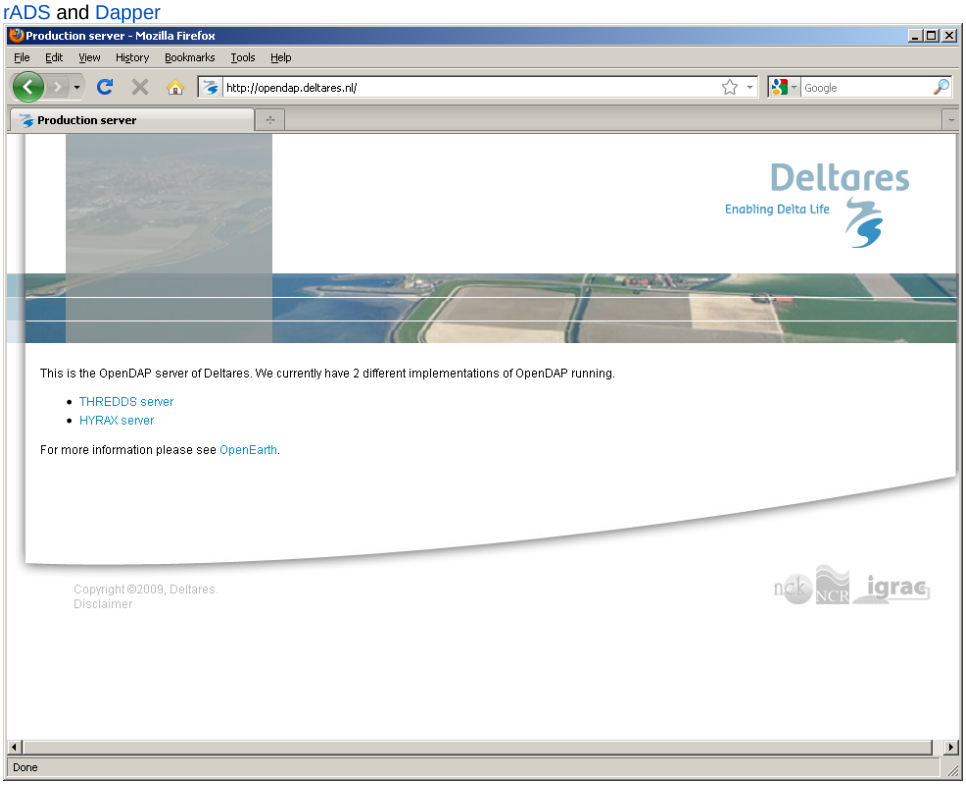
web overview of OPeNDAP data

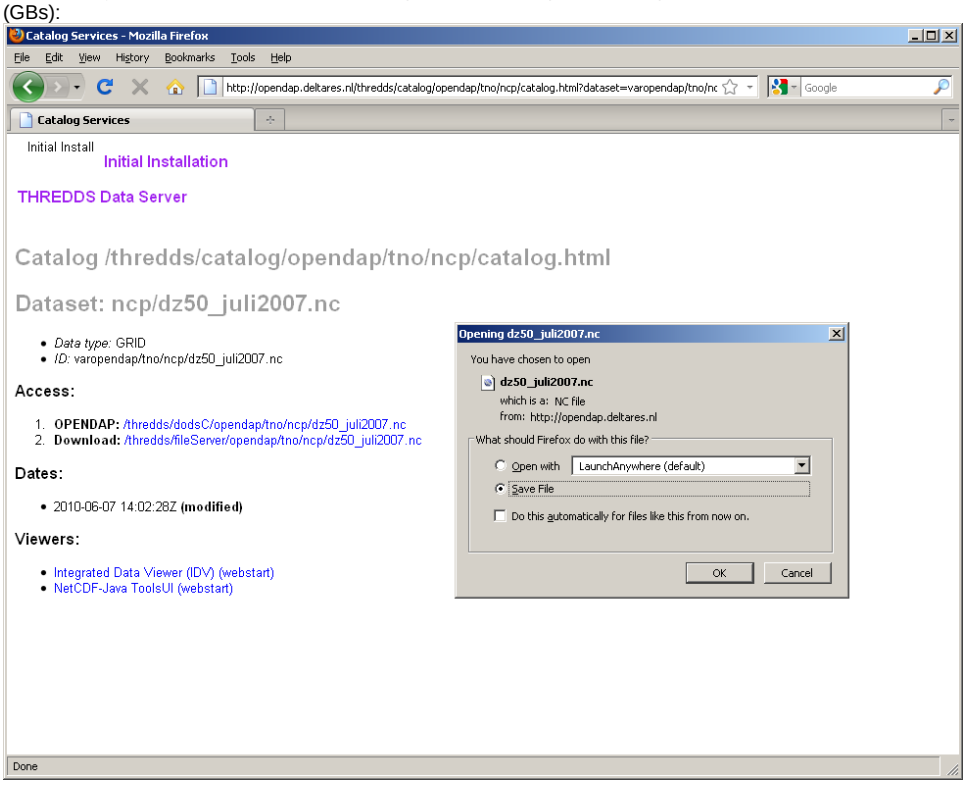
How to access data from an OPeNDAP server starting with a web browser

1. Go to an OPeNDAP server, e.g. opendap.deltares.nl. A growing list of external OPeNDAP servers is here. OpenEarth has two implementations of OPeNDAP operational running on exactly the same file server: THREDDS and HYRAX. Because they serve the exact same data, it does not matter which one you choose, we choose THREDDS here, because that one seems to have a wider use. Additional implementations are pydap, GrADS and Dapper

