THE BRITANNIA GROUP WHITE PAPER

CLIMATE CHANGE

SEVERE WEATHER AND ITS IMPACT ON SHIPPING RISKS

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CLIMATE CHANGE

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OUR PARTNER FOR THE ISSUE

TRIGLAV Maritime

Triglav Maritime provides bespoke, comprehensive consultancy services focusing on risk management, loss prevention, as well as marine vetting and assurance matters.

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Capt. Ostrowicki provides expert advice on risk management and safety management processes. In addition to marine incident and claim investigations, he performs management reviews, ISM and TMSA audits and in-depth risk assessments through data analysis. He has also authored several publications.

INTRODUCTION

DUE TO THE IMPACT OF CLIMATE CHANGE, THE FREQUENCY AND SEVERITY OF EXTREME WEATHER EVENTS IS CONTINUING TO INCREASE.

As weather patterns change, locations and seasons during which these events are likely to occur are becoming hard to predict.

Climate change leads to abrupt, unpredictable, and cascading impacts, resulting from complex interactions between natural and human-induced factors which are driving it.

It is necessary to recognise it as an ongoing and evolving challenge that requires comprehensive and proactive responses. For this, the maritime industry needs to build resilience and be prepared to mitigate the increased risks and the associated costs.

SEVERE WEATHER

ACCORDING TO THE BROAD DEFINITION[1], ***SEVERE WEATHER IS ANY ASPECT OF THE WEATHER THAT POSES RISKS TO LIFE OR PROPERTY AND REQUIRES TAKING MEASURES TO MINIMISE LOSS BY MITIGATION AND AVOIDANCE.***

At sea, severe weather refers to extreme meteorological phenomena characterised by hazardous conditions and potentially dangerous impacts on maritime activities, ships and crews. It encompasses a range of adverse weather conditions that pose risks to navigation safety, maritime operations and the wellbeing of persons at sea. Examples of severe weather events affecting shipping include:

- **Storms and tropical storms (also called typhoons and hurricanes)**: Severe storms at sea are characterised by strong winds and turbulent seas. They can cause significant damage to ships, infrastructure, and coastal areas, posing risks to maritime safety and navigation. Tropical storms are amongst the deadliest weather events, historically resulting in thousands of lives lost at sea[2].
- **Rough seas**: Rough seas are characterised by large waves and/or swell, resulting from high winds, storm surges or ocean currents. Rough seas can cause vessels to pitch, roll, and heave, increasing the risk of structural damage, cargo shifting, cargo loss and onboard injuries.
- **High winds**: Strong winds can create hazardous conditions for vessels, leading to reduced manoeuvrability, increased risk of capsizing, and difficulty maintaining course and speed. In addition to open sea, they may also contribute to incidents involving ships in ports, canals and waterways.
- **Rogue waves (extreme storm waves)**: Unusually large and unpredictable waves that can be extremely dangerous to ships. They may be steep-sided, greater than twice the size of the surrounding waves, and come unexpectedly from directions other than prevailing wind and waves[3]. As they are rare and difficult to measure, their existence was questioned until the first measurement obtained in 1995 at the Draupner platform in the North Sea. The "Draupner wave" measured 25.6 metres, more than twice as tall and steep as its neighbours. It is now believed that rogue waves are more frequent than previously believed and there could be as many as ten rogue waves forming in the world's oceans at any given moment[4].

SEVERE WEATHER (continued)

- **Heat waves**: Described also as 'extreme heat', heat waves are prolonged periods of abnormally hot weather (compared with the normal climate pattern in the area), typically associated with stationary or slow-moving high-pressure weather systems. Heatwaves exacerbate many types of risk, such as health-related, operational, technical and economic. Their impact has always been substantial but has notably increased in recent years[5]. In addition to their direct effect on ships, cargo, crew and ports, extreme heat can increase the risk of other types of disasters, such as wildfires, and have a cascading effect on supply chain disruptions.
- **Marine heat waves**: Unlike heat waves on land, marine heat waves can persist for many weeks or months, extend over much larger areas and may warm the ocean to depths of hundreds of metres. Their frequency has doubled since 1982[6]. In addition to their increasing impact on marine life (and the resulting social implications and economic losses), marine heat waves contribute to tropical storms through increased evaporation and increase the likelihood of extreme weather events.

