The Ozone Layer

AOSC 680

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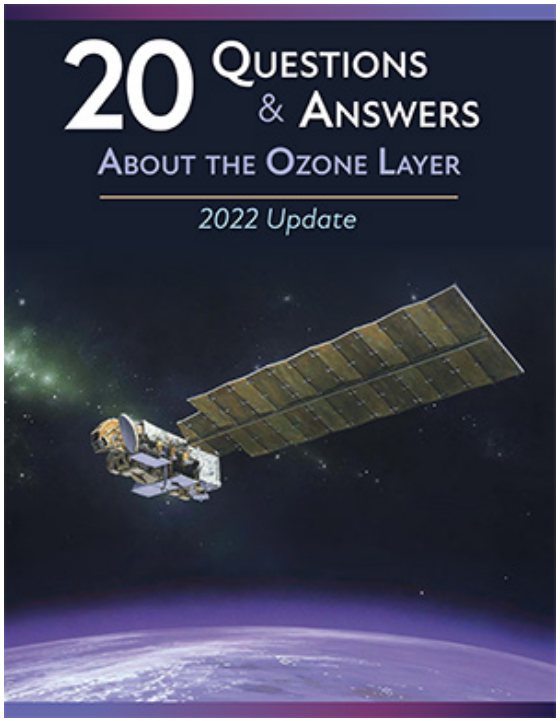
Class Web Sites:

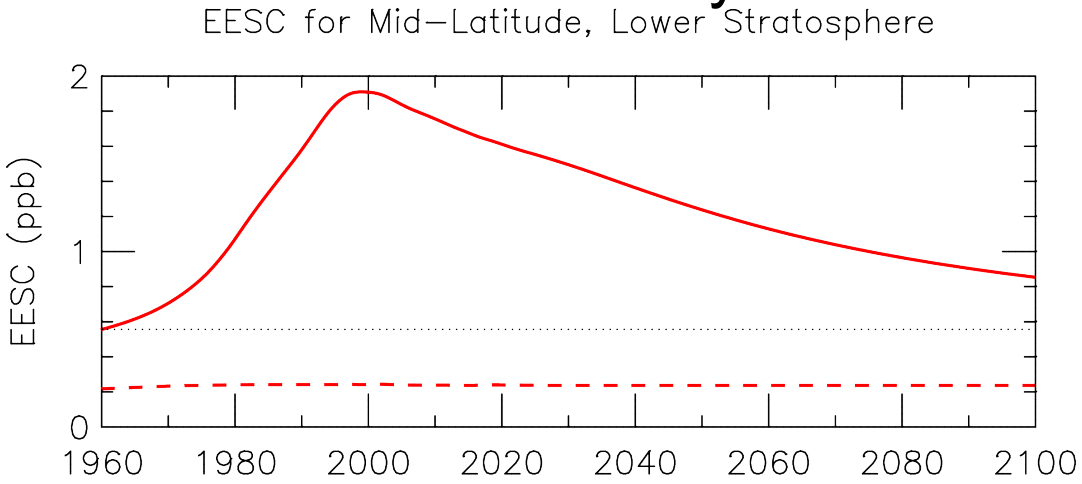
http://www2.atmos.umd.edu/~rjs/class/fall2024
https://umd.instructure.com/courses/1367293



Lecture 20

12 November 2024

Recovery of the Ozone Layer



EESC for mid-latitude, lower stratospheric air based on direct atmospheric observation of halogens up to 2022 and future projections that include estimates of emissions from **banks**, **feedstock use**, plus the **lifetime** for removal of each halocarbon, as given in **Table 7A-1, WMO/UNEP 2022**

EESC: Equivalent Effective Stratospheric Chlorine
Metric that reflects stratospheric chlorine & bromine concentrations due to decomposition of ozone depleting substances (ODSs) such as CFCs, halons, etc.