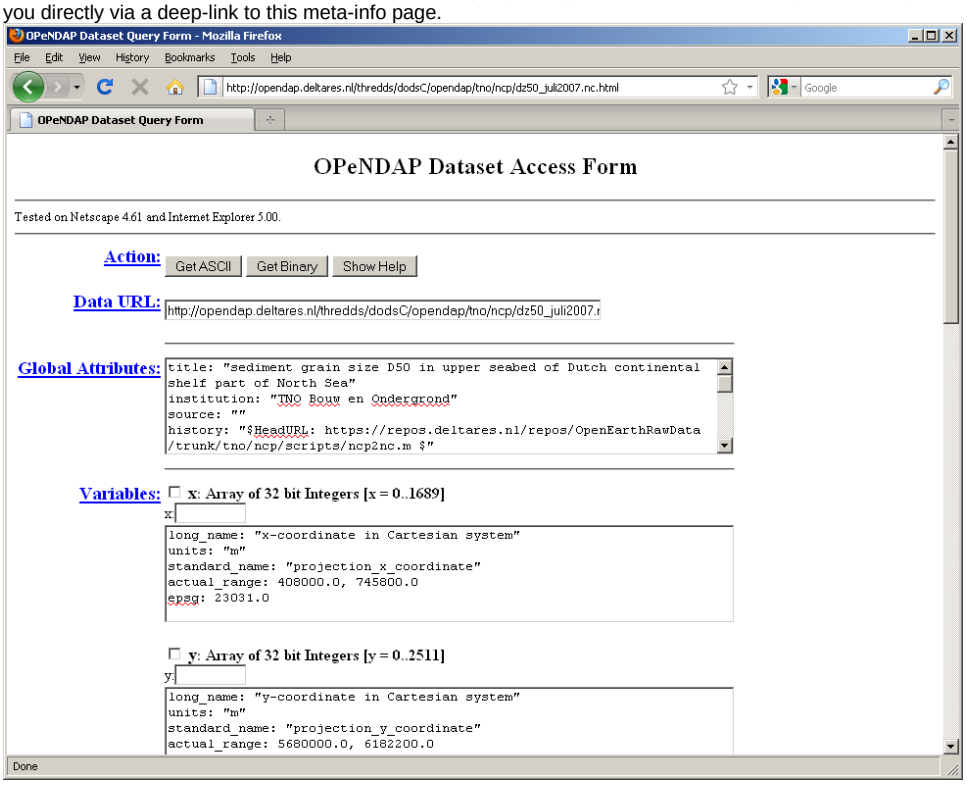


2. scroll down the directories: we chose to sort by owner, and then by data name.
3. Once you hit netCDF files (*.nc), click on it

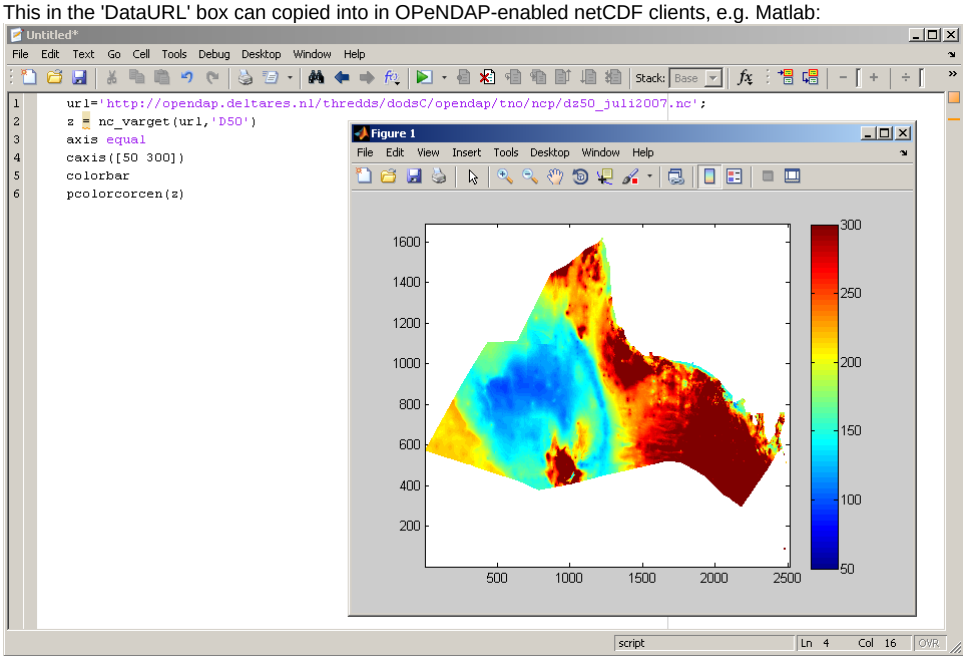
- after which you can choose for old-fashioned plain download (2. download), not recommened, as the netCDF files might web very big (GBs):



- or access meta-info through the OPeNDAP protocol (1. opendap). For some datasets we provide Google Earth overviews which takes you directly via a deep-link to this meta-info page.



4. This in the 'DataURL' box can copied into in OPeNDAP-enabled netCDF clients, e.g. Matlab:



The 'DataURL' string can be used (copy, paste) to read the data directly from the web into various software packages, e.g.:

- arcGIS
- ncBrowse
- Matlab
- Python
- R
- Delft3D

Examples for these packages are given below:

Accessing netCDF/OPeNDAP data with arcGIS

Buy arcGis 10 (9.2+) and use one of these options:

1. use native arcGIS netCDF support (no curvilinear model grids!)
    - http://webhelp.esri.com/arcgiSDEsktop/9.3/index.cfm?TopicName=Adding_netCDF_data_in_ArcGIS
    - http://www.narccap.ucar.edu/data/gis-howto.html
    - slides from ESRI at NASA HDF EOS workshop on improving arcGIS support for CF conventions http://hdfeos.org/workshops/ws15/agenda.php
    - http://blogs.esri.com/esri/arcgis/2011/04/19/environmental-data-collector-extension-for-arcgis-10-0/
2. download the free Environmental Data Connector EDC extension made by ASA on request of NOAA.
3. MGET arcGis 10.1 addition: http://mgel.env.duke.edu/mget

Accessing netCDF/OPeNDAP data with ncBrowse

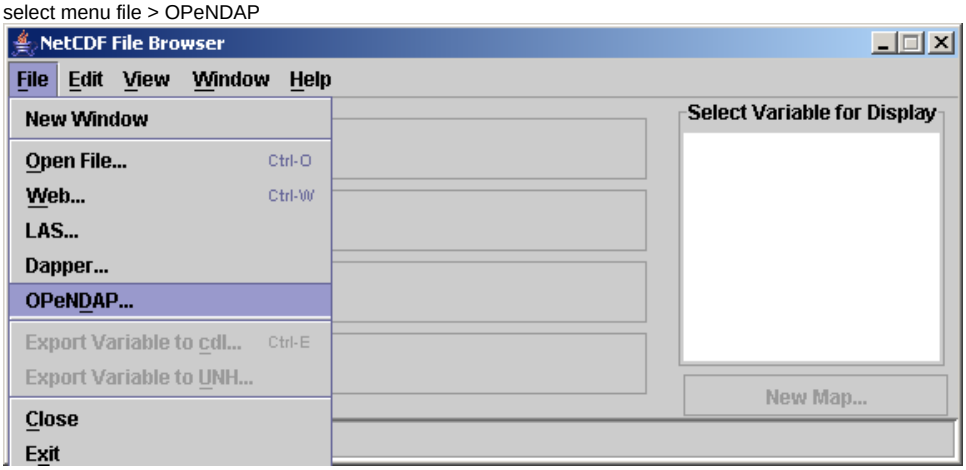
Download the free ncBrowse **1.6.3** from http://www.epic.noaa.gov/java/ncBrowse/. Note that the latest version is not the best to use. Use **1.6.3** if you only have classic netCDF3 files, use **1.6.5** only if you have netCDF3-64 bit offset files (neededf for files > 4 GB), but be aware that OPeNDAP functionality as explained in this tutorial malfunctions. For Windows 10, you might need to install the program with Compatibility mode set to Windows 7.

- Right-click on the setup file and click on ‘Properties’.
- Click on the ‘Compatibility’ tab and check the box ‘Run this program in compatibility mode for’ and select Windows 8/8.1 operating system or Windows 7 from the drop down menu and proceed with the installation.

For feed-back, please join the mailinglist ncbrowse@noaa.gov. The developer is aware of the plotting bugs in 1.6.6.

