3 Supervision of the crew by the Operator:

Georgian Airways did not have a Flight Operations Quality Assurance (FOQA) programme for its CRJ fleet. FOQA was not a mandatory requirement as per regulations (CRJ weighs less than 27 tonnes, hence this fleet was not required to have every flight analysed). Flight Data Records of only two flights per month were being sent by Georgian Airways for analysis abroad.

I.17.4 Oversight of the Operator by Georgian CAA:


Georgian CAA provided oversight to Nine Airlines approved by it. At the time of the accident, Georgian CAA did not have any Operations Inspector in its organization. Surveillance of Georgian Airways crew was being carried out by co-opting senior crew from the same Operator, who temporarily performed the functions of a CAA Operations Inspector and carried out Standardization check rides of Georgian Airways crew.

I.18 Additional information

Nil.

I.19 Useful or effective investigating techniques

Nil.

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II. ANALYSIS

During the course of the investigation, the following issues were examined:

II.1 Crew background and experience:

PIC was a 27 year old Airline Transport Pilot License holder who had completed his Command upgrade training in the recent past. He was declared a Captain on the CRJ 100/200 on 29/12/2010, only about three months before the accident. He had joined the Operator as a First Officer on CRJ fleet and later, had converted to Boeing 737 as a First Officer in the same company. He had operated in the DR Congo earlier as a First Officer with the same Operator. He underwent his Command Upgrade Training in 2010. His total flying experience was about 2815 hours. He had flown about 217 hours as Captain on the CRJ, up to the day of the accident.

First Officer was a 22 year old individual who had joined the Operator after finishing Commercial Pilot License Training. He had finished his conversion to CRJ on 29/11/2010 and had a total flying experience of 497 hours, of which about 344 hours were on CRJ.

The crew possessed appropriate ratings/licenses and were medically fit to undertake the flight. They had sufficient rest before flight and thus, fatigue was not a factor in the accident.

II.2 Aircraft Technical State.

II.2.1 Aircraft systems state:


FDR readouts and CVR transcript confirm that aircraft systems were functioning normally; there were no technical failures on the aircraft.

II.2.2 Load and Balance Sheet:

Load and Balance Sheet for Kisangani-Kinshasa sector could not be found at Kisangani or in the wreckage. Based on the Kinshasa- Kisangani sector Load and Balance Sheet (which was available), and the weight of fuel, passengers and cargo taken on board at Kisangani, it is estimated that Centre of Gravity for the Kisangani-Kinshasa sector was within limits.

II.2.3 Fuel quantity on board:

The aircraft had reported an endurance of 3 hours 20 minutes at the time of engine start at Kisangani. The aircraft had taken off from Kisangani at 1118 and the accident had occurred at 1256 52. Thus, it had flown only for one hour and thirty eight minutes till the moment of crash. Therefore, it can be deduced that the aircraft had sufficient fuel on board to either Hold at a fix /position nominated by ATC or to proceed to the alternate airfield.

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II.3 Meteorological conditions around Kinshasa at the time of the accident and inadequate Meteorological information provided to the Crew:

II.3.1 Size and severity of the weather system:

The severe weather phenomenon that affected Kinshasa and its surrounding areas at the time of the accident was a fast moving and severe Squall Line, as evident from the analysis of EUMETSAT photos. The cloud mass with very low level cloud base moved from North East of the airfield towards the South West at an approximate speed of 40-50 Km per hour. It also grew in size as it transited through Kinshasa area. The Squall Line probably contained extremely severe weather phenomenon including Microbursts. The severity of the weather can also be confirmed by the co-pilot exclaiming at two different times during the Approach about the huge size of the “Magenta” being shown on the on-board weather radar.

II.3.2 Approach Path and Airfield affected by inclement weather:


The Approach path and Kinshasa airfield were probably covered by inclement weather at the time of the accident, as evident on EUMETSAT image of 1257 42. The presence of significant clouds/severe weather on the Approach path can also be visualized by correlating the path flown by the aircraft Vis a Vis the Localizer path for Runway 24. While executing the Localizer Approach, the crew did not intercept and maintain thereafter, on the Localizer path for most part of the Approach. Instead, the crew flew to the south (left) of Localizer path. The crew also made a significant heading change to about 225 degrees to go further away from the Localizer path when the aircraft was between 10 NM – 7 NM from Threshold. This heading change was also probably done to remain clear of inclement weather being displayed on the weather radar. They did not over fly the Final Approach Fix even and intercepted the Localizer path only at 2 NM from Threshold of Runway 24.

II.3.3 Fast speed of the weather system:

The fast movement of the Squall Line can also be visualized by the fact that the weather information provided to the crew at 1249 54 by Kinshasa ATC stated 8000 meters of visibility while the weather report (SPECI) of 1300 hours reported a visibility of only 500 meters. The accident occurred at 1256 52. So, during the interim period of ten minutes, a rapid change in weather had taken place but the same was not conveyed to the crew by the ATC. The ATC did report a significant change in surface winds to the crew at 1255 29 when it reported that surface winds had become 280 degrees, 25 knots. The crew merely acknowledged this by saying ‘copied, copied’ and probably did not correlate this significant change in surface winds with the state of the storm over the airfield.

II.3.4 Strength of the weather system:

Turbulence associated with the weather system can be visualized by analyzing the rapid oscillations in elevator movement / corresponding Vertical G fluctuations and rudder/yaw damper movements recorded on the FDR between 1255 28 to 1255 55 and from 1256 20 to end of recording. Strength of the Microburst

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can also be visualized by noting that the aircraft was probably affected by a severe and sudden down draft/ vertical gust between 1256 43 and 1256 48 which was estimated to be of the order of 40-50 feet per second.

II.3.5 Inadequate capability to forecast fast moving weather:

Information gathered during the accident investigation confirmed that Meteorological services in D R Congo have limitations in observing and forecasting weather. The absence of weather radar seriously affects the capability to detect, track and provide early warning of the approach of fast moving severe weather phenomenon. Lack of weather radar also affected the Meteorological Services provided to MONUSCO by PAE.

Despite the lack of weather radar, the approaching Squall Line should have been observed when it came within visual range of Meteorological Observers on ground and appropriate warning should have been issued via the ATC to all approaching aircraft. The same was not done.


II.3.6 Additional information relating to weather reports:

The crew asked the ATC about the latest weather over the airfield at 1249 46, when they were about 32 miles from the airfield. During this weather report, ATC used the term 'thunderstorm over the station' while reporting weather. It is possible that the term 'Thunderstorm over the station' was not taken note of by the crew possibly because of the slight accent in which it was spoken by the ATC. This may have been the reason that the co-pilot read back only the visibility of 8000 meters when acknowledging the weather report. Also, following the weather acknowledgement, there was no discussion recorded on the CVR amongst the crew about the 'Thunderstorm over the station' being reported by the ATC.

II.4 Inappropriate assessment of weather information displayed on weather Radar by the crew:

On-board weather radar gave good information to the crew about the approach and movement of the severe weather system. The CVR contains details of repeated discussion of weather amongst the crew between 1238 19 and 1254 20. Initially, there was some doubt amongst the crew members whether the radar returns being displayed were ground echoes or were from inclement weather around the airfield. However, the crew soon realized that the weather radar was not showing ground echoes but was indicating adverse weather as confirmed by co-pilot's exclamatory comments at 1246 45 and at 1247 54. They even discussed that the clouds were moving and hoped that the airfield would be clear of clouds by the time they reached the airfield.

The PIC also confirmed having taken note of inclement weather around the airfield when at 1249 37, he directed the Co-Pilot to recheck the weather from ATC. Subsequently, between 1251 00 and 1251 13, the crew discussed the flight path to be flown around/ through the radar returns / Magenta being displayed on

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the weather radar. They also expected to be flying in rain as the PIC asked for “Continuous Ignition” to be put ON.

Magenta represents intense / extreme precipitation in video integrated processor categorization. Weather avoidance procedures call for avoiding Magenta colored area indicated on weather radar by at least 10/20 NMs laterally, yet the crew tried to attempt a landing when Magenta was being displayed over and around the airfield. This decision to continue approach indicates inappropriate assessment of the weather picture being displayed on their weather radar.

II.5 Runway sighting by the Co-Pilot probably precipitated the decision to attempt a landing:

During execution of the Localizer Approach, the PIC was flying the aircraft in clean configuration and at relatively high speeds while maintaining to the left of the Localizer path (probably to stay clear of weather). The on-board radar return indicated at 1254 00 that the inclement weather had not moved from the vicinity of the airfield, as confirmed by Co-Pilot’s remark ‘Did it move, no, it stays there’.

At 1254 04, when the aircraft was about 9 NM from the Threshold, the co-pilot visually picked up the runway to his right. The co-pilot prompted the PIC to go towards the runway on the right at 1254 15 saying ‘runway in sight, nothing there, only radar shows...’ He repeated at 1254 20 ‘Go to the right, I would say, there is nothing there’. At 1254 35, he again said ‘that is, that is, that is, runway in sight, there is nothing there’. At 1254 51, the co-pilot reiterated ‘Well, that is, don’t you see’. It was at this stage that the PIC also saw the runway because immediately thereafter, he disengaged the autopilot to start a turn towards the runway and acknowledged to the co-pilot that he had the runway in sight.


II.6 Inadequate Crew Resource Management (CRM) and Inappropriate Decision to attempt a landing:

When the PIC disengaged the autopilot to turn towards the runway at 1254 52, the aircraft was only 6.4 NM from Threshold, in clean configuration, at 3267 feet of altitude (about 2270 feet on RADALT) and flying at 210 knots IAS. To attempt a landing from this stage of flight, in the presence of extreme weather being indicated on the weather radar, is indicative of inappropriate decision making process in the cockpit and inadequate CRM. While carrying out the high speed and unstabilized Approach, the crew probably faced a situation overload. This may have also affected crew’s decision making capability.

II.7 Non adherence to Standard Operating Procedures (SOP):

Multiple examples of non- adherence to SOPs are evident in FDR data and in CVR transcripts.

The Crew carried out a descent below FL 100 at a speed above the speed prescribed by the D R Congo regulations or similar speed restrictions elsewhere in the world. The same crew had flown non- standard descents in earlier flights too, e.g. in the two flights flown on 31 March 2011.

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FDR data confirms that the aircraft was not configured for landing by the Final Approach Fix. The aircraft was configured for landing only at an altitude of 400 feet. This altitude is lower than the MDA (470 feet). By this time, aircraft was abeam the Missed Approach Point (MAP).

No call out of changeover to QNH at Transition Altitude of 5500 feet, no carrying out of Landing check list / obtaining landing permission / reporting on short finals as demanded by ATC, no callout by PNF of runway visible or not at MDA, continuing approach having entered rain when below MDA, are just such examples.

Aircraft speeds were significantly higher than recommended during the Approach. Over speed warning was audible even at 300 feet AGL on Approach.

Stabilized Approach procedures were not adhered to by the crew.

Weather avoidance procedures were not adhered to by the crew.


Windshear escape manoeuvre was not carried out as per SOP.

Go Around actions by the crew were also not in conformity with the Aircraft Operating Manual (Thrust was not increased to Go Around thrust, pitch attitude was not raised to Go Around attitude and Landing gear was not retracted). The normal Go Around N1 RPM should have been about 92-93% for the prevailing altitude and temperature. The FDR indicates that the crew opened throttles only to 88-89 % during the Go Around (according to Bombardier, the engine setting selected by the crew would also have allowed a successful Go Around). If standard operating procedure for Go Around had been adhered to (by opening thrust to Go Around Thrust and raising undercarriage), the aircraft would have reached a higher altitude by the time it encountered the severe weather and the chances of avoiding an accident may have improved.

II.8 FOQA relevance for crew operating away from parent base for extended periods of time:

While operating for MONUSCO, the crew operated in DRC for 3-6 months at a stretch before being replaced by another set of crew. Non adherence to SOPs mentioned above may have been the result of the crew operating far away from their parent base/country for such an extended period of time, with no one from the Operator / Georgian CAA / DRC CAA / MONUSCO to supervise them or to go through their flight parameters, in the absence of a Flight Operations Quality Assurance (FOQA) program at Georgian Airways. The crew probably believed that non adherence to procedures would not be noticed by their Supervisors.

It is an accepted fact that a FOQA programme adopted by an Operator results in positive benefits and ensures a higher level of compliance with established procedures. Had the Operator been following a policy of Flight Operations Quality Assurance for its CRJ fleet, it is likely that the crew may not have

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attempted such an unstabilized Approach and would have aborted the attempt to land much earlier. Had they done so, the accident may not have occurred.

II.9 Other important aspects related to the accident.

Besides the above mentioned factors, there is a need to review some other aspects which may have had a bearing on the accident.

II.9.1 Command Upgrade Training Syllabus being followed in Georgian Airways:

The PIC had completed his Command Training on the CRJ only in December 2010. This was his first ever Command on any Commercial Airliner type of aircraft. The syllabus for Initial Upgrade Training in Georgian Airways Training Manual specified only one sortie to be flown in the Simulator before commencement of Line Oriented Flight Training.


Only one simulator flight for first time upgrade to a Captain on an aircraft like the CRJ may not be considered adequate. Such a syllabus is also not in accordance with similar upgrade training programmes being carried out in other countries around the world.

As a First Officer, a crew member sits on the right seat and gets used to operating the yoke with the right hand while the throttles are operated by the left hand. When a First Officer begins his Upgrade Training to Captain, he/she for the first time, gets to sit on the left seat in a Simulator. Hence, during the first simulator flight, he/she barely gets time to get used to operating the yoke with his/her left hand and operating the throttle levers by right hand. Thus, in only one simulator sortie, a crew member upgrading to a Captain for the first time, does not develop requisite proficiency levels, especially in handling non normal situations.

