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HMS
המרכז לחקר מדיניות ואסטרטגיה ימית
Maritime Policy & Strategy Research Center

# MARITIME STRATEGIC EVALUATION FOR ISRAEL 2019/20


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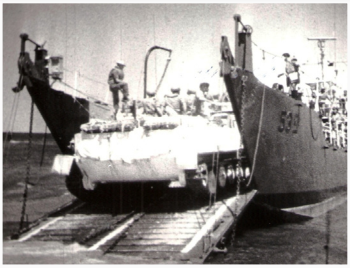

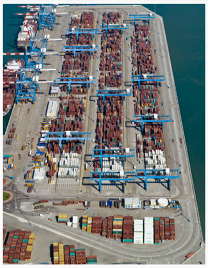

# Potential Impacts of Climate Changes on Israeli Maritime Security

*Semion Polinov*

As a small, densely populated country characterized by population and economic growth against a backdrop of land and water scarcity, Israel recognizes the importance of preparing for climate change in wide scope of this phenomena. Over the past decade, various Israeli research initiatives, consisting of representatives of government, academia, industry and non-governmental organizations, have been collecting knowledge on climate change and its impact on water, health, biodiversity and green building, analyzing these areas on an interdisciplinary basis using geostrategic and economic perspectives. Although (due to its geo-strategic situation) Israel is an "island" country largely dependent on the sea, scientific studies on the effects of climate change on maritime security are in their infancy. This article presents modern knowledge about climate change in the world and in the Israel region, its potential impact on various aspects of the maritime security of the State of Israel and recommendations in accordance with this knowledge.

## Current knowledge about Climate Change

To address the issue of climate change and their potential impacts, two fundamental issues need to be solved: identification and attribution, considering the geographical component, rather than a global issue or a local one at the state level. None of this is simple in the event of climate change. Results of climate change is part of today's reality (IPCC, 2014). During the 21st century significant changes are expected in the climate around the world. For most parts of the world, the average temperature has risen by an average of 0.6-0.3°C (Fig. 1) since 1860 and is expected to rise by 1.8°C to 2100°C (IPCC, 2014). Jones (1999) pointing on global surface air temperature raise in period of 1925-1944 by 0.370 C and over the period of 1978-1997 0.320 C (Jones, et al., 1999). While human activities are estimated to have caused approximately 0.5-1.0°C of global warming (McMichael, et al., 2006). These changes can lead to critical harm to human well-being and natural systems. There are no disagreements about the importance of these changes, but there is uncertainty about their power.

The Global economic loss due to an increase in temperature of 4°C is estimated at approximately 5% of the world's annual GDP, with the economic loss in specific regions significantly higher (Kompas, Pham, & Che, 2018), and this is just one example from a various impact of expected effects of climate change and global warming. The viability and prediction of a climate changes cost/benefit view of the adjustment process is expected to increase over time and the investment in prevention and adaptation is expected to be more worthwhile as the scientific knowledge will increase and uncertainty becomes less. Scientists have high confidence that global temperatures will continue to rise for decades to come, largely due to greenhouse gases produced by human activities (IPCC, 2018).

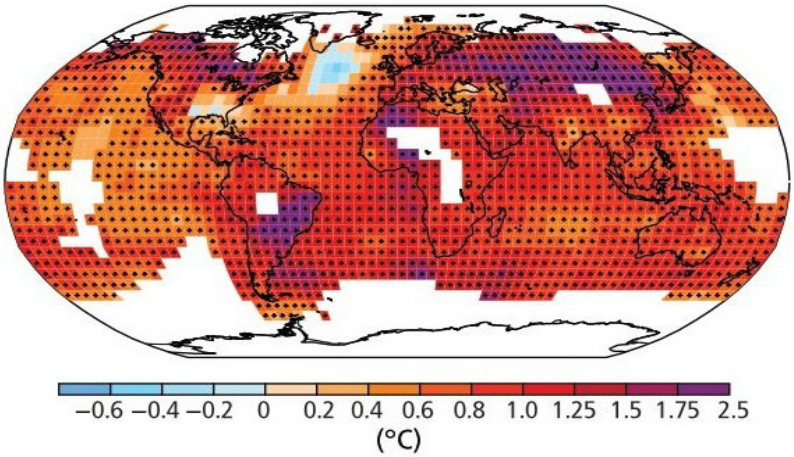


Figure 1: (a) Map of the observed surface temperature change, from 1901 to 2012; (b) Map of observed precipitation change, from 1951 to 2010 (IPCC, 2014).

