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The Ocean and Cryosphere in a Changing Climate in Latin America: Knowledge Gaps and the Urgency to Translate Science Into Action

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Climate Change hazards to social-ecological systems are well-documented and the time to act is now. The IPCC-SROCC used the best available scientific knowledge to identify paths for effective adaptation and mitigation of climate change impacts on the ocean and cryosphere. Despite all the evidence highlighted by SROCC and the key role of the ocean and cryosphere for climate change at all levels, Latin America (LA) faces challenges to take effective action mostly due to socio-economic vulnerability, political instability and overall technical capacities. Countries have adopted diverse actions as the information needed by policy makers has been made available, not necessarily in accessible and inclusive ways. Regional imbalance in economic development, technological level, capacity development, societal involvement, and governmental oversight have contributed to skewed geographical and technological gaps of knowledge on key ecosystems and specific areas preventing effective climate actions/solutions. We analyze the Nationally Determined Contributions (NDCs) from the region as proxies to the incorporation of IPCC recommendations. The gaps and opportunities for the uptake of ocean and climate science to political decision making is discussed as five key aspects: (i) climate assessment information and regional policies, (ii) knowledge production, (iii) knowledge accessibility, (iv) knowledge impact to policy, and (v) long term monitoring for decision making. We advocate that the uptake of SROCC findings in LA policies can be enhanced by: (a) embracing local realities and incorporating local, traditional and indigenous knowledge; (b) empowering locals to convey local knowledge to global assessments and adapt findings to local realities; (c) enhancing regional research capabilities; and (d) securing long-term sustainable ocean observations. Local and regional participation in knowledge production and provision enhances communication pathways, climate literacy and engagement which are key for effective action to be reflected in governance. Currently, the lack of accessible and inclusive information at the local level hampers the overall understanding, integration and engagement of the society to mitigate climate effects, perpetuates regional heterogeneity and threatens the efforts to reverse the course of climate change in LA. Local researchers should be empowered, encouraged, rewarded and better included in global climate-ocean scientific assessments.

Keywords: climate change, SROCC, local knowledge, policy makers, Latin America

INTRODUCTION

The critical importance of the ocean and the cryosphere to the climate system (Reid et al., 2009), hydrological cycles (Schanze et al., 2010; Liu et al., 2020) and the consequences to society (Nicholls, 2010) stimulated the IPCC to commission a Special Report on the Ocean and Cryosphere in a Changing Climate (hereafter SROCC) (IPCC, 2019a), which assessed climate change impacts on marine and coastal ecosystems. The combined effects of ocean warming, ocean acidification, and deoxygenation are reducing primary production and marine biodiversity, and impacting associated ecosystem services such as nutrient cycling, carbon sequestration and fisheries (Bindoff et al., 2019). Sea level rise and ocean extreme events are causing coastal damage, with natural and capital losses, and many associated socio-economic impacts (Nicholls, 1995; Leatherman, 2001). People dependent on or living in close connection with coastal, polar and mountain environments are especially vulnerable to the hazards of ocean and cryosphere change (Oppenheimer et al., 2019).

Climate change is a global phenomenon, but the scale to act is local, primarily influenced by a country's policies, geography, socio economic development, and vulnerability to climate-risks. Consequently, climate coastal adaptation policies have been developed, with substantial variations between countries, and across developmental status (Klein et al., 1999, 2001). Investigating how scientific knowledge and international recommendations based on science are being taken at national level is not simple, due to the time-lag between implementation, monitoring, evaluation and reporting. In addition, climate change adaptation actions generally lack scientific uptake and on-the-ground change, with most focus being on assessing vulnerability, compared to developing plans and actions (Gibbs, 2015).