Also, a simulator flight is the only time that a crew member can be exposed to and practice non normal procedures / emergency handling in a controlled environment. Similarly, a simulator is the only opportunity when Decision Making and Crew Resource Management skills can be practiced and reviewed, under simulated stressful situations. Hence, when upgrading to Captain for the first time, the norm in many airlines is to carry out 8-10 simulator flights, especially if this upgrade is on a CRJ class of aircraft.

The Go Around action taken by the PIC were also not in accordance with the Go Around actions specified in the Aircraft Operating Manual. Having flown only one simulator flight for Command conversion may have contributed to the lack of sufficient practice of executing Go Arouns. Similarly, inadequate response to windshear warning coming on may also be attributed to the fact that the PIC had last practiced a windshear situation in a simulator two years ago as a First Officer, on a different type of aircraft (Boeing 737).

Based on the above, it may be said that the PIC probably could not have developed requisite skills / experience needed to handle stressful / non normal situations, after having flown only one sortie in the Simulator during his Upgrade training.

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II.9.2 Take Off Go Around (TOGA) button probably not operated during Go Around:

It is common knowledge that Go Around maneuver is carried out very few times in routine line flying. It is only in the Simulator while doing non - normal procedures / Emergency Procedures that Go Arouns can be practiced sufficient number of times. The PIC had done only one Simulator sortie during his Command Upgrade training and hence, probably did not have many opportunities to practice Go Arouns.


Due to above mentioned factor, it is possible that the PIC may have not pressed the TOGA button while performing Go Around on the day of the accident. The PIC had been a First Officer on Boeing 737 before commencing his command training on the CRJ. There is a significant difference in the location and operation of TOGA button on the Boeing 737 as compared to a CRJ. On the Boeing 737, the TOGA button is located forward and adjacent to the Throttle Levers and is operated by pressing the index finger downwards. On the CRJ, the TOGA button is located on the side of the Throttle Levers and is operated by pressing the thumb sideways towards the Throttle Levers. Thus it is possible that habit interference may have played a part and PIC may not have instinctively pressed the TOGA button by his thumb.

Pressing the TOGA button brings the Flight Director command bars up on the ADI at 10 degrees nose up attitude. If the TOGA button was not pressed, the 10 degree reference indication of Flight Director command bars would not have appeared on the ADI. This lack of reference during the Go Around could have been the probable reason for the pitch attitude being raised initially only to about 8 degrees during the Go Around, instead of the recommended 10 degrees. It could also be the reason that the pitch attitude was not held steady at 10 degrees nose up during the subsequent climb out as the attitude had slowly came down to about 4-5 degrees nose up by the time the aircraft encountered the severe weather phenomenon/microburst. In the CRJ, the 10 degrees nose up reference indication of Flight Director command bars is also activated by Windshear Warning coming on. Hence, even if the 10 degree nose up command bar indication had not come on earlier due probable non pressing of TOGA button, it should have come on at the moment the Windshear Warning came on.

Another possible reason for the attitude coming down during the climb out could be that probably the throttles were not moved fully forward to Go Around thrust (as the N1 achieved was only 88-89% rather than 92-93%) and with the undercarriage not having been selected up, the aircraft would not accelerate during climb out. Thus, a lower attitude may have been maintained deliberately by the PIC in order to accelerate the aircraft to climb speed.

II.9.3 Oversight of the Operator by Georgian CAA

Georgian CAA had approved Georgian Airways Training Program. As stated above, the Upgrade Training Program was probably not robust enough to prepare crew adequately as first time Captains. Similarly, not having a dedicated Operations Inspector as part of Georgian CAA staff was probably not the ideal way to ensure oversight of Air Operators.

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II.9.4 Closure of airfield when visibility reduced to below Minima:

Kinshasa ATC did not declare the airfield closed when the visibility reduced below the minimum visibility of 2400 metres needed to fly a Localizer Approach. If the airfield had been declared closed, UNO 834 would not have continued its approach and the accident may not have occurred.

II.9.5 Use of term NOSIG:


ATC used the term NOSIG when conveying weather information to UNO 834. The term NOSIG implies that no significant change is expected in the weather in next 30 minutes, hence this term should not have been used when weather was indeed changing. Probably the ATC used this term as a matter of habit and without understanding its significance.

II.9.6. Analysis of final few seconds of flight:

When the crew visually sighted the runway, the weather radar was still showing presence of severe weather / ‘Magenta’ over the airfield as confirmed by co-pilot’s remarks at that time. Although visual sighting of the airfield may have prompted the crew to continue the Approach, the inclement weather had not moved away from the airfield.

Thus, when the aircraft entered rain below MDA and the crew could no longer see the runway even after selecting windshield wipers ON, the crew decided to do a Go Around. During the process of Go Around, the aircraft had to fly through the same very airspace where ‘Magenta’ had been indicated during the Approach all along. It is while climbing through this airspace, at about 397 feet AGL that the aircraft was affected by a severe external disturbance caused probably by a Microburst type phenomenon. The wind shear warning came on. The vertical gust/down draft pitched down the aircraft from about 4-5 degrees nose up to 7 degrees nose down, in a very short time. The vertical gust strength was calculated to be of the order of 40 to 50 feet per second. The aircraft rapidly lost height. Being at very low level, the crew did not have sufficient time to recover from the effects of this encounter. Recovery from the above mentioned significant upset, caused by the severe external disturbance at such low altitude, could not have been possible.

The significant and instantaneous elevator (nose up) deflection recorded on the FDR in the very last second of flight can probably be indicative of the instinctive response of the crew to the impending impact with the ground.

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III. CONCLUSIONS

III.1. Facts established by the investigation

1. The aircraft was serviceable and all aircraft systems worked satisfactorily during the flight.
2. The crew were appropriately licensed and medically fit for carrying out the flight. Fatigue was not a factor in the accident.
3. Weather over and around Kinshasa airfield degraded suddenly and significantly few minutes before the accident.
4. Crew was not informed of the degradation of the weather by the ATC. The airfield was not declared closed when visibility fell to below minimum required for Localizer Approach.
5. Crew was able to notice presence of severe weather around Kinshasa on the onboard weather radar from a considerable distance away from the airfield. They decided to continue their Approach despite presence of severe weather.
6. Crew carried out a high speed and un-stabilized Approach.
7. Standard Operating Procedures were not adhered to during flight.
8. Crew did not display appropriate Crew Resource Management in execution of the flight.
9. Crew encountered significantly severe weather (vertical gust/downdraft) associated with Microburst during the process of Go Around. This resulted in a sudden nose down pitch change and rapid loss of height at a stage when the aircraft was not far from the ground. By the time the crew could initiate recovery from the steep nose down pitching moment caused by encounter with severe weather, the aircraft hit the ground.

In addition to the above mentioned conclusions, it can also be reasonably surmised that the following issues too, affected the outcome of the accident:

- i. Georgian Airways Training program for Upgrade to Captain probably did not have adequate number of Simulator flights.
- ii. Georgian CAA approved a probably weak Training Program formulated by Georgian Airways for Upgrade to Captain.
- iii. Georgian CAA as well as DRC CAA probably did not exercise requisite degree of oversight of Georgian Airways crew operating in the DRC.
- iv. Crew was probably not adequately trained to carry out the task under non - normal /emergency conditions. The last time the PIC had practiced a wind shear escape maneuver had been two years ago, on a different type of aircraft (Boeing 737).

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III.2 Probable cause:


III.2.1 Probable cause of the Accident:

The most probable cause of the accident was the aircraft's encounter with a severe Microburst like weather phenomenon at a very low altitude during the process of Go Around. The severe vertical gust/downdraft caused a significant and sudden pitch change to the aircraft which resulted in a considerable loss of height. Being at very low altitude, recovery from such a disturbance was not possible.

The possibility of a somatogravic illusion caused Loss Of Control (LOC) as the primary cause of the accident, was also discussed by the investigation team. This was ruled out based on available evidence which showed that during the Go Around, the crew had initiated the climb at 1256 32 and had thereafter, maintained a climbing attitude for the next 12 seconds. At 1256 44, the aircraft experienced a sudden and steep nose down attitude change without a corresponding control input by the crew (as shown by FDR), Hence, Somatogravic Illusion caused Loss of Control was ruled out as a cause of accident.

III.2.2. Probable contributing factors:

1. The inappropriate decision of the crew to continue the approach, in face of extremely inclement weather being displayed on their weather radar, was probably the principle contributing factor responsible for the accident.
2. Lack of adequate supervision by the Operator to ensure that its crew complied with established procedures including weather avoidance procedures and Stabilized Approach criteria, was a probable contributing factor.
3. Inadequacy of Georgian Airways Training program for upgrade to Captain was a probable contributing Factor.
4. Lack of effective oversight of Georgian Airways by Georgian CAA was a probable contributing factor.
5. Lack of appropriate equipment at Kinshasa airport for identification and tracking of adverse weather phenomenon, resulting in failure by ATC to provide appropriate early warning to the aircraft, was probably a contributing factor.
6. ATC not declaring the airfield closed when visibility dropped below Minima was a probable contributory factor.

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IV.SAFETY RECOMMENDATIONS

In order to prevent similar accidents, the Investigation Team recommends the following:

1. Ministry of Transport, Government of Democratic Republic of Congo:

The Ministry of Transport of the DRC should provide appropriate Meteorological equipment to the Meteorological Service in DRC so that the expected level of meteorological services can be provided.

2. Civil Aviation Authority of Democratic Republic of Congo:

DRC CAA should exercise effective safety oversight over all operators in the Democratic Republic of Congo, including aircraft chartered by MONUSCO.

3. Airports Authority of DRC (RVA):

- a) RVA should procure appropriate weather radars for important airfields in the DRC or alternatively, provide suitable web connections to important Meteorological stations so that they can log on to relevant web sites like EUMETSAT, in order to monitor the weather conditions in real time;
- b) Provide appropriate training to the staff of the Meteorological Services as well as to the ATC, in order to improve their performance standards.

4. MONUSCO:

- a) To consider doing away with a separate Meteorological Service provider for its use and instead, rely only on DRC Government provided meteorological service.
- b) MONUSCO should demand that all Operators chartered by it should have a FOQA program in place, whose results should be shared with MONUSCO.

5. Georgian Airways:

- a) Operator to consider revision of its training program including the increased use of simulator flights for initial upgrade on type.
- b) Operator to ensure that a system is put in place to retain a copy of the Load and Balance Sheet on ground for each flight.
- c) Operator to consider implementation of FOQA Program for its CRJ aircraft as well.
- d) Operator to consider laying greater emphasis in its Ground Training program on the following:
 - Recognition and management of threats and errors; (ICAO Annex 1, Chapter 2, Para. 2.6.1.3.1.2 a)

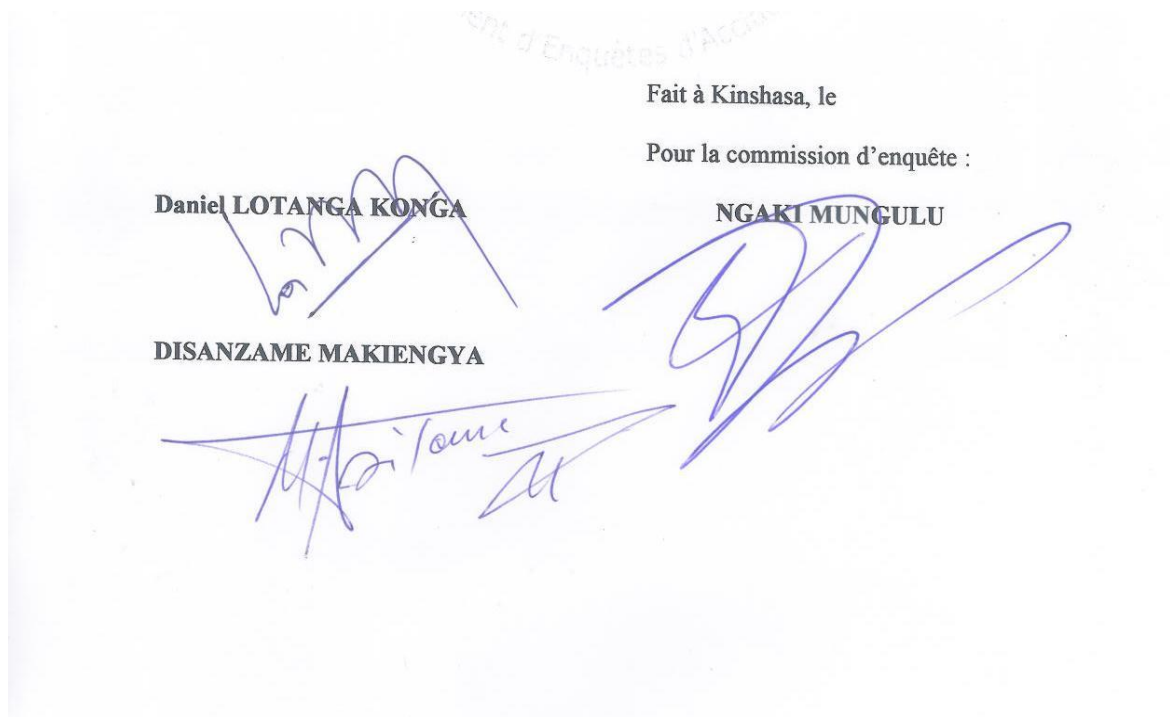
- Exercise of good judgment and airmanship, to include structured decision making and the maintenance of situational awareness; (ICAO Annex 1, Chapter 2, Para. 2.6.1.3.1.2 e)

6. Georgian Civil Aviation Authority:

- To exercise effective safety oversight over operations being conducted for extended periods of time by its Operators outside the main operational bases.
- Review the training program of Georgian Airways.

