Creating a data package

This chapter will teach you how to create and submit a data package to a DataONE MN via R. But first, please read this paper on the value of structured metadata, namely the Ecological Metadata Language (EML).

What is in a package?

A data package generally consists of at least 3 components.

1. Metadata: One object is the metadata file itself. In case you are unfamiliar with metadata, metadata are information that describe data (e.g. who made the data, how were the data made, etc.). The metadata file will be in an XML format, and have the extension `.xml` (extensible markup language). We often refer to this file as the EML, which is the metadata standard that it uses. This is also what you see when you click on a page in the Arctic Data Center.
2. Data: Other objects in a package are the data files themselves. Most commonly these are data tables (`.csv`), but they can also be audio files, NetCDF files, plain text files, PDF documents, image files, etc.
3. Resource Map: The final object is the resource map. This object is a plain text file with the extension `.rdf` (Resource Description Framework) that defines the relationships between all of the other objects in the data package. It says things like "this metadata file describes this data file," and is critical to making a data package render correctly on the website with the metadata file and all of the data files together in the correct place. Fortunately, we rarely, if ever, have to actually look at the contents of resource maps; they are generated for us using tools in R.

Packages on the Website

All of the package information is represented when you go to the landing page for a dataset. When you make changes through R those published changes will be reflected here. Although you can edit the metadata directly from the webpage but we recommend to use R in most cases.

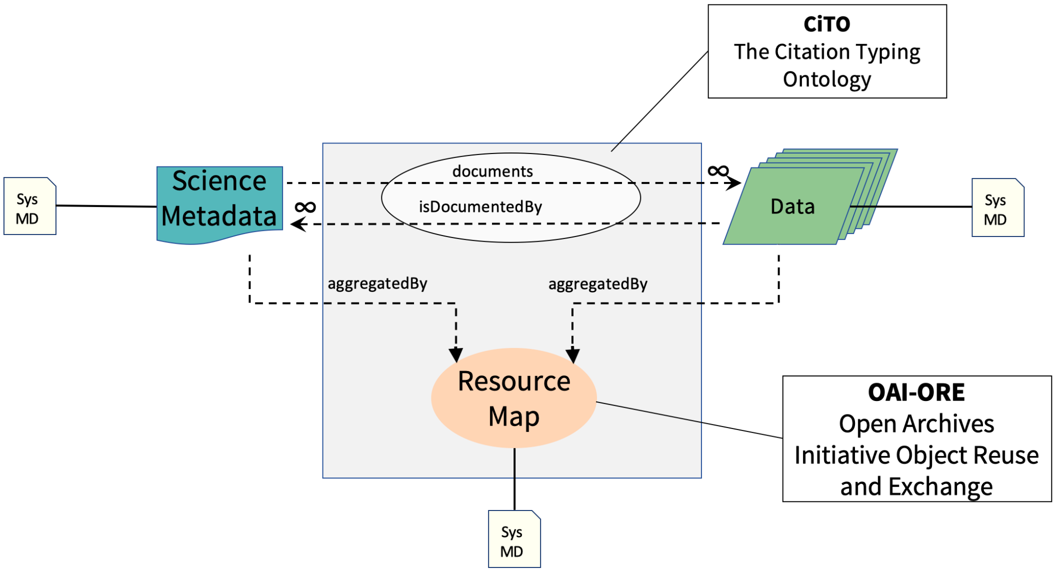
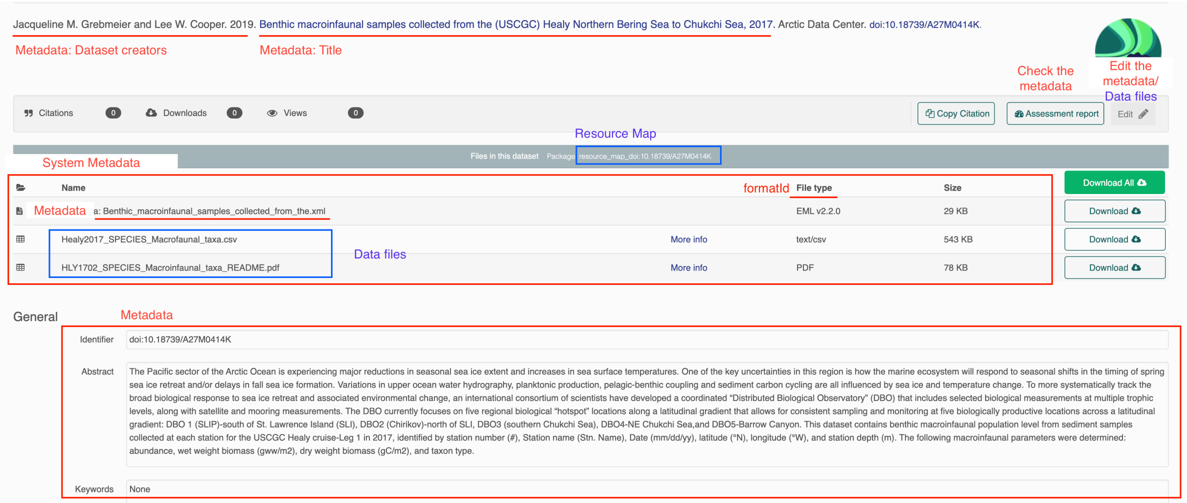


