Ocean Alkalinity Enhancement Data Management Protocol v0.1.0

Public consultation summary

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Context

The development of a protocol for managing data from ocean alkalinity enhancement field trials was initiated in June 2024 between Carbon to Sea, Submarine Scientific, and NOAA. Following two in person workshops and on-going collaboration with the Steering Team and Working Groups, an initial draft of the protocol was created, the Ocean Alkalinity Enhancement Data Management Protocol v0.1.0. This version was hosted by Carbon to Sea for an open public comment period from January 23, 2025 through March 17, 2025.

This document summarizes the feedback received during the open comment period and includes responses as resolutions to each reviewer comment. Line numbers refer to the v0.1.0 protocol line number corresponding to each comment. Comments are sorted by increasing line numbers.

We are enormously grateful to all participants in the open comment period for their time and valuable input that has been integrated to develop a more thorough and community-driven protocol.

Summary of feedback received

Line No.	Comment	Resolution
10c	Required Fields & Column Header Names: The section currently titled “Column header names” does more than just specify formatting—it actually defines schema requirements for datasets. A more precise name, such as "Required Fields & Column Header Names", might better reflect that this section not only dictates how headers should be formatted but also which fields in general should be included or excluded.	change: the "Column header names" section is now specific to recommended column header names.
10i	“This does not currently cover data standards for conceptual, process models, or models, or simplified plume mixing zone models.” It would be valuable to expand the scope of future protocol updates to include these + other models (e.g. reactive transport sediment models for CEW), as an OAE project will likely use a range of different types of models.	change: added text to description above the Model Description Template to address this: "Note that the model description template here applies to ‘Model data’ as defined in the Definition of Selected Terms, which includes any model simulations with physics with or without biogeochemistry solved on a realistic three-dimensional grid. Other types of models relevant to OAE research and CDR quantification, like reaction transport/mineral dissolution models, sediment and particle transport models, as well as ecotoxicological models, are not covered by this model

		description template and will be addressed in future versions of the OAE Data Management Protocol."
10k	& 10m – “Baseline” is defined as the reference point for comparing future measurements to assess the impact of the OAE intervention through time. “Control” is defined as the baseline for comparison during the intervention. But a control site can also be monitored to assess the impact of the OAE intervention through time, not just during the intervention.	change: the definition now includes "during and following intervention" .
10k	The definition of baseline is aligned with Isometric’s definition of “A set of data describing pre-intervention or control conditions to be used as a reference scenario for comparison.” Isometric’s definition of counterfactual is “a quantification of what would have happened in the absence of a particular intervention, i.e. assuming the baseline conditions,” which is also aligned with how counterfactual model experiments are used, so it’s great to see some alignment on terminology and would recommend keeping these!	change: the counterfactual model experiment has been updated slightly to be more consistent with Isometric's definition.
10l-10m	I understand how this OAE data management protocol having use outside of OAE but for mCDR more generally. This is why I believe 'intervention' is defined in a way that is broader than just OAE – great! With that in mind: sometimes 'intervention' is mentioned with and sometimes without OAE, but it could be useful to mention 'OAE intervention' whenever OAE is specifically addressed, and without if it could hypothetically pertain to mCDR more generally.	change: references to OAE intervention have been changed to 'intervention' when it may be applicable to other mCDR types.
15	Will there be an executive summary? I find it would be good to have an overview first!	no change: we feel an executive summary may be redundant to the following introduction sections: Background, Objectives & Guiding Principles, Methodology, and Intended Users.
17	Defining what a field trial project is would be helpful for the background/introduction section.	change: we have better defined what constitutes field trial data and clarified the difference between this and data from laboratory experiments in the "Intended Users" section.
18	We suggest defining “ocean sciences community”. This could have a place as a footnote, or be included in this section as appropriate.	change: we refer the reader to Acknowledgements.

18-19	What is the definition of “living document” in this context? Who will be responsible for maintaining this? Where will new information come from and how will it be logged for transparency? A general concept for a process or method for how the document will be reviewed, updated, etc., would be helpful in this section.	change: additional text has been added to explain who will be responsible for maintaining the protocol as well as process and timing for revisions.
22-24	If “...from academia, government, non-profit, and industry” comprise the ocean science community, this could be an appropriate place to define ocean science community using this existing definition.	change: reference to "ocean community" has been changed to "OAE science community".
25	Line 25: “Findable and discoverable” are the two aspects that don’t seem to be fully addressed in the document. These guidelines are great for recommending what should be archived, but to make sure that anyone (public, researchers, other stakeholders) can easily find where the data are stored is critical. One small way to improve this would be in the section “Where to store data” (line 450), which could be elaborated on to state that any report published needs to have links/references to all data repositories where all datasets related to the project are stored.	change: a section on 'Where to Store Data" has been added with links to recommended repositories.
38-40	Flexibility for Innovation: The commitment to allowing innovation within project designs is important. However, it would be beneficial to provide a mechanism for data providers to contribute their own data schemas or supplemental metadata additions which could extend this protocol. A process for proposing additions or adjustments would help ensure long-term flexibility while maintaining standardization.	change: we have included an email contact for this feedback.
40-42	Are there examples to point to for other ocean, coastal, or terrestrial protocols that have resulted in transparent data sharing and fulfilled the objectives listed here?	no change: while protocols exist in these fields, and have been referenced in the text when they are adopted for our protocol, an analysis on the downstream use and fulfillment of these objectives are uncommon.
46	Will this include across other sectors as well? Might be good to add that point if so.	no change: the potential applicability of this protocol is referred to in Intended Users.
52	We suggest removing the “first” in this section, as it seems redundant with “0.1.0”.	change: 'first' has been removed.

59	Is the term “Ocean Acidification Community” different from the OAE Community noted in 48? This term also introduces confusion with and “the ocean sciences community”. Are there differences between the three?	change: the previous mention of "Ocean Science Community" has been updated to "OAE community". The Ocean Acidification Community refers to researchers in the field of ocean acidification, which has a longer history than OAE, but community members may occupy both groups.
64	“Findable” by whom? The same request for clarification applies to “accessible” and “intercomparable”.	change: this has been updated to refer to data end-users for these points.
68	“Steering Committee” is another noun inconsistency. We suggest consistency of terms throughout the protocol for the same reference to limit confusion. For example, “Steering Team” and “Steering Committee” are both used in the Methodology section.	change: Steering Team has been changed to Steering Committee
70-75	This section states that the protocol is designed to assist OAE projects that include physical, life, modeling, and social science data at very different ranges of detail. We observed that the OAE project descriptions generally describe model output and social sciences, but then go into specific methodology for collecting data from sensors, discrete observations, sediment processes, etc. We suggest either maintain generalized and concise terms across the board (e.g., physical, life, modeling, social) or reflect the same level of detail for the overarching categories.	change: we have included text in Intended Users and Emerging Standards to explain that the level of development in various oceanographic observing methods vary, and as such the level of detail provided for each within the protocol are not consistent.
71-75	This entire section is one sentence. We suggest a re-structure for better clarity and understanding.	change: this section has been expanded based on additional reviewer feedback and includes >6 sentences.
71	This paragraph could be written a bit more clear. And is it only for field data and model data? Or would mesocosms or biological data or experiments also be important to include?	change: the paragraph has been updated to define that this is for field data, as well as to define what constitutes field data.
77	That might be good to explain up top/in an executive summary that this is best practices for people that may be interested in using this protocol and that it is a voluntary document. I am not sure if it is implied, but it would be great to see somewhere stated how this could be 'incentivized' to be used, such as having granting agencies encourage/require it and/or institutions	change: text has been added to explain that these are best practice recommendations to help any user develop their data management plan, however projects specifically claiming compliance to the protocol must meet the requirements herein. Granting agencies, institutions, regulatory and verifying bodies have also been included in Intended Users.