7. International Civil Aviation Organization:

ICAO may consider stipulating Flight Operations Quality Assurance (or Flight Data Monitoring) program as a mandatory requirement (i.e. a 'Standard') for all aircraft above 20000 KGs MTOW, engaged in commercial operations.



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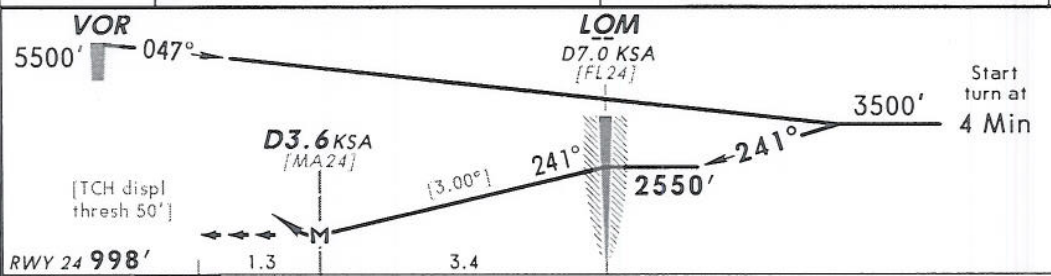
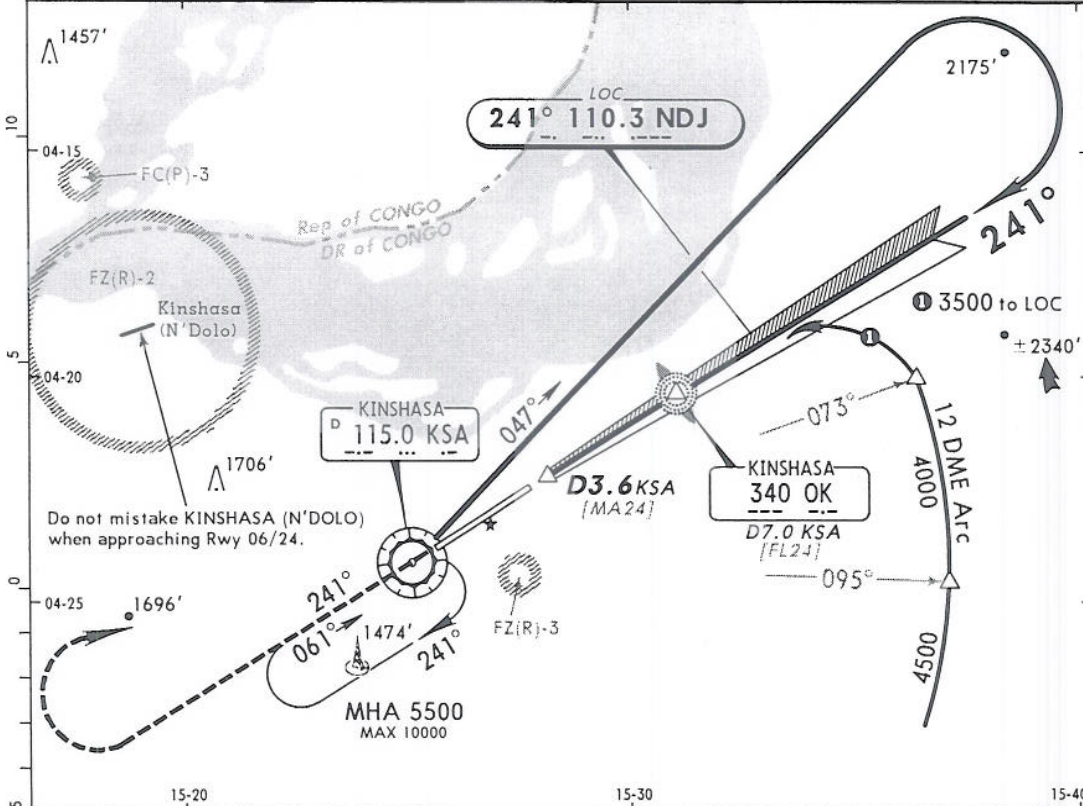
Notice: After 26 Jul 2013 0901Z, this chart may no longer be valid. Disc 14-2013

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FZAA/FIH
N'DJILI INTL

JEPPESEN KINSHASA, DR OF CONGO
9 NOV 07 (11-1)
LOC P Rwy 24

*ATIS	KINSHASA Approach		KINSHASA Tower		Ground
120.5	119.7		118.1		121.9
LOC NDJ 110.3	Final Apch Crs 241°	Minimum Alt LOM 2550' (1552')	MDA(H) 1470' (472')	Apt Elev 998' RWY 998'	4500'
MISSED APCH: Climb on R-241 KSA to 3500', then turn RIGHT to VOR and as directed.					
Alt Set: hPa	Rwy Elev: 36 hPa	Trans level: FL 60	Trans alt: 5500'	MSA KSA VOR	



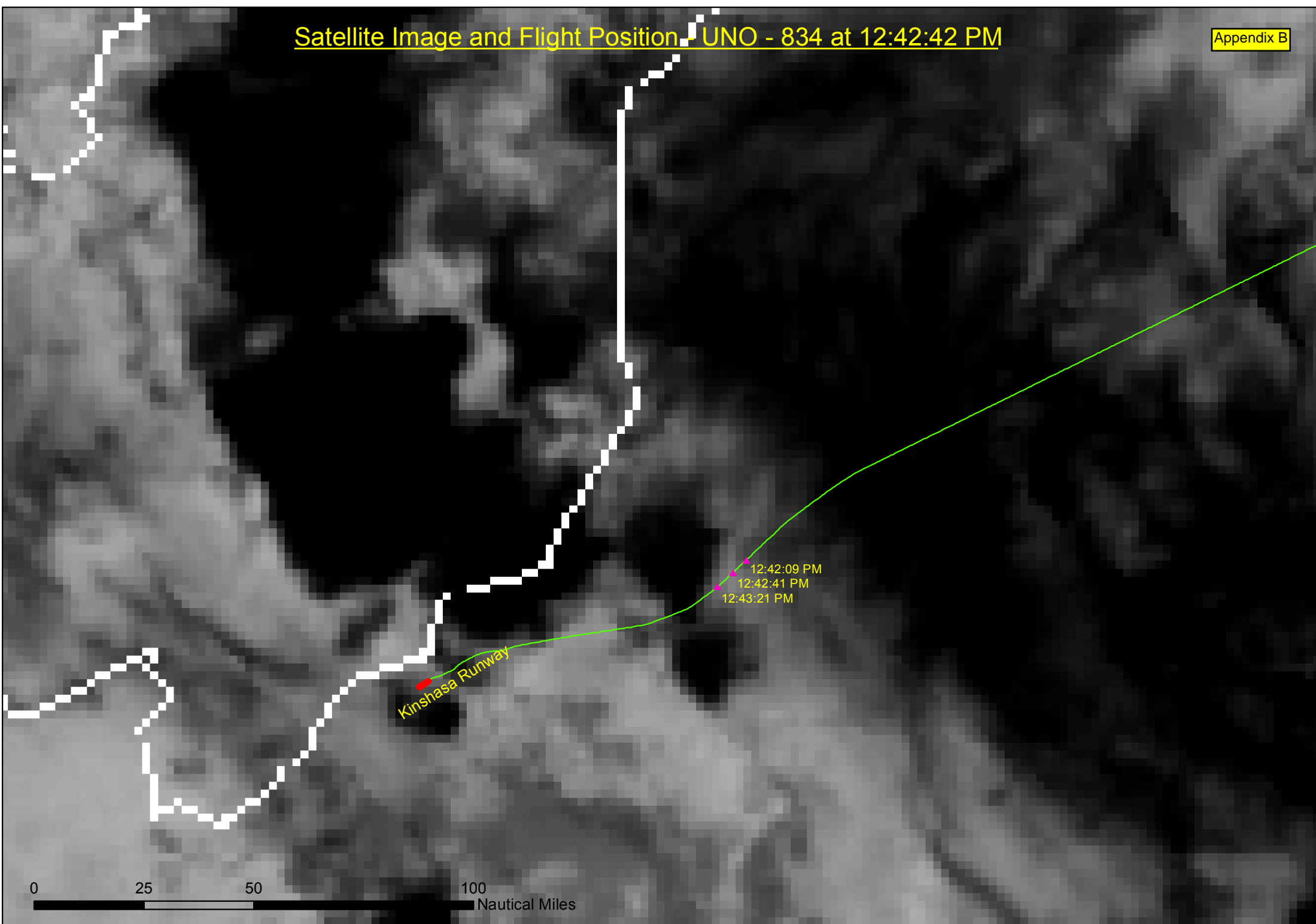
Gnd speed-Kts	70	90	100	120	140	160	Lighting - Refer to Airport Chart	3500' KSA on 115.0 R-241
Descent gradient 5.24% or Descent angle [3.00°]	372	478	531	637	743	849		
MAP at D3.6 KSA								

STRAIGHT-IN LANDING RWY 24		CIRCLE-TO-LAND	
MDA(H) 1470' (472')			
PANS OPS 3	A	Max Kts	MDA(H)
	B	100	1670' (672') 2800m
	C	135	1670' (672') 3700m
	D	180	1730' (732') 4600m
2400m		205	1730' (732') 4600m

CHANGES: Procedure.

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Satellite Image and Flight Position - UNO - 834 at 12:42:42 PM



