

Mission Scientist Report
Mission Nos. 248-1, 2, 3, 4

MS: Pennell
AMS: Cox on US C-130

The mission selection team approved the following missions for this day:

Mission 248-1, Type 6B
Aircraft: RP-3A

This mission was dedicated to fulfilling objectives of the Oceanographic subprogram.

Mission #248-2, Squall line
Aircraft: Queen Air

Mission #248-3, 7B1 or albedo mapping
Aircraft: Sabreliner

Mission #248-4, Type 1A or 2,
Aircraft: UK C-130 (1-2 hr 6B add-on after other
aircraft leave pattern)

US C-130
L-188
IL-18M
IL-18C
CV-990

As an alternate for the 1A/2 mission the US C-130, UK C-130 and L-188 were to join for a 5B2 mission. At the end of the 5B2 mission, the UK C-130 was to remain and execute a 6C mission. The alternate for the CV-990 was a 7B2 + cloud photography. The alternate for the two IL-18's was a cloud physics mission.

Mission 248-4

Mission Plan

The plans for the primary, 5B2 alternate and the 6B add-on for the UK-130 are appended to this report. The alternates for the two IL-18's and the CV-990 were planned by the respective AMS for these missions. The initial point was chosen as 09°30'N and 22°30'W. The AMS was to arrive at the IP around 11:15 with all other aircraft in this mission arriving at noon. In response to a request from Dr. Borovikov, the IL-18C was placed above the IL-18M in the vertical stack for the primary mission. Since we were anticipating disturbed weather in the B-scale array, the Vize and Hecla balloons were requested to be below 60 m from 12-18Z in order to allow the aircraft to operate in the C-scale array under IFR conditions. At 1900Z (4 September) the MS and AMS contacted Dr. Garstang on the Dallas concerning the planned balloon status for the following day.

Garstang reported that all balloons would be in the profile mode - between the surface and 1000 meters and that Quadra would be at anchor.

Mission Execution

In reviewing the IR satellite photographs the morning of the mission, it was evident that the more or less continuous ITC of the previous day had broken up into a series of small clusters. In the 0700 IR there were 7 individual clusters in or near the B-scale array with one small cluster apparently in the C-scale array. The latter observation was confirmed both by the Quadra radar fax and the 0715 conversation with radar scientists Dr. Hudlow on the Oceanographer. Both ship radars showed active convection in the C-scale array and its immediate vicinity. Based on this information, the primary mission looked quite probably by briefing time. However, it was decided in the event of going to the alternate, the mission scientist and ATC would assist the IL-18's in setting up a suitable area for their work.

After the AMS was airborne, the MS continued to review the incoming satellite and radar data. Radar fax were received from the Quadra on schedule, and they showed that convective activity was definitely on the increase in the Quadra vicinity. Gillis and Oceanographer radar also reported very active convection across the middle of the B-scale array.

By 10:30 the information from the satellite and the radars showed that an L-shaped band of active convection existed across the B-scale array. East of the Quadra, the band made a turn toward the South and extended southward as far as the Oceanographer. Quadra and Oceanographer radar indicated that the eastern portion of this line - at the heel of the L - was the most active. The echo system was persistent and not moving appreciably.* The MS called the AMS, advised him of the situation and suggested a box pattern be flown with the SW corner of the box placed near the Quadra. At 11:55 the MS received the position of the pattern which was a 100 by 90 nautical mile box with the western and southern edges 15 nautical miles to the west and south of Quadra.

After the pattern was set, there were no further adjustments. The only further communications between the AMS and MS, which affected the mission execution, concerned the 6B add-on for the UK C-130. At about 14:20 Mr. Nicholls (MRF coordinator) talked to Prof. Woods on the ship Discovery. Woods said that conditions were good for the

* As the day progressed, this L-shaped pattern evolved into two active clusters - one located in the NE portion of the B-scale array (the one flown) and one in the NW portion of the array.

thermal mapping flight (6B). Nicholls worked out a flight plan which would take about 1 hour to execute. The MS then called the AMS and suggested that the UK C-130 carry out this mission since the UK-130 could commence the 6B after the other aircraft had finished the 1A pattern. This was done.

Conclusions

The mission was a definite success. Although Quadra radar indicated that maximum convective activity (as reflected in the intensity of the echoes and in cloud top heights) was reached at about 1100Z, the system remained very active for the entire time the aircraft were in the area. For example, Quadra reported intensity codes ranging from 4-5 and cloud tops ranging from 45,000' (12Z) to 35,000' (15Z) during the time span that research aircraft were in the area. This cluster was one of the most active of the experiment, one of the best organized systems, and certainly the most stationary.* This lack of movement enabled the aircraft to come closer to completely encompassing the area of intense convection than any mission thus far in GATE. The combined ship and aircraft data for this day should prove to be an interesting set indeed.