Latin America and the Caribbean[1] (hereafter LAC) represents a high contrast region where wealth and prosperity coexist with vulnerability and extreme poverty, explained by low growth (Fernández-Arias and Fernández-Arias, 2021). The region hosts 1/3 of the world's most biodiverse countries and highly urbanized regions (UNEP, 2011). It comprises 46 countries, dependent territories and overseas departments on the edge of the Atlantic and Pacific oceans and the Caribbean Sea and is limited to the south by the Southern Ocean. Altogether, LAC has more than 30,000 km of coastline, ranging from the tropical region—dominated by mangroves, seagrass meadows and coral reefs—to subtropical and temperate areas, dominated by salt marshes, rocky shores and macroalgal beds all the way to the Drake passage, where the influence of the Southern Ocean and Antarctica is well-documented (Sijp and England, 2004; Scher and Martin, 2006; Livermore et al., 2007; Yang et al., 2014; Viebahn et al., 2016; England et al., 2017). This continent-wide latitudinal range reflects diverse oceanic domains and climate influences, responsible for the high diversity of marine habitats and ecosystems (Miloslavich et al., 2011; Turra et al., 2013; Spalding et al., 2017) where hotspots of "exceptional marine biodiversity" and fisheries coincide with areas most severely affected by global warming (Ramírez et al., 2017). Coastal areas surrounding the Mesoamerican reef and nearby islands are low-lying and extremely vulnerable to sea level rise. Extreme hydrometeorological events are frequent and coastal erosion is a widespread threat (particularly severe in Northern and Northeast Brazil—Silva et al., 2014), associated with human interventions, poor coastal planning and management but also influenced by the morphodynamic nature of the coast (Silva et al., 2014), as most coastal areas in the region. The diversity of this region is also reflected by a wealth of peoples, languages, social-political systems, cultures, traditions and origins that constitute a unique mosaic of diversities with 780 indigenous peoples and 560 different languages (Freire et al., 2015) that heightens regional imbalance and skewed geographical and technological gaps.

Despite the alarming magnitude and extent of climate change effects shown by SROCC, Latin America (hereafter LA) is challenged to take effective action due to socio-economic vulnerability. Extreme poverty in LA reached unprecedented levels in 2020 (ECLAC, 2021), and social inequality indices, like unemployment and labor participation rates, have worsened particularly among women, despite the recent emergency social protection measures adopted in the COVID-19 pandemic. The recently published Regional Human Development Report[2] for LAC (UNDP, 2021) highlights that concentration of power, violence in all its forms and failed social protection of policies and frameworks cause the contrasts found in the region. These promote high inequality and low growth, challenging the intake of the recommendations from SROCC even though the region plays a key part in the global green recovery (UNDP, 2021).

This paper analyzes the adopted Nationally Determined Contributions (NDCs) in LAC as a reflection of the incorporation

[1]The acronyms LAC and LA are not used interchangeably: LAC refers solely for evidence from Latin America and Caribbean while LA is used when evidence refers to Latin America.

[2]Regional Human Development Report for Latin America and the Caribbean in https://www.latinamerica.undp.org/content/rblac/en/home/library/human_development/regional-human-development-report-2021.html.

of IPCC recommendations. We briefly discuss gaps and opportunities in the region for the uptake of ocean and climate science to political decision making, organized in five key categories: (i) climate assessment information and regional policies, (ii) knowledge production, (iii) knowledge accessibility, (iv) knowledge impact to policy, and (v) long term monitoring for decision-making. We finally present some conclusions and propose future actions.

NATIONALLY DETERMINED CONTRIBUTIONS (NDCS) AS SCIENCE UPTAKE INDICATORS

Nationally Determined Contributions (NDCs) are official Government commitments to comply with UNFCCC's targets. NDCs may also reflect how IPCC findings are perceived and incorporated into policy documents that go beyond current national climate plans and bring us closer to the Paris Agreement goals of decarbonizing economies and improving resilience. We reviewed the NDC reports submitted by 31 Latin American and Caribbean countries to the NDC registry[3] and searched for expressions such as "oceans and coasts," "fisheries," "risk management," "gender," "UN 2030 Agenda," "interculturality," "community-based solutions," "ecosystem-based adaptations," and "cryosphere." In addition, we incorporated Socio Economic indicators such as Gross Domestic Product (GDP) per capita, Human Development Index (HDI), and specific GDPs for 2017 and 2019, relative to the overall values of GDP estimates for the whole world, extracted from the World Bank Database[4] Results are shown in **Table 1**.

