# ENRAM readme

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March 31, 2014

University of Amsterdam

netherlands eScience center

by SURF & NWO

# Chapter 1

# Getting started

Software has been developed by Adriaan Dokter and Martin de Graaf during previous stages of the project. Adriaan's software is written in the C programming language, whereas most of Martin's work is in IDL. The two components work together to read radar signals from ODIM-HDF5 formatted files containing radar sensor data, most importantly reflectivities and radial velocities. The software can use these data to visualize the intensity of bird migration around a radar station, either as PPI's[1] or as altitude profiles. The software further includes algorithms to calculate cluttermaps for a given radar station.

The current stage of the project attempts to preserve the functionality of the existing radar analysis workflow. This has been implemented by creating a virtual machine in which all necessary software has been set up and configured correctly and consistently, such that the entire workflow may be reproduced by running just one script ('/home/wbouten/enram/start-processing.sh'). Furthermore, the code is now stored using a version control system (git), and is publicly accessible at GitHub (https://github.com/NLeSC/enram).

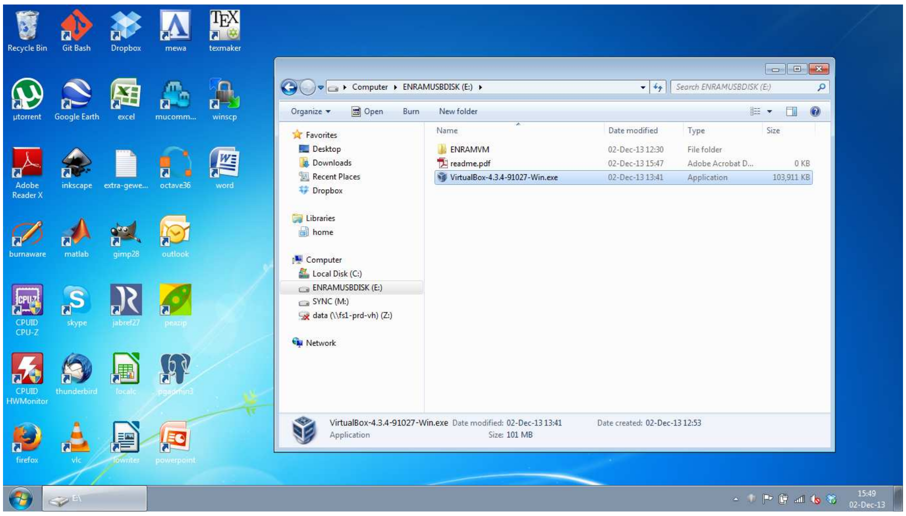
The rest of this document explains how to install the VirtualBox software (Section 1.1), how to create a virtual machine and how to start it (Section 1.2), how to start the ENRAM data processing (Chapter 2), and finally it provides some background about how the virtual machine is organized (Chapter 3).

Since you are reading this file, it is assumed that you have plugged in the USB drive that contains all the data and software pertaining to the ENRAM project.

[1] http://en.wikipedia.org/wiki/Plan_Position_Indicator

## 1.1 Installing VirtualBox

Use Windows Explorer to browse the USB disk contents. The USB disk should show up as ENRAMUSBDISK in the left hand pane (see figure 1.1). The disk should at least contain the following: (1) a folder 'ENRAMVM' (which contains the virtual hard drive file that we will use in the next section), a file 'readme.pdf' (which is the document you have before you), and a VirtualBox installer for Windows.

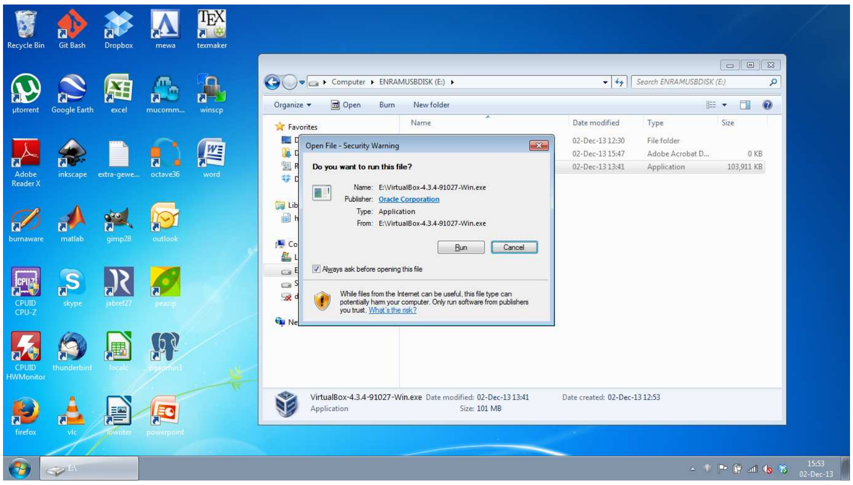


| Name | Date modified | Type | Size |
|---|---|---|---|
| ENRAMVM | 02-Dec-13 12:30 | File folder | |
| readme.pdf | 02-Dec-13 15:47 | Adobe Acrobat D... | 0 KB |
| VirtualBox-4.3.4-91027-Win.exe | 02-Dec-13 13:41 | Application | 103,911 KB |

VirtualBox-4.3.4-91027-Win.exe Date modified: 02-Dec-13 13:41 Date created: 02-Dec-13 12:53
Application Size: 101 MB

Figure 1.1

Double-click on the VirtualBox installer file ('VirtualBox-4.3.4-91027-Win.exe') to start the setup wizard. A menu will show up (Figure 1.2). Click on the button labeled 'Run'.



Open File - Security Warning

**Do you want to run this file?**

Name: E:\VirtualBox-4.3.4-91027-Win.exe
Publisher: Oracle Corporation
Type: Application
From: E:\VirtualBox-4.3.4-91027-Win.exe

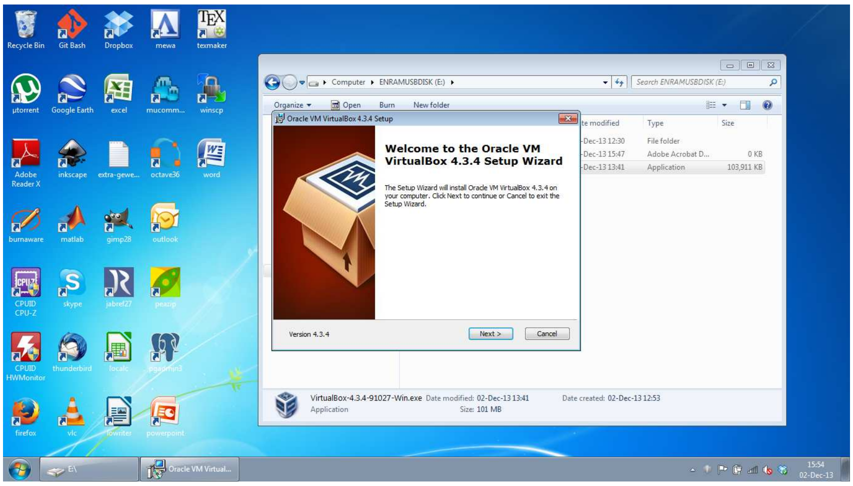
☑ Always ask before opening this file

While files from the Internet can be useful, this file type can potentially harm your computer. Only run software from publishers you trust. What's the risk?

VirtualBox-4.3.4-91027-Win.exe Date modified: 02-Dec-13 13:41 Date created: 02-Dec-13 12:53
Application Size: 101 MB

Figure 1.2

The setup wizard program should now start. On the first page of the setup wizard (Figure 1.3), click the button labeled ‘Next’.



