Climate Change and Ozone Hole

Greenhouse Gases

Carbon dioxide (CO_2) and methane (CH_4) are the two most important anthropogenic ("man-made") greenhouse gases and responsible for global warming.

Despite their importance our knowledge about their natural and anthropogenic sources and sinks has large gaps. A good knowledge of their sources and sinks is required for reliable climate prediction.

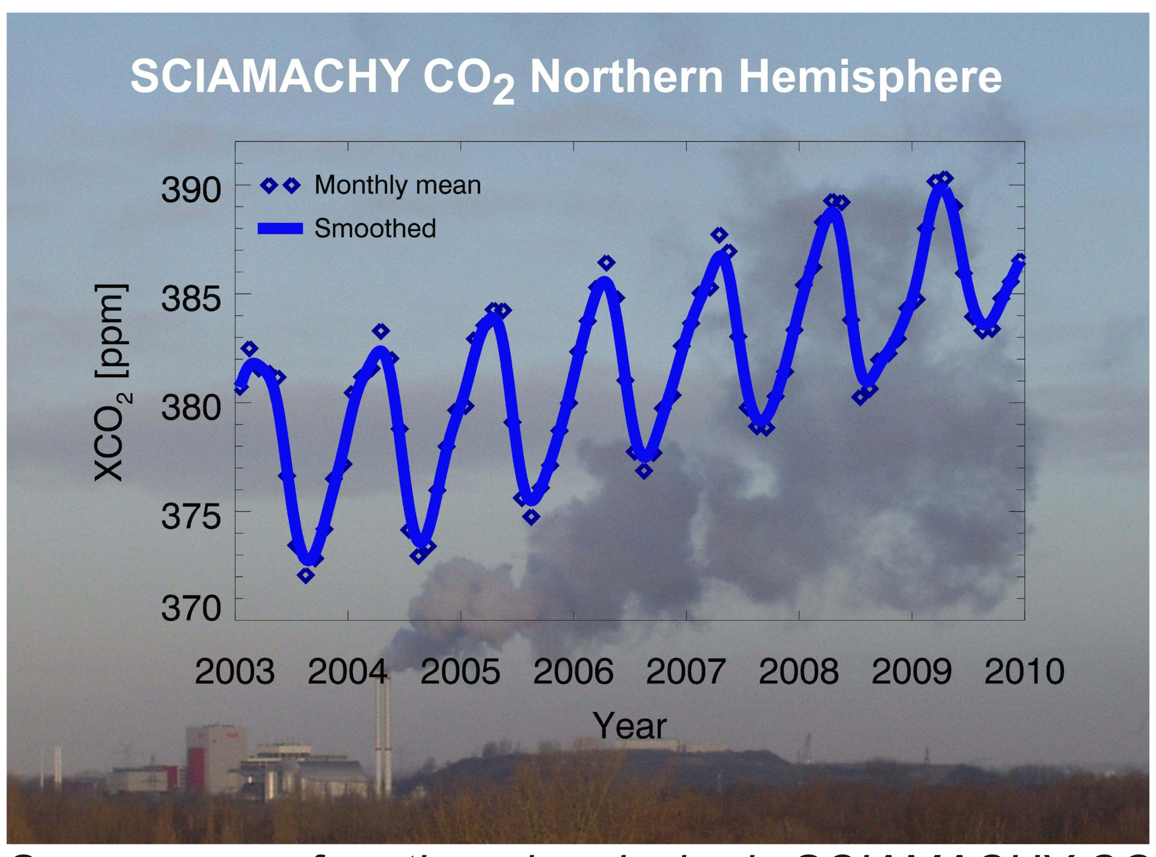
Satellite observations can add important missing global information.
At IUP we develop retrieval algorithms to convert the spectra measured by SCIAMACHY into information on atmospheric CO_2 and methane.