Overall, severe weather at sea encompasses a range of hazardous conditions and meteorological phenomena that require careful monitoring, risk assessment, and response measures to ensure maritime safety and mitigate potential impact.

Whilst none of the above phenomena are new, their impact on the shipping industry is likely to evolve and increase due to climate change.

SHIPPING INDUSTRY AND **SEVERE WEATHER**

THE SHIPPING INDUSTRY IS HEAVILY DEPENDENT ON WEATHER CONDITIONS DUE TO THE INHERENT RISKS ASSOCIATED WITH MARITIME OPERATIONS.

Weather influences various aspects of shipping activities, including navigation, route planning, cargo handling and crew safety. This dependence underscores the importance of proactive risk management, contingency planning and continual adaptation.

Sadly, there are many examples of severe weather contributing to serious incidents resulting in loss of life and ships. Some of them led to introducing new regulatory requirements and industry practices as lessons were learned. Examples of these widely publicised incidents include:

- The grounding of the container ship Ever Given in 2021, which resulted in the obstruction of the Suez Canal was attributed to high winds during a sandstorm as one of the direct causes. Although there were no casualties, this incident had a considerable economic impact and resulted in very large claims.
- Sinking and the loss of 33 crew members of the cargo ship El Faro (2015), where the key causes included a failure to avoid the tropical storm and handle the ship against it, whilst relying on outdated weather sources[7]
- Sinking of the ferry Estonia (1994) with the loss of 852 lives, attributed to the failure of bow door and ramp in heavy weather[8]
- Sinking of the OBO carrier Derbyshire during Typhoon Orchid in 1980 with the loss of 44 lives, caused by water ingress to forward section of the ship, ultimately resulting in structural failure. Subsequent investigations indicated that the ship may have encountered a super rogue wave[9]

With climate change, the risk of severe weather-related incidents increases if a shipowner is not duly prepared.

Historically, the shipping industry has developed various strategies and practices to mitigate the risks presented by severe weather. Risk mitigation strategies for severe weather apply to the following, general areas:

- **NAVIGATION AND ROUTE PLANNING**
  Mariners rely on ship routeing, meteorological and hydrological data, and weather forecasts to plan safe and efficient routes, avoiding areas prone to severe weather and adverse sea conditions. Route optimisation and severe weather avoidance (reflecting the ship and cargo properties) play a key role in preventing losses and delays.

  The established ship routeing practices reflect the knowledge of weather and hydrological phenomena built over decades, or even centuries, including patterns such as seasonal winds and typical tracks of low-pressure systems and storms.

- **VESSEL STABILITY**
  Severe weather, including high wind, rough seas, and heavy swell, can affect vessel stability, potentially leading to a loss of control, listing or capsizing. Both intact and where applicable, damage stability requirements have been included in international conventions and reflected in Flag State regulation. Ship design, stability calculations, and operational practices are optimised to ensure that ships can safely withstand a range of weather conditions and maintain stability in adverse seas.

  Ships stability failure in severe sea conditions are associated with the loss of stability in waves, parametric rolling, surf-riding and broaching-to, as well as a dead ship condition[10]. It should be noted that some of the phenomena which contributed to cargo damage or loss were recognised and addressed in the past (e.g. by the International Maritime Organization's "Revised Guidance to the Master for Avoiding Dangerous Situations in Adverse Weather and Sea Conditions" MSC.1/Circ.1228) but continue to become ever more relevant due to the evolution of ship size and design.

- **CARGO HANDLING AND STOWAGE**
  Weather conditions influence cargo handling operations, including loading, stowage and securing cargo onboard ships. Severe weather, in particular rough seas can pose risks to cargo safety. These risks are managed by the regulation and industry practice relevant to the type of cargo, whether liquid bulk, solid bulk, break bulk/general cargo or containers. Cargo stowage plans are developed to minimise the risk of shifting cargo, structural damage, and loss overboard during adverse weather conditions. It should be noted the safe stowage practices for every ship and every cargo have their limitations. For example, the existing requirements of the "Code of Safe Practice for Cargo Stowage and Securing" (CSS Code) - applicable to **all cargoes other than bulk** - are closely related to accelerations and forces acting on a ship in a seaway. In turn, the measures applicable to the stowage and securing of cargo should be based on the most severe weather conditions which, based on experience, may be expected for the intended voyage. In Annex 13, the CSS Code warns that in the case of roll resonance with amplitudes exceeding 30°, the limits of transverse acceleration may be exceeded, and that effective measures should be taken to avoid this condition.

