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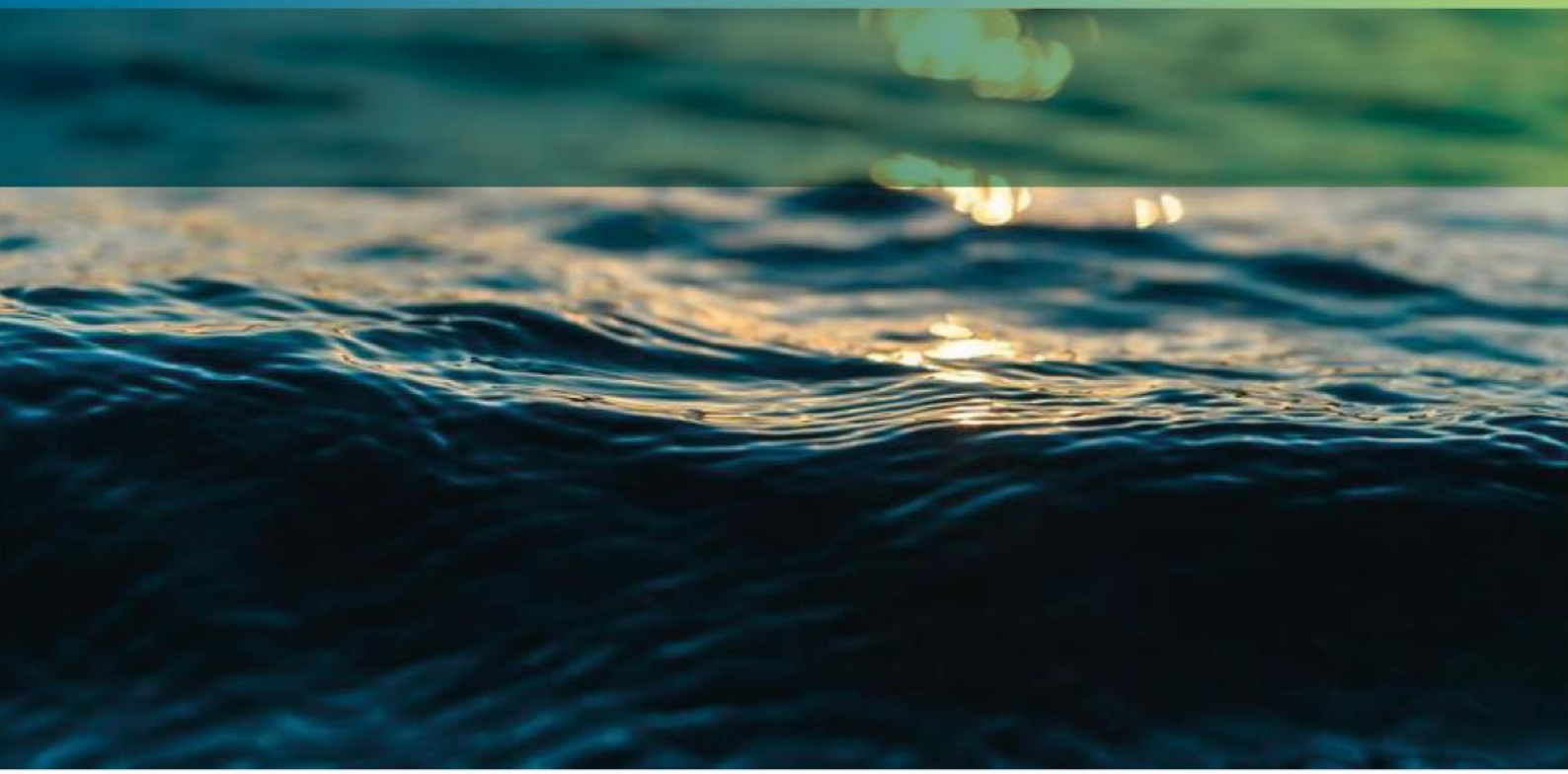
INSTITUT DE RELATIONS INTERNATIONALES ET STRATÉGIQUES

CLIMATE SECURITY IN THE WESTERN INDIAN OCEAN



OBSERVATOIRE Défense & Climat

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Direction générale des relations internationales et de la stratégie
MINISTÈRE DES ARMÉES

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FOREWORD

The Ministry of Armed Forces regularly outsources studies to private research institutes, according to a geographical or sectoral approach, aimed to complement its internal expertise. These contractual relations are part of the development of the prospective approach to defence, which, as underlined by the latest White Paper on Defence and National Security, "must be able to draw on an independent, multidisciplinary, original strategic reflection, integrating academic research as well as the one of specialised institutes".

A large part of these studies was made public and available on the site of the Ministry of Armed Forces. In the case of a study published in a piecemeal manner, the Directorate General for International Relations and Strategy can be contacted for more information.

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ABOUT THE AUTHORS

François Gemenne

François Gemenne is a specialist of environmental geopolitics and migration governance at the University of Liège, where he is a FNRS senior research associate and the Director of the Hugo Observatory. He also heads the Observatory on Defence and Climate of the French Ministry of Defence, jointly with Julia Tasse at IRIS. He is a lead author for the IPCC and he also lectures on climate change and migration policies in different universities, including Sciences Po and Sorbonne University in Paris.

Sofia Kabbej

Sofia Kabbej is a researcher at the Observatory of Climate Change Impacts on Defense and Security (IRIS), where she aims to bring critical security perspectives. Her current research focuses on the climate- security – risk prevention nexus and its implications for political modernity, more specifically for sovereignty. She also explores issues related to the governance of geoengineering.

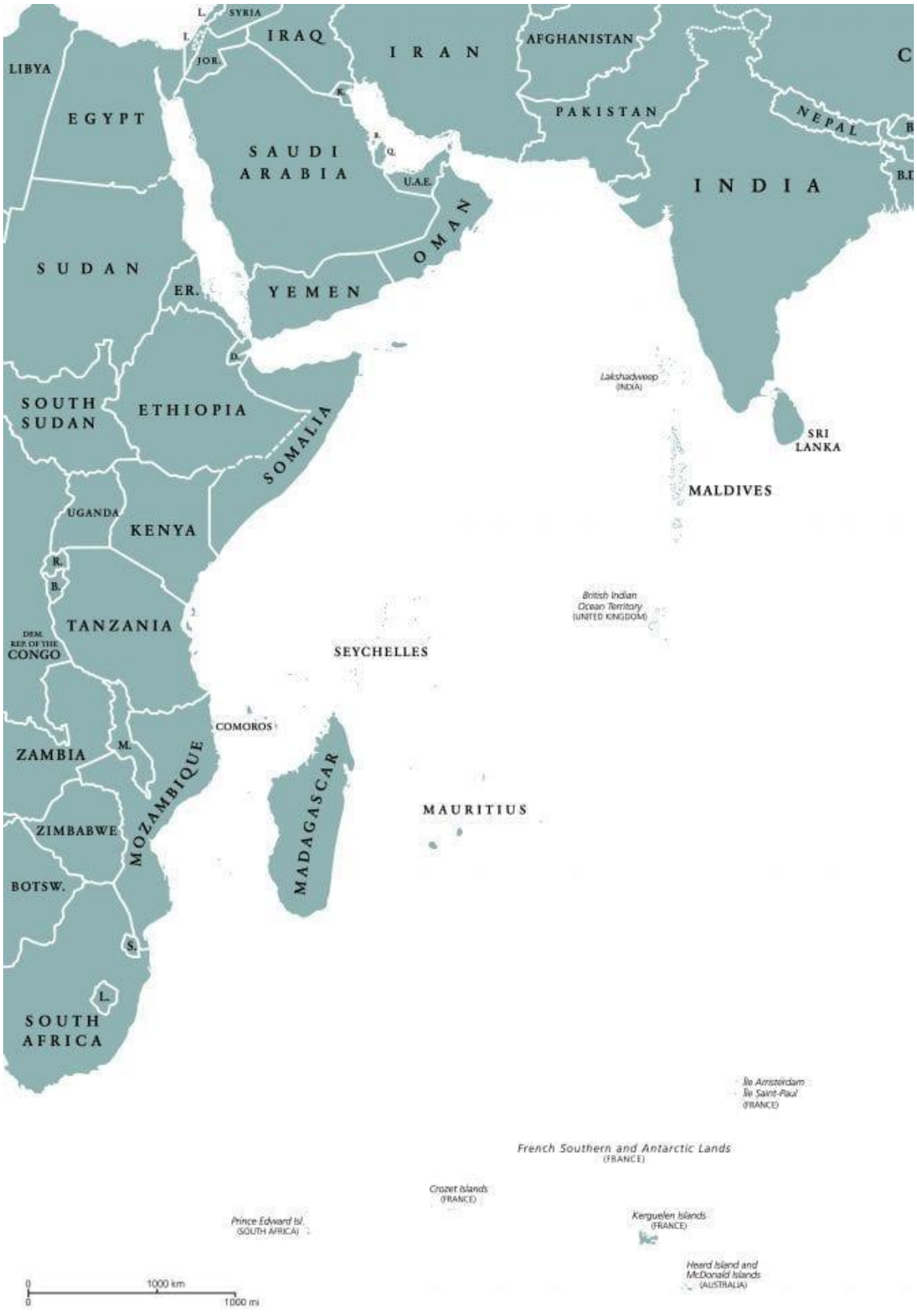
Roman Monange

Roman Monange is a research assistant intern at the Observatory of Climate Change Impacts on Defense and Security. He is waiting for the validation of his Research Master's degree in International Security and Defence at Jean Moulin Lyon 3 University. Specialising on climate and defence subject, he realised his master's thesis on the action of French Ministry of Armed Forces in response to Climate Change.

Julia Tasse

Julia Tasse is a research fellow at IRIS, where she heads the Energy and Climate Program. She is the co-director, jointly with François Gemenne, of the Observatory of Climate Change Impacts on Defense and Security of the French ministry of Armed Forces. Her research focuses on the ocean, security and climate nexus from a geopolitical perspective. She has a specific approach linked to her background in climate sciences (Master in Environmental Sciences) and her experience in the maritime field for various organisations. She is also part of the editorial board *of La Revue internationale et stratégique*.

GEOGRAPHICAL SCOPE OF THE REPORT



EXECUTIVE SUMMARY

PART 1: A CHANGING STRATEGIC ENVIRONMENT

I) Main strategic trends in the Indian Ocean region

The Indian Ocean (IO) is a strategic area, whose importance significatively grew since the Cold War.

Crucial maritime crossroad

Rich in natural resources, the IO is the busiest trade route worldwide. The trade flow concentration gives to maritime openings and straights a critical importance (oil and gas trade playing a major role). China's vigorous economic growth contributed to the rapid development of littoral countries.

Growing competition between India, China and the United States in the Indian Ocean

The United States (US) became IO's hegemonic power in the aftermath of WWII. However, its influence tends to decrease while India and China strengthen their military capabilities and expand their presence. China developed the Belt and Road Initiative (BRI) since 2013, which aims to increase trade flows to and from China through a series of trade partnerships and massive investments in foreign transport infrastructures. This growing influence generates concerns and counter-balancing attempts. The US and India, seeking to maintain their presence over the IO, reinforced their cooperation. **The competition between India and China leads to a race for access to overseas military bases, civil facilities and market shares in transport infrastructures.**

Parallel middle powers' influence strategies

In this context, **regional middle powers such as France and Australia also reinforced their involvement in the region. Both countries** seek to fortify multilateralism, cooperation and dialogue, especially with 'like-minded' countries, such as India. This also includes strengthening and empowering regional organisations and institutional mechanisms competent on security issues.

National and international fragmentation dynamics

The security architecture in the region is very fragile, with numerous organisations covering specific topics. This situation leads to simultaneous regional integration and fragmentation dynamics. The shortcomings of the regional security context encourage countries to develop *hedging strategies* and strengthen their own military capabilities. The resulting fragile balance is put at risk by traditional points of tension such as border disputes, but also by national crises. The latter tend to spread across borders, as it is the case in the Horn of Africa. International and national tensions seem to be multiplying, due to significant

and exacerbating divisions between and inside countries political, cultural, ethnic, religious, economic and ideological issues.

II) Specific issues in the Western Indian Ocean

Weak states, fragile states and crises internationalisation

Whereas some Indian Ocean littoral states are among the richest, the Western Indian Ocean (WIO) is mainly composed of "least developed countries". Many are considered as fragile states and experience humanitarian crisis and civil war. Several terrorist groups emerged in the area and expanded their presence, especially in East Africa.

Increasing influence of non-state actors

State weakness jeopardizes economic development and contributes to the emergence of a power vacuum, at risk of being filled by non-state actors. Criminal activities endanger traditional economic sectors and affect livelihoods, driving population to migrate. **The growth of criminal activities contributes to weaken states' capacity over their territory and population.** It also favours the establishment of international criminal and terrorist networks, such as the 'smack track' from Afghanistan to Mozambique.

Significant human insecurity

As a result, important human insecurity issues, worsened by armed conflicts and public services weaknesses, affect most WIO countries. These sources of insecurity impact economic growth, coupled with remaining structural deficiencies and vulnerabilities - such as low levels of industrialisation and dependency on primary commodities exports. Population growth, significant migratory flows and urbanisation add up to existing tensions, whereas the region already experience regular hunger crisis and water scarcity. While numerous WIO countries heavily depend on ecosystems for food, water and jobs, these are increasingly degraded by ever growing human pressures, natural resources depletion and climate change impacts.

III) Climate change impacts in the Western Indian Ocean

Rising atmospheric temperatures and changing rainfall patterns

Various climate change impacts threaten livelihoods in the region. Atmospheric temperatures are expected to rise - feeding in increasing drought trends - and monsoon will become increasingly difficult to forecast. All these trends endanger livelihoods and especially food security. Heat waves might also affect productivity, while thermal shocks will reduce working hours span. **Overall, heat waves and water scarcity will trigger stress for both humans and crops, potentially leading to food systems destabilisation.**

Disrupted precipitation regimes and extreme weather events

The convergence of different climate phenomena (El Nino Southern Oscillation, Indian Ocean Dipole) leads to high forecast uncertainty. Growing sea surface temperature, both a cause and a result of these phenomena, will affect precipitations: **droughts and heavy rainfalls alternation might result in water scarcity, landslides and booming vector-borne diseases.**

Warmer sea surface temperature will facilitate cyclones formation, in the world's most prolific ocean for tropical cyclones. Increased tropical storms size and lifetime will lead to more (+8 % per decade) cyclones – which are very intense storms. **As a result, HADR operations are expected to become more frequent and will require the involvement of military means in new territories**, where extreme weather events occurrence was relatively low before. Additional threats such as the underwater volcano emerging off the coasts of Mayotte might also mobilise defence forces capacities.

Ocean warming: sea level rise and fish migration

Ocean warming prompts sea-level rise, both due to Antarctic ice melting and dilatation. **The significant but disparate sea-level rise in the WIO threatens coastal populations' physical and food security.** This raises concern in a zone where crucial marine biodiversity faces destruction due to urban development and pollution, thus weakening ecosystem services of mangroves, beaches and coral reefs. **Ocean warming will also affect fish stocks in the region: migrating poleward and towards deeper zones of the ocean, fish schools will get unreachable to local and industrial fishing fleets.** The projected threefold decrease in catch potential could threaten coastal populations' livelihoods and fuel tensions in the fishing sector. Fish depletion could significantly impact island countries' economy and push populations to look for alternative revenue streams or migrate.

PART 2: RISK ASSESSMENT MATRIX

The following matrix aims to describe interactions between all aforementioned changes and well-known, more established risks.

RISK PROFILE

military HADR missions related risks (low intensity)

defence forces surveillance missions related risks (low intensity)

area geopolitical situation related risks (low intensity)

counter-terrorism efforts related risks (high intensity)

TABLE 1: Climate-related risks in the WIO region that would require a military involvement (i.e. requiring military involvement).

LIKELIHOOD		SERIOUSNESS				
		No disruptive effects; 'business as usual'	Tensions temporarily increase; situation is manageable within existing processes	Conflict is temporary and generally constrained by existing arrangements	Significant disruption; limited to areas	Significant widespread disruptions
		NEGLIGIBLE	**MINOR**	**SIGNIFICANT**	**MAJOR**	**CATASTROPHIC**
Most unlikely but might occur in exceptional circumstances	**RARE**	-	-	-	-	-
Unlikely to occur without significant change in current circumstances	**UNLIKELY**	-		-	-	-
Can occur in most circumstances in the foreseeable future	**POTENTIAL**	-	**Rejection of a foreign presence or private assets** **Political instability and social tension due to economic/food insecurity**	**Growing influence of major powers in the region**	**Strategic infrastructure degradation or destruction** **Terrorist attack on public or private assets**	-
Will occur in current circumstances	**LIKELY**	-	**Mis-development and mis-adaptation to climate change** **Significant planned displacements**	**Pressure on HADR capacities**	**Sanitary crisis**	-
Already occurs regularly	**ALMOST CERTAIN**	-	**Criminal activity increase**	**More frequent incursions in EEZ** **Irregular migrations**	-	**Fish stock depletion**

PART 3: RECOMMENDATIONS

I. General regional cooperation (diplomatic, scientific, political)

Greater regional cooperation in different domains is needed to tackle the security impacts of climate change in the IO. France, Australia and India can lead such regional cooperation, which should also include island states and territories. Such cooperation should include diplomatic, scientific and political dimensions. We provide here recommendations to foster the implementation of such initiatives:

- Reinforce scientific cooperation
- Support the extension of the Pacific Environmental Security Forum towards the West of the Indian Ocean
- Support regional organisations
- Build capabilities in maritime domain awareness
- Provide training in port state control enforcement

II. Vulnerability of key infrastructures (prevention)

Sea-level rise and other climate change impacts will put significant military and civilian facilities at risk. Yet data on key infrastructures remain scarce as urbanisation expanded quickly in the region, sometimes in the absence of adequate regulatory frameworks.

- Identify key infrastructures and assess their vulnerability to climate change impacts
- Address gaps in the international regulatory regime for undersea cables

III. Human security challenges (intervention)

The absence of coordinated relief structure remains a significant problem, despite the presence of the PIROI, a regional structure from the Red Cross/Red Crescent.

