Ocean and coastal regions under stress

The ocean covers nearly three quarters of the Earth's surface, contains 96% of its living space, provides around half of the oxygen we breathe, and is an increasing source of protein for a rapidly growing world population. However, human activity is having an impact on this precious resource on local, regional and global scales.

Over the coming decades and centuries, ocean health will become a direct consequence of increasing atmospheric CO2 concentrations. These changes will affect the ocean in ways that we are only beginning to understand. The ocean and atmosphere are closely connected, and the ocean is a major sink for atmospheric CO2.

Over the coming decades and centuries, ocean health will become a direct consequence of increasing atmospheric CO2 concentrations. These changes will affect the ocean in ways that we are only beginning to understand. The ocean and atmosphere are closely connected, and the ocean is a major sink for atmospheric CO2.

It is imperative that international decision-makers understand the fundamental and rapid change to ocean chemistry is likely to be more than the simple addition of each.

Imporantly and worthwhile, the "hot spots" of multiple stressors are likely to coincide with areas of nutrient-poor productivity and current supporting substantial fisheries and fishery-dependent communities in developing countries (see map).

The ocean covers nearly three quarters of the Earth’s surface, contains 96% of its living space, provides around half of the oxygen we breathe, and is an increasing source of protein for a rapidly growing world population. However, human activity is having an impact on this precious resource on local, regional and global scales.

Over the coming decades and centuries, ocean health will become a direct consequence of increasing atmospheric CO2 concentrations. These changes will affect the ocean in ways that we are only beginning to understand. The ocean and atmosphere are closely connected, and the ocean is a major sink for atmospheric CO2.
The ocean covers nearly three quarters of the Earth's surface, contains 96% of its living space, provides around half of the oxygen we breathe and is an increasing source of nutrients for a rapidly growing world population. However, human activity is having an impact on this precious resource on local, regional and global scales.

Over the coming decades and centuries, ocean health will become increasingly stressed by at least three interacting factors. Rising seawater temperature, ocean acidification and ocean deoxygenation will each cause substantial changes in marine physics, chemistry and biology. These changes will affect the ocean in ways that we are only beginning to understand.

Importantly and worryingly, these ‘hot spots’ of multiple stressors are likely to coincide with areas of high productive capacity, and thus supporting significant and diverse fisheries and economic productivity and sustainability.

The average acidity of the upper ocean has already declined by around 0.1 pH unit from the 1980s to the present day. If CO2 emissions continue at the current rate, if CO2 emissions continue at the current rate, the average acidity of the upper ocean will have increased by around 30% by the year 2100, and in some parts of the ocean it is already 0.3 pH units lower than it was in the 1980s. Importantly and worryingly, the impacts of ocean acidification and deoxygenation will be compounded by the warming of the ocean, which will make ocean acidification and deoxygenation much more severe. When CO2 enters the ocean it rapidly goes through a series of chemical reactions which increase the acidity of the surface seawater (lowering its pH). The reactions which increase the acidity of the ocean in this way are very rapid, and a large amount of CO2 is stored in the ocean as carbonate, bicarbonate and carbonate ions in seawater. However, the ocean can absorb only around 30% of the atmospheric CO2 that enters the ocean surface. The remainder is dissolved in the upper ocean, where it makes the ocean more acidic. Ocean acidification is directly caused by the increase of carbon dioxide (CO2) levels in the atmosphere, driven by human activity. Each year, the increase of CO2 levels in the atmosphere rapidly goes through a series of chemical reactions which increase the acidity of the surface seawater (lowering its pH). These reactions increase the acidity of the upper ocean, where it makes the ocean more acidic.