Oracle VM VirtualBox 4.3.4 Setup

**Welcome to the Oracle VM VirtualBox 4.3.4 Setup Wizard**

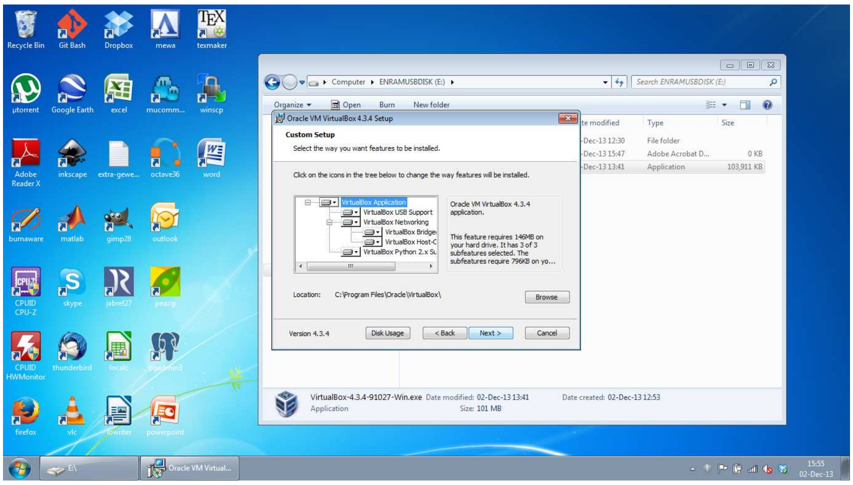
The Setup Wizard will install Oracle VM VirtualBox 4.3.4 on your computer. Click Next to continue or Cancel to exit the Setup Wizard.

Version 4.3.4

VirtualBox-4.3.4-91027-Win.exe Date modified: 02-Dec-13 13:41 Date created: 02-Dec-13 12:53
Application Size: 101 MB

Figure 1.3

On the next page of the setup wizard (Figure 1.4), click the button labeled ‘Next’.



Oracle VM VirtualBox 4.3.4 Setup

**Custom Setup**

Select the way you want features to be installed.

Click on the icons in the tree below to change the way features will be installed.

Oracle VM VirtualBox 4.3.4 application.

This feature requires 146MB on your hard drive. It has 3 of 3 subfeatures selected. The subfeatures require 796KB on yo...

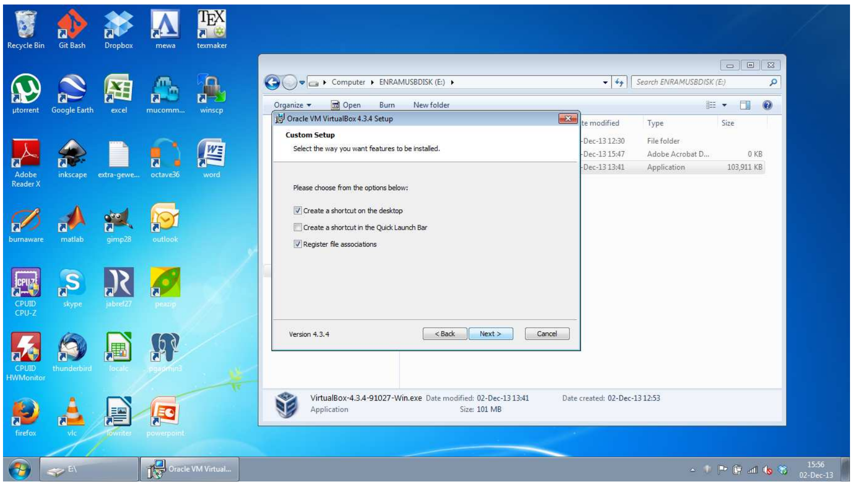
Location: C:\Program Files\Oracle\VirtualBox\

Version 4.3.4

VirtualBox-4.3.4-91027-Win.exe Date modified: 02-Dec-13 13:41 Date created: 02-Dec-13 12:53
Application Size: 101 MB

Figure 1.4

On the next page of the setup wizard (Figure 1.5), check the items as you like. Then click the button labeled ‘Next’.



Custom Setup

Select the way you want features to be installed.

Please choose from the options below:

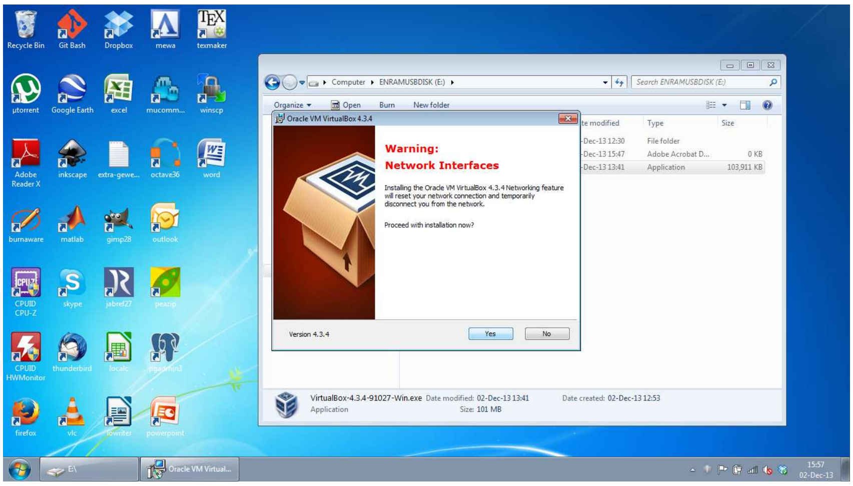
☑ Create a shortcut on the desktop

□ Create a shortcut in the Quick Launch Bar

☑ Register file associations

Figure 1.5

Make sure you are not currently doing something that requires network access (like downloading a big file). Then, on the next page of the setup wizard (Figure 1.6), click the button labeled ‘Yes’.



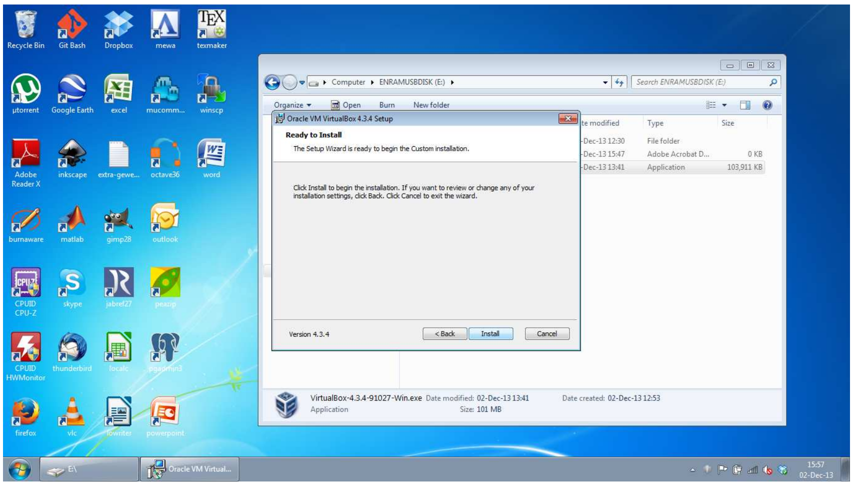
Warning:
Network Interfaces

Installing the Oracle VM VirtualBox 4.3.4 Networking feature will reset your network connection and temporarily disconnect you from the network.