80	(syntax) refers to 'protocols', but lines 71& 74 refer to 'protocol' (singular).	change: Protocol is now singular.
93-94	Data Submission Requirements: It's a bit of a challenge to be so specific on this section when the data repositories / tools haven't been all defined yet (except for OCADS system). Rather than referring to "Data Submission," it may be clearer to append to this a section on "Supporting Data Submission & Repository Requirements", which could provide guidance for repositories and data platforms that want to support this protocol.	change: additional repositories have been suggested as well as further details on what is considered compliant for a repository. We have included a note with contact email directed to data systems managers interested in supporting the mCDR sector.
102	I see down below there are two repositories suggested - see below comment as well. It would be good to state here that there are some repositories recommended and it might be good to see more recommended	change: this section has been revised and is now focused on metadata without a reference to data submission (as this is a seperate section). The Metadata section does now point the reader to Guidelines for Data Management, which include the section on where to store data. We have also expanded the list of recommended repositories.
103	metadata and naming: Would it be possible to clarify this as "Project and Experiment Metadata"? This would make it clearer what level of metadata is being described.	change: the metadata fields for field data have been re-organized into a hierarchical structure including: Project, Experiment, and Dataset.
103	(needs clarification) guidance for users who are required to use a structured metadata interface that doesn't meet standards laid out in this protocol? Should they submit their via the OCADS form as well, to ensure interoperability? This question seems to be addressed in lines 124-25, so perhaps just shift that sentence up?	change: we have included the requirement that the required metadata fields must be included with data upload to the submitter's chosen repository as a separate file if the repository's metadata system does not include the required fields.
104	Could put the web address as a hyperlink behind the word metadata form and delete the address in the text?	change: this reference has been removed in the revised text.
107-108	Metadata Template File Issues: Several metadata fields lack clearly defined units and controlled vocabularies: - pH temperature reporting should specify whether it is in Celsius or Fahrenheit. The current option of "in-situ temperature" allows non-numeric values, which may cause inconsistencies. - Calibration temperature should have a required unit. - Time fields generally specify UTC but do not define a consistent format.	change: units have been included with the new lists of column header names and descriptions. Time fields have been standardized to all use the same format and the format is explicit. Controlled vocabularies are referenced with the authoritative sources provided, where available.

	- Controlled vocabularies (e.g., "Data Submitter", "Investigator", "Sea Names") should link to authoritative sources. Standardizing these would improve consistency and prevent ambiguity.	
113	Beginning sentence with small case letter (mCDR)? How about in mCDR	change: this section text has been largely revised and no longer begins with 'mCDR'.
114	“mCDR research, particularly OAE, involves creating deliberate perturbations to study their effects.” Since this line is early in the document, I’d soften the language to ‘involves investigation of perturbations’ to expand to natural analog research.	change: updated text to ‘involves investigation of perturbations’ .
116	Structuring OAE Metadata: Right now, all metadata is bundled under “OAE Metadata”, but different metadata types likely have distinct purposes. Structuring it into Project Metadata, Experiment Metadata, and Dataset Metadata could improve clarity. For example: Project metadata stays constant across all experiments. Experiment metadata applies to a specific study but remains consistent across datasets. Dataset metadata is unique to each submitted dataset. This structure would also help align metadata submission steps with the likely data collection workflow.	change: the OAE Metadata table has been organized into categorical sections based on this suggestion, creating a hierarchical structure.
116	I am not sure it is clear that OAE Metadata is a name for a certain data template. Maybe, change the sentence to “The data template/form OAE Metadata provides ...”	change: we have re-structure the metadata sections into the following categories for clarity: Project, Experiment, and Dataset where OAE-relevant fields may occur throughout these rather than pulled separately.
127-128	File Format Requirements: To ensure interoperability, it would be beneficial to provide templates and programmatic validation tools for each file format (plain text, netCDF, XML). If that's too much, then perhaps adding clarification on the expected structure for each file format would help maintain consistency.	no change: we hope to expand on the development of user-friendly templates in future versions.

134	Would be useful to know funding for the project as well	no change: this field has been included in Project Metadata
134c	Project ID: A link to data from related projects would be useful. Some projects have several phases. Data from the first phase of the project could link data from the second phase or other sub projects with related research (connecting modelling, observational and experimental data within the same project). I see that this is done in 134k (Other datasets collected from this project). Maybe, line 132c could refer to 134k if it applies.	no change: the current Experiment ID field is meant to help differentiate the phases of a project to the level that makes sense to the project planner. Specific links to DOIs within the Project ID are provided in the metadata field 'Other datasets collected from this project'.
134a	OAE Metadata - Every field should be required, unless otherwise noted below.	change: the following text has been added to metadata "All fields are required unless otherwise noted below."
134d	and elsewhere: I'd prefer simplifying 'manipulated' throughout this doc to 'enhanced' – since that's what we're all doing in OAE, enhancing alkalinity. Because this descriptor is 'Experiment type', I would simplify [model output] to [model] throughout (as we're not saying 'natural results')	change: we have replaced the 'experiment type' field with 'mCDR experiment type' as many reviewers had concerns with the original field and controlled vocabulary options for this. The options are now 'control' 'baseline' 'intervention' 'model' 'other'. 'Intervention' has been used in place of 'manipulated'.
134d	I have read the "controlled vocabularies" section and it is not intuitive to me what would constitute a "natural" experiment type. "Experiment", to me, implies an inherent manipulation. I would consider baseline/control data a subcategorization of data within an experiment (i.e. treatment vs control data). It does not seem like you mean a natural analog study here, because this is considered an "observation type" (line 134f) later. Vocabulary and characterizations that are more intuitive to me are something like: "study (?) type" is either "empirical" or "model", then → "experiment type" is field study, mesocosm, natural analog, etc then → "treatment type" is baseline, control, or manipulated (Note: I like "manipulated" relative to other options considered in the document)	change: we have replaced the 'experiment type' field with 'mCDR experiment type' as many reviewers had concerns with the original field and controlled vocabulary options for this. The options are now 'control' 'baseline' 'intervention' 'model' 'other'. 'Intervention' has been used in place of 'manipulated'. Because the current protocol is for field data, a further breakdown is not yet required, however if this protocol is expanded to mesocosm studies and natural analogs an additional field will be added to facilitate the differentiation of these as needed.

