What are the impacts of within-field farmland management practices on the flux of greenhouse gases from arable cropland in temperate regions? A systematic map protocol

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Environmental Evidence

SYSTEMATIC MAP PROTOCOL

Open Access

What are the impacts of within-field farmland management practices on the flux of greenhouse gases from arable cropland in temperate regions? A systematic map protocol

Alexandra M. Collins[1*], Neal R. Haddaway[2,3], Biljana Macura[2], James Thomas[4], Nicola Randall[5], Jessica J. Taylor[6], Steve Cooke[6] and Alyssa Gilbert[7]

Abstract

Background: Reducing greenhouse gas emissions is a vital step in limiting climate change and meeting the goals outlined in the COP 21 Paris Agreement of 2015. Studies have suggested that agriculture accounts for around 11% of total greenhouse gas emissions and the industry has a significant role in meeting international and national climate change reduction objectives. However, there is currently little consensus on the mechanisms that regulate the production and assimilation of greenhouse gases in arable land and the practical factors that affect the process. Practical advice for farmers is often overly general, and models based on the amount of nitrogen fertiliser applied, for example, are used despite a lack of knowledge of how local conditions affect the process, such as the importance of humus content and soil types. Here, we propose a systematic map of the evidence relating to the impact on greenhouse gas flux from the agricultural management of arable land in temperate regions.

Methods: Using established methods for systematic mapping in environmental sciences we will search for, collate and catalogue research studies relating to the impacts of farming in temperate systems on greenhouse gas emissions. We will search 6 bibliographic databases using a tested search string, and will hand search a web-based search engine and a list of organisational web sites. Furthermore, evidence will be sought from key stakeholders. Search results will then be screened for relevance at title, abstract and full text levels according to a predefined set of eligibility criteria. Consistency checking will be employed to ensure the criteria are being applied accurately and consistently. Relevant studies will then be subjected to coding and meta-data extraction, which will be used to populate a systematic map database describing each relevant study's settings, methods and measured outcomes. The mapping process will help to identify knowledge gaps (subjects lacking in evidence warranting further primary research) and knowledge clusters (subjects with sufficient studies to allow a useful full systematic review), and will highlight best and suboptimal research methods.

Keywords: Methane, nitrous oxide, Climate change, Global warming, Climate, Carbon, COP, Climate targets, Farming, Sustainable farming

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Background

Reducing greenhouse gas emissions is a vital step in attempting to reduce climate change and meet the goals outlined in the Paris Agreement resulting from the COP21 in 2015 (http://unfccc.int/paris_agreement/items/9485.php). Studies have suggested that agriculture accounts for around 11% of total greenhouse gas emissions [1] and the industry has a significant role in meeting international and national climate change reduction objectives (e.g. England and Wales's National Union of Farmers' goal of reaching net zero greenhouse gas emissions across the agriculture sector by 2040 [2] and targets set for the agricultural sector in The Scottish Government's Climate Change Plan [3]).

The atmospheric flux of greenhouse gases, including the production of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), is governed by the activity and turnover of microbial communities in the soil [4, 5], which is strongly regulated to changes in soil physical conditions, organic matter status and nutrient availability resulting from agricultural management [6, 7]. For example the prevailing driver of N_2O production, which has a global warming potential 298 times larger than CO_2 over a 100 year period [8], is the conversion of nitrogen applied as fertilisers to nitrate through processes such as nitrification and denitrification [5] and into the atmosphere as the greenhouse gas N_2O. CH_4 can only be produced under anaerobic conditions by bacteria (methanogens) but is also consumed by other bacterial groups (methanotrophs) when oxygen is available, acting as a sink for the CH_4 produced in the soil [9]. Production of CH_4 in agricultural fields is usually connected to high soil organic carbon levels, and organic soils that are sometimes water-logged are considered as the main sources of CH_4 from agricultural soils [10]. Soil management by farmers therefore plays a central role in defining the conditions for the soil bacteria and thus the production of greenhouse gases from soils.

Despite this, there is currently little consensus on the conditions and mechanisms that regulate the production and assimilation of greenhouse gases in arable land and the practical factors that affect the process. There is a broad diversity of land management options available to farmers (e.g. intensive tillage using mouldboard plough versus direct drilling or conservation tillage) and the impacts of these different options on greenhouse gas emissions is not well known. Practical advice for farmers is therefore often overly general, and models based on the amount of nitrogen fertiliser applied, for example, are used despite a lack of knowledge of how local conditions affect the process, such as the importance of drainage, humus content and soil types.