Proceed with installation now?

Figure 1.6

On the next page of the setup wizard, click the button labeled ‘Install’.


Oracle VM VirtualBox 4.3.4 Setup

**Ready to Install**

The Setup Wizard is ready to begin the Custom installation.

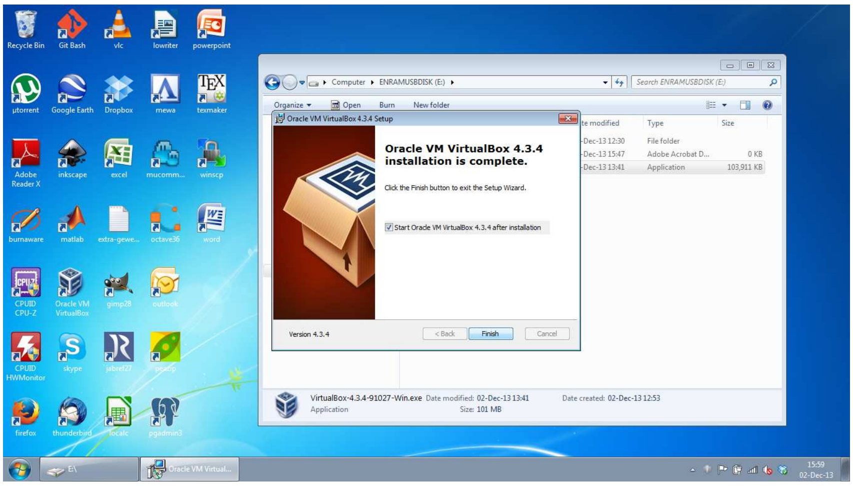
Click Install to begin the installation. If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.

Version 4.3.4

VirtualBox-4.3.4-91027-Win.exe Date modified: 02-Dec-13 13:41 Date created: 02-Dec-13 12:53
Application Size: 101 MB

Figure 1.7

Allright! Looks like you just installed VirtualBox. Leave the checkbox checked (Figure 1.8) and click on the button labeled ‘Finish’.


Oracle VM VirtualBox 4.3.4 Setup

**Oracle VM VirtualBox 4.3.4 installation is complete.**

Click the Finish button to exit the Setup Wizard.

☑ Start Oracle VM VirtualBox 4.3.4 after installation

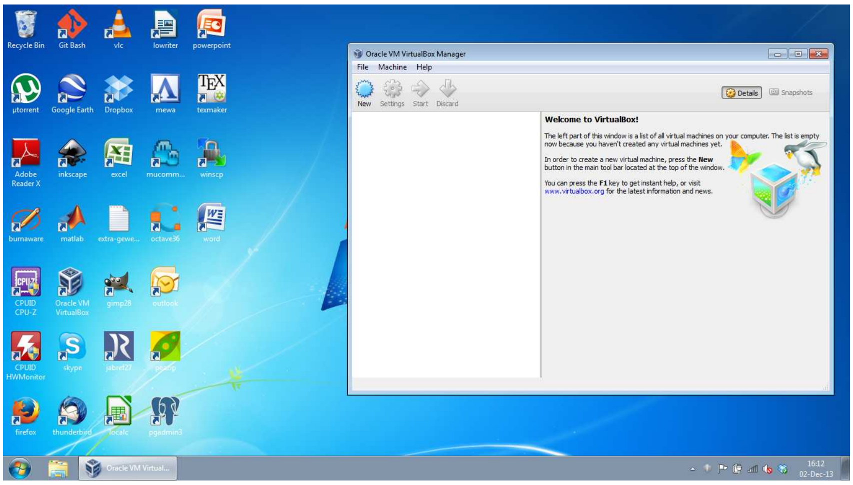
Version 4.3.4

VirtualBox-4.3.4-91027-Win.exe Date modified: 02-Dec-13 13:41 Date created: 02-Dec-13 12:53
Application Size: 101 MB

Figure 1.8

## 1.2 Creating a virtual machine and running it

Before we can access all the goodies that are on the virtual disk, we need to create a so-called *virtual machine*. Start the VirtualBox program if it has not already started. Since this probably is the first time you started VirtualBox, the program will show a welcome message (Figure 1.9). Click on light blue icon in the top left corner labeled 'New'.



**Welcome to VirtualBox!**

The left part of this window is a list of all virtual machines on your computer. The list is empty now because you haven't created any virtual machines yet.

In order to create a new virtual machine, press the **New** button in the main tool bar located at the top of the window.

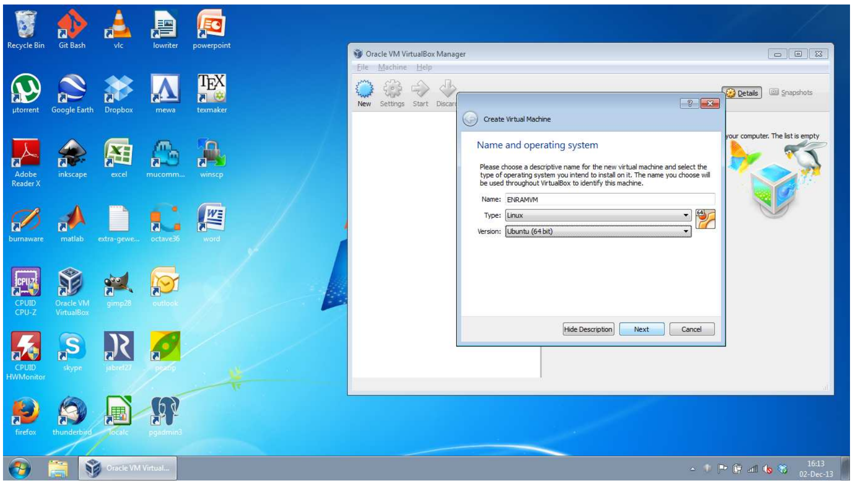
You can press the **F1** key to get instant help, or visit www.virtualbox.org for the latest information and news.

Figure 1.9

In this window (Figure 1.10), specify 'ENRAMVM' as the name of the virtual machine.

Use the drop-down menus to choose the type of operating system ('Linux') and the version ('Ubuntu 64-bit').

Click the button labeled 'Next'.



Name and operating system

Please choose a descriptive name for the new virtual machine and select the type of operating system you intend to install on it. The name you choose will be used throughout VirtualBox to identify this machine.

Name: ENRAMVM

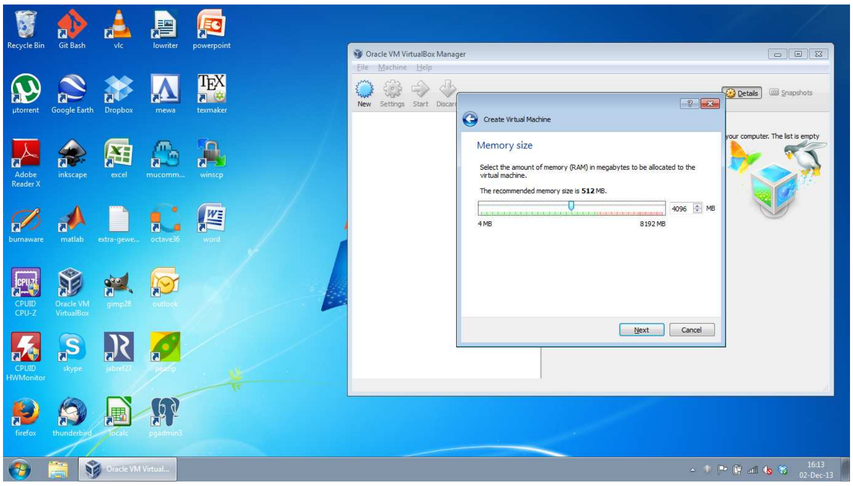
Type: Linux

Version: Ubuntu (64 bit)

Figure 1.10

In this window, you need to specify the amount of virtual memory that your virtual machine will have. Set it to 4096 MB (Figure 1.11).

