



CO<sub>2</sub>  
Human  
Emissions

# Mid-Term Dissemination and Exploitation Report

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Co-ordinated by  
 ECMWF



# CO<sub>2</sub> Human Emissions

## D7.6 Mid-Term Dissemination and Exploitation Report

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# CO<sub>2</sub> Human Emissions

## CHE: CO<sub>2</sub> Human Emissions Project

Coordination and Support Action (CSA)  
H2020-EO-3-2017 Preparation for a European  
capacity to monitor CO<sub>2</sub> anthropogenic emissions

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## 1 Executive Summary

To ensure that the CHE project remains visible and results are taken up by the wider community, dissemination and exploitation activities play a major role.

D7.6 provides an update of the activities performed by the project partners within the first 21 months of the project, and reviews both dissemination and exploitation plans.

To-date, three journal papers have been published; CHE researchers presented their work in nine times in conferences and 28 times in workshops; and participated in six events organised by other H2020 projects.

Exploitation activities remain focused on improving the various scientific elements produced within the CHE project, with the ultimate aim being to establish an anthropogenic CO<sub>2</sub> monitoring capacity within the Copernicus framework.

## 2 Introduction

### 2.1 Background

CHE, as a Coordination and Support Action, is bringing together European expertise and a consolidated approach to building an operational CO<sub>2</sub> emission monitoring capacity. CHE partners are at the forefront of developments in the compilation of emission inventories, the observation of the carbon cycle from ground-based and satellite measurements, the process modelling of the carbon cycle, atmospheric transport modelling, and data assimilation and inversion systems. There will be four main areas of work covering: observations, emission inventories, modelling and inversion systems.

The central questions that CHE will address are:

- What does it take to have a combined bottom-up and top-down estimation system capable of distinguishing the anthropogenic part of the CO<sub>2</sub> budget from the natural fluxes?
- How can we make the first steps towards such a system that can use the high spatial and temporal resolution of satellite observations to monitor anthropogenic emissions at the required time scales?
- And what does it take to transform a research system into a fully operational monitoring capacity?

CHE will support a large community by providing a library of realistic CO<sub>2</sub> simulations from global to city scale to examine the capacity for monitoring future fossil fuel emissions and to adequately dimension space mission requirements.

### 2.2 Scope of this deliverable

#### 2.2.1 Objectives of this deliverables

The objective of D7.6 is to report on the dissemination activities of the first 21 months and provide an update, where appropriate, to the dissemination and exploitation plans.

#### 2.2.2 Work performed in this deliverable

As per the initial deliverable D7.3, feedback from the partners was collected in the form of questionnaires, identifying the relevant aspects pertaining to both dissemination and exploitation.

### 2.2.3 Deviations and counter measures

No deviations have been encountered.

## 3 Dissemination Activities

### 3.1 Report on Dissemination Activities

CHE has been active on various dissemination streams, including publications, workshops, conferences, etc.

The following publications have been prepared to-date:

- Denier van der Gon, H. A. C., Kuenen, J. J. P., Janssens-Maenhout, G., Döring, U., Jonkers, S., and Visschedijk, A.: TNO\_CAMS high resolution European emission inventory 2000–2014 for anthropogenic CO<sub>2</sub> and future years following two different pathways, *Earth Syst. Sci. Data Discuss.*, <https://doi.org/10.5194/essd-2017-124>, in review, 2017.
- Walther, S., Duveiller, G., Jung, M., Guanter, L., Cescatti, A., & Camps-Valls, G. (2019). Satellite observations of the contrasting response of trees and grasses to variations in water availability, *Geophysical Research Letters*, 46, 1429– 1440. <https://doi.org/10.1029/2018GL080535>
- Agustí-Panareda, A., Diamantakis, M., Massart, S., Chevallier, F., Muñoz-Sabater, J., Barré, J., Curcoll, R., Engelen, R., Langerock, B., Law, R. M., Loh, Z., Morguí, J. A., Parrington, M., Peuch, V.-H., Ramonet, M., Roehl, C., Vermeulen, A. T., Warneke, T., and Wunch, D.: Modelling CO<sub>2</sub> weather – why horizontal resolution matters, *Atmos. Chem. Phys.*, 19, 7347-7376, <https://doi.org/10.5194/acp-19-7347-2019>, 2019.

