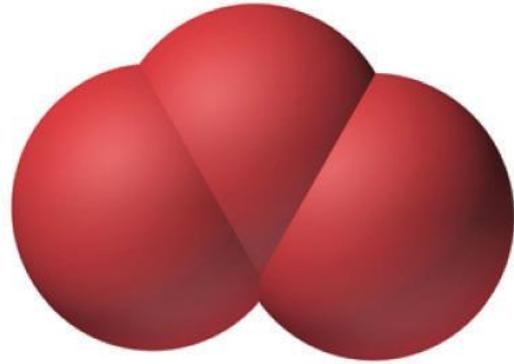
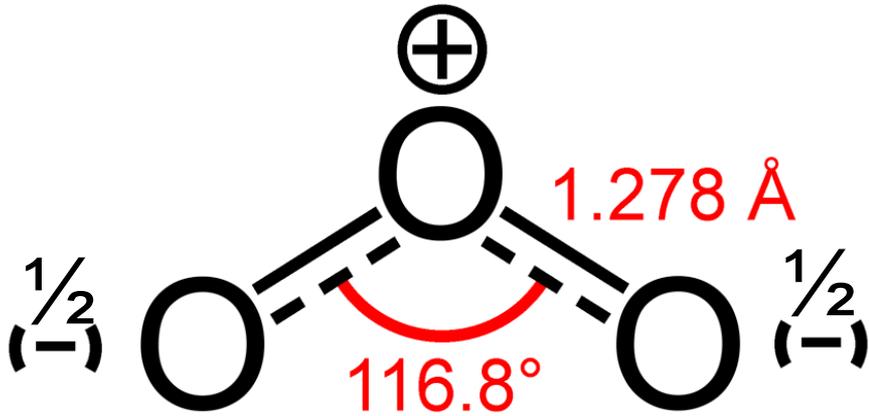