The sea level is one of the key indicators of climate change. On time-scales of millions of years, geological processes, such as changes in ocean basins geometry caused by plate tectonics, are dominant in affecting sea-level change, whereas on shorter time-scales of years and decades, oceanographic and climatic factors are more dominant (Lichter, Zviely, Klein, & Sivan, 2010)

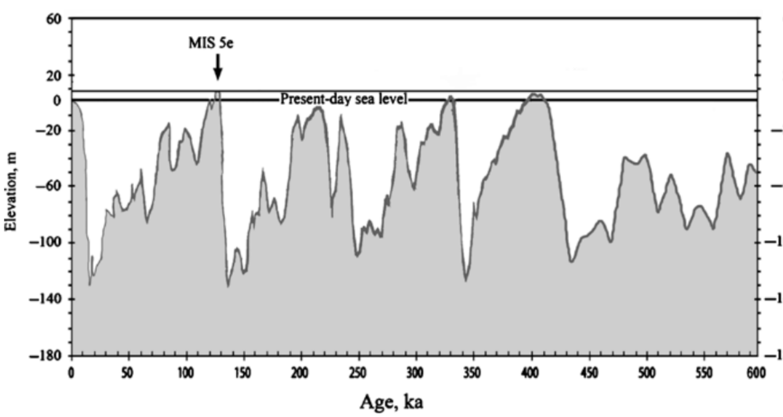


Figure 2: Global sea-level changes in the last 600 ka (kilo annum/thousands of years) thousands of year (Lichter et al., 2010).

The global level of the seas and oceans rose during the 20th century. These rises are almost certainly accelerated due to the natural variability of the climate and the human factor during the 21st century and beyond due to global warming and projected to rise by 60 cm by 2100 (IPCC, 2014), however the future extent of sea level remains uncertain (Nicholls & Cazenave, 2010).

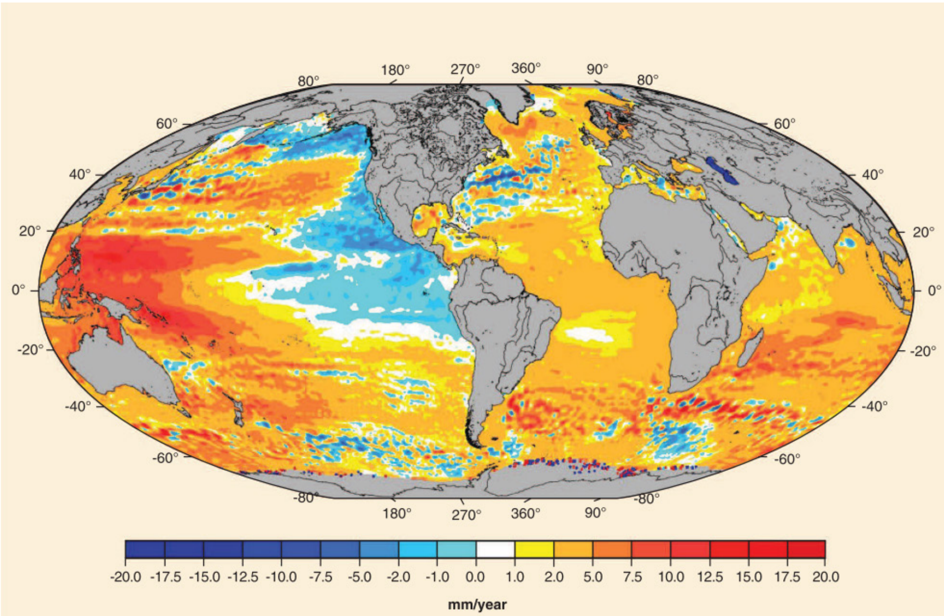


Figure 3: Regional sea-level trends from satellite altimetry in period of 1992-2009 (Nicholls & Cazenave, 2010)

During different measuring periods the sea level has been continuously raised up in the Mediterranean Sea region. From 1993-2012 founded significant trend of the mean sea level raise by 2.44±0.5 mm/year (Bonaduce, et al., 2016), while in period of 1993-1999 in Eastern Mediterranean the sea level has been raised up to 20 mm/yr. (Cazenave, et al., 2001). Although the impacts of sea-level rise are potentially large on coastal states, the application and success of adaptation are large uncertainties that require more assessment and consideration (Nicholls & Cazenave, 2010).

