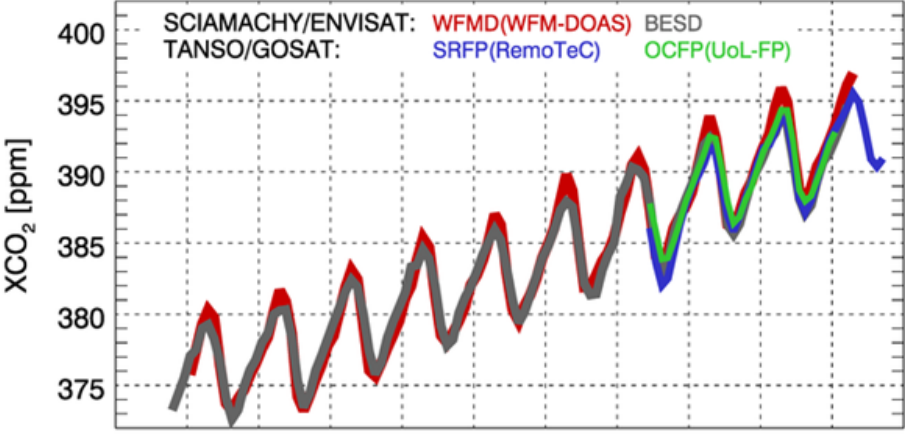


# Product Sheet: Air Quality CO2

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| Air quality CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  | <a href="#">Download Product Sheet</a> |
| <div><div>GHG-CCI CRDP#1</div><div><div>Carbon Dioxide (CO<sub>2</sub>) - NH (0°-60°N)</div><div><div><div>SCIAMACHY/ENVISAT: WFMD(WFM-DOAS)</div><div>TANSO/GOSAT: SRFP(RemoTeC)</div><div>BESD OCFP(UoL-FP)</div></div><div></div><div>Year</div></div><div>Satellite observed variability in XCO<sub>2</sub> concentrations over time (source: University Bremen/ESA)</div></div></div>                                                                                                                 |  |                                        |
| PRODUCT DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |                                        |
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                        |
| <div><div><div><input type="checkbox"/> Topographic information</div><div><input type="checkbox"/> Impact assessment</div><div><input checked="" type="checkbox"/> Change detection / continuous monitoring</div><div><input type="checkbox"/> Land cover / use</div><div><input type="checkbox"/> Near surface geology</div></div><div><div><input type="checkbox"/> Surface deformation</div><div><input type="checkbox"/> Precision ortho-images</div><div><input type="checkbox"/> Terrain information</div><div><input type="checkbox"/> Water quantity &amp; quality</div></div></div> |  |                                        |
| Uses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |                                        |
| <ul style="list-style-type: none"><li>• Environmental Assessment &amp; Permitting – Mining companies need to understand what impact they may have on the air quality around the operation for the people and the environment.</li><li>• Design, Construction &amp; Operations – Measurement and monitoring of the quantity of different particulates to the atmosphere.</li><li>• Closure and Aftercare – During closure and aftercare period should be demonstrated that there are no ongoing air emissions from the site and emissions return back to baseline</li></ul>                   |  |                                        |
| Challenges addressed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |                                        |
| <ul style="list-style-type: none"><li>• Permitting Process – Air quality</li><li>• Development and Operations – Environmental Monitoring</li><li>• Closure and Aftercare – Environmental Monitoring</li></ul>                                                                                                                                                                                                                                                                                                                                                                                |  |                                        |
| Geo-information needs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                                        |
| <ul style="list-style-type: none"><li>• P-6 Ambient Air Quality / Particulate Fallout</li><li>• DO-24 Monitoring air emissions – point source</li><li>• DO-25 Monitoring air emissions - fugitive</li><li>• CA-7 Demonstration of return to baseline air quality – including deposition</li></ul>                                                                                                                                                                                                                                                                                            |  |                                        |
| Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |                                        |

