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CESAR Coastal Environment under SARgassum crisis

Jean-Raphaël Gros-Désormeaux

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Project acronym and/or name

Sargassum Joint call 2019

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This document is to be filled out by the coordinator in collaboration with the French project partners. It must be sent by the coordinator within the deadlines specified in the acts of award:

- 1. to every funders of the project*
- 2. to the competitiveness clusters that labelled the project.*

Unless otherwise indicated, it reports on the activity of all the project partners, including the foreign partners.

It must be accompanied by an up-to-date public summary of the project, in compliance with the model associated with the present document.

This model must only be used for the intermediate report(s) defined in the funding acts of award, with the exception of report T0+6 for which there is a specific model. There is also a specific model for the final report.

A IDENTIFICATION

| | |
|---|---|
| Project acronym | CESAR |
| Project title | Coastal Environment under SARgassum crisis |
| Coordinator of the French part of the project (company/organization) | CNRS UMR 8053 |
| Project start date | ANR 01/01/2020 – FEDER 01/07/2020 |
| Project end date | ANR 31/12/2023 – FEDER 31/12/2023 |
| Competitiveness cluster labels and contacts (cluster, name and e-mail of contact) | IRN-IRCAB, Institut de recherche en sciences sociales sur la biodiversité Caraïbe-Amériques, mylene.volny-anne@cnrs.fr |
| Project website if applicable | https://ircab.hypotheses.org/anr-cesar |

| | |
|-----------------------------------|--|
| Author of this report | |
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| Date of writing | 02/02/2024 |
| Period covered by activity report | 01/01/2020 to 31/12/2023 |

A.1 PUBLIC ABSTRACT

This abstract (1 page) is intended to be distributed to a wide audience to promote the project's results. It will therefore not mention confidential results, and will use appropriate vocabulary that does not exclude technical terms. A French and an English version will be provided.

English version

Since 2011, pelagic sargassum strandings in the Caribbean have had significant environmental, health, economic, and socio-political consequences. Research efforts have tended to confirm the emergence of a new ecosystem subjected to the movements of water masses in the equatorial Atlantic. This phenomenon began in 2011 and intensified between 2012 and 2023, with an increase in sargassum biomass. Satellite imagery is employed to detect sargassum rafts in the equatorial Atlantic. Surface ocean current data for the same area are utilized to explain the passive annual drift. The combination of these two data sources has enabled the design of forecasting tools, which, however, remained challenging to implement when downscaling to coastal zones. This context has made the management of sargassum influxes difficult. The CESAR program has described and elucidated the dynamics of coastal sargassum flows at local spatial scales, while exploring various approaches pursued by French, Brazilian, and international political institutions to address this environmental issue. This involved improving knowledge on local forcing parameters, the dynamics of sargassum strandings in the Lesser Antilles, and the institutional and organizational initiatives implemented. Considering social, political, legal, and economic responses to these impacts poses a major challenge for the formulation of effective recommendations. CESAR has enhanced the operability of socio-technical systems for anticipation and response in managing sargassum strandings. The project gives a comprehensive framework for the methodological approach for developing a stranding forecast model at multiple scales from offshore detection down to local bays. Although not yet operational at this scale, the calibration work on the MOTHY model has significantly improved the accuracy of stranding forecasts disseminated by Météo France Antilles-Guyane. If the project's results have already improved the "pelagic sargassum stranding forecast bulletin" issued by Météo France, it is also noteworthy that the indicators developed within the CESAR framework are among the decision-support tools available to the public service. The enhancements to forecasting systems address the challenges of adaptive management of sargassum influxes at both local and international levels. Moreover, the study of responses at the time of strandings highlights a multitude of initiatives, whose main organizational and institutional barriers are linked to cooperation among actors and the adoption of a new legal framework specific to sargassum. The results of the CESAR project emphasize that sargassums are unidentified legal objects acting as a catalyst for law, calling for the

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application of the principle of common but differentiated responsibility (CBDR). The CBDR is recognized as a relevant international strategy to address global ecological incidents, whose causality cannot be precisely attributed to states or specific human activities. This approach suggests that although there is no single culprit for sargassum invasions, each actor shares some responsibility. The complexity of the phenomenon implies that responsibility should be distributed equitably and proportionally to the capacities and involvement of each concerned party. The implementation of CBDR faces challenges in harmonizing actions, integrating multidisciplinary knowledge, and the variability of financial capacities. The challenge of international cooperation moving from discursive intentions to effective actions appears as a major lever for regulating sargassum stranding crises. Studies conducted by Brazilian partners identify similar obstacles, emphasizing the importance of coordinated governmental action with civil society participation. Additionally, they have identified avenues for the economic utilization of sargassum, such as conversion to biogas, use as fertilizer, and other industrial applications, thus highlighting the potential of these approaches to mitigate environmental damage and support local communities. At the local level, the analysis of willingness to pay in the French Antilles has already identified an initial regulatory approach. While the majority of surveyed companies are not willing to allocate funds for cleaning or prevention of strandings, it is noted that 25% of respondents express a willingness to contribute, averaging 3% of their turnover. However, a tendency to dedicate time to cleaning activities was identified as a notable aspect of the survey. Among residents, although a large majority rejects the idea of financing these interventions, precisely because of an apparent lack of responsibility in the genesis of strandings, a significant fraction is ready to invest financially, with an average of 86 euros per year, or to dedicate six days per year to cleaning operations. The tourist population surveyed is willing to invest approximately 1.50 euros for cleaning operations. The results of the CESAR project lead to questioning the responsibility, financial burden, and financing mechanisms associated with the management of sargassum strandings. The dynamics observed in the French Antilles reveal a transfer of responsibility between the state and territorial communities, which in turn refer the issue to municipal authorities, thus creating ambiguity for citizens. This institutional uncertainty has potentially generated a propensity for personal initiative among the population. However, the establishment of a Public Interest Group dedicated to sargassum in 2023 constitutes a major institutional and organizational change, leading to new questions regarding the relevance and effectiveness of governmental action versus autonomous management or market regulation.