- Strengthen maritime safety capacity building
- Implement cooperation in disaster risk reduction and relief

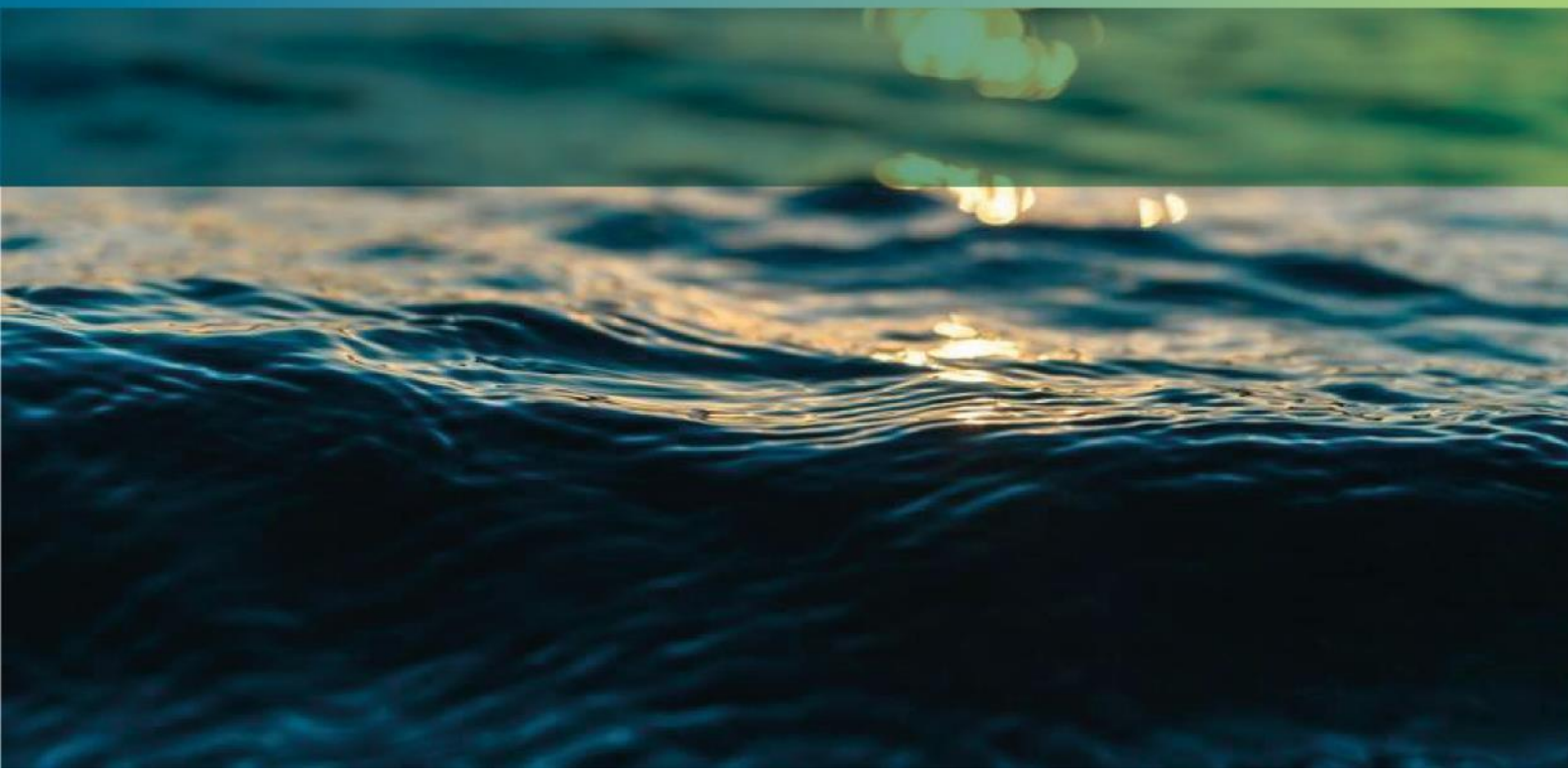
IV. Maritime surveillance

Maritime surveillance is another domain that could benefit from greater cooperation, and for which an extension of the Pacific Environmental Security Forum towards the West of the Indian Ocean could play a pivotal role.

- Foster cooperative responses to IUU fishing
- Build dialogue among coastguard agencies

PART 1

A CHANGING STRATEGIC ENVIRONMENT



I. Developments in the geopolitical environment

a) Main strategic trends in the Indian Ocean region

The Indian Ocean (IO) has been a strategic area since the Roman period and a major trade route between Eastern and Western worlds. At the heart of the hegemonic British Empire, its geo-strategic and geo-politic importance has been recognised by geopoliticians Halford J. Mackinder, Alfred T. Mahan and Nicholas Spykman. The British withdrawal in post-Second World War era generated a void rapidly filled **as the region became a hotspot of the Cold War. Both superpowers fought for security hegemony and regional influence in rim land countries**, aiming to gain military bases and create alliances with regional powers. The American containment strategy against USSR placed the IO as a strategic chokepoint, a status remaining in current attempts to counterbalance China's rise in the region (Nizamuddin, Iftekhar, Mohd Firoz, 2019). Littoral countries are very rich in natural resources, from oil and gas reserves to marine aggregates used in the construction industry (sand deposits, gravel etc.), placer deposits such as gold and platinum, and nodules of cobalt, manganese copper, nickel, etc. (Mohd Firoz, 2015).

Crucial maritime crossroad

As the world's busiest trade route, crossed by 25 % of global maritime traffic (Ministère des Armées, 2016) and more than half of the world's sea-borne oil, the IO is highly strategic. It could yet gain importance with an expected rise of world energy demand by 40 % by 2040 (IEA, 2019). Situated at the North-West, the Arabian Sea is one of the most strategic zones for world trade, granting access to the oil-rich Persian Gulf through the Strait of Hormuz, to the Red Sea, and the Mediterranean Sea through the Strait of Bab-el-Mandeb and the Suez Canal.

The Strait of Hormuz concentrates about one third of global oil maritime trade and 28 % of maritime gas flows (CNUCED, 2019), both constituting the densest maritime flows in the world (Numa, 2018). They mainly supply Asian countries, who import 70 % of Middle East's O&G products. **The Gulfs of Aden and Oman are therefore two crucial, yet vulnerable areas, neighboured by** unstable

states. The Mozambique Canal and the Cape of Good Hope are two other strategic areas for world trade situated in the Western Indian Ocean (WIO). Threats at seas, such as piracy, prompted states (individually and as coalitions) to conduct military operations and to enforce a maritime corridor in order to escort commercial fleets and super tankers (MSTC, 2020).

The IO has grown in importance with the rapid emergence of China, now being the first trading partner of the region, accounting for 16.1 % of regional total goods trade in 2017 (Kannangara, Collins and Waidyatilake, 2018). **The country brought about a strong development dynamic in the region**, **largely benefitting its neighbouring states, though at the expense of their economic independence** (Lemaître and Dellerba, 2020)**.**

Uncertainty remains about climate change impacts on IO trade flows in the coming decades. Maritime roads could, for instance, be disrupted by climate change impacts on agricultural production in countries of the IO rim, as well as by sea-level rise impacts on harbours and hubs. Economic damages should however remain limited as significant growth perspectives are expected in the region. Nonetheless, main hypotheses suggest that climate change impacts and environmental degradation in East African coastal states could participate in increasing insecurity factors, such as piracy and illegal traffics. In addition, over the 1999-2018 period, **countries most affected by extreme weather events were in the IO region and Southeast Asia** (Eckstein *et al*., 2019).

Growing competition between India, China and the United States in the Indian Ocean

The United States (US) has been the dominant stabilising power in the IO for about 75 years, relying on the U.S. 5th Fleet and military bases in Bahrain, Djibouti and the United Kingdom's possession Diego Garcia. **US superiority in the region is now challenged as China asserts itself as a major power, officially aiming at becoming a "leading world power" by 2050** (Dingding, 2017). In parallel, **India strengthens its own military capabilities in order to avoid being surpassed by China in the IO**. Although the US remains the first world military power, it is progressively losing the footprint it had over the IO.

China's all-out expansion is seen by most regional countries as both an opportunity and a source of concerns, due its increasing influence (Grare, 2020).

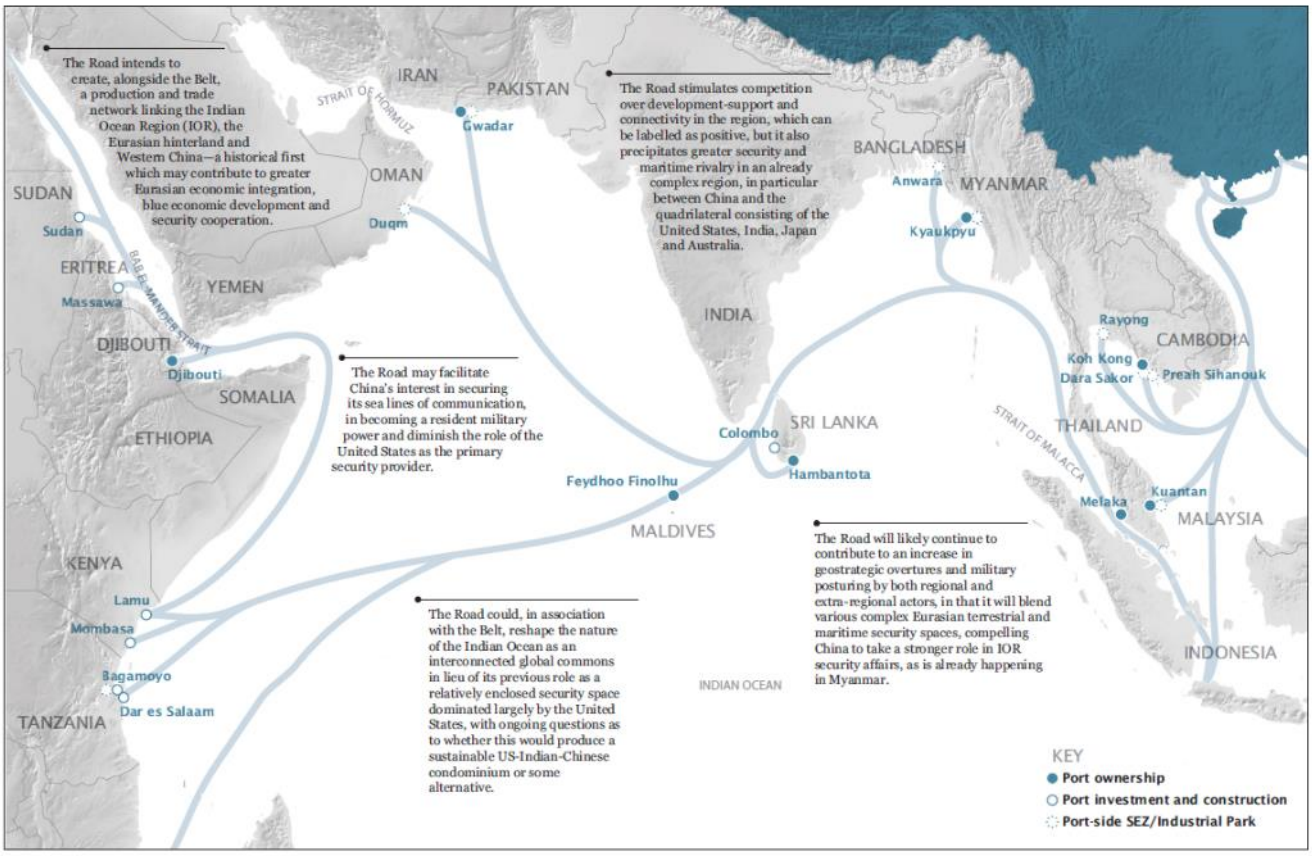


Figure 1 - Map of the Indian Ocean Region illustrating Maritime Silk Road security implications and investments" (source : Ghiasy et al, 2018)

Since 2013, China implements its new "Belt and Road Initiative" (BRI) strategy, which aims at re-establishing the *Silk road* from China to South East Asia, the rest of Eurasia and Africa. It is associated to the Maritime Silk Road Initiative (MSRI) on seas, which partly crosses the IO through routes connecting China to South Asia, the Middle East, East Africa and Europe (SIPRI, 2018).

China has launched large investment projects together with trade partners to strengthen regional transportation infrastructures. **It became the second trading partner of Africa in 2009,** holding 15 % of market shares, behind the European Union (EU) (36 %), including France (10 %). Commercial transactions between China and Africa rose sharply from 10 billion US dollars in 2002 to 185 billion US dollars in 2018 (Johns Hopkins, 2020). This increase is expected to continue, the continent being a central part of the BRI. When funding and

implementing infrastructure projects, China often proposes *package deals*: African countries remunerate China directly with raw materials. As of today, the main African ports connecting China to the IO rim are Mombasa (Kenya), Dar-es-Salam (Tanzania) and Djibouti. **The growing presence of China in Africa raises questions about African countries' indebtedness, possibly impeding their development.**

A growing number of conflicts and tensions involving China appear with its neighbouring countries - except Pakistan. This vigorous foreign policy adds to critics expressed regarding the potential reinforcement of the "people's democratic dictatorship" (People's Daily, 2004) authoritarianism. Several domestic issues are often reported in the media, such as the Uighurs situation, the status of Hong Kong, of Taiwan, or the implementation of the Social Credit System. Since June 2019, protests in Honk Kong are escalating and leading to critics from several countries (Blanchfield, 2020), including Australia.

China's growing influence is a major concern for the US, which seeks to counteract and maintain its own influence. Since 2009, and especially since the 2011 "Pivot to Asia" strategy, former President Barack Obama operated a shift in the US foreign policy, by moving the country's focus and military from Afghanistan and Iraq, to East Asia. The Obama Administration committed to sustain the American leadership in the region for the near future, notably by protecting defence budgets from potential cuts. President Obama wanted on the one hand to strengthen cooperative ties with China, in order to foster a constructive cooperation, and on the other, to re-establish a credible presence in Asia to reassure partner countries (Kenneth, 2011).

With the growing influence of China, many countries in the region, among which India and Australia, increasingly doubted the US capacity and willingness to maintain its hegemony in the region (Grare, 2012; Grare, 2020; Choong, 2020). Indeed, the American presence in the IO was historically related to its dependency on the Gulf's oil. The latter decreased since 2007, with the rise of its domestic oil production (David, Brewster, *et al.,* 2019). **After the election of Donald Trump, the "Pivot to Asia" strategy first appeared as progressively fading away**, as Trump withdrew from the Trans-Pacific Partnership and pressured

American's allies in South East Asia to increase their defence budgets. However, since the five-nation tour of Asia in November 2017 and the description of his "Indo-pacific dream", Trump's strategy towards East Asia appears more as a continuation of Obama's, with a more confrontational approach to China (Cronin, 2017). **Cooperation with India, described as the "lynchpin" of the Asia Pacific strategy, was given a central place in the US rebalancing strategy.** Seen as counterproductive to India's relationship with China by Indian former Prime Minister Singh, the US rebalancing strategy has been better welcomed by Indian Prime Minister Narendra Modi. **Since the 1990s, US perceptions regarding India's strategic role drastically shifted, as both countries now share converging economic and strategic interests.** With the signing of the "New Framework for Defence Cooperation" in 2005, cooperation between both countries have reached unprecedented levels. The US is India's first military exercises partner (Hanif, Khan, 2018), and its third arms supplier (Monsonis, 2019).

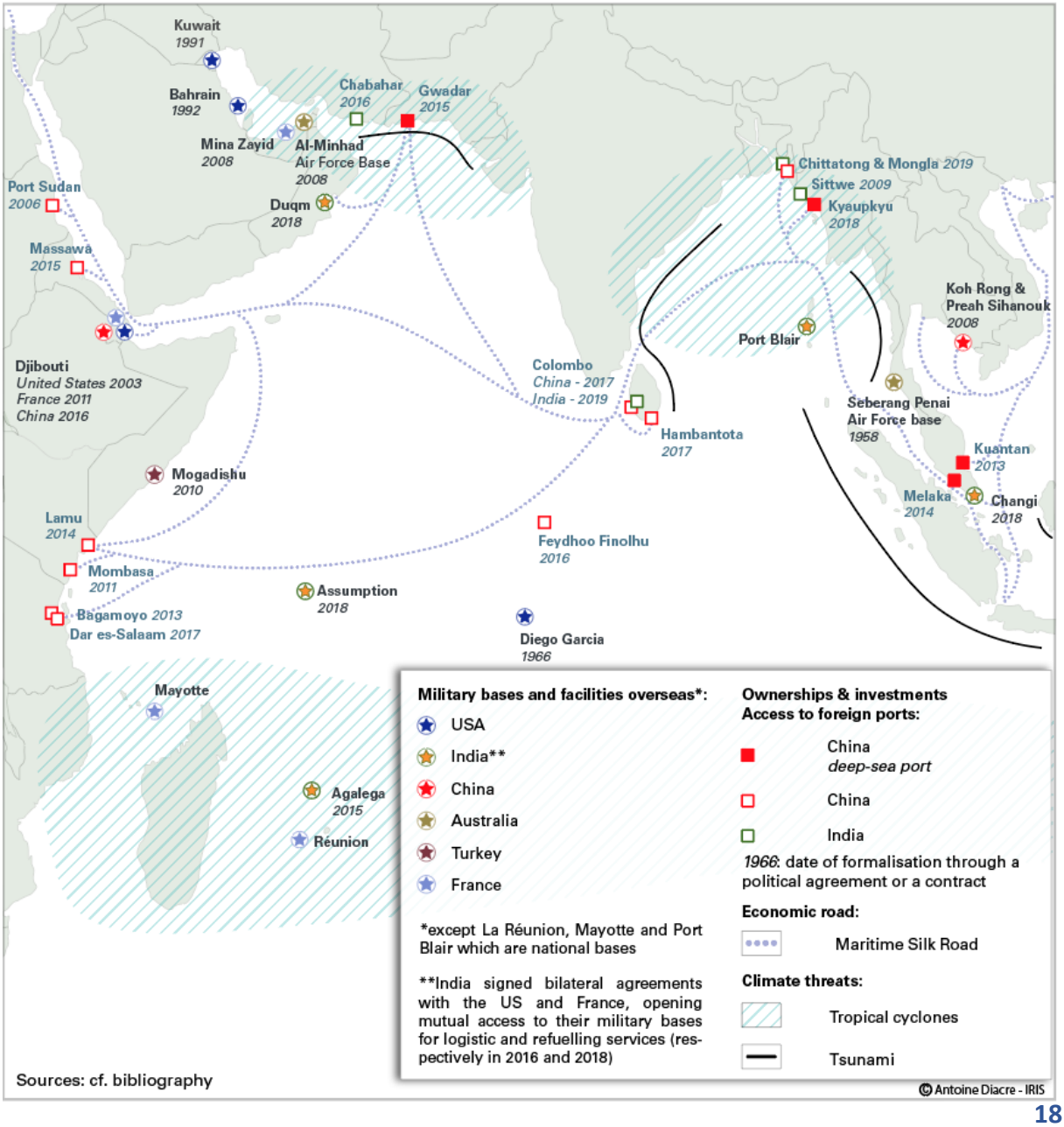
India considerably invests in maintaining and expending its footprint over the IO, by developing its military fleet and deploying more frequently around the Strait of Malacca. It shows concerns about China's growing presence and increasing submarines incursions in the IO since December 2013 (Unnithan, 2018). Moreover, the BRI encircles rather than integrates India, which is perceived as a way for China and Pakistan to land lock their common rival. Since the 1962 Sino-Indian war, the two countries have developed an informal alliance and ended border disputes. In 2015, they signed the China-Pakistan Economic Corridor (CPEC), one of China's largest foreign investments in the framework of the BRI. This road, connecting the Chinese city of Kashgar to the China-financed seaport of Gwadar in Pakistan, is seen by India as an encirclement. To thwart the BRI and grant itself access to Central Asia, India has looked for parallel terrestrial and maritime trade routes and facilities. The building of Chabahar Port, in partnership with Iran, and its connection to the Kandla Indian Port are key components of this alternative strategy.