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| <p>This product provides information on atmospheric carbon dioxide (CO<sub>2</sub>) – one of the most important greenhouse gases that contribute to global warming. Space-based remote sensing of the CO<sub>2</sub> column-average dry air mole fractions (XCO<sub>2</sub>) has the potential to provide observed global constraints on CO<sub>2</sub> fluxes across the surface-atmosphere boundary and to provide insight into the related biogeochemical cycles. XCO<sub>2</sub> products retrieved from these satellites have been validated with reference to high-resolution ground-based Fourier Transform Spectrometers (g-b FTS) data and model data.</p> <p>The Japanese Greenhouse Gases Observing Satellite, GOSAT, is the first satellite designed specifically for this application. GOSAT has been collecting CO<sub>2</sub> and methane (CH<sub>4</sub>) observations over the sunlit hemisphere since April 2009. These data are beginning to yield new insights into the carbon cycle. Furthermore, in July 2014 NASA launched the second satellite dedicated to the measurement of CO<sub>2</sub>- the Orbiting Carbon Observatory-2 (OCO-2). The OCO-2 satellite is being operated by NASA's Jet Propulsion Laboratory and its stated mission objective is to "Collect the first space-based global measurements of atmospheric CO<sub>2</sub> with the precision, resolution, and coverage needed to characterize its sources and sinks on regional scales and quantify their variability over the seasonal cycle". The spatial resolution of these instruments is relatively low (GOSAT: ~ 1 x 1 km<sup>2</sup>; OCO-2: ~ 1.5 x 2.5 km<sup>2</sup>). The major focus of both of these missions is the determination of the global CO<sub>2</sub> burden and its regional variations. OCO-3 is launched in May 2019 and will follow up on the OCO-2 observations onboard the International Space Station (ISS). GOSAT-2 has been launched in 2018 and the expected release of data is in 2019.</p> <p>In contrast, the first mission dedicated to the high-resolution measurement of CO<sub>2</sub> and CH<sub>4</sub> emissions from space is the commercial satellite GHGSat, which was launched in 2015. GHGSat spatial resolution is 50 x 50 m<sup>2</sup> , within a ground footprint of 10 x 15 km<sup>2</sup>. This allows high precision mapping of emissions from identified target sources as opposed to obtaining averages over large areas. Their demonstrator satellite could detect modest leaks from individual wells.</p> <p>Additionally to the satellite observations there are airborne observations that complement EO-based data within the Active Sensing of CO2 Emissions over Nights, Days &amp; Seasons (ASCENDS) initiative. Furthermore the Space Carbon Observatory (SCARBO) aims at supplementing the existing products with observations by multiple nano-satellites. This will result in more accurate observations of CO2. The launch of these nano-satellites are planned to be in 2028. Other future initiatives include MicorCarb (CNES) that is expected to be launched in 2020 and GOSAT-3 (follow-up of GOSAT-2 with expected launch 2022).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                   |                                         |                          |                                     |                      |
| Known restrictions / limitations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                   |                                         |                          |                                     |                      |
| <p>Spatial resolution of carbon dioxide retrievals from satellite-based EO are relatively coarse – native resolution of sensors on existing missions is approximately 4 km<sup>2</sup> (OCO-2) to 75 km<sup>2</sup> (GOSAT). Regional chemical transport models, used to assimilate the measurements of these missions have typical spatial resolutions ranging from 12 x 12 km<sup>2</sup> to 3 x 3 km<sup>2</sup>.</p> <p>Future systems or commercial systems should provide improved retrievals.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                   |                                         |                          |                                     |                      |
| Lifecycle stage and demand                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                   |                                         |                          |                                     |                      |
| Exploration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                   | Environmental Assessment and Permitting |                          | Design, Construction and Operations |                      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                   |                                         |                          | Mine Closure and Aftercare          |                      |
| <p><b>Environmental Assessment &amp; Permitting:</b> Mining companies need to understand what impact they may have on the air quality around the operation and what impact this air quality might have on people and the environment. As part of the permitting process it is necessary to establish what the baseline is, and to demonstrate that this will not be materially affected when mining operations are underway and when the mine is closed and rehabilitated. Sampling will be required over a wide area and will typically be governed by dispersion modelling. A 10 km<sup>2</sup> area may be taken as typical for monitoring of ambient air for a mid-size mining operation. Within this 10 km<sup>2</sup> area in the order of 10 to 20 sampling points may be established. There are sulphur (CO<sub>x</sub>, NO<sub>x</sub> and SO<sub>x</sub>). Individual metal parameters within the air column can also be determined. The amount of particulate that falls out on to the ground can be measured on a per m2 basis (typically 'X' mg/ m<sup>2</sup>/day). Minimum levels of detection can be taken from 'Technische Anleitung zur Reinhaltung der Luft', which is a comprehensive document issued by the German government, which describes air quality standards. This document, commonly referred to as the 'TA Luft', is used by many countries and organisations as a reference for air quality.</p> <p><b>Design, Construction &amp; Operations:</b> Mining operations will have point source air emissions from ventilations shafts, processing plants, labs, power plants etc. Measuring the quantity of different parameters emitted into the atmosphere (gaseous and solid) is an important aspect for mining companies to manage their potential environmental impact. Typical parameters are CO<sub>x</sub>, NO<sub>x</sub>, SO<sub>x</sub>, Particulate, H<sub>2</sub>S. The area required to be assessed will be dependent on the footprint of the mining operation and could be 1 km<sup>2</sup> to 10 km<sup>2</sup>. Air emissions can result in transboundary impacts on air quality beyond the site boundary. The extent of transboundary impact depends on the nature of the emission and also prevailing weather conditions and geographic features. Given the mobility of air emissions, an area of hundreds of km<sup>2</sup> may need to be monitored. Air emissions will take place on a continuous basis. Many air emissions will be stable and infrequent measurement of monthly to quarterly will be sufficient. Other emissions will be more variable and subject to disruption, these would ideally be measured on a continuous basis. In addition to point source air emissions, mines will have significant fugitive air emissions, these can be plumes from pit blasts, dust from vehicular movement, dust blow off TSF / WRD, and fires. Monitoring for fugitive emissions is an important aspect for mining companies to manage their potential environmental impact. This fugitive monitoring can also be used to identify sources of