French version

Depuis 2011, les échouages de sargasses pélagiques dans la Caraïbe ont des conséquences environnementales, sanitaires, économiques et sociopolitiques importantes. Les travaux de recherche réalisés tendent à confirmer l'existence d'un nouvel écosystème soumis aux mouvements des masses d'eau dans l'Atlantique équatorial. Le phénomène a débuté en 2011 et s'est intensifié entre 2012 et 2023, avec une augmentation de la biomasse de sargasses. L'imagerie satellite est utilisée pour détecter les radeaux de sargasses dans l'Atlantique équatorial. Les données sur les courants océaniques de surface pour la même zone sont utilisées pour expliquer la dérive annuelle passive. La combinaison de ces deux sources de données a permis de concevoir des outils de prévision, qui restaient toutefois difficiles à exploiter à l'échelle des zones côtières. Ce contexte rendait difficile la gestion des afflux de sargasses. Le programme CESAR a décrit et expliqué la dynamique des flux côtiers de sargasses à des échelles spatiales locales, tout en étudiant les différentes pistes explorées par les institutions politiques françaises, brésiliennes et internationales pour répondre à ce problème environnemental. Cela a impliqué l'amélioration des connaissances sur les paramètres de forçage locaux, sur la dynamique des échouages de sargasses dans les Petites Antilles, ainsi que sur les initiatives institutionnelles et organisationnelles mises en œuvre. La prise en compte des réponses sociales, politiques, juridiques et économiques face à ces impacts est un défi majeur pour la formulation de recommandations effectives. CESAR a amélioré l'opérationnalité des dispositifs socio-techniques d'anticipation et de réponse pour la gestion des échouages de sargasses. Le projet propose un cadrage exhaustif des approches méthodologiques de développement d'un modèle de prévision des échouages multi-échelles, à partir des détections de sargasses offshore jusqu'aux baies et milieux côtiers. Bien qu'il ne soit pas encore opérationnel à cette échelle, les travaux de paramétrage du modèle MOTHY ont considérablement amélioré la précision des prévisions d'échouage diffusées par Météo France Antilles-Guyane. Si les résultats du projet ont d'ores et déjà permis d'améliorer le « bulletin de prévision d'échouement de sargasses pélagiques » diffusés par Météo France, il est aussi à noter que les indicateurs conçus dans le cadre de CESAR sont des outils d'aide à la décision dont dispose le service public. Les améliorations apportées aux dispositifs de prévision répondent à des enjeux de

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gestion adaptative des afflux de sargasses au niveau local et international. En outre, l'étude des réponses apportées au moment des échouages, soulignent une multiplicité d'initiatives dont les principaux freins organisationnels et institutionnels sont liés à la coopération entre acteurs et à l'adoption d'un nouveau cadre juridique spécifique à la sargasse. Les résultats du projet CESAR soulignent que les sargasses sont des objets juridiques non identifiés à catalyseur de droit qui appellent à l'application du principe de responsabilité commune, mais différenciée (PRCD). Le PRCD est reconnu comme une stratégie internationale pertinente pour aborder les incidents écologiques globaux, dont la causalité ne peut être précisément imputée à des États ou à des activités humaines spécifiques. Cette approche suggère que bien qu'il n'existe pas de coupable unique pour les invasions de sargasses, chaque acteur partage une certaine responsabilité. La complexité du phénomène implique que la responsabilité soit distribuée de manière équitable et proportionnelle aux capacités et à l'implication de chaque partie concernée. La mise en œuvre du PRCD se heurte à l'harmonisation des actions, à l'intégration des connaissances pluridisciplinaires et à la variabilité des capacités financières. L'enjeu d'une coopération internationale qui passerait d'intentionnalités discursives à des actions effectives apparaît comme un levier majeur de régulation des crises d'échouages de sargasses. Les études menées par les partenaires brésiliens identifient des freins similaires en insistant sur l'importance d'une action gouvernementale coordonnée avec la participation de la société civile. En outre, ils ont identifié des pistes pour l'exploitation économique des sargasses, telles que la conversion en biogaz, l'utilisation comme fertilisant, et d'autres applications industrielles, soulignant ainsi le potentiel de ces approches pour atténuer les dommages environnementaux et soutenir les communautés locales. Au niveau local, l'analyse du consentement à payer dans les Antilles françaises a d'ores et déjà permis d'identifier une première piste de régulation. Si la majorité des entreprises sondées ne se montrent pas disposées à allouer des fonds pour le nettoyage ou la prévention des échouages, notons que ¼ des répondants manifeste une volonté de contribuer, à hauteur de 3% de leur chiffre d'affaires en moyenne. Cependant, une inclination à consacrer du temps aux activités de nettoyage a été identifiée comme un aspect notable de l'enquête. Parmi les résidents, bien qu'une large majorité rejette l'idée de financer ces interventions, précisément du fait d'une absence de responsabilité apparente dans la genèse des échouages, une fraction notable est prête à investir financièrement, avec une moyenne de 86 euros par an, ou à dédier six jours par an aux opérations de nettoyage. La population de touristes interrogés est favorable à investir près de 1,50 euro pour les opérations de nettoyage. Les résultats du projet CESAR conduisent à interroger la responsabilité, la charge financière et les mécanismes de financement associés à la gestion des échouages de sargasses. La dynamique observée dans les Antilles françaises révèle un transfert de responsabilité entre l'État et les collectivités territoriales, ces dernières renvoyant à leur tour la question aux autorités municipales, créant ainsi une ambiguïté pour les citoyens. Cette incertitude institutionnelle a potentiellement engendré une propension à l'initiative personnelle au sein de la population. Or, l'installation d'un Groupement d'Intérêt Public dédié à la sargasse en 2023 constitue un changement institutionnel et organisationnel majeur qui conduit à l'émergence de nouvelles interrogations quant à la pertinence et à l'efficacité de l'action gouvernementale face à une gestion autonome ou à une régulation par le marché.