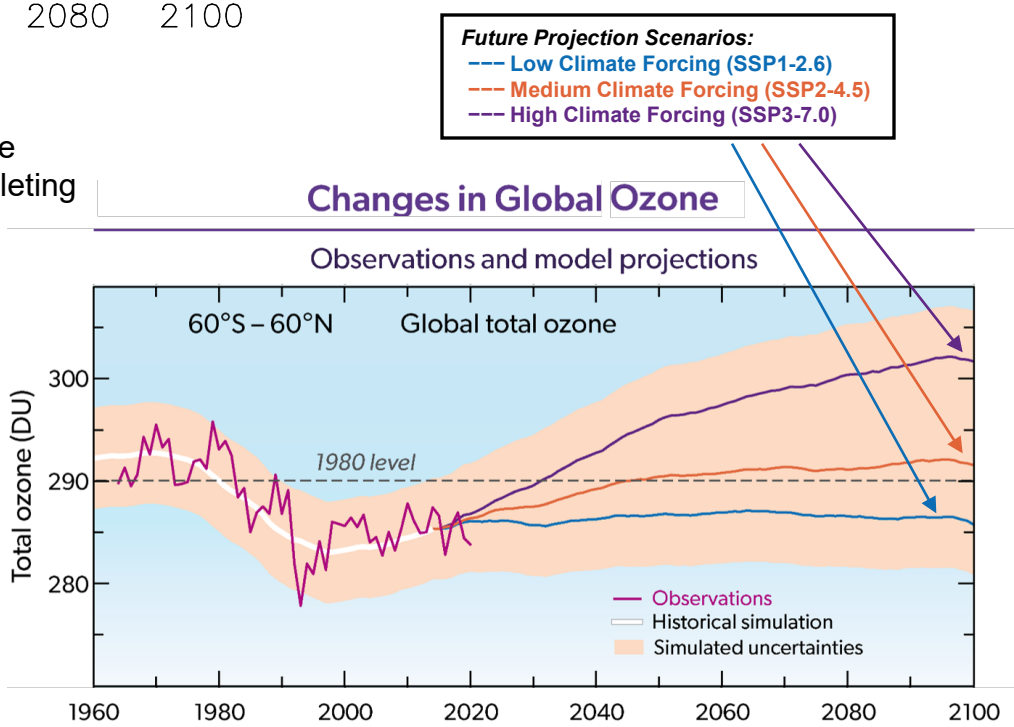
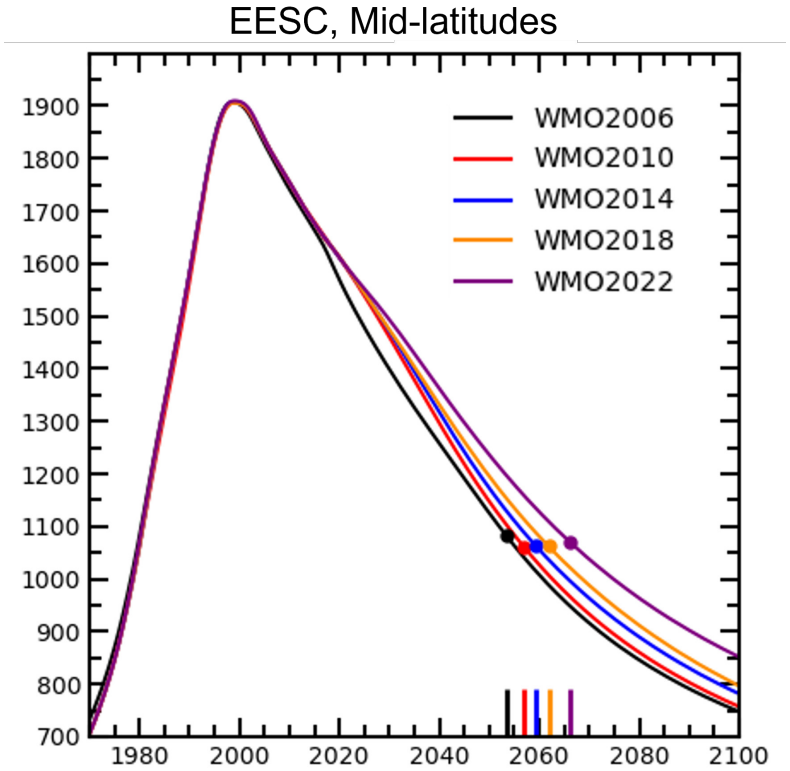


Fig Q20-1, WMO/UNEP Twenty QAs Ozone

We Should Be Good For The Recovery Of The Ozone Layer, Right?

Not So Fast



The return to EESC to the 1980 level advanced by 12.6 years between the 2006 and 2022 WMO Ozone Assessment Reports.