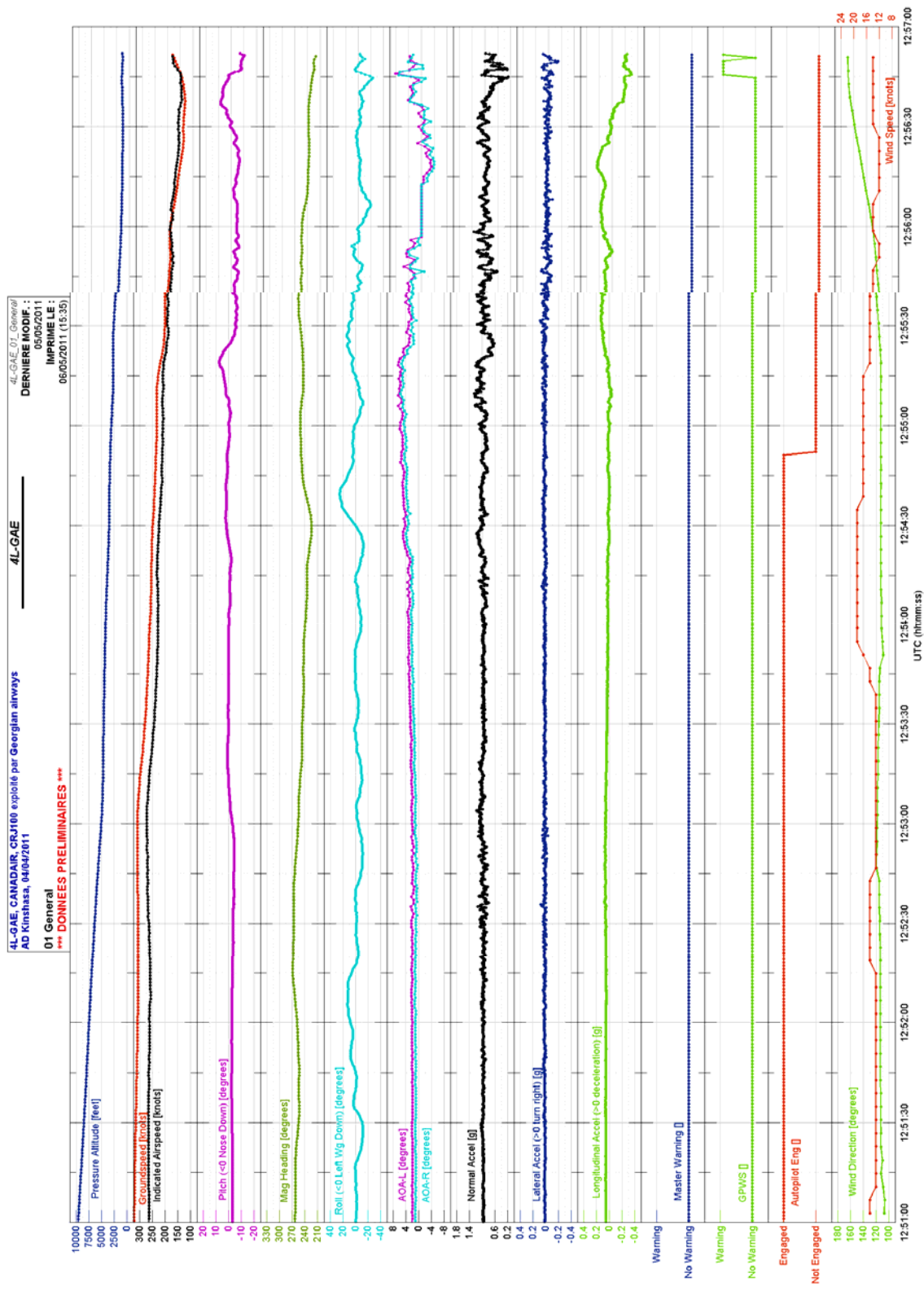
Kinshasa Runway

12:42:09 PM
12:42:41 PM
12:43:21 PM

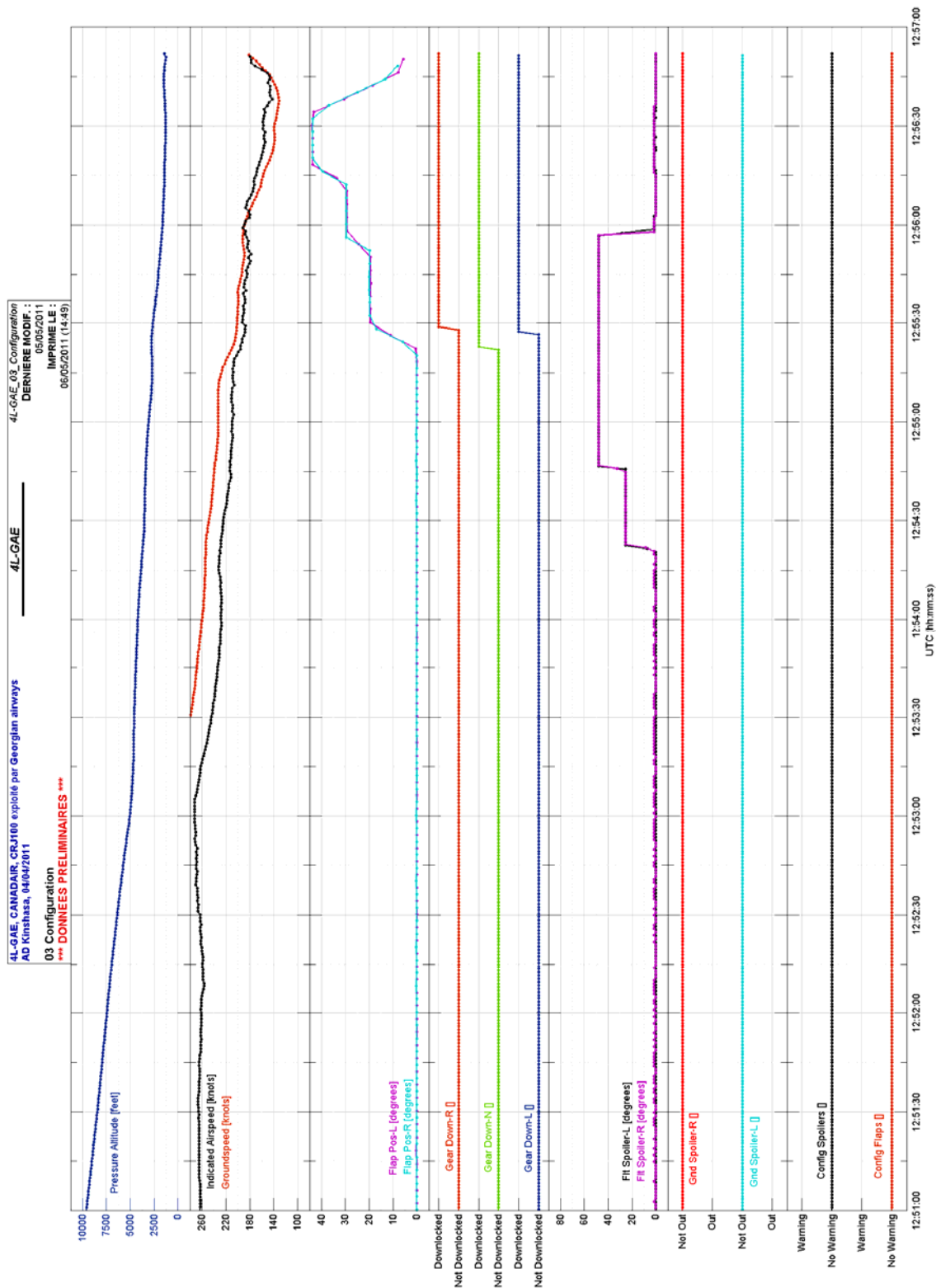
0 25 50 100 Nautical Miles

FDR READOUT

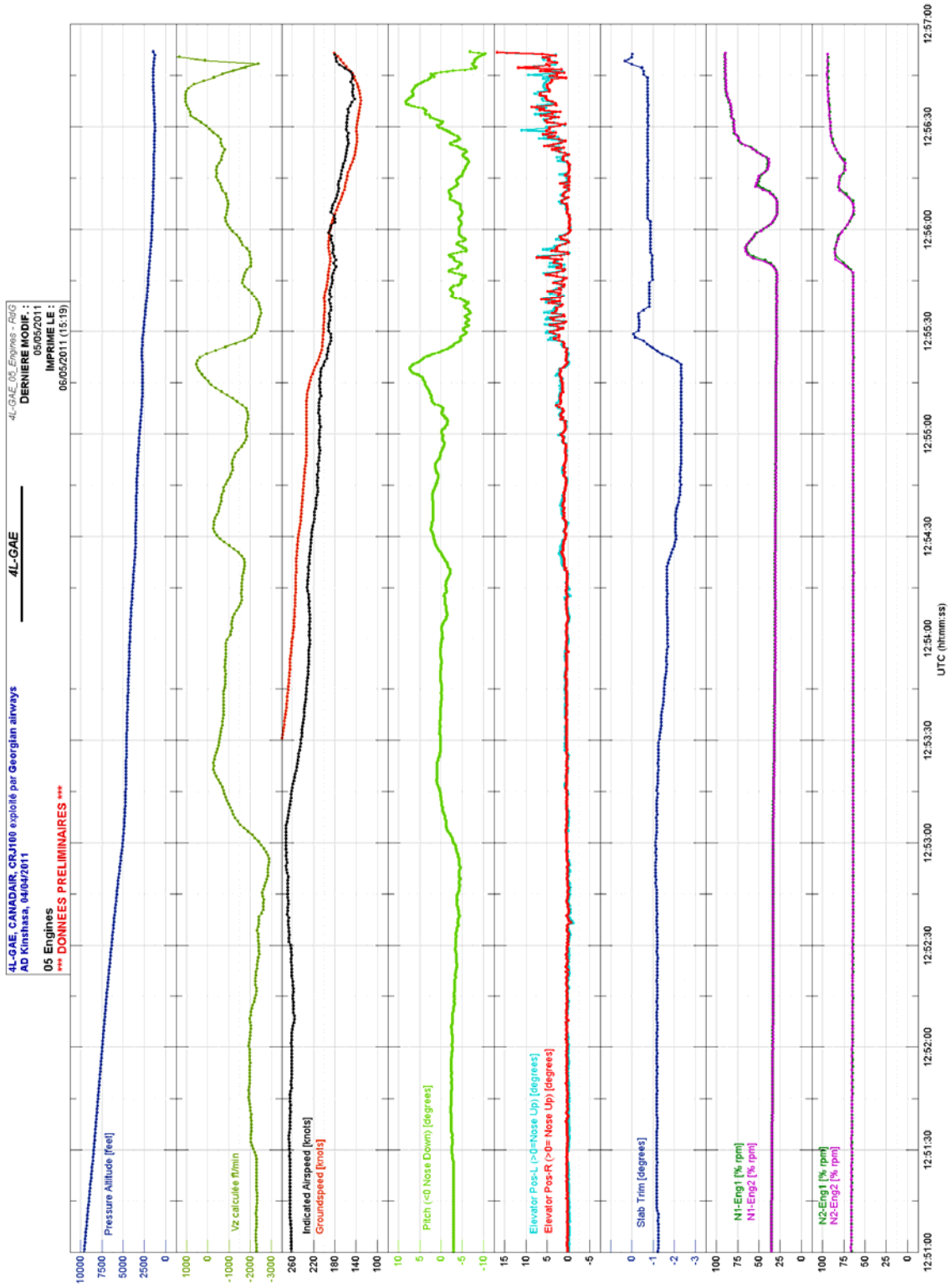
APPENDIX C



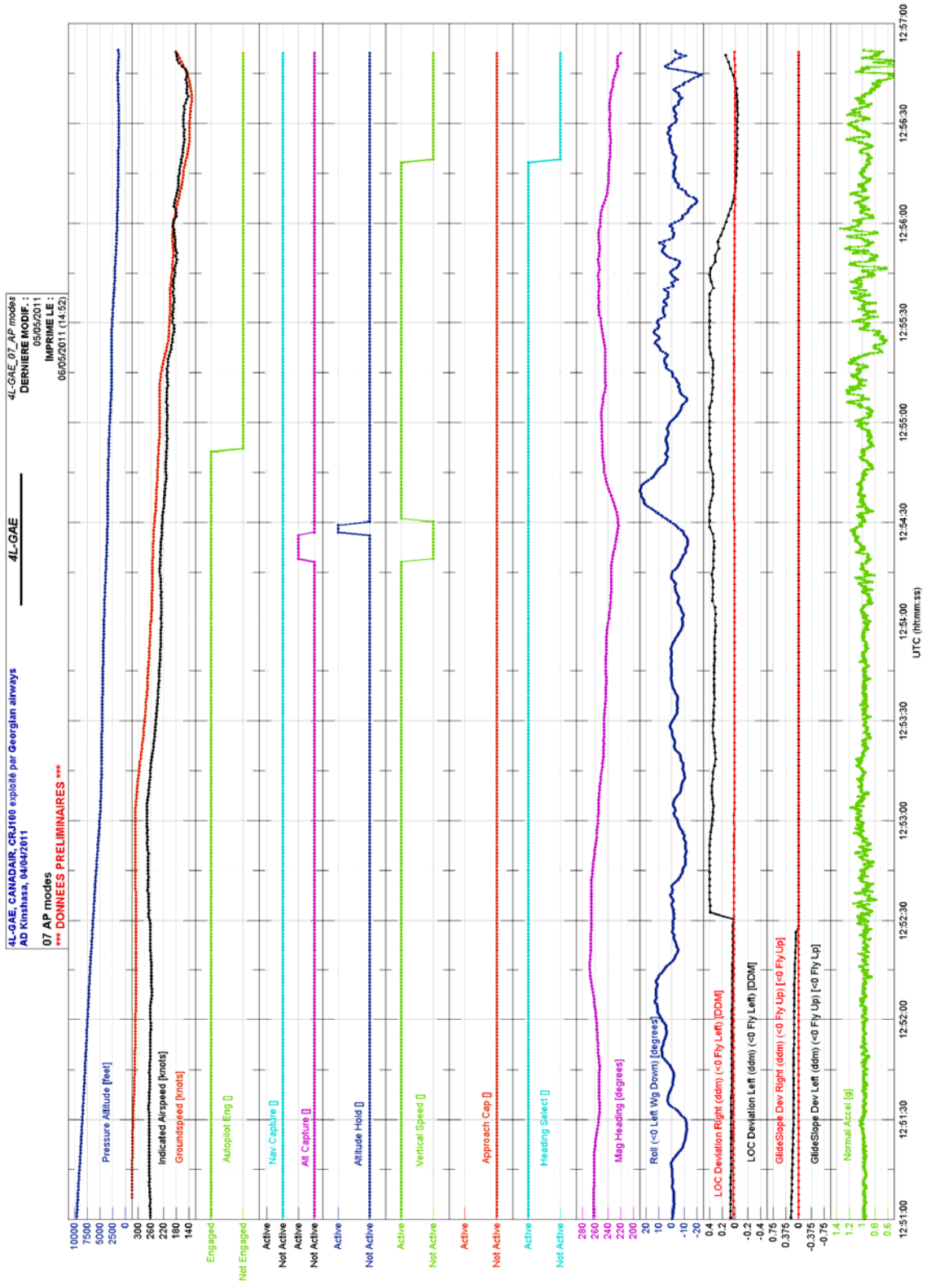
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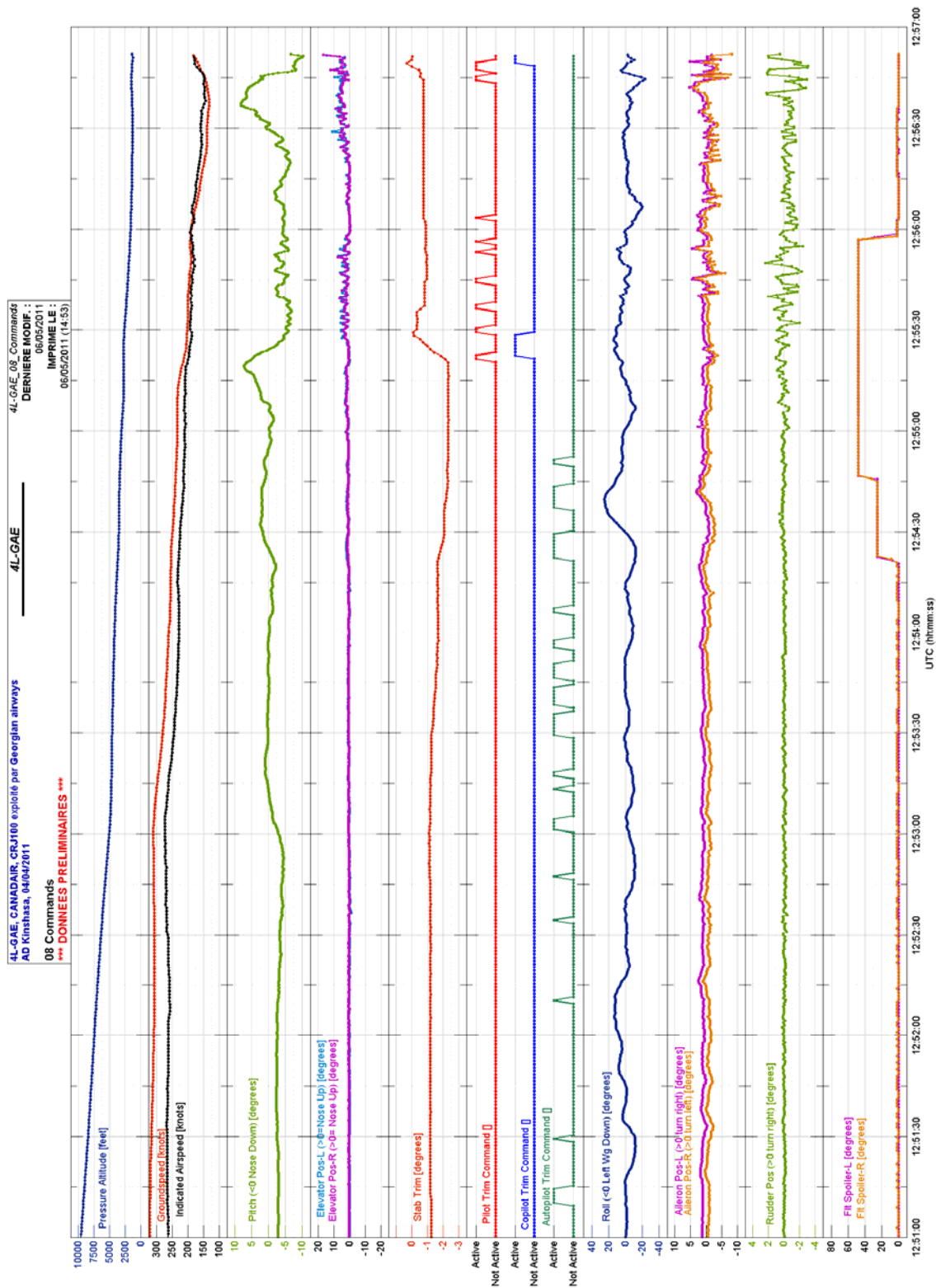
FDR READOUT