134d	We suggest that the experiment type [natural] [manipulated] [model output] includes [social] to allow for OAE projects to label if they're social science projects. Furthermore, we encourage you to reevaluate using [natural], which could be poor word choice when the opposite of [natural] is [unnatural]. If [natural] is referential to the relatively controlled state, [adjusted] may be a better fit. We do note that the protocol draft uses [intervention].	change: 'socioeconomic' has been added to the new 'observation types' to allow for a filter for these data. We have reevaluated the vocabulary for experiment types and have made modifications based on this and additional reviewer's recommendations. It is recommended in the revised text that socioeconomic studies use 'other' for experiment type.
134d	why not use the consistent terminology of "baseline" and "intervention" instead of natural/manipulated?	change: this is a category at a level above the project being mCDR-specific to aid in more broad searchability in the repository. For example, a ocean acidification experiment will also be 'manipulated' data that may be included in the same repository. However, to add additional clarity for mCDR projects, an 'mCDR Experiment Type' field has been added with options: intervention, baseline, control, model, other
134d	Experiment Type vs. Project Level: Would an experiment type always apply at the experiment level, or might some experiments within a project have multiple classifications? For example, some experiments may involve baseline sensor data (natural monitoring), and have other datasets that involve direct interventions. Defining how "experiment type" applies within the broader entity-relationship model (e.g., Project → Experiments → Datasets) would be useful.	change: the OAE metadata has been restructured in a hierarchical order as: Project -> Experiment -> Dataset, where multiple Experiments (e.g., model, intervention, baseline, or control) will occur under a single Project. For each experiment, the Project-level metadata may be copied, however a new Experiment-level metadata file must be completed.
134d-134h	(pages): Here, the protocol suggests including information about "relevant social science surveys" and "local sentiment surrounding coastal activities." As currently written, a social scientist would have to go through every protocol's site description to see if it's associated with a social science project or not because there isn't a tab to flag if a protocol includes social science data. Including a tab could save capacity. Additionally, the language "relevant social science surveys" could skew what type of social science research is being included and why. For example, someone could be researching an area for "MCDR social science" in a particular region and come up with nothing, while another may research "air or water quality", "industry pollution", "permitting legal battles", which could bring up social science studies that have had generational impact in that	change: a new field for social site description has been added to separate this information and help with findability for social scientists. A new field 'socioeconomic' has been included to the list of possible Observation Types. A new field to include links to public comments has also been added to aid social scientists. We have also created an independent metadata template for socioeconomic studies, with fields recommended by the social sciences working group. These updates, naming conventions, and content, were chosen with additional guidance from the social science working group.

	region, irrespective of whether they explicitly involve MCDR. That information would be helpful for MCDR project leads to understand local context and history. We suggest major revisions here to provide the same level of findability and accessibility for social science users as for physical/life science users and suggest a separate section for social science outside of "Site Description" as a possible solution.	
134e	here the guideline notes 'Project Condition' (ie. manipulated) which points to the row above, which is labeled 'Experiment type'. Would replace 'Project Condition' with 'Experiment type' for clarity.	change: this has been clarified
134e	I think you mean: project id + experiment type + numerical indicator?	change: this has been corrected
134f	Observation type - includes 'laboratory experiments'. In general, here and elsewhere, I think this document should further clarify its intention in setting apart field and laboratory studies. I would love to see coherent reporting standards for lab studies, but it doesn't seem to fit in this document, so it would be simpler to remove this from this section.	change: 'laboratory experiments' has been removed, however the observation type (now referred to as dataset type) for 'experiment' has been added as a general options for any measurements that have non-geospatial aspects which can include laboratory experiments. This option was included to be forward-thinking in future protocol versions that may include additional dataset types, and to mirror the data types provided by OCADS and SeaBASS.
134f	I don't fully understand the rationale of what is on the "observation type" list. For example, distinguishing between benthic and pelagic mesocosms, which is a pretty nuanced detail all things considered, and also not including tank mesocosms. – Why "field experiment" but not "field trial" or "commercial deployment"? I consider in-situ mesocosms field "experiments". I dont really think of the year-round, operational OAE project sites that a number of companies are running right now, and even selling carbon credits from, as "experiments". I dont think they would categorize them that way either. – Does "profile" mean water column profile? (As opposed to sediment profile). This (as well as time series and surface underway) seem like types of data one might collect during a field experiment or mesocosm experiment or natural analog study. As in, they seem like a second layer of data categorization.	change: the options and definitions of observation types have been updated (and renamed to data types) to reflect a more granular level for clarity and to avoid overlap. The provided options have been taken from OCADS and SeaBASS to be consistent with common naming for oceanographic field data types.

134f	We suggest adding an observation that relates to social science experiments (time series could maybe count); [human] or [community] could be options for consideration.	change: 'socioeconomic' has been added.
134f	Is it worth adding “incubations” or “ship-board incubations”	change: the option 'experimental' has been included which incubation data would fall under
134g	should allow space for a brief description too, since some folks might characterize their activity one thing for a marketing perspective when it actually aligns with something else (e.g. calling something marine ecosystem recovery but they’re doing ocean fertilization)	no change: these are controlled vocabularies rather than an open text section, creating the ability to be searchable. The user must select from the choices provided that are closest to their intervention method, or select 'other'. Details of the intervention should be provided in Experiment Description for further explanation.
134g	mCDR Pathways: Does this refer to the experiment or the project level? Can a project have multiple experiments each exploring different pathways? If so, it would be good to clarify whether this field is defined per experiment or per project.	change: because some mCDR projects do involve more than one method (e.g., iron fertilization with alkaline material), this field may now be selected as multiple choice. mCDR pathways is at the project level metadata, whereas for each experiment, the experimental metadata must be filled out.
134h	great illustrative example. consider including a sample website for community engagement activities here, to encourage inclusion of this type of information as well as published studies, to help social scientists and others connect with community groups.	change: a new metadata field for social context site description has been added, including fake example websites for local community discussion forums.
134h	,i: I love to see the call for field data context and project descriptions covering biogeochemistry, other industries, etc. I suspect folks will skimp here. More hypothetical examples that indicate the level of detail that is useful and expected would be helpful here, to prevent folks from simply not spending time on this piece. Perhaps soliciting examples from the various academic NOPP projects in OAE would speed this along.	change: the descriptions for these fields have been expanded, and a new field has been added for social site characteristics to specify this information.
134h	There's a lot of information that's asked for here, both about the physical environment as well as social & historical context. Suggest splitting this up into different sections. Information about the physical environment should be required (e.g. tidal patterns, climatological conditions, geological characteristics, marine setting) as that’s important for understanding and providing context of the data. Information about the local	change: the descriptions for these fields have been expanded, and a new field has been added for social site characteristics to specify this information.

