

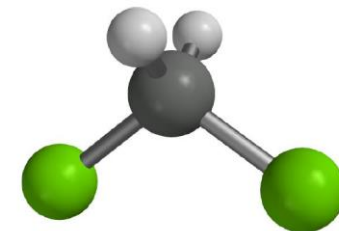
Dichloromethane & the Ozone Layer

Dr. Sébastien Gallet

Speaker Marcel Morin (Akzo Nobel)

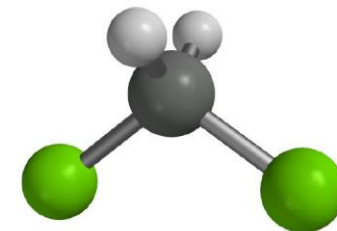
November 24th 2017

The Substance



- **Dichloromethane (DCM) or Methylene Chloride**
- **Produced on an industrial scale for a century, but also big natural bio-production with relevant emissions to the atmosphere.**
- **Used mainly as solvent for various applications in closed systems, but also emissive applications/products and fluorocarbon feedstock.**
- **Well investigated for toxicity & ecotoxicity.**

Properties



Physical state	liquid
Colour	colourless
Odour	characteristic
Relative Density at 20 °C (water = 1)	1.325
Vapour Pressure at 20 °C	476 hPa (mbar)
Freezing temperature	95°C / 178 K
Boiling temperature	40°C / 313 K
Molecular weight	84.93 g/mol
Self-ignition temperature at 1013 hPa in air	605°C / 878 K
Flash point	None *
Explosion / Flammability limits in air at 20 °C and 1013 hPa	13-22% (v/v)*
Partition coefficient n-octanol/water (Log Kow) at 20 °C and pH 7	1.25
Water Solubility at 20 °C	13.2 g/l

**Atmospheric
lifetime: 0.4 years**

**=> Very Short
Lived Substance
(VSLs)**

**=> not an Ozone
Depleting
Substance (ODS)**

GWP = 9 (low)

Uses

Major Applications

- **Solvent in pharmaceuticals production incl. natural drug extraction (industrial)**
- **Blowing agent in PU foam production for mattresses & upholstery (industrial)**
- **Solvent in paints & coatings (professional & consumers)**
- **Cleaning agent of vessels, piping and machinery (industrial)**
- **Metal degreasing (industrial)**
- **Paint stripping (industrial, professional, consumers)**
- **Intermediate / feedstock for HFC-32 (industrial)**

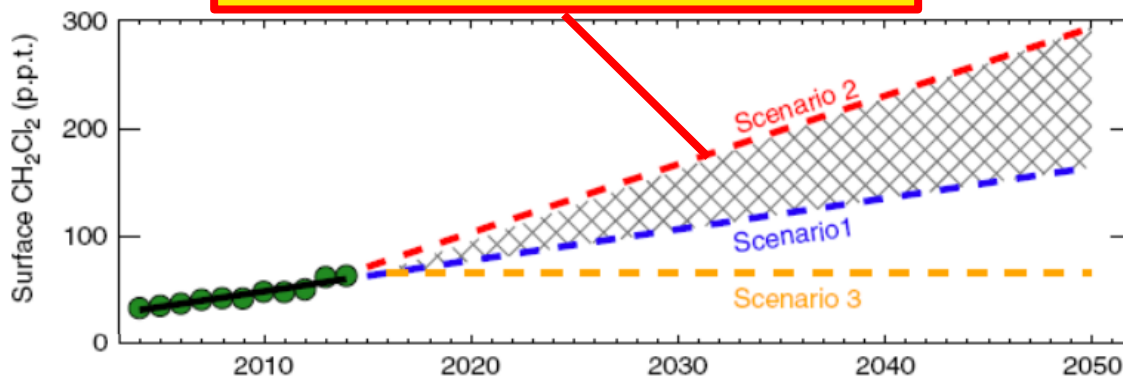
Minor Applications

- Solvent for production of polycarbonates, cellulose acetates fibres (industrial)
- Food extraction solvent (industrial)
- Degreasing of raw fur or raw leather (industrial)
- Laboratory solvent (industrial, professional)
- Aerosols: cleaners, hairspray, insecticide sprays (professional, consumers)

