Scientific leaflet

Blue Carbon: Carbon Storage in Coastal Ecosystems

What is "blue carbon"?

The term "blue carbon" elucidates the importance of marine ecosystems for our climate. Coastal ecosystems such as mangrove forests, seagrass meadows and salt marshes store particularly large amounts of carbon and are therefore often referred to as "blue carbon ecosystems". The carbon is absorbed by marine organisms, especially plants, and is primarily bound in the sediments. Since climate-damaging greenhouse gases can be removed from the atmosphere in this way, these reservoirs are also known as carbon sinks. Although there is not yet a standardised scientific definition of the term “blue carbon,” it is becoming increasingly important in international climate policy and is being discussed in connection with the (voluntary) carbon market, among other things. Here, emission credits from carbon storage are used to offset unavoidable greenhouse gases.

What role do natural carbon reservoirs play in climate protection?

In order to achieve the climate targets set by the parties to the Paris Agreement, Germany and the EU must significantly reduce emissions of climate-damaging greenhouse gases. At the same time, emissions that cannot be avoided, for example from agriculture, must be removed from the atmosphere and stored for the long term.

Ecosystems can absorb and bind carbon through their plants. These natural reservoirs, also known as natural sinks, include forests, soils, peatlands and the coastal ecosystems mentioned above. In greenhouse gas balances, the storage potentials from land use and forest management are summarised under the abbreviation LULUCF, i.e. land use, land use change and forestry.

What carbon storage capacity do coastal ecosystems have?

Seagrass meadows, mangrove forests and salt marshes can store up to 216 million tonnes (Mt) of carbon dioxide per year worldwide. Over centuries to millennia, they form an enormous carbon reservoir in the marine sediment of up to 22,000 Mt of carbon. Seagrass meadows, which occur on almost all coasts in water depths of one to three metres, can store around 75 to 150 Mt of carbon in the plants alone over this long period of time; in addition, they store up to 8,400 Mt of carbon in organic compounds in the sediments on the seabed.

Mangrove forests in the tropics and subtropics are adapted to the rising and falling water levels with the tides and can store 1,200 to 3,900 Mt of carbon in their biomass and up to 8,400 Mt in the marine sediment. Salt marshes, i.e. areas in northern latitudes that are exposed to high and low tides, can store a total of up to 1,350 Mt of carbon.

How well-researched are the carbon storage potentials of natural sinks?

The data situation and potential of natural sinks are still insufficiently researched in many cases and are subject to many uncertainties. For example, a global average value for annual carbon storage in mangroves does not necessarily reflect the carbon storage capacity that actually occurs locally. This is because the amount of carbon and the length of time for which it can be absorbed and stored by plants depends on many local conditions such as soil quality, climatic factors and the intensity of human disturbance. In addition, carbon fluxes have not yet been well researched in all ecosystems and regions of the world. Examples of this are the changes in carbon fluxes when paludicultures –

plants that grow on wet peatlands – are cultivated on peatland soils or when a salt marsh has been restored.

Nevertheless, in March 2023, the German government adopted the Action Program Natural Climate Protection (ANK) to protect natural ecosystems. The program contains a broad range of measures, including the increase of their carbon storage capacity. However, the action areas of the ANK still remain vague in many cases; conflicts over the use of land, for example with agriculture, are still unresolved in many places.

What contribution does Oeko-Institut's study "Potential of blue carbon for global climate mitigation" make to the scientific debate?

Our study titled "Potential of blue carbon for global climate mitigation" provides an overview of the use of the term "blue carbon" in the scientific literature and in international reports. From this, the experts derive a working definition of blue carbon and define criteria for measures that increase the carbon storage of marine ecosystems. They summarise the positive contributions and limitations of blue carbon for global climate protection and critically discuss the role it can play in international climate policy. The researchers analyse how blue carbon storage can currently be mapped in greenhouse gas inventories according to the rules of the Intergovernmental Panel on Climate Change (IPCC) and make recommendations for the future handling of the recording and accounting of blue carbon emissions.

Information on the client and the research partners

The study was carried out in collaboration with the Leibniz Centre for Tropical Marine Research (ZMT) on behalf of the German Environment Agency. Oeko-Institut led the project and was responsible for the content of the report. Chapters 1, 2, 4 and 6 were written by Oeko-Institut's experts. The ZMT was responsible for Chapter 3 of the report and is leading the second work package in the overall project.

Further information from Oeko-Institut on the climate protection potential of natural sinks:

"Not without trees - Natural carbon sinks for climate protection" – from Oeko-Institut's online magazine 1/2024

The webpage The role of natural sinks for climate neutrality and the associated short expert report on natural sinks and the potential of natural ecosystems to avoid greenhouse gas emissions and store carbon by Oeko-Institut (both in German)

Study on climate protection measures in the LULUCF sector (in German)

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