emission and implement corrective actions (including identifying spontaneous combustion fires and arrange to have these extinguished). The frequency required for monitoring this parameter is site specific. In many instances monthly would be sufficient but in particular for the identification of spontaneous combustion continuous monitoring would be of benefit</p> <p><b>Mine Closure &amp; Aftercare:</b> Monitoring will be required during the closure and aftercare period to demonstrate that there are no ongoing air emissions from the site that could cause an impact. Point sources will no longer be operational. The focus will be on fugitive emissions from WRD's and TSF's. Assessment of this parameter will involve field work including measurement of air quality for various parameters and measurement of particulate fallout. Depending on climatic conditions air emissions can travel long distances. The area to assessed can be hundreds of km<sup>2</sup>. Monthly data is sufficient, this can be used to calculate daily deposition rates</p> |                                   |                                         |                          |                                     |                      |
| Geographic coverage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                   |                                         |                          |                                     |                      |
| Coverage is global                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                   |                                         |                          |                                     |                      |
| EARSC Thematic Domain                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                   |                                         |                          |                                     |                      |
| Domain                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Atmosphere and Climate            |                                         |                          |                                     |                      |
| Sub-domain                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Atmosphere                        |                                         |                          |                                     |                      |
| Product description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Monitor Air Quality and Emissions |                                         |                          |                                     |                      |
| PRODUCT SPECIFICATIONS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                   |                                         |                          |                                     |                      |
| Input data sources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                   |                                         |                          |                                     |                      |
| Satellite                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | GOSAT                             | OCO-2                                   | GHGSAT                   | SCARBO                              | MicoCarb             |
| Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Operational                       | Operational                             | Operational              | Planned                             | Planned              |
| Operator                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | JAXA                              | NASA-JPL                                | GHGSAT                   | Airbus                              | CNES                 |
| Data availability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Public                            | Public                                  | Commercial               | n/a                                 | Public               |
| Resolution (m)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1 km                              | 1.5x2.5 km                              | 50 m                     | n/a                                 | 2x2 km               |
| Coverage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Global                            | Global                                  | Target anywhere globally | Target anywhere globally            | Global               |
| Frequency (days)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 3 days                            | 16 days                                 | n/a                      | n/a                                 | 16 days              |
| Launch year                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 2009                              | 2014                                    | 2016                     | 2030                                | 2022                 |
| Website                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <a href="#">link</a>              | <a href="#">link</a>                    | <a href="#">link</a>     | <a href="#">link</a>                | <a href="#">link</a> |
| Archived satellite products include the ENVISAT SCIAMACHY sensor.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                   |                                         |                          |                                     |                      |
| Minimum Mapping Unit (MMU)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                   |                                         |                          |                                     |                      |
| n/a (the product is directly based on the input data; the smallest unit is 1 pixel).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                   |                                         |                          |                                     |                      |
| Accuracy / constraints                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                   |                                         |                          |                                     |                      |
| Thematic accuracy: Atmosphere– Monitor Air Quality and Emissions. 80%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                   |                                         |                          |                                     |                      |
| For the mining industry the targeted nano-satellites probably are the most suitable source of information, because emissions from water plumes can be very low. Probably the emissions caused by mining activities won't cross the threshold in background values of the larger satellites.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                   |                                         |                          |                                     |                      |
| Spatial accuracy: See above. Needed accuracy in the mining sector is often for large areas in relatively high spatial resolution.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                   |                                         |                          |                                     |                      |
| Accuracy assessment approach & quality control measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                   |                                         |                          |                                     |                      |
| This is done by field validation using in-situ measurements.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                   |                                         |                          |                                     |                      |

