Satellite observations by the University of Bremen: Global greenhouse gas concentrations continued to increase strongly in 2022

Preliminary analyses of global satellite data by environmental researchers at the University of Bremen show that atmospheric concentrations of the two important greenhouse gases carbon dioxide (CO_2) and methane (CH_4) continued to rise sharply in 2022. The methane increase remains very high in 2022 at about 0.6% (11.8 ppb), but is below the record levels of the past two years (15.2 ppb and 17.1 ppb). The reasons for the current high increase are probably a combination of increased emissions and a temporary decrease in the atmospheric methane sink. The CO_2 increase is similar to past years, i.e., 0.5% (2.1 ppm).

The Institute of Environmental Physics (IUP) at the University of Bremen (UB) is a world-leading institute in the field of evaluation and interpretation of global satellite measurements of the greenhouse gases carbon dioxide (CO_2) and methane (CH_4) and other atmospheric trace gases, which are of great importance for climate and air quality.

IUP-UB leads the GHG-CCI greenhouse gas project of the European Space Agency's (ESA) Climate Change Initiative (CCI) and provides related data to the European Copernicus Climate Change Service C3S and the Copernicus Atmosphere Monitoring Service CAMS. The latest Copernicus communication on greenhouse gas trends (see link below) uses satellite data and analysis provided by IUP-UB.

Time series of greenhouse gas measurements from space begin in late 2002 with the SCIAMACHY instrument, which was proposed and scientifically led by scientists from IUP-UB and flew on ESA's Envisat satellite. These measurements are currently being continued by Japanese (GOSAT and GOSAT-2) and U.S. (OCO-2) satellites, among others.

The satellites measure the vertically averaged atmospheric mixing ratio of CO_2 and CH_4. These measurements are designated XCO_2 and XCH_4, and they differ from the commonly reported measurements of ground-level concentrations. The data are reported in parts per million (ppm) for CO_2 and in parts per billion (ppb) for CH_4. An XCO_2 concentration of 400 ppm means that the atmosphere contains 400 CO_2 molecules per one million air molecules.

The figure shows time series of the concentrations of both gases (top) since the beginning of 2003. As can be seen, CO_2 increases almost uniformly - in contrast to methane. The methane concentration was on average approximately constant between 2000 and 2006 but started to increase (again) since 2007 with record annual growth rates in 2020 and 2021 (bottom). The high growth rates are probably associated with a COVID-19-induced enhancement of the methane sink but also with increasing methane emissions (details see "Press Release"). Unfortunately, however, there are still many gaps in our knowledge on the various natural and anthropogenic sources and sinks of methane and other greenhouse gases. Consequently, it is important to optimally use and further improve the global observations system for climate relevant parameters.

Additional information:

Press Release:
Copernicus: 2022 was a year of climate extremes, with record high temperatures and rising concentrations of greenhouse gases
https://climate.copernicus.eu/copernicus-2022-was-year-climate-extremes-record-high-temperatures-and-rising-concentrations
(Link to corresponding Copernicus Press Release)

https://atmosphere.copernicus.eu/
(Copernicus Climate Change Service (C3S))

https://atmosphere.copernicus.eu/
(Copernicus Atmosphere Monitoring Service (CAMS))

https://climate.esa.int/en/projects/ghgs/
(Greenhouse gas project GHG-CCI of ESA's Climate Change Initiative)

www.iup.uni-bremen.de/eng
(Institute of Environmental Physics (IUP) of the University of Bremen)

www.iup.uni-bremen.de/carbon_ghg
(Website of satellite greenhouse gas group of the IUP)

