



Title: Exploring NEON eddy-covariance data products in HDF5 file format

Date: 11/20/2017

Author: Stefan Metzger and David Durden

Exploring NEON Eddy-Covariance Data Products in HDF5 file format

PREPARED BY:	ORGANIZATION:	DATE:
Stefan Metzger	Battelle, NEON Science - TIS	04/27/2017
David Durden	Battelle, NEON Science - TIS	11/27/2017



Title: Exploring NEON eddy-covariance data products in HDF5 file format

Date: 11/20/2017

Author: Stefan Metzger and David Durden

The National Ecological Observatory Network is a project solely funded by the National Science Foundation and managed under cooperative agreement by Battelle. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

TABLE OF CONTENTS

1	NEON EDDY-COVARIANCE DATA PRODUCTS.....	2
2	THE NEON HDF5 FORMAT	2
3	EXPLORING NEON HDF5 FILES	5
3.1	Download and install HDFView	6
3.2	Open and display the contents of an HDF5 file	6

LIST OF TABLES AND FIGURES

Table 1	NEON eddy-covariance data products	2
Figure 1	The generic NEON HDF5 file layout	4
Figure 2	HDFView view of open NEON HDF5 file.....	6
Figure 3	HDFView screenshot of opening the site group level of the NEON HDF5 file.	7

<i>Title:</i> Exploring NEON eddy-covariance data products in HDF5 file format	<i>Date:</i> 11/20/2017
<i>Author:</i> Stefan Metzger and David Durden	

Figure 4 HDFView screenshot of opening the data table group level of the NEON HDF5 file. 8

Figure 5 HDFView screenshot of opening the data table to explore data in the NEON HDF5 file. 9

Figure 6 HDFView screenshot of clicking on a HDF5 object that contains attributes to explore metadata in the NEON HDF5 file. 10

1 NEON EDDY-COVARIANCE DATA PRODUCTS

The following NEON data products in Table 1 are planned to be disseminated in HDF5 data format. EC profile and EC storage are used interchangeably in this document.

Table 1 NEON eddy-covariance data products.

Instrument system	Product level	Product catalog	Product name
EC turbulence	L1 statistics	NEON.DP1.00007	3D Wind Speed, Direction and Sonic Temperature
		NEON.DP1.00010	3D Wind Attitude and Motion Reference
		NEON.DP1.00034	CO2 Concentration - Turbulent
		NEON.DP1.00035	H2O Concentration - Turbulent
EC profile	L1 statistics	NEON.DP1.00099	CO2 Concentration - Storage
		NEON.DP1.00100	H2O Concentration - Storage
		NEON.DP1.00036	Atmospheric CO2 Isotopes

		NEON.DP1.00037	Atmospheric H2O isotopes
EC profile	L2 time-interpolated	NEON.DP2.00008	Temporally Interpolated CO2 Concentration
		NEON.DP2.00009	Temporally Interpolated H2O Concentration
	L3 space-interpolated	NEON.DP3.00008	Tower Temperature Profile
		NEON.DP3.00009	CO2 Concentration Profile
		NEON.DP3.00010	H2O Concentration Profile
	EC profile + turbulence combined	L4 fluxes	NEON.DP4.00002
NEON.DP4.00007			Momentum Flux
NEON.DP4.00137			Latent heat flux
NEON.DP4.00067			Ecosystem exchange; Tower - NEE *

*NEE: Net Ecosystem Exchange

These data products are produced for all NEON TIS sites and Mobile Deployment Platform (MDP) sites. The present HDF5 file contains EC turbulence and storage L1 statistics data products. Subsequent data products are being incrementally added to a single HDF5 file structure (see Sect. 2). We have two types of NEON eddy-covariance files: expanded daily files (containing additional quality metrics and ancillary data) and basic monthly files (concatenated daily files for a month with basic quality information).

2 THE NEON HDF5 FORMAT

HDF5 is a data model, library, and file format for storing and managing complex data. It has the following characteristics that are useful for the dissemination and exploration of NEON eddy-covariance data:

- Supports an unlimited variety of datatypes.
- Incorporates directory-like hierarchical structuring.
- Flexible and efficient I/O for high volume and complex data.



<i>Title:</i> Exploring NEON eddy-covariance data products in HDF5 file format	<i>Date:</i> 11/20/2017
<i>Author:</i> Stefan Metzger and David Durden	

- Self-describing, portable and extensible.
- Can be explored graphically via applications like HDFView and exported to a Spreadsheet program, as well as programmatically via the API from a wide variety of programming languages.

