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Proposal for a New Traffic Separation Scheme in the Canary Islands

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ABSTRACT

The waters of the archipelago of the Canary Islands are an obligatory route of passage for around 7,000 vessels per year and there is also a traffic between the islands of around 30,000 vessels per year whose destination or point of origin is one of the island ports. A large number of these vessels are tankers loaded with all kinds of dangerous cargoes, which means an additional risk should an accident involving one of them occur in the waters surrounding the islands. The experts agree that the effects of a petrol tanker accident in the Canary Islands would lead to the economic and ecological collapse of the archipelago. In the present paper, bearing in mind the points mentioned above, and in view of the last event of pollution caused by the sinking of the Oleg Naydenov and the unexpected behavior of the subsequent spill, proposals are made for the setting up of two new TSS to the west of the Canary Islands for those vessels in transit that will not be calling at a port of the archipelago, leaving the current schemes for the traffic whose destination is one of the islands. Also will be demonstrated that the implantation of the new TSS would not involve a significant increase in trip times or expenses for vessels sailing through them, as compared to the current routes.

1. Introduction and Background

The waters of the archipelago of the Canary Islands are an obligatory route of passage for around 7,000 vessels per year (SASEMAR, 2015) which, having passed by the west coast of Africa then head towards European waters, or vice versa. There is also the traffic between the islands of around 30,000 vessels per year whose destination or point of origin is one of the island ports. The combination of the two sets of traffic generates different types of pollution, from that produced by the discharges of oil or gas emissions into the atmosphere to acoustic contamination. A large number of these vessels are tankers loaded with all kinds of dangerous cargoes, which means an additional risk should an accident involving one of them occur in the waters surrounding the islands.

The experts agree that the effects of a petrol tanker accident in the Canary Islands would lead to the economic and ecological collapse of the archipelago, even though the State has deployed there, through the Maritime Rescue Society, 12 crafts of varying sizes, an airplane, two helicopters and a strategic base in Tenerife ready to act in the face of any contaminating event (SASEMAR, 2015). Moreover, Spain participates in the European programme for the rapid response of anti-pollution vessels, which allows up to 17 units to be mobilized in 24 hours with a joint capacity of collection of more than 60,000 cubic meters (EMSA, 2004).

Statistics show that oil pollution has been steadily declining since the 90s, being limited today to a few sightings of minor importance, mainly thanks to the air and satellite control of maritime traffic and discharges implemented by the Spanish state on these waters since the year 2009. The detection of discharges has been made possible through the European Remote-sensing Satellite radar (ERS), combing an area of 300,000 square kilometers around the archipelago. However, there is always the chance that events might occur like that of the fishing vessel

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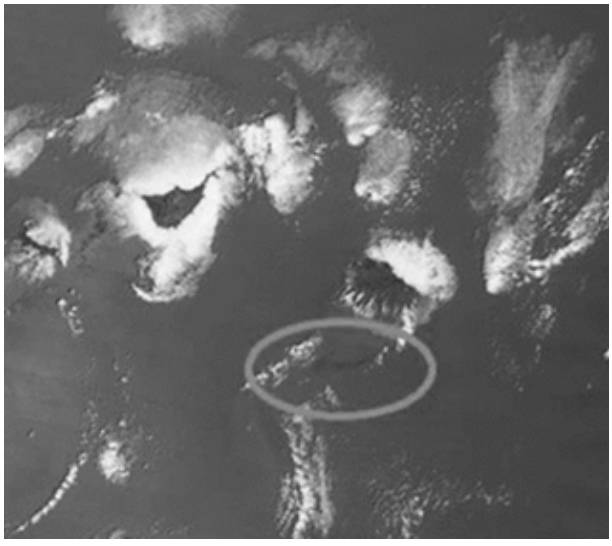
Oleg Naydenov (Larrea, 2015), a trawler of 120 meters in length which, after catching fire in the port of Las Palmas with 1,409 tons of fuel in its tanks, sank on the night of April 14, 2015 15 miles south of the island of Gran Canaria, after being towed out of the harbor, producing significant pollution by fuel oil in the area (See Fig.1.). All of the models indicated that the marine dynamics was positive and that if there was a spill, both the sea currents and the trade winds from the NE would help drag the slick towards the south, towards the open sea, away from the coast (Ivorra et al., 2015a, Ivorra et al., 2015b). Nothing could be further from the truth, as finally, the oil slick, after initially heading to the southwest as predicted, changed direction and headed north reaching, about 43 km from the south coast of the island of Gran Canaria, from the tip of Maspalomas to the beach of Guigui, the best preserved coast of the island and with a high ecological value, as it forms part both of the Biosphere Reserve of Gran Canaria and the Rural Park of Nublo.

