

**BLUE AMAZON MANAGEMENT  
SYSTEM (SISGAAZ): SOVEREIGNTY,  
SURVEILLANCE AND DEFENSE OF THE  
BRAZILIAN JURISDICTIONAL WATERS**

**ISRAEL DE OLIVEIRA ANDRADE  
ANTÔNIO JORGE RAMALHO DA ROCHA  
LUIZ GUSTAVO AVERSA FRANCO**

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**ISRAEL DE OLIVEIRA ANDRADE<sup>2</sup>  
ANTÔNIO JORGE RAMALHO DA ROCHA<sup>3</sup>  
LUIZ GUSTAVO AVERSA FRANCO<sup>4</sup>**

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2. Researcher at Ipea. E-mail: <israel.andrade@ipea.gov.br>.

3. International Relations professor and member of the Group for Studies and Research in International Security (Gepsi), at the University of Brasília (UnB). E-mail: <antonio.ramalho@gmail.com>.

4. Researcher at the National Development Research Program (PNPD) of Ipea. Professor of International Relations at the Centro Universitário do Distrito Federal (UDF). Member of Gepsi/UnB. E-mail: <luizgafranco@gmail.com>.

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## ABSTRACT

Brazil is a country with a maritime vocation, whose development is intrinsically associated with the sea. The Brazilian coast and jurisdictional waters' extension constitute a challenge on themselves to the national defense. The presence of fundamental potentialities for the country, such as valuable natural resources, important urban centers and large population concentrations along the coast, and communication routes underline the importance of watching and protecting this area, called Blue Amazon. In order to provide adequate means to protect this large area, the Navy has developed strategic programs. One of these programs is the Blue Amazon Management System (SisGAAz), which currently goes through a reformulation due to the country's budgetary restraints. This study aims to demonstrate the importance of developing and implementing SisGAAz to monitor the Blue Amazon. It also discusses the implications of its reformulation, as well as the possible alternatives.

**Keywords:** national defense; science, technology and innovation; Brazilian Navy; Blue Amazon; sea power; public policy.

## 1 INTRODUCTION

Covering approximately 70% of the planet's surface, the sea is seen as "a universe of riches still little known and explored", as well as "a natural and historical route of trade (...) bringing competitors and commercial partners together through telecommunications technology and opposing interests on the riches it holds" (More, 2013, p. 107). Since its origins, Brazil has shown itself to be a country with a maritime vocation, with national development historically dependent on the sea (even if the Brazilian maritime mentality is not yet proportional to this vocation).<sup>1</sup> In addition, because it holds one of the largest freshwater reserves in the world, the country's river waters (rivers and lakes) are of considerable importance for transportation and for the country's economy.

Brazil's maritime dimensions highlight the importance of the sea for Brazil: its coastline extends for 8.7 thousand kilometers, containing 68 ports, and is home to more than half of the country's population and gross domestic product (GDP) (Aguiar, 2017). In addition to the coastal region, Brazil also has 4.5 million square kilometers of jurisdictional waters that stand out for the presence of important natural riches – notably, 95% of oil and 83% of natural gas – and key trade and communication lines – 95% of Brazil's foreign trade passes through these waters (Andrade and Franco, 2018). It is important to be aware of these facts, since the physical geographic space constitutes the scenario for the construction of maritime strategies around the world (Holmes, 2014).

In order to "alert Brazilians of the importance of an area of greater dimensions than the Continental Amazon" (Barbosa Júnior, 2012, p. 219), the Brazilian Navy (MB) coined the expression Blue Amazon,<sup>2</sup> "a political-strategic concept that supports a robust economic development, supported by overcoming challenges in the political, strategic, economic, scientific, environmental, and social fields" (op. cit., p. 223).

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1. Maritime Mentality Program. Available at: <<https://bit.ly/2QbVGkg>>. Accessed on: Feb 8, 2018.

2. Blue Amazon is defined as the region comprising the sea surface, the waters overlying the seabed, the marine soil and subsoil contained in the Atlantic extension that projects from the coast to the outer limit of the Brazilian continental shelf (CS) (Brazil, 2016b, p. 171).

To fulfill its institutional mission – to prepare and employ naval power (a sub-component of maritime power)<sup>3</sup> as part of national defense – the Navy develops, through its strategic programs, means of action that allow it to maintain surveillance and control over Brazilian jurisdictional waters (AJB). Among such programs is the Blue Amazon Management System (SisGAAz), whose main purpose is the integrated monitoring and control of the international search and rescue (SAR) area under the responsibility of the MB, contributing to its ability to timely respond to threats, aggression, illegality, emergencies, or environmental disasters (Aguiar, 2017). Thus, this system will contribute to increasing the situational awareness of national authorities in these areas, improving their monitoring and control capacity and, consequently, their surveillance and defense of these spaces.

In addition to its importance for the surveillance of the AJBs, the system stands out for being a highly technological-intensive program, a fact that should be emphasized, since technology constitutes an important part of maritime power in the 21st century, directly influencing the distribution of capabilities among navies around the world (Till, 2009). However, despite its importance for the security and defense of the AJBs, the program, which began in 2009, has been undergoing a reformulation phase since 2015 for budgetary reasons, amid the economic crisis in which the country was immersed.

The objective of this study is to demonstrate the importance of the development and implementation of SisGAAz for Blue Amazon surveillance, presenting the main implications of its reformulation, as well as possible alternatives, in order to justify its permanence in the near future. To accomplish this goal, the work is structured in five main sections, including this introduction. The second section presents a brief characterization of the Blue Amazon, including its legal definitions and geographical delimitations, as well as its main potentialities and vulnerabilities. The third section focuses on the treatment given to the Blue Amazon by national defense policies, as well as the main surveillance and control systems in place. The fourth section is dedicated to the evaluation of SisGAAz, describing it, presenting its history and pointing out alternatives for its implementation. Finally, the conclusion presents the final considerations, as well as the main results and implications for public policies.

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3. A country's maritime power is composed of its navy and merchant marine. Geoffrey Till (2009, p. 83, our translation) defines maritime power as the ability to influence the behavior of others by what one does on and from the sea.



## 2 BLUE AMAZON: SURVEILLANCE AREA OF THE BRAZILIAN WEALTH IN THE SEA

In its origin, the main justification for SiSGAAz lies in the observation of data about Brazilian maritime power. For this, a brief characterization of the Blue Amazon is necessary, highlighting its potentials and vulnerabilities. Such characterization is necessary because, despite Brazil having a “maritime vocation” in its origins, “due to conjunctural factors, (...) there was, within the Brazilian population, a degradation of the maritime mentality, to the point that, nowadays, Brazilians, in their majority, think of the sea only in a ludic way”.<sup>4</sup> In fact, there is a “lapse of perception (...) in relation to issues of the sea” (More, 2013, p. 106),<sup>5</sup> which must be mitigated, since “the maritime environment achieves greater relevance for Brazil; because, below the Equator, observing the occupations of Earth spaces, we find that the predominance of the oceans is amplified” (Barbosa Júnior, 2012, p. 213).

### 2.1 Legal definitions and geographical delimitations of Brazilian Jurisdictional Waters

The BSA extend over approximately 3.5 million square kilometers. Their delimitation is based on the norms of the United Nations Convention on the Law of the Sea (UNCLOS), which divides them into four parts: i) territorial sea; ii) contiguous zone; iii) exclusive economic zone (EEZ); and iv) continental shelf – CS (figure 1). Besides these spaces, the AJB include internal waters and maritime spaces, in which Brazil exercises jurisdiction, to some degree, over activities, people, installations, vessels and living and non-living natural resources found in the liquid mass, on the seabed or subsoil, for the purposes of control and inspection, within the limits of international and national legislation. These maritime spaces include the band of two hundred nautical miles, counted from the baselines, plus the waters overlying the extension of the CS beyond two hundred nautical miles, where it occurs.