FDR READOUT



FDR READOUT



Appendix D

Relevant part of CVR TRANSCRIPT (UNO-834, 4L-GAE)

Legend:

Radio communication with external agencies (ATC and MONUSCO Flight Following): Depicted in Blue.

Call outs by aircraft systems and other audio: Depicted in Red.

Communication amongst crew: Depicted in Black. When crew heard conversing in Russian/Georgian, approximate English Translation is written in brackets in the Transcript.

Expletives indicated by : *****

Time	Caller	Transcript Information
1226 23	Co-pilot	Kinshasa, Kinshasa, United Nation 834, good afternoon, Sir
1228 30	Co-pilot	Kinshasa, Kinshasa, United Nation 834, good afternoon
1228 33	Co-pilot	Kinshasa, Kinshasa, United Nation 834
1228 46	Co-pilot	Kinshasa Air Ops, United Nation 834, good afternoon
1229 00	Co-pilot	Kinshasa Air Ops, United Nation 834
1229 28	Co-pilot	Kinshasa, Kinshasa, United Nation 834, good afternoon
1229 34	Area Control	UNO 834, Kinshasa, afternoon, go ahead
1229 39	Co-pilot	United Nation 834, routing from Kisangani to Kinshasa, approaching position GURUT, level 300 maintaining, next UDRID 1241 and destination Kinshasa 1255
1230 06	Co-pilot	Kinshasa, United Nation 834, did you copy
1230 57	Co-pilot	Kinshasa, Kinshasa, United Nation 834
1231 36	Co-pilot	Kinshasa approach, United Nation 834, good afternoon
1231 39	Kinshasa Approach	Kinshasa 834, good afternoon, go ahead
1231 42	Co-pilot	United Nation 834, routing from Kisangani to your station, now position is GURUD, level 300, unable to contact with 126.1 and request actual weather in Kinshasa
1231 57	Kinshasa Approach	Copy latest Kinshasa weather wind 340, 8 knots, visibility 10 kilometers, scattered 2500 feet, CB 3000 feet, CB located north-east, south-east, temperature 33, dew point 23, QNH 1009, trend NO SIG, over
1232 18	Co-pilot	OK, weather is copied and estimated time, well..., arrival in Kinshasa is 1255

1232 25	Kinshasa Approach	Copied, to report release by Kinshasa Area
1232 29	Co-pilot	OK, I will try on 126.1, good bye
1232 57	Co-pilot	Kinshasa, Kinshasa, United Nation 834
1233 02	Area control	Kinshasa 834, Kinshasa, go ahead
1233 05	Co-pilot	Good afternoon again, Sir, United Nation 834, routing from Kisangani to Kinshasa, position is GURUT, level 300 maintaining
1233 16	Area control	Roger, maintain flight level 300, report for descent
1233 21	Co-pilot	Maintaining 300, call you for descent, 834, thank you.
1233 28	PIC	<p>OK, approach briefing. Airport Kinshasa, left seat landing, runway 24, localizer approach.</p> <p>OK, localizer frequency is pre-selected both sides. ADF frequency pre-selected, final approach course will be 241, minimum descend altitude is 1470 both sides, minimum safe altitude is 4500, will descend 3500 and 2500. OK, at PISTONS (???), там получается где-то 5 миль, да? (over there it equals to approximately 5 miles, yes?), да, т-а-а-к (yes, OK).</p> <p>In case of go-around will climb straight ahead 3500, then turn right and return to Oscar Kilo, правым разворотом на, OK, 3500, в-о-о-т (right turn towards Oscar Kilo, 3500), APU is required, anti-ice is required, any question?,</p> <p>Descend check List, set, и скорости стоят (speeds are set) for 19,500 kg, V-ref is 135, is pre-selected, (Fuel) check, (TCAS) ON, OFF, ON то есть (I meant ON) OFF, check and clear, set, complete, thank you</p>
1235 05	Co-pilot	Kinshasa Air Ops, United Nation 834, good afternoon
1235 19	Co-pilot	Kinshasa Air Ops, United Nation 834
1235 45	Co-pilot	Kinshasa Air Ops, United Nation 834, good afternoon
1235 56	PIC	Вышел, наверное. Ну его ***** (He must have gone, probably. **)
1237 19	Co-pilot	Will request radial 075 and then will see.
1237 23	PIC	Запросим снижение, а в снижении уже посмотрим, их обойдем, да?, и все, сейчас этот radial, пока нам между ними надо пройти (we will request descend, during descend will see, will go round them, yes?, and that is it, now this radial, so far we need to pass between them)
1237 41	PIC	Heading mode.
1237 57	Co-pilot	Kinshasa Air Ops, United Nation 834, good afternoon
1238 10	Co-pilot	Kinshasa Air Ops, United Nation 834

1238 19	PIC	Лучок четко показывает, это видно, это видно (beam) is clearly showing, it is seen, it is seen)
1238 27	Co-pilot	So I set 1 degree and Zero degree.
1239 41	PIC	Давай снижение у него проси (let's ask him for descend)
1239 51	Co-pilot	Kinshasa, Kinshasa, United Nation 834, request descend
1239 59	Area Control	834, descend to KSA, flight level 100, report passing flight level 245
1240 05	Co-pilot	OK, descending to level 100, will call you passing 245, 834.
1240 49	PIC	vertical speed
1241 30	Co-pilot	Kinshasa Air Ops, United Nation 834
1241 33	MONUSCO Flt Following	834, go ahead
1241 34	Co-pilot	Good afternoon, Sir, United Nation 834, routing from Kisangani to your station, now position is UDRID, level 290, descending to 100, Kinshasa estimate 1300
1241 35	MONUSCO Flt Following	Report on ground
1241 36	Co-pilot	Call you on ground, 834
1241 36	Co-pilot	Good afternoon, Sir, United Nation 834,
1242 18	PIC	Да-да, сейчас посмотрим, мы на снижении еще (Yes, yes, now we will see, we are still descending)
1242 35	PIC	160, уже не нужно, *** что поймешь (160, it is not required already, I do not understand anything (in abusive slang))
1243 14	Co-pilot	Kinshasa Control, United Nation 834, passing level 245
1243 28	Co-pilot	Kinshasa, Kinshasa, UNO 834, passing 245
1243 33	Area control	Contact Kinshasa Approach 119.7
1243 38	Co-pilot	119.7 Have a nice day, thank you, good bye
1243 49	Co-pilot to Approach	Kinshasa Approach, United Nation 834, descending to level 100
1243 55	Kinshasa Approach	UN 834, confirm level passing and DME
1243 59	Co-pilot	Passing 240 and DME is 68 miles
1244 05	Kinshasa Approach	Copied, continue descend to KSA, flight level 100, report reaching
1244 12	Co-pilot	OK, continue descend to level 100 and request radial 061 for straight-in approach, runway 24
1244 19	Kinshasa Approach	Cleared radial 061, report reaching flight level 100
1244 25	Co-pilot	OK, cleared radial 061, call you reaching 100, 834
1244 37	Co-pilot	Давай на Киншасе (???) (Let's do it on Kinshasa...)

1244 39	PIC	Да пошли они в *****, *****, сейчас обойдем вот эту ****!*... (*** !, damn!, now we will go round this s***! (in abusive slang))
1244 43	Co-pilot	Да, когда обойдем(???) (Yes, when we will have gone around it)
1245 07	PIC	Или эту мы сейчас отсюда обойдем, посмотрим, сейчас, по расстоянию (Or we will go round it from here, we will see, by distance)
1245 11	Co-pilot	Он, короче, он видит... (It, I would say..., it sees...)
1245 17	PIC	Что? (What?)
1245 21	Co-pilot	Этот почти перешел уже, на, на runway стоит уже, короче, перейдет (This has almost crossed already, this on runway so will cross)
1245 28	Co-pilot	Пока долетим, там 10 минут, там еще лететь (We need still to fly for 10 minutes)
1245 45	Co-pilot	Check 250 ..., пошли (???) (let's go)
1245 59	Co-pilot	(Oh, OH, look how large it is!!!)
1246 23	PIC	А ну, чуть-чуть выше, а ну, подними, а ну, на ноль поставь, что там у нас? (So, set little bit up, Zero degrees, well, what do we have there?)
1246 33	PIC	Пусть вот так оно будет (Let it be like this)
1246 35	PIC	Ну, минус 0 – 2 где-то поставь, а то, когда сильно в минус, мы сейчас снижаемся сильно (Well, set it for minus 0 – 2, because we are descending steeply now)
1246 45	Co-pilot	Не, все равно, если земля, короче, показывает землю, а вот сейчас землю не показывает, вот, вот, еле-еле показывает, там magenta есть, это не земля, magenta (No, still, if it is the ground surface, I would say, it shows the ground surface, but now it is not showing the ground surface, that is, that is, barely shows, there is Magenta there. It is not the ground surface, it is Magenta)
1247 05	Co-pilot	Это что за traffic?... (What traffic is this?)
1247 54	Co-pilot	*****, там magenta! (****, there is magenta there!)
1248 40	PIC	Наш radial поставь, какой у нас? (Set our radial, what radial do we have?)
1248 42	Co-pilot	061
1248 44	PIC	Сейчас какой? (What radial do we have now?)
1248 46	Co-pilot	Сейчас, наверное, 85 (Now it is 85, probably)
1248 54	PIC	Где-то 70, с чем-то, наверное (Approximately 70 something, most likely)
1248 59	Co-pilot	75
1249 00	Kinshasa Approach	UNO 834, level passing, DME
1249 03	Co-pilot	Passing 140, DME is 37

1249 09	Kinshasa Approach	37, Charlie
1249 11	Co-pilot	Charlie, Charlie
1249 13	Kinshasa Approach	Copied, continue descend to KSA, flight level 060, report approaching for straight-in approach, runway 24
1249 24	Co-pilot	OK, descending to level 060 for straight-in approach, runway 24, call you approaching, 834
1249 34	PIC	А ну, weather еще спроси, какая погода (Well, ask again for weather, what is weather like?)
1249 36	Co-pilot	Как? (What?)
1249 37	PIC	Вот, weather, спроси еще раз, какой, погода какая, еще раз переспроси у них, они, видишь, нам, ****, 10000 давали, а там реально вон, *****! (Well, ask for weather once again, what is the weather like? Ask them once again, they, as you can see, *** they were giving us 10000, but in reality over there like this, *** ! (in abusive slang))
1249 46	Co-pilot	United Nation 834, request latest weather in Kinshasa
1249 54	Kinshasa Approach	Wind 210 degrees, 8 knots, visibility 8 kilometers, thunderstorm over station, scattered 2400 feet, few Charlie Bravo 3000 feet, Charlie Bravo located north-east, south-west and west, broken 12000 feet, temperature 38, correction 33, dew point 23, QNH 1008, trend NO SIG, over
1250 20	Co-pilot	OK, weather copied, QNH 1008, thank you very much, Sir
1250 25	Kinshasa Approach	Level passing now, DME
1250 27	Co-pilot	Now passing 100, DME is 30 miles, approaching... 10000
1250 31	Kinshasa Approach	Cleared for straight-in Approach, runway 24, QNH 1008, report 4500 feet, established on the localizer
1250 38	Co-pilot	OK, cleared to straight-in approach, runway 24, descending to 4500, call you established, 834
1250 47	PIC	4500 set
1250 50	Co-pilot	Check 4500
1251 00	Co-pilot	Может, короче, оттуда зайдём, а? (May be, I would say, will approach from there?)
1251 02	PIC	Справа, думаешь? (Do you think, from the right?)
1251 04	Co-pilot	Нет, не справа, какой справа? Как там направо идет, прямо там обойдем, слева, говорю (No, not from the right, why from the right? It goes to the right there, right over there, I say, will go round to the left)
1251 09	PIC	Ну ты видишь? Оттуда, сейчас мы вот так пройдем, между, вот так вот зайдём (Do you see? From there, now we will pass like this, in between, like this will