The direct and indirect impact of climate change will depend on how the world and nations will respond, for example the increased emissions and other aspects of climate change. The evidence indicates that climate change has already resulted in extreme weather events and sea level rises etc., with added threats to agricultural production in many parts of the world (Kompas et al., 2018).

## Anthropogenic Contribution to Climate Change

There are many “anthropogenic” (human-induced) factors that contribute to climate change (IPCC, 2014) and climate change will affect human health in many ways-mostly adversely (McMichael et al., 2006). Today there is no doubt that humans contribute to the climate changes and the pressures on the ocean and its growing environmental issue all over the world (Halpern et al., 2015a). At the same time, it is important to understand that cyclical climate changes are always occurring on the earth, which called “normal” system behavior, and in this case deviations from the “normal” pattern indicate anthropogenic impact on the climate (Loehle, 2004). Based on Ice cores Geological analysis, there is good evidence that past human activity contribute to increase of greenhouse gases ($CO_2$ mainly) since the Industrial Revolution (Etheddge et al., 1996; Lüthi et al., 2008), while this increase promote higher temperature in the atmosphere (Scheffer, Brovkin, & Cox, 2006). However, the magnitude of human impact predicted by existing models remains very uncertain due to the accumulation of uncertainties (Scheffer et al., 2006). Both, natural processes and human activities change the Earth’s energy balance and physical factors, and for a complete understanding, both of these topics need to be explored (IPCC, 2014).

Quantifying and mapping local and global scale human impacts on the climate change in a standardized, comparable manner offers a powerful means to assess both the spatial pattern and temporal change of individual human impact, as well as their total impact on climate change across highly variable geographies (Halpern et al., 2015a, 2008). Today, assessing the level of anthropogenic impacts on climate change and on the environment is becoming one of the most important scientific topics in which there is still great uncertainty regarding the rate and changes of anthropogenic impacts. In the scientific community in general and in climate research, there is a sweeping consensus that the current rates of climate change is man-made.

Human presence in impact on the ocean is thought to be increasing globally (Fig. 4), yet we know little about their spatial and temporal patterns of cumulative change, which human activity is most responsible for changes in ocean environment and contribution to climate change, and which places are experiencing the greatest increases. Based on cumulative impacts of the result of the most impacting pressures of human activity: fishing, climate change, and land-based sources, nearly 66% of the ocean and 77% on national jurisdictions suffering from an increase of human pressure, while 5% of the ocean under heavily impact (Halpern et al., 2015b, 2008). To understand the real threats to maritime security and the challenges to policy-makers, it is not enough just to look at climate change. Climate change is only one component of the larger problem of direct, man-made environmental change (Paskal & House, 2007).

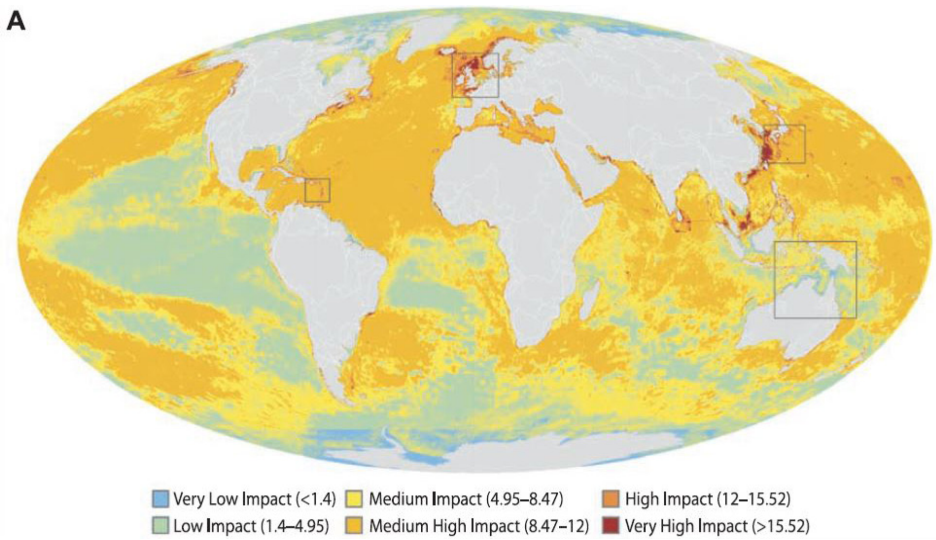


Figure 4: Global map of cumulative human impact (Halpern, 2008)

