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Sources of Halogen Oxides Along the Coastline of New Zealand: A Field Measurement Study

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The 2006 WMO/UNEP Scientific Assessment of Ozone Depletion identified halogenated very short-lived substances (VSLS) as contributors to the atmospheric budget of halogens. As well, it raised a question regarding the extent of the contribution of halogenated VSLS to atmospheric Bry and Iy. Traditionally, scientists have been more concerned in determining the anthropogenic budget of halogenated compounds while nature is the major producer of such species. In order to have a complete atmospheric budget of halogenated VSLS, it is important to have a better understanding of what species are biogenically produced as well as their respective degradation pathways. Oceanic emissions of halocarbons may be a new link between climate change and the composition of the global atmosphere. The rates of halocarbon emissions are sensitive to sea-surface temperatures (SSTs), nutrient supply and upwelling; all of which are to be affected by climate change. Therefore, increases in SSTs will increase emission rates. On the one hand, seaweed has been identified as a major producer of biogenic polyhalogenated VSLS. Marine macroalgae (kelp) and phytoplankton emit halogen containing gases into the marine boundary layer, constituting 90 to 95% of the total global flux of volatile halocarbons to the atmosphere. On the other hand, the possibility of industrial scale marine kelp farming as a means of carbon sequestration (i.e. marine analogy of the Kyoto Protocol forest) is being pondered by countries with long coastlines and little land suitable for forestation. Would a Kyoto Protocol forest analog be the right strategy for climate change mitigation?

With the use of a portable Multi Axis Differential Optical Absorption Spectroscopy (MAX-DOAS) spectrometer, studies have been performed in the coast of New Zealand in order to determine the presence of BrO and IO during the spring and summer months of the Southern Hemisphere. MAX-DOAS uses scattered sunlight received from multiple viewing directions. The spatial distribution of various trace gases close to the instrument can be derived by combining several viewing geometries. Ground based MAX-DOAS is highly sensitive to absorbers in the lowest few kilometers of the atmosphere. The selected sites had high biomass concentration of marine algae that would be exposed by low tides and therefore, stressed in order to liberate the species of interest. In order to better understand the environmental factors that modulate the emissions of halogen oxides from the marine environment to the troposphere, results have been correlated to local macro algae type, ozone concentration, tidal height, incident sunlight, temperature and wind speed and direction.