Click the button labeled 'Next'.



Memory size

Select the amount of memory (RAM) in megabytes to be allocated to the virtual machine.

The recommended memory size is **512** MB.

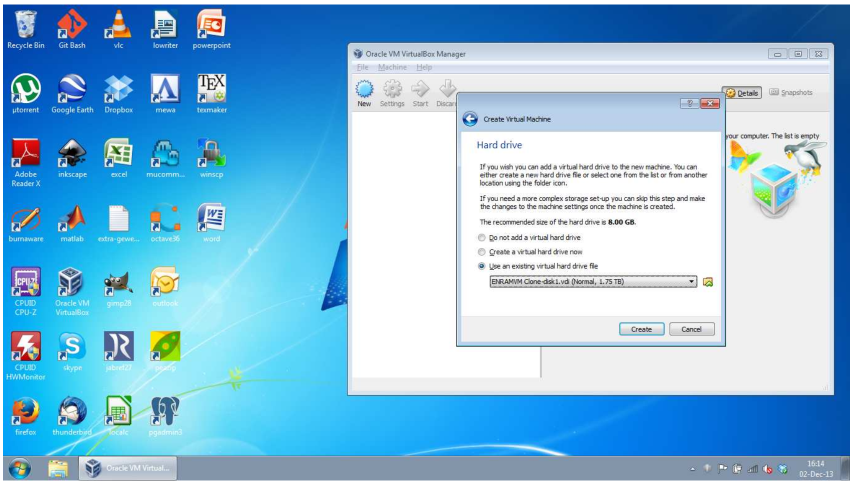
4096 MB

4 MB 8192 MB

Figure 1.11

In this window, make sure to choose the last option 'Use an existing virtual hard drive file'. Use the little folder icon to the right of the drop-down list to select the virtual hard drive file 'ENRAMVM Clone-disk1.vdi' that is located in folder 'ENRAMVM' on ENRAMUSBDISK.

Then, click the button labeled 'Create'.



Hard drive

If you wish you can add a virtual hard drive to the new machine. You can either create a new hard drive file or select one from the list or from another location using the folder icon.

If you need a more complex storage set-up you can skip this step and make the changes to the machine settings once the machine is created.

The recommended size of the hard drive is **8.00 GB**.

○ Do not add a virtual hard drive

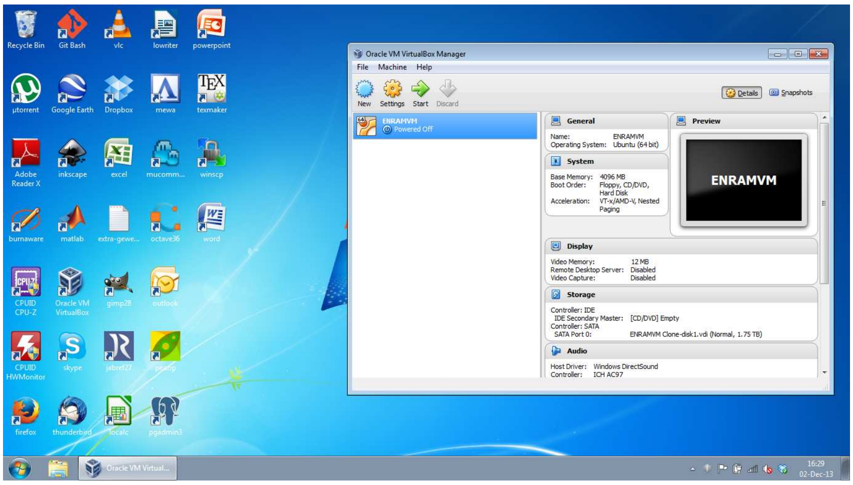
○ Create a virtual hard drive now

● Use an existing virtual hard drive file

ENRAMVM Clone-disk1.vdi (Normal, 1.75 TB)

Figure 1.12

Sweet! We have a virtual machine ('ENRAMVM'; Figure 1.13). Boot up the virtual machine by clicking the icon with the green arrow labeled 'Start'.



General
Name: ENRAMVM
Operating System: Ubuntu (64 bit)

System
Base Memory: 4096 MB
Boot Order: Floppy, CD/DVD, Hard Disk
Acceleration: VT-x/AMD-V, Nested Paging

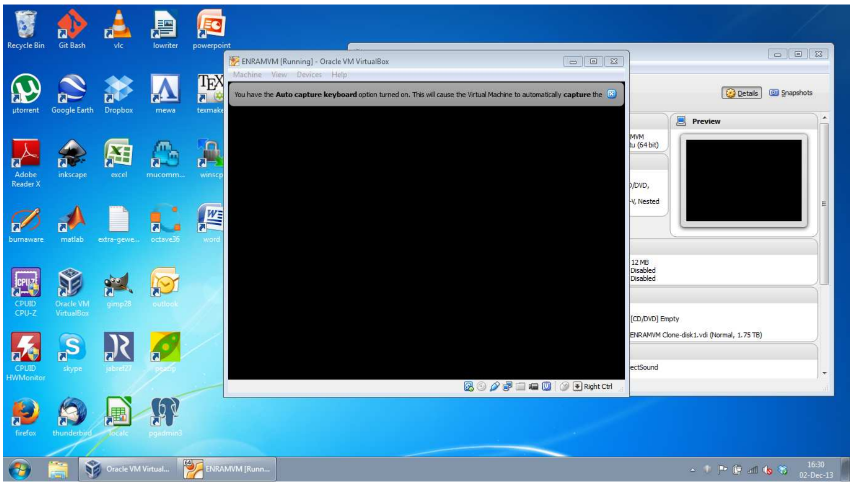
Display
Video Memory: 12 MB
Remote Desktop Server: Disabled
Video Capture: Disabled

Storage
Controller: IDE
IDE Secondary Master: [CD/DVD] Empty
Controller: SATA
SATA Port 0: ENRAMVM Clone-disk1.vdi (Normal, 1.75 TB)

Audio
Host Driver: Windows DirectSound
Controller: ICH AC97

Figure 1.13

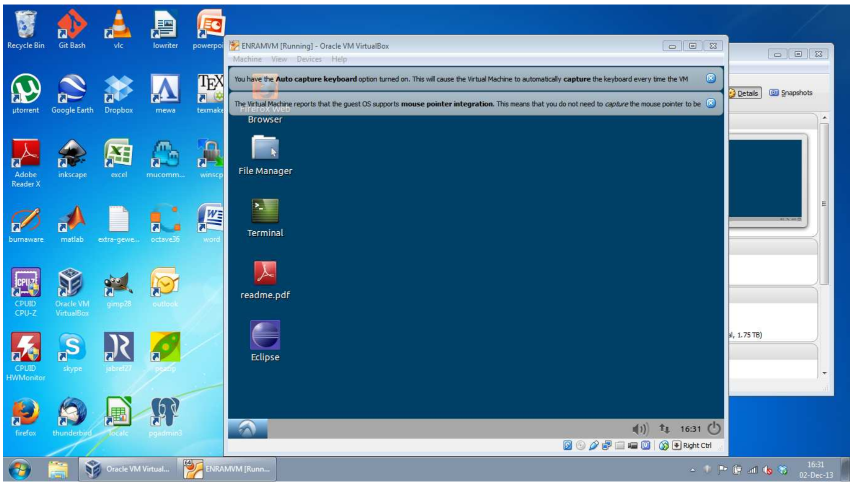
A new Window will pop up (Figure 1.14), which initially is just black, but after a couple of seconds, stuff will appear. There will likely also be two warning messages, but you can ignore these by clicking on the little blue icon in the top right corner of the ENRAMVM window.