In terms of website statistics, since recording website analytics in June 2018, the website had over 24,500 visits, averaging 2,000 visits a month.

Further dissemination activities since the start of the project are presented in Table 1.

**Table 1: Dissemination Activities**

Type of dissemination and communication activities	Description
<i>Participation to a conference</i>	<ol style="list-style-type: none"> <li>1. 13 April 2018 ECMWF: Presentation at EGU2018, Vienna, Austria</li> <li>2. 1-5 October 2018 ADS: SCARBO Presentation at the IAC conference in Bremen in October where CHE and VERIFY studies were mentioned for reference</li> <li>3. 10-14 December 2018 WU: AGU Fall meeting 2018, presentation Wouter Peters with reference to CHE and VERIFY</li> <li>4. 13-15 March 2019 WU: Netherlands Earth System Science Congress, Utrecht The Netherlands, presentation by Liesbeth Florentie</li> <li>5. 12 April 2019 ECMWF: “Science-based Greenhouse Gas Emission Estimates in Support of National and Sub-National Climate Change Mitigation” section, poster “Anthropogenic CO<sub>2</sub> emission uncertainties from inventories and statistics” on a roadmap of anthropogenic CO<sub>2</sub> emission prior uncertainty</li> </ol>

	<p>calculations based on IPCC 2006 and 2019 refinements guidelines</p> <ol style="list-style-type: none"> <li>6. 7-12 April 2019 ECMWF: EGU 2019, CHE poster</li> <li>7. 7-12 April 2019 WU: EGU 2019, Vienna, presentation CHE poster by Liesbeth Florentie</li> <li>8. 7-12 April 2019 EMPA: Presentation of library of nature runs at EGU 2019, Vienna, Austria</li> <li>9. 17 May 2019 MPG: Poster at ESA LPS Milan Italy</li> </ol>
<p><i>Participation to a workshop</i></p>	<ol style="list-style-type: none"> <li>1. 27-29 March 2018 ECMWF: Presentation at the BRI (Belt Road Initiative) Workshop, Salerno, Italy</li> <li>2. 18 April 2018 ECMWF: ASM Joint 28th ALADIN Workshop &amp; HIRLAM All Staff Meeting 2018, Toulouse, France</li> <li>3. 2-4 May 2018 ECMWF: CEOS AV-CV 14 meeting, NOAA, College Park, USA</li> <li>4. 12-13 June 2018 ECMWF: Copernicus Anthropogenic CO<sub>2</sub> Monitoring Mission Advisory Group Meeting No. 1, ESA, Noordwijk</li> <li>5. 18-19 June 2018 TNO: Workshop: Interfaces Between CEOS Agencies and the GHG Monitoring System; Joint Research Centre, Ispra (Italy), Hosted By: European Commission</li> <li>6. 17-20 September 2018 WU: IGIS-Transcom Workshop, Lund, presentation on latest developments of WU within CHE</li> <li>7. 17-20 September 2018 MPG: IGIS-Transcom Workshop, Lund, Presentation, <a href="https://fileshare.icos-cp.eu/s/R8LcanCpbQafw9X?path=%2FSession%201#pdfviewer">https://fileshare.icos-cp.eu/s/R8LcanCpbQafw9X?path=%2FSession%201#pdfviewer</a></li> <li>8. 17-20 September 2018 ECMWF: IGIS-Transcom Workshop, Lund, Poster Presentation</li> <li>9. 17-20 September 2018 ECMWF: IGIS-Transcom Workshop, Lund, Poster presentation, <a href="https://fileshare.icos-cp.eu/s/qBMs522E5G8XFK4#pdfviewer">https://fileshare.icos-cp.eu/s/qBMs522E5G8XFK4#pdfviewer</a></li> <li>10. 17-20 September 2018 UEA: IGIS-Transcom Workshop,</li> <li>11. 22 October 2018 ECMWF: Presentation at GCOS Science Day, Helsinki, Finland</li> <li>12. 22 October 2018 EMPA: Presentation of the CHE project and ongoing developments to the “Laboratory for Air Pollution / Environmental Technology” at EMPA, <a href="https://polybox.ethz.ch/index.php/s/CxNzZ8EiJtlvjK/download">https://polybox.ethz.ch/index.php/s/CxNzZ8EiJtlvjK/download</a></li> <li>13. 13 November 2018 ECMWF: Presentation at IG3IS Symposium, Geneva, Switzerland</li> <li>14. 26-29 Nov 2018 EMPA: Presentation of high-resolution CO<sub>2</sub> and NO<sub>2</sub> model simulations at ESA ATMOS 2018, Graz, Austria</li> <li>15. 16-18 December 2018 ULUND: Symposium participation: Second ADAPT Symposium on Advanced Understanding, Monitoring and Prediction of Weather, Climate and Environmental systems, Pennsylvania State University, State College, Pennsylvania, <a href="http://adapt.psu.edu/2018EnKFWorkshop/SYMPOSIUM18/index.php?loc=symposium">http://adapt.psu.edu/2018EnKFWorkshop/SYMPOSIUM18/index.php?loc=symposium</a></li> <li>16. 16-18 December 2018 iLab: Symposium presentation: Second ADAPT Symposium on Advanced Understanding, Monitoring and Prediction of Weather, Climate and Environmental systems, Pennsylvania State University, State College, Pennsylvania</li> </ol>