Here, we propose a systematic map of the evidence relating to the impact of agricultural management of arable land in temperate regions on greenhouse gas flux, including both mineral and organic soils.

Stakeholder engagement

The topic of this systematic map was identified as a priority by academics and discussed with stakeholders including; the UK's Department of Environment Food and Rural Affairs (Defra), Environment Agency, Natural Resources Wales, The Scottish Government, The Welsh Government, Centre for Hydrology and Ecology (CEH), The Technical Support Unit of Working Group III of the Intergovernmental Panel on Climate Change (IPCC), he National Farmers Union (NFU), World Wildlife Fund (WWF) and the UK's Natural Environment Research Council (NERC) who are also funding the work under their Environmental Evidence for the Future programme.

Stakeholders have provided input to this protocol by helping to review and refine the map's question. Stakeholders will be asked to identify potentially relevant literature, which will then be subject to the full screening process outlined below. Stakeholders will also be asked to comment on the coding strategy so that the information that is of most relevance to them is included in the map.

Objective of the map

The effects of agricultural management on greenhouse gases have previously been reviewed [11], but as yet there is no consensus as to how context (i.e. climate, fertiliser type and quantity, soil drainage, soil texture, and organic matter content) affects greenhouse gas fluxes. There is therefore a need for a systematic map the impact of arable farming practices on greenhouse gas emissions to examine the influence of these sources of heterogeneity across soil types and farming systems..

This systematic map will aim to catalogue and describe the evidence relating to the impacts of agricultural management activities on greenhouse gas fluxes. Wherever possible, evidence relating to the impact of other variables on greenhouse gas fluxes will be catalogued within studies, such as climate, fertiliser type and quantity, soil drainage, soil texture, and organic matter content. This review will allow the identification of knowledge gaps and knowledge clusters to be identified that can be researched further with novel primary research and full systematic reviews, respectively.

The primary question for this systematic map is as follows:

> *What evidence exists on the impacts of within-field farmland management practices on the flux of greenhouse gases from arable cropland in temperate*

regions?

These questions can be broken down into the following key elements:

Population: Arable farmland in temperate regions.
Intervention: All within-field farmland management practices applied to arable cropland.
Comparator: Without management, with different management, before management, with different intensities of management.
Outcome: Fluxes of greenhouse gases (methane, nitrous oxide, carbon dioxide).
Study type: Replicated observational and manipulative studies.

Methods

The review will follow the Collaboration for Environmental Evidence Guidelines and Standards for Evidence Synthesis in Environmental Management [12] and it conforms to ROSES reporting standards [13] (see Additional file 1).

Searching for articles

Searching for articles will involve attempts to source both traditional academic literature and grey literature.

Seven bibliographic databases will be searched to find academic literature, including: AGRIS Agricultural database (FAO), Directory of Open Access Journals, PubMed, Scopus, EThOS, ProQuest Dissertations and Theses Global, and Web of Science Core Collections. These databases will be searched using the following English language Boolean search string (presented in Web of Science format):

TS=((arable OR agricult OR farm* OR crop* OR cultivat* OR field*) AND (plough* OR plow* OR till* OR "direct drill*" OR fertili* OR biosolid* OR "bio solid" OR organic OR manur* OR sewage OR compost* OR amendment* OR biochar* OR digestate* OR "crop residue*" OR "crop straw*" OR mulch* OR "crop rotat*" OR "break crop*" OR "grass ley" OR "clover ley" OR legume* OR "bioenergy crop*" OR "cover crop*" OR "grass clover" OR "cropping system*" OR "crop system" OR "winter crop*" OR "spring crop*" OR "summer fallow*" OR "catch crop*" OR intercrop* OR conservation) AND (CH4 OR methane OR CO2 OR "carbon dioxide" OR N2O OR "nitrous oxide" OR GHG* OR "greenhouse gas*" OR "green-house gas*") AND (flux* OR dynamic* OR emission* OR exchang* OR balanc*))*

Searches will be performed using the subscriptions of Carleton University and conducted in English. Non-English articles search results will be recorded, (see "Article screening and study eligibility criteria" section).