As a species, humans often make direct and indirect impact (Fig. 4) and major alterations to the environment (Halpern et al., 2008). In the more recent past, massive population increases have had a dramatic effect on global sustainability. At the turn of the 20th century, there were around 1.65 billion people on the planet. At the turn of the 21st, there were around 6 billion. The result is, more groundwater pumped up, more forests cut, more urban sprawl, more developments in flood plains, etc. and, ultimately, a changed environment (Paskal & House, 2007).

The current climate change, which does not distinguish between the state and other administrative boundaries, has created the need to develop new strategic approaches to overcome the consequences of these changes (Hannah, 2010). The declaration of an EEZ brings a series of challenges and concerns (Fig. 5) for large-scale collaboration efforts (Katsanevakis et al., 2015) economic and socio-political interactions between countries can significantly increase the stability and preparedness of each of the states in the prevention of the serious consequences of climate change.

Successful cross-border cooperation depends on achieving various environmental goals and strengthening economic ties and the necessary political cooperation (Levin, et al., 2018). However, there are obstacles to finding effective ways to collaborate. For example, partly due to a long-term lack of trust, many leaders around the world are suspicious of such initiatives, as an example of the West insisting on global emissions reductions. Some see this hypocrisy as a way to prevent economic growth in the developing countries. In addition, some partners in the West are less likely than others to seek solutions. Most of both of these issues are related to the terminology currently in use, which is often confused or inaccurate and requires urgent clarification (Paskal & House, 2007).

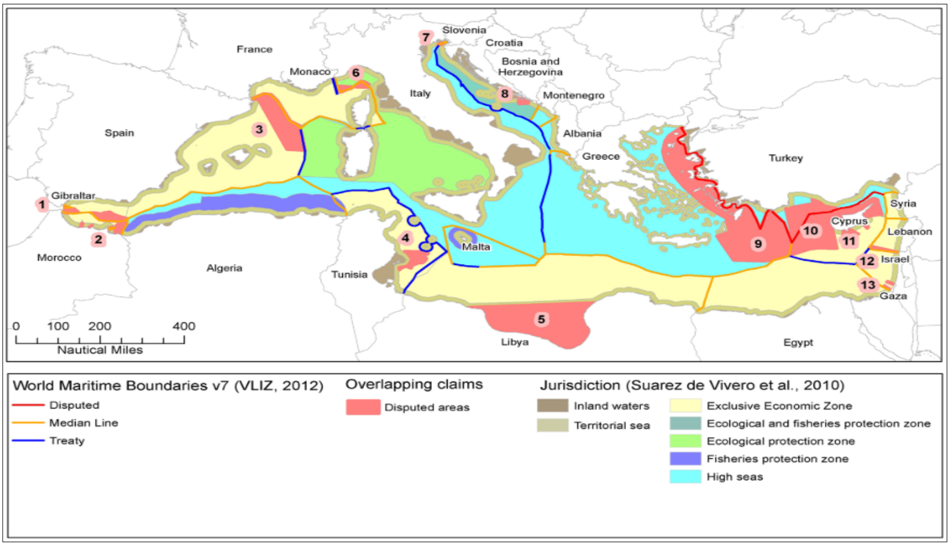


Figure 5: Marine boundaries and disputes in the Mediterranean Sea

## Climate Change and Maritime Security

Maritime Security is one of the latest buzzwords of international relations (Bueger, 2015). Major actors in maritime policy, ocean governance and international security have in the past decade started to include maritime security in their mandate or reframed their work (Germond & Mazaris, 2019) in such terms, Israel is in the initial steps despite being an “geo-political island”. In last decade, the contribution of the maritime domain to Israel’s resilience and security continued to grow (HMS, 2018).