New Delhi and Tehran were also discussing a railway project to connect Chabahar port city to Zahedan in South-Eastern Iran, but these discussions are on hold. This raised concerns in India, especially considering the improved relationship

between Iran and China with ongoing negotiations to finalise a bilateral 25-year strategic deal (Syed Zafar, 2020). India has simultaneously developed the *North-South Transport Corridor* project with Russia and Iran - to connect Mumbai and Saint Petersburg through Teheran and Baku, the India-Myanmar-Thailand Trilateral Highway and the *Asia Africa Growth Corridor* (AAGC) with Japan (Granger, 2020), but all are pending issues, due to administrative difficulties and geopolitical evolutions, one of which being the growing influence of China.

The increasing rivalry between China and India, partly taking place in the WIO, generates a race to obtain ports, military bases and overseas civil facilities.

Figure 2 - India-China competition in the IO (IRIS, 2020)



Besides several operations overseas in Middle-East and Africa, the *Australian Defence Force* (AFD) - the *Royal Australian Navy* (RAN) more specifically - has been involved for some years in the *Combined Maritime Forces* (CMF), a coalition fighting against terrorism and piracy off the Horn of Africa. **Australia announced during the January 2019 *Raisina Dialogue* an increase of its military presence and role in the IO. This recent foreign policy move can be linked to its deteriorating relationship with China** – paradoxically its first trading partner with 32.6 % of exports (Lemaître, Dellerba, 2020) - since 2017. The degradation accelerated in 2020. China took several measures against Australia, especially since Australian authorities criticized the new security law in Hong Kong (Lemaître and Dellerba, 2020) and requested an international investigation on Beijing's management of the Covid-19 pandemic crisis. **In order to reinforce cooperation and multilateralism, Australia also seeks to strengthen the Indian Ocean Rim Association (IORA) and other cooperation networks, such as the Indian Ocean Naval Symposium (IONS)**[1].

The IO being highly strategic and hosting several French overseas territories as well as one fourth of its Economic Exclusive Zone (Ministère des Armées, 2013), **France has developed an Indo-pacific security strategy. It aims at enhancing stability, by ensuring compliance with international law, promoting multilateralism and the consolidation of the regional security architecture. To do so, it also encourages strengthened strategic partnerships with like-minded countries. Australia and India are considered as such**, hence French attempts to foster a closer trilateral partnership. A first trilateral dialogue was held on September 9th, 2020, where the three parties agreed to organize such meetings regularly. French attempts had first been hampered by Australia's and India's divergent views on China and the US. Indeed, the fragile balance of powers in the region favours escalation risks. This situation brings about dilemmas - concerning the relation with the US among others: countries of the region may look for a guarantee of security, but such an alliance hinders any dissociation in the event of a direct conflict involving

[1] Those regional organisations are not composed of the same states. France is a member of IONS, whereas it inly has an observer status in IORA (cf. Annex 2).

the US. The latter being far from the region, and its protection in case of war not being granted, potential regional allies would be exposed on the front line. As a result, the strategy to be implemented is complex and differs in most cases depending on the country. However, **a stronger partnership between India and Australia seems increasingly relevant and possible, considering China's policy during the Covid-19 crisis**.

President Emmanuel Macron's visit to Australia in May 2018 and his vision statements along with the Australian then-Prime Minister Malcom Turnbull bespeak French consideration of Australia as a strategic partner. The two leaders more specifically agreed on the necessity to strengthen the regional architecture and cooperation opportunities on security issues, by integrating other strategic partners into trilateral dialogues or high-level dialogues (Grare, 2020). Scientific cooperation, on climate and environment issues among others, is seen as a potential way to foster integration.

The European Union (EU) also shows growing interests and concerns for 'Indo-Pacific' stakes, despite not having published a specific strategy yet. Trade flows across the IO directly impact EU countries, hence its priority to ensure freedom of navigation in strategic chokepoints (Péron-Doise, 2020). The EU is deepening its regional cooperation in maritime security with littoral states, especially 'Quad' countries: Australia, India, Japan and the US (Garima). The EU Commission is especially involved in the IORIS platform and the CRIMARIO initiative[2], the latter aiming at improving data sharing and capacity building. It also intervenes in a lesser extent in domains such as climate change, through capacity building for adaptation, risk prevention and management.

In addition to the aforementioned states (+ EU), other foreign powers and organisations expand their influence and presence in the region. Turkey

2 The EU Critical Maritime Routes Indian Ocean (CRIMARIO) project aims at enhancing Maritime Domain Awareness (MDA). It was established to enhance Maritime Domain Awareness (MDA) through information sharing, capability building and training. This was achieved through the implementation of the IORIS platform, an information sharing and incident management tool amongst others; and an extensive program of training in Maritime Data Processing (MDP) for analysis and visualisation of data." (CRIMARIO website : https://www.crimario.eu/en/the-project/rationale-objectives/).

increasing presence in East Africa since 2010 relies on a tight partnership with Somalia. Initially based on development and food security aid, this cooperation rapidly evolved to include military matters, capacity building and training. In 2017, Turkey opened its largest military base overseas in Mogadishu. This presence is seen by some countries – Saudi Arabia, the United Arab Emirates (UAE), Ethiopia and the US – as a way to expand its sphere of influence, in the midst of geopolitical rivalries in the Middle East. If Turkey's influence in the Horn of Africa and in the Arab Peninsula - through its collaboration with Qatar - may fuel tensions with the Arab coalition fighting in Yemen, its presence in Somalia seems to have positive effects. Indeed, Turkey contributed to the convening of competing factions in historic diplomatic talks (Gurpinar, Abdulle, 2019).

Finally, Russia presence in the IO, though growingly consolidated, has been episodic. The country strengthens its military ties with China, in maritime cooperation especially[3]. Both countries led trilateral naval exercises in 2019, with South Africa (November) and Iran (December). Russia also reinforces its partnership with Sri Lanka, which appears as a pivot state in the region (Bhadrakumar, 2020).

National and international fragmentation dynamics

The WIO region remains torn between integration and fragmentation. **The lack of a real security architecture drives countries to improve their own defence capabilities. Most of them also implement *hedging strategies***, consisting of limiting risks by multiplying options (partnerships, memberships, bilateral or multilateral collaboration). Despite their numbers (cf. Annex 2), most regional organisations are limited in nature and competencies which hamper cohesion and a shared sense of belonging (Grare, 2012). **Some of them are used as influence tools and impact regional tensions, thus leading to complex membership games.** As an illustration, Myanmar and Pakistan IORA memberships having been blocked, by Bangladesh for Myanmar, and India for Pakistan (Meng, 2018). Moreover, IOAR's greater integration of China as a dialogue partner, especially since the BRI has been launched, has sparked Indian distrust in this

3 Singh Abhijit, "Russia's engagement in the Indian Ocean", Observer Research Foundation, https://www.orfonline.org/research/russias-engagement-in-the-indian-ocean-59324/.

association (Guan, 2017). Besides, even if IONS is WIO's most inclusive organisation for littoral countries, it mainly focuses on maritime security (cf. Annex 2).

Geopolitical rivalries foster fragmentation dynamics, which are also at play in most littoral countries. The IO is thus characterised by an unstable social and political environment.

In addition, the region is constantly experiencing conflicts and crisis, hence its integration, most of the time, in the area known as the "crescent of crisis" (Boulanger, 2011). Tensions between neighbouring countries evolved towards exacerbated confrontations, including between India and China, India and Pakistan, or Somalia and Kenya. These conflicts often arise from border disputes, such as in Kashmir, but also from increasingly asserted ethnic and religious cleavages – sometimes harnessed by political powers. **Efforts to cooperate, bilaterally or through regional organisations**, **are jeopardized by significant differences in politics, culture, economy and religion**. At the national level, fragmentation grows, leading to civil wars, autonomist or separatist claims, and terrorism.

Distrust between regional countries can be fed by the presence of foreign powers. There are many foreign military bases in the region, including in Djibouti. In parallel, several countries consolidate their influence in the region. Saudi Arabia has deployed an influence strategy in the whole Eastern Africa, from Somalia to Mozambique and Comoros, to diffuse its confessional ideology – Wahhabism - including through humanitarian organisations (Ammour, 2018). Some countries support actors that are not recognised by the international community, such as Iran with the Houthi-rebels in Yemen, and the UAE with some governments of Somalia's regions or federal states - which perceive Mogadishu as too close to Qatar and Turkey.

These geopolitical rivalries and sources of instability may, on the one hand, be further fuelled by climate change impacts. As a "threat multiplier", these impacts could exacerbate existing tensions and endanger livelihoods. In fragile states, climate-related security issues may feed instability as a result, among others, of migrations and internal displacements. On the other hand, climate change impacts,

by affecting every IO rim country, constitute a common ground that could foster discussion and cooperation.

b) Specific issues for the Western Indian Ocean

Fragile states and crisis internationalisation

Numerous WIO rim states belong to the United Nations (UN) "least developed countries" category, characterised by low capita income and development levels. It is the case of Yemen, Somalia, Ethiopia, Comoros, Madagascar, Mozambique and Tanzania (UN, 2018). As a result, the region is sometimes called the "Heart of the Third World" or "Ocean of the South" (Meng, 2018). **Some states are considered as "fragile",** due to public authorities lack of capacity to provide basic security to their population, and to the overall rise of violence, extreme poverty and partial territorial control loss to domestic or foreign terrorist groups (Rahn, 2015). The Fragile States Index (FSI) identifies, for each country, "normal" social, economic and political pressures, but also pressures exceeding state's capacity to manage them. In 2020, Yemen has been ranked in top position for the second year in terms of vulnerability and fragility (Fragile States Index, 2020). It has been described by the UN as the "worst humanitarian situation in the world" (UN, 2019), due to the ongoing civil war and its human consequences. Second comes Somalia, a country facing important difficulties to decrease its high poverty level and enduring a civil war since 1978 (Lugan, 2013). Moreover, the development of piracy, terrorist attacks in neighbouring countries, and interventions by foreign powers and coalitions contributed to internationalise this conflict. Somalia's fragmentation, its government incapacity to enforce law, interventions of Ethiopia and the plundering of fishing resources by foreign fleets resulted in an economic collapse. Many fishermen have turned to piracy since 1991, which resulted in numerous counter-piracy operations in the Horn of Africa undertaken by countries – Russia, India, China - or coalitions – CMF, North Atlantic Treaty Organisation (NATO), EU.

Pakistan constitutes another challenge to regional security as it is spreading risks due to the Taliban rebellion, mostly concentrated in tribal north-western regions.

Other armed groups are also active in Northern Kenya, in Ethiopia's southern and western extremities, in Mozambique, in Yemen and in Pakistan.

Increasing presence of non-state actors

The Horn of Africa illustrates the many interlinkages between extreme poverty, conflicts, terrorism and criminality. Power vacuum and instability feed vicious circles by jeopardizing economic development and endangering livelihoods. Those instability factors catalyse criminality and connections between different crises, such as in the Somali case with piracy or maritime terrorism. The Horn of Africa observed a strong increase in piracy in the 2000s, which seems to be declining due to multiplying military operations (Atalante, Ocean Shield, etc.). In 2017, 84 piracy incidents occurred in the Indian Ocean, out of a total of 180 worldwide (Kannangara, Collins and Waidyatilake, 2018). However, maritime terrorism seems to be emerging as a new threat at sea. Indeed, numerous attacks or attempts have been listed in the Strait of Hormuz and the Gulf of Oman since 2018 (Meredith, 2019).

Furthermore, the IO is currently at the core of an expanding opium trade network, starting in Afghanistan. Heroin quantity conveyed through IO maritime trade routes rose from 200 kgs (2012) to 4,500 kgs (2016) (Kannangara, Collins and Waidyatilake, 2018). This trade network connects Makran, a coastal region stretching between Iran and Pakistan, to Kenya, Tanzania and South Africa, through the Mozambique Canal and Mozambique. East African countries constitute important transit hubs towards West Africa and Western Europe. **This route, called "the Southern route" or "the smack track"** (France's Minister for Armed Forces, 2017), **is estimated to be the transit zone for around 20 % percent of the heroin produced in Afghanistan** (thus 16 % of total world's heroin). **This route is also used for other forms of traffics**, including migrant smuggling, and human and arms trafficking. The heroin economy has been a crucial component of the growth of coastal and border towns, urbanisation, and development in East and Southern Africa (Haysom, 2020).

Facing the increasing vigilance and activism of Kenyan and Tanzanian authorities, along with other countries fighting against traffics in the region (France,

United Kingdom, Australia, the US, etc.), **traffickers are constantly adapting their *modus operandi*. They extend their maritime routes and delivery points southward, to Mozambique**, where they benefit from a facilitated passage due to large borders and insufficient surveillance (allAfrica, 2020).

According to the representative of the United Nations Office on Drugs and Crime (UNODC) in Mozambique, the traffic of heroin from the country to Europe is one of the main sources of the ongoing conflict in Cabo Delgado, opposing the Mozambican forces to Islamic terrorists. Traffickers and other stakeholders involved in illegal activities would work on nurturing crises and situations of instability, to push authorities to focus on other issues. Strict connection between Islamic groups and drugs trafficking has not been proven yet (allAfrica, 2020), but **drugs trafficking is considered as an important funding source for terrorist organisations**.

More broadly, many littoral states experience the rise of radical Islamism, with a growing presence of terrorist groups, including Al-Qaeda and the Islamic State of Iraq and Syria (ISIS) (Liabot, 2019). **The continuously reconfiguring terrorist threat is rising in the WIO and cannot be considered as a national issue, due to current global ramifications** (Dhruv, 2018). Al-Shabaab, the most important terrorist group in the WIO, bespeak this internationalisation. Launched in Somalia in 2004, the formal al-Qaeda affiliated group historically concentrated its activities in the Horn of Africa, but is now very active in East Africa and has a branch in Yemen. In response to security crackdowns in Somalia and Kenya, enabling public authorities to take back cities and towns, and to cutback recruitment in Kenya, **the group adapted its strategy**. It now aims at pressuring regional governments and African Union troops (AMISOM) to withdraw from Somalia by **increasing its presence and attacks in the rest of East Africa**. It enables Al-Shabaab to recruit and raise funds, by consolidating relationships with fighters in Southern Tanzania and Northern Mozambique. In Tanzania, its ties with local groups have proved to be useful for hiding, recruiting and funding. The country is a haven, as it does not contribute to AMISOM mission. Moreover, local youth shares a strong anti-state feeling, notably in the Pwani region, which is a new pool for recruitments. **Between 2009 and 2012, Tanzanians would have been the**

second largest cohort of foreigners joining Al-Shabaab in Somalia, after Kenyans. The pace of attacks in the country accelerated since 2015. As in Somalia and Kenya, fighters in Tanzania have been adapting to Tanzanian's authorities increased pressure. Several of them moved further south to Northern Mozambique. **In several countries** (Kenya, Tanzania), **governmental responses took the form of indiscriminate crackdowns against Muslim male youths, which may have worsened the situation** (Crisis Group, 2018).

Mozambique, towards a new illustration of the paradox of plenty ?

Since the discovery of massive gas reserves in 2010 and 2013, the province of Cabo Delgado in Northern Mozambique is a major stake for the future of the country. It could indeed become the 4th gas exporter in the world (Bensimon, 2019). Mozambique is one of the 10 poorest countries in the world, due to its long civil war (1976-1992) and the following economic mismanagement. The two main projects, Mozambique LNG (Total) and Rovuma LNG (Exxon Mobil & Eni), represent crucial industrial programmes for the country. Even though they should respectively generate 25 and 30 billion US dollars, questions have been raised regarding their environmental footprint. Nevertheless, terrorist attacks have multiplied in the region since 2017. The Islamic State claimed an operation for the first time on July 4th, 2019. Most attacks were attributed so far to 'shebabs' (Bensimon, 2019), firstly without any link with the famous Somalian group Al-Shabaab ("shebabs" meaning young in Arabic). Connections would have developed since, while regional powers and the African Union were increasing their pressure on terrorist groups in Somalia, Kenya, then Tanzania (Crisis Group, 2018). Fighters whose number is estimated between 300 and 1,500 - led around 200 attacks with a frequency increasing from an average of two per month to twelve per month between 2017 and November 2019 (Bensimon, 2019). In response to this growing insecurity - aggravated by the cyclones Idai and Kenneth in 2019 -, the government seems to favour a strategy based on an increasing presence of private security companies. As the Mozambican forces are "un-prepared and under-resourced" (Prashad, 2020), the government relies on security or paramilitary companies, hired by itself to fight the insurrection - as the South African Dyck Advisory Group (DAG), the Russian Wagner Group and Frontier Services Group -, or by multinational corporations to protect gas projects – as Arkhê Risk Solutions and GardaWorld. This strategy is criticized by the population, as it would mainly consist of protecting foreign workers, firms and plants, at the expense of tackling the social and political roots of the crisis. Above mentioned projects could thus worsen the country's natural environment, and its security. It has already been accompanied by a militarisation dynamic, which tends

to fuel socio-political tensions, corruption cases, leading to increased social inequalities and population displacements.