	<ol style="list-style-type: none"> <li>17. 18 December 2017 ECMWF: Kick-off meeting of Phase B of the CO<sub>2</sub> Task Force B, Brussels</li> <li>18. 21 Jan 2019 EMPA: Presentation of CHE project and modelling activities at COSMO User Workshop, ETH Zurich, Switzerland</li> <li>19. 30-31 January 2019 ECMWF: CO<sub>2</sub> MAG meeting</li> <li>20. 12 March 2019 ECMWF/JRC: CHE/VERIFY General Assembly, Reading (UK), Tuesday, 12th I 2019, poster "Anthropogenic CO<sub>2</sub> emission uncertainties from inventories and statistics" on a roadmap of anthropogenic CO<sub>2</sub> emission prior uncertainty calculations based on IPCC 2006 and 2019 refinements guidelines + first comparison results with European regional emissions.</li> <li>21. 20 Mar 2019 EMPA: Presentation of COSMO-GHG CO<sub>2</sub> simulations at kilometer scale at ICCARUS 2019 workshop, Offenbach, Germany</li> <li>22. 15 April 2019 ECMWF: TCCON discussion at EUMETSAT</li> <li>23. 17 April 2019 WU: Follow-up workshop 'Verification of emissions: opportunities in the Netherlands?', Utrecht, The Netherlands</li> <li>24. 8-9 May 2019 ECMWF: CO<sub>2</sub> MAG meeting</li> <li>25. 13-17 May 2019 ULUND: Poster presentation at ESA Living Planet Symposium <a href="http://lps19prog.esa.int">http://lps19prog.esa.int</a></li> <li>26. 13-17 May 2019 WU: ESA Living Planet Symposium presentation Maarten Krol</li> <li>27. 13-17 May 2019 iLab: ESA Living Planet Symposium poster presentation</li> <li>28. 13-17 May 2019 EMPA: Presentation of SMARTCARB and CHE CO<sub>2</sub> simulations at ESA Living Planet Symposium, Milan, Italy</li> </ol>
<i>Web-site</i>	<ol style="list-style-type: none"> <li>1. Project Website</li> <li>2. ECMWF: <a href="https://www.ecmwf.int/en/about/media-centre/focus/developing-european-capacity-monitor-worldwide-co2-emissions">https://www.ecmwf.int/en/about/media-centre/focus/developing-european-capacity-monitor-worldwide-co2-emissions</a></li> </ol>
<i>Press Release</i>	<ol style="list-style-type: none"> <li>1. <a href="https://www.ecmwf.int/en/about/media-centre/news/2018/experts-discuss-way-forward-ambitious-co2-monitoring-project">https://www.ecmwf.int/en/about/media-centre/news/2018/experts-discuss-way-forward-ambitious-co2-monitoring-project</a></li> </ol>
<i>Participation in activities organised jointly with other H2020 project(s)</i>	<ol style="list-style-type: none"> <li>1. 13-15 February 2018 ECMWF: VERIFY Kick-off meeting, Brussels</li> <li>2. EMPA: Distribution of Deliverable 2.1 to members of the Verify project.</li> <li>3. ADS: SCARBO website (<a href="http://scarbo-h2020.eu/">http://scarbo-h2020.eu/</a>) with reference to CHE Kick-off study, and to ECWMF (G. Balsamo) as part of the User Advisory Board.</li> <li>4. 28 November 2018 ECMWF: JRC-VERIFY Progress Meeting, Ispra, Italy.</li> <li>5. 6 February 2019 ADS: SCARBO Annual review with reference to ECWMF (G. Balsamo) as part of the User Advisory Boards #1 and #2 and to coordination with CHE activities</li> <li>6. 12-14 March 2019 All Partners: Organisation of Joint CHE--VERIFY General Assembly</li> </ol>