B DELIVERABLES AND MILESTONES

When applicable for the project, reproduce the table of milestones and deliverables provided at the start of the project. Indicate all the deliverables, including any deliverables deleted or added with respect to the initial list.

| No. | Designation | Nature* | Date of supply | | | Partners (underline the responsible partner) |
|-----|---|--------------------|-------------------|--------------|----------------|---|
| | | | Initially planned | Re-scheduled | Delivered | |
| 1 | Review report on satellite observation and drift models | Report | M12 | M24 | June 2023 | CNRS |
| 2 | Retrospective analyses of transportation patterns of Sargassum in the equatorial and Western Atlantic and the Lesser Antilles | Report Data | M24 | M36 | September 2023 | NIOZ |
| 3 | Algorithm and semi-automation detection for Sentinel series | Report Software | M12 | M24 | June 2022 | TerraSigna |
| 4 | Article submitted for publication | Milestone | M18 | M30 | In progress | CNRS |
| 5 | Report on low-cost and effective drone-based protocol for monitoring | Report Data | M12 | M24 | September 2022 | CNRS HUMMING |

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| No. | Designation | Nature* | Date of supply | | | Partners (underline the responsible partner) |
|-----|--|----------------------------|----------------------|------------------|------------------|--|
| | | | Initially planned | Re- scheduled | Delivered | |
| | Sargassum strandings | | | | | DRONE |
| 6 | Report on the action implemented for improving the quality of MOTHY drifting models for Sargassum including (observation monitoring, validation, calibration, atmospheric forcing (Ensemble Predicting System approach), oceanic forcing (high resolution) | Report Software Data | M24 | | November 2021 | Météo France |
| 7 | Article submitted for publication | Milestone | M24 | M36 | In progress | Météo France |
| 8 | Report concerning the refinement of final products for decision makers | Report | M18 | | October 2021 | CNRS |
| 9 | Final products showing and workshop with decision makers and local authorities | Milestone | M24 | M44 | In progress | CNRS |
| 10 | Scientific report on law and public policies for Sargassum management in Amazonia | Report | M24 | M42 | December 2023 | UPM |
| 11 | Scientific report on law and public policies for Sargassum management in the Caribbean | Report | M24 | M42 | August 2022 | UA |
| 12 | Interactive mapping of actors | Prototype | M12 | M30 | Not delivered | CNRS |
| 13 | Submission of scientific articles in PRJ on actors' roles and dynamics | Milestone | M36 | M36 | June 2022 | IRD UA CNRS |
| 14 | Country profiles | Report | M24 | M44 | August 2022 | CNRS |
| 15 | Scientific report on international tools for Sargassum management | Report | M36 | M44 | December 2022 | CNRS |
| 16 | Policy briefs on regional and international cooperation | Poster | M36 | M44 | December 2023 | UPM |
| 17 | Executive summary and policy brief on Improvement of legal instruments and public action | Report | M36 | M44 | December 2023 | UA CNRS |

* milestone, report, software, prototype, data, etc.

C PROGRESS REPORT

C.1 INITIAL OBJECTIVES OF THE PROJECT

Maximum 10 to 20 lines.

CESAR's overall goal is to deliver advanced knowledge, tools, and methodologies for managing Sargassum influxes in the Caribbean, focusing particularly on the French Antilles. It sets out to enhance understanding of Sargassum and improve stranding forecasts for the islands while providing recommendations for strategic management actions. CESAR is structured around specific objectives designed to develop a predictive system for Sargassum movements from large basin to regional scales, and to analyze legal and governance frameworks to better address this environmental crisis.

The project centers on two main work streams:

WP1 - Monitoring and Forecasting: This work group is dedicated to satellite detection and environmental risk assessment related to Sargassum, developing tools based on modeling their drift in the Caribbean region. The aim is to refine stranding forecasts to better prepare local communities.

WP2 - Sustainable Governance: It explores adaptation strategies and governance in response to Sargassum influxes, aiming to establish sustainable and effective management of these environmental crises.

Focusing on the French Antilles and northern Brazil, CESAR aspires to transform Sargassum management through innovation in monitoring, forecasting, and strategic responses, thereby contributing to the

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enhanced resilience of communities against this phenomenon.

C.2 WORK PERFORMED AND RESULTS ACHIEVED IN THE PERIOD CONCERNED

Maximum 1 page. Work performed and results obtained during the period concerned, conformity of work progress with initial schedule. Clearly indicate who performed the work, and do not omit to mention the work performed by the foreign partners.