The search string proposed has been built based on experience from a systematic review evaluating the effects of agricultural management on greenhouse gas emissions in lowland peatland systems [11] and a systematic map investigating the effects of agricultural management on soil organic carbon [14]. Due to overlaps in the intervention and outcome elements of these question experience on the most appropriate search terms was shared by authors who spanned the different reviews, i.e. the outcomes terms optimised during the development of Haddaway et al. [11] were used.

The search string will be tested for sensitivity by comparing a benchmark list of 25 articles known (see Additional file 2) to be relevant to the review team and the advisory group. Where articles are not identified in two test databases (Web of Science and Scopus) the reasons for missed items will be examined and the search string adapted accordingly. Any adaptation that may be necessary will be clearly recorded in the final systematic map report.

Attempts to identify grey literature will include searches of Google Scholar which has been demonstrated to be effective in identifying traditional academic and grey literature together [15]. Two simplified search strings consisting of arable or agriculture, and outcome words related to greenhouse gases will be used, and the resulting references will be sorted by relevance. The first 250 results from each search string will be exported into Excel and duplicates will be removed. Each reference will be examined and screened for appropriateness. Customized search strings used in search engines will be recorded in an appendix. All resulting relevant articles will be included in the article database.

Additionally, the websites of key organisations will be searched for relevant studies by using built-in search facilities and by searching the sites 'by hand' (i.e. focusing on any 'Publications' pages and examining site maps where available). These websites will include:

- British Society for Soil Science.
- Centre for Ecology and Hydrology.
- Department of Agriculture, Environment and Rural Affairs, Northern Ireland.
- European Environment Agency.
- Environment Protection Agency Ireland.
- European Commission Joint Research Centre.
- Gov.UK.
- National Trust.
- Natural England.

- Natural Resources Wales.
- Project Drawdown.
- Rothamsted Repository.
- Scottish Environment Protection Agency.
- Scottish Government.
- SNIFFER.

Finally, a public call for relevant studies and sources of studies that may not be readily identified will be made via the expert advisors' and stakeholders' networks and social media (e.g. Twitter and Research Gate).

After the search results have been collated, duplicates will be removed using a combination of reference management software (EndNote) and systematic review management software (EPPI-Reviewer 4) [16]. The review will be managed within EPPI-Reviewer 4.

Article screening and study eligibility criteria

Screening process

The final set of deduplicated search results will then be subjected to screening in a two-stage approach, assessing title and abstracts and finally full text documents; including only those articles that are eligible in the subsequent stage. At each stage the number of excluded results will be documented, and the reasons for excluding articles at abstract and full text will also be recorded in an additional file published alongside the final map report.

Before screening is performed in full, eligibility will be assessed at each stage by two reviewers on a random subset of 10% of articles, and the level of agreement (consistency) will be tested by calculating a Kappa statistic [17]. All disagreements will be discussed in detail and inclusion criteria definitions improved where necessary. Where the level of agreement results in a Kappa statistic below 0.6 the consistency checking will be repeated until a 'moderate' agreement is achieved.

In order to retrieve full text documents the review team will have access to the libraries and subscriptions of the organisations participating in the review team and advisory group. Where articles cannot be sourced due to a lack of subscription, inter-library loans will be requested and/or authors will be contacted directly with requests for digital offprints. Unobtainable articles will be listed in an appendix to the final review report.

Reviewers who have authored articles considered in this review will not pass decisions regarding screening or study validity assessment of their own work.

Eligibility criteria

At each stage, eligibility will be assessed according to the subject scope and methods in each primary research article. For the purposes of clarity, we break this down into the following eligibility criteria:

Eligible subject(s):	Arable farmland in temperate climates defined as fully humid and summer dry, i.e., Cfa, Cfb, Cfc, Csa, Csb, Cs in Köppen–Geiger classification [17]. Peatlands will be included only when being used for agricultural purposes. Crops that are primarily found in tropical regions (e.g., rice, sugarcane, bananas) will be excluded as these were considered as not relevant to the stakeholders. Grasslands, pastures and forests, will be excluded.
Eligible intervention(s):	Any farmland management practice applied to the crop or the soil, and that could be applied to entire fields. This would include, for example: fertilisation; addition of amendments (e.g. lime); different crop rotations; soil tillage. Practices such as buffer strips that are not feasible as whole-field interventions are excluded. Comparisons of different starting soil types/contents (e.g. phosphorus concentration, moisture content) will be excluded if no actual intervention is present in the study. Land use change studies will be excluded, i.e. where land is changed from arable to another type of use e.g. from arable to urban development.
Eligible comparator(s):	Different levels of a management practice or an absence of a particular practice, either spatially (nearby control fields or plots) or temporally (i.e. before a management practice was initiated). Studies without a comparator at the intervention level will not be eligible. Studies that compare different crops (e.g., wheat vs corn) with the same intervention will be excluded.