The average acidity of the upper ocean has already declined by around 0.1 pH unit from the 1980s to the present day. If CO2 emissions continue at the current rate, the average acidity of the upper ocean will have increased by around 30% by the year 2100, and in some parts of the ocean it is already 0.3 pH units lower than it was in the 1980s. Importantly and worryingly, the impacts of ocean acidification and deoxygenation will be compounded by the warming of the ocean, which will make ocean acidification and deoxygenation much more severe. When CO2 enters the ocean it rapidly goes through a series of chemical reactions which increase the acidity of the surface seawater (lowering its pH). The reactions which increase the acidity of the ocean in this way are very rapid, and a large amount of CO2 is stored in the ocean as carbonate, bicarbonate and carbonate ions in seawater. However, the ocean can absorb only around 30% of the atmospheric CO2 that enters the ocean surface. The remainder is dissolved in the upper ocean, where it makes the ocean more acidic. Ocean acidification is directly caused by the increase of carbon dioxide (CO2) levels in the atmosphere, driven by human activity. Each year, the increase of CO2 levels in the atmosphere rapidly goes through a series of chemical reactions which increase the acidity of the surface seawater (lowering its pH). These reactions increase the acidity of the upper ocean, where it makes the ocean more acidic.

The average acidity of the upper ocean has already declined by around 0.1 pH unit from the 1980s to the present day. If CO2 emissions continue at the current rate, the average acidity of the upper ocean will have increased by around 30% by the year 2100, and in some parts of the ocean it is already 0.3 pH units lower than it was in the 1980s. Importantly and worryingly, the impacts of ocean acidification and deoxygenation will be compounded by the warming of the ocean, which will make ocean acidification and deoxygenation much more severe. When CO2 enters the ocean it rapidly goes through a series of chemical reactions which increase the acidity of the surface seawater (lowering its pH). The reactions which increase the acidity of the ocean in this way are very rapid, and a large amount of CO2 is stored in the ocean as carbonate, bicarbonate and carbonate ions in seawater. However, the ocean can absorb only around 30% of the atmospheric CO2 that enters the ocean surface. The remainder is dissolved in the upper ocean, where it makes the ocean more acidic. Ocean acidification is directly caused by the increase of carbon dioxide (CO2) levels in the atmosphere, driven by human activity. Each year, the increase of CO2 levels in the atmosphere rapidly goes through a series of chemical reactions which increase the acidity of the surface seawater (lowering its pH). These reactions increase the acidity of the upper ocean, where it makes the ocean more acidic.

The average acidity of the upper ocean has already declined by around 0.1 pH unit from the 1980s to the present day. If CO2 emissions continue at the current rate, the average acidity of the upper ocean will have increased by around 30% by the year 2100, and in some parts of the ocean it is already 0.3 pH units lower than it was in the 1980s. Importantly and worryingly, the impacts of ocean acidification and deoxygenation will be compounded by the warming of the ocean, which will make ocean acidification and deoxygenation much more severe. When CO2 enters the ocean it rapidly goes through a series of chemical reactions which increase the acidity of the surface seawater (lowering its pH). The reactions which increase the acidity of the ocean in this way are very rapid, and a large amount of CO2 is stored in the ocean as carbonate, bicarbonate and carbonate ions in seawater. However, the ocean can absorb only around 30% of the atmospheric CO2 that enters the ocean surface. The remainder is dissolved in the upper ocean, where it makes the ocean more acidic. Ocean acidification is directly caused by the increase of carbon dioxide (CO2) levels in the atmosphere, driven by human activity. Each year, the increase of CO2 levels in the atmosphere rapidly goes through a series of chemical reactions which increase the acidity of the surface seawater (lowering its pH). These reactions increase the acidity of the upper ocean, where it makes the ocean more acidic.

The average acidity of the upper ocean has already declined by around 0.1 pH unit from the 1980s to the present day. If CO2 emissions continue at the current rate, the average acidity of the upper ocean will have increased by around 30% by the year 2100, and in some parts of the ocean it is already 0.3 pH units lower than it was in the 1980s. Importantly and worryingly, the impacts of ocean acidification and deoxygenation will be compounded by the warming of the ocean, which will make ocean acidification and deoxygenation much more severe. When CO2 enters the ocean it rapidly goes through a series of chemical reactions which increase the acidity of the surface seawater (lowering its pH). The reactions which increase the acidity of the ocean in this way are very rapid, and a large amount of CO2 is stored in the ocean as carbonate, bicarbonate and carbonate ions in seawater. However, the ocean can absorb only around 30% of the atmospheric CO2 that enters the ocean surface. The remainder is dissolved in the upper ocean, where it makes the ocean more acidic. Ocean acidification is directly caused by the increase of carbon dioxide (CO2) levels in the atmosphere, driven by human activity. Each year, the increase of CO2 levels in the atmosphere rapidly goes through a series of chemical reactions which increase the acidity of the surface seawater (lowering its pH). These reactions increase the acidity of the upper ocean, where it makes the ocean more acidic.