The raise of Maritime Security is happening now with climatic changes; therefore, a growing number of governments and non-state actors are beginning to adapt to the complex consequences of climate changes. As a result, new approaches are being developed that focus on maritime strategic thinking and an understanding of how climatic changes impacting now and when new climatic changes may affect maritime security and what results this may lead to, such as political tensions, armed conflicts etc. However, many countries do not have a national maritime strategy based on scientific conclusion about climatic changes and their potential impacts on national maritime security (Bueger, 2015). In a global view, currently recorded a large number of cases where climate change interacts with diverse, complex and unstable social, political, economic and strategic situations, forcing them to a new type of problems to which in many cases, the state level has not developed any concept for solving such problems. Since climate changes occur “so fast” and in some cases are unpredictable, they alter the balance and “order of things” on which the security of nations is based (Germond & Mazaris, 2019). Today, such changes have taken an important role as powerful strategic forces that need to be fully understood. It is strongly influenced on international relations, future conflicts, wars etc. The initial effects of climate change vary depending on existing economic, political, and social structures in different regions of the world (Halden, 2007).

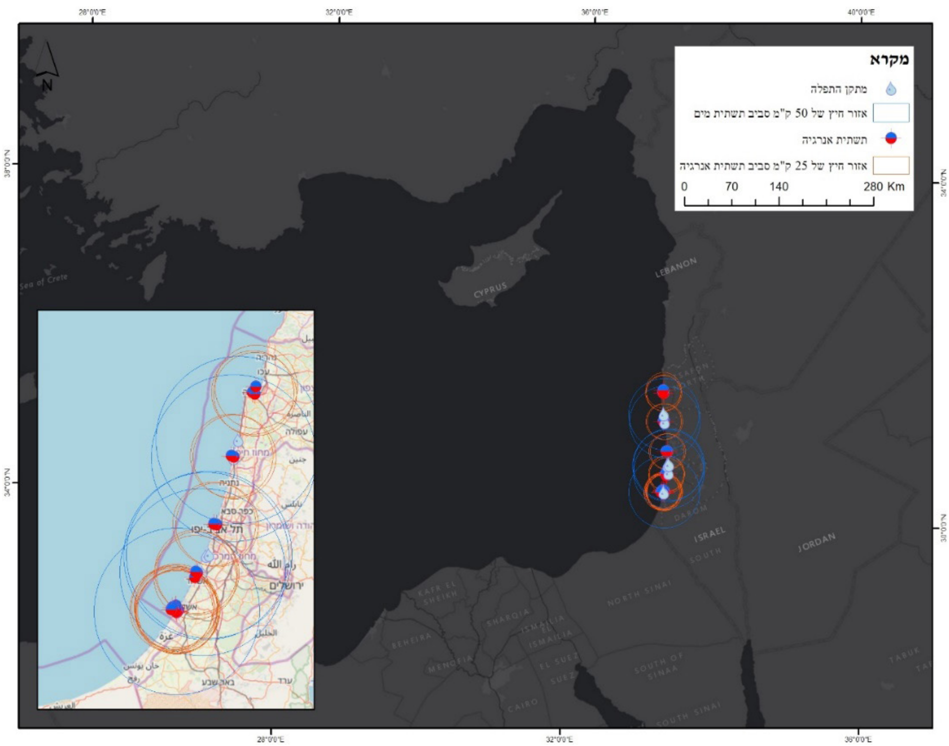


Figure 6: The location of important water and energy infrastructures along the coastlines of the Mediterranean coast of Israel with proposed buffer zones for monitoring and early detection of potential hazardous in the sea (50 km for water infrastructures and 25 km for energy). “Zoom in” map present location of buffer zones and territorial water (12 NM).

There is growing awareness that many important and critical aspects of Israeli maritime security are threatened or potential to be, by direct and indirect impacts of climate change on marine and coastal ecosystems, maritime/coastal tourism, maritime transport, coastal communities and national infrastructure located along the coastline (Fig. 6). Therefore, the development of the Israeli marine geostrategy is required in the period of strong natural changes due to climate change and, apparently, is a new and modern way adopted by a growing number of other governments and non-state structures that at different levels assess and combat the impact of climate change due to for its potential difficult consequences.

## Climate Change and Israeli Maritime Security

Israel is sensitive to the potential impacts of the unpredicted climatic and environmental changes due to its geographical and political location. Despite 190 km of Mediterranean Sea coastline with high number of national importance infrastructures (Fig. 6), densely populated, the potential impact of climate change on such infrastructure and population is poorly covered but is well known and is widely discussed.