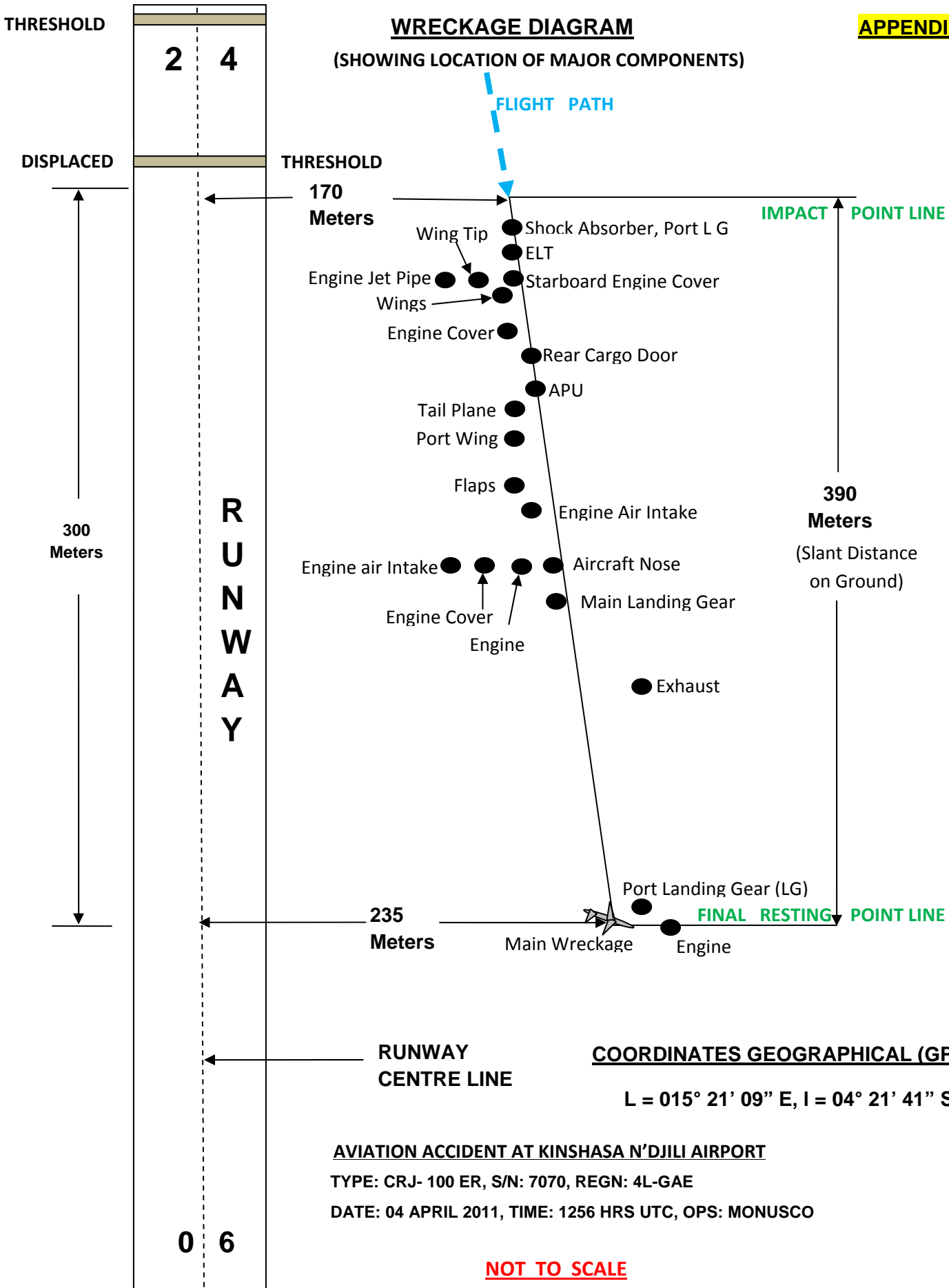
		enter)
1251 13	Co-pilot	Да-да, я это говорю, что немножко, короче, слева, и... (Yes-yes, this is what I say that, a little bit, I would say, from the left, and...)
1251 32	Co-pilot	Ну, смотри, какой! Короче, о-о-о, огромный! (Well, look at this, What a.. I would say huge!)
1251 40	Co-pilot	Ну, все равно, если там нам придется 10 минут максимум, короче, покрутятся, все равно сойдет, м-м-м, переезжает уже (But, anyway, even if we should make circling for maximum 10 minutes, we will land exactly. I would say, orbit over there, it will still be OK, cloud moving already).
1251 47	PIC	Какая безопасная у нас здесь? (What is our safe altitude here?)
1251 50	Co-pilot	У нас стоит 4000, а, 4500, да, 4500 (We have set 4000, no, 4500, yes, 4500)
1252 02	Co-pilot	О-о-о, говорил, что на 3000 футов, короче, эти облака (They said cloud ceiling at 3000 feet, I would say, these clouds..)
1252 07	Co-pilot	Во-от, эти... (Well, those...)
1252 10	Co-pilot	*****, прилетели бы мы на 5 минут... (Damn, if we had arrived 5 minutes before ...)
1252 13	Kinshasa Approach	UNO 834, confirm flight level passing
1252 15	Co-pilot	Passing 060, DME is 20 miles
1252 21	Kinshasa Approach	Thank you, report established 4500 feet on localizer
1252 24	Co-pilot	Will call you
1252 26	PIC	Active frequency (Localizer)
1252 27	Co-pilot	Т-а-а-к, на VOR-е, короче, я буду (Well, I will be on VOR)
1252 38	Co-pilot	(There is a big mess)
1253 03	Co-pilot	Пойдем, короче, там, если... что увидим, и все (We will fly there, I would say, If we see anything, then that is it)
1253 11	PIC	Давай, включи cont-ignition (Well, switch on Cont-ignition)
1253 15	Co-pilot	Т-а-а-к..., Cont-ignition is ON (Well, Cont-ignition is ON)
1253 18	PIC	Check
1253 29	Kinshasa Approach	UNO 834, position now?
1253 33	Co-pilot	Position 14 miles inbound, maintaining 4500
1253 37	Kinshasa	Ready for descend?

	Approach	
1253 40	PIC	Affirm, descending
1253 41	Co-pilot	Affirm, descending to 3500
1253 44	ATC	Charlie, Charlie, descend to 3500 feet, report reaching, report passing
1253 48	Co-pilot	Will call you
1254 00	Co-pilot	Перешло? Н-е-е-т, там стоит... (Did they move? No, it's exactly there...)
1254 04	Co-pilot	Got runway in-sight
1254 07	PIC	Где runway? (Where is the runway?)
1254 08	Co-pilot	В-о-о-т, справа от нас, вот (Over there, on our right, there)
1254 13	PIC	Cont-ignition включил? (Did you switch on Cont-ignition?)
1254 15	Co-pilot	Да, включил, да, runway in-sight, там ничего не стоит, просто radar показывает... (Yes, I switched it on, yes, runway in-sight, there is nothing there, only radar shows...)
1254 20	Co-pilot	Возьми направо, короче, ничего там нет (Go to the right, I would say, there is nothing there)
1254 28	PIC	Report established
1254 31	Co-pilot	(**).
1254 35	Co-pilot	Вот-вот-вот, runway in-sight, ничего там нет (See, see, see, runway in-sight, there is nothing there)
1254 41	Co-pilot	United Nation 834, localizer established, runway 24, 3500 feet
1254 47	Kinshasa Approach	On 118.1, good landing (wish you)
1254 49	Co-pilot	On 118.1, thank you, good bye
1254 51	Co-pilot	Та-ак, вот, не видишь? (Well, that is, don't you see?)
1254 51		Autopilot off sound.
1254 53	PIC	Вижу, вижу, все (OK, in sight, I see)
1254 55	Co-pilot	Kinshasa Tower, United Nation 834, localizer established, runway 24, good afternoon
1255 02	Kinshasa Tower	UN 834, Kinshasa Tower, good afternoon, report on short final, runway 24
1255 10	Co-pilot	Call you on short final 24, 834
1255 20	PIC	Flaps 8
1255 21	Co-pilot	speed normal, gear extension
1255 23	PIC	Continue, flaps 8
1255 29	Kinshasa Tower	834,winds now 280 degrees, 25 knots
1255 31	Co-pilot	?????
1255 35	Co-pilot	Cabin crew - prepare for landing, please
1255 36	PIC	Copied
1255 37	Co-pilot	Copied, copied, 834

1255 44	PIC	Bce, 3500 (That is it, 3500)
1255 46	Co-pilot	Та-ак (Well)
1255 49	PIC	Flaps 30
1255 51	Co-pilot	Speed normal, flaps 30
1255 51		Single chime.
1255 53		Beginning of over speed warning (clacker) coming on
1255 56	Co-pilot	Flight spoilers deployed
1256 00		Single chime.
1256 03	Aircraft audio	Five Hundred, (clacker continues)
1256 05	Co-pilot	Та-ак, 500. Above (Well, 500 above)
1256 06	PIC	Flaps 45
1256 08	Co-pilot	Та-ак, speed not normal (Well, speed not normal)
1256 10	Aircraft audio	Minimums
1256 11	Co-pilot	Сбрось, немножечко, скорость (Reduce speed a little bit)
1256 12	PIC	Flaps 45
1256 13	Co-pilot	Flaps 45. Beginning of over speed warning (clacker) coming on.
1256 15	PIC	Speed V-ref
1256 16	Co-pilot	Speed V-reference
1256 18	PIC	Flight director OFF. End of over speed warning (clacker)
1256 20	Aircraft audio	Three Hundred
1256 21	Co-pilot	OK, Three Hundred
1256 22		Sound of rain falling on windscreen can be heard, which continues till end of recording.
1256 26	PIC	Включи дворники! (Switch on canopy windscreen wipers!)
1256 30	Co-pilot	Нет, ничего не видно, давай на второй! (No, nothing in sight, let's go around!)
1256 32	PIC	Go around, flaps 8.
1256 33	Co-pilot	OK
1256 34	Co-pilot	Flaps 8
1256 38	Co-pilot	United Nation 834, going around
1256 45	Co-pilot	*****!!! (Damn it !)
1256 46	Kinshasa Tower	834, Kinshasa
1256 48	Aircraft GPWS call	Wind shear, wind shear, wind shear
1256 49	PIC	Flaps up!
1256 49	Aircraft GPWS call	Wind shear, woop woop, pull up
1256 50	Co-pilot	Так, flaps up (OK, flaps up)
1256 52	Co-pilot	Давай, скорость, скорость!!!, а-а... (Come on! Increase Speed, increase speed !)

WRECKAGE DIAGRAM

(SHOWING LOCATION OF MAJOR COMPONENTS)



1. AVIATION CIVILE GEORGIENNE

Dear Mr. DISANZAME MAKIENGYA Ambroise

I would like to thank you for the issuance of the draft final report, which appears to be totally different from the one disseminated officially on June 8, 2012. I trust its modification has been prompted by the comments which have been provided to Accredited Representatives by the UN and Georgian Airways. However, upon a closer review of the new draft, I have to admit that at certain moments the new Draft report is allocating more attention to assumptions rather than to strict analysis of facts available to the Investigation Team. Several conclusions have been agreed upon by its distinguished members on more than one occasion; however, these conclusions do not seem to be reflected properly, although they were based on the consensus of the investigation team. As an Accredited Representative, I would like to take this opportunity to provide some clarifying comments, which would promote the overall effectiveness of the Report and which are attached to this letter.

As per provisions of ICAO Annex 13, you may be willing to incorporate the comments in the Final Report. However, you are kindly requested to append the foregoing comments in their entirety to the Final Report.

Yours sincerely,

DAVID GIUNASHVILI

Head of Civil Aviation and Maritime Transport Accident
Incident Investigation Bureau, Ministry of Economy and
Sustainable Development of Georgia

Comments:

1.1 History of flight.

It is important to note that the last phrase « Before the crew could regain orientation » implies that orientation was temporarily lost and the aircraft was uncontrolled by the crew. It is an improper assumption since the investigation team has repeatedly concluded that the crew was in full control of the aircraft throughout the final phase referred to as « Top of Climb to Impact ». The severe weather disturbance placed the aircraft in a significant nose-down attitude close to the ground, from which recovery was not possible despite the continuous efforts of the crew to return the aircraft to the normal position, which was achieved immediately before impact. It is our understanding that the elimination of the reference to alleged disorientation of the crew would only serve the clarity of the Report.

2.3.5 Inadequate capability to forecast fast moving weather:

When the crew realized the discrepancy between the ATC reported weather and the picture on the airborne weather radar, from 12: 33:30 to 12:41:34 the crew repeatedly and unsuccessfully tried to contact MONUSCO Kinshasa Flight Following Duty Officer for the updated weather

information on the airfield to confirm the situation. The contact was finally established at 12:41:33, the crew reported ETA (13:00) to Kinshasa, however the updated weather information was not available at the time. Despite the rapidly deteriorating weather conditions, the updated meteo report was received by the Duty Officer from PAE Meteo only at 12 :55 (a second before the crash), which he tried to communicate to the crew at 13 :03 (FF report refers). It is evident, that sufficient time was available for the MONUSCO FF to carry out its duties in bad weather situation, including getting the alert weather analysis from PAE Meteo, contact the aircraft and inform about weather, obtain decision from Air Ops and advise the crew about landing or diversion. All these actions failed to be performed.