Risk management was the most common feature, addressed by 29 countries, followed by Ocean and coastal activities ($n = 27$). Fisheries actions were reported for 19 countries, while ecosystem-based adaptation appeared in 18, such as Mexico's Blue Carbon action. Gender equity/balance issues were a concern for 17 countries and frequently mentioned by most countries, although not included by Guatemala and Uruguay. Community based adaptation is of particular interest in 16 countries, while Agenda 2030 has been considered by 15 countries in their NDCs. Interculturality, the existence and equitable interaction of diverse cultures and the possibility of generating shared cultural expressions through dialogue and mutual respect[5] was important for 13 countries. The least frequent concern was with the Cryosphere, only included in the NDCs of Argentina, Chile and Peru (**Figure S1**).

NDCs in the LAC region have been developed according to local context and capacities. Commitments to climate change mitigation and adaptation are frequent, but specific targets to "oceans and cryosphere" have not been prioritized. For example, SROCC reports coral reefs as amongst the most susceptible ecosystems and yet the Mesoamerican Arrecifal Barrier has not been included among local NDCs. The same rationale goes for "Ocean and Coasts" in the NDCs from Brazil, Guyana, Nicaragua, and Peru which seems invisible to national commitments despite the proportion of coastal and marine areas in these countries. NDCs in the region have not yet been impacted by SROCC findings as reflected by the first (and now the second more recent) round of NDC submissions. Unless the climate and ocean communities recognize LAC's socio-economic contexts and associated environmental and social vulnerabilities to consider uniting to act, this scenario might not change significantly over time.

[3]https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx
[4]https://data.worldbank.org/indicator
[5]As expressed by the Convention on the Protection and Promotion of the Diversity of Cultural Expressions (Art. 4.8).

GAPS AND OPPORTUNITIES IN LATIN AMERICA

Climate Assessment Information and Regional Policies

National Adaptation Plans (NAPs) are policy driven commitments that translate the NDCs into local and sectoral actions. Technology Needs Assessments (TNAs) are rights of States to claim the necessary technology to comply with IPCC recommendations. NDCs, NAPs and TNAs are three different, but complementary, instruments that countries in LAC seek to implement. While NDCs are designed to fulfill international commitments, NAPs and TNAs reflect national capacities and local vulnerabilities, yet to be targeted in IPCC assessments.

IPCC assessments are geographically and disciplinarily skewed, strongly based on the most influential science produced by developed countries (Vasileiadou et al., 2011), with a disproportionate influence of formally educated and economically advantaged groups (Castree et al., 2014). Thus, as LAC contributions to SROCC have been limited (nine authors from seven countries), the resulting recommendations also lead to limited local application. Moreover, political leadership in the region favors socio-economic policies over environmental protection (e.g., Custer et al., 2018, in relation to the UN 2030 Agenda). Yet NAPs generally show two main pathways: while developed countries focus on economic risks and opportunities, developing countries prioritize natural resources and conservation (Alves et al., 2020). A clearer connection between environmental threats and socio-economic concerns must be established so regional leaders feel safer and supported to make decisions. Local researchers should be encouraged to work closely with communities and aid in bridging knowledge gaps.

The IPCC epistemic community defines knowledge as information published in peer-reviewed papers, generally neglecting publications in other languages and other sources of knowledge (traditional, indigenous, and local knowledge—ILK). SROCC has made an effort to include ILK (Abram et al., 2019) and yet LA-ILK's representation was slim. One can argue that SROCC has favored traditional, formally educated, and economically advantaged groups as most scientific assessments do (Castree et al., 2014) perpetuating cultural and geographical imbalance. Representation matters and the participation of Lead Authors from LAC in SROCC was also low. Ten out of 103 SROCC authors were self-identified as belonging to 8 LAC

TABLE 1 | Specific categories listed as targets to meet either UNFCCC's climate targets or specific SDGs from 31 countries from Latin American and the Caribbean region (LAC) according to the NDC Registry*. Countries are alphabetically listed. Economic indicators, *i.e.*, Gross Domestic Product (GDP) per capita, Human Development Index (HDI), and specific GDPs for 2017 and 2019 relative to overall world GDP estimates for these specific years were world extracted from World Development Indicators**, at the World Bank website.

