

Kiel Declaration on Ocean Deoxygenation

Participants of the international conference

“Ocean Deoxygenation: Drivers and Consequences – Past – Present – Future”,

3 – 7 September 2018 in Kiel, Germany organized by:

Kiel Collaborative Research Center SFB 754 and Global Ocean Oxygen Network (GO₂NE – IOC-UNESCO)

The ocean is losing its breath

Oxygen in the ocean supports the largest ecosystems on the planet. It is alarming that the ocean is losing oxygen, termed ocean deoxygenation, primarily due to global warming by greenhouse gas emissions and pollution by nutrients and organic wastes, particularly in coastal waters. We call on all nations, societal actors, scientists and the United Nations to:

- (a) Raise global awareness about ocean deoxygenation through local, regional and global efforts, including interdisciplinary research, innovative outreach, and ocean education.
- (b) Take immediate and decisive action to limit pollution and in particular excessive nutrient input to the ocean.
- (c) Limit global warming by decisive climate change mitigation actions.

Both the Paris Agreement addressing Climate Change and the United Nations' 2030 Agenda for Sustainable Development demand conservation and sustainable use of the ocean, seas and marine resources in order to safeguard ocean ecosystems and their current and future societal benefits. These are severely threatened by ocean deoxygenation.

Scientists assembled at the conference and from around the world agree that:

1. During the past 50 years oxygen-depleted waters have expanded four-fold. Some areas of the ocean have lost up to 40% of their oxygen.
2. The ongoing loss of oxygen from the ocean is a rapidly increasing threat to marine life, the ocean's ecosystems and coastal communities.
3. Global warming impacts ocean oxygen in two ways: the capacity to hold oxygen decreases in warming waters, whilst warming reduces ocean mixing and circulation limiting the supply of oxygen from the atmosphere. Pollution by nutrients and organic waste enhances oxygen demand by increasing biological production and oxygen consumption during decomposition.
4. Deoxygenation disrupts marine ecosystems, affects fish stocks and aquaculture and leads to loss of habitat and biodiversity. It can, in extreme cases, lead to the production of toxic gases when all oxygen in the water has been lost.
5. Deoxygenation can accelerate global warming via enhanced marine production of greenhouse gases under low oxygen conditions.
6. The problem of deoxygenation is predicted to worsen in the coming years under continued global warming and increasing nutrient input to coastal regions as human populations and economies grow.
7. Expanded observation is immediately required for accurate documentation and prediction of ocean oxygen changes, and for improved understanding of its causes and consequences.
8. Strategies to slow and eventually reverse deoxygenation and its ecological impacts need to be co-developed between science and societal actors. This will contribute to the UN Decade of Ocean Science for Sustainable Development.

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