

The SBUV and TOMS Satellite Instruments and the Montreal Protocol

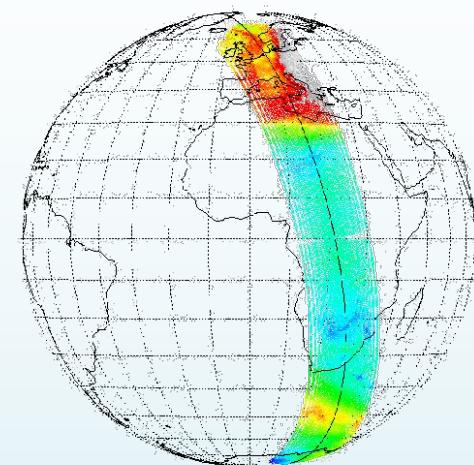
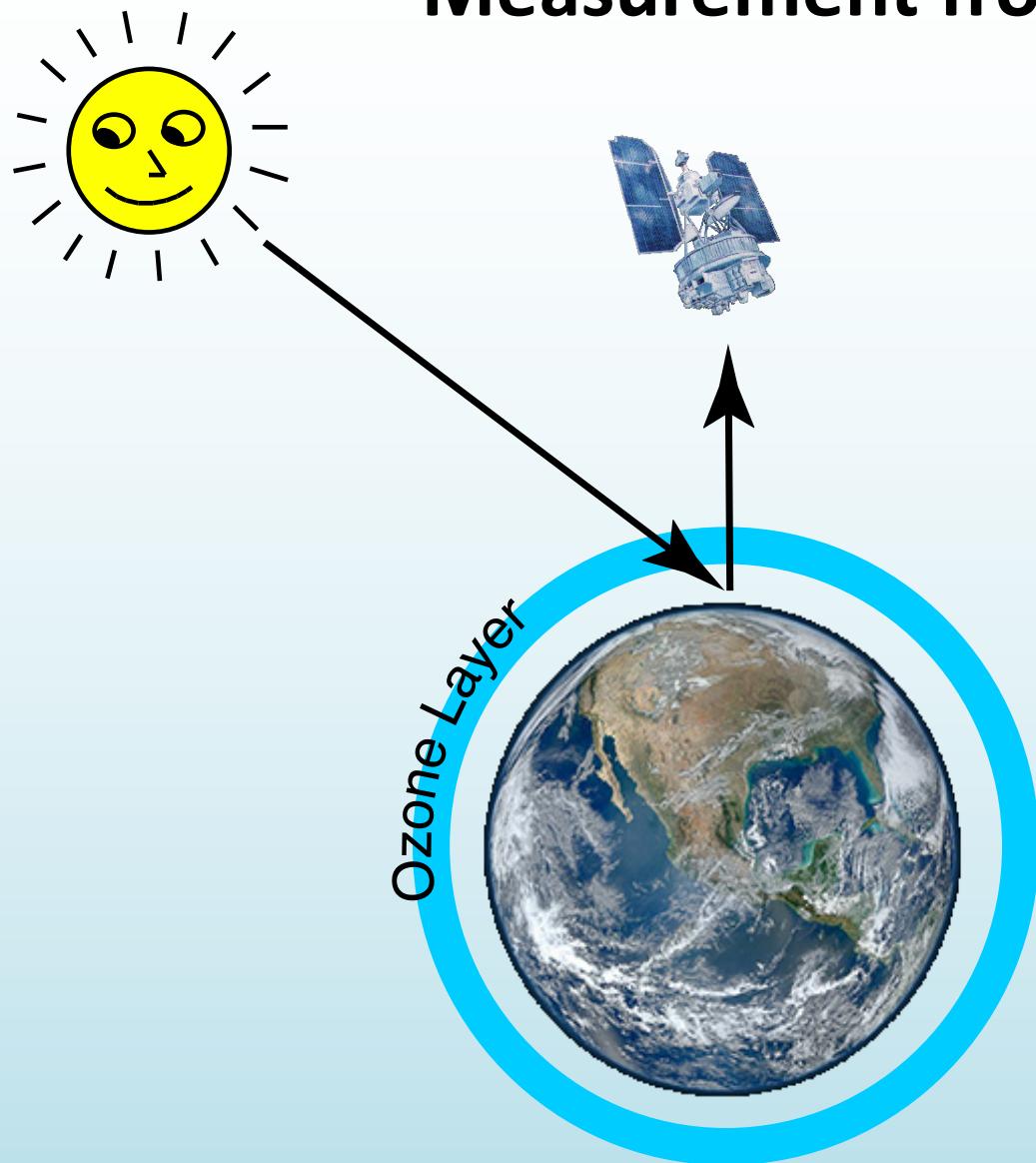
Richard S. Stolarski
Johns Hopkins University
(NASA Goddard Emeritus)

I will focus on the backscatter ultraviolet (BUV) satellite instruments and their importance to the Montreal Protocol