Categories Countries	Risk management	Gender	Ocean and coasts	Agenda 2030	Ecosystem based adaptation	Fisheries	Interculturality	Community based adaptation	Cryosphere	GDP 2017	HDI 2017	R_GDP 2017	R_GDP 2019
Antigua & Barbuda	1	1	1	1						2.17	0.78	1.02	3.00
Argentina	1	1	1	1	1	1	1	1	1	1.76	0.83	0.82	−2.44
Bahamas	1	1	1	1		1				2.08	0.81	0.98	0.17
Barbados	1	1	1		1					0.32	0.80	0.15	−0.18
Belize	1	1	1	1						−0.13		−0.06	−1.27
Brazil	1			1	1		1			0.51	0.76	0.24	0.30
Chile	1	1	1	1	1		1	1	1	−0.24	0.84	−0.11	−0.11
Colombia	1	1		1	1	1	1	1		−0.16	0.75	−0.08	1.49
Costa Rica	1	1	1	1	1	1	1	1		2.80	0.79	1.31	0.89
Cuba	1	1		1						1.77	0.78	0.83	0.00
Dominica	1	1	1			1				−7.00	0.72	−3.28	2.62
Dominican Republic	1	1	1	1	1					3.52	0.74	1.65	3.16
Ecuador	1	1	1	1	1	1	1	1		0.57	0.75	0.27	−1.29
El Salvador	1	1				1				1.74	0.67	0.82	1.48
Grenada	1	1	1		1			1		3.87	0.77	1.81	1.13
Guatemala	1	1				1	1	1		1.36	0.65	0.64	1.78
Guyana	1					1				3.22	0.65	1.51	3.86
Haiti	1	1	1	1						0.96	0.50	0.45	−2.31
Honduras	1	1			1					3.08	0.62	1.45	0.78
Jamaica	1	1	1	1	1	1	1			0.50	0.73	0.23	0.19
Mexico	1	1	1	1	1	1	1	1		0.93	0.77	0.44	−0.91
Nicaragua	1			1	1	1	1	1		3.31	0.66	1.55	−4.03
Panamá	1	1	1	1	1	1	1			3.81	0.79	1.79	1.05
Perú	1		1		1		1	1	1	0.83	0.75	0.39	0.41
Saint Kitts and Nevis		1	1							−2.74	0.78	−1.29	1.65
Saint Lucia	1	1	1	1	1		1	1		2.96	0.75	1.39	0.98
St Vincent and the Grenadines	1	1	1			1				0.66	0.72	0.31	0.12
Suriname	1	1			1	1	1	1		0.76	0.72	0.36	−0.53
Trinidad & Tobago		1								−2.77	0.78	−1.30	−0.29
Venezuela	1	1				1		1			0.76	0.00	0.00

Note that negative scores are shown in red.
**https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx.*
***https://ourworldindata.org/human-development-index and http://wdi.worldbank.org/.*

countries[6] (97% of the total authoring contribution). The USA alone had 15 authors, in contrast with other LAC countries such as Cuba and Trinidad and Tobago—the only SIDS regionally represented—as well as Mexico and Brazil—two of the largest and most populated countries in LA—which accounted for one participant each. Apart from language and representation, technical and scientific capacity deficiencies refrained researchers in the region from contributing more (Polejack and Coelho, 2021).

Knowledge Production

Knowledge production of the ocean-climate nexus in LA insofar as the uptake of such knowledge to national advisory exercises is still incipient, possibly due to limited technical capacities in the region combined with a deficient access to marine

[6]These countries are: Argentina, Brazil, Costa Rica, Cuba, Ecuador, Mexico, Peru, and Trinidad and Tobago.

technologies and research platforms. International cooperation aids local researchers to overcome such bottlenecks (Soler, 2021). Argentina, for example, has developed a national strategy to strengthen marine research capabilities, allowing for better coordination and optimization of resources, the "Pampa Azul" initiative. However, seven years after its launching, economic instability jeopardized investments, despite international commitments. One current opportunity is the All-Atlantic Ocean Research Alliance, a South to North multilateral scientific cooperation open to countries in the region (Polejack et al., 2021). It aligns research priorities, infrastructure, and budget, to overcome the knowledge gaps in the Atlantic, informing decisions for improved societal benefit. As a result, the Alliance fosters marine technology transfer and balanced knowledge co-production.

