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DETERMINING THE LOCATION OF MALAYSIA AIRLINES FLIGHT MH370

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Abstract. Malaysia Airlines Flight 370, which was flying from Kuala Lumpur, Malaysia, to Beijing, China, lost communication with air traffic control shortly after take-off on March 8, 2014, and vanished. While the rest of the world awaited news of the missing plane and the 239 people on board, officials and experts began to look into the limited information available concerning the airliner's real activities. The disappearance of a Malaysia Airline flight, carrying 239 passengers and crew, is one of the world's biggest aviation mysteries. Despite all the efforts and evidence obtained so far, the crash site of Malaysia Airlines Flight MH370 could not be determined exactly. In this study, which we have done, the crash zone of the aircraft has been determined approximately by using the data in the previously prepared reports. In addition, the average ocean current speeds, directions and the parts of the debris of the aircraft were investigated on the satellite images, and the estimation of the area where the plane crashed was tried to be strengthened.

Keywords: location, debris, MH370 flight, safety, plane crash, wreckage.

Introduction

On March 8, 2014, Malaysia Airlines Flight 370 (MH370) went missing while flying from Kuala Lumpur to Beijing, carrying 12 Malaysian crew members and 227 passengers. Many publications have been made regarding the location of the aircraft (MH370) crash site (Griffin et al., 2016; Cha, 2014; Chen et al., 2015; Ashton et al., 2015; Ulich et al., 2020). In these papers, the desired results (the location of the place where the plane crashed) could not be achieved. In our study, we tried to determine the crash site of Malaysia Airlines Flight MH370 aircraft, taking into account the data and evaluations obtained from previous studies.

1. Materials and methods

Data, maps and evaluations of previously prepared reports were used in this study. Calculating the exact location of the crash site seems quite difficult by using the available data. Especially the fuel in the tank of the aircraft (MH370) and the amount of fuel used, satellite images and maps of the debris pieces formed in the region after the crash were investigated. In addition, data on the average current speeds of the area where the plane crashed in the Indian Ocean was obtained and an estimation was made about the location of the plane crashed.

2. Results

Figure 1 shows the route, speed, UTC times and distance of MH370 after taking off from Kuala Lumpur airport in Malaysia (NBC, 2018). It is understood that after a certain time (approximately 100 minutes) the plane took off, its route changed. Communication with the aircraft was finally achieved at 17:06:43 LT (01:06:43 UTC Time) local time. As a result of this interrupted communication, satellite data (Inmarsat-3 F1), satellite images and WSPRS system were investigated. Using WSPR and satellite data, the approximate route of the aircraft (MH370) is shown as in Figure 2 (NZHerald, 2021; Godfrey, 2020).

In previous studies and prepared reports Malaysian Government (2014), Australian Government (2015, 2017), Ulich et al. (2020), Kwek (2018), the route of the aircraft (MH370) was given by both satellite and WSPR starting from the second arc to the seventh arc as in Figure 2. UTC time, ground speed, fuel values, wind speed and directions in each arc are indicated. As a result of the calculations made using these data, it has been computed that the total distance traveled is approximately between 4460 and 5125 km (depending on the fuel usage situation, Figure 4). In addition, the vertical profile of the plane's route is drawn alongside the horizontal profile and the height (altitude) values are shown in Figure 3 (Cenciotti, 2014).

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Figure 1. Route of the aircraft (MH370) after take-off from Kuala Lumpur Airport (NBC, 2018)