Figure 1: Image captured by the NASA Terra satellite in which can be observed the oil slick caused by the sinking of the Oleg Naydenov.



Source: SINC.

At the same time, the International Maritime Organization (IMO) is the UN agency responsible, among other things, for establishing Maritime Traffic Separation Schemes (TSS) in those areas where it deems it necessary to increase the safety of navigation and the protection of the marine environment.

To perform this task, IMO has issued general provisions on the organization of maritime traffic (IMO, 1999) compiled in a document titled Ships' Routeing, which states that the objectives of all TSS depend on the circumstances of the hazard which they are designed to mitigate in each case, but that they will focus primarily on enhancing the safety of maritime traffic by reducing the risk of collisions and groundings, especially in environmentally sensitive areas.

The same document states that it is the responsibility of the coastal States to design or modify any TSS that is wholly or partly within their jurisdictional waters or close to these waters, indicating the reasons they may have for excluding certain vessels or certain classes of vessels from using a traffic routeing scheme or any part thereof and any other traffic organization measures necessary for vessels or certain classes of vessels which are to be ruled out of the use of a traffic routeing scheme or any part thereof. Whenever a State carries out an action of this type, they must previously consult with the IMO so that it can approve or modify the system for the purposes of international navigation. The scope of all traffic separation schemes will be constrained to that which is essential to the safety of navigation and the protection of the marine environment.

Due to the fact that six of the seven islands have been declared a Biosphere Reserve by UNESCO (Carmona, 2009), in 2005, the Canary Islands was declared a Particularly Sensitive Sea Area (PSSA) by the International Maritime Organization (IMO-MEPC, 2005). A PSSA, according to the rules of the IMO, is one that should be given special protection in view of its importance for recognized ecological, socio-economic or scientific reasons, as its environment may be damaged as a result of maritime activities.

The new maritime traffic regulatory and routeing measures which the coastline of the Canary Islands archipelago had not disposed of until then included a new system of compulsory reporting of vessels in the perimeter of the Canary Islands PSSA (CANREP) (IMO- CANREP, 2006), two new maritime traffic separation schemes (IMO, 2006) between the islands of Tenerife and Gran Canaria and between Gran Canaria and Fuerteventura, through which all vessels carrying dangerous goods, including petrol tankers, must pass notifying their cargo, origin and destination, and finally a navigation-free area around Lanzarote Island.

In the present paper, bearing in mind the points mentioned above, and in view of the last event of pollution caused by the sinking of the Oleg Naydenov and the unexpected behavior of the subsequent spill, proposals are made for the setting up of two new TSS to the west of the Canary Islands for those vessels in transit that will not be calling at a port of the archipelago, leaving the current schemes for the traffic whose destination is one of the islands. In this way, the transit of thousands of vessels and millions of tons of dangerous goods is avoided in interisland areas in which, if an accident were to occur, there would be serious consequences to the marine environment and to the main industry of the islands which is tourism.

All of this is, in short, a modification in the regulation of the flow of maritime traffic in transit navigating in the proximities of the Canary Islands, leading to an improvement in the protection of its coasts, taking into account in particular its status as a PSSA.