Use of regional knowledge is hindered in world assessments for several reasons. Despite budget constraints, political and economic instability, LAC researchers produce a wealth of knowledge that often faces intra-academic barriers, such as language (Angulo et al., 2021). Knowledge relevant to local systems are often published in languages other than English or outside of mainstream Journals receiving less attention by peers and thus becoming invisible to global assessments like SROCC. Therefore, local researchers are again critical to make such knowledge visible to global reporting processes. Regional ILK needs to permeate more effectively into global assessments like IPCC and IPBES reports to complement classic scientific information. At the same time, the results/findings from such reports must return to local communities in a language that both society and policymakers understand and relate to, so that the uptake of such knowledge is enhanced. Science cannot be detached from local realities, even if the final message pertains to global effects. Translation of scientific knowledge to local languages is certainly essential to allow for a more equitable extraction of the information from these assessments making calibrated language and the whole process more palatable to the general public since its information is designed to provide evidence, agreement and communicate uncertainties (Mastrandrea et al., 2010) based on peer-reviewed research. By adjusting the language, it allows the information and its flow to be more inclusive and receptive to diversity, particularly when interculturality is taken into account. Although many perceive the region as sharing similar languages, geographies and cultures, reality shows a huge diversity of languages and cultures but also values and beliefs. Latin America and the Caribbean are as diverse and wide as the geographic breadth and ecosystems/biomes described in-between. Thus, climate change perception of threats needs to account for local realities and require larger representation of specific groups, knowledge and traditions at different assessment processes.

Climate knowledge production is also dependent on multiscale observing systems to produce accurate scenarios and long-term predictions. Nevertheless, despite existing initiatives, there are still considerable capacity and data gaps (Malone et al., 2010; Foltz et al., 2019; Smith et al., 2019; Speich et al., 2019; IOC-UNESCO, 2020) due to insufficient observations. These gaps are particularly critical in coastal Africa, South America, the Caribbean, Southeast Asia, and Small Island Developing States, where development pressure and high social vulnerability hamper ocean and climate sustained observations. These areas should represent high monitoring priorities and efforts.

Knowledge Accessibility

Societal engagement is influential in science uptake to inform decisions by pressing governments to act, as well as by using scientific information to transform behavioral patterns and foster climate and ocean literacy, and social innovation. Consequently, inclusion and equity require accessible language and capacity development. In socio-ecological systems, where scientific uncertainty and societal stakes are high, values tend to be in dispute and decisions are urgent. The Post-Normal Science framework (PNS, Funtowicz and Ravetz, 1993) proposes a multi-stakeholder engagement in the decision making, jointly considering the risks and opportunities to act. We need to address social vulnerabilities at the local level to enhance and sustain the engagement of LA in the green/blue economy. Thus, PNS could be an adequate framework for developing SROCC's recommendations further.

Scientific knowledge used to be restricted to academic groups and publications and discussed within invisible schools (Sieber, 1991). Recently, the Open Science Movement has attempted to make this knowledge available to all (Aspesi and Brand, 2020). Open Science is about making scientific research and data freely accessible, but should also mean dialoguing with society, while embracing ILK in support of better-informed decision making (Oliver and Cairney, 2019; Safford and Brown, 2019).

Broad stakeholder engagement (affected communities, indigenous peoples, local and regional representatives, policy makers, managers, interest groups and organizations) has the potential to combine and use relevant knowledge (Obermeister, 2017) and balance the disproportionate influence that economically advantaged groups have in most scientific assessments (Castree et al., 2014). The formal process of IPCC assessments follows predetermined formats and standards[7,8], uses specific calibrated language and approaches unfamiliar to many scientists and policy makers in LA. Locally, there is little interaction and support by IPCC focal points to promote learning-oriented methodologies, familiarity with the language and experience to address the IPCC process, hampering regional/local participation. Although the recognition and use of ILK is expanding in peer-reviewed research (Savo et al., 2016; Abram et al., 2019) thus providing information and responses to guide and inform policy with different perspectives (Huntington, 2011; Nakashima et al., 2012; Lavrillier and Gabyshev, 2018), most global assessments have not yet incorporated ILK information (Obermeister, 2017) thus limiting the potential of local adaptation response (Ford et al., 2016).