Carbon Dioxide

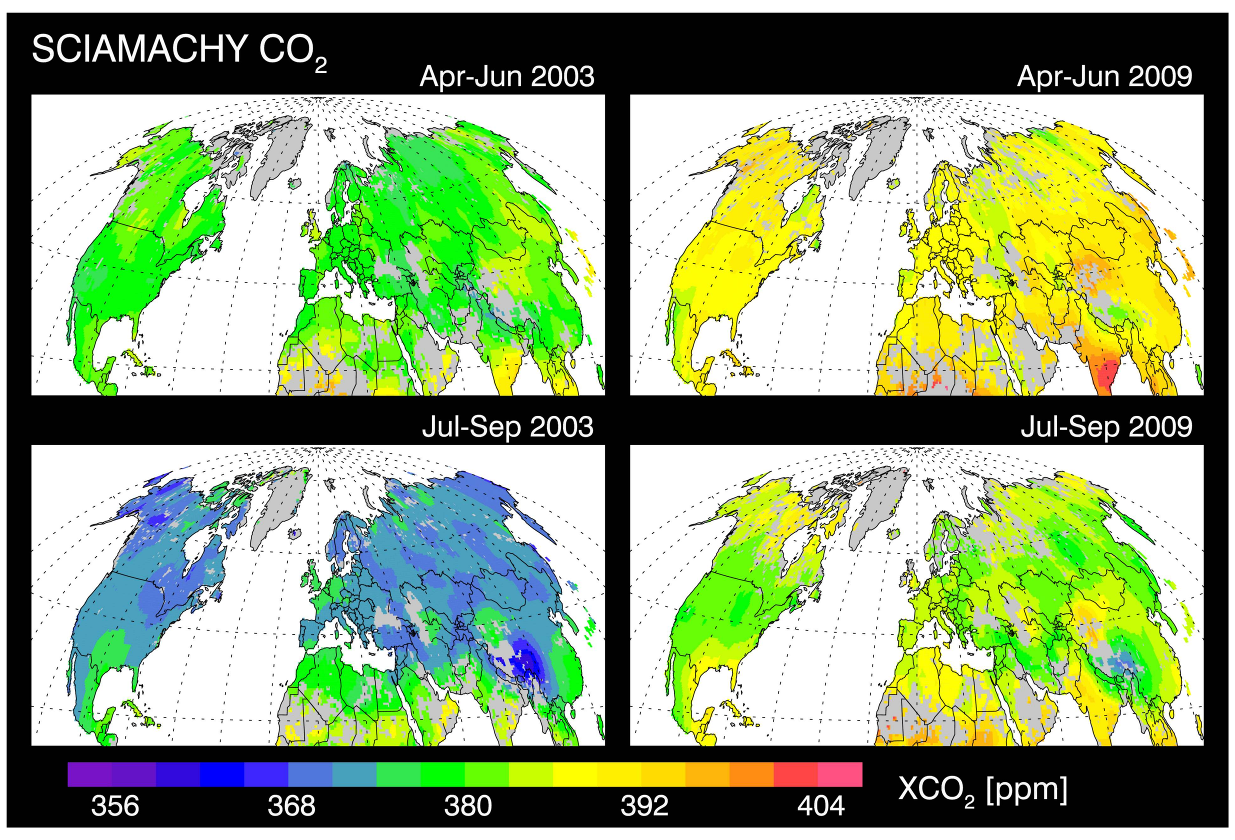
Atmospheric carbon dioxide (CO_2) is increasing by about 0.5% per year and shows large regular variations within each year.

The CO_2 increase is mainly caused by burning of fossil fuels (oil, coal, and gas).

The regular up and down of the atmospheric CO_2 concentrations is mainly due to uptake and release by vegetation.



Seven years of northern hemispheric SCIAMACHY CO_2 measurements.