You have the **Auto capture keyboard** option turned on. This will cause the Virtual Machine to automatically **capture** the

Figure 1.14

After a couple more seconds, your newly created ENRAMVM machine will have finished booting and will be ready for you to use. It will show you a blue desktop with a few icons on it (Figure 1.15).



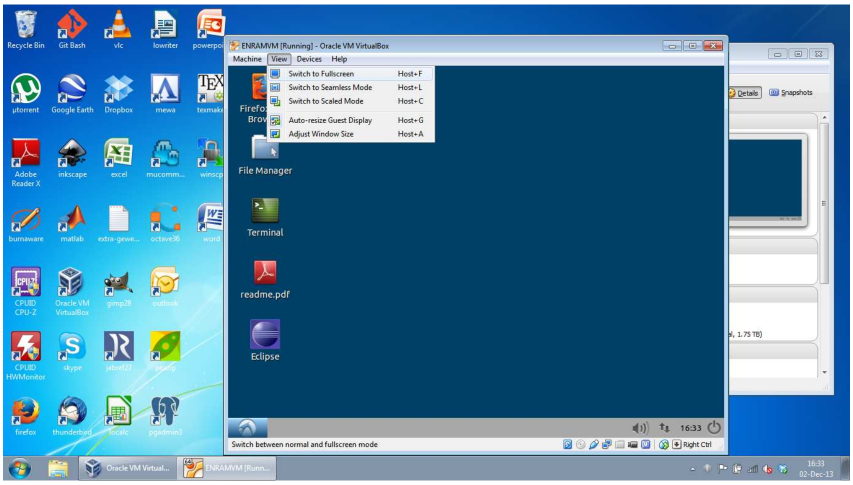
ENRAMVM [Running] - Oracle VM VirtualBox

You have the **Auto capture keyboard** option turned on. This will cause the Virtual Machine to automatically **capture** the keyboard every time the VM

The Virtual Machine reports that the guest OS supports **mouse pointer integration.** This means that you do not need to *capture* the mouse pointer to be

Figure 1.15

Before we do anything else, let's first maximize the virtual screen. You can do this by clicking on the menu item 'View' and then selecting 'Switch to Fullscreen' (Figure 1.16).



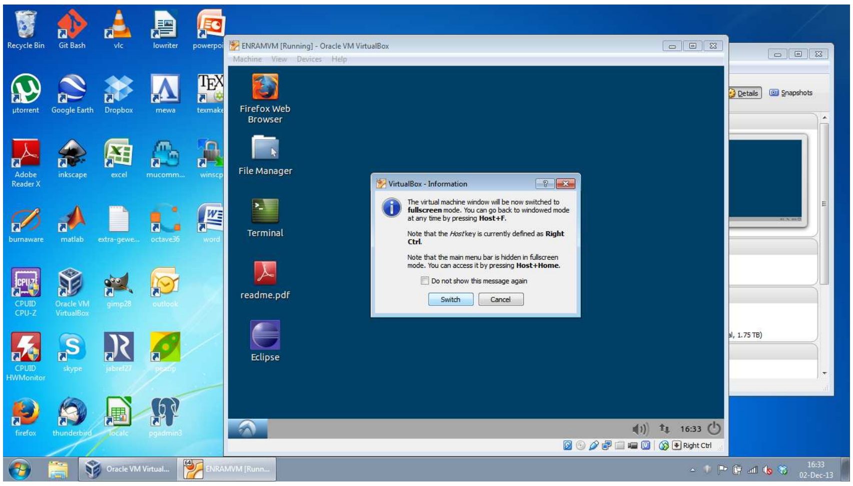
ENRAMVM [Running] - Oracle VM VirtualBox

Switch between normal and fullscreen mode

Figure 1.16

Note that you can toggle between fullscreen and windowed mode by simultaneously pressing the letter F button and the Ctrl button on the right hand side of your keyboard (Figure 1.17).

Click the ‘Switch’ button to switch to Fullscreen mode.



VirtualBox - Information

The virtual machine window will be now switched to **fullscreen** mode. You can go back to windowed mode at any time by pressing **Host+F**.

Note that the *Host* key is currently defined as **Right Ctrl**.

Note that the main menu bar is hidden in fullscreen mode. You can access it by pressing **Host+Home**.

□ Do not show this message again

Switch Cancel

Figure 1.17

You should now see the virtual machine’s desktop fullscreen (Figure 1.18).

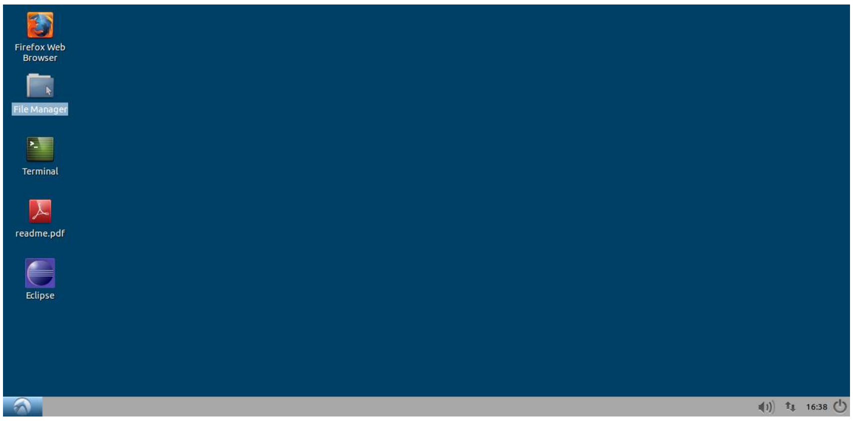


Figure 1.18

The next chapter explains how to use the ENRAM software and data, but at some point you'll want to power down the virtual machine, so let's look at that first.

Click on the blue icon in the taskbar in the lower left corner of the screen, and choose 'Logout' (Figure 1.19).

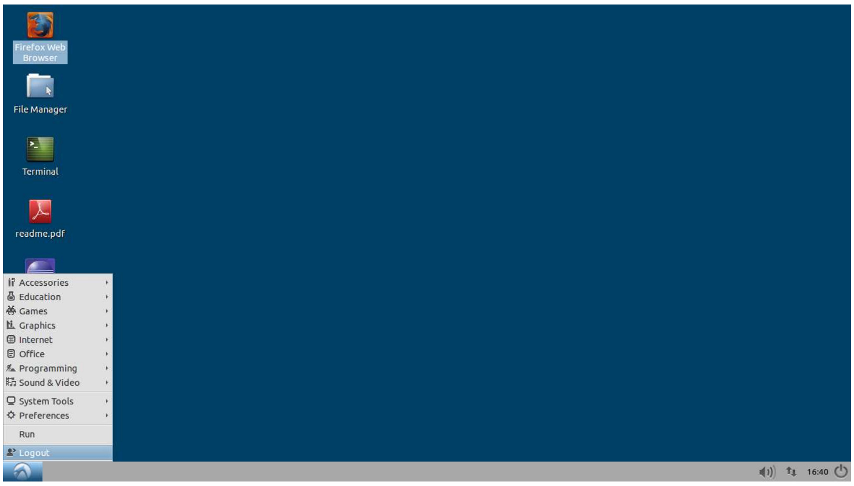


Figure 1.19

In this menu, choose ‘Shutdown’ to power down the virtual machine (Figure 1.20). After a few seconds, you will be back at you Windows desktop (Figure 1.21).