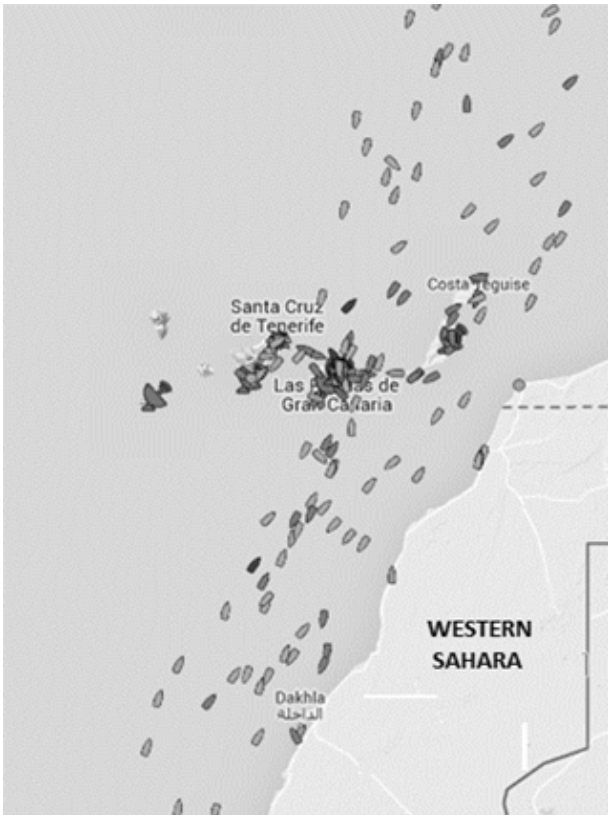
2. Methodology

The methodology to follow to determine the new TSS model proposed consists firstly in carrying out a study of the geostrategic situation of the Canary Islands archipelago in order to then proceed to an analysis of the declaration of the islands as a PSSA and, secondly to study the meteor-oceanographic conditions of the area to then finish with the application of the general provisions governing the TSS.

2.1. Geostrategic Situation of the Archipelago

The geographical situation of the Canaries archipelago means that its waters are an obligatory route of passage for the great ocean routes between Europe, Africa and Asia, as well as for all those ships which set sail from the Mediterranean ports and whose ports of destination are in Central America and South America (See Fig.2.). Taking into account only the traffic of oil, it is estimated that an average of 1,500 tankers of great tonnage per year sail the Spanish waters of the Canary Islands, this being the usual route linking European ports with the oilfields of the Persian Gulf, Nigeria, etc. Due to the geographical position of the various islands which make up the archipelago, this traffic mostly passes through the sea area between the islands of Gran Canaria and Fuerteventura.

Figure 2: Snapshot of the traffic around the Canary Island on June 8, 2016.

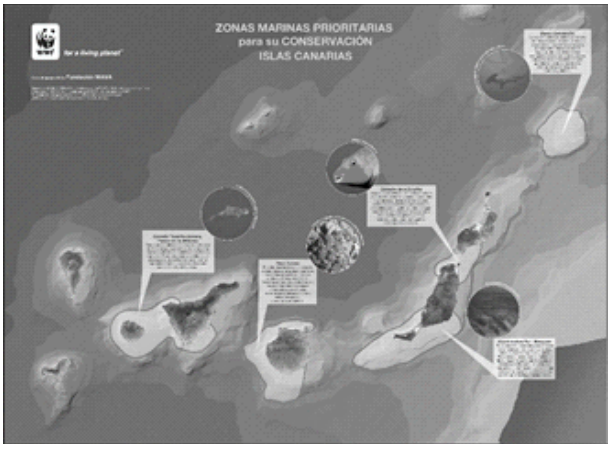


Source: Localizatodo.com

2.2. Declaration of the Canary Islands as a PSSA

According to resolution A.1087(28) of the IMO (IMO-PSSA, 2013), a PSSA is that which must be the object of special protection, in accordance with the measures adopted by the IMO, due to its importance for its recognized economic or scientific characteristics, if these characteristics might suffer damage as a consequence of international maritime activities.

Figure 3: Marine Zones of the Canary Islands given priority for their conservation.



Source: http://www.wwf.es

Several colonies of marine cetaceans are found in the Maritime Area of the Canary Islands, particularly those of the globicephala family which are in clear decline, if not heading towards extinction in the world and they also are on the route of the petrol tankers coming from the Cape of Good hope transporting petrol to Europe, and vice versa (See Fig.3.).