Figure 1: From the DataOne Community Meeting (Session 7)



Jacqueline M. Grebmeier and Lee W. Cooper. 2019. Benthic macroinfaunal samples collected from the (USCGC) Healy Northern Bering Sea to Chukchi Sea, 2017. Arctic Data Center. doi:10.18739/A27M0414K.

Files in this dataset Package resource_map_doi:10.18739/A27M0414K

Name		File type	Size
a: Benthic_macroinfaunal_samples_collected_from_the.xml		EML v2.2.0	29 KB
Healy2017_SPECIES_Macrofaunal_taxa.csv	More info	text/csv	543 KB
HLY1702_SPECIES_Macroinfaunal_taxa_README.pdf	More info	PDF	78 KB

General

Identifier doi:10.18739/A27M0414K

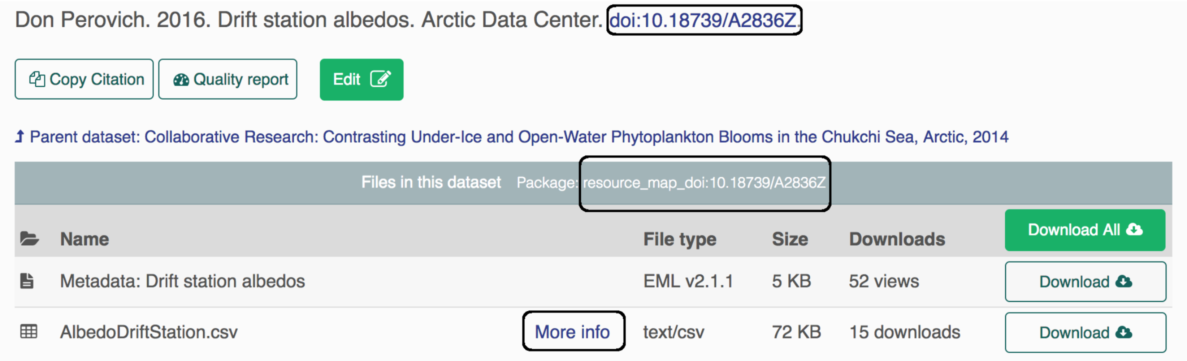
Abstract The Pacific sector of the Arctic Ocean is experiencing major reductions in seasonal sea ice extent and increases in sea surface temperatures. One of the key uncertainties in this region is how the marine ecosystem will respond to seasonal shifts in the timing of spring sea ice retreat and/or delays in fall sea ice formation. Variations in upper ocean water hydrography, planktonic production, pelagic-benthic coupling and sediment carbon cycling are all influenced by sea ice and temperature change. To more systematically track the broad biological response to sea ice retreat and associated environmental change, an international consortium of scientists have developed a coordinated "Distributed Biological Observatory" (DBO) that includes selected biological measurements at multiple trophic levels, along with satellite and mooring measurements. The DBO currently focuses on five regional biological "hotspot" locations along a latitudinal gradient that allows for consistent sampling and monitoring at five biologically productive locations across a latitudinal gradient: DBO 1 (SLIP)-south of St. Lawrence Island (SLI), DBO2 (Chirikov)-north of SLI, DBO3 (southern Chukchi Sea), DBO4-NE Chukchi Sea,and DBO5-Barrow Canyon. This dataset contains benthic macroinfaunal population level from sediment samples collected at each station for the USCGC Healy cruise-Leg 1 in 2017, identified by station number (#), Station name (Stn. Name), Date (mm/dd/yy), latitude (°N), longitude (°W), and station depth (m). The following macroinfaunal parameters were determined: abundance, wet weight biomass (gww/m2), dry weight biomass (gC/m2), and taxon type.

