



International Civil Aviation Organization

**Third Meeting of the Asia/Pacific Regional Search and Rescue Task Force
(APSAR/TF/3)**

Maldives, 25 – 29 January 2015

Agenda Item 4: Asia/Pacific and inter-regional SAR planning, coordination and cooperation

MH370 SEARCH AND RESCUE OPERATIONS AND LESSON LEARNT

(Presented by Malaysia)

SUMMARY

This paper presents an overview of the chain of events of the Kuala Lumpur Aeronautical Rescue Coordination Centre in response to the SAR operations for Malaysia Airlines Flight MH370

1. INTRODUCTION

1.1 On 8th March 2014, MH370 a Boeing 777-200, aircraft registration 9M-MRO departed from KLIA at 00:41am Local Time (LT) 1641 UTC en-route from Kuala Lumpur, Malaysia to Beijing, China with 239 persons-on-board. At time 01.19 am LT (1719 UTC), MH370 was transferred by Kuala Lumpur Air Traffic Control Centre (KL ATCC) to Ho Chi Minh Air Traffic Control Centre (HCM ATCC) at the transfer point IGARI (85 nautical miles North East of position ‘VKB’) in accordance with normal Air Traffic Control procedures. The pilot acknowledged the transmission. This was the last contact with KL ATCC.

1.2 At approximately 5 nautical miles East of IGARI, the radar label started to ‘coast’ i.e. began to fade and eventually dropped from the KL ATCC radar screen. Based on queries from HCM ATCC, subsequent attempts to establish communication with MH370 were futile and failure to obtain a position report from various sources resulted in the Kuala Lumpur Aeronautical Rescue Coordination Centre (KL ARCC) being activated at 05.30am LT (2130 UTC).

2. DISCUSSION

MH370 Information

2.1 Significant information (all times in UTC)

AIRCRAFT IN DISTRESS	MAS 370 / B772 / 9MMRO / Black Box (37.5Khz)	
HEX ID	Fix	CDA439E7AA35CD1
	Portable	CDA439E7AA35DD1
NATURE OF EMERGENCY	Aircraft Missing	
PILOT’S INTENTION	Not Reported	
LAST REPORTED POSITION	Estimate for position IGARI given to HCM ATCC	1722 UTC
	Transfer of Communication to HCM	1719 UTC
	Actual time of crossing position IGARI	1720 UTC

	Target Coasting (5 NM East of IGARI)	1721 UTC (LKP)
	Target dropped from KL ATCC radar	1722UTC
AIRCRAFT FLIGHT PLAN	DCT PIBOS R208 IKUKO R208 IGARI M765 BITOD L637 TSN W1 BMT W12 PCA G221 BUNTA A1 IKELA P901 IDOSI DCT CH DCT BEKOL A461 YIN A461 VYK	
POINT OF DEP / ATD	WMKK / 1641 UTC	
DESTINATION / ETA	ZBAA / 2215 UTC	
ALTERNATE AERODROME	ZBTJ / ZBSJ	
OPERATOR / OWNER	MALAYSIA AIRLINES	
POB / QBD	239 / 0710 HRS	
COLOUR	WHITE WITH RED AND BLUE STRIPE	
REMARKS	<ul style="list-style-type: none"> • No radio notification of flight problem from the crew • No radio communication from crew after 1719 • No ELT transmissions received 	

Note: LKP – Last Known Position

SAR Action by KL ARCC

2.2 KL ARCC action was based on International Aeronautical and Maritime Search and Rescue Manual which are divided into 5 stages:

a) AWARENESS

2.3 Action taken until this stage was carried out by the Watch Manager, KL ATCC based on the standard operating procedures, which are:

01:38 am	HCM ATCC enquired about MH 370, informed KL ATCC that radar target last seen at BITOD. [a waypoint after IGARI inside HCM FIR]. KL ATCC proceeded with communication check without any success.
02:15 am	Queried Malaysia Airlines (MAS) and was informed that based on MAS flight tracker, the aircraft was in Cambodian airspace. This information was relayed to HCM ATCC. HCM ATCC advised that still no communication with MH370.
02:19 am	KL ATCC queried if HCM ATCC was taking Radio Failure action
03:30 am	MAS informed that the flight tracker was not an accurate tracking tool but based on flight trajectory projection.
03:30 am - 05:30 am	Further coordination efforts were made to locate aircraft with Ho Chi Minh and Singapore ATCCs with no success.