It should also be taken into account that over thirty thousand vessels per year visit the ports of the Canary Islands and that the traffic between the islands generates all types of pollution: from oils for the causes described above to acoustic contamination due to the noise of the engines and propellers, to atmospheric emissions etc. There is also the ever-present risk of accidents with unforeseeable consequences.

For all of these reasons, in 2003 the Spanish Ministry of Development presented to the IMO the proposal for the designation of the Canary Islands as a PSSA.

The Spanish representation presented the content of the proposal and its justifications to the IMO, after which the experts who made up the delegation participated in the Technical Work Group responsible for examining the various technical and scientific aspects and assessing compliance with the criteria for PSSA based on the criteria of Resolution A927(22) of the IMO. The result of the assessment carried out by the Technical Group was positive, considering that the technical documentation submitted by the Ministry of Development, together with the additional information provided by the members of the Spanish delegation, met the requirements for the Canary Islands to be designated by the IMO as a PSSA.

The new regulatory and routeing measures that the coast of the Canary Islands had not disposed of until that moment included:

- A new system of compulsory reporting for ships in the perimeters of the PSSA of the Canary Islands (CANREP) (See Fig.4.).

- Two new TSS between the islands of Tenerife and Gran Canaria and between Gran Canaria and Fuerteventura,

Figure 4: Outer limits of the Notification System CANREP. View of the set of PSSA with the associated Protective Measures (TSS and navigation-free zones).

Source: http://www.wwf.es

with two traffic lanes, one Area of Precaution and coastal navigation zones (See Fig.5.).

- Navigation-free zones around the islands of Lanzarote, Tenerife, Gran Canaria, La Palma and El Hierro.

Each of the TSS approved has:

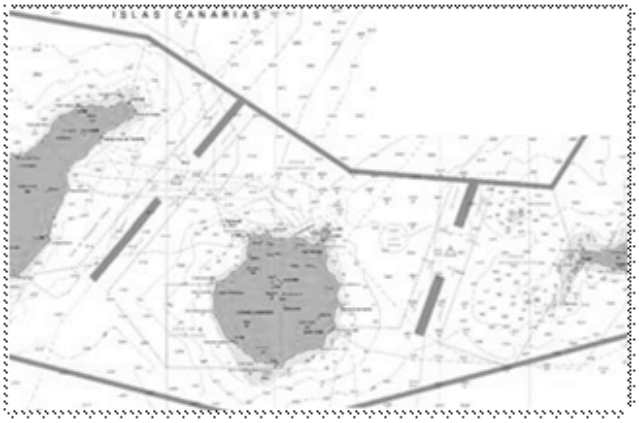
- Two traffic lanes of three miles in width, in the north and south direction respectively, to channel the traffic in transit through the archipelago.
- An intermediate traffic separation area of two miles in width.
- A precaution zone which forms a rectangle inserted in the traffic lanes where the crossover of the traffic in transit and the interisland traffic will be made.
- Two coastal navigation zones for local traffic.

The Ministry of Development, through the Maritime Authorities of Las Palmas and Tenerife and the Maritime Rescue Coordination Centers (MRCC) of these two cities, monitor the "associated protective measures" approved by the IMO, control the separation of maritime traffic and the oil tankers carrying heavy fuels along their coasts and ensure that the ban on ship traffic is fulfilled in the five navigation-free zones, of great natural and biological value.

The new compulsory notification system in the PSSA fulfils several objectives related to the safety of navigation and the prevention of pollution in this sea area. Notification of entry to and exit from the zone will be mandatory for ships carrying polluting goods such as heavy fuels through the Regional Coordination Centre (RCC) of Las Palmas (East Route) or that of Tenerife (West Route) allowing the centers to have up-to-date information on the transit of these vessels through the PSSA so that they can alert the rescue services in the fastest time possible for immediate action if necessary.

At present, the navigation aids existing in the area are considered sufficient, as these enable the vessels to determine their position with the level of accuracy required by the International Regulations for Preventing Collisions at Sea (IMO-COLREG, 1972), which must fulfilled by all vessels passing through the TSS (SASEMAR, 2011).