Significant human insecurity

Most of Western Indian Ocean littoral states share deep human security issues. The Horn of Africa, as numerous countries of the WIO, illustrates the existing linkages between state fragility, extreme poverty, armed conflicts, criminality, terrorism and population vulnerability. It is difficult, if not impossible, to determine causal relationships, as the different factors rather feed into each other.

Trafficking, terrorism or piracy, are 'non-conventional' security threats, still bringing about a context of instability and violence, which impacts economic development. **Most conflicts arise from governance issues, and most related deaths are not directly due to physical violence, but rather to the breakdown of systems and the spread of disease** (ICRC, 2020). For most of WIO countries, numerous indicators, as extreme poverty rate, access to healthcare or malnutrition, are alarming.

State fragility, conflicts and insecurity impact economic stability (UN, 2020). Nonetheless, in 2018 the Growing Domestic Product (GDP) of East Africa was the highest of the continent, with a 5.7 % increase. Such economic growth is driven by Ethiopia, Tanzania, Kenya and Djibouti, mainly by the industry and services sectors, but is far from being inclusive and well shared. In addition, numerous risks may undermine growth prospects. **Almost all countries depend on primary commodities for exports, and, *de facto*, on global commodity price, which leads to a strong vulnerability to external sectoral shocks and price volatility**. The deterioration in terms of trade[4] jeopardized structural transformation. This has in turn hampered industrialisation and export dependency reduction, while slowing down growth, and increasing current account deficits and external debt. The

[4] The terms of trade is an economic concept referring to the price of one country's exports in terms of one another. The deterioration means that the price of a nation's exports decreases relative to the prices of its imports. It will require more exports to get the same quantity of imports.

primary sector still absorbs almost 70 % of the labour force, whereas the manufacturing sector remains weak. This weakness is due to a lack of investments and the competitive threat of Chinese manufacturing imports (Mold, 2017). The primary sector is likely to keep on developing as the WIO population is projected to grow to 306 million by 2030 (an increase of nearly 50 %), and quadruple to 818 million by 2100 (FAO, 2018).

Numerous African countries' economies rely on ecosystem services - providing water, food, but also jobs – that are endangered by climate change impacts and other factors. Conflicts are among the major source of environmental damage, whereas natural resources depletion and related competition could be the main causes of some regional conflicts (Onanga-Anyanga, 2019). Resource scarcity leads to shifts in pastoralists mobility patterns in East Africa. It sometimes escalates into tensions or conflicts. Food and water shortages are among the most visible scourges for human security in the WIO. Since 2011, South Africa, Kenya, Yemen, Oman and Saudi Arabia regularly face severe water scarcity, followed by Ethiopia, Somalia, Pakistan and India, at a lower level (Charvet, 2020). These countries also experience regular hunger crises, significant parts of their population depending on humanitarian aid. In Madagascar, for instance, an average of 40 to 62 % of the population was considered as undernourished between 2015 and 2017 (Brunel, 2020). Fish stock depletion and overexploitation – including because of illegal, unreported and unregulated (IUU) fishing - also threaten food security. Furthermore, it undermines development efforts to eradicate poverty in fishing-dependent countries.

These sources of vulnerability are exacerbated by global pressures like population growth, migrations, urbanisation, and climate change. Demographic growth seems to worsen the situation (cf. Annex 1). The African population is expected to increase by nearly 50 % by 2030, and quadruple by 2100 (FAO, 2018), which should lead to a proportionate increase - if not more important - of the food and water demand as well as livestock forage. Industrialisation is likely to need increasing water quantity, while people's consumption habits are evolving, including in cities. It may also deteriorate following land-grabbing practices. Since

2006-2007, agricultural land sales and rentals to foreign powers, such as China, India, South Korea or the Gulf States, have multiplied. This could worsen food insecurity if harvests are exported, and if landlords also obtain control over groundwater resources. In some countries, such as South Africa (Bayliss, 2013), water has been privatised and financialised. Expectations of a structural water resources scarcity accentuate price increase and economic and social inequalities, as well as water stress by encouraging predation behaviours, stocks constitution and speculation.

In a context of growing population, the lack of short- and long-term socio-economic opportunities fuels important migratory flows. Mid 2019, East Africa hosted an estimate of 7.9 million migrants (UN DESA, 2019), including 3.6 million refugees and asylum seekers (UNHCR, 2020) coming mainly from Somalia and Yemen, while Ethiopia, Kenya and Uganda stand as the main immigration destinations. Kenya hosts the refugee camps Dadaab and Kakuma, which are among the most important worldwide (Raptim, 2018). Mayotte being France's main entry point, it attracts migrants from Comoros and East Africa. **Internal displacements are also very important in several countries**. They are estimated to account for 2 million people in Yemen, and 1.6 million in Somalia. **Most of them converge to cities, participating to the urbanisation** of already poor and overcrowded neighbourhoods, very vulnerable to climate change impacts (CICR, 2020). Economic opportunities being limited, those phenomena tend, again, to fuel criminal activities and insecurity.[5]

East African countries are among the most vulnerable to climate change, particularly because of their dependency on the primary sector, and the lack of economic and institutional capacities to cope with climate change impacts. Climate change impacts have the potential to undermine, if not to dismantle, progresses in socio-economic well-being. They are compounded by factors such as widespread

[5] "The complex risks arising from climate change, fragility and conflict can contribute to the emergence and growth of Non-State Armed Groups (NSAGs). This does not imply that there is a direct link between climate change and NSAG-related violence and conflict. However, large-scale environmental and climatic change contributes to creating an environment in which NSAGs can thrive and opens spaces that facilitate the pursuit of their strategies" (Nett & Ruttinger, 2016).

poverty, human diseases, and high population density (WWF, 2006). **70 % of countries most vulnerable to climate change are also amongst the most fragile countries in the world** (Rüttinger, 2020). **These different pressures, among which climate change, weaken already poorly resilient countries and populations, perpetuating vicious circles of human insecurity.**

II. The changing natural environment in the Western Indian Ocean

Coastal territories and islands share common natural characteristics in the WIO, including fragile ecosystems such as coral reefs, mangroves, etc. They are exposed to similar extreme weather events – tropical storms and cyclones. The latter will be exacerbated by climate change (Rakotobe, 2012), which will increase populations' vulnerability, drive the demand for coordinated Humanitarian Assistance and Disaster Relief (HADR) and will potentially contribute to increased food insecurity, and other factors of conflicts. Overall, the lack of reliable and regional meteorological data constrains weather and climate forecasts in the region.

a) Climate change effects on atmosphere and oceans

Rising atmospheric temperatures and changing rainfall patterns

Climate evolutions

The WIO is exposed to rising temperatures. From 1960 to 2010, regional atmospheric temperatures increased with sub-regional variabilities. Average temperatures in Mauritius gained 2°C on this period, 1°C in Comoros and between 1.5°C and 0.5°C in Madagascar (Rakotobe, 2012). In the northern part of the region, the temperature increase reached 0.87°C in Pakistan (Chaudhry, 2017) and 1.3°C in East Africa (Hose, 2011). **Overall, atmospheric temperatures should continue on an increasing trend by the end of the century, with a variability between 2.8°C (low emissions scenario) and 3.9°C (business as usual scenario) in Southern WIO and 1.8°C to 4.3°C in Northern WIO** (Chaudhry, 2017 and Hose, 2011).

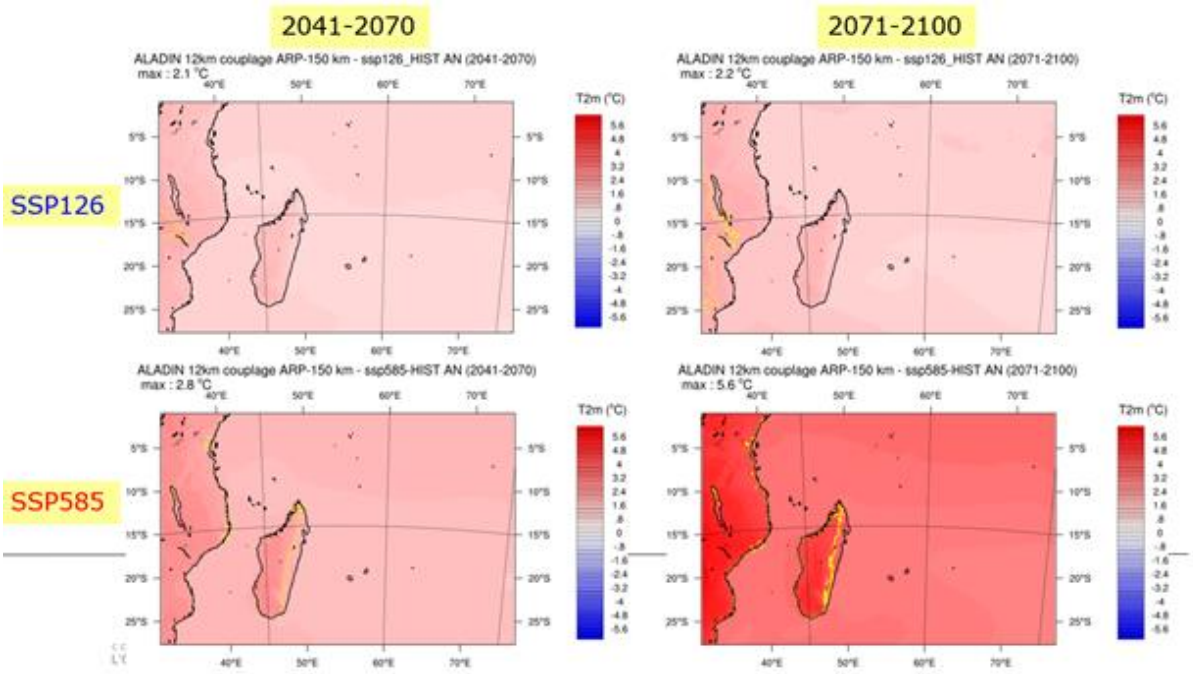


Figure 3 – South Western Indian Ocean temperature evolution projections based on the ALADIN model and the latest IPCC scenario (SSP126 is an update of the RCP2.6 and SSP585 of the RCP8.5[6])

Projections, whether based on IPCC global models or regional models such as the ALADIN model from the BRIO project[7], are divergent and, thus, constrain accurate forecast. As hindering factors, high interannual variability of WIO weather events adds up to the gradual but incomplete understanding of regional climate phenomena convergence: the Indian Ocean Dipole (see next part), the El Nino Southern Oscillation (ENSO) and the Intertropical convergence zone.

Rainfall patterns rely on several parameters, including sea surface temperature (SST). From 1976 to 2006, **precipitations decreased over the region** except along the Seychelles (Rakotobe, 2012). IPCC scenarii diverge depending on the GHG concentration: the RCP4.5 scenario (medium range GHG emissions) implies an annual increase of 1 to 9 % rainfall, when the RCP6.0 scenario, based on a high GHG concentration, and thus stronger greenhouse effect, encompasses a 3-5 % precipitation decrease.

[6] IPPC has developed four scenarios (RCP2.6, RCP4.5, RCP6.0, RCP8.5) which refers to the level of greenhouse gases concentration measured with a possible range of radiative forcing values in the year 2100 (from 2.6 to 8.5 W/m^2). RCP 2.6 trajectory is likely to keep global temperature rise below 2°C by 2100 (Annex 3).

[7] https://www.commissionoceanindien.org/portfolio-items/brio/

Overall, scenarii agree on the intensification of dry and wet seasons. If the overall rainfall level remains the same, rainfalls will be more intense and occur on fewer days, increasing risks of landslide and flood-related events.

Geopolitical consequences

This could have direct impacts on illegal activities. It has been observed that drug trafficking decrease during the monsoon season, due to difficult navigation conditions. Shortened monsoon periods could facilitate such illegal activities.

Along with a global increase of average temperature on land, water cycle disruptions or intensification will inevitably impact livelihoods. Warmer air can limit the ability to work and cause distress due to heat waves. Indeed, hotter, wetter work conditions affect human body metabolism and thus productivity. The wet-bulb global temperature is an index reflecting heat stress for the human body, taking into account temperature, humidity but also exposure to sun and wind. This index will be particularly high in the Indo-Gangetic plain and around the Persian Gulf (ID4D, 2019).

Droughts threaten food security, as crops and cattle will suffer from water stress. Finally, floods caused by intense and repetitive rainfalls could drown crops, generate landslides, and facilitate the spread of vector-born (malaria) and hydric (cholera) diseases. It is conceivable that the economic destabilisation brought about by climate change could lead populations towards illegal sources of income, thus compromising civil security in the area.

Increasing sea surface temperature

Climate evolutions

The IO is the warmest of all five oceans (Sarkar, 2020) and its sea surface temperature rises very quickly. This is partly due to by the lack of open path with the Arctic Ocean. Indeed, through the Atlantic Meridional Overturning Circulation (AMOC – cf. figure 4), cold waters from the Arctic Ocean are distributed across the globe.

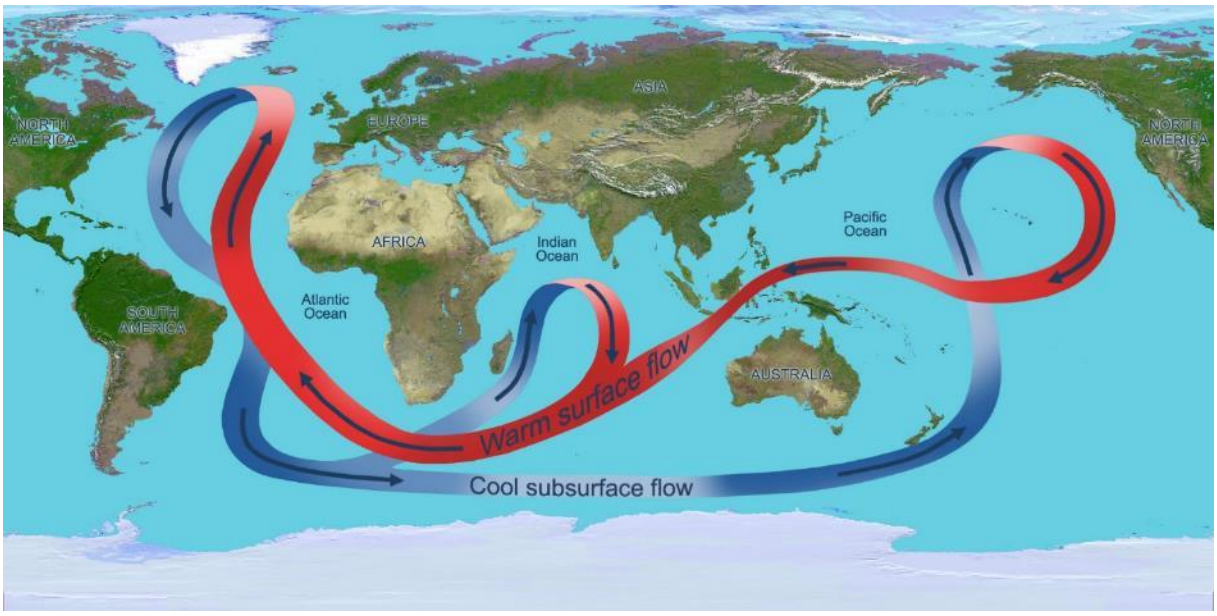


Figure 4 – The Atlantic meridional overturning circulation (AMOC), distributing heat around the globe

Reacting to this circulation, sea surface temperature (SST) varies from a colder Western Indian Ocean to a warmer Eastern part. This has direct impacts on species and biotopes in the area but also on air-circulation, and thus, rainfall and storms.

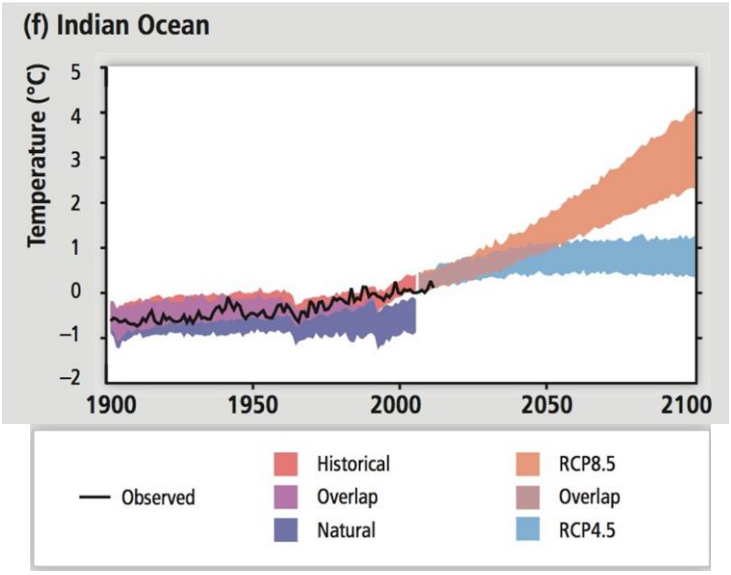


Figure 5 – Observed and expected sea surface temperature in the Indian Ocean (source: IPCC, 2014)

Sea surface temperature (SST) increase has been especially significant in the IO (+1.04°C in the tropical Indian Ocean compared to 0.65°C globally from 1950 to 2015) (IPCC, 2019).

This sea surface warming was directly attributed to human activities (90 % of it can be linked to GHG emissions according to IPCC, 2019). More broadly, the WIO observed a sharper increase of its sea surface temperature (+1.28°C between 1901 and 2012) than the EIO (+0.78°C) (Dueri, 2017). **Forecasts range between a 2.8°C and 3.9°C increase in SST by 2090 in the business as usual scenario (UNDP).**

The Indian Ocean Dipole

Unravelled in 1999, the Indian Ocean Dipole is a weather oscillation – such as ENSO – occurring in the Indian Ocean. Based on the SST difference between the eastern and the western parts of the Indian Ocean, it directly influences rainfalls and tropical storms formation. During a negative IOD episode, rainfalls increase in the eastern part of the IO due to warmer SST. In the WIO, on the contrary, it can lead to water shortages and droughts: 2017 extreme droughts in East Africa have been associated with a strong negative IOD episode. During a positive IOD, warm water will move towards the western side, carrying along intense rainfalls and potential tropical storms. These storms can enhance risks of displacements, floods and health issues – such as the outbreak of Rift Valley fever in 2006 affecting humans and animals.