2.4 The KL ARCC was activated at 5:30 am (2130 UTC) by Air Traffic Controllers who are SAR trained and rostered in every shift.

2.5 Delay in the activation of the KL ARCC was partially contributed to conflicting reports received from Malaysia Airlines, that the aircraft was still flying based on their flight tracking system and reports on the media indicating that MH370 had landed safely in Nanning airport in China. Upon further queries and investigation, these reports were found to be baseless and inaccurate. Precious time was wasted pursuing these unfounded reports.

b) INITIAL ACTION

2.6 Upon activation of the KL ARCC by the SAR trained personnel, awaiting a full complement of staff, to commence complete SAR operations, the following actions are taken:

- i. Sent notification to all relevant SAR agencies on MH370 by fax and phone calls;
- ii. Requested from SAR agencies, for assets available that could be deployed to the search area;
- iii. Requested a RADAR plot from KL ATCC maintenance unit, to verify the last known position of MH370 in order to establish the initial search area;
- iv. Requested weather data from the Malaysian Metrological Department for search planning and tasking;
- v. Informed Ho Chi Minh on the activation of KL ARCC and verifying with them on their actions as the last known position of MH370 was in their territory;
- vi. Advised Singapore RCC and updated them on the situation, since the area of search is within Singapore's FIR boundary.

c) PLANNING

2.7 Based on the last observed radar position, which was North East of position IGARI, the initial search area was determined. HCM RCC was advised of their responsibility on the provision of SAR in accordance of Annex 12. While waiting for the next course of action by HCM RCC, KL ARCC proceeded with the initial search planning.

2.8 Initial SITREP (Situation Report) and Search and Rescue Unit Briefing was prepared and sent out to the relevant SAR agencies. NOTAM (Notice to Airman) of the Search Area was sent out to notify all concerned.

2.9 The search area was revised on a daily basis, based on the number of asset available, taking into consideration of sea current conditions.

d) OPERATION

2.10 The MH370 SAR operations managed by the KL ARCC can be divided into 2 Phases which are as follows:

- i. 1st Phase : Within the Eastern and Western KL SRR; *refer Figure I & II*
- ii. 2nd Phase : Within the Northern and Southern Corridors; *refer Figure III & IV*

2.11 The initial search and rescue operations concentrated on the Eastern side of Peninsular Malaysia, surrounding the last known position of MH370. Consideration was also given, should the aircraft be able to proceed to its destination or to any other airport based on various possible scenarios. All possible search patterns were calculated and carried out including Track Crawl, along the route of MH370 to its last known position.

2.12 Information was also passed to Oil Rig Operators based in the Kota Bharu, Terengganu and Kerteh, on the East coast of Peninsular Malaysia for any possible sighting or reports. This information was also given to helicopters that operate in and out to the oil rig area.

2.13 Information was also passed to the Malaysian Control Centre (MCC) for possible reports to police stations (SAR point of contact) throughout the country. The first air SRU to be deployed was RESCUE 101, a Bombardier CL415 from the Malaysian Maritime Enforcement Agency (MMEA). A vessel, KM AMANAH also from the MMEA, was redirected to the Last Known Position (LKP) of MH370 to conduct a search.

2.14 The KL ARCC was informed by the Royal Malaysian Air Force (RMAF) of a possible Air Turn Back by MH370 on 8 March 2014, at 10:30pm (1430 UTC). The RMAF also mentioned that the area towards the West of Peninsular Malaysia was the last known position observed on the military radar. At this stage, the KL ARCC was unable to determine whether MH370 did indeed make an air turn back, and it required further analysis and verification. Despite the uncertainties surrounding the ‘latest’ information received, it was decided that both areas to the East and West of Peninsular Malaysia would be searched, and a large number of assets, aircraft and vessels were deployed to search these areas.