2.7 Non adherence to Standard Operating Procedures (SOP):

Certain statements in this Section seem to be devoid of objective analysis pertinent to the situation during the approach phase of the flight, and which may seem misleading in determining the factors contributing to the accident.

The DRC Air Space Regulation requirement to maintain speed below 250 knots is applicable during the Localizer Approach. However, the crew was implementing Visual Approach starting from 12:54:52 and the higher IAS, maintained by the crew, inadmissible by FCOM, which allows deviation of 10 knots in standard weather conditions. Under the conditions of inclement weather and turbulence, present on Kinshasa airfield, FCOM recommends to maintain higher speed to ensure the stability of the aircraft. Hence, due to the decision to carry out weather avoidance maneuver the crew correctly delayed configuration of the a/c and chose higher speed settings (reference is made to FCOM 02-06-5). The same should be applied to the analysis of the Previous Flights flown by the same crew.

In our opinion, the statement that the Go Around was not carried out in conformity with Aircraft Operation Manual, does not fully reflect the analysis of the crew actions carried out by the Investigation Team and leads to the irrelevant impression that Go Around procedure may have been unsuccessful due to deviation.

Thrust settings were 90.2 instead of prescribed 92 percent, which is an insignificant deviation as per FCOM. It is obvious, that under the conditions of extreme turbulence it is highly unlikely to set such precise setting. At the same time, the Investigation Team was clearly advised by the Manufacturer experts' team, and this is correctly reflected in the Report, that although the go-around power was not fully set and the landing gear was not retracted, with two engines operating at the selected N1 speed, sufficient performance should have been available to perform a successful go around. However, the Report makes an assumption that increased thrust setting may have improved the chances to avoid the accident, which seems irrelevant for the purpose of the investigation and cannot be considered as a contributing factor to the accident.

The Landing Gear was not retracted, since the positive climb rate was not yet stabilized. This is in compliance with FCOM requiring achieving a positive climb rate before retracting undercarriage. The initial pitch attitude was set at about 9 degrees; however the subsequent slow pitch down to 2 degrees nose-up is commanded by the crew, which occurs with broadly constant airspeed, suggesting the crew was tracking the airspeed during the go-around, as prescribed by FCOM procedures. This is another indication that the crew was in control of the aircraft, and not disoriented.

The same analysis pattern should be applied to TOGA button operation. No record is made by the FDR on the application of TOGA button, so description of the actions of the PIC can only be hypothetical. However, the aircraft behavior at this stage shows more evidence in favor of the application of TOGA than to the contrary. The nose up pitch of 9 degrees is within the scope of the reference indication of Flight Director and the pitch attitude change to 4-5 degrees was slow and controlled, which is not the case when the Flight Director indication is not on the ADI.

2.9.1 Command Upgrade Training Syllabus being followed in Georgian Airways:

Training Program for Upgrade to Captain of the Operator is approved by the Georgian CAA. It is in compliance with the Georgian legislation, and is based on the internationally adhered civil aviation norms and standards (ICAO). The Operator's program for Upgrade to Captain requires one simulator sortie with a duration of 3 hours, containing five landings and including all elements required for the transition to the PIC, including Decision Making and CRM skills. It is our opinion that implementation of the Training Program that meets the standards of ICAO cannot be considered as a factor contributing to the accident.

2.8 FOQA relevance for crew operating away from parent base for extended periods of time:

FOQA program is not a mandatory requirement per regulation and it is misleading to state that its absence renders supervision of its crew's inadequate. However, we are concurrent on the opinion that incorporation of FOQA into ICAO requirements may promote the level of compliance with established procedures.

Summary

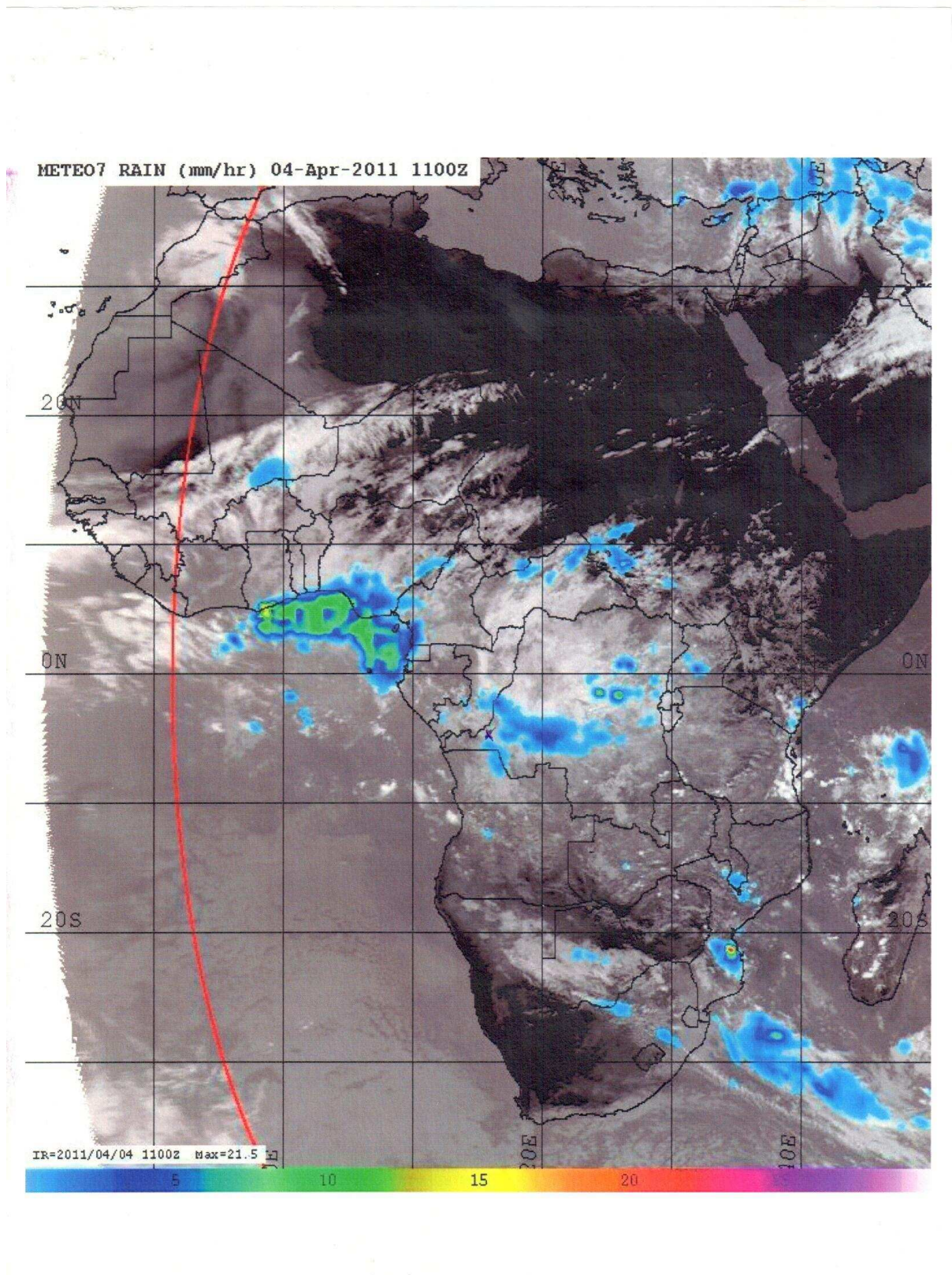
The analysis provided in the Report is highly detailed and extensive. However, there are some points that lack clarity and diversification of approach in the attempt to define and correctly evaluate all the factors contributing to the accident.

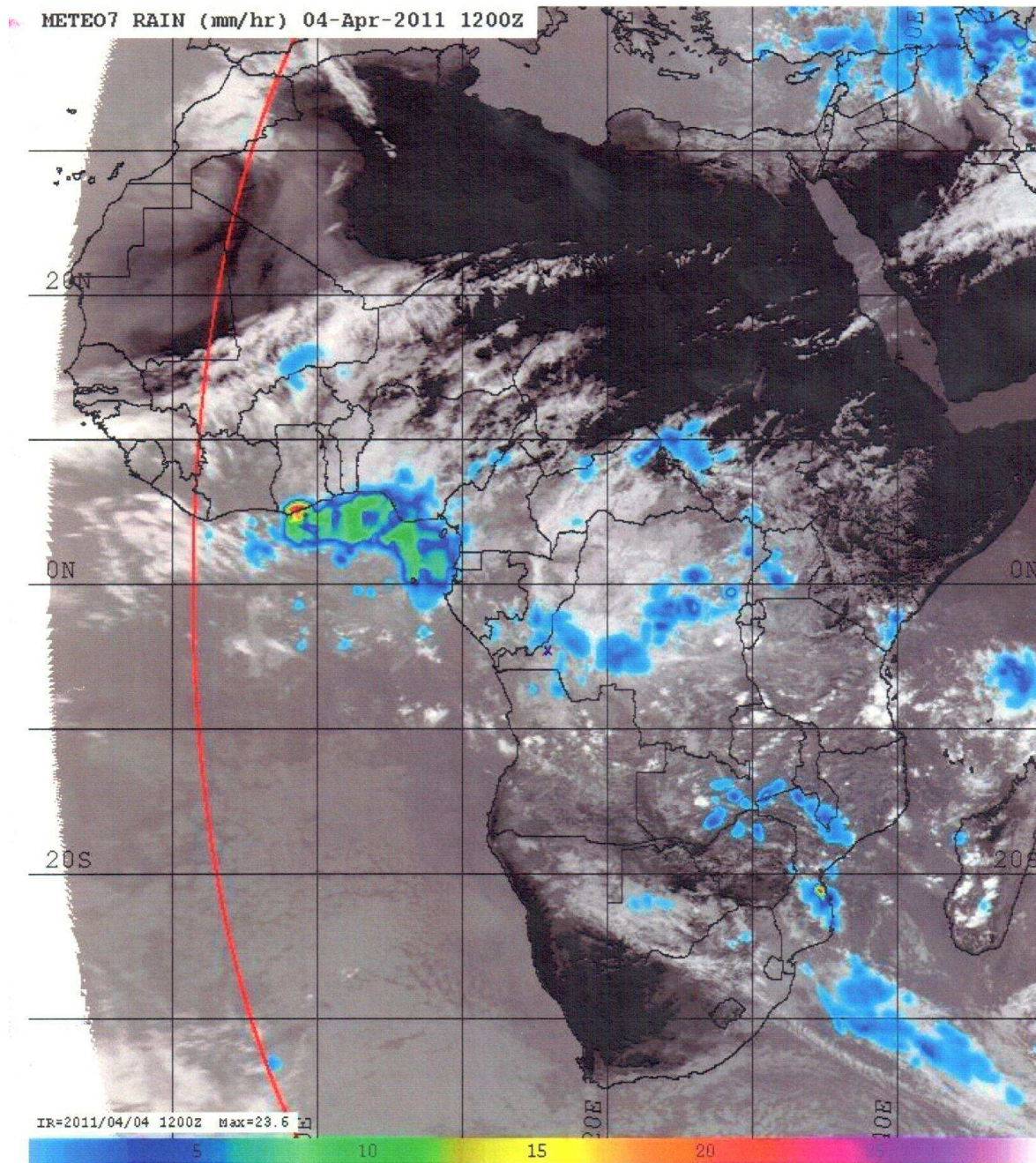
- The information gathered by the Team confirms the inadequacy of meteorological equipment and competence skills of the ATC staff in Kinshasa. MONUSCO has established separate Flight Following division at Kinshasa Airport to augment its air operations for the purpose of mitigation of the effects of such deficiencies. Since the flight was operated under the contract with UN the FF was involved in monitoring the flight, provision of the weather information as well obtaining decisions and advising the crew for landing and diversion. These functions were not performed.
- When observing the discrepancy in the weather information between received data and the indication on the radar, the crew several times called on MONUSCO FF to receive confirmed weather update. The Duty Officer was not available for contact. Extensive discussion amongst the crew, as per CVR, indicates that the crew was concerned and perplexed. Their decision was to get closer to make a final decision, since the weather mass was moving away from the airfield. It is not evident that the crew failed to take cognizance of « Thunderstorm over the station », since they were discussing this alert and discussed the way to avert/flythrough/in between the weather mass. As observed from the CVR, the crew made a decision to continue approach based on the visual of the runway and the clear path to it. In view of the discrepant weather information from ATC, onboard radar and the absence of the information from MONUSCO FF, in its