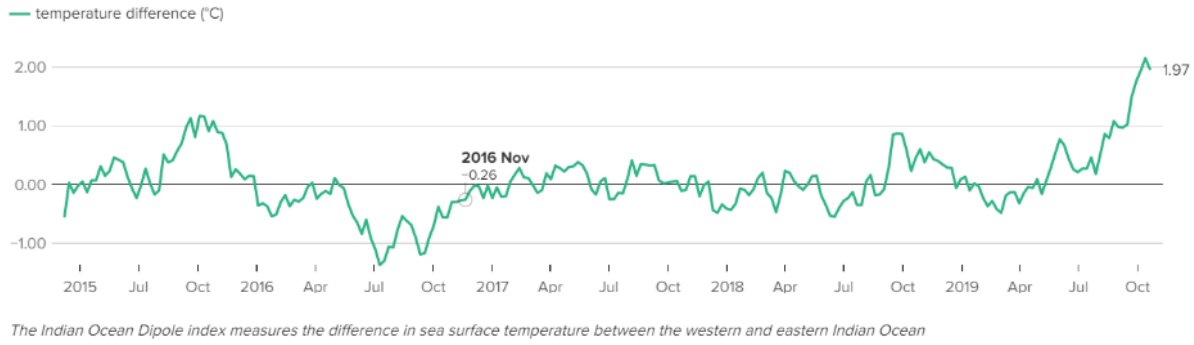


Figure 6 – SST difference between WIO and EIO, reflecting the Indian Ocean Dipole index evolution from 2015 to October 2019 (source: Commonwealth of Australia, Bureau of Meteorology)

On average, each IOD phase occurs every three to five years. These different phases have been intensifying in recent years and the trend should continue. IPCC projections indicate that extreme positive IOD events will increase in frequency (threefold in the 21st century compared to the 20th century in scenario RCP8.5) (IPCC, 2019), thus multiplying tropical storms probabilities. On the other hand, negative IOD events are more and more brutal, with a 2016 event leading to a decrease of 50 % rainfall in some region, and food/water insecurity for about 15 million people in Somalia, Ethiopia and Kenya (IPCC, 2019).

Geopolitical consequences

Recently, a positive IOD episode between fall 2019 and early 2020 was estimated to have caused important rainfall events in Ethiopia, Somalia, and Kenya. It was followed by a hot and dry weather in the spring, and early summer 2020. **The wet winter and dry spring generated optimal conditions for locust breeding and locust proliferation. Such event could then be associated with the desert locust plague,** currently affecting 42 million people in East Africa, and countries neighbouring the Arabian Sea with dramatic consequences on food security – a 1km long locust swarm is able to eat as much grain as 35,000 in a day (FAO, 2020b).

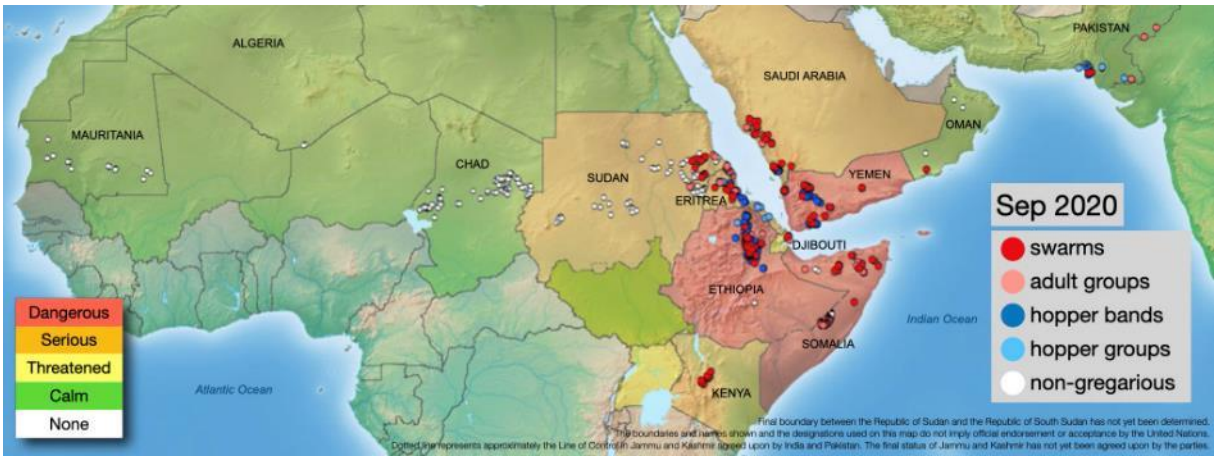


Figure 7 - Evolution of the locust plague as of October 5th, 2020 (source: FAO locust watch)

Sea level rise and coastal flooding risks

Climate evolutions

Warmer waters dilate and drive cryosphere (ice on land and on sea) melting, and thus sea level rise. Estimations range from 0.4 to 1.2 mm rise per year during past decades in the WIO (Rakotobe, 2012). Despite difficult forecasting (because of regional and interannual variability, and weather oscillations influence), **sea level is expected to rise by 0.5 to 0.6 meters in the WIO by 2100 in a quite optimistic scenario (RCP4.5).**

Geopolitical consequences

This significant but disparate sea level rise threatens the physical security of coastal populations (erosion, decreasing extreme weather events protection) and food security (groundwater salinization, commercial species migration).

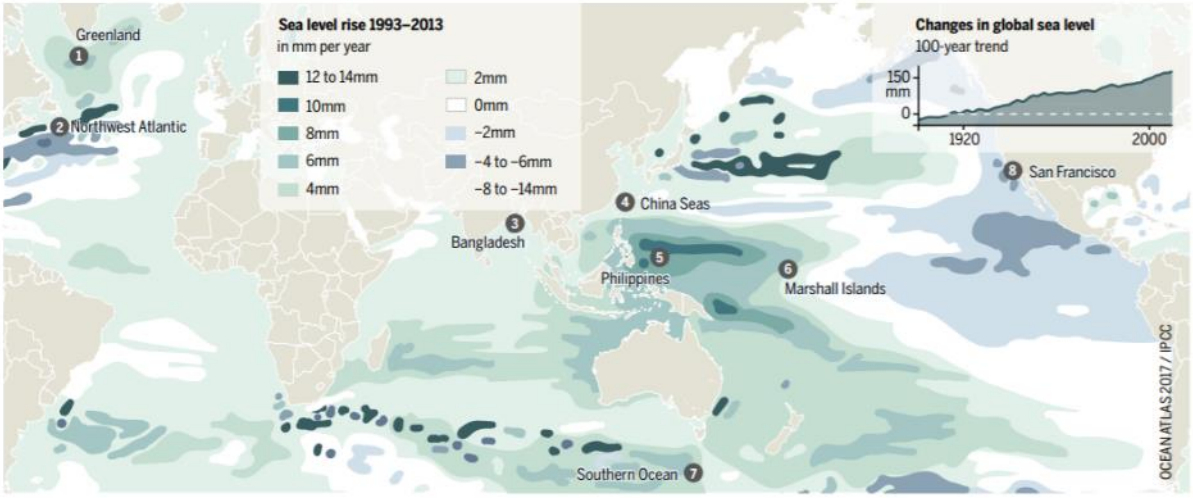


Figure 8 – Sea level rise evolution from 1993 to 2013 (source: the Ocean Atlas of the Heinrich Böll Foundation, 2017)

The WIO is particularly exposed to coastal erosion due to the impacts of sea level rise and unplanned coastal building. Disorganised coastal urbanisation and sand extraction – causing the disappearance of 90 % of Grande Comore beach surface in past 20 years (COI, 2011a) – accelerate coastal erosion. However, risks remain disparate across the region. While Comoros is heavily affected - without any impacts on EEZ delimitation - Seychelles is relatively spared and **Mauritius is exposed to a reduction of its maritime domain** due to the potential submersion of low altitude islands such as Saint Brandon, Agaléga (IOC, 2011b).

b) Anthropogenic – including climate related – pressures on biodiversity

Fish stocks depletion

Climate evolutions

Atmospheric CO_2 concentration increase not only causes greenhouse effects, but also dilutes CO_2 in surface waters and, through currents, in the overall ocean water column. **Triggering ocean acidification, it can lead to species migration or extinction. The largest ocean biome declines due to acidification have been**

observed in the IO (IPCC, 2019), while the WIO is currently considered as the world's second richest biodiversity hotspot (FAO, 2018).

Ocean water acidification, warming and the associated oxygen depletion lead species to migrate poleward or towards deepest waters to cooler or less acidic zones, to adapt, and sometimes to flourish or go extinct in extreme cases. Indeed, chemical and physical characteristics influence the physiology (ability to survive and reproduce) and the mobility of marine species.

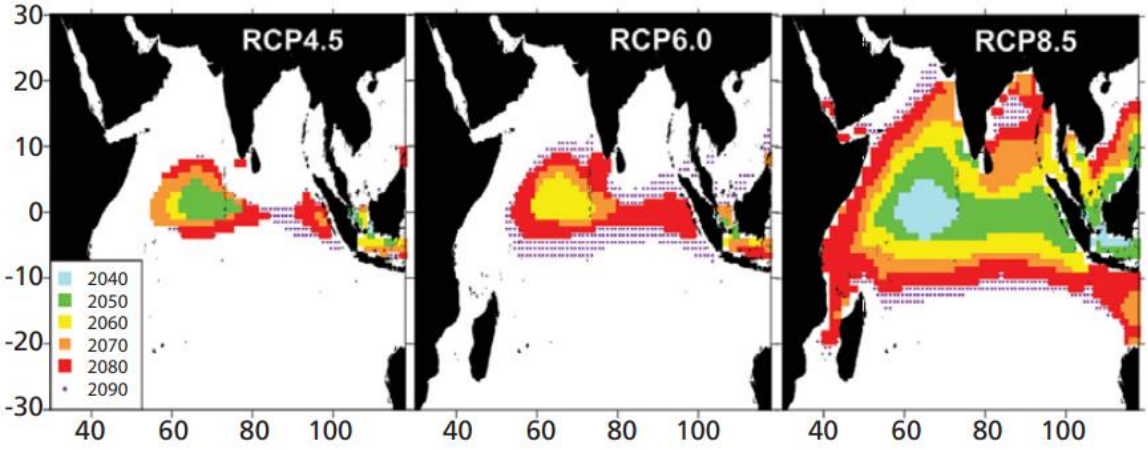


Figure 9: unsuitable marine biodiversity thermal habitat (>31°C) forecast in the Indian Ocean, according to different IPCC scenario – RCP4.5, RCP6.0 and RCP8.5 (source: FAO, 2018)

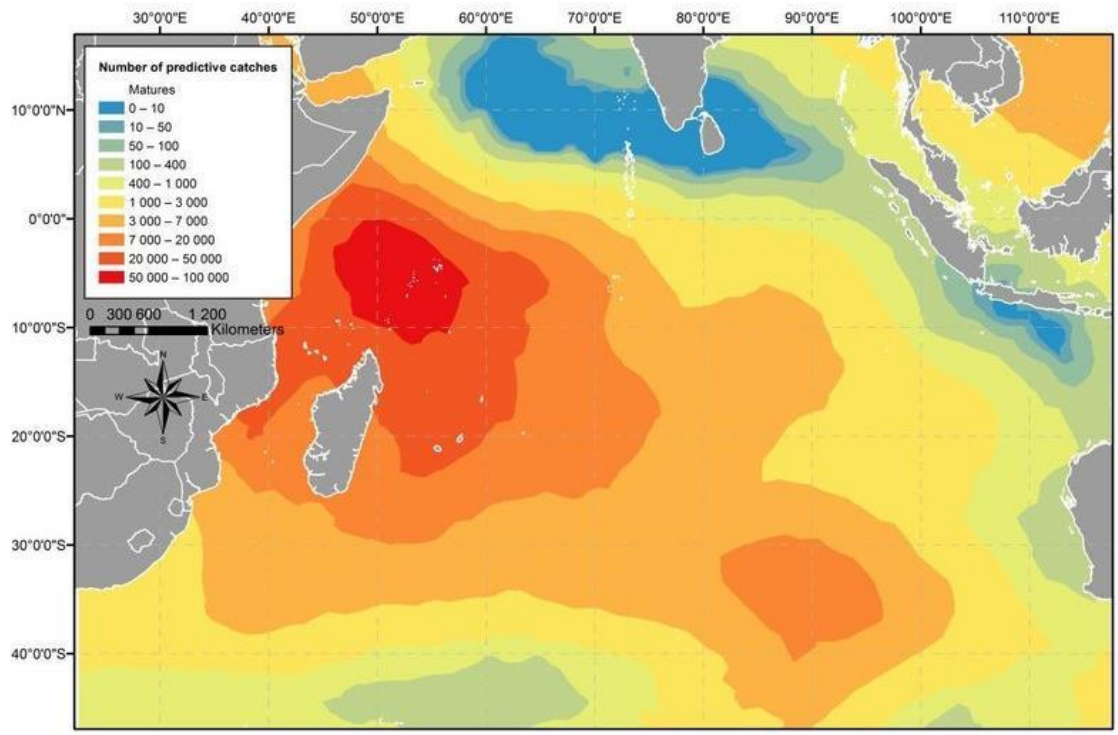


Figure 10: Distribution of matures albacore tuna, Thunnus alalunga, in the Indian Ocean for all fisheries from IOTC data from 1980 to 2012 (source: Nikolic, 2014)

According to IPCC projections[8], **tropical marine biodiversity in the WIO will be affected more significantly (threefold decrease in catch potential) than the global average by the end of the 21st century** under the scenario RCP8.5 (IPCC, 2019). Even in the most optimistic scenario (RCP2.6), fish stock depletion remains certain in the WIO (Barange et al., 2014), especially tuna migration.

Habitat destruction, pollution, water warming, and acidification also threaten coral reefs, mangroves and coastal ecosystems. Coral bleaching events are expected to occur every 5 years in the WIO by 2088. The deterioration of coral reefs will impact fisheries (coral reefs and mangroves being nurseries), cultural activities, and tourism, and thus crucial social and economic pillars. Mayotte recent bleaching events (in 1998 with a 90 % mortality rate, followed by 2004, 2010 and 2015) and the recent massive oil spill triggered by the *MV Wakashio* in Mauritius illustrate WIO's ecosystems vulnerability.

Geopolitical consequences

Fish stock depletion, mangrove deforestation and coral bleaching could considerably impact the economy of the region, considering the high dependency of local communities on marine ecosystems, as a source of food and revenue. **Many countries such as Seychelles depend on fishing for their food security and economy. These territories remoteness and dependence on food imports reinforce their vulnerability. The lack of fishing surveillance and monitoring capacities, along with pressure on fish stocks due to climatic and anthropogenic stressors could fuel tensions and conflicts.** For instance, Spain's industrial fleets have recently been subject to accusations of overfishing in the region[9].

[8] Relying on incomplete data sets as per species interactions.

[9] https://www.undercurrentnews.com/2020/04/01/scientists-urge-eu-to-further-address-indian-ocean-yellowfin-overfishing/

Coastal and marine biodiversity regulation services

Climate evolutions

The ecologic continuum arrays from marine to coastal and inland ecosystems. In addition to being a source of revenue and food security, coastal ecosystems (coral reefs, mangroves, sea-grass beds, sea marsh, wetlands), it provides local populations with *« regulating services »*, that gradually decrease with their degradation. **Regulating services encompass coastal protection against erosion (through the dissipation of up to 97% wave power), sedimentation disruptions, extreme weather event impacts, floods, while allowing climate regulation and water filtration.** Regulating services can be categorized according to the following characteristics: whether they "provide" (food, energy, water), whether they "regulate" (climate, floodings, water purification) or they constitute "cultural" benefits (tourism, local spirituality, knowledge).

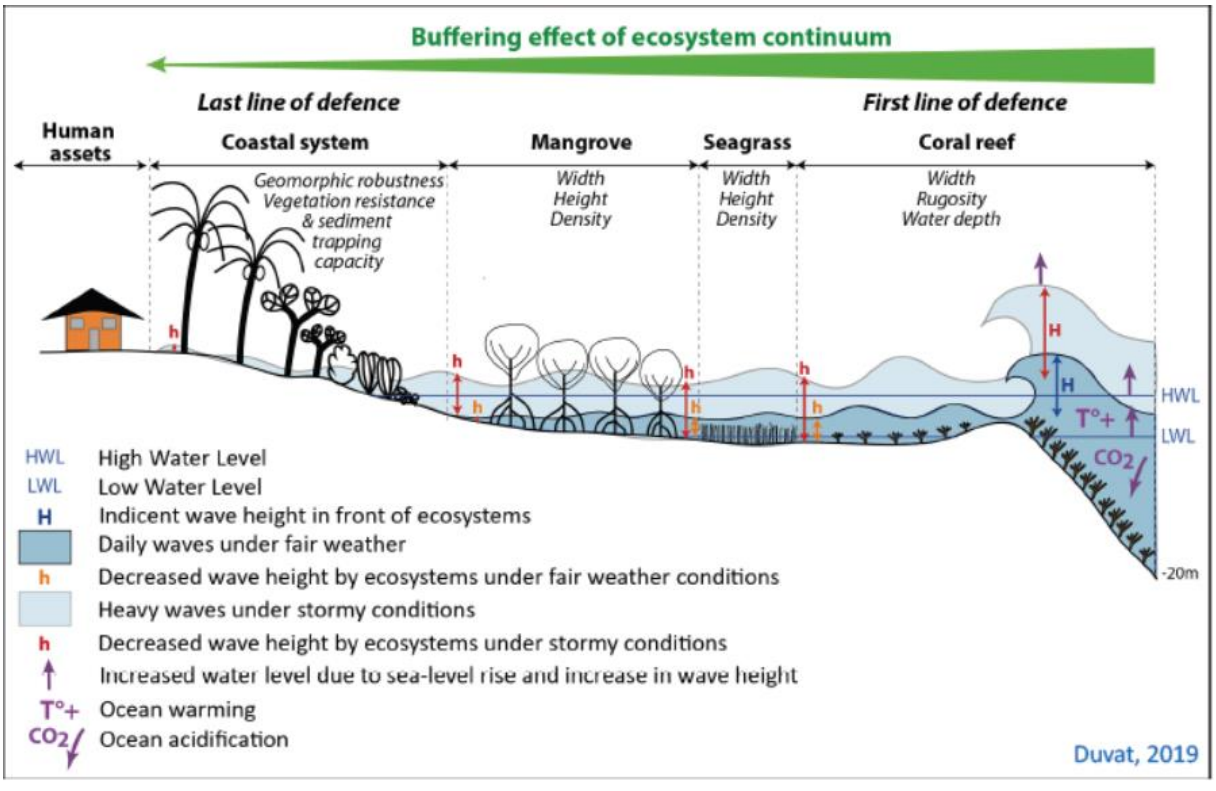


Figure 11 : Ecosystem services from coastal and marine ecosystem (source: Duvat, 2019)

Geopolitical consequences

Their degradation will affect coastal stability and population's physical security. With an important number of small islands and low-lying territories, social vulnerability (exposure to climate change, socio-economic sensibility, adaptability) will significantly rise in the region.

c) Increasing extreme events occurrence

Extreme weather events outbreak

Climate evolutions

The IO is the world's most prolific ocean for tropical cyclones – a cyclone is the name commonly given to a tropical storm in the Indian Ocean characterized by winds exceeding 165km/h – development (IOC, 2011c), with around 9 cyclones per year on average in the western part. **Since 1975, tropical storms – with winds under 165km/h - occurrence remained relatively stable, but their evolution, and thus intensification - in tropical cyclones is more and more frequent**.