The NEON HDF5 format is organized hierarchically, following the NEON data products numbering scheme:

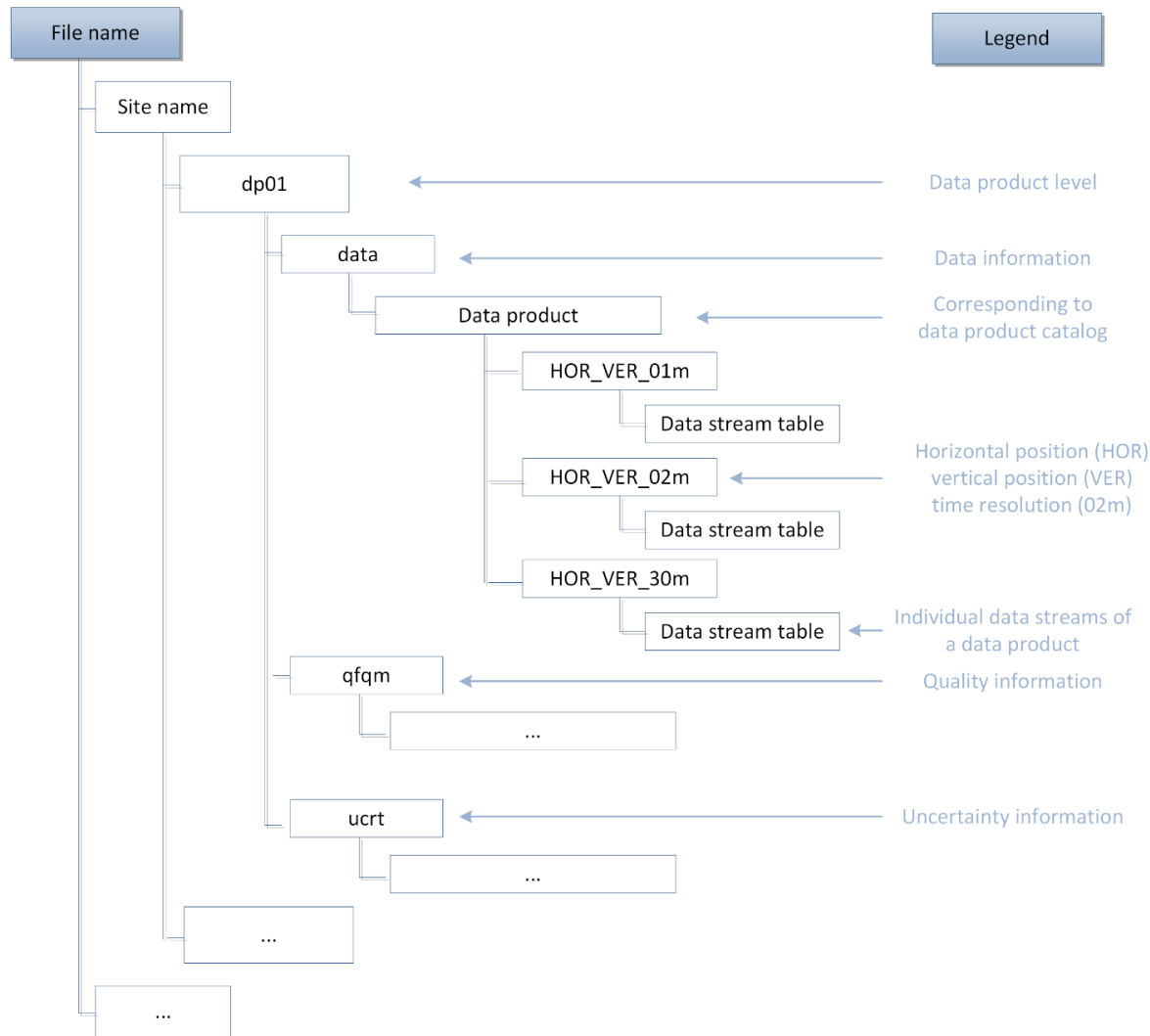


Figure 1 The generic NEON HDF5 file layout

Layout for Level 1 data products (see the readMe and objDesc in the HDF5 file for additional layout information and descriptions for all objects found in the file after data download):