in brackets = typical user group

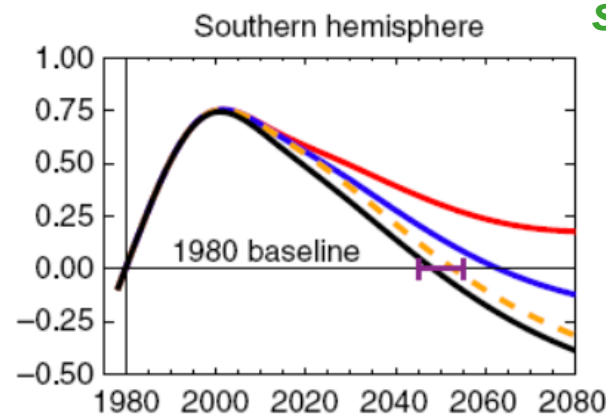
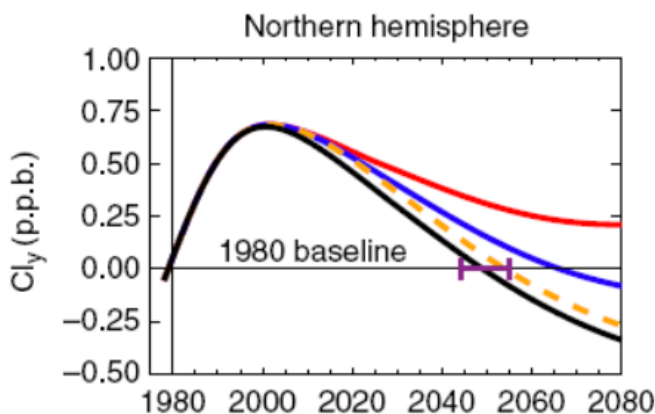
Emission Scenario by *Hossaini et al 2017**