Eligible outcomes: Fluxes of greenhouse gases (CO_2, CH_4, N_2O).

Eligible study designs: Any observational or manipulative experimental study. Modelling studies, greenhouse or laboratory studies and ex situ experiments will not be included.

Eligible languages: Attempts to include articles in a range of languages in addition to English will be made. These are likely to include French, Danish, German, Norwegian and Swedish. Articles judged as eligible but in other languages will be listed in an additional file published alongside the final review report.

Study validity assessment

Formal study validity assessment will not be conducted as part of this SM in line with standard guidance for systematic maps [18]. Rather, we will record a selection of meta-data and coding variables that affect study validity (e.g. sample size). No critical appraisal of these data will be undertaken, but sufficient information will be extracted to allow full critical appraisal in any subsequent systematic review(s) conducted on the map outputs. This information will include:

- Study design type.
- Length of study.
- Replication and randomisation details.
- Clarity and detail of methods.

Data coding strategy

Following full text screening, a database of all relevant studies will be produced, which will describe the articles from which the studies are taken along with information about the study setting, experimental design, and measurement methods used (see Table 1 for the proposed

Table 1 Proposed coding and meta-data extraction schema

Variable	Description	Meta-data or coding
Study ID	Unique study identifier linked to article ID	Meta-data
Citation	Full citation of the article containing the study	Meta-data
Email address	Main author email address provided within the publication if present	Meta-data
Study country		Coding
Latitude	Decimal degree	Meta-data
Longitude	Decimal degree	Meta-data
Köppen-Geiger climate zone	Climate zones	Coding
Soil texture classification	USDA texture classifications	Coding
Soil comments	Description of soil texture, including clay, silt, sand percentages, alternative soil classification names, etc.	Meta-data
Intervention start	Year during which the intervention began	Meta-data
Intervention end	Year during which the intervention ended or when the study was completed	Meta-data
Intervention duration	Length of the study period in years	Meta-data
Intervention type	Amendments, crop rotation, fertiliser, tillage, other, multiple	Coding
Number of different treatments	Total number of farming practices investigated and reported	Meta-data
Different treatments detail	Description of the treatments investigated and reported	Meta-data
Study design	Before-after-control-intervention, before-after, comparator-intervention	Coding
Experimental design	Randomised control trial, split/strip plot, Latin square, paired design, purposive	Coding
Spatial replication	Number of true spatial replicates at the intervention level, i.e. if the intervention was applied at the field scale replication would need to be at the field scale also	Meta-data
Temporal replication	Multiple time points measured after intervention (yes/no)	Coding
Measured outcome	N_2O, CO_2, CH_4	Coding
Quantification method	Description of GHG measurement method, e.g. infrared spectrometer	Meta-data
Sampling equipment	Static chamber, dynamic chambers, eddy flux covariance tower	Coding
Sampling equipment description	Description of tower set-up, including tower height, gap filling, etc. Description of mitigation measures for chamber equipment, e.g. presence of boardwalks, permanent collars, pressure equalisers, radiators, etc.	Meta-data

coding strategy). Information regarding possible sources of heterogeneity will be extracted (in the form of meta-data and coding) from across the eligible articles. Such variables will include: climate zone; fertiliser type; fertiliser quantity; presence of soil drainage; soil texture classification; soil physical characteristics; crop type; above-ground biomass; concurrent land management; land management history; and organic matter content.

Study mapping and presentation

A final SM report will be submitted to the Open Access journal Environmental Evidence. The report will describe the evidence base using text, figures and tables, summarising the quantity of evidence found within major categories and major management practice groups (e.g. organic versus conventional), fertiliser regimes (e.g. organic, mineral, other amendments), and soil texture classifications. A narrative synthesis in the final review report will combine this with additional details documenting all activities involved in the creation of the map in appendices to the report. The report will conclude with a section on the implications of the findings for research and policy.