- /SERC: measurement site four-letter site code
 - /SERC/dp01: Level 1 data products
 - /SERC/dp01/data: Data information
 - /SERC/dp01/data/irgaCo2: Data product identification code (irgaCo2 = NEON.DP1.00034_CO2 Concentration - Turbulent)
 - /SERC/dp01/data/irgaCo2/000_060_30m: Turbulent CO2 data product at the tower (HOR = 000), top level (VER = 060) and 30 minute time resolution (TMI = 30m)
 - /SERC/dp01/data/irgaCo2/000_060_30m/densMoleCo2: molar density of carbon dioxide
 - ...
 - /SERC/dp01/data/irgaCo2/000_060_01m, with peer-folders analogous to /SERC/dp01/data/irgaCo2/000_060_30m
 - /SERC/dp01/data/irgaH2o (NEON.DP1.00035, H2O Concentration - Turbulent), with sub-folders analogous to /SERC/dp01/data/irgaCo2
 - /SERC/dp01/data/soni (NEON.DP1.00007, 3D Wind Speed, Direction and Sonic Temperature), with sub-folders analogous to /SERC/dp01/data/irgaCo2
 - /SERC/dp01/data/soniAmrs (NEON.DP1.00010, 3D Wind Attitude and Motion Reference), with sub-folders analogous to /SERC/dp01/data/irgaCo2
 - /SERC/dp01/qfqm: Quality information, with sub-folders analogous to /SERC/dp01/data
 - ...
 - /SERC/dp01/ucrt: Uncertainty information, with sub-folders analogous to /SERC/dp01/data
 - ...
 - /SERC/dp02: Level 2 data products
 - /SERC/dp03: Level 3 data products
 - /SERC/dp04: Level 4 data products
 - /SERC/dp0p: Level 0 prime data products

3 EXPLORING NEON HDF5 FILES

3.1 Download and install HDFView

Download HDFView for your operating system from the [HDF group website](#). Install HDFView on your computer, which will install the underlying libraries to enable exploring the file.

3.2 Open and display the contents of an HDF5 file

This section walks through the step-by-step procedure to open and explore the NEON HDF5 files using HDFView:

- Double-click the .h5 file you want to view
- The .h5 file opens in HDFView, with contents organized in a hierarchical “folder” fashion similar to Windows Explorer:

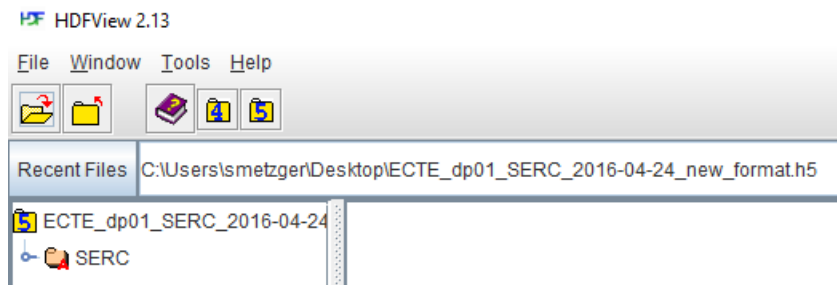


Figure 2 HDFView view of open NEON HDF5 file.

- In case double clicking the .h5 doesn't open the file, alternative way is to double click HDFView application file and open HDFView, then drag the .h5 file from window explorer to HDFView. The .h5 file should now open in HDFView.
- By double-clicking on a “parent” folder, its “children” folders are exposed:

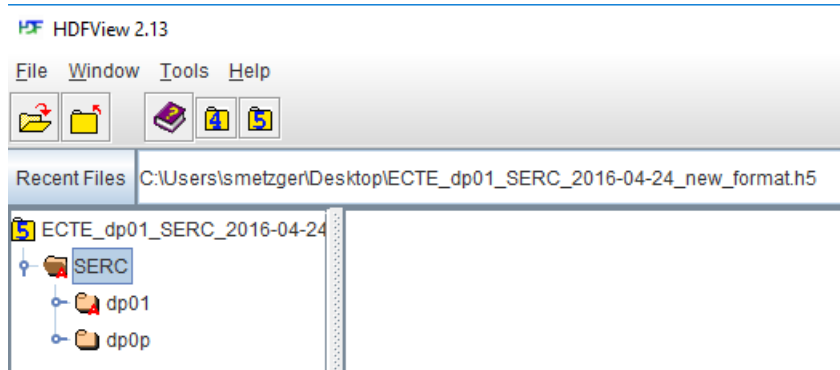


Figure 3 HDFView screenshot of opening the site group level of the NEON HDF5 file.