	sentiment should be recommended, as this is more subjective and is better placed to be required as part of the Social sciences data best practices instead.	
134h	& 134c: In study areas with many bordering countries, potential conflicts with other countries or permits from foreign governments should be pointed out. It should be indicated, if time series of field observations show gaps that are due to political conflicts, as this may be an indicator for unstable sampling protocols in the future.	change: added a sentence to reflect this: "Additionally, in study areas with nearby state or federal jurisdiction borders, potential conflicts with other countries or permits from foreign governments should be described."
134i	I would find it easier to search project description and collaborator/personnel involved in two separate fields. Project description to me is the scientific project. The collaborators/personnel would answer WHO was involved. Co-leads and collaborators as well as their affiliations would be useful, unless this is implied somewhere?	no change: a field for "Investigators" has been added to the Experiment metadata
134k	Data Submission Structure: It's confusing now the field name says "other datasets collected from this project", but the value speaks about other datasets produced from "the same experiment". It would be useful to clarify whether submission is expected to happen once per project, or once per experiment, and clarify which kinds of other datasets are expected to be referenced here.	change: because data from a single Experiment ID may be submitted to more than one repository (for example if sensor and discrete carbonate data were submitted to NOAA-OCADS, and biological data were submitted to NCBI), this field provides a link to these data sets under the same Experiment ID so that they are findable. Additionally, it is requested to include any Experiment IDs (and DOIs) from the Project ID. We have clarified the description for this field so that this is more obvious.
134k	“Datasets and experiments” might be an easier way to phrase this field since it asks for both in the description	change: the field name now includes 'experiments', we have also revised the description to be more specific.
134l	(syntax) add "or on-going" to column to match column.	change: 'ongoing' has been added
134l	Illustrative example should include a sample link to 'Algae Lock' and timeframe of previous trials, to encourage inclusion of this kind of information by users.	change: a fake example link has been added as well as a timeframe for operations.
134l	Think this can be recommended, unless there is good reason why this is needed? Any co-located mCDR activity that potentially impacts the project results should be required, but what is the purpose of listing previous activity that occurred a few years ago if it no longer impacts the	change: we have updated the text to clarify that only co-located mCDR activity that potentially impacts the project results is required.

	physical/chemical/biological conditions of the current project?	
134m	include sample map or lat/long for smelting plant, to encourage inclusion of this kind of information by users.	change: an example latitude/longitude position has been added
134n	Recommended if known, could be that unreported data is not known	change: updated to specify that these refer to data that have been or are used by the project (defacto known), but are not openly available
134o	Narrative description required as part of site description, with links to datasets used as reference to inform the narrative. But otherwise recommended (don't need to list all the possible relevant datasets here).	change: field name has been updated to "Meteorological and tidal data" and field description has been updated to request for any open datasets that are referenced in the experiment but not uploaded with the data submission.
134s	at the AGU workshop, we discussed pointing users towards relevant information that isn't typically recorded, but could nevertheless be informative, including things that went wrong in the field, or circumstances that required in-the-moment plan adjustments. Such things *might* be captured in blogs and digitized notebooks, but it's worth calling this particular kind of information out here, and encouraging users to include it.	change: this is now requested in the Experiment description.
134t	add a row for documenting any relevant regulatory parameters and/or limits to dosing trials at this location, including name(s) of regulatory authority?	change: additional permitting details have been added as metadata fields. Relevant regulatory parameters and/or limits to dosing are now requested in the Project description.
134t	Everything in this table should be required	change: In fields description added "All fields are required if applicable to your project, unless noted as recommended".
134u	OAE treatment type: Recommend 'aqueous' alkalinity over 'dissolved' throughout the document.	change: 'dissolved alkalinity' has been updated to 'aqueous alkalinity' throughout.

134u	I would not differentiate between “mineral alkalinity addition” and “coastal enhanced weathering”. In either case, its adding alkaline minerals or particulate slurry to seawater either directly (via boat, truck, etc) or through coastal outfalls to increase its alkalinity. The goal of coastal enhanced weathering is not to form carbonate minerals, as stated on 510g, it is to form alkalinity. In both cases you can have minerals in the water column and on the seafloor in variable proportions. As an example, as I recall, Planetary’s addition of brucite from a coastal outfall resulted in ~35% in the water column, ~65% of the material settling on the seafloor while Vesta’s last placement of olivine from a barge resulted in ~10% in the water column, 90% of the material on the seafloor. In your current format, Planetary’s project would be a “mineral alkalinity addition” but Vesta’s would be “coastal enhanced weathering”. Seems like an arbitrary distinction. My suggestion is to just bundle both these terms together as “mineral alkalinity addition”. However, I also think this is somewhat ambiguous with “river alkalinity addition”which is also adding minerals, and in this case the only difference is the mechanism of introduction to the ocean (river, not outfall for example). So, consider bundling “river alkalinity addition” into “mineral alkalinity addition” as well and then add a new data layer with the options such as river, wetland, coastal ocean or open ocean. I highlight this because a lot of people are focused on adding minerals to marshes and it would be helpful to capture that sort of major distinction as well.	change: 'mineral alkalinity addition' is now used for 'coastal enhanced weathering' and 'river alkalinity addition'. The controlled vocabulary fields for 'coastal enhanced weathering' and 'river alkalinity addition' have been removed and the definition for mineral alkalinity addition has been broadened. A new field 'Dosing dispersal hydrologic location' may be used to differentiate from river addition, coastal, etc.

134u	and 510g: Comment 1: Ephemeral uses a process where minerals are dispersed in shallow areas of the continental shelves, further from the near-shore environment which has been used for olivine placements to date. We term this “Oceanic enhanced weathering” to differentiate it from near-shore/beach deployments. As written this definition of “Coastal enhanced weathering”, which refers to placement in “boulders or berms”, excludes our process. We’d suggest either adding “Oceanic enhanced weathering” as a controlled vocabulary term, or revising the definition of “Coastal enhanced weathering” to include offshore deployments on the continental shelves. Comment 2: This definition of Coastal Enhanced Weathering states that carbon is stored in carbonate minerals. That is only one possible storage pathway for Coastal/Oceanic Enhanced Weathering, and it is curious that you’d include this pathway under the vocabulary for “OAE” as no alkalinity enhancement would take place with this pathway. However the other storage pathway is DIC, and that is generally the goal for Coastal/Oceanic Enhanced Weathering. Recommend adjusting the definition to indicate DIC (and thus OAE) is the primary storage mechanism, but allow flexibility under the Coastal/Oceanic Enhanced Weathering vocabulary terms to allow for mineralization as a secondary storage mechanism (as some projects may result in some combination of both mineralization and DIC storage).	change: 'mineral alkalinity addition' is now used for 'coastal enhanced weathering' and 'river alkalinity addition'. The controlled vocabulary fields for 'coastal enhanced weathering' and 'river alkalinity addition' have been removed and the definition for mineral alkalinity addition has been broadened. A new field 'Dosing dispersal hydrologic location' may be used to differentiate from river addition, coastal, etc.
134v	are these ALL the options? Should there be an "other" to cover unanticipated feedstocks?	change: this is now an open list with recommendations provided for known feedstock types.
134v	feedstock options could be more flexible. Mining byproducts and coproducts may not be neatly described by a single mineral. I would suggest adding a field for CDR potential (Isometric Feedstock module) or equivalent potential hydroxide formation to help standardize and compare across feedstocks	change: 'Alkalinity Feedstock' options have been updated to be an open list for flexibility. A field to describe CDR potential has been added.