2.15 On 15th March 2014, based on data compiled by the Joint Investigation Team (JIT) based in Malaysia comprising experts and specialist from Malaysia, China, USA, UK and France, and other senior government and academic sources, the Prime Minister of Malaysia announced that the SAR operations on the Eastern and Western parts of Peninsular Malaysia would be suspended. The experts had drawn up a new search area, comprising the Northern and Southern Corridors.

2.16 All relevant agencies and the countries identified along the Northern and Southern corridors were informed. Diplomatic Notes were sent through the Ministry of Foreign Affairs, Malaysia (MOFA) to all the relevant countries within the corridors on a government to government basis. The KL ARCC remained opened to facilitate coordination between all agencies while awaiting new leads.

2.17 Action taken by the KL ARCC during this period was as follows:

- a) Establish communication with the relevant SAR authorities in the respective countries and provide the necessary information on MH370.
- b) Request updates from countries along both the corridors and their next course of action, SAR plan and assets to be deployed in the operation as per Annex 12 requirements.
- c) Provide updates to relevant agencies and the Next of Kin (NOK) on a daily basis.

2.18 Feedback received from the Diplomatic Note sent to Northern and Southern Corridor countries were as follows:

- a) Northern Corridor Countries - Countries in the Northern corridor provided information to KL ARCC on their action taken. However most of the countries in the Northern corridor responded that there was no sighting of MH370 within their countries area of responsibility.
- b) Southern Corridor Countries - Indonesia requested KL ARCC to provide more details from the International Investigators before they could proceed with any SAR operations within their country. A liaison officer from BASARNAS, Indonesia was attached to KL ARCC to assist with the coordination. Australia will conduct SAR operation with their Search and Rescue Region (SRR).

2.19 KL ARCC continued with the air search planning for areas within a portion of the Southern corridor (S1, S2 & S3) which are reachable by the air SRU’s based in Malaysia. Japan, India, Korea, the US Navy and the UAE participated in these search efforts. *Refer to Figure V.*

2.20 The Australian RCC refined their search areas (S5 & S6) based on their intelligence. China, Japan, Korea, US Navy, New Zealand and Malaysia redeployed their assets to Perth and continued the SAR operations there, with Australia’s Australian Maritime Safety Authority (AMSA) taking the lead role in planning the SAR operations.

2.21 The KL ARCC remained open and provided AMSA with updates and the latest relevant information to enable AMSA to continue with the SAR operation. This information included Satellite Images from France, China, Thailand and the Malaysian Remote Sensing Agency. A liaison officer from AMSA was also attached to the KL ARCC to assist in the coordination process.

2.22 On 24th March 2014, the JIT refined the search area towards areas S4 & S5. The Prime Minister of Malaysia then announced during a Press Conference that MH370 ended in the Indian Ocean within the Southern corridor. With this announcement, SAR operations within the Northern Corridor were suspended.

Search Effort and Results

2.23 For the eight days, from 8th to 15th March 2014, Phase 1 coordinated by KL ARCC and the RMAF were:

- a) Eastern Peninsular Malaysia
 - i. SAR Plan by KL ARCC
 - ii. Search area covered Eastern South China Sea
 - iii. Cumulative search area of 573,000 sq km
 - iv. 28 search aircraft used, from China, Japan, Malaysia, Singapore, Thailand, USA and Vietnam.
 - v. 34 search vessels used from China, Malaysia, Singapore, USA and Vietnam.
- b) Western Peninsular Malaysia
 - i. SAR Plan by RMAF
 - ii. Search area covered the Straits of Malacca, Andaman Sea and the Bay of Bengal, West of Sumatra
 - iii. Cumulative search area of 4.56 million sq km
 - iv. 36 search aircraft used from Australia, Bangladesh, China, India, Indonesia, Malaysia, New Zealand, Republic of Korea, Singapore, Thailand, UAE and USA.
 - v. 35 search vessels used from Bangladesh, China, India, Indonesia, Malaysia, Thailand and USA.

