CLIMATE CHANGE INITIATIVE

# Ozone_cci Newsletter

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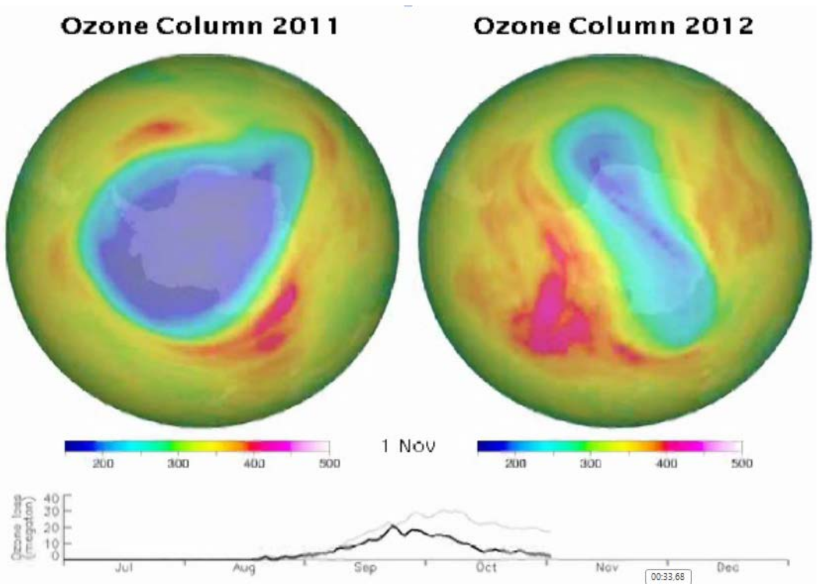


*Ozone distribution over the South Pole from July to December during the years 2011 (left) and 2012 (right). The 2012 ozone hole duration, geographical extension and depth was much smaller than that of 2011. Ozone loss over the South Pole is displayed at the bottom (the bold dark line indicates the ozone loss for 2012 and the grey line for 2011). The ozone maps were generated by the assimilation of GOME-2 total ozone data into the model TM3DAM. GOME-2 is carried by Eumetsat's MetOp mission.*

*Credits: KNMI*

## Ozone hole, ozone variability and climate change

Satellites show that the recent ozone hole over Antarctica was the smallest seen in the past 10 years. Long-term observations also reveal that Earth's ozone has been strengthening following international agreements to protect this vital layer of the atmosphere.

According to the GOME-2 ozone sensor on the Eumetsat's MetOp weather satellite, the hole over Antarctica in 2012 was the smallest in the last 10 years.

The GOME-2 instrument continues the long-term monitoring of atmospheric ozone started by its predecessors on the ERS-2 and Envisat satellites.

Since the beginning of the 1980ies the ozone hole develops over Antarctica each spring season (i.e. from September to November), showing a marked decrease in the total amount of ozone of up to 70%.

In the lower stratosphere at about 15-25 km altitude, ozone is almost completely destroyed during this season.

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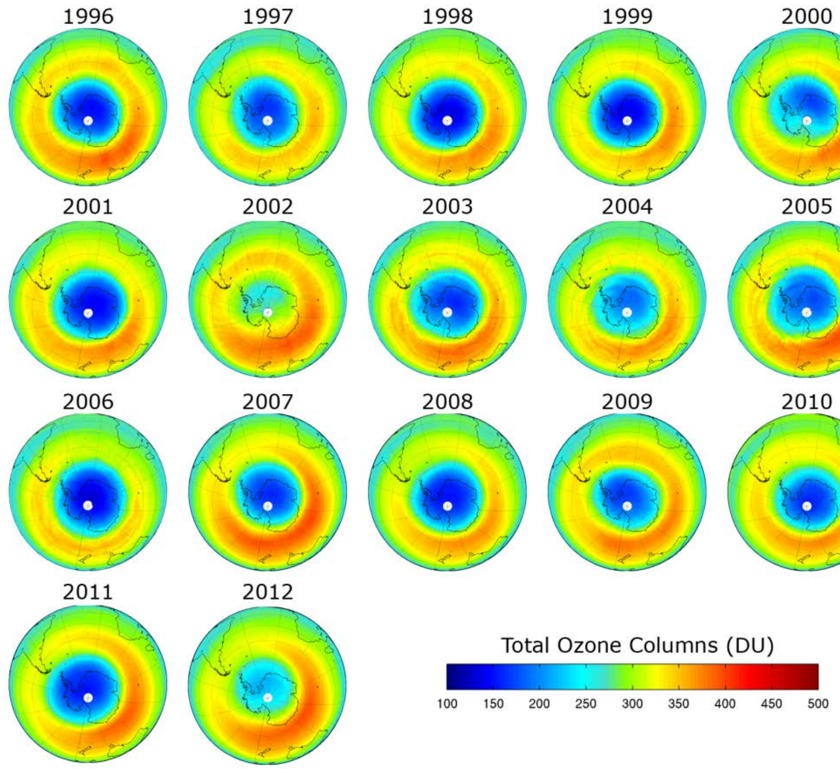
Relatively shortly after the discovery of the ozone hole, the ozone destruction mechanism in the south-polar stratosphere was explained as a combination of special meteorological conditions and changes in chemical composition induced by man-made chlorofluorocarbons (CFCs) and halons.