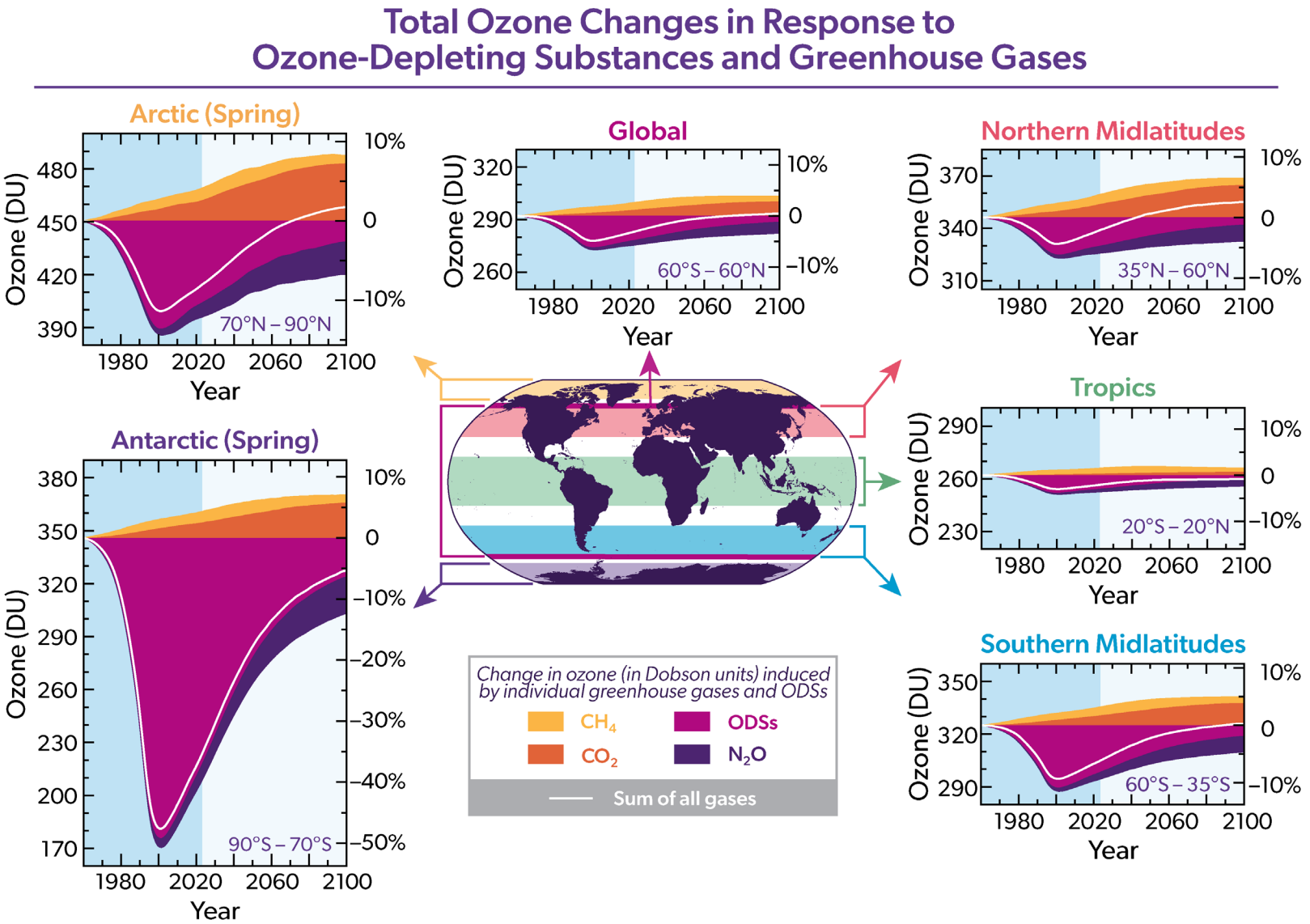
Of this delay:

- **bank calculation** methods account for ~4 years
- changes in the assumed **atmospheric lifetime** for certain ODSs account for ~3.5 years
- an under-estimate of the emission of **carbon tetrachloride (CCl_4) used as a feedstock** accounts for ~3 years
- updated **historical emissions** estimates (i.e., illegal production of ODSs) accounts for ~1 year.