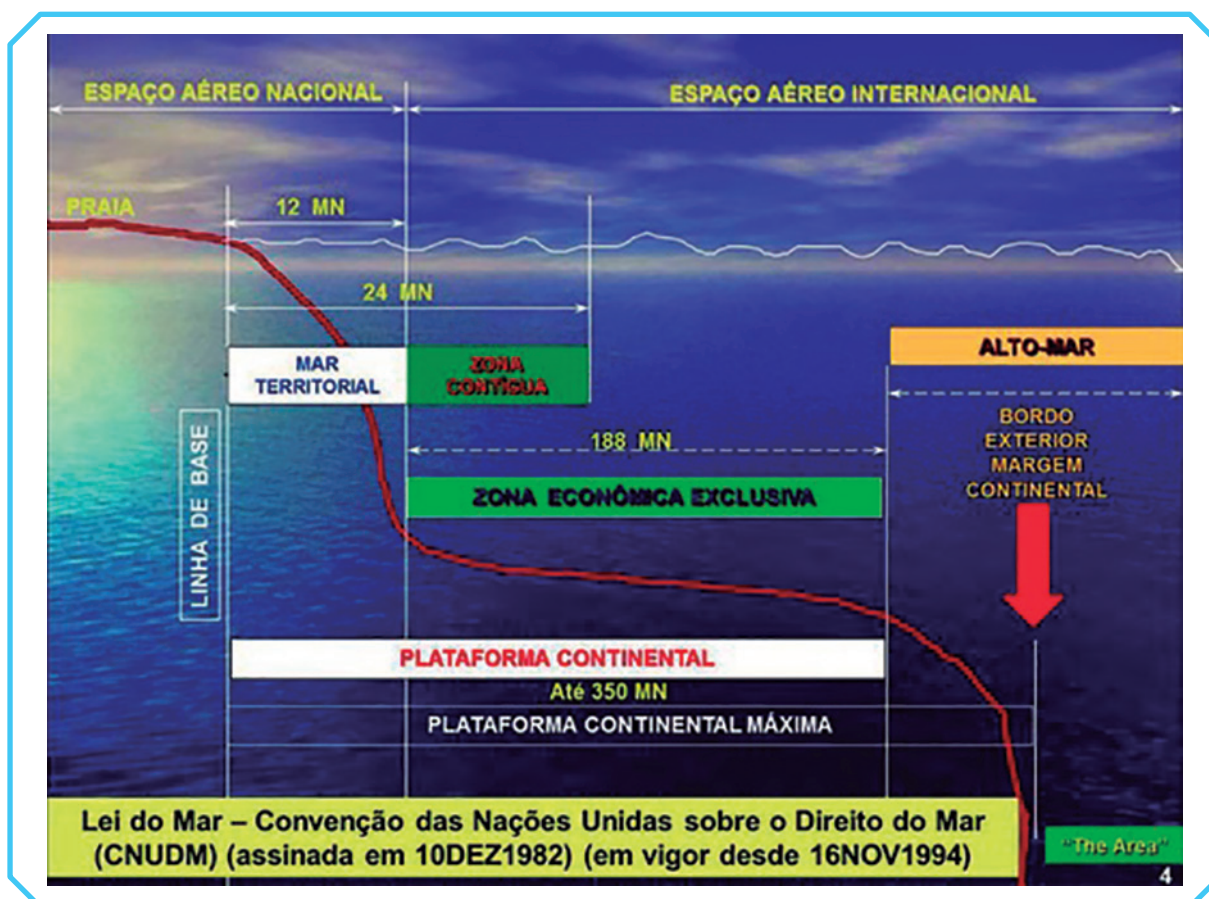
4. Maritime Mentality Program. Available at: <<https://bit.ly/2QbVGkg>>. Accessed on: Mar. 1st, 2018.

5. According to Rodrigo More (2013, p. 106-107), “nautical leisure and tourism, clean beaches for bathing, the richness of the pre-salt layer of oil are valid perceptions of the importance of the sea”, to which are also added, “mining of the marine soil and subsoil, energy production, defense and national security; marine bioprospecting, protection of biodiversity and the marine environment; innovation, research and technological development of equipment and substances from living and non-living resources of the sea; development of technologies for oceanographic, climatological and biotechnology applications; protection and research of living species, such as fish farming and mariculture; control of coastal occupation and urban and environmental studies of the impact of cities on protected areas (i.e. mangroves) and the ocean”.



**FIGURE 1**

Division of maritime spaces according to UNCLOS



Source: Arruda (2014, p. 22).

Adapted by: Julio Soares de Moura Neto.

According to UNCLOS, the territorial sea is defined as “an area of adjacent sea” in which the “sovereignty of the coastal State extends beyond its territory and internal waters”, including the overlying airspace and the seabed and subsoil (Brazil, 1995, art. 2, §§ 1 and 2), extending up to twelve nautical miles (NM) from the “baselines” (op. cit., art. 3).<sup>6</sup> Furthermore, the convention defines as internal waters those “waters lying inside the baseline of the territorial sea” (op. cit., art. 8, § 1), that is, rivers and lakes located in the national territory, which also have important ports and communication routes.

Contiguous to the territorial sea, between 12 and 24 MN of the baselines, is the contiguous zone. It is a space where “the coastal state may take the necessary control measures to (...) prevent infractions

6. The definitions and possible methods for determining baselines are provided in articles 4, 5, 7 and 14 of the UNCLOS.

of customs, tax, immigration, or sanitary laws and regulations in its territory or territorial sea”, as well as “repress infractions of laws and regulations in its territory or territorial sea” (Brazil, 1995, art. 33).

The third part is the EEZ, “a zone situated beyond and adjacent to the territorial sea”, governed by a “specific legal regime” that defines “the rights and jurisdiction of the coastal State and the rights and freedoms of the other States” (Brazil, 1995, art. 55), extending up to 200 MN from the baselines (op. cit., art. 57). In this zone, the coastal state has “sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, living or non-living, of the waters above the seabed, the seabed, and its subsoil”, besides the rights of “exploring and exploiting the zone for economic ends” (op. cit., art. 56, § 1, a).

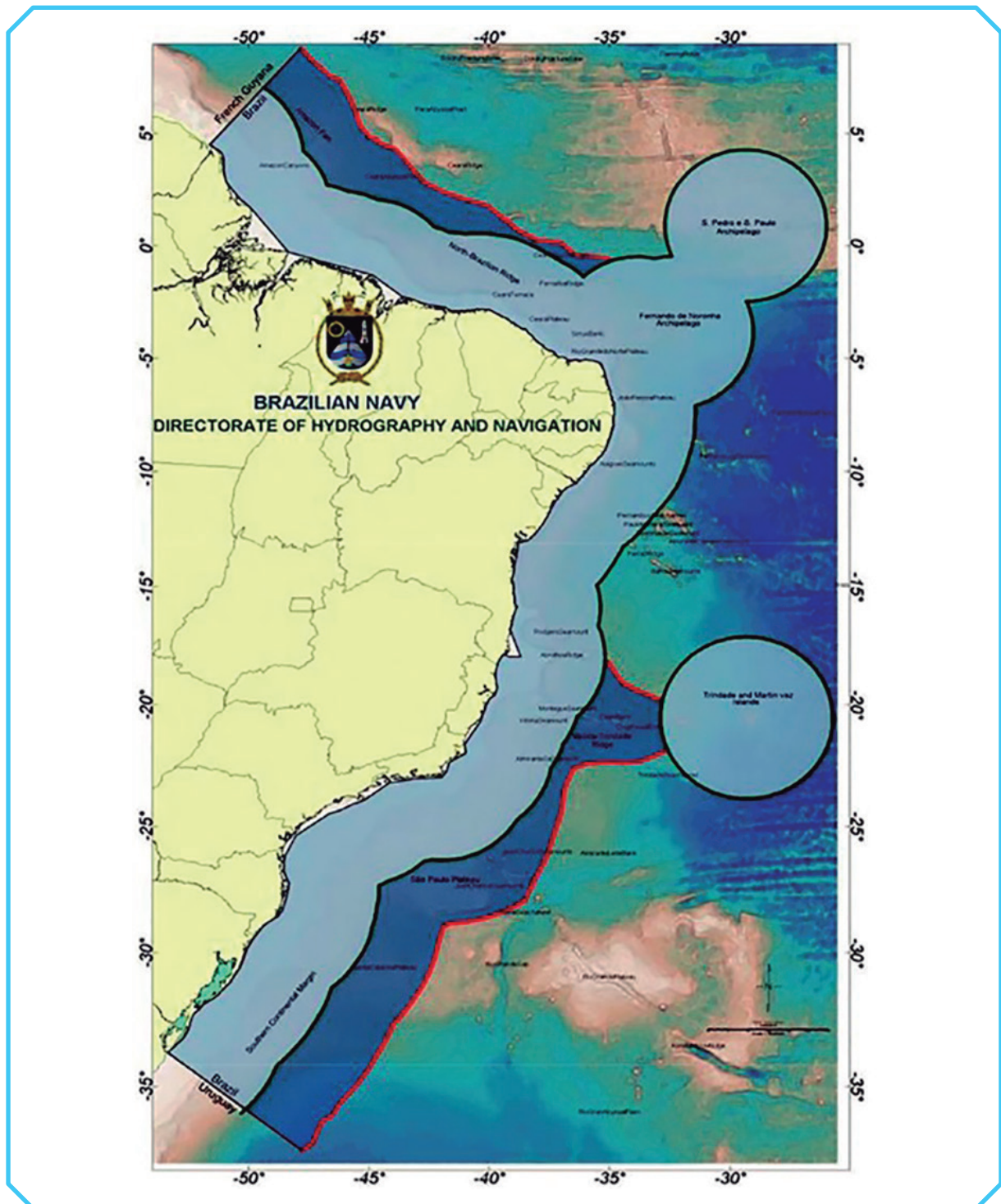
Moreover, the UNCLOS establishes the “continental shelf of a coastal State” as being “the bed and the subsoil of the submarine areas which extend beyond its territorial sea as far as the natural extension of its land territory up to the outer edge of the continental margin” (Brazil, 1995, art. 76, § 1). The convention also defines that its “outer limit (‘) shall not exceed 350 nautical miles from the baselines from which the breadth of the territorial sea is measured” (op. cit., art. 76, § 6).<sup>7</sup> There is also the possibility of extending the CS to up to 350 MN “on the basis of equitable geographical representation” (op. cit., art. 76, § 8), where the state “exercises sovereign rights (...) for the purpose of exploring and exploiting its natural resources” (op. cit., art. 77).<sup>8</sup>