Two Major Topics

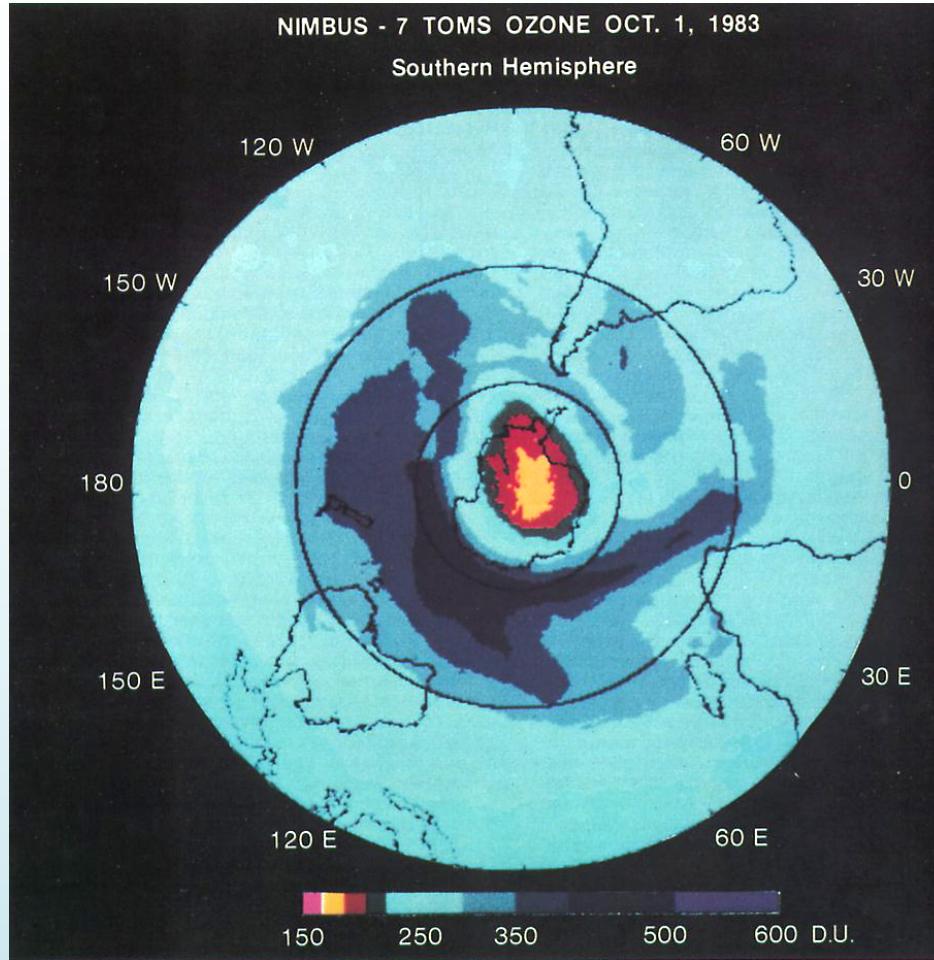
- TOMS/SBUV and the ozone hole
- SBUV as a long-term global ozone data set

Backscatter Ultraviolet Measurement from a Satellite



**Single Orbit Above
14 Orbits per Day**

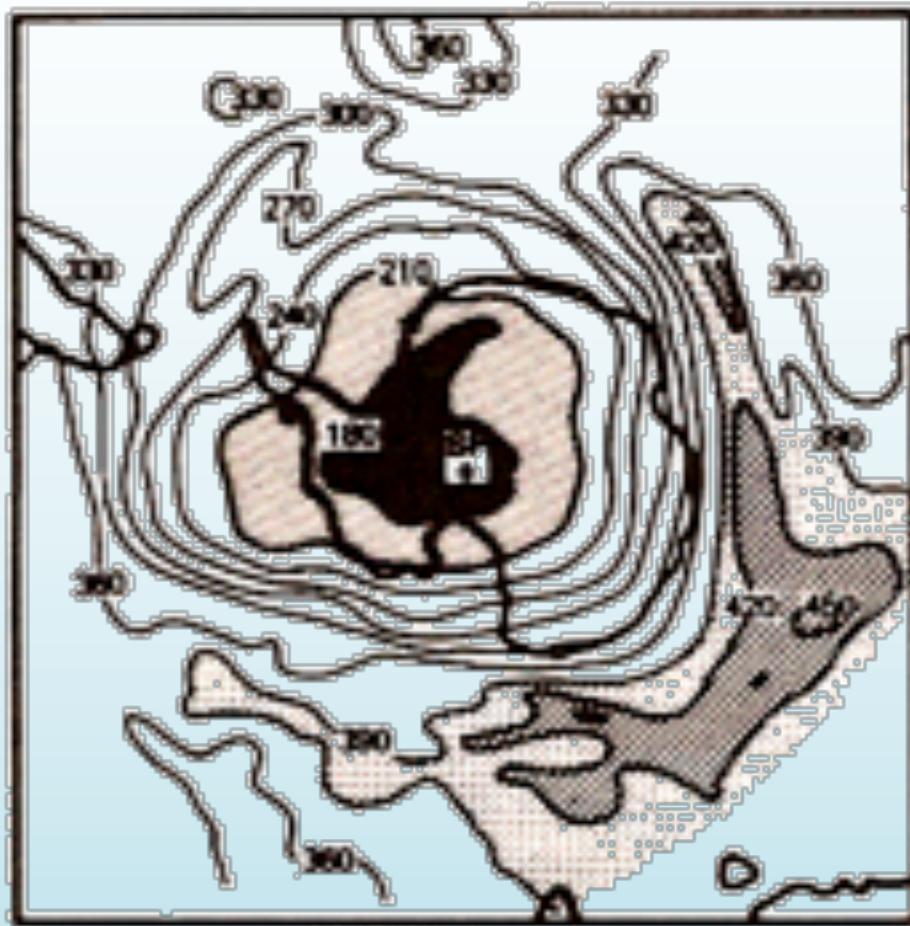
TOMS/SBUV and the ozone hole



First ozone hole image made from TOMS data
(shown by P.K. Bhartia at IAGA meeting in Prague, Aug. 1985)