Some underlying causes of delay such as **capture of ODSs from banks** and **future feedstock emissions**, are amenable to future controls.

Lickley *et al., Atmos. Chem. Phys.*, accepted, 2024

Recovery of the Ozone Layer



These simulations use CO_2, CH_4, and N_2O from the medium climate forcing (SSP2-4.5) scenario of Figure Q20-1

Fig Q20-2, WMO/UNEP Twenty QAs Ozone

We Should Be Good For The Recovery Of The Ozone Layer, Right?

Not So Fast

Changes in total column ozone, 1996–2020

- Northern Hemisphere mid-latitudes (35°N–60°N), total column ozone trends are negligible (0.0 ± 0.7% decade^{-1}).
- Southern Hemisphere mid-latitude (35°S–60°S), total column ozone has increased (0.8 ± 0.7% decade^{-1}).

Total Column Ozone not recovering as fast as **"expected"**, particularly in NH mid-latitudes

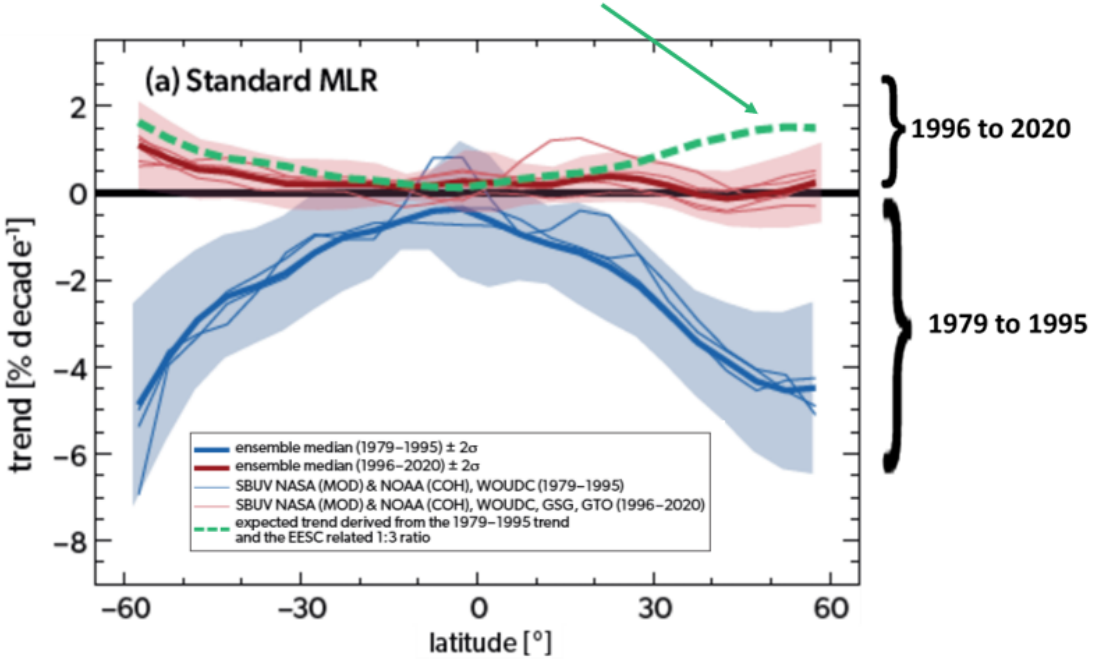


Figure 3-7. TCO linear trend in % decade^{-1} as a function of latitude for 1979–1995 (blue) and 1996–2020 (red), estimated using SBUV NASA (MOD), SBUV NOAA (COH), GTO, GSG, and WOUDC datasets, with (a) an MLR model that includes typical proxies