Based on the provisions of the UNCLOS and in accordance with its norms, the Brazilian State defined, through Law No. 8.617, of January 4, 1993, and Decree No. 1.530, of June 22, 1995, the limits of the AJB (Brazil, 1993; 1995). This law, besides reproducing parts of the text of the convention, brings fundamental provisions for the management of jurisdictional waters. The geographical delimitation of such spaces is presented by figure 2.

7. The parameters for the precise definition of the limits of the continental shelf are in art. 76, §§ 4 and 5.

8. Including “mineral and other non-living resources of the seabed and subsoil as well as living organisms belonging to sedentary species, that is, those that during the capture period are immobile on the seabed or subsoil or can only move in constant physical contact with the seabed or subsoil” (Brazil, 1995, art. 77, § 4).

**FIGURE 2**  
Geographical delimitation of Brazilian maritime spaces



Source: Brazilian Navy.

In this sense, the law assures “ships of all nationalities the right of innocent passage in Brazilian territorial waters”,<sup>9</sup> being such ships “subject to the regulations established by the Brazilian government” (Brazil, 1993, art. 3). With regard to the EEZ, the law states that “marine scientific research (...) may only be conducted by other States with the prior consent of the Brazilian government, under the terms of the legislation in effect that regulates the matter” (Brazil, 1995, art. 8, sole paragraph). Besides, according to the law, the “realization by other States (...) of military exercises or maneuvers, particularly those involving the use of weapons or explosives, can only occur with the consent of the Brazilian government” (op. cit., art. 9).

Regarding the CS, the law defines that “marine scientific research (...) may only be conducted by other States with the prior consent of the Brazilian government, under the terms of the legislation in force that regulates the matter”, having the Brazilian government the “exclusive right to authorize and regulate the perforations on the continental shelf, whatever their purposes” (Brazil, 1993, art. 13, §§ 1 and 2). Furthermore, the “layout of the line for the laying” of submarine cables and pipelines in the CS “will depend on the consent of the Brazilian government”, which can “establish conditions for the laying of cables and pipelines that penetrate its territory or territorial sea” (op. cit., art. 14, §§ 1 and 2).

It should be mentioned that Brazil’s CS extends, in several places, beyond the 200 MN limit, where there are strategic natural resources for the country (figure 3).<sup>10</sup> For this reason, the Brazilian State pleads for recognition of the extended CS within the UNCLOS norms. This is an area of 953,525 km<sup>2</sup> (Figueirôa, 2014), which, if approved, would raise the total area of the AJB to more than 4.5 million square kilometers, which is equivalent to more than half of Brazil’s continental territory (Arruda, 2014).<sup>11</sup> In this sense, in

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9. According to the law, “passage will be considered innocent as long as it is not detrimental to peace, good order, or the security of Brazil, and must be continuous and rapid” (Brazil, 1993, art. 3, § 1).

10. It should be noted that the UNCLOS foresees this possibility, upon specific and detailed request, bearing in mind parameters that combine the depth of the oceans from the baselines and the intended extent.

11. For more information on Brazil’s claim to extend its CS, see Figueirôa (2014).



May 2004, the Brazilian government submitted its proposal for the extension of the CS to the Commission on the Limits of the Continental Shelf (CLPC), obtaining a response from it in April 2007, which presented restrictions concerning about 19% of the requested area.<sup>12</sup>

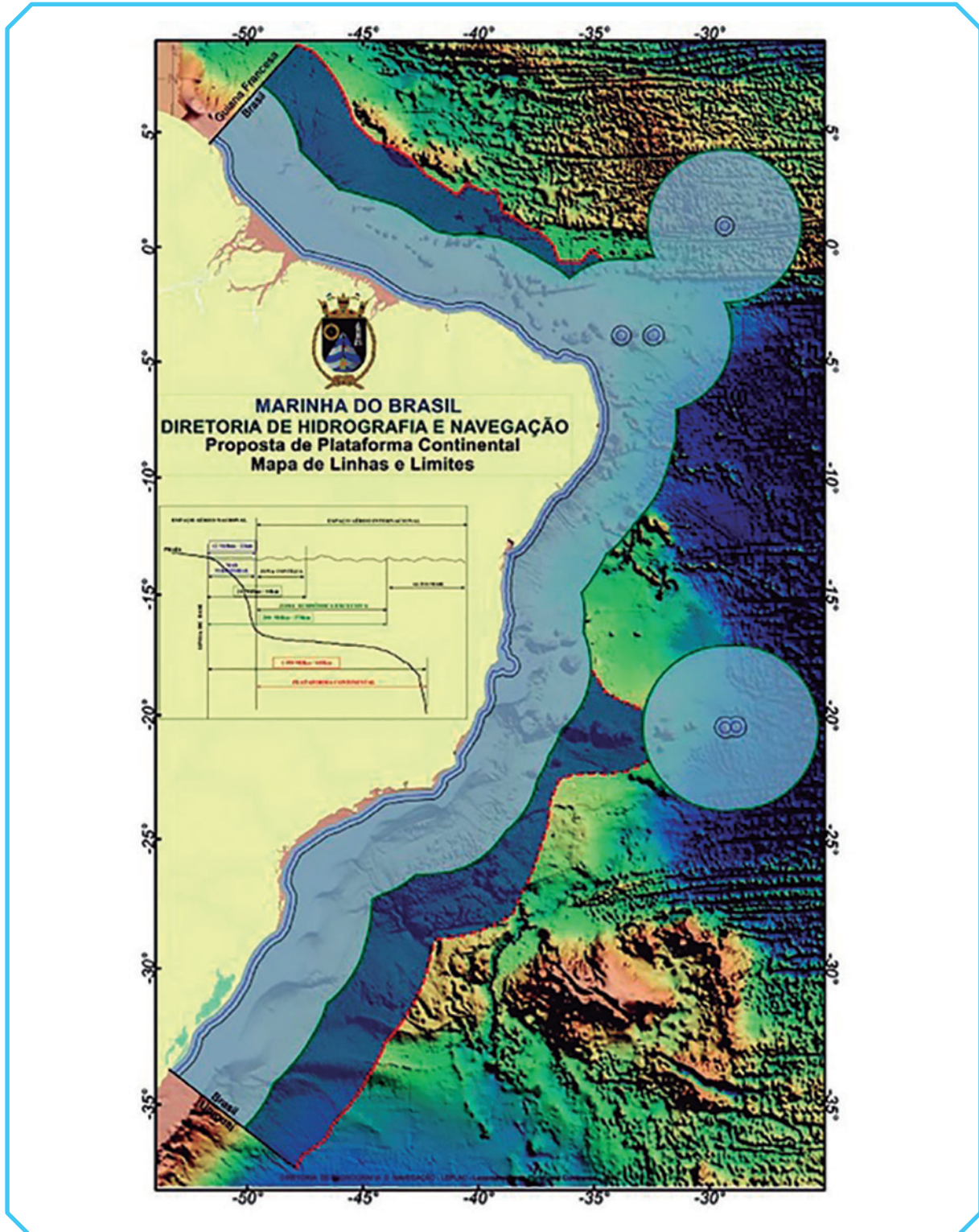
Thus, in July 2008, the Inter-ministerial Commission for the Resources of the Sea (CIRM) decided to elaborate the Revised Proposal for the Outer Limit of the Brazilian CS to be sent to the CLPC. To facilitate the elaboration, the Brazilian coast (and the country's CS) was divided in three regions: south, equatorial and oriental. In this sense, the proposal was divided in partial proposals, each one referring to one of the three regions, so that the partial proposal of the southern region was forwarded to the CLPC in April 2015, the proposal of the equatorial region was ready in May 2016 to be forwarded, soon, to the commission and, finally, the proposal of the eastern region is being prepared.<sup>13</sup>

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12. It should also be added that Brazil used this regime not only as an instrument to promote its exclusive interests, but also in the execution of its foreign policy, through international cooperation initiatives, aiming at sharing its expertise with other countries, especially those bordering the South Atlantic, to register and expand their respective jurisdictional waters.