International agreements on protecting the stratospheric ozone layer (Montreal Protocol in 1987 and its amendments), efficiently stopped the rapid increase in concentrations of the main CFCs in the troposphere and since the mid-1990ies, a decline in tropospheric CFC content has been observed (WMO, 2011).

However, due to the long lifetimes of CFCs in the atmosphere, it will take until the middle of this century for the stratosphere's chlorine content to go back to values resembling those observed in the 1960ies.




*Time-series (1996 to 2012) of polar total ozone mean values over the months of September, October and November as measured by GOME, SCIAMACHY and GOME-2 flown on ERS-2, Envisat and MetOp, respectively. Smaller ozone holes are evident during 2002 and 2012.*

*Credits: BIRA/IASB*

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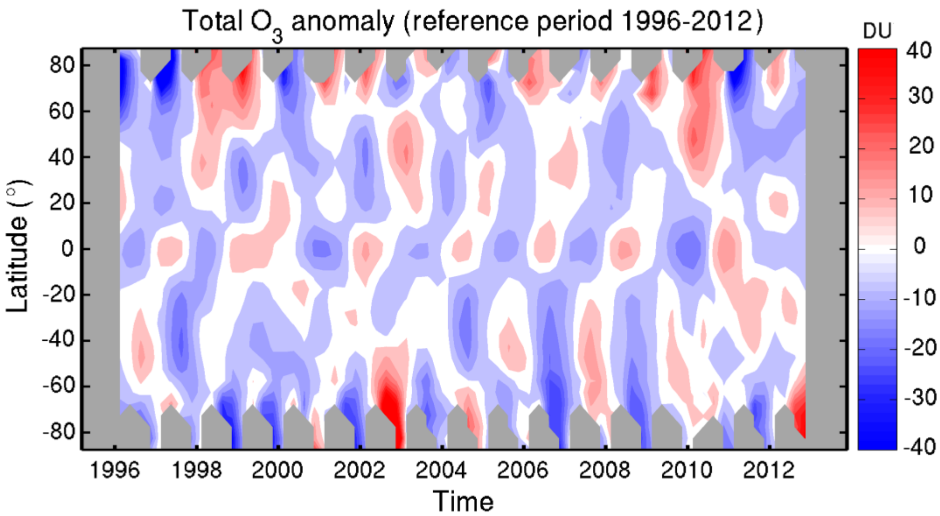



*Time-series of zonal mean anomalies in total ozone derived from the new multi-sensor CCI ozone data sets based on GOME, SCIAMACHY and GOME-2 instruments. Ozone column anomalies are related to meteorological phenomena such as the Quasi Biennial Oscillation (QBO). They also reveal unusual excursions such as e.g. the record low ozone observed during Spring 2011 in the Arctic, or smaller than usual Antarctic ozone holes in 2002 and 2012.*

*Credits: BIRA/IASB*

The timing of the ozone layer recovery and in particular the closure of the ozone hole is particularly difficult to forecast since the variability and future evolution of the ozone layer is affected by a number of processes, among them climate change which exerts an influence on atmospheric dynamics and – via temperature changes – on ozone chemistry.