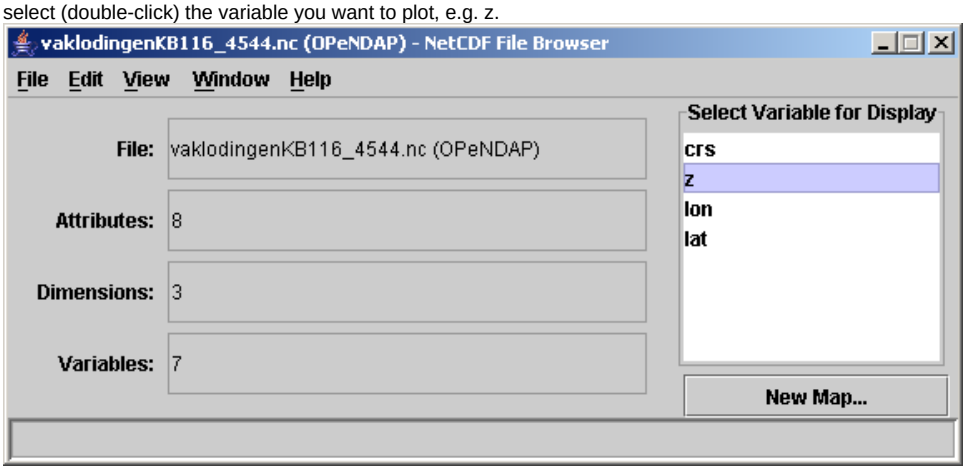
version	released	netCDF3	netCDF3-64 bit offset	netCDF4	OPeNDAP	plotting
1.6.3	2006-aug-24	✓	✗	✗	✓ ℹ	✓
1.6.5	2012-jun-15	✓	✓	✗	✗	✓
1.6.6	2013-apr-24	✓	✓	✓	✗	✗ ℹ
1.6.7	2013-may-20	✓	✓	✓	✗ ℹ	✓

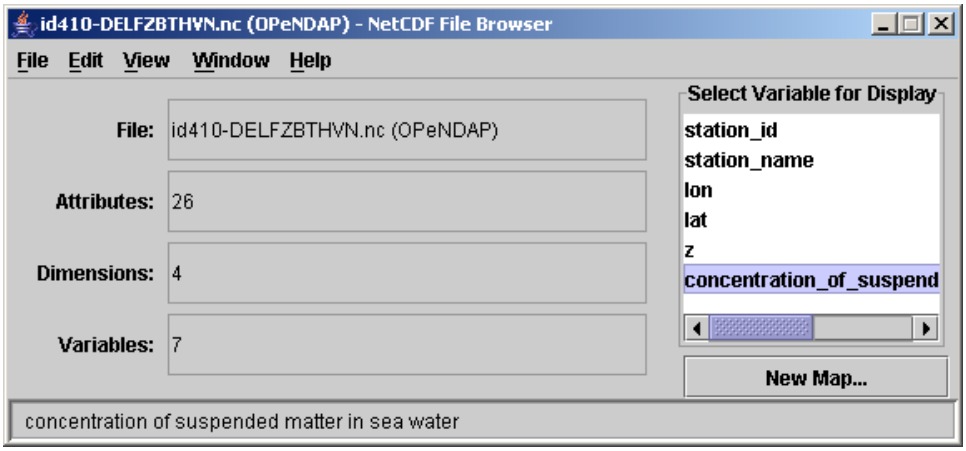
1. select menu file > OPeNDAP



and paste the url you just copied. The viewer will now download the meta-information from the OPeNDAP server. Even if when the underlying file would be a hundreds of GB, this step is always very fast.

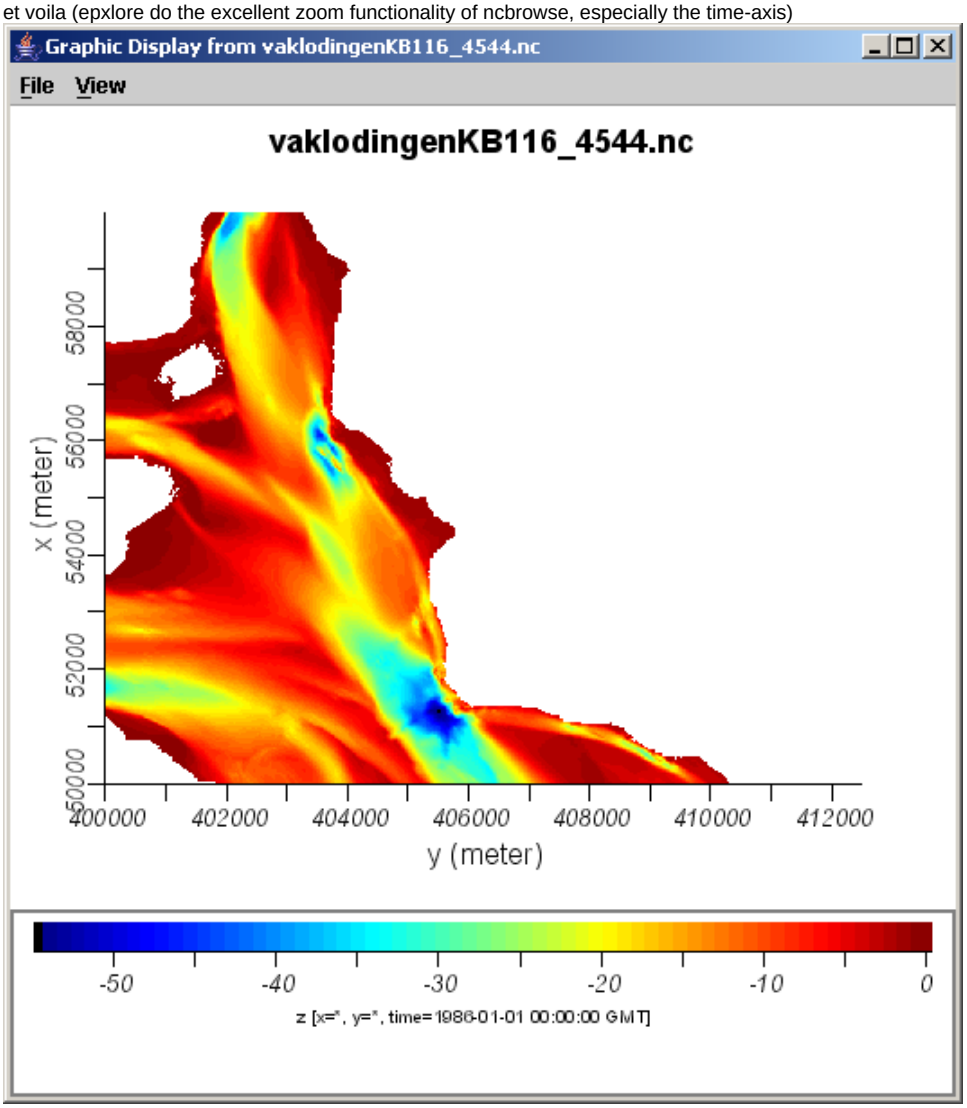
2. select (double-click) the variable you want to plot, e.g. z.