13. Brazilian CS survey plan. Available at: <<https://bit.ly/2zCJSgl>>. Accessed on: May 10, 2018.

**FIGURE 3**  
Brazilian proposal for an extended continental shelf



Source: Directorate of Hydrography and Navigation/Brazilian Navy.

## 2.2 Potentialities and vulnerabilities of the Blue Amazon

Besides making up a considerable portion of the national territory, AJBs possess a series of natural and mineral riches, as well as population centers and vital communication lines and trade routes for Brazil. In the words of Geoffrey Till (2009, p. 37), “being maritime brings vulnerabilities as well as opportunities”. Thus, the existence of these assets, together with associated vulnerabilities, risks and threats, is what justifies the presence of the MB, including the need for the force to be endowed with adequate means of surveillance and control of these areas.

In this sense, an important aspect of the AJBs to be emphasized is the concentration of population, as well as the strong presence of Brazilian productive infrastructure in coastal regions. According to data from the Brazilian Institute of Geography and Statistics (IBGE), approximately 80% of the country’s population is located within 200 km of the ocean coast. In addition, about 90% of the industrial production and infrastructure and about 80% of the Brazilian production is located in these same regions. Such factors are enough to highlight “the need for the protection of this vital Brazilian area” (Silva, 2012, p. 14).

In addition, a fundamental strategic issue is added, as raised by Alfred Thayer Mahan, still in the nineteenth century, which guides the geopolitical debate ever since. On the one hand, the presence of these riches and potentials and the strategic position that the South Atlantic occupies in the world, as seen during the Second World War (1939-1945), justify the need to protect it in every way. On the other hand, large and medium-sized extra-regional powers are globally positioned and also deploy in this region, either permanently, with military bases, or temporarily, through the presence of maritime platforms and fishing or research vessels in adjacent international waters (figure 4).



**FIGURE 4**  
British military bases in the South Atlantic



Source: Brazilian Navy.

Besides US and British bases in the South Atlantic, China has recently been requesting authorization from the United Nations to explore the seabed in this region. Thus, it is not unreasonable to think that the South Atlantic may be the object of dispute in the more distant future, as is the case today in the South China Sea, where territorial disputes, for obvious reasons, are more complex and immediate.

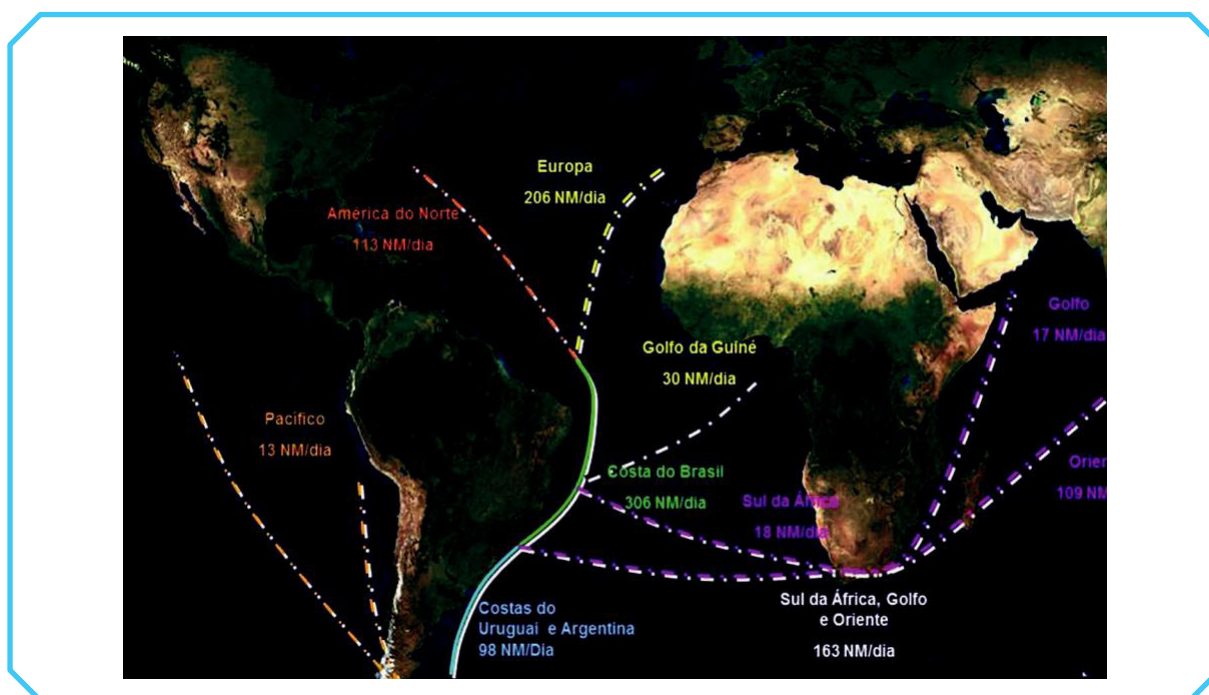
Also of extreme importance are the natural resources existing in the Blue Amazon, especially oil and natural gas. In 2002 the reserves of these resources totaled 9.81 billion barrels, of which 8.87 billion came from the AJB.<sup>14</sup> With the discovery of the pre-salt, a few years later, these numbers increased even more. According to the National Agency of Petroleum, Natural

14. *Vertente Econômica*. Available at: <<https://bit.ly/2FYsjgJ>>. Accessed on: Dec. 21, 2017.

## DISCUSSION PAPER

Gas and Biofuels (ANP), 89.04%<sup>15</sup> of Brazilian oil and 76.12%<sup>16</sup> of natural gas are extracted in fields located in jurisdictional waters (Brazil, 2016a).

Another very important potential of the Blue Amazon are the Maritime Co-Communication Lines (LCM) that pass through it, enabling the flow of almost 95% of Brazilian foreign trade,<sup>17</sup> representing about US\$ 480 billion in transported goods (Arruda, 2014, p. 41-42). It draws attention to the fact that almost all of the country's foreign trade is transported by sea, highlighting "the full dependence on maritime communication lines" (Silva, 2012, p. 14) as one of Brazil's main vulnerabilities in its maritime space (figure 5).

**FIGURE 5****Maritime lines of communication in Brazilian foreign trade**

Source: Arruda (2014, p. 41).

Adapted by: Julio Soares de Moura Neto.

15. Average for the first quarter of 2016, according to ANP data.

16. Average for the first quarter of 2016, according to ANP data.

17. According to data from the Ministry of Development, Foreign Trade and Services (MDIC), in 2017, only 13.52% of Brazilian exports and 10.81% of Brazilian imports are transacted with countries with which Brazil has a land border (Argentina, Bolivia, Colombia, Guyana, Paraguay, Peru, Suriname, Uruguay and Venezuela). Of these, only Argentina is among the ten largest exporters and importers of Brazilian goods.

In this sense, the “loss of control of maritime traffic” would be a “disastrous event for the national economy” (Silva, 2012, p. 14), which reinforces the need for surveillance and control of the Blue Amazon by the Brazilian state. Thus, “the defense of maritime communications remains a major concern, since they are still militarily vital and central to the health of economies forced by largely geographic circumstances to be maritime” (Till, 2009, p. 100). It is precisely in this aspect that monitoring and control systems prove highly relevant to national defense.