In decades to come, this phenomenon should continue, **with increasing intensity, size and lifetime of tropical storms and of cyclones** (Kossin, 2020). As a result, despite a steady number of tropical storms, they will more likely intensify into cyclones. The increase of major cyclone events is estimated to 8 % per decade (Rakotobe, 2012). This increase could be directly linked to anthropic greenhouse gas emissions and human-generated aerosols (Dunne, 2020). **Moreover, tropical cyclones are also expected to develop quicker**, as warm waters facilitate their formation and intensification, thus limiting the efficiency of early warning systems (Sarkar, 2020).

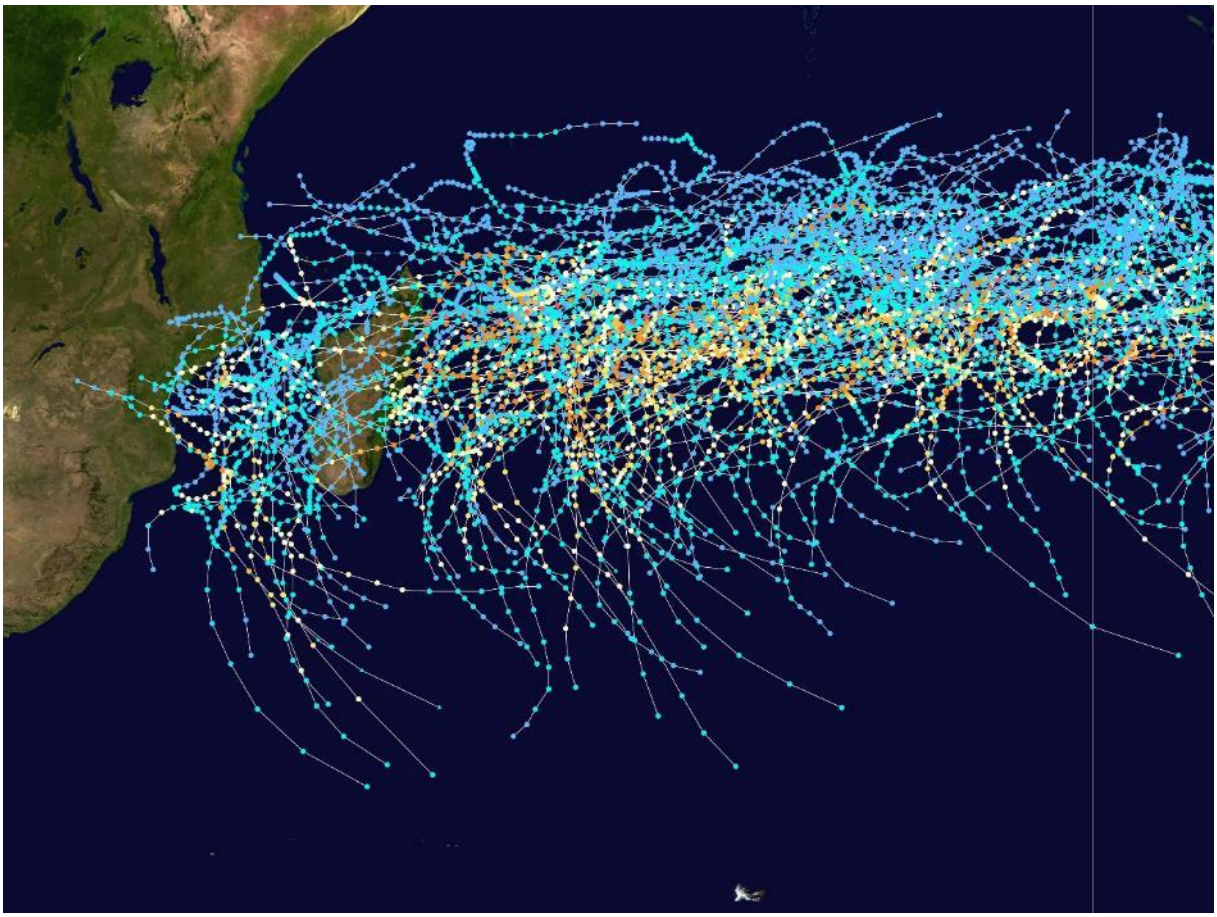


Figure 12 - Tracks of all tropical cyclones in the southwestern Indian Ocean between 1980 and 2005 (source: NOAA[10])

The extreme weather events exposition zone will grow northwards and southwards. Warmer waters in the previously spared Arabian Sea could facilitate cyclones formation: an increasing number of cyclones (five cyclones in 2019) will intersperse the pre and post monsoon seasons (IPCC, 2019 and Sarkar, 2020). In 2020, SST in the Arabian Sea has been 1°C hotter than usual (Soni, 2020).

Southwards of the Indian Ocean, the broadened cyclone impact zone will notably include the Seychelles, northern Madagascar, and Mozambique. These countries will likely experience more frequent storms turning into cyclones.

[10] https://www.aoml.noaa.gov/hrd-faq/#1569507388495-a5aa91bb-254c

Increased extreme weather event intensity will lead to higher exposure to important winds, coastal (due to marine submersion) and continental (due to heavy rains) floods, and associated landslides. Warmer STT will foster cyclone intensification just before it reaches land, leading to even more damages.

Geopolitical consequences

Islands such as Comoros, Mayotte, La Réunion, Seychelles, and coastal cities are particularly at risks. The 2019 deadly Idai cyclone illustrates the influence of warm STT on cyclone development, and the potential multiplication of such events in decades to come in the WIO. Indeed, as depicted below, the SST in the area north from Madagascar was warmer than usual few days before the formation of the tropical storm that led to Idai.

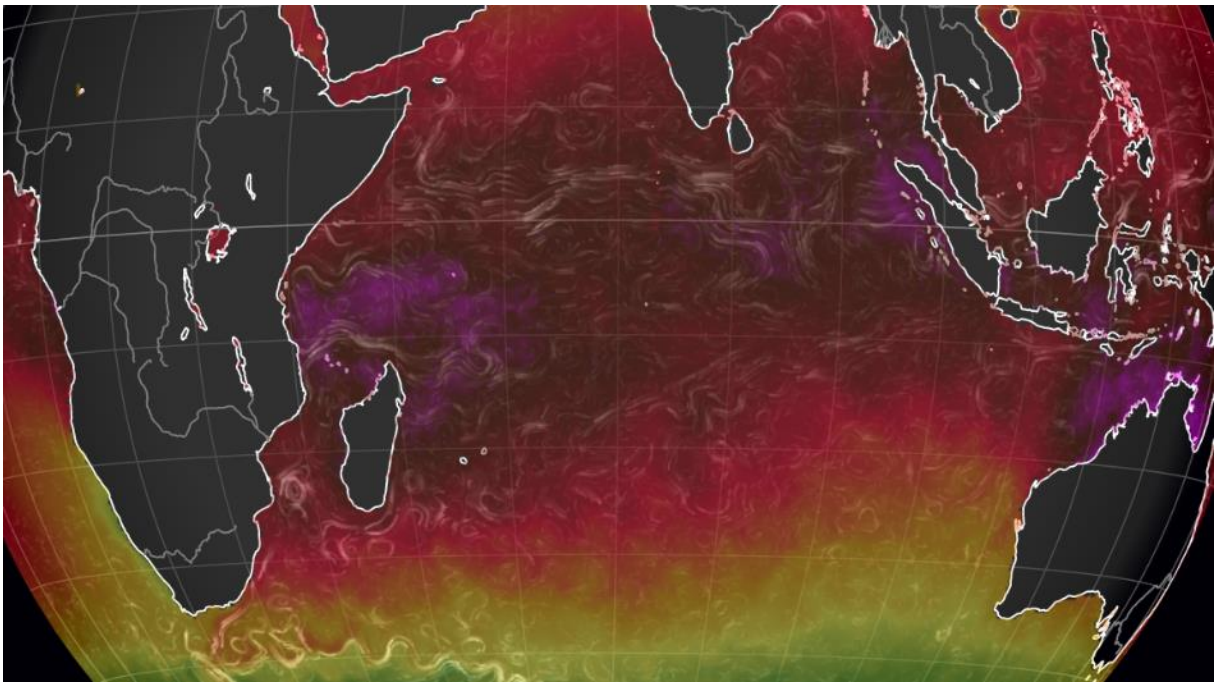


Figure 13 - Screenshot of the SST of the Indian Ocean on March 9th, 2019, along with currents[11] (warmer waters are depicted in dark pink).

Idai devastated Mozambique, Malawi and Zimbabwe mid-March 2019, causing important floods and destructions, and affecting more than 2 million people (Dunne, 2020). It is one of the two most intense cyclones of the 2018-2019

[11] https://earth.nullschool.net/

WIO season, which was the costliest season since 1967 (when recordings began) (Dunne, 2020).

After an emergency call from the regional Red Cross, common interventions of the Plateforme d'Intervention Régionale de l'Océan Indien (PIROI) Center from the Red Cross and the Red Cross from Mozambique were technically supported by French defence forces in the SWIO ("Forces armées de la zone sud de l'océan indien", or FAZSOI) – whom delivered 100 tons of material by sea. The FAZSOI also answered a call for support from the Mozambican government, enabling the delivery of aid.

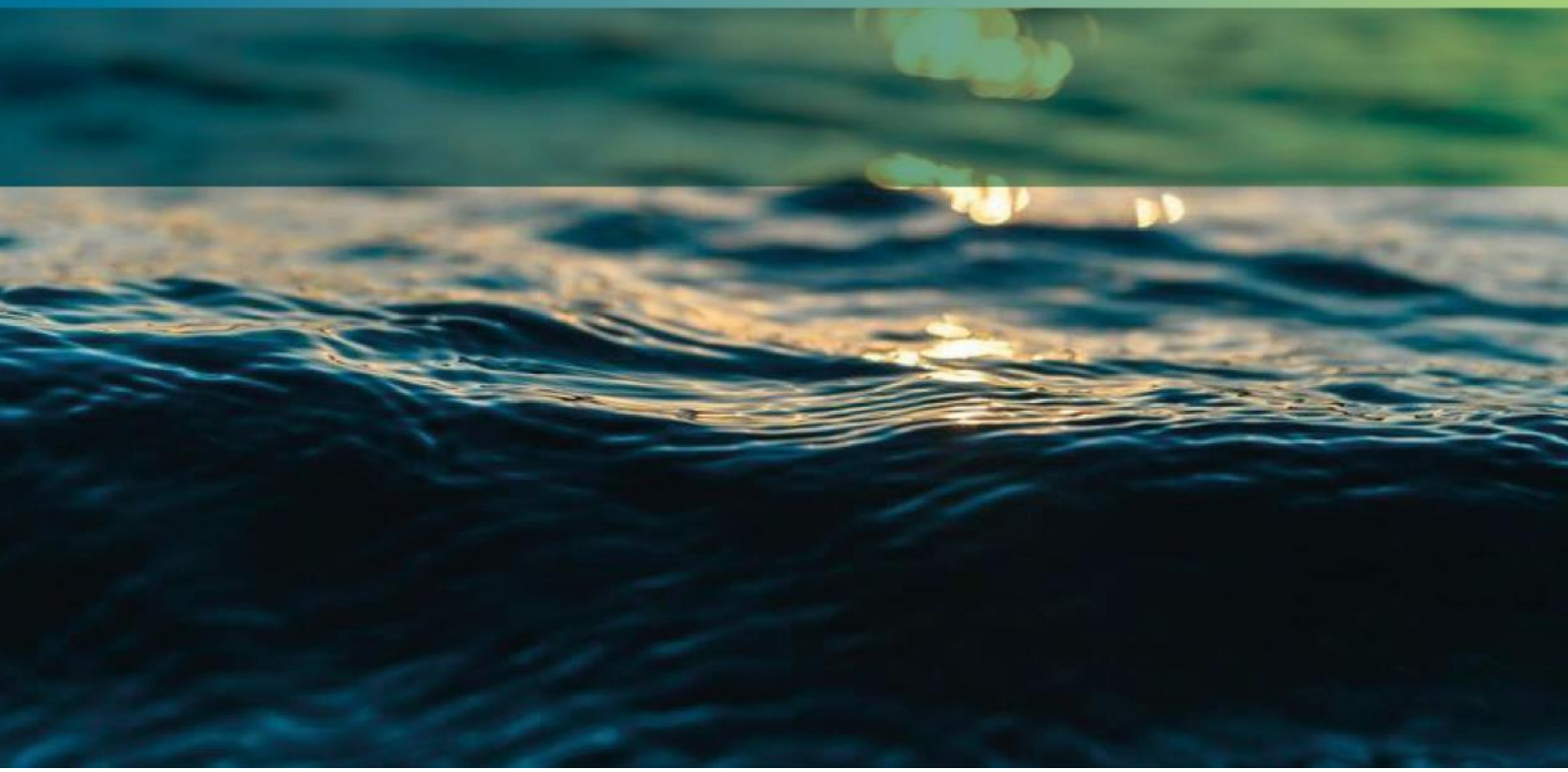
Because of steadily growing extreme weather event intensity, humanitarian assistance and disaster relief (HADR) operations in the area may increasingly have to respond to large, repetitive floods, landslides, and winds. Cooperation and mutual capacity building between defence forces and civilian HADR stakeholders such as the Red Cross are increasingly necessary to optimise interventions and prevent non concerted, sometimes mutually hindering, operations. Populations around the IO (1/3 of the global population) are particularly exposed to extreme weather events, living in low-lying cities, agricultural deltas and small islands (Sarkar, 2020).

Earthquakes, volcanic eruptions, and tsunamis

The WIO is a subduction zone, leading to volcanic and seismic activity. As coastal urbanisation develops around the IO, low-lying islands and coastal areas are particularly vulnerable to an increasing risk of earthquakes and tsunamis. **The example of the recently discovered (2019) submarine volcano off the island of Mayotte illustrates this incremental exposure:** such volcanic activity would have been the source of the numerous (more than 1,800 since 2018) earthquakes affecting the island. It has modified seabed morphology and is deemed as a serious threat by the FAZSOI, as any increase in its activity could trigger tsunamis.

PART 2

RISK ASSESSMENT MATRIX



The following matrix aims to describe interactions between all aforementioned changes and well-known, more established risks.

Although this matrix was inspired by the report "Environmental security in the eastern Indian Ocean, Antarctica and the Southern Ocean", published in May 2019, **it only includes risks related to climate change impacts potentially requiring military involvement in the WIO region**. Thus, and contrary to the matrix developed in the Australian report, **we do not consider the impacts of climate change to be a security risk for the region per se**, but rather seek to determine how these impacts contribute to the emergence of risks impacting defence forces in the WIO.

I. Risk Matrix Table

RISK PROFILE

military HADR missions related risks (low intensity)

defence forces surveillance missions related risks (low intensity)

area geopolitical situation related risks (low intensity)

counter-terrorism efforts related risks (high intensity)

IMPACTS OF CLIMATE CHANGE CONTRIBUTING TO IDENTIFIED RISKS[12] **:**


Water (availability, access, drinkability).


Pastoral lands / agricultural lands (availability, access, land degradation, yields decline, drought, rainfall changes)


Ecosystem stability (degradation of terrestrial and/or marine ecosystems and/or coastal services)


Fish stocks (overexploitation, species migration or loss)


Extreme weather events (tropical storms, cyclones, tsunamis, etc.)


Proliferation of disease vectors (vector-borne diseases, water-based diseases)

[12] The icons used in the matrix to illustrate the impacts of climate change which contribute to the emergence of risks were produced by ADELPHI, as a part of the interactive platform *« Mapping Environmental Conflict & Cooperation »* (https://factbook.ecc-platform.org/)

TABLE 1: Climate-related risks in the WIO region that would require a military involvement (i.e. requiring involvement).

LIKELIHOOD		SERIOUSNESS				
		No disruptive effects; 'business as usual'	Tensions temporarily increase ; situation is manageable within existing processes	Conflict is temporary and generally constrained by existing arrangements	Significant disruption; limited to areas	Significant widespread disruptions
		NEGLIGIBLE	**MINOR**	**SIGNIFICANT**	**MAJOR**	**CATASTROPHIC**
Most unlikely but might occur in exceptional circumstances	**RARE**	-	-	-	-	-
Unlikely to occur without significant change in current circumstances	**UNLIKELY**	-		-	-	-
Can occur in most circumstances in the foreseeable future	**POTENTIAL**	-	**Rejection of a foreign presence or private assets** **Political instability and social tension due to economic/food insecurity**	**Growing influence of major powers in the region**	**Strategic infrastructure degradation or destruction** **Terrorist attack on public or private assets**	-
Will occur in current circumstances	**LIKELY**	-	**Mis-development and mis-adaptation to climate change** **Significant planned displacements**	**Pressure on HADR capacities**	**Sanitary crisis**	-
Already occurs regularly	**ALMOST CERTAIN**	-	**Criminal activity increase**	**More frequent incursions in EEZ** **Irregular migrations**	-	**Fish stock depletion**

II. Risks and challenges

The following risks have been numbered decreasingly, from the least likely and least significant (13) to the most likely and catastrophic (1).

Potential minor risks

- 13. Rejection of a foreign presence or private assets on a territory

The presence of foreign armed forces and public or private assets on a territory may lead to protests and attacks for various reasons, including their environmental impact. Private companies' environmental footprint is increasingly being scrutinized by the public. Those criticized might face protests, taking the form of material degradation or sabotages against infrastructures and/or employees. Fossil fuel extraction facilities could, for instance, be targeted by protesters through acts of vandalism, sabotages or terrorism. Such protests could lead to environmental risks by compromising the safety of facilities (i.e.: pipeline explosion, oil spill).