  In heavy weather, **solid bulk cargoes** present risks resulting from

shifting or liquefaction / dynamic separation.

Bulk cargo shifting may occur where the cohesive strength of the solid bulk cargo is insufficient to withstand the effects of ship's transverse motion (rolling). It should be noted that the International Maritime Solid Bulk Cargoes (IMSBC) Code in section 5.4.3. stipulates that non-cohesive bulk cargoes having an angle of repose less than or equal to 30° should be carried according to the provisions applicable to the stowage of grain cargoes (which typically flow freely and have angle of repose around 20°).

In turn, liquefaction or dynamic separation may occur in solid bulk cargoes which are prone to it and have sufficiently high moisture content, as well as particle size distribution which does not allow the moisture to drain freely. Heavy weather may become a factor because of ship's motion on the cargo.

Liquid bulk cargoes may also be affected in severe weather, due to sloshing if loaded with ullages outside the acceptable limits. Sloshing can result in severe structural damage to the ship, which may lead even to loss of structural integrity and leakage. Sloshing damage may also affect ships such as membrane LNG carriers, where it can be very costly and difficult to repair.

Heat waves present challenges when maintaining cargo quality during transport. Perishable goods, such as flowers, pharmaceuticals and agricultural products transported in temperature-controlled conditions may be affected by equipment issues, delays or supply chain disruptions. Cargo packaging may also be affected by heat and lose its protective properties e.g. due to warping or melting of plastic, and in result expose delicate cargo to damage. Furthermore, electronics transported by sea (both finished products and components) may be highly sensitive to heat and require adequate packaging and storage conditions.

The risk of damage to agricultural cargoes may also increase in extreme heat, for example with soybeans in bulk. This highlights the need to adhere to the good industry practice, in particular cargo ventilation requirements. It is also worth noting that for some cargos like soybeans, the combination of high temperature and moisture content may significantly reduce the allowable storage time.

Marine heat waves may, among others, lead to algal blooms and dieback of local seagrass and kelp species, which may in turn impact ship operation and waterway availability.

- **PORT OPERATIONS AND LOGISTICS**

Severe weather events can disrupt port operations, including vessel berthing, cargo handling, terminal operations as well as waterway blockages, such as the 2021 Suez Canal blockage. In turn this may result in berthing delays (and increased weather exposure to waiting ships), as well as in supply chain disruptions which may have a cascading effect on the ship and cargo, e.g. the increased risk of damage to perishable goods. It should be noted that ships experiencing severe weather in port are subject to increased risk of incidents, damage and/or additional costs related e.g. to tug assistance where required.

Compared with storms or high winds, heat waves present a different risk exposure in ports, associated with the strain on port infrastructure, as well as operational disruptions. As an example, machinery such as cranes, conveyors or forklifts can only safely operate in a certain

temperature range, beyond which it may be exposed to overheating, increased risk of technical failure, fire, as well as slower turnaround times, delays and stoppages.

It should be noted that the impact of a heat wave may be relatively larger in countries where mild weather typically prevails, and as such the infrastructure may not be sufficiently prepared to withstand extreme heat – compared with locations where such temperatures are not unusual.

Shipowners, operators, and port authorities should implement contingency plans and safety measures to mitigate the impacts of severe weather on ships, port infrastructure, vessel traffic, and supply chain logistics.

- **CREW SAFETY AND WELLBEING**

  Seafarers face a variety of safety risks during severe weather conditions, resulting from the ship motion, exposure to sea whilst working on open decks, as well as other types of personal injury where weather conditions could be one of the underlying causes.