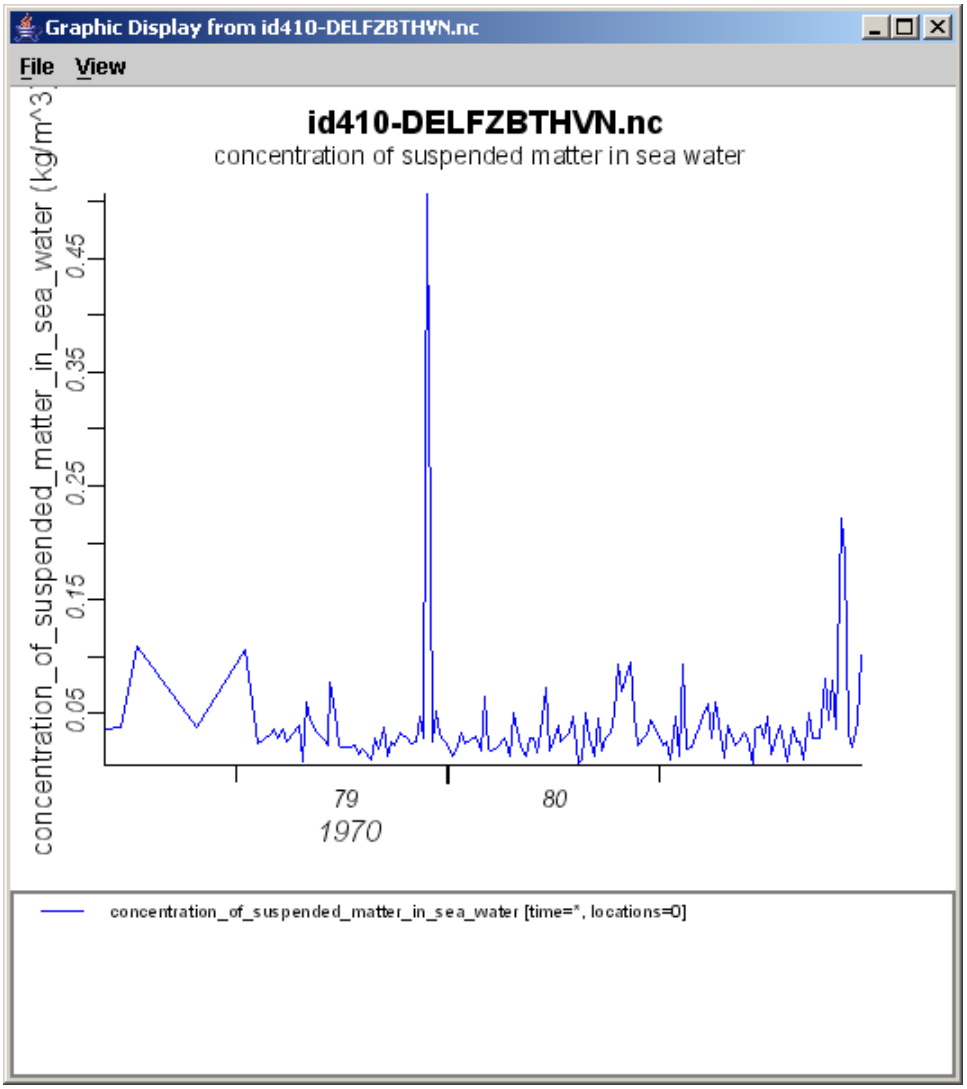




3. Define the data subset to get. Set the x dimension as x-axis, and y the y-dimension as y-axis. Not until you press graph variable the viewer will actually get the data. Even if when the underlying file would be a hundreds of GB, this step can be pretty fast provided the subset you chose is not too big. Only when you make too big a selection, ncBrowse will ill-behave. This will happen for instance with the 100 + years of tidal elevation dataset at station DelftZijl Buitenhaven. This selection step is the essential difference with the approach of downloading a netCDF file and then using ncBrowse to view that local file from your harddisk. With OPeNDAP you do not have to download an entire file before you can view it, because you can request only a specific slice, or a subset of a matrix.

4. et voila (epxlore do the excellent zoom functionality of ncbrowse, especially the time-axis)





Accessing netCDF/OPeNDAP data with Matlab

Since Matlab R2012a native OPeNDAP support has been added to the Matlab netcdf package that exists since R2008b+. (For older Matlab releases, get snctools which is shiiped with OpenEarthTools) From OpenEarthTools run the following set-up function to add all relevant paths:

```
run('...\openearthtools\matlab\oetsettings.m')
```

1. Go to an OPeNDAP server (e.g. http://opendap.deltares.nl) and pick a netCDF file by copying the contents of the Data URL box.
2. Define the associated url you just copied.

   ```
   url_grid = 'http://opendap.deltares.nl/thredds/dodsC/opendap/rijkswaterstaat/vaklodingen
   /vaklodingenKB116_4544.nc'
   url_time = 'http://opendap.deltares.nl/thredds/dodsC/opendap/rijkswaterstaat/waterbase
   /concentration_of_suspended_matter_in_water/id410-DELFZBTHVN.nc'
   ```

   and select the variable you want to plot by looking at the file contents

   ```
   ncdisp(url_grid)
   ncdisp(url_time)
   ```

3. Define the data subset to get. Not until you issue the nc_varget you will actually get the data. Even if when the underlying file would be a hundreds of GB, this step can be pretty fast provided the subset you chose is not too big. Only when you make too big a selection, Matlab will take long. This will happen for instance with the 100 + years of tidal elevation dataset at station DelftZijl Buitenhaven. This selection step is the

essential difference with the approach of downloading a netCDF file and then using Matlab to view that local file from your harddisk. With OPeNDAP you do not have to download an entire file before you can view it, because you can request only a specific slice, or a subset of a matrix.

```
G.x = ncread(url_grid,'x');
G.y = ncread(url_grid,'y');
G.z = ncread(url_grid,'z',[1 1 1],[Inf Inf 1]); % get only one timestep (here: 1st), but all x and y,
note: ncread is zero based. note: matlab has different dimension order than other netCDF tools: t is
last here
```

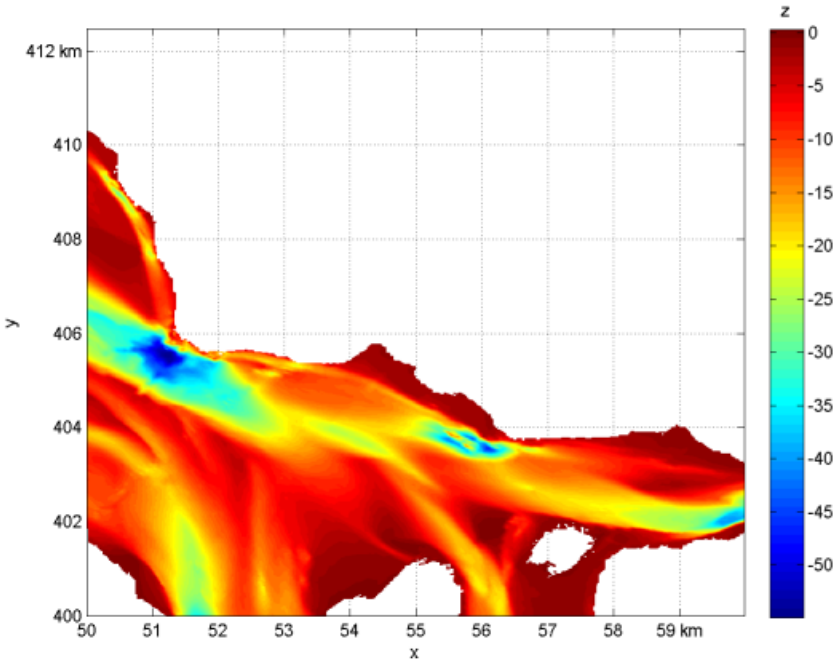
```
T.t   = ncread_cf_time(url_time,'time'); % adapt reference date of 1970 in netCDF to Matlab reference
date of 0000
T.eta = ncread(url_time,'concentration_of_suspended_matter_in_water');
```