Figure 5: Traffic Separation Schemes of the Canary Islands. Eastern and western routes.



Source: mfom.es

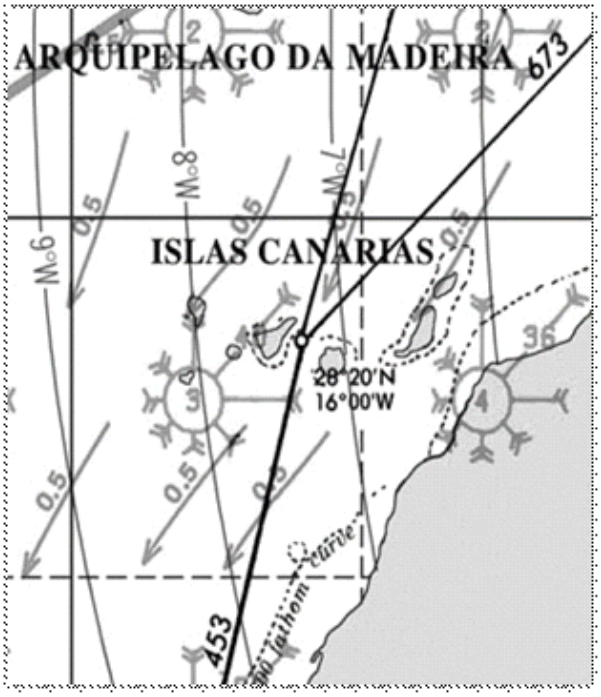
2.3. *Meteoro-Oceanographic Conditions of the Zone*

One of the main fears in the face of an oil spill in the archipelago are the ocean currents, as several of these converge in the area with different directions and intensities (Arístegui et al., 1994). One of these starts on the African coast and crosses the eastern islands moving towards the south of Gran Canaria, where there is a large eddy. Although this is the predominant direction, the currents are changeable, and the variability is huge, so that new eddies are generated periodically (Knoll et al., 2002).

Fig.6 is an extract from the Pilot Chart of the North Atlantic Ocean where you can see the so-called "Canary Islands current" and the trade winds.

The island coasts open to the north are exposed to the trade winds and face sea swells with waves several meters high and this situation lasts almost all year. In contrast, the island coasts of the southern parts are downwind and are more sheltered (Clavell, 2005).

Figure 6: Pilot Chart of the North of Atlantic Ocean.



Source: UKHO

2.4. Tool: General Provisions on Ships' Routeing

It is an indisputable fact that the widespread compliance with the measures designed to organize traffic approved by the IMO for international application has contributed to the safety of navigation, reducing the risk of collisions and groundings, and bringing with it also a reduction in the risk of polluting the marine environment and harming marine life.

These measures are provided with a legal framework in regulation V/8 of the International Convention for the Safety of Life at Sea 1974 (IMO-SOLAS, 2004), which recognizes the IMO as the only international body with the authority to establish and adopt routeing measures at the international level, and in rules 1d) and 10, in their amended form, of the International Regulations for Preventing Collisions at Sea, of 1972 (IMO-COLREG, 1972), which provide for the adoption by the IMO of traffic separation schemes and regulate the behavior of ships within or near such schemes.