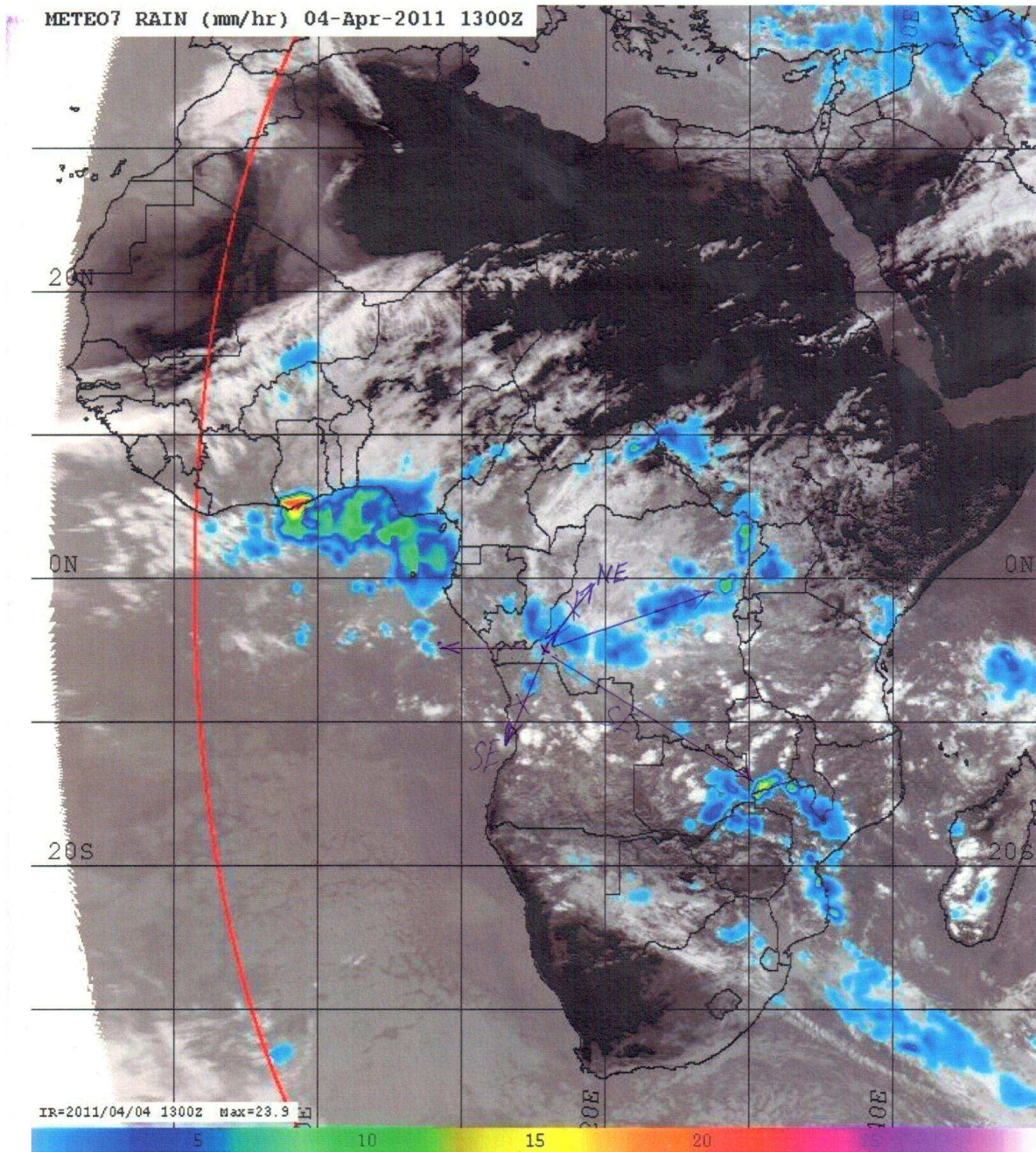
judgment the crew relied on the visual information, which indicated that runway was clear at 12 :54 :04. Under the circumstances this decision was appropriate.

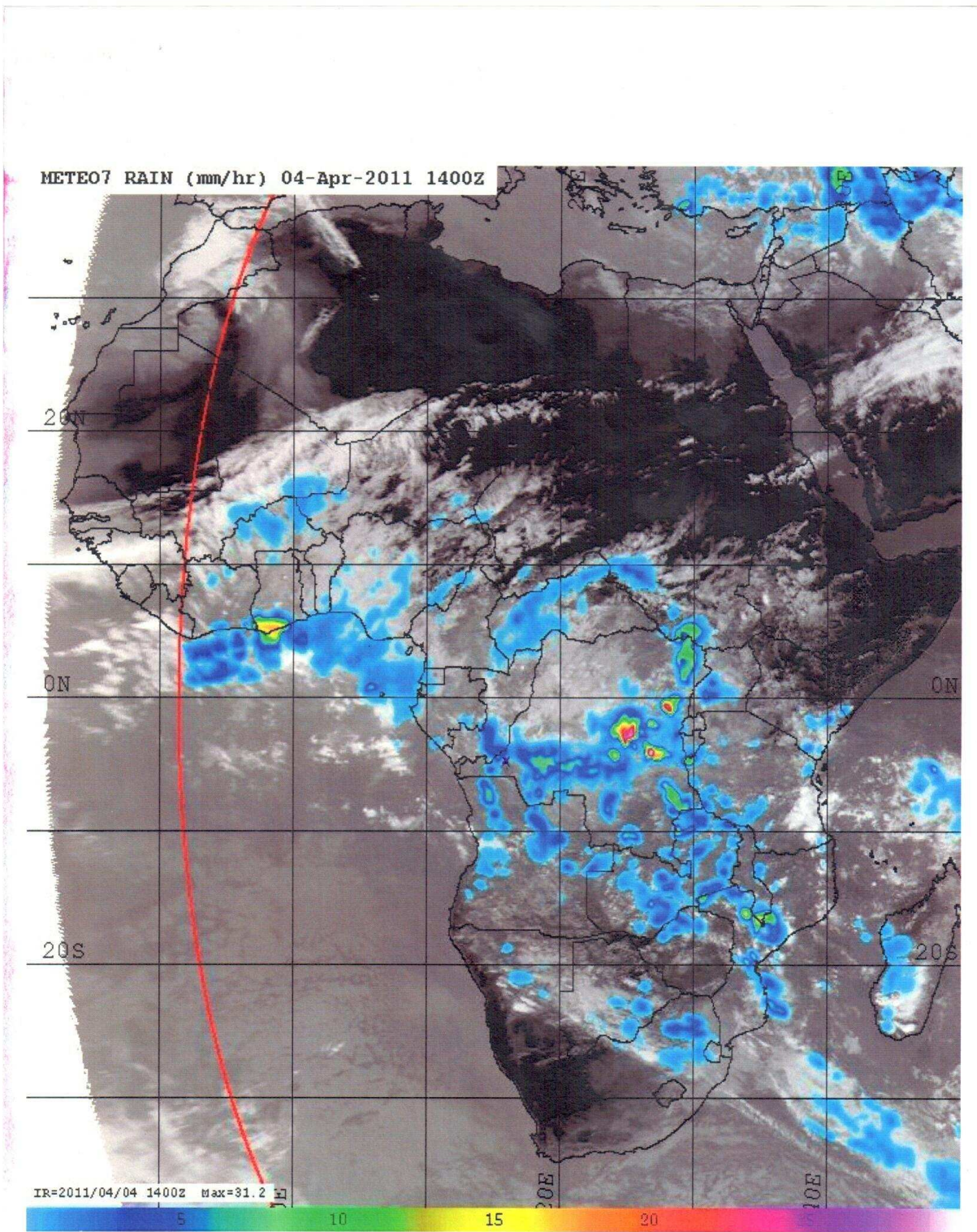
- Some non-adherence to procedures was caused by time limitations. The rest of the indicated deviations are addressed in my comments above.
- Non implementation of non-mandatory FOQA is not an evidence of the lack of effective oversight.
- Operator's Training Program is in conformity with ICAO standards, although its modification may provide a more robust training for the pilots dedicated for work in the areas with severe weather conditions and inadequate meteorological capabilities.

Proceeding from the above, we request to identify as the *principle* contributing factor for the accident **“The inappropriate decision of the crew to continue the approach, in face of extremely inclement weather being displayed on their weather radar; and based on inadequate and untimely ATC and MONUSCO Flight Following Service support, was probably the principle contributing factor responsible for the accident.”**











**METEOROLOGICAL OFFICE
KINSHASA, D.R.C.**

METAR AND SPECI REPORTS

DATE: 04 APRIL 2011

Kinshasa:

METAR AIR TERMINAL KINSHASA 041200Z VRB03KT 9999 SCT025 FEW030CB 33/24 Q1009 CB
@ N & E=

Kalemie:

METAR FZRF 041200Z 14005KT 9999 FEW020 FEW025CB 31/20 Q1012 CB@SE=

Kisangani – Bangboka:

SPECI FZIC 041215Z VRB03KT 4000 -RA BKN015 29/23 Q1011=

METAR FZIC 041200Z VRB03KT 9999 BKN015 30/23 Q1012=

Bunia:

METAR FZKA 041200Z 12012KT 9999 FEW015 FEW025 FEW120 SCT300 30/14 Q1014.6=

Bukavu:

METARFZMA 041200Z 24010KT 9999 FEW016 BKN060 18/15 Q1020=RERA

METARFZMA 041100Z 00000KT 4000 RA FEW008 OVC020 18/17 Q1024=

SPECIFZMA 041040Z 00000KT 4000 RA FEW008 OVC020 18/16 Q1024=

METARFZMA 041000Z VRB03KT 8000 FEW013 OVC023 18/14 Q1023=

Goma:

METAR FZNA 041200Z 19005KT 9999 SCT015 BKN080 22/17 Q1019=

Lubumbashi:

METAR FZQA 041200Z VRB03KT 9999 BKN015 FEW020CB 28/19 Q1014=CB@SE

Dungu:

METAR FZJC 041200Z 22007KT 9999 FEW018 FEW120 SCT300 33/18 Q1015=

SUNRISE AND SUNSET IN LOCAL TIMINGS

PLACE	FZAA	FZEA	FZIC	FZUA	FZRF	FZOA	FZKA	FZNA	FZMA	FZQA	HUEN
SUNRISE	06:00	05:47	06:19	06:33	06:06	06:18	05:59	06:04	06:06	06:14	06:51
SUNSET	18:04	17:54	18:26	18:35	18:11	18:22	18:07	18:09	18:11	18:13	18:57



METEOROLOGICAL OFFICE
KINSHASA, D.R.C.

METAR AND SPECI REPORTS

DATE: 04 APRIL 2011

Kinshasa:

METAR AIR TERMINAL KINSHASA 041300Z 13022KT 7000 TSRA BKN020 FEW025CB BKN100
28/21 Q1007 CB@N, E-S; LSA-1=

Kalemie:

METAR FZRF 041300Z 15010KT 9999 FEW020 FEW025CB 31/22 Q1011 CB@SE=

Kisangani – Bangboka:

SPECI FZIC 041215Z VRB03KT 4000 -RA BKN015 29/23 Q1011=

METAR FZIC 041200Z VRB03KT 9999 BKN015 30/23 Q1012=

Bunia:

METAR FZKA 041300Z 12014KT 9999 FEW015 FEW025 FEW120 SCT300 30/14 Q1013.0=

Bukavu:

METARFZMA 041200Z 24010KT 9999 FEW016 BKN060 18/15 Q1020=RERA

METARFZMA 041100Z 00000KT 4000 RA FEW008 OVC020 18/17 Q1024=

SPECIFZMA 041040Z 00000KT 4000 RA FEW008 OVC020 18/16 Q1024=

METARFZMA 041000Z VRB03KT 8000 FEW013 OVC023 18/14 Q1023=

Goma:

METAR FZNA 041300Z 16006KT 9999 SCT020 BKN080 22/16 Q1017=

Lubumbashi:

METAR FZQA 041300Z 14005KT 9999 BKN020 FEW025CB 28/17 Q1013 CB@E-SE=

Dungu:

METAR FZJC 041300Z 23008KT 9999 SCT018 FEW120 SCT300 33/17 Q1013.2=

SUNRISE AND SUNSET IN LOCAL TIMINGS

PLACE	FZAA	FZEA	FZIC	FZUA	FZRF	FZOA	FZKA	FZNA	FZMA	FZQA	HUEN
SUNRISE	06:00	05:47	06:19	06:33	06:06	06:18	05:59	06:04	06:06	06:14	06:51
SUNSET	18:04	17:54	18:26	18:35	18:11	18:22	18:07	18:09	18:11	18:13	18:57



METEOROLOGICAL OFFICE
KINSHASA, D.R.C.

METAR AND SPECI REPORTS

DATE: 04 APRIL 2011

Kinshasa:

SPECI AIR TERMINAL KINSHASA 041325Z 32007KT 9000 SCT020 FEW025CB BKN100 25/22
Q1006 CB@N, RERA=

SPECI AIR TERMINAL KINSHASA 041310Z 13022KT 4000 TSRA BKN020 FEW025CB BKN100
28/21 Q1007 CB@ALL QDS=

METAR AIR TERMINAL KINSHASA 041300Z 13022KT 4000 TSRA BKN020 FEW025CB BKN100
28/21 Q1007 CB@ALL QDS=

Kalemie:

METAR FZRF 041300Z 15010KT 9999 FEW020 FEW025CB 31/22 Q1011 CB@SE=

Kisangani – Bangboka:

SPECI FZIC 041215Z VRB03KT 4000 -RA BKN015 29/23 Q1011=

METAR FZIC 041200Z VRB03KT 9999 BKN015 30/23 Q1012=

Bunia:

METAR FZKA 041300Z 12014KT 9999 FEW015 FEW025 FEW120 SCT300 30/14 Q1013.0=

Bukavu:

METARFZMA 041300Z 20005KT 9999 FEW016 BKN080 19/16 Q1019=

Goma:

METAR FZNA 041300Z 16006KT 9999 SCT020 BKN080 22/16 Q1017=

Lubumbashi:

METAR FZQA 041300Z 14005KT 9999 BKN020 FEW025CB 28/17 Q1013 CB@E-SE=

Dungu:

METAR FZJC 041300Z 23008KT 9999 SCT018 FEW120 SCT300 33/17 Q1013.2=

SUNRISE AND SUNSET IN LOCAL TIMINGS

PLACE	FZAA	FZEA	FZIC	FZUA	FZRF	FZOA	FZKA	FZNA	FZMA	FZQA	HUEN
SUNRISE	06:00	05:47	06:19	06:33	06:06	06:18	05:59	06:04	06:06	06:14	06:51
SUNSET	18:04	17:54	18:26	18:35	18:11	18:22	18:07	18:09	18:11	18:13	18:57