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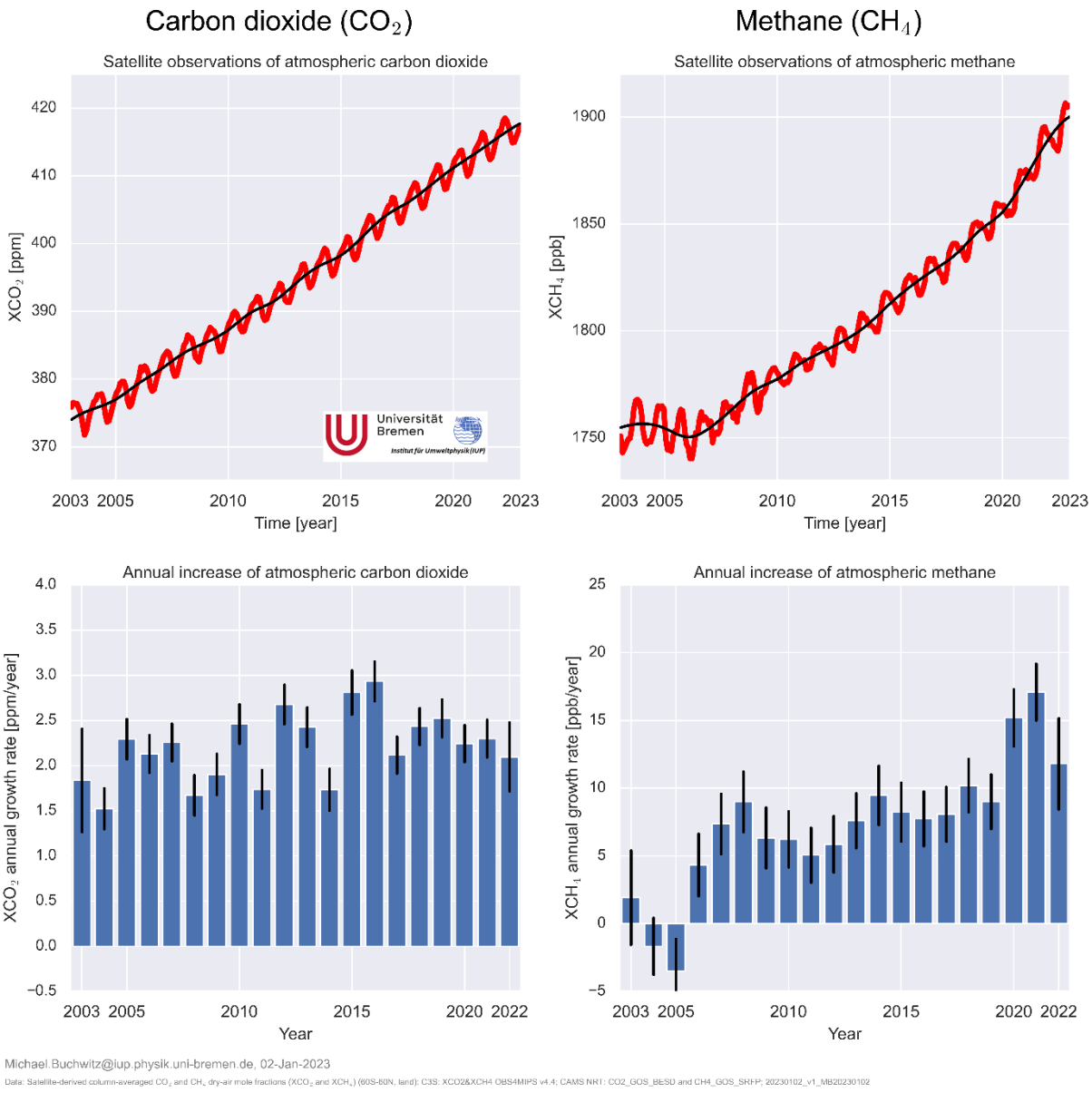

Time series of atmospheric concentrations (top) and annual rates of increase (bottom) of the two greenhouse gases CO_2 (left) and methane (right). Link: https://www.iup.uni-bremen.de/carbon_ghg/figs8/A4_ts5_XCO2_XCH4_C3SCCI_OBS4MIPS_v4.4_CAMSNRT_20230102_v1_MB20230102_IUP.png