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REVIEW

Halocarbon emissions from marine phytoplankton and climate change

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Abstract Long-lived and short-lived halocarbons have long been known for their adverse effects on atmospheric chemistry, especially ozone depletion that may be directly or indirectly influenced by global climate change. Marine organisms including phytoplankton contribute shorter-lived halocarbon compounds to the atmosphere. Oceans cover more than 70% of the Earth's surface making the marine phytoplankton a significant presence. Changes in the environment will inevitably affect this widely distributed group of organisms. Various predictions have been made about how phytoplankton will respond to climate change, but as yet little is known about the interactions between phytoplankton, climate change and halocarbon emissions. We provide a summary of studies on halocarbon emissions by marine phytoplankton isolated from different climatic zones that includes data from our recent studies on tropical marine phytoplankton. It is important to determine and characterize the contribution of the phytoplankton to the halocarbon load in the atmosphere to allow their interaction with the changing global climate to be understood. Using these data, we compare the range of halocarbons emitted by phytoplankton with halocarbon emission data for seaweeds, a well-known biogenic contributor of short-lived halocarbons. Sørensen's coefficient of similarity of 0.50 was calculated, which suggests that half of the detected halocarbon species present in seaweeds are also present in phytoplankton.

Keywords Marine halocarbons · Phytoplankton · Biogenic sources · Climate change · Ozone depletion

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Introduction

The group of halogenated compounds known as halocarbons have received less attention for their contributions to climate change than other greenhouse gases such as carbon dioxide, methane and nitrous oxide. Once in the atmosphere halocarbons give rise to bromine, chlorine and iodine radicals that can cause the catalytic destruction of ozone, resulting in increased penetration of harmful UV radiation to the Earth's surface. Most of the long-lived halogenated compounds are derived from man-made chemicals, while marine biogenic sources such as phytoplankton and the macroalgae (seaweeds) are the main contributors of the shorter-lived compounds to the atmosphere. Phytoplankton are distributed throughout the euphotic zone of all of the Earth's aquatic environments, while the macroalgae are mostly found in the littoral zone of rocky coastlines. Recent successes in using algae as feedstocks for biofuel, industrial biomaterials and biopharmaceuticals have initiated large-scale mass cultivation of both the micro- and macroalgae.