The average acidity of the upper ocean has already declined by around 0.1 pH unit from the 1980s to the present day. If CO2 emissions continue at the current rate, the average acidity of the upper ocean will have increased by around 30% by the year 2100, and in some parts of the ocean it is already 0.3 pH units lower than it was in the 1980s. Importantly and worryingly, the impacts of ocean acidification and deoxygenation will be compounded by the warming of the ocean, which will make ocean acidification and deoxygenation much more severe. When CO2 enters the ocean it rapidly goes through a series of chemical reactions which increase the acidity of the surface seawater (lowering its pH). The reactions which increase the acidity of the ocean in this way are very rapid, and a large amount of CO2 is stored in the ocean as carbonate, bicarbonate and carbonate ions in seawater. However, the ocean can absorb only around 30% of the atmospheric CO2 that enters the ocean surface. The remainder is dissolved in the upper ocean, where it makes the ocean more acidic. Ocean acidification is directly caused by the increase of carbon dioxide (CO2) levels in the atmosphere, driven by human activity. Each year, the increase of CO2 levels in the atmosphere rapidly goes through a series of chemical reactions which increase the acidity of the surface seawater (lowering its pH). These reactions increase the acidity of the upper ocean, where it makes the ocean more acidic.

The average acidity of the upper ocean has already declined by around 0.1 pH unit from the 1980s to the present day. If CO2 emissions continue at the current rate, the average acidity of the upper ocean will have increased by around 30% by the year 2100, and in some parts of the ocean it is already 0.3 pH units lower than it was in the 1980s. Importantly and worryingly, the impacts of ocean acidification and deoxygenation will be compounded by the warming of the ocean, which will make ocean acidification and deoxygenation much more severe. When CO2 enters the ocean it rapidly goes through a series of chemical reactions which increase the acidity of the surface seawater (lowering its pH). The reactions which increase the acidity of the ocean in this way are very rapid, and a large amount of CO2 is stored in the ocean as carbonate, bicarbonate and carbonate ions in seawater. However, the ocean can absorb only around 30% of the atmospheric CO2 that enters the ocean surface. The remainder is dissolved in the upper ocean, where it makes the ocean more acidic. Ocean acidification is directly caused by the increase of carbon dioxide (CO2) levels in the atmosphere, driven by human activity. Each year, the increase of CO2 levels in the atmosphere rapidly goes through a series of chemical reactions which increase the acidity of the surface seawater (lowering its pH). These reactions increase the acidity of the upper ocean, where it makes the ocean more acidic.
The ocean covers nearly three quarters of the Earth's surface, contains 96% of its living space, provides around half of the oxygen we breathe and is an increasing source of a growing world population. However, human activity is having an impact on this precious resource on a local, regional and global scales.

Over the coming decades and centuries, ocean health will become increasingly stressed by at least three interacting factors. Rising concentrations of carbon dioxide (CO2) in the atmosphere will lead to increased CO2 in surface seawater (lowering its pH). The ocean has already removed about 30% of anthropogenic CO2 emissions, despite a rate of sea rise seen for 60 million years.

Importantly and worryingly, “hot spots” of multiple stressors are likely to coincide with areas of economic productivity, currently supporting substantial fisheries and subsistence livelihoods in developing countries (see map).

In the future many parts of the ocean are likely to experience more than one of these stressors at the same time. The ocean itself is a naturally stratified system, with warmer and nutrient-poor upper layers and cooler and nutrient-rich deep waters. As warming occurs, there will likely be a more rapid increase in the number of “hot spots” of multiple stressors.
Ocean Stress Guide
What the ocean will experience this century without urgent and substantial reduction in greenhouse gas emissions.