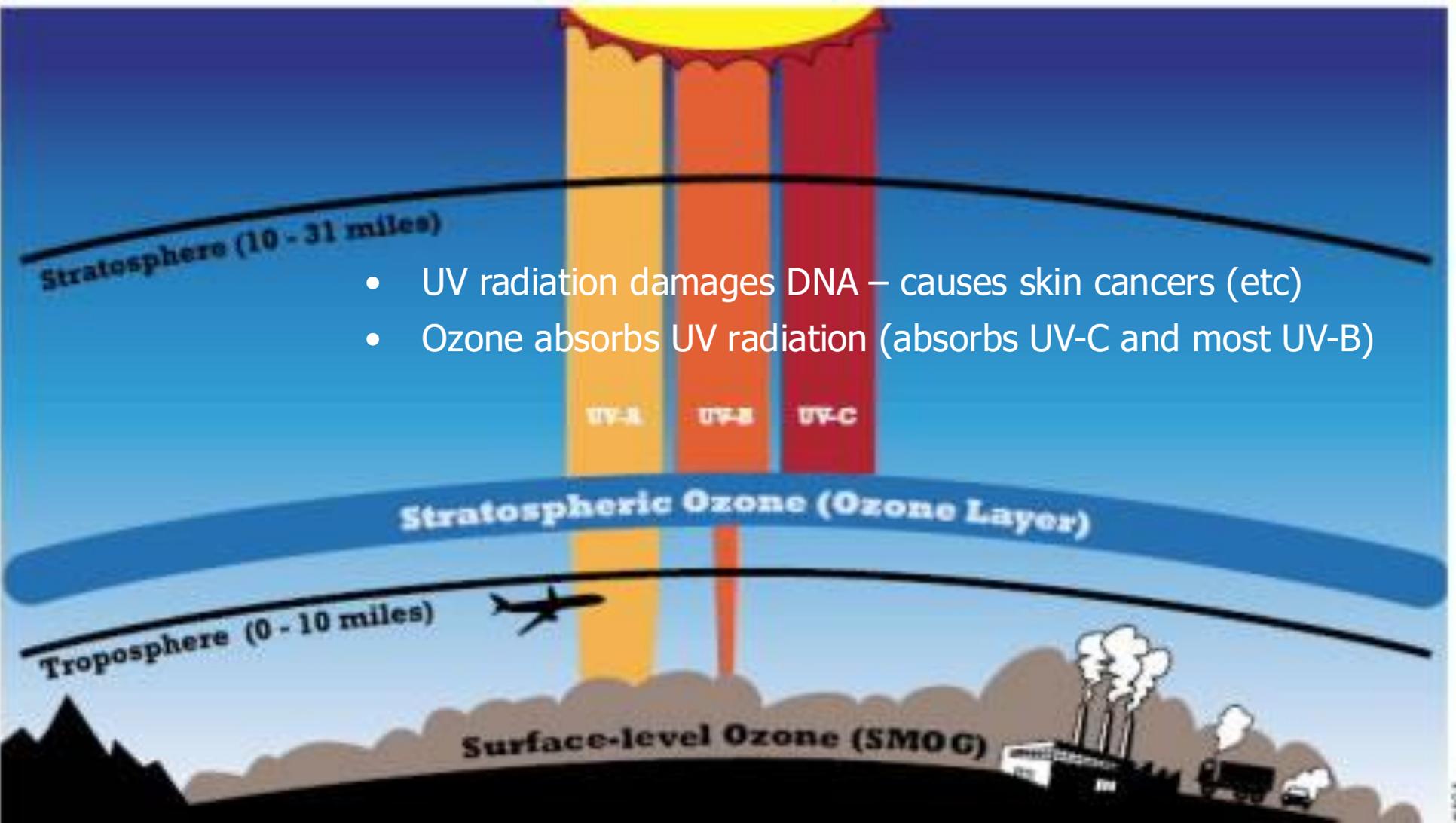


[WWW.CHEMSHEETS.CO.UK](http://www.chemsheets.co.uk)

OZONE & CFCs

ozone = O_3

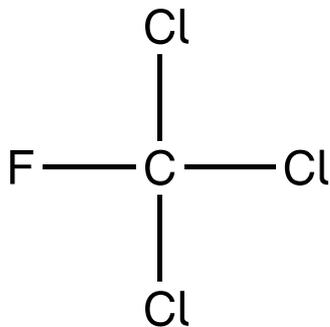




- UV radiation damages DNA – causes skin cancers (etc)
- Ozone absorbs UV radiation (absorbs UV-C and most UV-B)