134v	and L513-515: Comment 1: This vocabulary does not capture industrial byproduct feedstocks such as Blast Furnace Slag, Basic Oxygen Furnace Slag, Electric Arc Furnace Slag, and Ladle Slag. Ephemeral is using Blast Furnace Slag for our pilot project. All the other vocabulary words are minerals. If you wanted to constrain this to minerals, then you could add mineral components of these slags such as Akermanite, Akermanite, and Alunoakermanite. However this would necessitate allowing projects to be described using multiple mineral vocabulary words, not just a single one. Comment 2: The vocabulary includes the world “olivine”, however pure olivine is rarely contemplated for deployments, and olivine-rich rock such as “dunite” (>90% olivine), or “peridotite” (40-90% olivine) are used. One suggestion to resolve both comments is to make the vocabulary for “Alkalinity feedstock type” refer to rocks (e.g. “limestone”, “dunite”), industrial byproducts (e.g. “blast furnace slag”), or “mineral” (for if a pure mineral has been extracted or produced), and add a new field “Alkalinity feedstock minerals” which would allow one or more of the alkalinity-producing minerals to be listed.	change: we have included the field 'Alkalinity feedstock processing' to differentiate between electrochemical, mineral, synthetic and an option for blended or other. A new 'Alkalinity feedstock' field is included as an open field to name the alkaline mineral, with suggested names provided for common feedstocks.
134w	Standardizing Chemical Descriptions: The description provided includes detailed information (e.g., NaOH solution concentration, gas tagging). Is there a way to make this more structured and machine-readable (e.g. using registered chemical identifiers in existing scientific ontologies like CHEBI:32145 (https://www.ebi.ac.uk/chebi/searchId.do?chebiId =CHEBI:32145). Ideally, structured vocabularies and units would allow for programmatic validation while minimizing the burden on data submitters. With the right tooling, it should be possible for this to be done with minimal burden to data providers.	no change: we agree that structured and machine-readable descriptions would be useful throughout, but as this may require technical tooling to build these in and be user friendly, this will not be included in the current version. However, this is a goal for future development.

135a	this Physiological Response section seems a little light... is this really ALL the information that might be needed here? I understand 'physiological' to mean biological responses; I would expect fields for species, timeframe, monitored parameters, etc here. I see that inclusion of this type of information is 'recommended in L337-40; why not 'required'? It's also unclear whether this section is intended for field experiments, mesocosms, lab studies, or all three. Alright, I see now that this is all specified in L492-494, but no need to leave readers hanging! Consider referencing L492-94 (and also L549-52) from L135a.	change: this table has been removed to keep the protocol consistent with field data, specifically. It will be included should a laboratory and mesocosm protocol develop.
135a	Physiological Response Studies: It feels like this doesn't belong in this section without further description. This section is much less detailed with limited examples. I suggest moving this completely to the appendix and noting that further detail should follow, or moving it into another protocol entirely. I suspect most of the physiological studies we're thinking about here are lab experiments– so it should be clarified if this targets those studies or biological observations in-situ.	change: this table has been removed to keep the protocol consistent with field data, specifically. It will be included should a laboratory and mesocosm protocol develop.
135b	Targeted acidity or alkalinity levels: recommend specifying targeted pH/ total alkalinity addition, which is usually how this is described in lab methods.	change: this table has been removed to keep the protocol consistent with field data, specifically. It will be included should a laboratory and mesocosm protocol develop.
135d	Location is useful, but I'm more interested in source: seawater source, biological source (which I know is requested in the appendix table). Again this indicates lab work, outside of the scope of what I think this document might want to be.	change: this table has been removed to keep the protocol consistent with field data, specifically. It will be included should a laboratory and mesocosm protocol develop.
135e	Treatment duration- this reads as overall project timeline, not 'we dosed this critter in alkalinity for x days'. Recommend suggesting more detail, especially if organisms are exposed to ambient conditions and acclimatized over time, or if they're in situ but exposed to some range of alkalinity and pH anyway, etc.	change: this table has been removed to keep the protocol consistent with field data, specifically. It will be included should a laboratory and mesocosm protocol develop.
147	Considering that this is for research on mCDR methods, should the metadata on models also include the power usage of model runs? Models run on supercomputers consume a lot of energy, resulting in carbon emissions if they are not run with renewable energy.	no change: we appreciate that power usage of model runs could result in significant carbon emissions and may be relevant to the Life Cycle Analysis (LCA) of an mCDR project, but LCA data is

		outside the scope of these data standards.
147a	Again, is this something where collaborators and affiliations should be noted?	change: a field for 'Investigators' has been added to include name, affiliation, contact information, etc.
147af	- ag: Horizontal Resolution Units: For clarity, the field name should explicitly include the expected unit (e.g., "Range of Horizontal Resolution (m/km)"). If allowing multiple units, a separate unit field should be included. This guide is a generally useful writeup on suggested best practices for how to model quantities & measurements in data standards initiatives: https://linkml.io/linkml/howtos/model-measurements.html	no change: we are following common practices by oceanographic repositories, which do not include units in field names, but rather in the description.
147ah	raw data.... but helpful if they could note any processing of these forcing data. This may need to be in a narrative description.	change: added a narrative description field to note any processing of forcing data
147ah	What about providing links to the actual input fields derived from the data that's used to run the model? There may be significant work re-gridding, smoothing, processing of the data before it can be used to run the model.	change: methodology and code to generate actual processed/re-gridding input fields derived from external forcing datasets should be included with the model code and configuration files provided and therefore it is not necessary to reproduce these. We have added a comment to reflect this to the first bullet point of the Guidelines for Model Output section
147am	It could be useful to include an example of biogeochemical atmospheric forcing here too, for example dust deposition as can be prescribed in the PISCES model. Not just the physical model can have atmospheric forcing.	change: we have added requests for biogeochemical atmospheric forcings here, including dust deposition.
147au	Maybe 'Time stepping scheme & parameters' would be better. Euler, Runge-Kutta are schemes, but the example only gives the parameter. Both are necessary for proper model reconstruction and for understanding how it was run.	change: we have changed the field name to 'Time stepping scheme and parameters' as suggested and updated the example to include both
147aw	Think this should be recommended. Agree this is useful information to collect, but it isn't fully necessary for reproducibility of model output.	change: we have indicated this section as recommended but not required
147d	Wouldn't this always be "model output"? Natural/manipulated is redundant with	change: this field has been revise to 'mCDR experiment type', which is an upper-level category for any mCDR experiment to aid in filtering. Options include: baseline, control, intervention, model, other. It is correct that model

		experiments will always choose 'model'. We have clarified this explicitly in the Data Guidelines section.
147d	Experiment Type for Model Data: It's not clear whether it would be possible to have values other than "model_output" for model datasets. If that is indeed a restriction (e.g. model datasets must have value "model_output"), it would be good to make that explicit.	change: this field has been revised to 'mCDR experiment type', which is an upper-level category for any mCDR experiment to aid in filtering. Options include: baseline, control, intervention, model, other. It is correct that model experiments will always choose 'model'. We have clarified this explicitly in the Data Guidelines section.
147e	Why not standardize the language to use “intervention” instead of “perturbation”? Perturbation could be confused with sensitivity studies where certain model parameters are perturbed.	change: this field has been revised to 'mCDR experiment type', which is an upper-level category for any mCDR experiment to aid in filtering. Options include: baseline, control, intervention, model, other., where model data will always be categorized as 'model'.
147e	Controlled Vocabulary for Model Experiments: The vocabulary section further below does not currently allow for “counterfactual and perturbation” or “other” categories. If allowing multiple values is desirable, it would be nice to embed those requirements explicitly in the vocabulary, or make it explicit that this field allows for multiple values from the vocabulary, comma separated.	change: this field has been revised to 'mCDR experiment type', which is an upper-level category for any mCDR experiment to aid in filtering. Options include: baseline, control, intervention, model, other., where model data will always be categorized as 'model'.
147g	it would be helpful to have a simple multiple choice as well [OAE scientific research] [pilot aimed toward commercial deployment][permitting support][ecosystem assessment] [CDR credits][other]	no change: we appreciate this suggestion, however given the broad range of overlapping purposes for model use and lack of standard vocabularies for these, for now we have not included these but will consider this for future versions of the protocol.
147h	Required for datasets that inform the model, otherwise recommended. Other data related to the project should be searchable via the Project ID, and it might be information overload & redundant to list everything here if it’s not related to the model.	change: we have added additional information to reflect that data used to force, inform or validate the model are required here, but additional project data are not