- At the lowest level the “data tables” containing the individual data streams of a data product are exposed:

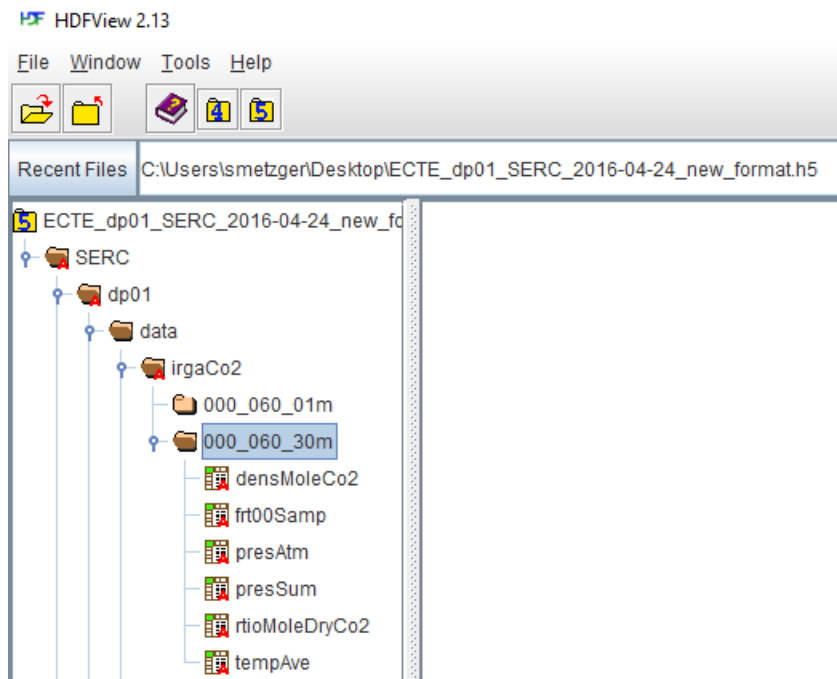


Figure 4 HDFView screenshot of opening the data table group level of the NEON HDF5 file.

- Double clicking a data table displays the values it contains:

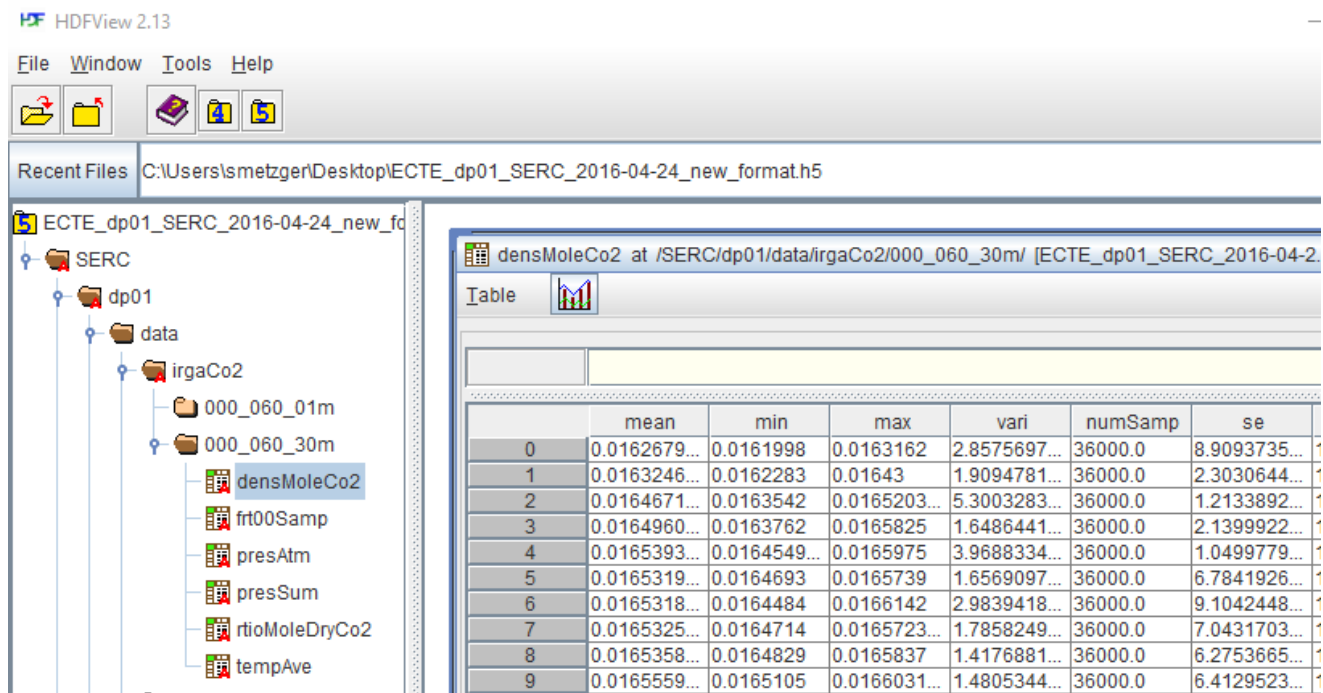


Figure 5 HDFView screenshot of opening the data table to explore data in the NEON HDF5 file.

- Folders and data tables with a red **A** “watermark” contain contextual attributes such as units etc.

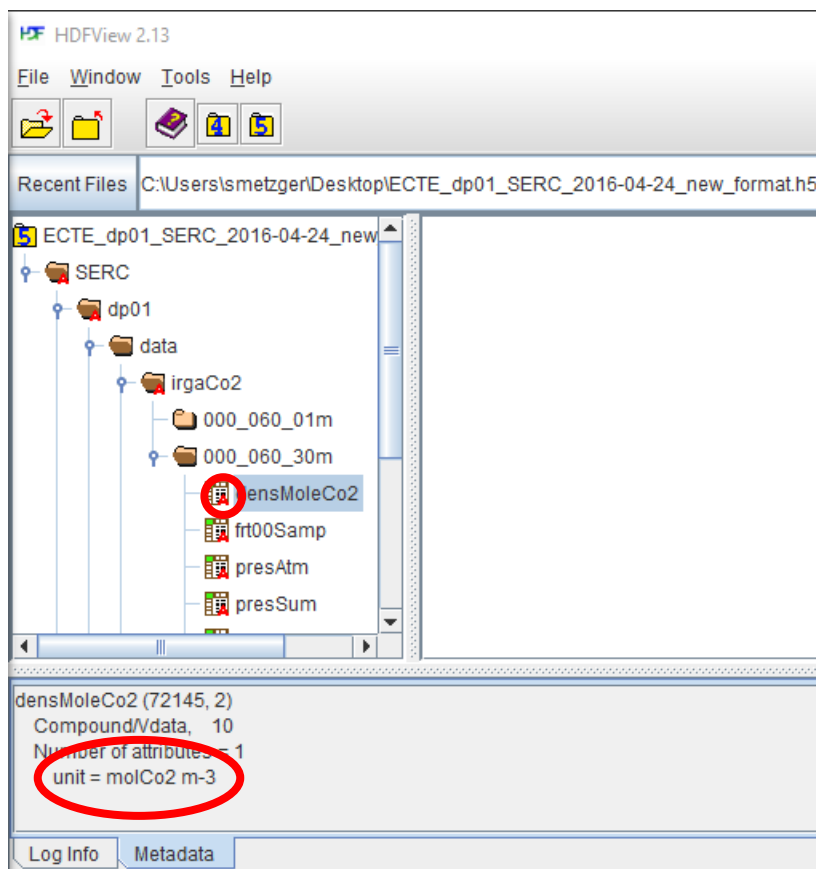
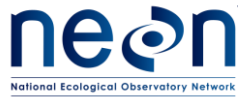


Figure 6 HDFView screenshot of clicking on a HDF5 object that contains attributes to explore metadata in the NEON HDF5 file.

Please be aware that the attributes/metadata display behavior varies between different versions. For example, for the version 2.13, the attributes/metadata will display in the lower panel as showed in the graph above. For the version 3.0, the metadata dialog box appears by right-clicking the object (icon) in the tree and selecting the “Show Properties” command from the Context menu. The HDF metadata display contains two tabbed panes, showing the general metadata and the user-defined attributes. If you use other versions, please review the user manual for guidance.



Title: Exploring NEON eddy-covariance data products in HDF5 file format

Date: 11/20/2017

Author: Stefan Metzger and David Durden