Today, the most important component of climate change that affect or could potentially affect Israeli Maritime security as a result of the climate change are:

1. **Rainfall regime** – changes in the rainfall regime in Levant region, mainly decrease in annual quantity, seasonal distribution, intensity and timing (Zittis, 2018). This trend have major impacts on the country's water resources, which will increase the dependence on desalination plants. Trends in the duration of rain and dry periods during the rainy season also have important environmental consequences, especially for agriculture and ecosystems. For example, long dry periods can cause the soil to dry out, which means that more irrigation is required, while longer periods of rain can increase the risk of flooding (Ziv, et al., 2014). Few research indicated positive correlation between change in Israeli rainfall regime and increase of forest fires (Levin & Saaroni, 1999; Turco, et al., 2017) which also lead to increase off runoff (Wittenberg & Inbar, 2009). Such wildfires and post runoffs produce significant ecological and economic impacts that often go well beyond the traditional impact indicator.
2. **Sea level rise** – The rise in sea level in the Mediterranean during the 20th century was quite similar to the average global rise in sea level of 0.5–2.5 mm / year. This trend, however, has not been consistent throughout the course of the century. Few studies shows two completely different sea level trends over last century (Klein & Lichter, 2009; אלמגור & פרת, 2012). In addition to the unavoidable dangers associated with flooding the lowlands along coastal areas, sea level rise can also cause beach erosion, salt penetration into freshwater aquifers and other damage to the coastal environment (Lichter, et al., 2010). The expected economic impact

of maintaining the current level of operation of Israeli marine infrastructures along Mediterranean coastline as a result of sea- level rise is approximately US$200 million and US$500 million, for 0.5 m and 1 m sea-level rise, respectively (Zviely, et al., 2015).

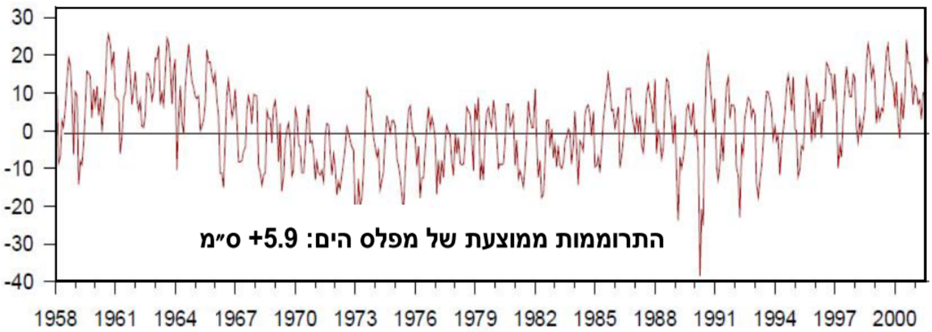


Figure 7: Sea level changes based on Jaffa and Ashdod tide gauge stations records 1958-2000. (אלמגור & פרת, 2012). Y axis in cm.

3. **Increase of sea surface temperature** – Several studies have shown that the surface temperature of the Mediterranean Sea has increased over the past 3 decades. In study of Pastor (2018), a consistent warming trend has been found for daily sea surface temperature data series derived from satellites (1982–2016) for the whole Mediterranean region and for different temporal scales, from daily to monthly, seasonal and decadal estimates (Pastor, et al., 2018). For instance, (Nykjaer, 2009) in a study covering the period 1985-2006 noticed that sea surface temperature in upper layer has been increasing at an average rate of 0.03±0.008 C $yr^{-1}$ for the western basin and 0.05±0.009 C $yr^{-1}$ for eastern basin. Additional study (Shaltout & Omstedt, 2014) covering the period of 1982-2012 founded similar average SST by 0.035±0.0070 C $yr^{-1}$. The Levantine sub-basin is initially warmer and current warming process at a much higher rate compared to the entire Mediterranean Sea (Pastor, et al., 2018; Shaltout & Omstedt, 2014). Such increase of SST and marine heatwaves (Jacox, 2012) significantly impact on marine biota (Marbà, et al., 2015) and seagrasses and microalgae that playing important role in marine ecology (Koch, et al., 2013) in Levant region.
4. **Increase of air temperature** – Israeli summers are getting warmer and winters are colder. The increase in the summer minimum temperature is more pronounced than the increase in maximum temperature, while the decrease in maximum temperature in winter is greater than the decrease in minimum. The result of these changes is a decrease in the daily range of air temperature in both seasons (Ben-

Gai, et al., 1999). Such temperature increase and change in daily range potentially could lead width range of impact on human health (IPCC, 2014, 2018). A popular and one of the most famous examples of such changes in the temperature regime is the European summer of 2003 with average temperature 3.50 C above normal, caused the death of approximately 22,000 to 45,000 over two weeks (International Federation of Red Cross and Red Crescent Societies, 2004). However, in some cases, the relationship between temperature and the development of contagious diseases, human migration, local land use changes is not strongly correlated, although in some cases a positive relationship is found (Patz, et al., 2005).