### **3 BLUE AMAZON AND NATIONAL DEFENSE: PUBLIC POLICIES, CONCEPTS AND SURVEILLANCE SYSTEMS AIMED AT BRAZILIAN JURISDICTIONAL WATERS SECURITY**

The previous section made clear the strategic importance of the Blue Amazon for Brazil and the need for national defense to ensure its surveillance and protection. In fact, “Brazil must pay more attention to its vast coastal zone, increasing the state presence in the region to ensure the recognition of its sovereignty and discipline the exploitation of maritime resources” (Penna Filho, 2015, p. 150). This task falls mainly to the MB, which has sought the appropriate means to accomplish it, including through the development of surveillance systems that ensure the control of the AJB. The search for such systems, however, is made from the main public policies dedicated to defense issues, discussed below.

#### **3.1 Public policies: the structuring documents of national defense**

The main objectives, guidelines and projects of national defense are expressed in the three structuring documents of the area: National Defense Policy (PND), National Defense Strategy (END) and National Defense White Paper (LBDN). The first two present important provisions and guidelines for defense (in general) and for the Blue Amazon (in particular).

First, the PND stands out for being “the country’s highest-level document on defense matters” and for defining “the highest objectives in this area” (Brazil, 2016c, p. 8). In this sense, in its analysis of the domestic environment, it highlights the “Brazilian natural maritime vocation (...) supported by its extensive coastline, the magnitude of foreign trade practiced through it, and the undeniable strategic importance of the South Atlantic”, highlighting the

“vital relevance to the country” of the Blue Amazon, given its “high potential of living and non-living resources, among these, the largest oil and gas reserves in Brazil” (op. cit., p. 4).

Furthermore, one of the central components of the PND are the National Defense Objectives (OND), together with the guidelines that guide their fulfillment. One of these objectives is, precisely, to “ensure defense capabilities, for the fulfillment of the constitutional missions of the Armed Forces” (Brazil, 2016c, p. 12). This, in turn, translates into the need to “provide the Armed Forces with the necessary capabilities to conduct surveillance, control and defend the Brazilian territory, jurisdictional waters and airspace, and provide the security of maritime lines of communication”, which includes “the adequate equipping of the Armed Forces, using modern technologies and efficient equipment and in quantities compatible with the magnitude of the tasks assigned” (idem, ibidem).

In other words, the PND correctly frames the protection of the South Atlantic within an integrated vision of national defense, necessary to substantiate the promotion of sustainable socioeconomic development of the nation, including in its maritime space. To this end, the PND specifies the political objectives and their interaction, and provides the means necessary to execute this public policy.

As a complement to the PND, the END “establishes guidelines for the adequate preparation and training of the Armed Forces, in order to guarantee the country’s security both in peacetime and in crisis situations”.<sup>18</sup> Thus, it defines medium and long term strategic actions aimed at the modernization of national defense structures, which includes the definition of guidelines and orientations for the performance of the forces in the fulfillment of their objectives.

In this sense, the document presents defense strategies (ED), which are “directly aligned” to the ONDs presented by the PND, and are also complemented by defense strategic actions (AED), “which aim to guide the measures that should be implemented towards achieving the National Defense Objectives” (Brazil, 2016c, p. 33).

In this context, the second ED, Strengthening Dissuasion Capacity, is complemented by the eighth and ninth ED, “demonstrate the ability to counter the concentration of hostile forces near the borders, the limits of Brazilian jurisdictional waters and the national airspace” and “develop the capabilities of monitoring and controlling airspace, cyberspace, territory, Brazilian

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18. National Defense Strategy. Available at: <<https://bit.ly/36Xa4Ty>>. Accessed on: Feb. 15, 2018.

jurisdictional waters and other areas of interest” (Brazil, 2016c, p. 32-34), respectively. Moreover, the strategy presents general defense fundamentals, among which is included the Protection capability. This capability is especially important for the Blue Amazon, since its strengthening “requires the adequacy of the means and methods of surveillance over the national territory, including the Exclusive Economic Zone, the continental shelf, and the overlying outer space” (op. cit., p. 19).

Besides the ED and the AED, aimed at national defense as a whole, the strategy presents specific provisions for each of the forces. In this sense, when referring to the MB, the document determines that “deterrence against any concentration of hostile forces in waters of national interest” is the “priority objective of the maritime security strategy” (Brazil, 2016c, p. 26). The strategy also expresses concern about the “intensification of occurrences of illicit acts at sea, in the form of piracy, human and drug trafficking, smuggling, illegal fishing, environmental crimes, and others”, making it necessary for the Navy “to have means capable of detecting, identifying, and neutralizing actions that pose a threat in Brazilian jurisdictional waters” (idem, *ibidem*).<sup>19</sup> Thus, for the “fulfillment of this set of attributions”, “basic tasks of Naval Power” are established, among which are “monitoring the sea, including from space”, which “must integrate the Navy’s repertoire of operational practices and capabilities” (idem, *ibidem*).

These are, in summary, the highest level legal provisions that frame the need for monitoring the seas and promoting the permanent situational awareness necessary for the proper fulfillment of the Brazilian State’s responsibilities in relation to the protection of its jurisdictional waters.

Besides national defense in general, the MB has attributed increasing importance to the issue of science, technology and innovation (ST&I). Such importance can be seen by the publication of a STI strategy by the MB, which “publicly signals the scientific-technological areas through which the components of the Triple Helix – government, academia and industry – may contribute to the development and improvement of the Force”.<sup>20</sup> Having as its “most important

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19. The strategy also emphasizes the need for such means to be exclusively national, in order to guarantee autonomy.

20. Speech delivered by Admiral Bento Costa Lima Leite de Albuquerque Junior at the Navy Command (Brasilia/DF), on April 25, 2018, on the occasion of the celebration of Science, Technology and Innovation Day in the Brazilian Navy.



characteristic” its “alignment with the high level conditioning documents” (PND, END, LBDN, Policy on Science, Technology and Innovation for National Defense – PCTIDN, National Strategy of Science, Technology and Innovation – ENCTI), this strategy presents “the rationalization of the use of MB resources (...), resorting, when necessary, to the other members of the ‘Triple Helix’” as the “philosophy that permeates the planning and control of research and development (R&D) actions of ST&I” (Brazil, 2017, p. 28-29).

The MB’s ST&I strategy is, thus, an “instrument of information for the actors, military and civilian, public and private, that participate, directly or indirectly, in the Brazilian Navy’s Science, Technology and Innovation System (SCTMB)” (Brazil, 2017, p. 17), thus achieving “three main desired effects”: the “coordinated direction of the SCTMB, primarily to meet the needs of the Navy of Tomorrow and the Future”;<sup>21</sup> the “presentation of the vision and strategy of the ST&I sector of the MB to decision-makers, key players, partners, clients, and executors”; and the “optimization of the application of financial resources managed by the ST&I sector for the execution of its portfolio of projects that meet the strategic programs of interest to the Force” (idem, ibidem).

The strategy envisions the following challenges ahead for the SCTMB: the “search for scientific and technological mastery in sensitive or strategic areas of interest to the MB (...),<sup>22</sup> with emphasis on the design, construction and operation of nuclear propulsion submarines”; the “monitoring and control of Brazilian jurisdictional waters and other maritime areas of interest”; the “security and safety of the Brazilian territorial waters and other maritime areas of interest”, with emphasis on the design, construction and operation of nuclear propulsion submarines”; the “monitoring and control of Brazilian jurisdictional waters and other maritime areas of interest”; “cyber security and defense”; the “continuous acquisition of knowledge about the different operational environments of interest to the MB”; the “improvement of the combatant’s physical and psychological health and performance before, during and after naval warfare operations”; the “capacity building for nuclear, biological, chemical, radiological and explosive artifact defense”; the “overcoming of barriers and

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21. The concepts of the Navy of Tomorrow and the Navy of the Future are in Brazil (2017, p. 16).

22. They are: command, control, communications, computer, intelligence, surveillance, and reconnaissance systems; cyber defense and security; operational environment; nuclear and energy; naval, aircraft, and Marine platforms; combatant performance; and nuclear, biological, chemical, radiological, and explosive artifact defense (Brazil, 2017, p. 43).

limitations of access to technologies, goods and services of interest to the Navy's strategic projects"; the "uncertainties inherent to the continuous provision of human and financial resources for long-term ST&I projects"; and the "assurance of a continuous and efficient technological and knowledge management" (Brazil, 2017, p. 20-21).

This is intended to make the SCTMB a "dynamic, harmonic, integrated, synergetic, interdisciplinary and adaptive system" (Brazil, 2017, p. 23), endowed with "highly trained human resources and compatible infrastructure, focused on reducing external dependence to meet the technological demands" of the responsible military organizations (idem, ibidem).