Keywords None

About identifiers

Each object (metadata files, data files, resource maps) on the ADC or the KNB (another repo) has a unique identifier, also sometimes called a "PID" (persistent identifier). When you look at the landing page for a dataset, for example here, you can find the resource map identifier listed under the title in the gray bar after the words "Files in this dataset Package:" (`resource_map_doi:10.18739/A2836Z`), the metadata identifier in the "General > Identifier" section of the metadata record or after the title with blue font (`doi:10.18739/A2836Z`), and the data identifier by clicking the "more info" link next to the data object, and looking at the "Online Distribution Info" section (`arctic-data.9546.1`).

Note, all datasets submitted are given a preliminary identifier (usually starting with `urn:uuid:`). When the dataset is finalized, a doi will be issued.



Don Perovich. 2016. Drift station albedos. Arctic Data Center. doi:10.18739/A2836Z.

↥ Parent dataset: Collaborative Research: Contrasting Under-Ice and Open-Water Phytoplankton Blooms in the Chukchi Sea, Arctic, 2014

Files in this dataset Package: resource_map_doi:10.18739/A2836Z

Name		File type	Size	Downloads	Download All
Metadata: Drift station albedos		EML v2.1.1	5 KB	52 views	Download
AlbedoDriftStation.csv	More info	text/csv	72 KB	15 downloads	Download

Different versions of a package are linked together by what we call the "version chain" or "obsolescence chain". Making an update to a data package, such as replacing a data file, changing a metadata record, etc, will result in a new identifier for the new version of the updated object. When making changes to a package, always use `datapack::uploadDataPackage()` for updating the entire package on the *latest versions* of all objects to ensure that the version chain is maintained.

Upload a package

We will be using R to connect to the NSF Arctic Data Center (ADC) data repository to push and pull edits in actual datasets. To identify yourself as an admin you will need to pass a 'token' into R. Do this by signing in to the ADC with your ORCid and password, then hovering over your name in the top right corner and clicking on "My profile", then navigating to "Settings" and "Authentication Token", copying the "Token for DataONE R", and finally pasting and running it in your *R console*.

> ⚠ Warning
>
> **This token is your identity on these sites, please treat it as you would a password** (i.e. don't paste into scripts that will be shared). The easiest way to do this is to always run the token in the *console*. There's no need to keep it in your script since it's temporary anyway.

You will need to retrieve a new one after it either expires or you quit your R session.

Sometimes you'll see a placeholder in scripts to remind users to get their token, such as:

```r
options(dataone_test_token = "...")
```

> Note
>
> Since we will be working on the test site and not the production site, please remember to get your token from test.arcticdata.io

Next, please be sure these packages are loaded for the training (these should already exist if you are working on the server):

```r
library(devtools)
library(dataone)
library(datapack)
library(EML)
library(remotes)
library(XML)
library(uuid)
```

If any package could not be loaded, use the following command (replacing package_name with the actual package name) to install the package, then load them.

```r
install.packages("package_name")
```

Now you'll install the `arcticdatautils` and `datamgmt` packages with the code below. If prompted to update packages during the installation process, **skip the updates.** Now, run the following code to install and load the libraries.

```r
remotes::install_github("nceas/arcticdatautils")
library(arcticdatautils)
remotes::install_github("nceas/datamgmt")
library(datamgmt)
```

> Note
>
> When you are usually working with data packages, you will only need the following:

```
library(dataone)
library(datapack)
library(EML)
library(arcticdatautils)
```

For this training, we will be working exclusively on the Arctic test site, or “node.” In many of the functions you will use this will be the first argument. It is often referred to in documentation as `mn`, short for member node. More information on the other nodes can be found in the reference section under Set DataONE nodes Set DataONE nodes

For example, if we are using the test site, set the node to the test Arctic node:

```
d1c_test <- dataone::D1Client("STAGING", "urn:node:mnTestARCTIC")
```

Once all set up you can first publish an object (data). If you are curious how everything magically works, here is a handy diagram:

datapack Background

adapted from the dataone and datapack vingettes

`datapack` is written differently than most R packages you may have encountered in the past. This is because it uses the S4 system instead.

```
library(dataone)
library(datapack)
library(uuid)
```