Apart from private companies, diplomatic incidents or public rejection may also be triggered by foreign armed forces HADR intervention. As a result of WIO states' and nongovernmental organisations' limited capacities to cope with disasters and crisis, foreign defence forces could increasingly be mobilised for humanitarian purposes. Such presence could develop into tensions with national or local authorities criticized by their population, for instance, especially if operations get bogged down, and further lead to diplomatic incidents and tensions with national or local authorities. Tensions may also emerge if local authorities do not react quickly enough and refuse, at the same time, foreign assistance for political reasons (in the case of an oil spill for instance).

- 12. Political instability and social tensions due to economic/food insecurity

Climate change impacts can degrade ecosystems upon which depend livelihoods and lead to significant economic damage, particularly in the primary sector. Environmental degradation worsens due to punctual pollutions, such as oil spills (endangering food and revenue sources). Governments might be blamed for inaction against climate change impacts or active ecosystem deterioration. For some countries, this could lead to sectoral collapses (i.e. tourism) and the development of parallel, sometimes criminal, networks. Financial aid flow mismanagement and evidence-based links with criminal organisations constitute potential pitfalls that governments should consider when tackling climate change consequences. Such phenomenon could directly alter states' capacities. Fragile authorities (Madagascar, Tanzania, Mayotte), or tourism-based countries (Seychelles, Mauritius, Kenya) may thus tip into instability, riots, civil strives, lootings and thefts, due to growing competing to access vital resources. Defence forces could be mobilised and deployed to enforce law.

Potential significant risk

- 11. Growing influence of major powers in the region

Vulnerability to climate change impacts on the long run could create opportunities for major powers to expand their influence through support programs guided by strategic goals, at risk of destabilising regions or countries. If WIO states face a growing number of extreme weather events, and experience important national income losses due to the collapse of their economies (fisheries, agriculture, tourism) , they could get dependent on financial support offered by major foreign powers interested in accessing natural resources (water, land). The increasing influence of foreign powers in WIO could impact regional security by adding pressure on already pressured natural resources, leading to an increased competition among countries and inside countries of the region, as well as between foreign powers and countries of the region. Such predation logics could impact human security, while contributing to erode WIO states' sovereignty.

Potential major risks

- 10. Strategic infrastructure degradation or destruction

Extreme weather events could severely damage or destroy strategic infrastructures, especially if ecosystem services, such as coastal protection, are degraded. A lack of adaptation or "mis-adaptation"[13] could also worsen their vulnerability. The degradation or destruction of main transport infrastructures (airports, roads, ports), energy installations, or security forces facilities would affect resilience capacity and complexify emergency response, aggravating the potential for crisis. In some cases, the assistance of military engineering could be necessary to respond to the lack or failure of public services. Surveillance and monitoring capabilities may also be impacted, while they are necessary for some missions, to prevent extreme weather events and anticipate the response.

- 9. Terrorist attack on public or private assets

Ecosystems degradation, including due to climate change, will affect livelihoods and could lead to high unemployment rates, social downgrading, and misery. The lack of economic opportunities coupled with state failure, inefficient public services and non-state actors' opportunism, could fuel criminal activities, such as trafficking, but also terrorism. Such a dynamic cannot solely be explained by environmental/climate factors, but rather how those interact with existing or emerging cultural, economic, political, social and historical factors. In the event of terrorist attacks multiplication, military means could be deployed. Maritime terrorism is difficult to tackle as attacks are often quick and unexpected, potentially aiming at various targets, including infrastructures. Submarine cables constitute a potential target: they are strategic, yet vulnerable infrastructures, due to their location and the inherent difficulty to monitor and secure them.

[13] Mis-adaptation refers to adaptation policies or projects that mis-match the needs and/or context of its implementation. For instance, the construction of a sea-wall on fragile grounds.

Likely and minor risks

- 8. Mis-development and mis-adaptation to climate change

Mis-adaptation or mis-development projects may constitute considerable pitfalls if mis-planned or mis-implemented. They could expose populations to more difficult living conditions and increase their vulnerability to climate change impacts to the extent that HADR defence forces support is required in the event of a crisis (whether chronic or punctual). Some governments might be willing to support sustainable development projects but lack appropriate financial and human resources. They could also be proposed adaptation or mitigation foreign investment projects that do not take local specificities into account, leading to mis-development/ and or mis-adaptation. Among other, this may, take the form of industrial or energy-related projects, mitigating GHG emissions but destroying ecosystems or endangering local livelihoods. Governmental priorities in economic development could also lead to put adaptation and mitigation measures aside, for the benefit of development projects and at the expense of a greater vulnerability to climate change impacts of some areas and populations. The construction of a new fossil fuel extraction facility, for instance, appears to be in contradiction with mitigation and adaptation actions needed to reduce WIO populations' vulnerability to climate change.

- 7. Significant planned displacements

Climate change impacts add pressure on ecosystems, infrastructures and populations, contributing to unsustainable living conditions that fuel internal population displacements[14]. Those impacts affect continental, marine and coastal ecosystems, and their ability to provide services, on which WIO populations highly depend. Fish stocks depletion, agricultural yield decrease or soil fertility decline threaten development and livelihoods, and push populations to move towards more attractive zones. In addition, extreme

[14] In the context of this report, and although it is a type of migration, we make a clear distinction between displacements and migrations. Displacements here refer to planned internal migration movements that defence forces could be to take part to.

weather event increased frequency and intensity contribute to the vulnerability of these populations by threatening to destroy homes, etc. As a result, planned internal population displacements can occur, eventually requiring the support of defence forces. First, following large relocation policies addressing future risks, whether it be relocating local populations temporarily or permanently – if the zone is largely exposed and if current adaptation means are not sufficient. Second, in response to the occurrence of an extreme event to relocate affected populations. Third, it could be linked to political dynamics using climate change as a motive to exclude unwelcome populations. Examples of planned internal displacements can be found in some small island states, such as Vanuatu.[15]

Likely and significant risks

- 6. Pressure on HADR capacities

The increasing number of extreme weather events and crises associated to climate change impacts could lead to conjunctural and structural HADR capacity gap. WIO countries are highly exposed to major extreme weather events, whose intensity and frequency are reinforced by climate change impacts. This could potentially lead to a situation where foreign defence forces intervene to compensate local states' response shortcomings during emergencies. In case of habitat and infrastructures destruction cause by a cyclone for instance, defence forces can contribute to disaster relief through aid transport and distribution. Defence forces in the region will thus increasingly be mobilised for humanitarian interventions, that could lead to important pressures on defence forces' HADR material and human resources. Simultaneous, yet differently geographically distributed, extreme weather event occurrence could result in conjunctural capacity-gaps, forcing defence forces to conduct arbitrations with, potentially, serious human consequences.

In the medium or long term, defence forces could also face structural capacity-gaps (material and human resources), especially since their interventions tend to diversify

[15] https://www.iom.int/news/vanuatu-launches-national-policy-climate-change-and-disaster-induced-displacement

with new civil-military operations (Shikandra, Resilience for instance), and to enlarge to include new intervention areas, such as eastern African countries. For instance, French defence forces' contribution to surveillance operations and crisis prevention may increase, leading to an over-solicitation and pressure on forces and equipment.

Likely major risk

- 5. Sanitary crisis

The combination of increased frequency and intensity of extreme weather events, increasing human interaction with the wild environment, along with reduced local states HADR capacity could lead to the emergence of important sanitary crises in the WIO. Those could be triggered by food insecurity and water shortage, as well as climate-based proliferation of transmission vectors (mosquitoes, stagnant waters following important rainfalls). Whether they be zoonoses or not, vector-borne diseases, critical respiratory or contagious diseases might affect large part of the regional populations. Climate change induced migrations could also appear to be a circulation factor for diseases. Such sanitary crisis management will inevitably require military means (aid distribution, field hospitals, etc.).

Almost certain but minor risk

- 4. Criminal activity increase

Criminal activities in the WIO already considerably require the involvement of defence forces for surveillance missions. Such operations are expected to increase in the future considering local population's dependency on ecosystem services and the risk of economic sectorial collapse (fishing, tourism) in the region. Even if acts of piracy are rare nowadays, the WIO region remains exposed to it. Maritime traffic in the WIO being prominent and expected to grow continuously, commercial fleets remain potential targets. The fight against piracy is already an essential part

of regional defence forces activities, cooperating with WIO states to ensure maritime security (surveillance). The development of drug trafficking in the WIO is another factor of concern and intervention for defence forces. It supplies touristic areas, benefitting from the lack of surveillance of some areas and leads to the development of other criminal activities, such as prostitution and thefts. Note that climate change impacts would not constitute the sole explanatory factor for the multiplication of criminal activities in the region. The risk of increased criminal activities also depends on WIO states' political response to economic, humanitarian and environmental crisis, and their capacity to anticipate, prepare and respond to such crisis.

Almost certain and significant risks

- 3. More frequent incursions in EEZ

Numerous EEZ, including French ones, already observe high numbers of foreign fleets incursions. **These incursions could become more frequent: fish stock depletion forecasts and seafood demand growth might cause an increase in fishing vessels incursions whereas increased interest for mineral and oil & gas resources may exacerbate maritime borders' disputes.** As for risk n°1, it could mobilise military means for surveillance and intervention. There are several reasons for foreign vessels operating in a country's EEZ illegally, including carrying out research activities, intelligence and surveillance missions. EEZ incursions may also result from industrial fleets fishing operations. Beyond countries' EEZ violations, industrial vessels may venture illegally into waters reserved to small-scale fisheries. Between 2012 and 2016, this form of illegal fishing operations represented 3 % to 6 % of industrial fishing time in African countries' EEZ, out of a total of 4.2 million hours, or 166 million kWh out of 4.9 billion kWh in total (Belhabib, Cheung, *et al.,* 2019).

- 2. Irregular migrations

WIO is a region prone to irregular migration networks' activities. In order to reduce pressure on resources and public services, and prevent tensions in hosting countries, defence forces are often mobilised for border freeing missions, maritime surveillance or search and rescue. French departments in the region observe the arrival of several thousands of migrants each year, especially Mayotte with approximatively 16,000 on their shores in 2008, coming from Comoros, East Africa and Asia (Torre, 2008). In 2019, 3 842 migrants would have been intercepted on seas (YD, 2020). In the same year, 27,000 illegal migrants have been freed at borders during the civil-military Shikandra Operation, launched in August 2019 (Europe 1, 2020). Even if climate change impacts do not constitute the sole factor for displacements and migrations, they could worsen the situation and add pressure in already fragile departure states, or in attractive territories like Mayotte. Surveillance against irregular migration is the main mission of Mayotte naval base (via the State Action at sea Command (AEM PC) which depends on the Prime Minister Services) (Ministère des Armées, 2019). Surveillance, control and monitoring, as well as search and rescue civil-military missions (following the model of the civil-military deployment of the Shikandra operation) could increase in number and scope in the future, adding on to already existing ones.

Almost certain and catastrophic risk

- 1. Fish stock depletion

WIO marine ecosystems are threatened by forecasted climate change consequences on living conditions (though still uncertain due to insufficient data collection)**. Whether for recreational or fishing activities, local states' economies highly rely on healthy fish stocks. Legal fishing** (operated by small-scale fisheries and large industrial fishing fleets) **and illegal, unreported and unregulated (IUU) fishing add up to current climate change consequences and habitat destruction.**

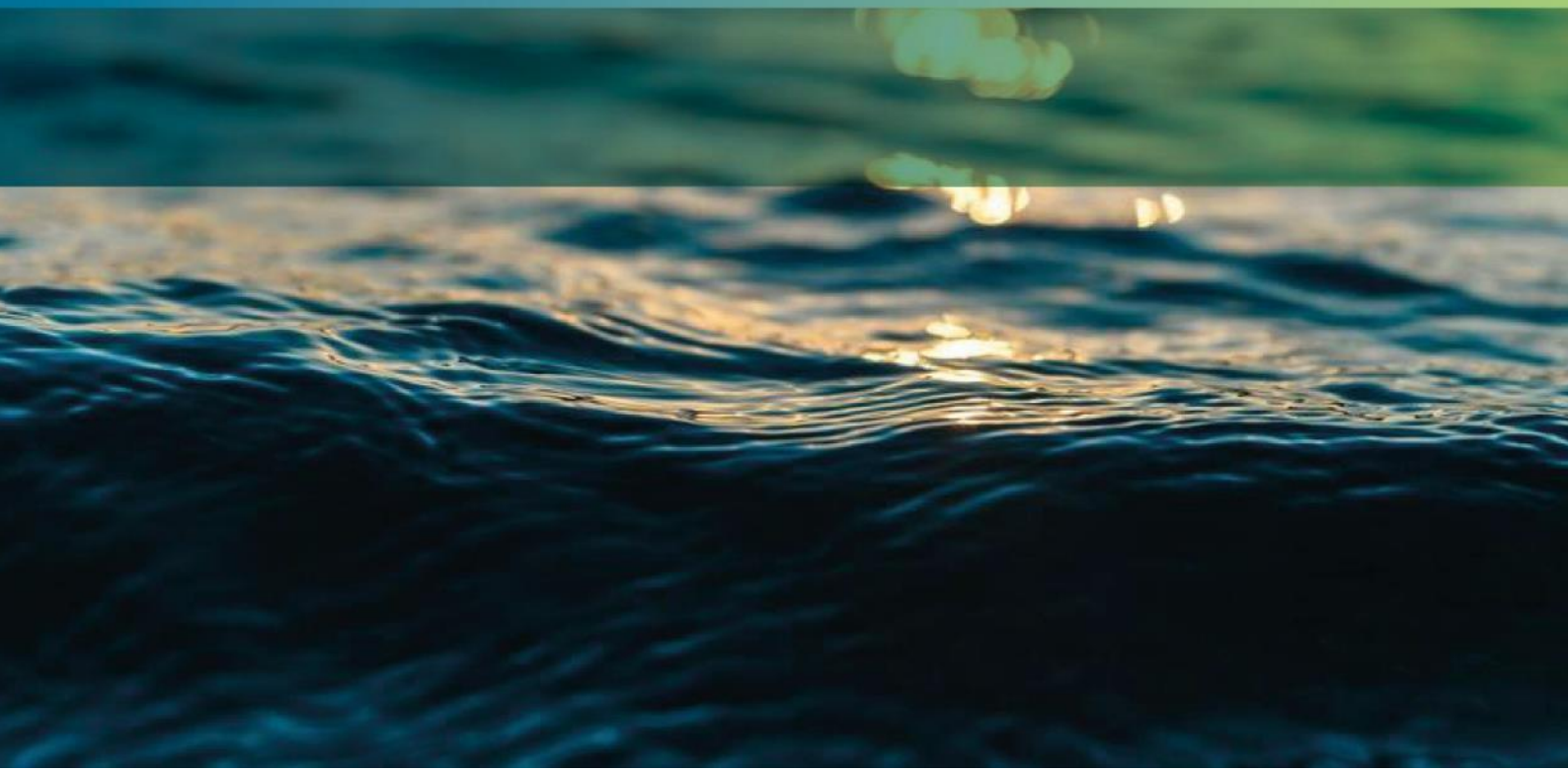
Firstly, mangroves and coral reefs (both affected by human activities and climate change impacts) are fish and prawn nurseries. In the water column, climate pressure will affect fish schools' localisation (deep- and poleward trends) and physiology (reduced growth and reproduction abilities, due to acidification, water temperature and trophic chain disruptions).

Tuna and sardine (especially near South Africa and Mozambique) are essential to WIO economies. Mozambique economy has been ranked 8th most vulnerable to climate change impacts on fisheries, which provide 50 % of the population protein intakes (FAO, 2018). Tuna represents Maldives' single most important export commodity. 30 % of Seychelles GDP relies on industrial fisheries and, following the El Nino event in 1997/98 and its bleaching effect on coral, 42 % of tuna-related benefits collapsed (FAO, 2018). **Change in tuna's migratory patterns will modify industrial fleets landing sites and thus local economies. Other WIO countries (Madagascar, Tanzania, Mozambique, Comoros) have large scall-scale fishing fleets. Small-scale fishermen will have more difficulty than industrial fleets to follow fish schools, to deeper or southern waters.**

Increased competition for fish stocks might lead to tensions amongst small-scale fishermen and between industrial fleets for new fishing agreements. Local states' reduced capacity to control their EEZ leads to compromises – some of them providing full access to their waters as Mauritius did with Japan – and small-scale fishermen pushed to find alternative revenue streams. This might result in tensions between local fishermen, foreign industrial fleets and regulators. **The multiplication of fishing stakeholder in the WIO urgently requires better monitoring, control and surveillance enforcement, that defence forces can provide.**

PART 3

RECOMMENDATIONS



I. General regional cooperation (diplomatic, scientific, political)

Greater regional cooperation at different levels is needed to tackle the security impacts of climate change in the IO. France, Australia and India can lead such regional cooperation, which shall also include island states and territories. **Such cooperation should include diplomatic, scientific and political components.** Below are recommendations to foster the implementation of such initiatives:

➢ Reinforce scientific cooperation

Climate data remain fragmented and scarce in the region and could benefit from a greater cooperation between regional partners. One example of such cooperation is the BRIO project, supported by the Indian Ocean Commission (IOC) and funded by the French Development Agency (AFD). BRIO is a joint project between the meteorological services of La Réunion (Météo France), Madagascar, Mauritius, Seychelles and Comoros to develop a specific South West Indian Ocean climate model, named Aladin. Such a model has the potential to provide climate information downscaled at a regional scope, so that policymakers can directly use it for urban adaptation.

The rise of sea surface temperature will have significant impacts on the blue economy, in particular on fishing and tourism. **Therefore, cooperation in marine science and blue economy is essential. This cooperation should encompass research partnerships and provide a space for discussion between researchers and policymakers.** The IOC could provide an effective platform for such exchanges to happen.

Regional data collection and sharing constitute the first steps towards an integrated regional response to the security impacts of climate change in the region. Replicating the scientific monitoring of climate change impacts on Scattered Islands' biodiversity – involving both the French armed forces in the Indian Ocean (FAZSOI) and the local police forces (TAAF, 2016), surveillance programs could benefit from partnerships between scientific institutes/departments and defence forces.

