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Interactive comment on "A machine learning based global sea-surface iodide distribution" *by* Tomás Sherwen et al.

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The paper describes compilation of a global ocean water Iodide climatology applying a machine learning approach that combines a compilation of Iodide observations and other climatologies on parameters such as SST, nitrate, radiation to explain these observations. This compilation of a global ocean water Iodide climatology is of large relevance for large-scale studies on air quality, atmospheric chemistry and climate interactions given the role of ocean Iodide in emissions to the atmosphere affecting atmospheric composition and also involving some potentially relevant feedback mechanisms. Overall the paper is well written and presents a sound approach to provide a new dataset to be further applied in Earth system studies and fits within the scope of ESSD. Consequently, I recommend publication of this manuscript in ESSD after the

following generally minor comments have been addressed. Note that, since I am not experienced with machine learning methods, my comments are mostly limited to the context of the presented work and the description of the main results coming out of this approach.

Abstract: "simple functions of sea-surface temperature (Chance..)"; I would leave out here the references (generally not included in abstract) and rather state that: "have generally fitted sea-surface iodide observations to relatively simple functions using iodide proxies such as nitrate and sea-surface temperature"

Page 2: line 4, "..oxygen level."

Page 2: line 10: I am generally not keen on calling for inclusion of references to my work but since this reference is already included in this ms, the study by Ganzeveld et al. (2009) was also mainly aiming to assess the role of Iodide as one of main reactants in oceanic O3 deposition and the resulting impacts on atmospheric composition.

Page 2, line 16: "catalytically destroy ozone (Chameides and Davis, 1980)." Here it would be interesting to add here that this thus mechanisms thus implies the presence of a negative feedback mechanism involving this O3 and Iodide chemistry as also being assessed in a modelling study by Prados Roman et al. (2016)

Page 4, line 7/8: "they need to be available at an appropriate resolution as a gridded product"; here it would be useful to indicate an estimate of this required resolution given the (known) scale of the heterogeneity in the distribution of the parameters that potentially explain Iodide. For example, given the anticipated (large) contrasts between coastal and open ocean waters, what minimum resolution is needed?

Page 4; line 14: " This horizontal resolution was used as this is the highest resolution of the current generation of global atmospheric chemistry simulations (Hu et al., 2018)." Here it might be interesting to mention that this resolution of 12.5km also seems to be sufficient for application meso-scale meteorological – Air quality model studies used

for regional scale studies. We deploy for example now the meso-scale modelling system WRF-CHEM at a resolution of ∼20km, including a mechanistic representation of oceanic ozone deposition including Iodide reactivity.

Section 3.1: Not being very familiar with the application of machine learning methods, I really appreciate the explanation that this given on the specifics of the approach. There is still some terminology that would require further in-depth checking out the details of the followed approach but think that is a nice way to also explain it all to the readers mostly interested at the end in the final outcome of application of this methodology, the global Iodide dataset. Page 9, line 35: "...variability is both well constrained by observations. Some of the highest..."

Page 10, lines 12-14: " The new predicted values lay between Chance et al. (2014) and MacDonald et al. (2014) in the tropics, however, within the polar regions, the new prediction is significantly higher than both of the previous parameterisations." Not so much a comment but so this result is further stressing the need for additional measurements in the Arctic that we might now get with the upcoming MOSAiC field campaign.

Page 11, line 26/27: "A higher iodide sea-surface concentration would also result in a greater calculated ozone deposition (Luhar et al., 2017; Sarwar et al., 2016).". Here a reference to the Ganzeveld et al. 2009 paper would be really appropriate with this paper showing the first step to consider the impact of global Iodide distribution on global ozone deposition (and atmospheric ozone).

Page 11, line 31: "Considering that the average predicted concentration globally here is 106 nM (Sect. 4.2), these errors are notable"

Figure 6: here the observations are indicated by dots that are so small that you cannot see to what extent the inferred values compare to those observations. You could try to enhance the size of those dots.

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