Science diplomacy, the interrelation between research and international relations, can reduce inequalities and bridge communities by aiding in the implementation of international

[7]https://www.ipcc.ch/documentation/procedures/
[8]https://www.ipcc.ch/site/assets/uploads/2018/09/ipcc-principles-appendix-a-final.pdf

provisions aimed at leveraging scientific capabilities in LAC (Ruffini, 2018; Salpin et al., 2018; Polejack and Coelho, 2021). By incorporating scientific literature in other languages, other sources of knowledge, and regional input, global assessments like SROCC reduce most of its imbalance. The opportunity presented by the UN Decade of Ocean Science (Ryabinin et al., 2019; Polejack, 2021), particularly through the Ocean Literacy movement seek creative ways to bridge science, policy, diplomacy and society (Santoro et al., 2017; Borja et al., 2020).

Knowledge Impact to Policy Change

Climate change adaptation and mitigation requires coherence of global, national, and local levels of governance, a challenge to the integration of political and administrative systems. There is a void between international treaties, national regulations, and local implementation due to the lack of broad stakeholder participation in the formulation of these policies, undermining their adequacy (Keskitalo et al., 2016). The development of effective responses involves societal adjustment and modification of current behavior provoking such changes.

Scientific advice is playing an increasing role in policy and decision-making (Gluckman, 2016a). Governments require scientific evidence in a wide range of situations (e.g., Gluckman, 2016b), but there is still the need to respect the different imperatives in science and in policy, so better-informed decisions are made, and research is promoted and sustained in the long-term (Parkhurst, 2016).

Interculturality matters to LAC (UNDP, 2021) and has been recognized as an important regional aspect that defines local identity as reflected in a few NDCs. Thus, as scientists, we must incorporate the local social, cultural, and political forces to seek mutual understanding and cooperation to also find solutions to climate change adaptation. Local institutional and policymaking landscapes are determinant of how scientific evidence is perceived and used in the decision-making process, mostly because these decisions consider a wide range of factors that are grounded on local realities, including social values and beliefs (Cairney, 2016) and traditional and local knowledge, reflected in the interculturality aspects brought by a few NDCs. Latin America has a diversity of political systems that produce and apply scientific evidence in a variety of ways, deriving from national and subnational realities that often challenge the Western-democratic perspective of the use of evidence, so dominant in global reporting exercises (Parkhurst, 2016). Thus, standard global solutions can become locally irrelevant and there is a need to consider these realities when co-designing fit-for-purpose local solutions. In this sense, local actors (scientists, the public and stakeholders) are better equipped to act as knowledge brokers within their local social-political contexts.

Importance of Long-Term Monitoring for Decision-Making

Long-term observations inform society about change rates in ocean warming, sea-level rise, acidification, and deoxygenation (Breitburg et al., 2018; Bourlès et al., 2019; Turk et al., 2019), including coastal areas where the effects on ecosystems and ecosystem services are often associated with social vulnerability, highly affecting society (IPCC, 2019b). Detection of climate change in coastal regions is difficult because of their natural variability, requesting long-term ocean observing systems (Duarte et al., 2013; Turk et al., 2019). Globally coordinated ocean observing systems provide the information needed to support climate prediction on different timescales (e.g., Sloyan et al., 2019). However, many existing records are still short to detect anthropogenic change, and some regions remain undersampled (e.g., deep-sea, shelves). Southern Hemisphere temperate, subpolar and polar latitudes are among the least studied areas of the planet, which represents a serious gap to decrease the uncertainty of global models predicting future climate scenarios (Meredith et al., 2019). Long-term data is essential to measure changes to ecological and environmental conditions, but also the outcome of policies and human behavioral changes (Pecl et al., 2017). Thus, long-term ocean observatories in LAC, combining environmental data (such as Essential Ocean Variables-EOVs) with social sciences and traditional knowledge need to be developed and implemented (Abram et al., 2019; Fennel et al., 2019).