Mission 248-2

Mission Plan

The mission plan is outlined in the appended briefing sheet. The original plan was to have the Queen Air and Electra intercompare after takeoff. After intercomparison the Queen Air was to do a synoptic cross-section to the east at 500' out and 10,000' back. If an interesting feature were encountered, such as a squall line, the flight track would be modified in order to work this feature.

Mission Execution

The execution of this mission was hampered both by delays in the printing of the morning satellite pictures and by problems with the Queen Air INS. The morning satellite products were, at times, 1½ hours old before they were received by the MS. This meant that the Queen Air scientist had to leave for the originally scheduled 10:30 take-off before the 0900 2-mile picture was available. The INS problems resulted in the mission first being delayed and finally being aborted.

* It is interesting to note that for all its apparent organization, the system was definitely on its way down by 15Z. By 18Z the 2-mile satellite photograph showed that the cluster was dead. There was no evidence of its existence in the next day's photographs.

The initial take-off was delayed when the INS system failed to align properly. At that time it appeared that the mission would be cancelled and the aircraft scientist returned to the GOCC. After the aircraft scientist had left, the platform was successfully aligned and the aircraft was taken up for a test flight. The platform appeared to be working and the aircraft scientist was called back to the aircraft to continue the mission as planned. In the meantime, the MS had seen the 1000 2-mile satellite photograph. This picture showed an apparently westward moving squall line having its leading edge at about 15°N , 13°W . This information was relayed to the Queen Air pilot since the MS was unable to find the Queen Air aircraft scientist. It was not until the 12Z 2-mile photograph that it became clear that the squall line was propagating more to the SW and that the edge along 15°N was not as active. However, by the time this information was received it was 1330 and too late to affect the mission.

The Queen Air successfully penetrated the weak western edge of the system along 15°N . However, the INS failed again shortly after penetration and only rough wind information (using DME) was obtained on the 10,000' return leg.

Conclusions

This mission can only be considered a partial success due to the failure to obtain the 10,000' cross section. However, the low level data should prove interesting since this flight represents the first aircraft cross section through any type of West African squall line. Finally, since the flight track began over the ocean, some interesting data on the sea-land transition at low levels were also garnered.

De-briefing Comments from Aircraft Scientists

Mission 248-4

IL-18C: Borovikov said that they did not penetrate any Cb's. Melnichuck observed convective code 5 but no heavy precipitation or severe turbulence. The aircraft encountered severe icing.

IL-18M: Aircraft flew $A_1 - A_2 - A_3 - A_4 - A_1 - A_2$. Encountered hail which destroyed the albedometer.³ Generally moderate turbulence. Encountered the greatest turbulence (0.2 -.3G) in freezing rain at 1201Z (just before reading A_1 on the initial box). Aircraft was always in cloud. Data for winds recorded every 2 minutes.

CV-990: Flew the box twice at 35K and once at 39. Flew $\frac{1}{4}$ of a fourth box (A_1-A_2) before leaving for Dakar. Never above cloud tops. Encountered moderate turbulence along A_2-A_3 each time the area was traversed (3 times). In Ci almost all of the time. However, at A_3 the aircraft broke into the clear and was underneath an anvil. At A_3 it was clear to the West. Light turbulence at 39,000'. Along A_2-A_3 winds were E to NE at 10-15 kts with some winds to 28kt. In the other regions the winds were low and from the W and S.

L-188: Definitely not a decaying system. Generally light NE winds in the western part of the box (A_3-A_4). Strong WSW winds in the southern part of the pattern. The greatest convergence was in the southern part of the pattern but it seemed to be moving northward. Along A_1-A_2 and A_4-A_1 winds were light and variable. Significant vertical shear both in speed and direction between the surface and flight level (1500'). It was not uncommon for the surface wind speed to exceed that at flight level. 25 kt winds at the surface in the southern part of the pattern.

US C-130: (AMS) At 5000' and below there should be strong convergence. Pattern placement was based on Quadra radar. Up to 20 kt easterly winds around A_1 on the first circuit. Up to 20 kt easterlies around A_2 on the second circuit. 17 kt westerlies near A_3 . Northerly winds along A_4-A_1 . It was not particularly turbulent.

UK C-130: This was a very good system. There definitely was strong convergence at 500 ft. System appeared better organized and more compact on the 2nd pass. On the second circuit each of the four corners was in the clear. Spiral bands were observed on the aircraft radar. The aircraft scientist observed that he had never seen more impressive echoes from an aircraft radar. This was the best system yet. The aircraft scientist was amazed to learn that the system appeared to be dying on the late afternoon satellite photographs.