4. plot ...

```
pcolorcorcen(G.x,G.y,G.z')
axis equal
axis tight
tickmap('xy')
grid on
xlabel('x')
ylabel('y')
colorbarwithtitle('z')
```

```
figure
plot(T.t,T.eta)
datetick('x')
grid on
```

5. et voila



Download the code of this Matlab example (repos,OPeNDAP_access_with_Matlab_tutorial.m)

See also: Accessing netCDF/OPeNDAP data with **python**, Accessing netCDF/OPeNDAP data with **R**, curvilinear model data subsetting with python

Accessing netCDF/OPeNDAP data with Python

Get PythonXY, add the netCDF4 package (PythonXY installer). Not all netCDF4 packages have been compiled with opendap yet. Therefore, manually also install the pydap package with easy_install.

```
python # start python in DOS shell to install easy_install
>>> from ez_setup import use_setuptools
```

```
>>> use_setuptools()
>>> exit() # now easy_install works outside python
easy_install Paste  # sometimes Paste is problematic, so let's install itmanually
easy_install Pydap
```

OpenEarthTools provides a module `opendap.py` that makes pydap quack like netCDF4 (repos, manual download) so you can talk directly to opendap data via the web. Now execute the following Python lines, or download the full example code (repos,manual download):

```
#!/usr/bin/env python
# Read data from an opendap server
import netCDF4, pydap,     urllib
import pylab,   matplotlib
import numpy as np
from opendap import opendap # OpenEarthTools module, see above that makes pypdap quack like netCDF4
```

1. Go to an OPeNDAP server (e.g. http://opendap.deltares.nl) and pick a netCDF file by copying the contents of the Data URL box.
2. Define the associated url you just copied.

```
url_grid = r'http://opendap.deltares.nl/thredds/dodsC/opendap/rijkswaterstaat/vaklodingen
/vaklodingenKB116_4544.nc'
url_time = r'http://opendap.deltares.nl/thredds/dodsC/opendap/rijkswaterstaat/waterbase
/concentration_of_suspended_matter_in_water/id410-DELFZBTHVN.nc'
```

3. Extract the data.

```
# Get grid data
grid   = opendap(url_grid)
G_x    = grid.variables['x']
G_y    = grid.variables['y']
G_z    = grid.variables['z']

G      = {} # dictionary ~ Matlab struct
G['x'] = G_x[:].squeeze()
G['y'] = G_y[:].squeeze()
G['z'] = G_z[1,:,:].squeeze() # download only one temporal slice

# represent fillValue from data as Masked Array
# the next release of netcdf4 will return a masked array by default, handling NaNs
# correctly too (http://code.google.com/p/netcdf4-python/issues/detail?id=168)
G['z'] = np.ma.masked_invalid(G['z'])
```

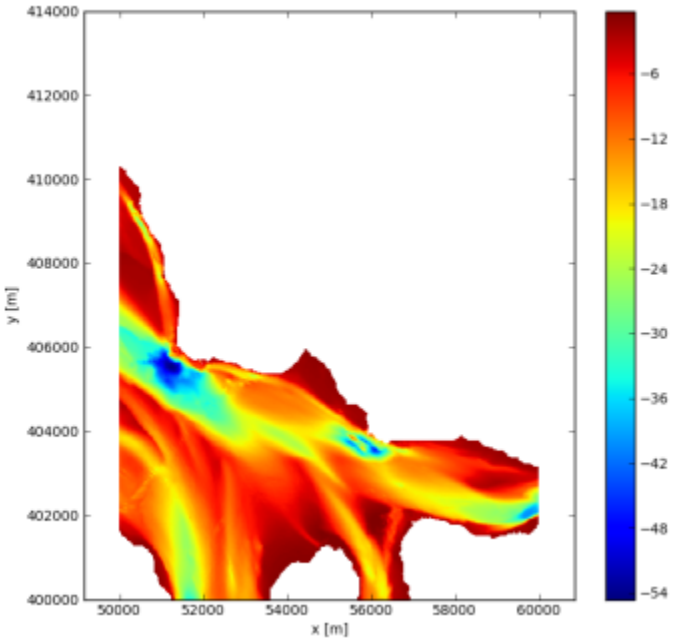
```
# Get time series data
time   = opendap(url_time)
T_t    = time.variables['time']
T_z    = time.variables['concentration_of_suspended_matter_in_water']

T      = {} # dictionary ~ Matlab struct
T['t'] = netCDF4.num2date(T_t[:], units=T_t.units)
T['z'] = T_z[:].squeeze()
```

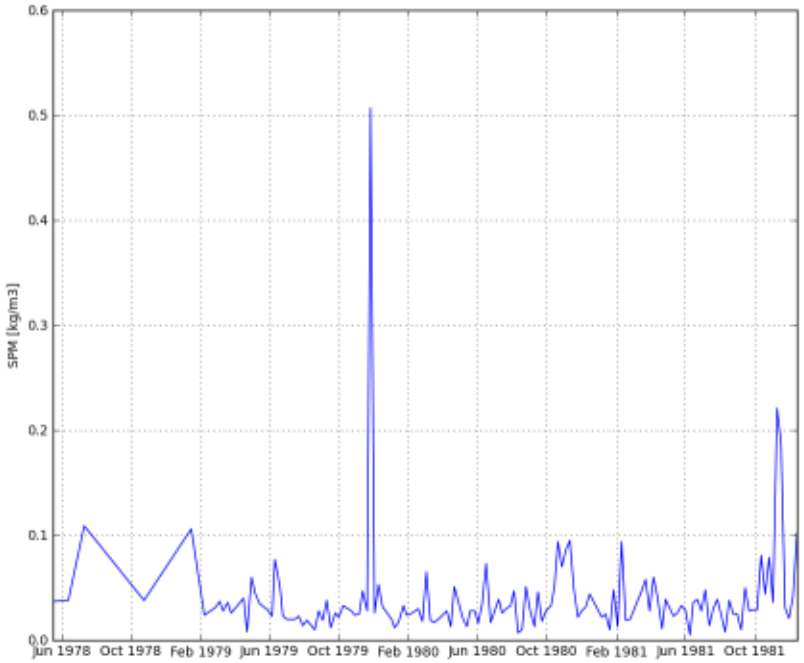
4. plot ...

```
# plot grid data
matplotlib.pyplot.pcolormesh(G['x'],G['y'],G['z'])
pylab.xlabel('x [m]')
pylab.ylabel('y [m]')
matplotlib.pyplot.colorbar()
matplotlib.pyplot.axis('tight')
matplotlib.pyplot.axis('equal')
matplotlib.pyplot.title(url_grid)
pylab.savefig('vaklodingenKB116_4544')
```

```
# plot time series data
pylab.clf()
matplotlib.pyplot.plot_date(T['t'], T['z'], fmt='b-', xdate=True, ydate=False)
pylab.ylabel('SPM [kg/m3]')
matplotlib.pyplot.title(url_time)
pylab.savefig('DELFZBTHVN')
```

5. et voila





Download the code of this python example (repos,manual download) + *opendap.py* pydap2netCDF4 module (repos, manual download).