Questionable and Unsupported Extrapolation

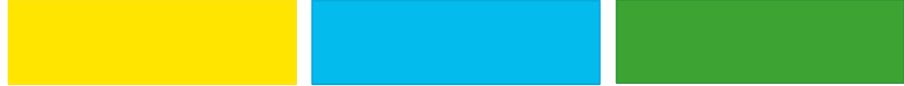


= 11 million tonnes/year

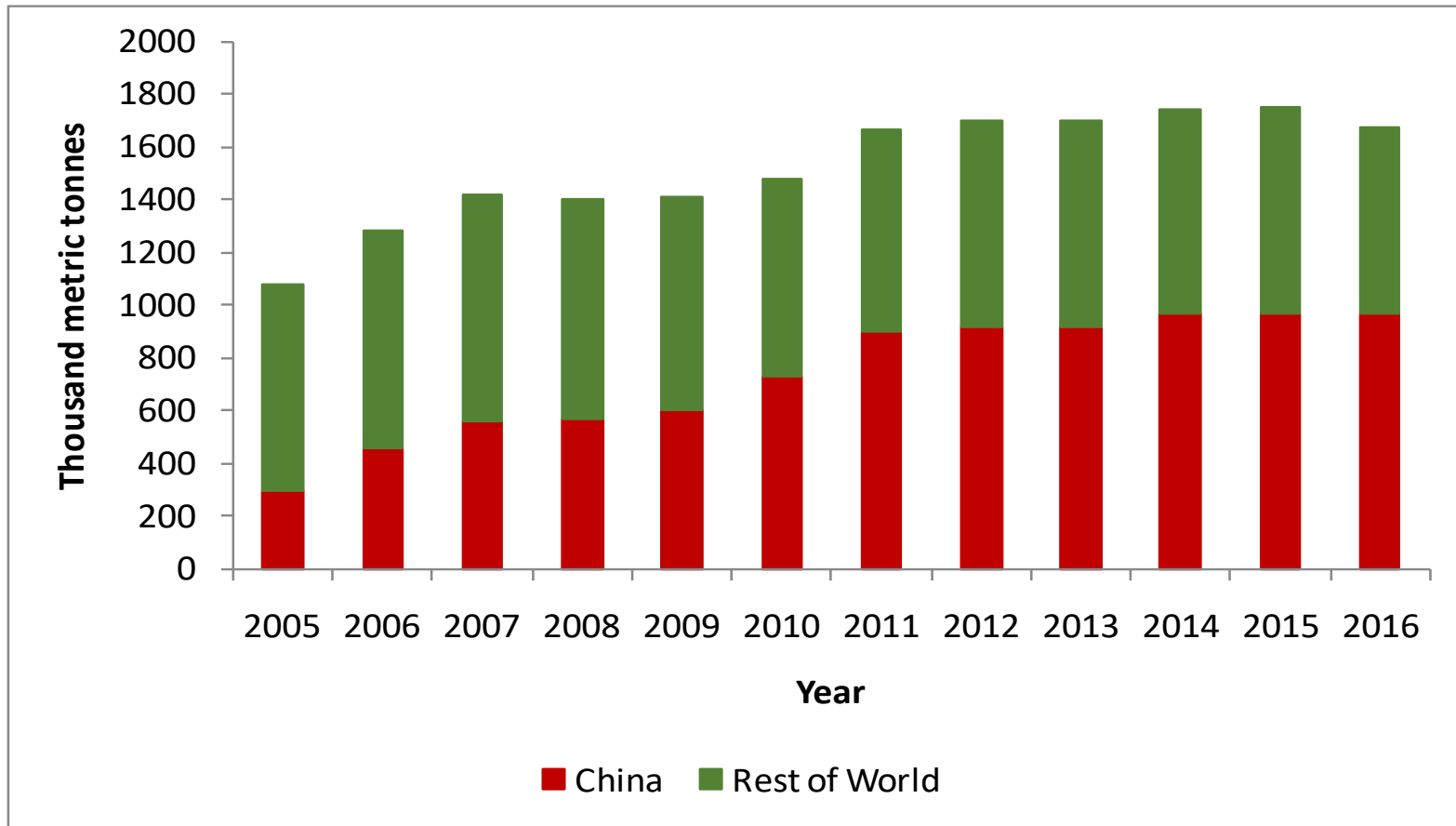
BUT:
real global emissions are constant since 2013: 1.3 mil t/y



*) Hossaini R., M.P. Chipperfield, S.A. Montzka, A.A. Leeson, S.S. Dhomse and J. A. Pyle (2017), The increasing threat to stratospheric ozone from dichloromethane, Nature Communications DOI: 10.1038/ncomms15962