  Heat waves may adversely affect the crew and third parties on board (such as stevedores). Protracted exposure to extreme heat may lead to heat injury or severe heat-related illness (such as heat stroke), as well as exhaustion, difficulty concentrating, confusion and potential loss of consciousness. Heat exposure may also aggravate several illnesses, for example kidney diseases.

  Finally, severe weather may also impact the crew wellbeing and in result indirectly contribute to incidents, for example due to lack of rest and fatigue.

  Shipowners and operators should implement safety protocols, training programs, and emergency response procedures to mitigate health and safety risks and ensure crew members are prepared to respond effectively to adverse weather events.

BRITANNIA P&I DEDICATED SEVERAL PUBLICATIONS TO THE AREA OF PREVENTION OF LOSSES IN SEVERE WEATHER, WHICH RE-ITERATE THE ESTABLISHED INDUSTRY PRACTICES:

Operational guidance on parametric rolling: Reducing Container Losses

Heavy Weather – Preventing Cargo Damage and Loss Webinar

Heavy Weather Leading to a Fatality BSafe Case Study

Heat Damage to Agricultural Cargoes on Board

Seasonal Cargoes: Brazilian Soybean, Wheat and Fertiliser

OUR UNDERSTANDING OF CLIMATE CHANGE IS CONTINUALLY EVOLVING.

The overwhelming extent of the change - characterised by many overlapping or cascading factors - limits our ability to exhaustively identify and assess the associated risks. As a result, some of these risks may remain underestimated until the change is recognised and researched.

The evidence is clear: according to the Intergovernmental Panel on Climate Change (IPCC) **"Sixth Assessment Report"** (2021)[5], ***the human-caused rise in greenhouse gases has increased the frequency and intensity of extreme weather events.***

TROPICAL STORMS

The main impact is from the increase in ocean temperatures and the associated higher moisture content in the air. Warm ocean water and high moisture content are two of the main ingredients required for tropical cyclones to form and further intensify to storm level[11].

Climate change affects not only tropical cyclones, but also large-scale climate patterns which influence their formation – such as El Niño and La Niña in the Pacific Ocean, Saharan dust emissions etc.

The following changes are occurring, or are likely to occur due to climate change[12]:

- **Global tropical cyclone intensities are expected to increase** on average by 1% to 10%. This change will likely lead to an even larger increase in the destructive potential per tropical storm.
- **The probability of rapid intensification** of tropical cyclones is also projected to increase.
- **Increase of the proportion of tropical storms that reach the highest Categories 4 and 5** on Saffir-Simpson hurricane wind scale. Extending the scale has been recently proposed (see paragraph below).
- **More locations will become affected by tropical storms:** increasing sea surface temperatures are likely to cause the areas where the tropical cyclones form to extend further from the equator. Observations already show a poleward shift in the latitude of maximum intensity of tropical cyclones in the northwest Pacific basin.
- **More intense rainfall** is also predicted to increase the destructive potential of tropical storms, with a higher risk of coastal flooding due to storm surges.

  Researchers have recently proposed adding a new category to the Saffir-Simpson hurricane wind scale. According to the research, the current highest, catastrophic Category 5 is not sufficient anymore and may lead to an underestimation of risk[13]. Due to global warming, storm intensities continue to increase. According to the proposal, the particularly destructive Typhoon Haiyan (2013) does not appear to be an isolated case anymore and wind speed records will likely continue to be broken. The proposal suggests cutting off Category 5 at the sustained wind speed of 86 m/s (167 kts, 309 km/h), and including Category 6 above that.

  The proposed extension of the Saffir-Simpson hurricane wind scale is a strong example of the escalating weather hazards resulting from climate change. Only five tropical storms since 1980 would be qualified as Category 6 under the proposal, and all of them occurred in the last 9 years.