Frequency / timeliness

n/a

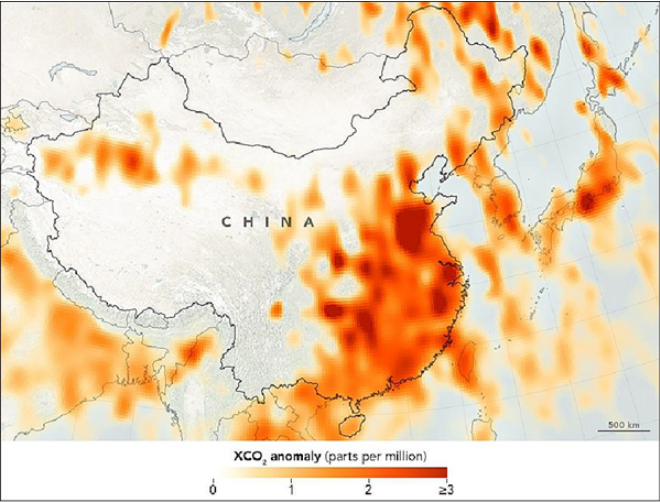
Availability

Data is typically freely available for non-commercial use through the open data policy of the different space agencies. See for an overview of the used satellites the table above.

Delivery / output format

Typically, the datasets are delivered in HDF5, NetCDF, binary or in shapefiles.

USE CASE



Source: NASA Earth Observatory, maps by Joshua Stevens, using OCO-2 anomaly data

CO2 observations based on observations from OCO-2 revealing major anthropogenic sources of CO2, as shown for example here in this figure over Eastern China ([Hakkarainen, 2016](#)). Other regions include Europe and USA and individual cities.