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21GRD04 - isoMET – Data Management Plan

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DATA MANAGEMENT PLAN

Grant Agreement number	21GRD04
Project short name	isoMET
Project full title	Metrology for European emissions verification on methane isotopes
Data management plan	1 st <input type="checkbox"/> 2 nd <input checked="" type="checkbox"/>

TABLE OF CONTENTS

- 1 Data management plan2
 - 1.1 Data summary2
 - 1.2 Findable, Accessible, Interoperable and Re-usable (FAIR) Data2
 - 1.2.1 Making data findable, including provisions for metadata2
 - 1.2.2 Making data accessible3
 - 1.2.3 Making data interoperable4
 - 1.2.4 Increase data re-use5
 - 1.3 Other research outputs6
 - 1.4 Allocation of resources7
 - 1.5 Data security7
 - 1.6 Ethics7
 - 1.7 Other issues8
- 2 Open science: research data management8

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PU - Public, fully open

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European Partnership  Co-funded by the European Union

Data Management Plan

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1 Data management plan

1.1 Data summary

Questions	Answers
1 Will you re-use any existing data and what will you re-use them for? State the reasons if re-use of any existing data has been considered but discarded.	Yes. Data from databases (MEMO2 database) outside of the project were used to establish a database that served as input to atmospheric transport modelling exercises in the project and beyond. Spectral data from the HITRAN database were used for absorption line identification.
2 What types and formats of data will the project generate or re-use?	The following data formats were generated by the project: typically, ASCII, Excel format, jpeg (graphics, images), docx and pdf (for text) and CSV. Data formats were chosen such that they support Open Source software, or software from different vendors to maximise the uptake of datasets by other user groups.
3 What is the purpose of the data generation or re-use and its relation to the objectives of the project?	Data were generated and stored in specific formats within the project to enable the development of a harmonised isotope dataset of atmospheric CH ₄ in Europe (objective 1) as well as its interpretation applying CH ₄ isotope source signatures with reported traceability (objective 2). Thus, the following data were uploaded on the ICOS carbon portal: Database: European database for methane isotopic signatures (13C and D and clumped) available at https://doi.org/10.18160/TACQ-TAQU Field site data Atmospheric GHG data product (ch4, 13ch4, 13ch4_stdev, d2h_ch4, d2h_ch4_stdev) available at: https://meta.icos-cp.eu/objects/q3UE_OHutLOs93XM22wq-hKH The harmonised data were used by project participants for atmospheric chemistry transport modelling (objective 3). Data generated were used in conference presentations at conferences e.g. OPTICA 2023 (Germany) and peer reviewed publications e.g. E. Safi et al, Analytical Chemistry 2024, 96, 6139-6147. Data from questionnaires and surveys were used to support end-user uptake (objective 4).
4 What is the expected size of the data that you intend to generate or re-use?	The estimated overall size of the data/research outputs is around 400 GB.
5 What is the origin/provenance of the data, either generated or re-used?	Data originated from several sources, which will include: participants' pre-existing data, data from the scientific literature, real-world measurement data, model simulation data and inter-laboratory comparison data. Data was uploaded on the ICOS carbon portal (https://doi.org/10.18160/TACQ-TAQU , https://meta.icos-cp.eu/objects/q3UE_OHutLOs93XM22wq-hKH). The provenance of the data was documented to meet relevant standards. The data are accompanied by information on e.g. how they were captured, when and the production time.
6 To whom might your data be useful ('data utility'), outside your project?	The data generated in this project will be useful to greenhouse gas networks, atmospheric monitoring communities and gas working groups such as ICOS, CCQM-GAWG, EMN-COO, WMO-GAW and academia. Aside analytical instrument and gas standard providers as well as companies in the oil and gas exploitation area are expected to uptake results.

