

The Assessment of Oil Pollution in Seribu Islands based on the Numerical Models

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Abstract

In order to improve the information on the state of the Indonesian marine environment that is gained from satellite data, the joint German-Indonesian Pilot Study IndoNACE (Indonesian seas Numerical Assessment of the Coastal Environment) was proposed to produce oil pollution density maps of two dedicated regions of interest (ROIs) in Indonesian waters, namely the Western Java Sea and the Strait of Makassar.

One of the case study areas in the Western Java Sea is Seribu Islands, located in the northern part of Jakarta, the Capital City of Indonesia. This region is influenced mainly by the monsoon, where during the west monsoon; ocean current flows generally from north to the east, and on the other hand, during the east monsoon the current flows mainly westward while part of this current flows northward and southwestward to the Sunda Strait.

In this area, there are some oil spill occurrences, such as in 2004, 2007, 2008, 2011, and 2014. Unfortunately, information about the sources of these oil spills are difficult to obtain, while, on the other hand, Seribu Islands has some Marine Protected Areas (MPAs) as well as marine aquaculture sites that vulnerable to the oil pollution. Based on this condition, in order to trace the oil pollution sources and their trajectories as well as potential impacts to the environment, the assessment based on the in-situ measurements and numerical models will be done in this study.

1. Marine Protected Areas in Indonesia

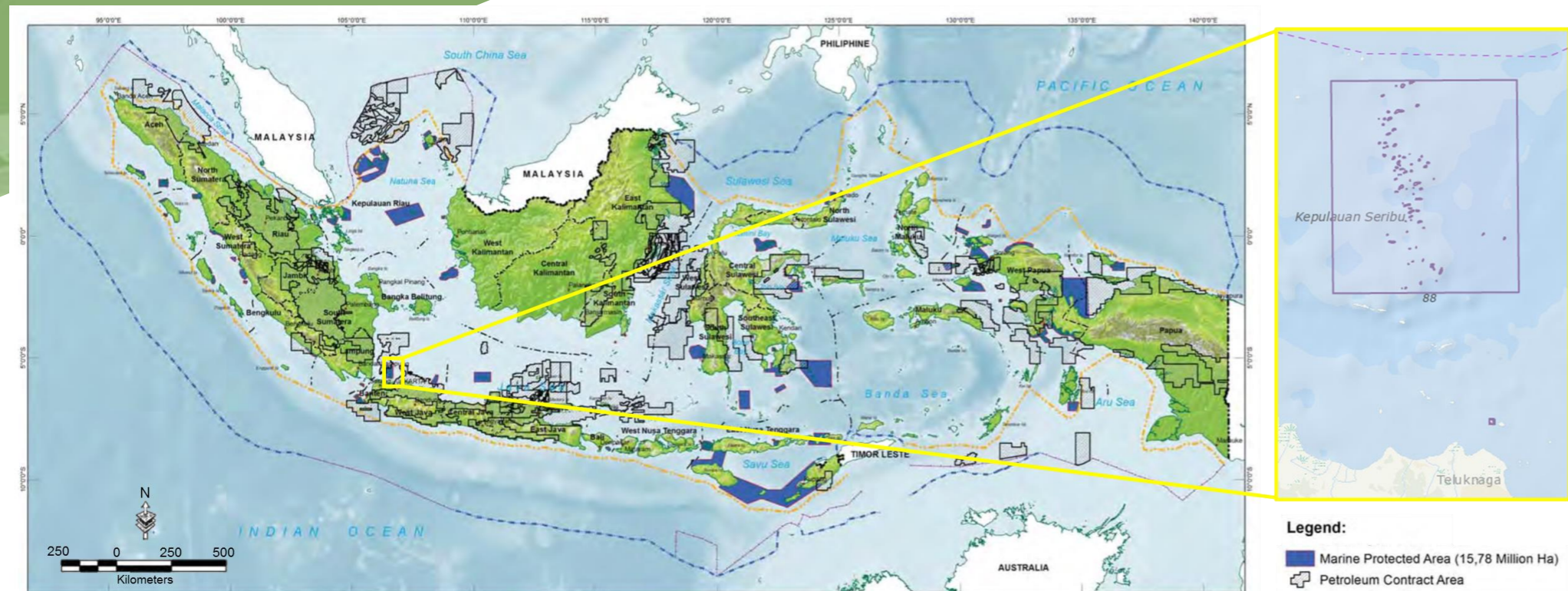


Figure 1. Map of Marine Protected Areas and petroleum contract areas in the Indonesia waters where one of them is located in Seribu Islands as indicated by yellow box (Source: Yulianto et al., 2013).

