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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Direct evidence for coastal iodine particles from Laminaria macroalgae - linkage to emissions of molecular iodine" *by* G. McFiggans et al.

G. McFiggans et al.

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Firstly, apologies for incorrectly replying to referee 1's comments in this slot. Please find the following in response to referee 2.

The authors would like to thank the referee for the interesting alternative perspective and stimulating thoughts on the manuscript. The referee has identified the key issues concerning marine iodine cycling.

As outlined in our response to Dr MalinŠs comment:

... the particle burst phenomenon is only observed at low tide when Laminariales are fully exposed to the air. I agree entirely with the referee and Dr Malin that molecular iodine (and indeed HOI) will likely rapidly react with DOM when the kelps are sub-

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merged and that they are only fully exposed infrequently. This is borne out by the lack of particles formed in the experiments exposing submerged specimens to ozone. The vast majority of iodine emitted by the kelp beds will therefore not be available to the atmosphere as molecular iodine. However, the coastal low tide atmospheric molecular iodine that is observed is the source of the new ultrafine particles, even if itŠs not the major fate of the iodine emitted from Laminaria the most of the time.

This somewhat skirts the thorny issue. There are three important unanswered questions:

i) are the coastal new particles regionally or globally significant? ii) are new particles formed as a result of deeper macroalgal or open ocean microalgal iodine emissions? and related to ii) iii) what are the fates and atmospheric implications of open ocean iodocarbon emissions.

Whilst this manuscript aims to explore the mechanisms of coastal particle formation and start to answer question i), much further work is required to address all three issues in any way more meaningful than speculation.

We do not dispute any of the statements made by referee 2 on this matter, but consider that it is beyond the scope of this preliminary study to address these questions. The authors certainly intend to pursue the answers and encourage further work in this area. Large scale field, laboratory and modelling studies are required to scratch the surface of this field more deeply. An additional section 7 has been added to the manuscript to outline these issues, but can only weakly address them.

Concerning the technical corrections:

We seek advice from the ACP office as to whether Figure 2 requires modification Ű the original figure is perfectly legible on screen and in print. It may be more to do with the conversion by ACP.

The caption to Figure 7 has been modified. The colour plots are available in the web

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version, and as ACP is an online journal I would presume are available to most readers. A reformatted version is available if this is not the case.

Methodology: What is a typical day/night cycle? Specify. Add more details:

The samples were exposed to a 16 hour light, 8 hour dark cycle. No attempt was made to match the spectral signature of the lamp and ambient daylight. The coldroom light took a normal tungsten filament bulb. The manuscript has been modified.

How were the macroalgae sampled? The holdfast was prised from the rock to which it was fastened by hand (with significant removal of skin from knuckles and loss of blood). This was done snorkelling off the rocks at Mace Head and in the Swillies in the Menai Straits and smaller samples were collected from the shoreline near Dunstaffnage.

Time between sampling and conducting the experiment? The Mace Head experiments were conducted between five minutes and two days of cropping. There was no discernable difference with storage time. The UMIST experiments were conducted over a period of several months. There was no significant difference in results until the samples had visibly deteriorated (more than two months after cropping).

Storage of the macroalgal samples until the experiment was conducted? For the Mace Head experiments the samples were kept in a covered bucket in coastal water. For the UMIST experiments, they were kept in 40L plastic containers in seawater from the location they were cropped for transportation. The seawater from Dunstaffnage was filtered, from the Menai Straits unfiltered. The coldroom storage at 276K in the light cycle described above was used to store them at UMIST.

Size and age of the macroalgae samples? The samples ranged from 15 to 20 cm for Dunstaffnage Laminaria saccharina samples up to 1.5 m for Menai Strait Laminaria hyperborea. Age undetermined.

Were whole plants or parts of the macroalgae investigated? Whole plants and cut strips of frond, but normally whole plants.

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Was the algal tissue damaged during the sampling procedure? Normally not. Obviously if cut fronds were used, the fronds were cut. There was no discernable difference in particle generation response between the cases.

Did the algal tissue changed colour or was damaged during the experiment? Under extreme experiments, many hours of exposure to high ozone concentrations, repeated over several days, there was discolouration and dryness. In most experiments though, there was no visible discolouration or damage.

The particle formation response was very robust and repeatable irrespective of storage conditions or apparent condition of the specimens. This may be illustrated by the fact that dried dead Laminaria japonica species bought from a health food shop, when rehydrated, gave a strong particle formation response. The difference between this and live samples, was that the response did not recover when left between ozone exposures.

We thank the referee for bringing the perspective of a macroalgal biologist to the consideration of this manuscript.

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 939, 2004.