147j	The formatting of the model output section is very explicitly set up for just ROMS or GCMs. This is in pretty stark contrast to the experiment section which is pretty versatile for a wide range of experiment types. Other models the industry is using include reaction transport/mineral dissolution models for CDR quantification, sediment and particle transport models, as well as ecotoxicological models and ecosystem models (ecotox models and ecosystem models being very different from just the ecosystem component of the aforementioned GCMs ()). I think the model output section would need a pretty significant overall/additional buildout to be flexible enough for these other model types. Maybe that is for a v data protocol but flagging but I think this is important to do as right now the model section has a very narrow scope and is therefore less utility.	change: added text to description above the Model Description Template to address this: "Note that the model description template here applies to 'Model data' as defined in the Definition of Selected Terms, which includes any model simulations with physics with or without biogeochemistry solved on a realistic three-dimensional grid. Other types of models relevant to OAE research and CDR quantification, like reaction transport/mineral dissolution models, sediment and particle transport models, as well as ecotoxicological models, are not covered by this model description template and will be addressed in future versions of the OAE Data Management Protocol."
147t	Equations for each explicitly modeled parameter should be provided, most likely in links to publications, but should be noted if any equations or parameter values (e.g. growth rates) were modified.	change: added "Equations for each explicitly modeled parameter should be provided (can be links to publications), and it should be noted if any equations or parameter values (e.g. growth rates) were modified."
147u	There are lots of relevant parameterizations in the model (e.g. vertical mixing scheme). I think this could be lumped into the BGC description	change: removed separate field and added Air-sea CO2 flux parameterization to the BGC model description
147w	Structuring Additional Model Components: The guidance for submitting additional components (e.g., sea ice, sediment, atmosphere) is vague. Could this be structured into a standardized format to ensure clarity in submissions?	change: changed language in field description to reflect that additional model components should repeat the standard field names used in the physics and BGC model components (Name, Version, Codebase, Description, References).
147y	Recommend being explicit in the instructions that georeferencing information must be included here, as done in the example.	change: updated instructions to reflect that georeferencing information must be included here.
158	the red flag to indicate requirements is a bit odd-makes me think of things to avoid. Maybe a check mark symbol instead?	change: the flag symbols have been changed to something more visually neutral
200	Missing Value Code (-999): Why is -999 used for missing values instead of a reserved keyword like N/A or null? Using a numeric placeholder could be problematic for fields where -999 might be a valid value.	no change: we have chosen to use -999 as this is the missing value code used for NOAA data, and we are not aware of any cases where -999 might be a valid value.

205-211	Data Quality Flags: For highly structured formats (e.g., NetCDF), integer flags may be useful. However, for more human-readable file formats like Excel, using a controlled vocabulary instead of integer codes might improve clarity.	no change: to stay as consistent as possible with conventional flagging definitions in ocean sciences the flagging definitions here are maintained. Using numerical flags can also help to avoid spelling errors and aids in logical sorting.
244	Description of the model output is also a requirement	change: updated text to include "description of model output"
245	The flag symbol is larger than previous flags. If size matters for its definition, that should be clarified, else we suggest revising for consistency and clarity.	change: the flag symbols have been changed to something more visually neutral and all checked for consistent sizing.
245-252	If difficult to archive model forcing datasets, can still require reproducibility of these input datasets by sharing the methods & code for generating them.	change: added an additional statement to suggest that methods/code for generating forcing data can be shared as an alternative to archiving forcing datasets.
259	Ambiguity in “Parameter Names May”: This section is marked as a requirement, but the wording is ambiguous (“parameter names may...” instead of “should” or “must”). Clarifying whether this is a recommendation or a strict requirement would help.	change: updated text to remove ambiguity on required content
259-260	These appear to be linking to experimental naming conventions, not to parameter naming conventions.	no change: this text now links to Model Output Variables
269-273	It would be helpful to provide a high-level rationale for each of these.	change: a high level rationale for the chosen parameters have been added following the list of parameters
275	“inputs”: inputs and functions (or links to references and open-source locations for those functions).	change: we have included text to describe the methods and equations used for derived variables in a ReadMe file, as well as pointing the author to the Derived Variables section for further details.
276-277	“It is recommended...” Note that many ocean models operate on a sigma for hybrid coordinate or terrain following coordinate system. May be helpful to either ask to regrid to a depth coordinate or else to provide the data and functions needed to do the regridding.	change: an additional statement has been added recommending that any model with a sigma, hybrid or terrain-following coordinate system either regrid to depth coordinates or else provide data and functions needed to do the regridding.
281-282	could you add more here? I don't see why this is necessarily the case.	change: this has been expanded to clarify that data storage may be decreased in cases where multiple unique intervention experiments are run

		referenced to a single baseline experiment
285-286	common naming conventions for model variables can adhere to the CF naming conventions. https://cfconventions.org/	change: this is now referenced under the new heading for model output under section 'Column Header Names'
291	add “data to transform from model vertical coordinates to z coordinates.”	change: this has been added
301	/302: Requirements in intervention: recommend adding concentration, time explicitly here (as flow rate isn’t enough data to extrapolate amount of alkalinity added).	change: 'concentration' is required in 'alkalinity feedstock description' and as a variable when feedstock concentration varies.
316-318	Units for Flow Rate and Mineral Mass Addition: Units should be explicitly provided, or specific units required, for variables like flow_rate, mineral_mass_addition, and mineral_mass_addition_rate. The recommended file format should also be specified.	change: text added to include units with each variable and submit data as .csv if possible
326-333	"Additional Information" vs. "Additional Details": This section inconsistently refers to "Additional Information" and "Additional Details". One term should be chosen and used throughout.	change: this has been updated to 'Additional details' to be consistent.
332-333	OAE Metadata vs. OAE Supplemental Metadata: Sometimes this metadata is referred to as "OAE Metadata", and other times as "OAE Supplemental Metadata". If these refer to the same thing, a single consistent name should be used.	change: 'supplemental' has been removed to be consistent.
333	Recommend including sediment depth interval(s) sampled as well, as this is critical information if multiple samples are taken from a single core, as is common.	change: sediment sampling depth interval(s) are recommended to be included with data
424	Will there be a choice for embargoed data? Will there be a way to incentivize/encourage all sectors to submit data including companies?	change: a recommendation for a maximum embargo period for academically-funded research is provided. Reporting recommendations for all sectors are included.