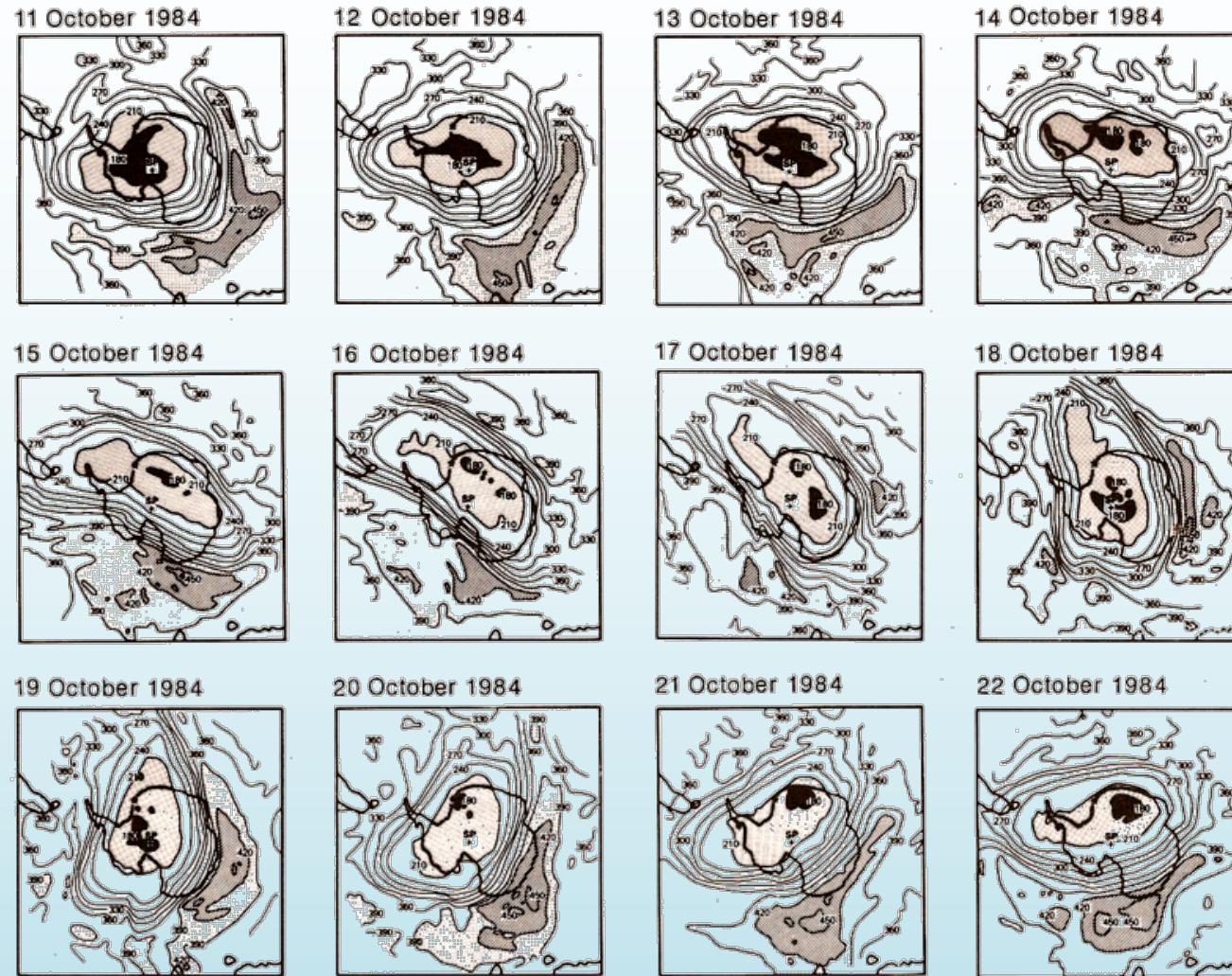
Daily TOMS measurements showing rotation of ozone minimum with Antarctic vortex