Fig 3-7, WMO/UNEP Scientific Assessment of Ozone Depletion Report

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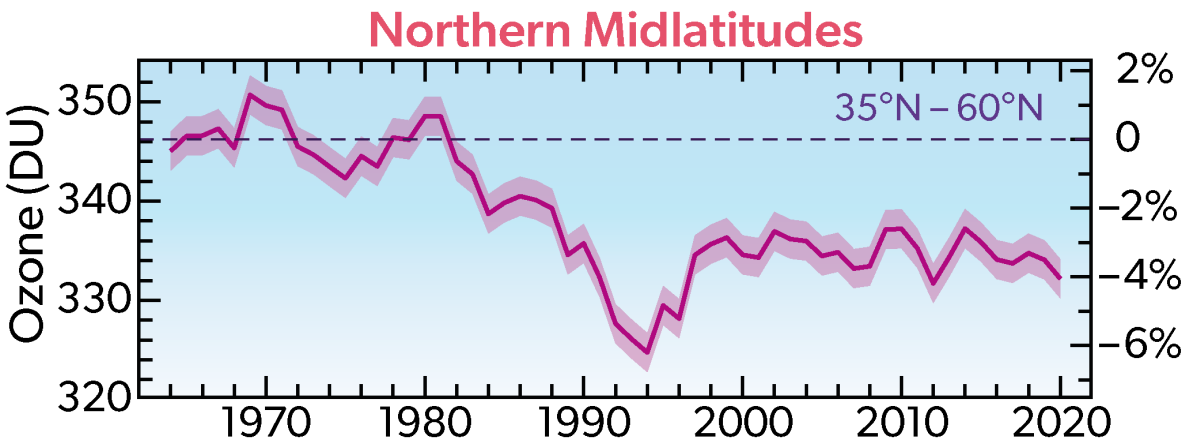
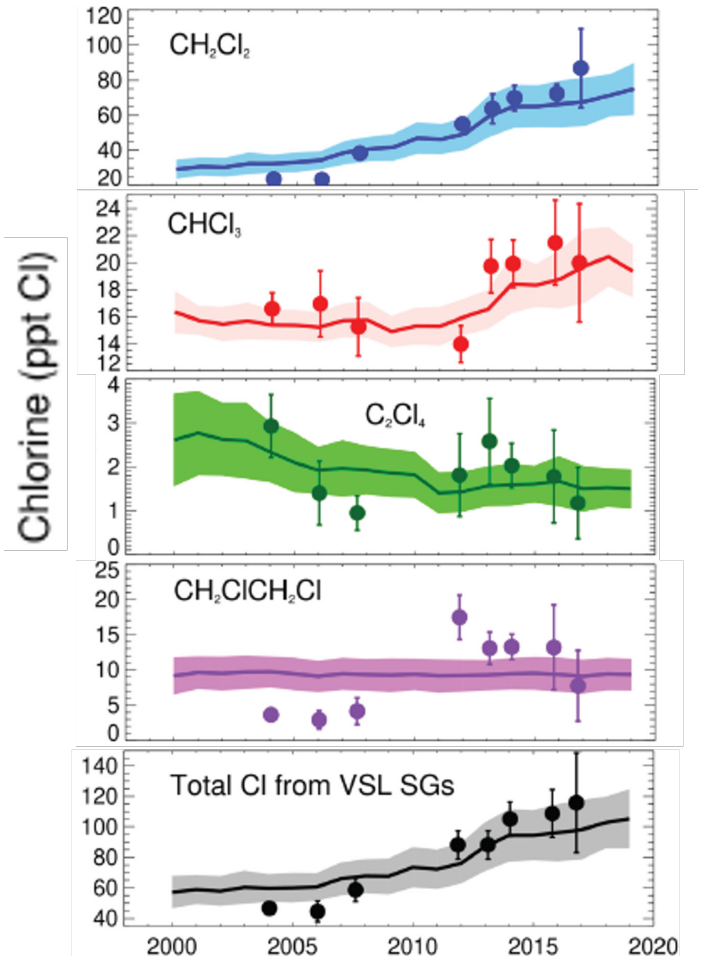


Fig Q12-1, *WMO/UNEP 20 QAs Ozone Layer*

We Should Be Good For The Recovery Of The Ozone Layer, Right?

These gases, all mainly anthropogenic, have lifetimes for atmospheric removal of less than 6 months and are not controlled by the Montreal Protocol.