STORMS

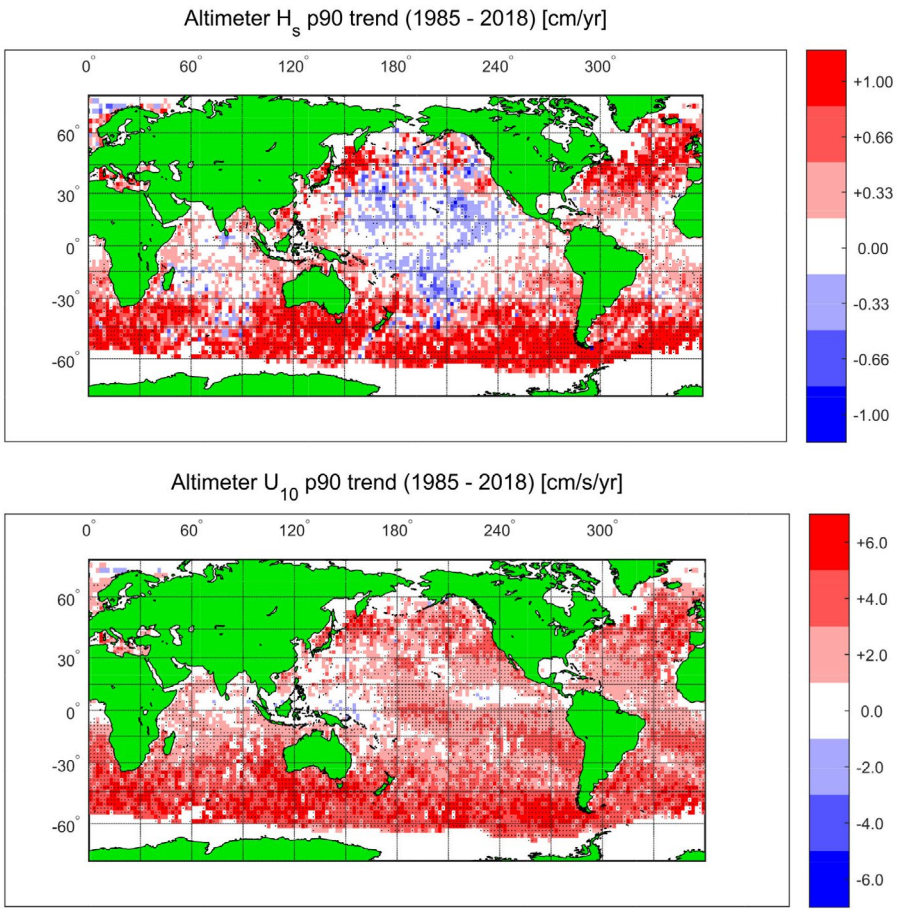
Climate change also affects other storms, not classified as tropical. The disruption of weather patterns has resulted in the following, observable changes[14]:

- Alteration of typical storm tracks: since the 1990s, there has been a poleward shift (a shift further north or south) in the storm tracks
- Mean significant wave height (SWH) has reduced in some areas (e.g. north of the United Kingdom), whilst it has increased in other (e.g. south of the UK). It is expected that the most severe waves will increase in height, whilst there could be an overall reduction in mean SWH, e.g. in the North Atlantic.

The practical consequence is that if/when ships do encounter storms, they may be more severe and follow tracks different to those experienced before. This introduces an increase in storm unpredictability, which further highlights the need to implement appropriate risk mitigation.

ROUGH SEAS: WIND, WAVES AND SWELL

Expected changes in waves, wind and swell are expected to have the largest impact on shipping, compared with other phenomena (such as rainfall). Research shows that the speed of extreme winds, as well as the height of extreme waves has increased across various ocean regions. For example, in the Southern Ocean extreme waves have increased by 5% in the last 30 years. The picture below provides visual reference of the global increase in extreme wind speed (top) and extreme wave height (bottom), based on satellite measurements[15]:



Global trends in extreme (90th percentile) wind speed (top) and wave height (bottom) over the period 1985-2018. Areas which a red indicate increasing values, whereas blue indicates decreases.

While the 30-years increase may not seem like much, the actual effect over time on both shipping and coastal infrastructure is likely to have significant ramifications. As an example, the Norwegian ExWaCli project (Extreme Waves & Climate Change), which focused on the impact of climate change on wave conditions with respect to the classification rules, found that an increase of the significant wave height beyond 0.5 m in the North Atlantic would have a large impact on the current ship design practice.