Indonesia has 108 Marine Protected Areas (MPAs) with total size of about 15.8 million hectares (MMAF, 2012) where some of those MPAs are located close to petroleum contract area. Around 0.4 hectares of potential area for MPAs are overlapped with oil and gas mining concession areas as shown in Figure 1.

2. Oil Spill Occurrence



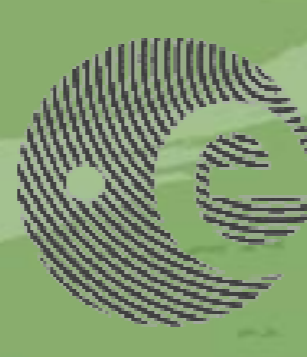
Figure 2. Oil slick along the southern shore of western Pari Island, one of the island belongs to Seribu Islands where its location is in the southern part.

There was a thin layer in the sea surface that expected as oil slick found in the Pari Island during the field survey at 6th November 2015. This oil slick was found in southern shore western part of Pari Island (Figure 2). Total hydrocarbon in this location is 1.7 mg/l, while in the eastern part the total hydrocarbon is 1.5 mg/l.

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3. Sea Surface Current

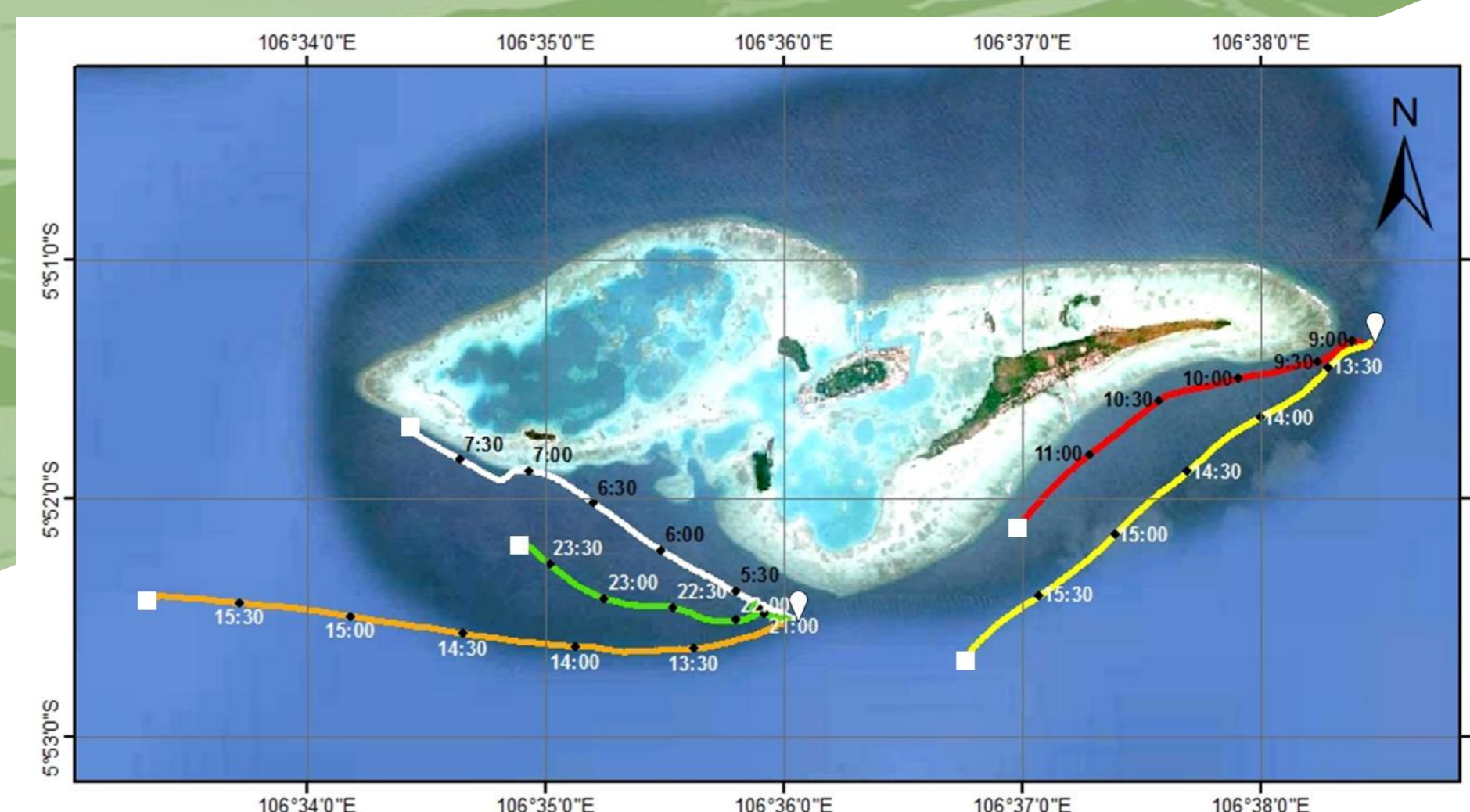


Figure 3. Drifter's path line obtained during the survey. Balloon and square symbols show the initial and final positions of drifters. The drifters released 5 times at 2 locations with duration about 3 hours. Orange, green, and yellow lines show the drifter's path during ebb tide, while white and red lines show the path during flood tide.