Knowledge gap and cluster identification strategy

A series of heat maps (cross tabulations of key descriptors, e.g. interventions and outcomes, interventions and populations/settings) will be produced. These will be compared with one another and the differences between groupings to systematically identify knowledge clusters (subtopics that are well-represented by research studies) and knowledge gaps (subtopics that are comparatively under-represented by research studies). This will be performed by visual inspection by a methodology expert of the review team (i.e. not a subject expert to avoid preconception bias). Additionally, we will aim to present the results using the EviAtlas tool [19], which will allow studies to be presented via location of the study and make use of dropdown filters so that studies relating to different soil types, interventions and GHG emissions can be easily identified.

Supplementary information

Supplementary information accompanies this paper at https://doi.org/10.1186/s13750-019-0182-2.

Additional file 1. ROSES form for systematic map protocols.

Additional file 2. A List of benchmark articles.

Acknowledgements
This protocol has been developed from a Mistra EviEM systematic mapping project (http://eviem.se/en/projects/soil-organic-carbon-stocks/) and we thank the review team involved in that project for their excellent basis from which we were able to work.

Authors' contributions
NRH produced a first draft of this manuscript, heavily revised by AMC, edited, and commented on by all authors. All authors read and approved the final manuscript.

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Consent for publication
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Competing interests
The authors declare that they have no competing interests.

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Publisher's Note

Section / sub-section	Topic
Title	Title
Type of review	Type of review
Authors contacts	Authors contacts
Abstract	Structured summary
Background	Background
Stakeholder engagement	Stakeholder engagement
Objective of the review	Objective
	Definitions of the question components
Methods	
Searches	Search strategy
	Search string
	Languages – bibliographic
	Languages – grey literature
	Bibliographic databases
	Web – based search engines
	Organisational websites
	Estimating the
	Search update
Article screening and study	Screening strategy
	Consistency checking
	Inclusion criteria
	Reasons for exclusion
Critical appraisal	Critical appraisal strategy
	Critical appraisal used in synthesis
	Consistency checking

Data extraction	Meta-data extraction and coding
Data synthesis and	Narrative synthesis strategy
	Knowledge gap and cluster
	Demonstrating procedural
Declarations	Competing interests

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[5] Leeds Institute of Health Sciences. https://medhealth.leeds.ac.uk/info

Description

The title must indicate that it is a systematic map protocol, and must
Select one of the following types of review: systematic map, systematic
The full names, institutional addresses, and email addresses for all
Abstract must not exceed 350 words and must include two sections 1)
Describe the rationale for the review in the context of what is already
The planned/actual role of stakeholders throughout the review process
Describe the primary question and secondary questions (when

Break down and summarise question key elements e.g. population, intervention(s)/exposure(s), comparator(s), and outcome(s).

Provide Boolean-style full search string and state the platform for which the string is formatted (e.g. Web of Science format)
List languages to be used in bibliographic database searches.
List languages to be used in organizational websites searches and web-
Provide the number of bibliographic databases to be searched.
Provide the number of web – based search engines to be searched.
Provide the number of organisational websites to be searched.
Describe the process by which the comprehensiveness of the search
Describe any plans to update the searches during the conduct of the
Describe the methodology for screening articles/studies for
Describe clearly the process for checking consistency of decisions
Describe the inclusion criteria used to assess relevance of identified
State that you will provide a list of articles excluded at full text with
Describe here the method you propose for critical appraisal of study
Describe how the information from critical appraisal will be used in
Describe how repeatability of critical appraisal of study validity will be

Describe the method for meta-data extraction and coding for studies
Describe methods to be used for narratively synthesising the evidence
Describe the methods to be used to identify and/or prioritise key
Describe the role of systematic reviewers (who have also authored
Describe of any financial or non-financial competing interests that the

for systematic mapping in environmental sciences. Environmental Evidence, 5(1),
.., 2016. Updating and amending systematic reviews and systematic maps in envir
art, R., Sweet, J.B. and Wilhelm, R., 2017. A framework for stakeholder engageme
dards for Evidence synthesis in Environmental Management. Version 5.0. www.er
o/639/information_specialists/1500/search_concept_tools. Accessed 12/11/2017