Ocean acidification can reduce the ocean’s ability to absorb carbon dioxide from the atmosphere, as shown below. Major highlights to concern about the issues of multiple stressors and projected changes of ocean warming, acidification, and deoxygenation on ocean systems, which will occur in the coming decades in a high CO2 world.

Your awareness can make a difference
Following awareness raising concerning ocean acidification at the United Nations Framework Convention on Climate Change meetings (2009 - 2014) the international partnership for the Observation of the Global Oceans (IOGPO) with 16 partner institutes from 10 countries; Dr Patrizia Ziveri, patrizia.ziveri@uab.cat, http://medsea-project.eu
Mediterranean Sea Acidification in a Changing Climate 32 partner institutes from 10 countries; Dr Jean-Pierre Gattuso, gattuso@obs-vlfr.fr, http://epoca-project.eu
European Project on Ocean Acidification IAEA Peaceful Uses Initiative project, Ms Lina Hansson, L.Hansson@iaea.org
Plymouth Marine Laboratory
Scripps Institution of Oceanography at UC San Diego, OCEANA; 2015 6pp.
Plymouth Marine Laboratory, UK Ocean Acidification Research Programme, European Project on Ocean Acidification, Mediterranean Sea Acidification in a Changing Climate project,

Plymouth Marine Laboratory
Scripps Institution of Oceanography at UC San Diego, OCEANA; 2015 6pp.
Plymouth Marine Laboratory, UK Ocean Acidification Research Programme, European Project on Ocean Acidification, Mediterranean Sea Acidification in a Changing Climate project,

Partners

Message supported by

Hot, Sour & Breathless - Ocean under stress
How is the biggest ecosystem on Earth faring?

CONTINUING 90% OF THE LIVING SPACE ON EARTH  ●  HAS 80% OF EARTH’S LIVING ORGANISMS  ●  COVERS 71% OF THE EARTH  ●  ALMOST HALF OF THE OXYGEN WE BREATHE IS PRODUCED BY OCEAN PLANTS  ●  90% OF MARINE PRODUCTION 7 BILLION PEOPLE, WITH AT LEAST 4 BILLION PEOPLE, WITH AT LEAST 4 BILLION PEOPLE  ●  30% OF WORLD TRADE IS CARRIED ACROSS THE OCEANS  ●  HOLDS AN ESTIMATED 80% OF EARTHS MINERAL RESOURCES
Ocean Stress Guide

What the ocean will experience this century without urgent and substantial reduction in greenhouse gas emissions.

Your awareness can make a difference

Following warnings about upcoming issues and events at the United Nations Framework Convention on Climate Change meetings (2009-2015) the international partnership at the United Nations Framework Convention on Climate Change (UNFCCC) is now highlighting its concern about the impacts of the multiple and interacting stressors of ocean warming, acidification and deoxygenation on ocean systems, which will culminate in the coming decades in a high-CO2, warm world. This publication has received support from international organisations and programmes.

Please email fieldsupport@ocean.org for any further details.

Ocean Stress Guide

What the ocean will experience this century without urgent and substantial reduction in greenhouse gas emissions.

Your awareness can make a difference

Following warnings about upcoming issues and events at the United Nations Framework Convention on Climate Change meetings (2009-2015) the international partnership at the United Nations Framework Convention on Climate Change (UNFCCC) is now highlighting its concern about the impacts of the multiple and interacting stressors of ocean warming, acidification and deoxygenation on ocean systems, which will culminate in the coming decades in a high-CO2, warm world. This publication has received support from international organisations and programmes.

Please email fieldsupport@ocean.org for any further details.

Ocean Stress Guide

What the ocean will experience this century without urgent and substantial reduction in greenhouse gas emissions.

Your awareness can make a difference

Following warnings about upcoming issues and events at the United Nations Framework Convention on Climate Change meetings (2009-2015) the international partnership at the United Nations Framework Convention on Climate Change (UNFCCC) is now highlighting its concern about the impacts of the multiple and interacting stressors of ocean warming, acidification and deoxygenation on ocean systems, which will culminate in the coming decades in a high-CO2, warm world. This publication has received support from international organisations and programmes.

Please email fieldsupport@ocean.org for any further details.

Ocean Stress Guide

What the ocean will experience this century without urgent and substantial reduction in greenhouse gas emissions.

