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CLIMATE CHANGE

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The ocean is critical in regulating the Earth's climate: it has absorbed 89% of the excess heat trapped inside the atmosphere since the 1970s, and every year absorbs at least a quarter of the carbon dioxide (CO_2) released by human activities.

The ocean's ability to absorb heat and CO_2 means that marine ecosystems, and the human activities within them, are particularly vulnerable to climate change. Rising sea level and temperatures, reduced pH values, changes in rainfall amounts and reduced sea ice coverage, among others, are all effects of the rising atmospheric greenhouse gas concentrations. These pressures have resulted in documented changes to marine ecosystems, for example in the distribution of species and the timing of key life stage events. Local and regional impacts can vary, and some regions are experiencing changes at a much faster rate (for example, in the Arctic Waters (Region I)). Climate extremes, such as marine heatwaves, storms and waves are also becoming more prevalent.

Increased atmospheric greenhouse gas concentrations and the related impacts on the marine environment are influenced by almost all socio-economic drivers and by a wide-ranging number of associated human activities, both on land and at sea.

Human activities in the marine environment and marine ecosystems will need to adapt to both the observed and anticipated changes. In addition, the coastal and marine environment offers opportunities for reducing anthropogenic greenhouse gas emissions, (e.g. through the production of offshore wind and wave energy), for protecting and restoring natural greenhouse gas sinks (such as blue carbon and sedimentary carbon) and for establishing anthropogenic carbon storage, often referred to as carbon capture and storage (CCS). These opportunities need to be fully explored and maximised to support climate action.

Since the industrial revolution, greenhouse gases emitted by human activities have caused the Earth's climate (the long-term average prevailing conditions) to change. These greenhouse gases have originated from the combustion of fossil fuels (such as coal, oil and gas) and from changes

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in agriculture, forestry and other land use. Greenhouse gases are effective at trapping the heat inside the Earth's atmosphere, like layers of blankets to keep your body warm on a cold night. This additional energy in the Earth system has led to global warming, with impacts for terrestrial environments and the ocean. The majority of this heat has been absorbed by the ocean, highlighting the importance of the ocean in regulating the Earth's climate.

In the ocean, climate change has led to warming, decreased oxygen concentrations, marine heatwaves and sea-level rise, with many further related impacts across marine ecosystems and the services they provide. Moreover, the excess CO2 released into the atmosphere by human activities is being drawn down into the ocean, leading to. Climate change is also triggering widespread change in the water cycle by changing the prevailing atmospheric conditions and causing changes to other parameters such as stratification and ocean circulation. Climate extremes, such as storms and waves are becoming more prevalent.

These changes in the physical and chemical conditions of the marine environment are affecting marine habitats and ecosystems across the OSPAR Maritime Area, although there are regional and local variations in these pressures. The root cause is global, but the effects, such as storms and floods or changes in rainfall, are felt at more local scales. There are also regional variations in the rate of change, for example the higher rates of sea temperature warming in Arctic Waters.

These localised effects can trigger changes in other regions. Some studies have suggested that losses of Arctic sea-ice may affect the position and strength of strong winds such as the polar vortex and the jet stream, which may then cause extreme weather at mid-latitudes.

Not all pressures are changing at the same rate across the OSPAR Maritime Area, and some regions are experiencing changes at a much faster rate (Arctic Waters). Changes in sea-level rise and in the frequency and intensity of the strongest storms may impact lower lying areas in OSPAR countries more significantly. The eventual climate risk, a combination of vulnerability and exposure, emerges on a much more local scale, requiring a national response.

Because of the connectivity between land and sea, land-based impacts may also lead to pressures on the coastal and marine environment, for example from intense rainfall events.