2.24 For the subsequent six days, from 18th to 23rd March 2014, the air search within the Southern Corridor (S1, S2 & S3) was coordinated by KL ARCC together with BASARNAS, Indonesia were:

- i. Joint SAR Plan by Indonesia and Malaysia
- ii. Cumulative search area of 1.63 million sq km
- iii. 8 search aircraft used, from India, Japan, Malaysia, UAE, USA and Republic of Korea

Challenges of the SAR Operation & Lesson Learnt

2.25 Challenges faced by the KL ARCC during the MH370 SAR Operation were:

- a) Due to the complexity of the MH370 event, compounded with the absence of conventional data, such as aircraft last known position, altitude, speed, actual flight route to determine the correct datum, hindered the effectiveness of the SAR operations.
- b) Absence of distress beacon detections.
- c) The unavailability of updated regional maps outside KL FIR and facilities hampered the SAR operation. KL ARCC had to resort to using Google Earth for maps as a solution to it. Unavailability of Search Planning software and specific equipment restricted the RCC in providing a complete and comprehensive tasking order.

- d) The insufficient number of adequately dedicated SAR personnel at the KL ARCC hampered the rostering of SAR personnel in the RCC over a prolonged period of time as all SAR personnel are air traffic controller rostered for operational duties at KL ATCC. At the same time, many SAR trained officers were also assigned tasks at various locations either at the main operations room located in hotels in the city, and briefing the Next of Kin.
- e) The verification of the military radar data took longer than expected and this resulted in the KL ARCC initially conducting the search in the Eastern and Western areas of Peninsular Malaysia.
- f) The outdated directory of SPOC within the Asia Pacific region as stated in ICAO documents delayed the transfer of information between the respective RCC's.
- g) Incomplete detailed information made available to the KL ARCC on how certain search area was derived hampered fast action by other States, as they are acquiring this information to do their SAR operation.
- h) The participation of numerous military organizations during the search in KL SRR and within neighboring States SRR required continuous detailed briefings to be given. This turned out to be a daunting task. The availability of a Liaison Officer from BASARNAS and AMSA at the KL ARCC ensured smoother coordination of the SAR operation.

SAR System Improvements

- 2.26 To extend the transmission life of Underwater Locator Beacons installed in flight recorders on all commercial aircraft.
- 2.27 Closer civil/military airspace coordination and communication.
- 2.28 Clear defined division of responsibilities between the search and rescue functions (Annex 12) and the air accident investigation search and recovery functions (Annex 13).
- 2.29 Establish a legal framework to support the roles and responsibilities in handling various SAR missions.

Appreciation Note

- 2.30 Malaysia would like to take this opportunity to express our gratitude and thanks to all the States that had provided us with assistance and cooperation during the search for MH370.

3. ACTION BY THE MEETING

- 3.1 The meeting is invited to:
 - a) Note the information contained in this paper; and
 - b) Discuss any relevant matters as appropriate.

