



# The effect of desiccation on the emission of volatile bromocarbons from two common temperate macroalgae

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**Abstract.** Exposure of intertidal macroalgae during low tide has been linked to the emission of a variety of atmospherically-important trace gases into the coastal atmosphere. In recent years, several studies have investigated the role of inorganic iodine and organoiodides as antioxidants and their emission during exposure to combat oxidative stress, yet the role of organic bromine species during desiccation is less well understood. In this study the emission of dibromomethane ( $\text{CH}_2\text{Br}_2$ ) and bromoform ( $\text{CHBr}_3$ ) during exposure and desiccation of two common temperate macroalgae, *Fucus vesiculosus* and *Ulva intestinalis*, is reported. Determination of the impact exposure may have on algal physiological processes is difficult as intertidal species are adapted to desiccation and may undergo varying degrees of desiccation before their physiology is affected. For this reason we include comparisons between photosynthetic capacity ( $F_v/F_m$ ) and halocarbon emissions during a desiccation time series. In addition, the role of rewetting with freshwater to simulate exposure to rain was also investigated. Our results show that an immediate flux of bromocarbons occurs upon exposure, followed by a decline in bromocarbon emissions. We suggest that this immediate bromocarbon pulse may be linked to volatilisation or emissions of existing bromocarbon stores from the algal surface rather than the production of bromocarbons as an antioxidant response.

## 1 Introduction

Seaweeds in intertidal habitats exhibit zonation patterns influenced by multiple abiotic and biotic factors. This includes the ability to tolerate desiccation during tidal emersion, which tends to determine the upper shore limit of a species. Tidal variations in exposure are natural and to survive in the intertidal region sessile organisms, including seaweeds, have evolved mechanisms to withstand the rapid fluctuations in temperature, light, salinity and nutrient availability that occur in the intertidal region. Studies have shown that seaweeds grow faster when continually submerged compared to those that are exposed during the daily tidal cycle (Williams and Dethier, 2005) strongly suggesting that emersion causes a metabolic cost to the algae. A common physiological response to stress is an increase in reactive oxygen species, ROS, and if these are produced at a rate faster than the alga can quench them this can lead to oxidative stress (Lesser, 2006). Variation in environmental conditions during exposure may also combine to enhance the impact on the algae. For example, a reduction in photosynthesis due to inorganic carbon limitation and damage to photosystem II (PSII) reduces the energy available to regenerate antioxidants (Burritt et al., 2002), thereby hindering the response to oxidative stress and reducing the ability to cope with prolonged desiccation.

Desiccation may form part of post-harvest processing for both wild and farmed seaweed species as in some cases biomass is left to dehydrate before further processing. As this process often occurs in the open potential emissions of