The strategy also highlights the imperative to be implemented "through partnerships with civilian and military scientific and technological institutions, industry and academia", requiring "cooperation and coordination with the other singular forces and other areas of government" in order to act "at the technological frontier, seeking, whenever possible, the dual use – military and civilian – of technology" (Brazil, 2017, p. 35). It is also perceived that the STI&I infrastructure – both inside and outside the MB – "presents very high acquisition and ownership costs", requiring "close cooperation among all members of the Triple Helix, in order to provide mutual support and obtain synergistic effects that will enable the transformation of STI&I R&D projects into operational capabilities" (op. cit., p. 42).

### **3.2 Current Navy command and control systems**

It is clear, by reading the PND and the END, that the surveillance and control of the AJB are vital for the protection of the Blue Amazon and, consequently, constitute a mission of the MB. Therefore, it is necessary to evaluate the command and control systems available to the Navy, which can be integrated and/or used as a basis for the SisGAAz in the future.

Currently, the monitoring of the Blue Amazon is performed through the Naval Command and Control System (SisNC2), the main command and control system of the MB, based on the Theater of Maritime Operations Command Center (CCTOM) and operated by the Naval Operations Command (ComOpNav), located in Rio de Janeiro (RJ). Thus, SisNC2 "may be the main system of the future SisGAAz" (Manso, 2013, p. 74). The CCTOM is fed with data



collected by ships and aircraft (ANVs) of the MB and the Brazilian Air Force (FAB) in “naval or air patrol operations or even in transit” (Chaves Junior, 2013, p. 26). Thus, in order to “monitor non-military vessels, the database is fed by the Maritime Traffic Control System (Sistram), which receives information from various sources” (idem, ibidem).

Managed by the Brazilian Navy’s Maritime Traffic Control Command (Comcontram) in RJ, Sistram forms the structural basis of the AJB monitoring system, allowing the Brazilian government to track vessels in the SAR area under its responsibility. The information collected by this system is passed on, in turn, to SisNC2 by Comcontram. Sistram can also be used for surveillance and combat illegal fishing, piracy, drug and weapons trafficking due to its compatibility with “other similar control centers in the world” (Chaves Junior, 2013, p. 27). Such characteristics will make the system “an important link with SisGAAz” (Manso, 2013, p. 72).

Sistram is also supported by other integrated systems, including the Maritime Monitoring System in Support of Petroleum Activities (SIMMAP) and the Program for Satellite Tracking of Fishing Vessels (PREPS). SIMMAP was created due to the “increase in maritime traffic involved in oil and natural gas exploration and production activities along the Brazilian coast” (Chaves Junior, 2013, p. 29), aimed at increasing safety and preventing environmental accidents in these areas. Resulting from an agreement between the Directorate of Ports and Coasts (DPC) and the ANP, the system “identifies and monitors maritime traffic related to the oil and gas industry, through the tracking of vessels used in this activity” (idem, ibidem). In turn, the PREPS, constituted by joint initiative of the MB and the former Ministry of Fisheries and Aquaculture,<sup>23</sup> has the purpose of “monitoring, fisheries management and control of fishing fleet operations” (Chaves Junior, 2013, p. 30).

### 3.3 Maritime situational awareness

Arising from the concept of maritime domain awareness – developed in the United States of America after the September 11, 2001 attacks – the concept of maritime situational awareness

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23. Currently Secretaria da Aquicultura e Pesca do Ministério da Agricultura, Pecuária e Abastecimento (SAP/Mapa).

(MSA) was developed within the North Atlantic Treaty Organization (NATO) in late 2006.<sup>24</sup> It is a broader concept than the previous one, “adapting to the definitions used by other countries and allowing better cooperation” (Faria, 2012, p. 219). In general terms, the CSM is defined as

formation of the perception arising from the processing of all available data that may affect maritime lines of communication, the exploration and exploitation of living and non-living resources; the environment and the protection and defense in jurisdictional waters and the safeguarding of human life at sea and in the region of SAR responsibility, resulting in accurate, timely and relevant information (Brazil, 2014, p. A-8).

One of the main purposes of the CSM is to “provide interaction between government agencies, private companies and security forces, domestically and in the international community” (Faria, 2012, p. 219). Its main purpose is to “develop the capability to identify existing threats, as soon and as far away from the country as possible, through the integration of intelligence data, surveillance, observation, and navigation systems, interacting in the same operational framework” (op. cit., p. 220).

In this sense, the concept points to the imperative of developing “a structure that encompasses data collection, monitoring, sensors of naval and aerial means and the correct analysis of facts, allowing for a quick and accurate response”, a context in which navies assume an “increasingly relevant role” (Faria, 2012, p. 220). Thus, the fulfillment of the subsidiary attributions<sup>25</sup> by the MB contributes to the increase of the CSM in the country (op. cit., p. 220-225). However, the Navy’s current apparatus is still insufficient for this (idem, ibidem), making it necessary to improve the command and control systems. It is precisely this gap that SisGAAz seeks to fill, as will be examined in the next section of this paper.

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24. The attack on the USS Cole off the coast of Yemen in 2000 raised the issue in the scale of priorities of armed forces around the world, given the vulnerability associated with valuable war platforms, designed to clash with other equally powerful war machines, in the face of agile and inexpensive structures, made possible by the latest technological developments. This process has forced the militaries of many countries to rethink their long-term strategies, given the reemergence of insurgent tactics and asymmetric warfare.

25. These are: “to provide navigation safety; to implement and enforce laws and regulations at sea and inland waters; to act, through preventive and repressive actions, on the land border, at sea and inland waters, against cross-border and environmental crimes; and to cooperate with federal agencies in the repression of crimes related to the use of the sea, inland waters and port areas” (Faria, 2012, p. 225).

### **3.4 The Maritime Information Acquisition Situational Awareness System: the SisGAAz pilot project**

The Situational Awareness System by Maritime Information Acquisition (SCUA) is a software developed by the Navy Research Institute (IPqM), since December 2015, at the request of ComOpNav, in order to contribute to the increase of the CSM, due to the need to update the SisNC<sup>2</sup> to the precepts established in the NDS. The system – named after a seabird (Skua) known for its fierce way of defending its territory – basically consists of a 100% national technology tool that integrates information from various available systems and sensors.

SCUA was successfully employed during the Rio 2016 Olympic Games to assist maritime area control in both Guanabara Bay and the Rio de Janeiro coast. The main feature of this system is the possibility of staggered development of the system. It also has the potential to adapt to various budget scenarios.

Therefore, mainly due to the unfavorable outlook regarding financial resources, SCUA was officially adopted by the MB in the second half of 2018 as the pilot project for SisGAAz.

## **4 THE SISGAAZ**

Conceived as “a monitoring and control system related to the international concept of maritime security and for the protection of the Brazilian coast”, the SisGAAz was “designed to become the Navy’s main command and control system”, enabling “the management of sea-related activities that involve surveillance, monitoring, pollution prevention, natural resources, among others” (Brazil, 2016b, p. 60). Aiming at the expansion of the CSM, the system will allow, on the part of the MB, greater anticipation, which, “combined with the mobility and presence of the Brazilian Naval Power, will enable the defense of the AJBs” (idem, ibidem).

### **4.1 General description and background of the program’s development**

SisGAAz is considered one of the Navy’s most daring projects, and is also one of its strategic programs that stand out for its scientific-technological intensity (Andrade et al., 2019). Its main

objective is to continuously develop systems for monitoring and control of the AJB and the SAR area. The use of satellites, radars and sensing equipment is also foreseen for the monitoring of the Blue Amazon, through the integration of information and decision support networks. In this way, it will be possible to increase the safety and efficiency of surveillance and SAR operations in the AJB, besides contributing to the development of dual technologies – applicable to both defense and civilian areas (Brazil, 2012, p. 196-197). Furthermore, the previous analysis – through a study conducted by the Ezute Foundation – of monitoring and control systems in South Africa, Australia, Canada, France, India and Italy indicated that there are similarities between such systems and what is sought with the SisGAAz.<sup>26</sup>

It is important to emphasize that this program – as well as others considered strategic by the Armed Forces – is part of a broader context of rapprochement between national defense and ST&I policies, mainly due to the “search for autonomy” by defense (Andrade and Leite, 2017, p. 386), i.e., the effort to develop defense technologies, systems, and products (but of multiple applications) endogenously.<sup>27</sup> It should be noted, therefore, that there is an expectation of technological drag and creation of new service demands from the activities developed in the program, especially in the areas of civil engineering, transportation, security, and energy.<sup>28</sup>

The SisGAAz project began in 2009, aiming to meet the “demand for resources capable of efficiently carrying out monitoring, surveillance and defense activities in the Blue Amazon” (Chaves Junior, 2013, p. 12). As seen, its goal is to create a single and integrated monitoring system, based on existing systems. Therefore, it is not about reinventing the wheel, but innovating, enhancing the use of already available resources. In this context, the program is based on three pillars, associated with the MB’s main missions: “the priorities established by the END (...); the perception of the various threats foreseen in the context of the Blue Amazon (...); and (...) the safeguarding of human life at sea” (op. cit., p. 36). Furthermore, it is divided into two subsystems: the Blue Amazon Monitoring System (dedicated to prevention and control) and the Blue Amazon Protection System (dedicated to defense and reaction).