Work forecast for the next period(s).

WP1. Sargassum influx monitoring and forecast in the Caribbean: from satellite- based detection to environmental risk assessment

Satellite imagery from S2 and S3 satellites is adept at detecting Sargassum rafts at sea. Each offers unique, complementary insights at varying resolutions, with S3 daily data proving most effective for stranding forecasts. Integrating S2, S3, and SolarCam network data from Martinique's beaches under Sub-task 1.1.1 allowed offshore detections to be correlated with recorded coastal strandings. This foundation supported the drift modeling tool's development in Sub-task 1.1.2, focusing on refining drift models with oceanic and atmospheric forces. The recurrent massive Sargassum strandings in the Antilles since 2011 demand thorough research to decipher their behavior and trends. Our study analyzed stranding data and Sentinel-2 and 3 satellite imagery from January 2020 to April 2023, revealing yearly stranding fluctuations. Cloud cover limitations and satellite data interpretation challenges notwithstanding, the combination of stranding and satellite data offers a holistic view of Sargassum strandings' spatio-temporal patterns in the Antilles, enhancing understanding and informing management strategies. Parallel efforts focused on enhancing trajectory simulation tools for Sargassum raft drift forecasts. Météo France's testing of the MOHY model, originally developed for marine pollution, was recalibrated for Sargassum drift simulations. Despite challenges in calibrating MOHY due to uncertainties in replicating raft drift with buoys and correlating remote sensing observations, substantial efforts are underway to refine calibration for better Sargassum drift and stranding forecasts. An evaluation report has laid out strategies for in-situ drift studies of Sargassum rafts, crucial for advancing prediction capabilities. Today's data acquisition aids in generating forecast bulletins, yet analyzing Sargassum stranding risks in the Antilles is vital for managing arrivals and planning mitigations. A review of international data highlighted the need for a risk scale indicator with a confidence index to better support public policy decisions, aiming to convert presence and drift data into actionable insights despite inherent uncertainties. Task 1.2's development of decision-support indicators represents a step forward in synthesizing information and enhancing decision-making processes for policymakers.

WP2. Towards a sustainable governance of Sargassum influx

Legal frameworks and governance mechanisms at the Martinican, Amazonian, Caribbean, and international levels for managing Sargassum influxes were assessed. We focused on identifying active environmental laws and governance to manage Sargassum impacts across coastal and estuarine zones from Brazil to the Caribbean. The aim was to evaluate the effectiveness and adaptability of these regulations, including comparisons with algae management in the Antilles, Brittany, and New Caledonia. We explored international cooperation frameworks, considering extending current regulations to address Sargassum strandings and emphasizing Caribbean cooperation for tailored action frameworks due to the region's diversity in organizations, legal tools, and entities. An analysis of regional legal instruments and their interplay with maritime laws was conducted, focusing on natural hazards and coastal management, leading to the introduction of new legal tools at various levels to manage Sargassum strandings and support decision-making. Two primary improvement areas were identified: establishing steering committees including affected stakeholders, and integrating Sargassum management into an integrated coastal management approach, aligning with the "good ecological status of waters" objective under the Water Framework Directive (WFD). This approach is backed by the Sargassum coordinator in Guadeloupe, proposing a syndicate for broader coastal management. Despite the mention of Sargassum in water management plans, the detailed impact assessment on water status is lacking, with persistent pollutants like chlordecone complicating WFD goals in the Antilles, delaying optimal ecological water status by 2039. However, these proposals encounter obstacles, necessitating additional comparative studies among municipalities to accurately identify challenges. Municipalities face financial and logistical

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difficulties in managing affected sites effectively. The quality of work relies heavily on the involvement of stakeholders, which restricts the scope of difficulty assessment, especially for municipalities. To enhance the situation, it is recommended to organize meetings gathering all concerned stakeholders to discuss proposals and common objectives. It is crucial to bolster capacities and promote collaboration to overcome financial and environmental disparities for effective funds management. Without proactive cooperation, the risk of the allocated resources failing to adequately address the scale of Sargassum strandings increases, potentially exacerbating social tensions.

C.3 COLLABORATION WITH FOREIGN PARTNERS

Maximum ½ pages. Indicate the work performed in collaboration with the foreign partners of the project, highlighting the added value of the collaboration. Mention the difficulties encountered if any.