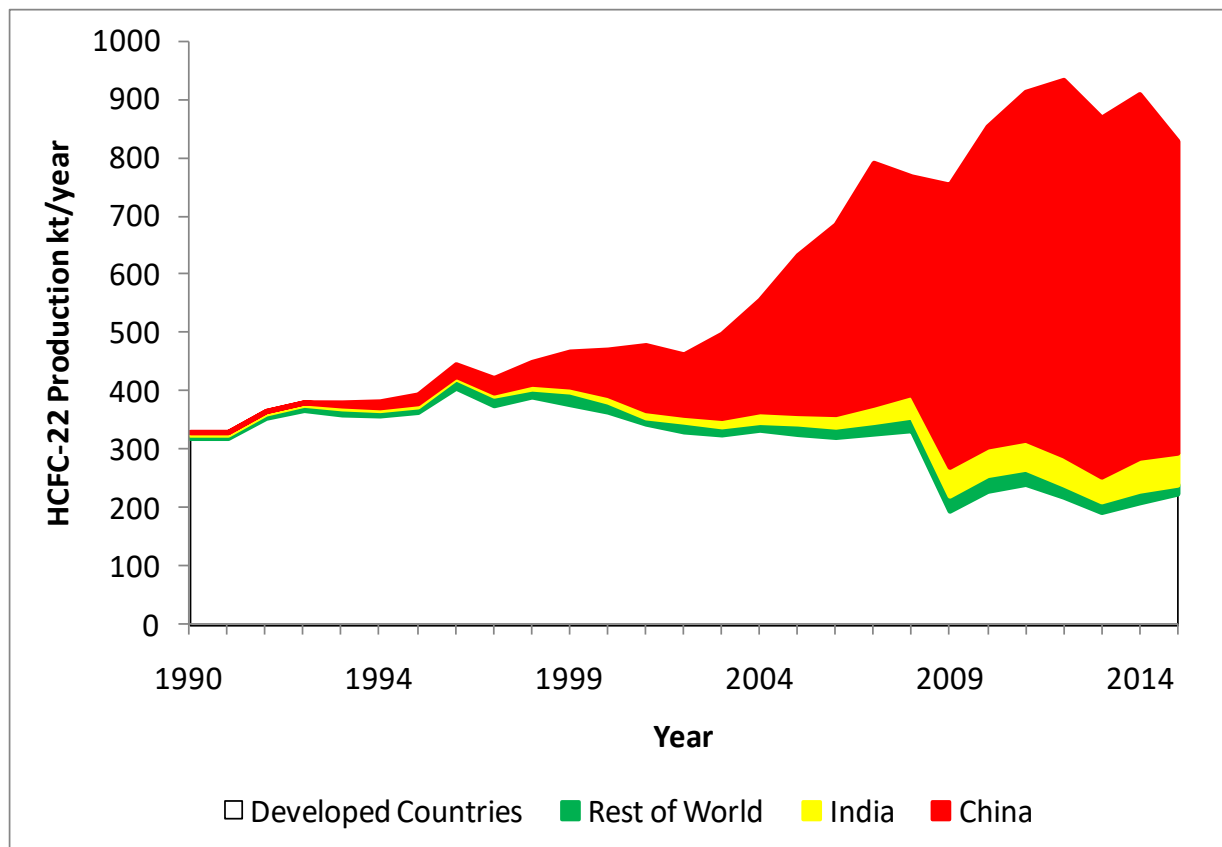


DCM Global Production Capacity



Source: IHS Markit

DCM and HCFC-22



HCFC-22
production
needs
Chloroform



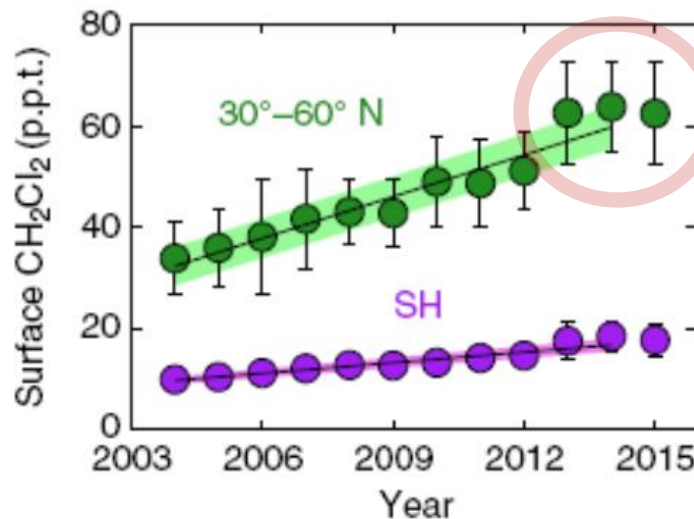
Chloroform
production is
linked with DCM
production:
typ. ratio 60:40
to 40-60

BUT:
DCM production
is not equal to
DCM emissions!