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26. Interview with Commander Marcos Vinicius da Silva Roberto, SisGAAz manager.

27. For further analysis about the importance of STI&I issues in the MB’s strategic programs, see Andrade et al. (2019).

28. Interview with Commander Marcos Vinicius da Silva Roberto, SisGAAz manager.

Thus, thanks to specific sensors and systems, the system will allow “the collection of data (monitoring), the fusion and processing of these, production of information to support the decision and finally decision making so that the available means can act (protection)” (Chaves Junior, 2013, p. 36).

Regarding its integration with other systems and platforms, the SisGAAz will be integrated with “other systems inside and outside the MB” (Manso, 2013, p. 68). Within the Navy, the SisNC2 stands out, which encompasses Sistram, among other systems; beyond the force, another system to be integrated is the Military Command and Control System of the Ministry of Defense (SISMC<sup>2</sup>/MD), which, in turn, brings together the Integrated Border Monitoring System (SisFron),<sup>29</sup> of the Brazilian Army (EB), and the Brazilian Aerospace Defense System (SisDABra) of the FAB. Furthermore, the SisGAAz is expected to be integrated with “systems of institutions not belonging to national defense, such as those linked to the ministries of Finance, Transportation, Mines and Energy, Science and Technology, Justice and others, as well as regulatory agencies and companies” (idem, *ibidem*).

The system will be fed with data from other sources, such as “beyond horizon radar (OTHR), FAB maritime patrol aircraft, unmanned aerial vehicles (UAV) and others” (Manso, 2013, p. 68-69). Finally, there is the possibility of interaction of SisGAAz with systems of other countries and international organizations, such as the Long Range Identification System (LRIT), of the International Maritime Organization, and the Trans-Regional Maritime Network (T-RMN).<sup>30</sup>

Besides these systems, according to Chaves Junior (2013, p. 38), “[f]undamental, also, will be the presence of a Brazilian Geostationary Satellite (SGB)”, as well as the “Remote Sensing Satellite (SERE), which will also feed the SisNC<sup>2</sup>”.<sup>31</sup> It is also worth mentioning the support provided by the

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29. In the specific case of SisFron, integration with SisGAAz is made possible by the fact that both systems use a service-oriented architecture and common technology that allows information exchange between them.

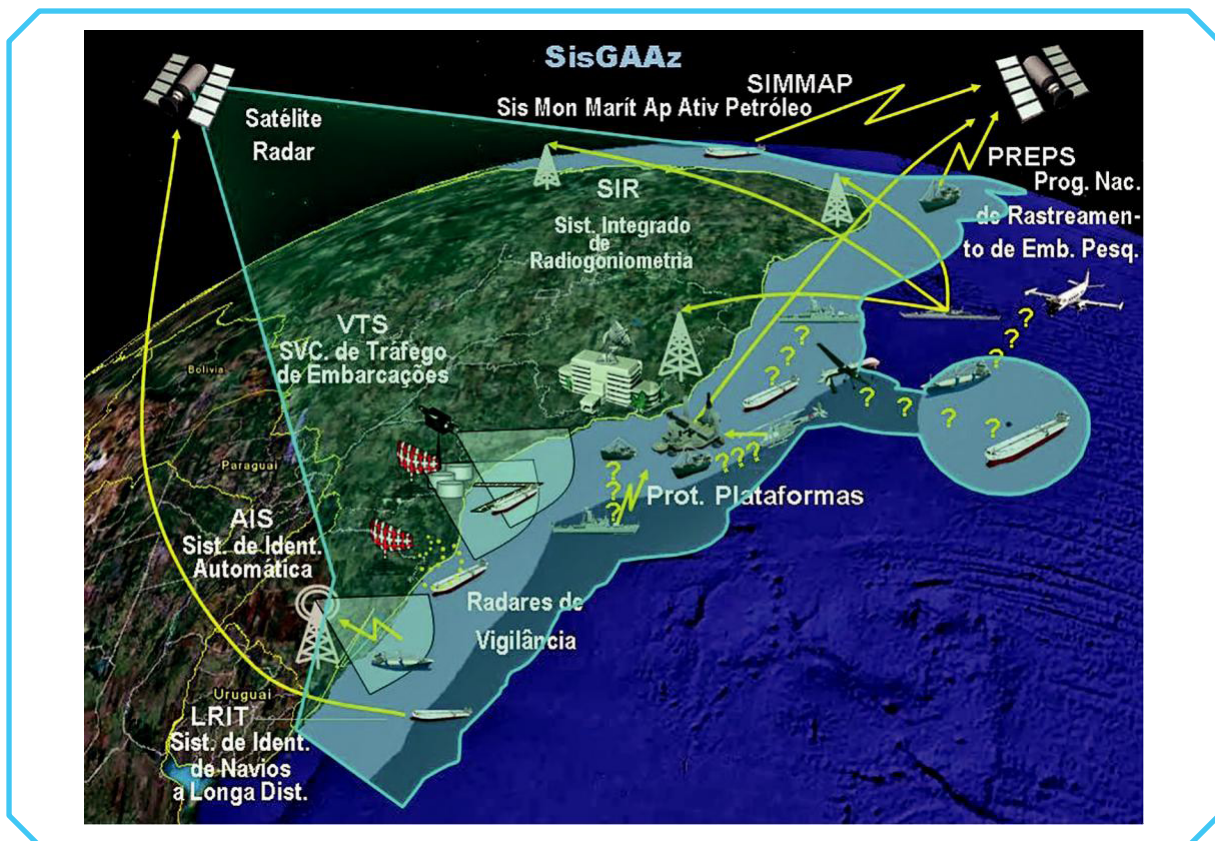
30. Interview with Commander Marcos Vinicius da Silva Roberto, SisGAAz manager.

31. SERE consists, basically, in the “use of remote data”, which have as characteristics “the ability to cover large areas (coastal and ocean regions)”, “detection, identification and monitoring of ships of various sizes, in the most remote locations of the globe’s surface” and “discretion and low vulnerability to countermeasures” (Chaves Junior, 2013, p. 39). Furthermore, it is divided into two segments: space, “which may adopt, for data collection, the Optical System or the Synthetic Aperture Radar System”; and land, “composed of Orbital Data Receiving Stations – ERDO” (idem, *ibidem*).



Strategic Program for Space Systems (PESE), of the FAB, which “will provide the space infrastructure necessary for the operation of various strategic projects”, including the SisGAAz. Within the scope of PESE, the role played by the Geostationary Defense and Strategic Communications Satellite (SGDC), “the first Brazilian geostationary equipment for civilian and military use”, launched in May 2017, stands out.<sup>32</sup> Figure 6 illustrates the integrated conception that is being given to SisGAAz. This is a complex process involving a number of institutions, among which trust must be continuously fostered.

**FIGURE 6**  
Operation and functioning of SisGAAz



Source: Brazil (2018, p. 61).

The implementation of the program was conceived in four modules. The first covered the area from Santos (SP) to Vitória (ES), focused mainly on monitoring the structures for prospecting, exploring, and exporting oil and natural gas, which is why it demands a high degree of precision. The second module covered the mouth of the Amazon River. The third covered the

32. Geostationary satellite begins to be tested. Available at: <<https://bit.ly/2DWIAfF>>. Accessed on: Mar. 2, 2018.

Brazilian coast from the South to the Northeast region. The fourth, finally, covered the inland fluvial waters.

According to the END, the areas covered by the first two modules “deserve special attention, from the point of view of the need to control maritime access to Brazil” (Brazil, 2016b, p. 26). Thus, it is expected that, when fully operational, the SisGAAz will enable the “collection of data, their processing, the orderly presentation of these data and (...) decision support”, aiming at the “control of events in the maritime environment”, which would be “the initial step towards the effective control of the Blue Amazon” (Chaves Junior, 2013, p. 43).

