1. Introduction
Ozone-depleting substances (ODIs) have both man-made and natural origins (Fig. 1)

2. Time trends of chlorinated gases from a firm air

3. VSL halogen contribution

4. Methyl halide emissions by the Brassica family

5. Growth in rapeseed production

6. Emissions of halogenated VSLS from tropical seaweeds

7. Conclusions

Potential for Future Threats to Ozone Recovery from ‘Short’ and ‘Very Short-lived’ Halocarbons

“Substantial uncertainties remain in quantifying the full impact of chloride- and bromine-containing VSLS on stratospheric ozone.”

UNEP “Scientific Assessment of Ozone Depletion: 2010” (WMO, 2011)

WMO (2011) states that VSLS gases currently contribute:

-80 (range 40-130) ppt of chlorine; and
1-8 ppt of bromine, equivalent to 65 - 480 ppt of Equivalent Effective Stratospheric Chlorine (EESC) assuming immediate release of halogens in the lower stratosphere.

-100 to -610 ppt (a mid-point value of 350 ppt); a substantial fraction of total EESC (Fig. 3)

Emissions of halogenated VSLS from tropical seaweeds

VSLS emissions from tropical seaweeds have been barely studied, but are pertinent to stratospheric EESC because of the potential for fast convective transport in this region.

Emission rates for some typical seaweeds in Malaysia are shown in Fig. 7, including a farm specimen of Kappaphycus: Caulerpopsis, Sargassum and Ulva are also potential commercial species. About 80% of seaweed cultivation in the tropics is of Kappaphycus spp. (Neish, 2003)

Production of tropical seaweeds is growing rapidly (Fig. 8) and total tropical seaweed production reached 200 kT dry weight (approx. 2,000 kT fresh weight) by 2007 (Phang et al., 2011)

We estimate seaweed biomass between 20 and 205 to be about 20,000 kT fresh weight (after Kappaphycus spp. to be about 20,000 kT fresh weight (after Baker et al., 2001), so present day levels of seaweed cultivation are already significant.

However, the contribution of VSLS from tropical seaweeds relative to mangroves, sediments, marine phytoplankton, etc., is presently unknown.

The Montreal Protocol does not account for the potential impacts of man-made and natural VSLS, nor short-lived halocarbons from cultivation practices.

There is evidence for increasing abundances of chlorinated VSLS, Future increases in halogenated short-lived gases and VSLS are possible due to economic and climate-related pressures.