See also: OPeNDAP subsetting with python,Accessing netCDF/OPeNDAP **unstructured grids** with python, Accessing netCDF/OPeNDAP data with **R**, Accessing netCDF/OPeNDAP data with **Matlab**, curvilinear model data subsetting with python

Accessing netCDF/OPeNDAP data with R

Get R, which includes several netCDF4 packages.

```
require(ncdf)
```

1. Go to an OPeNDAP server (e.g. http://opendap.deltares.nl) and pick a netCDF file by copying the contents of the Data URL box. Because the netcdf packages for windows are not yet opendap-enabled, download them.
2. Define the associated url you just copied.

```
url_grid <-
"http://opendap.deltares.nl/thredds/fileServer/opendap/rijkswaterstaat/vaklodingen/vaklodingenKB116_4544.
nc" # note: netcdf4 does not work on windows R

url_time <-
"http://opendap.deltares.nl/thredds/fileServer/opendap/rijkswaterstaat/waterbase
/concentration_of_suspended_matter_in_sea_water/id410-DELFZBTHVN.nc"

download.file(url_grid, "vaklodingenKB116_4544.nc", method = "auto",
quiet = FALSE, mode="wb", cacheOK = TRUE)

download.file(url_time, "id410-DELFZBTHVN.nc", method = "auto",
quiet = FALSE, mode="wb", cacheOK = TRUE)
```

   A complete linux image with the R netcdf package compiled with OPeNDAP is available upon request from ""adaguc "at" knmi.nl"".
3. Extract the data.

```
grid.nc <- open.ncdf("vaklodingenKB116_4544.nc")

# look what's in there...
grid.nc

# Get grid data
G.x <- get.var.ncdf(grid.nc,'x')
G.y <- get.var.ncdf(grid.nc,'y')

# get only first timestep
G.z <- get.var.ncdf(grid.nc,'z')[,,1]

# to get a black background, and set the scale of depth values to start from 0.
G.z[G.z == -9999] <- 0

# image.plot needs sorted x- and y-values;
# as y-values are descending, the order is reversed here...
G.y <- rev(G.y)
G.z <- G.z[,length(G.y):1]
```

```
time.nc <- open.ncdf("id410-DELFZBTHVN.nc")
# look what's in there...
time.nc

T.t <- get.var.ncdf(time.nc,'time')
T.eta <-
get.var.ncdf(time.nc,'concentration_of_suspended_matter_in_sea_water')
```

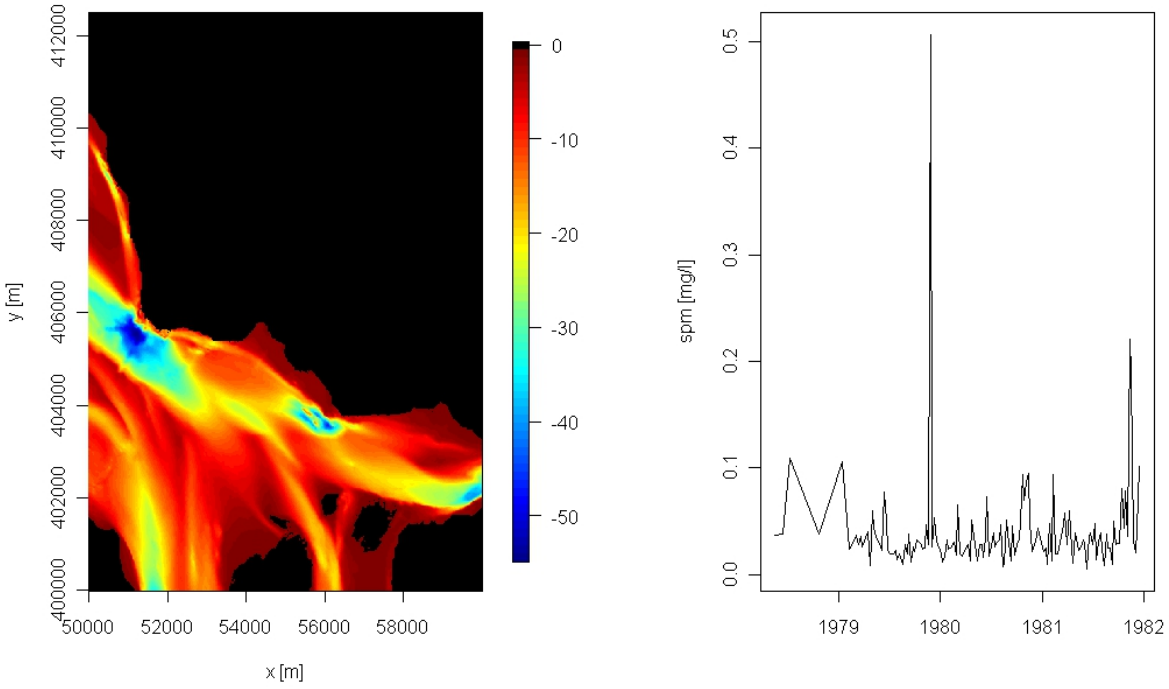
4. plot ...

```
# R-package fields provides nice image facilities and color schemes
par (mfrow = c(1,2))
library(fields)
```

```
image.plot(G.x,G.y,as.matrix(G.z),
        col = c(tim.colors(),"black"),
        xlab = "x [m]", ylab = "y [m]")
```

```
plot(as.Date(T.t, origin="1970-01-01"), T.eta, type = "l", ylab = "spm
[mg/l]")
```

5. et voila



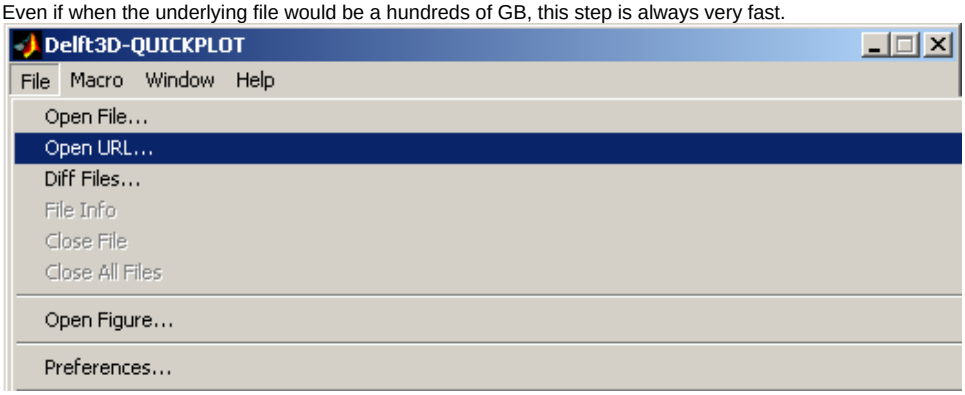
Download the code of this R example (repos,manual download), which was provided by Karline Soetaert and Tom van Engeland.