1.2 Findable, Accessible, Interoperable and Re-usable (FAIR) Data

1.2.1 Making data findable, including provisions for metadata

Questions	Answers
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7 Will data be identified by a persistent identifier?	Yes. Published data have a DOI obtained from an open access repository.
8 Will rich metadata be provided to allow discovery? What metadata will be created? What disciplinary or general standards will be followed? In case metadata standards do not exist in your discipline, please outline what type of metadata will be created and how.	Published data have a DOI obtained from an open access repository. The project consortium ensured that these submissions contain sufficient meta data to be reused without restrictions. The metadata provided information on the following: datasets (description, date of deposit, author(s)); the funding source (European Partnership on Metrology, additional funding if acquired); grant project name, acronym and number; licensing terms; persistent identifiers, the authors involved.
9 Will search keywords be provided in the metadata to optimise the possibility for discovery and then potential re-use?	Yes, the following search keywords were provided in the metadata to optimise the discovery and potential re-use of the deposited datasets: , methane isotopes, CH ₄ emissions, DCH ₃ D, ¹³ CH ₄ .
10 Will metadata be offered in such a way that it can be harvested and indexed?	PTB OAR complies with FAIR principles. The metadata are indexed by common search engines like google Scholar and BASE dataset search (https://www.base-search.net/). All metadata are exported via the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) and can be harvested.

1.2.2 Making data accessible

Questions	Answers
Repository:	
11 Will the data be deposited in a trusted repository?	Yes, the project's datasets were deposited in trusted open access repository i.e. the PTB's Open Access Repository (https://oar.ptb.de).
12 Have you explored appropriate arrangements with the identified repository where your data will be deposited?	No, the data will be uploaded via a standard procedure and require no special arrangements.
13 Does the repository ensure that the data are assigned an identifier? Will the repository resolve the identifier to a digital object?	Yes, the PTB-OAR repository registers a DOI for each published item, which is resolvable to the URL of the digital object.
Data:	
14 Will all data be made openly available? If certain datasets cannot be shared (or need to be shared under restricted access conditions), explain why, clearly separating legal and contractual reasons from intentional restrictions. Note that in multi-beneficiary projects it is also possible for specific beneficiaries to keep their data closed if opening their data goes against their legitimate interests	All of the data that were needed to validate the results presented in scientific publications/research outputs were made openly available as the default, unless there is a specific reason not to publish it. Other data/research outputs may be made available on a case-by-case basis if it is relevant for third parties.

Questions	Answers
or other constraints as per the Grant Agreement.	
15 If an embargo is applied to give time to publish or seek protection of the intellectual property (e.g. patents), specify why and how long this will apply, bearing in mind that research data should be made available as soon as possible.	The data used in scientific publications, posters and oral communications were made available for re-use as soon as was reasonably possible.
16 Will the data be accessible through a free and standardised access protocol?	Data associated with the project activities and used in publications were made available. The PTB-OAR offers access to the data sets via the HTTPS protocol and the OAI-PMH interface.
17 If there are restrictions on use, how will access be provided to the data, both during and after the end of the project?	No restrictions on the use of the published data are envisaged.
18 How will the identity of the person accessing the data be ascertained?	There is no need to ascertain the identity of persons accessing the data.
19 Is there a need for a data access committee (e.g. to evaluate/approve access requests to personal/sensitive data)?	The consortium did not establish a DAC.
Metadata:	
20 Will metadata be made openly available and licensed under a public domain dedication CC0, as per the Grant Agreement? If not, please clarify why. Will metadata contain information to enable the user to access the data?	Yes, metadata were made openly available and licensed using an appropriate open-access license CC 0. Metadata included the information necessary to (re)use the data.
21 How long will the data remain available and findable? Will metadata be guaranteed to remain available after data are no longer available?	The data will remain available and findable for the lifetime of the PTB OAR, which is expected to be a minimum of 20 years. If data are withdrawn from PTB-OAR, the DOI and the URL of the original object are retained. In case of closure of the PTB OAR, best efforts will be made to integrate all content into suitable alternative institutional and/or subject based repositories.
22 Will documentation or reference about any software be needed to access or read the data and will this be included? Will it be possible to include the relevant software (e.g. in open source code)?	No software will be needed and therefore no additional documentation will be provided. The data will be in a common format and can be read using widely available software (open source or commercial).