	7. 27-28 Mar 2019: WU: Global inverse modeling for projects CHE, ASICA, COS-SOC (H2020), workshop with participation of ECMWF and Wageningen Univ as well as Utrecht Univ
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### 3.2 Update to Dissemination Plan

CHE has, in deliverable D7.3, provided an initial plan for Dissemination and Communication Activities. Figure 1 presents the current status.

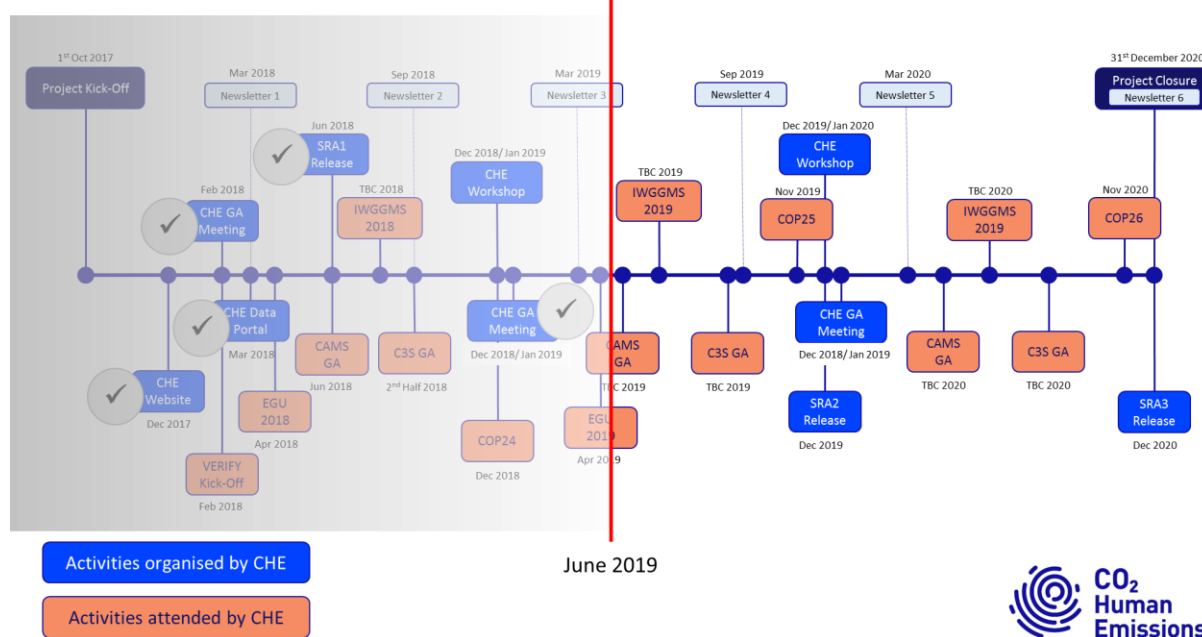


Figure 1: CHE Dissemination Plan

Apart from the first CHE Workshop, all activities foreseen in the plan to be organised by CHE were realised. The workshop was postponed to coincide with other activities. To-date, one newsletter has been released. However, the CHE website [www.che-project.eu](http://www.che-project.eu) has provided regular updates and news items with around 20 articles published.