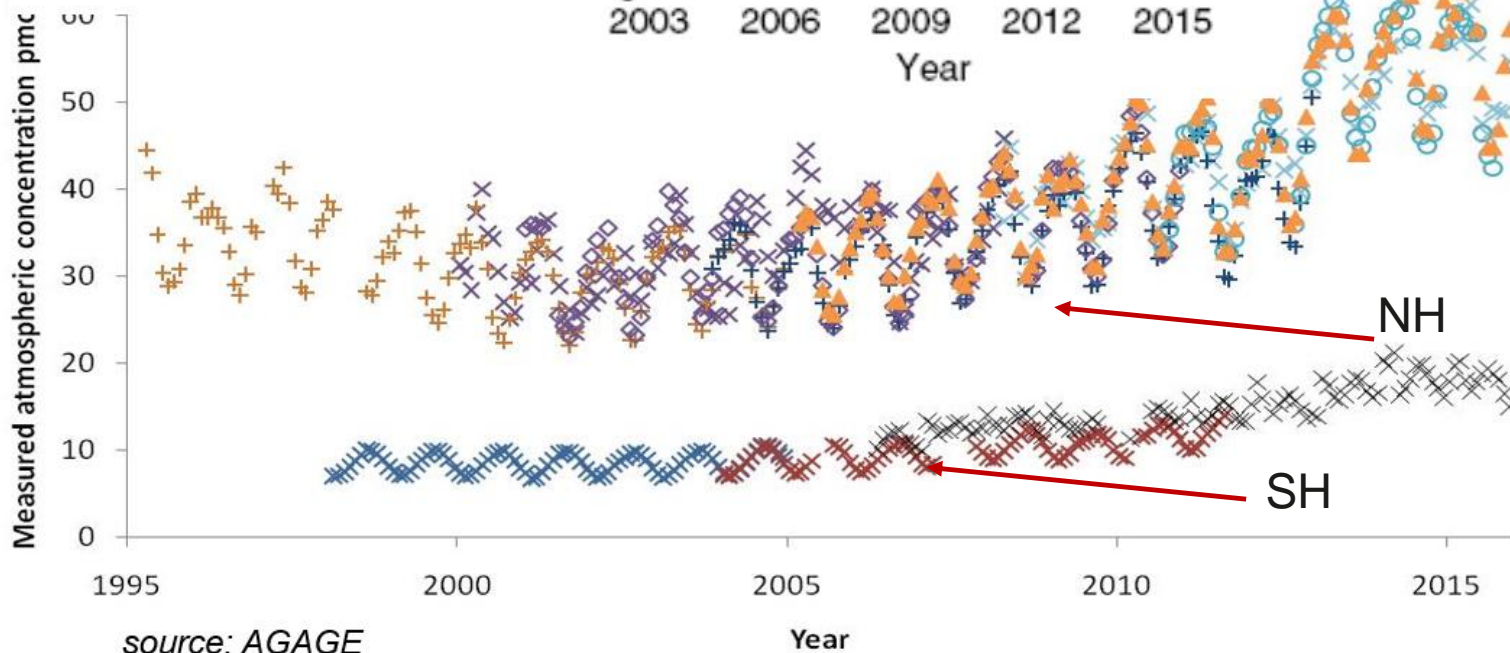
Global production of HCFC-22, showing contributions from developed countries (not under Article 5 of the Montreal Protocol), India, China and the rest of the world.

NOAA data used by Hossaini et al.

- ignored 2013-2015
- linear extrapolation of NH measurements, not global
- for 4 times the observational database



Measured data:
global emissions
~1,3 mil t/a.
stable since 2013



source: AGAGE

× CGO × CGO × JFJ × JFJ + MHD + MHD × SMO ◇ ZEP ○ ZEP ▲ THD

Continuous sampling stations

Effect of DCM on Ozone Layer

- Little transport of DCM from northern hemisphere to southern hemisphere via stratosphere (due to short atmospheric lifetime)
- DCM that does get into the stratosphere decomposes rapidly by photolysis at the wavelengths of light in the lower stratosphere
- DCM reduces with altitude: surface layer concentration reduced by 56 % at the tropical tropopause (point of injection of air into the stratosphere)
- Contribution to overall stratospheric chlorine is low and highly variable between countries and regions
- Therefore DCM is not an ODS, but a VSLS (very short lived substance) as defined by UNEP
- **Contribution of all anthropogenic and natural DCM emissions to stratospheric ozone depletion is negligible.**

DCM Regional Regulations

- DCM is well regulated in the industrialised countries for emission control and use conditions, e.g.
 - US: TSCA, Clean Air Act
 - CA: Canadian Environmental Protection Act
 - EU: REACH, Industrial Emission Directive (VOC Directive),
 - JP: Chemical Substitution Law
- China: has recently listed DCM on the draft list of priority substances
- India: The Air (Prevention and Control of Pollution) Act, 1981, and later amendments

Conclusion

- DCM is a VSLs and the impact on the ozone layer is negligible.
- Emissions are predominantly controlled by regulation. Some more of those regulations are underway in several countries.
- Global DCM emissions are stable/declining. No increase anticipated.
- Contribution of all (anthropogenic and natural) DCM emissions to stratospheric ozone depletion is less than 1 % of the present total.
- Regulating DCM under the MP would not bring benefits to the ozone layer.

Questions ?

www.chlorinated-solvents.eu

www.hsia.org

sga@cefic.be