The multidisciplinary scientific collaboration initiated between physics, biology, modeling, and social sciences continues under the ANR Sarg'Alert project. The findings from the CESAR project are expected to contribute to the integrated approach for the operational forecasting of Sargassum strandings within the framework of the ANR's second joint Sargassum call. This research trajectory extends the collaboration to new partners (ICARE UAR 2877 - AERIS/ICARE Data and Services Center; AEM Mexican Space Agency; MARBEC MARine Biodiversity, Exploitation & Conservation; IRISA Institute for Research in Computer Science and Random Systems; LIS Laboratory of Computer Science and Systems; MIO Mediterranean Institute of Oceanology; UFPE Federal University of Pernambuco). The collaboration with NIOZ (The Netherlands), initiated within the CESAR project framework, will continue. The Royal Netherlands Institute for Sea Research (NIOZ) is the national oceanographic institute of the Netherlands. NIOZ has a strong interest and concern for the marine habitat of the Caribbean, particularly with Aruba, Bonaire, Curaçao, Sint Maarten, Saba and Sint Eustatius part of the Kingdom of the Netherlands. The joint call by ANR and collaborating research funding agencies highlight the growing influxes of Sargassum seaweed currently impacting the Caribbean coastlines and the islands of the Kingdom of the Netherlands are no exception. This is a concern for NIOZ and the collaboration through the CESAR project is seen as an initial formal step to build up scientific collaboration on improving knowledge of Sargassum ecology, effective monitoring, management, and mitigation. NIOZ has already funded an observational campaign in 2019 with the principal Dutch Research Vessel "Pelagia" sampling for Sargassum across the Atlantic Ocean from the Azores to Guadeloupe. The Principal Scientist of this past expedition, Prof. Linda Amaral-Zettler (NIOZ), has encouraged the research of this CESAR proposal, providing a Letter of Support. Both Dr Candy and Prof. Amaral-Zettler are keen to collaborate both on this project CESAR but also in building up knowledge and capability in Sargassum science for The Netherlands, France and the wider global community. Building on existing efforts at NIOZ to monitor and simulate currents in the Caribbean Sea and Atlantic, use of multi-scale highly parallelized hydrodynamic models and the development of tracking approaches to identify nutrient supplies to Saba Bank (connected to another NIOZ RV Pelagia expedition 64PE414) efforts at NIOZ will focus on developing a new multi-scale stochastic Lagrangian framework to give the first Sargassum forecasting model capable of following its entire life-cycle, from the atlantic to local bays.

C.4 WORK SCHEDULED

Maximum ½ pages. Indicate the work planned during the rest of the project, stemming from the work already performed.

The major challenge to be addressed will consist of continuing the dissemination of expertise acquired within the CESAR project framework, particularly in the context of the GIP Sargasses.

C.5 DIFFICULTIES ENCOUNTERED AND SOLUTIONS

Maximum 10 to 20 lines. Any difficulties encountered and the solutions envisaged, e.g.: technical deadlock, service provider default, failure to meet deadlines, budget control. Does the project content need reviewing? Does the project schedule need reviewing?

The CESAR consortium was forced to adapt the initial ANR project to the administrative and financial constraints of European funds. After adapting the scientific content, the project was again submitted to a selection process (ERDF). The pandemic has added other constraints, especially for WP2 whose work requires field missions. In general, all tasks have been delayed, including WP1. The authorization of travel under condition of the health pass already allows implementing the missions. The extension granted by the ANR should also make it possible to provide all the deliberations before the end date of the project.

C.6 SIGNIFICANT EVENTS AND RESULTS

Write a few lines for each significant event or result. This could give rise to communication on the project with the agreement of the project coordinator.

Jean-Philippe Maréchal (CNRS) and Ali Bel Madani (Météo France) coordinated a special issue entitled "[Surface Drift in the Ocean with Application to Floating Material, Pollutants and Biota](#)" in JMSE (2.458). Oceanic currents are a fundamental component of the Earth system through their ability to redistribute heat from the Equator to the poles, and more generally, to transport physical, chemical, biological, and anthropogenic matter, and properties across the World Ocean. The strongest currents, which are usually found near the ocean surface, are driven by a combination of wind and pressure gradients in the open ocean, sometimes complemented by other drivers such as tides or breaking surface waves, most notably in the coastal zone that is characterized by particularly complex hydrodynamic processes and land-air-sea interactions. Even in the open ocean, near-surface currents are associated with oceanographic processes acting on a wide range of spatial and temporal scales, from sub-mesoscale and mesoscale turbulence to large-scale wind-driven gyres and thermohaline circulation and over periods of days to decades. Floating material of various origins including pollutants and biota (e.g., plastic debris, harmful algal blooms, Sargassum algae and other rafts, oil spills) are directly carried by surface ocean currents, sometimes over large distances and long periods, but also through the direct action of wind stress, i.e., windage. Understanding how such material is carried and dispersed by currents, winds, and other geophysical phenomena is paramount for a broad range of applications including, but not limited to search and rescue operations, operational monitoring and forecasting of floating material drift. Solange Teles, Lise Tupiassu and Jean-Raphaël Gros-Désormeaux organized the [1st International Seminar on Cross-Views between the Amazon and the Caribbean on the issue of sargassum](#) from 18 to 19 March 2021. This seminar was held within the framework of the VIII Week of International Scientific Cooperation Amazon-Caribbean on the management and use of the Amazonian territory, the Tapajos and Araguaia-Tocantins basins in relation to the IBIS CAPES-COFECUB research project. We have started to establish synergies and collaborations with researchers from other projects. A space was opened for the submission of abstracts and presentation of papers. The abstracts were based on an interdisciplinary vision highlighting the relationship between cartography and law, ecology and law, international environmental law and international relations. The work analysed the management and use of territory in the Tapajós and Araguaia-Tocantins basins and the management of sargassum.

A seminar was held on 23/02/2022 by Jean-Philippe Maréchal on Sargassum influx overview presenting all aspects of the Sargassum phenomenon: history, environmental and economic impacts, remote sensing detection, forecast and risk assessment (<https://youtu.be/6mOqqC233Jc>).

A ten-minute film was produced to present the main results of the project at the "Joint call, Research, development and innovation, SARGASSUM". Following meeting" (<https://youtu.be/GhiepW9n1Ic>).