11 October 1984



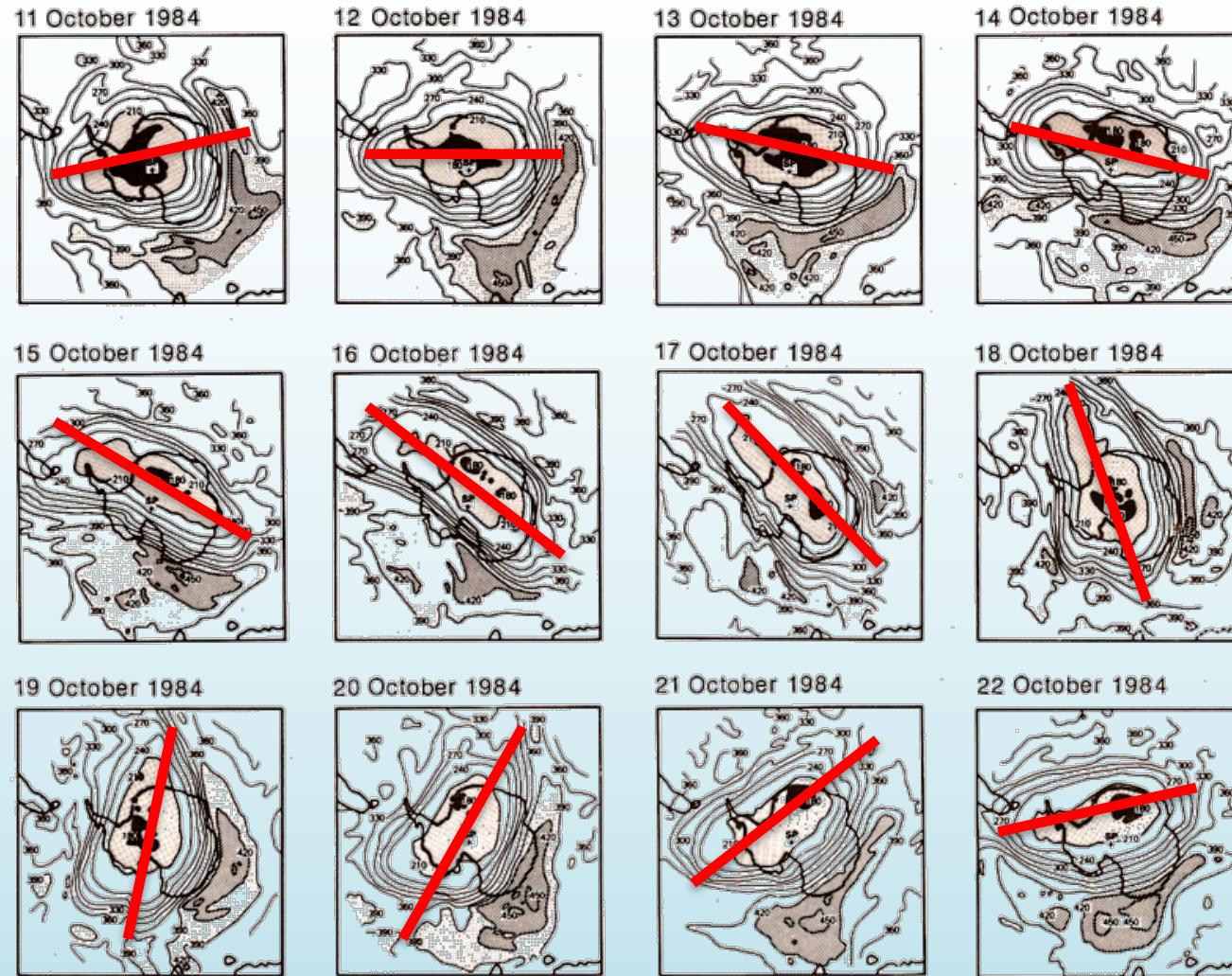
Stolarski et al. (1986), Nature, 322, 808-811

Daily TOMS measurements showing rotation of ozone minimum with Antarctic vortex



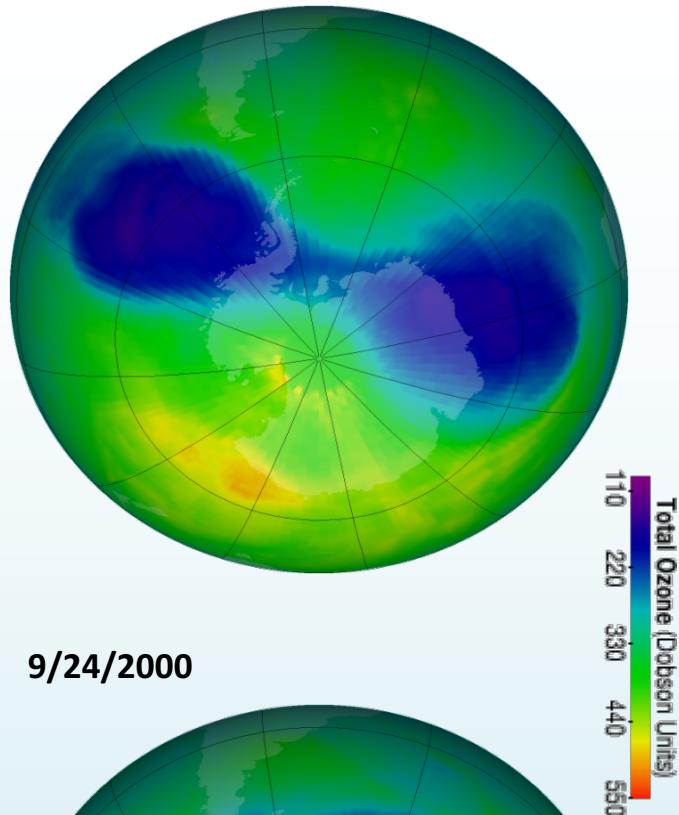
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Daily TOMS measurements showing rotation of ozone minimum with Antarctic vortex