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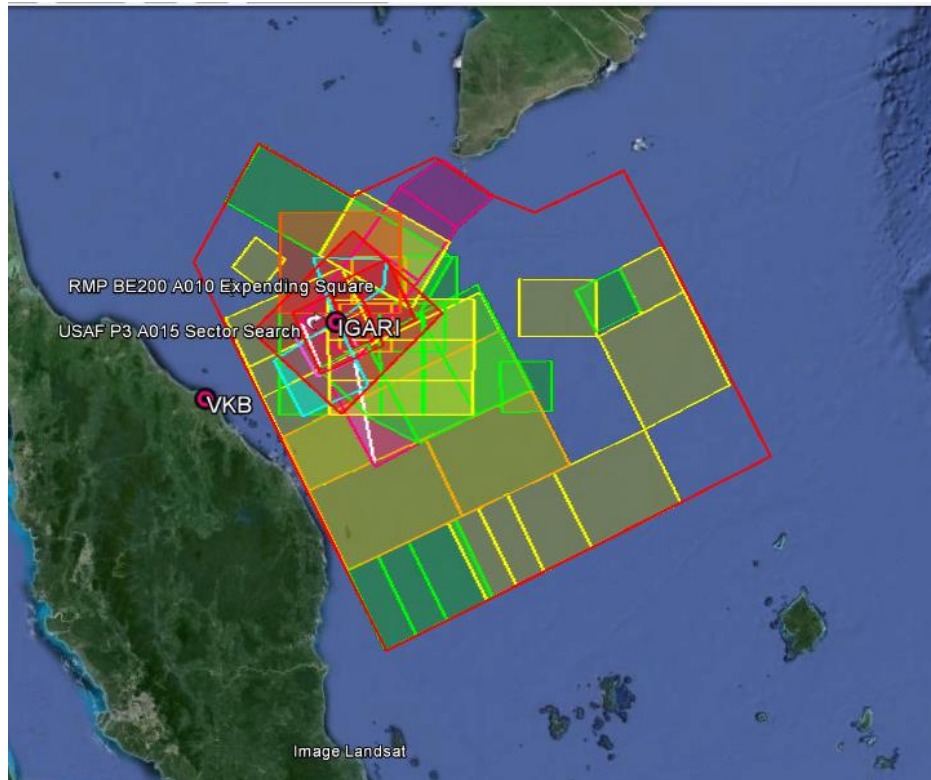