C.7 WORK SPECIFIC TO THE COMPANIES (WHERE APPLICABLE)

Company xxx

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10 to 20 lines maximum per company. Describe the project activities of each company in the consortium, focusing on the contributions, collaborations and outlooks associated with the project. Specify more particularly the industrial or technological application prospects, the economic and commercial potential, prospects for integration in the industrial activity, etc.

| | |
|--|--|
| Company | CLS Collecte Localisation Satellites |
| Author (name + e-mail address) | Marion SUTTON msutton@groupcls.com |
| CLS is a subsidiary of CNES and CNP. The company has been providing Earth observation and monitoring solutions since 1986. It offers a Sargassum detection and monitoring tool available via a secure web portal. SAMTool provides an operational service supported by analysts, based on a unique combination of Earth observation satellite data. Within the CESAR project, CLS led the efforts in designing indicators to help assess the risk of Sargassum strandings. The results include the development of a detection score and a confidence index to evaluate the stranding risk. | |

| | |
|--|---|
| Company | TERRASIGNA |
| Author (name + e-mail address) | Sorin Constantin et Ioan Daniel Șerban office@terrasigna.com |
| TERRASIGNA carried out the development of a processing chain for the detection and mapping of Sargassum using Earth observation data. The system was deployed on the servers of the Directorate of Computer and Digital Systems at the French University of the Antilles. A workstation was dedicated to running the processing chain. | |

C.8 CONSORTIUM MEETINGS (COLLABORATIVE PROJECTS)

Indicate the consortium meetings, including the meetings with the foreign partners and the meetings between French partners if any.

| Date | Place | Partners present | Subject of the meeting |
|---|---|---------------------------------------|--|
| Sept 2020 | Kick-off meeting WP1 | METEO FRANCE – CNRS – UA | General framework and responsibilities in CESAR's WP1. |
| 17 th December 2020 | 1 st International Workshop – Coastal Environment under Sargassum Crisis | CNRS – UPM (Sao Paulo) – UFPA (Belém) | Discussions were held on sargassum (i) as a new ecosystem, a hotspot of marine biodiversity, (ii) as a health problem, when it washes up on beaches and causes emissions that affect people's lives, limit activities (e.g. fishing, recreation, etc.) and cause an ecological problem (e.g. preventing turtles from laying their eggs on the beach sand). |
| 26 th February 2021 | Online meeting | CNRS – UA | General framework and responsibilities in CESAR's WP2. Some preliminary results were presented, considering multilateral and regional treaties, as well as the UN Resolution A.Res.70-75 of 8 December 2015. |
| 18 th -19 th March 2021 | Webinar | CNRS – UA | presentation of tasks 2.1 and 2.2 in the webinar on the "I International Seminar - Crossing views between the Amazon and the Caribbean on the Sargasso issues" and the "VIII Week of International Cooperation Amazon-Caribbean: Management and use of the Amazonian territory along the Tapajós and Araguaia-Tocantins basins |
| 18 th May 2021 | Online | CNRS – UA – IRD | launching meeting for CESAR's WP2 |

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| Date | Place | Partners present | Subject of the meeting |
|------------------------------|--|--|--|
| | meeting | | activities |
| 20 th July 2021 | Hybrid meeting: LC2S meeting room and online access | CNRS – UA – IRD | Scientific positioning of the contributors regarding the implementation of the tasks of WP2. Establishment of a working schedule |
| March 7 th , 2023 | Joint call, Research, development and innovation, SARGASSUM Following meeting | Région Guadeloupe, Agence National de la Recherche, ADEME, CHU Guadeloupe, IRD, CNRS, UA | Progress, results and outlook for APP projects https://youtu.be/GhiepW9n1lc |

C.9 FREE COMMENTS

Comments from the coordinator

General comments at the coordinator's discretion, on the state of project progress, interaction between the partners, etc.

The coordinator wonders about the causes of the funding problems encountered by a project that has been announced as a laureate in 2019.

Comments from the other partners

Free comments from the other partners if appropriate

...

Comments from the foreign partners on project progress

Free comments from the foreign partners if appropriate (solicit them accordingly)

...

Question(s) posed to the funders

Questions posed to the funders, if any

...

What kind of research needs to be funded in the next Sargassum Joint Call ?

What topic, consortium, etc...

...

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D PROJECT VALORIZATION AND IMPACT SINCE BEGINNING

This section groups elements accrued since the beginning of the project, which will be monitored as its proceeds and taken up in the final project review.

D.1 PUBLICATIONS AND COMMUNICATIONS

Indicate the publications resulting from the project using the usual standards for the field. If the publication is accessible on line, indicate the website address. The ANR encourages the publishing of articles stemming from the projects it funds, in compliance with the rights of the co-authors and editors, in the open multidisciplinary archive HAL: <http://hal.archives-ouvertes.fr/>

Important: avoid artificially increasing the number of publications, mention only those that result directly from the project (after it started, and which mention the support of the ANR and the project reference).

| List of the multi-partner publications in collaboration with at least one of your foreign partners (resulting from jointly conducted work) | | |
|--|------------------------------|---|
| International | Peer-reviewed journals | 1. |
| | Books or chapters in books | 1. 2. |
| | Communications (conferences) | 1. 1st International Seminar "Cross Perspectives between Amazonia and the Caribbean, the Sargassum Issue", March 18 and 19, 2021, https://mycore.core-cloud.net/index.php/s/Cm5fKI3HSApfEvu#pdfviewer |
| France | Peer-reviewed journals | 1. 2. |
| | Books or chapters in books | 1. 2. |
| | Communications (conferences) | 1. 2. |
| Outreach initiatives | Popularization articles | 1. 2. |
| | Popularization conferences | 1. 2. |
| | Others | 1. 2. |