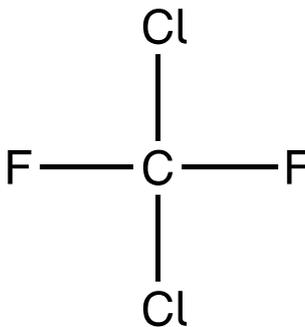
CFCs - chlorofluorocarbons

contain: chlorine, fluorine, carbon



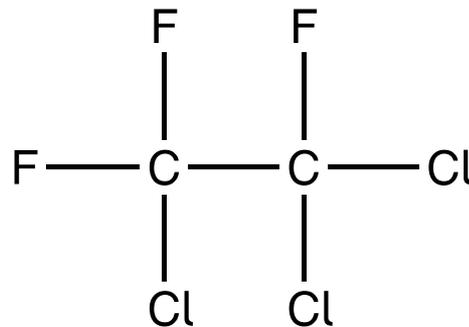
trichlorofluoromethane

CFC-11



dichlorodifluoromethane

CFC-12



1,1,2-trichloro-1,2,2-trifluoroethane

CFC-113

USES OF CFCs

Coolants in
fridges



Propellants in
aerosols

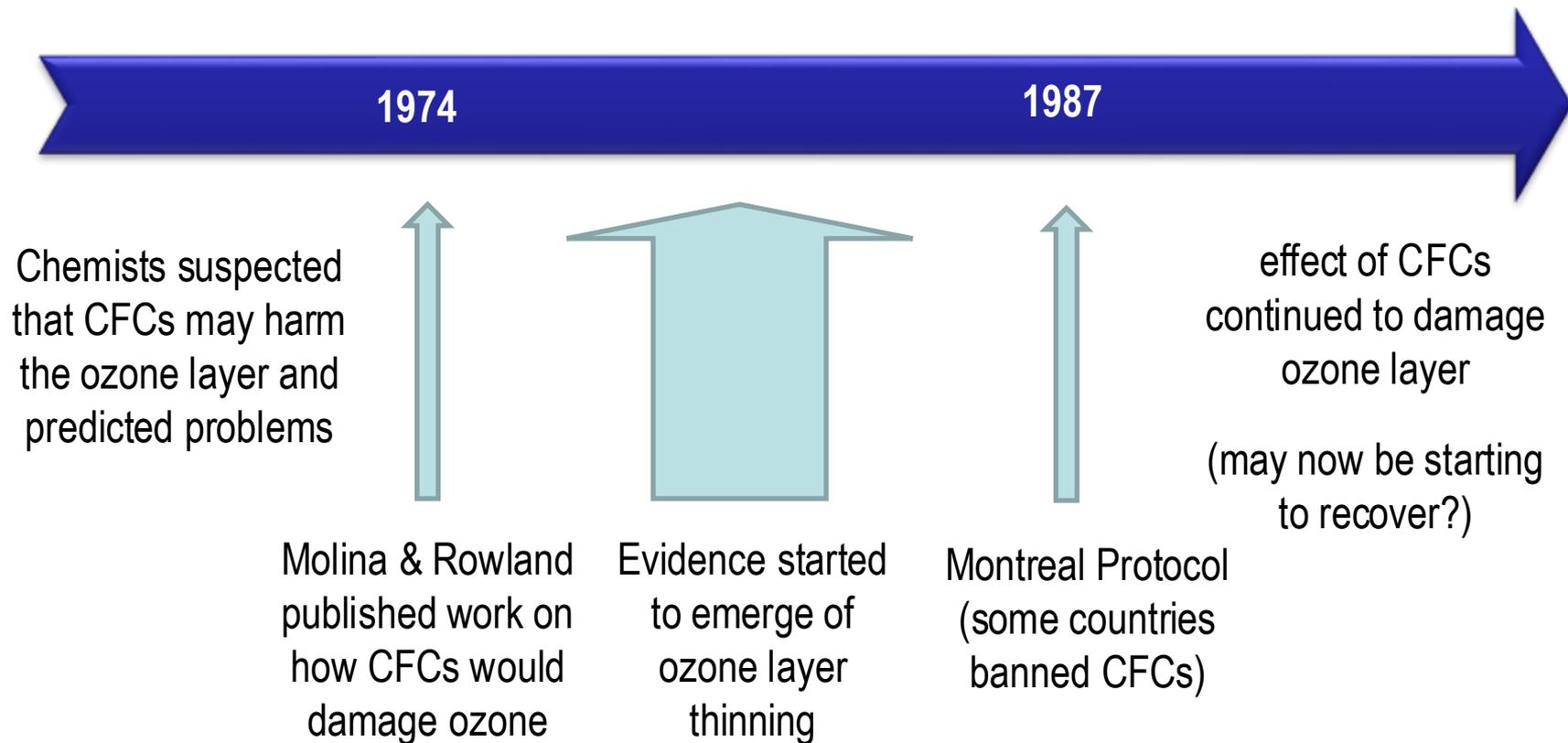


Degreasing
circuit boards

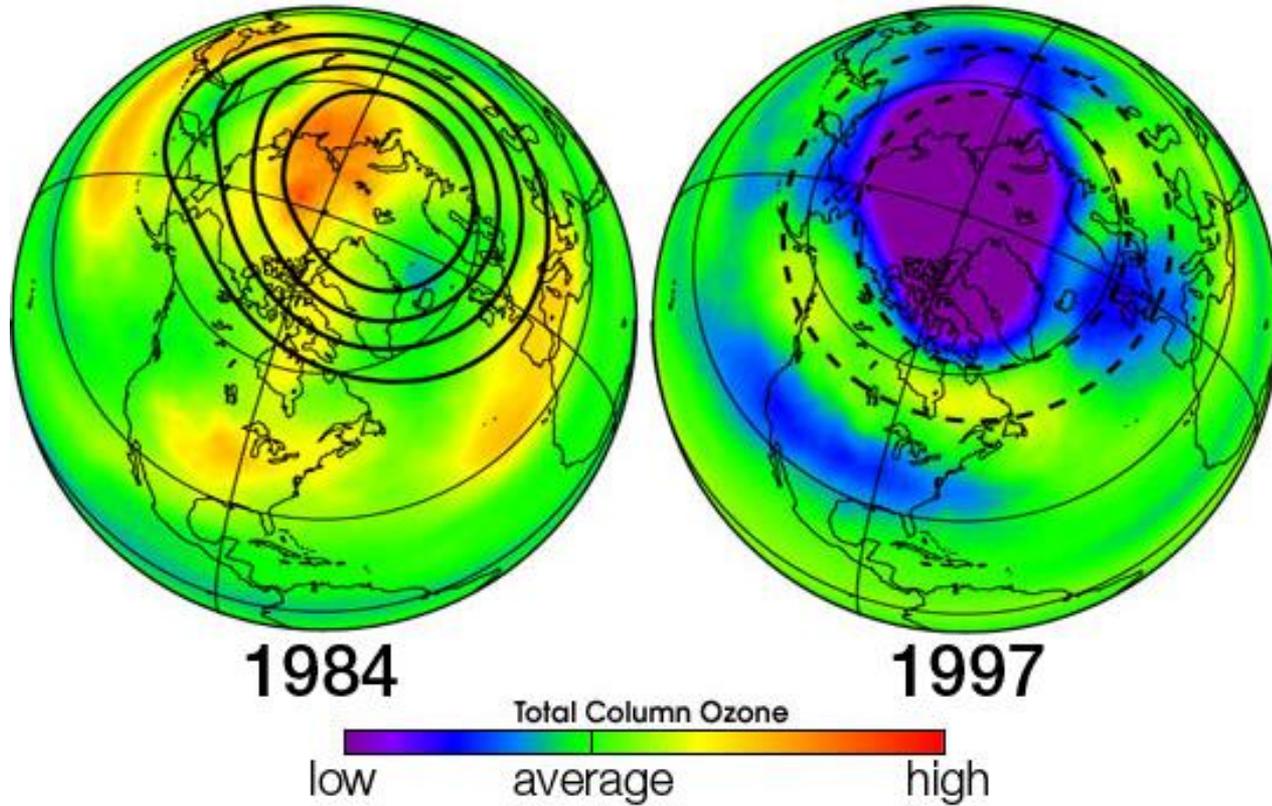
Dry cleaning
solvents



CHEMISTS



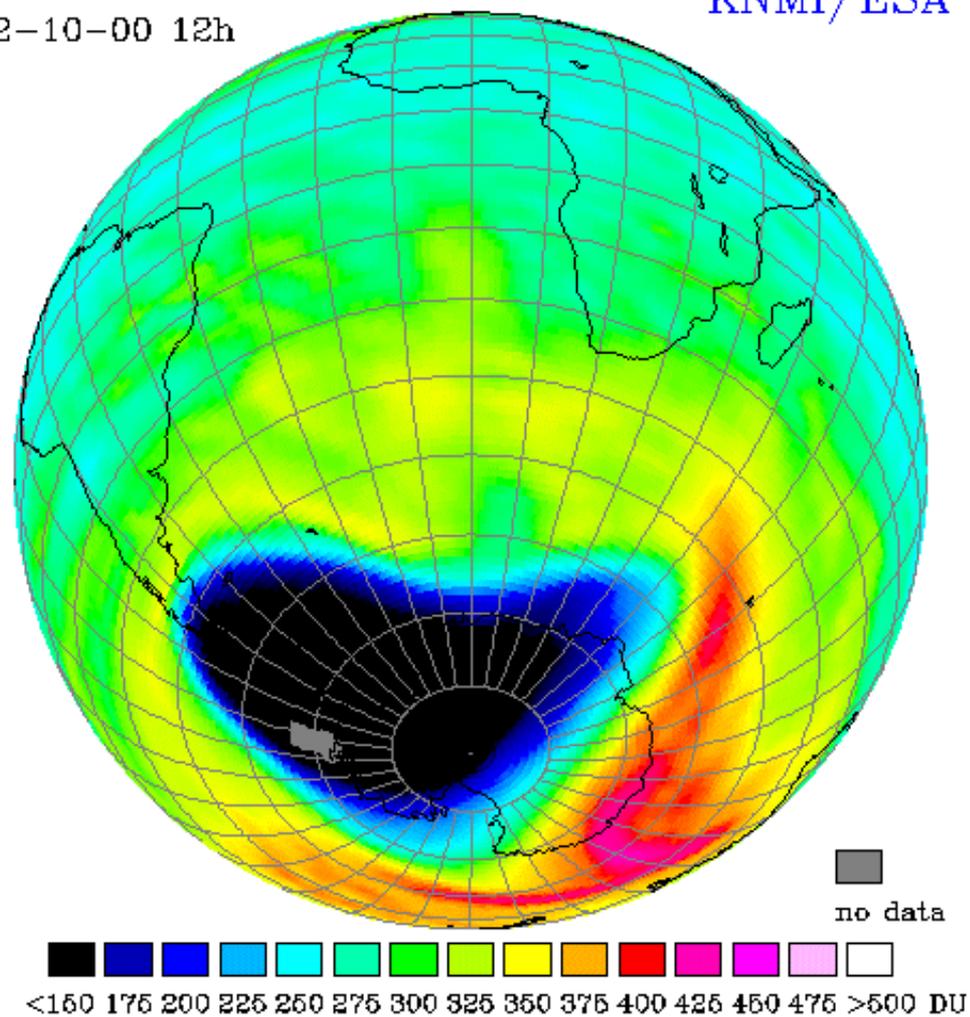
Nobel Prize 1995



effect of CFCs
continued to damage
ozone layer for some
time

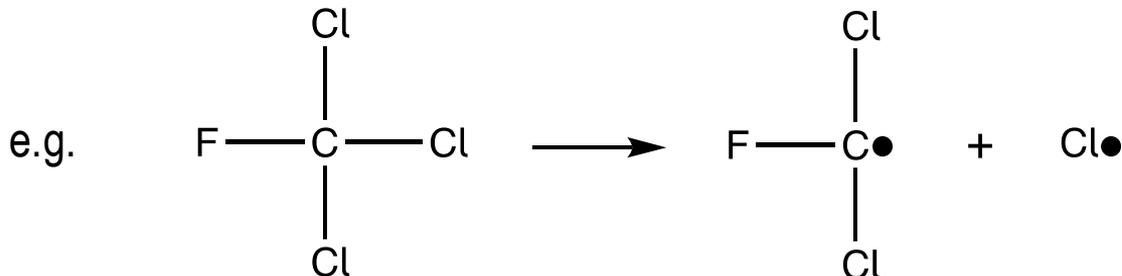
Assimilated GOME total ozone
12-10-00 12h

KNMI/ESA



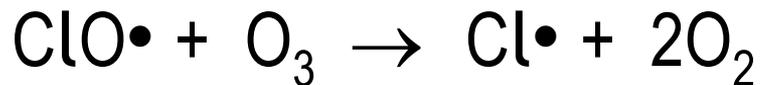
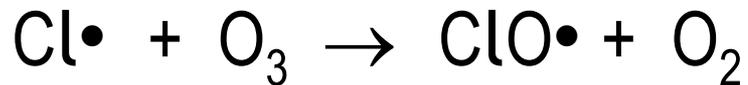
CFCs & OZONE

- CFCs rise to the stratosphere
- uv light provides energy to break C-Cl bonds
- forms $\text{Cl}\cdot$ radicals



CFCs & OZONE

Cl• radicals react to destroy ozone in chain reaction (one Cl• radical can destroy 1000s of O₃ molecules)