Data packages

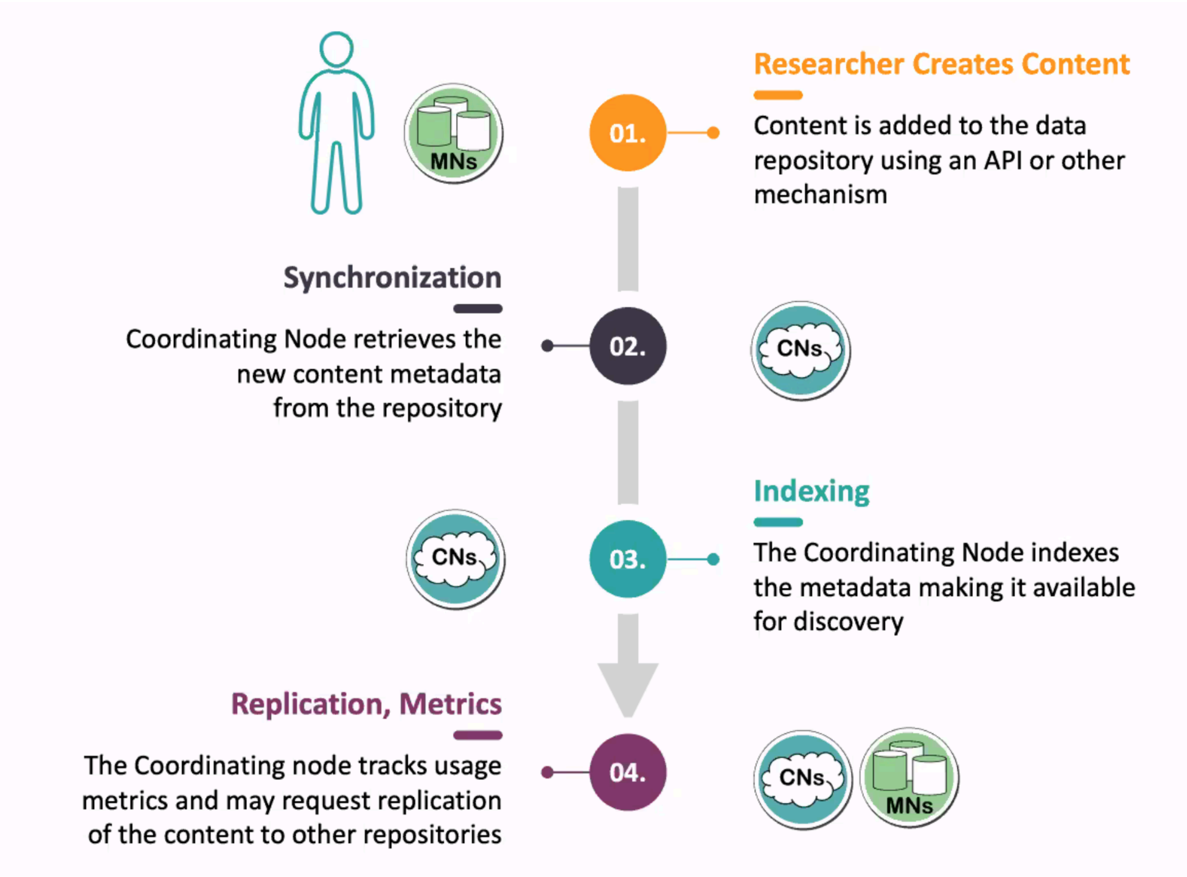
Data packages are a class that has slots for `relations` (provenance), `objects`(the metadata and data file(s)) and `systemMetadata`.

Navigating data packages

Nodes

Using this example on arcticdata.io

```
d1c_test <- dataone::D1Client("STAGING", "urn:node:mnTestARCTIC")
```



01.

Researcher Creates Content

Content is added to the data repository using an API or other mechanism

02.

Synchronization

Coordinating Node retrieves the new content metadata from the repository

03.

Indexing

The Coordinating Node indexes the metadata making it available for discovery

04.

Replication, Metrics

The Coordinating node tracks usage metrics and may request replication of the content to other repositories

Figure 2: From the DataOne Community Meeting (Session 7)

To use the member node information, use the `mn` slot

```
d1c_test@mn
```

> Note
>
> To access the various slots using objects created by datapack and dataone (e.g. `getSystemMetadata`) requires the `@` which is different from what you might have seen in the past. This is because these use the S4 system.

Get an existing package from the Arctic Data Center. Make sure you know as you go through this training whether you are reading or writing to test or production. We don't want to upload any of your test datasets to production!

```
d1c <- dataone::D1Client("PROD", "urn:node:ARCTIC")
dp <- dataone::getDataPackage(d1c, "resource_map_urn:uuid:1f9eee7e-2d03-43c4-ad7f-f300e013
```

Data Objects

Check out the `objects` slot

```
dp@objects
```

Get the number for data and metadata files associated with this data package:

```
getSize(dp)
```

Get the file names and corresponding pids

```
getValue(dp, name="sysmeta@fileName")
```

Get identifiers

You can search by any of the `sysmeta` slots such as `fileName` and `formatId` and get the corresponding identifier(s):

```
metadataId <- selectMember(dp, name="sysmeta@ADD THE NAME OF THE SLOT",
                           value="PATTERN TO SEARCH BY")
```

Example:

```
selectMember(dp, name="sysmeta@formatId", value="image/tiff")
selectMember(dp, name="sysmeta@fileName", value="filename.csv")
```

Provenance

View the provenance as a dataTable. We will get into detail in the Building provenance chapter.

```
dp@relations$relations
```

Exercise 2a

Select a dataset from the catalog on the Arctic Data Center. Observe the number of data files in the dataset. Try to find identifiers for the metadata file and resource map on the landing page for the dataset based on the screenshot shown above.