5. **Impact on GDP** - Global warming with no state action will led to decrease of GDP. There have been relatively few attempts to examine the full global, disaggregated, and intertemporal effects of climate change on GDP using large-scale economic modeling. Based on large-scale economic model is fully disaggregated with forward-looking behavior, spanning across 139 countries and 57 broad commodity groups, with full computational convergence over a period of 200 years (See table 1 and 2). As a numerical modeling, this model shows the potential economic benefits of following the Paris Climate Agreement (Kompas et al., 2018)

Table 1: Impacts of Global Warming (3∘C) of neighboring countries of Israel on the World GDP (%Change/Year) (Kompas et al., 2018).

| Year | Saudi Arabia | Egypt | Israel | Iran | Jordan | Greece | Cyprus | Turkey |
|---|---|---|---|---|---|---|---|---|
| 2027 | −0.378 | −0.354 | −0.198 | −0.167 | −0.158 | 0.108 | 0.025 | 0.007 |
| 2037 | −0.831 | −0.714 | −0.410 | −0.350 | −0.342 | 0.2 | 0.042 | −0.008 |
| 2047 | −1.332 | −1.086 | −0.632 | −0.558 | −0.555 | 0.281 | 0.049 | −0.045 |
| 2067 | −2.422 | −1.867 | −1.102 | −1.047 | −1.052 | 0.402 | 0.024 | −0.180 |

Table 2: Long-Run Impacts of Climate Change Scenarios of neighboring countries of Israel on the World GDP (%Change/Year) (Kompas et al., 2018).

| Country | Saudi Arabia | Egypt | Jordan | Iran | Israel | Turkey | Cyprus | Greece |
|---|---|---|---|---|---|---|---|---|
| 10C | −1.650 | −1.083 | −0.982 | −0.894 | −0.743 | −0.342 | −0.194 | −0.048 |
| 20C | −3.457 | −2.377 | −1.998 | −2.044 | −1.514 | −0.842 | −0.462 | −0.149 |
| 30C | −5.449 | −4.000 | −3.254 | −3.516 | −2.317 | −1.540 | −0.816 | −0.275 |
| 40C | −7.773 | −6.143 | −4.835 | −5.365 | −3.416 | −2.479 | −1.481 | −0.708 |

These and other effects of climate change are having a serious and ongoing impact on Israel's maritime security through aspects such as the water sector, agriculture, health, biodiversity, coastal and urban environments, in addition to their geostrategic and environmental and social impacts. In 2009, Israel's government prepared a national climate change policy and action plan that include both mitigation and adaptation measures. In the wake of the decision, an Israeli Climate Change Information Center (ICCIC) was set up by the Ministry of Environmental Protection in 2011 to compile the existing knowledge in Israel and abroad, to identify knowledge gaps, and to submit recommendations to the government on national and local adaptation measures. Based on the findings, developed recommendations on a climate change adaptation plan for Israel, on both the national and local levels (ICCIC, 2014). In light of the high importance of the sea to the state of Israel, the development of a similar plan is required that will cover the vital aspects of maritime security in Israel and provide a clear plan of action at the state level.

## Conclusions and Recommendations

This paper gained feed official strategic documents, which aim to increase awareness but also propose and apply management and mitigation measures towards reducing risks for Israeli Maritime Security. Climate change will also hit neighboring countries, some of which have little ability to cope with these problems due to development and governance difficulties. Israel must also be prepared in this context, such as:

1. Climate refugees
2. Marine pollution originating outside the waters of Israel.
3. Agriculture degradation and political instability

Under this context, the potential socio-economic, environmental and health impacts at local, regional and global scales should receive considerable attention by Israeli decision makers based on scientist findings. There is a consensus on the need to deepen the understanding of the links between climate change effects and threats to maritime security and human health, but it remains to be seen how existing knowledge on the interplay between climate change and maritime security should be translated into Maritime Geostrategy of Israel.

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