Further explanation	Checklist/Meta-data
The title should normally be the same or very similar to the review	Meta-data
See CEE Guidance on systematic mapping [1], and on amendments and	Meta-data
	Checklist
	Checklist
A theory of change and/or conceptual model can be presented that links	Checklist
	Checklist
The primary question is the main question of the review. Secondary	Checklist
For other question types see [4,5]	Meta-data
Details regarding search strategy testing should be provided.	Checklist
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	Checklist
Vote-counting (tallying of studies based on the direction or significance	Checklist
	Checklist
Reviewers who have authored articles to be considered within the review	Checklist
	Checklist

p.7.

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Author response		Comments
What are the impacts of within-field farmland management practices on the flux of greenhouse gases from arable cropland in temperate r		
systematic map		
Yes		
Yes		
Yes		No theory of change or
Yes		details provided in a dedicated section
Yes		
Population: Arable farmland in temperate regions; Interventions: All within-field farmland management practices applied to arable cropland; Comparator: Without management.		
Yes		
(arable OR agricult* OR farm* OR crop* OR cultivat*) AND (plough* OR plow* OR till* OR "direct drill*" OR fertili* OR biosolid* OR "bio solid" OR organic OR manur* OR		
English		
English		
	7	AGRIS Agricultural database (FAO), Directory of Open Access Journals, PubMed, Sc
	1	Google scholar
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Yes	Table provided
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Yes	
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1.

egions? A systematic map protocol

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Benchmarked Articles

Title
Soil carbon dynamics under different cropping and p
Soil properties, crop production and greenhouse gas
Effects of long-term tillage and drainage treatments
Effects of agronomic practices on the soil carbon sto
Long-Term Influence of Tillage and Fertilization on N
Long-term trends in nitrous oxide emissions, soil nitr
Effects of soil tillage and fertilization on resource eff
Soil aggregation and greenhouse gas flux after 15 ye
Soil carbon fluxes and balances and soil properties o
Soil carbon, soil nitrate, and soil emissions of nitrous
Long-term tillage effects on soil carbon storage and
Quantifying annual N2O emission fluxes from grazed
The effect of N fertilizer forms on nitrous oxide emis
Nitrous oxide emissions from fertilised UK arable soi
Soil N2O emissions with different reduced tillage me
Impact of reduced tillage on greenhouse gas emissio
The impact of ploughing intensively managed tempe
Greenhouse gas emissions from intensively managed
Multiyear greenhouse gas flux measurements on a t
The impact of cultivation on CO2 and CH4 fluxes ove
Field N(2)O, CO(2) and CH(4) fluxes in relation to till
To what extent can zero tillage lead to a reduction ir
Difference in Soil Methane (CH4) and Nitrous Oxide
Comparison of soil greenhouse gas fluxes from exter
Annual emissions of CO2, CH4 and N2O from a temp

Citation	Region	URL
Chan KY, Conyers MK, Li GD, Helyar KR, Poile G, Oates A, Ba	Australia	http://www
Chirinda N, Olesen JE, Porter JR, Schjønning P. Soil properti	Denmark	http://www
Datta A, Smith P, Lal R. Effects of long-term tillage and drai	Ohio, USA	https://ww
Dersch G, Böhm K. Effects of agronomic practices on the so	Austria	https://link
Feiziene D, Feiza V, Slepetiene A, Liaudanskiene I, Kadziene	Lithuaina	https://dl.s
Grandy AS, Loecke TD, Parr S, Robertson GP. Long-term tre	Michigan, USA	https://ww
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Shrestha RK, Lal R, Rimal B. Soil carbon fluxes and balances	Ohio, USA	https://ww
Hellebrand HJ, Strähle M, Scholz V, Kern J. Soil carbon, soil	Germany	https://link
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Drewer J, Anderson M, Levy PE, Scholtes B, Helfter C, Parke	Scotland	https://link
Taft HE, Cross PA, Edwards-Jones G, Moorhouse ER, Jones D	UK	https://ww
Beyer C, Liebersbach H, Höper H. Multiyear greenhouse gas	Germany	https://onl
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Drewer J, Yamulki S, Leeson SR, Anderson M, Perks MP, Ski	Scotland	https://link
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