



# Climate change

## Appendix One: Direct Impacts



Image: Ian Kippax

## Appendix One: Direct Impacts of Climate Change

Climate Parameters		Climate Change Risks (Direct)			Impact on Maritime Heritage	
Greenhouse Gas Emissions		Melting of the cryosphere	Sea level rise	Coastal inundation (flooding)	Coastal erosion and loss, marine erosion and loss, and coastal damage	Increased need for often costly repairs and maintenance; loss of assets
					Permanent submersion of low-lying areas	
					Population migration	
				Disruption of communities, loss of rituals, and breakdown of social interactions		
				Sea-water incursion		
				Increased likelihood and impact of storm surges		

Greenhouse Gas Emissions	Global temperature change, including rise and increased fluctuations in the atmosphere, cryosphere, and oceans			Increased storminess and likelihood of storm surges		
				Tidal changes	Increased sub-marine corrosion	
				Changes in depositional processes		
		Atmospheric moisture change: changes to the global hydrological cycle and water availability	Precipitation changes	Increased winter precipitation	Increased rainwater penetration into historic buildings and vessels, sometimes affecting historic contents	
				Increased intensity of precipitation / increase in periods of intense precipitation		
				Increase in time / periods of wetness	Splitting, cracking, flaking, and dusting of materials and surfaces	
				Changes to relative humidity cycles		
				Increased inland flooding	Erosion of inorganic and organic materials due to floodwaters	

	Global temperature change, including rise and increased fluctuations in the atmosphere, cryosphere, and oceans			Changes in relative humidity			
				Increase in temperature fluctuations			Strain on materials due to increased seasonal temperature contrasts
				Increase in soil-moisture content	Changes in water-table levels and ground water change		Corrosion of metals
							Subsoil instability, ground heave, subsidence, loss of stratigraphic integrity due to cracking and heaving
							Eutrophication accelerating microbial decomposition of organics
		Physical changes to porous building materials and finishes due to rising damp					

				Other combined effects e.g. increase in moisture combined with fertilisers and pesticides	Damage due to faulty or inadequate water disposal systems; historic rainwater goods not capable of handling heavy rain and often difficult to access, maintain, and adjust
				Changes in soil chemistry	Crystallisation and dissolution of salts caused by wetting and drying affecting standing structures, archaeology, wall paintings, frescos and other decorated surfaces
				Changes in salinity of water bodies	
		Increase of diurnal and seasonal extreme weather events		Increase in snow loading	
				Increase in lightning episodes	

Greenhouse Gas Emissions		Increase in weather unpredictability		Changes to working seasons, last-minute changes reducing working hours and season length
		Changes to winds	Increase in high winds and intensity of winds, changes in directions of winds	Penetration of moisture into porous cultural heritage materials
			Changes in air circulation	Static and dynamic loading of historic or archaeological structures
				Structural damage and collapse
				Increased vulnerability of tall structures, such as masts
			Inches in wind-driven rain and sand and salt	Deterioration of surfaces of historic structures due to increased corrosion

	Global temperature change, including rise and increased fluctuations in the atmosphere, cryosphere, and oceans	Changes in Biogeography : changes in the distribution of animals, plants, and pathogens, including invasive species	Spread northwards of existing eco-species	e.g. Sub-species of marine borers such as Sheerness' North African Scorpion colony	Increased destruction of wooden structures - collapse of structural timber and timber finishes
			Increase in breeding seasons and population growth	e.g. For certain sub-species of marine borers such as Sheerness' scorpion population numbers	
			Introduction of other new species		
			Decline of native plant materials	Reduction in availability of native species for repair and maintenance of buildings	
			Increase in mould growth (due to temp. increase and humidity increase)		
			Proliferation of invasive (non- native) species		e.g. Clogging engines and

Greenhouse Gas Emissions					decreasing water depth		
			Changes in natural heritage and appearance of landscapes surrounding historic vessels and their associated infrastructure / which they are part of				
			Changes in traditional maritime livelihoods				
			Changes to lichen colonies on buildings				
		Changes to tourism season, including disruption and lengthening					Loss of income
		Disruption to staff, volunteers, and visitors					Loss of working hours, loss of income
		Heatwaves	Drought and Water Unreliability	Erosion			
			Salt weathering				
			Desertification	Impact on health of population			abandonment and collapse



Greenhouse Gas Emissions	Global temperature change, including rise and increased fluctuations in the atmosphere, cryosphere, and oceans		Fall in the water table		
			Change in water table chemistry		
			Increased fire risks		
		Changes in freeze-thaw and ice storms	Freeze-thaw / frost damage	Damage inside brick, stone, ceramics that have got wet and frozen within material before drying	
				Biochemical deterioration	
		Increase in wet frost			
		Overheating of structures / thermal stress		Changing 'fitness for purpose' of some structures. For example overheating of the interior of buildings can lead to inappropriate alterations to the historic	

			fabric due to the introduction of engineered solutions	
			Deterioration of facades due to thermal stress	
	Ocean acidification		Increased corrosion	
			Changes in bio-geographies	
	Destruction of the ozone layer	Increase in solar radiation	Increased fading, scorching, and associated sunlight issues	
	Increase in acid rain (change impact of precipitation)	Stone recession by dissolution of carbonates		
Blackening of materials				
Climate and environmental pollution acting together	Release / use of toxic pollutants, changes indisposition of pollutants	Including pollution from shipwrecks, which is being accelerated as they continue to corrode	Corrosion of metals	

	<p>Increase of plastic pollution, particularly from single-use plastics</p>	<p>Influence on bio-colonisation</p>	<p>Damage to ships through bio-colonisation and invasive species</p>	
	<p>Overfishing</p>	<p>Changes in biodiversity</p>	<p>Damage to ships and boats - engines, keels, rudders</p>	
<p>Other forms of Environmental degradation</p>				