At the heart of climate change research is the requirement of sustained observations with time series frequent and long enough to develop baselines and climatologies. Baselines are compared with anomalies, changes in phenology, trends or changes in populations, and spatial distribution. Time series enables us to characterize variability, reduce uncertainty, and increase forecast and prediction which can guide the outcome of policies and human behavioral and environmental change. Bio-Environmental baselines and time series represent global trends and local pressures that can be evaluated against natural variation for policy and decision-making at many levels (Muelbert et al., 2019). Integrative scenarios, combining environmental, socioeconomic and health sciences, such as the Nexus method (Howells et al., 2013), has been successfully applied to climate and fisheries in the Humboldt Current System (Garteizgogeascoa et al., 2020), in the assessment of climate vulnerability in Brazil (Araujo et al., 2019), and in the International Long-Term Ecological Research (LTER) programs described in Muelbert et al. (2019) and detailed for LAC in **Table S2**.

Consequently, better government climate-related decisions are likely to occur when decision-makers are exposed to climate scenarios and environmental indicators with dynamic outputs, even in face of models' limitations and potential risks of being misused to support biased political statements (Saltelli et al., 2020). According to Haasnoot et al. (2015), scenarios lead to increased awareness of when and which adaptation policies should be applied.

CONCLUSIONS

Despite the efforts to disseminate, warn and engage as many nations as possible in a global effort to reverse the course of climate change, high inequality and low economic growth in several regions are hampering the overall understanding, integration, and engagement to mitigate climate effects, thus perpetuating regional heterogeneity (UNDP, 2021). The goals and specific objectives of climate change strategies around the world tend to reflect a global agenda that, at least for LA, are often detached from national/regional vulnerabilities and contexts which in part respond to delayed actions. It needs to change.

In order to reduce knowledge gaps in LA, there is a need to secure investment in long-term observations and to promote capacities, which will also raise the accuracy of models and predictions. Sustainable research funding shall provide local and regionally oriented information and advice. Moreover, successful initiatives like Pampa Azul, AtlantOS, the All-Atlantic Ocean Research Alliance, Rede Clima, Acceso Libre a la Información Científica—ALICIA, the National Repository in Mexico and the Cartagena Convention (**Table S1**) reflect State policies trying to overcome bottlenecks in LA. The interruption of such policies jeopardizes future investments and continuity of climate action mitigation.

How would Latin America engage in climate action globally while maintaining its identity and structure of interconnected social, economic, and ecological systems? It is imperative to develop specific national-institutional capacities and public awareness to support and advance a long-term process with a more diverse and multi knowledgeable approach embracing local cultures, language, and broader participation of local communities (**Figure 1**). Despite political and economic limitations, the region must be integrated not only from a commercial perspective of goods and services (i.e., Mercosur) but also from an environmental standpoint to implement its strategies against irreversible climate change. A few organizations in the region could facilitate this coordination and strengthen the participation of LAC representatives in global reporting assessments such as SROCC. The InterAmerican Institute for Global Change (IAI—Instituto InterAmericano para la Investigación del Cambio Global) is a regional intergovernmental organization that promotes interdisciplinary scientific research and capacity building, informing local and regional decision-makers about important issues of global change. Although the IAI has mechanisms in place to provide scientific evidence for the improvement of its Parties' public policies, it is essentially intergovernmental, i.e., triggered by diplomatic negotiations that depend upon national mechanisms of integration with other stakeholders. The Economic Commission for Latin America and the Caribbean (ECLAC) is also another important intergovernmental organization in the region that could enhance the coordination in climate change responses, significantly