The remainder of the CHE Dissemination Plan remains relevant with the timing and number of newsletters to be decided based on availability of news items. It is planned that the number of publications will increase significantly with the initial results of the WPs 1 to 4 becoming available.

## 4 Exploitation

Deliverable D7.3 already outlined potential exploitation avenues, as presented here again in Table 2.

Table 2: CHE Exploitation

<b>Exploitable Products</b>	<ul style="list-style-type: none"> <li>• A high-resolution inverse modelling framework using state-of-the art input</li> <li>• Emission and emission uncertainty gridmaps</li> <li>• XCO<sub>2</sub> retrieved from OCO-2 satellite mission</li> <li>• Methods to exploit Sentinel Carbon</li> <li>• Model outputs for designing observation system simulation experiments</li> <li>• Recommendations for the construction of a future prototype including roadmap to implementation and cost assessment of</li> </ul>
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	<p>the service elements of a future CO<sub>2</sub> anthropogenic emission monitoring system.</p> <ul style="list-style-type: none"> <li>• Space-borne CO<sub>2</sub> monitoring instrument/mission concepts needed to fill the gap in terms of revisit time and observational performance and considering current CO<sub>2</sub> operational missions and those in development</li> <li>• A proposal of space based infrastructure for future Carbon Human Emission monitoring</li> </ul>
<b>Exploitation Activities during the Project</b>	<ul style="list-style-type: none"> <li>• Incorporating results into existing modelling framework.</li> <li>• Scientific papers</li> <li>• Review state-of-the art</li> <li>• Competitive/ benchmark analysis</li> <li>• Contribution to IG3IS implementation plan, which outlines observation and modelling requirements for top-down emission estimation and how such a system could be implemented, due in 2018</li> <li>• To make, as soon as possible, proposal for low cost system of measurements fitting requirements and agenda of next generation of space based instrument for Carbon Human Emission measurements</li> </ul>
<b>Exploitation Activities after the end of the Project</b>	<ul style="list-style-type: none"> <li>• Expand the approach developed in CHE to a broader geographic area post-CHE, and upscale it so it's able to handle the masses of data that will become available.</li> <li>• Use of the OCO-2 data product by CHE inverse modellers</li> <li>• Scientific papers</li> <li>• Develop the regional CO<sub>2</sub> modelling system into a quasi-operational system supporting the operation of a Swiss CO<sub>2</sub> observing system with low-cost CO<sub>2</sub> sensors, high-precision instruments and possibly remote sensing.</li> <li>• Productisation/operationalisation, further developments, integration into other services</li> <li>• To develop low cost system of Carbon Human Emission measurements</li> </ul>
<b>Consortium-wide/Joint Exploitation</b>	<ul style="list-style-type: none"> <li>• Suite of modelling systems able to sensibly address the problem, potentially able to contribute to an ensemble estimation approach</li> <li>• Develop a strategy to operationalise functional parts of the modelling system described above</li> <li>• Longer-term goal would be operationalisation for Copernicus Climate Change Service (C3S)</li> <li>• Definition of a global CO<sub>2</sub> monitoring system of systems</li> <li>• End to End system of Carbon Human Emission measurements</li> </ul>

An update to the exploitation survey run for Deliverable D7.3 has confirmed that the products and activities described above remain relevant, with the main outcome of the CHE project being an operational service for monitoring of anthropogenic CO<sub>2</sub> emissions.

## 5 Conclusion

D7.6 reported on the dissemination activities performed in the first 21 months, and reviewed the dissemination and exploitation plans.

The exploitation plan will be revisited towards the end of the project with a view of establishing the relevant activities to be performed after the end of the project, and providing a definitive IPR register to serve as a reference point for project partners.

## Document History

Version	Author(s)	Date	Changes
0.1	Daniel Thiemert (ECMWF)	03/06/2019	Initial version
0.2	Daniel Thiemert (ECMWF)	06/06/2019	Updated dissemination activities
0.3	Daniel Thiemert (ECMWF)	10/06/2019	Version for internal review
1.0	Daniel Thiemert (ECMWF)	26/06/2019	Final version after review

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Johan Strandgren (DLR)	26/06/2019	Approved with comments

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