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# Satellite observations of atmospheric carbon dioxide for Copernicus services

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Previously, satellite-derived atmospheric carbon dioxide ($CO_2$) and methane (CH4) Essential Climate Variable (ECV) data sets have been generated and made available via the GHG-CCI project of ESA's Climate Change Initiative (CCI, http://www.esa-ghg-cci.org/). Currently, the production and provision of these data sets is being continued operationally via the Copernicus Climate Change Service (C3S, https://climate.copernicus.eu/), which is implemented by ECMWF on behalf of the European Commission (EC). In this presentation an overview about these data sets will be given focusing on column-averaged dry-air mole fractions of $CO_2$, denoted $XCO_2$. Currently, this C3S data set covers the time period 2003-2017 but will be extended each year but one additional year. In addition, $XCO_2$ from GOSAT is generated in quasi near-real-time for the Copernicus Atmosphere Monitoring Service (CAMS, https://atmosphere.copernicus.eu/) and the combined C3S/CAMS data set covering 2003-2018 has been used to provide up-to-date information on, for example, annual mean $XCO_2$ growth rates. Main applications for the C3S data set are climate and carbon related applications such as comparisons with climate models and improving our knowledge of $CO_2$ sources and sinks. Current satellites have however not been optimized to monitor anthropogenic emissions. To improve this situation in the future, ESA and the EC supported by other institutions and European and international scientist are working on the specification of a $CO_2$ Monitoring ($CO_2$M) mission, which will likely be a constellation of Sentinel satellites. In addition to high-resolution (approx. 2x2 km2) $CO_2$ and CH4 observations, $CO_2$M will also provide Solar-Induced-Fluorescence (SIF) and information on $NO_2$ and aerosols probably via dedicated instruments on the same platform. In the presentation an overview about these current and future Copernicus $CO_2$-related activities will be presented.