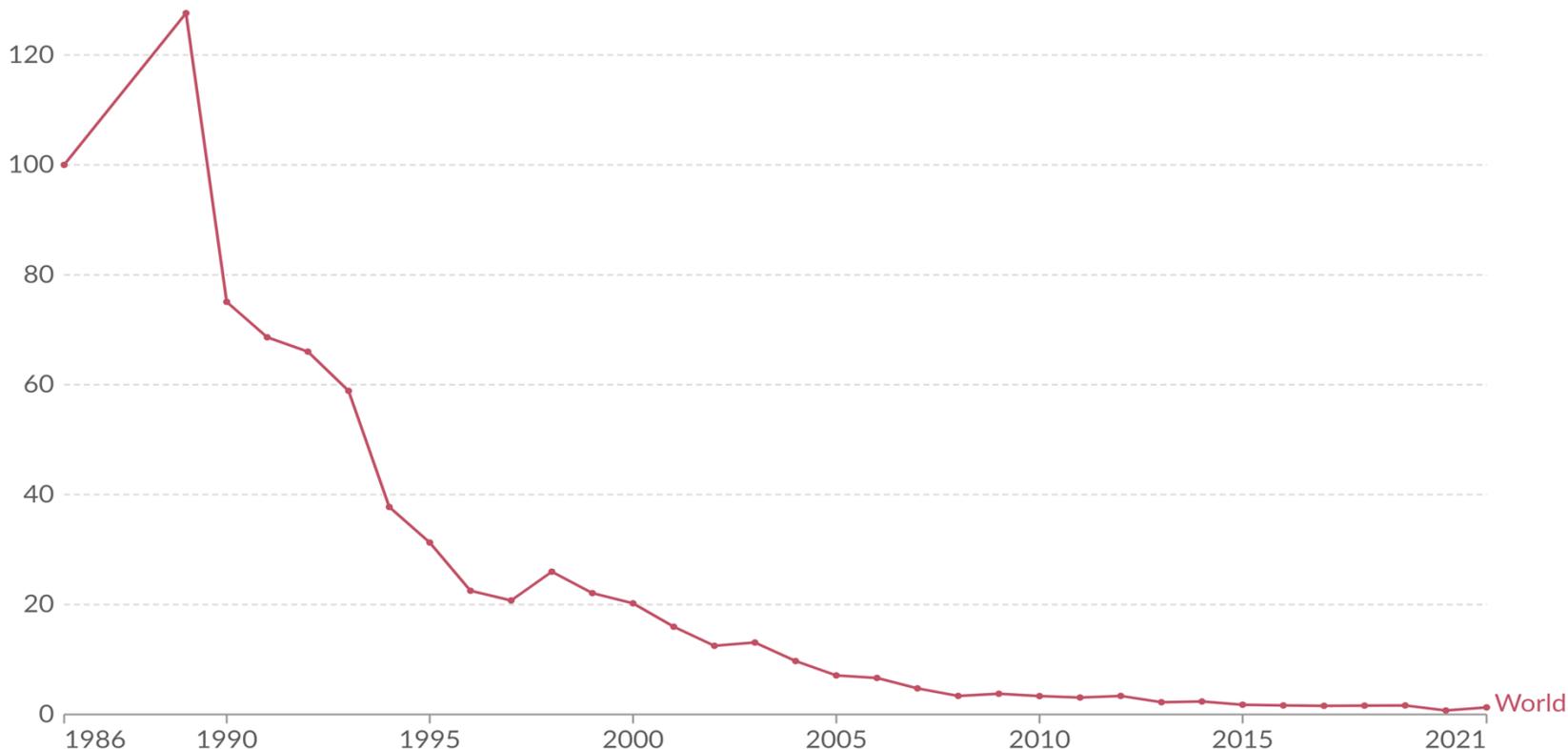
MONTREAL PROTOCOL

- In 1987, 24 countries signed up the Montreal protocol to ban the uses of CFCs.



Change in the consumption of ozone-depleting substances

Consumption of ozone-depleting substances, measured relative to 1986 (where consumption in 1986 is equal to 100).



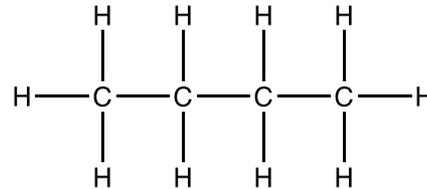
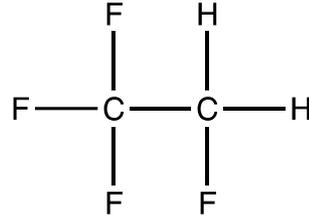
MONTREAL PROTOCOL

- There are many fridges (etc) still in use or to be disposed of containing CFCs.