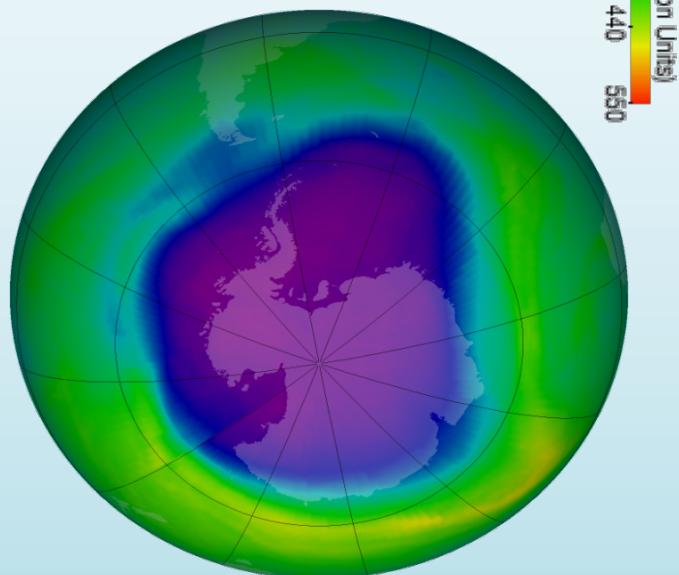


Stolarski et al. (1986), Nature, 322, 808-811

9/24/2002



9/24/2000

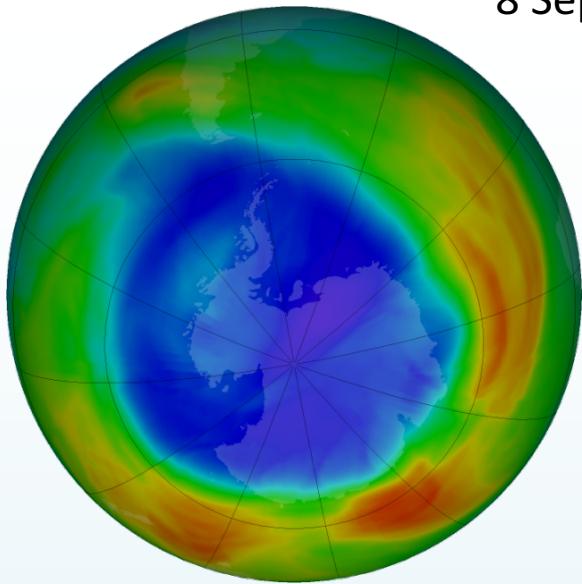


Daily mapping shows
some odd features of
ozone hole such as split
in 2002

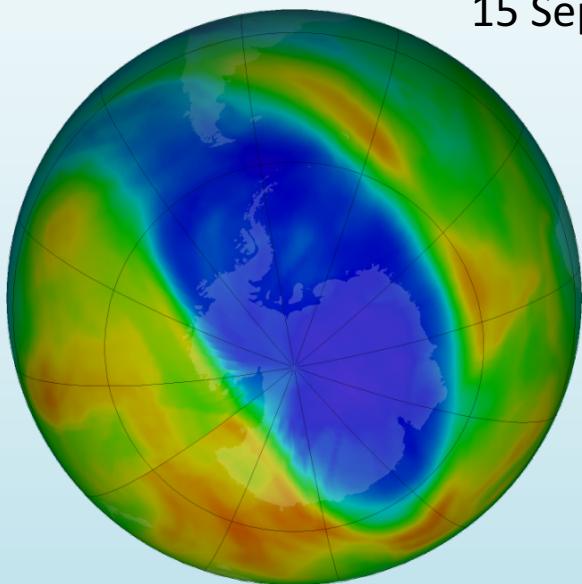
or more normal year in
2000

<https://ozonewatch.gsfc.nasa.gov>

8 September 2017



15 September 2017

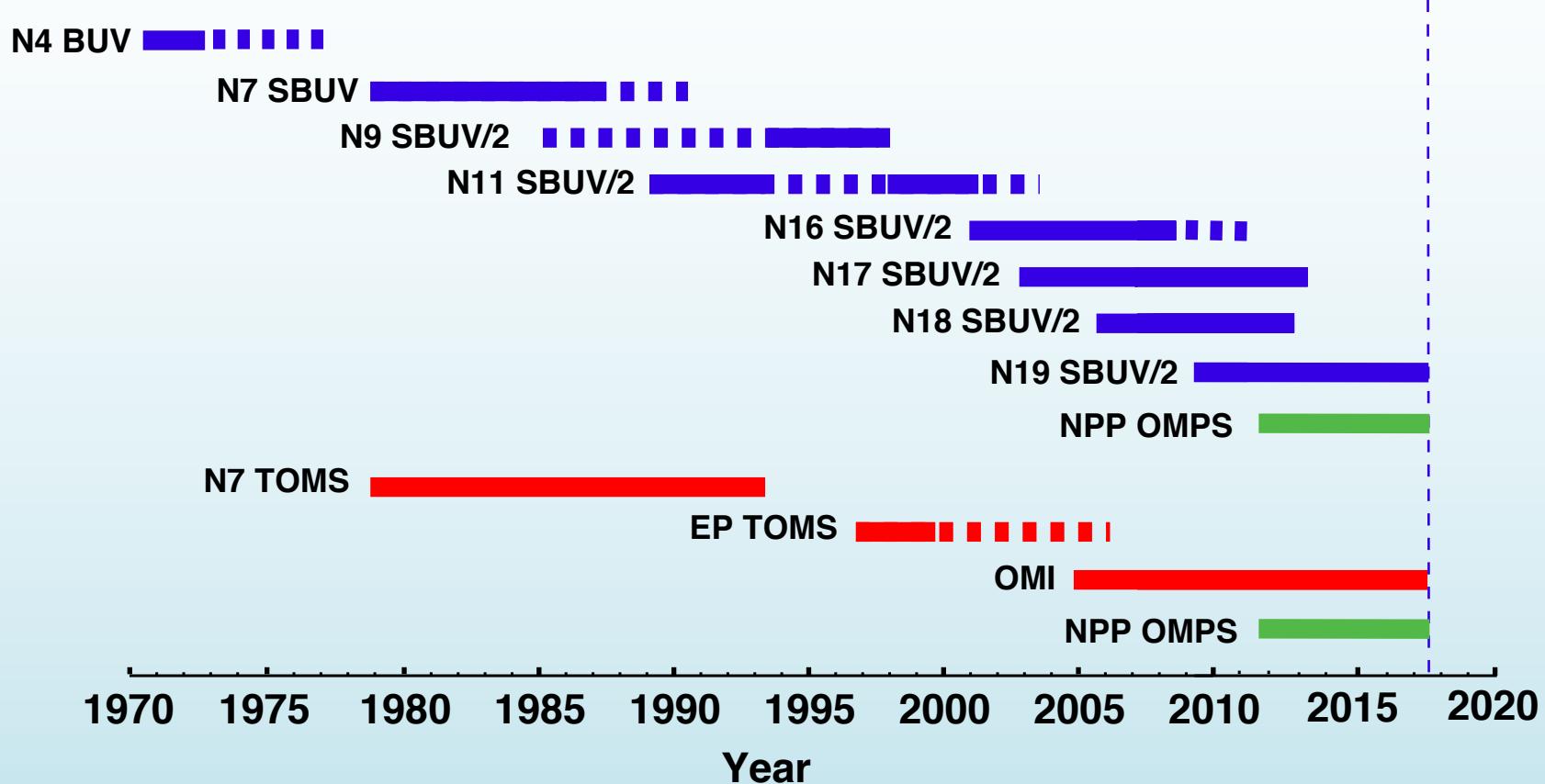