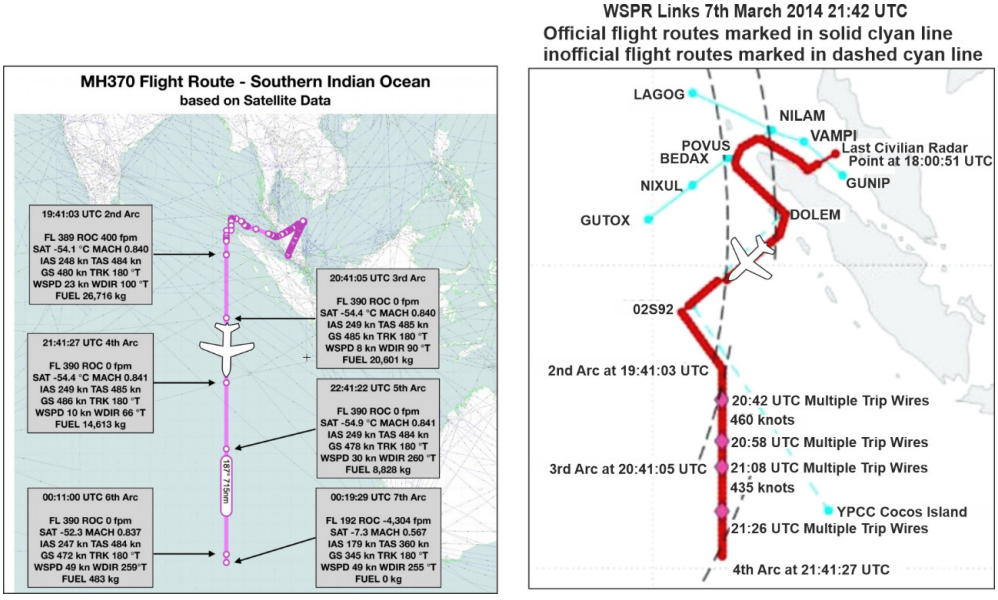

Figure 2. Anomalous Long Path WSPR DX links during the MH370 Flight Close Up and MH370 Flight Route based on satellite data (NZHerald, 2021; Godfrey, 2020; Ulich et al., 2020)

In the last conversation with the aircraft (MH370) (01:19 UTC), it appears that the aircraft was at an altitude of 35 000 feet and the aircraft continued to fly at an altitude of 35 000 feet until 02:15 UTC. But later on, the plane went up to an altitude of 45 000 feet. The aircraft (MH370) descended to an altitude of 23 000 feet again after a certain time. It is stated that the last satellite connection was provided by the aircraft at 08:11 UTC. At 08:19 UTC, communication with the aircraft was completely cut off because the aircraft ran out of fuel. When the data of the reports prepared by the aircraft are investigated, it has been determined that 34 139 kg of fuel at 18:27:43 UTC and 33 524 kg of fuel at 18:29:00 UTC (0.092 hours after the 18:22:12 last radar position). The fuel value of the aircraft in the second arc is specified as 26716 kg. In addition, the most important feature of the second arc is that it passes through 2° S and 92° E coordinates, where Melbourne FIR, Jakarta FIR and Columbus FIR meet (Figure 2). The aircraft (MH370) passed the second arc at 19:41:03 UTC. In addition, the hourly fuel consumption of the aircraft is given as 6630 kg/h on average (Fuel consumption may vary depending on the load condition of the aircraft, weather conditions and flight altitude, etc. The number given here is the average value). It has been computed that the fuel in the aircraft will be sufficient for a period of approximately 6 to 6.5 hours from the second arc (SKYbrary, 2021; Zigya, 2021; Godfrey, 2020; Ulich et al., 2020).

In Figure 4, the maximum (5125 km – red circle) and minimum (4460 km – yellow circle) distance values that the aircraft can travel from the K0 point (second arc) depending on fuel consumption are shown. In Figures 4 and 5, the suggestions of various scientists and pilots

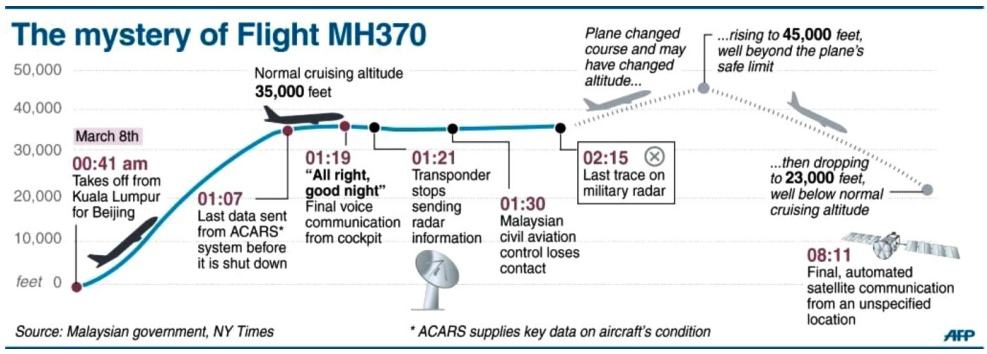

Figure 3. Vertical profile values of the aircraft (Cenciotti, 2014)