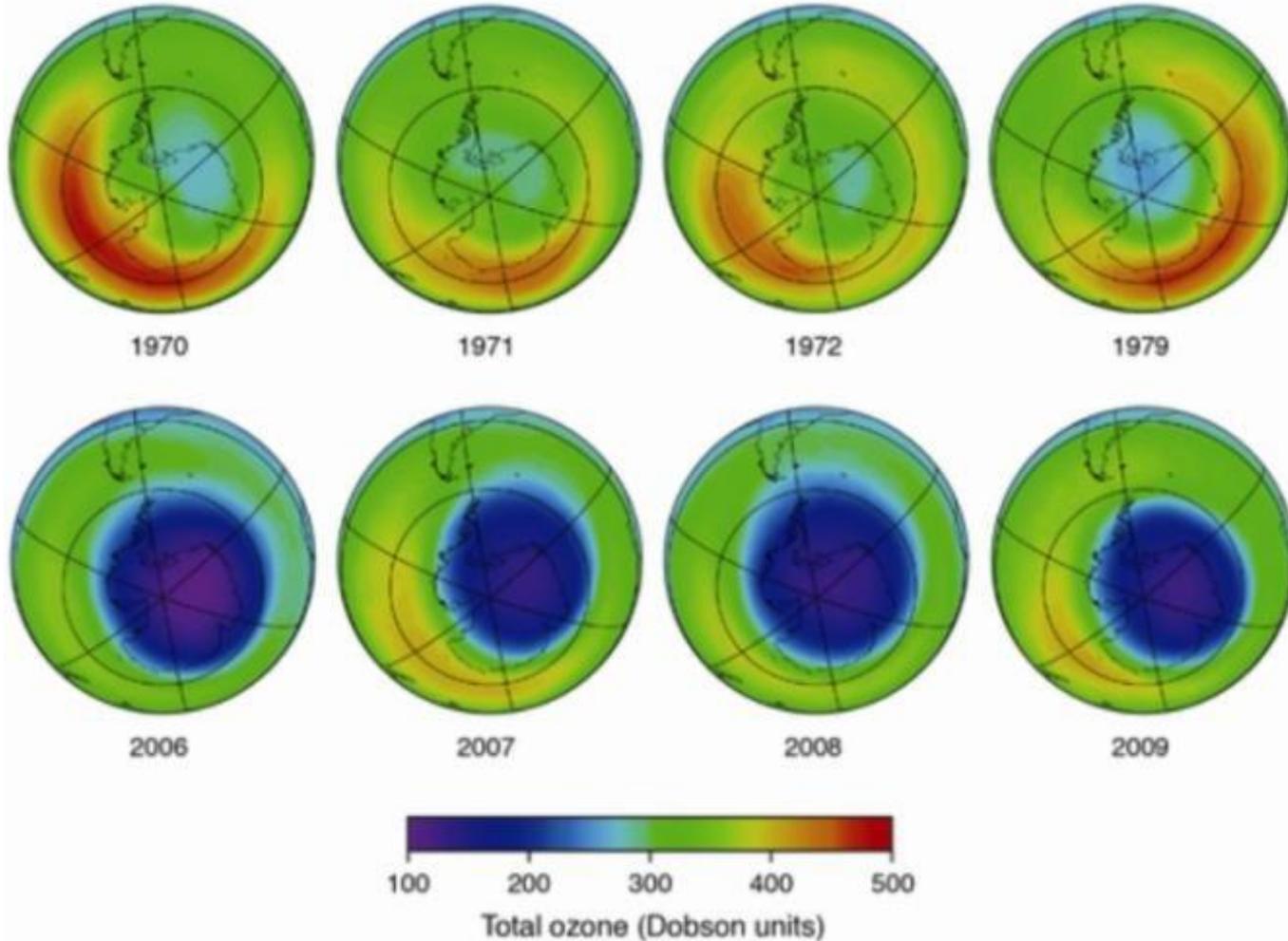


ALTERNATIVES to CFCs

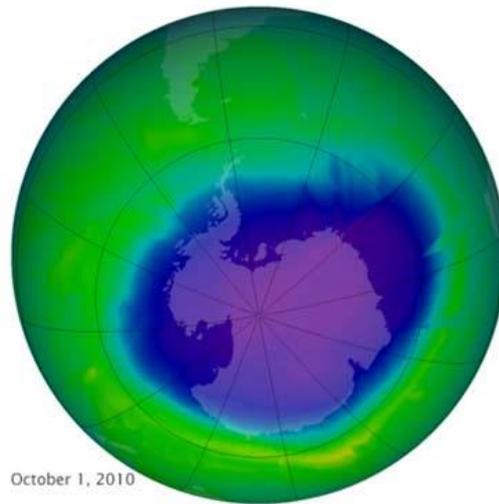
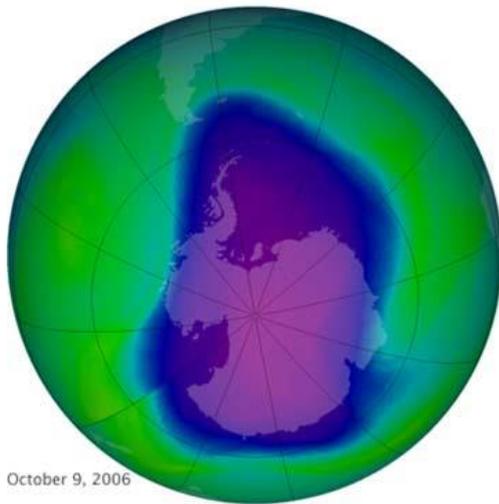
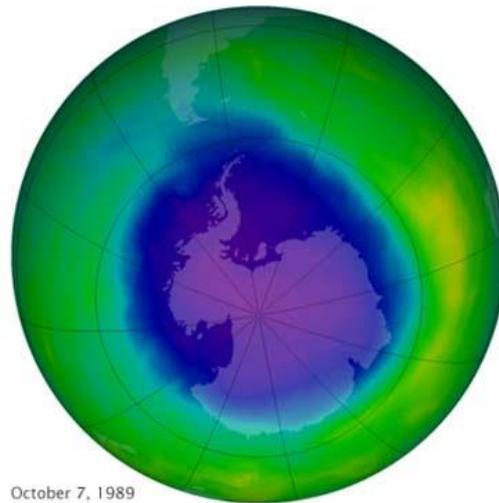
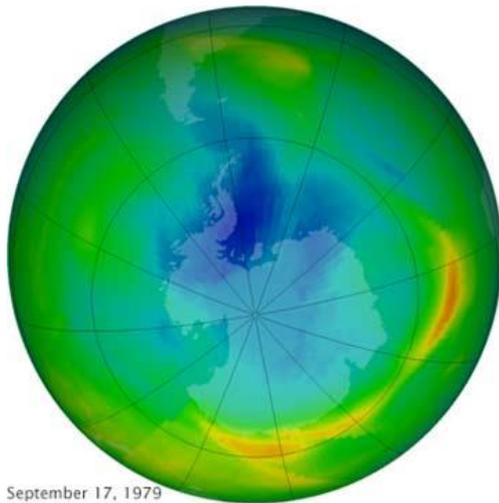
- compounds with similar properties but no Cl atoms



