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S.E. Asian emissions of ozone depleting substances observed from measurements in Taiwan

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Springtime measurements of long-lived ozone depleting substances (ODSs) were made in four successive years (2013 – 2016) at a number of locations in Taiwan. At this time of year the wind is predominantly from northerly and north-easterly directions, bringing air masses to Taiwan from mainland China, Korea and Japan, as well as from local sources. While some of the dominant ODSs (CFC-11, CFC-12) show little deviation from typical northern hemispheric background values, several others do during flow from these landmasses. These include ODSs that have only recently been identified at global "background" sites, and observed to be rising in abundance, such as CFC-113a and HCFC-133a. These two compounds exhibited a significant degree of covariation, while occasional elevated levels of CFC-113 were also associated with higher levels of the same. Evidence for emissions of CFC-114a was observed, but not CFC-114, suggesting an independent origin of the former. Substantially elevated mole fractions of many HCFCs were observed, notably HCFC-141b, HCFC-142b and HCFC-22. Elevated levels of some of the halon gases were noted, especially halon-1211 and halon 1202; but not halon-1301. Small enhancements of CCl4 were also observed.

Certain industrial processes may give rise to co-variations in some of the above species. In the manufacture of HFC-134a, for instance, CFC-113 is isomerised to form CFC-113a, then fluorinated to produce CFC-114a which is subsequently converted by hydrogenolysis to HFC-134a. In the manufacture of HFC-125, CFC-113, CFC-113a and HCFC-133a can all be produced as by-products. The former process would explain the apparent unique emission of CFC-114a, as opposed to CFC-114. In addition we observed correlation with somewhat elevated levels of CFC-115, which can be formed in the same process by over-fluorination. Previous measurements of H-1202 have suggested that this gas might also be an accidental industrial by-product; in this case from the manufacture of H-1211 from the over-bromination of HCFC-22. These newer measurements would not however, be consistent with such a source, and suggest an origin independent of the observed H-1211. Overall the observations in Taiwan point to continuing emissions of a number of ODS species in the S.E. Asian region.