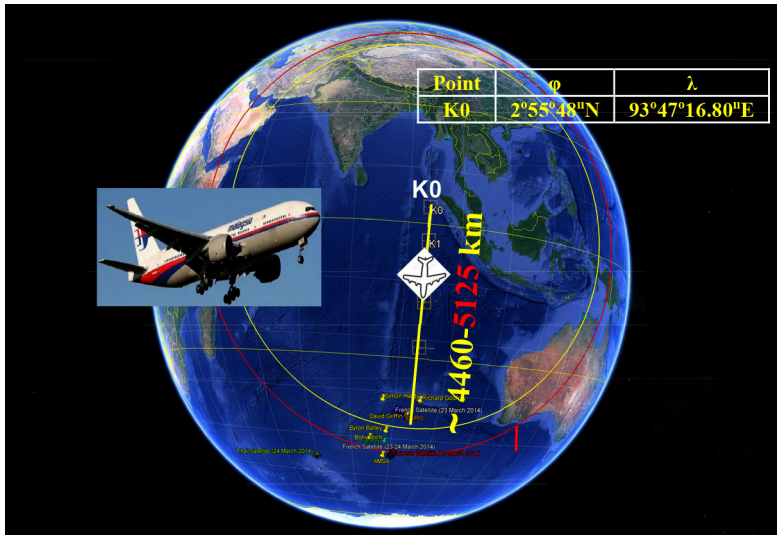

Figure 4. Maximum (red circle) and minimum (yellow circle) distance values that the aircraft (MH370) will travel from the second arc (K0 point) according to fuel condition and consumption

regarding the crash points of the aircraft are given. According to Richard Godfrey, the coordinates of the point where the plane crashed were calculated as 33º.177 S–95º.300 E. According to David Griffin, the coordinates of the point where the plane crashed are given as 35º.6 S–92º.80 E. According to Bobby Ulich, the coordinates of the point where the plane crashed were obtained as 41º.01 S–84º.33 E. The coordinates of the point where the plane crashed are given by Simon Hardy as 39º 22′ 46″ S–87º 6′20″ E. The coordinates obtained by the Australian Maritime Safety Authority (AMSA) for the point where the plane crashed were calculated as 45º 15′ 12.70″ S–87º 53′ 49.54″ E. The coordinates calculated according to Byron Bailey are given as 38º.082 S–87º.40 E Australian Government (2015, 2017), Minchin et al. (2017), NZHerald (2021), Pattiaratchi & Wijeratne (2016), Godfrey (2020), Ulich et al. (2020). As seen in Figure 5, the points between the red circle and the yellow circle are the points of Ulich and Bailey (Ulich et al., 2020). Other points fall outside this area. In addition, in Figure 5, it has been suggested that the debris images of the aircraft were displayed by French, Chinese, Thai and Australian satellites in the regions where they are located. It is concluded that the images of Chinese, French and Australian (CSIRO (Geoscience Australia and the Commonwealth Scientific and Industrial Research Organization)) satellites give better results when both the area where the plane crashed and the ocean currents are investigated (Minchin et al., 2017). The China satellite images showed objects measure 13 m by 18 m (43ft by 59ft), 14 m by 19 m and 24 m by 22 m. The French satellite images showed objects up to 23 m in length. The Thai satellite images showed objects ranged from 2 m to 15 m in size. When the location of the images of the Thai satellites is evaluated according to both the direction of the current and the region where the plane crashed, it was not suitable in terms of latitude and longitude values. Because other debris and garbage residues are constantly moving with the currents in this region (Figures 5 and 6) (Minchin et al., 2017).