Antarctic Total Ozone
(October monthly averages)

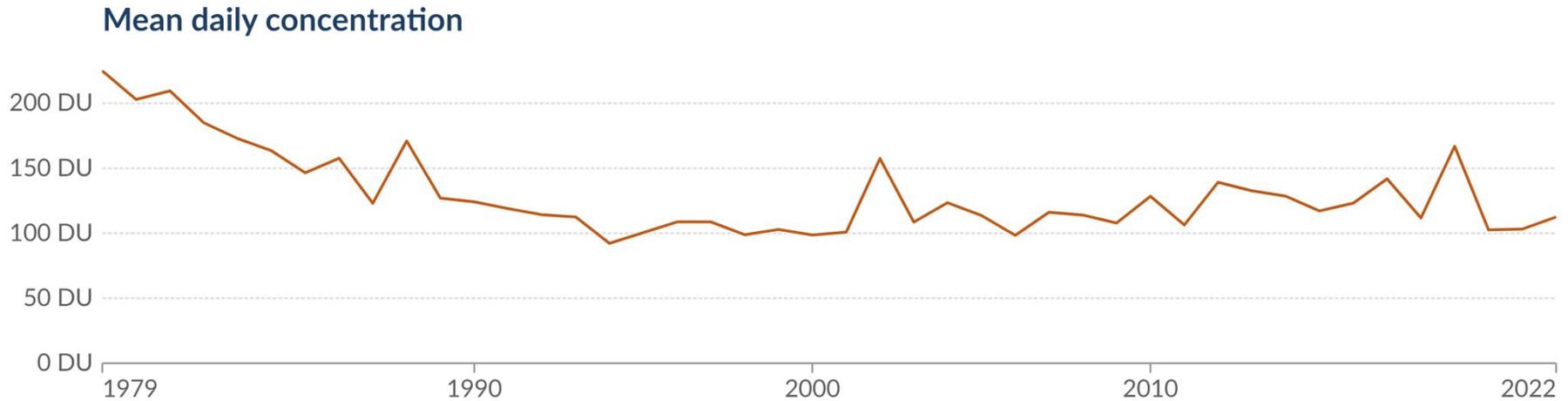


it is taking time
for CFC ban to
have an effect
– it got worse
for some time



Concentration of ozone in the stratosphere

Stratospheric ozone concentration in the Southern Hemisphere – based on satellite measurements at a latitude south of 40°S. This is measured in Dobson Units (DU)¹.



Data source: NASA Ozone Watch (2023)

OurWorldInData.org/ozone-layer | CC BY



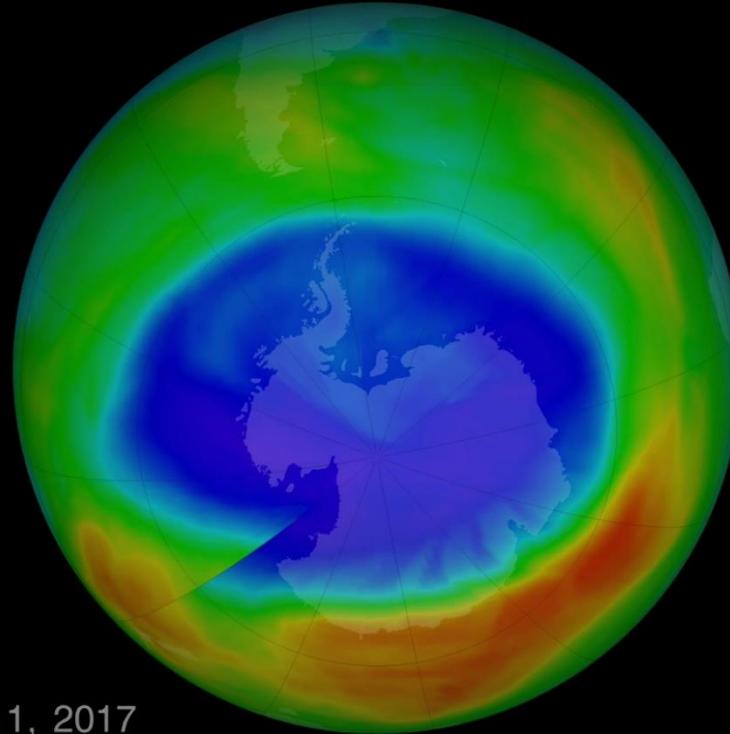
NASA Sees Definitive Evidence of the Montreal Protocol's Success



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but there may be some evidence it is starting to recover



Climate 101: Ozone Depletion | National Geographic