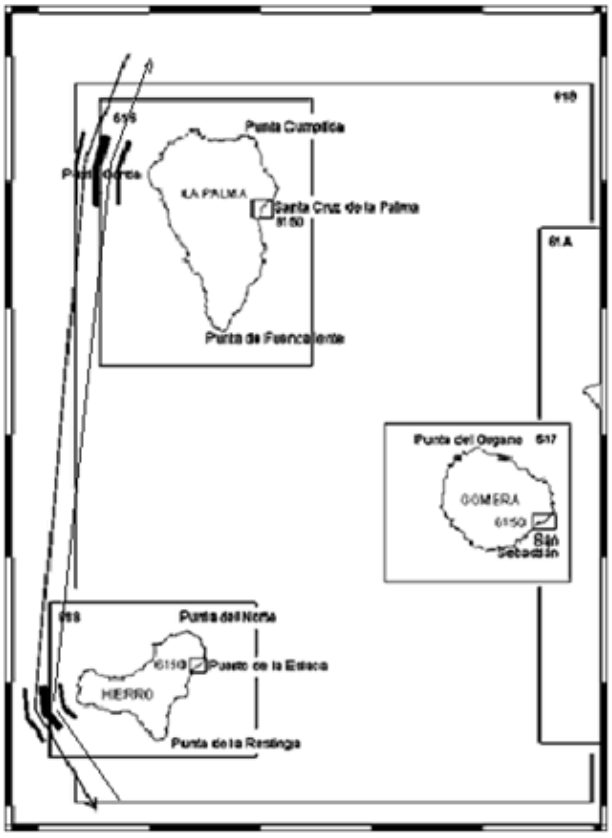
To carry out this task, the IMO has laid down the General Provisions on Ships' Routeing (IMO, 1999) gathered in a document entitled "Ships' Routeing", in which it is stated that it is the responsibility of the coastal States to design or modify any TSS which is located partially or totally within its jurisdictional waters or close to them.

2.5. Establishment of a New TSS

Given the high demand for maritime traffic in this area and the importance of protecting its coastline declared as a PSSA, this work sets out to design an expansion of the existing TSS in the vicinity of the Canary Islands, adding one TSS on the west coast of El Hierro and another on the west coast of La Palma, in order to oblige vessels in transit to navigate the western end of the Canary Islands and thus, in the event of a pollution incident, prevent this marine area of great ecological sensitivity from being damaged.

Fig.7 shows an indicative sketch of the proposal: two new linked TSS running along the west coast of the Canary Islands, of compulsory use for all types of vessels and especially for those carrying dangerous goods, which would be laid out in the following way:

Figure 7: General view of the TSS proposed.



Source: Authors

3. Process of Elaboration of TSS

In order to establish the distance to land of the side of the TSS closest to the coast, both for the island of El Hierro and the island of La Palma, the reference used was the distance from the TSS of Finisterre to land, whose closest side is 21 miles away. As the above-mentioned meteorological conditions of winds and currents were favorable, this distance was considered sufficient and in this way, the flow of traffic would not be too far from land.

Once this distance at which the new TSS would be situated was established, the points numbered 1 to 24 were set one by one (see Tables 1 and 2).

As can be observed in Fig. 8 and Fig. 9, the TSS proposed are made up of two traffic lanes of 7 miles in width, the further east for the northbound traffic and the further west for the

Tabla 1. TSS West of Isla de la Palma coordinates

TSS West of La Palma			
Description	*Nº*	*Latitude*	*Longitude*
	1	28º 56´04.25´´N	18º 18´13.47´´ W
Separation line	2	28º 50´36.88´´N	18º 21´42.26´´ W
	3	28º 45´39.76´´N	18º 21´58.03´´ W
	4	28º 58´20.14´´N	18º 25´32.96´´ W
Separation zone	5	28º 57´37.79´´N	18º 23´15.17´´ W
	6	28º 52´23.52´´N	18º 29´33.27´´ W
	7	28º 51´53.84´´N	18º 27´06.51´´ W
	8	28º 45´48.85´´N	18º 30´30.27´´ W
	9	28º 45´46.19´´N	18º 27´57.85´´ W
Separation line	10	28º 59´52.95´´N	18º 30´33.50´´ W
	11	28º 53´55.47´´N	18º 35´11.28´´ W
	12	28º 45´55.89´´N	18º 36´45.78´´ W

Source: Authors.