Your awareness can make a difference

Following warnings about upcoming issues and events at the United Nations Framework Convention on Climate Change meetings (2009-2015) the international partnership at the United Nations Framework Convention on Climate Change (UNFCCC) is now highlighting its concern about the impacts of the multiple and interacting stressors of ocean warming, acidification and deoxygenation on ocean systems, which will culminate in the coming decades in a high-CO2, warm world. This publication has received support from international organisations and programmes.

Please email fieldsupport@ocean.org for any further details.

Ocean Stress Guide

What the ocean will experience this century without urgent and substantial reduction in greenhouse gas emissions.

Your awareness can make a difference

Following warnings about upcoming issues and events at the United Nations Framework Convention on Climate Change meetings (2009-2015) the international partnership at the United Nations Framework Convention on Climate Change (UNFCCC) is now highlighting its concern about the impacts of the multiple and interacting stressors of ocean warming, acidification and deoxygenation on ocean systems, which will culminate in the coming decades in a high-CO2, warm world. This publication has received support from international organisations and programmes.

Please email fieldsupport@ocean.org for any further details.

Ocean Stress Guide

What the ocean will experience this century without urgent and substantial reduction in greenhouse gas emissions.

Your awareness can make a difference

Following warnings about upcoming issues and events at the United Nations Framework Convention on Climate Change meetings (2009-2015) the international partnership at the United Nations Framework Convention on Climate Change (UNFCCC) is now highlighting its concern about the impacts of the multiple and interacting stressors of ocean warming, acidification and deoxygenation on ocean systems, which will culminate in the coming decades in a high-CO2, warm world. This publication has received support from international organisations and programmes.

Please email fieldsupport@ocean.org for any further details.

Ocean Stress Guide

What the ocean will experience this century without urgent and substantial reduction in greenhouse gas emissions.

Your awareness can make a difference

Following warnings about upcoming issues and events at the United Nations Framework Convention on Climate Change meetings (2009-2015) the international partnership at the United Nations Framework Convention on Climate Change (UNFCCC) is now highlighting its concern about the impacts of the multiple and interacting stressors of ocean warming, acidification and deoxygenation on ocean systems, which will culminate in the coming decades in a high-CO2, warm world. This publication has received support from international organisations and programmes.

Please email fieldsupport@ocean.org for any further details.

Ocean Stress Guide

What the ocean will experience this century without urgent and substantial reduction in greenhouse gas emissions.

Your awareness can make a difference

Following warnings about upcoming issues and events at the United Nations Framework Convention on Climate Change meetings (2009-2015) the international partnership at the United Nations Framework Convention on Climate Change (UNFCCC) is now highlighting its concern about the impacts of the multiple and interacting stressors of ocean warming, acidification and deoxygenation on ocean systems, which will culminate in the coming decades in a high-CO2, warm world. This publication has received support from international organisations and programmes.

Please email fieldsupport@ocean.org for any further details.

Ocean Stress Guide

What the ocean will experience this century without urgent and substantial reduction in greenhouse gas emissions.

Your awareness can make a difference

Following warnings about upcoming issues and events at the United Nations Framework Convention on Climate Change meetings (2009-2015) the international partnership at the United Nations Framework Convention on Climate Change (UNFCCC) is now highlighting its concern about the impacts of the multiple and interacting stressors of ocean warming, acidification and deoxygenation on ocean systems, which will culminate in the coming decades in a high-CO2, warm world. This publication has received support from international organisations and programmes.

Please email fieldsupport@ocean.org for any further details.

Ocean Stress Guide

What the ocean will experience this century without urgent and substantial reduction in greenhouse gas emissions.

Your awareness can make a difference

Following warnings about upcoming issues and events at the United Nations Framework Convention on Climate Change meetings (2009-2015) the international partnership at the United Nations Framework Convention on Climate Change (UNFCCC) is now highlighting its concern about the impacts of the multiple and interacting stressors of ocean warming, acidification and deoxygenation on ocean systems, which will culminate in the coming decades in a high-CO2, warm world. This publication has received support from international organisations and programmes.

Please email fieldsupport@ocean.org for any further details.