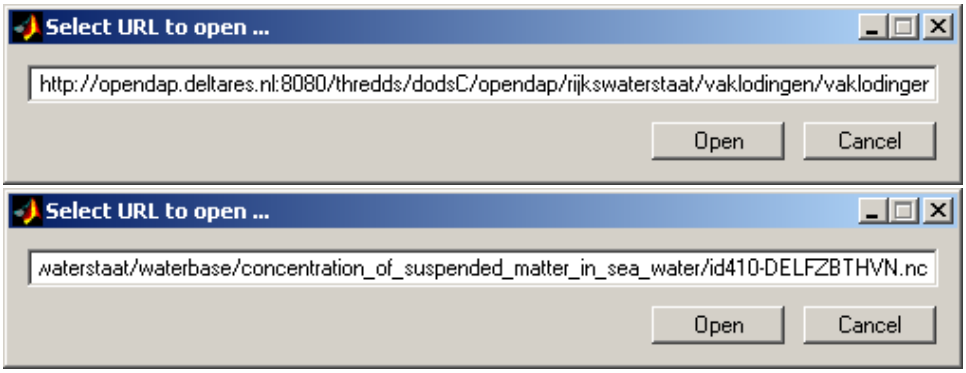
See also: Accessing netCDF/OPeNDAP data with **python**, Accessing netCDF/OPeNDAP data with **Matlab**, PostgreSQL access with **R**, OPeNDAP subsetting with **R**

Accessing netCDF/OPeNDAP data with Delft3D-Quickplot.

Get Delft3D (code is available as open source since jan 1st 2011). (Download Delft3D-Quickplot-OPeNDAP manual.)

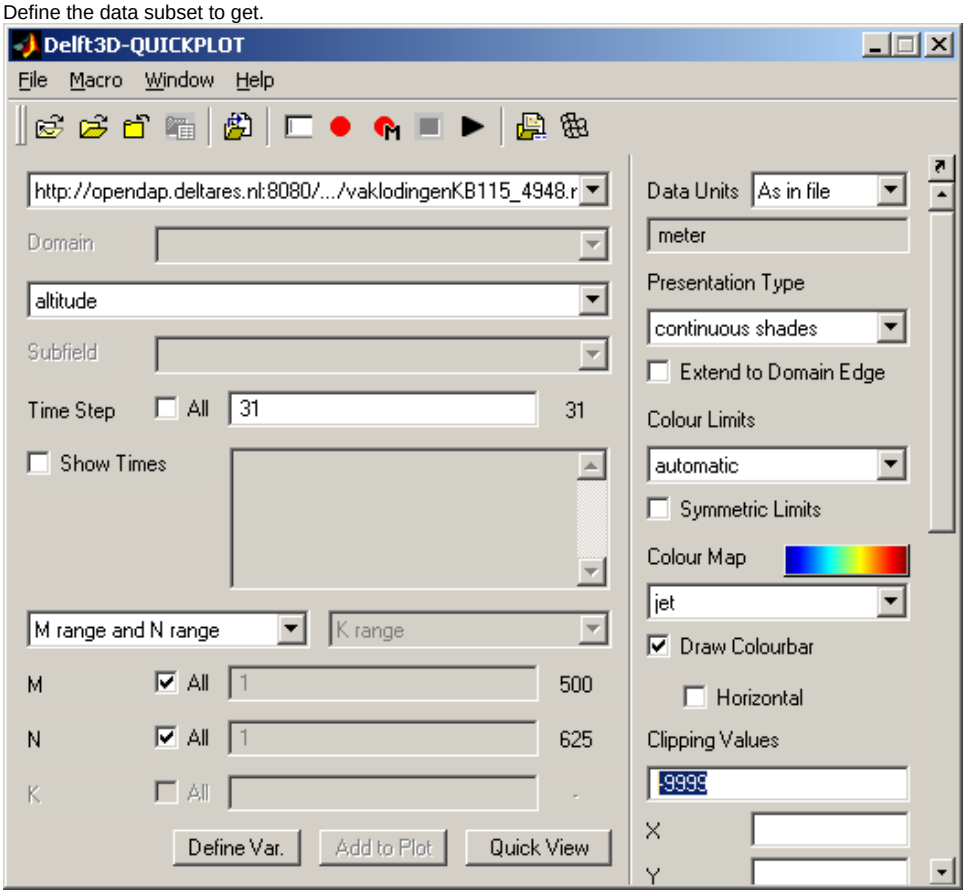
1. select menu file > url and paste the url you just copied. Delft3D-Quikcplot will now download the meta-information from the OPeNDAP server. Even if when the underlying file would be a hundreds of GB, this step is always very fast.