ROGUE WAVES (EXTREME STORM WAVES)
The increase in storm intensity and changes to storm tracks is likely to lead to secondary effects, such as an increased frequency of rogue waves. The DNV GL position paper published in 2016 summarised the latest knowledge on rogue waves and discussed how to utilise this knowledge to improve the current ship design[16]. Rogue waves are currently not explicitly included in classification rules, due to the lack of consensus on the probability of their occurrence. According to DNV GL, taking rogue waves into account in the design and operation of ships may become an important part of adaptation to climate change.

EXAMPLE OF LESSONS ON ROGUE WAVES LEARNED BY OFFSHORE INDUSTRY:

The Draupner platform, on which the first recorded measurement of a rogue wave took place in 1995, had been designed to withstand a wave of 20 m (64 feet) with an estimated probability of occurring once every 10,000 years. The "Draupner wave" measured 25.6 m (85 feet), and it did not match any previous wave model[4]. Since then, it has become clear that rogue waves occur more frequently than originally thought. The operators of the Draupner platform, have since introduced an internal requirement that accounts for rogue waves[16].

HEAT WAVES (periods of abnormally hot weather) have significantly increased in frequency and impact. In all global warming scenarios, the highest increase of temperature of hottest days is projected in mid-latitude and semi-arid regions at up to twice the rate of global warming[5]. Due to the widespread impact on the population and infrastructure, heat waves have already resulted in national emergencies in several countries (for example, the United Kingdom in July 2022).

SEVERE WEATHER HAS ALWAYS BEEN ONE OF THE KEY FACTORS CONTRIBUTING TO CLAIMS.

Climate change exacerbates the impacts of severe weather on maritime risks. As the frequency and severity of heavy weather events continues to increase, so does the cost and complexity of incidents/claims where weather is a causal factor.

The changes to risk exposure will likely continue to occur across the board along with the increasing scale of severe weather events and the resulting disruption. This includes the following types of incidents/claims, which may be caused or exacerbated by severe weather:

- Damage or loss, deterioration, spoilage of cargo: Cargo damage is the key area of risk sensitive to severe weather events. As summarised above, the shipping industry has long-established risk mitigations for all types of cargo damage. However, these measures may require review and potentially introduce new practices and solutions, for example increasing the extent of temperature-controlled supply chain (which in turn may involve significant costs).
- Collisions, allisions, groundings and structural failures; general average liabilities. As extreme weather events increase in frequency and severity, these claims are likely to increase as ships become exposed to weather exceeding their operational or technical limits.
- Spills, hazardous material releases, environmental pollution incidents: Associated with the increased risk of collisions, groundings etc., the probability of spills and pollution incidents may increase correspondingly, and in turn may necessitate the review of regulation and good industry practice.
- Delays, performance claims, laytime disputes, and other resulting losses: Both ship/port operations and supply chain logistics have always been sensitive to severe weather. However, the scale of severe weather disruptions may reach a level at which they cascade and become difficult to mitigate with currently available resources and infrastructure. Claims resulting from laytime, and other contractual disputes may be the immediate effect of that disruption. The application of force majeure clauses to the consequences of extreme weather may also evolve.
- Damage to port infrastructure, terminals, and facilities: Port infrastructure damages resulting from extreme weather may indirectly contribute to or exacerbate other claims – such as damage to ships, issues with cargo storage and quality, or pollution allegations.
- Claims associated with towage and salvage: Severe weather may complicate or even prevent certain towage or salvage activities, such as bunker removal. In case of an extreme weather event, the risk of the operation becoming unsuccessful increases, along with the potential to generate further costs and even result in another incident/claim.
- Personal injury and crew claims: Severe weather has direct impact on personal safety and the likelihood of personal injury or death, as well as other indirect risks such as heat-related accidents.

Whilst these risks are not new, their evolution is not easy to predict due to the potential for cascading effects (e.g. of a global waterway blockage), as well as the presence of 'outliers' in the form of relatively rare but very large claims, which are characterised by low probability and high consequence. As weather has historically been a causal factor in many of these 'outliers', it can be reasonably expected to remain among the key causes.

Changes in weather patterns are therefore likely to introduce new challenges for underwriting, loss prevention and claims management, requiring P&I clubs to adapt their strategies and practices accordingly.