When the reports and articles about the aircraft (MH370) are investigated, the following results are reached about the data, maps and calculations obtained. Those computations indicated that due to the addition fuel savings and from fuel remaining in the fuel supply piping the aircraft had at least 400 kg of burnable fuel remaining when it reached 41.2º S–88.2º E (see Figure 5, green arrow) (Ulich et al., 2020). Using the descent model data presented in appendix B.2.7 of the paper "The Final

Resting Place of MH370" resulted in a descent range of 110.5 Nm (204.646 km) in a time of 18.3 minutes with a fuel burn of 332 kilos taking into account head winds of up to 58 Nm/h (107.415 km/h). The position at 41.2° S–88.2° E as pointed out is short of the 43° S–88° E Last Estimated Position (LEP) location and in this case by 107 Nm (198.164 km) (Ulich et al., 2020; Pattiaratchi & Wijeratne, 2016). With the additional 110 Nm (203.720 km) from the descent the LEP at 43° S–88° E can be achieved. This of confirms the LEP at 43° S–88° E is plausible. The LEP near 43° S–88° E is the only location that can explain the suspected debris areas near 45° S–90° E and at 35° S–90° E and still support the location, timing and amount of debris that has been recovered on Reunion Island, Madagascar and Africa. Figures 6 and 7 show the simulated debris along the crash site where it had drifted by the 18 of March 2014 along with the current speed. The airplane symbols in Figure 7 represent the suspected debris area near 45° S–90° E. It is evident that none of the simulated debris is close to 45° S–90° E at this point in time which means that if the suspected debris near 45° S–90° E is from MH370.

As seen in Figure 5, it was assumed that the images of France (23–24 March 2014) and China (18 March 2014) satellites of the area where the plane crashed are close to the region where the debris of the plane is located. The ocean currents shown in Figure 6 also support this situation. When the currents in the Indian Ocean are investigated, the following situations have been reached (Figure 6). The East Australian Current (water from the Pacific) is relatively weak. The Agulhas Current has a transport close to that of the Gulf Stream. Thus, it seems clear that the aircraft wreckage and the areas of the drop points will move westward to the Indian Ocean according to the current speed and direction, except for the region of Thai satellite images (Figures 6 and 7). Figure 8 gives detailed information about the times and locations of the debris of the aircraft (Kwek, 2018; Gao et al., 2018).

The HYCOM global ocean model was used as an input to a particle tracking model to track debris over a

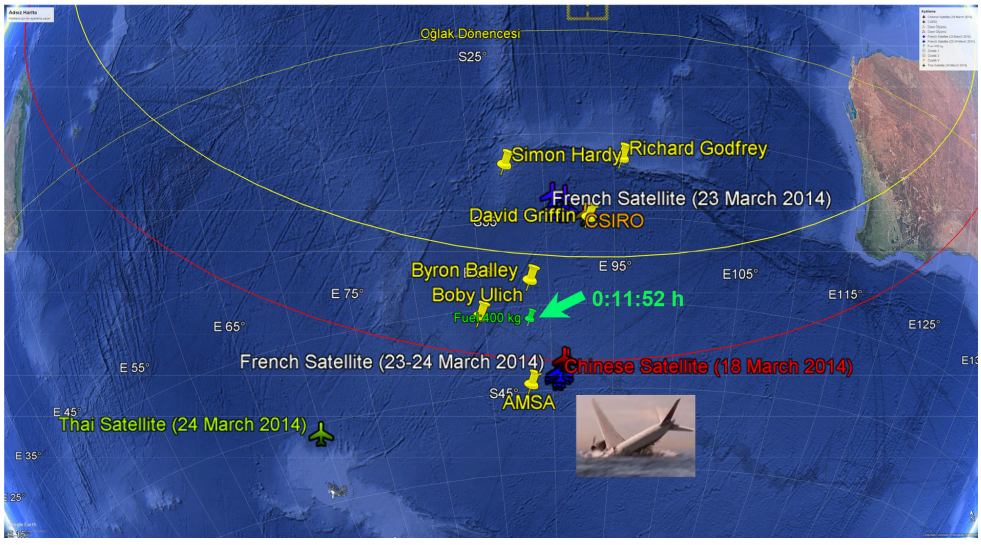

Figure 5. Points of the plane crash suggested by various scientists and pilots (yellow thumbtack symbol) and regions of China, Australia, France and Thailand satellite images (airplane symbol) (Minchin et al., 2017)

