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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Spectroscopic studies of molecular iodine emitted into the gas phase by seaweed" *by* S. M. Ball et al.

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We thank the referees for their helpful suggestions for improving the manuscript, for their judgement that this work makes an important contribution to understanding I2 emission from seaweed species, and their recommendations that the work now be published in ACP.

Referee #1.

With hindsight, there are parts of the manuscript that could have been written more succinctly. Therefore we have deleted 9 lines of text from Section 2.3 concerning the theory of DOAS spectral fitting (which is adequately covered by the references) and made corresponding minor adjustments to the remainder of this section. We have also

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deleted the majority of the text about the Leigh et al 2009 ACPD paper from the fourth subsection of the Conclusions (lines 9-23 deleted on p26361). However, we note that Roscoff RHaMBLe was the first field deployment of this particular BBCEAS instrument and the first demonstration anywhere of LED-BBCEAS being used to detect molecular iodine (Andy Ruth's group had previously used the related IBBCEAS technique, but with significant technical differences). Because there is no separate instrument paper to reference, we prefer to retain the detailed instrument description and discussion of the highly quantitative nature of the I2 determinations.

We agree with Referee #1 that I2 emission rates could potentially depend on the surface area of the seaweed exposed to air/ozone. In future, it would be interesting to measure emission rates per unit surface area (in addition to mass) in order to gain extra knowledge about the I2 emission mechanism. For the present work, we choose to report emission rates per unit mass (fresh weight) because mass was a very convenient metric for our samples. Field surveys of seaweed biomass also commonly report results in units of kg per square metre geographical area (e.g. Golléty et al., J. Phycol. 44, 1146-1153 (2008) and Gévaert et al., J. Sea Res., 60, 215-219 (2008)), and reporting our I2 emissions normalised to the plants' mass(es) aided the use of these data in modelling atmospheric I2 concentrations observed during the RHaMBLe campaign (Leigh et al. ACPD this special issue). From a practical perspective, a key aim of the incubation experiments was to perform measurements on whole plants in order to most closely mimic natural conditions, and it is not obvious how one could accurately determine the surface area of a whole plant of one of the highly structured species such as a Fucus. We admit that we ought to have noted the dimensions and hence surface area of the flat, rectangular fragments or entire thallus of Laminaria digitata, but omitted to do so. However there are complicating factors even in this most favourable case. For example, the blade's thickness depends on the age of the plant. Additionally, the laminae are narrow and thickened in plants growing at exposed sites, whereas at sheltered sites the blades are wider and thinner. Such relationships mean that the surface area to volume ratios of plants is not a conserved quantity, and the consequence

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this has for I2 emission rates remains a topic for further study.

We thank the referee for drawing our attention to the recent paper by Huang et al. This paper appeared in ACPD in January 2010, whereas our discussion paper was submitted in November 2009. We now include a reference to Huang's work in the list of ambient I2 observations cited in the Introduction (p26334, line 3). We have also added the following sentence in Section 4.2 where we discuss how I2 emission rates are affected by ozone: "Very recently, Huang et al (2010) observed increased emissions of I2 with increasing ambient ozone mixing ratios from seaweeds growing in situ in Mweenish Bay on the west coast of Ireland, nearby Mace Head (here the dominant species are A. nodosum and F. vesiculosus)."

The referee is quite right that nucleation kinetics depend in complex ways on, amongst other parameters, the production rate of condensable gases from their precursors and the time allowed for the particles to grow to detectable sizes. We apologise if inadvertently we have placed too much emphasis on the threshold behaviour and linear dependence of particles on I2 mixing ratio when discussing the main features of Figure 5 et seq. To counter this, we have adjusted the final sentence of the first paragraph of Section 4.3 and added some further text: "Non-linear processes in the iodine oxidation chemistry....expected to further amplify the effects that biological variability in I2 emissions exert on particle formation rates. Similarly, the precise details of threshold behaviour for nucleation, the values of the threshold I2 concentrations and the linear (or otherwise) relationship between I2 mixing ratios and particle numbers depend in complex ways on experimental conditions (e.g. the photolysis rate of I2 and thus the flux of I atoms, the time allowed for the particles to grow before detection, etc). Whilst a thorough understanding of the nucleation mechanism ought to be able to reproduce experimental observations, the observations themselves are properties of the experimental system and are thus not directly relevant to particle nucleation under ambient conditions, except for refining nucleation theory.

Referee #2

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The authors were delighted by the enthusiastic endorsement from Referee #2. We have made three of the four minor modifications as requested:

p26344, line 3: “by” inserted in “are characterised by an immediate”

p26350, line 1: “the physiological function of iodine is different. . .”

p26365, line 14: corrected the spelling of Laminaria in the Palmer (2005) reference.

We have checked the main text carefully, but cannot find any occurrence of “Laminaria” or “Fucus” without their upper case first letters. However, there are instances of lower case names in the references, but here we have retained the form of the title in the original papers.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 26329, 2009.

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