432	Timeline for data submission: "...verifiers will need to verify model results prior to credit delivery, requiring models to be rigorously tested and validated before the intervention project begins to ensure that accurate model-based quantification of CDR can be executed and shared on a scale of weeks, depending on planned reporting periods." This may not always be true, and sets apart credit delivery from academic research, both of which are covered under this doc. I expect that models will be in development during almost all interventions over the next few years of early field trials. And some studies will be observational without models. Would recommend softening this language. "Data for all purposes should be submitted by the earlier of the deadlines set by the project funders, regulators, registry, and other stakeholders..." Would recommend rewording, this sounds like any and all data should be submitted at the earliest timeline– when realistically, regulatory data will be submitted on regulatory timelines and other research data will be submitted on different schedules, to different audiences. I would say something along the lines of "Project developers must fulfill all data delivery requirements set by the project funders, regulators, registry, and other stakeholders. For submission for scientific archiving, we recommend the following..." I'd also note that data for certain purposes (ie. regulatory) may already have prescribed formats that do not match guidelines here, and may not end up in the same databases. For example, our compliance sensors in our permitted outfall zone may be reported directly to our regulator and only referenced as part of the metadata to an NCEI-type database, but not resubmitted. Sensor data timeline: I recognize the interest in providing delayed and real-time data rapidly, on order of months, but this feels very unrealistic. We would not report project data quarterly for an in-situ ocean acidification study to NCEI, we would report it at the end of some experiment/ project period as we approach publication of our results. I'm not convinced that NCEI could accept data so frequently for ongoing projects, particularly in light of recent terminations. To me, realistic data reporting timeline is 1) as frequently	change: thank you for these suggestions and reflections. We have completely revamped the timeline recommendation section to a case-by-case and industry-based level versus data type that should reflect the reviewer suggestions here. The section referencing model data needs for verification has been removed. The recommended text has been modified to "Project developers must fulfill all delivery requirements set by the project funders, regulators, registry, and other stakeholders. We recommend the following timelines for project developers, project funders, regulators, registries, and other stakeholders to have quality-controlled project data archived:" as the new timelines give recommendations for each of these sectors. There is now a clause for data that may be delayed due to laboratory lag times for analyses that is outside of the control of the project leads.

	as required to project funders, regulators, registry, and other stakeholders in the format and databases required by those commitments, with 2) ideally annual reporting to NCEI databases, with 6 month data reporting as a loftier ideal. Some near-real time data could be reasonably shared on better timelines, but this is likely to be on for-purpose platforms (project websites or similar) and not to archival databases. The text here calls for delayed-mode data to be available 3 months from collection (when the sensor is placed in-situ) which is confusing– 3 months from collection, yes, but the sensor may be placed in situ and left in place for some period of time before the collection should start that clock. On model output: are OAE models ever really 'completed'? Not yet, at this stage. Experimentation will be ongoing, so this isn't a helpful timeline. I suspect we will all sit on our data for some time until we are ready to submit for publication or for other purposes like verification. I would not agree with a 3 month clock when that time is likely necessary for model output analysis and description, + time to think about archiving appropriately. Finally, are we talking about archiving model data in general? All model experiments? Just those representing an OAE intervention? What about hypothetical studies/ sites? This language could be tightened up. On discrete data: A timeline of 3 months from collection to report discrete data from samples including carbonates, sediment processes, nutrients, biological data etc. is extremely unrealistic. We might sit on our samples for months before shipping them to a lab that will slowly analyze them and then we need to analyze the data before we can think about archiving it. Academic carbonate labs frequently have lag times of >6 months. Nutrient labs can be much longer. Biological data can be in analysis for months as well as researchers sort through it. I can't think how to assign a recommended timeframe here, other than specifying some period of months after samples have been analyzed and data returned to the OAE project	

	lead, which may be completely divorced from the project itself. Submission for publication, + review cycles, may also identify gaps or edits that must be made to datasets before we want data to appear in NCEI or similar, to ensure that it is represented properly.	
440-448	Lines: Recommend removing these timeline guidelines, and instead recommending that projects submit data to their chosen archives within a month of submission to a regulator, registry, funder, etc. Timelines for publication should always be determined by the purpose of the data, and this would ensure that the data are archived in a timely manner.	change: timeline guidelines have been broken down into sector-based timelines and based on use-case.
450	CAN users store data in multiple repositories? SHOULD they? Some guidance here would be useful. If this is likely to happen, then include recommendations for cross-referencing, synchronizing and retiring duplicate data sets.	change: it is now clarified that data may be stored in multiple repositories, if necessary. A requirement has also been added so that any reports must include links to all data sets from the project.
455	Are there additional data repository suggestions for people in other parts of the world than the US?	change: additional repositories (US and non-US based) have been recommended.
457	Encourage users to archive a copy of their entire submission on a non-government drive, in the event that access to these federal repositories is cut off.	change: we recommend that data are backed up either on an internal network, or a secondary repository such as Zenodo, figshare, or Pangaea
502-503	Governance of Controlled Vocabularies: The document defines controlled vocabularies but doesn't specify how they are governed, updated, or versioned. Since new science and mCDR pathways will emerge, a mechanism should exist to allow for community contributions and extensions.	change: we have included a section on this under "Emerging Standards"
504a	See our comments under "Intended Users" and "OAE Metadata". We suggest including social as an experiment type, and an associated definition.	change: 'other' has been added to experiment types. And 'socioeconomic' has been added to observation types to allow for a filter for these data.
505a	The definition column cycles through "method", "process", "approach", and "strategy" when describing MCDR pathways (and then for coastal blue carbon and marine ecosystem recovery it has no noun at all). We suggest edits in the same vein as our comments under section "Methodology" so as to promote more clarity.	change: the consistent use of 'method' to define these terms has been applied throughout.

505b	Should sinking of terrestrial biomass in (i) anoxic marine basins and (ii) anoxic burial in marine sediments also be represented in this list of controlled vocabularies? And what about Equatic's process & other "pre-equilibrated" alkalinity storage in oceans.	change: the controlled vocabularies for mCDR pathways have been updated and now include a more general path of "biomass sinking" which includes terrestrial and oceanic-processed biomass sinking. The description is inclusive of anoxic basins, seafloor, or sub-sea floor.
505e	In the 'Definition' column, what does "technology-driven" mean? We suggest edits to clarify in the box.	change: definition has been updated to clarify Direct Ocean Capture is a method that uses electrochemical processes to remove dissolved carbon dioxide (CO_2) directly from seawater for carbon storage or reuse."
505f	We suggest replacing "plants" with "organisms", as phytoplankton/microalgae are not plants.	change: 'plants' has been replaced with 'organisms'
505h	We suggest rephrasing "making them natural and effective solutions for mCDR" to "making them naturally occurring sinks for carbon", as phrasing this pathway as a solution may invite bias.	change: this pathway has been removed
505h	This doesn't seem like a pathway, but instead is referring to the carbon itself stored in coastal ecosystems. The CDR pathway would be marine ecosystem recovery/restoration below in	change: this pathway has been removed
505i	If seagrass is included in this description as well as in coastal blue carbon, then why are mangrove forests and salt marshes excluded? We suggest including rationale if there is a distinction, else including all four in both sections for consistency.	change: salt marshes and mangrove forests are now included.
510a	This category is combining many different types of information that's not mutually exclusive, which can be confusing. We can separate this out into:1) the alkalinity source/processing (electrochemistry, mineral mining & grinding, synthetically derived) 2) phase upon delivery into ocean (solid, dissolved/liquid, slurry) 3) method of delivery (river, dispersal onto coastal areas, outfalls, ships) 4) pre-equilibrated or not , See Fig. 1 here for a visual of the different categories: https://sp.copernicus.org/articles/2-oae2023/3/2023/	change: the treatment type options have been updated as suggested. In addition, fields to describe the phase, method of delivery, and whether it is pre-equilibrated have been added as metadata fields.
510c	Isn't this process also called Direct Ocean Capture? It may be more inclusive to include that alternate name if certain intended users recognize that term more.	no change: while these may both be electrochemical processes, there is no alkalinity increased with DOC.