Tabla 2. TSS West of Isla de El Hierro coordinates

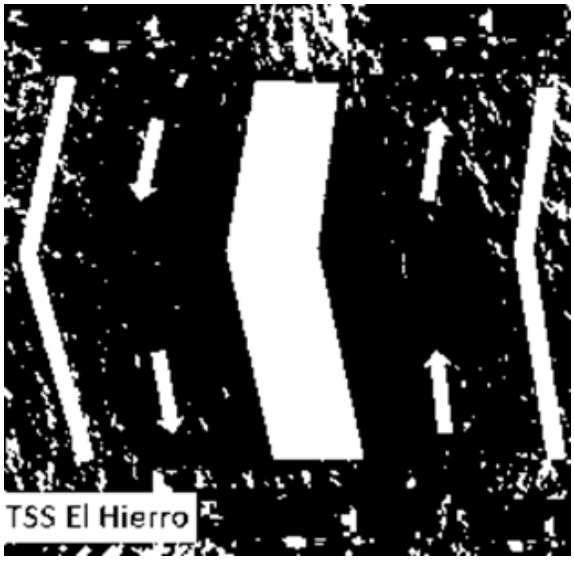
	TSS West of El Hierro		
Description	*Nº*	*Latitude*	*Longitude*
	13	27º 44´42.80´´N	18º 30´09.04´´ W
Separation line	14	27º 40´40.94´´N	18º 30´35.93´´ W
	15	27º 35´31.81´´N	18º 29´25.54´´ W
	16	27º 44´34.39´´N	18º 38´05.21´´ W
Separation zone	17	27º 44´36.73´´N	18º 35´46.79´´ W
	18	27º 40´21.03´´N	18º 38´42.14´´ W
	19	27º 40´29.80´´N	18º 36´10.24´´ W
	20	27º 35´13.96´´N	18º 37´07.27´´ W
	21	27º 35´20.25´´N	18º 34´37.90´´ W
Separation line	22	27º 44´27.70´´N	18º 43´38.72´´ W
	23	27º 40´01.33´´N	18º 44´32.23´´ W
	24	27º 34´59.30´´N	18º 42´36.48´´ W

Source: Authors.

Figure 8: TSS of La Palma.

Source: Authors

Figure 9: TSS of El Hierro.



Source: Authors

southbound traffic, separated by a separation zone of 4 miles in width.

4. Implantation of a New Compulsory Reporting System for Ships

In the same way as there already exists a compulsory reporting system for ships in the perimeter of the PSSA of the Canary Islands (CANREP), now with the proposed expansion of the TSS, a new reporting system is established which will be compulsory on entrance to or exit from each new TSS, both that of El Hierro and that of La Palma, called WESTCANREP, monitored from the RCC of Tenerife fulfilling the "Guidelines and criteria on ship reporting systems". This measure would comply with the Spanish Ministry of Development Royal Decree 210/2004, of November 26, by which a monitoring and

Figure 10: General view of the TSS proposed with winds and currents.

Source: Authors

information system for maritime traffic was established.

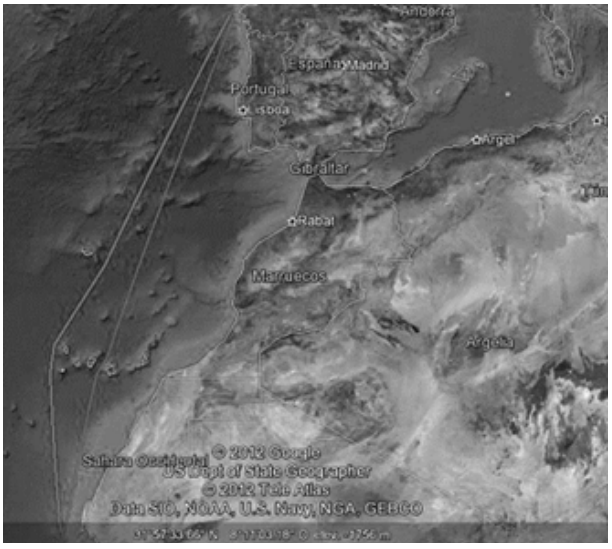
5. Discussion

The justification for this proposed expansion of the Canary Islands TSS lies in two distinct but clearly related facts: on the one hand, in the last episode of marine pollution caused by an oil spill from a ship, the case of the fishing vessel Oleg Naydenov in April 2015 and on the other hand in the existence, as is widely known, of both the sea current of the Canary Islands, southwest in direction and present almost all the year, and the north-east trade winds, also present throughout the year, causing a sea swell that moves towards the south-west with waves several meters high. The combination of the two events resulted in a surprising and unexpected contamination of the south of the island of Gran Canaria, in an area of high ecological and tourist value. Fig.10 shows the new TSS proposed and the directions of the prevailing winds and currents on the set of islands that form the archipelago of the Canary Islands.