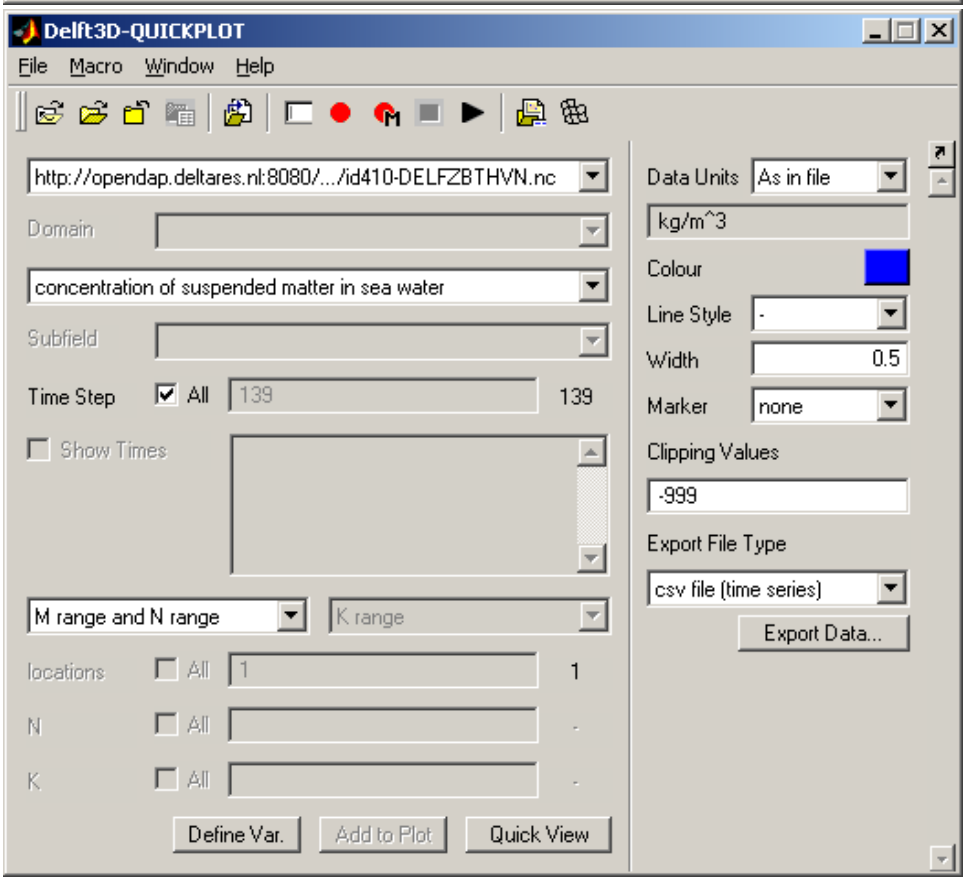




2. Select the variable you want to plot by looking at the file contents

3. Define the data subset to get.





4. et voila

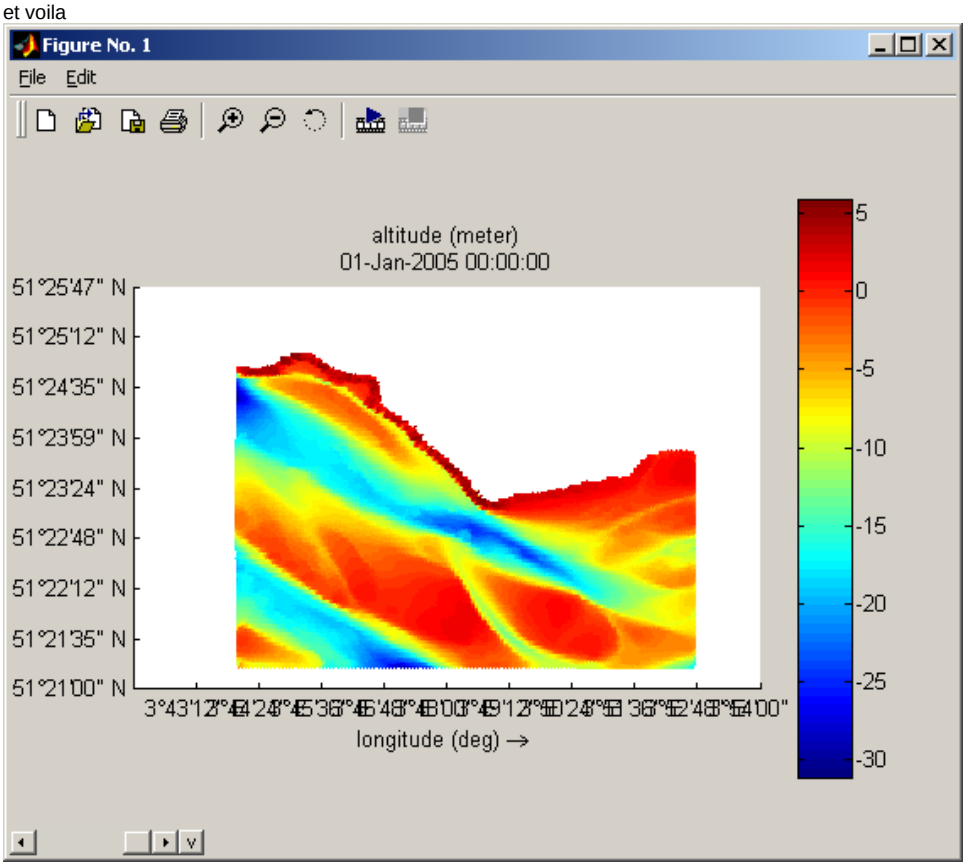


Figure No. 1
File Edit
altitude (meter)
01-Jan-2005 00:00:00
51°25'47" N
51°25'12" N
51°24'35" N
51°23'59" N
51°23'24" N
51°22'48" N
51°22'12" N
51°21'35" N
51°21'00" N
longitude (deg) →
5
0
-5
-10
-15
-20
-25
-30

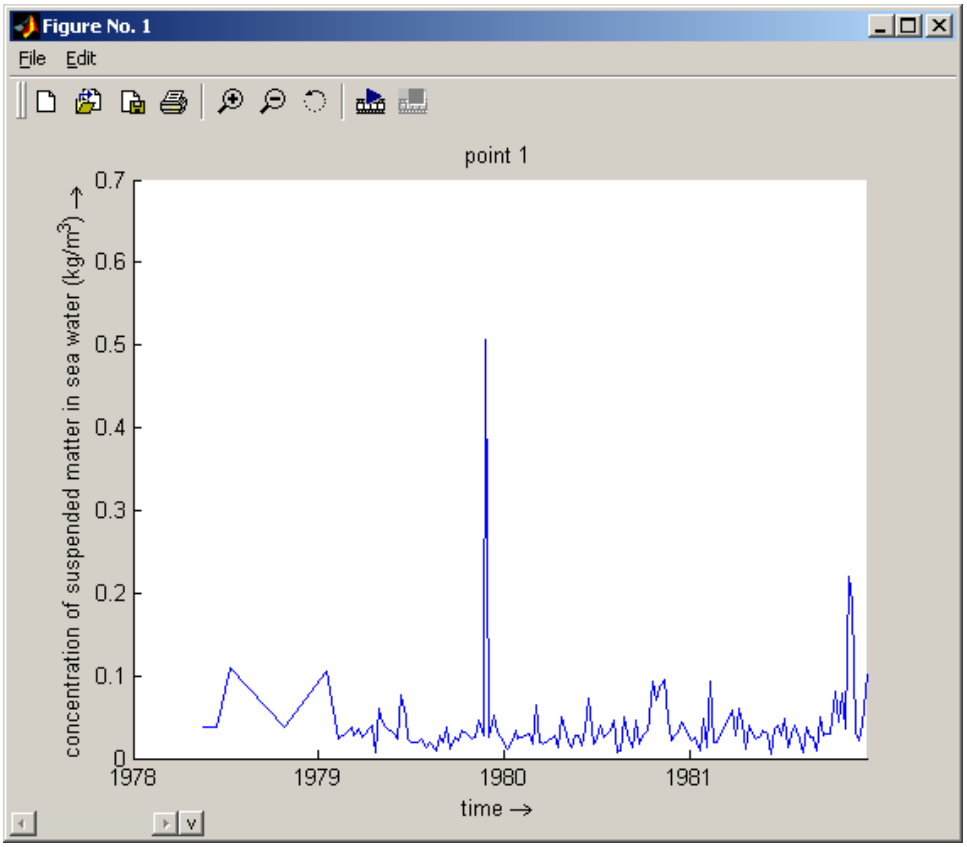


Figure No. 1
File Edit
point 1
concentration of suspended matter in sea water (kg/m3) →
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1978
1979
1980
1981
time →