Not So Fast

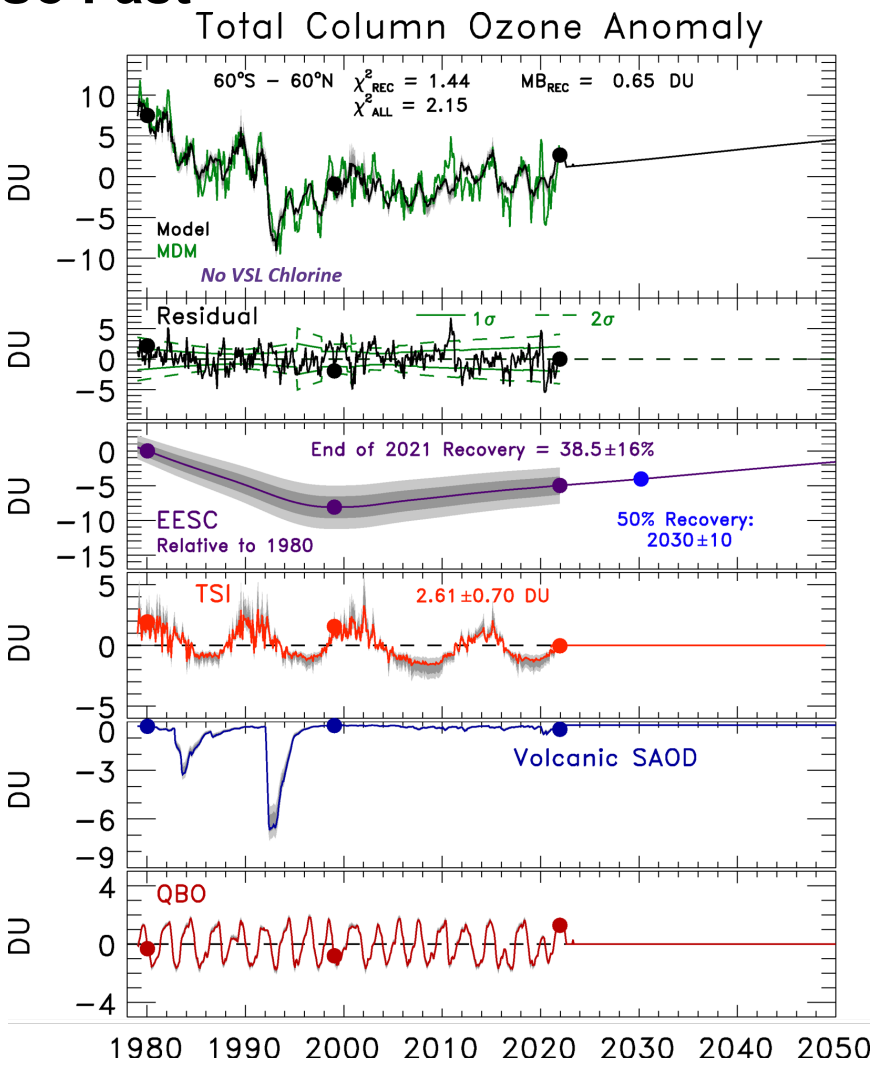


Fig 1-8, 2022 *WMO/UNEP Scientific Assessment of Ozone Depletion Report*
https://csl.noaa.gov/assessments/ozone/2022/downloads/Chapter1_2022OzoneAssessment.pdf

McBride et al., manuscript in preparation

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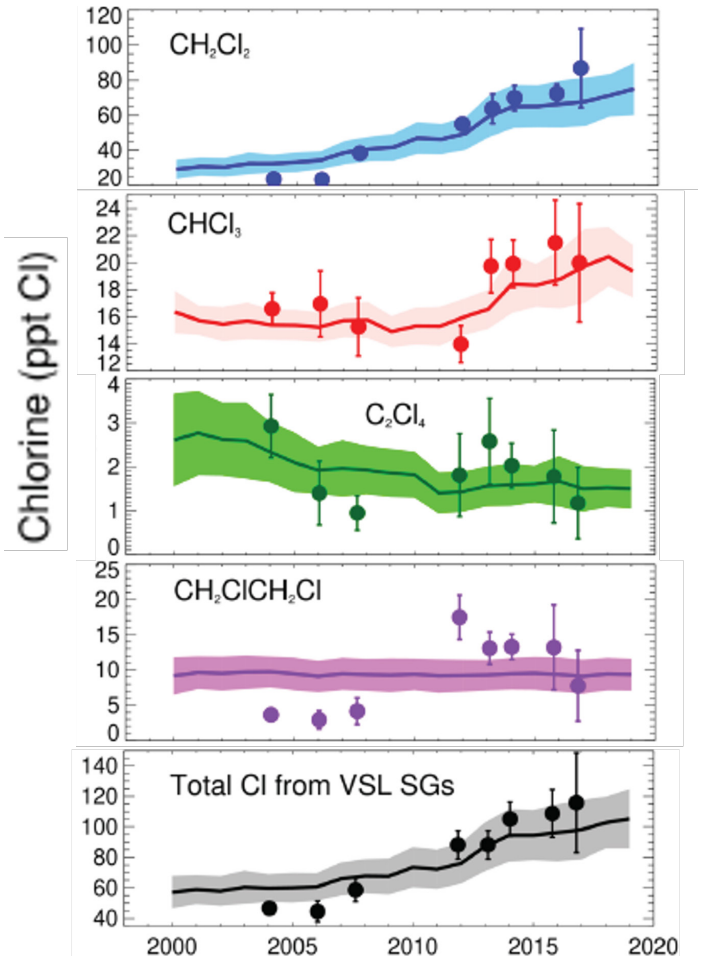