The program was first structured in three major phases: i) conception; ii) contracting; and iii) development. In January 2015, the design phase was concluded and the three proposals submitted by the participating consortia were approved. As of 2016, the country’s economic situation and the budget cuts made compromised the program’s conclusion schedule. The following phases, contracting and development, were initially planned to last fourteen years (Brazil, 2017, p. 3-5).

In terms of budget execution, SisGAAz is far below what was planned. Initially, the estimated global value was around R\$12 billion, during the period 2011-2033 (Brazil, 2012, p. 198).<sup>33</sup> However, to date, only the equivalent of 1.75% of this amount has been effectively executed.

The achievement of the program (initially planned for 2024) foresees the development and mastery of state-of-the-art technologies, as well as its integrated coordination, requiring that the development of the system be entirely national and with a high level of equipment nationalization. SisGAAz stands out among the strategic programs of the MB due to the importance of partnerships between national and foreign companies that involve technology

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33. According to the SisGAAz manager, Commander Marcus Vinicius da Silva Roberto, the mere knowledge of this value by the interested companies made them pressure the decision makers to execute the program in its entirety (instead of in smaller steps, as initially planned).



transfer (Andrade et al., 2019).<sup>34</sup> The role played by the Ezute Foundation, one of the main partners in the survey of the MB's command and control needs, which is responsible for the system's operational concept, already presented to companies interested in its execution, is also noteworthy.

Some aspects of the program, such as the possible use of satellites and the development of software to obtain data, highlight the importance of the level of nationalization of the companies involved. In this sense, contracting foreign companies would generate vulnerability, given the loss of autonomy resulting from the absence of control over the information produced, making the use of national resources preferable. These, however, are not yet available, increasing the time it takes to complete the program.<sup>35</sup>

This is, by the way, a constant dilemma in the acquisition of defense equipment. Either one invests in indigenous development, which takes more time and involves higher risks, or one buys off-the-shelf equipment. In the first case, the period in which the country has less than desirable protection is extended, but strategic autonomy is attained and investment is made in strengthening the defense and innovation industrial base – which usually generates positive externalities for other economic sectors, contributing to the development of national science and technology in a broader, deeper and more permanent way. In the second, more effective protection is acquired in the short term, at the cost of structural vulnerabilities in the economic, S&T&I and strategic fields, given the well-known black box effect.

Not by chance, Machiavelli already warned about the relevance of fighting with one's own weapons, because one cannot rely on the weapons of others. In this case, in particular, the risk is higher. To buy equipment of this nature, notwithstanding the confidentiality agreements provided for in the contract, is to open to others the dialogues and strategic communications of a country, as well as information that could be decisive in a conflict situation. When it comes

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34. It is noteworthy that, during the contracting phase, MB received proposals from three consortia, all composed of Brazilian companies in partnership with foreign companies: i) consortium Águas Brasileiras, composed of Embraer Defesa e Segurança (EDS) and Airbus Defence & Space; ii) consortium Nosso Mar, composed of ODT, MDA, INDRA and SAAB; and iii) consortium Mar Azul, composed of Orbital Engenharia and China Aerospace Science and Industry Corporation.

35. Interview with Commander Marcos Vinicius da Silva Roberto, SisGAAz manager.

to the South Atlantic, one cannot forget Argentina's experience with French missiles during the Falklands war.

The high expectations placed on the system highlight the need to modernize the MB equipment and train personnel to operate it. However, even though the SisGAAz is "considered and defined by the MB as a defense system (...) strategic for national defense, (...), whose discontinuity will cause significant damage to the MB's activities",<sup>36</sup> the program was reformulated as of November 2015, due to the federal government's fiscal adjustment.<sup>37</sup>

#### 4.2 Alternatives in progress

The reformulation of SisGAAz raises important questions regarding its future. First of all, there are considerable implications for the scientific-technological field. Due to the recurrent technological leaps that are common in programs involving cutting edge technologies such as SisGAAz, the recent adoption of a more measured way of conducting the program may aggravate the country's scientific-technological backwardness in an area considered strategic. The fact that the reformulation occurred for budgetary reasons aggravates the situation, since this is still an incipient program. The recently adopted pilot project, congregating the existing monitoring systems, although fully operational, does not completely meet the Navy's needs for the surveillance and protection of the Blue Amazon.

This, in turn, leads to a second question concerning the maintenance of the central idea of the program (the defense of the Blue Amazon), despite the impossibility of achieving it in the short term. It is a matter of evaluating SisGAAz as part of a larger modernization effort of the MB and the other Armed Forces that includes the Plan for Articulation and Equipment of the Brazilian Navy (PAEMB) and the Plan for Articulation and Equipment of Defense (PAED). In this sense, the SisGAAz is one of the priority strategic programs for the Navy and for national defense.

36. SisGAAz – um projeto ambicioso. Available at: <<https://bit.ly/3zwwLpM>>. Accessed on: Apr. 12, 2016.

37. *MB decide não decidir e interrompe programa*. Available at: <<https://bit.ly/2zbKvjj>>. Accessed on: Apr. 12, 2016.

## 5 FINAL CONSIDERATIONS AND RECOMMENDATIONS

The Blue Amazon represents valuable Brazilian assets and, consequently, a source of considerable vulnerabilities and threats to Brazil. However, despite being a country with a natural maritime vocation, the Brazilian maritime mentality is still incipient.

The majority of the Brazilian population is not fully aware of the country's maritime power and the real importance of the sea's resources and potential, nor of the need to adequately watch over and protect this heritage. Its dimension, at the same time that it presents various aspects for national development, constitutes a challenge for the defense of the country, given the imperative to monitor such a vast area. After all, its extension is equivalent to more than half of the national territory and in it are found considerably important natural resources, as well as commercial lines that make the vast majority of Brazilian foreign trade viable, making it essential to the country's economy. In addition, it is worth remembering the importance of river waters for the country's economy, for the transportation of people and cargo, among other relevant economic and social activities. In this sense, it is vital to provide the MB with adequate means of action to watch over, monitor, and protect the AJB and its riches. The SisGAAz is a relevant tool in this regard.

However, the imperative of protecting the AJB is faced with the need to reestablish the balance of public accounts and overcome the fiscal crisis that has taken hold in the country in recent years. This scenario has caused the resources available for defense and the Armed Forces' strategic programs, in general, to become even more scarce, leading to the need to reformulate some important programs, including SisGAAz.

The delay in implementing this program may have important negative effects not only for Brazilian maritime security, but also for the country's scientific-technological development. Besides depriving Brazil of a strategic system for the protection of a vital area, the readjustment of SisGAAz widens the already considerable gap between Brazil and developed countries in this field. Making the SisGAAz viable must, therefore, be among the government's priorities, for reasons of sovereignty, national defense, and also for economic reasons in its dismemberments.

Thus, working with the possibilities of the current context, we have an intermediate scenario, in which the delay in the development of SisGAAz brings negative effects, which are being mitigated by efforts to minimize the damage. In this context, while this system is being conducted in a partial way, it is recommended to maintain and intensify the efforts of programs and projects that contribute, directly or indirectly, to the success of SisGAAz. After all, it is expected that the overcoming of the economic crisis in the country and the budget constraints will allow the resumption of investments in strategic programs.

It is worth noting that the mission of surveillance and protection of the Blue Amazon has been carried out in a restricted manner, far below the operational needs of the MB for this purpose. For this very reason, the SisGAAz was conceived and is being implemented. The state and Brazilian society must become aware of the importance of prioritizing investment in SisGAAz, which is a necessary instrument to ensure effective Brazilian sovereignty in the Blue Amazon.

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### **Head of the Publishing Department**

Reginaldo da Silva Domingos

### **Assistants to the Head of the Department**

Rafael Augusto Ferreira Cardoso

Samuel Elias de Souza

### **Supervision**

Camilla de Miranda Mariath Gomes

Everson da Silva Moura

### **Typesetting**

Aeromilson Trajano de Mesquita

Anderson Silva Reis

Cristiano Ferreira de Araújo

Danilo Leite de Macedo Tavares

Jeovah Herculano Szervinsk Junior

Leonardo Hideki Higa

### **Cover design**

Aline Cristine Torres da Silva Martins

### **Graphic design**

Aline Cristine Torres da Silva Martins

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### **Ipea Bookstore**

SBS – Quadra 1 – Bloco J – Ed. BNDES, Térreo

70076-900 – Brasília – DF – Brazil

Tel.: + 55 (61) 2026 5336

Email: [livraria@ipea.gov.br](mailto:livraria@ipea.gov.br)



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