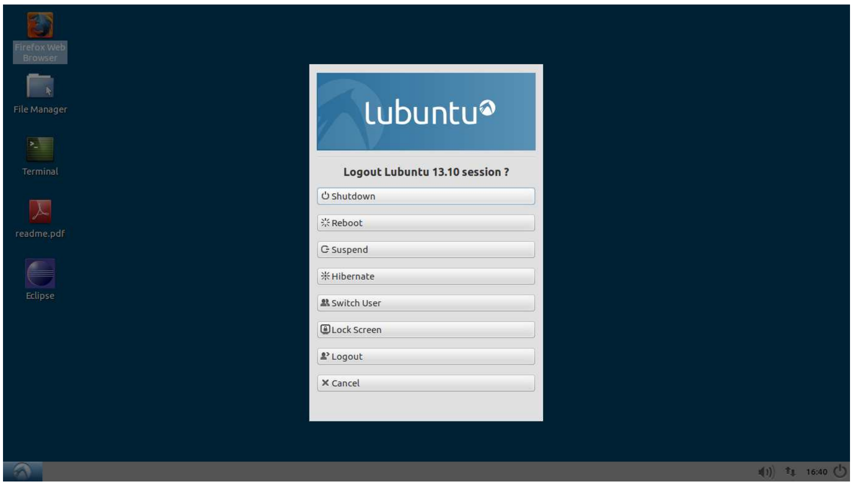
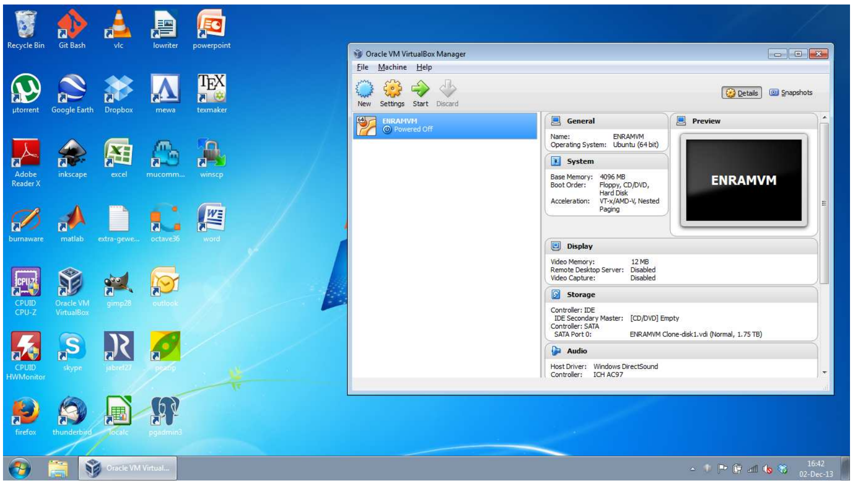


Figure 1.20



General
Name: ENRAMVM
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System
Base Memory: 4096 MB
Boot Order: Floppy, CD/DVD, Hard Disk
Acceleration: VT-x/AMD-V, Nested Paging

Display
Video Memory: 12 MB
Remote Desktop Server: Disabled
Video Capture: Disabled

Storage
Controller: IDE
IDE Secondary Master: [CD/DVD] Empty
Controller: SATA
SATA Port 0: ENRAMVM Clone-disk1.vdi (Normal, 1.75 TB)

Audio
Host Driver: Windows DirectSound
Controller: ICH AC97

Figure 1.21

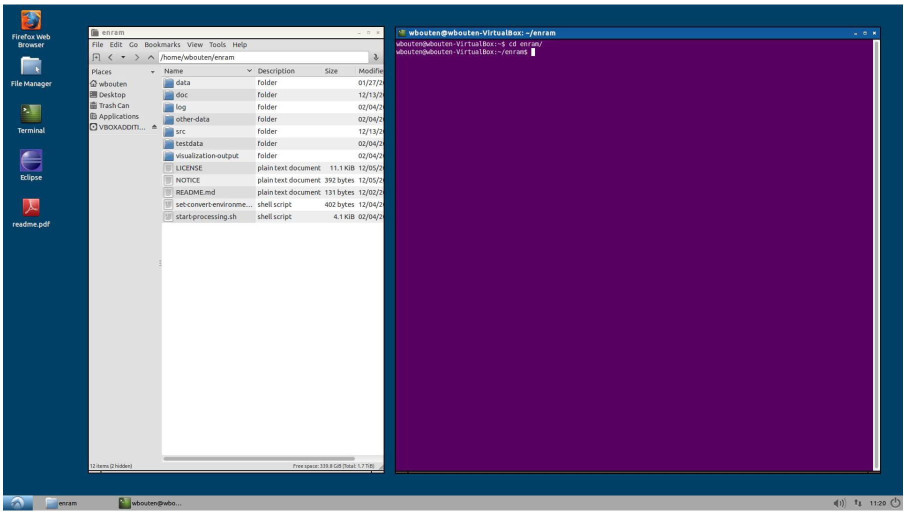
# Chapter 2

# Using the ENRAM software

Make sure you have your virtual machine running (as in Figure 1.18).

Start the File Manager by clicking on the desktop icon labeled ‘File Manager’. In the file manager window, double-click on the directory called ‘enram’ to inspect its contents.

Start a terminal by double-clicking the desktop icon labeled ‘Terminal’. This should bring up a terminal program (Figure 2.1). In the terminal window, use the `cd` command to change directory into the ‘enram’ directory.



| Name | Description | Size | Modifie |
|---|---|---|---|
| data | folder | | 01/27/2 |
| doc | folder | | 12/13/2 |
| log | folder | | 02/04/2 |
| other-data | folder | | 02/04/2 |
| src | folder | | 12/13/2 |
| testdata | folder | | 02/04/2 |
| visualization-output | folder | | 02/04/2 |
| LICENSE | plain text document | 11.1 KiB | 12/05/2 |
| NOTICE | plain text document | 392 bytes | 12/05/2 |
| README.md | plain text document | 131 bytes | 12/02/2 |
| set-convert-environme... | shell script | 402 bytes | 12/04/2 |
| start-processing.sh | shell script | 4.1 KiB | 02/04/2 |

wbouten@wbouten-VirtualBox: ~/enram

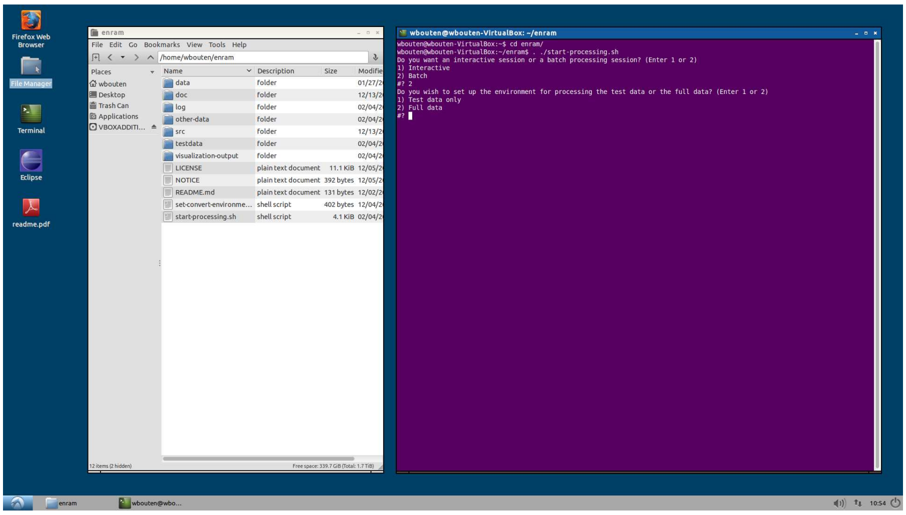
```
wbouten@wbouten-VirtualBox:~$ cd enram/
wbouten@wbouten-VirtualBox:~/enram$
```