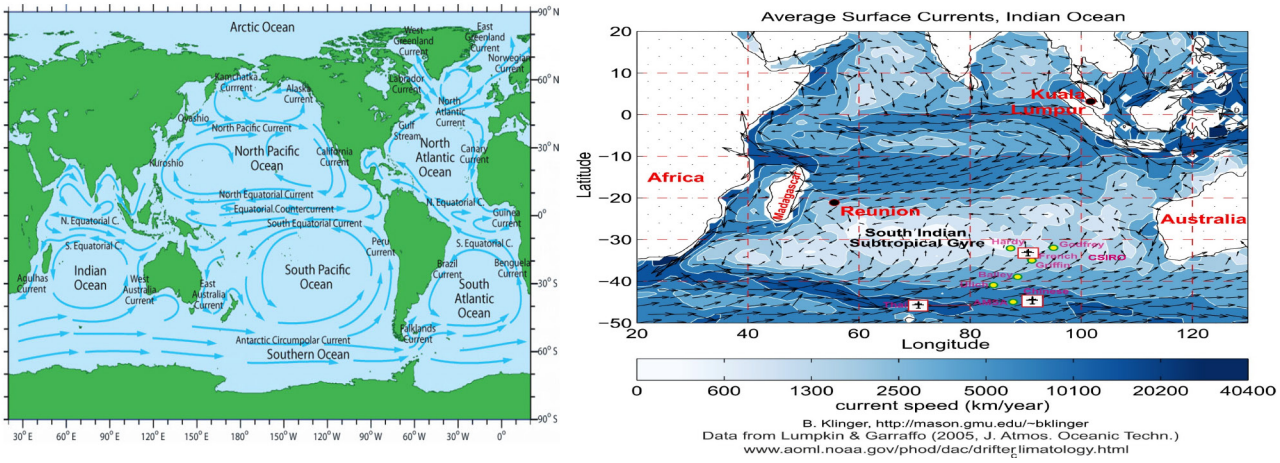

Figure 6. Average speed and directions of ocean currents, and the regions from China, Australia, France and Thailand satellite imagery (airplane symbol) (Webb, 2021; Zigya, 2021; Colgan, 2015; Klinger, 2015; NBC, 2018; Yuhas, 2014)

16–24 month timeframe, coinciding with the discovery of the flaperon on Reunion Island. As explained in the sections above, the aircraft debris appears to have struck Reunion, Mauritius Island and Mozambique, South Africa Beaches based on current direction and speed (Figures 7 and 8). These parts of the debris of the aircraft are listed in Australian Government (2015, 2017), NBC (2018), Neumann (2015), Klinger (2015), Kwek (2018), Colgan (2015),Australian Transport Safety Bureau [ATSB] (2014).

On 28 April 2014, the surface search for MH370 coordinated by the Australian Maritime Safety Authority (AMSA) was concluded and the ATSB assumed responsibility for conducting the underwater search for the aircraft, see Figure 9 (Australian Government, 2015, 2017). In our study, the investigation of the area where the plane crashed was made by taking into account the maximum and minimum range that the plane could reach depending on the amount of fuel remaining, the location of the debris pieces, and the ocean current direction and speeds (Figure 10). The region we recommend as a result of our investigation is marked on the map in a white rectangle (Figures 9 and 10). A small portion of the area we propose has already been searched by the Australian research group. However, the rest of the region was not included in the study (Figure 9). Where the French and Chinese satellite imaged the aircraft wreckage, the ocean current velocity was 7500 km/year northeast. In this region, there is current at a speed of 20.5 km per day. 15 days after the disappearance, 50 km northwest of the AMSA point is reached by traveling 307.5 km in the opposite direction (southwest) from the place detected in the French satellite image. Where the Chinese satellite detected the aircraft remains, there is a current of 20.5 km per day. In this image, which was obtained 10 days after the disappearance, a 205 km journey in the opposite direction (southwest) reaches a region 70 km northeast of the place indicated by the AMSA point. Therefore, it is foreseen that researches should be carried out in the area between 42^0 S–45^0 S latitudes and 87^0 E–92^0 E longitudes given in Figure 10.