Figure 1: Eastern Search Area

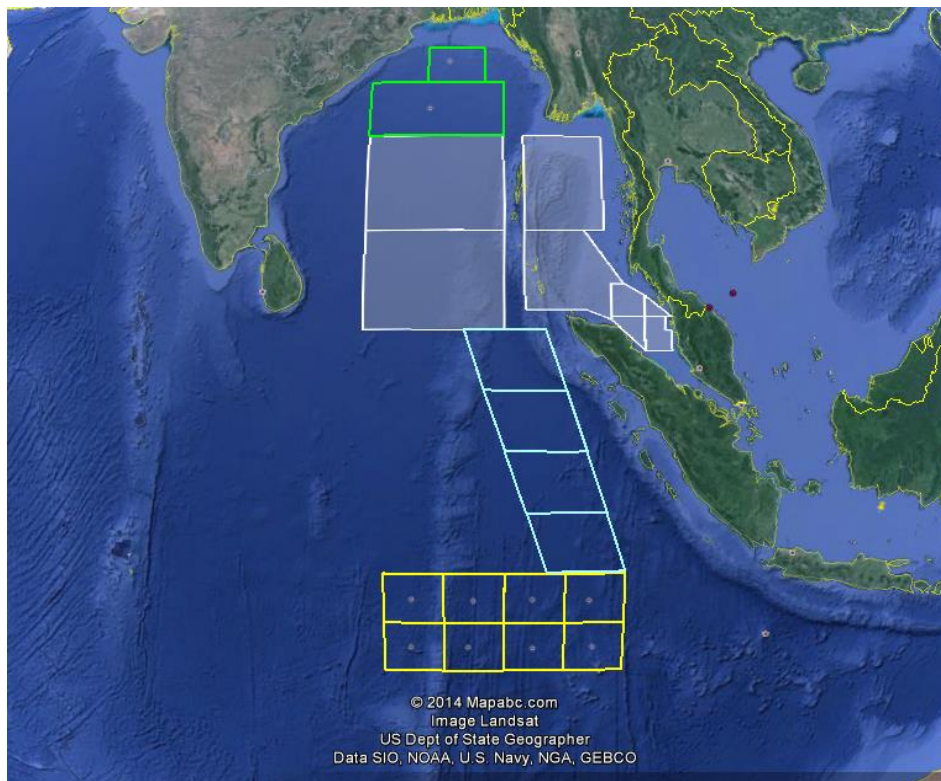


Figure II : Western Search Area

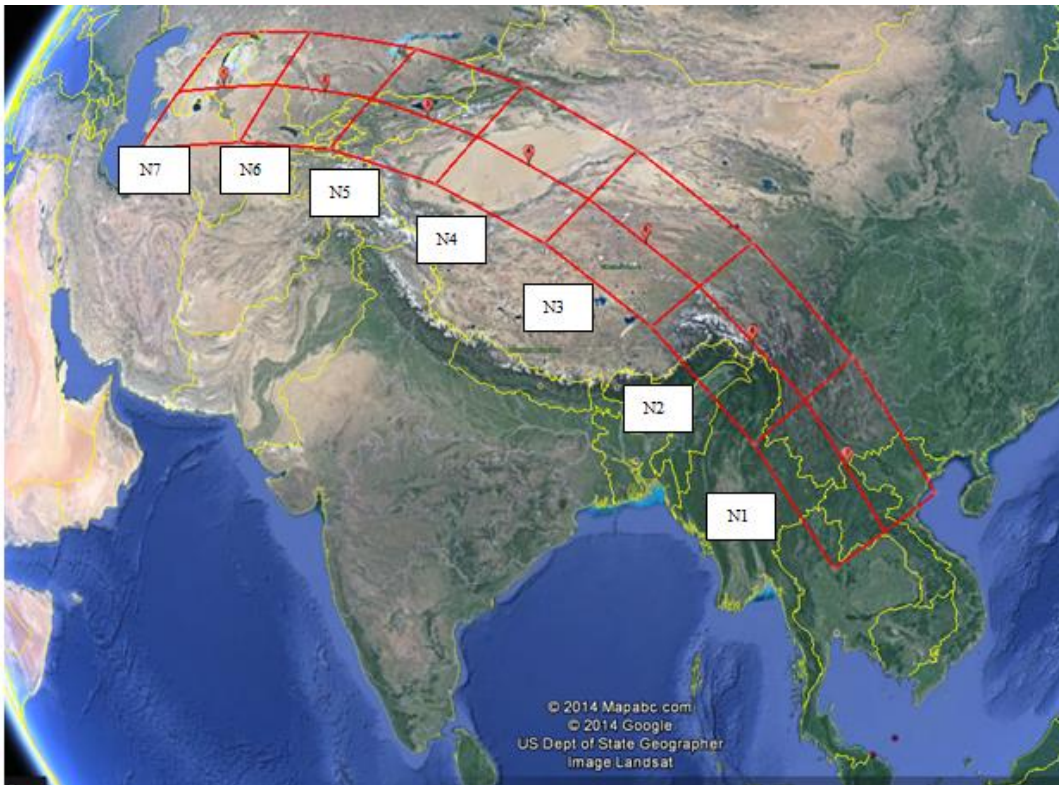