1.2.3 Making data interoperable

Questions	Answers
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23 What data and metadata vocabularies, standards, formats or methodologies will you follow to make your data interoperable to allow data exchange and re-use within and across disciplines? Will you follow community-endorsed interoperability best practices? Which ones?	Vocabularies that were used include those of ISO and IEC e.g., ISO/IEC Guide 99 (VIM), ISO 14532, ISO 7504, Isotopic Abundances and Atomic Weights of the International Union of Pure and Applied Chemistry (IUPAC), and the SI Brochure. The guidelines specific for reporting terms of expression for isotope ratio presented by Coplen (DOI: 10.1002/rcm.5129) were followed.
24 In case it is unavoidable that you use uncommon or generate project specific ontologies or vocabularies, will you provide mappings to more commonly used ontologies? Will you openly publish the generated ontologies or vocabularies to allow their re-use, refinement or extension?	No mappings were necessary, as the datasets were described using standard terminologies. Mapping was not required as the terminology used was chosen to be compatible with the existing literature.
25 Will your data include qualified references ¹ to other data (e.g. other data from your project, or datasets from previous research)?	Yes, the project's datasets were deposited in the chosen repository (PTB OAR) and included qualified references to other datasets from the same project and previous projects.

1.2.4 Increase data re-use

Questions	Answers
26 How will you provide documentation needed to validate data analysis and facilitate data re-use (e.g. readme files with information on methodology, codebooks, data cleaning, analyses, variable definitions, units of measurement, etc.)?	The documents were created in PDF to ensure that they cannot unintentionally be changed.
27 Will your data be made freely available in the public domain to permit the widest re-use possible? Will your data be licensed using standard re-use licenses, in line with the obligations set out in the Grant Agreement?	Yes. Data are provided through a trusted repository with an appropriate open-access license (CC BY). Example data include: Database: European database for methane isotopic signatures (13C and D and clumped) available at https://doi.org/10.18160/TACQ-TAQU Field site data Atmospheric GHG data product (ch4, 13ch4, 13ch4_stdev, d2h_ch4, d2h_ch4_stdev) available at: https://meta.icos-cp.eu/objects/q3UE_OHutLOs93XM22wq-hKH
28 Will the data produced in the project be useable by third parties, in particular after the end of the project?	Any data published in open-access journals will be usable by third parties after the datasets have been deposited in a trusted repository. The data that does not relate to peer-reviewed publications will be made available for re-use on a case-by-case basis.

¹ A qualified reference is a cross-reference that explains its intent. For example, X is regulator of Y is a much more qualified reference than X is associated with Y, or X see also Y. The goal therefore is to create as many meaningful links as possible between (meta)data resources to enrich the contextual knowledge about the data. (Source: <https://www.go-fair.org/fair-principles/i3-metadata-include-qualified-references-metadata/>)

Questions	Answers
29 Will the provenance of the data be thoroughly documented using the appropriate standards?	Yes, the provenance of the data generated within the project were documented using the Provenance and Context Content Standard (PCCS) Matrix.
30 Describe all relevant data quality assurance processes.	Data quality was assured through several quality assurance procedures such as repeated and comparison measurements, adherence to standards for data recording, use of controlled vocabularies and standard terminology, metrological characterisation of the measurement set-ups, validation of the data collected, provision of test results along with the data, and peer-review of publications based on the data.
31 Further to the FAIR principles, DMPs should also address research outputs other than data, and should carefully consider aspects related to the allocation of resources, data security and ethical aspects.	<p><i>Allocation of resources</i></p> <p>The estimated curation and storage/preservation costs for making the data and research outputs FAIR was 5000 € (personnel costs). These costs were kept to a minimum by using i) suitable trusted repositories from the Registry of Research Data Repositories https://www.re3data.org/ where no additional costs were associated with long-term preservation, and ii) by making only relevant data and outputs FAIR.</p> <p><i>Data security</i></p> <p>The participants stored other research outputs on their organisations' networks, which are protected by firewall, backups etc. Other research outputs were stored in the project's SharePoint environment, with password-protected login.</p>

1.3 Other research outputs

Questions	Answers
32 In addition to the management of data, beneficiaries should also consider and plan for the management of other research outputs that may be generated or re-used throughout their projects. Such outputs can be either digital (e.g. software, workflows, protocols, models, etc.) or physical (e.g. new materials, antibodies, reagents, samples, etc.).	<p>The other research outputs such as new calibration methods, and protocols produced by the project were stored in the project share point environment that all project participants have access to.</p> <p>New reference materials (RMs) for CH₄ isotope ratio measurements were developed and the information on the RMs was stored on the project SharePoint. A (metrological) concept for harmonisation of CH₄ field site measurements was developed by the consortium participants and shared with all project participants via the project SharePoint where it was stored.</p>
33 Beneficiaries should consider which of the questions pertaining to FAIR data above, can apply to the management of other research outputs, and should strive to provide sufficient detail on how their research outputs will be managed and shared, or made available for re-use, in line with the FAIR principles.	<p>Documentary research outputs, e.g. protocols were managed and handled in accordance with the FAIR principles unless agreed within the consortium otherwise. No project outputs were considered that cannot be disclosed during the project.</p> <p>As far as possible, the FAIR data approaches specified in questions 7-31 above were applied to the management of this project's other research outputs, particularly 8, 9, 17, 18, 21 and 28.</p>