Eventually this could cause it to fall on the ocean floor belly-up. According to Prof. Dr. Goong Chen, if the plane had crashed into the sea at a horizontal angle, it would have definitely disintegrated. Fragments of the hull would surface and attract the attention of

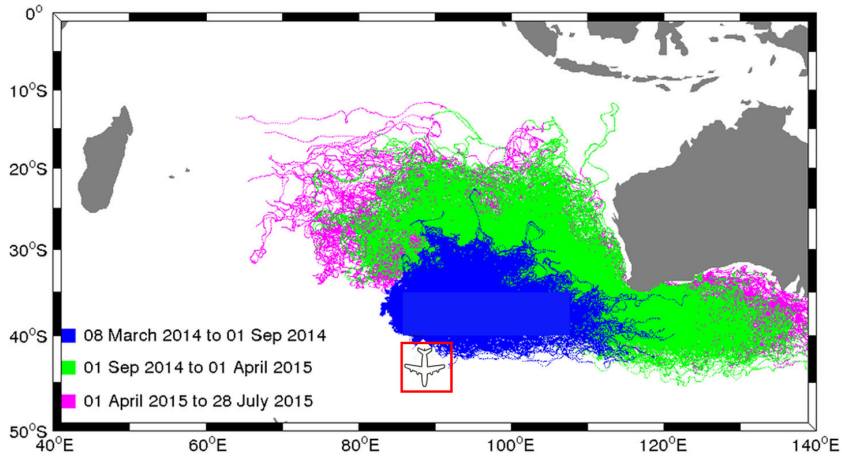

Figure 7. Graph of the debris movement effect of the current velocity over time of the area where the MH370 crashed (airplane symbol) (Zigya, 2021; Neumann, 2015; Pattiaratchi & Wijeratne, 2016; Gao et al., 2018; Kwek, 2018)

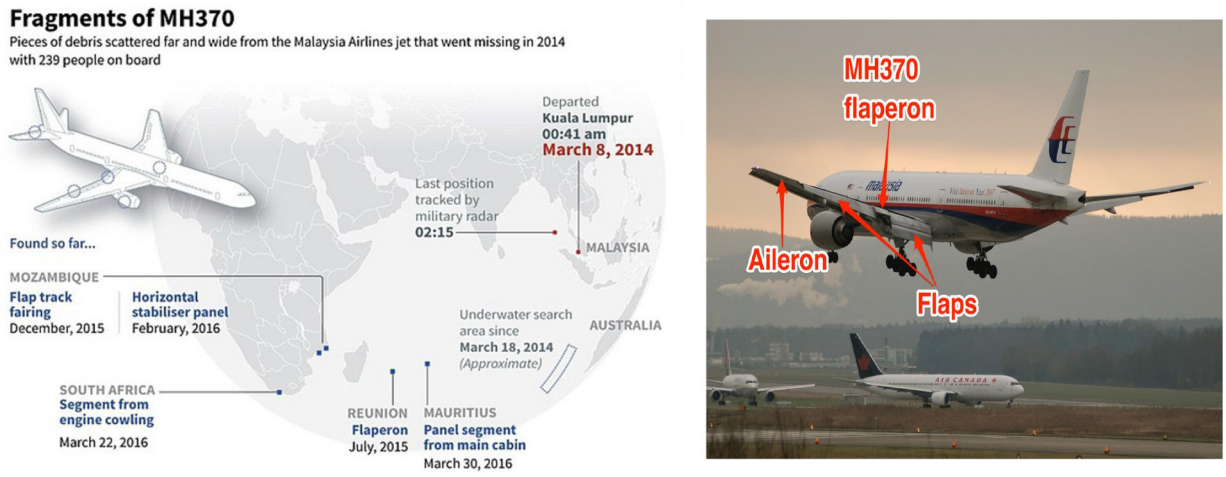

Figure 8. Locations and times when the debris of the aircraft (MH370) was found (Kwek, 2018)

Figure 9. Maps where the Australian research team conducted the search and our recommended region (white rectangular) (Australian Government, 2015, 2017)