Figure 2.1

You can now start the ENRAM workflow as follows. Type:
`.  ./start-processing.sh`

(But make sure to type it exactly as it is displayed here, including the leading dot).

The terminal will then first ask you whether you want an interactive session or you want to start processing in batch mode; then it will ask you to select either the test data set or the full data set (Figure 2.2).



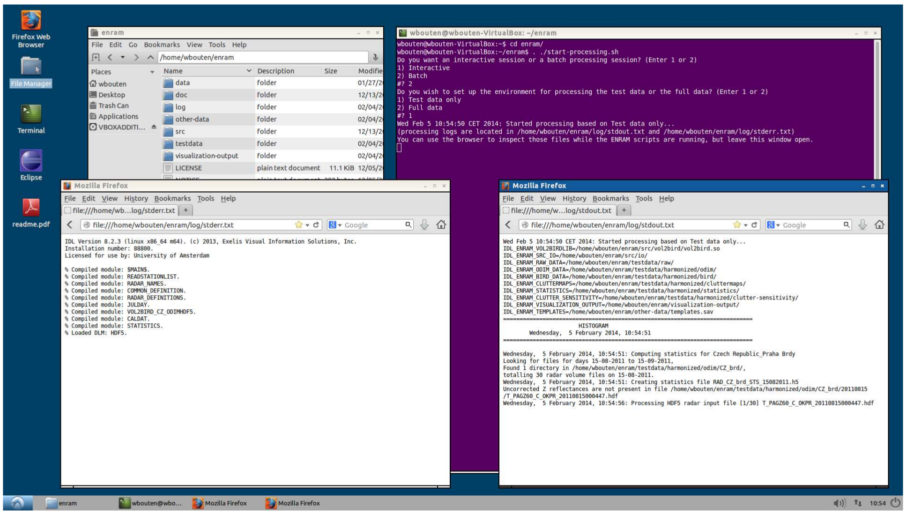
| Name | Description | Size | Modifie |
|---|---|---|---|
| data | folder | | 01/27/2 |
| doc | folder | | 12/13/2 |
| log | folder | | 02/04/2 |
| other-data | folder | | 02/04/2 |
| src | folder | | 12/13/2 |
| testdata | folder | | 02/04/2 |
| visualization-output | folder | | 02/04/2 |
| LICENSE | plain text document | 11.1 KiB | 12/05/2 |
| NOTICE | plain text document | 392 bytes | 12/05/2 |
| README.md | plain text document | 131 bytes | 12/02/2 |
| set-convert-environme... | shell script | 402 bytes | 12/04/2 |
| start-processing.sh | shell script | 4.1 KiB | 02/04/2 |

```
wbouten@wbouten-VirtualBox:~$ cd enram/
wbouten@wbouten-VirtualBox:~/enram$ . ./start-processing.sh
Do you want an interactive session or a batch processing session? (Enter 1 or 2)
1) Interactive
2) Batch
#? 2
Do you wish to set up the environment for processing the test data or the full data? (Enter 1 or 2)
1) Test data only
2) Full data
#?
```

Figure 2.2

Answer '1' or '2' and press Enter at each question. The terminal will now set up the necessary environment variables.

If you chose to process the data in batch mode, you can use the Firefox web browser to view the batch program's feedback (Figure 2.3) while the terminal program is running. Just navigate to 'file:///home/wbouten/enram/log/stderr.txt' and 'file:///home/wbouten/enram/log/stdout.txt'. Note that these locations have been added to the bookmarks, so if you just type 'stderr' or 'stdout' in Firefox's URL bar, it should suggest the corresponding files automatically.



Firefox Web Browser
File Manager
Terminal
Eclipse
readme.pdf
enram
wbouten@wbouten-VirtualBox: ~/enram
Mozilla Firefox
File Edit View History Bookmarks Tools Help
file:///home/wb...log/stderr.txt
file:///home/wbouten/enram/log/stderr.txt
file:///home/w...log/stdout.txt
file:///home/wbouten/enram/log/stdout.txt
Google
enram
wbouten@wbo...
Mozilla Firefox
Mozilla Firefox
10:54

```
wbouten@wbouten-VirtualBox:~$ cd enram/
wbouten@wbouten-VirtualBox:~/enram$ . ./start-processing.sh
Do you want an interactive session or a batch processing session? (Enter 1 or 2)
1) Interactive
2) Batch
#? 2
Do you wish to set up the environment for processing the test data or the full data? (Enter 1 or 2)
1) Test data only
2) Full data
#? 1
Wed Feb 5 10:54:50 CET 2014: Started processing based on Test data only...
(processing logs are located in /home/wbouten/enram/log/stdout.txt and /home/wbouten/enram/log/stderr.txt)
You can use the browser to inspect those files while the ENRAM scripts are running, but leave this window open.
```

```
IDL Version 8.2.3 (linux x86_64 m64). (c) 2013, Exelis Visual Information Solutions, Inc.
Installation number: 88800.
Licensed for use by: University of Amsterdam

% Compiled module: $MAIN$.
% Compiled module: READSTATIONLIST.
% Compiled module: RADAR_NAMES.
% Compiled module: COMMON_DEFINITION.
% Compiled module: RADAR_DEFINITIONS.
% Compiled module: JULDAY.
% Compiled module: VOL2BIRD_CZ_ODIMHDF5.
% Compiled module: CALDAT.
% Compiled module: STATISTICS.
% Loaded DLM: HDF5.
```

```
Wed Feb 5 10:54:50 CET 2014: Started processing based on Test data only...
IDL_ENRAM_VOL2BIRDLIB=/home/wbouten/enram/src/vol2bird/vol2bird.so
IDL_ENRAM_SRC_IO=/home/wbouten/enram/src/io/
IDL_ENRAM_RAW_DATA=/home/wbouten/enram/testdata/raw/
IDL_ENRAM_ODIM_DATA=/home/wbouten/enram/testdata/harmonized/odim/
IDL_ENRAM_BIRD_DATA=/home/wbouten/enram/testdata/harmonized/bird/
IDL_ENRAM_CLUTTERMAPS=/home/wbouten/enram/testdata/harmonized/cluttermaps/
IDL_ENRAM_STATISTICS=/home/wbouten/enram/testdata/harmonized/statistics/
IDL_ENRAM_CLUTTER_SENSITIVITY=/home/wbouten/enram/testdata/harmonized/clutter-sensitivity/
IDL_ENRAM_VISUALIZATION_OUTPUT=/home/wbouten/enram/visualization-output/
IDL_ENRAM_TEMPLATES=/home/wbouten/enram/other-data/templates.sav
================================================================================
                        HISTOGRAM
        Wednesday,  5 February 2014, 10:54:51
================================================================================

Wednesday,  5 February 2014, 10:54:51: Computing statistics for Czech Republic_Praha Brdy
Looking for files for days 15-08-2011 to 15-09-2011,
Found 1 directory in /home/wbouten/enram/testdata/harmonized/odim/CZ_brd/,
totalling 30 radar volume files on 15-08-2011.
Wednesday,  5 February 2014, 10:54:51: Creating statistics file RAD_CZ_brd_STS_15082011.h5
Uncorrected Z reflectances are not present in file /home/wbouten/enram/testdata/harmonized/odim/CZ_brd/20110815
/T_PAGZ60_C_OKPR_20110815000447.hdf
Wednesday,  5 February 2014, 10:54:56: Processing HDF5 radar input file [1/30] T_PAGZ60_C_OKPR_20110815000447.hdf
```