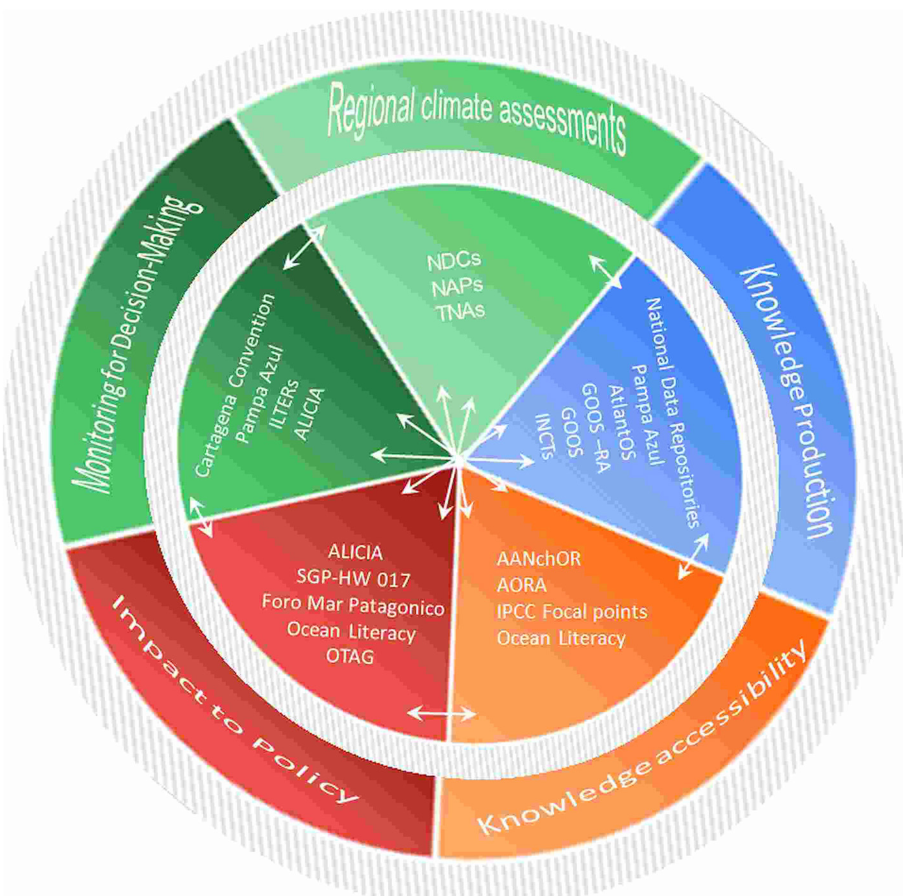

FIGURE 1 | Examples of current initiatives that can narrow the gaps and explore opportunities for the uptake of ocean and climate science to political decision making in LA across five key categories: (i). climate assessment information and regional policies, (ii). knowledge production, (iii). knowledge accessibility, (iv). knowledge impact to policy, and (v). long-term monitoring for decision-making. (Note see **Table S1** for additional information and references).

contributing to regional knowledge production and public policies, while promoting the transition to environmentally sustainable and low carbon economies (UNDP, 2021). However, both IAI and ECLAC apply similar diplomatic processes as the IPCC and the UNFCCC, with little synergy with local stakeholders. Moreover, neither have a climate (not to mention ocean) focus and not all countries in the region are Parties to those organizations. Therefore, while we recognize that regional organizations can aid in bridging global, regional and national perspectives based in science, we advocate that local researchers can act as knowledge brokers and should be empowered, encouraged, rewarded and better included in global climate-ocean scientific assessments.

Addressing climate change entails modifying the status quo facing resistance from influential groups in society that interfere with the development of local climate change policies (Meadowcroft, 2009). In this perspective, we advocate that the uptake of SROCC findings in LA policies can be enhanced by: (a) embracing local realities and knowledge purveyors; (b) empowering locals to both inform local knowledge to global assessments and adapt those findings to local realities; (c) enhancing regional research capabilities; and (d) securing ocean observations for the long run. The adoption and incorporation of SROCC's recommendations into NDCs depend strongly on the local reality which is dictated by the relationship between adaptation-related processes (social vulnerability, low growth, as well as high contrasts and inequalities) and political pressures.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

MMCM led the process with all co-authors (MC, LCC, MNL, AP, ACP-P, and ER-A) who have substantially contributed to the document, its revision, reading and approving the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fclim.2021.748344/full#supplementary-material

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