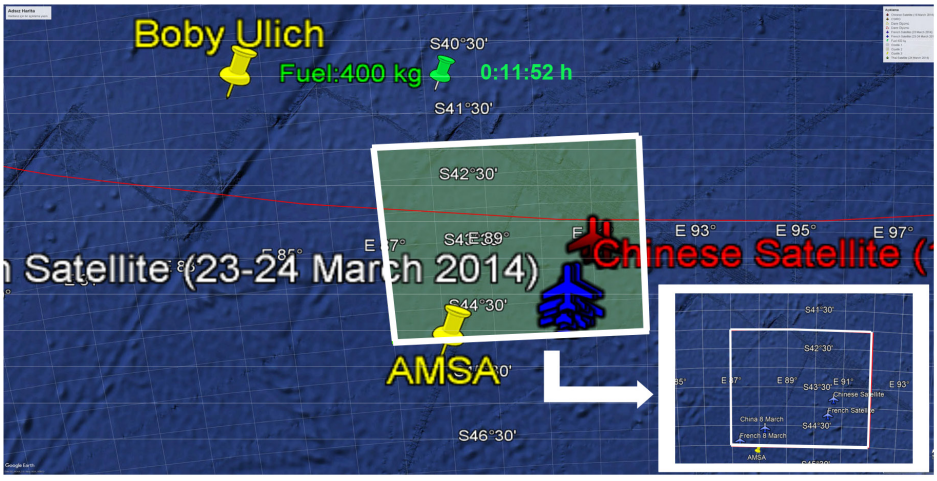

Figure 10. Illustration of the area where the plane is predicted to crash on the map (white rectangular-green region)

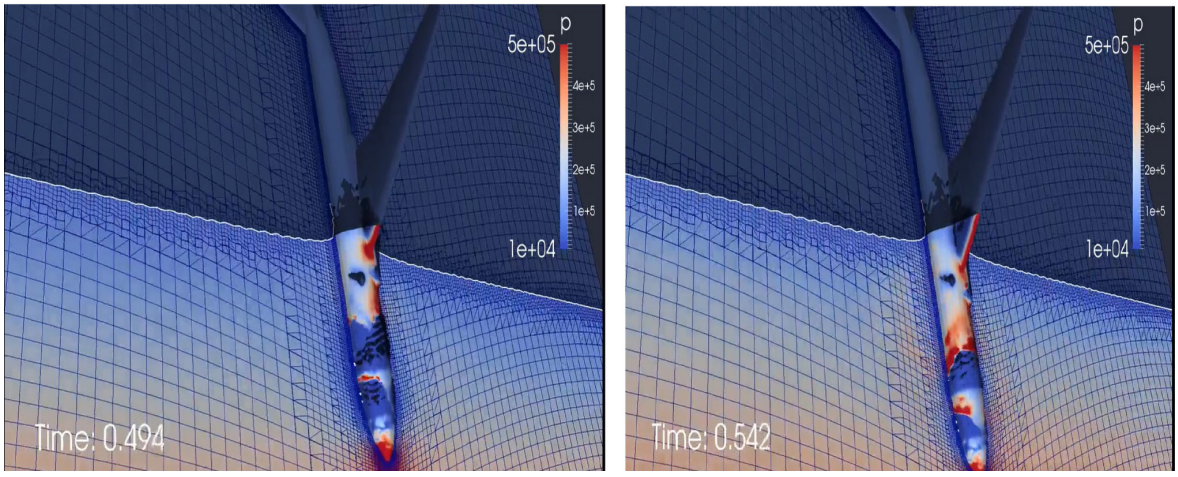

Figure 11. This is a nose-dive situation (Pitch angle = −90º, angle of approach = 93º) of MH370 (Chen et al., 2015)

search parties. Claiming that the Boeing 777 type plane crashed into the sea at a 90-degree angle, Chen says, "Thus, the fuselage remained in one piece and went to the bottom of the water in a few minutes." These parts of the aircraft (MH370) is exposed to high pressure values after falling into the ocean emerge as the nose part, middle fuselage and wings, respectively (Figure 11) (Chen et al., 2015).

Conclusions

In our study we have done, all satellite images, data and maps on the crashed point of the plane (MH370) into the ocean have been evaluated and investigated in detail. Considering the plane's fuel, ocean currents and speed, especially for the coordinates of the debris in the satellite images taken, a general estimation of the area where the plane crash has been made. Current velocities and directions in the Indian Ocean also played an important role in this investigation. As a result of the evaluation of the data obtained, it comes to the fore that the plane may be between the coordinates of 42º–45ºS and 87º–92ºE as the crashed zone. These results are based only on an approximation (calculations of fuel consumption and ocean current velocity and direction) applied by our team.

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