**2017 ozone hole
beginning to see
significant
distortion of
vortex**

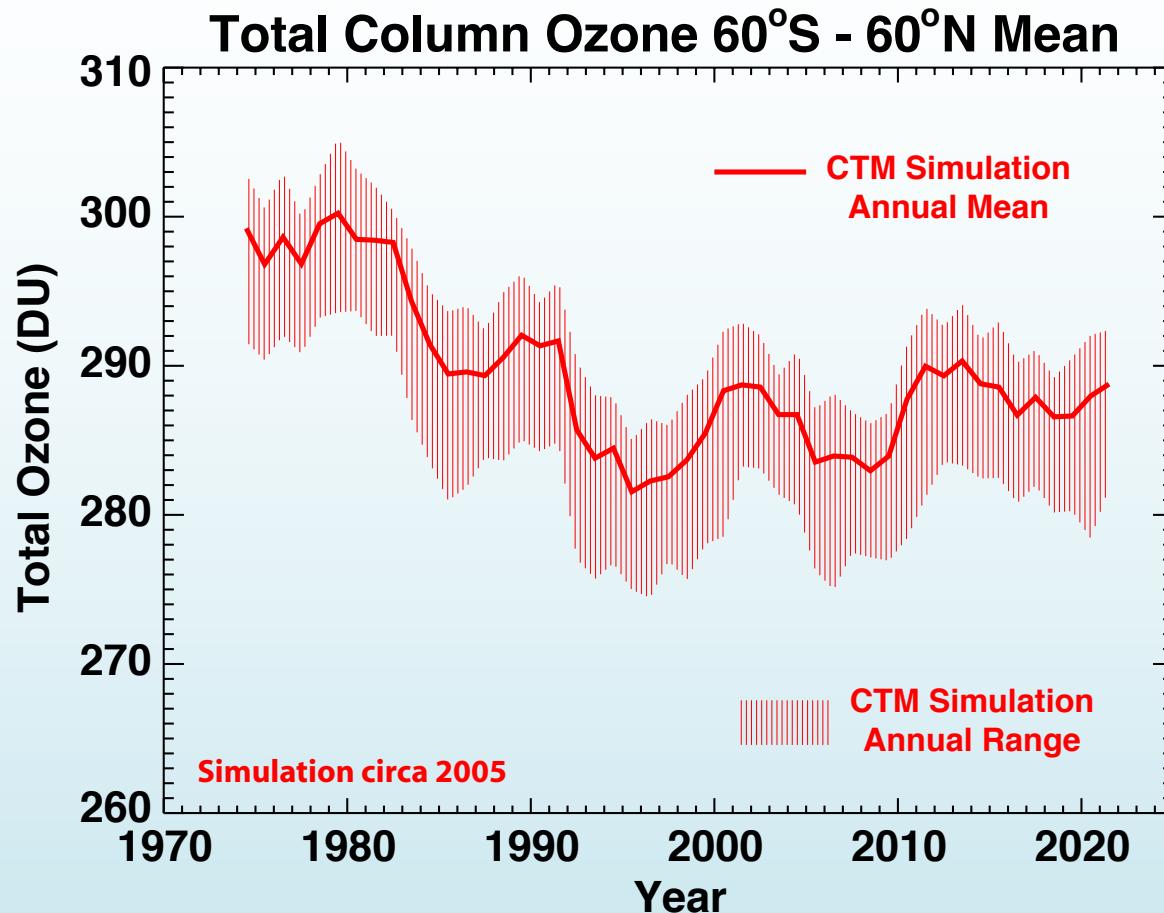
Images from NPP OMPS instrument

SBUV as a long-term global ozone data set

Backscatter Ultraviolet Satellite Instruments

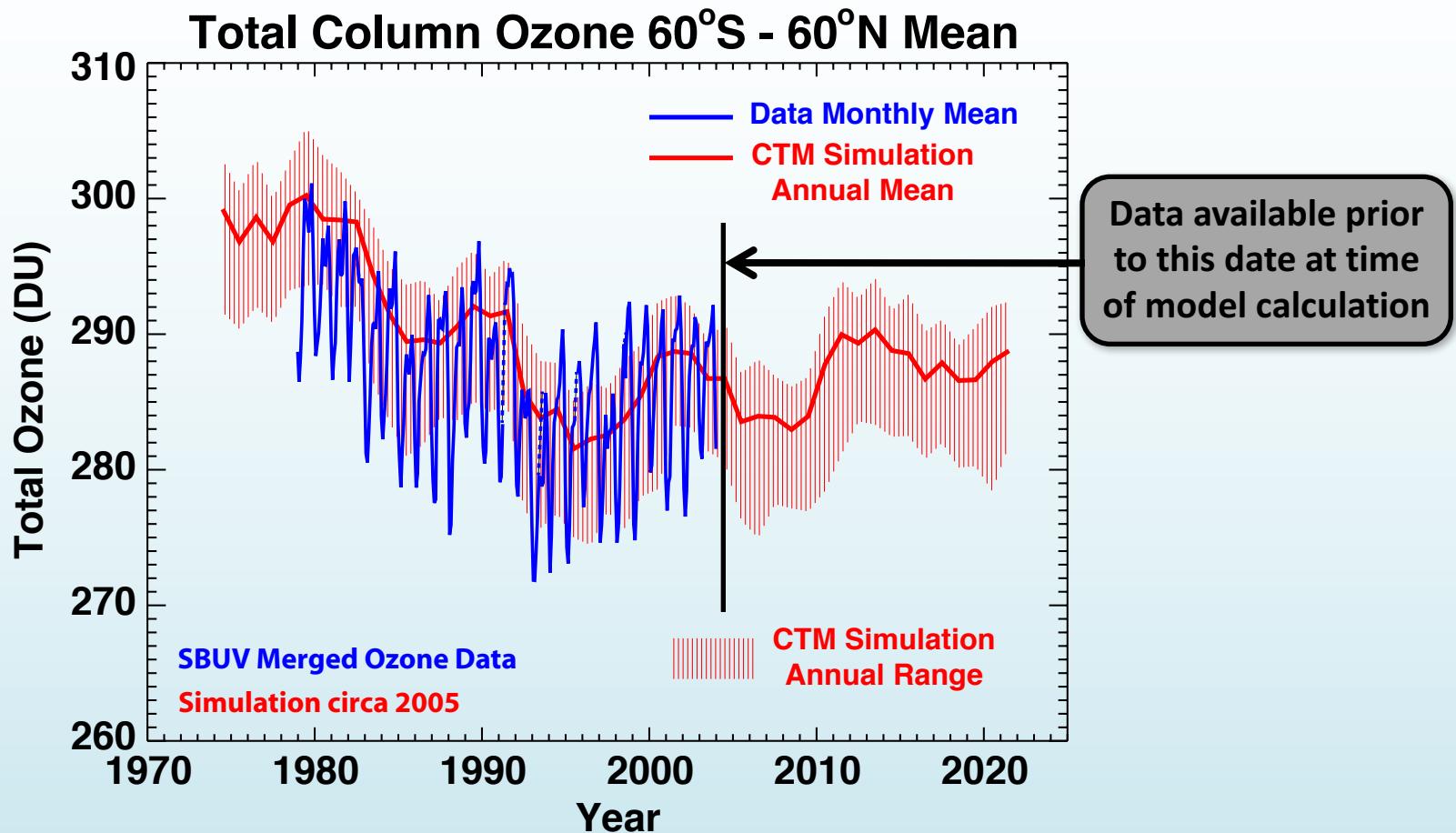


CTM projection of total ozone including CFCs, solar cycle and volcanoes



Model: Stolarski et al. (2006), J. Atmos. Sci., 63, 1028–1041