The path lines have similar pattern either during ebb or flood tides. The drifters average distance is approximately 3.76 km during 3 hours of observation. Thus, the average current speed is 0.37 m/s. According to path lines pattern, it can be concluded that the surface current is flow south-westward, either during ebb or flood tides. It can be expected that when an oil spill occurred, the oil will spread to the southwest. However, further observation is needed in order to compare the path lines during the neap and spring tides and also in different locations.

MONTHLY AVERAGE OF CURRENT IN NOVEMBER (2010-2014)

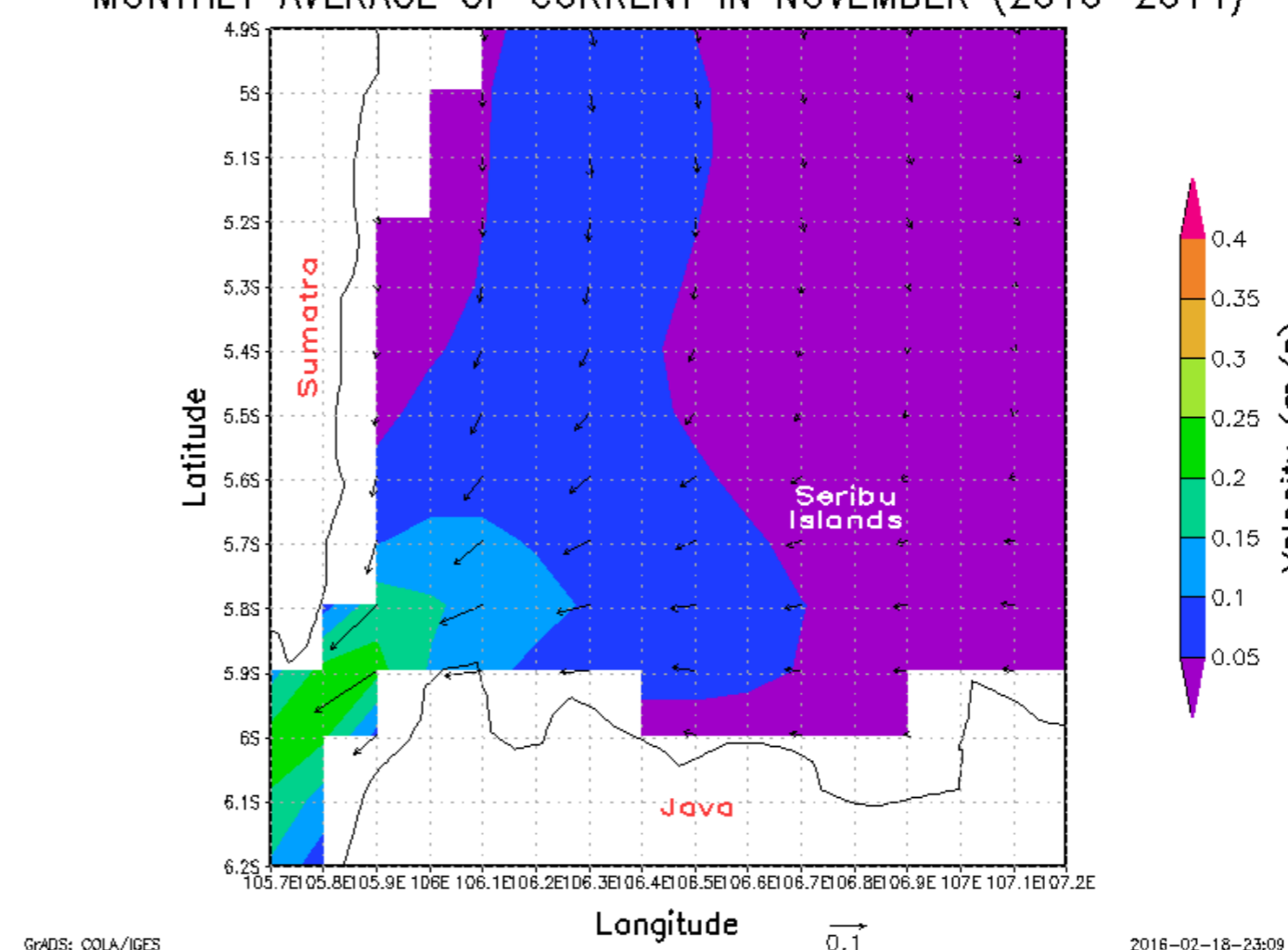


Figure 4. Monthly average of surface current in November (2010-2014) from HAMSOM model results.