To better understand these complex processes, scientists rely on data derived from observations and on results from numerical simulations based on complex atmospheric models.

Although ozone has been observed for several decades, an outstanding task is to combine existing observations from many different sensors on different platforms in such a way that one gets consistent and homogeneous data products suitable for solid scientific investigations.

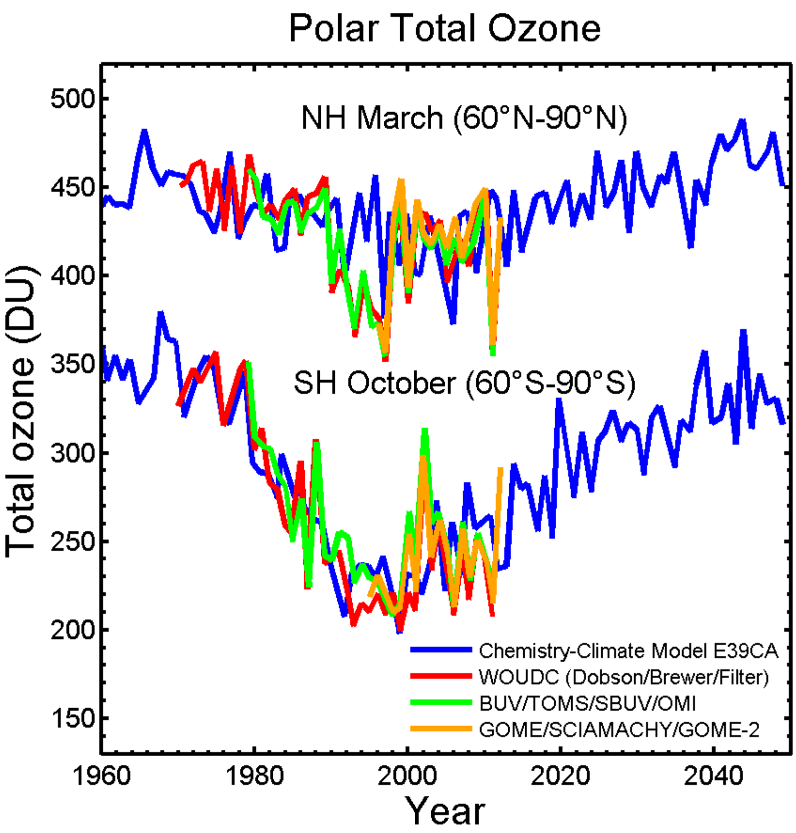
Within the ESA Climate Change Initiative (CCI), harmonized ozone Climate Data Records (CDRs) are generated to better document the variability of ozone changes at different scales in space and time.

One burning question is whether extreme events such as the record Arctic ozone loss in 2011 or the weak Antarctic holes in 2002 and 2012 are or will become more frequent under the influence of the climate change.

To provide some insight into this and other related questions, observations are compared with numerical models which simulate the complex atmospheric processes and their interaction with climate.

Based on prognostic studies with Chemistry Climate Models (CCMs) it is expected that the ozone layer will build up again and that the ozone hole over Antarctica will be closed in the next decades (Dameris and Loyola, 2011).

However due to the complexity of the interrelations between atmospheric chemistry and climate and the uncertainties on prognostic scenarios, surprising developments can not be ruled out in the future.




*Total polar ozone in the northern and southern hemispheres as measured by various instruments, including GOME, SCIAMACHY and GOME-2 flown on ERS-2, Envisat and MetOp, respectively (in orange). The blue line depicts projections based on simulations from the Chemistry Climate Model E39CA. The total ozone reached its lowest levels in both hemispheres in the late 1990s, and it is expected to increase in the coming years.*

*Credits: ESA/DLR/Eumetsat/NASA/WMO /GAW*

*Dameris, M. and D. Loyola, Recent and future evolution of the stratospheric ozone layer, Chapter 45 in Atmospheric Physics, Background-Methods-Trends, Ed. U. Schumann, Springer Heidelberg New York Dordrecht London, doi: 10.1007/978-3-642-30183-4, ISBN 978-3-642-30182-7, pp. 747-761, 2012.*