| List of the multi-partner publications (resulting from jointly conducted work) | | |
|--|------------------------------|--|
| International | Peer-reviewed journals | 2. 3. |
| | Books or chapters in books | 3. 4. |
| | Communications (conferences) | 2. 3. |
| France | Peer-reviewed journals | 3. DAVID Carine, DAVID Victor, « Les sargasses, d'objet juridique non identifié à catalyseur de droits », <i>Revue juridique de l'environnement</i> , 2023/3 (Volume 48), p. 585-605. URL: https://www.cairn.info/revue-juridique-de-l-environnement-2023-3-page-585.htm |
| | Books or chapters in books | 3. 4. |
| | Communications (conferences) | 3. 4. |
| Outreach initiatives | Popularization articles | 3. 4. |
| | Popularization conferences | 3. 4. |
| | Others | 3. 4. |

| List of single-partner publications (involving a single French partner) | | |
|---|------------------------|---|
| International | Peer-reviewed journals | 1. 2. |
| | Books or chapters in | 1. Parra-Leylavergne, A. (2023). The Social Construction of |

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| | | |
|-----------------------------|-------------------------------------|---|
| | books | International Environmental Policies in the Caribbean: The Case of Sargassum. In: Jay Kassiola, J., Luke, T.W. (eds) The Palgrave Handbook of Environmental Politics and Theory. Environmental Politics and Theory. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-031-14346-5_22 |
| | Communications (conferences) | <ol style="list-style-type: none"> 1. Karine Galy, Conférence sur la coopération internationale et la crise des sargasses à l'école d'automne à l'UQAM au Canada, 30 octobre au 4 novembre 2023. 2. Karine Galy, Conférence sur la coopération internationale et la crise des sargasses dans le cadre de l'Ateliers Schuman et d'un partenariat "Convergence transatlantique" à l'UQAM, 30 octobre au 4 novembre 2023. 3. |
| France | Peer-reviewed journals | <ol style="list-style-type: none"> 1. Karine Galy, "La gestion des afflux massifs de sargasses dans la grande Caraïbe : nouvel enjeu de la coopération régionale ", <i>Études caribéennes</i> [Online], 53 Décembre 2022, Online since 15 December 2022. URL: http://journals.openedition.org/etudescaribeennes/24248 ; DOI: https://doi.org/10.4000/etudescaribeennes.24248 |
| | Books or chapters in books | <ol style="list-style-type: none"> 1. 2. |
| | Communications (conferences) | <ol style="list-style-type: none"> 1. Eric Kamwa <i>et al.</i>, Conférence au colloque de l'ASRDLF à la Réunion sur les réponses des approches économiques à la gestion des échouages de sargasses dans les Antilles françaises, 28-30 juin 2023. 2. |
| Outreach initiatives | Popularization articles | <ol style="list-style-type: none"> 1. 2. |
| | Popularization conferences | <ol style="list-style-type: none"> 1. 2. |
| | Others | <ol style="list-style-type: none"> 1. 2. |

| List of single-partner publications (involving a single foreign partner) | | |
|---|-------------------------------------|---|
| International | Peer-reviewed journals | <ol style="list-style-type: none"> 3. Leuzinger, Marcia Dieguez; Silva, Solange Teles da. Sargassum: para além dos danos, uma questão de prevenção e oportunidades. <i>Revista de Direito Ambiental</i>. vol. 108. ano 27. p. 163-184. |
| | Books or chapters in books | <ol style="list-style-type: none"> 2. 3. |
| | Communications (conferences) | <ol style="list-style-type: none"> 4. 5. |
| France | Peer-reviewed journals | <ol style="list-style-type: none"> 2. 3. |
| | Books or chapters in books | <ol style="list-style-type: none"> 3. 4. |
| | Communications (conferences) | <ol style="list-style-type: none"> 3. 4. |
| Outreach initiatives | Popularization articles | <ol style="list-style-type: none"> 3. 4. |
| | Popularization conferences | <ol style="list-style-type: none"> 3. 4. |
| | Others | <ol style="list-style-type: none"> 3. 4. |

D.2 OTHER VALORIZATION FACTORS

The valorization factors are spin-offs other than publications. The following shall be detailed in particular:

- national and international patents, licences, and other elements of intellectual property resulting from the project.
- software and any other prototype
- standardization actions
- launching of product or service, new project, contract, etc.
- development of a new partnership,
- creation of a platform available to a community
- company creation, spin-off companies, fund-raising

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- others (international opening, etc.).

In this table, give details of the national and international patents, licences, and other valorization factors resulting from the project, the know-how, any other spin-offs from the project, any partnerships, etc.. See those announced in the technical appendix in particular.

| List of factors. Indicate the titles, years and comments | |
|--|---------------------------------|
| International patents obtained | 1. 2. |
| International patents pending | 1. 2. |
| National patents obtained | 1. 2. |
| National patents pending | 1. 2. |
| Operating licences (obtained / transferred) | 1. 2. |
| Company creations or spin-offs | 1. 2. |
| New collaborative projects | 1. SargAlert (ANR-22-SARG-0001) |
| Scientific symposiums | 1. 2. |
| Others (specify) | 1. 2. |

D.3 COMPETITIVENESS CLUSTERS (LABELLED PROJECTS)

For projects labelled by one or more competitiveness clusters,

Project collaboration with the cluster(s) that labelled it

What collaborations have there been between your project and the competitiveness cluster(s) that labelled it?

...