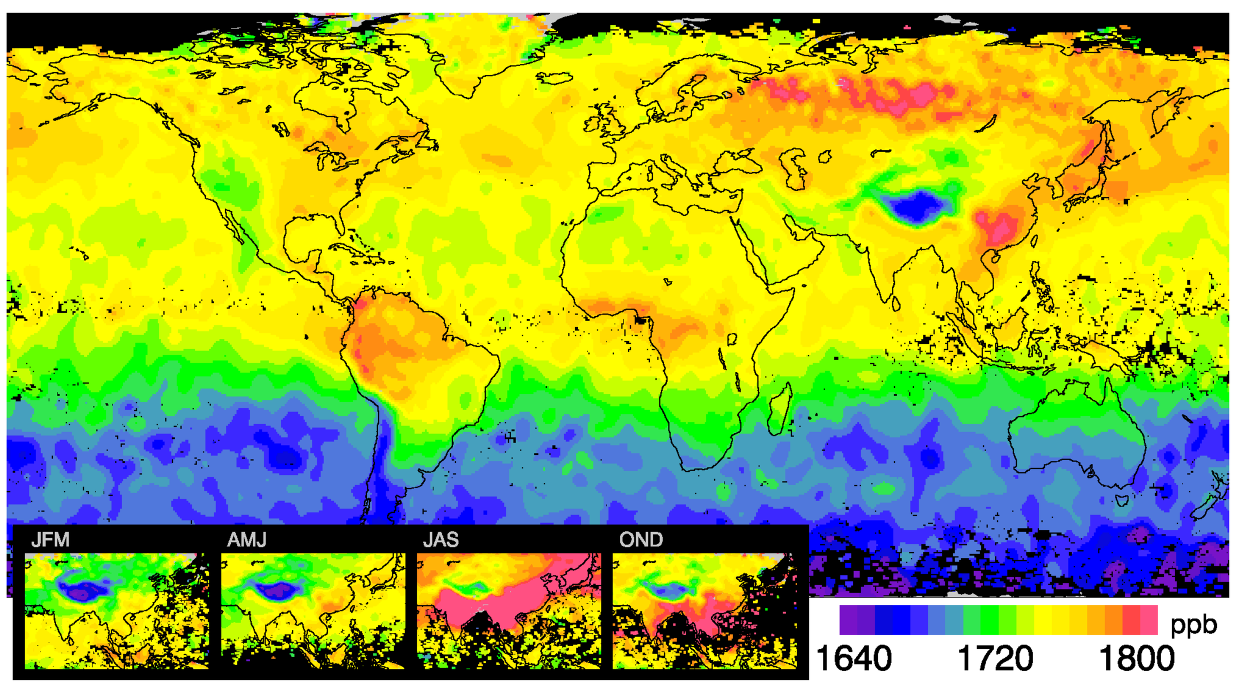


Maps of northern hemispheric CO_2 as measured by SCIAMACHY.

Methane

Methane (CH_4) is emitted to the atmosphere by many different natural and anthropogenic sources e.g. wetlands, rice fields, waste disposal sites (land fill), enteric fermentation by ruminants (e.g., cattle, sheep etc.), biomass burning, seeps, thawing of permafrost or releases of methane hydrates from ocean bottom etc..

The dominant methane source regions such as Siberian wetlands and the rice paddy and agricultural releases in parts of China and India are clearly visible in the SCIAMACHY measurements.
The increase in atmospheric CH_4 is complex and is primarily attributed to the anthropogenic modification of the terrestrial biosphere.



Maps of atmospheric CH_4 as measured by SCIAMACHY.