Figure 2.3

## Chapter 3

# Organization of the software

Currently, data from the following stations are included:

Table 3.1: List of radar stations

| station code | full name |
|---|---|
| CZBRD | Brdy-Praha, Czech Republic |
| CZSKA | Skalky, Czech Republic |
| FIANJ | Anjalankoski, Finland |
| FIIKA | Ikaalinen, Finland |
| FIKOR | Korpo, Finland |
| FIKUO | Kuopio, Finland |
| FILUO | Luosto, Finland |
| FIUTA | Utajärvi, Finland |
| FIVAN | Vantaa, Finland |
| FIVIM | Vimpeli, Finland |
| FRABB | Abbeville, France |
| FRALE | Aléria, France |
| FRAVE | LAvesnois, France |
| FRBLA | Blaisy-Haut, France |
| FRBOL | Bollène, France |
| FRBOR | Bordeaux, France |
| FRBOU | Bourges, France |

Table 3.1: List of radar stations

| station code | full name |
|---|---|
| FRCAE | Falaise, France |
| FRCHE | Cherves, France |
| FRCOL | Collobrières, France |
| FRGRE | Grèzes, France |
| FRMCL | Montclar, France |
| FRMOM | Momuy, France |
| FRMTC | Montancy, France |
| FRNAN | Nancy, France |
| FRNIM | Nîmes, France |
| FRTRO | Arcis-sur-Aube, France |
| HRBIL | Bilogora, Croatia |
| IEDUB | Dublin, Ireland |
| IESHA | Shannon, Ireland |
| NLDBL | De Bilt, The Netherlands |
| NLDHL | Den Helder, The Netherlands |
| NOAND | Andoya, Norway |
| NOBML | Boemlo, Norway |
| NOHAS | Hasvik, Norway |
| NOHGB | Haegebostad, Norway |
| NOHUR | Hurum, Norway |
| NORSA | Rissa, Norway |
| NORST | Rost, Norway |
| NOSTA | Stad, Norway |
| PLBRZ | Brzuchania, Poland |
| PLGDA | Gdansk, Poland |
| PLLEG | Legionowo, Poland |
| PLPAS | Pastewnik, Poland |
| PLPOZ | Poznań, Poland |
| PLRAM | Ramża, Poland |
| PLRZE | Rzeszów, Poland |

Table 3.1: List of radar stations

| station code | full name |
|---|---|
| PLSWI | Świdwin, Poland |
| SEANG | Ängelholm, Sweden |
| SEARL | Stockholm-Arlanda, Sweden |
| SEASE | Ase, Sweden |
| SEHUD | Hudiksvall, Sweden |
| SEKIR | Kiruna, Sweden |
| SEKKR | Karlskrona, Sweden |
| SELEK | Leksand, Sweden |
| SELUL | Luleå, Sweden |
| SEOSU | Östersund, Sweden |
| SEOVI | Örnsköldsvik, Sweden |
| SEVAR | Vara, Sweden |
| SEVIL | Vilebo, Sweden |
| SILIS | Lisca, Slovenia |
| SKKOH | Kojsovska hola, Slovakia |
| SKMAJ | Maly Javornik, Slovakia |

## 3.1 Directory structure

The following table lists a selection of the most important files and directories as used in the 'ENRAMVM' Virtual Machine.

| **Location** | **Description** |
|---|---|
| (relative to `/home/wbouten/enram/`) | |
| `data/` | conbtains the radar data and derived products |
| `data/harmonized/bird/` | contains radar data as HDF5 files after harmonization from zip, gz.tar, gif, etc. |
| `data/harmonized/cluttermaps/` | contains cluttermaps for a given station, at different threshold levels of clutter |
| `data/harmonized/odim/` | radar data for all stations for the period 15-Aug-2011 to 16-Sep-2011 in ODIM-HDF5 format. |

| **Location**<br>(relative to `/home/wbouten/enram/`) | **Description** |
|---|---|
| `data/harmonized/statistics/` | contains output from `src/process/statistics.pro` |
| `data/raw/` | radar data for most stations for the period 15-Aug-2011 to 16-Sep-2011 as provided by individual weather services |
| `data/stations.txt` | configuration file containing a list of stations that are part of the data set to be analyzed |
| `doc/` | some relevant literature |
| `doc/readme/` | the latex files needed for compiling this document |
| `log/stderr.txt` | standard error log |
| `log/stderr.txt` | standard output log |
| `other-data/` | miscellaneous data (currently not used) |
| `src/` | source code main directory |
| `src/io` | country-specific i/o routines written in IDL |
| `src/lib` | programs and functions from external libraries, written in IDL |
| `src/process/bird_call.pro` | IDL program that reads the radial velocity, reflectivity, and cluttermap. and then calls various procedures from Adriaan's library, ultimately resulting in profiles of bird density around a given station. |
| `src/process/cluttermap.pro`[1] | IDL program that calculates cluttermaps at various thresholds of the statistics data. Output is written to `data/harmonized/cluttermaps/`. |
| `src/process/flysafe2.pro` | IDL program that loops over a range of dates and various clutter threshold levels, and then calls `bird_call.pro`. |
| `src/process/histogram.pro`[1] | IDL program that loops over a range of dates and stations, and then calls `statistics.pro`. |
| `src/process/statistics.pro` | IDL program that calculates a histogram that serves as a base for constructing cluttermaps later. Output is written to `data/harmonized/statistics/` |
| `src/raw-to-odim-conversion-tools` | |

| Location | Description |
|---|---|
| (relative to /home/wbouten/enram/) | |
| | (incomplete) collection of conversion scripts, mostly written in Bash and C, with which the initial conversion was performed to convert the data from data/raw to the ODIM-HDF5 format in data/harmonized/odim. |
| src/visualization/make_bird_density_profiles.pro[1] | IDL program that creates figures of bird density as a function of time and altitude. |
| src/visualization/make_colored_donut_maps.pro[1] | IDL program that creates a figure in which the bird density around each radar is plotted as a colored donut. |
| src/visualization/make_ppi_time_space_bird_rain.pro[1] | IDL program that creates a map of distributed PPI's of rain and of bird density, at given time intervals. |
| src/visualization/multi_ppi.pro[1] | IDL program that visualizes multiple PPI's. |
| src/visualization | figure-generating programs |
| src/vol2bird | stores Adriaan Dokter's C language program |
| testdata/ | subset of data/, used in integration testing |
| visualization-output/ | directory where all visualization programs place their output figure files |

[1] This program is part of the main data processing pipeline, as defined in the Bash script start-processing.sh.