510d	The term “Mineral alkalinity addition” confusingly conflicts with “River alkalinity enhancement” and “Coastal enhanced weathering”, which also add mineral alkalinity. Suggest “Ocean liming”, “Mineral slurry addition”, “Rapidly dissolving mineral addition” or similar, and to update definition to indicate the minerals must dissolve in the water column, to differentiate it from “Coastal enhanced weathering”.	change: to avoid confusion, 'mineral alkalinity addition' is now used for 'coastal enhanced weathering' and 'river alkalinity addition'. The controlled vocabulary fields for 'coastal enhanced weathering' and 'river alkalinity addition' have been removed and the definition for mineral alkalinity addition has been broadened. In order to differentiate between the various dispersal methods and locations when adding alkaline material, additional fields describing dosing have been added.
511c	We suggest changing “such as mCDR treatment” to “(e.g., mCDR treatment)”.	change: updated to 'e.g., mCDR treatment'
511d	.: Consider rephrasing “A perturbed model experiment describes...” to “Perturbation refers to a deliberate disturbance or modification” or “...a deliberate intervention or modification”.	change: this has been reworded for clarity.
511d	.: Suggest changing “simulation” to a different word, as the current word evokes modeling.	change: "simulation" has been replaced with "experiment" for consistency.
539	Maybe, add a section with contacts. Specify who to contact with questions specific to each section to resolve uncertainties.	change: we have included a contact email for questions and comments regarding the protocol
575-581	What is the purpose of the indentation here? It is not matched and does not have hyphens like the other subsections. We suggest revising for consistency.	change: indents have been removed
599-657	We suggest reformatting for consistency. For example, the Coordination Team and Data Initiative Steering Committee list the contributors in one continuous row with no affiliations. Then, the Advisory and Consultation group lists contributors in one continuous row with affiliations, some abbreviated and some fully spelled. Meanwhile, the working groups are in a separate format with paragraph spacing and their affiliations, either fully spelled out or abbreviated or paraphrased (for example, is it Dalhousie or is it Dalhousie University? American Uni., or American University?).	change: this has been reformatted for consistency
624	My affiliation should be listed as SeaO, not Ebb Carbon	change: affiliation has been updated
624	Tim Dyson - company name is bluesonde technologies	change: affiliation has been updated
624	Daan Reijnders is at SeaO, not Ebb	change: affiliation has been updated

647	please change 'Sea Grant' to 'Washington Sea Grant'	change: affiliation has been updated
667-668	We suggest revisiting this section to ensure that the citations are matching. We have caught one, but it would be best to go through each one to ensure consistency.	change: the references have been updated as needed
711	Where is the "Resources" tab that is referenced? I didn't see it here: https://www.dropbox.com/scl/fi/syufqljsi/Metadata_template_..xlsx?rlkey=nfusfvsrmrvaup=t=&dl=	change: this sentence has been removed
718	Same as above	change: this sentence has been removed
727	In: Physiological Header Descriptions include natural or artificial seawater, collection location, great. It is missing seawater processing– is the seawater filtered, sterilized, UV'd? If so this needs to be clear– and again this indicates lab work, not field work, and should be clarified.	change: references to recommendations for physiological laboratory studies have been removed from this version of the protocol to be consistent with providing recommendations for OAE field trial data. We hope to include recommendations for mesocosm and laboratory studies in future version.
NA	Baseline is currently defined as initial set of data before the intervention, but clarify that this could also include data after the intervention concludes and no traces of CDR impacts remain.	change: this has been clarified
NA	I see no compelling reason to mention only one software for calculating carbonate chemistry, especially since nine others have been shown to produce nearly identical results. I therefore recommend either listing all of them or omitting them entirely. In the latter case, the paper below could be cited as a reference for guidance. Orr J. C., Epitalon J.-M. & Gattuso J.-P., 2015. Comparison of ten packages that compute ocean carbonate chemistry. Biogeosciences:. doi:./bg	change: we have explained that there is no requirement to use CO2Sys as many options exist that have been shown to produce similar results and have cited Orr et al., 2015.
NA	General: The dataset fields generally lack an 'Author' or 'Contact' field. Maybe this is a deliberate omission for privacy reasons. However, it may sometimes be useful to know which organization or person inquiries on the dataset could be addressed/traced back to. This is common in CCHDO, for example. It's also useful when trying to get access to some of the model output that was too large to host on a public server.	change: new example files for the dataset metadata have been included, which include fields for contact, etc.
NA	Sediment processes data section: again this feels light and out of place. I would recommend moving all of this to the appendix pending further	no change: even if there are sections that are less described than others, the content recommendations and requirements provided should be as

	detail/ example, along with biological/ physiological data section.	simple to find for a researcher providing sediment data as for sensor data, as such it is preferred to keep similar content together under the same main title
NA	A general thought: Where will this protocol live? On Carbon to Sea or somewhere else? What linked files can be archived with it (like NOAA's OCADS metadata file?) It might be helpful to have a list of linked references at the end for visibility and to prevent loss of files in the event of increasing NOAA disruptions.	change: the final protocol will be hosted by Carbon to Sea, we intend to include spreadsheets and documents that will also be internally hosted for users to download.
NA	We think that this protocol would benefit from more consistent use of the terms and descriptors of the MCDR pathways, as well as the intended audience. Consolidating terms used would ensure consistency in what is being defined, who is being defined, and this would go a long way towards making this a more versatile product. This comment is doubly important given that the intended users cover a broad inter-disciplinary scope for OAE research and development.	change: the options and controlled vocabularies for mCDR pathways has been revised to be more consistent between the level each field is describing.
NA	We also suggest ways to expand inclusion of social science in the protocol. The protocol states that a working group is developing a social science piece so the suggestions here could be added now to set up foundations for that update when it is ready. We suggest that social science be included as a categorical metric in the OAE metadata, and at the same level of detail, as the physical and life science metrics (more specific edits are in the Minor Revisions/Line Edits). As currently written, social science surveys are included as miscellaneous descriptions of an OAE study, less structured than the physical and life science categories. As a category at the same level as physical/life science categories, social science would be able to offer the same detail and insights in a way more findable and accessible for social science and non-social science users.	change: a new field for social site characterization has been added to separate this information and help with findability for social scientists. A new field 'socioeconomic' has been included to the list of possible Observation Types. We have also created an independent metadata template for socioeconomic studies, with fields recommended by the social sciences working group. These updates, naming conventions, and content, were chosen with additional guidance from the social science working group.
NA	Make it clear and obvious at the beginning of the document that baseline, control, and intervention data sets must be separated. The first mention of this is on page 29	change: the first mention of this requirement is now near the beginning in the Metadata introduction.