Activities financed by the complementary funding on account of cluster labelling (public laboratories only)

Detail the activities carried out by the public laboratories using the complementary funding granted on account of the labelling. Indicate in particular the partners involved and the collaborative work conducted with the cluster(s).

| | |
|--|--|
| Amount of the complementary funding granted by the ANR (for each public laboratory) | <ul style="list-style-type: none"> - Partner XXX: €xxx - Partner YYY: €yyy |
|--|--|

| Type of action implemented | Details (open list of examples) | Expenditure cluster complement* |
|--|---|---------------------------------|
| Actions contributing to the strategic reflection and the cluster's scientific programme planning | E.g.: Participation in the thematic days organized by the cluster | Xxx: €xxy Yyy: €yyy |
| Scientific and public communication actions beneficial for the renown of the cluster | E.g.: projects symposium | Xxx: €xxy Yyy: €yyy |
| Development of partnership research (looking for partners, partnership management costs, project engineering, etc.) | E.g.: consortium agreement, costs of training in intellectual property aspects, in project management, expenses relative to the project setup | Xxx: €xxy Yyy: €yyy |

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| | | |
|--|---------------------------|------------------------|
| Research valorization and transfer to the industrial sector | E.g.: patentability study | Xxx: €xxy Yyy: €yyy |
|--|---------------------------|------------------------|

* Estimation of expenditure charged to the funding complement granted on account of labelling by a competitive cluster, public partners only.

D.4 PERSONNEL RECRUITED ON FIXED-TERM CONTRACTS (EXCLUDING INTERNS, FRENCH PARTNERS ONLY)

This table summarizes project recruitment of non-permanent personnel on fixed-term contracts or equivalent. Fill out one line per person hired for the project when the hiring has been partially or entirely financed with the ANR grant and the contribution to the project has lasted at least 3 months, all employment contracts combined, subject to the condition that the ANR grant can only represent a portion of the person's remuneration over the duration of his or her participation in the project.

Interns who have an internship agreement with an educational establishment must not be mentioned.

Additional information on the professional future of the persons concerned will be requested at the end of the project. Their career path may be tracked for up to 5 years after the end of the project.

| Identification | | | | Before recruitment for the project | | | Recruitment for the project | | | |
|------------------------------|---------|---------------------------------|---|---|---|---------------------------------------|--|-----------------------------|---------------------|--|
| Surname and first name | Sex M/F | E-mail address (1) | Date of last news | Last diploma obtained at time of recruitment | Place of studies (France, EU, outside EU) | Prior professional experience (years) | Partner who hired the person | Position in the project (2) | Date of recruitment | Duration of missions (months) (3) |
| PRIAM Jonathan | M | Jonathan.priam@univ-antilles.fr | | Master in human and social sciences - Geography | University of the West Indies - Martinique | 8 years | CNRS Scientific Research National Center | Engineer | 01/01/2021 | 10 months 100 % |
| MARÉCHAL Jean-Philippe | M | marechal.jean@gmail.com | | PhD - HDR Tropical marine environment | E.P.H.E. (École pratique des Hautes Études) | 15 years | CNRS Scientific Research National Center | Researcher | 04/01/2021 | 36 months 50 % |
| PARRA LEYLAVER GNE Lusmiriam | F | andrealaylaver@gmail.com | | PhD political and social science | University of Liège (Belgium) | 4 years | CNRS Scientific Research National Center | Researcher | 09/01/2021 | 12 months 100 % |
| STEPHAN Gwendoline | F | Gwendoline.stephane@meteo.fr | A continuation of the contract has been proposed by Météo-France for one additional year, from 1st November | PHD | EU (France, Germany) | 3 | Météo-France | post-doctoral | 01/01/21 | 10 (due to their skill and previous experience in post-doctoral positions, in order to keep the allocated budget and give a salary corresponding to the qualifications, the post-doctoral has been proposed for a 10 months duration). |
| TUPIASSU Lise | F | ltupiassu@gmail.com | | PhD | Federal university of Para (Brazil) | 8 years | CNRS Scientific Research National Center | Researcher | 06/02/23 | 3 months 80 % |

Table filling-out aid

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- (1) **E-mail address:** indicate an e-mail address that will be as long-lasting as possible
- 2) **Position in the project:** post-doctoral, doctoral student, engineer or equivalent, technician, individual contractor, other (specify)
- (3) **Duration of missions:** indicate the total duration in months of the project missions carried out or planned (including missions not financed by the ANR).

The personal information collected shall undergo computerized data processing for the sole needs of the depersonalized study on the professional future of the people recruited for ANR projects. The information will not be transferred in any way and will be kept by the ANR for a maximum period of 5 years after the end of the project concerned. Pursuant to the Act No. 78-17 of 6 January 1978, amended, relative to Data Processing, Files and Personal Privacy Protection, the persons concerned have a right of access to, correction and deletion of their personal data. The persons concerned shall be informed directly of this right when their contact details are filled out. They can exercise this right by contacting the ANR (<http://www.agence-nationale-recherche.fr/Contact>).

D.5 FINANCIAL STATUS

Give an indicative account of the grant budgets spent by the partners. Indicate how this complies with the forecasts and explain any significant divergences.

| Name of partner | Grant budgets spent (in %) | Comments (if necessary) |
|-----------------|----------------------------|-------------------------|
| CNRS | 86% de 35285,60 € | |
| METEO FRANCE | 100% de 61891,56 € | |

E APPENDICES (IF NECESSARY)

Access to the CESAR project deliverables: scientific report intended for the EC (European Commission) and the CTM (Territorial Collectivity of Martinique).

Access to the FEDER-CTM financial annex: state of expenditure and resources, CESAR indicators.

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