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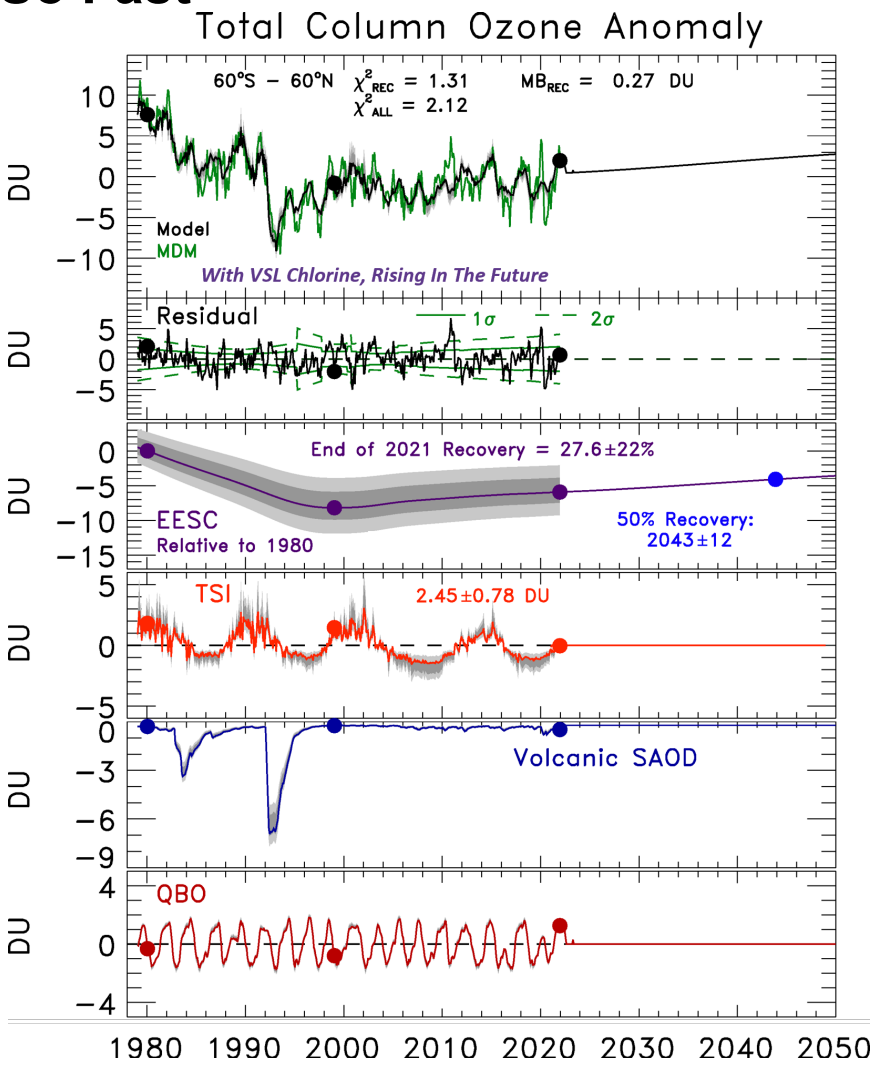

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