If a spill were to be caused by any vessel in transit in the area where the installation of the new TSS is proposed, the above-mentioned current and winds would collaborate in preventing this spillage from coming near the island coasts as they would move it towards the west, that is, they would move it away from the archipelago.

If in contrast, the spill should occur in any of the current TSS located between the islands of Tenerife, Gran Canaria and Fuerteventura (see Figure 5), since these routes cross right through the middle of the Canary Islands archipelago, it would be dragged towards the west, taking it directly towards one of the islands. Therefore, any episode of pollution in this area would have an environmental impact of enormous consequences reaching the coasts of the islands most to the west: Gran Canaria, Tenerife, El Hierro, La Gomera and La Palma. Therefore these schemes already in existence would be left only for ships that are in transit to or from any of the ports of the islands. As a result of diverting traffic from the western part of the Canary Islands forcing it to sail in the new schemes, there will be a slight

Figure 11: General view of the route proposed towards the north and current route.



Source: Authors on Google Earth

elongation in the mileage of the ships since the previous route is more direct than the proposed route and therefore shorter.

In order to calculate what this diversion involves, let us take as an example the asphalt tanker "Mar Paula", whose daily fuel consumption is 8 tons and whose maximum speed is 12 knots, as can be seen in Fig.11, which shows the new route and the old one, both heading towards the TSS of Finisterre.

The new route is 1,431 miles long while the current route is 1,392 miles, so the difference between the two is 39 nautical miles. At a speed of 12 knots there would be a delay of 3 hours and 15 minutes and a difference in consumption of 1.08 tons, figures which are negligible for a trip of these characteristics.

Considering the new route proposed, and in compliance with the Spanish legislation on the establishment of a monitoring and information systems for maritime traffic (Government of Spain. Ministry of Development, 2010), some points along the coast of the nearest islands which are protected from the prevailing winds and currents could be established as ports of refuge for vessels in need of assistance.

6. Conclussions

1. The geographical situation of the Canaries archipelago means that its waters are an obligatory route of passage for the great ocean routes between Europe, Africa and Asia, as well as for all those ships which set sail from the Mediterranean ports and whose ports of destination are in Central America and South America.

2. The declaration of the Canary Islands by the IMO as a PSSA meant that regulatory measures were established in its waters on compulsory vessel notification (CANREP) and on routeing, with two new maritime traffic separation schemes (IMO, 2006) between the islands of Tenerife and Gran Canaria

and between Gran Canaria and Fuerteventura, as well as several areas of navigation to avoid, which the coast of the Canary islands did not have until that moment.

3. One of the main fears in the face of a spill of crude oil in the archipelago are the ocean currents since several of these converge in the area with different directions and intensities.

4. The General Provisions on Ships' Routeing of the IMO, gathered in the document entitled "Ships' Routeing", state that it is the responsibility of the coastal States to design or modify any TSS that is wholly or partially located within its jurisdictional waters or close to them.

5. With the introduction of the new TSS proposed, if a spill were to be caused by any vessel in transit in the area where the installation of the new TSS is proposed, the prevailing currents and winds would collaborate in preventing this spillage from coming near the island coasts as they would move it towards the west, that is, they would move it away from the archipelago.

6. The implantation of the new TSS would not involve a significant increase in trip times or expenses for vessels sailing through them, as compared to the current routes. 7. All those vessels that do not have as their origin or destination any port of the Canary Islands would be forced to pass through the new TSS and to report to the WESTCANREP reporting system. Otherwise, they would use the existing TSS.

8. The introduction of the new TSS would be a major step for the protection of the marine environment, wildlife, the coasts and therefore tourism in the Canary Islands, largely eliminating the threat to the coasts of the islands currently posed by the transit of merchant ships between the islands.

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