Create a new data package

adapted from the dataone and datapack vingettes

```
library(dataone)
library(datapack)
library(uuid)
```

To create a new data package, follow the code below. Remember, a data package is a class that has slots for `relations` (provenance), `objects`(the metadata and data file(s)) and `systemMetadata`.

```
dp <- new("DataPackage")
```

Upload new data files

Create and add a metadata file

In this example we will use this previously written EML metadata. Here we are getting the file path from the dataone package and saving that as the object `emlFile`.

This is a bit of an unusual way to reference a local file path, but all this does is looks within the R package `dataone` and grabs the path to a metadata document stored within that package. If you print the value of `emlFile` you'll see it is just a file path, but it points to a special place on the server where that package is installed. Usually you will just reference EML paths that are stored within your user file system.

```r
emlFile <- system.file("extdata/strix-pacific-northwest.xml",
                       package = "dataone")
```

Create a new `DataObject` and add it to the package. In the case below, our new `DataObject` will be a metadata file.

```r
metadataObj <- new("DataObject",
                   format = "https://eml.ecoinformatics.org/eml-2.2.0",
                   filename = emlFile)

dp <- addMember(dp, metadataObj)
```

Check the dp object to see if the `DataObject` was added correctly.

```r
dp
```

Add some additional data files

```r
sourceData <- system.file("extdata/OwlNightj.csv", package = "dataone")

sourceObj <- new("DataObject", format = "text/csv", filename = sourceData)

dp <- addMember(dp, sourceObj, metadataObj)
```

> **Note**
>
> If you want to change the formatId please use `updateSystemMetadata` (more on this later in the book)

Upload the package

```
d1c <- dataone::D1Client("STAGING", "urn:node:mnTestARCTIC")
```

Make sure to give access privileges to the ADC admins. Although you may be tempted to edit the format of the string in the `subject` argument, you must keep it exactly as is. Otherwise you'll run into error messages!

```
myAccessRules <- data.frame(subject = "CN=arctic-data-admins,DC=dataone,DC=org",
                            permission = "changePermission")
```

Get necessary token from test.arcticdata.io to upload the dataset prior uploading the datapackage:

```
packageId <- uploadDataPackage(d1c, dp, public = TRUE,
                               accessRules = myAccessRules, quiet = FALSE)
```

ℹ Note

If you want to preserve folder structures, you can use this method
In this example, adding the csv files to a folder named data and scripts:

```
outputData <- system.file("extdata/Strix-occidentalis-obs.csv", package="dataone")

outputObj <- new("DataObject", format = "text/csv", filename = outputData,
                 targetPath = "data")

dp <- addMember(dp, outputObj, metadataObj)

progFile <- system.file("extdata/filterObs.R", package = "dataone")

progObj <- new("DataObject", format = "application/R", filename = progFile,
               targetPath = "scripts", mediaType = "text/x-rsrc")

dp <- addMember(dp, progObj, metadataObj)
```

Exercise 2b

This exercise will take you through how to do the submission process through R instead of the webform (exercise 1).

Part 1 - Gather your data files

For our convenience, we will be grabbing the metadata and data files from the file we published earlier:

- Locate the data package you published in Exercise 1 by navigating to the "My Profile > My Data" section on test.arcticdata.io.
- Download the metadata and data files and transfer them to the Datateam server.

Part 2 - Working in R

Now we want to publish the metadata and data files we downloaded again to `test.arcticdata.io`

- Obtain a token and **please note** that for this exercise please make sure you grab the token from the arcticdata test site
- Publish your metadata and data file to the site.

```r
#set the node
d1c_test <- dataone::D1Client("STAGING", "urn:node:mnTestARCTIC")
dp <- new("DataPackage")

#add your metadata
metadataObj <- new(...)
dp <- addMember(...)

#add your data files
sourceObj <- new(...)
dp <- addMember(...)

#upload your package
myAccessRules <- data.frame(...)
packageId <- uploadDataPackage(...)
```

- View your new data set by appending the metadata PID to the end of the URL test.arcticdata.io/#view/...
- If you are successful it should look the same as the dataset you created in exercise 1