In the second transition monsoon (November), the current magnitude is vary from 0.05 to 0.15 m/s which is relatively smaller compare to previous month. Even though the current is weak, most of the oil spill occurrences in the western Java Sea, especially around Seribu Islands, were found during November.

4. Satellite Images

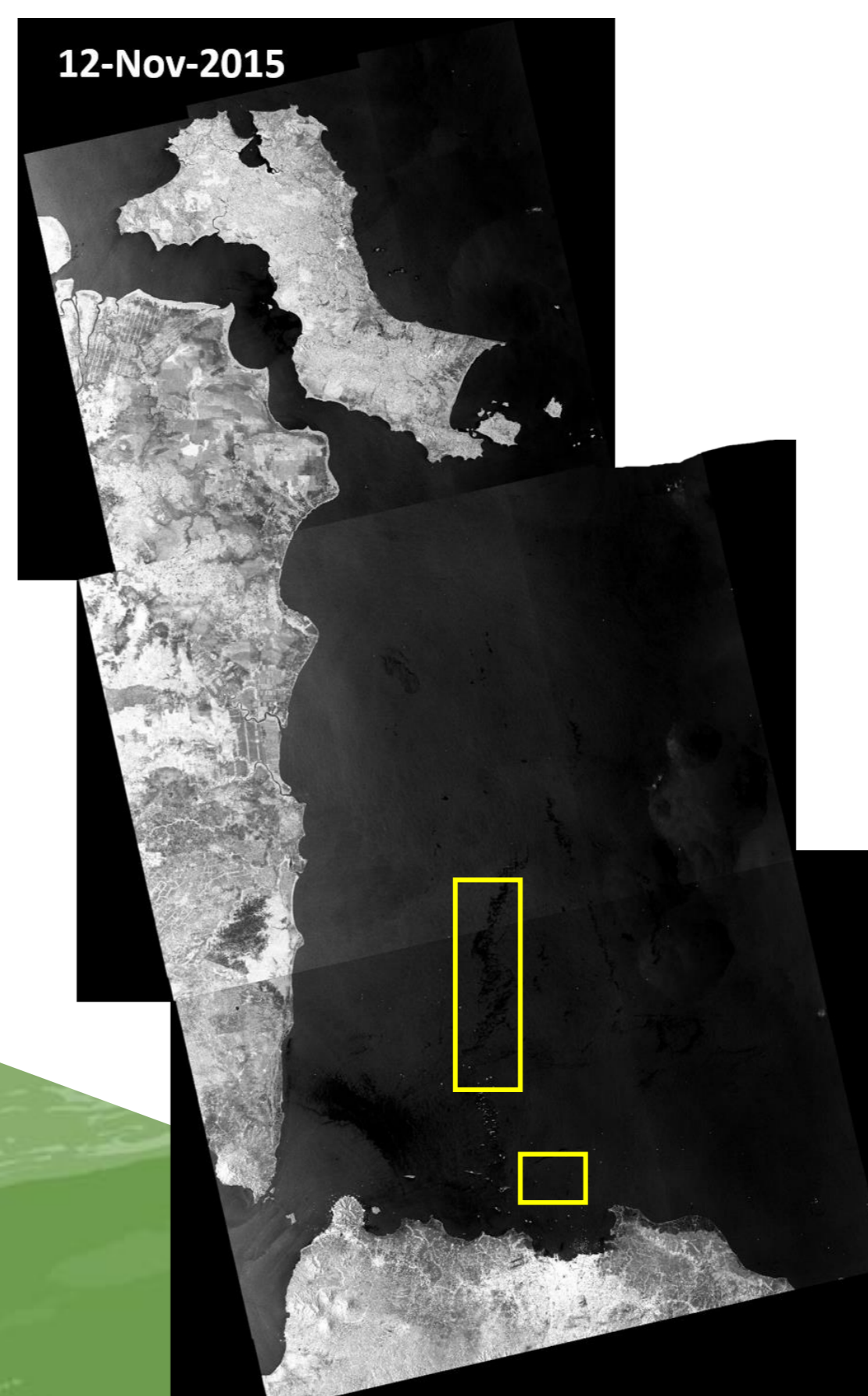


Figure 5 shows satellite images from Sentinel 1A SAR in the Western Java Sea at 12th November 2015. There are some areas that have darker colours than the surrounding areas and can be identified as oil slicks. Those area are expected to be the location of oil spill (shown by the yellow boxes).

Figure 5. Satellite images in the Western Java Sea at 12th November 2015 from Sentinel 1A SAR that show some oil slicks close to Seribu Islands.