Note: The MS thinks that the comments of the aircraft scientists on the lower level aircraft are particularly interesting in the light of how rapidly the system collapsed in the later part of the day.

Mission 248-2

Queen Air: Section was obtained through the N portion of the squall line. They were N of the main portion of activity but this was not obvious until they had penetrated the system. Good wind data until 1329 to 1341 (did not observe exact time that the INS failed). Using DME they computed 50 kt easterly winds at 10,000'. On the low level crossing of the coast line strong gradients were observed.

Mission Scientist's Log

- 0715 - Conversation with Hudlow. Informed him that AMS would be contacting him 11:15-11:30 for latest information. No fax from Oceanographer. Their transmitter is out with no chance of fixing without air drop of parts. Hudlow sees echoes to E, N, and W. Major systems to the NW and NE, level 5, tops to 35K. These two systems appear to have merged. At this time echoes are persistent and moving to the SW at 5kt.
- 0900 - Queen Air and Sabreliner Briefing - After intercomparison with the Electra, Queen Air does synoptic cross section at 500' out 10,000' back as shown in the scientific flight plan. If an interesting situation i.e. squall line, arises along the track the flight would be modified in order to work this feature. If pattern intersects an intense squall line the flight plan would be modified to a box at 500' or 1000' and 10,000'. Sabreliner: albedo survey in Casamance or 7B1 in lima area.
- 0920 - P3 called Duncan Ross for coordinates of ART grid. Ross could not be found. Finally found Ross at 9:27. Recommend that Oceanographer representative always be present to set P3 coordinates. Location of ART grid (SST map) $08^{\circ}46'N$ $23^{\circ}20'W$.
- 1000 - 0900 radar description from Gillis and Oceanographer. Will get further radar information from Oceanographer at 10:15.
- 1020 - Queen Air aborts due to INS failure.
- 1025 - Verbal radar description from Oceanographer. 2 significant features in last (0700) code. EW line to N of Oceanographer and long broken set of echoes to NE. West portion of line has decreased in intensity. East end of line has merged with blob and is intensifying. Most intense activity falls to east of C-scale. West end of line has decreased in activity. No significant movement. Echo intensity is up.
- 1030 - Message to Cox:
1. Gillis radar indicates an intense line of echoes WNW to ESE right over their position. Cores 50 db.
 2. 0900 satellite agrees with Gillis and Quadra radar. EW line of echoes across Quadra intersects the WNW to ESE line from Gillis.
 3. 1025 - Oceanographer: 2 significant echo features: EW line through C-array and blob to the East. Hudlow says that the western portion of the line is decreasing in activity. This is portion in C-scale array. No significant movement of echo pattern.

4. 0930 satellite generally agrees with Hudlow description. Quadra also says that most intense activity to the East. Suggest a box to the east of the C-scale array with SW corner anchored near the Quadra.

- 1100 - Message on Quadra fax: Hecla balloon below 60 m from 1200-1800Z. Meteor FLOP 600 m Quadra unchanged.
- 1105 - GATE control called and said there was a conflict between P3 mission and 1A. P3 had to be moved out of the C-scale array in order to allow 1A to be flown. Aircraft scientist on P3 requested advice from Ross as to where he should go. Ross was in Dakar shopping. When P3 missions are flown there must be an Oceanographic assistant MS on duty all the time that the P3 mission is being flown. I could give no recommendations except for P3 to get out of the C-scale array.
- 1110 - After a test hop the Queen Air determined that INS was O. K. and decided to fly mission. Relayed message to aircraft scientist through pilot. Squall line east of Dakar, leading edge according to 1000 2-mi satellite 15°N 13°W .
- 1125 - Queen Air called and said that they were off at 11:22.
- 1155 - Received Cox's Box:
- | | | |
|----------------|-------|-------|
| A ₁ | 0944N | 2120W |
| A ₂ | 0816N | 2120W |
| A ₃ | 0816N | 2300W |
| A ₄ | 0944N | 2300W |
- 1206 - Queen Air says they are going to work 15°N , 14°W at 1305, i.e. squall line.
- 1405 - AMS called. 41C had completed 1st box. Cox reported NE winds in NE corner of box and SW winds in SW corner. Cox reports definite circulation.
- 1420 - 306D lost INS and had to abort.
- 1425 - Nicholls talked with Woods on Discovery about mapping mission. Woods said VFR conditions and he requested UK-130 to do some mapping in his area. Nicholls worked out the pattern. Would require 1 hr.
- 1440 - Passed SST mapping pattern to Cox. Suggested that pattern could be flown since 130 could leave and do mission after other aircraft had finished 1A.
- 1525 - Was informed that MTB would do 1 hr oceanography.