➢ Support the extension of the Pacific Environmental Security Forum towards the West of the Indian Ocean

Our assessment of the security impacts of climate change in the IO shows the need for a forum, where data, experiences and best practices could be shared between partners of the region. Such fora exist in other regions of the world – such as the South Pacific Defence Ministers Meeting (SPDMM). As countries of the WIO belong to different continents and are part of various existing regional organisations, it appears complicated to create an *ad hoc* forum. Thus, one option could be to expand the Pacific Environmental Security Forum (PESF) towards the WIO. Hosted by the INDOPACOM, the PESF takes a growing importance by turning into a partnership, which includes France. Moreover, as environmental issues already constitute the core focus of the organisation, it could progressively integrate maritime and security issues related to climate change. **This expansion of the PESF mandate could provide an optimal platform for regional cooperation but could also be granted a more operational role by monitoring the security impacts of climate change in the region.**

➢ Support regional organisations

A first step towards the establishment of an Indian Ocean Environmental Security Forum could be an observer role within the Indian Ocean Commission (IOC) for both India and Australia (India obtained it in March 2020). The IOC is currently the principal regional organisation and has developed an expertise on topics related to security and climate change, such as blue economy or humanitarian relief. It could therefore play a leading role in fostering regional stability in the face of climate change, including by integrating climate security into its activities. **IORA could constitute another forum, a recent Memorandum of Understanding having been signed with AFD to strengthen the organisation's capacities "to**

promote the Blue Economy and Fisheries Management"[16], thus building capacity on climate-related topics.

The International Oceanographic Commission Perth Programme, hosted at UNESCO since 1998, **could also be reinforced with additional regional partnerships, which could strengthen oceanographic research in the region.**

➢ Build capabilities in maritime domain awareness

Although some countries of the region have solid monitoring capacities of their maritime domain, it is not the case of all countries. **This capacity-gap generates loopholes for illegal fishing, trafficking and other illegal practices. Regional cooperation, including military cooperation, should support capacity-building for maritime domain awareness, in order to improve the coverage of monitoring.** A larger coverage of the maritime domain could significantly reduce the security risks associated with climate change in the region.

France[17] and the European Union support the Regional Maritime Information Fusion Centre, established in Madagascar. This centre reunites countries of the South-western part of the IO, but Australia could join the centre as a partner. Reinforced cooperation with similar centres established in Singapore and New Delhi should also be encouraged.

Finally, **the EU Critical Maritime Routes Indian Ocean (CRIMARIO) project,** aiming at enhancing Maritime Domain Awareness (MDA), **recently expanded its geographical scope to Asia and Oceania** to further foster cross sectoral and cross regional cooperation in maritime security. Through this programme, France recently sent a liaison officer to India, and should be followed by Australia.

[16] https://www.iora.int/en/events-media-news/news-updates-folder/blue-economy-partnership-launched-between-iora-and-france

[17] France also propose assistance to sailing in the Indian Ocean with the maritime security cell ALINDIEN MARSEC (ministry of Armed forces) which provides data and hotline services.

➢ Provide training in port state control enforcement

Similarly, port state control enforcement remains uneven in the region. Capacity building in this domain could also reduce the risk of illegal maritime activities, and hence the security risks associated with climate change. This training programme could be hosted and coordinated by the IO Memorandum of Understanding on Port State Control, which remains unsigned by many countries of the region.

Such training could benefit from partnerships with regional organisations such as the IOC, or possibly the Indian Ocean Environmental Security Forum, once established.

II. Vulnerability of key infrastructures (prevention)

Sea level rise and other climate impacts will put key military and civilian facilities at risk. **While constructions and projects expanded quickly in the region - sometimes in the absence of adequate regulatory frameworks - data remain scarce.**

➢ Identify key infrastructures and assess their vulnerability to climate change impacts

Key infrastructures can easily be identified, but their vulnerability remains complicated to assess due to the lack of precise assessment methods. **A standardization of the latter across the IO region would facilitate the sharing of experiences and best practices.** In this regard, France reviewed the vulnerability of some of its infrastructure, with an innovative systemic methodology which could be shared with IO partners in order to facilitate the standardization of vulnerability assessments[18]. It could thus be interesting to build a network with the Coalition for

[18] Cf. Notes d'analyse 2 and 4 on Port Bouet (Cote d'Ivoire) military base vulnerability : https://www.defense.gouv.fr/dgris/recherche-et-prospective/observatoires/observatoire-geopolitique-des-enjeux-des-changements-climatiques

Disaster Resilient Infrastructure (CDRI) launched by Indian Prime Minister Narendra Modi during the UN Climate Action Summit 2019.

Such assessment needs to include two phases: first, an identification of key infrastructures; then a systematic assessment of their vulnerability through a standardized methodology.

➢ Address gaps in the international regulatory regime for undersea cables

Over the last few years, undersea cables multiplied in the region. Yet, there are many legal loopholes in the international regulatory regime that reinforce the vulnerability of sectors relying on telecommunications (finance, health, government) explained by their dependency on Internet connexion. Both trends contribute to the emergence of security risks in the region, especially for island states. **A systematic assessment of these loopholes should be undertaken,** and the risks they pose in the face of climate change or criminal/terrorist attacks (especially in onshore connection hubs or during maintenance or installation of those cables) should be systematically assessed. **Regional lobbying efforts could then be pursued so that gaps are addressed in the international regulatory regime.**

III. Human security challenges (intervention)

The absence of coordinated relief structure remains a significant problem, despite the presence of the PIROI, a regional structure from the Red Cross/Red Crescent.

➢ Strengthen maritime safety capacity building

Maritime safety remains crucial and could be jeopardised by the impacts of climate change. The absence of coordination is detrimental to the best use of resources: for example, two similar radars have recently been funded by

neighbouring countries, while sharing the data provided by one radar would have been enough. **Data collection and sharing, as well as common public policies for risk anticipation and interoperability of SAR and HADR missions constitute the first steps towards an optimized response to climate change impacts. The mutualisation of equipment and monitoring capacities could significantly serve this objective.** Similarly, in the short term, interoperability and coordination could be boosted and sustained through information sharing and the organisation of shared HADR exercises and simulations between defence forces of the region, following the dynamic introduced by the French presidency of IONS – planning such exercise for 2022.

➢ Implement cooperation in disaster risk reduction and relief

PIROI is a joint initiative between the Red Cross branches from Comoros, France (Réunion and Mayotte), Mauritius, Madagascar, Mozambique, the Seychelles and Tanzania. This initiative paves the way for a regional cooperation in disaster risk reduction and relief, and needs to be supported. Other countries and territories of the region could join. For this, **closer cooperation with the military would be welcomed, and governments should be encouraged to include civilian actors in training for and preparing HADR operations.** For instance, PIROI could officially take part in exercises (briefing and on the field) organized by the FAZSOI.

In this perspective, **regional defence forces, including ADF, are invited to join the platform as observers, thus creating an overarching structure facilitating cooperation. Similarly, it is also recommended to include military personnel into civilian trainings, such as those of the PIROI.**

IV. Maritime surveillance

Maritime surveillance is another domain that could benefit from closer cooperation. Such cooperation could be implemented through an extension of the Pacific Environmental Security Forum towards the West of the Indian Ocean.

➢ Foster cooperative responses to IUU fishing

Illegal, unreported and unregulated fishing (IUU fishing) remains a major risk in the region, and is likely to be exacerbated by climate change, as migrating and depleting fish stocks will encourage illegal practices. **Responses to IUU fishing are patchy and uneven in the region and would benefit from more exchanges between countries through international structures.** Although working on maritime security to a larger extent than IUU fishing, the Regional Programme for the Promotion of Maritime Security (MASE) appears to be one of the most appropriate fora for such exchanges to happen. However, the EU funding for this program runs out at the end of 2020, and the program does not include countries of the Eastern Indian Ocean. It would be relevant to invite them in the next funding period.

Moreover, technical support should be provided for the implementation of tool of semaphoric coverage such as SPATIONAV, that could enable data sharing and mutualisation between neighbouring countries.

Bilateral and multilateral cooperation in the fight against IUU fishing should be encouraged, on the model of the Kerguelen-Heard-McDonald French-Australian cooperation, relying on information sharing and interoperability.

➢ Build dialogues among coastguard agencies

In order to facilitate the training of coast guards, the IOC could initiate a collaboration with the Heads of Asian Coast Guard Agencies Meeting (HACGAM), of which France is an observer since 2019. As an observer too, a participation of the IOC to this meeting would enable closer cooperation between Indo-Pacific countries on domains covered by HACGAM: environmental protection, fight against illegal activities, SAR and capacity building.

In addition, **establishing a facility for the professional development of senior coast guard practitioners could facilitate information-sharing and dialogue,** as well as joint training exercises.

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ANNEXES

I. Annex 1. Probabilistic Population Projections, with median and upper 95 percent prediction interval

*Upper 95 percent prediction interval, 2015-2100

Region, country	Total population (thousands)				
	2019	2030	2030*	2050	2050*
Eastern Africa					
Comoros	851	1 081	1 142	**1 502**	1 760
Djibouti	974	1 054	1 116	1 186	1 384
Ethiopia	112 079	138 297	148 026	**188 455**	228 140
Kenya	52 574	65 412	69 064	**95 505**	110 957
Madagascar	26 969	35 960	38 035	**55 294**	64 983
Mauritius	1 266	1 310	1 364	1 249	1 384
Mayotte	**??**	344	362	**497**	569
Mozambique	30 366	41 437	43 869	**65 544**	78 363
La Réunion	**??**	947	984	989	1 098
Seychelles	97 625	101	105	100	111
Somalia	15 443	16 493	17 415	**27 030**	32 670
United Republic of Tanzania	58 005	82 927	87 428	**137 136**	161 773
Southern Asia					
Pakistan	216 565	244 916	258 185	309 640	359 341
India	1 366 418	1 527 658	1 605 060	1 705 333	1 977 997
Islamic Republic of Iran	82 914	88 529	93 234	92 219	104 435
Western Asia					
Yemen	29 162	36 335	38 326	47 170	54 281
Oman	4 975	5 238	5 434	5 844	6 409

Sources : Probabilistic Population Projections based on the World Population Prospects: The 2015 Revision, Department of Economic and Social Afairs, Population Division, United Nations ; "Population, total", World Development indicators, The World Bank (consulted on September 14, 2020), http://api.worldbank.org/v2/en/indicator/SP.POP.TOTL?downloadformat=excel.

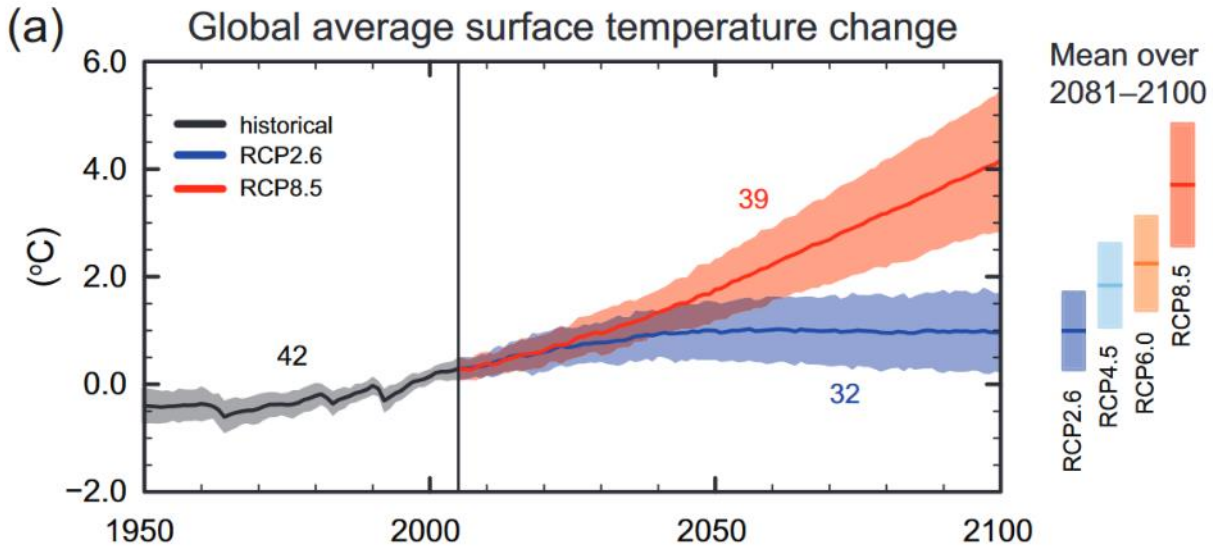
II. Annex 2: Regional Organisations and Fora*

Organisation/forum	Members	Fields of competence
ASEAN Defence Ministers' Meeting (ADMM)	**Members**: BN, ID, LA, KH, MM, MY, PH, SG, TH, VN; **Observers:** AU, CN, **IN**, JP, KR, NZ, RU, US (ADMM-Plus)	Highest defence consultative and cooperative mechanism in ASEAN. Seeks to promote regional peace and stability through greater Dialogue and Transparency in defence and security, Capacity building. Practical cooperation has grown in Maritime security, HADR.
Association of South-East Asian Nations (ASEAN)	**Members**: BN, ID, KH, LA, MM, MY, PH, SG, TH, VN**;** **Observers:** AU, BD, CA, CN, **IN**, JP, KP, KR, **LK**, MN, NZ, PG, **PK**, RU, TL, US, EU	Regional organisation promoting intergovernmental cooperation and integration in economic, political, security and military fields notably. It is a central union in Asia-Pacific region.
Bali Process	**Members:** AE, AF, AU, BD, BN, BT, CN, FJ, **FR,** HK, ID**, IN,** IQ**, IR,** JO, JP, KH, KI, KP, KR, LA, **LK,** MM, MN, MO, MV, MY, NP, NR, NZ, PG, PH, PK, PW, SB, SG, SY, TH, TL, TO, TR, US, VU, VN, WS, ILO, IOM, UNHCR, UNLDC; **Observers:** European Commission, AT, BE, CA, DE, DK, ES, FI, IT, NL, NO, PL, RO, RU, SE, **ZA**, CH, GB	Forum dedicated to policy dialogue, information sharing and practical cooperation on People Smuggling, Trafficking in Persons and Related Transnational Crime
Bay of Bengal Initiative for MultiSectoral Technical and Economic Cooperation (BIMSTEC)	**Members**: BD, BT, **IN**, **LK**, MM, TH, NP	International organisation which has identified 14 priority sectors, among which Energy, Fisheries, Agriculture, Public Health, Environmental & Disaster Management, Climate Change.
FRANZ	**Members**: AU, **FR,** NZ; **Observers:** CK, FJ, KI, NR, NU, PG, WS, SB, TK, TO, TV, VU	Civilian-led arrangement supported by defence forces focused on Disaster reconnaissance and Relief assistance coordination.
Heads of Asian Coast Guard Agency Meeting (HACGAM)	**Members**: AU, BD, BH, BN, CN, HK, ID, **IN**, JP, KH, KR, LA, **LK**, MM, MV, MY, PK, SG, TH, TR, VN	Forum dedicated to Capacity-building in Coast guard organisations, Dialogue on Maritime Safety, Security and Environment protection.
Intergovernmental Authority on Development (IGAD)	**Members**: DJ, **ET**, **KE**, SD, **SO**, SS, UG	Initially created for environmental management (drought and desertification), it expanded to economic cooperation and integration, promotion and maintenance of peace and security.
Indian Ocean Commission (IOC)	**Members**: **FR**, KM, **MG**, **MU**, **SC**; **Observers:** CN, **IN**, JP, MT	Organisation which promotes cooperation in numerous fields, among which economic development, agriculture, fishing, conservation of resources and ecosystems, blue economy.
Indian Ocean Naval Symposium (IONS)	**Members** : AE, AU, BD, ER, **FR**, ID, **IN**, **IR**, **KE**, **LK**, MM, **MU**, MV, MY, **MZ**, **OM**, **PK**, SA, **SC**, SG, TH,	Initiative seeking to increase dialogue and cooperation

	TL, **TZ**, **ZA**; **Observers:** CN, DE, ES, IT, JP, **MG**, NL, RU	between littoral States' navies on Maritime Security issues.
Indian Ocean Rim Association (IORA)	**Members** : AE, AU, BD, **IN**, ID, **IR**, **KE**, KM, **LK**, **MG**, **MU**, MV, MY, **MZ**, **OM**, **SC**, SG, **SO**, TH, **TZ**, **YE**, **ZA**; **Observers:** CN, DE, EG, **FR**, GB, IT, JP, KR, US, TR	Initially focused on economic and trade, the fields of competence have been extended to integrate Maritime Safety and Security, Fisheries Management, Disaster Risk Management, Academic, Science & Technology, Blue Economy
Regional Cooperation Agreement on Combating Piracy and Armed Robbery against Ships in Asia (ReCAAP)	**Members**: AU, BD, BN, CN, DK, **IN**, JP, KH, KR, LA, **LK**, MM, NL, NO, PH, SG, TH, US, VN	Government-to-government arrangement focused on Piracy, armed robbery against ships, and Information sharing, through its Centre (ReCAAP ISC).
South-Asian Association for Regional Co-Operation (SAARC)	**Members**: AF, BD, BT, **IN**, **LK**, MV, NP, **PK**; **Observers:** AU, CN, **IR**, JP, KR, MM, **MU**, US	Promotes economic and regional integration, but also owns a Disaster Management Centre (SDMC-IU), which provides Technical support, Capacity building and Training services and facilitates Information and expertise sharing
Southern African Development Community (SADC)	**Members**: BN, ID, LA, KH, MM, MY, PH, SG, TH, VN; **Observers:** AU, CN, **IN**, JP, KR, NZ, RU, US (ADMM-Plus)	Regional Economic Community aiming at contributing to Continental and Regional integration, and promoting Development Cooperation.
Indian Ocean Memorandum of Understanding on Port State Control (IOMOU PSC)	**Members:** AU, BD, **DJ,** ER, **ET, IN, IR, KE, LK**, **MU,** MV, MY, **MZ, OM, SC,** SD, **TZ, YE, ZA**	Following IMO's resolution A.682(17), this MoU is a regional agreement on Port State Control (PSC), which aims at improving ships inspections through better coordination between countries.
Shangai Cooperation Organisation (SCO)	**Members:** CN, **IN,** KG, KZ, **PK,** RU, TJ, UZ; **Observers:** AF, AM, AZ, BY, **IR**, KH, **LK**, MN, NP, TM, TR, ASEAN, CEI	Organisation centred on security-related issues, promoting military cooperation, intelligence sharing and counterterrorism. However, economic and cultural cooperation, and social development are increasingly important stakes.

**Western Indian Ocean countries are in bold*

III. Annex 3: IPCC Scenarios



Source: IPCC Summary for Policymakers, 2013