IT IS PERHAPS UNFORTUNATE THAT THERE IS NOT ONE SIMPLE ANSWER TO WHAT THE INDUSTRY STAKEHOLDERS NEED TO DO TO MINIMISE THE EVOLVING RISK.

In the long term, collaboration between industry stakeholders, flag state administrations, regulatory bodies, classification societies and scientific experts is essential to develop comprehensive solutions for managing the increasing impact of severe weather associated climate change. The ExWaCli project mentioned above is a good example of the foresight required to meet these challenges. Sharing of knowledge and risk mitigation practices should enable the industry to build the required resilience.

From the perspective of a shipowner or operator, the currently existing requirements set out by the International Safety Management (ISM) Code include the systematic review of companies' operations, activities and development of risk controls. Therefore, the risks associated with severe weather should already be covered to a satisfactory degree in guidance and procedures established in a ship's Safety Management System – relevant to the current exposure.

However, it is necessary to continually recognise and react to the change in risk exposure. The challenge to shipowners and operators will likely be presented by emerging or evolving risks they had not experienced before in their operational profile and/or trading area, and in result they have not developed sufficient organisational awareness of the risk and the required mitigation. For example, a local operator and their personnel may have experience in dealing with severe weather, but they may still need to adapt to the consequences of encountering a tropical storm as a new risk in their operational area.

This highlights the need to keep the systematic review up to date, as well as knowledge sharing so that hazards are identified, and risks competently assessed pro-actively (rather than in response to incidents or losses). Therefore, it is fundamental to build resilience in advance, preferably through a structured approach relevant to the business.

We have already outlined the strategies that the shipping industry has in place to manage the risks associated with severe weather. The key actions that shipowners, operators and seafarers should consider to track the effects of climate change and maintain the necessary risk perception may be summarised as follows:

- **ADAPT TO REGULATORY CHANGES**
  Monitor regulatory changes and participate in industry workgroups and other settings to maintain awareness of the evolving/emerging risks and forthcoming regulatory measures.
- **INDUSTRY BEST PRACTICE**
  Track and implement best industry practice relevant to severe weather. Consider participation in a relevant management self-assessment programme and utilise it to analyse and implement best practice guidance from other industry stakeholders.
- **OPTIMISE VOYAGE PLANNING, ROUTE OPTIMISATION AND OPERATIONS**
  Utilise advanced weather forecasting tools, routeing software and services, and real-time monitoring systems. Review the policies and procedures to avoid or limit exposure in high-risk areas prone to severe weather. If required, consider adopting flexible scheduling and alternative routes to minimise exposure to severe weather hazards.

- **INNOVATION AND RESEARCH**
  Incorporate climate resilience considerations[17] into ship design, construction, and operation. In addition, to ship design aimed to withstand severe weather events (stability and buoyancy, structural integrity, cargo securing, redundant systems and backup power etc.), these measures may involve improved ship routeing and monitoring, weather forecasting, and preventing cargo loss. Invest in research and innovation initiatives to develop and deploy new technologies, materials, and solutions for enhancing resilience to climate change and severe weather.

- **INFORMATION AND COMMUNICATION**
  Stay informed about emerging risks associated with extreme weather events and monitor the projections applicable to the trading area. Promote open communication and knowledge sharing between ships and shore management to support informed decisions in response to the evolving/emerging risks related to severe weather.

- **TRAINING AND RESOURCES**
  Ensure seafarers have the knowledge and resources required to deal with the evolving risks. Provide crew with training, education, and drills to enhance their preparedness and response capabilities during severe weather events. Use seafarers' feedback to improve their engagement; promote a culture of teamwork and continuous improvement.

- **EFFECTIVE RISK MANAGEMENT**
  Ensure that risk assessments for key operations are reviewed and kept up to date as needed. Utilise the available technology to support risk mitigation onboard ships.

  Diversify risk management strategies by implementing a combination of safety management, operational, and insurance-based measures to mitigate the evolving/emerging risks.

- **INVEST IN VESSEL RESILIENCE**
  Consider the availability of upgrades, retrofits, and enhancements to improve resilience to severe weather-related risks. This may include reinforcing hull structures, improving cargo stowage and securing, implementing the appropriate technical equipment and installing improved weather monitoring systems.

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