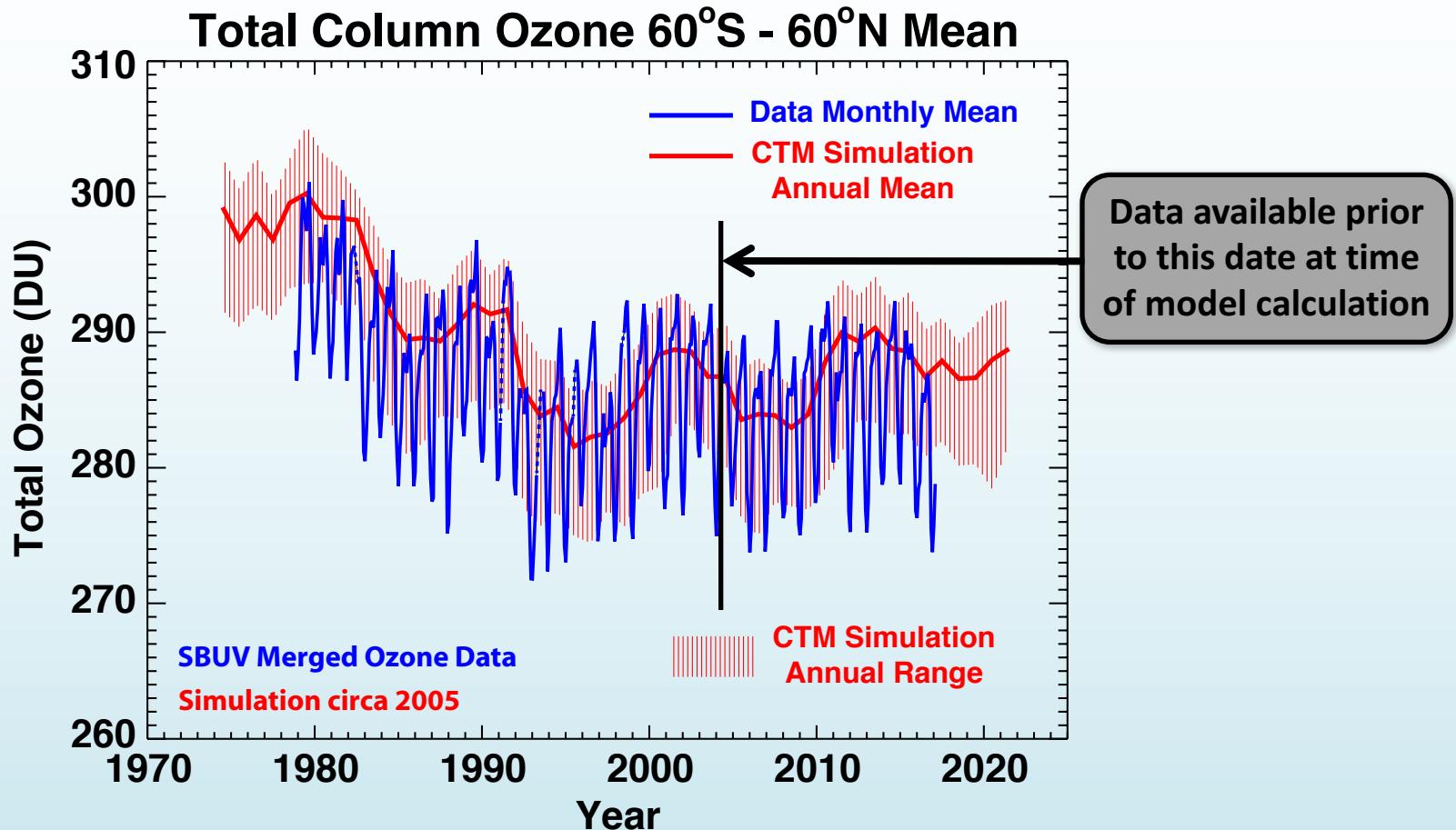
Model comparison with SBUV ozone data



Data: Stolarski and Frith, (2006) ACP 6, 4057-4065

Model: Stolarski et al. (2006), J. Atmos. Sci., 63, 1028–1041

Extension of SBUV data through Feb-2017



Data: Frith et al. (2014) JGR, 119, 9735-9751 (updated)

Model: Stolarski et al. (2006), J. Atmos. Sci., 63, 1028–1041

Data available at https://acd-ext.gsfc.nasa.gov/Data_services/merged

Backscatter UV Instruments (Summary)

- Provided early maps of ozone hole and its relationship to polar meteorology
- Launched on both research and operational polar-orbiting satellites providing past and future continuous global measurements

Ozone hole maps available at:

<https://ozonewatch.gsfc.nasa.gov>

Merged ozone data available at

https://acd-ext.gsfc.nasa.gov/Data_services/merged