Figure III : Northern Corridor

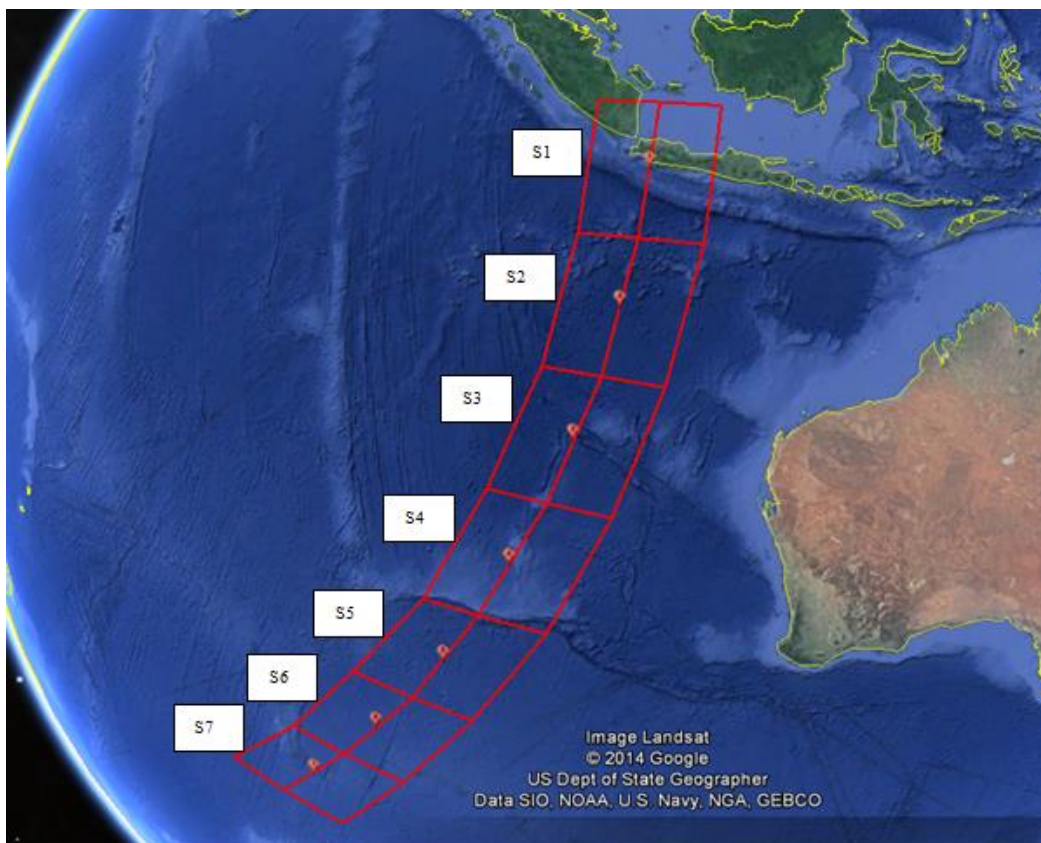


Figure IV: Southern Corridor

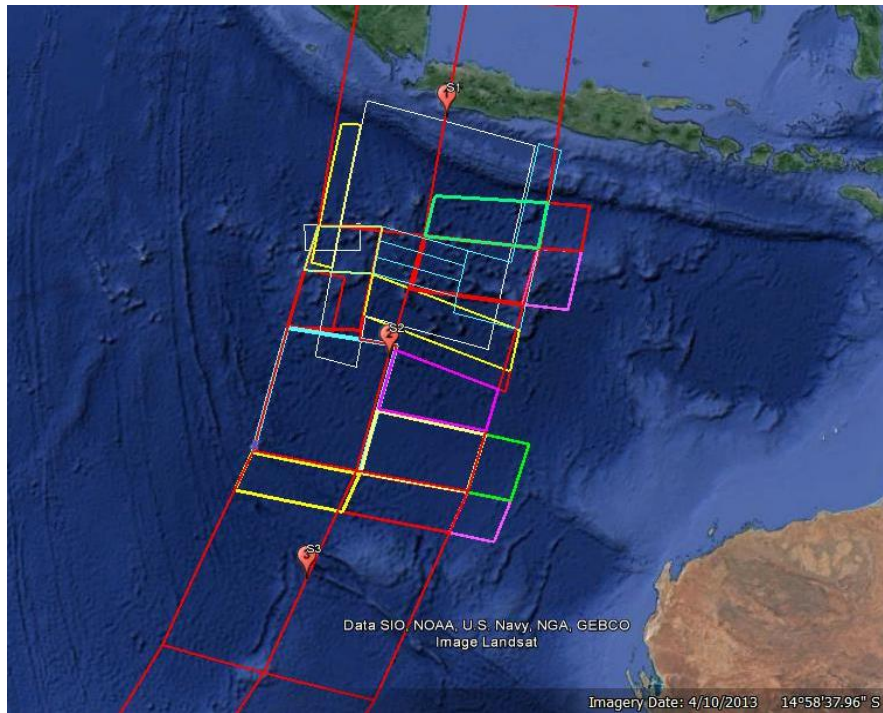


Figure V : S1, S2 & S3 Search Area