1.4 Allocation of resources

Questions	Answers
34 What will the costs be for making data or other research outputs FAIR in your project (e.g. direct and indirect costs related to storage, archiving, re-use, security, etc.) ?	The estimated curation and storage/preservation costs for making the data and research outputs FAIR was 5000 € (personnel costs). These costs was kept to a minimum by using i) suitable trusted repositories from the Registry of Research Data Repositories https://www.re3data.org/ where no additional costs were associated with long-term preservation, and ii) by making only relevant data and outputs FAIR.
35 How will these be covered? Note that costs related to research data/output management are eligible as part of the European partnership on metrology grant (if compliant with the Grant Agreement conditions).	The costs for making the data FAIR were included in the project's budget and can be claimed in accordance with the Grant Agreement's conditions.
36 Who will be responsible for data management in your project?	The coordinator, with support from the participants, had overall responsibility for the management of data/research outputs and quality assurance. The coordinator was responsible for coordinating updates to the data management plan and for deciding on a case-by-case basis which data/research outputs were kept and for how long. The participant(s) that produced the data was responsible for organising backup and storage, archiving, and for depositing the data/research outputs within the chosen repositories.
37 How will long term preservation be ensured? Discuss the necessary resources to accomplish this (costs and potential value, who decides and how, what data will be kept and for how long)?	<p>Long term preservation was ensured by depositing the data within repositories. There were no costs associated with the long-term preservation of the data.</p> <p>The coordinator was responsible for coordinating updates to the data management plan and for deciding on a case-by-case basis which data/research outputs were kept and for how long.</p>

1.5 Data security

Questions	Answers
38 What provisions are or will be in place for data security (including data recovery as well as secure storage/archiving and transfer of sensitive data)?	<p><i>Data recovery and secure storage</i> Data was backed up on the participant organisations' own servers (protected by firewall, backups, etc.), to mitigate the very low risk of loss of data from the central repository. Deposition of research output in the PTB-OAR provided additional security as it has multiple replicas in a distributed file system which is backed up on a nightly basis.</p> <p><i>Transfer of sensitive data</i> This project did not generate sensitive data.</p>
39 Will the data be safely stored in trusted repositories for long term preservation and curation?	Yes, the data will be safely stored in PTB's Open Access Repository, which is stored on two physically and geographically separated servers that are regularly backed up. PTB is working towards German Initiative for Network Information (DINI) certification.

1.6 Ethics

Questions	Answers
40 Are there, or could there be, any ethics or legal issues that can have an impact on data	<p>There were issues that could impact on data sharing:</p> <ul style="list-style-type: none"> ▪ Data collected by the consortium at field sites were not shared without the site owner's explicit consent.

Questions	Answers
sharing? These can also be discussed in the context of the ethics review. If relevant, include references to ethics report(s) and the ethics section in the Annex 1.	<ul style="list-style-type: none"> ▪ Data was anonymized and only disclosed after discussions and considerations. ▪ The data from the survey was made anonymous to comply with the General Data Protection Regulation (GDPR).
41 Will informed consent for data sharing and long-term preservation be included in questionnaires dealing with personal data?	The project has no plans to share data with identifiable personal information.

1.7 Other issues

Questions	Answers
42 Do you, or will you, make use of other national / funder / sectorial / departmental procedures for data management? If yes, which ones (please list and briefly describe them)?	Data management was compliant with the research data policy of the European Partnership of Metrology programme and with European laws about data security and the protection of privacy (e.g. GDPR).

2 Open science: research data management

Statement	Put an X in the box to confirm	Or, list any exceptions to this
All participants have adhered to the requirements of the project's GA and CA with respect to open science: research data management (GA Article 17 and its Annex 5) for this reporting period	<input checked="" type="checkbox"/>	