Response to comments by Anonymous Referee #1

This manuscript is concerned, in general terms, with trying to understand and model the observed iodo emissions from ocean surfaces. As such it is interesting, and certainly takes an ambitious stance. However, as written, it is two quite different papers, put together into a single MS. The two - a laboratory exploration of the influences exerted by various parameters on the emission, and a modelling study, using a new parameterization of HOI and I2 emissions - are quite unconnected in almost every way. I suggest they be disentangled, and published separately.

RESPONSE: We thank Referee #1 for his comments. However, we strongly disagree with the statement that the two parts of the paper are "unconnected in almost every way". The objective of our paper is to report a parameterisation of the inorganic iodine flux from the ocean surface based on laboratory experiments where a wide range of environmentally relevant variables have been considered, and showing that this parameterisation yields reasonable estimates of the reactive iodine mixing ratios when compared with a dataset spanning a wide range of oceanic conditions. The referee has provided no substantial comments to back up his/her suggestion of splitting the paper in two. We would therefore prefer to keep the structure of paper as submitted.

Some comments I can make on the MS follow.

Page 31448, lines 20-21: I think you must assume the I2 is at its equilibrium vapour pressure here. This should be made explicit, as well as any checks done to ensure this was so.

RESPONSE: Yes, it is assumed that the I_2 is at its equilibrium vapour pressure. The iodine crystals within the cell were allowed to equilibrate for some time before the experiments were started, and it was established that the entraining flow of N_2 was sufficiently slow to ensure that evaporation of I_2 was fast enough to maintain the equilibrium vapour pressure.

Change in p. 31448, l. 19-21: "The experimental setup was calibrated using a known flow of I_2 vapour, produced by passing N_2 through a glass trap containing solid I_2 (Sigma Aldrich) in equilibrium with its vapour phase, for each of the light sources used."

Page 31449, lines 17-19: What absorption coefficient(s) and wavelengths were used to extract the [HA] from the absorbance?

RESPONSE: Extinction coefficients and molecular weight are not available for HA; instead a specific absorbance (SUVA) value for humic acid of 5 L mg^{-1} m^{-1} at 254 nm was used (Weishaar, J. L.; Aiken, G. R.; Bergamaschi, B. A.; Fram, M. S.; Fujii, R.; Mopper, K. Evaluation of specific ultraviolet absorbance as an indicator of the chemical composition and reactivity of dissolved organic carbon. Environ. Sci. Technol. 2003, 37, 4702–4708.) Absorption due to HA at 254 nm was ~0.1 therefore, this gives a DOC concentration of ~2 mg L^{-1}.

Change in p. 31449, l. 18: "The concentration of humic acid was determined by UV/Vis spectroscopy to be around 2 mg dm^{-3}, using a specific absorbance of 5 L mg^{-1} m^{-1} at 254 nm (Weishaar et al., 2003)".

Page 31450, lines 3-8: Please either show the trace impurity result, or state quantitatively how much I2 was associated with the impurity in the NaCl.

RESPONSE: <50 x 10^{-9} M iodide so at least 20 times smaller than the concentration used in the salinity experiments. The equivalent in terms of I_2 flux would be < 6 x 10^8 molecule cm^{-2} s^{-1} at 0.5 M NaCl, i.e. well within experimental error (±4 x 10^9 molecule cm^{-2} s^{-1}).

Change p 31450, l. 8: "The equivalent in terms of I_2 flux would be < 6 x 10^8 molecule cm^{-2} s^{-1} at 0.5 M NaCl, i.e. well within experimental error (±4 x 10^9 molecule cm^{-2} s^{-1})."

line 21: the monolayer-forming conc for SDS seems very high.

RESPONSE: This concentration (6.2 mM) was taken from the reference cited (Hore et al. 2005) "SDS (Aldrich) was dissolved in 18.2 MΩ Nanopure water to achieve a bulk concentration of 6.2 mM. At this concentration, a well-ordered monolayer forms at the interface." They also reference Gragson et al. 1997 (J Am Chem Soc) who gave bulk concentrations necessary to form a well-ordered monolayer ranging from 4-8 mM SDS.

Page 31451: How did the results of experiments done with the different photolysis sources compare? What was the advantage of having the 3 sources?

RESPONSE: The three sources showed varying detection limits (hence the necessary changes in the O_3 concentration used). The tungsten lamp showed high sensitivity for I_2 but did not allow measurements of HOI. The xenon lamp was used for measurements of HOI, however, the sensitivity and selectivity using this light source was poor and therefore the laser was employed to measure I_2 and HOI independently.

Change p. 31448, l. 19 (experimental section): "The tungsten lamp showed high sensitivity for I_2 but did not allow measurements of HOI. The xenon lamp was used for measurements of HOI, however, the sensitivity and selectivity using this light source was poor. The laser was employed to measure I_2 and HOI independently and enabled high sensitivity for both species and back-to-back operation."

Page 31452, line 20-21: I think it was Tobias and Jungwirth who should be credited here.

RESPONSE: This information was taken from the Gladich et al. (2011) reference cited. We have added the reference to Tobias and Jungwirth, 2006.

Page 31454, lines 20-25: I do not follow how a lack of T-dependence gives rise to an activation energy, as proposed here.

RESPONSE: The lack of temperature dependence applies only to the I^- + O_3 reaction, the overall temperature dependences are for the flux of HOI and I_2 out of solution. These arise from the various temperature dependences of parameters in the model, including the respective Henry's law constants, diffusion constants, mass transfer velocities etc.

Page 31456, line 1 AND Fig 5: Could there be 2 different dependences here?

RESPONSE: Note first that the open ocean surface iodide concentrations plotted in Fig. 5 are sparse, were recorded in separate cruises at different locations and different seasons of the year, and span more than 2 decades. The variability of iodide may result from a number of different processes which are not fully understood. However, a clear pattern emerges when plotting the available open ocean iodide concentration data vs. SST or latitude. In particular ln(SSI) vs 1/T provides a convenient parameterization which accounts for this general trend. An upcoming paper by Chance et al. (submitted) discusses the global ocean iodide field in detail.