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Emissions and Distribution of Reactive Iodine from Seaweed in Coastal Regions

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Emissions and Distribution of Reactive Iodine from Seaweed in Coastal Regions Reactive iodine species impact atmospheric chemistry in several ways. They play an important role in the process of ozone destruction at mid-latitudes and possibly in polar regions. Besides bromine, reactive iodine compounds also affect the atmospheric cleaning mechanisms by changing its oxidation capacity. Recent field studies indicate that reactive iodine may impact the local climate in coastal areas by playing a key role in the formation of new particles which could influence cloud micro physical properties. Particularly high concentrations of the reactive iodine are found at mid-latitude coastal sites, which are emitted by seaweed exposed to oxidative stress during low tide. However, previous measurements of iodine and iodine oxide have been performed only at very few sites, mainly at the atmospheric research station Mace Head located at the west coast of Ireland. Thus, there is still very limited knowledge on the involved seaweed species and their contribution to local, regional and global iodine emissions and also the potential iodine mediated particle formation. In order to investigate these questions, we performed extensive measurements at ten different sites along the west coast of Ireland in 2011 and 2012. We applied a mobile Long Path (LP)-DOAS for path averaged IO measurements and open path Cavity Enhanced (CE-) DOAS for IO in-situ measurements. Similar to LP-DOAS, open path CE-DOAS measures trace gases directly in the atmosphere. Additionally, another Long Path-DOAS system monitoring IO, OIO and I_2, was permanently located at Mace Head. This allows an inter-comparison of the different locations with the reference station Mace Head while respecting the influence of temporally varying meteorology. We observed significant differences to former investigations and conclusions. First, IO concentrations were much higher (typically factor of 10 and more) on every measuring site compared to Mace Head. IO levels up to 40 ppt were observed with LP-DOAS and 70 ppt at 1.3 m height with CE-DOAS. Second, we found out that *Laminaria digitata* is not a dominant iodine source to the atmosphere, while *Ascophyllum nodosum* due to its high abundance in the intertidal zone is by far the strongest source. Third, we observed also high IO levels above 30 ppt at rainy, cold and windy weather. Thus former observations that these emissions arise only at sunny and warm weather could not be confirmed. Fourth, we investigated that IO increases rapidly with decreasing distance to the emitting seaweed patches. Above the seaweed patches IO reaches concentrations much above 50 ppt which is sufficient to start particle nucleation events. We conclude that coastal seaweed emissions are thus much more relevant for the atmosphere than so far expected from previous observations performed at Mace Head which is rather characterized by low IO levels in comparison to other locations. Reasons and explanations for these findings will be presented. A review of the coastal seaweed iodine emissions and its influence on the atmosphere is thus urgently needed. In a third field study on the east coast of the New Zealand south island, for the first time high IO mixing ratios of up to 68 ppt were observed on a southern hemispheric coast. Four, previously uninvestigated, seaweed species were identified as emitters of reactive iodine species and emission rates were estimated. The observations in New Zealand showed also differences in the seaweed distribution to northern hemispheric locations which need to be considered in global estimates of coastal iodine emissions.