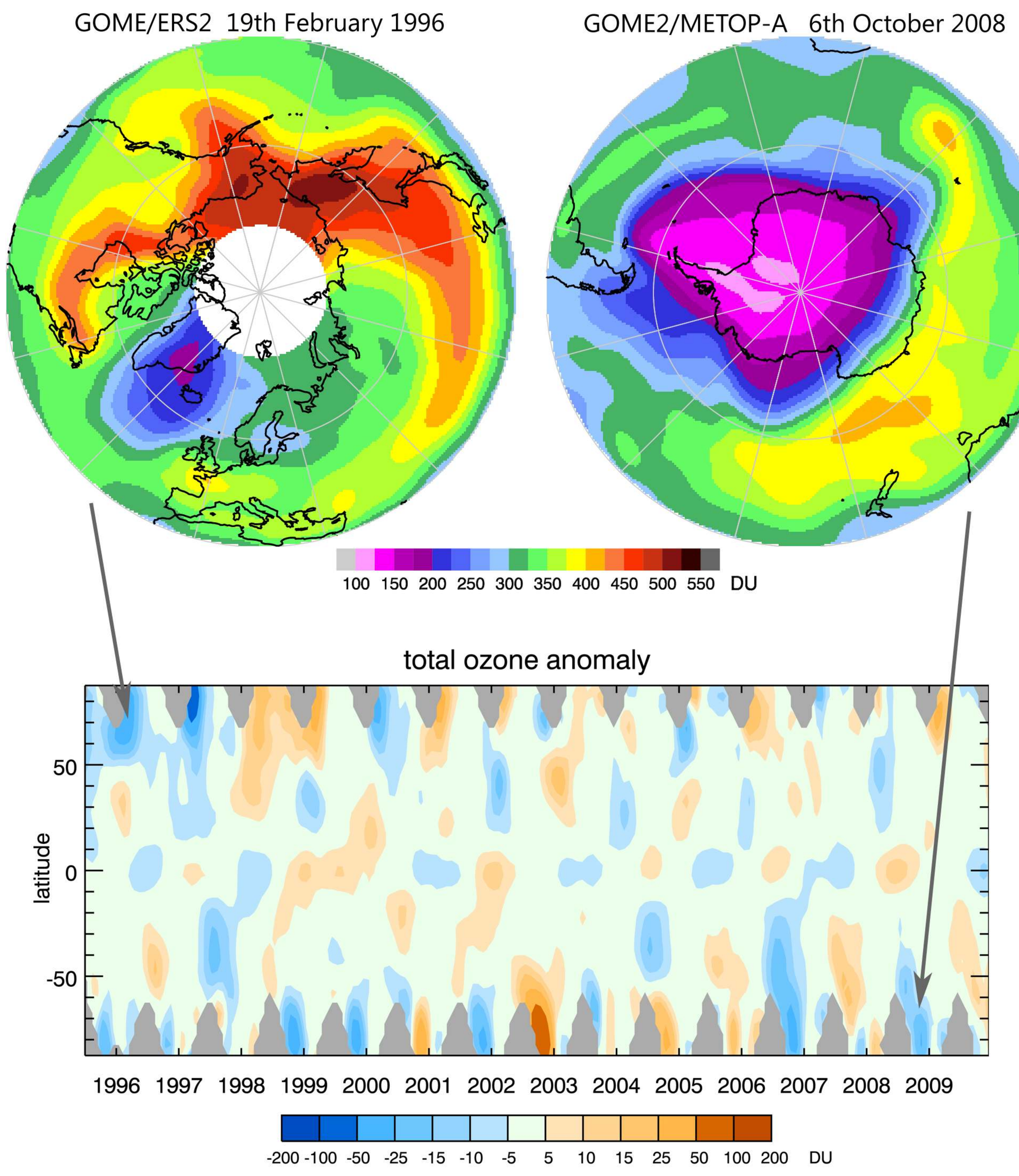
Polar ozone depletion ("ozone hole")

The ozone hole above Antarctica is formed every year during austral spring.

The main process responsible for the severe chemical ozone loss are reactions with halogen compounds, produced as a result of the release of manmade chlorofluorocarbons (CFCs) and related species.

As a consequence of the Montreal Protocol, which successfully phased out ozone depleting substances, the stratospheric halogen loading is now slowly declining.

A recovery to pre-ozone hole era values is not expected before the middle of this century.



The rate of global ozone recovery to a large extent depends on the feedback from future climate change.

Year-to-year changes in meteorology leads to variability in the Antarctic ozone hole and more sporadic and variable chemical ozone loss above the Arctic during polar spring.

Total ozone column amount above the Arctic (top, left) and Antarctica (top, right). Violet colors indicate regions of very low ozone. The bottom panel shows the total ozone anomalies and the year-to-year variability in global ozone.

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